THURSTON COUNTY
SHORELINE MASTER PROGRAM UPDATE

SHORELINE ANALYSIS AND CHARACTERIZATION

PREPARED FOR:

THURSTON COUNTY
STRATEGIC PLANNING
BUILDING # 1, 2ND FLOOR
2000 LAKERIDGE DRIVE SW
OLYMPIA, WA 98502-6045

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1 INTRODUCTION

1.1 PURPOSE

The purpose of this document is to provide an Analysis and Characterization of the shoreline jurisdiction within Thurston County. The characterization process is an evaluation of existing conditions as well as the functions and values of ecosystems within the County. The results of this process provide the foundation for the County’s Shoreline Master Program (SMP) update and are utilized to create shoreline environment designations, goals and regulations. In addition, these results allow the county to identify gaps in shoreline related data and opportunities for conservation and restoration activities throughout the county. Under the standard SMP Update process, the Analysis and Characterization directly follows, and is built upon, the library of available information identified in the Shoreline Inventory. As such, Thurston County’s Shoreline Inventory is Appendix B to this document.

1.2 TIMELINE AND FUNDING

The timeline for local governments to develop or amend Shoreline Master Programs is provided by RCW 90.58.080. Pursuant to RCW 90.58.080(2)(a)(iii), Thurston County and the cities within it are required to complete the amendment process by the end of 2011.

In order to meet this deadline, the County is conducting a multi-phased update of its SMP over a three-year period (2007 – 2010). The Analysis and Characterization process occurs in the fourth phase of the overall Thurston County SMP update process. The phases are as follows:

- Phase 1 – Coordination
- Phase 2 – Public Information and Outreach
- Phase 3 – Preliminary Shoreline Jurisdiction, Goals, and Policies
- Phase 4 – Inventory and Analysis of Shoreline Conditions
- Phase 5 – Environment Designations and Shoreline Regulations
- Phase 6 – Address Cumulative Impacts
- Phase 7 – Restoration Plan
- Phase 8 – Local Adoption and State Approval of Final SMP

Thurston County Strategic Planning Department (TCSP) is the lead local government agency for the County’s SMP update. Grette Associates, in collaboration with TCSP, prepared this Shoreline Analysis and Characterization.

---

1 Phase 4: Inventory and Analysis of Shoreline Conditions is the focus of this document.
The Washington State Department of Ecology (Ecology) provided funding for the majority of the update process through a SMA grant (Agreement No. G0800104). State funds for grants to update local SMPs are provided by Budget Bill ESSB 6090.

1.3 Development of Shoreline Master Programs for Local Jurisdictions within Thurston County

Thurston Regional Planning Council (TRPC) is working with the local City jurisdictions within Thurston County to assist with the development of their SMPs and updates. Olympia, Tumwater, and Lacey are actively working to update their individual city shoreline master programs at this time. In addition, TRPC is also working with the cities of Yelm, Tenino, and Rainier, to complete their SMP updates.

Although the County and cities are working separately on the SMP update tasks, lead regulators within each jurisdiction periodically coordinate for the purpose of exchanging information throughout the development process. Coordination among neighboring jurisdictions is strongly recommended by Ecology for all SMP updates.

1.4 Background

1.4.1 Washington State Shoreline Management Act and Shoreline Jurisdiction

The SMP requirement, including subsequent amendments, is a result of the Shoreline Management Act (SMA). The Shoreline Management Act of 1971, Chapter 90.58 Revised Code of Washington (RCW), was adopted by the citizens of Washington in 1972. The overall goal of the SMA is to “prevent the inherent harm in an uncoordinated and piecemeal development of the state’s shorelines.” This act is designed to provide for three broad polices: (1) protect shoreline natural resources and ecological functions, (2) reserve shorelines for water dependent and associated water-related uses, and (3) promote public access for water-dependent and water-related uses that are compatible with ecological protection.

The SMA applies to all “Shorelines of the State” and “Shorelines of Statewide Significance”.

Pursuant to RCW 90.58.030(2)(d), Shorelines of the State include:

- all marine waters;
- streams with greater than 20 cubic feet per second mean annual flow;
- lakes 20 acres or larger;
- upland areas called shore lands that extend 200 feet landward from the edge of these waters; and
- the following areas when they are associated with one of the above:
  - biological wetlands and river deltas; and
1. Introduction

Shoreline Analysis and Characterization

- some or all of the 100-year floodplain including all wetlands within the 100-year floodplain.

Pursuant to RCW 90.58.030(2)(e), Shorelines of Statewide Significance include:

- Pacific Coast, Hood Canal and certain Puget Sound shorelines;
- all waters of Puget Sound and the Strait of Juan de Fuca;
- lakes or reservoirs with a surface acreage of 1,000 acres or more;
- larger rivers (1,000 cubic feet per second or greater for rivers in Western Washington, 200 cubic feet per second and greater east of the Cascade crest); and
- wetlands associated with all the above.

Shorelines of Statewide Significance are considered to have greater than regional importance and are given special consideration under the SMA. For Shorelines of Statewide Significance, preferred uses are, in order of priority, to: "recognize and protect the state wide interest over local interest; preserve the natural character of the shoreline; result in long term over short term benefit; protect the resources and ecology of the shoreline; increase public access to publicly owned shoreline areas; and increase recreational opportunities for the public in the shoreline area."

Local jurisdictions and Ecology work together to ensure that the policies of the SMA are applied to activities occurring in the vicinity of regulated shorelines. Local jurisdictions act as the primary regulators and utilize SMPs, a planning and regulatory document, to establish policies, goals and land use regulations for the shoreline. Ecology serves in a support and review capacity to the local jurisdictions, but is also required to review and approve certain shoreline permits and must approve new or amended SMPs.

Local SMPs are adopted under guidelines established by Ecology, as defined in WAC 173-26. These guidelines allow local planners to tailor SMP goals, polices, standards and regulations to the specific needs of individual communities. In addition, the SMP is also meant to be used to provide comprehensive planning for the County’s shoreline area (RCW 90.58.030(3)(b)).

1.4.2 Adoption and Revisions of the Thurston County Shoreline Master Program

The "Shoreline Master Program for the Thurston Region" was first adopted in 1976. Major revisions to this document were conducted in 1983 and 1990. The TRPC prepared the original SMP document and its two major revisions, as well as the original inventory of all marine, lake, and river shorelines.

1.4.3 Additional Thurston County Regulations, Comprehensive Plans, Policies, and Programs used for shoreline management.

Thurston County Development Services utilizes a variety of other regulations, policies, plans, and programs to supplement the goals and regulations contained within the SMP, and to manage
shoreline resources and regulate development near the shoreline. All development projects are reviewed for compliance with the Thurston County Code (TCC), including but not limited to: Thurston County Comprehensive Plan, Zoning Ordinance (TCC 20, 21, 22, and 23); Critical Areas Ordinance (TCC 17.15); Shoreline Master Program for the Thurston Region, Storm Water Drainage Design and Erosion Control Manual (TCC 15.05); and the State Environmental Policy Act (SEPA) Ordinance (TCC 17.09.). The County works with other entities such as the Thurston Conservation District, Stream Team, South Sound Salmon Recovery Group and watershed lead entities to promote awareness of shoreline issues. In addition, the County has developed Shellfish Protection Districts, Basin plans, and Capital facilities plans to further the goals and the policies of the SMP and promote wise shoreline usage.

1.4.4 Report Organization

This report identifies ecosystem-wide processes and how these processes relate to shoreline functions. Ecosystem processes and functions are evaluated at three different scales: (1) a watershed or landscape scale, (2) a basin level scale and (3) a shoreline reach scale. The purpose of the watershed or landscape scale characterization is to identify ecosystem processes that shape shoreline conditions and determine which processes have been altered or impaired. The purpose of the basin level analysis is to provide further refinement of the analysis provided in the watershed level characterization and to provide a more localized review basis for the reach scale. The intent of the shoreline reach scale inventory and characterization is to: (1) identify how existing conditions in or near the shoreline have responded to process alterations; and (2) determine the effects of the alteration on shoreline ecological functions. The findings of the shoreline characterization and analysis will help provide a framework for future updates to the County’s shoreline management policies and regulations.

The information in this report is organized into four chapters, a reach analysis matrix, and seven appendices as follows:

Chapter 1: Introduction, discusses the purpose of this report, provides background on the regulatory context for shoreline planning, and outlines the overall organization of the report.

Chapter 2: Methodology, describes the methods used for both the inventory and characterization process. Appendix B to this document contains the Inventory created by the process described in this chapter.

Chapters 3 through 7 as well as Appendix A contain the results of the Characterization process described in Chapter 2.

Chapter 3: Ecosystem Profile, provides regional context and a profile of the ecosystems within the County.

Chapters 4 through 7: Basin Analyses, provide a review of the basins of Thurston County, with separate chapters by Water Resource Inventory Area (WRIA). The County includes jurisdictional shorelines in four WRias: WRIA 11 – the Nisqually River watershed, WRIA 13 – the Deschutes River watershed, WRIA 14 – the Kennedy/Goldsborough, and WRIA 23 – the Upper Chehalis Watershed. It should be noted that a small portion of WRIA 22 – the Lower Chehalis Watershed is also located within the County. However, because the portion of the...
County located within this WRIA does not contain any shoreline jurisdiction, this document does not provide further detail about WRIA 22.

The Basin Analysis provides information on basin characteristics, public access, Shorelines of the State within the basin, Priority Habitats and Critical Areas. It also provides information on any noted evidence of processes disturbed or potentially impacted function, available research, studies and spatial information obtained during the inventory process, and any recreation or restoration projects that have occurred within the basin. The Basin Analysis serves as a foundation for the Reach Analysis (Appendix A). Each basin analysis chapter is concluded with a table that identifies the page number of the reach analysis for reaches within that basin.

Appendix A: Reach Analysis Matrix, provides a review of the shoreline reaches within Thurston County. A matrix format was selected in lieu of a narrative format to increase public accessibility to the document, specifically in terms of document navigability and length. The Reach Analysis is entirely table-based and presents the very large volume of reach information resulting from the Analysis and Characterization. The Reach Analysis is provided in an Appendix, rather than a separate chapter, due to its format and length. The matrices are generally grouped by water body type, including lakes, rivers/streams, and marine. The reach matrices are organized first by water body type and second by WRIA, third by basin, and finally by reach. Each reach, represented by a single row in the matrix, provides the following information for the subject reach and surrounding shoreline jurisdiction:

- a unique reach identifier;
- the basin in which the reach is located;
- the name of the water body on which the reach is located;
- the length of the reach;
- physical features;
- biological features divided into species and habitat sub-columns;
- land use/zoning information;
- public access sites;
- shoreline structures and modifications;
- processes that may have been impacted by the existing shoreline structures and modifications;
- enhancement or restoration activities implemented;
- opportunities for restoration; and
- notes
The WRIA, basin, and reach analyses comprise the Analysis and Characterization. This document is also supported by the following appendices:

- Appendix B: Shoreline Master Program Update Inventory Matrix;
- Appendix C: GIS data sources used in development of the map folio;
- Appendix D: Abbreviations used in the document
- Appendix E: Chapter 3 Literature Review
2 METHODS

The Inventory and Characterization process was divided into two separate tasks. An inventory of all available data resources was conducted first. That process is described in section 2.1 of this chapter, with further detail in Appendix B of this document. The Inventory resulting from that process is provided as Appendix B.

The second task was a characterization of the processes and functions of the shorelines of Thurston County, and is represented by this document. These processes and functions were evaluated at three different scales: (1) a watershed or landscape scale, (2) a basin level scale and (3) a shoreline reach scale. The results of this characterization process are presented in Chapters 3 though 7 and Appendices A and B.

2.1 SHORELINE JURISDICTION AND PLANNING AREA BOUNDARY

Shoreline jurisdiction and planning area boundaries were determined by overlaying the following: (1) a 200 foot buffer to all shorelines of the state, (2) the 100-year flood plain, and (3) the associated wetlands that overlapped the 200 foot shoreline buffer. Wetland buffers were not included. Some wetlands were added or removed from the SMP jurisdiction after field verification.

2.2 INVENTORY

Ecology guidelines to support SMP amendments require both the Inventory and resulting Analysis and Characterization to be based on scientific and technical information. Pursuant to WAC 173-26-201(3)(c), these efforts should use existing sources of information that are both relevant and reasonably available. However, no new data collection or research is required.

In order to conduct the Inventory process, Thurston County staff collected all data within its records. In addition, internet (typical governmental, resource agencies, non-profit restoration and/or enhancement groups) and library information sources were reviewed. Each document or resource was reviewed for relevancy, whether it addressed Ecology requirements, and the scale (County, WRIA, or Basin) to which the information applied. All relevant data were incorporated into an Inventory Matrix (Appendix B); sources reviewed but dismissed from further use were noted as such for documentation purposes.

The documents and resources obtained during the Inventory process were utilized for the creation of the remainder of the Analysis and Characterization including the Ecosystem Profile, the Basin Analysis and the Reach Analysis.

2.3 ECOSYSTEM PROFILE

In the SMP update process, local jurisdictions are required by SMA guidelines to identify and assess key ecosystem-wide processes that create, maintain, or affect, Thurston County’s shorelines. Ecosystem-wide processes were evaluated at three scales, in Water Resource Inventory Areas (WRIAs), basins, and individual shoreline reaches. The method utilized by Thurston County to describe watershed processes was partially based on the document Protecting Aquatic Ecosystems by Understanding Watershed Processes: A Guide for Planners. Ecology
Ecosystem-wide processes are described as the physical and chemical interactions that form and sustain the landscape over geographic scales of watersheds to basins (thousands to hundreds of square miles). Ecosystem-wide processes include the delivery, movement, and loss, of water, sediment, nutrients, pathogens, toxins, and wood as they enter, pass through, and leave the watershed (Stanley et al, 2008).

While the methodology in the Stanley et al., 2008 document focused on freshwater ecosystems, this characterization report also applied the concepts and approach to the marine nearshore environment, in order to describe nearshore coastal processes such as littoral drift; sediment supply, transport, and deposition; coastal erosion; water quality; and functions provided by nearshore marine riparian vegetation. Assessing ecosystem processes and functions at the watershed, basin, and reach-level scales provides planners with a broader understanding of how ecosystem-wide processes shape conditions in the shoreline planning areas.

### 2.4 Basin Analysis

The Basin Analysis serves to describe the basins within the County. For organizational purposes, multiple chapters (4 through 7) comprise the Basin Analysis; a chapter was devoted to each WRIA and the basins contained within it.

For each basin, information is presented related to general land use; public access; shorelines, priority habitats and critical areas; evidence of processes disturbed or potentially impacted function; available research, studies and spatial information; restoration opportunities; and reach data. Basin information was obtained from mapping and literature resources outlined within Appendix B: Shoreline Master Program Update Inventory Matrix and Appendix C: GIS data resources. The methodology used to gather the information presented in each of the basin narrative subsections is described within this section.

#### 2.4.1 General Land Use

Basin size and location information was obtained utilizing ArcGIS shapefiles provided by Thurston County Geodata and Thurston County Strategic Planning.

Some of the basins within the County have received more in-depth study, and additional information is available for these basins. When available, this additional information was included within the Basin Analysis narrative sections. As such, greater detail is provided in some basin narrative sections than others.

Current land use information was taken from zoning/assessor data obtained from County Geodata resources.

Existing and projected increase dwelling unit data were obtained from the Dwelling Unit Forecast by Watersheds and Basins developed by the Thurston Regional Planning Council, Population and Employment Forecast Work Program (2004-2005, 2007).
2. Methods

2.4.2 Public Access

Two types of public access points were identified: defined and informal. Defined access points include mapped boat launches, parks with shoreline access, and government land such as parks, county trails and bikeways. Defined access points were identified utilizing ArcGIS shapefiles, websites, and literature resources including:

- The Profile. Thurston Regional Planning Council. October 2006
- ArcGIS mapping layers (summarized in the table below).

Table 1. GIS Data Layers used for Basin Public Access Review*

<table>
<thead>
<tr>
<th>GIS Data Layer</th>
<th>File Name</th>
<th>Description of Data Layer</th>
<th>Reference for Data Layer</th>
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<tbody>
<tr>
<td>Aerials</td>
<td>Thurston County, 2006 Aerials</td>
<td>Thurston GeoData Center</td>
<td></td>
</tr>
<tr>
<td>Basins</td>
<td>Thurston County Basins, WA.</td>
<td>Thurston GeoData Center; Stormwater Department; Thurston County Current Planning, (1993)</td>
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<tr>
<td>bridges</td>
<td>Bridges in Thurston County, WA, USA.</td>
<td>Thurston GeoData Center, 1999</td>
<td></td>
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<tr>
<td>Cotrail</td>
<td>County Rails to Trails.</td>
<td>Thurston GeoData Center and Thurston County Parks Department (M. Welter), 2000</td>
<td></td>
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<td>govtland</td>
<td>Government owned lands in Thurston County</td>
<td>Thurston County Assessor’s Office</td>
<td></td>
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<tr>
<td>Jurisdiction_21Apr09_Final3</td>
<td>Proposed Thurston County Shoreline Jurisdiction</td>
<td>Thurston County Strategic Planning Department</td>
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<tr>
<td>launches</td>
<td>WDFW Boat Launches</td>
<td>Washington State Department of Fish and Wildlife</td>
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</table>
2. Methods

<table>
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<th>File Name</th>
<th>Description of Data Layer</th>
<th>Reference for Data Layer</th>
</tr>
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<td>military</td>
<td></td>
<td>Fort Lewis encompassing Thurston and Pierce Counties</td>
<td>Thurston GeoData Center</td>
</tr>
<tr>
<td>parkpnts</td>
<td></td>
<td>County Park Locations</td>
<td>Thurston GeoData Center, February 2000</td>
</tr>
<tr>
<td>Parks</td>
<td></td>
<td>Thurston County Parks</td>
<td>Thurston GeoData Center, County and City Parks Department</td>
</tr>
<tr>
<td>Roads</td>
<td></td>
<td>The road data are a representation of the Thurston County's ground transportation network. It includes the majority of the roads that serve four or more commercial or residential sites.</td>
<td>Thurston GeoData Center</td>
</tr>
<tr>
<td>WRIA</td>
<td></td>
<td>Thurston County water resource inventory areas.</td>
<td>Washington State Department of Ecology</td>
</tr>
</tbody>
</table>

* For a complete listing of all ArcGIS data layers used during this review process. Please refer to Appendix C.

Informal access to the shoreline was considered to be available in locations where public roads intersected any portion of shoreline jurisdiction, including, but not limited to, all crossings of jurisdictional water bodies. Intersections of public roads and shoreline jurisdiction were identified within the reach analysis (Appendix A).

2.4.3 Shorelines

Information regarding the length of shoreline within each basin was obtained from Thurston County Strategic Planning Staff.

Using GIS spatial analysis tools, the sum of designated shoreline length within each basin was calculated for lakes, streams, and marine shorelines.

2.4.4 Priority Habitats/Critical Areas

Priority habitats and critical areas within the basins were identified using ArcGIS mapping layers. The data layers were utilized are provided in the table below.

Table 2. GIS Data Layers used for Priority Habitats/Critical Area review *

<table>
<thead>
<tr>
<th>GIS Data Layer Name</th>
<th>Description of Data Layer</th>
<th>Reference for Data Layer</th>
</tr>
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<tbody>
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<td>Aerials</td>
<td>Thurston County, 2006 Aerials</td>
<td>Thurston GeoData Center</td>
</tr>
<tr>
<td>All_foragefish_data</td>
<td>Forage Fish Data of Puget Sound shoreline for Thurston County, Washington. This data is compiled from surveys done by Washington Dept. of Fish and Wildlife between 1972 &amp; 2004. Forage fish species include Sand Lance, Surf Smelt, Rocksole &amp; Herring</td>
<td>Thurston County Regional Planning Council</td>
</tr>
<tr>
<td>anadpres</td>
<td>Anadromous Fish Presence, 07012002</td>
<td>WDFW</td>
</tr>
<tr>
<td>anadrear</td>
<td>Anadromous Fish Rearing Areas, 07012002</td>
<td>WDFW</td>
</tr>
<tr>
<td>anadspwn</td>
<td>Anadromous Spawning Areas, 07012002</td>
<td>WDFW</td>
</tr>
<tr>
<td>barriers</td>
<td>Anadromous Fish Barriers, 07012002</td>
<td>WDFW</td>
</tr>
</tbody>
</table>
## Methods

### GIS Data Layer Name | Description of Data Layer | Reference for Data Layer
--- | --- | ---
Basins | Thurston County Basins, WA. | Thurston GeoData Center; Stormwater Department; Thurston County Current Planning, (1993)
bullchar | WDFW Bull Trout/Dolly Varden Presence, Spawning and Rearing Areas. 07012002 | WDFW
coastal_unstable_slps | Unstable slopes as identified within the Coastal Zone Atlas | Washington State Department of Ecology, Shorlends and Coastal Zone Management Program, 2004
Contours | Two Foot Contours of Thurston County, Washington used for shaded relief map. This dataset was developed as part of the county's aerial program. It is comprised of black and white photography from a flight flown in June of 1996. | Thurston County Survey Office, Thurston GeoData Center, David Smith & Associates
floodzns | Flood Zones (FEMA 100 & 500 yr). | FEMA
Hazslide | Thurston County, WA landslide hazards/soils. | Thurston GeoData Center
Hazslope | Thurston County Hazardous Slopes, WA. | Thurston GeoData Center
herring | WDFW Herring Pre-Spawn Holding Areas and Spawning Grounds. | Washington State Department of Fish and Wildlife
Hgw | High water and 300 foot buffers | Thurston GeoData Center
hydric | This coverage provides the county with the hydric soils data of the USDA. | Thurston GeoData Center, SCS, and DNR
hydro | The hydro data are a representation of the Thurston County's hydro network. It includes all water bodies: rivers, lakes, ponds, inlets. | Thurston GeoData Center
Jurisdiction_21Apr09_Final3 | Proposed Thurston County Shoreline Jurisdiction | Thurston County Strategic Planning Department
landslide_Erode | Areas along Thurston County's shoreline that are eroding or have had landslides and associated information. | No data reference available
oakhabit | Oak Habitat (includes the following designations: dominant, conifer mixed, conifer deciduous) | Thurston GeoData Center, Thurston Regional Planning Council
phsfish | PHS designated Resident and Anadromous Fish, 07012002 | WDFW
rocksole | Rock sole Spawning Areas | WDFW
sandlance | Sand lance Spawning Areas | WDFW
sasi | Anadromous fish species | WDFW
seabirds | WDFW Seabird Colonies | WDFW
sen_area | WDFW Priority Species (Sensitive Areas) | WDFW
sen_site | WDFW Priority Species (Sensitive Sites) | WDFW
2. Methods

<table>
<thead>
<tr>
<th>GIS Data Layer Name</th>
<th>Description of Data Layer</th>
<th>Reference for Data Layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>shell</td>
<td>WDFW Shellfish Spawning, Rearing, and Harvesting Areas</td>
<td>Washington State Department of Fish and Wildlife</td>
</tr>
<tr>
<td>smelt</td>
<td>WDFW Smelt Spawning Areas</td>
<td>Washington State Department of Fish and Wildlife</td>
</tr>
<tr>
<td>soils</td>
<td>This coverage provides the county with the soil classification data of the USDA.</td>
<td>Thurston GeoData Center, SCS, and DNR</td>
</tr>
<tr>
<td>streams</td>
<td>The hydro data are a representation of the Thurston County's hydro network. It includes all water bodies: rivers, lakes, ponds, inlets.</td>
<td>Thurston GeoData Center, 2003</td>
</tr>
<tr>
<td>wetlands</td>
<td>This dataset was created as a composite of the wetland delineations identified by The Thurston Regional Planning Council (TRPC) staff and the National Wetlands Inventory data.</td>
<td>The Thurston Regional Planning Council and NWI, and The Thurston GeoData Center</td>
</tr>
<tr>
<td>WRIA</td>
<td>Thurston County water resource inventory areas.</td>
<td>Washington State Department of Ecology</td>
</tr>
</tbody>
</table>

* This table represents the primary data layers that were used during this analysis process. For a complete listing of all ArcGIS data layers used during this review process, please refer to Appendix C.

Many of the data layers utilized during the review process contain sensitive information that has been generated by state agencies and is not available to the general public. As such, the presence of a sensitive species or areas within a basin is noted but the exact location of the sensitive species or area is not specified.

In addition to data listed above, the priority habitat/critical areas subsection also contains information that was discovered during the inventory and/or subsequent review process that was considered to be relevant. This includes but is not limited to information such as fish stocking of basin lakes, distinguishing geological features, and any additional habitat information within the basin.

Some of the basins contain no mapped critical areas. In these instances, the following note is provided after the section heading: “There are no priority habitats or critical areas mapped within this basin.” It is not the reviewer’s intent to indicate that there are no critical areas within the basin. However, the statement is intended to convey that reviewed GIS data layers do not map critical areas within the basin. Further field review may be needed to confirm whether or not critical areas are located within the basin. Completion of extensive field verification of critical areas within each basin is beyond the scope of the Analysis and Characterization task outlined in the Ecology guidelines and WAC 173-26.

2.4.5 Evidence of Processes Disturbed or Potentially Impacted Function

Data relating to evidence of processes disturbed or potentially impacted function within the basins were identified using ArcGIS mapping layers, which are summarized in the table below.
### Table 3. GIS Data Layers used for Evidence of Processes Disturbed or Potentially Impacted Function Review*

<table>
<thead>
<tr>
<th>GIS Data Layer Name</th>
<th>Description of Data Layer</th>
<th>Reference for Data Layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerials</td>
<td>Thurston County, 2006 Aerials</td>
<td>Thurston GeoData Center</td>
</tr>
<tr>
<td>allmines</td>
<td>This data shows all known mines in Thurston County. The data was created on 09/15/1999</td>
<td>Thurston GeoData Center</td>
</tr>
<tr>
<td>barriers</td>
<td>Anadromous Fish Barriers, 07012002</td>
<td>WDFW</td>
</tr>
<tr>
<td>Basins</td>
<td>Thurston County Basins, WA.</td>
<td>Thurston GeoData Center; Stormwater Department; Thurston County Current Planning, (1993)</td>
</tr>
<tr>
<td>bridges</td>
<td>Bridges in Thurston County, WA, USA.</td>
<td>Center, Thurston GeoData , 1999</td>
</tr>
<tr>
<td>bulkheads</td>
<td>Marine bulkheads of Thurston County, Washington</td>
<td>Thurston Regional Planning Council</td>
</tr>
<tr>
<td>Csites</td>
<td>Contamination sites in Thurston County, WA</td>
<td>Thurston County Environmental Health Dept.</td>
</tr>
<tr>
<td>Culverts</td>
<td>GPS location of all culverts in the county</td>
<td>Thurston County Roads and Transportation</td>
</tr>
<tr>
<td>Damage96</td>
<td>Flood damage location points from 1996.</td>
<td>Thurston GeoData Center</td>
</tr>
<tr>
<td>Flood96</td>
<td>Visible flooded areas in Thurston County during 1996 flood.</td>
<td>Thurston GeoData Center</td>
</tr>
<tr>
<td>Flood99</td>
<td>Contour based flood information for 1999 event.</td>
<td>Thurston GeoData Center</td>
</tr>
<tr>
<td>floodzns</td>
<td>Flood Zones (FEMA 100 &amp; 500 yr).</td>
<td>FEMA</td>
</tr>
<tr>
<td>Hazslide</td>
<td>Thurston County, WA landslide hazards/soils.</td>
<td>Thurston GeoData Center</td>
</tr>
<tr>
<td>Hazslope</td>
<td>Thurston County Hazardous Slopes, WA.</td>
<td>Thurston GeoData Center</td>
</tr>
<tr>
<td>Hgw</td>
<td>High water and 300 foot buffers</td>
<td>Thurston GeoData Center</td>
</tr>
<tr>
<td>Jurisdiction_21Apr09_Final3</td>
<td>Proposed Thurston County Shoreline Jurisdiction</td>
<td>Thurston County Strategic Planning Department</td>
</tr>
<tr>
<td>landfills</td>
<td>Landfills located in Thurston County, WA, USA</td>
<td>Thurston GeoData Center</td>
</tr>
<tr>
<td>landslide_Erode</td>
<td>Areas along Thurston County's shoreline that are eroding or have had landslides and associated information.</td>
<td>No data reference available</td>
</tr>
<tr>
<td>mineral</td>
<td>Thurston County mines - 1997</td>
<td>Thurston County Current Planning and Thurston GeoData Center</td>
</tr>
<tr>
<td>pcdcul</td>
<td>This coverage contains the Pierce Conservation District (PCD) Fish Passage Inventory Project site locations. PCD completed an inventory of culverts (and some small dams, fishways and natural barriers) in the Nisqually Watershed in 2002.</td>
<td>Pierce Conservation District, August 19, 2005</td>
</tr>
<tr>
<td>roads</td>
<td>The road data are a representation of the Thurston County's ground transportation network. It includes the majority of the roads that serve four or more commercial or residential sites.</td>
<td>Thurston GeoData Center</td>
</tr>
</tbody>
</table>
2. Methods

<table>
<thead>
<tr>
<th>GIS Data Layer Name</th>
<th>Description of Data Layer</th>
<th>Reference for Data Layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>skook_culv</td>
<td>Lewis County Conservation District's Skookumchuck Culverts Data.</td>
<td>Lewis County Conservation District 2002</td>
</tr>
<tr>
<td>utility</td>
<td>Utilities (Gas, Fiber Optics, and Power Transmission Lines).</td>
<td>Thurston GeoData Center</td>
</tr>
<tr>
<td>wildculv</td>
<td>Thurston County Department of Fish and Wildlife fish passage culverts.</td>
<td>Washington State Department of Fish and Wildlife</td>
</tr>
<tr>
<td>wqgauges</td>
<td>Thurston County water quality gauging stations locations.</td>
<td>Thurston County Stormwater Department</td>
</tr>
<tr>
<td>WRIA</td>
<td>Thurston County water resource inventory areas.</td>
<td>Washington State Department of Ecology</td>
</tr>
<tr>
<td>wria13_culverts</td>
<td>Culverts located within WRIA 13</td>
<td>South Puget Sound Salmon Enhancement Group</td>
</tr>
<tr>
<td>wria14_culvert</td>
<td>Culverts located within WRIA 14</td>
<td>South Puget Sound Salmon Enhancement Group and WDFW</td>
</tr>
</tbody>
</table>

In addition to utilizing the data layers listed above, staff researched available public information regarding impacts and disturbed processes from the following Washington State Departments: Ecology, Health, Natural Resources, and Fish and Wildlife.

For some of the basins, there was no evidence of processes disturbed or potentially impacted function at the basin analysis level. In such cases, a note of “No evidence of processes disturbed or potentially impacted function was noted for this basin” is provided in this subsection. In some instances, the reach-level analysis resulted in the identification of impacts that were not evident at the basin level. In these instances, the reach analysis will note impacts that were not identified during the basin analysis.

2.4.6 Available Research, Studies and Spatial Information

Reports, studies or other information pertinent to the basin that was gathered during the Inventory and review process are summarized/cited in this subsection. The source citation is followed by notes if the source contained information regarding a specific area of shoreline jurisdiction.

2.4.7 Enhancement or Restoration Activities Implemented:

Information on enhancement or restoration activities implemented within each basin was initially obtained during the Inventory review process. As few documents, reports or studies are generated for smaller enhancement/restoration activities, the Inventory process did not capture many of these projects. To address this, researchers made an attempt to indentify further enhancement or restoration activities conducted within the County. Various agencies, governmental organizations, non-profit groups and tribes were contacted. The majority of the queried agencies responded that the most comprehensive list of their enhancement or restoration activities could be obtained by querying the Washington State Recreation and Conservation
2. Methods

Funding Board (RCO)/Salmon Recovery Funding Board (SRFB) website: http://www.rco.wa.gov/default.asp.

The website contains a grant project mapping program that provides information on all of the projects that receive RCO/SRFB funding. The mapping program identifies the location, project number, primary agency in charge of each project, and current status. The data linked to the map also provide a more detailed description of the project.

Enhancement and restoration activities identified using the RCO/SRFB mapping program were added to this subsection. These entries are distinguished from the items identified during the initial Inventory review process by underlining; the title of the project, the project number, the lead agency, and the status of the project are provided. A project description follows the underlined information. In order to ensure that the project description is accurate, the description provided is listed exactly as shown on the website. The text pulled from the website is in quotation marks to distinguish it as having been obtained directly from another source.

2.4.8 Reach Data

Reach data for the water bodies within the basin are provided in tabular format. The table contains the name of the reach series and the number of reaches. This table can be used to navigate to the reach analysis for a particular basin, supplied in Appendix A.

2.5 Reach Break Determination

Reach analysis began with the determination of reach breaks. A reach break is the point at which one shoreline reach ends and another begins. The methodology for determining reach break was generally based on Ecology guidance (as described at http://www.ecy.wa.gov/programs/sea/sma/st_guide/SMP/inven_analysis/ppt_presentations/CTP_day2.ppt).

Per Ecology guidance, existing GIS information were used to initially determine shoreline type based on inherent physical characteristics. River shoreline types were generally classified as low or moderate gradient and low, moderate, or highly confined. Determination of lake type was not necessary for reach break determinations. For marine and riverine shorelines, additional information regarding shore forms (e.g., stream mouths, eroding bluffs, or floodplain characteristics) was considered to differentiate among shoreline types along a continuous shoreline area.

Additionally, in-depth consideration of physical features was necessary to further divide or combine areas into cohesive reaches for analysis. The features that were considered include:

- Marine Shorelines
  - Drift cells
  - Sediment and freshwater inputs
- River Shorelines
2. Methods

- Confluence of streams
- Tributary inputs
- Gradient/confine ment changes

- Lake Shorelines
  - Slope and surficial geology
  - Soils and nearshore substrate

For all shorelines, following review of physical features, riparian vegetation width and fragmentation, land use, zoning and ownership classes, park boundaries, and City or Urban Growth Boundaries were all considered to refine potential reach break locations.

Proposed reach breaks were reviewed by multiple parties for accurate assessment of physical, biological, and use features as well as for ultimate use as a management tool. The resulting final reach breaks represent the product of a detailed assessment process using all of the above steps and data.

During the creation of final reach breaks, an effort was made to place reach break points on parcel lines in order not divide parcels in half. This was done to avoid the potential for a parcel to contain more than one environmental designation. Due to the emphasis of placing reach break points on parcel lines, these locations do not always exactly line up with the locations of key environmental characterizations (e.g., topography might begin to change shortly before or after a reach break point). Breaks were located closest to the environmental change that was also on a parcel line. Despite this focus on parcel line reach break placement, there were some instances when a reach break was located mid-parcel because that was where the geographic change occurred (e.g., basin lines). This was particularly true when an environmental change occurred within a large parcel.

2.6 Reach Analysis

Reach analysis was primarily conducted using Thurston County Geodata GIS information, which includes other publicly available data layers (e.g., Ecology, WDFW), a high-resolution aerial photo series (2006), and supplemental information from the basin analysis. The goal of the reach analysis was to provide a high-resolution description of the existing condition of the shoreline along a particular reach, and to use that information to assess impacted reach processes. The reach analysis results were collated in a tabular-format matrix (Appendix A). Methods for populating the columns of that matrix are described below.

2.6.1 Reach ID/Water Body/ Basin Name

The Reach ID column was populated with a unique identifier that combines the names of the reach break points bounding the reach.
Each reach break point was coded according to the name of the primary water body (e.g., Skookumchuck River = SK) with which the reach/point was associated. Lake and marine points were additionally distinguished by preceding the water body with and L or an M (e.g., Lake Skookumchuck = LSK). Reach break points were then numbered sequentially (e.g., SK-11, SK-12). Reaches were then named accordingly, i.e. the name of the reach bounded by SK-11 and SK-12 is SK-11-SK-12.

For jurisdictional tributary reaches, naming according to the primary reach was maintained, but a secondary numerical identifier was added capture the tributary. For instance, Johnson Creek is a jurisdictional tributary to the Skookumchuck River (primary water body). Its confluence with the river is located at a reach break identified as SK-11. Therefore, all reach break points on Johnson Creek begin SK-11 and are numbered sequentially from there (e.g., points SK-11-1, SK-11-2, individual reach named SK-11-1-SK-11-2). This naming convention maintains easy reference for tributaries to the primary jurisdictional water body and to the location of their confluences.

The associated water body and basin name for a reach is also provided for easy reference.

**2.6.2 Length of Designated Shoreline**

Digitized lines representing designated shorelines were split at points proximal to each reach break point. The resulting cut lengths of shoreline were then associated with the appropriate reach. Finally, the length of designated shoreline for each reach was calculated.

Additionally, the length of designated shoreline for rivers is the sum of both sides of a reach. The only exception to this methodology is for those rivers were the other side of a reach is located in another jurisdiction. Island shoreline within river bodies located within Thurston County jurisdiction area also included in the length of designated shoreline figure. Since some reaches only encompass jurisdictional area and not any designated shoreline, those reaches do not have an associated shoreline length value.

**2.6.3 Physical Features**

Shoreline reach physical features were identified using ArcGIS mapping layers. The data layers utilized are provided in the table below.

**Table 4 GIS Data Layers used for Physical Features Review**

<table>
<thead>
<tr>
<th>GIS Data Layer Name</th>
<th>Description of Data Layer</th>
<th>Reference for Data Layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerials</td>
<td>Thurston County, 2006 Aerials</td>
<td>Thurston GeoData Center</td>
</tr>
<tr>
<td>allgsa</td>
<td>Geologically Sensitive Areas</td>
<td>Thurston GeoData Center</td>
</tr>
<tr>
<td>DNR_DRAFT_landslides.ls_poly</td>
<td>Past landslides</td>
<td>DRAFT Thurston County marine shore landslide and landslide hazard mapping. 2007. WA Department of Natural Resources.</td>
</tr>
<tr>
<td>GIS Data Layer Name</td>
<td>Description of Data Layer</td>
<td>Reference for Data Layer</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Floodzns</td>
<td>Flood Zones (FEMA 100 &amp; 500 yr). FEMA 100 is the 100-year floodplain</td>
<td>Thurston GeoData Center</td>
</tr>
<tr>
<td>hotpoly</td>
<td>Limited Groundwater Concern</td>
<td>Thurston GeoData Center</td>
</tr>
<tr>
<td>Jurisdiction_21Apr09_Final 3</td>
<td>Proposed Thurston County Shoreline Jurisdiction</td>
<td>Thurston County Strategic Planning Department</td>
</tr>
<tr>
<td>Segments_spft</td>
<td>Salmon and Steelhead Habitat Inventory and Assessment (SSHIAP) - Salmonscape Stream Attributes. Stream gradient, confinement, and habitat.</td>
<td>Washington State Department of Fish and Wildlife and the Northwest Indian Fisheries Commission.</td>
</tr>
<tr>
<td>Slope_DEM_25ft</td>
<td>Steep slopes</td>
<td>PSLC 2002 - Bare Earth LiDAR DEM. Puget Sound LiDAR Consortium. 2002. LiDAR originally sampled at 6 ft cell size. Re-sampled to 25 ft cell size based on Thurston County CAO rise over run distance for slope calculation. Steep slopes were marked as “yes” if a single cell of 40% or greater slope was present anywhere within the SMP jurisdiction within that reach. The Thurston County Critical Areas Ordinance defines slopes greater than 40% to be steep slopes.</td>
</tr>
<tr>
<td>Slope_DEM_25ft</td>
<td>Potential landslide area</td>
<td>PSLC 2002 - Bare Earth LiDAR DEM. Puget Sound LiDAR Consortium. 2002. LiDAR originally sampled at 6 ft cell size. Re-sampled to 25 ft cell size based on Thurston County CAO rise over run distance for slope calculation. Potential landslide areas were marked “yes” if a single cell of 15% or greater slope was present anywhere within the SMP jurisdiction within that reach based on Thurston County’s CAO definition of potential landslide hazard areas.</td>
</tr>
</tbody>
</table>
### 2. Methods

<table>
<thead>
<tr>
<th>GIS Data Layer Name</th>
<th>Description of Data Layer</th>
<th>Reference for Data Layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soils</td>
<td>Hydric soils and soil names</td>
<td>U.S. Department of Agriculture, Natural Resources Conservation Service, Soil Survey Geographic (SSURGO) database for Thurston County, WA. 2006. The Hydric soils layer was created for the SMP update by selecting all soil names listed in the TC CAO as Hydric soils.</td>
</tr>
<tr>
<td>Streams</td>
<td>Streams</td>
<td>Thurston GeoData Center</td>
</tr>
<tr>
<td>swater</td>
<td>High Groundwater Hazard</td>
<td>Thurston GeoData Center</td>
</tr>
<tr>
<td>Wetlands</td>
<td>Wetlands</td>
<td>Thurston GeoData Center</td>
</tr>
<tr>
<td>WRIA</td>
<td>Thurston County water resource inventory areas.</td>
<td>Thurston County Geodata Center</td>
</tr>
</tbody>
</table>

From the ArcGIS layers listed in the above table, the following physical features information was gathered. Data collected was slightly different for marine, river, and lake shorelines, due to the data available.

**Table 5 Physical Feature Data Collected for Marine, River and Lake Shorelines**

<table>
<thead>
<tr>
<th>Shoreline</th>
<th>Category</th>
<th>Response</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>MARINE</td>
<td>Shoreline type</td>
<td>List of shoreline types present</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Slope stability</td>
<td>List of slope stability classes present along OHWM.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Steep slopes (&gt;=40% slopes)</td>
<td>yes/no, anywhere in jurisdiction</td>
<td>qualitative descriptions of amount and/or location</td>
</tr>
<tr>
<td></td>
<td>Potential landslide area (&gt;=15% slopes)</td>
<td>yes/no, anywhere in jurisdiction</td>
<td>qualitative descriptions of amount and/or location</td>
</tr>
<tr>
<td></td>
<td>Past landslides</td>
<td>yes/no, anywhere in jurisdiction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Drift cell changes</td>
<td>List of drift cell directions.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Surface hydrology</td>
<td>Streams with stream mouths, associated wetlands, 100-year floodplain, inlets, pocket estuaries.</td>
<td>qualitative descriptions of amount and/or location</td>
</tr>
</tbody>
</table>

*Thurston County Shoreline Master Program Update*  
*July 14, 2009*  
*Shoreline Analysis and Characterization*  
*19*
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<table>
<thead>
<tr>
<th>Shoreline</th>
<th>Category</th>
<th>Response</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High groundwater hazard</td>
<td>yes/no, anywhere in jurisdiction. Only listed as &quot;yes&quot; if mapped within the jurisdiction but outside of mapped wetlands and water bodies.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Limited groundwater concern</td>
<td>yes/no, anywhere in jurisdiction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hydric soils</td>
<td>yes/no, anywhere in jurisdiction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil names</td>
<td>List of soil names and MRCS soil identification number present anywhere in jurisdiction.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bedrock age</td>
<td>List of bedrock names and ages present anywhere in jurisdiction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lithology</td>
<td>List of lithology names present anywhere in jurisdiction</td>
<td></td>
</tr>
<tr>
<td>RIVER</td>
<td>Gradient</td>
<td>List of gradients present, broken into classes. &lt;2% = Low gradient, &lt;8% = Moderate gradient, &lt;20% = Steep, &gt;20% = Very steep</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Confinement</td>
<td>List of confinement classes present</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Habitat</td>
<td>List of habitats present</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Steep slopes (≥40% slopes)</td>
<td>yes/no, anywhere in jurisdiction</td>
<td>qualitative descriptions of amount and/or location</td>
</tr>
<tr>
<td></td>
<td>Potential landslide area (≥15% slopes)</td>
<td>yes/no, anywhere in jurisdiction</td>
<td>qualitative descriptions of amount and/or location</td>
</tr>
<tr>
<td></td>
<td>Surface hydrology</td>
<td>Tributaries and confluences, associated wetlands, 100-year floodplain.</td>
<td>qualitative descriptions of amount and/or location</td>
</tr>
<tr>
<td></td>
<td>High groundwater hazard</td>
<td>yes/no, anywhere in jurisdiction. Only listed as &quot;yes&quot; if mapped within the jurisdiction but outside of mapped wetlands and water bodies.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Limited groundwater concern</td>
<td>yes/no, anywhere in jurisdiction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Geologically sensitive area</td>
<td>yes/no, anywhere in jurisdiction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hydric soils</td>
<td>yes/no, anywhere in jurisdiction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil names</td>
<td>List of soil names and MRCS soil identification number present anywhere in jurisdiction.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bedrock age</td>
<td>List of bedrock names and ages present anywhere in jurisdiction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lithology</td>
<td>List of lithology names present anywhere in jurisdiction</td>
<td></td>
</tr>
<tr>
<td>Shoreline</td>
<td>Category</td>
<td>Response</td>
<td>Additional Information</td>
</tr>
<tr>
<td>-----------</td>
<td>----------</td>
<td>----------</td>
<td>------------------------</td>
</tr>
<tr>
<td>LAKE</td>
<td>Steep slopes (&gt;=40% slopes)</td>
<td>yes/no, anywhere in jurisdiction</td>
<td>qualitative descriptions of amount and/or location</td>
</tr>
<tr>
<td></td>
<td>Potential landslide area (&gt;=15% slopes)</td>
<td>yes/no, anywhere in jurisdiction</td>
<td>qualitative descriptions of amount and/or location</td>
</tr>
<tr>
<td></td>
<td>Surface hydrology</td>
<td>Tributaries and confluences, associated wetlands, 100-year floodplain.</td>
<td>qualitative descriptions of amount and/or location</td>
</tr>
<tr>
<td></td>
<td>High groundwater hazard</td>
<td>yes/no, anywhere in jurisdiction. Only listed as &quot;yes&quot; if mapped within the jurisdiction but outside of mapped wetlands and water bodies.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Limited groundwater concern</td>
<td>yes/no, anywhere in jurisdiction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Geologically sensitive area</td>
<td>yes/no, anywhere in jurisdiction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hydric soils</td>
<td>yes/no, anywhere in jurisdiction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil names</td>
<td>List of soil names and MRCS soil identification number present anywhere in jurisdiction.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bedrock age</td>
<td>List of bedrock names and ages present anywhere in jurisdiction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lithology</td>
<td>List of lithology names present anywhere in jurisdiction</td>
<td></td>
</tr>
</tbody>
</table>

2.6.4 Biological Features

Due to the sensitive nature of WDFW Priority Habitats and Species information, specific locations of species and habitats within the reaches were not included, although there are general descriptions for the locations of some habitat types. The locations of specific habitat features, such as raptor nests, are not identified within the matrix. Further, if a reach was less than ¼ mile in length, species point locations were duplicated in neighboring reaches to prevent inadvertent dissemination of sensitive species information.

Species

The species sub-column was populated primarily using species information present in the WDFW Priority Habitats and Species GIS layer. This data included, but was not limited to: salmonids and other priority fish species, priority animal species, and priority habitat information. Habitat data was applied to species information in cases where habitats were applied to individual species. For instance, where a reach included habitat for Roosevelt/Rocky Mountain elk, elk would be included in the species information.
Habitat and other Site Specifics

The habitat sub-column provides a narrative description assessing the following attributes, if present, within the reach:

- Wetlands and associated buffers;
- Anadromous Fish spawning or rearing;
- WDFW Oak Habitats;
- WDFW PHS species habitats (for marine layers this also includes herring, rock sole, sand lance, seabirds, shellfish, clams, and eelgrass based on DNR Shorezone data);
- 100-year floodplain; and
- Qualitative assessment of vegetation within the shoreline jurisdiction based on the most recent aerial photographs available (2006).

For riverine reaches, the location of habitat features was identified generally, in order to maintain an appropriate resolution for sensitive data. The location of these features was identified utilizing the Left/Right bank naming convention (Figure 1). The naming convention is based on an observer’s perspective facing downstream (direction of flow): the observer’s right hand side is “right bank”, left hand side is “left bank”. This convention provides a consistent approach for bank naming that is not dependent on cardinal direction (north, east, south and west). Therefore the bank naming is continuous for the entire water course, regardless of the compass orientation of the stream.

For those unfamiliar with this naming convention, cardinal directions follow the left bank right bank designation.
2. Methods

Figure 1. Left and Right bank designations for various flow scenarios.

2.6.5 Land Uses within the Shoreline Jurisdiction

Land Use

The Land Use sub-column identifies land use within a reach based on the Thurston County Assessor’s land use codes associated with the Geodata Parcel shapefile. All shapefiles utilized for this analysis process are identified in Appendix C. The Assessor’s land use codes were simplified into the following major land uses: residential, commercial, transportation, utilities, other, recreation, parks, agriculture, mining, timber/forestland, undeveloped, open space, industrial, aquatic, and other. All land use types identified within a reach were included in this sub-column; the order is not specific.

Zoning

The zoning for a reach is provided from the Geodata Zoning shapefile. All zoning types identified within a reach are included in this sub-column; the order is not specific. Zoning abbreviations are included within Appendix: E.

Current SMP designation

The current SMP designation is provided from the Thurston County Geodata GIS shapefile. Those areas that do not have a current designation are noted with the text “not designated”. All
current SMP designations identified within a reach were included in this sub-column; the order is not specific.

2.6.6 Public Access Sites

Public access within a reach was assessed primarily using ArcGIS data layers (Thurston County, DNR), but was supplemented with information on additional known public access programs (e.g., WDFW Water Access Site boat launch facilities). Aerial photographs occasionally augmented mapped information, but typically were used to confirm presence or extent of mapped facilities.

Access was generally categorized under four types:

- Launches;
- Trails (mapped trails and bikeways);
- Roads (public roads intersecting any portion of associated shoreline jurisdiction); and
- Parks and Government Land.

For the first three elements, all identified features are included in the analysis. Since mapped parks include public preserves or other facilities that do not necessarily provide shoreline access, access was confirmed either using the ArcGIS data layer attributes identifying shoreline facilities (e.g., swimming), park information available elsewhere (e.g., County or State websites), or aerial photograph review. Parks that do not provide shoreline access, or where access is limited to informal approach by boat from the water, were not considered to provide public access. When related to the review process, information regarding limited access or informal approach by water is included in the Notes column as identified in Section 2.6.11.

Government Land is a feature mapped by Thurston County to include three primary land types: Capitol Forest, Native American tribe reservation lands, and Fort Lewis. Lands within Capitol Forest were considered to have public access and road access within those lands was additionally noted. Native American tribe reservation lands may contain areas of public access, but were not considered to provide access due to private ownership within those lands. Fort Lewis was not considered to provide public access.

2.6.7 Shoreline Structures and Modifications

Shoreline structures and modifications were assessed primarily using a number of Thurston County Geodata layers and aerial photograph review. Categories were: modifications, facilities, adjacent land uses, and water quality (Table 4). In each response, all elements were included with a yes/no response based on data and aerial review, with additional information as described below. If a category is not applicable for a reach, such as the shellfish rating for a riverine environment, a response of N/A is provided.
2. Methods

Table 6 Shoreline Structure and Modification Review

<table>
<thead>
<tr>
<th>Category</th>
<th>Elements (yes/no response)</th>
<th>Additional Information*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modifications</td>
<td>Piers/docks/boat ramps</td>
<td>Type</td>
</tr>
<tr>
<td></td>
<td>Groins/jetties</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Culverts</td>
<td>Number within associated jurisdiction, number blocked.</td>
</tr>
<tr>
<td></td>
<td>Dams</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Armoring</td>
<td>Brief description of location</td>
</tr>
<tr>
<td>Facilities</td>
<td>Roads</td>
<td>Number within associated jurisdiction.</td>
</tr>
<tr>
<td></td>
<td>Bridges</td>
<td>Number within associated jurisdiction, bridge name or general location</td>
</tr>
<tr>
<td></td>
<td>Railroads</td>
<td>Number within associated jurisdiction</td>
</tr>
<tr>
<td></td>
<td>Marinas</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Utilities</td>
<td>Type within associated jurisdiction, data also includes number of utilities if necessary</td>
</tr>
<tr>
<td>Adjacent Land Uses</td>
<td>Agriculture</td>
<td>Based on land use and aerial photographs</td>
</tr>
<tr>
<td></td>
<td>Aquaculture</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Impervious Surface</td>
<td>A response of Yes is provided if visual estimation of &gt;10%. If visual estimation of &gt;30% a note is also provided.</td>
</tr>
<tr>
<td>Water Quality</td>
<td>303 (d) list</td>
<td>Parameters listed</td>
</tr>
<tr>
<td></td>
<td>Contaminated sediments</td>
<td>Parameters or additional information listed</td>
</tr>
<tr>
<td></td>
<td>Shellfish harvest ratings (rating)</td>
<td>DOH shellfish harvest rating provided</td>
</tr>
</tbody>
</table>

*When necessary additional information on these categories is provided in the Notes column.

2.6.8 Processes that may be Impacted

For each reach, elements identified under structures and modifications were assessed to determine whether they were likely to impacts shoreline processes and/or function. If impact was likely, a narrative descriptions of impacted processes typically resulting from those elements was included in this column. If an impact was not considered likely, an explanation was included in the notes column.

2.6.9 Enhancement or Restoration Activities Implemented

This column provides RCO/SRF board project numbers that refer back to text in basin narrative. Refer to Section 2.4.7 of this chapter for further information.

The enhancement/restoration column was also used to track land acquisition completed within each reach as part of on-going enhancement or restoration programs, including the Black River Unit of the USFWS Nisqually Wildlife Refuge. Land acquisition was determined using ownership information in the Assessor’s parcel information.

2.6.10 Opportunities for Restoration and/or Protection

This column includes opportunities for restoration and/or protection that have been formally recognized or otherwise identified. While other opportunities may exist throughout the County
for land acquisition, use changes, bulkhead removal, vegetation restoration, and a number of other categories of restoration and enhancement, it is beyond the scope of the Analysis and Characterization to identify new opportunities.

This column was also used to identify reaches that include land within the boundaries of identified restoration programs, including the Black River Unit of the USFWS Nisqually Wildlife Refuge, that has either not yet been acquired, or for which restoration activities have not commenced.

2.6.11 Notes

This column is used to provide additional clarification for information addressed in the rest of the Reach Analysis Matrices. It is also used to capture items of interest and characteristics that did not fit into a specific column, which include, but were not limited to:

- Water quality/quantity monitoring sites;
- Fish hatcheries;
- Fluctuations in jurisdiction between County and cities and/or UGAs;
- Non-culvert fish barriers;
- Any questionable fish barrier not confirmed by map elements or aerial photograph;
- Presence of public preserves or parks; and
- Parcel ownership complexity for marine tidelands.
- Thurston County Staff notes about specific areas.
3 ECOSYSTEM CHARACTERIZATION AND ECOSYSTEM-WIDE PROCESSES

3.1 INTRODUCTION

This chapter describes Thurston County’s ecosystems and ecosystem-wide processes that influence and shape shoreline ecological functions, in accordance with WAC 173-26-210(3)(d). Information is presented at a broad scale and provides a foundation for understanding shoreline management in the context of ecosystem-wide processes. The chapter begins with a description of Thurston County’s regional setting, including the hydrogeologic factors/process controls of topography, climate, geology, and hydrology that govern ecosystem-wide processes. It describes nearshore and freshwater processes and effects of process alterations on ecosystem function. It describes priority species and habitats existing in Thurston County. The remaining sections provide information about the WRIAs located within Thurston County including: location, size, ecosystems, basins, historical use, current use, noted disturbances of process and projected future use. This chapter is intended to serve as an overview to provide context for the Basin Analysis located in Chapters 4-7 and the Reach Analysis located in Appendix A.

3.2 REGIONAL OVERVIEW

Thurston County is located in western Washington at the southern point of Puget Sound. The total area of the county is approximately 717 square miles. The County is bordered by Pierce County to the northeast, Lewis County to the south, Grays Harbor County to the west, and Mason County to the north/northwest.

Thurston County is one of the most rapidly urbanizing regions of Puget Sound. Since the 1960’s, Thurston County’s population has generally exceeded the statewide growth rate. Thurston County’s population grew by 14.8 percent, to roughly 238,000 residences, between 2000 and 2007; Thurston County’s cities and UGA’s contain approximately 67 percent of the residential population (TRPC, 2007).

3.2.1 Thurston County Shorelines

Thurston County contains both marine and freshwater shorelines.

3.2.1.1 Marine Shorelines

Thurston County is adjacent to several bodies of marine waters within the Puget Sound. The major marine waters are as follows and are provided in order from east to west: Nisqually Reach, Henderson Inlet, Budd Inlet, Eld Inlet, and Totten Inlet.

3.2.1.2 Freshwater Shorelines

Rivers, Streams, and Associated Floodplains

Thurston County is drained by five major rivers, in addition to several small streams which flow directly in to Puget Sound. The five major rivers are described below in order from east to west.

The Nisqually River is the easternmost river in Thurston County, forming the east county border with Pierce County. The Nisqually River is fed by glaciers on the south flank of Mount Rainier.
It flows from Mount Rainier in a northwesterly direction into Puget Sound at a point about ten miles northeast of Olympia. The vast majority of the River and its regulated tributaries include associated 100-year floodplain. The associated floodplain is relatively simple by comparison with other rivers in the County (e.g., Chehalis). It is typically tightly associated with the channel but widens in a number of areas, effectively expanding the area of regulated shoreline well beyond the 200-ft zone.

The Deschutes River begins in the Bald Hills of Lewis County and flows northwesterly. The Deschutes River is roughly parallel to the Nisqually River and is located five to ten miles to the west of the Nisqually. It flows into the Puget Sound at Budd Inlet in the City of Olympia. The vast majority of the River and its regulated tributaries include associated 100-year floodplain. The associated floodplain is somewhat more complex than that of the Nisqually River and includes a number of wide spots, lobes, and alternate channels based on the local topography. This contributes to a more complicated associated shoreline jurisdiction.

The Skookumchuck River also begins in the Bald Hills of Lewis County. It flows north into Thurston County where it drains the hills in the south central portion of the County. It winds towards the City of Bucoda and then turns in a southern direction to its confluence with the Chehalis River in Lewis County. Part of the upper Skookumchuck River has been impounded to form Lake Skookumchuck. Most of the River and its regulated tributaries include associated 100-year floodplain. Below Lake Skookumchuck, the floodplain is relatively wide and is complex in areas including lobes, alternate channels, and areas where the floodplain includes pockets of non-floodplain land. It also extends up at least one non-regulated tributary. All of these characteristics contribute to a more complicated associated shoreline jurisdiction.

The Chehalis River flows into Thurston County in a northwesterly direction from Lewis County. It crosses from Lewis County into the southwestern corner of Thurston County where it drains the Michigan Hills area and receives water from both Prairie and Scatter Creeks. The Chehalis discharges into the Pacific Ocean at Grays Harbor. The entire Chehalis River and most of Scatter Creek, its single regulated tributary within the County, include associated 100-year floodplain. The topography around the Chehalis River results in a very wide, very complex associated floodplain, particularly where the Black and Chehalis Rivers share 100-year floodplain areas. The most complicated floodplain areas are in the uppermost reaches within the County and the area immediately downstream of the Scatter Creek confluence. The Scatter Creek floodplain is relatively wide downstream of the City of Tenino and includes features such as lobes and alternate channels. The lower reaches of the Chehalis River (within Thurston County), along with the lower reaches of the Black River (again within the County), have some of the most complicated associated jurisdiction in the County due to floodplains and the wetlands which are also typical of the area.

The Black River, like the Skookumchuck, is also a tributary to the Chehalis River. The Black River drains a large portion of the easternmost Black Hills and much of the prairie area east of the river. The gradient of the Black River is not great enough for effective drainage, and consequently, has a large number of adjacent wetlands throughout its course. Its confluence with the Chehalis is within Grays Harbor County.
In addition to the five large rivers, there are three regulated streams draining Puget Sound shorelines. Kennedy Creek originates in northwest Thurston County and flows to Totten Inlet by way of Mason County. Kennedy Creek does not have associated floodplain. McLane Creek drains the area immediately south of the head of Eld Inlet. Its associated floodplain is relatively simple but wide in places. Woodland Creek drains the area immediately south of the head of Henderson Inlet. It also has a relatively simple associated floodplain.

Two additional regulated streams (Sherman Creek and North Fork Porter Creek), do not connect to the five larger rivers in Thurston County. Both streams originate in the southwest area of the County within Capitol Forest and eventually drain to the Chehalis River. Neither stream includes associated floodplain or substantial wetland areas; their jurisdiction is primarily defined by the 200-ft distance from OHWM.

**Lakes**

Lakes greater than 20 acres and therefore managed under the SMA within Thurston County include the following: McIntosh Lake, Tempo Lake, Deep Lake, Offutt Lake, Munn Lake, Scott Lake, Pitman Lake, Long Lake, Southwick Lake, Patterson Lake, Black Lake, Ward Lake, Hewitt Lake, Summit Lake, Lawrence Lake, Clear Lake, Elbow Lake, Bald Hill Lake, St. Clair Lake, Sunwood Lake, Skookumchuck Lake, Shinke pond, several unnamed lakes, and several unnamed ponds.

Lakes that are located within the County but within a municipal jurisdiction are not included in this list. Additional information for these lakes is provided in the Basin Narrative. Information at an even more detailed scale can be found within the Reach Analysis.

**Wetlands**

Most regulated freshwater jurisdiction, with the exception of some of the higher gradient streams and rivers, are also mapped as wetland areas. Associated wetland areas, those areas outside of the actual waterbody, are less ubiquitous within County shorelines. In low gradient areas, including the main stems of the major rivers and many of the lakes, associated wetland and associated floodplain areas often co-occur. The Black River, which has a particularly low gradient and very slow flow, has large areas where a quite wide channel, essentially the entire floodplain, is almost entirely vegetated with complex wetland vegetation (much of this area has been identified by the USFWS as priority restoration/conservation area as part of the Black River Unit of the Nisqually Wildlife Refuge). The Deschutes River includes large reaches where associated wetlands extend beyond the floodplain; again, a function of a relatively low gradient reach.

Particularly in low-gradient areas, wetlands (like floodplains) are often not associated with a single regulated waterbody but rather form a complex between them. The complex of wetland and floodplain making up associated wetland jurisdiction between the Chehalis and Black Rivers an example of this, as is the much smaller complex located between Scott and Deep Lakes.

In higher gradient areas, including much of Capitol Forest and the upper reaches of the Nisqually and Skookumchuck Rivers, associated wetlands are much less prevalent.
3.3 **ECOSYSTEM-WIDE PROCESSES**

3.3.1 **Hydrogeologic Setting/Process controls**

The hydrogeologic setting/process controls refers to the regional topography, geology, soils, and climate which together, govern the movement of water, sediment, nutrients, pathogens, organic material, and heat/light through a watershed (Stanley et al., 2005). The hydrogeologic setting/process controls determine the type of geochemical and biological processes that will occur in a region or watershed, for example the types and extents of habitats and the physical form of the landscape.

**Figure 2.** Relationships in the nearshore marine environment between process controls and ecosystem processes operating at the watershed/landscape and local scales, as well as habitat structures and ecological functions (adapted from Williams et al, 2001; Ruckelshaus and McClure, 2007).

3.3.2 **Topography**

Thurston County’s topography varies from coastal lowlands to Puget prairie flatlands to the foothills of the Cascades. The northwest and southeast corners of the County are marked by peaks ranging from 1,700 to 3,000 feet in elevation. However, the central region rarely exceeds 600 to 700 feet in altitude and most of the prairie areas range from 100 to 500 feet in altitude. Glacial activity in Thurston County’s geologic past left the land scattered with lakes and ponds. The northernmost boundary of the County is determined by the shoreline of Puget Sound. Inlets exclusive to the County are Budd, Henderson, and Eld Inlets. Budd and Henderson Inlets are
3. Ecosystem Characterization and Ecosystem-Wide Processes

Thurston County Shoreline Master Program Update
July 14, 2009
Shoreline Analysis and Characterization

3.3.3 Geology

Thurston County lies within the Puget Trough. The Puget Trough is a long northward slanting lowland located between the Cascade Mountains on the east and the Olympic Mountains on the west, extending from central western Oregon into Canada.

The geologic history of the region can be condensed into three general time frames, ordered here from oldest to newest. Thurston County’s bedrock was formed from 50 to 2 million years ago, by volcanism and marine deposition. The volcanism resulted from the North American plate moving over more dense oceanic rocks.

The geology, soils and land forms of Thurston County are largely the result of glacial action during the ice age that lasted from 2,000,000 years ago to 10,000 years ago (the Pleistocene Epoch). Between 2 million to approximately 10,000 years ago, during the Pleistocene epoch, the landscape experienced multiple glacial and inter-glacial periods that provided the raw materials and shaped much of the modern landscape in the Puget Sound lowlands. During the Pleistocene ice age, valley glaciers joined into huge continental glaciers that were thousands of feet thick. At their maximum advance, the glaciers extended to Scatter Creek south of Olympia, and to the Deschutes River in eastern Thurston County. The glaciers advanced and retreated four times during the ice age, with the last advance (ending around 14,000 years ago) referred to as the Vashon glaciation. As the glaciers moved southward from British Columbia they gouged and scoured the land beneath them and picked up large amounts of sediment ranging from boulders to silt. The friction of movement caused melting of the ice at the glaciers' base, resulting in some of the sediment load being deposited as a compressed layer directly below the glacier. This formed the dense, generally impermeable material known as glacial till (also hardpan or boulder clay).

Most recently, from 10,000 years ago to present, the large ice sheets receded and the post-glacial reorganization occurred. As the glaciers melted, the waters that flowed off it carried large amounts of silt, sand, and gravel. Coarser materials were deposited close to the glacier's edge, while sands were carried farther and deposited on the flood plains. Silt and clay were deposited mainly in lakes and marine waters. Except for numerous scattered “islands” of older consolidated rocks, the entire basin has been partly filled with unconsolidated fluvial and glacial materials of the Pleistocene age. The meltwater from the retreating glaciers carved complex drainages that likely that likely created an outlet from the Puget Sound lowlands to what is now the Chehalis River and Grays Harbor. After the glacier melted, large remnant ice blocks were left on the outwash plains and covered by younger sediments. When the ice blocks melted, the surface collapsed into the holes left by the melted ice, thereby forming the numerous "kettle" lakes of the County.
3.3.4 Climate

Thurston County has a marine type climate with mild temperatures year-round. In the warmest months, the average high temperature ranges between 75 and 80 degrees. In the winter months, high temperatures average 45 degrees. Like most of western Washington, Thurston County’s weather is characterized by cool, dry, sunny summers and mild, wet winters. Average yearly rainfall for Thurston County is 50 inches with the majority of precipitation occurring between October and May. Precipitation is highest in areas of higher elevation such as the headwaters of the Deschutes, and in the Black Hills. Precipitation typically occurs as low-intensity, long-duration storms. The county spans at least two of Washington’s climatic regions; the Puget Sound Lowlands, and the western Cascades.

Global Climate Change

Thurston County’s shorelines will undoubtedly be impacted by global climate change over time. Effects of global climate change will occur everywhere on the shorelines, but will probably be most pronounced on the nearshore areas. The United Nations Intergovernmental Panel on Climate Change (IPCC, 2007) concluded that, “Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global mean sea level.”

University of Washington’s Climate Impacts Group researchers and others have dedicated substantial effort to modeling potential climate change effects on the Pacific Northwest. From these models, they state that if all carbon dioxide emissions were halted today, ambient atmospheric concentrations would still continue to change climate conditions in the Puget Sound region for many decades (Snover et al., 2005). Despite these modeling efforts, uncertainty exists regarding the precise timing, magnitude, and extent of climate change impacts in the Puget Sound region. However, it is certain that global climate change impacts will occur. Being proactive by developing plans and taking action now will reduce harm to natural resources and human communities in the future.

The IPCC predicts that average global surface temperature could increase from 2.5 to 10.4°F, and global sea level could rise between 4 and 35 inches between 1990 and 2100, depending on both the rate of natural changes and the response of the climate system to present and future greenhouse gas emissions (IPCC, 2007). Thurston County’s shorelines are likely to be impacted in multiple ways from increasing temperatures and sea levels, as described below.

Temperature Effects on Habitat

Over the past century, Washington has already experienced climate change (Casola et al., 2005a). The surface air temperature has increased on average by approximately 1.5°F. Over the past 80 years, snowpack has declined, particularly at lower elevations. The beginning of snowmelt and peak stream flows in snow-fed rivers has been occurring earlier in the year. Many plants are also blooming earlier (Casola et al., 2005a).

Washington is likely to face an increase in temperature across all seasons over time (Casola et al., 2005a). By the 2020s, average Pacific Northwest temperatures will likely rise between 2.5 and 3.7°F, with additional increases the 2040s of between 3.1 and 5.3°F. As air temperatures rise,
water temperatures are also predicted to increase. Increased air and water temperatures may create inhospitable conditions in lakes, rivers, and salt water, for coldwater fish species such as salmon, trout. The change in conditions may be beyond those species’ ability to adapt. Along with temperatures, lake and ocean stratification may also increase which may reducing available nutrients and increase competition among fish species. Additionally, rising air and water temperatures may further impair areas of Puget Sound that are already suffering from low dissolved oxygen levels (e.g., Hood Canal) (Casola et al., 2005a).

Some marine plant species, such as eelgrass and bull kelp, appear to have a narrow range of tolerance for water temperature. As such, these species may suffer as a result of projected temperature increases (Snover et al. 2005). Changes in marine plant communities could alter habitat for marine species that are not substantially affected by moderate water temperature increases, but that depend on bull kelp and eelgrass habitat for shelter, food, or nesting sites.

Pacific salmon species have an unusual life cycle that might make them particularly sensitive to air and water temperature changes (Casola et al., 2005a). Increased summer stream temperatures could stressing juvenile salmon rearing in those streams as well as create thermal barriers to upstream migration of adult salmon. Lower winter snowpack and earlier spring runoff may increase the occurrence of redd-scouring events and prevent the flushing of juvenile salmon to salt water in runoff. In marine waters, higher water temperatures or altered currents may affect the food availability and change predator distribution, though the impacts of climate change on these factors are not well understood (Casola et al., 2005a).

As water temperatures increase, marine and freshwater planktonic communities may also change (King County, 2006). Warm temperatures in shallow water over prolonged periods favor several groups of organisms, including bluegreen cyanobacteria, (some species of which make toxic substances to people and animals); dinoflagellates, (which produce the toxins that cause red tides); and chlorophyte algae, (some species of which form sizable filamentous masses that cover rocks and structures) (King County, 2006).

Precipitation and Runoff

The modeling results of effects of global climate change on precipitation levels are somewhat uncertain, because many factors influence precipitation that are not well understood (Casola et al., 2005a). However, the majority of models predict that Washington will receive more precipitation with most increases occurring from October through March due to climate change during the 21st century. As winter temperatures increase, more of this precipitation to fall as rain rather than snow, leading to reduced snowpack and earlier spring runoff (Casola et al., 2005a).

Air temperature and precipitation changes from global climate change will affect stream flow, stormwater runoff, and water temperature (Casola et al., 2005a). Stream flow is predicted to experience varying impacts depending on whether a stream is fed primarily by snowmelt or rainfall (Casola et al. (2005a). Low elevation coastal rivers (e.g., the Nisqually River) have flow volumes closely connected to seasonal precipitation patterns; as winter precipitation increases, winter flows in these systems are thus also likely to increase. Rivers draining intermediate “transient snow zone” elevations have higher sensitivity to the proportion of winter precipitation falling as snow versus rain. These rivers typically have peak flows during November and December and again during spring runoff. Rivers draining “transient snow zone” elevations are
likely to see an increase in “wet season” flows as rainfall increases, reduced spring and summer flows, and an earlier occurrence of runoff. Basins dominated by transient snow zones are also expected to experience an increase in moderate floods, though large floods are expected to occur at roughly the same frequency as present (Casola et al., 2005a).

As temperatures increase and snowpack declines toward mid-century, river systems that depend on snowmelt will likely have peak runoff occur earlier in the spring, as well as have lower summer base flows (King County, 2006). Both of these changes may greatly impact fish and other biota adapted to coldwater habitat during the warm, dry months of summer (King County, 2006).

**Sea Level Rise**

One of the anticipated effects of climate change in the Pacific Northwest is sea-level rise. In response to global climate change, sea levels are estimated to rise between 4 and 35 inches, by 2100, (Intergovernmental Panel on Climate Change 2006). In Olympia, land subsidence alone is already responsible for a sea level rise of approximately 1 foot per century. Adding the impacts of climate change to subsidence on sea level rise may result in, port district inundation and central business district flooding in Olympia in the future (Casola et al. 2005b).

Climate change might affect sea levels and coastlines of Washington State in a number of ways (Casola et al., 2005b). Coastal flooding and erosion could be increased by rising sea levels, particularly in areas of tectonic subsidence and on flat beaches. To protect infrastructure, shoreline armoring in many areas may have to be enhanced, while in other areas, development and housing may simply have to be abandoned or moved in response to flooding. Landslide and freshwater flooding occurrence may also increase with winter precipitation. In order to minimize additional risks to infrastructure in the future, further development in coastal hazard areas could be discouraged (Casola et al., 2005b).

Sea level rise may also considerably change the geographic locations of the shoreline jurisdiction over time. A sea level rise of up to 3 feet will cause a substantial movement of water inland and would be particularly pronounced in lower slope or flatter areas (King County, 2006). Water moving inland has the potential to flood beachfront homes and cause associated property damage, as well as significantly increasing erosion of feeder bluffs. Rising sea level is also likely to disrupt other coastline ecological processes. Predicted habitat changes in the Puget Sound are and increased shoreline erosion, loss of estuarine beach and tidal flat areas, saltwater intrusion into freshwater wetlands and brackish marshes, and reduction in tidal marshes, (NWF, 2007).

Options to address the impacts of rising sea levels were presented by Casola et al. (2005b), including:

- Preserving ecological buffers to allow for beach migration inland;
- Restoring wetlands to control runoff and floods;
- Augmenting shoreline protection while understanding its negative consequences on shoreline habitat;
- Monitoring for invasive species; and
- Creating a disaster relief plan for erosion and flooding events.
3. Ecosystem Characterization and Ecosystem-Wide Processes

### Figure 3. Estimated projections of sea-level rise for Thurston County (in Herrera, 2005)

<table>
<thead>
<tr>
<th>Factors Affecting Sea Level</th>
<th>1990</th>
<th>2000</th>
<th>2025</th>
<th>2050</th>
<th>2075</th>
<th>2100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global average sea-level rise (ft.)</td>
<td>0.0</td>
<td>0.1</td>
<td>0.3</td>
<td>0.7</td>
<td>1.2</td>
<td>1.6</td>
</tr>
<tr>
<td>East Pacific surcharge (ft.)</td>
<td>0.0</td>
<td>0.1</td>
<td>0.3</td>
<td>0.3</td>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td>Local subsidence (ft.)</td>
<td>0.0</td>
<td>0.1</td>
<td>0.2</td>
<td>0.6</td>
<td>0.4</td>
<td>0.6</td>
</tr>
<tr>
<td>Total Sea-level Rise (ft.)</td>
<td>0.0</td>
<td>0.2</td>
<td>0.8</td>
<td>1.2</td>
<td>2.3</td>
<td>2.9</td>
</tr>
</tbody>
</table>

Source: Canning (2001).

3.3.5 Shoreline Processes, Process Intensive Areas and Alterations

3.3.5.1 Nearshore Processes

The marine nearshore environment is “The estuarine/delta, marine shoreline and areas of shallow water from the top of the coastal bank or bluffs to the water at a depth of about 10 meters relative to Mean Lower Low Water. (This is the average depth limit of light penetration.) This zone incorporates those geological and ecological processes, such as sediment movement, freshwater inputs, and subtidal light penetration, which are key to determining the distribution and condition of aquatic habitats. By this definition, the nearshore extends landward into the tidally influenced freshwater heads of estuaries and coastal streams” (Puget Sound Nearshore Ecosystem Restoration Project (PSNERP), 2003).

Marine nearshore environments are formed and maintained by landscape-level ecosystem processes such as net shore-drift (Williams et al., 2004). These landscape processes must function properly across various spatial scales in order to maintain nearshore habitats and the species that occupy and depend on them (including juvenile salmonid species and many species of commercially/recreationally harvestable shellfish) (Williams and Thom 2001; Ruckleshaus and McClure, 2007). The health of nearshore environments is linked to physical processes at the landscape-scale (Williams et al. 2004, Difenderfer et al., 2006). Physical processes form habitat structure, which influences habitat-related processes, which in turn shape ecological functions and values. Nearshore environments are also affected by chemical and biological processes.

This section discusses key ecosystem-wide processes in the marine nearshore involving the delivery, movement, and loss, of water, sediment, nutrients, pathogens, toxins, and wood:

- Water processes: circulation, including tides/currents;
- Sediment processes: beach processes and coastal erosion; net shore-drift; coastal bluff landslides; and fluvial influences;
- Water quality processes: nitrogen, phosphorus, pathogens, toxics, and heat/light;
- Riparian vegetation processes: large woody debris, organic matter.
3.3.5.2 Water Processes

Circulation

South Puget Sound oceanographic circulation processes are typical of a fjordal estuary, with landward flow at depth and seaward flow at the surface. Local rivers deliver freshwater which usually flows seaward on the surface. This occurs because freshwater has lower salinity and is warmer than incoming Pacific Ocean water, which makes it less dense. The incoming water from the Pacific Ocean is colder and more saline than the freshwater, causing it to be more dense and flow landward along the bottom (Nightengale, 2000). These layers are mixed by a combination of wind, bathymetry, and lunar influence. The influx of saltier water and seawater intrusions to Puget Sound are greatest when the tidal range is smallest, due to neap tides (when the moon is in the first and last quarters). The mixing of fresh and salt water occurs most during spring tides when the moon is full or new as a result of higher velocity tidal currents (Nightengale, 2000). The difference in temperature, salinity, and density between the freshwater and saltier ocean water, as well as the level of wind on the water surface, determines the degree of mixing (Nightengale, 2000).

Tides and Currents

Salt water in the Puget Sound enters from the Pacific Ocean through the Strait of Juan de Fuca then diverges south into Puget Sound. Tides in the Puget Sound are semi-diurnal, with two unequal two high tides and two unequal low tides daily. As the distance from the Pacific Ocean increases, mean tidal range in the Sound also increases. Thurston County contains some of the largest tide ranges in Puget Sound (greater than greater than 4 meters between MLLW and MHHW (Finlayson, 2006). Budd Inlet has the largest tide range (4.4 meters with spring maximum tides of over 5 meters).

Tidal currents are muted within South Puget Sound, particularly within protected Henderson, Budd, and Eld Inlets (Albertson et al., 2002). The edge of the Nisqually estuary touching Puget Sound is the most exposed portion of the marine shoreline and tidal currents here are typically stronger and are directed to the northwest. More information on tidal currents in Thurston County can be found in the results of hydrodynamic models produced by hydraulic and water quality process investigations within the South Sound (Albertson et al., 2002). Tidal currents have been measured were the basis for the Environmental Fluid Dynamics Code (EFDC) model created for the Budd Inlet Scientific Study Report (Aura Nova et al., 1998). Budd Inlet has a flushing rate of between 8 to 12 days with established circulation patterns (Aura Nova et al., 1998).

3.3.5.3 Sediment Processes

Beach Processes and Coastal Erosion

The composition of Puget Sound area beach is primarily determined by three main influences: wave energy, sediment sources, and relative position of the beach within a littoral cell. Wave energy is controlled by fetch (the open water over which winds blow without any interference from land). In Puget Sound, winds and waves originating from the south are the most frequent (prevailing) and strongest (predominant) wind direction.
Waves generated by wind sporadically erode beaches and the toe of coastal bluffs which, helps initiate bluff landslides. Coastal bluffs (referred to as feeder bluffs or contributing bluffs) provide the primary source of sediment for most Puget Sound Beaches (Downing, 1983). Beach sediment composition is influenced by bluff composition and wave energy. Waves act to sort coarse and fine sediment. Larger, higher energy waves can move larger rocks when smaller waves are unable. Bluffs composed of coarse gravel will provide different sediment to a beach than a bluff containing sandy material. Sand, gravel, and silt dominate the bluffs in Thurston County. Sand and gravel are the primary beach sediments, because the silt is winnowed away from the beach face to deeper water.

Puget Sound beaches frequently have two distinct foreshore components: a high-tide beach and a low-tide terrace (Downing, 1982). The high-tide beach is a comparatively steep beach face composed of coarse sediment with an abrupt slope break at its waterward extent. In a mixed sand and gravel beach, sand is typically winnowed out of the high-tide beach by wave action (Chu, 1985 in Herrera 2005) and deposited on the low-tide terrace. The low-tide terrace extends seaward from the break in slope at the toe of the high-tide beach. The low-tide terrace is typically a gently sloping accumulation of poorly-sorted fine-grained sediment (Komar, 1976). The low-tide terrace also contains the lag deposits derived from bluff recession (larger rocks, cobbles, and boulders).

In addition to wave energy and sediment sources, tidal range also influences beaches over time. Coastal erosion rates tend to increase with decreasing tidal range (Rosen, 1977) due to the focus of wave energy at a narrow vertical band with small tidal range, in contrast to the dispersal of wave energy over a large vertical band with a greater tidal range. Coastal erosion in Puget Sound occurs most when high-wind events overlap with high tides and the waves directly hit the backshore and bluffs (Downing, 1983).

**Net Shore-drift**

Beach sediment is moved along the shoreline through the process of littoral drift (shore drift). Littoral drift is the product of wind-generated waves approaching the shore from an oblique angle. Since it is caused by wind-generated waves, littoral drift can change in response to short-term shifts in wind direction including daily, weekly, and seasonally. Over longer periods of time, many shorelines demonstrate a single direction of net shore-drift. The direction of net shore-drift is ascertained through geomorphologic analysis of coastal landforms and beach sediment patterns. Most shorelines can be divided into distinct littoral, or drift, cells. These cells act independently of each other and each have discrete sources and sinks of sediment. Each drift cell is a system with three elements: a sediment source which is the erosional feature that originates the drift cell; the transport zone where waves move the sediment alongshore with minimal sediment input; and a deposition zone where the sediment finally comes to rest, often creating spits or barrier beaches. The sediment deposition area is the end of the drift cell and it occurs when wave energy is no longer strong enough to transport sediment in the drift cell. = (Driftcell.shp metadata, Ecology Coastal Atlas).

Net shore-drift creates unique drift cells through the process of transporting sediment over time from a feeder bluff to a depositional shoreform. This process creates stretches of shoreline where sediment flow is effectively isolated from adjacent shoreline stretches. Correctly functioning
drift cells are critical for creating and maintaining nearshore habitats for nearshore dependent species such as salmon, and shellfish. Due to their importance as an ecosystem process and unique nature, drift cells are useful elements for planners to use to delineate the shoreline into reaches for characterization and management.

**Coastal Bluff Landslides**

Along the shores of much of Thurston County, erosion of sedimentary deposits has created high-elevation, often unstable coastal bluffs. Coastal landslides are the primary contributor of sediment to beaches and net shore-drift systems. Coastal landslides typically occur on bluffs where a combination of characteristics makes the bluff vulnerable to slope failure, and during and following periods of prolonged high precipitation in the winter (Tubbs, 1974; Gerstel et al., 1997; Shipman, 2004). Characteristics that makes the bluff vulnerable to slope failure include the underlying geology of the bluff, its level of wind-exposure, the local hydrology (groundwater and surface water), and the extent of development impacts (Hampton et al., 2004). Wave exposure makes many Thurston County bluffs susceptible to coastal landslides.

The long-term cause of bluff recession is usually undercutting of the toe of the bluff. Significant waves caused by windstorms attacking the toe of the bluff can directly activate bluff failures. Bluffs exposed to greater wind energy (fetch) receive higher wave energy during storms, causing greater toe erosion and bluff undercutting, and subsequently more frequent landslides (Shipman, 2004). More often, toe erosion leads bluff landslides by a period of years, and bluff instability increasingly progresses up the slopes. Bulkheads can reduce wave attack to bluff toes causing undercutting, but bulkheads can accelerate erosion of the beach.

Bluff landslides are more likely to occur in locations where there is a history of landslides, and/or where the bluff strata consist of an unconsolidated, permeable layer (sand), on top of a comparatively impermeable layer (dense silt or clay) (Gerstel et al., 1997). Water is able to percolate through the permeable layer, but then collects above the impermeable layer, creating a “slip-plane”, or zone of weakness. Mass wasting (landslides and larger deep-seated failures) is typically caused by this stratigraphic pattern.

Thurston County’s beaches are composed primarily of sand and pea gravel overlying cobble. The glacially derived sediment is delivered to the beaches by bluff erosion or landslides. Forage fish, including sand lance and surf smelt, spawn preferentially on beaches of mixed sand and pea gravel (Penttila, 2000). Eelgrass beds rely on sediment with high proportions of sand and pea gravel and are not able to flourish in sediment-deprived systems dominated by cobble (Hirschi, 1999). Salmon rely on the nearshore sand and pea gravel beaches in several ways such as for gently sloping beaches as safe havens from predators during migration, on forage fish for nourishment, and on eelgrass beds for cover and foraging habitat (Groot and Margolis, 1991).

**Fluvial Influences on the Nearshore**

Fluvial systems (rivers and streams) shape nearshore character and can cause change in the marine landscape. Most river sediment delivered to the coast is initially deposited in deltas. Subsequently, since fluvial sediment is often too fine to remain in the nearshore due to prevailing wave regimes, the majority of river-borne sediment is transported further waterward than beaches and deposited on delta fronts and in deeper water (Downing, 1983). The coarse grain
portion of the river and stream sediment is typically transported in net shore-drift cells. However, it makes up only a small portion of the total beach sediment as the majority is derived from the erosion and landsliding of unconsolidated bluffs.

How much and what type of fluvial sediment is delivered to the nearshore is dependent on the qualities of the upland: the rocks and soils found there, the amount and type of vegetation, the climate, and the elevation (Komar, 1976). The more fluvial sediment delivered to the coast, the greater its influence on nearshore processes. When the lower sections of river systems are diiked or separated from their depositional floodplains, too much fluvial sediment is frequently deposited at the river mouth. The excessive sediment deposition forms a prograded river delta and damages estuarine habitat.

Fluvial systems influence the nearshore in numerous ways including salinity changes, sediment supply, altered littoral drift, and habitat formation. Fluvial systems locally decrease the salinity of the marine water. Fluvial sediment transport provides sediment to local beaches, which can assist in the establishment of ecologically valuable habitats including marshes, shallow water deltaic habitats, sand and mudflats, and distributary channels. The abundance and density of aquatic flora (e.g., eelgrass) and fauna can be affected by fluvial influences. River or stream discharge into the nearshore can alter littoral drift patterns, commonly leading to the formation of alongshore bars or shoals and creating increased shoreline complexity. Depending on river discharge and wave conditions, these features can display seasonal dynamics, be ephemeral or permanent.

Water Quality Processes

Puget Sound marine nearshore water quality is the result of many complex interactions between physical and biological processes. In the continental United States, Puget Sound is the largest fjord-type estuary. Puget Sound’s main basin is over 900 feet deep; however, the South Sound basin is much shallower. Many factors combine to influence South Puget Sound water quality by delivering nutrients, organic matter, pathogens, and inorganic compounds, including, but not limited to: salty, cold water from the Pacific Ocean, terrestrial watersheds that contribute freshwater runoff to the Sound through surface and groundwater discharge, and atmospheric inputs of water, nutrients, and pollutants. Materials that influence water quality (e.g., nutrients, organic matter, etc.) are also stored and released from the bottom sediment of Puget Sound.

The physical structure of the nearshore determines the extent of mixing of the inputs. In general, As the distance south from the Strait of Juan de Fuca increases, the influence of the deeper marine waters is also reduced, while the influence of terrestrial inputs increases. Nutrients, organic matter, pathogens, and inorganic compounds influence and provide important feedback loops for water quality provide as well as form the basis for biological processes (e.g., primary production of algae and other plankton).

Nutrients (Nitrogen and Phosphorus)

Thurston County’s nearshore and marine waters receive inputs of nutrients and organic matter from nearshore bottom sediments and mixing with deeper ocean waters via upwelling and estuarine circulation as well as from adjacent uplands, streams, rivers, and groundwater seeps. Typically, nitrogen and phosphorus inputs from natural sources are much greater than
anthropogenic sources in Puget Sound (Harrison et al., 1994). However, South Puget Sound has a number of characteristics which lead to a greater contribution of nitrogen and phosphorus inputs from terrestrial and anthropogenic sources than oceanic influences (Albertson et al., 2002).

The South Sound is characterized by a high shoreline to water surface-area ratio with relatively shallow depths, stratification of the water column, slow flushing times, protected bays and narrow inlets (Albertson et al., 2001; Herrera, 2005). These conditions make it difficult to dilute nutrients entering the nearshore from adjacent uplands, rivers, and streams by mixing or flushing. Due to these physical characteristics, the South Sound is vulnerable to the effects of excess nutrients which can lead to water quality problems associated with eutrophication (algae blooms) and low levels of dissolved oxygen (hypoxia).

Eutrophication and increased dissolved oxygen (hypoxia) levels can be detrimental to marine organisms. Excess nutrients stimulate greater phytoplankton growth or algal blooms which in turn reduce light levels reaching the sea bottom, which then reduces the growth and vigor of other plants such as eelgrass and kelp (Williams and Thom, 2001). Excess nutrients can also contribute to contamination of shellfish beds with the harmful bacteria associated with some nutrient sources (i.e., fecal coliforms) and through and from harmful algal blooms (eutrophication), which are thought to contribute to Paralytic Shellfish Poisoning (PSP) and Amnesiac Shellfish Poisoning (ASP) (WDOH, 2005). Excess nutrients can also affect phytoplankton community composition, resulting in an indirect affect on marine food webs that rely on phytoplankton. Eutrophication and low dissolved oxygen resulting from increased anthropogenic nutrient inputs or from stratification that can locally concentrate nutrients also have negative impacts on other marine species, including: critical salmonids; forage fish spawning; riparian buffers; shorebird and seabird nesting and foraging; and marine mammal foraging, migration, and haulout habitats. Already, South Puget Sound experiences periods with dissolved oxygen levels low enough to kill marine organisms more frequently than other areas of Puget Sound.

Many human land uses in the upland watersheds draining to Puget Sound contribute to excess nutrients, toxins, and pathogens, for example: failing septic systems, use of fertilizers and pesticides, agricultural operations (animal manure, fertilizers), contaminated sediments, wastewater treatment plants, and stormwater runoff from impervious surfaces (Embrey and Inkpen, 1998).

The processes that control nutrient inputs, dispersion, and areas of concentration also influence inputs and concentrations of pathogens, pollutants, and toxins in Thurston County nearshore waters. Specific water quality impairments are described in the reach analyses.

Pathogens

Fecal coliform was used as an indicator of overall pathogens because it is monitored in Ecology water quality studies and it is the most commonly occurring pathogen. The presence of fecal coliform bacteria indicates the possibility that feces and pathogenic organisms are also present. However, fecal coliform bacteria may not reliably predict pathogens and enteric viruses in the marine environment (Glasoe and Christy, 2004). Humans may introduce fecal matter and
associated pathogens to water bodies in many ways which include but are not limited to septic systems built on or near marine and estuarine shorelines, marina and boating activities, and pet waste.

**Toxins/Metals**

The State of Washington and the Puget Sound Partnership have declared an objective for the recovery of Puget Sound, to significantly improve water quality by reducing toxics and pollutants entering Puget Sound. To date, toxic contaminants in Puget Sound have threatened water quality, reduced marine habitat, and resulted in shellfish closures. Toxic contaminants in the marine nearshore have been documented as a continually increasing problem in the South Sound area. The Department of Ecology and other state agencies are currently studying toxic contaminant loading to Puget Sound in an effort to identify toxic input sources. Preliminary study results indicate that surface water runoff and stormwater may be the largest contributing factors to pollutant loading in Puget Sound (Hart Crowser et al., 2007). Toxics contaminants include metals such as lead, copper, zinc, mercury, and other persistent chemicals including PCBs, flame retardants, and phthalates. These toxics are concentrated in the food chain and have detrimental effects to marine organisms including, but not limited to: fish, shellfish, Puget Sound. Southern resident Puget Sound orcas have been found to have some of the highest concentrations of fire retardants and PCBs found in the world in marine mammals (Ross, 2005).

**Heat/Light**

Shaded shorelines will receive lower levels of solar radiation than exposed shorelines. Higher levels of solar radiation can support higher levels of primary productivity, which influences water quality.

### 3.3.5.4 Vegetation Processes

Riparian vegetation processes affect delivery of large wood and organic matter to the shorelines, wildlife habitat and migration corridors, shade, habitat structure, microclimate regulation, and nutrient levels (Brennan and Culverwell, 2004).

**Organic Matter, Large Wood, and Habitat**

Bluff-top and shoreline vegetation is a source of organic matter and large woody debris to the nearshore in bluff landslides as well as serving habitat functions for many species. Large woody debris from riparian vegetation areas provide multiple habitat functions such as: potential nesting, roosting, refuge and foraging opportunities for wildlife; foraging, refuge, and spawning substrate for fishes; and foraging, refuge, spawning, and attachment substrate for aquatic invertebrates and algae. For example, bluff trees are favorite spots for nesting and perching by bald eagles as well as other bird species. Vegetation overhanging from the bluff supplies terrestrial insects for marine fish consumption, provides shade for surf smelt and sand lance eggs, and provides cover at high tide (Brennan and Culverwell, 2004).

**Water Quality**

Riparian buffers provide measurable water quality protection from nearshore nutrient sources. The value of riparian buffers for protecting water quality depends on a number of factors, including: type and level of pollution, surrounding land uses, vegetation type, soil type, slope,
annual rainfall, and adequate buffer width and integrity. The amount of impervious surface and vegetated cover is directly related to soil stability and sediment control. In developed areas where riparian vegetation has been removed and soils have been compacted, soil quality is typically degraded (May, 2000). Water that is not absorbed or intercepted by vegetation creates surface runoff over the surface that can increase the potential for landslides, lead to erosion, siltation, burial of aquatic environs, and introduction of contaminants into water. Stormwater and agricultural runoff commonly contain pollutants such as excess nutrients, metals, and organic chemicals, typically in particulate form. Therefore, controlling waterborne sediments with riparian buffers often also removes a large percentage of the pollutant load to water bodies (May, 2000).

3.3.5.5 Nearshore Process-intensive Areas

Nearshore process-intensive areas for water quality, coastal erosion, and beach processes in Thurston County often coincide. In general, process-intensive areas include feeder bluffs, stream/river deltas, marine riparian areas, accretionary landforms, estuaries, and tidal inlets. These process intensive areas play key roles in maintaining and shaping critical nearshore habitat including eelgrass meadows, kelp forests, beaches and backshore, banks and bluffs, mudflats, tidal marshes, sand spits, and marine riparian areas. The habitats supported by process-intensive areas provide critical ecosystem functions such as providing areas for primary production, providing foraging and refuge opportunities for birds and other wildlife, supporting invertebrates and juvenile and adult fish (including salmonids). In order to support and maintain all of the above habitats, bluff sediment input and net shore-drift system processes must continue to function properly (Johannessen, 1999).

Feeder bluffs are process intensive areas for coastal erosion and beach processes. Feeder bluffs are the sediment source for drift cells. They provide the beach sediment essential to maintain critical habitats throughout the drift cell including: forage fish spawning areas; eelgrass beds; and accretionary landforms such as spits and pocket estuaries at the end of a drift cell. Sediment can also be contributed to the nearshore through landslides or surface runoff, which can lead to surficial erosion, siltation, contamination of water, and burial of aquatic environs. Pocket estuaries and spits often protect valuable salt marsh habitat. Salt marshes provide habitat for primary productivity, and shelter and forage for many species including juvenile salmonids. Tidal inlets maintain water quality and nutrient dynamics for spit/marsh complex by maintaining maintain circulation processes important for flushing these critical habitats.

Estuaries, tidal inlets, tidal marshes, and lagoons are process intensive areas for circulation and beach processes. Highly productive habitats, estuaries provide flood attenuation, nutrient retention and cycling, erosion/shoreline protection, habitat structure/connectivity functions, and food web support. Water circulation within an estuary fundamentally influences the estuary habitat functions. Water movement from rivers, waves, and tides erodes and deposits sediments, carries organic material and nutrients, and transports fish and prey items. Water movement also affects the complexity and physical form of the estuary (e.g., depth, slope, size of the system, connections to other habitats, landform, and channel network) which also affects habitat for shellfish, salmonids and other species. Circulation processes also create habitat features within the estuary, such as pockets and bars (Redman et al., 2005). Estuaries are critical nurseries for out-migrating salmonid fry; allowing the fry time to adjust to changing salinity levels.
Additionally, estuaries serve as nurseries for other aquatic species that are a primary source of food for salmon. These shallow water habitats provide a refuge from predators for juvenile salmonids and other species while migrating. Estuaries are significant shellfish production areas because the shellfish depend on good water quality and well-functioning circulation patterns. Pocket estuaries are non-natal lagoons with coastal stream mouths and freshwater input. Salt marshes, lagoons, and brackish marshes occur in areas with tidal inundation and flushing. The vegetation in salt marshes traps and stabilizes sediments. Salt marsh habitat supplies complex, branching, tidal channel networks where juvenile salmonids forage and hide from predators. Salt marshes also form migratory linkages between marine and riverine environments (Brewer et al., 2005). In Thurston County, major estuaries include the Nisqually Delta/estuary, Henderson, Eld and Totten estuaries. Marine riparian and critical saltwater habitat areas are described in detail in basin analysis the individual reach sections.

Deltas are process intensive areas for beach processes and fluvial processes. Deltas are formed at river and stream mouths where the freshwater enters the nearshore. The velocity of stream flow decreases when the river or stream water enters the larger marine water body. When the water slows down, the stream loses energy to carry most of the sediments and nutrients being transported, and deposits the sediments on the delta. Not only do deltas provide a source of sediment, organics, and LWD to the nearshore, but they also typically provide important habitat functions for salmonids including foraging, physiological transition from fresh to salt water, predator avoidance, and migratory corridors to marine feeding grounds (Simenstad et al., 1982). The habitat functions of deltas also benefit other nearshore-dependent species. In Thurston County, the major river delta is the Nisqually Delta.

Riparian vegetation areas are process intensive areas for coastal erosion, water quality, and organic debris, playing a part in nutrient cycling, sediment control, heat/light inputs, and habitat. Riparian vegetation areas processes affect wildlife habitat, shade, habitat structure, microclimate, and nutrient levels (Brennan and Culverwell, 2004).

3.3.5.6 Marine Nearshore Shoreline Protection and/or Restoration Measures

In accordance with WAC 173-26-201, this section identifies measures necessary to protect and/or restore ecological functions and ecosystem-wide processes. For this section, protection and restoration measures have been listed under a single process, but will also positively impact other processes. The interconnection between ecosystem-wide and shoreline processes means that protection and restoration measures will positively influence multiple processes. For example: maintaining or restoring marine riparian buffers, including the tops of marine bluffs, with native vegetation is only listed under Vegetation Processes, however, this measure will impact all processes in multiple ways, some of which are: increased infiltration of precipitation; increased slope stability; reduced runoff and associated sediment, nutrients, and toxins; increased habitat complexity; and maintenance of a source of large woody debris and organic matter. Protection and restoration measures for nearshore marine shorelines are not limited to those listed here. Most marine nearshore and freshwater protection and restoration measures are interchangeable. Please also refer to the freshwater protection and restoration measures outlined in Section 3.3.2.9.
Hydrologic Processes:

- Protect and restore estuaries, pocket estuaries, tidal inlets, tidal marshes, lagoons, and shallow water/low velocity habitats
- Maintain stream mouths and deltas unobstructed
- Prohibit new construction and encourage removal of dikes or levees; stream channelization; and/or wetland ditching

Sediment Processes:

- Maintain feeder bluffs to continue natural erosion processes
- Maintain adequate distance from feeder bluffs for new development to eliminate the need for shoreline protection structures
- Remove existing bulkheads and armoring
- Encourage bio-engineering or soft armoring for replacement shoreline structures
- Limit piers, docks, boat ramps, groins, and jetties

Water Quality Processes:

- Increase level and extent of treatment for stormwater
- Limit impervious surface allowed for residential and commercial development
- Increase surface water setbacks for new and replacement septic systems
- Encourage relocation of existing septic systems further from water bodies.
- Prohibit commercial or industrial uses producing contaminants adjacent to shoreline
- Prohibit non-water related commercial and industrial development

Vegetation Processes:

- Maintain or restore marine riparian buffers, including the tops of marine bluffs with native vegetation
- Increase riparian buffer distance for replacement of non-conforming structures
- Increase percent forest cover, particularly hydrologically mature forests
- Increase structural and species diversity of marine riparian buffer vegetation
- Restore riparian vegetation on existing developed lots
- Encourage maintenance of large woody debris within water bodies
- Reintroduce large woody debris to streams
- Preserve and restore fish and wildlife habitat connectivity

3.3.5.7 Freshwater Processes

The health and function of freshwater shoreline systems is, like the nearshore environment, influenced to a large degree by the movement or storage of materials such as water, sediment, nutrients, pathogens, and organic matter (e.g., LWD). Key ecosystem-wide processes in freshwater shoreline systems are described below.
This section discusses:

- Hydrologic processes: surface water storage, surface runoff and peak flows, groundwater recharge/discharge/flow;
- Sediment processes: mass wasting, surface erosion, and bank erosion;
- Water quality processes: nitrogen, phosphorus, pathogens, toxins/metals, and heat/light inputs;
- Vegetation processes: large woody debris and organic matter.

**Hydrologic Processes**

Infiltration and groundwater recharge are two important hydrologic process mechanisms. In Puget Sound, highly water permeable areas are glacial outwash, especially recessional outwash (Dinicola, 1990 as cited in Vaccaro et al., 1998). These areas are identified as important infiltration/recharge areas because they have a relatively high capacity for infiltrating precipitation and surface water (Winter, 1988).

Impervious surfaces can negatively impact all areas of a watershed, but they are particularly detrimental in areas that would naturally have high infiltration and recharge rates (i.e., permeable deposits on low slopes). Watersheds with more than 10 percent impervious area have shown increases in runoff resulting from decreased infiltration capacity (Glasoe and Christy, 2004; Paul and Meyer, 2001; Booth and Reinelt, 1993). Recharge in areas with 50 percent impervious surface, such as residential areas, is reduced by 50 percent (in Stanley et al., 2005).

The percent of forest cover in a watershed also influences hydrologic processes such as the rate of water infiltration and recharge. The reduction of hydrologically mature vegetation, can alter natural surface runoff patterns, particularly in rain-on-snow and snow-dominated zones. During rain-on-snow events, areas cleared of hydrologically mature forest in the rain-on-snow zone can produce 50 to 400 percent more outflow from snowpacks than areas with hydrologically mature forest (Coffin and Harr, 1992 as cited in Stanley et al., 2005a). The increased outflow in non-forested areas is primarily caused by the additional snow on the ground, as well as a higher rate of snowmelt due to the absence of sun-blocking vegetation cover (Brunengo et al., 1992; Coffin and Harr 1992). Rain-on-snow areas converted from forest cover to non-forest cover are more likely to generate peak runoff.

**Surface Water Storage**

Surface water storage is a principal part of the hydrologic cycle. Reduction or loss of surface water storage potential can shift stream flow, volume, and timing (Collins et al., 2003) or increase fluctuations of water levels in lentic systems (Euliss and Mushet, 1999). Water storage can be directly impacted by land use via the filling of floodplains, wetlands, and/or hyporheic zones. Water storage can be indirectly reduced by disconnecting a stream/river from its floodplain. Surface water storage connectivity is reduced as a consequence of construction of dikes or levees along stream channels; stream channelization and incision; and/or wetland ditching. Some of the results of these modifications operate at the watershed scale (e.g., increased sediment supply); whereas others occur at the reach scale (i.e., channel modifications and incision).
Surface Runoff and Peak Flows

The processes of surface runoff and peak flows are closely related to infiltration/recharge as described above. Surface runoff is inversely correlated to infiltration/recharge. Runoff is impacted by development that increases the density of drainage and impervious surface. The increased drain density synchronizes runoff during peak events, resulting in increased the magnitude and frequency of peak flows. The presence of roads is commonly related to artificial water transport systems such as ditches and storm sewers. It has been shown that roads in forested areas cause physical disturbances that extend the length of headwater channels and convert subsurface flow to overland flow, resulting in increased drainage density.

The patterns of surface runoff are strongly influenced by season. Particularly in the Pacific Northwest, hydrologic systems are notably sensitive to warm rain-on-snow events, when large volumes of surface water can be released at one time into the system. Winter snowmelt is a critical element in rain-on-snow events that result in most major peak flow events (WFPB, 1997). Within the Puget Sound area, rain-on-snow and snow-dominated zones occur primarily between 1,500 to 4,500 feet where weather patterns frequently cause the temperature to fluctuate between freezing to above freezing (WDNR, 1991). Hydrologically mature forest, particularly coniferous forest, influences winter snow accumulation and melt rates in rain-on-snow forest zones by altering solar radiation intensity and wind-assisted heat flux (WFPB, 1997). Natural surface runoff patterns in rain-on-snow zones can also be altered by forest practices and land clearing. Areas in the rain-on-snow zone that are cleared of hydrologically mature vegetation can generate 50 to 400 percent greater outflow from snowpacks than forested areas (Coffin and Harr, 1992). The upper section of the Deschutes River basin is the only region in Thurston County which is mapped by Washington Department of Natural Resources (WDNR) as dominated by rain-on-snow and snow (WDNR, 1991).

Groundwater Recharge/Discharge/Flow

In Thurston County, groundwater flow patterns depend upon the movement of infiltrated rainfall into a complex structure of glacial deposits that include several major regional aquifers. These aquifers occur between 1,200 to 1,800 feet below the surface in glacially derived sediments from the Pleistocene and Holocene that overlie Tertiary bedrock. In the shallow soils in the steep regions, infiltrated precipitation either travels sideways as subsurface flow at the soil-bedrock contact, or travels through cracks and fissures in the bedrock to deep groundwater. Lowland river valleys and outwash plains with low relief contain much deeper, porous soils capable of storing large water quantities in surficial aquifers.

In the past, flow patterns and groundwater aquifers in Thurston County have been investigated by the USGS. More recently, research efforts have focused on detailing the surficial recharge and discharge patterns near the Deschutes River (Drost et al., 1998; Sinclair and Bilhimer, 2007). Several geohydrologic units, including significant regional aquifers have been identified below Thurston County. A surficial aquifer, made up of both young alluvium and recessional outwash materials exists at the surface of a large area in Thurston County. This aquifer is primarily unconfined and often overlaps with the ground surface in depressions, discharging groundwater and forming depressional wetlands, lakes, or causing groundwater flooding (USGS, 2000).
There is a tight link between aquatic systems and land use in the contributing basins. Groundwater availability for maintaining ecological functions during the summer low-flow period is influenced primarily by groundwater recharge fed by precipitation. However, extracting groundwater by draining, ditching, pumping, or other means decreases flow paths and reduces retention time, resulting in a decrease in groundwater available for discharge during low runoff periods (Freeze and Cherry, 1979; Morgan and Jones, 1999). Due to this pattern, important areas for protecting groundwater resources are primarily recharge areas where surficial deposits have high permeability.

**Sediment Processes**

Sediment generation and transport is a vital ecological process, particularly for fluvial and lacustrine systems. Sediment movement into, through, and out of freshwater shoreline ecosystems influences their form and functions, including: (1) shoreline morphology, (2) hydrologic and hydraulic characteristics, (3) surface and groundwater ability to interact, and (4) type and extent of aquatic habitat.

Stream channels constantly erode the landscape and streams transport the sediment throughout the watershed. Sediment production, storage, and transport processes also influence the morphology and function of freshwater ecosystems. Mass wasting (e.g., landslides, lahars), and channel migration (e.g., eroding the outside of a meander bend) deliver sediment to channels via overland flow (Stanley et al., 2005). Climate and landscape physical features interact to determine the relative importance of sediment generation and transport pathways. For example, sedimentation can drastically alter the shape, volume, and hydraulic resistance time of lakes.

Changes to sediment supply impact the ecological functions of aquatic ecosystems in wide-ranging ways including impairing habitat quality and water quality. Sediment is naturally supplied by surface erosion and mass wasting, but each mechanism can supply excessive sediment inputs to aquatic ecosystems when human use has altered the landscape. Land use changes, such as harvesting timber, urbanization, and road construction, have generally accelerated fine sediment production. Forest cover loss can increase production of fine sediment as the volume of runoffs and peak flows increase. When flows increase, channel erosion and channel destabilization occur. Loss of forest cover also results in the removal of fine-root biomass which increases the potential for mass wasting. Increased sediment to fluvial systems can influence rates of instream sediment transport and storage.

Sediment can be stored in streams, wetlands, and lakes before it is transported farther downstream to estuaries and nearshore ecosystems. Floodplain disconnection and channelization cause loss of overbank sediment deposition in the floodplain during peak flows. Sediment storage capacity on the landscape is also reduced by draining and filling depressional wetlands. Alterations to surface water storage also indicate reduced sediment storage.

Aquatic habitat can be adversely impacted by increases in fine sediment loading. Fine sediment fills in the interstitial spaces of channel bed gravels and reduces the water and oxygen exchange between stream flow and the channel bed. In addition, fine sediment can transport nutrients, metals, and other pollutants.
**Mass Wasting**

The potential for mass wasting is a combination of topography, soil and bedrock properties, vegetation, and hydrologic conditions. The key sediment producing areas in the Puget Sound lowlands are landslide and erosion-prone areas which are typically found along marine bluffs. Roads (paved and unpaved) are frequently the most significant source of sediment inputs to Puget Sound aquatic ecosystems (Swanson et al., 1987). Roads increase mass wasting rates directly by altering slope properties that influence slope failure (Knutson and Naef, 1997) or indirectly by focusing excess water on landslide-prone areas (Swanson et al., 1987). Though loss of forest cover may also increase rates of mass wasting, roads are the dominant influence.

**Surface Erosion**

Surface erosion typically occurs when particles are entrained by rainfall and overland flow. Historically, forest cover limited surface erosion (Swanson et al., 1987). However, with increased loss of forest cover, particle entrainment by rainfall and overland flow also increased, resulting in increased sediment inputs to aquatic systems. Generally, erosion rates are lower when there is a denser vegetative cover (Dunne and Leopold, 1978). Roads also deliver increased sediment inputs to aquatic systems via surface erosion. Beschta (1978) found that roads within roughly 200 feet of aquatic ecosystems dramatically increase surface erosion and sediment inputs. In areas where land uses directly disturb the soil, even areas with low erosion potential can contribute significant sediment, for example bare fallow soil areas or till agriculture can increase surface erosion by 40 to 50 percent (Rapp et al., 1972). Erosion can be a water quality issue in areas near water bodies or near drainage to surface water features by delivering sediment, as well as potentially carrying toxic pollutants, high levels of nutrients, or pathogens.

**Bank Erosion**

A key source of sediment, gravels, and nutrient transfer in rivers is channel migration (Collins, 1994; Raines, 2007). Channels naturally migrate through alluvial valleys, resulting in erosion at the outside of the meander bend. This results in continuous sediment supply to streambed gravels and transfer of nutrients between the channel and floodplain. This process occurs extensively in the Deschutes River, as it meanders through a glacial upland eroding glacial outwash and till terraces. Since stream channels adjust during and after significant runoff events, sediment contribution as a result of channel migration likely varies over time.

Altered sediment supply-transport processes and changes in flow patterns in streams can cause changes in stream morphology including increased bank erosion, channel migration rates, and channel enlargement. Riparian vegetation loss, including the loss of root masses which stabilize river banks, increases stream bank susceptibility to mass failures and fluvial entrainment.

**Water Quality Processes**

Many alterations to water quality processes have occurred in Thurston County, including point sources (e.g., focused discharge from a wastewater treatment plant), and non-point sources (e.g., diffuse discharge from agricultural fields). The construction of impervious surfaces and stormwater conveyance infrastructure has altered water quality processes by bypassing natural hydrologic pathways such as soil infiltration and percolation. Toxic, nutrients, and pathogens
that can negatively impact water quality can build up on impervious surfaces, and be washed into aquatic ecosystems during storm events.

Water quality alterations can be assessed by comparing state water quality standards to local water quality in streams and lakes. The Department of Ecology maintains a database, known generally as the 303(d) list, of water bodies where water quality issues are known to exist. Waters that are known to exceed State water quality standards are Category 5. Water bodies rated as category 4, indicate that a clean-up plan has been developed (also known as a Total Maximum Daily Load [TMDL]) and is being implemented.

Nutrients (Nitrogen and Phosphorus)

Nutrient cycling in aquatic ecosystems can be influenced by changes to hydrology and sediment supply at the watershed scale. Alterations to hydrology and sediment supply are discussed in other sections. This section focuses on nutrient input alterations as a result of certain land uses. Increased nitrogen inputs to both aquatic ecosystems and groundwater can come from fertilizer originating from commercial forest lands, agricultural, and residential areas. Excess nitrogen and other nutrients can also be contributed by fecal waste generated from septic tanks, commercial agriculture, and/or hobby farms. There is not a strong correlation between phosphorus and specific types of land use (Ebbert et al., 2000). However, potential sources of increased phosphorus input can come from areas where fertilization and surface erosion are both prevalent (e.g., dairy farms, till agriculture, and urban growth areas).

Aquatic environments can also be altered by other human impacts that influence nutrient retention and removal. For example, denitrification was found to occur throughout riparian areas at high levels (4 to 16 milligrams per liter [mg/L])(Cox et al., 2005). Denitrification is the process where soil bacteria convert soil nitrogen to nitrates, increasing ease of plant absorption. At low soil oxygen levels, another different form of bacteria converts the nitrates into gases such as nitrogen, nitrogen dioxide, and nitrous oxide, which all return to the atmosphere. Loss of riparian forest cover and floodplain disconnection can limit hyporheic function and nitrogen fixation rates, as well as stop sediment and absorbed phosphorous deposition. Additionally, drainage and loss of wetlands reduces the quantity and rate of denitrification in a watershed.

Water quality within lakes is typically sensitive to nutrient loading, which can cause algal blooms and changes in dissolved oxygen levels. In areas where shoreline vegetation is lacking and groundwater runoff through developed areas is the primary water source, water temperatures increase in lakes. High water temperatures combined with nutrient loading from surrounding land use encourage the growth of algae and aquatic plants as well as affect dissolved oxygen.

Pathogens

Fecal coliform was used as an indicator of pathogens in this report because of pathogens, it occurs most commonly, and because Ecology monitors it in water quality studies. Natural concentrations of pathogens in water are very low, and pathogen inputs are chiefly associated with human disturbance. Sources of fecal matter and related pathogens resulting from humans include animal operations such as dairies and hobby farms and onsite septic systems.
Since pathogens are derived principally from anthropogenic sources, the majority of the research investigating their removal has been conducted at water quality management facilities. However, some research results are applicable to natural systems. Standing water was shown to promote pathogen removal through increased filtration and predation by other microbes (The U.S. Environmental Protection Agency (EPA), 2002). Fecal coliform was found not to be discharged to surface water from groundwater USGS studies (Cox et al., 2005). These studies point towards surface transport as a major pathway for pathogens. With this in mind, process-intensive areas for pathogen removal are areas that promote water and sediment retention and/or predation by microorganisms, such as depressional wetlands, floodplains, and permeable deposits draining into surface waters via subsurface flow or groundwater recharge, (Hemond and Benoit, 1988). Alteration of function or destruction of these areas can impair the ability of the landscape to process pathogens.

**Toxins and Metals**

Certain land use practices have associated toxins and metals which can be harmful when released to aquatic ecosystems. Numerous urban land uses produce contaminants such as organic compounds, polychlorinated aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and pesticides. For example, industrial processing facilities and gas stations combust petroleum, oil and coal onsite, producing PAHs that may be released to aquatic ecosystems (Van Metre et al., 2000; Schueler and Holland, 2000a). Motor vehicles, building materials, and rooftops may release heavy metals (e.g., cadmium, copper, and zinc) (Schueler and Holland, 2000b). Some lawn care products used by businesses and residential property owners contain potentially harmful chemical fertilizers, insecticides, and/or herbicides (Schueler and Holland, 2000c, 2000d). Agriculture and forestry are also potential sources of pesticides (Allan, 2004).

Toxins and metals typically do not occur in naturally high concentrations. The mechanisms by which these contaminants reach aquatic systems and impact water quality are the result of increased inputs (land uses, and storage or environmental uptake. Metals/toxins are absorbed and stored in depressional wetlands with organic soils, wetlands with clay soils that have a high cation exchange capacity, and riparian areas with organic soil layers. Floodplain deposited sediment can store/absorb toxins temporarily.

Contaminants are transported from urban and rural lands to the surrounding watershed and aquatic environments primarily through the mechanism of runoff. Impervious surfaces (i.e., roads, sidewalks, pavement, roof tops) are significant actors in stormwater runoff and associated contaminant transportation (Brabec et al., 2002; Booth, 2000).

**Heat and Light**

An important component of water quality is water temperature. Heat and light affect water temperature, the extent of which is controlled by a number of factors. Many of the factors that control heat and light are difficult to manage in the context of the SMP, for example, climate, groundwater inputs, and air temperature. This report focuses on the role of riparian areas on heat and light because these areas provide the best management opportunities.

The influence of riparian condition on heat and light inputs has been extensively studied (Welch et al., 2003). The recommended minimum riparian width required to maintain natural function of
heat/light inputs in Puget Sound is thirty meters (Castelle et al., 1994; May, 2000), but in order to maintain microclimate within the riparian buffer, a wider buffer is necessary (Brosofske et al., 1997; May, 2000). A positive shading influence on streams may still be provided by riparian zones as narrow as 11 meters (FEMAT, 1993; Knutson and Naef, 1997; May, 2000). As streams increase in size, riparian zone width becomes less important in controlling temperature properties because other factors such as channel geometry begin to have a more significant relative influence on temperature than shading controls on stream insulation.

**Vegetation Processes: Large Woody Debris**

Freshwater aquatic systems in the Pacific Northwest Region are greatly shaped by the presence of a formerly ubiquitous hydrologically mature forest. Riparian forests provide inputs of large wood as fallen trees or logs (known as Large Woody Debris [LWD]) into rivers and streams. The LWD significantly affect the ecological functioning and geomorphic form of riverine and lacustrine ecosystems (Maser et al., 1988; Nakamura and Swanson, 1993; Collins and Montgomery, 2002; Abbe and Montgomery, 1996; Collins et al., 2002; Montgomery et al., 2003a; Montgomery et al., 2003b). LWD serves as a source of organic material to aquatic ecosystems and is regarded as a principal factor in the formation of stream structure and associated habitat characteristics such as pools and riffles. The presence, movement, storage, and decomposition of LWD affects vegetation species diversity. In combination, LWD and riparian vegetation provide nesting, perching, and roosting habitat for many bird species, foraging, cover, and movement corridors for many species, and thermal protection, nutrients, and sources of food (terrestrial insects) to a variety of fish and wildlife species. Large woody debris (LWD) and organic material is principally supplied to rivers, streams, or wetlands through the processes of mass wasting (landslide events that convey trees and vegetation as well as sediment), windthrow (trees, branches, or vegetation propelled by wind into a stream or river), or bank erosion/channel migration from riparian areas roughly 200 feet on either side of stream channels (Stanley et al., 2005). Mass wasting is the primary LWD source in low-order streams whereas wind throw and bank erosion/channel migration provide LWD in all types and sized of streams (Reeves et al., 2003; Benda et al., 2002). In large streams, fluvial transport is the primary mechanism of LWD redistribution, whereas in small streams, debris-laden floods are the chief redistribution mechanism.

Human caused disturbances in riparian forests such as forest clearing or roads reduce forest cover and decrease LWD recruitment potential to streams via mass wasting landslides, bank erosion, or channel migration. Reduced LWD and woody debris in streams subsequently causes adverse changes in channel/habitat-forming processes (Bilby, 1984; Heifetz et al., 1986; McDade et al., 1990; Van Sickle and Gregory, 1990; Bilby and Ward, 1989).

### 3.3.5.8 Freshwater Process-intensive Areas

As with the marine nearshore environment, freshwater process-intensive areas for hydrologic, sediment, water quality, organic matter processes in Thurston County often coincide (Table 3-7).
Table 7 Process-intensive Areas for Hydrologic, Sediment, Water Quality, and Vegetation Processes

<table>
<thead>
<tr>
<th>Process-intensive Area</th>
<th>Processes</th>
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<tbody>
<tr>
<td>Rain-on-snow and snow-dominated zones</td>
<td>Surface runoff and peak flows</td>
</tr>
<tr>
<td>Channel migration zones</td>
<td>Surface runoff and peak flows</td>
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<td></td>
<td>Groundwater flow/discharge</td>
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<td></td>
<td>Surface erosion</td>
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<td></td>
<td>Sediment storage</td>
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<td>Floodplains</td>
<td>Process-intensive Area</td>
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<td>Surface water storage</td>
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<td>Sediment storage</td>
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<td></td>
<td>Nutrient retention/cycling</td>
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<td>Lakes</td>
<td>Surface water storage</td>
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<td></td>
<td>Sediment storage</td>
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<td></td>
<td>Nutrient retention/cycling</td>
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<td>Wetlands and infiltrative soils</td>
<td>Surface water storage</td>
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<td></td>
<td>Nutrient sink</td>
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<td></td>
<td>Sediment storage</td>
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<td></td>
<td>Pathogen removal</td>
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<td></td>
<td>Toxins/metals removal</td>
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<td>High groundwater areas</td>
<td>Groundwater flow/discharge</td>
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<td>Surface water storage</td>
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<tr>
<td>Bare ground/early seral stage vegetation cover</td>
<td>Surface runoff and peak flows</td>
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<td></td>
<td>Surface erosion</td>
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<tr>
<td>Landslide-prone areas/ steep slopes with erodible soils/areas of mass wasting</td>
<td>Organic debris input</td>
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<td></td>
<td>Sediment delivery</td>
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<tr>
<td>Riparian areas</td>
<td>Nutrient sink</td>
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<td>Toxins/metals removal</td>
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<td>Heat/light control</td>
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<tr>
<td>Aquifer recharge areas</td>
<td>Infiltration/recharge</td>
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<td>Groundwater flow/discharge</td>
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<td>Nutrient cycling</td>
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<td>Pathogen removal</td>
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<tr>
<td>Streambanks</td>
<td>Organic debris input</td>
</tr>
<tr>
<td></td>
<td>Sediment delivery</td>
</tr>
</tbody>
</table>

**Hydrologic Processes**

Hydrologic process-intensive areas are locations influenced by soil permeability and precipitation, and include: rain-on-snow zones and snow-dominated zones; channel migration zones; high groundwater areas; wetlands; lakes; and ponds. These areas of high infiltration and recharge capacity commonly occur in Thurston County’s alluvial and glacial outwash valleys. The capacity of groundwater to recharge through infiltration will be highest in areas with large levels of precipitation.
3. Ecosystem Characterization and Ecosystem-Wide Processes

Sediment Processes

Landslide-prone areas and steep slopes with erodible soils are process-intensive areas for sediment delivery and transport processes. Mass wasting occurs most commonly in the foothills, where precipitation is high and topographic relief is more extreme. Areas of surface erosion are for the most part located along shorelines in hilly areas. Lakeshores also provide important sediment sources. Areas of bare ground or early seral stage vegetation cover are process-intensive areas for surface runoff and peak flows as well as surface erosion.

Water Quality Processes

Wetlands, riparian areas, and surficial aquifers are process-intensive areas for water quality processes such as nutrient cycling/uptake, pathogen and toxin removal, and heat and light control. Depressional wetlands are process intensive areas for removal and/or retention of fecal matter and associated pathogens. These areas are primarily located in lowland areas with outwash deposits.

Lowlands provide nutrient retention and loss, while surficial aquifers retain groundwater nutrients. Functions such as nitrogen loss and some temporary storage of phosphorous occur in valley bottoms. Nitrification (transformation) occurs in upland areas or terraces. Headwater streams temporarily store nitrogen from biotic uptake and adsorption. Upland depressional wetlands supply storage (phosphorous, nitrogen), transformation (nitrogen) and loss (nitrogen) functions. The full suite of loss/retention mechanisms occur primarily in floodplain areas.

Metals and other toxins are introduced to aquatic ecosystems by human actions in much higher concentrations than the trace amount metals occur in nature. It is difficult to discern the process of metal/toxin inputs under natural conditions versus human input. Metals are stored in the landscape through adsorption in wetlands with clay or organic soils.

Vegetation Processes: Large Woody Debris

Riparian areas within 200 feet of aquatic resources, channel migration zones (CMZs), and areas of mass wasting are process-intensive areas for organic debris inputs including LWD. The extent of the CMZs is not known for most streams and rivers in Thurston County, therefore, the Federal Emergency Management Agency (FEMA) 100-year floodplain was used to identify the area of potential LWD recruitment from channel migration and bank erosion.

3.3.5.9 Freshwater Shoreline Protection and/or Restoration Measures

In accordance with WAC 173-26-201, this section identifies measures necessary to protect and/or restore ecological functions and ecosystem-wide processes. For this section, protection and restoration measures have been listed under a single process, but will also positively impact other processes. The interconnection between ecosystem-wide and shoreline processes means that protection and restoration measures will positively influence multiple processes. For example: maintaining or restoring native riparian forest cover is only listed under Vegetation Processes, however, this measure will impact all processes in multiple ways, some of which are: increased infiltration of precipitation; reduced runoff and associated sediment, nutrients, and toxins; improved habitat connectivity; and maintenance of a source of large woody debris. Protection and restoration measures for freshwater shorelines are not limited to those listed here.
Most freshwater and marine nearshore protection and restoration measures are interchangeable. Please also refer to the marine nearshore protection and restoration measures in Section 3.3.2.6.

**Hydrologic Processes:**

- Limit amount of impervious area for residential development
- Limit amount of impervious area for allowed commercial and industrial development
- Prohibit new development within the floodplain, channel migration zone, hyporheic zone, or wetlands
- Encourage relocation of existing structures out of floodplain and channel migration zones
- Restore floodplain connectivity
- Protect riverine wetlands and side channel habitats
- Increase percent forest cover, particularly hydrologically mature forests
- Prohibit new construction and encourage removal of dikes or levees along stream channels; stream channelization; and/or wetland ditching

**Sediment Processes:**

- Maintain natural stream channels to continue natural erosion processes
- Prohibit or limit new stream or lake armoring
- Remove existing bulkheads and armoring
- Encourage bio-engineering or soft armoring for replacement shoreline structures
- Maintain adequate distance from steep slopes for new development to eliminate the need for shoreline protection structures
- Maintain stream mouths and deltas unobstructed
- Protect and restore wetland, floodplain and stream connectivity
- Protect depressional wetlands
- Limit roads in shoreline jurisdiction
- Maintain and restore riparian buffers with native vegetation

**Water Quality Processes:**

- Increase level, and extent of treatment for stormwater
- Limit impervious surface allowed for residential and commercial development
- Increase surface water setbacks for new and replacement septic systems
- Encourage relocation of existing septic systems further from water bodies
- Prohibit commercial or industrial uses producing contaminants adjacent to shoreline
- Prohibit non-water related commercial and industrial development
- Maintain and restore riparian buffers with native vegetation

**Vegetation Processes:**

- Maintain riparian buffer with native vegetation
- Increase riparian buffer distance for replacement of non-conforming structures
- Increase structural and species diversity of riparian buffer vegetation
Restore riparian vegetation on existing developed lots
Encourage maintenance of large woody debris within waterbodies
Reintroduce large woody debris to streams
Preserve and restore fish and wildlife habitat connectivity

3.3.5.10 Process Alterations for Marine and Freshwater Shorelines

Altering the physical and biochemical processes that create and maintain shoreline environments will typically have adverse effects on shoreline ecological functions. This section describes the primary alterations of concern for Thurston County’s shorelines, grouped into four main categories:

- Modifications;
- Facilities;
- Adjacent land uses;
- Water quality.

Modifications

Piers, Docks, and Boat ramps

Piers, docks, or boat ramps may alter hydrologic and sediment transport as well as shoreline habitat components (e.g., light, vegetation). The resulting impacts may include: altered beach sediment size/type, decreased sediment abundance, increased flow energy, reduced water quality from flow alteration, accumulation of drift material, reduction in beach material elsewhere along the shoreline, decreased and increased erosion at adjacent properties, and habitat modification. The modification to wave energy and sediment transport is likely to result in changes in sediment availability and habitat modification such as the location of forage fish spawning and rearing areas.

Overwater structures such as piers, docks, and boat ramps change light availability which may result in modification to in-water vegetation and result in modification to food abundance. Changes in light from overwater structures may also have an effect on fish movement, predation, and migration.

Overwater structures may be constructed of materials containing contaminants. The leaching of contaminants from these materials may result water quality issues. In addition, overwater structures are often piers, dock, and marinas that may serve as a point source for boat engine exhaust, fuel spills, stormwater runoff from adjacent parking areas.

Groins and Jetties

Groins and jetties may alter hydrologic and sediment transport. The resulting impacts may include: altered beach sediment size/type, decreased sediment abundance, modified flow energy, reduced water quality from flow alteration, accumulation of drift material, reduction in beach material elsewhere along the shoreline, decreased and increased erosion experienced by adjacent properties without overwater structures, and modification to habitat.
Armoring

Shoreline armoring is generally defined as the placement of structures within the nearshore to prevent bank erosion, control the movement of sediment, and intercept wave energy. Shoreline armoring structures include but are not limited to bulkheads, breakwaters, rockeries, revetments, jetties, and groins.

In the marine nearshore, shoreline armoring can disrupt the generation of sediment and net shore-drift patterns, leading to adverse affects on shoreline morphology and habitat function. Armoring such as bulkheads along feeder bluffs inhibit or eliminate sources of beach sediment for drift cells. The beaches located waterward of armored shorelines lose fine sediment via the increased wave reflection caused by waves hitting the armoring (Macdonald et al., 1994). A heavily armored area (with bulkhead and/or groins) can gradually lose its beach due to sediments not reaching the beach or not staying on the beach. Ultimately, armoring alterations can result in a change in habitat structure from mixed-fine substrate communities (that frequently support eelgrass) to coarser substrate communities that hold less habitat value for migrating salmon fry. Additionally, docks, intertidal bulkheads and other fills can force migrating juvenile salmon into deeper water where there may be a significantly higher risk of predation.

Armoring directly and indirectly impact forage fish spawning habitat. Direct armoring impacts of forage fish spawning habitat include burial of spawning habitat by structures, loss of shoreline/riparian vegetation, substrate coarsening and lowering of the beach profile in front of bulkheads, and damage caused by equipment while eggs are incubating on the beach (MacDonald et al., 1994). Indirect impacts occur through sediment transport disruption and/or impoundment of sediment, and water quality degradation (Long et al., 2005). Forage fish are especially vulnerable to shoreline modifications and processes affecting sediment input, transport, or deposition, because they depend on suitable beach substrates for spawning habitat. In addition to appropriate beach substrates for spawning, forage fish, particularly surf smelt and sand lance, also necessitate intact riparian vegetation to provide shade and microclimate control over spawning areas (Rice, 2006). Pacific herring have slightly different spawning habitat requirement from surf smelt and sand lance, in that their spawning occurs principally within the lower intertidal and shallow subtidal zones, and their spawning habitat requirements are focused on vegetation such as eelgrass or algae.

Disruption of the habitat forming processes of alongshore sediment generation and transport can threaten important aquatic plant communities (Ruckelshaus and McClure, 2007; WDNR Nearshore Research Project, 2007). Eelgrass and kelp beds are vulnerable to altered sediment processes, decreased light penetration resulting from overwater structures, and reduced water quality. Since eelgrass and kelp bed communities provide essential habitat areas for juvenile salmonids for feeding, rearing, and refuge, alterations to these communities can be harmful to young fishes. Bird and fish species that prey upon juvenile salmon can also be impacted by habitat alterations negatively affecting young fishes. Eelgrass and kelp beds are also threatened by dredging, erosion/sedimentation from upland activities, overwater structures (docks, piers, etc.) that impede light penetration, higher water temperature resulting from lack of shade, excessive nutrient inputs, pollutant loading, and invasive plant competition from cordgrass and Sargassum (PSAT, 2001).
Culverts
Culverts that block fish passage may alter hydrology and habitat access. Resulting impacts may include: altered flow and habitat function, reduced habitat access, habitat fragmentation, reduction in fish populations, and loss of native species.

Dams
Dams alter hydrologic regimes. Resulting impacts may include: periodic low flows and/or flooding, areas of high erosion, and limited ability to maintain flows necessary for habitat function.

Facilities
Roads
Roads within associated wetlands may result in habitat fragmentation and altered hydrologic transport.

Roads within the floodplain may result in reduced or altered floodplain connectivity, and floodplain capacity.

Bridges
Bridges may alter water and sediment transport. Resulting impacts include: altered water velocity, changes in local development of habitat features (pools, riffles, and gravel bars). If undersized, impacts may also include: increased water velocity, incised channels, erosion, road washouts, and increased downstream flooding.

Railroads
Railroads within the floodplain may result in reduced or altered floodplain, channel and side channel connectivity, water storage, and/or floodplain capacity.

Railroads within associated wetlands may result in habitat fragmentation and altered hydrologic transport through reduction of channel and side channel habitat and rearing capacity.

Marinas
Ports or marinas alter hydrologic and sediment transport which may result in aquatic and nearshore loss of habitat, and water quality impacts.

Utilities
Utility installation often results in vegetation disturbance; vegetation maintenance or other disturbance with utility easements may be required.

Adjacent Land Uses
Agriculture
Agriculture has resulted in reduced shoreline vegetation. Modification to shoreline vegetation may alter sediment transport, hydrologic regimes, and habitat. Resulting impacts may include alteration to: bank stabilization, erosion, water quality, sediment loading, recruitment/transport of
woody and organic debris, habitat diversity, shoreline and in-water temperatures, water storage, attenuation of flow energy, removal of excessive nutrients and flooding regimes.

**Aquaculture**
Aquaculture may result in altered sediment transport, hydrologic regimes and habitat.

**Impervious Surface**
Impervious surfaces exceeding 10% may affect surface water flow, groundwater infiltration, aquifer recharge and removal of excessive nutrients and contaminants. Resulting impacts may include: flooding, modified attenuation of flow energy, modification of habitat, reduced/increased inputs into headwaters, modification to water temperatures and reductions in water quality and quantity.

The type of development found within an area often determines the type of impact that will be found. Rural and less developed areas may contain impacts such as timber harvesting adjacent to the shoreline or agriculture related modifications to water quality/flow. Urban areas often contain increased impervious surface coverage and other development related impacts such as bulkheads.

Increases to impervious surfaces and/or decreases to vegetative cover, increase short-term or storm flow to streams. The irregularities in flow alter in-stream conditions and habitat. For example, instability of the adjacent shoreline and channel erosion may result from modified stream flow. In addition, increased impervious surfaces result in rapid overland flow and reduced capacity for groundwater infiltration. As groundwater infiltration is reduced, aquifer recharge and available water for groundwater fed adjacent water bodies is reduced. The reduction in available water often results in a reduction to habitat functionality.

On nearshore marine shorelines, concentrated surface water resulting from impervious surface runoff can erode bluff crests while simultaneously saturating soils. Saturated soils exacerbate with natural slope stability along coastal bluffs and can trigger landslides (Shipman, 2004).

**Modification of vegetation adjacent to the shoreline**
The land adjacent to the shoreline provides for water quality processes, light energy, and sediment processes. The vegetation also provides large wood debris and organic matter. Vegetation along the shoreline is often modified for residential and commercial development along the shoreline. Modification occurs as a result of but is not limited to the following: shoreline armoring, construction of overwater structures, construction of transportation/utility lines adjacent to the shoreline.

Removal of vegetation adjacent to the shoreline may result alteration to the following: reduction of habitat functionality, loss or simplification of adjacent habitat, decreased suitability for forage fish spawning, reduction to soil and bank stabilization resulting in increase sediment loads and/or the increase of fine sediment, reduction of leaf and other organic matter such as large woody debris, reduction of available food sources for wildlife, modification to shoreline temperature, dissolved oxygen, bacteria levels, light, and nutrient cycling, and decrease in upland pollution sequestration.
Shoreline vegetation removal reduces overwater shade and LWD recruitment potential, which in turn impact prey resources for juvenile and resident salmon (WDFW and PNPTC, 2000). Lack of maintenance or failure to plant vegetation on bluffs can result in low root strength and can increase the likelihood of future landslides. Coastal bluffs that have experienced significant alterations to both the vegetation cover and natural drainage regime are especially vulnerable to landsliding (Gray and Sotir, 1996; Menashe, 1993; Menashe, 2001; Roering et al., 2003).

**Water quality**

Water quality may be impacted by point sources, such as outfall from an industrial plant, and non-point sources such as: failing onsite septic systems; pet and animal wastes; urban and agricultural runoff such as fertilizers, high levels of organic nutrients, and petroleum byproducts; and stormwater contamination through cross connections with sewage lines carrying nutrients, pharmaceuticals, and estrogenic compounds.

**303 (d) list**

Washington State is required to produce a list of all impaired surface waters in the state that are used by the public pursuant to Section 303(d) of the federal Clean Water Act. Included on the list are estuaries, lakes, and streams that do not meet the state surface water quality standards and are not expected to improve within the next two years. Inclusion on the 303(d) list may result in the amount of pollutants allowed to be released into the subject waterbody for permits issued by Ecology.

Within the state of Washington, primary water quality concerns are focused on temperature and fecal coliform bacteria. Salmon and other fish species within Washington State require cooler water temperatures for the majority of their life cycle. The most common causes of high water temperatures are direct water discharge and removal of shoreline vegetation. Fecal coliform acts a disease vector within a water system. The source of fecal coliform within a water system is generally livestock and/or failing septic systems.

In addition, other reductions to water quality that may result in placement on the Washington State 303(d) listing include: toxic substances, suspended sediment/erosion, organic waste, and excessive nutrients.

**Contaminated sediments**

Contaminated sediment may have an impact on water quality and habitat. Sediment could be contaminated by toxic substances, organic waste, and excessive nutrients.

**Shellfish harvest ratings**

Shellfish resources are highly vulnerable to habitat loss and changes in resulting from urbanization and certain forms of human development (Glasoe and Christy, 2004). A poor shellfish harvest rating or beach closure is likely to indicate that protective action is needed.
3.4 OVERVIEW OF KEY SPECIES AND HABITATS IN THURSTON COUNTY

3.4.1 Thurston County Critical Areas
The Thurston County Critical Areas Ordinance addresses the following types of critical areas, all of which occur within shorelines: Wetlands, streams, Floodplains, Geologic Hazard Areas including Marine Bluffs, Important Habitats and Species, Critical Aquifer Recharge areas. Regulations protecting Critical Areas are included with the CAO TCC 17.15 which are currently being updated.

Aquifer recharge areas
Pursuant to TCC 17.15.200, "Aquifer recharge areas" means those areas of Thurston County which have an aquifer under them and which allow water to enter the soil and geological materials in ways and in quantities that replenish natural groundwater systems and aquifers.

Important Habitats and Species
Pursuant to TCC 17.15.200, "Important habitats and species" means those state priority habitats and species and those local habitats and species recognized as such by TCC 17.15.200.

Important Habitat and Species include those listed in Table 8 and Table 9 of the CAO. These are specifically addressed in Section 3.7 – Fish and Wildlife Habitats.

Special Management Areas
Pursuant to TCC 17.15.200, "Special management areas" means those geographic areas of Thurston County which contain a unique combination of physical features and require a special set of management techniques specifically designed for that area, or where the uniqueness of the area demands an even greater degree of environmental protection.

Geologic Hazard areas
Pursuant to TCC 17.15.200, "Geologic hazard areas" means those areas that because of their susceptibility to erosion, earthquake or other geological events, are not suited to siting commercial, residential or industrial development consistent with public health or safety concerns.

Geologic hazard areas most often occurring in Thurston County shorelines are marine bluffs, hazardous slope and hazardous slide areas, which are common throughout the County.

Floodplains
Pursuant to TCC 17.15.200, floodplains include the following pertinent definitions:

- "Floodplain, one hundred-year," "one hundred-year floodplain" or "flood hazard areas" means those lands which are subject to a one percent or greater chance of flooding in any year. Note that this is the definition for floodplain used throughout the SMP update process.

- "Floodplain, five hundred-year" or "five hundred-year floodplain" means those lands which are subject to 0.2 percent or greater chance of flooding in any year. These areas are
identified as the "B" zone on the Flood Insurance Rate Maps from the Federal Emergency Management Agency.

- "Floodway" means those portions of the floodplain adjoining and including the channel of a river or stream which discharges the flood water and flow of that river or stream. It is any place where the water is moving with velocity and a definite current, but does not include other portions of the floodplain where the water is just standing.

Associated floodplain is specifically addressed in Section 3.2.1.2 – Rivers, Streams, and Associated Floodplains.

**Streams**

Pursuant to TCC 17.15.200, "Streams" means those areas of Thurston County where surface waters flow sufficiently to produce a defined channel or bed. A "defined channel or bed" is an area which demonstrates clear evidence of the passage of water and includes but is not limited to bedrock channels, gravel beds, sand and silt beds and defined-channel swales. The channel or bed need not contain water year-round. This definition is not meant to include irrigation ditches, canals, storm or surface water runoff devices or other entirely artificial watercourses unless they are used by salmon or used to convey streams naturally occurring prior to construction.

Regulated streams are specifically addressed in Section 3.2.1.2 – Rivers, Streams, and Associated Floodplains.

**Wetlands**

Pursuant to TCC 17.15.200, "Wetlands" means areas that are inundated or saturated by ground or surface water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Wetlands do not include those artificial wetlands intentionally created from non-wetland sites, including, but not limited to, irrigation and drainage ditches, grass-lined swales, canals, detention facilities, wastewater treatment facilities, farm ponds, and landscape amenities, or those wetlands created after July 1, 1990, that were unintentionally created as a result of the construction of a road, street, or highway. Wetlands may include those artificial wetlands intentionally created from non-wetland areas created to mitigate conversion of wetlands.

The CAO regulates protection of freshwater and marine estuarine wetlands. Associated wetlands are specifically addressed in Section 3.2.1.2 – Wetlands.

**3.4.2 Threatened and Endangered Species and Critical Habitats**

Thurston County provides habitat resources for many federally and/or state listed threatened and endangered species. Many of these species rely upon the shorelines of the county for some portion of their life cycle.
### Table 8 Thurston County Threatened and Endangered Species

<table>
<thead>
<tr>
<th>Organism (Common Name)</th>
<th>Scientific Name</th>
<th>Federal Status</th>
<th>State Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amphibians</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oregon Spotted Frog</td>
<td><em>Rana pretiosa</em></td>
<td>FC</td>
<td>SE</td>
</tr>
<tr>
<td><strong>Birds</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marbled murrelet</td>
<td><em>Brachyramphus marmoratus</em></td>
<td>FT</td>
<td>ST</td>
</tr>
<tr>
<td>Northern spotted owl</td>
<td><em>Strix occidentalis caurina</em></td>
<td>FT</td>
<td>SE</td>
</tr>
<tr>
<td>Streaked Horn Lark</td>
<td><em>Eremophila alpestris strigata</em></td>
<td>FC</td>
<td>SE</td>
</tr>
<tr>
<td><strong>Fish</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chinook salmon (federal critical habitat)</td>
<td><em>Oncorhynchus tshawytscha</em></td>
<td>FT</td>
<td>SC</td>
</tr>
<tr>
<td>Steelhead trout</td>
<td><em>Oncorhynchus mykiss</em></td>
<td>FT</td>
<td></td>
</tr>
<tr>
<td>Bull trout (federal critical habitat)</td>
<td><em>Salvelinus confluentus</em></td>
<td>FT</td>
<td>SC</td>
</tr>
<tr>
<td><strong>Invertebrates</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mardon skipper</td>
<td><em>Polites mardon</em></td>
<td>FC</td>
<td>SE</td>
</tr>
<tr>
<td>Oregon silverspot</td>
<td><em>Speyeria zerene hippolyta</em></td>
<td>FT</td>
<td>SE</td>
</tr>
<tr>
<td>Taylor’s checkerspot</td>
<td><em>Euphydryas editha taylori</em></td>
<td>FC</td>
<td>SC</td>
</tr>
<tr>
<td><strong>Mammals</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Southern Resident killer whale (federal critical habitat)</td>
<td><em>Orcinus orca</em></td>
<td>FE</td>
<td>SE</td>
</tr>
<tr>
<td>Humpback whale</td>
<td><em>Eremophila alpestris strigata</em></td>
<td>FE</td>
<td>SE</td>
</tr>
<tr>
<td>Steller sea lion</td>
<td><em>Eumetopias jubatus</em></td>
<td>FT</td>
<td>ST</td>
</tr>
<tr>
<td>Fisher</td>
<td><em>Martes pennanti</em></td>
<td>FC</td>
<td>ST</td>
</tr>
<tr>
<td>Mazama (Western) pocket gopher</td>
<td><em>Thomomys mazama</em></td>
<td>FC</td>
<td>ST</td>
</tr>
<tr>
<td>Western gray squirrel</td>
<td><em>Sciurus griseus</em></td>
<td>FC&lt;sub&gt;0&lt;/sub&gt;</td>
<td>ST</td>
</tr>
<tr>
<td><strong>Reptiles</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Western pond turtle</td>
<td><em>Clemmys marmorata</em></td>
<td>FC&lt;sub&gt;0&lt;/sub&gt;</td>
<td>SE</td>
</tr>
<tr>
<td><strong>Plants</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Golden paintbrush</td>
<td><em>Castilleja levisecta</em></td>
<td>FT</td>
<td></td>
</tr>
<tr>
<td>Water howellia</td>
<td><em>Howellia aquatilis</em></td>
<td>FT</td>
<td></td>
</tr>
</tbody>
</table>

**Abbreviations**

FC-Federal Candidate Species  
FT-Federal Threatened Species  
FE-Federal Endangered Species  
FC<sub>0</sub>-Federal Species of Concern  
SC-State Candidate Species  
ST-State Threatened Species  
SE-State Endangered Species
3.4.2.1 WDFW Priority Habitats and Species

The WDFW Priority Habitats and Species (PHS) Program manages information for priority species identified by the State. Priority species include State Endangered, Threatened, Sensitive, and Candidate species; animal aggregations (e.g., heron colonies, bat colonies) considered vulnerable; and species of recreational, commercial, or tribal importance that are vulnerable. WDFW reports the following PHS information for Thurston County, many of which may occur in regulated shorelines:

Table 9  Thurston County Threatened and Endangered Species Habitats

<table>
<thead>
<tr>
<th>Type</th>
<th>Species or Habitat (Common Name)</th>
<th>Scientific Name for species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitats</td>
<td>Aspen stands</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Biodiversity areas &amp; corridors</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Herbaceous balds</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Old-growth/mature forest</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Oregon white oak woodlands</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>West side prairie</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Riparian</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Freshwater wetlands &amp; fresh deepwater</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>In-stream</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Puget Sound nearshore</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Caves</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Cliffs</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Snags and Logs</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Talus</td>
<td>---</td>
</tr>
<tr>
<td>Amphibians</td>
<td>Cascade torrent salamander</td>
<td><em>Rhyacotriton cascadae</em></td>
</tr>
<tr>
<td></td>
<td>Van Dyke's salamander</td>
<td><em>Plethodon vandykei</em></td>
</tr>
<tr>
<td></td>
<td>Oregon spotted frog</td>
<td><em>Rana pretiosa</em></td>
</tr>
<tr>
<td></td>
<td>Western toad</td>
<td><em>Bufo boreas</em></td>
</tr>
<tr>
<td>Birds</td>
<td>Common murre</td>
<td><em>Uria aalge</em></td>
</tr>
<tr>
<td></td>
<td>Marbled murrelet</td>
<td><em>Brachyramphus marmoratus</em></td>
</tr>
<tr>
<td></td>
<td>Western grebe</td>
<td><em>Aechmophorus occidentalis</em></td>
</tr>
<tr>
<td></td>
<td>W WA nonbreeding concentrations of: loons, grebes, cormorants, fulmar, shearwaters, storm-petrels, alcids</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>W WA breeding concentrations of: cormorants, storm-petrels, terns, alcids</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Great blue heron</td>
<td><em>Ardea herodias</em></td>
</tr>
<tr>
<td></td>
<td>Brant</td>
<td><em>Branta bernicla nigricans</em></td>
</tr>
<tr>
<td></td>
<td>Cavity-nesting ducks: wood duck, Barrow’s goldeneye, common goldeneye, bufflehead, hooded Merganser</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Western Washington nonbreeding concentrations</td>
<td>---</td>
</tr>
</tbody>
</table>
### 3. Ecosystem Characterization and Ecosystem-Wide Processes

<table>
<thead>
<tr>
<th>Type</th>
<th>Species or Habitat (Common Name)</th>
<th>Scientific Name for species</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3. Ecosystem</td>
<td>of: Barrow's goldeneye, common goldeneye, Bufflehead</td>
<td></td>
</tr>
<tr>
<td>Characterization</td>
<td>Harlequin duck</td>
<td><em>Histrionicus histrionicus</em></td>
</tr>
<tr>
<td></td>
<td>Waterfowl concentrations</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Bald eagle</td>
<td><em>Haliaeetus leucocephalus</em></td>
</tr>
<tr>
<td></td>
<td>Golden eagle</td>
<td><em>Aquila chrysaetos</em></td>
</tr>
<tr>
<td>Fish</td>
<td>Pacific lamprey</td>
<td><em>Lampetra Tridentata</em></td>
</tr>
<tr>
<td></td>
<td>River lamprey</td>
<td><em>Lampetra ayresi</em></td>
</tr>
<tr>
<td></td>
<td>Olympic mudminnow</td>
<td><em>Novumbra hubbsi</em></td>
</tr>
<tr>
<td></td>
<td>Pacific herring</td>
<td><em>Clupea pallasi</em></td>
</tr>
<tr>
<td></td>
<td>Longfin smelt</td>
<td><em>Spirinchus thaleichthys</em></td>
</tr>
<tr>
<td></td>
<td>Surfsmelt</td>
<td><em>Hypomesus pretiosus</em></td>
</tr>
<tr>
<td></td>
<td>Bull trout/ Dolly Varden</td>
<td><em>Salvelinus confluentans</em></td>
</tr>
<tr>
<td></td>
<td>Chinook salmon</td>
<td><em>Oncorhynchus tsawytscha</em></td>
</tr>
<tr>
<td></td>
<td>Chum salmon</td>
<td><em>Oncorhynchus keta</em></td>
</tr>
<tr>
<td></td>
<td>Coastal res./ searun cutthroat</td>
<td><em>Oncorhynchus clarki</em></td>
</tr>
<tr>
<td></td>
<td>Coho</td>
<td><em>Oncorhynchus kisutch</em></td>
</tr>
<tr>
<td></td>
<td>Pink salmon</td>
<td><em>Oncorhynchus gorbuscha</em></td>
</tr>
<tr>
<td></td>
<td>Rainbow trout/ steelhead/ inland redband trout</td>
<td><em>Oncorhynchus mykiss</em></td>
</tr>
<tr>
<td></td>
<td>Sockeye salmon</td>
<td><em>Onchorhynchus nerka</em></td>
</tr>
<tr>
<td></td>
<td>Pacific cod</td>
<td><em>Gadus macrocephalus</em></td>
</tr>
<tr>
<td></td>
<td>Pacific hake</td>
<td><em>Merluccius productus</em></td>
</tr>
<tr>
<td></td>
<td>Walleye pollock</td>
<td><em>Theragra chalcogramma</em></td>
</tr>
<tr>
<td></td>
<td>Brown rockfish</td>
<td><em>Sebastes auriculatus</em></td>
</tr>
<tr>
<td></td>
<td>Copper rockfish</td>
<td><em>Sebastes caurinus</em></td>
</tr>
<tr>
<td></td>
<td>Quillback rockfish</td>
<td><em>Sebastes maliger</em></td>
</tr>
<tr>
<td></td>
<td>Lingcod</td>
<td><em>Ophiodon elongatus</em></td>
</tr>
<tr>
<td></td>
<td>Pacific sand lance</td>
<td><em>Ammodytes hexapterus</em></td>
</tr>
<tr>
<td></td>
<td>English sole</td>
<td><em>Pleuronectes vetulus</em></td>
</tr>
<tr>
<td></td>
<td>Rock sole</td>
<td><em>Lepidopsetta bilineata</em></td>
</tr>
<tr>
<td>Invertebrates</td>
<td>Geoduck</td>
<td><em>Panopea abrupta</em></td>
</tr>
<tr>
<td></td>
<td>Butter clam</td>
<td><em>Saxidomus gigantea</em></td>
</tr>
<tr>
<td></td>
<td>Native littleneck clam</td>
<td><em>Protothaca staminea</em></td>
</tr>
<tr>
<td></td>
<td>Manila clam</td>
<td><em>Venerupis philippinarum</em></td>
</tr>
<tr>
<td></td>
<td>Olympia oyster</td>
<td><em>Ostrea conchaphila</em></td>
</tr>
<tr>
<td></td>
<td>Pacific oyster</td>
<td><em>Crassostrea gigas</em></td>
</tr>
<tr>
<td></td>
<td>Dungeness crab</td>
<td><em>Cancer magister</em></td>
</tr>
<tr>
<td></td>
<td>Pandalid shrimp (Pandalidae)</td>
<td><em>Pandalidae sp.</em></td>
</tr>
<tr>
<td></td>
<td>Beller's ground beetle</td>
<td><em>Agonum belleri</em></td>
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</table>
3. Ecosystem Characterization and Ecosystem-Wide Processes

<table>
<thead>
<tr>
<th>Type</th>
<th>Species or Habitat (Common Name)</th>
<th>Scientific Name for species</th>
</tr>
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<tbody>
<tr>
<td>Pacific clubtail</td>
<td><em>Gomphus kurilis</em></td>
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<tr>
<td>Leschi's millipede</td>
<td><em>Leschius mcallisteri</em></td>
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<tr>
<td>Mardon skipper</td>
<td><em>Plebes mardon</em></td>
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</tr>
<tr>
<td>Puget blue</td>
<td><em>Plebejus icarioides blackmorei</em></td>
<td></td>
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<tr>
<td>Valley silverspot</td>
<td><em>Speyeria zere ne bremeri</em></td>
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<tr>
<td>Taylor's checkerspot</td>
<td><em>Euphydryas editha taylor</em></td>
<td></td>
</tr>
</tbody>
</table>

**Mammals**

- Dall's porpoise: *Phocoenoides Dalli*
- Harbor seal: *Phoca Vitulina*
- Orca (killer whale): *Orcinus Orca*
- Pacific harbor porpoise: *Phocoena phocoena*
- Roosting concentrations of: big-brown bat, myotis bats, pallid bat
- Townsend’s big-eared bat: *Corynorhinus townsendii*
- Western gray squirrel: *Sciurus griseus*
- Western pocket gopher: *Thomomys mazama*
- Fisher: *Martes pennanti*
- Marten: *Martes americana*
- Columbian black-tailed deer: *Odocoileus hemionus columbianus*
- Elk: *Cervus canadensis*

**Reptiles**

- Western pond turtle: *Clemmys marmorata*

3.4.2.2 Salmonids

Both federally listed and non-listed species of salmonids use streams, rivers, and nearshore habitats throughout Thurston County. In Thurston County, Chinook, coho, pink, and summer and fall chum salmon, resident and searun cutthroat trout, as well as summer and winter steelhead are documented in the larger rivers and streams. Thurston County rivers and streams provide spawning and rearing habitat for summer and fall Chinook, coho, and chum salmon as well as for winter and summer steelhead trout. Resident fish are also present in streams and lakes through Thurston County.

3.4.3 Nearshore Habitats and Species

Important nearshore marine habitats in Thurston County include eelgrass and seagrass, kelp and other algal communities; shellfish beds; forage fish spawning areas; marine mammal habitats (seal and sea lion haulouts); seabird/waterfowl concentration areas; estuaries and other intertidal wetlands/marshes, lagoons, and nearshore riparian habitats.

3.4.3.1 Eelgrass and Kelp

Although Thurston County has limited mapping of eelgrass, there are some known areas associated with the Nisqually Delta; as well as the potential for habitat recovery in other areas of the County. Eelgrass (*Zostera marina*) is a native marine seagrass that develops extensive meadows on fine sand, gravel, and mud substrates in the lower intertidal and shallow subtidal...
zones within semi-protected or protected shorelines (Bulthuis, 1994; Thom et al., 1998). Eelgrass typical substrate locations have fine to medium sands as well as containing comparatively high levels of organic matter and nutrients (Simenstad, 2000). Typically this includes shallow tideflats, lining channels in estuaries, and in the shallow fringe areas of the subtidal zone. Eelgrass primarily grows between tidal elevations of +1 meter to -2 meters relative to mean lower low water (MLLW) (Thom et al., 2001; Simenstad, 2000).

Eelgrass can reach 2 meters in height, forming a dense canopy. Where undisturbed, eelgrass can grow in nearly adjoining corridors within a drift cell, but also grows patchily within and between drift cells. In general, eelgrass corridors decrease in width as beach gradient steepens and waters increase in turbidity (Simenstad, 2000). Eelgrass beds supply an important source of organic matter to food webs in the intertidal/shallow subtidal zones. Eelgrass plants produce organic carbon which is delivered to the food web via microbial decomposition of eelgrass materials (Williams and Thom, 2001). Juvenile salmon, and numerous species of fish and other marine animals use the decomposed organic matter in their diets. Eelgrass provides habitat structure and refuge from predators, for salmon and other species. Whereas herring use eelgrass for spawning and rearing habitat, epiphytic algae and other organisms use eelgrass leaves as attachment sites to ameliorate wave and current energy (PSAT, 2001).

Thurston County does not have extensive kelp beds mapped. However, there are areas of algal communities that could support kelp under the right conditions. Kelp, or macrophytic brown algae, forms dense, highly productive undersea forests that provide support to numerous marine species. Kelp forests are primarily composed of bull kelp (*Nereocystis luetkeana*) and other large brown algae. Kelp uses holdfasts to attach to substrates. The distribution of kelp is limited to areas with rocky or coarse substrates, light penetration to the bottom, and moderate wave/current energy. Kelp beds reduce wave energy and provide sheltered habitat within the kelp bed or adjacent surface waters for resting/rafting seabirds and other animals.

3.4.3.2 Estuaries and Intertidal Wetlands/Marshes

Estuaries are semi-protected inland waters with freshwater inputs that act as transition zones between freshwater and marine environments. They make up the area at the mouth of a river or stream from the head of tidal influence seaward to the point where fluvial influences no longer dominate.

Estuarine habitat in Thurston County is diverse, ranging from riverine estuaries to small alongshore salt marshes influenced mainly by marine processes. Historically, Thurston County estuaries were located at the mouths of the major river systems. Several of these have been highly modified and the habitat impacted such as Budd Inlet. However, there are still remnants present even in the most impacted areas. Nisqually Delta is the largest and most prominent of the Thurston County systems. Estuaries are also located in Eld Inlet’s Mud Bay area, Henderson Inlet at the mouth of Woodland Creek and the Oyster Bay area on Totten Inlet. Other smaller pocket estuaries are present along the marine shoreline, particularly where a freshwater stream or lagoon is present.

Estuaries supply critical ecological functions and biological resources including: nutrient retention and cycling, food web support, and habitat structure/connectivity, erosion/shoreline
3. Ecosystem Characterization and Ecosystem-Wide Processes

protection, and flood attenuation. Estuaries supply critical habitat for the fish migration as well as refugia for many marine and brackish species. They provide critical functions for salmon by providing salinity gradients that allow juveniles to gradually adjust to salt water as well as serving as nurseries for a multitude of aquatic species that are a forage base for salmon.

Many species, including juvenile salmonids use estuaries and other shallow water habitats, as a refuge from predation when migrating, particularly when complex habitat features such as woody debris or submerged vegetation are absent (Kahler et al., 2000). Juvenile Chinook salmon and summer chum both depend on estuarine environments (WDFW and PNPTC, 2000). For recovery of threatened salmon stocks in Puget Sound, preservation and/or restoration of estuaries is considered crucial (Brewer et al. 2005; Hood Canal Coordinating Council, 2005; Todd et al., 2006).

Salt marshes and brackish marshes are tidally inundated habitats. Salt marshes occur in areas at and above mean higher high water (MHHW), where sediment supply and accumulation are relatively high. Salt marshes can occur on river and stream deltas, such as the Nisqually River Delta, along sand spits sheltered from waves and currents, and in bays. Salt marsh root mats and areas of dense stems trap and stabilize sediments. The accumulation of sediment cause marshes tend to extend outward over time as the sediments entering the delta from rivers are captured and retained by salt marsh vegetation. Salt marshes provide complex, branching networks of tidal channels used by juvenile salmonids for feeding and refuge from predators. The tidal channel networks also form migratory linkages to riverine and marine environments (Brewer et al., 2005).

As well as the major estuaries listed above, there are tidal marsh systems called “pocket estuaries” that are believed to support the early marine life histories of juvenile salmon species, though not connected to the natal watersheds (Hood Canal Coordinating Council, 2005). Pocket estuaries occur in embayments where freshwater seeps or streams occur. It is critical for rearing and migrating salmonids to maintain linkages between major estuarine deltas and other shallow nearshore habitats/corridors (WDFW and PNPTC, 2000).

3.4.3.3 Shellfish Resources

Cobble to fine sand beaches and tidal sand and mudflats are important habitats for many shellfish species. Intertidal areas in Thurston County support hardshell clams including butter clams (Saxidomus gigantea), native littleneck (Protothaca staminea), Manila clams (Venerupis philippinarum), cockles (Clinocardium nuttallii), and horse clams (Tresus spp.). Geoducks (Panopea abrupta) typically burrow offshore in subtidal areas up to 2 to 3 feet into the mud or soft sand. Shrimp, crab, Olympia oysters (Ostrea conchaphila) and non-native Pacific oysters (Crassostrea gigas) also inhabit the shoreline areas. Dungeness crab (Cancer magister) frequent eelgrass beds, and red rock crab (Cancer productus) inhabit rocky terrain with less silt content (Thurston County 2008, WDFW, DOE).

Shellfish beds perform a number of ecological functions including stabilizing substrates, cycling nutrients, enhancing water quality (filtering and retention), creating habitat structure (e.g., oyster reefs), and providing food for a wide variety of marine invertebrates, birds, fish, and mammals. Shellfish beds and commercial and recreational shellfish harvest beaches are found along the
shorelines of Thurston County. Tribal shellfish beaches and growing areas are also distributed throughout the County. Water quality issues and their effect on the harvest of commercial and recreational shellfish has resulted in the Henderson Inlet and Nisqually Reach Shellfish Protection Districts (Thurston County Public Health and Social Services 2009).

3.4.3.4 Forage Fish

Forage fish such as smelt, sand lance and herring are a critical prey base for salmonids. Forage fish use a variety of shallow nearshore and estuarine habitats for spawning, feeding, and rearing (Long et al., 2005). Surf smelt (*Hypomesus pretiosus*) and Pacific sand lance (*Ammodytes hexapterus*) have habitat requirements for spawning in the upper intertidal zones of beaches, within a limited tidal elevation range, and in substrate of specific size and type (Penttila, 1978; 1995). In contrast, Pacific herring (*Clupea harengus*) spawn in intertidal and shallow subtidal areas, where they deposit eggs on marine vegetation at elevations between 0 and -10 feet MLLW (WDFW, 2000a). Spawning habitat suitable for forage fish for these species is limited, and these species are especially vulnerable to changes in beach morphology, beach sediment characteristics (sources, transport or deposition), or nearshore riparian cover (WDFW, 2000a).

3.4.3.5 Nearshore Riparian Areas

Marine riparian areas occur at the interface between upland and aquatic areas and provide unique protection of the aquatic nearshore by the preservation of vegetation and protection of hydrologic regimes. According to Brennan and Culverwell (2004), healthy nearshore riparian systems are defined by the following characteristics:

- Long linear shapes,
- High edge-to-area ratios,
- Microclimates distinct from those of adjacent uplands,
- Standing or flowing water present all or much of the year, or a capacity to convey or retain water,
- Periodic flooding, which results in greater natural diversity,
- Composition of native vegetation differing somewhat from upland (inland) systems (e.g., different species abundance, diversity, and structure), and
- Support systems for terrestrial and aquatic biota.

Intact riparian habitats provide many critical ecological functions including water quality protection, sediment control, nutrient microclimate control, woody debris to help build complex habitat and stabilize beach substrate, wildlife habitat, insect food sources for juvenile fish, and shaded cover (Brennan and Culverwell, 2004). Slope stability is dependent on a healthy nearshore riparian vegetation zone to protect against landslides and other erosion hazards. Nearshore riparian vegetation can mitigate the effects of excessive soil moisture which can lead to erosion and/or mass instability by promoting evapotranspiration and providing root masses that support mechanical slope stability (Brennan and Culverwell, 2004).
3.4.4 Freshwater Habitats and Species

3.4.4.1 Freshwater Wetlands

Thurston County’s Critical Areas Ordinance is consistent with the state and federal definition of wetland. WAC 173-22-030 defines wetlands as “those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.” Wetlands perform numerous functions including: flood attenuation; water quality protection and groundwater recharge; habitat provision for numerous species of fish and wildlife. Freshwater wetlands provide biogeochemical functions involving trapping and transforming chemicals and improving water quality in the watershed; hydrologic functions related to reducing flooding and maintaining water regimes; and food web and habitat functions (Granger et al., 2005).

Freshwater wetlands are present throughout the County and mapped on our Geodata system. Wetlands are frequently indicated by areas dominated by “hydric” soil types (including organic soil deposits), areas of low slope, depressional areas, along streams, and on slopes/transitional areas where groundwater is expressed to the surface.

Wetlands associated with shorelines of the state, or the shoreline jurisdiction, are managed under the SMA. In the context of the SMA, associated wetlands means wetlands that are in proximity to shorelines or that influence or are influenced by waters subject to the Act (WAC 173-22-030 (1)). These typically include wetlands that are functionally related to the shoreline through a hydrologic connection or other factors, and wetlands that physically extend into the shoreline jurisdiction.

3.4.4.2 Riparian Areas

Freshwater riparian areas function similarly to marine nearshore riparian areas. Riparian zones contribute to healthy streams by suppressing the erosional processes that move sediment, mechanically filtering and/or storing upland sediments before they can enter stream channels, and dissipating energy and inhibiting sediment input (Knutson and Naef, 1997). Riparian areas perform water quality functions related to pollutant removal. This occurs primarily through trapping/storing of nutrients and heavy metals in the vegetation root systems and fine sediment present in the riparian areas.

Riparian zones are the major source of large woody debris (LWD) input to streams. This large woody debris is crucial to creating habitat within the ecosystem. Structural complexity within streams is developed from trees, root wads, and limbs that fall into the stream resulting from normal tree mortality, mass slope movement, windthrow, or bank undercutting. LWD creates complex hydraulic patterns that form pools and side channels; waterfalls; enhanced channel sinuosity; and other physical and biochemical channel changes. Aquatic species depend on the in-channel structural diversity created by LWD for hiding, overwintering habitat, and juvenile rearing, in all sizes of streams and rivers (Knutson and Naef, 1997).

Forest practices, including clear cutting, can damage and degrade many of the riparian zones on state-owned and private forest lands in Thurston County. Forest and Fish rules have helped...
minimize the short and long term effects of forest cover loss. However, the recovery on a basin scale and overall ecological functions may take time to recreate functional habitats.

3.4.5 Terrestrial Wildlife Habitats

Other habitat resources within Thurston County include terrestrial forests (including old growth/mature forests), native outwash prairies, and oak woodlands. Lowland forests are dominated by western hemlock (*Tsuga heterophylla*), Douglas-fir (*Pseudotsuga menziesii*), and western red cedar (*Thuja plicata*).

Grassland and oak habitats occur in Thurston County especially in the southern and eastern portions of the County. Many rare grassland species are declining with increased urbanization and the suppression of frequent fires that once sustained the grasslands, leading to more densely forested areas (WDNR, 2005).

3.5 WRIAs

A "watershed" is an area that drains into a common river, lake, or other waterbody. The boundaries of these watersheds have been used to divide the state into 62 areas known as water resource inventory areas (WRIAs). The WRIAs were formalized under Washington Administrative Code (WAC) 173-500-040 and authorized under the Water Resources Act of 1971, Revised Code of Washington (RCW) 90.54. Thurston County contains portions of the following WRIAs: 11-Nisqually, 13-Deschutes, 14-Kennedy Goldsborough, and 23-Upper Chehalis. A small portion of WRIA 22-Lower Chehalis is located in the western most portion of the county. However, this WRIA does not contain any shorelines of statewide significance.

The remainder of Chapter 3 provides information on these WRIAs.
3.5.1 WRIA 11 – Nisqually

3.5.1.1 WRIA 11 Characteristics

WRIA 11 is located within the eastern portion of Thurston County. WRIA 11 is 760.9 square miles in size. Approximately 131 square miles of this WRIA is located within Thurston County. 12% of the county is located within this WRIA.

The headwaters of WRIA 11 begin on the Nisqually Glacier located on Mount Rainier. From there, the Nisqually River flows in a northerly direction and provides the border between Thurston and Pierce Counties. The northern border of WRIA 11 and the Nisqually River occurs at the confluence of the river into Puget Sound. This area coincides with the Nisqually Wildlife Refuge.

WRIA 11 also contains a series of springs associated with McAllister Creek. These springs, in addition to providing the headwaters for McAllister Creek also serve as a water supply for the City of Olympia.

The highest population density for this WRIA located within Thurston County is the City of Yelm. This WRIA also contains portions of the Lacey Urban Growth Area, the Nisqually Indian Reservation and Fort Lewis.
3. Ecosystem Characterization and Ecosystem-Wide Processes

3.5.1.2 Basins

The basins located within WRIA 11 are as follows:

<table>
<thead>
<tr>
<th>Basin</th>
<th>Area within WRIA (Acres)</th>
<th>Percent Area of WRIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alder Lake</td>
<td>2653.68</td>
<td>3.22</td>
</tr>
<tr>
<td>Bald Hill Lake</td>
<td>776.93</td>
<td>0.94</td>
</tr>
<tr>
<td>Clear Lake</td>
<td>1110.84</td>
<td>1.35</td>
</tr>
<tr>
<td>Deschutes River</td>
<td>1588.86</td>
<td>1.93</td>
</tr>
<tr>
<td>Elbow Lake</td>
<td>1162.50</td>
<td>1.41</td>
</tr>
<tr>
<td>Lake Lawrence</td>
<td>97.50</td>
<td>0.12</td>
</tr>
<tr>
<td>McAllister Creek</td>
<td>18681.10</td>
<td>22.65</td>
</tr>
<tr>
<td>Nisqually</td>
<td>30394.79</td>
<td>36.85</td>
</tr>
<tr>
<td>Spurgeon Creek</td>
<td>545.73</td>
<td>0.66</td>
</tr>
<tr>
<td>Thompson Creek (Nisqually)</td>
<td>9643.03</td>
<td>11.69</td>
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<tr>
<td>Woodland</td>
<td>556.37</td>
<td>0.67</td>
</tr>
<tr>
<td>Yelm Creek</td>
<td>15281.80</td>
<td>18.52</td>
</tr>
</tbody>
</table>

Further information on these basins is located in Chapter 4 of this document.

3.5.1.3 Historical Use

The land area identified as WRIA 11 was one of the first settlement areas within the Puget Sound. The Yelm Prairie area was the location of crossroads of major trails utilized by Native Americans prior to the onset of European settlement. European exploration of area encompassed within this WRIA began in 1792. In 1833, the Hudson Bay Company selected a site near the Nisqually Delta for a fort. As a result of this site selection, initial European settlement of the County took place in WRIA 11. Settlement and subsequent land clearing and farming of the area near McAllister Creek occurred in 1845. Increased European settlement of the County (as well as Washington and Oregon in general) occurred in 1850 as result of Donation Land Claim Law. The increase in settlement and resulting increased need for transportation resulted in the establishment of the first ferry across the Nisqually River in 1852. In 1880, railroad construction to the city of Yelm occurred. In 1904, settlers began diking the Nisqually estuary. The diking process was completed in 1920. In 1912, settlers within the area began the establishment of Yelm Ditch. Logging along Nisqually River occurred starting in the 1890’s. Railroad transportation through central portion of WRIA was established in 1907. Logging of the areas around the City of Yelm occurred from 1910 to the mid-1970’s logging. The Yelm Hydroelectric project was completed in 1929.

3.5.1.4 Current Land Use

The predominant land use for WRIA 11 is as follows: Single family residential 16.3 %, Agriculture 10%, Designated Forest Land 22%, and Undeveloped Land 33%.

The predominant zoning designations for WRIA 11 are as follows: Long Term Forestry (15%), Military Reservation (15%), and Rural Residential - One Dwelling Unit per Five Acres (43%).

3.5.1.5 Projected Future Use

TRPC analysis of future basin use within this WRIA reflects that this area will experience increased residential development. Please refer to specific basins for additional data.
3.5.1.6 Ecosystems

Freshwater and associated terrestrial shoreline ecosystems within WRIA 11 include the Nisqually River, as well as wetlands and flood plains associated with the Nisqually River. Yelm Creek is a major tributary to the Nisqually River that is located in Thurston County.

In addition to the Nisqually River, the Nisqually River delta is another freshwater ecosystem located within Thurston County. This delta system is one of the few estuaries in the Puget Sound that has not been heavily impacted by industrial and urban development. However, this delta system has been modified by agricultural uses, placement of fill, the Interstate Highway 5 corridor, and rail lines. These modifications have resulted in alterations to hydrology and sediment transport, habitat diversity, organic and LWD inputs, and tidal exchange.

The delta ecosystem is the natal estuary of the largest independent Chinook population in the South Sound. Although undocumented at this time, it is thought that other local Chinook populations may also use this ecosystem during their lifecycle.

WRIA 11 contains a small amount of marine-based ecosystem along the Nisqually Reach.

3.5.1.7 Major Disturbance of Processes

Major disturbances of process that are apparent at the WRIA level within this basin are as follows:

- The Interstate Highway 5 corridor, a rail line, and areas of fill and diking are located within the wetland and floodplain areas associated with the Nisqually River and Nisqually Delta.

- Thurston County Aerials and literature research reflect human modification of Yelm Creek associated with a hydroelectric project.

- Many of the areas adjacent to the rivers within this WRIA are utilized for agriculture. Review of the 2006 aerials of this area indicated that natural shoreline vegetation, associated habitat and occasionally water courses have been modified as a result of the agricultural practices within these areas.

Smaller, more localized disturbances to shoreline and hydrologic related processes are provided within the basin narrative, Chapter 4 and the Reach Analysis Matrix, Appendix A.
3.5.2 WRIA 13 – Deschutes

3.5.2.1 WRIA 13 Characteristics

WRIA 13 is located within the central portion of the County in a northwest/southeast direction. This WRIA encompasses the majority of the cities of Olympia, Lacey, Tumwater and the Urban Growth Areas (UGAs). The majority of the Thurston County population lives within the Deschutes WRIA.

WRIA 13 encompasses 270 square miles in central Thurston County. Approximately 235 square miles of this WRIA is located in Thurston County. 37% of the County is located within this WRIA.

3.5.2.2 Basins

The basins located within WRIA 13 are as follows:

<table>
<thead>
<tr>
<th>Basin</th>
<th>Area within WRIA (Acres)</th>
<th>Percent Area of WRIA</th>
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</thead>
<tbody>
<tr>
<td>Alder Lake</td>
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<tr>
<td>Bald Hill Lake</td>
<td>16.70</td>
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<tr>
<td>Beaver Creek</td>
<td>730.44</td>
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<tr>
<td>Black Lake</td>
<td>656.00</td>
<td>0.44</td>
</tr>
<tr>
<td>Bloom Ditch</td>
<td>4.69</td>
<td>0.00</td>
</tr>
</tbody>
</table>
3. Ecosystem Characterization and Ecosystem-Wide Processes

<table>
<thead>
<tr>
<th>Basin</th>
<th>Area within WRIA (Acres)</th>
<th>Percent Area of WRIA</th>
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</thead>
<tbody>
<tr>
<td>Capitol Lake</td>
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<tr>
<td>Chambers</td>
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<td>5.59</td>
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<tr>
<td>Clear Lake</td>
<td>739.19</td>
<td>0.49</td>
</tr>
<tr>
<td>Dana Passage</td>
<td>1126.75</td>
<td>0.75</td>
</tr>
<tr>
<td>Dempsey Creek</td>
<td>23.00</td>
<td>0.02</td>
</tr>
<tr>
<td>Deschutes River</td>
<td>53702.70</td>
<td>35.69</td>
</tr>
<tr>
<td>East Bay</td>
<td>2775.62</td>
<td>1.84</td>
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<tr>
<td>Eld Inlet (East)</td>
<td>4179.03</td>
<td>2.78</td>
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<td>Ellis Creek</td>
<td>1469.88</td>
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<tr>
<td>Green Cove Creek</td>
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<tr>
<td>Henderson</td>
<td>7305.08</td>
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<tr>
<td>Indian Creek</td>
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<tr>
<td>Johnson Creek</td>
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</tr>
<tr>
<td>Lake Lawrence</td>
<td>1589.48</td>
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</tr>
<tr>
<td>McAllister Creek</td>
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<tr>
<td>McIntosh Lake</td>
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<td>McLane Creek</td>
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<td>Mission Creek</td>
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<td>Moxlie Creek</td>
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</tr>
<tr>
<td>Nisqually River</td>
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<td>0.77</td>
</tr>
<tr>
<td>Nisqually Reach</td>
<td>4644.64</td>
<td>3.09</td>
</tr>
<tr>
<td>Offut Lake</td>
<td>1433.54</td>
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<td>Percival Creek</td>
<td>4569.38</td>
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<td>Perry Creek</td>
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<td>Reichel Lake</td>
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<td>Salmon Creek (Black)</td>
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<td>0.01</td>
</tr>
<tr>
<td>Scatter Creek</td>
<td>254.18</td>
<td>0.17</td>
</tr>
<tr>
<td>Schneider</td>
<td>680.54</td>
<td>0.45</td>
</tr>
<tr>
<td>Spurgeon Creek</td>
<td>6116.44</td>
<td>4.06</td>
</tr>
<tr>
<td>Tempo Lake</td>
<td>749.01</td>
<td>0.50</td>
</tr>
<tr>
<td>Thompson Creek (Nisqually)</td>
<td>651.16</td>
<td>0.43</td>
</tr>
<tr>
<td>Thompson Creek (Skookumchuck)</td>
<td>207.31</td>
<td>0.14</td>
</tr>
<tr>
<td>Waddell Creek</td>
<td>20.83</td>
<td>0.01</td>
</tr>
<tr>
<td>West Bay</td>
<td>1932.82</td>
<td>1.28</td>
</tr>
<tr>
<td>Woodard</td>
<td>4477.57</td>
<td>2.98</td>
</tr>
<tr>
<td>Woodland</td>
<td>18319.70</td>
<td>12.17</td>
</tr>
<tr>
<td>Yelm Creek</td>
<td>384.75</td>
<td>0.26</td>
</tr>
</tbody>
</table>

Further information on these basins is located in Chapter 5 of this document.

3.5.2.3 Historical use

In 1824, a British exploration expedition traveled the areas in and around the Chehalis River and Black River to Eld Inlet. Approximately twenty years later, in 1841, an American expedition mapped and named Budd, Totten, Eld, and Henderson Inlets. Settlement near Deschutes Falls began in 1845. This settlement resulted in the creation of Tumwater. A gristmill was developed near the Deschutes Falls in 1846-47. Increased European settlement of the County (as well as
3. Ecosystem Characterization and Ecosystem-Wide Processes

Washington and Oregon as a whole) occurred in the 1850s result of Donation Land Claim Law. Lacey was established in 1848; Olympia was established in 1850; Rainier was established in 1890. Commercial oyster operations also began in this area in 1890. A rail line through Lacey was established in 1891. This line crosses through Lake Pattison. During the mid 1920s, resorts opened on Hicks, Long, Pattison, and Southwick Lakes.

3.5.2.4 Current Land Use

The predominant land uses within WRIA 13 are as follows: Single family residential (24%), Designated Forest Land (27%), and Undeveloped Land (18%).

The predominant zoning designations within WRIA 13 are as follows: Long Term Forestry (38%) and Rural Residential - One Dwelling Unit per Five Acres (63%).

3.5.2.5 Projected Future Use

TRPC analysis of future basin use within this WRIA reflects that this area will experience increased residential development. Please refer to specific basins for additional data.

3.5.2.6 Ecosystems

Major ecosystems within this WRIA include marine waters and terrestrial shorelines adjacent to Henderson, Budd and portions of Eld Inlet and freshwater and terrestrial shorelines related to the Deschutes River including associated wetlands and floodplains.

3.5.2.7 Major Disturbance of Processes

Major disturbances of process that are apparent at the WRIA level within this basin are as follows:

- The majority of the marine shoreline within this WRIA has been developed for residential use. 2006 aerials reflect that large portions of the shoreline have been armored and the vegetation adjacent to the shoreline has been modified.

- Review of the available Thurston County aerials reflect that human modification of flood plain and wetlands associated with the Deschutes River has occurred.

- Many of the areas adjacent to the rivers within this WRIA are utilized for agriculture. Review of the 2006 aerials of this area indicated that natural shoreline vegetation, associated habitat and occasionally water courses have been modified as a result of the agricultural practices within these areas.

- Smaller, more localized disturbances to shoreline and hydrologic related processes are provided within the basin narrative, Chapter 5, and the Reach Analysis Matrix, Appendix A.
3.5.3 WRIA 14 – Kennedy/Goldsborough

3.5.3.1 WRIA 14 Characteristics

WRIA 14 covers about 381 square miles of the southwest terminus of Puget Sound. The majority of Thurston County portion WRIA 14 is located on what is known as the Steamboat Island Peninsula but also contains Summit Lake and Kennedy Creek. Oyster Bay and is flanked by Eld Inlet and Mud Bay on the eastern side. Within Thurston County, the region encompasses the extreme southwest terminus of Puget Sound, including a portion of Eld Inlet and the entirety of Totten Inlet.

WRIA 14 is 381 square miles in size. Approximately 48 square miles are located within Thurston County. 9% of the County is located within this WRIA.

3.5.3.2 Basins

The basins located within WRIA 14 are as follows:

<table>
<thead>
<tr>
<th>Basin</th>
<th>Area within WRIA (Acres)</th>
<th>Percent Area of WRIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burns</td>
<td>165.75</td>
<td>0.54</td>
</tr>
<tr>
<td>Eld Inlet (West)</td>
<td>4911.57</td>
<td>16.05</td>
</tr>
<tr>
<td>Kennedy Creek</td>
<td>9575.74</td>
<td>31.29</td>
</tr>
<tr>
<td>McLane Creek</td>
<td>113.03</td>
<td>0.37</td>
</tr>
<tr>
<td>Perry Creek</td>
<td>3869.98</td>
<td>12.65</td>
</tr>
<tr>
<td>Pierre</td>
<td>103.20</td>
<td>0.34</td>
</tr>
</tbody>
</table>
3. Ecosystem Characterization and Ecosystem-Wide Processes

<table>
<thead>
<tr>
<th>Basin</th>
<th>Area within WRIA (Acres)</th>
<th>Percent Area of WRIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Porter Creek</td>
<td>121.25</td>
<td>0.40</td>
</tr>
<tr>
<td>Schneider Creek</td>
<td>5242.86</td>
<td>17.13</td>
</tr>
<tr>
<td>Squaxin Passage</td>
<td>488.94</td>
<td>1.60</td>
</tr>
<tr>
<td>Summit Lake</td>
<td>1899.70</td>
<td>6.21</td>
</tr>
<tr>
<td>Totten Inlet</td>
<td>4107.19</td>
<td>13.42</td>
</tr>
<tr>
<td>Waddell Creek</td>
<td>0.40</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Further information on these basins is located in Chapter 6 of this document.

3.5.3.3 Historical use

Similar to the other WRIAs within the County, settlement by Europeans in this area increased in the 1850s as result of Donation Land Claim Law. Records indicate that between the years of 1927-59, the northern point of the Steamboat Island area was used as a fishing resort. More intensive residential development resulting in the land use patterns currently reflected in this WRIA began primarily during the mid-1950s to 1960’s.

3.5.3.4 Current Land Use

The predominant land uses in WRIA 14 are as follows: Single family residential (20 %), Designated Forest Land (27%), and Undeveloped Land (37 %).

The predominant zoning designations in WRIA 14 are as follows: Long Term Forestry (47 %) and Rural Residential - One Dwelling Unit per Five Acres (45 %).

3.5.3.5 Projected Future Use

TRPC analysis of future basin use within this WRIA reflects that this area will experience increased residential and commercial development. Please refer to specific basins for additional data.

3.5.3.6 Ecosystems

Major ecosystems within WRIA 14 include marine and terrestrial shorelines adjacent to Totten and Eld Inlets. In addition, this WRIA also contains freshwater and terrestrial shorelines associated with Kennedy Creek and Summit Lake.

3.5.3.7 Major Disturbances of Processes

Major disturbances of process that are apparent at the WRIA level within this basin are as follows:

- The majority of the marine shoreline within this WRIA has been developed for residential use. 2006 aerials reflect that large portions of the shoreline have been armored and the vegetation adjacent to the shoreline has been modified.

- Restriction of outflow of Summit Lake
3. Ecosystem Characterization and Ecosystem-Wide Processes

Smaller, more localized disturbances to shoreline and hydrologic related processes are provided within the basin narrative, Chapter 7, and the Reach Analysis Matrix, Appendix A.

3.5.4 WRIA 23 – Upper Chehalis

Note: Thurston County contains a small portion of WRIA 22 – Lower Chehalis. However, it does not contain any jurisdictional shoreline and is therefore incorporated into this chapter.

3.5.4.1 WRIA 23 Characteristics

The WRIA 23 is located within the southern central portion of the county. The cities of Rochester, Bucoda, Grand Mound and Tenino are located within this WRIA.

WRIA 23 covers about 1,298 square miles. Approximately 319 square miles is located in Thurston County. 42% of the County is located in this WRIA.

3.5.4.2 Basins

The basins located within WRIA 23 are as follows:

<table>
<thead>
<tr>
<th>Basin</th>
<th>Area within WRIA (Acres)</th>
<th>Percent Area of WRIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allen Creek</td>
<td>3418.65</td>
<td>1.68</td>
</tr>
<tr>
<td>Beaver Creek</td>
<td>15123.30</td>
<td>7.41</td>
</tr>
<tr>
<td>Black Lake</td>
<td>4870.04</td>
<td>2.39</td>
</tr>
<tr>
<td>Black River</td>
<td>25092.30</td>
<td>12.30</td>
</tr>
</tbody>
</table>
### 3. Ecosystem Characterization and Ecosystem-Wide Processes

#### 3.5.4.3 Historical use

Similar to the other WRIAs within the County, literature review indicates that settlement by Europeans within this WRIA increased in the 1850s as result of Donation Land Claim Law. The cities of Bucoda, Tenino, Rochester, and Grand Mound were established between the 1850s to the 1890s. In the 1880s, railroad construction connected Bucoda and Tenino. This rail line crosses multiple creeks and streams including the Skookumchuck River, Scatter Creek and Beaver Creek. The platting of Rochester and Grand Mound occurred in the 1890s. Construction of Interstate Highway 5 began in 1954 and would have had, at a minimum, a mild impact to both Scatter and Beaver Creek.

<table>
<thead>
<tr>
<th>Basin</th>
<th>Area within WRIA (Acres)</th>
<th>Percent Area of WRIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bloody Run</td>
<td>2061.79</td>
<td>1.01</td>
</tr>
<tr>
<td>Bloom Ditch</td>
<td>5005.49</td>
<td>2.45</td>
</tr>
<tr>
<td>Dempsey Creek</td>
<td>5820.26</td>
<td>2.85</td>
</tr>
<tr>
<td>Deschutes River</td>
<td>994.19</td>
<td>0.49</td>
</tr>
<tr>
<td>East Fork Independence Creek</td>
<td>1550.91</td>
<td>0.76</td>
</tr>
<tr>
<td>Fall Creek</td>
<td>1443.02</td>
<td>0.71</td>
</tr>
<tr>
<td>Frost Prairie</td>
<td>1843.46</td>
<td>0.90</td>
</tr>
<tr>
<td>Hanaford Creek</td>
<td>6094.57</td>
<td>2.99</td>
</tr>
<tr>
<td>Johnson Creek</td>
<td>6481.10</td>
<td>3.18</td>
</tr>
<tr>
<td>Kennedy Creek</td>
<td>88.70</td>
<td>0.04</td>
</tr>
<tr>
<td>Lincoln Creek</td>
<td>1879.04</td>
<td>0.92</td>
</tr>
<tr>
<td>Lost Valley</td>
<td>1143.31</td>
<td>0.56</td>
</tr>
<tr>
<td>McIntosh Lake</td>
<td>48.17</td>
<td>0.02</td>
</tr>
<tr>
<td>McLane Creek</td>
<td>126.97</td>
<td>0.06</td>
</tr>
<tr>
<td>Michigan</td>
<td>2630.15</td>
<td>1.29</td>
</tr>
<tr>
<td>Mima Creek</td>
<td>7940.43</td>
<td>3.89</td>
</tr>
<tr>
<td>Monroe Creek</td>
<td>1072.12</td>
<td>0.53</td>
</tr>
<tr>
<td>O’Connor</td>
<td>2189.08</td>
<td>1.07</td>
</tr>
<tr>
<td>Offut Lake</td>
<td>98.52</td>
<td>0.05</td>
</tr>
<tr>
<td>Percival Creek</td>
<td>142.41</td>
<td>0.07</td>
</tr>
<tr>
<td>Perry Creek</td>
<td>7.83</td>
<td>0.00</td>
</tr>
<tr>
<td>Porter Creek</td>
<td>7463.76</td>
<td>3.66</td>
</tr>
<tr>
<td>Prairie Creek</td>
<td>13550.90</td>
<td>6.64</td>
</tr>
<tr>
<td>Reichel Creek</td>
<td>405.93</td>
<td>0.20</td>
</tr>
<tr>
<td>Salmon Creek (Black)</td>
<td>4620.25</td>
<td>2.26</td>
</tr>
<tr>
<td>Salmon Creek (Skookumchuck)</td>
<td>2830.57</td>
<td>1.39</td>
</tr>
<tr>
<td>Scatter Creek</td>
<td>27169.20</td>
<td>13.32</td>
</tr>
<tr>
<td>Sherman Creek</td>
<td>6187.11</td>
<td>3.03</td>
</tr>
<tr>
<td>Skookumchuck</td>
<td>9471.62</td>
<td>4.64</td>
</tr>
<tr>
<td>Thompson Creek (Skookumchuck)</td>
<td>20966.50</td>
<td>10.28</td>
</tr>
<tr>
<td>Waddell Creek</td>
<td>11160.40</td>
<td>5.47</td>
</tr>
<tr>
<td>Zenkner</td>
<td>3002.16</td>
<td>1.47</td>
</tr>
</tbody>
</table>

Further information on these basins is located in Chapter 7 of this document.
3.5.4.4 Current Land Use

The predominant land uses within WRIA 23 are as follows: Single family residential (12 %), Designated Forest Land (30%), and Undeveloped Land (33%).

The predominant zoning designations within WRIA 23 are as follows: Long Term Forestry (39 %) and Rural Residential - One Dwelling Unit per Five Acres (41 %).

3.5.4.5 Projected Future Use

TRPC analysis of future basin use within this WRIA reflects that this area will experience increased commercial and residential development in Grand Mound and Rochester areas. Additionally, it is projected that this area may also experience an increase in industrial development. Please refer to specific basins for additional data.

3.5.4.6 Ecosystems

The major ecosystems within WRIA 23 are freshwater shorelines associated with the Chehalis River, the Skookumchuck River, and the Black River. The Black River is well known for having impeded water flow and associated wetlands. Terrestrial ecosystems such as outwash prairies, Mima Mounds and oak stands are also prevalent in this area and may or may not be associated with the shoreline jurisdiction.

3.5.4.7 Major Disturbances of Processes

Major disturbances of process that are apparent at the WRIA level within this basin are as follows:

- Interstate Highway 5 crosses through Scatter Creek, Beaver Creak as well as associated wetlands and floodplains.

- Highway 12 crosses wetlands and floodplains associated with the Black and Chehalis Rivers.

- Many of the areas adjacent to the rivers within this WRIA are utilized for agriculture. Review of the 2006 aerials of this area indicated that natural shoreline vegetation, associated habitat and occasionally water courses have been modified as a result of the agricultural practices within these areas.

- *The Upper Chehalis Initial Watershed Assessment (1995) notes that there are* many issues impacting water availability for this basin including: variation in natural water supply, increased water demand during periods of decreased supply availability, and degraded surface water supply.

- The Chehalis Basin Level 1 Assessment conducted in 2000 by Envirovision et al. notes that: “Field observations [for the Upper Chehalis basin] have indicated that removal of trees and other vegetation along much of the upper river has reduced shading, which contributes to high dry-season temperatures. The TMDL study recommends increasing vegetative shading along the Chehalis River and its tributaries.”
• Smaller, more localized disturbances to shoreline and hydrologic related processes are provided within the basin narrative, Chapter 7, and the Reach Analysis Matrix, Appendix A.
The data provided in this chapter are divided into subsections focused on the basins located within the Nisqually Water Resource Inventory Area (WRIA 11). Each subsection begins with an overview of the basin and includes information regarding basin characteristics and water bodies, public access, and priority habitats/critical areas. Additional data follows regarding impacts to function, specific sources of basin information, and restoration/enhancement opportunities. In addition to specific sources cited below, the content of this chapter generally is based on documents, mapping information, and other resources described in Appendix B: Shoreline Inventory. That appendix highlights pertinent WRIRAs and basins for each source.
4.1 **Alder Lake**

Alder Lake basin is located in the southeastern corner of Thurston County. It is 2,657 acres in size. The majority of the basin, 2,652 acres, is located in WRIA 11. A small portion of this basin, 5 acres, is located in WRIA 13. As the majority of Alder Lake basin is located in WRIA 11, review of it is provided in this chapter. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.2863</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.2863</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>11.3494</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>11.3494</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Alder Lake basin is bordered by the Nisqually basin to the north and south, Alder Lake to the east, and the Deschutes River basin to the west.
The land mass of the basin is split into two portions by Alder Lake. Alder Lake is the largest lake in Thurston County and is a man-made impoundment of the Nisqually River behind the Alder Dam. Alder Dam was created in 1945 and is a hydroelectric resource for Tacoma Power.

Water in this basin generally flows towards Alder Lake and the Nisqually River and ultimately into south Puget Sound.

Primary land use for this basin is divided almost evenly between designated forest and undeveloped land. The southern portion of this basin contains Snoqualmie National Forest lands. The Thurston Regional Planning Council’s (TRPC) population forecast indicates that there are no dwelling units identified within this basin and none projected for a period of time extending to 2030.

4.1.2 Public Access

Public access to Alder Lake may be obtained through a WDFW boat launch located in Pierce County. The WDFW website indicates that fishing access to Alder Lake is available within Thurston County but does not specify the location.

In addition to defined public access to the shoreline, informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

4.1.3 Priority Habitats and Critical Areas

Alder Lake is mapped as containing resident cutthroat trout and kokanee. The kokanee population within Alder Lake is supplemented by WDFW stocking. The Alder Dam serves as a barrier to anadromous fish passage.

Alder Lake basin is also mapped as providing habitat for osprey, bald eagle as well as waterfowl concentrations. Elk habitat is mapped adjacent to the basin directly to the south of the Thurston County border.

As noted in the basin characteristics sub-section, the land mass of the basin is split into two portions by Alder Lake. The majority of the eastern portion of the basin is mapped as hazardous slope/slide areas. In the western portion of the basin, hazardous slide areas are only mapped in the northern portion of the basin adjacent to the lake. Both the eastern and western portions of the basin are mapped as containing snag rich areas and mature open forest. In addition to hazardous slope/slide areas and mature open forests, the majority of the eastern basin is also mapped as containing wetland areas.

This basin contains a small number of un-named streams that flow into Alder Lake. These streams are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

4.1.4 Evidence of Processes Disturbed or Potentially Impacted Function

Alder Dam is located in this basin.
Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

4.1.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for Alder Lake basin:

A USGS gauge located at the dam. USGS gauges provide real time data on parameters such as stream flow, reservoir, water-quality, meteorological, and groundwater sites. The website at which this data may be obtained is: http://waterdata.usgs.gov/wa/nwis/rt.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

4.1.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

Tacoma Power Natural Resources Program is implementing a variety of fisheries and wildlife habitat improvements while providing recreational opportunities. Kokanee planting, nesting boxes for wood duck and bluebirds, and improving Elk forage are just a few of the programs in and around Alder Lake and the surrounding 3,500 acres of wildlife land. Information on these restoration efforts was obtained from http://www.ci.tacoma.wa.us/power/parksandpower/hydro_power/nisqually_river_project.htm on May 13, 2008.

Acquisition of three sites, RCO Project Number 67-704, DNR, completed

“This agreement will acquire 50 year leases on three sites known as Green River (20 acres), Alder Lake (35 acres), and Long Lake (47 acres).”

Development of Three Recreation Sites, RCO Project Number 67-705, DNR, completed

“This agreement involves the development of three Natural Resources sites known as Long Lake, Alder Lake, and Lummi Island.”

Alder Lake Expansion, RCO Project Number 82-702, DNR, completed

“This project proposal is for the expansion development of an existing freshwater campground located along the southeast shore of Alder Lake. Expansion of the camping facilities is necessary to prevent deterioration due to extremely heavy seasonal use.”
4.1.7 Reach Data

The following is a summary of reach information for the Alder Lake basin.

<table>
<thead>
<tr>
<th>Water body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nisqually River</td>
<td>NI</td>
<td>1</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alder Lake</td>
<td>LAL</td>
<td>2</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no marine reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

4.2 Bald Hill Lake

4.2.1 Basin Characteristics

Bald Hill Lake basin is located in southeastern Thurston County. It is 794 acres in size. The majority of this basin, 784 acres, is located in WRIA 11; a small portion, 10 acres, of this basin is located in WRIA 13. As the majority of the Bald Hill Lake basin is located in WRIA 11, review
of it is provided in this chapter. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>1.0547</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Bald Hill Lake basin is bordered by Elbow Lake basin to the north, Nisqually basin to the east, the Deschutes River basin to the south, and Clear Lake basin to the south and west.

Water in Bald Hill lake basin generally flows towards Bald Hill Lake.

Primary land use for this basin is divided between designated forest and undeveloped land. The TRPC population forecast indicates that there are no dwelling units identified within this basin and none projected for a period of time extending to 2030.

4.2.2 Public Access

There is no defined public access to Bald Hill Lake. However, mapping indicates that the basin does contain a state-owned public preserve park approximately 346 acres in size. As such, it is likely that public access to Bald Hill Lake may be obtained through the park.

In addition to defined public access to the shoreline, informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

4.2.3 Priority Habitats and Critical Areas

The WDFW fishing guide identifies that Bald Hill Lake contains largemouth bass and perch.

This basin is mapped as providing habitat for wood duck, peregrine falcon, and Whulge checkerspots.

Oak woodlands are mapped in the basin. These woodlands vary and include oak conifer mixed and oak dominant with some points of native and semi-native grassland. However, the majority of these oak woodlands are located outside of the shoreline jurisdiction. Oak woodland is located within the shoreline jurisdiction of the Bald Hill Lake.

Steep rock cliffs and bluffs are also mapped within this basin and may be utilized by area bats.

Hazardous slopes are mapped within the eastern portion of the basin as well as the southern portion of the lake.
This basin has mapped high ground water flood hazard areas associated with the lake.

This basin contains one mapped un-named stream that flows into Bald Hill Lake. This stream is not mapped as meeting shoreline jurisdiction requirements. However, this stream is likely to qualify as critical areas pursuant to TCC 17.15.

4.2.4 Evidence of Processes Disturbed or Potentially Impacted Function

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

4.2.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for Bald Lake basin:

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

4.2.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

Statewide Natural Area Preserves, RCO Project Number 85-706, DNR, completed

“This project is for the acquisition of selected parcels of land for inclusion within the statewide system of Natural Area Preserves. These parcels have been approved for acquisition by the Natural Heritage Advisory Council, and will be acquired as they become available. Funding is authorized by Engrossed Substitute House Bill No. 1157, 1984 Regular Session. These 5 areas of property are Bald Hill Lake, Carlisle Bog, Methow Rapids, Skookum Inlet, and Kings Lake Bog.”

South Sound Prairie and Grassland Bald Restoration, RCO Project Number 08-1535, WDFW proposed

“The Washington WDFD will use this grant to develop and plant seeds of rare plants in the Scatter Creek, Mima Mounds, Bald Hill, Rocky Prairie, and West Rocky Prairie areas. These areas are home to rare plants, animals, and plant communities of concern to both the WDFD and the DNR. The project goal is to develop cooperative actions to restore these rare habitats, including developing genetically appropriate seed sources for use in restoration work. To date, restoration has relied on propagation and transplanting of plugs from seeds collected by hand,
which does not generate enough seed to meet the restoration needs. The two agencies are entering into a partnership to build the seed production capacity to allow for direct seeding in grassland and oak woodland restoration in western Washington. The department will contribute $15,000 in equipment.”

4.2.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Lake</td>
<td>LBA</td>
<td>1</td>
</tr>
<tr>
<td>Marine</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

4.3 Clear Lake

![Map of Clear Lake](image)
4.3.1 Basin Characteristics

Clear Lake basin is located in southeastern Thurston County. Clear Lake basin is 1,850 acres in size. The majority of this basin, 1,111 acres, is located in WRIA 11; a smaller portion of this basin, 739 acres, is located in WRIA 13. As the majority of the Clear Lake basin is located in WRIA 11, review of it is provided in this chapter. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>4.9894</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Clear Lake basin is bordered by the Nisqually basin to the north, Elbow Lake basin to the northeast, Bald Hill Lake basin to the east, and the Deschutes River basin to the south.

This basin contains a portion of Elbow Lake Park, which is primarily located in Elbow Lake basin (see section 4.5).

Water in Clear Lake basin generally flows to Clear Lake.

Primary land use for this basin is divided primarily among rural residential, designated forestland, and undeveloped land. The TRPC population forecast indicates that there were 630 dwelling units identified within this basin as of 2006 and projects an increase to 830 dwelling units by 2030.

4.3.2 Public Access

Public Access to Clear Lake is available via a WDFW boat launch. The boat launch area contains public restroom facilities as well as a limited parking area.

The subdivisions of Clearwood and Single Tree Estates also have boat launches and swimming access to Clear Lake.

In addition to defined public access to the shoreline, informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

4.3.3 Priority Habitats and Critical Areas

Fish priority habitat areas are not mapped within this basin; however, there are two fish barriers associated with the southern side of Clear Lake. In addition, WDFW stocks Clear Lake with rainbow trout and triploid rainbow trout.
Small portions of oak conifer forest and native grasslands are located in the central eastern corner of this basin. However, these areas do not appear to be associated with the shoreline jurisdiction.

Hazardous slopes within the basin are mapped near a pond (also known as Blue Water Lake) associated with Clear Lake as well as the eastern section of the basin.

Extensive wetlands occur that are associated with Clear Lake and Elbow Lake.

This basin contains one mapped un-named stream that connects Clear Lake to an un-named pond in the Nisqually basin. This stream is not mapped as meeting shoreline jurisdiction requirements. However, this stream is likely to qualify as critical area pursuant to TCC 17.15.

### 4.3.4 Evidence of Processes Disturbed or Potentially Impacted Function

Muskrat Dam (also listed as Clearwood Dam 2) is located in this basin. The coordinates for the dam are Latitude 46.8215 and Longitude -122.4696.

Beaver Dam (also listed as Clearwood Dam 1) is located in this basin. The coordinates for the dam are Latitude 46.8198 and Longitude -122.4712.

A barrier study conducted for the years of 1996-2000 by WDFW noted two barriers within the basin. Both barriers were noted on the southern side of Clear Lake. The mapping does not reflect roads associated with these barriers.

Clear Lake basin is primarily zoned for long term forestry. Forest harvest areas are visible in aerial photographs. Loss of forest cover adjacent to the shoreline may impact shoreline process and function.

### 4.3.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Clear Lake basin:

A water quality sample site is located on Clear Lake. This water quality sample site provides 1996 data on trophic state indices and Secchi disk reading. The website at which this data may be obtained is: [http://www.geodata.org/swater/strm.asp?strm=NISCLL](http://www.geodata.org/swater/strm.asp?strm=NISCLL).

**Rate of Urbanization and Forest Harvest in Thurston County 1985-2000**, January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

**The Relationship of Land Cover to Total and Effective Impervious Area**, June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.
4.3.6 **Enhancement or Restoration Activities Implemented:**

The following enhancement or restoration activities have been implemented in this basin:

**Statewide Water Access Stage 1, RCO Project Number 68-603, WDFW completed**

“This project involves the acquisition of approximately 10 miles of perpetual pedestrian streambank easements and 17 sites for boat launching and/or vehicle parking, together with necessary access rights of way in various locations throughout the state.”

**Boating Access Development, RCO Project Numbers 69-71 and 69-611, WDFW completed**

“This project agreement is for the development of boat launching sites, with typical development to consist of an access road with appropriate signs, perimeter fence and gate, graded and graveled parking area, sanitary facilities, launching ramp or ramps, information and regulatory signs, and landscaping.”

### 4.3.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>There are no riverine reaches in this basin.</td>
<td>n/a</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clear Lake</td>
<td>LCL</td>
<td>16</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>There are no marine reaches in this basin.</td>
<td>n/a</td>
</tr>
</tbody>
</table>

| Total Reaches | 16 |

### 4.4 **Deschutes River**

This basin is located primarily in WRIA 13. Please refer to section 5.11 for further information.
4.5 ELBOW LAKE

4.5.1 Basin Characteristics

Elbow Lake basin is located in southwestern Thurston County. The basin is 1,163 acres in size and is located entirely within WRIA 11. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>2.7492</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Elbow Lake basin is bordered by the Nisqually basin to the north and Bald Hill Lake and Clear Lake basins to the south.

Elbow Lake Park is located in this basin. The state-owned park is approximately 340 acres in size and is currently undeveloped.
Water from Elbow Lake basin generally flows towards Elbow Lake and Elbow Lake Creek. Elbow Lake Creek connects to Yelm Ditch and Powell Creek and ultimately the Nisqually River.

Primary land use for this basin is divided mostly between designated forest and undeveloped land. The TRPC’s population forecast indicates that as of 2006 there were 20 dwelling units identified within this basin and projects an increase to 50 dwelling units by 2030.

4.5.2 Public Access

Public access to Elbow Lake may be obtained in Elbow Lake Park from a trail located off Elbow Lake Road.

In addition to defined public access to the shoreline, informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

4.5.3 Priority Habitats and Critical Areas

Mapping resources do not indicate if, or what kinds of fish species are located in Elbow Lake. A review of fishing websites indicates that the lake contains resident cutthroat, largemouth bass and perch. Elbow Lake Creek is mapped as supporting cutthroat.

This basin is mapped as providing habitat for the common loon, bald eagle, osprey, and wood duck.

The basin is mapped as having a low elevation freshwater wetland/pond area in its central portion.

Hazardous slopes are associated with western side of lake. Hazardous slide areas interspersed throughout the basin.

High ground water flood hazard area mapped as associated with the ponds located in the middle of the basin.

Oak habitat is mapped in the southern most portion of the basin.

This basin contains two mapped streams. One stream is identified as Elbow Lake Creek and appears to connect Elbow Lake to the Nisqually River via Yelm Ditch. The other stream is un-named and connects two un-named ponds within the south western portion of the basin. These streams are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

4.5.4 Evidence of Processes Disturbed or Potentially Impacted Function

A barrier study conducted for the years of 1996-2000 by WDFW noted one barrier in this basin located on Elbow Lake creek. The mapping does not reflect a road associated with this barrier.

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.
4.5.5 **Available Resources, Studies, and Spatial Information**

The following research, studies and spatial information are available for Elbow Lake basin:

**Rate of Urbanization and Forest Harvest in Thurston County 1985-2000.** January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

**The Relationship of Land Cover to Total and Effective Impervious Area.** June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

4.5.6 **Enhancement or Restoration Activities Implemented**

The following enhancement or restoration activity has been implemented in this basin:

**Elbow Lake, RCO Project Number 74-515, State Parks, completed**

“This agreement is a joint State/Local project for the acquisition of 320 acres including 79 acres of freshwater surface on Elbow, Bass and Beaver Lakes.”

4.5.7 **Reach Data**

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Lake</td>
<td>LEL</td>
<td>2</td>
</tr>
<tr>
<td>Marine</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Total Reaches</strong></td>
<td></td>
<td><strong>2</strong></td>
</tr>
</tbody>
</table>

4.6 **Lake Lawrence**

This basin is located primarily in WRIA 13. Please refer to section 5.19 for further information.
4.7 **McAllister Creek**

McAllister Creek basin is located in the northeastern portion of Thurston County. It is 19,765 acres in size. The majority of the basin, 18,615 acres, is located in WRIA 11; a small portion, 1,150 acres, is located in WRIA 13. As the majority of the McAllister Creek basin is located in WRIA 11, review of it is provided in this chapter. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>10.7304</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.1182</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>11.8602</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>5.4412</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>5.4412</td>
</tr>
</tbody>
</table>

McAllister Creek basin is bordered by Nisqually Reach basin and the Thurston County border to the north, the Nisqually and Thompson Creek basins to the east, the Deschutes River basin to the south and the Spurgeon Creek and Woodland basins to the west.
The source for McAllister Creek is springs, which are used by the City of Olympia for their public water supply.

Lake St Clair lies within this basin.

The western portion of McAllister Creek basin contains a portion of the City of Lacey as well as a portion of Lacey’s Urban Growth Area. The southern portion of the basin contains portions of Fort Lewis. The eastern portion of the basin contains a part of the Nisqually Indian Reservation. The northern portion of the basin contains approximately half of the Nisqually Wildlife Refuge Federal Park.

Water within the McAllister Creek Basin generally flows towards McAllister Creek, the Nisqually River and ultimately south Puget Sound.

Primary land use for this basin is urban and rural residential, military reservation, agriculture and designated forest. The TRPC’s population forecast indicates that as of 2006 there were 6,340 dwelling units identified within this basin and projects an increase to 9,810 dwelling units by 2030.

### 4.7.2 Public Access

There are three defined access points to the shoreline jurisdiction located within this basin. One is provided at Luhr Beach. This area contains a boat launch, a fishing pier, as well as The Nisqually Reach Nature Center. The nature center serves as an education resource for school children. The other two access points within the basin are public boat launches onto Lake St. Claire. One is a concrete boat launch with an associated parking area as well as handicap access. The second launch is noted to be less established.

In addition to defined public access to the shoreline, informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

### 4.7.3 Priority Habitats and Critical Areas

WDFW stocks Lake St. Clair with brown trout, rainbow trout and triploid rainbow trout.

Portions of McAllister creek are mapped as supporting resident cutthroat trout, sockeye and pink salmon, sea-run cutthroat trout, chum salmon, fall Chinook, coho salmon and winter steelhead. In addition, McAllister Creek is also mapped as providing both spawning and rearing habitat for chum salmon and fall Chinook. Medicine creek is mapped as supporting resident and sea-run cutthroat trout, as well as winter steelhead. Eaton Creek is mapped as supporting resident cutthroat and rainbow trout. Raymond ditch which flows into Eaton Creek is also mapped as having channel catfish. Waterfowl concentrations are mapped along Eaton Creek.

Mapped species within this basin include wood duck, band-tailed pigeon, mountain quail, western bluebird, Mazama pocket gopher, and waterfowl concentrations. Areas of western gray squirrel, bald eagle, osprey, and heron habitats are mapped within the basin.
Many areas of possible hazardous slopes/slides are mapped within this basin including the Nisqually ridge, portions of Fort Lewis, sites located around Lake St. Clair and intermittently through the southern portion of the basin.

The southern tip of this basin is mapped as containing oak-conifer and oak dominant forests as well as native, semi-native and non-native grasslands.

Small patches of high ground water flood hazard areas are mapped throughout the basin. The largest high ground water flood hazard area within the basin is located northeast of the intersection of Nisqually Cut off Road SE, Steilacoom Road SE, and 7th Ave SE. High ground water flood hazard areas are also associated with Raymond ditch within this basin.

Most of the mapped wetlands are within the northern portion of this basin and coincide with the Nisqually Wildlife Refuge. Wetlands are associated with the area between Raymond ditch and Eaton creek as well as Lost Lake.

This basin contains several streams including McAllister Creek, Eaton Creek as well as several unnamed tributaries. Some portions of McAllister Creek contain shoreline jurisdiction and have reaches assigned in section 4.7.7. The remainder of McAllister Creek as well as the associated tributaries are not mapped as a shoreline of the state as they are not currently identified as exceeding a 20 cubic feet per second mean annual flow. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

4.7.4 Evidence of Processes Disturbed or Potentially Impacted Function

McAllister Spring Lake Dam is located in this basin. The Primary Coordinates are: Latitude 47.0282 and Longitude -122.7246.

Medicine Creek Reservoir Dam is located in this basin. The Primary Coordinates are: Latitude 47.0548 and Longitude -122.7262.

Nisqually Trout Farm Dam is located in this basin. The Primary Coordinates are: Latitude 47.0615 and Longitude -122.7296.

I-5 crosses the wetlands associated with the Nisqually Reach and associated flood plains within this basin.

The areas of the basin east of the Nisqually ridge are subject to flooding. Martin Way experienced an embankment slide east of Ridge View Drive during the 1996 flood event.

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

A barrier study conducted for the years of 1996-2000 by WDFW noted a barrier a fish blockage where McAllister Creek intersects with Hartman Creek.

A study of fish passage culverts conducted in 1996 by the WDFW noted one fish barrier within this basin located at the intersection of Eaton Creek and Evergreen Valley Road.
The basin is subject to flooding within, and outside the mapped FEMA 100-year floodplain. The central portion of the basin experienced five areas of flood damage during a 1996 flood event and also experienced flooding during a 1999 flood event. The majority of the basin is mapped within the 100-year flood plain.

Thurston County lists remaining below TMDL’s for fecal coliform and maintaining shellfish habitat as their primary concerns for this basin.

The TRPC study of Rate of Urbanization and Forest Harvest in Thurston County 1985-2000 indicates that urban cover within this basin as of 2000 was 7%.

4.7.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for McAllister Creek basin:

Eaton Creek has a water quality sampling site and rain gauge. Further information regarding information gathered at this site can be obtained at http://www.geodata.org/swater/strm.asp?strm=NISEA0

The McAllister Creek basin is part of the Nisqually Shellfish protection district. The shellfish protection district was established due to a downgrade in 2000 from “conditionally approved” to “restricted” for the Puget Sound waters fed by this basin. As of 2007, the majority of the area adjacent to the McAllister basin was approved. However the Nisqually Reach area still contained some restricted as well as prohibited areas. Further information can be obtained at the following websites: http://www.co.thurston.wa.us/shellfish/ and http://www.doh.wa.gov/ehp/sf/Pubs/gareports/nisqually.pdf

Henderson and Nisqually TMDL Study. February 2003. Debby Sargeant, Mindy Roberts, and Barb Carey, L.G., L.HG. This study summarizes historical data and findings for the basins and describes a TMDL evaluation project design.

McAllister/Eaton Creek Comprehensive Drainage Basin Plan, March 1994. Thurston County Department of Water and Waste Management, Storm and Surface Water Program (TCDWWM) generated this plan to provide residents and government entities with future surface water management plans. The plan provides basin characteristics, problem identification, management approaches as well as plan recommendations.


Nisqually National Wildlife Refuge: Final Comprehensive Conservation Plan and Environmental Impact Statement. 2004 USFWS. This report outlines the community vision and provides evaluation of four alternatives for future management of Nisqually National Wildlife Refuge.

Nisqually Reach Pollution Source Identification Task 5: DNA Typing Analysis Final Report, May 2004. Thurston County Public Health and Social Services department, Environmental Health Division. The purpose of the report was to discern pollutant source types at Nisqually
Reach and along McAllister Creek with the ultimate objective of reducing the amount of fecal coliform bacteria entering the Nisqually Reach from McAllister Creek and nearshore areas.

**Nisqually Sub-Area Land Use Plan and Zoning.** November 1992. Thurston County Planning Department. This plan was designed to inform the Comprehensive Plan and assist planners with future zoning decisions. The plan provides good historical context. Zoning information may have been modified as a result of more recent reviews.

**The Relationship of Land Cover to Total and Effective Impervious Area.** June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

**Rate of Urbanization and Forest Harvest in Thurston County 1985-2000.** January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

**Thurston County Water Resources Annual Monitoring Report 2003-2005 Water Years.** 2007. Thurston County Environmental Health and the Thurston County Storm and Surface Water Program. This report rates creek water quality as “fair”. This rating is due to the failure of both parts of the fecal coliform standard. In addition, the dissolved oxygen standard was violated 7 of 9 times and the temperature standard was violated once. The report also notes that the basin experiences reductions in water quality due to non-point pollution problems from agriculture and on-site sewage disposal systems. In addition, the basins outflow into the Nisqually reach, a location utilized by commercial shellfish businesses.

The report notes that Lake St. Claire shoreline residents have voiced concerns about erosion and property damage caused by boat and jet-ski wakes in the larger, southwest basin.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

### 4.7.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

**Nisqually Delta 66, RCO Project Number 66-601, WDFD, completed**

“The purpose of this agreement was to acquire approximately 300 acres in Thurston County at the mouth of the Nisqually River as the initial acquisition of the Nisqually Delta Waterfowl Range.”

**Nisqually Delta # 2, RCO Project Number 68-601, WDFD, completed**

“This project acquired approximately 170.4 acres on the Nisqually Delta in Thurston County for open space and waterfowl protection.”
Nisqually # 4, D’Miller, RCO Project Number 68-608, WDFD, completed

“This project acquired approximately 1 acre of land to be incorporated into the Nisqually Delta Waterfowl Game Range.”

Nisqually Delta – Luhr, RCO Project Number 70-606, WDFD, completed

“This project agreement is for the acquisition of approximately two acres with 627 feet of frontage on McAllister Creek, together with 450 feet of tidelands, as an access site to the Nisqually Delta.”

Nisqually Delta – Teal Slough, RCO Project Number 70-607, WDFD, completed

“This project agreement is for the acquisition of approximately 20 acres of Tidelands in the Nisqually Delta, bordering other Game Department Ownings.”

Luhr Landing Access, RCO Project Number 74-627, WDFD, completed

“This agreement is for the re-development of boat access facilities for Saltwater and Nisqually Flats to provide boat access for boating, hunting, and fishing in the Lower Puget Sound Area. The project will provide improved parking area, access road, boat launching ramp and sanitary facilities.”

Thomsen Fencing/Riparian Planting, RCO Project Number 01-1424, Thurston County Conservation District, completed

“This project will improve the health of McAllister Creek by installing about 20,000 linear feet of fence along McAllister Creek and some of the larger drainage ditches that flow into McAllister Creek. In addition to fencing, this project will include the planting of native plants in several areas along McAllister Creek that flows through the Thomsen Farm.”

4.7.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>9</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lake St. Clair</td>
<td>LSC</td>
<td>21</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nisqually Reach</td>
<td>MNI</td>
<td>5</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>35</td>
</tr>
</tbody>
</table>
4.8 **NISQUALLY**

4.8.1 **Basin Characteristics**

Nisqually basin is located along the eastern border of the county. It is 31,555 acres in size. The majority of this basin, 30,367 acres, is located in WRIA 11; a small portion, 1,188 acres, is located in WRIA 13. As the majority of the Nisqually basin is located in WRIA 11, review of it is provided in this chapter. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
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<tr>
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<tr>
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<td>SMA Marine</td>
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</tr>
<tr>
<td>SSS Marine</td>
<td>1.6061</td>
</tr>
</tbody>
</table>

The Nisqually basin is flanked on its eastern side by the eastern boundary of the county. On the western side, the Nisqually basin is bordered by McAllister Creek, Thompson Creek, Yelm
Creek, Lake Lawrence, Deschutes River, Elbow Lake, Clear Lake, Bald Hill Lake, and Alder Lake basins.

This basin contains a portion of the Nisqually Wildlife refuge, a federal wildlife park. A small portion of the City of Yelm as well as a portion of the associated urban growth area is located within this basin. The basin also contains portions of the Nisqually Indian Reservation, Snoqualmie Reservation land as well as Fort Lewis. The shoreline jurisdiction for this basin includes the Nisqually River as well as associated streams, wetlands and flood plains.

Water within the Nisqually River basin generally flows to the Nisqually River and south Puget Sound.

Primary land use for this basin is divided among residential use, designated forest and undeveloped land. The TRPC’s population forecast indicates that as of 2006 there were 2,330 dwelling units identified within this basin and projects an increase to 3,690 dwelling units by 2030.

### 4.8.2 Public Access

There is one defined public access location within this basin. That defined access is a boat launch onto the Nisqually River. It is located at the end of 6th Street.

In addition to defined public access to the shoreline, informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

### 4.8.3 Priority Habitats and Critical Areas

Nisqually River is mapped as supporting fall Chinook, chum, coho and pink salmon, summer and winter steelhead, sea-run cutthroat and resident cutthroat trout. The river is also mapped as providing spawning and rearing habitat for fall Chinook, pink, coho, and chum salmon, and winter steelhead.

Lackamas Creek, Toboton Creek, and Yelm Ditch are mapped as supporting coho salmon and resident cutthroat trout. In addition there are four unnamed tributaries to the Nisqually River mapped as supporting resident cutthroat trout.

Alder Lake, which is directly adjacent to this basin, is mapped as containing resident cutthroat trout and kokanee.

The Nisqually basin is also mapped as providing habitat for bald eagle, waterfowl, wood duck, mountain quail, reticulate sculpin, piliated woodpecker, black tailed deer, elk, western bluebird, osprey, and band-tailed pigeon.

Sensitive areas such as urban natural open space, wetlands, riparian zones, and estuarine zones are mapped throughout the basin. Hazardous slopes are mapped within the southern portion of this basin. Non-farmed wetlands and wet pasturelands adjacent to the Nisqually support large
numbers of waterfowl nesting each season. The basin is also adjacent to shellfish habitat areas located to the north.

This basin contains several streams associated with the Nisqually River including Edna Creek, Powell Creek, Yelm Ditch, Toboton Creek, Lackamas Creek, Centralia Canal, as well as several unnamed tributaries. The Nisqually River and portions of the Centralia Canal contain shoreline jurisdiction and have reaches assigned in section 4.8.7 and described in Appendix A. The remainder of creeks and ditches as well as the associated tributaries are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

4.8.4 Evidence of Processes Disturbed or Potentially Impacted Function

Thurston County has identified the following concerns for this basin: TMDL’s for fecal coliform, flooding, and maintaining quality fish and shellfish habitat.

Le Grande Dam, located on the Nisqually River, is within this basin.

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

A barrier study conducted for the years of 1996-2000 by WDFW noted the following barriers: an unnamed stream and 133rd Avenue, 2 barrier culverts on Longmire Road, and 3 barrier culverts on Neat Road.

Flooding of the Nisqually occurred during the 1996 flood event. Five areas of moderate road damage occurred within this basin during the 1996 flood. Longmire Road and Bald Hill road experienced some damage during the 1996 flood event.

4.8.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Nisqually basin:

The Nisqually River has four stick gauges utilized for measuring river and flooding heights.

There are two USGS gauges providing real time data on parameters such as streamflow, reservoir, water-quality, meteorological, and groundwater sites. The website at which this data may be obtained is: http://waterdata.usgs.gov/wa/nwis/rt.

Natural Hazards Mitigation Plan for the Thurston Region, 2003. Andrews et al. The study notes the following on the flooding history of the Nisqually River:

Flooding history of the Nisqually River: The Nisqually River watershed drains the area along the eastern boundary of the county. Much of the land along the Nisqually River, from the Nisqually Delta at Puget Sound to McKenna (on the Pierce County side), is occupied by the Nisqually Indian Reservation and Fort Lewis Military Reservation. Historically, nuisance flooding occurs when the flow rate exceeds about 8,000 cubic feet per second (cfs). Since 1972, the river exceeded this flow rate 12 times. Moderate flooding occurs when the flow rate exceeds 15,000 cfs. Since 1972, this occurred seven
times. Major flooding occurs when the flow rate exceeds about 22,000 cfs. This has been exceeded twice since 1972, in November 1995 and February 1996. The February 1996 flow rate, which exceeded 45,000 cfs, established the flood of record. Creeks within the Nisqually can be affected by localized rainfall events but in general they flood whenever the river is flooding. Also, it can take much less rainfall for creeks to rise to threatening levels without the nearby river flooding.

**Nisqually National Wildlife Refuge: Final Comprehensive Conservation Plan and Environmental Impact Statement.** 2004 USFWS. This report outlines the community vision and provides evaluation of four alternatives for future management of Nisqually National Wildlife Refuge.

**Nisqually River Basin Fecal Coliform Bacteria and Dissolved Oxygen Total Maximum Daily Load Study.** May 2005. Sargeant, D., M. Roberts, and B. Carey. This study provides Department of Ecology results for a TMDL study for fecal coliform bacteria in the Nisqually River, the Nisqually Reach of Puget Sound, Ohop Creek, Red Salmon Creek, and McAllister Creek from March 2002 through September 2003. Results showed that the Nisqually River and most of the Nisqually Reach met fecal coliform water quality standards and showed improving trends. Therefore, no load reductions are recommended; however, continued monitoring is suggested.

**Nisqually Sub-Area Land Use Plan and Zoning.** November 1992. TCPD. This plan was designed to inform the Comprehensive Plan and assist planners with future zoning decisions. The plan provides good historical context. Zoning information may have been modified as a result of more recent reviews.

**Rate of Urbanization and Forest Harvest in Thurston County 1985-2000.** January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

**The Relationship of Land Cover to Total and Effective Impervious Area.** June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

### 4.8.6 Enhancement or Restoration Activities Implemented:

The following enhancement or restoration activities have been implemented in this basin:

**Statewide Water Access (45 Sites), RCO Project Number 66-604, WDFD, completed**

“Complete acquisition of approximately 20 boat launching sites and 16 miles of pedestrian streambank easements, together with access roads and parking areas, on lakes, streams, and salt water areas around the state.”
Nisqually – Handicapped Access Project, RCO Project Number 69-614, WDFD, completed

“This project agreement is for the development of a fishing area on the Nisqually River in Thurston County, designed specifically to accommodate handicapped fishermen.”

Nisqually River – Handicapped Fishing, RCO Project Number 76-610, WDFD, completed

“Partial re-development of a flood damaged (winter 1974) 0.5 acre site on the Nisqually River located 1 mile east of I-5, to serve as a handicapped fishing site. The site was originally constructed in 1969 with IAC assistance, for the same purpose.”

Mosman Shoreline Acquisition, RCO Project Number 00-1053, Nisqually R Land Trust, completed

“The acquisition will permanently protect a 35 acre section of the mainstem Nisqually River in WRIA 11. The property is undeveloped woodland with excellent riparian habitat values. If purchased, the land will remain undeveloped in perpetuity, which will facilitate improvement of natural salmon production in the mainstem Nisqually. This project is part of a larger salmon recovery effort to permanently protect the mainstem Nisqually shoreline and riparian habitat, a distance of approximately 42 river miles. Acquisition of this critical habitat is well underway in the Nisqually basin, with over 60% of the river permanently protected. This project will primarily benefit Chinook salmon and steelhead, both species that depend on the mainstem for spawning and rearing. Project supporters include the Nisqually River Council and the Nisqually Indian Tribe.”

Wilcox Flats – Phase 1, RCO Project Number 00-1087, Nisqually River Land Trust, completed

“This project was successful in providing permanent protection to an important salmon habitat area. The Wilcox Flats is a low-lying flood plain area that is cut by several side channels of the Nisqually River. In the late 1970's the area was subdivided onto 40+ small lots. This project in its original proposal called for the acquisition of 13 parcels totaling 36.5 acres. It was called "phase 1" because we anticipated seeking additional acquisition funds from the SRFB. Ultimately, using cost efficiencies, 19 parcels totaling 51.8 acres were purchased through this grant. Only one property owner, DeGeorge (1.67 acres), refused our offer of appraised value for this property. In addition to the SRFB funded acquisitions, the Nisqually Land Trust has acquired a number of other parcels in the Wilcox Flats area (see map). In total the protected property in the Wilcox Flats area is 129 acres (42 parcels).”

Nisqually Estuary Restoration, RCO Project Number 00-1857, Nisqually Indian Tribe, completed

“This project will restore to the Nisqually Delta and estuary approximately 31 acres of diked pasture, returning it to its original saltmarsh condition. The project will be accomplished by removing perimeter dikes adjacent to Red Salmon Slough, a Nisqually Delta tributary, and allowing the tide to again flow over the saltmarsh. The site of this project is the 410 acre Braget Farm, located on the Pierce County side of the Nisqually Delta and now owned by the Nisqually Indian Tribe. In July 2000 the Tribe completed an inventory and preliminary restoration plan for the farm which identified estuarine restoration opportunities and established a priority for
implementation. This grant application will fund the highest priority identified in that plan. Restoration of estuarine habitat was identified in the Nisqually Chinook Recovery Plan as the highest recovery priority for the Nisqually River. Further, because the Nisqually River estuary provides a high percentage of estuarine habitat in southern Puget Sound, this restoration project is significant for regional salmon recovery.”

Collins/Bartlett Shoreline Acquisition, RCO Project Number 00-1860, Nisqually River Land Trust, completed

“The objective of the Collins/Bartlett shoreline purchase is to permanently protect a section of the mainstem Nisqually River (WRIA 11) by acquiring in fee 20 acres, with approximately 1200 feet of river frontage. These two 10-acre parcels are adjacent to larger 20+ acre Land Trust ownership, and acquiring them will expand this block of permanently protected habitat. The Collins parcel is undeveloped and has excellent habitat values. The Bartlett property is primarily pasture and will be an excellent area for habitat restoration. If purchased, the land will remain undeveloped in perpetuity; this will facilitate improvement of natural salmon production of the mainstem Nisqually. This project is part of a larger salmon recovery priority for the Nisqually River, to permanently protect the mainstem Nisqually shoreline and riparian habitat, a distance of approximately 42 river miles (or 84 shoreline miles). Acquisition of this critical habitat is well underway in the Nisqually basin, with over 65% of these shoreline miles permanently protected. Acquiring the Collins/Bartlett shoreline is an important step in furthering this implementation. This acquisition will primarily benefit Chinook salmon and steelhead, both species that depend on the mainstem for spawning and rearing. The applicant will hold title to the land and provide long-term stewardship and land management. The project is supported by the Nisqually River Council and the Nisqually Indian Tribe.”

Nisqually River Watershed Revegetation, RCO Project Number 00-1862, Pierce Conservation District, completed

“This project will establish or improve riparian buffers along streams in the Nisqually River Watershed by utilizing two existing programs at the Pierce Conservation District. Technicians from the Farm Assistance program will work with landowners to prepare a riparian buffer planting plan. All planting plans are written according to USDA Natural Resources Conservation Service specifications and standards. Stream Team will hire WCC crews for site prep, order materials, and coordinate volunteers to plant the buffer. Trees and shrubs have potential to benefit salmon in many ways. They provide shade to cool waters in the summer and provide root strength to prevent streambank erosion. They contribute leaf litter as a food source, and once grown, fall into the stream providing many benefits to juvenile salmon. Many times, private landowners are interest in improving riparian conditions, but lack the funds and resources to do so. For example, many landowners do not qualify for the Conservation Reserve Enhancement Program that provides eligible landowners with cost-share dollars to establish streamside buffers. This proposal accommodates those landowners who are not eligible to receive financial help from state and federal programs. This grant proposal consists of purchasing plant materials, protective devices to increase survival and time from the Washington Conservation Corps to assist in site preparation.”
Green Crow Shoreline Acquisition, RCO Project Number 01-1291, Nisqually River Land Trust, completed.

“This project will acquire in fee approximately 52 acres, with approximately 2500 feet of river frontage. These two parcels, one 32 acres and one 20 acres, are adjacent to 73 acres of Land Trust ownership, and acquiring them will expand this block of permanently protected habitat. Both parcels are undeveloped and have excellent shoreline habitat values. The larger parcel contains 26 acres of forested upland, including 16 acres of merchantable timber. The 20-acre parcel is in the 100-year flood plain, although it also contains some large timber.”

Nisqually River Shoreline Protection, RCO Project Number 02-1476, Nisqually River Land Trust, completed

“This project is seeking funds to acquire critical shoreline property without identifying in advance each individual parcel. Rather, actual parcels will be evaluated and ranked for acquisition using selection criteria. Each potential acquisition, once identified, will be reviewed and approved by the Nisqually Salmon Recovery Lead Entity, in consultation with the Nisqually Habitat Workgroup, and by the IAC grant officer. The target for the project is a minimum of 100 acres of shoreline property, covering a minimum of two river miles.”

Nisqually/Powell Protection and Restoration, RCO Project Number 04-1637, Nisqually River Land Trust, in progress

“The goal of this project is to permanently protect through a 264-acre acquisition a large section of Nisqually River shoreline and flood plain wetland, and to restore natural flood plain functions and anadromous access to the Powell Creek watershed. The project will result in the protection of nearly 3 miles of Nisqually River shoreline, riparian habitat, and a major flood plain wetland complex at the confluence of the Nisqually and Powell Creek. This is the greatest length of Nisqually River shoreline in private ownership. The confluence wetland complex is the most substantial such complex on the Nisqually. Insuring their permanent protection is a very substantial action. Following acquisition, the restoration part of the project will result in the removal of three Powell Creek culverts and a concrete bridge abutment located on the Nisqually at RM 31.9. Powell Creek drains a forested area in SE Thurston County. The culverts are migration barriers to the existing upstream wetlands that provide critical juvenile rearing habitat. By removing them, connectivity to the single largest off-channel complex in the entire Nisqually River Basin will be restored. The restoration project also will make 3 miles of habitat and provide spawning and rearing habitat accessible for coho, Chinook, steelhead, cutthroat possibly chum. The Powell Creek site was selected for early action restoration as a result of the recently completed Nisqually River Off-Channel Habitat Assessment.”

Miller Shoreline Protection, RCO Project Number 04-1658, Nisqually R Land Trust, completed

“The goal of this project is to permanently protect 3000 feet of shoreline and to build upon an already protected shoreline habitat block. This project proposes to acquire approximately 56 acres along the Nisqually River downstream of McKenna in Thurston County. This acquisition target is adjacent to the already protected Mosman shoreline and would extend the protected shoreline by approximately 3000 feet (just over 1/2 mile). The current owners total acreage is
approximately 60 acres and includes a small home. This property is located in the Whitewater Reach of the Nisqually River. The shoreline habitat of this property parcels is low to moderate bank, with a heavy growth of older mixed species timber. There is an unnamed tributary stream on the southern portion of the property and there also are numerous wetlands on-site. As described more fully in the application, the habitat values of the property are under substantial threat. The entire 60-acre property is currently on the market for $395,000. The owner has proposed to create a small 4-acre m/l lot for the cabin and to sell the remaining acreage to the applicant for $230,000. If creation of the small lot cannot be permitted, the alternative is to purchase the southern portion of the lot (approximately 22 acres) in fee and to impose a strict conservation easement on the remaining property that would provide permanent protection for the shoreline property and habitat values.”

**Elledge-McKenna Creek – R3, RCO Project Number 05-1365, South Puget Sound SEG, completed**

“This project will establish a partnership between the South Puget Sound Salmon Enhancement Group (SPSSEG), the Natural Resource Conservation Service (NRCS), the Family Forest Fish Passage Program (FFFPP), Nisqually Indian Tribe, and a private small forest landowner in order to restore access to critical off-channel habitat for salmonids in McKenna Creek, a tributary to the Nisqually River at RM 20. The goal of this project is to remove an undersized and perched fish-blocking culvert from beneath a forest road and replace the culvert with a larger diameter half-arch culvert. The fish blockage culvert prevents salmonids from traveling more than 120 feet up McKenna Creek. McKenna Creek is approximately two miles long and drains a 12-acre spring fed wetland at its headwaters. The importance of McKenna creek to salmonid recovery is not so much the habitat of the creek itself, but this large upstream open water wetland that has the potential to provide critical over-wintering habitat for juveniles. Historically, the McKenna Reach of the Nisqually River included significant off-channel refuge habitat. However, with human encroachment, much of the off-channel habitat has been negatively altered or disconnected from fish-bearing waters. In the "Nisqually Chinook Recovery Plan" and in the "Multi-species Recovery Strategy for the Nisqually Mainstem", the McKenna Reach is ranked in the "highest priority for restoration" category.”

**Kist Shoreline Acquisition, RCO Project Number 05-1528, Nisqually R Land Trust, completed**

“The Nisqually River Land Trust will use this grant to acquire about 20 acres along the Nisqually River in Thurston County and downstream of Powell Creek. Much of the upland portion of the property is heavily forested, and will be managed for timber harvest. The river is used for spawning and rearing by several species, including chinook salmon and steelhead. This acquisition would make a substantial addition to the block of protected habitat along the Nisqually River.”

**Bald Hill NRCA 2006, RCO Project Number 06-1842, DNR, in progress**

“The DNR will use this grant to buy 1,280 acres for a Bald Hill Natural Resource Conservation Area to be added to the Bald Hill Natural Area Preserve. Bald Hill has the best occurrence in the state of the white oak/sedge-camas woodland association, a globally critically imperiled element. Bald Hill has important occurrences of low elevation freshwater wetland and Douglas-fir-
madrone hairy honeysuckle forest. The population of Taylor's checkerspot butterfly is of global importance. It is one of a few populations that appears to be stable. Rare plants include small-flowered trillium, common bluecup, Nutall's quillwort, and one of two known Washington populations of California sword-fern. This project would improve manageability and long-term viability of the site”.

Nisqually NWR Estuary Restoration, RCO Project Number 07-1901, Ducks Unlimited Inc., in process

“Ducks Unlimited Inc. will use this grant to remove dikes, restoring 700 acres of estuary, in the Nisqually National Wildlife Refuge. By removing the dikes, the natural processes of the estuary will be restored. This is the single, largest estuary restoration project ongoing in the Pacific Northwest, and combined with recent smaller restorations by the Nisqually Tribe, will result in the recreation of an estuary. The Nisqually estuary provides important feeding and rearing habitat for a variety of fish and wildlife, including Chinook salmon and Puget Sound steelhead, both of which are threatened with extinction. This restoration project will contribute to the recovery of one of the most depleted wetland components in south Puget Sound. Restoring 700 acres of estuary would increase salt marsh habitat in south Puget Sound by 46 percent, a substantial increase in the Puget Sound region. Restoration of the Nisqually estuary is identified as the highest priority to recover threatened Nisqually River Chinook in the Puget Sound Salmon Recovery Plan and is expected to double the number of naturally spawning Chinook salmon in the watershed. The Nisqually watershed also provides important habitat for bull trout, which are listed as threatened with extinction under the federal Endangered Species Act. Ducks Unlimited will contribute $422,999.”

### 4.8.7 Reach Data

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<thead>
<tr>
<th>Water Body</th>
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<th>Reaches</th>
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</thead>
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<td>Nisqually Reach</td>
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</table>

Total Reaches 36

### 4.9 Spurgeon Creek

This basin is located primarily in WRIA 13. Please refer to section 5.34 for further information.
4.10 THOMPSON CREEK (NISQUALLY)

4.10.1 Basin Characteristics

Thompson Creek (Nisqually) basin is located in the central portion of the county along the eastern border. It is 10,294 acres in size. The majority of the basin, 9,643 acres, is located in WRIA 11. A small portion of the basin, 651 acres, is located in WRIA 13. As the majority of the Thompson Creek basin is located in WRIA 11, review of it is provided in this chapter. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
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<tr>
<td>SMA Stream</td>
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</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
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</tbody>
</table>

Thompson Creek (Nisqually) basin is bordered by the Nisqually basin to the north, Yelm Creek basin to the northeast extending to the southeast, Deschutes River basin to the southwest and McAllister Creek basin to the west.
This basin contains a portion of the City of Yelm as well as a portion of the associated urban growth area. The northwestern portion of basin contains Fort Lewis property. The basin also contains Cochrane Memorial Park.

Water within the Thompson Creek (Nisqually) basin generally flows towards the Nisqually River.

Primary land use for this basin is divided between residential use and undeveloped land. The Thurston Regional Planning Council’s population forecast indicates that as of 2006 there were 1,220 dwelling units identified within this basin and projects an increase to 7,880 dwelling units by 2030.

4.10.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

4.10.3 Priority Habitats and Critical Areas

The portion of the Nisqually River located within this basin is mapped as supporting and providing spawning habitat fall Chinook, pink, coho and chum salmon, and winter steelhead.

Yelm Creek is mapped as providing rearing and spawning habitat for coho salmon, chum salmon, and fall Chinook.

Thompson Creek is mapped as supporting resident cutthroat trout.

The southern area of basin is mapped as containing habitat for waterfowl concentrations. In addition, western bluebirds and western gray squirrel are mapped within this basin

Oak conifer woodlands are mapped within this basin adjacent to Highway 507.

This basin contains Thompson Creek and portions of the Centralia Canal. Both Thompson Creek and the portions of the Centralia Canal contained within this basin contain shoreline jurisdiction and have reaches assigned in section 4.10.7 and described in Appendix A.

4.10.4 Evidence of Processes Disturbed or Potentially Impacted Function

A barrier study conducted for the years of 1996-2000 by WDFW noted two barriers within the basin. These barriers were noted on Thompson Creek and the other on Yelm Creek. There are no roads mapped associated with these barriers.

Timber and forestland use exists within the reaches of this basin.
4.10.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Thompson Creek basin:

A water quality sample site is located on Yelm Creek.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

4.10.6 Enhancement or Restoration Activities Implemented:

The following enhancement or restoration activities have been implemented in this basin:

Lower Yelm Restoration Project, RCO Project Number 01-1409, South Puget Sound SEG, Project Location: Near the city of Yelm, completed

“This project will add wood to the creek to scour pools, sort and retain gravel, slow bank erosion and provide cover for juvenile salmonids. Additional rearing habitat will be made available by reconstructing a pond/wetland area that was filled with sediment by a debris flow several years ago. An existing fence will be improved to ensure livestock exclusion from the creek. Livestock access has increased erosion, impaired water quality and degraded the riparian vegetation.”

4.10.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
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<tr>
<td>Nisqually River</td>
<td>NI</td>
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<td>Thompson Creek</td>
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<td>Marine</td>
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<tr>
<td>Total Reaches</td>
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</tr>
</tbody>
</table>
4.11 **WOODLAND**

Woodland basin is located primarily in WRIA 13. Please refer to section 5.40 for further information.

4.12 **YELM CREEK**

4.12.1 **Basin Characteristics**

Yelm Creek basin is located in the eastern portion of the county. It is 15,667 acres in size. The majority of the basin, 15,273 acres, is located in WRIA 11; a small portion of the basin, 394 acres, is located in WRIA 13. As the majority of the Yelm Creek basin is located in WRIA 11, review of it is provided in this chapter. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
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<td>SSS Lake</td>
<td>0.0000</td>
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<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>
The Yelm Creek basin is bordered by the Nisqually basin to the east, Lake Lawrence and Deschutes River basins to the south, and Thompson Creek basin to the west.

The basin contains portions of the City of Yelm as well as portions of the associated urban growth area.

Water within Yelm Creek basin generally flows towards the Nisqually River.

Primary land use for this basin is divided among residential use, designated forest, agriculture and undeveloped land. The TRPC’s population forecast indicates that as of 2006 there were 2,870 dwelling units identified within this basin and projects an increase to 5,150 dwelling units by 2030.

4.12.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

4.12.3 Priority Habitats and Critical Areas

The portion of Nisqually River located within this basin is mapped as supporting resident and sea-run cutthroat trout, winter and summer steelhead, chum, coho, pink, and fall Chinook salmon. In addition, this portion of the Nisqually River includes mapped spawning habitat for coho and chum salmon.

Yelm Creek is mapped as supporting chum, fall Chinook, coho salmon, and resident cutthroat.

The basin is mapped as containing habitat for reticulate sculpin and western bluebird. Waterfowl concentrations are mapped in the southern section of the basin.

The northern portion of the basin contains scattered small areas of oak-conifer forest.

High ground water flood hazard areas are located throughout the basin. Wetlands are mapped throughout the majority of western portion of basin.

This basin contains several streams including Yelm Creek, Centralia Canal, as well as several unnamed tributaries. The entire length of Centralia Canal within this basin is considered a shoreline of the state and have reaches assigned in section 4.12.7 and described in Appendix A. Some portions of Yelm Creek contain shoreline jurisdiction and have reaches assigned in section 4.12.7 and described in Appendix A. The remainder of Yelm Creek as well as the associated tributaries are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

4.12.4 Evidence of Processes Disturbed or Potentially Impacted Function

Thurston County records note that low stream flow is a concern for this basin.
Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

The TRPC study of *Rate of Urbanization and Forest Harvest in Thurston County 1985-2000* indicates that urban cover within this basin as of 2000 was 7%.

### 4.12.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Yelm Creek basin:

**Rate of Urbanization and Forest Harvest in Thurston County 1985-2000**, January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

**The Relationship of Land Cover to Total and Effective Impervious Area**, June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

### 4.12.6 Enhancement or Restoration Activities Implemented:

No enhancement or restoration activities have been identified within this basin.

### 4.12.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yelm Creek</td>
<td>YE</td>
<td>12</td>
</tr>
<tr>
<td>Centralia Canal</td>
<td>CE</td>
<td>4</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no lake reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no marine reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Total Reaches</strong></td>
<td></td>
<td><strong>16</strong></td>
</tr>
</tbody>
</table>
The data provided in this chapter are divided into subsections focused on the basins located within the Deschutes Water Resource Inventory Area (WRIA 13). Each subsection begins with an overview of the basin and includes information regarding basin characteristics and water bodies, public access, and priority habitats/critical areas. Additional data follows regarding impacts to ecological function, specific sources of basin information, and restoration/enhancement opportunities. In addition to specific sources cited below, the content of this chapter generally is based on documents, mapping information, and other resources described in Appendix B: Shoreline Inventory. That appendix highlights pertinent WRIAs and basins for each source.

5.1 Alder Lake

This basin is located primarily in WRIA 11. Please refer to section 4.1 for further information.

5.2 Bald Hill Lake

This basin is located primarily in WRIA 11. Please refer to section 4.2 for further information.

5.3 Beaver Creek

This basin is located primarily in WRIA 23. Please refer to section 7.2 for further information.
5.4 **BLACK LAKE**

This basin is located primarily in WRIA 23. Please refer to section 7.3 for further information.

5.5 **BLOOM DITCH**

This basin is located primarily in WRIA 23. Please refer to section 7.6 for further information.

5.6 **CAPITOL LAKE**

Capitol Lake basin is located primarily within the jurisdiction of the Cities of Tumwater and Olympia. The basin does contain two small islands of County jurisdiction. However neither island contains jurisdictional shorelines.

5.7 **CHAMBERS**

5.7.1 **Basin Characteristics**

Chambers basin is located in the central portion of the County. It is 8,416 acres in size and located entirely within WRIA 13. Jurisdictional shoreline information for this basin is summarized below.
### 5. Basin Analysis – WRIA 13 (Deschutes)

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>5.2087</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>7.5877</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

The Chambers basin is bordered by Moxlie Creek basin, Indian Creek basin, and Woodland Creek basin to the north, Woodland Creek basin to the east, Spurgeon Creek basin to the south, and Deschutes River basin to the west.

 Portions of this basin are located within the City of Lacey, Lacey Urban Growth Area, City of Tumwater, City of Olympia, and the Olympia Urban Growth Area.

 Water from this basin generally flows in a northwesterly direction toward the Deschutes River and ultimately into south Puget Sound.

 Primary uses of this basin are both urban and rural residential and undeveloped land. The TRPC population forecast indicates that as of 2006 there were 9,830 dwelling units identified within this basin and projects an increase to 16,390 dwelling units by 2030.

#### 5.7.2 Public Access

 Portions of the Chehalis Western Trail are located in this basin and may provide direct or visual access to the shoreline jurisdiction.

 Public access to Ward Lake may be obtained by a WDFW boat launch that is also located in this basin.

 In addition to defined public access to the shoreline, informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

#### 5.7.3 Priority Habitats and Critical Areas

 Both Chambers Creek and Chambers Ditch are mapped as supporting coho salmon and sea-run cutthroat trout. Rearing and spawning habitat for cutthroat trout and coho salmon is mapped within the western portion of this basin.

 WDFW stocks Ward Lake with kokanee, rainbow trout and triploid rainbow trout.

 Mazama pocket gopher, Olympic mudminnow and wood duck habitat are mapped within this basin.

 An oak-conifer forest area is mapped in the central portion of this basin.
Wetland areas are mapped throughout the basin. Wetland areas are also concentrated along the lake, streams and ditches of this basin.

The 100-year flood plain areas within this basin are associated with Chambers Lake in the northern portion of the basin and Chambers Creek in the southern portion of the basin. High ground water flood hazard areas are mapped throughout the basin. The largest high ground water flood hazard area is associated with Chambers Lake and is located in the northern portion of the basin. Hazardous slope/slide areas are also mapped in this basin; however, these areas are not located near a shoreline jurisdiction.

This basin contains several streams including Chambers Creek, Chambers Ditch as well as several unnamed tributaries. Some portions of Chambers Creek are considered shorelines of the state and have reaches assigned in section 5.7.7 and described in Appendix A. The remainder of Chambers Creek as well as the associated tributaries are not mapped as a shoreline of the state as they are not currently identified as exceeding a 20 cubic feet per second mean annual flow. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

5.7.4 Evidence of Processes Disturbed or Potentially Impacted Function

This basin contains a former toxic clean-up site located adjacent to Ward Lake at the former Briggs Nursery Site. The former nursery contained areas of undeveloped land, greenhouses, chemical storage and mixing areas, two fertilizer sheds, offices and laboratory space. All structures and hard surfaces have been demolished and septic tanks have been removed. The majority of the contamination areas at this site have already been cleaned.

Smith Lake is mapped as having experienced flooding during a 1999 flood event and is also mapped as a high ground water flood hazard area.

Areas of flooding occurred within the southern portion of the basin during the 1999 flood event.

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

The TRPC study of Rate of Urbanization and Forest Harvest in Thurston County 1985-2000 indicates that urban cover within this basin as of 2000 was 17%.

5.7.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Ward Lake basin:

Thurston County has identified flooding and high ground water concerns for this basin.

This basin is mapped as containing two gauges. One is a water quality sample site, and the other is a stream gauge. Further information can be obtained at http://www.geodata.org/swater/strm.asp?strm=DESCH0.

The County has located a water level gauge for Ward Lake. In addition, the County obtains trophic state indices as well as secchi disk readings for the lake. Further information on this data may be obtained at http://www.geodata.org/swater/strm.asp?strm=DESWAL.

Chambers/Ward/Hewitt Comprehensive Drainage Basin Plan, July 1995. Thurston County Storm and Surface Water Program. The plan was generated to respond to concerns over the impacts of urban development on the natural resources of the basin. The plan includes a basin characterization, problem identification and recommendations.

Impervious Surface Reduction Study: Draft Report, November 1994. City of Olympia Public Works Department Water Resources Program. This study was conducted to reduce the per person amount of impervious surfaces in light of growth.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000, January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area, June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Water Resources Monitoring Report 2003-2005 Water Years, 2006. Thurston County Department of Social Services Environmental Health Division and Thurston County Department of Waste Water Management. The report identifies the water quality of Ward Lake as excellent to good. However, the report does note that the lake is on the Ecology 303(d) list of impaired water bodies for PCB contamination in fish. The report identifies the major issues for Ward Lake as follows: rapid development and spills and storm related sewage spills have occurred into Ward Lake in the past.

This report also notes that the Chambers Creek water quality was fair to good. The report identifies that the major issues for this basin are high nitrate concentrations at the mouth of Chambers creek and that increasing levels of development in the basin may impact stream quality.

WRIA 13 Watershed Assessment, 2004. WRIA 13 Watershed Planning Committee. This assessment provides information on WRIA 13 including existing plans, programs, and data, land use, geology and groundwater, surface water, water quality, and water rights.

WRIA 13 Watershed Plan: Revised Draft, October 2004. Thurston County. This plan provides background planning information, recommendations for planning, water quantity and quality information, and habitat data.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.
5.7.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

WRJA 13 Nearshore Restoration Design Pro, RCO Project Number 04-1389, South Puget Sound SEG, in progress

“The WRJA 13 Nearshore Design Project will use the Thurston County Nearshore Assessment, WRJA 13 Culvert Inventory and beach seining data to locate restoration opportunities along the shorelines of WRJA 13. This project will work with landowners living along Thurston County's shorelines to identify potential projects. Projects will focus on restoring nearshore processes including restoring sediment and wood recruitment, estuaries, and other shoreline processes.”

5.7.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name</th>
<th>Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td>Chambers Creek</td>
<td>DE-2</td>
<td>3</td>
</tr>
<tr>
<td>Lake</td>
<td>Hewitt Lake</td>
<td>LHE</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Ward Lake</td>
<td>LWA</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Unknown 1</td>
<td>LUNK1</td>
<td>2</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td></td>
<td>7</td>
</tr>
</tbody>
</table>

5.8 Clear Lake

This basin is located primarily in WRJA 11. Please refer to section 4.3 for further information.
5.9 Dana Passage

5.9.1 Basin Characteristics

Dana Passage basin is located along the northern border of the County at the end of the Boston Harbor peninsula and is directly adjacent to Puget Sound. It is 1,127 acres in size and is located entirely within WRIA 13. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>6.0791</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Dana Passage basin is bordered by East Bay basin as well as Henderson basin to the south and South Puget Sound to the north.

Water within this basin generally flows north into south Puget Sound.
The primary uses of this basin are rural residential and undeveloped land. The TRPC population forecast indicates that as of 2006 there were 280 dwelling units identified within this basin and projects an increase to 420 dwelling units by 2030.

5.9.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

5.9.3 Priority Habitats and Critical Areas

The marine shoreline provides habitat for forage fish species including rock sole, smelt and sand lance. In addition, the marine shoreline is mapped as containing shellfish habitat.

The basin is mapped as containing multiple priority habitat areas including three areas of estuarine zones and lagoons, as well as one urban natural open space with a meadow surrounded by forest. The privately owned meadow is thought to be used by fox, deer, grouse, pigeon and other birds.

The basin is mapped as containing wetland areas. The wetland areas are interspersed throughout the basin but become more extensive towards the eastern edge and southern portion of the basin.

The entire shoreline within this basin located adjacent to Puget Sound is mapped as a landslide hazard area.

This basin contains one mapped un-named stream that flows into Puget Sound. This stream is not mapped as meeting shoreline jurisdiction requirements. However, this stream is likely to qualify as critical areas pursuant to TCC 17.15.

5.9.4 Evidence of Processes Disturbed or Potentially Impacted Function

Marine shorelines within this basin contain bulkheads. The County has also identified that stormwater management and increasing shoreline development are concerns for this area.

5.9.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Dana Passage basin:

Bulkheading in Thurston County: Impacts on Forage Fish Spawning Habitat. 2005. Environmental and Thurston Regional Planning Council. The shorelines in this basin were identified as high priority area for preservation.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002 TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.
The Relationship of Land Cover to Total and Effective Impervious Area, June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

WRIA 13 Watershed Assessment. 2004. WRIA 13 Watershed Planning Committee. This assessment provides information on WRIA 13 including existing plans, programs, and data, land use, geology and groundwater, surface water, water quality, and water rights.

WRIA 13 Watershed Plan: Revised Draft, October 2004. Thurston County. This plan provides background planning information, recommendations for planning, water quantity and quality information, and habitat data.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

5.9.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

WRIA 13 Nearshore Restoration Design Pro, RCO Project Number 04-1389, South Puget Sound SEG, in progress

“The WRIA 13 Nearshore Design Project will use the Thurston County Nearshore Assessment, WRIA 13 Culvert Inventory and beach seining data to locate restoration opportunities along the shorelines of WRIA 13. This project will work with landowners living along Thurston County's shorelines to identify potential projects. Projects will focus on restoring nearshore processes including restoring sediment and wood recruitment, estuaries, and other shoreline processes.”

Little Fish Trap Restoration, RCO Project Number 06-2219, South Puget Sound SEG, in progress

“The South Puget Sound Salmon Enhancement Group will use this grant to restore a small pocket estuary and spit adjacent to a salmon-bearing stream. The original spit was modified in the early 1940s. This project will use on-site material to re-configure the spit shape and tidal channel to increase the size of the estuary by at least 0.6 acre. Chinook and chum salmon rely heavily on estuaries for refuge. When landowners filled in the historical stream and tidal channel, sediment was diverted into the estuary instead of the beach, damaging habitat. The enhancement group will contribute $30,000 from a grant.”

5.9.7 Reach

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lake</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

There are no riverine reaches in this basin.
5.10 Dempsey Creek

This basin is located primarily in WRIA 23. Please refer to section 7.7 for further information.

5.11 Deschutes River

5.11.1 Basin Characteristics

Deschutes River basin is located in the central portion of the County and extends from the rural southeastern portion of the County to the urban central portion of the County. It is 56,286 acres in size. The majority of the basin, 53,741 acres, is located in WRIA 13; smaller portions of this basin are located in WRIA 11 (1,463 acres) and WRIA 23 (1,082 acres). As the majority of the Deschutes River basin is located in WRIA 13, review of it is provided in this chapter. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Marine</th>
<th>n/a</th>
<th>n/a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dana Passage</td>
<td>MBU</td>
<td>5</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

There are no lake reaches in this basin.
The Deschutes River basin is bordered by Moxlie Creek basin, Chambers Creek basin, Spurgeon Creek basin, Tempo Lake basin, McAllister Creek basin, Thompson Creek basin, Yelm Creek basin, Lake Lawrence basin, Nisqually basin, Clear Lake basin, Bald Hill Lake basin and Alder Lake to the east. The Deschutes River basin is bordered by Percival Creek basin, Black Lake basin, Salmon Creek basin, Bloom Ditch basin, Beaver Creek basin, Offut Lake basin, Scatter Creek basin, McIntosh Lake basin, Johnson Creek basin, Reichel Lake basin, and Thompson Creek basin to the west. The Deschutes river basin is bordered by the Capitol Lake basin to the north and reaches the County border to the south. The Deschutes River flows to the north and drains to Puget Sound through Capitol Lake to Budd Inlet.

The upper watershed lies at 3,800 feet with steep slopes of over 70 percent in places. The middle and lower watershed has more gentle topography with slopes between 5-30 percent and an alluvial flood plain. The upper 11 miles of the river has a steep gradient, and the lower 40 miles has a fairly uniform moderate gradient.

Water in this basin generally flows towards the Deschutes River, which lies in the center of the basin. The Deschutes River flows into north into the Puget Sound.

Portions of the Cities of Olympia and Tumwater as well as portions of the associated urban growth areas are located with the northern portion of the basin. The central eastern portion contains the City of Rainier as well as the associated urban growth area. Additionally, the basin also contains the Tumwater Falls hatchery and portions of Fort Lewis.

Primary land use for this basin is divided among rural and urban residential use, agricultural use and designated forest. The majority of the basin is rural. However, the northern tip of this basin contains portions of the City of Tumwater and the Tumwater Urban Growth Area. As such, primary land use also reflects the urban aspects of this basin as the remainder of the basin is utilized for retail, services, transport, utilities, and commercial/industrial applications. The TRPC population forecast indicates that as of 2006 there were 6,540 dwelling units identified within this basin and projects an increase to 12,470 dwelling units by 2030.

### 5.11.2 Public Access

The basin has one mapped launch. It is located on Munn Lake. Public access to the shoreline jurisdiction may also be obtained through multiple county and/or city parks including the following: Deschutes Falls Park, Deschutes River Park, Tumwater valley mini golf, Pioneer Park, Ruth Prairie Park, as well as the Chehalis Western Trail/Vail loop trail.
In addition to defined public access to the shoreline, informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

5.11.3 Priority Habitats and Critical Areas

Anadromous and resident fish habitat within the basin is mapped as follows:

The Deschutes River is mapped as supporting resident and sea-run cutthroat trout, coho and fall Chinook salmon, sea-run and winter steelhead. The river is also mapped as supporting the spawning and rearing of fall Chinook, winter steelhead, and coho salmon.

Chambers Creek is mapped as supporting coho salmon and sea-run cutthroat trout. Spurgeon Creek is mapped as supporting fall Chinook and coho salmon.

An unnamed stream connecting Tempo and Offut lakes is mapped as supporting winter steelhead, coho salmon, and sea-run and resident cutthroat trout.

Silver Creek is mapped as supporting resident and sea-run cutthroat trout, coho salmon, sea-run and winter steelhead.

Johnson Creek is mapped as supporting winter steelhead and sea-run cutthroat trout.

An unnamed stream connected to Lake Lawrence is mapped as supporting resident and sea-run cutthroat, coho salmon, and winter steelhead sea-run.

Hull creek (alternatively identified as Pipeline Creek) is mapped as supporting resident cutthroat, sea-run cutthroat, and coho salmon.

Fall Creek is mapped as supporting for winter steelhead, sea-run cutthroat, and coho salmon.

An un-named stream east of fall creek is mapped as supporting resident cutthroat trout and coho salmon.

Mitchell Creek is mapped as supporting resident and sea-run cutthroat, coho salmon, and winter steelhead.

An un-named stream east of Mitchell creek is mapped as supporting coho salmon.

Thurston Creek is mapped as supporting resident and sea-run cutthroat trout, fall Chinook and coho salmon.

An un-named stream east of Thurston Creek is mapped as supporting fall Chinook and coho salmon.

Spurgeon Creek, Fall Creek, Mitchell Creek, Johnson Creek and Thurston Creek as well as a few unnamed streams adjacent to the Deschutes are mapped as providing spawning and rearing habitat for coho salmon.
Little Deschutes River is mapped as supporting for resident cutthroat trout.

The WDFW stocks Munn Lake with rainbow and triploid rainbow trout.

In addition to priority habitats related to fish species listed above, the Deschutes basin contains the following priority habitats related to bird, mammal, and insect species: Mazama pocket gopher, streaked horned lark, elk, checkerspots whuludge, wood duck, osprey, wild turkey and Oregon vesper sparrow.

The following species are also mapped within this basin: waterfowl concentrations, western blackbirds, western bluebirds, and Oregon lamprey.

Hazardous slopes and slide areas are mapped in the southern portion of this basin.

Wetlands and floodplains are mapped throughout the basin.

This basin contains several streams associated with the Deschutes River including Chambers Creek, Spurgeon Creek, Mitchell Creek, Little Deschutes River as well as several unnamed tributaries. The Deschutes River including Chambers Creek, Spurgeon Creek, Mitchell Creek, and Little Deschutes River are considered shorelines of the states and have reaches assigned in section 5.11.7 and described in Appendix A. The remainder of creeks and ditches as well as the associated tributaries are not mapped as a shorelines of the state as they are not currently identified as exceeding a 20 cubic feet per second mean annual flow. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

5.11.4 Evidence of Processes Disturbed or Potentially Impacted Function

Cougar Mountain Farm Dam is located within this basin. The Primary Coordinates are: Latitude 46.8298 and Longitude -122.5496.

Prince Dam is located within this basin. The Primary Coordinates are: Latitude 46.8298 and Longitude -122.5512.

Tumwater Falls Dam is located within this basin. The Primary Coordinates are: Latitude 47.0148 and Longitude -122.9046.

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

A study of fish passage culverts conducted in 1996 by the WDFW noted three fish barriers within this basin. These barriers were noted at the following intersections: unnamed stream and Tumwater Boulevard, the Deschutes River and Tempo Lake Road near Stedman Road, and an un-named stream near a crossing with Bald Hill Road.

A subsequent study of fish barriers conducted during the years of 1996 to 2000 identified twelve barriers. Barriers due to insufficient flow were identified on the Deschutes River near Bald Hill Road (2 separate instances), on Thurston Creek, on an un-named stream located between Mitchell and Johnson Creek, on Mitchell Creek (3 separate instances), on an un-named stream east of Fall Creek, on Fall Creek, and on Pipeline Creek. Two barriers indentified as “PC” were
noted. One is located on an un-named stream near Bald Hill Road; the other barrier is located on an un-named stream near Wapiti Lane. The metadata for this GIS layer does not identify what a “PC” barrier is.

5.11.5 Research, Studies, and Available Spatial Information

Thurston County has identified flooding and fish habitat concerns for the Deschutes River basin. WDFW conducts wild salmon population monitoring as well as fish rearing along the Deschutes River. Although this monitoring occurs within the City of Tumwater jurisdiction, the information gathered during this review process is applicable to those portions of the Deschutes River within the County jurisdiction. Further information on these efforts can be obtained at the following websites: http://wdfw.wa.gov/fish/wild_salmon_monitor/deschutes_river.htm, http://wdfw.wa.gov/hat/hgmp/pdf/puget_sound/chinook/tumwater_falls_yearling_fall_chinook.pdf, and http://www.deschuteswatershedcenter.org/

There are multiple water quality sample sites located along the Deschutes River. The site at E street has the most recent data (2005). New data has not been inputted for the other sites since 1994. Further information obtained from these sites may be obtained at: http://www.geodata.org/swater/strm.asp?strm=DESDE0.

A water quality sample site is mapped on Ayer (Elwanger) creek. The last collected information listed occurred in 1998. Further data may be obtained at: http://www.geodata.org/swater/summary.asp?site=DESAY0400&yrnbr=.

A water quality sample site is mapped on Spurgeon Creek. The last collected information occurred in 2005. Further data may be obtained at: http://www.geodata.org/swater/strm.asp?strm=DESSP0.

Several stick gauges, used to monitor river height, are located along the Deschutes River. These gauges are located where the river intersects with the following roads: Rich Road, Waldrick Road, Military Road, Vail Cutoff, and Vail Loop.

A USGS gauge is located at the Tumwater Falls dam and where the Deschutes River is crossed by Vail Loop. USGS gauges provide real time data on parameters such as streamflow, reservoir, water-quality, meteorological, and groundwater sites. The website at which this data may be obtained is: http://waterdata.usgs.gov/wa/nwis/rt.


Black Lake/Littlerock/Delphi Sub-area, 1981. TRPC. This report provides recommendations for future residential, commercial, and industrial development. It also provides information of the area’s history, resources, and characteristics.

Impervious Surface Reduction Study: Draft Report, November 1994. City of Olympia Public Works Department Water Resources Program. This study was conducted to reduce the per person amount of impervious surfaces in light of growth.

Natural Hazards Mitigation Plan for the Thurston Region, 2003. Andrews et al. The study notes the following on the flooding history of the Deschutes River:

Flooding history of the Deschutes River: The Deschutes River flows diagonally across the central portion of the county and enters into Budd Inlet via Capitol Lake. Historically, nuisance flooding occurs when the flow rate exceeds about 3,000 cfs. Since 1972, the river has exceeded this flow rate 27 times. Moderate flooding occurs when the flow rate exceeds about 4,000 cfs. Since 1972, this has occurred 14 times. Major flooding occurs when the flow rate exceeds about 6,000 cfs. This has happened six times since 1972, in January 1972, January 1974, January 1990, April 1991, February 1996, and December 1996. The flood of record was in January 1990 when the flow rate reached 9,600 cfs. Creeks within the Deschutes Watershed can be affected by localized rainfall events but in general they flood whenever the river is flooding. Also, it can take much less rainfall for creeks to rise to threatening levels without the nearby river flooding.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000, January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area, June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

WRIA 13 Watershed Assessment, 2004. WRIA 13 Watershed Planning Committee. This assessment provides information on WRIA 13 including existing plans, programs, and data, land use, geology and groundwater, surface water, water quality, and water rights.

WRIA 13 Watershed Plan: Revised Draft, October 2004. Thurston County. This plan provides background planning information, recommendations for planning, water quantity and quality information, and habitat data.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

5.11.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

Munn Lake Redevelopment, RCO Project Number 84-603, Washington State Department of Fish and Wildlife, completed

“The purpose of this agreement is to construct a driveway turnaround area; install asphalt paving of the parking lot, install a speed bump, and paint striping; remove existing boat launch ramp,
regrade, and reinstall at new location; construct 711 lineal feet of six-foot high, slatted, chain-link fence; install one handicapped toilet; and install oil separator. All of these developmental elements will be constructed at Munn Lake, located in Thurston County.”

Deschutes Falls Park, RCO Project Number 92-359, Thurston County Parks and Recreation, completed

“This project acquired a 154-acre site at the headwaters of the Deschutes River in SE Thurston County. Site features lush forests, grassy meadows, two waterfalls that plunge 15 and 35 feet, a 75-foot-deep gorge, and approximately 5,000 feet of frontage on the Deschutes River.”

Lemon Road Riparian Enhancement, RCO Project Number 99-1685, Thurston County Conservation District, completed

“This project is directly adjacent to a Federally funded enhancement project that was completed by the CD in late ‘98. It will include continued fencing of stream for livestock exclusion and revegetation of stream corridor. Other issues may be identified, as a Farm Plan is developed to implement Best Management Practices. This site is up stream of the County proposed Lemon Rd. culvert replacement to open habitat. Completing this adjacent project is a priority for non-point and habitat issues for the CD. Revegetation of riparian corridor includes approximately 2.5 acres. This system is utilized by Coho and Chum. Habitat of this tributary of Woodard Creek is poor. The main limiting factors addressed in the 2496 draft Limiting Factors Analysis shows this system to have sediment and stormwater issues, as well as forest canopy degradation. This project will limit livestock access, reducing sediment and stabilizing banks, and establish riparian vegetation for long term habitat benefit. The draft limiting factors analysis for HB2496 and the independent review provided by the South Puget Sound subregional work group was headed by Thurston County. Project has landowner commitment and construction of fencing will begin as weather permits in early 1999. Planting will occur during the dormant season of 99-00.”

Lemon Road Culvert Replacement, RCO Project Number 99-1682, Thurston County Roads and Transportation, completed

“In 1997, the Washington Department of Fish and Wildlife (WDFW) did the original assessment of this barrier culvert as part of a report entitled Thurston County Barrier Culvert Inventory. Methods included a field assessment of the type of barrier problem and cause; physical attributes of the culvert including water depth inside the culvert, slope and outfall drop as well as information about the Plunge pool and channel. The quality of the habitat was also considered and a Priority Index was assigned for each barrier culvert. The Priority Index for this culvert is 20.94 out of a high of 37 for Thurston County. Culverts with higher priority indexes have already been fixed, are in other jurisdictions (such as Olympia or Tumwater), or are very expensive. The Washington Department of Fish and Wildlife (WDFW) describes this culvert as a total barrier with a perched outfall and an outfall drop of 0.6 feet. The depth of the water within the culvert is inadequate for fish passage. This project involves removing the existing culvert and replacing it with an 8 foot diameter pipe countersunk approximately 1.5 feet. The design work is complete and permits will be submitted in mid-February for a construction target of summer, 1999. Construction will be completed in the fall of 1999 before the fall salmon spawning runs. This project will open up 27 square meters of rearing habitat, and 14,752 square meters of spawning
habitat for chum, coho, steelhead, cutthroat and rainbow. Stream Team volunteers shall perform revegetation within six months of project completion and shall perform monitoring functions for one year after completion of the project.”

**South Puget Sound Prairies and Oak Woodland, RCO Project Number 02-1199, Washington State Department of Fish and Wildlife, in progress**

“Several agencies and organizations in addition to the project sponsor are committed to restoration and conservation of south Puget Sound prairie communities including the the Washington Department of Natural Resources, U.S. Fish and Wildlife Service, The Nature Conservancy (TNC), Fort Lewis, and Thurston County Parks. TNC, with the assistance of several partners, drafted the South Puget Sound Prairies Site Conservation Plan to serve as the basis for future conservation and restoration efforts. This regional plan highlights the proposed project as of the highest priority. This project includes three additions to existing prairie and oak woodland reserves: Tenalquot, where native prairie plant communities are probably in poor condition but the likelihood of successful restoration is high due to favorable soil conditions. Scatter Creek has high quality native prairie (Idaho fescue-white-topped aster grassland) and a riparian strip of mature oak. West Rocky includes approximately 300 acres of mounded prairie, 400 acres of wetlands, and 40 acres of oak woodland. Many species of plants and animals dependent on the prairie and oak woodland communities are found on these sites. The list of rare species includes two federally threatened, three federal candidate, and five species of concern.”

**WRIA 13 Nearshore Restoration Design Pro, RCO Project Number 04-1389, South Puget Sound SEG, in progress**

“The WRIA 13 Nearshore Design Project will use the Thurston County Nearshore Assessment, WRIA 13 Culvert Inventory and beach seining data to locate restoration opportunities along the shorelines of WRIA 13. This project will work with landowners living along Thurston County's shorelines to identify potential projects. Projects will focus on restoring nearshore processes including restoring sediment and wood recruitment, estuaries, and other shoreline processes.”

**Woodard Bay NRCA – Phase 1 (Restoration) 2008, RCO Project Number 08-1402, Washington State Department of Natural Resources, proposed**

“The Washington Department of Natural Resources will use this grant to restore a pasture with two ponds, one as large as 5.6 acres, on newly acquired lands, referred to as the "Rutherford Parcel." Some of the land around the ponds contains dense blackberry thickets, and the surrounding landscape has grown hay. Crews will control invasive species such as Himalayan blackberry and reed canary grass, plant native trees and shrubs in the pond buffers and wetland plants in the wetlands, and install bat boxes. The goal is to replace most of the invasive species around the ponds with native trees and shrubs, and to improve the quality of the wetland habitat. The total area to be restored is about 12 acres. The surrounding hay fields buffer the restoration area from nearby homes, and will be restored later.”

### 5.11.7 Reach Data

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<tr>
<th>Water Body</th>
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<tr>
<td>Shoreline Analysis and Characterization</td>
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5.12 EAST BAY

5.12.1 Basin Characteristics

East Bay basin is located on the eastern side of Budd Inlet. It is 2,777 acres in size and is entirely within WRIA 13. The basin is divided into two sub-basins. The two sub-basins are articulated north to south and are separated by Ellis Creek basin and Mission Creek basin. The southern sub-basin is located within the City of Olympia and is therefore not covered within this report. The northern sub-basin is located within the County and is 2,408 acres in size. It and is referred to as

<table>
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<th>River</th>
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<td>Mitchell Creek</td>
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<td>Little Deschutes River</td>
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</table>
“the basin” for the remainder of this section. Jurisdictional shoreline information for this basin is summarized below.

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<thead>
<tr>
<th>Shoreline Jurisdiction</th>
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</tr>
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<tbody>
<tr>
<td>SMA Stream</td>
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</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.0000</td>
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<tr>
<td>SSS Lake</td>
<td>0.0000</td>
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<tr>
<td>SMA Marine</td>
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<tr>
<td>SSS Marine</td>
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The East Bay basin is bordered by Dana Passage basin to the north, Henderson and Woodard basins to the east, Ellis Creek basin to the south and Budd Inlet to the west.

Water in this basin generally flows east towards south Puget Sound.

Primary land use of this basin is rural residential and undeveloped land. However, agricultural use as well as forestry use is also represented. The TRPC population forecast indicates that as of 2006 there were 1,930 dwelling units identified within this basin and projects an increase to 2,210 dwelling units by 2030.

5.12.2 Public Access

A public boat launch is available at the Boston Harbor Marina. The marina is privately owned but accessible to the public and provides a variety of amenities including: marine views, picnic areas, a retail establishment, boat and kayak rentals, overnight moorage, as well as a fuel dock. Additionally, Burfoot Park provides 1,100 feet of shoreline access to the public as well as views of the state capitol building and Olympic Mountains.

In addition to defined public access to the shoreline, informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

5.12.3 Priority Habitats and Critical Areas

The marine shoreline is mapped as supporting forage fish species of smelt, sand lance and rock sole. Shellfish habitat is mapped within the basin near Boston Harbor.

Mountain quail, purple martin, and sea bird nesting habitat is mapped within this basin.

A high salinity lagoon adjacent to Budd Inlet is mapped near the center of the basin. In addition, several un-named streams are mapped as flowing into this lagoon area. Large wetland areas are mapped throughout the basin.

Hazardous slopes are mapped along the marine shoreline. In addition, known landslide points are mapped along the majority of this shoreline.
This basin contains a small number of un-named streams that flow into Budd Inlet. These streams are not mapped as meeting shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

5.12.4 Evidence of Processes Disturbed or Potentially Impacted Function

This basin is adjacent to Budd Inlet. Ecology is working on reducing the level of contamination within the entire Budd Inlet area. In addition to the area-wide investigation, cleanup work is underway at several other sites in Budd Inlet. Budd Inlet is part of the Governor's Puget Sound Initiative and a high priority area for Ecology.

A barrier study conducted for the years of 1996-2000 by WDFW noted two barriers within the basin. These barriers were noted at the intersection of Adams Creek and Boston Harbor road and the intersection of an un-named stream and 47th Street.

Thurston County notes that maintaining TMDLs for contaminants and improving the poor marine water quality are concerns for this basin.

The TRPC study of Rate of Urbanization and Forest Harvest in Thurston County 1985-2000 indicates that urban cover within this basin as of 2000 was 10%.

5.12.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the East Bay basin:

**Bulkheading in Thurston County: Impacts on Forage Fish Spawning Habitat.** 2005. Herrera Environmental and Thurston Regional Planning Council. This study identifies two areas within this basin as high priority areas for restoration.

**Henderson Inlet Watershed Action Plan.** October 1989. TRPC. A small portion of this basin is included within the area studied for this action plan. The action plan addresses agricultural practices, onsite sewage disposal, storm water, forestry, boating, salmon net pens, and monitoring. For each section, water quality impacts, problem statements, goals, objectives, and action recommendations are presented. Implementation and funding is also addressed.

**Impervious Surface Reduction Study: Draft Report.** November 1994. City of Olympia Public Works Department Water Resources Program. This study identifies ways to reduce the per person amount of impervious surfaces in light of growth.

**Rate of Urbanization and Forest Harvest in Thurston County 1985-2000.** January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

**The Relationship of Land Cover to Total and Effective Impervious Area.** June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.
5. Basin Analysis – WRIA 13 (Deschutes)

WRIA 13 Watershed Assessment. 2004. WRIA 13 Watershed Planning Committee. This assessment provides information on WRIA 13 including existing plans, programs, and data, land use, geology and groundwater, surface water, water quality, and water rights.

WRIA 13 Watershed Plan: Revised Draft. October 2004. Thurston County. This plan provides background planning information, recommendations for planning, water quantity and quality information, and habitat data.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

5.12.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

In 2007, Capitol Land Trust was awarded six grants, totaling $1.79 million and conserving almost 300 acres in Mason and Thurston Counties. One of the grants was utilized for a conservation activity in this basin. The project focused on conservation of estuarine and nearshore habitat at the mouth of Gull Harbor, a 30-acre estuary containing 2.2 miles of forested shorelines in Olympia. Gull Harbor is one of southern Puget Sound’s most intact estuarine environments, providing high quality habitat for coho, steelhead, chum, sea-run cutthroat and Chinook salmon as well as important prey species such as sand lance, surf smelt and Pacific herring. The project will connect the open shoreline environment of Budd Inlet to the sheltered habitat of Gull Harbor, including the entire estuary mouth, bay mouth spit and protected lagoon. The site is threatened by residential development and impacted by livestock grazing in nearshore areas. The current project site is adjacent to about 2 miles of marine shorelines and 150 acres of upland habitat already protected with conservation easements through previous projects.

Quail Cove Acquisition, RCO Project Number 74-057, Thurston County Parks and Recreation, completed

“This project is for the acquisition of 16.82 acres adjacent to the existing Quail Cove park site on Budd Inlet approximately 7 miles north of Olympia. The additional acreage will allow a more complete and multi-use development of the site as a county park. The IAC and BOR helped the county acquire the existing park (Burfoot Property, IAC #67-047A) which has 400 feet of waterfront on Budd Inlet.”

Boston Harbor Boat Launch – Parking, RCO Project Number 81-800, Washington State Department of Fish and Wildlife, completed

“This agreement consists of the acquisition of approximately 1/4 acre of land fronting on Main St. in the community of Boston Harbor in Thurston County for the purpose of constructing a parking area to accommodate about 20 - 25 cars/trailers for users of the adjacent boat launch ramp into Puget Sound.”

Gull Harbor Conservation, RCO Project Number 02-1529, Capitol Land Trust, completed
“Capitol Land Trust will acquire a conservation easement that permanently protects Gull Harbor, a 30-acre estuary, with 2.2 miles of surrounding shoreline vegetation and 64 acres of adjacent upland. Gull Harbor is located on the east side of Budd Inlet, north of Olympia. It is one of southern Puget Sound's most intact estuarine environments, providing high quality habitat suitable for chum, coho, sea-run cutthroat, chinook, and prey species such as sand lance, surf smelt, and Pacific herring. When all project phases have been completed, the entire estuary -- three (3) miles of shoreline and 700 acres of upland-riparian habitat will be protected.”

Adams Creek Fish Passage Project, RCO Project Number 04-1387, South Puget Sound SEG, completed

“Adams Creek originates in wetlands and flows 1.5 miles to its confluence with Gull Harbor, located approximately 5 miles north of downtown Olympia. The Adams Creek Fish Passage Project will remove a fish passage barrier low in the watershed and provide an additional 1 mile of upstream habitat for coho, chum and cutthroat. This project will provide financial and technical assistance to private landowners living on Adams Creek. The project will remove a 2.5' barrier culvert and replace it with a full span rail car bridge. This alternative was chosen as a cost effective method of restoring function to the road crossing and salmon habitat. Landowners will be involved throughout all stages of this project including construction, planting, plant survival monitoring and maintenance. Gull Harbor has been the focus of on going conservation and restoration efforts.”

WRIA 13 Nearshore Restoration Design Pro, RCO Project Number 04-1389, South Puget Sound SEG, in progress

“The WRIA 13 Nearshore Design Project will use the Thurston County Nearshore Assessment, WRIA 13 Culvert Inventory and beach seining data to locate restoration opportunities along the shorelines of WRIA 13. This project will work with landowners living along Thurston County's shorelines to identify potential projects. Projects will focus on restoring nearshore processes including restoring sediment and wood recruitment, estuaries, and other shoreline processes.”

5.12.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
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<tr>
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<td>There are no riverine reaches in this basin.</td>
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</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
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<td>There are no lake reaches in this basin.</td>
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<tr>
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<td>Budd Inlet</td>
<td>MBU</td>
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<tr>
<td>Total Reaches</td>
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</tr>
</tbody>
</table>
5.13 Eld Inlet (East)

5.13.1 Basin Characteristics

The Eld Inlet (East) basin is located in the northern portion of the County. It is 4,247 acres in size and is entirely within WRIA 13. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
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<td>SMA Stream</td>
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<td>SSS Stream</td>
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<td>SMA Lake</td>
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<td>SMA Marine</td>
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<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Eld Inlet basin is bordered by West Bay and Green Cove Creek basins to the east, Percival Creek, McLane Creek and Perry Creek to the south and Eld Inlet to the west.

Water within this basin generally flows towards the west into Eld Inlet.
5. Basin Analysis – WRIA 13 (Deschutes)

This basin is located primarily within the County, but it also contains some portions of the City of Olympia and the Olympia UGA.

Primary land use for this basin is divided among rural residential use, educational use by Evergreen State College, undeveloped land, designated forest, and agricultural use. The TRPC population forecast indicates that as of 2006 there were 6,540 dwelling units identified within this basin and projects an increase to 12,470 dwelling units by 2030.

5.13.2 Public Access

There is no defined shoreline access in this basin. Semi-public access to the shoreline may be available through the Evergreen State College campus. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

5.13.3 Priority Habitats and Critical Areas

Forage fish data indicates that the marine shoreline of this basin provides habitat for rock sole and smelt. In addition, the portion of the basin north of 62nd Street provides shellfish habitat.

Habitat for harbor seal, shorebirds, bald eagle, purple martin, osprey, and great blue heron are mapped within Eld Inlet adjacent to this basin. Two lagoon habitats are mapped along the marine shoreline.

Shorebird concentrations as well as lagoon areas are mapped within the southern portion of this basin in association with Mud Bay. In addition, forage habitat for shorebirds is mapped both north and south of the highway crossing of Mud Bay.

The entire marine shoreline is within the 100-year flood plain. In addition, 100-year flood plain is also located within the basin associated with Mud Bay and the adjacent area.

High ground water flood hazard areas are mapped within the basin west of Buckthorn Road and south of 62nd Street.

Hazardous slopes/slides areas as well as known landslide areas are mapped along the entire marine shoreline.

Wetlands are mapped throughout the basin running parallel to the marine shoreline.

This basin contains a small number of un-named streams that flow into Eld Inlet. These streams are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

5.13.4 Evidence of Processes Disturbed or Potentially Impacted Function

Bulkheads are located along the majority of the marine shoreline of this basin.

Flood damage occurred to Aspinwall Road during the 1996 flood event.
A barrier study conducted for the years of 1996-2000 by WDFW noted four barriers within the basin. These barriers were located on the following locations: unnamed stream and 67th Ave, unnamed stream and 64th Ave, unnamed stream and Houston Drive, and unnamed stream and 17th Avenue.

5.13.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Eld Inlet basin:

Thurston County has identified shoreline development as a concern for this basin.

A water quality sample site is mapped on Simmons Creek. Further information can be obtained at: http://www.geodata.org/swater/strm.asp?strm=ELDS10.

Bulkheading in Thurston County: Impacts on Forage Fish Spawning Habitat. 2005. Herrera Environmental and Thurston Regional Planning Council. This study identified three areas within this basin as high priority areas for restoration.

Eld Inlet Watershed Action Plan. October 1989. TRPC. This document provides a tool to inform management decisions for reducing the pollution affecting Eld inlet. Plan provides a watershed description, information regarding water quality, sources of non-point pollution, and an implementation strategy.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

WRIA 13 Watershed Assessment. 2004. WRIA 13 Watershed Planning Committee. This assessment provides information on WRIA 13 including existing plans, programs, and data, land use, geology and groundwater, surface water, water quality, and water rights.

WRIA 13 Watershed Plan: Revised Draft. October 2004. Thurston County. This plan provides background planning information, recommendations for planning, water quantity and quality information, and habitat data.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

5.13.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:
17th Avenue Culvert Replacement, RCO Project Number 99-1439, Thurston County, completed

“The Washington Department of Fish and Wildlife (WDFW) describes this as a total barrier. The culvert is undersized and perched with an outfall drop-off of 1.7 feet. The existing 24" diameter culvert will be replaced with a 72" diameter culvert. The culvert will be countersunk into the streambed approximately 1.5 feet allowing the stream to establish a natural streambed through the pipe.”

Eld Inlet/ McClane Creek Habitat A and R, RCO, Project Number 01-1235, Capitol Land Trust, completed

“This project will protect in perpetuity (through fee-simple and conservation easement) a highly functional marine nearshore, estuarine, and saltmarsh wetland complex and enhances the riparian zone and upland of an adjacent perennial stream to improve fish access to off-channel rearing habitat. The protected and restored habitat will support all adult and juvenile life history stages for chum, coho, sea-run cutthroat, and steelhead salmon; providing an undisturbed site for resting, protection from predators, salinity transition, and feeding.”

WRIA 13 Nearshore Restoration Design Pro, RCO Project Number 04-1389, South Puget Sound SEG, in progress

“The WRIA 13 Nearshore Design Project will use the Thurston County Nearshore Assessment, WRIA 13 Culvert Inventory and beach seining data to locate restoration opportunities along the shorelines of WRIA 13. This project will work with landowners living along Thurston County's shorelines to identify potential projects. Projects will focus on restoring nearshore processes including restoring sediment and wood recruitment, estuaries, and other shoreline processes.”

Lower Eld Inlet Habitat Conservation, RCO Project Number 07-1774, Capitol Land Trust, in progress

“The Capitol Land Trust will use this grant to buy and conserve 55 acres and 1.25 miles of highly functional estuarine and marine nearshore habitat in lower Eld Inlet in Olympia. Lower Eld Inlet is a shallow, relatively undisturbed, estuarine complex consisting of extensive tidal marshes and mudflats. The project builds upon successful Eld Inlet conservation efforts that have protected more than 4 miles of marine shorelines and 500 acres of coastal wetland, nearshore and surrounding upland areas within the watershed. The property’s rich tidal mudflats, vegetated shorelines and associated uplands provide feeding, resting and salinity-transitioning habitat for multiple salmon species: coho, steelhead and Chinook (both listed under the federal Endangered Species Act), cutthroat and native chum. Not surprisingly, the estuarine habitats are important for Pacific sandlance, Pacific herring and surf smelt, as well as for bald eagles and large populations of shorebirds and waterfowl. The land proposed for acquisition contains no bulkheads, docks or other modifications and is an outstanding example of an intact, natural estuarine and coastal wetland habitat once characteristic of the region. Acquisition will provide the highest level of protection to a highly-functional system. The land trust will contribute $147,620 from a local grant.”
5.13.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
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<tr>
<td></td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>11</td>
</tr>
</tbody>
</table>

5.14 **ELLIS CREEK**

This basin has no mapped shoreline jurisdiction and is therefore not reviewed in this document.

5.15 **GREEN COVE CREEK**
5.15.1 Basin Characteristics

Green Cove Creek basin is located in the central portion of the Cooper Point peninsula. It is 2,636 acres in size and is entirely within WRIA 13. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.1467</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Green Cove Creek basin is bordered by West Bay and Eld Inlet basins to the north, Percival Creek basin to the south and Schneider basin to the east.

The water within this basin generally flows to the north into south Puget Sound.

The majority of this basin is located within the City of Olympia; however, a small portion of the basin is located within the County.

Primary land use for this basin is divided among rural and urban residential use, undeveloped land, and educational use. The TRPC population forecast indicates that as of 2006 there were 1,940 dwelling units identified within this basin and projects an increase to 2,840 dwelling units by 2030.

5.15.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

5.15.3 Priority Habitats and Critical Areas

Streams within the basin are mapped as containing chum salmon, winter steelhead, coho salmon as well as resident and sea-run cutthroat trout. The stream is also mapped as providing spawning habitat for chum salmon and winter steelhead.

This basin is also mapped as providing habitat for mudminnow, wood duck, and great blue heron.

The basin is mapped as containing areas of high ground water flood hazard areas. Additionally, flood zones as well as high ground water areas are associated with Louise Lake.
Hazardous slide/slope areas are mapped along extent of Green Cove Creek basin. Wetlands are mapped in the northeast corner and southwest corner.

The 100-year flood plain as well as wetlands are mapped along the majority of the creek in this basin.

There are significant peat bog wetlands associated with Green Cove Creek.

This basin contains Green Cove Creek. Green Cove Creek is not mapped as meeting the shoreline jurisdiction requirements. However, this stream is likely to qualify as critical areas pursuant to TCC 17.15.

5.15.4 Evidence of Processes Disturbed or Potentially Impacted Function

A barrier study conducted for the years of 1996-2000 by WDFW noted two barriers within the basin. One barrier was located at the intersection of Green Cove Creek and Country Club road; the other was located at the intersection of Green Cove Creek and 36th.

Grass Lake Dam, also known as Wanoname 131 dam, is located in this basin. The Primary Coordinates are: Latitude 47.0559 and Longitude -122.9582.

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

The TRPC study of Rate of Urbanization and Forest Harvest in Thurston County 1985-2000 indicates that urban cover within this basin as of 2000 was 10%.

5.15.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Green Cove Creek basin:

Thurston County has identified flooding to be a concern for this basin.

There is a rain gauge located on Butler Creek.

This basin contains a water quality stream gauge for Green Cove Creek. Further information regarding data obtained at this gauge can be located at http://www.geodata.org/swater/strm.asp?strm=ELDGC0.

Green Cove Creek Comprehensive Drainage Basin Plan, December 1998. Thurston County and City of Olympia. The plan contains policies, regulations, and capital projects generated in an effort to prevent future water quality and stormwater runoff problems, correct known problems, and protect fish habitat within the Green Cover Creek basin. The plan contains a basin characterization including information on hydrology, water quality, fish habitat, problem identification and analysis, an alternatives analysis, as well as a recommended plan and proposal for implementation.
Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Water Resources Monitoring Report 2003-2005 Water Years. 2006. Thurston County Department of Social Services Environmental Health Division and Thurston County Department of Waste Water Management. The Green Cove Creek water quality is rated as good. Major issues were identified as urban development and stormwater runoff.

WRIA 13 Watershed Assessment. 2004. WRIA 13 Watershed Planning Committee. This assessment provides information on WRIA 13 including existing plans, programs, and data, land use, geology and groundwater, surface water, water quality, and water rights.

WRIA 13 Watershed Plan: Revised Draft. October 2004. Thurston County. This plan provides background planning information, recommendations for planning, water quantity and quality information, and habitat data.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

5.15.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

WRIA 13 Nearshore Restoration Design Pro, RCO Project Number 04-1389, South Puget Sound SEG, in progress

“The WRIA 13 Nearshore Design Project will use the Thurston County Nearshore Assessment, WRIA 13 Culvert Inventory and beach seining data to locate restoration opportunities along the shorelines of WRIA 13. This project will work with landowners living along Thurston County's shorelines to identify potential projects. Projects will focus on restoring nearshore processes including restoring sediment and wood recruitment, estuaries, and other shoreline processes.”

Snyder Cove Creek Fish Passage Project, RCO Project Number 07-1742, Wild Fish Conservancy, in progress

“The Wild Fish Conservancy will use this grant to replace a fish-blocking culvert on Snyder Cove Creek, do some minor restoration to the channel and monitor the project. Snyder Cove Creek is a perennial, fish-bearing watershed that flows into the east side of Eld Inlet. The watershed is largely intact, protected within The Evergreen State College forest. It offers excellent spawning and rearing habitat, and supports populations of cutthroat trout, sculpin and lamprey. Sunset Beach Drive crosses the creek at its mouth through an undersized culvert, creating a barrier to the upstream migration of fish, effectively blocking almost 1 mile of fish..."
habitat. The watershed has the potential to support populations of coho, chum, resident and sea-run cutthroat and possibly steelhead. The existing 3-foot diameter culvert will be replaced with a 14-foot-wide and 10-foot-high culvert. The conservancy or the college will monitor the effectiveness of the culvert replacement for three years. The conservancy will contribute $168,333 from a federal grant and cash.”

5.15.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Lake</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Marine</td>
<td>Eld Inlet</td>
<td>MEL</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.16 HENDERSON
5. Basin Analysis – WRIA 13 (Deschutes)

5.16.1 Basin Characteristics

Henderson basin is located in the northern portion of the County. This basin is 7,306 acres in size and is entirely within WRIA 13. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.8284</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.1822</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>20.4419</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Henderson basin is bordered by Nisqually Reach basin to the east, Woodland and Woodard basins to the south, and East Bay and Dana Passage basins to the west.

The land mass of this basin is split down the middle by Henderson Inlet. Water in this basin generally flows into Henderson Inlet.

Primary land use for this basin is divided among residential use, Woodard Bay State Park, undeveloped land, designated forest, and agriculture. The Thurston Regional Planning Council’s population forecast indicates that as of 2006 there were 1,050 dwelling units identified within this basin and projects an increase to 1,460 dwelling units by 2030.

5.16.2 Public Access

View and/or direct public access to the shoreline jurisdiction may be obtained from the Chehalis Western trail. In addition, the Chehalis Western trail terminates at Woodard Bay Park which also provides shoreline access within this basin.

In addition to defined public access to the shoreline, informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

5.16.3 Priority Habitats and Critical Areas

Woodard Creek is mapped as containing habitat for chum and coho salmon, winter steelhead, and sea-run cutthroat trout, with spawning areas for chum salmon. In addition, there is an unnamed stream crossing Johnson point road that is mapped as containing resident cutthroat trout.

The marine shoreline provides habitat for shellfish and forage fish including rock sole and smelt. The marine shoreline also provides habitat for osprey and purple martin.
The south eastern corner of the basin contains wood duck habitat. Woodard Park includes habitat for bat species including Long legged myotis, Yuma myotis, and little brown myotis.

Estuarine zone in south center portion of the basin moderated protected by marine embankments with free connections with the open sea, bluffs, reach substrates marshes, eelgrass beds and associated inter tidal habitats. (also western beach) also associated with western beach estuarine zone is a harbor seal pull out where pupping occurs seasonally.

High ground water flood hazard areas are dispersed throughout the west side of the basin.

Hazardous slide areas are associated with the eastern side of the basin; hazardous slope areas are associated with the western side of the basin. Areas demonstrating landslide/erosion are located along the marine bluffs of this basin.

Wetlands are present throughout the basin. The largest concentration of wetlands occurs within the western portion of the basin.

The 100-year flood plain in this basin is associated with two northernmost streams on the western side of the basin and Puget Sound.

This basin contains several streams including portions of Woodland Creek, Meyer Creek as well as several unnamed tributaries that flow into Henderson Inlet. The portions of Woodland Creek located within this basin are considered shorelines of the state and have reaches assigned in section 5.15.7 and described in Appendix A. The remainder of the streams within this basin are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

**5.16.4 Evidence of Processes Disturbed or Potentially Impacted Function**

A 2001 study of culverts conducted by Thurston County Roads and Transportation identified a blocked culvert located where an un-named stream is crossed by 77th Street.

Bulkheads are located primarily on the eastern side and on north portion of western side of this basin. The southernmost section of the basin contains fewer bulkheaded areas.

Taber Dam is located in this basin. The Primary Coordinates are: Latitude 47.0848 and Longitude -122.8279.

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

**5.16.5 Available Resources, Studies, and Spatial Information**

The following research, studies and spatial information are available for the Henderson basin:

Thurston County has identified TMDLs, fecal coliform and shellfish habitat concerns for this basin.
Henderson Inlet contains a water quality sampling site. This water quality sample site provides 1996 data on trophic state indices and Secchi disk reading. The website at which this data may be obtained is: http://www.geodata.org/swater/strm.asp?strm=NISCLL.

This basin is part if the Henderson Inlet Shellfish Protection District adopted by the Board of County Commissioners in December 2001. Washington State law required the board to form the district after the state Department of Health closed portions of the two watersheds to shellfish harvesting because of unacceptably high levels of fecal coliform bacteria. A revised protection district was adopted on November 21, 2005. The modifications were based upon the recommendations submitted in 2003 by the shellfish protection district stakeholder groups.


Bulkheading in Thurston County: Impacts on Forage Fish Spawning Habitat, 2005. Herrera Environmental and Thurston Regional Planning Council. This study identifies three areas within this basin as high priority areas for restoration.

Henderson Inlet and Nisqually Reach Shellfish Protection Districts Implementation Work Plan, March 1, 2005. Thurston County.

Henderson Inlet Watershed Action Plan, October 1989. Thurston County Planning Department. This basin is identified within the action plan. This action plan addresses agricultural practices, onsite sewage disposal, storm water, forestry, boating, salmon net pens, and monitoring. For each section, water quality impacts, problem statements, goals, objectives, and action recommendations are presented. Implementation and funding is also addressed.

Henderson Inlet Watershed Characterization Report, August 29, 2007, Thurston County GeoData Center, Water and Waste Management. This report provides a watershed characterization as well as a listing of potential restoration opportunities.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000, January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area, June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

WRIA 13 Initial Assessment – Henderson Inlet Watershed: Revised Draft, March 2001. WRIA 13 Watershed Planning Committee. This report provides a general description of the inlet including geology, hydrology, water rights, water use, surface and ground water quality, and fisheries habitat. The report was generated before the major findings and recommendations sections which is to be added later.
WRIA 13 Watershed Assessment, 2004. WRIA 13 Watershed Planning Committee. This assessment provides information on WRIA 13 including existing plans, programs, and data, land use, geology and groundwater, surface water, water quality, and water rights.

WRIA 13 Watershed Plan: Revised Draft, October 2004. Thurston County. This plan provides background planning information, recommendations for planning, water quantity and quality information, and habitat data.


Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

5.16.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

Puget Sound Anglers’ Reefs # 1, RCO Project Number 82-804, WDFW

“This project is for the placement of pre-cast concrete rubble and other materials on the bottom of Puget Sound in eight predetermined locations to provide improved habitat for bottom fish to enhance fishing opportunities.”

WRIA 13 Nearshore Restoration Design Pro, RCO Project Number 04-1389, South Puget Sound SEG, in progress

“The WRIA 13 Nearshore Design Project will use the Thurston County Nearshore Assessment, WRIA 13 Culvert Inventory and beach seining data to locate restoration opportunities along the shorelines of WRIA 13. This project will work with landowners living along Thurston County's shorelines to identify potential projects. Projects will focus on restoring nearshore processes including restoring sediment and wood recruitment, estuaries, and other shoreline processes.”

5.16.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Woodland Creek</td>
<td>WO</td>
<td>2</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shinke Lake</td>
<td>LSH</td>
<td>1</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Henderson</td>
<td>MHE</td>
<td>22</td>
</tr>
<tr>
<td>Budd Inlet</td>
<td>MBU</td>
<td>1</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>26</td>
</tr>
</tbody>
</table>
5.17 INDIAN CREEK

5.17.1 Basin Characteristics

Indian Creek basin is located in the central portion of the county to the east of Budd Inlet. It is 1,500 acres in size and is entirely within WRIA 13. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>4.1800</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Indian Creek basin is bordered by the Mission Creek, Ellis Creek, Woodard basins to the north, Woodard basin to the east, Chambers Creek, and Moxlie basins to the southeast. Indian Creek drains to Budd Inlet.
The basin is located primarily within the City of Olympia; however, portions of it are located within the Urban Growth Area. Additionally there is an “island” of County jurisdiction within this basin.

Water in this basin generally flows into Deschutes River and Budd Inlet.

Primary land use for this basin is divided between residential use and undeveloped land. Primary land use also reflects the urban aspects of this basin as the remainder of the basin is utilized for retail, services, transport, utilities, and commercial/industrial applications. The TRPC population forecast indicates that as of 2006 there were 2,310 dwelling units identified within this basin and projects an increase to 3,040 dwelling units by 2030.

5.17.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

5.17.3 Priority Habitats and Critical Areas

Indian creek is mapped as supporting resident cutthroat trout.

Bigelow Lake, which is a large wetland system, is mapped as providing habitat for wood duck.

A large wetland complex is mapped in the northern portion of the basin.

This basin contains Indian Creek that connects Bigelow Lake, within the Indian Creek basin, to Moxlie Creek, within the Moxlie Creek basin. This stream is not mapped as meeting the shoreline jurisdiction requirements. However, this stream is likely to qualify as critical area pursuant to TCC 17.15.

5.17.4 Evidence of Processes Disturbed or Potentially Impacted Function

A barrier study conducted for the years of 1996-2000 by WDFW noted one fish barrier within this basin located at the intersection of Fredrick Road and Indian Creek.

A WRIA 13 culvert study conducted by the South Puget Sound Salmon Enhancement Group from the 1990’s to 2004 identified seven culverts associated with Indian creek and 15 crossing that present a blockage to fish passage due to slope, outfall, and/or velocity.

Flood damage occurred at the intersection of Indian Creek and 12th Avenue NE during the 1996 flood event.

The TRPC study of Rate of Urbanization and Forest Harvest in Thurston County 1985-2000 indicates that urban cover within this basin as of 2000 was 29%.

5.17.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Indian Creek basin:
Indian Creek contains a water quality sample site and a rain gauge.

Henderson Inlet Watershed Action Plan, October 1989. TRPC. A small part of this basin is included in this action plan. The plan addresses agricultural practices, onsite sewage disposal, storm water, forestry, boating, salmon net pens, and monitoring. For each section, water quality impacts, problem statements, goals, objectives, and action recommendations are presented. Implementation and funding is also addressed.

Indian Moxlie Creek Comprehensive Drainage Basin Plan, May 1993. City of Olympia. The city of Olympia generated this plan to address concerns over the impact of urbanization on surface waters within the basin. The plan provides a basin characterization, basin problem analysis as well as management proposals.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000, January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area, June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Salmon Habitat Protection and Restoration Plan for the Water Resource Inventory Area 13, Deschutes. July 2004. Thurston Conservation District. This document provides information about this basin as well as priority habitat restoration projects.

Water Resources Monitoring Report 2003-2005 Water Years, 2006. Thurston County Department of Social Services Environmental Health Division and Thurston County Department of Waste Water Management. This report identifies water quality for Indian Creek as poor. The report cites the rating due to fecal coliform concentrations as being consistently high and resulting in failure of both parts of the standard as well as elevated metals and organics detected in creek sediments in past studies as the reasoning behind the poor rating. The report also identifies the major water quality issues for this creek stemmed from fecal coliform bacteria contamination as well as storm water runoff from local roadways and Interstate Highway 5 contributes.

WRIA 13 Watershed Assessment, 2004. WRIA 13 Watershed Planning Committee. This assessment provides information on WRIA 13 including existing plans, programs, and data, land use, geology and groundwater, surface water, water quality, and water rights.

WRIA 13 Watershed Plan: Revised Draft, October 2004. Thurston County. This plan provides background planning information, recommendations for planning, water quantity and quality information, and habitat data.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.
5.17.6 Enhancement or Restoration Activities Implemented

No enhancement or restoration activities have been identified within this basin on the RCO/SRF grant site.

Several enhancement and restoration activities have been conducted within the City of Olympia jurisdiction by the City of Olympia.

5.17.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>There are no riverine reaches in this basin.</td>
<td>n/a</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bigelow Lake</td>
<td>LBI</td>
<td>2</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>There are no marine reaches in this basin.</td>
<td>n/a</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.18 JOHNSON CREEK

This basin is located primarily in WRIA 23. Please refer to section 7.13 for further information.
5.19 Lake Lawrence

5.19.1 Basin Characteristics

Lake Lawrence basin is located in the southeast portion of the county. The basin is approximately 1,688 acres in size. The majority of the basin, 1,594 acres, is located in WRIA 13; a small portion of the basin, 94 acres, is located in WRIA 11. As the majority of the basin is located in WRIA 13, review of it is provided in this chapter. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>5.7368</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Lake Lawrence basin is bordered by Yelm Creek basin to the north, the Nisqually basin to the east, and the Deschutes River basin to the south and the west.

Lawrence Lake Park is located within this basin on the southern edge of the lake.
5. Basin Analysis – WRIA 13 (Deschutes)

Water within this basin generally flows to the south towards the Deschutes River.

Primary land use for this basin is divided among residential use, undeveloped land, and agriculture. The TRPC population forecast indicates that as of 2006 there were 510 dwelling units identified within this basin and projects an increase to 620 dwelling units by 2030.

5.19.2 Public Access

This basin contains a WDFW boat launch access to Lake Lawrence.

In addition to defined public access to the shoreline, informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

5.19.3 Priority Habitats and Critical Areas

The stream that flows into Lake Lawrence is mapped as supporting winter steelhead, coho salmon, sea-run cutthroat resident cutthroat trout.

WDFW stocks Lake Lawrence with rainbow and triploid rainbow trout.

Blue heron and bald eagle habitat are located within this basin. In addition, waterfowl concentrations are associated with Lake Lawrence.

The 100-year flood plain is associated with Lake Lawrence.

High ground water flood hazard areas are associated with southern edge of the lake.

Wetlands are mapped along the southern and western edges of the lake.

Lake Lawrence has an un-named stream connecting it to the Deschutes River. This connection is considered a shoreline of the state. Review of this area is incorporated into the reach review for Lawrence Lake as well as the Deschutes River. Reaches associated with Lawrence Lake are assigned in section 5.18.7 and described in Appendix A. Reaches associated with the Deschutes River are assigned in section 5.11.7 and described in Appendix A.

5.19.4 Evidence of Processes Disturbed or Potentially Impacted Function

The Lake Lawrence outflow acts as a lake level control structure. Thurston County mapping data associated with this control structure notes that it needs to be cleared of debris. It is also listed as a fish passage barrier due to insufficient flow and screening.

Lake Lawrence Dam is located in this basin. The primary coordinates are: Latitude 46.8482 and Longitude -122.5829.

5.19.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Lawrence Lake basin:
This basin has two water quality gauges, one level gauge within the northern portion of the basin and a rain gauge within the southern portion of the basin.

**Rate of Urbanization and Forest Harvest in Thurston County 1985-2000.** January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

**The Relationship of Land Cover to Total and Effective Impervious Area.** June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

**WRIA 13 Watershed Assessment.** 2004. WRIA 13 Watershed Planning Committee. This assessment provides information on WRIA 13 including existing plans, programs, and data, land use, geology and groundwater, surface water, water quality, and water rights.

**WRIA 13 Watershed Plan: Revised Draft.** October 2004. Thurston County. This plan provides background planning information, recommendations for planning, water quantity and quality information, and habitat data.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

### 5.19.6 Enhancement or Restoration Activities Implemented

No enhancement or restoration activities have been identified within this basin.

### 5.19.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>River</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no riverine reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Lake</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lake Lawrence</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td><strong>Marine</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no marine reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Total Reaches</strong></td>
<td></td>
<td>8</td>
</tr>
</tbody>
</table>

### 5.20 McAllister Creek

This basin is located primarily in WRIA 11. Please refer to section 4.7 for further information.
5.21 McIntosh Lake

5.21.1 Basin Characteristics

McIntosh Lake basin is located in the southern central portion of the county. This basin is 1,486 acres in size. The majority of the basin, 1,426 acres, is located in WRIA 13. A small portion of the basin, 60 acres, is located in WRIA 23. As the majority of McIntosh Lake basin is located in WRIA 13, review of it is provided in this chapter. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>3.4384</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

McIntosh Lake basin is bordered by the Deschutes River basin to the north and east, the Johnson Creek basin to the southeast and Scatter Creek basin to the west.
Water in this basin generally flows to the north towards the Deschutes River.

Primary land use for this basin is divided among residential use and designated forest. The TRPC population forecast indicates that as of 2006 there were 100 dwelling units identified within this basin and projects an increase to 130 dwelling units by 2030.

5.21.2 Public Access

Public access to McIntosh Lake is available via a state boat launch with public restrooms. In addition there is a County trail adjacent to McIntosh Lake that may provide additional direct or view access to the shoreline.

In addition to defined public access to the shoreline, informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

5.21.3 Priority Habitats and Critical Areas

WDFW stocks McIntosh Lake with rainbow and triploid rainbow trout.

Wood duck habitat is associated with the lake.

High ground water flood hazard areas and wetlands are mapped along the northern end of lake. The entire lake is identified as a 100-year flood plain and the lake level can fluctuate dramatically depending on season and inflow.

Hazardous slide/slope areas are associated with south western edge of lake.

5.21.4 Evidence of Processes Disturbed or Potentially Impacted Function

A barrier study conducted for the years of 1996-2000 by WDFW noted one barrier in this basin located at the intersection of an unnamed stream and 153rd Ave SE.

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

5.21.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for this basin:

Thurston County has identified lake water quality is a concern for this basin.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.
WRIA 13 Watershed Assessment. 2004. WRIA 13 Watershed Planning Committee. This assessment provides information on WRIA 13 including existing plans, programs, and data, land use, geology and groundwater, surface water, water quality, and water rights.

WRIA 13 Watershed Plan: Revised Draft. October 2004. Thurston County. This plan provides background planning information, recommendations for planning, water quantity and quality information, and habitat data.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

5.21.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

McIntosh Lake, RCO Project Number 75-642, Washington State Department of Fish and Wildlife, completed

“This project involves the redevelopment of an existing boat launch facility on McIntosh Lake, located 4 miles east of Tenino in Thurston County.”

5.21.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Lake</td>
<td>LMC</td>
<td>5</td>
</tr>
<tr>
<td>McIntosh Lake</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Marine</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>
5.22 McLane Creek

5.22.1 Basin Characteristics

McLane Creek basin is located in the western portion of the County. It is 7,306 acres in size. The majority of the basin, 7,074 acres, is located in WRIA 13. Smaller portions of the basin are located in WRIA 14 (108 acres) and in WRIA 23 (124 acres). As the majority of McLane Creek basin is located in WRIA 13, review of it is provided in this chapter. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>2.5767</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.1258</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

McLane Creek basin is bordered by Perry Creek and Eld Inlet basins to the north, Percival Creek and Black Lake basins to the east, Dempsey Creek basin to the south, and Waddell Creek basin to the west.
Capitol forest extends into the center of the basin from the east. McLane nature trail, located off Delphi road, is also located in this basin.

Water in this basin generally flows to the north towards Eld Inlet.

Primary land use for this basin is divided among residential use, undeveloped land, and designated forest. The TRPC population forecast indicates that as of 2006 there were 470 dwelling units identified within this basin and projects an increase to 750 dwelling units by 2030.

5.22.2 Public Access

There is no defined shoreline access in this basin. However, access to the shoreline jurisdiction is available within the McLane Nature Trail Park. In addition, informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

5.22.3 Priority Habitats and Critical Areas

McLane Creek and its fish bearing tributaries are mapped as supporting chum salmon, sea-run and resident cutthroat trout, and coho salmon. In addition, McLane Creek is mapped as supporting the spawning of chum salmon.

Wood duck and pileated woodpecker habitat are mapped within this basin.

Small high ground water flood hazard areas and wetlands are mapped adjacent to McLane Creek.

Hazardous slide/slope areas are mapped throughout the basin.

This basin contains several streams including McLane Creek, Swift Creek and Beatty Creek as well as several unnamed tributaries. Some portions of McLane Creek are considered shorelines of the state and have reaches assigned in section 5.21.7 and are described in Appendix A. The remainder of McLane Creek as well as the other creeks within the basin and associated tributaries are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

5.22.4 Evidence of Processes Disturbed or Potentially Impacted Function

A study of fish passage culverts conducted in 1996 by the WDFW noted four fish barrier within this basin. These barriers were noted at the following intersections: Swift Creek and Cedar Flats Road (2 barriers), an unnamed stream and Cedar Flats Road, and Swift Creek and Munson Drive.

A barrier study conducted for the years of 1996-2000 by WDFW noted two barriers within the basin. These barriers were noted at the following locations: Swift Creek and a private driveway and on an unnamed stream with no associated road.

A WRIA 13 culvert study conducted by the South Puget Sound Salmon Enhancement Group from the 1990’s to 2004 identified the following blockages within this basin: a culvert located at the headwaters of Beatty Creek, on Chelsie Lane, and Cedar Flats Road.
Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

5.22.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the McLane Creek basin:

This basin has a mapped water quality sample site located near the intersection of McLane Creek and Delphi Road. This site is listed as providing both a water quality gauge and stream gauge.

Thurston County has identified stream water quality as a concern for this basin.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC.
This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Water Resources Monitoring Report 2003-2005 Water Years. 2006. Thurston County Department of Social Services Environmental Health Division and Thurston County Department of Waste Water Management. The report identified water quality for McLane Creek as good. This rating is based on that the creek often fails Part II of the fecal coliform standard. The report identifies that major issues for the creek are agricultural nonpoint sources and Logging practices.


WRIA 13 Watershed Assessment. 2004. WRIA 13 Watershed Planning Committee. This assessment provides information on WRIA 13 including existing plans, programs, and data, land use, geology and groundwater, surface water, water quality, and water rights.

WRIA 13 Watershed Plan: Revised Draft. October 2004. Thurston County. This plan provides background planning information, recommendations for planning, water quantity and quality information, and habitat data.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

5.22.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

McLane Creek Expansion, RCO Project Number 85-707, Washington State Department of Natural Resources, completed

“This project proposal is for the development of a parking area, interpretive display, and approximately 3/4 mile of interpretive trail, as an addition to the existing McLane Creek Interpretive Area located along the northeast edge of the Capitol State Forest.”
McLane Creek Peters Restoration Project, RCO Project Number 00-1888, Thurston County Conservation District, completed

“The objectives of this project are build a livestock crossing, erect fences for livestock exclusion, plant riparian vegetation and provide large woody debris (LWD) integration to improve salmon habitat. This project will improve approximately 0.45 miles of degraded salmon habitat that is utilized by coho, chum, resident and coastal cutthroat, and steelhead. The restoration project will take place on McLane Creek located within 14.24 acres of property owned by Doug and Suzanne Peters. Currently, horses and llamas have direct access to the creek. Implementation of a livestock crossing will prevent livestock access while allowing utilization of all pasture. Fencing with a minimum 50' buffer will protect surface waters and vegetation. The participating members of the project are the Thurston Conservation District and the property owners. The restoration project will take place in 2001. However, the re-vegetation efforts will be monitored thereafter to assure sustainability.”

Beatty Creek Barrier Removal, RCO Project Number 01-1236, Thurston County Conservation District, completed

“This project will remove one spillway and two culverts, excavate accumulated sediments, and install an 80 foot long by 14 foot wide steel fabricated bridge. The pond and stream will be excavated to allow habitat restoration. Stream-bed controls will be installed at a 5% slope from the downstream channel, through the pond and 100 feet upstream of the pond. Total length of channel restoration is 300 feet. The removal of these obstacles would make approximately 1.33 miles of stream available to coho, steelhead, and cutthroat.”

Perkins Creek Fish Passage 02, RCO Project Number 02-1483, South Puget Sound SEG, completed

“Perkins Creek is located in the McLane Watershed near the west boundary of WRIA 13. Perkins Creek is a multiple salmonid stream system, offering spawning and rearing habitat to chum, coho, winter steelhead and cutthroat trout. The project will remove an anadromous fish barrier culvert and replace it with a larger structure that will allow unimpeded salmonid migration at all life stages. This project will open .75 miles of critical tributary spawning habitat in the McLane Creek basin.”

McLane Creek Nature Trail, RCO Project Number 06-1769, Department of Natural Resources, in progress

“The Department of Natural Resources will use this grant to renovate the McLane Creek Nature Trail in rural Thurston County to preserve public safety and protect natural resources. Work will include replacing an aging log bridge, building an educational viewing platform to minimize damage to sensitive streamside plants and soil, redeveloping the entry by adding a covered structure for group gatherings and an information board, developing a new trail, and replacing the restrooms. The facility is near capacity during the summer and fall and is in great need of renovation. The McLane Creek Nature Trail is on the eastern edge of Capitol State Forest. The site provides a unique combination of family friendly hiking trails, and easy access to views of freshwater wetland beaver ponds, salmon and bird habitat, and a low elevation forest.”
5.22.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>McLane Creek</td>
<td>MCL</td>
<td>4</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no lake reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eld Inlet</td>
<td>MEL</td>
<td>1</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

5.23 MISSION CREEK

This basin is located within the jurisdiction of the City of Olympia. The basin does contain a small portion of the Olympia Urban Growth area, within the county’s jurisdiction. However, this area does not contain jurisdictional shorelines.

5.24 MOXLIE CREEK

This basin is located within the City of Olympia Jurisdiction.

5.25 NISQUALLY

This basin is located primarily in WRIA 11. Please refer to section 4.8 for further information.
5.26 NISQUALLY REACH

5.26.1 Basin Characteristics

Nisqually Reach basin is located in the northeast corner of the County. It is approximately 4,645 acres in size and is located entirely within WRIA 13. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>10.7152</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>4.1157</td>
</tr>
</tbody>
</table>

Nisqually Reach basin is bordered by Nisqually Reach to the northeast, McAllister Creek and Woodland basins to the south and Henderson basin to the west.

A portion of the City of Lacey is located in the southern section of the basin. In addition, this basin includes small portions of the Nisqually shellfish district.
Tolmie State Park is also located within this basin. Tolmie State Park is a 105-acre marine shoreline park. This park has 1,800 feet of saltwater shoreline on Puget Sound.

Water in this basin generally flows north towards Nisqually Reach.

Primary land use for this basin is divided among residential use and undeveloped land. The TRPC population forecast indicates that as of 2006 there were 1,630 dwelling units identified within this basin and projects an increase to 3,840 dwelling units by 2030.

5.26.2 Public Access

This basin contains two private boat launch sites: Zittell’s Marina and Puget Marina. Public access to the shoreline may be obtained at Tolmie State Park within this basin.

In addition to defined public access to the shoreline, informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

5.26.3 Priority Habitats and Critical Areas

The marine shoreline provides habitat for shellfish and forage fish including smelt, sand lance, rock sole, and herring. The marine shoreline also provides habitat for bald eagle, blue heron and waterfowl concentrations.

Hazardous slopes are mapped along the marine shoreline within this basin.

Wetlands are mapped in vertical bands oriented in a north/south direction within the northern section of the basin.

This basin contains a small number of un-named streams that flow into the Puget Sound. These streams are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

5.26.4 Evidence of Processes Disturbed or Potentially Impacted Function

A WRIA 13 culvert study conducted by the South Puget Sound Salmon Enhancement Group from the 1990’s to 2004 identified an outfall barrier located at the intersection of an unnamed stream and 76th Avenue.

Review of 2006 Aerials indicated bulkheads are scattered within the northern and southern ends of the basin and are concentrated throughout the majority of the central portion of the basin.

5.26.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Nisqually Reach basin:

Thurston County has identified TMDLs, fecal coliform and shellfish habitat as concerns for this basin.
This basin is part of the Nisqually Reach Inlet Shellfish Protection District adopted by the Board of County Commissioners in December 2001. Washington State law required the board to form the district after the state Department of Health closed portions of the two watersheds to shellfish harvesting because of unacceptably high levels of fecal coliform bacteria.

Bulkheading in Thurston County: Impacts on Forage Fish Spawning Habitat, 2005. Herrera Environmental and Thurston Regional Planning Council. This study identifies one area within this basin as high priority area for restoration.

Impervious Surface Reduction Study: Draft Report, November 1994. City of Olympia Public Works Department Water Resources Program. This study identifies ways to reduce the per person amount of impervious surfaces in light of growth.

Nisqually Reach Pollution Source Identification Task 5: DNA Typing Analysis Final Report, May 2004. Thurston County Public Health and Social Services Department; Environmental Health Division. This report identifies that the Nisqually Reach shellfish areas have been downgraded due to increasing levels of fecal coliform bacteria in the water and seeks to clarify the pollution source.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000, January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area, June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

WRIA 13 Watershed Assessment, 2004. WRIA 13 Watershed Planning Committee. This assessment provides information on WRIA 13 including existing plans, programs, and data, land use, geology and groundwater, surface water, water quality, and water rights.

WRIA 13 Watershed Plan: Revised Draft, October 2004. Thurston County. This plan provides background planning information, recommendations for planning, water quantity and quality information, and habitat data.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

5.26.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

Tolmie State Park, RCO Project Number 71-503, State Parks, completed

“Funding provided for the initial development of Tolmie Beach State Park (formerly Jones Beach State Park), located in Thurston County on the shores of Puget Sound.”
Beachcrest Estuary Improvement Project, RCO Project Number 08-2051, South Puget Sound SEG, in progress

“The South Puget Sound Salmon Enhancement Group will use this grant to create more diverse habitat at Beachcrest estuary, a small, impounded pocket estuary along the Nisqually River. Crews will install a culvert to enhance fish passage and create a channel to connect the saltwater to freshwater fringe habitat. Crews also will remove a rock bulkhead and replace it with a more ecologically friendly structure that mixes some rock with large woody materials and salt-tolerant plants. Restoring and improving pocket estuaries can increase the survival of Chinook salmon in Puget Sound. The enhancement group will contribute $32,187 from a grant.”

5.26.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Lake</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Marine</td>
<td>MNI</td>
<td>20</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>20</td>
</tr>
</tbody>
</table>
5.27 **Offut Lake**

Offut Lake basin is located near the center of the County. It is approximately 1,532 acres in size. The majority of the basin, 1,430 acres, is located in WRIA 13. A small portion of the basin, 102 acres, is located in WRIA 23. As the majority of Offut Lake basin is located in WRIA 13, review of it is provided in this chapter. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>3.0314</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Offut Lake basin is bordered by the Deschutes River basin to the north and east, the Scatter Creek basin to the south and the Beaver Creek basin to the west.
Water in this basin generally flows to the east towards the Deschutes River.

The current primary uses of the basin are rural residential, designated forest and undeveloped land. The TRPC population forecast indicates that as of 2006 there were 310 dwelling units identified within this basin and projects an increase to 410 dwelling units by 2030.

5.27.2 Public Access

A WDFW boat launch provides public access to Offut Lake. The boat launch area contains a public restroom as well as limited parking facilities. Additional public access may be obtained from Offut Lake Resort located at 4005 120th Avenue SE, Tenino, WA 98589.

In addition to defined public access to the shoreline, informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

5.27.3 Priority Habitats and Critical Areas

The stream that connects Offut Lake to the Deschutes River is mapped as supporting winter steelhead, coho salmon, resident cutthroat and sea-run cutthroat trout. This stream is also mapped as supporting the spawning of coho salmon. The mapping of these fish habitats ends at the barrier mapped at the intersection of Offut Lake and the outflow connecting the lake to the Deschutes River. Offut Lake is mapped as supporting resident cutthroat as well as rainbow trout, largemouth bass and perch.

WDFW stocks Offut Lake with cutthroat trout, rainbow trout and triploid rainbow trout.

Offut Lake basin is also mapped as providing habitat for wood duck and bald eagle.

Urban oak canopy and oak-conifer forest is associated with Offut Lake along the north and southwest sides.

5.27.4 Evidence of Processes Disturbed or Potentially Impacted Function

A study of fish passage culverts conducted in 1996 by the WDFW noted one fish barrier within this basin. This barrier was noted at the intersection of an unnamed stream and Offut Lake Road SE.

A barrier study conducted for the years of 1996-2000 by WDFW indicates that the outflow of Offut Lake is also blocked due to insufficient flow and screens.

Aerial photos indicate that stream channel within the eastern portion of the basin has been modified to parallel a private driveway.

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

This basin contains several mapped un-named stream that flow into Offut Lake. In addition, this basin also contains a portion of an un-named stream that is mapped as connecting Offut Lake to
the Deschutes River. Portions of these streams are mapped as shorelines of the state. The reaches Review of these streams are incorporated into the reaches identified for Offut Lake. These reaches are assigned in section 5.26.7 and described in Appendix A. The remainder of the streams are not mapped as a shoreline of the state as they are not currently identified as exceeding 20 cubic feet per second mean annual flow. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

5.27.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Offut Lake basin:

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

WRIA 13 Watershed Assessment. 2004. WRIA 13 Watershed Planning Committee. This assessment provides information on WRIA 13 including existing plans, programs, and data, land use, geology and groundwater, surface water, water quality, and water rights.

WRIA 13 Watershed Plan: Revised Draft. October 2004. Thurston County. This plan provides background planning information, recommendations for planning, water quantity and quality information, and habitat data.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

5.27.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

Offut Lake, RCO Project Number 75-644, WDFW, completed

“This project involves the reconstruction of an existing boat launch facility on Offut Lake to improve and enlarge launch facilities. Offut Lake is located six miles north of Tenino”

5.27.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lake</td>
<td>LOF</td>
<td>6</td>
</tr>
</tbody>
</table>

There are no riverine reaches in this basin.
5.28 Percival Creek

5.28.1 Basin Characteristics

Percival Creek basin is located in the central portion of the county. It is 4,712 acres in size. The majority of the basin, 4,548 acres, is located in WRIA 13. A small portion of the basin, 164 acres, is located in WRIA 23. As the majority of the Percival Creek basin is located in WRIA 13, review of it is provided in this chapter. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>8.8484</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>1.2721</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

There are no marine reaches in this basin.
Percival Creek basin is bordered by Eld Inlet (west) basin, Green Cove Creek, Schneider and Capitol Lake basins to the north, Capitol Lake and Deschutes basins to the east and Black Lake and McLane Creek basins to the west. Percival Creek flows north and drains into Capitol Lake.

The majority of basin is located within Cities of Olympia, Tumwater or their associated Urban Growth Areas.

Water within this basin flows in an easterly direction towards Capitol Lake and Budd Inlet. The Percival Creek Comprehensive Drainage Basin Plan date May 1993 generated by City of Olympia, City of Tumwater, and Thurston County provides additional information on water flow in this basin as follows:

“The creek system consists of a main stem, one major tributary, and several minor tributaries. The main stem of Percival Creek begins at Trosper Lake and flows north for approximately 2.4 miles to its confluence with the main tributary, the Black Lake drainage ditch. The Black Lake drainage ditch, a man-made channel, originates at Black Lake and, like Percival Creek, flows in a northerly direct for approximately two miles.”

Primary land use for this basin is divided among residential use, undeveloped land, designated forest, and commercial/industrial. The TRPC population forecast indicates that as of 2006 there were 4,760 dwelling units identified within this basin and projects an increase to 8,300 dwelling units by 2030.

5.28.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

5.28.3 Priority Habitats and Critical Areas

Black Lake ditch is mapped as containing fall Chinook and coho salmon, sea-run and resident cutthroat trout.

This basin is mapped as providing habitat for mink, wood duck, and osprey.

High ground water flood hazard areas are associated with Black Lake Ditch and land in between Black Lake Ditch and Percival Creek.

Landslide hazard areas associated with Percival Creek.

Wetlands are mapped as associated with Black Lake ditch and southern end of Percival Creek.

This basin is mapped as containing Black Lake Ditch and Percival Creek. Black Lake ditch is considered a shoreline of the state and has a reach assigned in section 5.27.7 and are described in
Appendix A. Percival Creek is not mapped as meeting the shoreline jurisdiction requirements. However, this stream is likely to qualify as critical areas pursuant to TCC 17.15.

5.28.4 Evidence of Processes Disturbed or Potentially Impacted Function

A study of fish passage culverts conducted in 1996 by the WDFW noted two fish barriers within this basin. One barrier is a culvert located on Black Lake ditch. There is no road crossing mapped as associated with this culvert. The second blocked culvert is located at the intersection of Mottman Road and Black Lake Ditch.

A barrier study conducted for the years of 1996-2000 by WDFW noted five barriers within the basin. These barriers were noted at the following locations: Black Lake ditch and Mottman Road (two instances), Percival Creek and Mottman Road, Chapperel Road and Percival Creek, and Sapp Road and Percival Creek.

A WRIA 13 culvert study conducted by the South Puget Sound Salmon Enhancement Group from the 1990’s to 2004 identified a blockage of Percival Creek at the Sapp Road crossing. The blockage is listed as being due to slope.

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

The TRPC study of Rate of Urbanization and Forest Harvest in Thurston County 1985-2000 indicates that urban cover within this basin as of 2000 was 28%.

5.28.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Percival Creek basin:

Thurston County has identified lake water quality as a concern for this basin.

This basin contains five water quality gauges. These gauges are as follows: two stream gauges on Percival Creek, two water quality sample sites, and a stream gauge on Black Lake ditch.

Water Resources Monitoring Report 2003-2005 Water Years. 2006. Thurston County Department of Social Services Environmental Health Division and Thurston County Department of Waste Water Management. This study noted water quality for Percival Creek as good. This rating was based upon the creek meeting all water quality standards including both sections of the fecal coliform test. Major issues for this creek as identified within this report are as follows: the basin is subject to rapid development, increases in stormwater due to the development could result in impacts to water quality, stream bank erosion, hillslope failures, and channel scour, reductions to Black Lake water quality could Percival Creek and Percival Cove, homeless people are known to establish camps within the riparian corridor.

Black Lake/Littlerock/Delphi Sub-area. 1981. TRPC. This report provides recommendations for future residential, commercial, and industrial development. It also provides information of the area’s history, resources and characteristics.
Impervious Surface Reduction Study: Draft Report, November 1994. City of Olympia Public Works Department Water Resources Program. This study identifies ways to reduce the per person amount of impervious surfaces in light of growth.

Percival Creek Comprehensive Drainage Basin Plan, May 1993. City of Olympia Public Works Department in conjunction with city of Tumwater and Thurston County. This plan responds to concerns of the impacts of urban development on natural resources of the basin. The plan provides basin characterization, analysis of problems within the basin, and possible management solutions.

Percival Creek Corridor Plan, Volume 2 Upper Reach, February 1986. TRPC. This plan provides a management tool to guide future land use decisions along the creek. The plan addresses natural and urban features, summarizes plans, ordinances and studies, and lists community involvement.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000, January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area, June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

WRJA 13 Watershed Assessment, 2004. WRJA 13 Watershed Planning Committee. This assessment provides information on WRJA 13 including existing plans, programs, and data, land use, geology and groundwater, surface water, water quality, and water rights.

WRJA 13 Watershed Plan: Revised Draft, October 2004. Thurston County. This plan provides background planning information, recommendations for planning, water quantity and quality information, and habitat data.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

5.28.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

Percival Creek Restoration and Outreach

The Thurston Conservation District will re-establish riparian plantings along 625 linear feet of the Black Lake ditch and replace two acres of invasive vegetation with native shrubs in the Black Lake ditch wetland. Black Lake ditch was excavated in 1922 to drain Black Lake's extensive wetlands to Percival Creek and now provides good salmon spawning habitat in its lower reach. In addition to the restoration components of the project, 50 teachers will be trained in restoration biology, and hands-on training and restoration activities will be provided to 370 area students. Project partners include Thurston County, the City of Olympia, The Washington Departments of Transportation and Fish & Wildlife, and the Nisqually River Education Project. Partial funding
for this project is provided by the U.S. Fish and Wildlife Service. For more information refer to: http://www.epa.gov/owow/wetlands/restore/5star/fy04grants.html

5.28.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black Lake Ditch</td>
<td>BL</td>
<td>1</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no lake reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no marine reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

5.29 Perry Creek

This basin is located primarily in WRIA 14. Please refer to section 6.5 for further information.

5.30 Reichel Lake
5.30.1 Basin Characteristics

Reichel Lake basin is located in the southeast portion of the County. It is approximately 5,147 acres in size. The majority of the basin, 4,713 acres, is located in WRIA 13. A small portion of the basin, 434 acres, is located in WRIA 23. As a majority of the Reichel Lake basin is located in WRIA 13, review of it is provided in this chapter. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>2.3831</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.9635</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Reichel Lake basin is bordered by Deschutes River basin to the north and east, Thompson Creek basin to the south and Bloody Run basin to the west.

Water within this basin generally flows to the north to the Deschutes River.

Primary land use for this basin is divided between agricultural and designated forest. The TRPC population forecast indicates that as of 2006 there were 20 dwelling units identified within this basin and projects an increase to 50 dwelling units by 2030.

5.30.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

5.30.3 Priority Habitats and Critical Areas

The stream connecting the Deschutes River to Reichel Lake is mapped as supporting coho salmon, sea-run and resident cutthroat trout, and winter steelhead. Spawning habitat for coho salmon is mapped within this basin.

The water bodies within this basin are also mapped as providing habitat for waterfowl concentrations.

This basin is mapped as containing areas of conifer/deciduous oak habitat.

High groundwater flood hazard areas are associated with Reichel Lake.

Hazardous slopes located within this basin in the area south of Gordon Road.
5.30.4 Evidence of Processes Disturbed or Potentially Impacted Function

Flood damage occurred to Chatwood and Mulqueen Roads during the 1996 flood event.

A study of fish passage culverts conducted in 1996 by the WDFW noted one fish barrier within this basin. This barrier was noted at the intersection of an unnamed stream and Chatwood Road.

A WRIA 13 culvert study conducted by the South Puget Sound Salmon Enhancement Group from the 1990’s to 2004 identified two blocked culverts within this basin. One occurs at the intersection of an unnamed stream and Chatwood Road; one occurs at the intersection of an unnamed stream and Gordon Road.

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

This basin contains several un-named streams. The main stem of the stream connects Reichel Lake with the Deschutes River. The other un-named streams are mapped as tributaries to this main stem. The main stem is mapped as a shoreline of the state and has reaches assigned in section 5.29.7 and described in Appendix A. The remainder of the associated tributaries are not mapped as a shoreline of the state as they are not currently identified as exceeding a 20 cubic feet per second mean annual flow. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

5.30.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Reichel Lake basin:

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000, January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area, June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

WRIA 13 Watershed Assessment, 2004. WRIA 13 Watershed Planning Committee. This assessment provides information on WRIA 13 including existing plans, programs, and data, land use, geology and groundwater, surface water, water quality, and water rights.

WRIA 13 Watershed Plan: Revised Draft, October 2004. Thurston County. This plan provides background planning information, recommendations for planning, water quantity and quality information, and habitat data.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.
5.30.6 Enhancement or Restoration Activities Implemented

No enhancement or restoration activities have been identified within this basin.

5.30.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unnamed creek</td>
<td>DE-24</td>
<td>4</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reichel Lake</td>
<td>LRE</td>
<td>2</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no marine reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

5.31 SALMON CREEK

This basin is located primarily in WRIA 23. Please refer to section 7.29 for further information.

5.32 SCATTER CREEK

This basin is located primarily in WRIA 23. Please refer to section 7.30 for further information.

5.33 SCHNEIDER

This basin is located primarily in WRIA 14. Please refer to section 6.8 for further information.
5.34 Spurgeon Creek

5.34.1 Basin Characteristics

Spurgeon Creek basin is located in the eastern central portion of the County. It is approximately 6,662 acres in size. The majority of the basin, 6,134 acres, is located in WRIA 13. A small portion, 528 acres, is located in WRIA 11. As the majority of the Spurgeon Creek basin is located in WRIA 13, review of it is provided in this chapter. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>10.8202</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>1.8804</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Spurgeon Creek basin is bordered by Chambers and Woodland basins to the north, McAllister Creek basin to the east, and Deschutes River and Tempo Lake basins to the southeast.
The southern half of this basin contains a portion Fort Lewis.

Water in this basin generally flows to the west towards the Deschutes River.

Primary land use for this basin is divided among residential, undeveloped land and designated forest. The TRPC population forecast indicates that as of 2006 there were 610 dwelling units identified within this basin and projects an increase to 820 dwelling units by 2030.

5.34.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

5.34.3 Priority Habitats and Critical Areas

The western half of Spurgeon Creek provides habitat as well as rearing and spawning areas for coho salmon.

Spurgeon Creek is also mapped as providing habitat for reticulate sculpin, Olympic mudminnow, and wood duck.

Wetlands are mapped along the majority of the length of Spurgeon Creek.

The southern portion of the basin is mapped as containing scattered oak woodlands.

This basin contains several streams including Spurgeon Creek and an un-named stream connecting Sunwood Lake to Spurgeon Creek. The length of Spurgeon Creek within this basin is considered a shoreline of the state and has reaches assigned in section 5.33.7 and described in Appendix A. The un-named stream is not mapped as meeting the shoreline jurisdiction requirements. However, this stream is likely to qualify as critical areas pursuant to TCC 17.15.

5.34.4 Evidence of Processes Disturbed or Potentially Impacted Function

A WRIA 13 culvert study conducted by the South Puget Sound Salmon Enhancement Group from the 1990’s to 2004 identified one blocked culvert within this basin located in the Chehalis Western Trail.

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

5.34.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for this basin:

Water Resources Monitoring Report 2003-2005 Water Years. 2006. Thurston County Department of Social Services Environmental Health Division and Thurston County Department of Waste Water Management. The report identifies the water quality for Spurgeon creek as good. The reason for this rating is noted as failed Part II of the fecal coliform water quality standard in 2005. Additionally the stream channel is severely impacted by peak stormwater flows. The major
issues for this creek as identified by this report are as follows: High volumes of stormwater discharging directly to the creek are causing bank failures, streambank erosion, flooding, stream channel scour, and water quality degradation. City of Olympia constructed a stormwater treatment facility at the headwaters of the creek to improve the quality of urban stormwater discharging to the creek.

**Rate of Urbanization and Forest Harvest in Thurston County 1985-2000.** January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

**The Relationship of Land Cover to Total and Effective Impervious Area.** June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

**WRIA 13 Watershed Assessment.** 2004. WRIA 13 Watershed Planning Committee. This assessment provides information on WRIA 13 including existing plans, programs, and data, land use, geology and groundwater, surface water, water quality, and water rights.

**WRIA 13 Watershed Plan: Revised Draft.** October 2004. Thurston County. This plan provides background planning information, recommendations for planning, water quantity and quality information, and habitat data.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

### 5.34.6 Enhancement or Restoration Activities Implemented

No enhancement or restoration activities have been identified within this basin.

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spurgeon Creek</td>
<td>DE-11</td>
<td>4</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sunwood Lake</td>
<td>LSUN</td>
<td>7</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no marine reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Total Reaches</strong></td>
<td></td>
<td><strong>11</strong></td>
</tr>
</tbody>
</table>
5.35 Tempo Lake

5.35.1 Basin Characteristics

Tempo Lake basin is located in the center of the County. It is situated southeast of Lacey, Olympia, and Tumwater, north of Tenino, and northwest of Rainier. It is approximately 749 acres in size and is located entirely within WRIA 13. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.9674</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Tempo Lake basin is bordered by Spurgeon Creek basin to the northeast and the Deschutes River basin to the southwest.
Tempo Lake was established in 1961. The Tempo Lake Glade Association notes that the site was originally an alder farm. The reservoir and new name took place in 1962 with a petition to the United States Board of Geographic Names that was signed by all the property owners within a mile or so of the reservoir. The lake level is controlled by the residents of the Tempo Lake subdivision. Additional data on the Tempo Lake Community is available at the following website: http://tempolake.org/index.html.

The eastern third of the basin contains a portion of Fort Lewis.

Water in this basin generally flows to the west towards the Deschutes River.

Primary land use for this basin is divided among residential, undeveloped land, and designated forest. The TRPC population forecast indicates that as of 2006 there were 70 dwelling units identified within this basin and projects an increase to 120 dwelling units by 2030.

5.35.2 Public Access

Tempo Lake is a private lake. As noted, on the Tempo Lake Glade Association website, non-residents who wish to fish the lake must be accompanied by a resident.

In addition to defined public access to the shoreline, informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

5.35.3 Priority Habitats and Critical Areas

A bog is mapped in the center of this basin.

5.35.4 Evidence of Processes Disturbed or Potentially Impacted Function

A study of fish passage culverts conducted in 1996 by the WDFW noted one fish barrier within this basin located on an unnamed stream and Tempo Lake Drive.

A WRIA 13 culvert study conducted by the South Puget Sound Salmon Enhancement Group from the 1990’s to 2004 identified a blockage located at the intersection of an unnamed stream and Tempo Lake Drive.

Flood damage to Stedman Road occurred in 1996.

5.35.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Tempo Lake basin:

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.
5.35.6 Enhancement or Restoration Activities Implemented

No enhancement or restoration activities have been identified within this basin.

5.35.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Lake</td>
<td>LTE</td>
<td>1</td>
</tr>
<tr>
<td>Marine</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

5.36 WADDELL CREEK

This basin is primarily located in WRIA 23. Please refer to section 7.34 for additional information.
5.37 **WEST BAY**

5.37.1 **Basin Characteristics**

West Bay basin is located in the northern portion of the County on the Cooper Point Peninsula. It is approximately 1,933 acres in size and is located entirely within WRIA 13. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>8.7720</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

West Bay basin is bordered by Budd Inlet to the east, Schneider basin to the south, Green Cove Creek and Eld Inlet basins to the west.

The southern portion of this basin is located in the City of Olympia and urban growth area.
Water in this basin generally flows to the east towards Budd Inlet.

The primary use of the basin is urban and rural residential as well as undeveloped land. The TRPC population forecast indicates that as of 2006 there were 1,970 dwelling units identified within this basin and projects an increase to 2,980 dwelling units by 2030.

5.37.2 Public Access

There is a mapped, un-named launch site located in the south portion of the basin near Harbor View Road.

In addition to defined public access to the shoreline, informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

5.37.3 Priority Habitats and Critical Areas

Butler Cove is mapped as supporting sea-run and resident cutthroat trout.

The marine shoreline is mapped as supporting shellfish as well as smelt, rock sole, and sand lance. Habitat for harbor seal is mapped adjacent to the southern edge of the basin.

In addition to marine and fish life, the basin is mapped as providing habitat for purple martin and bald eagle.

The marine shoreline has mapped hazardous slide areas in the southern portion of the basin.

High ground water flood hazard areas and wetlands are mapped adjacent to unnamed lake in the southern portion of the basin.

This basin contains Butler Creek as well as a small number of un-named streams that flow into the Puget Sound. These streams are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

5.37.4 Evidence of Processes Disturbed or Potentially Impacted Function

A study of fish passage culverts conducted in 1996 by the WDFW noted three fish barrier within this basin. These barrier were identified at the following locations: at the intersection of an unnamed stream and Klien road, the intersection of Butler Cove and French Road, and at the intersection of Butler Cove and Westwood.

A WRIA 13 culvert study conducted by the South Puget Sound Salmon Enhancement Group from the 1990’s to 2004 identified two block culverts within this basin: One was located at the intersection of Butler cove and French Road; one was located at the intersection of Butler Creek and Windolph Road.
A barrier study conducted for the years of 1996-2000 by WDFW noted one barrier within the basin. This barrier was located on Butler Cove.

This majority of the marine shoreline within this basin is armored.

Timber/forestland use exists within the reaches of this basin.

The TRPC study of Rate of Urbanization and Forest Harvest in Thurston County 1985-2000 indicates that urban cover within this basin as of 2000 was 14%.

The basin is adjacent to Budd Inlet. Ecology is assessing Budd Inlet as a toxic clean-up site. Budd Inlet contains dioxin contamination, thought to have resulted from historical industrial use of shore areas or stormwater runoff. Budd Inlet is part of the Governor's Puget Sound Initiative and a high priority area for Ecology.

A site of impacted function is Industrial Petroleum Eistributors. Industrial Petroleum Distributors is located at 1117 West Bay Drive NW, Olympia, Thurston County. In 1998, the Thurston County Health Department conducted a Site Hazard Assessment of the property, ranked the site a high concern and Ecology placed the site on its Hazardous Sites List. Contamination of the site was likely the result of previous industrial use of the property. According to the Ecology website, the site is currently undergoing a feasibility study and remedial investigation. These reports will inform the Clean Up action plan. Ecology will review this plan and provide for public comment prior to approval.

A site of impacted function is Hardel Mutual Plywood. The Hardel Mutual Plywood site is located at 1210 West Bay Drive NW in Olympia. Investigations at the site in 2004 confirmed presence of contamination, including: Heavy oil and diesel petroleum in groundwater and soil, free floating petroleum product on the west site of the property, polycyclic aromatic hydrocarbons in soil (north area of property) and in groundwater (south area of the property). This review is part of the Puget Sound initiative. Review of this site appears to be ongoing.

A site of impacted function is Reliable Steel. The Reliable Steel site is located on Budd Inlet at 1218 West Bay Drive in Olympia. In May 2006, the site was placed on the “Confirmed and Suspected Contaminated Sites” list. Also in May 2006, the site entered the Voluntary Cleanup Program. This program assists parties conducting independent cleanups with some Ecology oversight or assistance. In August 2006, the site was included as part of the Puget Sound Initiative and became a priority for Ecology. Reliable Steel was removed from the Voluntary Cleanup Program due to inactivity and was entered into the formal MTCA cleanup program. Review appears to be ongoing.

A site of impacted function is West Bay Marina. The West Bay Marina site is located at 2100 West Bay Drive in Olympia. The site lies on the West Bay of Budd Inlet, east of West Bay Drive, and north of the Reliable Steel cleanup site. The Marina entered the Voluntary Cleanup Program in 1999 to clean up a petroleum release from an underground storage tank system. Thurston County Health Department recommended “No Further Action” after the underground storage tanks were removed and contaminated soils were excavated. Ecology is now requiring additional work be done to determine full nature and extent of contamination. Review appears to be ongoing.
Kaufman Dam is located in Thurston County, WA. The Primary Coordinates are: Latitude 47.0748 and Longitude -122.9363.

5.37.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the West Bay basin:

Thurston County has identified TMDLs as a concern for this basin.

**Bulkheading in Thurston County: Impacts on Forage Fish Spawning Habitat.** 2005. Herrera Environmental and Thurston Regional Planning Council. This study identified areas within this basin prone to landslide as high priority areas for restoration.

**Impervious Surface Reduction Study: Draft Report.** November 1994. City of Olympia Public Works Department Water Resources Program. This study identifies ways to reduce the per person amount of impervious surfaces in light of growth.

**The Relationship of Land Cover to Total and Effective Impervious Area.** June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

**WRIA 13 Watershed Assessment.** 2004. WRIA 13 Watershed Planning Committee. This assessment provides information on WRIA 13 including existing plans, programs, and data, land use, geology and groundwater, surface water, water quality, and water rights.

**WRIA 13 Watershed Plan: Revised Draft.** October 2004. Thurston County. This plan provides background planning information, recommendations for planning, water quantity and quality information, and habitat data.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

5.37.6 Enhancement or Restoration Activities Implemented

No enhancement or restoration activities have been identified within this basin.

5.37.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Lake</td>
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<td>n/a</td>
</tr>
<tr>
<td>Marine</td>
<td>MBU</td>
<td>8</td>
</tr>
</tbody>
</table>

**Thurston County Shoreline Master Program Update**  
**Shoreline Analysis and Characterization**
5.38 **WOODARD**

**5.38.1 Basin Characteristics**

The Woodard basin is located in the northeast corner of the county. It is 4,478 acres in size and is located entirely within WRIA 13. Jurisdictional shoreline information for this basin is summarized below. Woodard Creek flows north into Henderson Inlet.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.6597</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>
Woodard basin is bordered by Henderson and East Bay basins to the north, Henderson and Woodland basins to the east, Chambers basin to the south, Indian Creek, Ellis Creek and East Bay Creek basins to the west.

Water in this basin generally flows to the west towards Budd Inlet.

Primary land uses for this basin are rural residential and undeveloped land. The TRPC population forecast indicates that as of 2006 there were 3,860 dwelling units identified within this basin and projects an increase to 5,530 dwelling units by 2030.

5.38.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

5.38.3 Priority Habitats and Critical Areas

Woodard Creek is mapped as supporting chum and coho salmon, winter steelhead, and sea-run and resident cutthroat trout. Spawning habitat for chum and coho salmon, winter steelhead, and sea-run cutthroat trout is mapped within this basin.

This basin is mapped as providing habitat for wood duck and Olympic mudminnow.

Wetlands are mapped throughout the center of the basin and are primarily associated with Woodard Creek.

The 100-year flood plain within this basin is associated with Woodard Creek.

High ground water flood hazard areas are located in the northeast corner of basin.

Hazardous slopes in this basin are associated with Woodard Creek.

This basin contains Woodard Creek as well as several un-named tributaries. These streams are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical area pursuant to TCC 17.15.

5.38.4 Evidence of Processes Disturbed or Potentially Impacted Function

This southeast side of this basin experienced flood damage during the 1999 flood event.

A WRIA 13 culvert study conducted by the South Puget Sound Salmon Enhancement Group from the 1990’s to 2004 identified a blocked culvert within this basin at the intersection of an unnamed creek and South Bay Road.
A study of fish passage culverts conducted in 1996 by the WDFW noted three fish barrier within this basin. These barriers are as follows: Woodard Creek and Libby Road (2 culverts blocked), and unnamed stream and Libby Road.

The TRPC study of Rate of Urbanization and Forest Harvest in Thurston County 1985-2000 indicates that urban cover within this basin as of 2000 was 17%.

5.38.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Woodard basin:

There is a stream gauge on Woodard Creek

Thurston County has identified TMDLs for fecal coliform and maintaining shellfish habitat as concerns for this basin.

Woodard basin is part of the Henderson Inlet Shellfish Protection District adopted by the Board of County Commissioners, December 2001. Washington State law required the board to form the district after the state Department of Health closed portions of the two watersheds to shellfish harvesting because of unacceptably high levels of fecal coliform bacteria. A revised protection district was adopted on November 21, 2005. The modifications were based upon the recommendations submitted in 2003 by the shellfish protection district stakeholder groups.

Henderson Inlet Watershed Action Plan. October 1989, Thurston County Planning Department. Created to inform management of non-point pollution. The plan addresses types of non-point pollution, monitoring objectives, identification of problems, and action recommendations.

Henderson Inlet Watershed Characterization Report. August 29, 2007, Thurston County GeoData Center, Water and Waste Management. This report provides a watershed characterization as well as a listing of potential restoration opportunities.


Impervious Surface Reduction Study: Draft Report. November 1994. City of Olympia Public Works Department Water Resources Program. This study identifies ways to reduce the per person amount of impervious surfaces in light of growth.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Water Resources Monitoring Report 2003-2005 Water Years. 2006. Thurston County Department of Social Services Environmental Health Division and Thurston County Department of Waste Water Management. This report lists general water quality for Woodard Creek as fair. The fair rating is due to failed both parts of the fecal coliform water quality standard in 04/05. Listed on 303d list for past violations of fecal coliform, dissolved oxygen and pH standards,
Although pH and dissolved oxygen standards were meet during the last two water years. The report identifies agricultural practices and urban stormwater as major issues for Woodard Creek.

WRIA 13 Watershed Assessment. 2004. WRIA 13 Watershed Planning Committee. This assessment provides information on WRIA 13 including existing plans, programs, and data, land use, geology and groundwater, surface water, water quality, and water rights.

WRIA 13 Watershed Plan: Revised Draft. October 2004. Thurston County. This plan provides background planning information, recommendations for planning, water quantity and quality information, and habitat data.

Woodard Bay Natural Resources Conservation Area: Preliminary Reconnaissance Report. June 1988. This report serves as a collection of the data available to serve the preparation of a Management Plan. The report includes data on the topography, water quality/quantity, vegetative communities, wildlife resources, priority species as well as more anthropocentric uses such as archaeological and historical features, transportation, shoreline use, and zoning.

Woodland and Woodard Creek Comprehensive Drainage Basin Plan. August 1995. Thurston County Department of Water and Waste Management. This plan identifies water resource problems related to development and recommend solutions.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

5.38.6 Enhancement or Restoration Activities Implemented

No enhancement or restoration activities have been identified within this basin.

5.38.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>There are no riverine reaches in this basin.</td>
<td>n/a</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shinke Lake</td>
<td>LSH</td>
<td>2</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>There are no marine reaches in this basin.</td>
<td>n/a</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>
5.39 WOODLAND

Woodland basin is located in the central-northeast portion of the County. The basin is approximately 18,877 acres in size. The majority of the basin, 18,369 acres, is located in WRIA 13. A small portion, 508 acres, is located in WRIA 11. As the majority of the Woodland basin is located in WRIA 13, review of it is provided in this chapter. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
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<td>SSS Lake</td>
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<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Woodland basin is bordered by the Nisqually Reach and Henderson basins to the north, the McAllister Creek basin to the east, Spurgeon Creek basin to the south, and Chambers and Woodard basins to the west. Woodland Creek flows north into Henderson Inlet.
The majority of this basin is located in either the City of Lacey or the Lacey Urban Growth Area. The basin also contains small portions of unincorporated Thurston County as well as the City of Olympia and Olympia Urban Growth Area.

This basin is part of the Henderson Inlet Protection Area.

Thurston County owns a large area of esturine wetland at the mouth of Wooard Creek as it enters Henderson Inlet. The property on which this esturine wetland sits is approximately 66 acres in size.

Water in this basin generally flows to the west towards Budd Inlet.

The TRPC population forecast indicates that as of 2006 there were 17,900 dwelling units identified within this basin and projects an increase to 29,560 dwelling units by 2030.

5.39.2 Public Access

This basin contains one WDFW motor boat launch access. Shoreline access from the water may also be obtained within this basin from Long Lake. However, the defined access points to Long Lake are located in another basin.

In addition to defined public access to the shoreline, informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

5.39.3 Priority Habitats and Critical Areas

Hicks Lake is stocked with rainbow and triploid rainbow trout by WDFW. Pattison Lake is stocked with rainbow trout by WDFW.

Creeks within this basin are mapped as supporting largemouth bass, rainbow trout, resident and sea-run cutthroat trout, coho and chum salmon, and winter steelhead. This basin is mapped as providing spawning habitat for chum salmon.

WDFW stocks Pattison Lake with rainbow trout.

This basin contains habitat for western gray squirrel, mountain quail, mink, wood duck, waterfowl concentrations, and bald eagles.

The basin contains multiple oak habitat areas including: oak-conifer forest, oak woodlands, oak dominated, conifer deciduous, and urban canopy woodlands.

Hazardous slope/slide areas, wetland areas, and high ground water flood hazard areas are scattered throughout the basin.

The 100-year flood plain is associated with most water bodies within the basin.
This basin contains Woodland Creek as well as several unnamed tributaries. Some portions of Woodland Creek contain shoreline jurisdiction and have reaches assigned in section 5.38.7 and described in Appendix A. The remainder of Woodland Creek as well as the associated tributaries are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

5.39.4 Evidence of Processes Disturbed or Potentially Impacted Function

A study of fish passage culverts conducted in 1996 by the WDFW noted one fish barrier within this basin. This barrier was noted at the intersection of unnamed stream and 26th Avenue NE.

A WRIA 13 culvert study conducted by the South Puget Sound Salmon Enhancement Group from the 1990’s to 2004 identified a culvert blocked by debris on an unnamed stream. The mapping does not reflect a road associated with this barrier.

Flood damage occurred within this basin to the I-5 corridor and Hawks Prairie Road during the 1996 flood event.

Pattison Lake is divided into two basins, north and south, by placement of fill material for a railroad.

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

The TRPC study of Rate of Urbanization and Forest Harvest in Thurston County 1985–2000 indicates that urban cover within this basin as of 2000 was 21%.

5.39.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Woodland basin:

This basin contains three water quality gauges. These gauges include one level gauge and two water quality sample site. In addition, Hicks Lake within the basin also contains a rain gauge.

Woodland Creek is part of a TMDL study.

Thurston County identifies TMDLs, fecal coliform and maintaining shellfish habitat as concerns for this basin.

Woodland basin is part of the Henderson Inlet Shellfish Protection District adopted by the Board of County Commissioners in December 2001. Washington State law required the board to form the district after the state Department of Health closed portions of the two watersheds to shellfish harvesting because of unacceptably high levels of fecal coliform bacteria. A revised protection district was adopted on November 21, 2005. The modifications were based upon the recommendations submitted in 2003 by the shellfish protection district stakeholder groups.

Water Resources Monitoring Report 2003-2005 Water Years. 2006. Thurston County Department of Social Services Environmental Health Division and Thurston County Department of Waste Water Management. This study includes Long Lake. Water quality for this lake is
listed as fair. This rating is due to the lake experiences nuisance blue-green algae blooms and many areas of the lake have emergent aquatic plants that interfere with recreational activities. The lake was treated with an aquatic herbicide in 1991 to eradicate the exotic aquatic plant, Eurasian water milfoil. Since the herbicide treatment, the milfoil infestation has been controlled through hand-pulling and bottom barriers.

Hicks Lake is also included in this study. The report identifies water quality for Hicks Lake as good. This rating is based on the data that the water quality is generally good and supports recreational uses. The report identifies major issues for Hicks Lake as: low water levels occur during summer months, especially during periods of drought such as in 2001. High lake levels can also occur during higher than normal winter rainfall conditions. Extreme high lake levels causing flooding of some lakeshore structures. The outlet channel is on private property, is not maintained, and restricts the flow of water out of the lake. High density residential land use, storm water discharges, and other non-point pollution in this urban setting could degrade water quality if measures are not taken to prevent it.

Pattison Lake is included in the study. Quality of the lake is listed as good to fair. This rating is due to algae blooms, filamentous algae growth, and aquatic plant growth that have, at times, impaired water clarity and fishing and boating activities, within the lake. In addition, the study notes that blockages in the outlet channel in past years have caused the lake level to rise, flooding docks and yards.

Woodland Creek is also included in this report. The report identifies water quality for Woodland Creek as fair. The rating is due to Woodard Creek failing both parts of the fecal coliform standard. This creek is also listed on the 303d list for violations of fecal coliform and dissolved oxygen, and temperature in the upper reach. The report identifies the major issues for the creek as: urban stormwater discharges contributing to water quality problems, non-point pollution from failing on-site septic systems and livestock in the watershed, and shellfish harvest downgrades in Henderson Inlet that occurred in 2000, 2001, and 2005 due to bacteria pollution from Woodland Creek and other tributaries.

Henderson Inlet Watershed Action Plan. October 1989. Thurston County Planning Department. This plan intends to inform management of non-point pollution. The plan addresses types of non-point pollution, monitoring objectives, identification of problems, and action recommendations.

Henderson Inlet Watershed Characterization Report. August 29, 2007. Thurston County Geodata Center and Thurston County Department of Water and Waste Management. This report provides a watershed characterization as well as a listing of potential restoration opportunities.


Impervious Surface Reduction Study: Draft Report. November 1994. City of Olympia Public Works Department Water Resources Program. This study identifies ways to reduce the per person amount of impervious surfaces in light of growth.
The Relationship of Land Cover to Total and Effective Impervious Area, June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

WRIA 13 Watershed Assessment, 2004. WRIA 13 Watershed Planning Committee. This assessment provides information on WRIA 13 including existing plans, programs, and data, land use, geology and groundwater, surface water, water quality, and water rights.

WRIA 13 Watershed Plan: Revised Draft, October 2004. Thurston County. This plan provides background planning information, recommendations for planning, water quantity and quality information, and habitat data.

Woodland and Woodard Creek Comprehensive Drainage Basin Plan, August 1995. Thurston County Department of Water and Waste Management. This plan identifies water resource problems related to development and recommend solutions.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

5.39.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

Boating Access Development, RCO Project Numbers 69-71 and 69-611, Washington State Department of Fish and Wildlife, completed

“This project agreement is for the development of boat launching sites, with typical development to consist of an access road with appropriate signs, perimeter fence and gate, graded and graveled parking area, sanitary facilities, launching ramp or ramps, information and regulatory signs, and landscaping.”

Pacific Avenue Community Park, RCO Project Number 92-070, Lacey Parks and Recreation Department, completed

“Acquisition of 70 acres to be used as a community park. Proposed future development will include interpretive and walking trails, informal open space, outdoor theater, and group picnic area.”

Carpenter Road Culvert Replacement, RCO Project Number 99-1680, Thurston County Roads and Transportation Department, completed

“In 1997, the Washington Department of Fish and Wildlife (WDFW) did the original assessment of this barrier culvert as part of a report entitled Thurston County Barrier Culvert Inventory. Methods included a field assessment of the type of barrier problem and cause; physical attributes of the culvert including water depth inside the culvert, slope and outfall drop as well as information about the plunge pool and channel. The quality of the habitat was also considered and a Priority Index was assigned for each barrier culvert WDFW describes this culvert as a total
barrier, with two concrete 2 foot diameter pipes side by side. Both are perched, broken about 2 feet from the end at the outfall and have an outfall of 0.5 feet. The depth of the plunge pool is 1 foot. The project involves removing both existing culverts and replacing them with an 8 foot diameter pipe countersunk approximately 1.5 feet. The design work is complete and permits will be submitted in mid-February for a construction target of summer, 1999. The project will be completed by fall, 1999. This project will open up 254.74 square meters of rearing habitat, and 122.64 square meters of spawning habitat for chum, coho, steelhead, cutthroat and rainbow. The Thurston Conservation District is seeking funding for a linked project upstream from this one that will remove a barrier on private land, fence the riparian corridor for livestock exclusion, and revegetate the riparian corridor. Stream Team volunteers shall perform revegetation within six months and perform monitoring functions for one year after completion of the project.

Jorgenson Creek Fish Passage, RCO Project Number 99-1681, Thurston County Conservation District, completed

“Thurston Conservation District (TCD) requests that the funds originally allocated for the Stancil Creek Fish Passage Project be approved for use on a similar project in the same watershed, the Jorgenson Creek Culvert Replacement. The TCD will partner with the South Puget Sound Salmon Enhancement Group to complete the project. Jorgenson Creek is a small spring-fed stream draining a .5 square mile basin in Lacey, Washington. Fish species in Jorgenson Creek include cutthroat trout, coho salmon, chum salmon, sculpin, and others. An existing 36"-diameter concrete culvert under a paved road blocks most fish use of 3/4-mile upstream habitat within a rural watershed. The existing culvert is a total block to chum salmon, juvenile salmon, and trout; some adult coho salmon probably swim upstream through the existing culvert. A preliminary design report has been completed by the South Puget Sound Salmon Enhancement Group. The proposed project would replace the existing culvert with an 8'-wide x 6'-high aluminum pipe arch. Project design conforms to the "Stream Simulation Option" for culvert replacement (WDFW 1999). The replacement pipe arch would provide unrestricted fish passage (juvenile and adult fish), and would also improve passage of flood flows, natural bedload, and floating wood at the project location.”

Pleasant Glade Road Salmon Barrier, RCO Project Number 00-1887, Thurston County Roads and Transportation, completed

“This project proposes to replace two concrete culverts with a 28 foot long bridge, which would open up about 5.5 miles of important upstream habitat mostly chum and coho and smaller numbers of chinook, cutthroat and steelhead. Currently, these 48" concrete culverts convey Woodland Creek under Pleasant Glade Road, a public county road. An extensive scour pool has developed at the outfall due to the undersizing of the existing culverts, creating a low flow barrier to adult fish. This scour pool plus the perched ends of the culverts significantly inhibit adult fish passage and are likely total barriers to upstream juvenile migration. Woodland Creek has been identified in the Salmonid Habitat Limiting Factors Analysis for WRIA 13 as one of the streams with the greatest potential for restoring salmon runs in this WRIA. Replacing these culverts is listed as a high priority in the Woodland and Woodard Creek Comprehensive Drainage Basin Plan, 1995, in the Woodland Creek Enhancement Plan, 1993, and in the Habitat Limiting Factors Report for WRIA 13, 1999. This project will provide a critical link to other restoration efforts along Woodland Creek. Letters of support have been received from Lacey and
the Washington Conservation Commission. A bridge is justified for this location because of the width and velocity of the stream. Although the initial cost is more expensive, the bridge will provide the maximum benefit to fish passage.”

**Pleasant Glade Park, RCO Project Number 01-1111, Lacey Parks and Recreation Department, completed**

“This project proposes to replace two concrete culverts with a 28 foot long bridge, which would open up about 5.5 miles of important upstream habitat mostly chum and coho and smaller numbers of chinook, cutthroat and steelhead. Currently, these 48" concrete culverts convey Woodland Creek under Pleasant Glade Road, a public county road. An extensive scour pool has developed at the outfall due to the undersizing of the existing culverts, creating a low flow barrier to adult fish. This scour pool plus the perched ends of the culverts significantly inhibit adult fish passage and are likely total barriers to upstream juvenile migration. Woodland Creek has been identified in the Salmonid Habitat Limiting Factors Analysis for WRIA 13 as one of the streams with the greatest potential for restoring salmon runs in this WRIA. Replacing these culverts is listed as a high priority in the Woodland and Woodard Creek Comprehensive Drainage Basin Plan, 1995, in the Woodland Creek Enhancement Plan, 1993, and in the Habitat Limiting Factors Report for WRIA 13, 1999. This project will provide a critical link to other restoration efforts along Woodland Creek. Letters of support have been received from Lacey and the Washington Conservation Commission. A bridge is justified for this location because of the width and velocity of the stream. Although the initial cost is more expensive, the bridge will provide the maximum benefit to fish passage.”

**Salazar Culvert Replacement 01, RCO Project Number 01-1239, South Puget Sound SEG, completed**

“This project, located at approximately River Mile 2.6, entails the replacement of a set of culverts in Woodland Creek, which drains into Henderson Inlet. The double culverts are partial barriers that do not satisfy the WDFW fish passage criteria. Their structural integrity is compromised and will eventually become total blockages. This project replaces the culverts with a bridge that will allow unimpeded fish passage for salmonids at all life stages.”

### 5.39.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Woodland Creek</td>
<td>WO</td>
<td>5</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Southwick Lake</td>
<td>LSO</td>
<td>1</td>
</tr>
<tr>
<td>Pattison Lake</td>
<td>LPA</td>
<td>7</td>
</tr>
<tr>
<td>Hicks Lake</td>
<td>LHI</td>
<td>4</td>
</tr>
<tr>
<td>Goose Lake</td>
<td>LLO</td>
<td>2</td>
</tr>
<tr>
<td>Long Lake</td>
<td>LLO</td>
<td>10</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
There are no marine reaches in this basin. n/a n/a

| Total Reaches |     | 29 |

**5.40 Yelm Creek**

This basin is located primarily in WRIA 11. Please refer to section 4.12.
The data provided in this chapter are divided into subsections focused on the basins located within the Kennedy Goldsborough Water Resource Inventory Area (WRIA 14). Each subsection begins with an overview of the basin and includes information regarding basin characteristics and water bodies, public access, and priority habitats/critical areas. Additional data follows regarding impacts to function, specific sources of basin information, and restoration/enhancement opportunities. In addition to specific sources cited below, the content of this chapter generally is based on documents, mapping information, and other resources described in Appendix B: Shoreline Inventory. That appendix highlights pertinent WRIAs and basins for each source.
6.1 **BURNS**

6.1.1 **Basin Characteristics**

Burns basin is located in the northwest portion of the County. It is 166 acres in size and is located entirely within WRIA 14. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
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</tbody>
</table>

Burns basin is bordered by Totten Inlet and Totten Inlet basin to the north, Pierre basin to the east, Schneider Creek basin to the South, and Totten Inlet basin to the west.

Water within Burns basin generally flows into Totten Inlet.
Primary land use for this basin is divided among residential, undeveloped land, and agriculture. The TRPC population forecast indicates that as of 2006 there were 40 dwelling units identified within this basin and projects an increase to 60 dwelling units by 2030.

6.1.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

6.1.3 Priority Habitats and Critical Areas

Shellfish habitat is mapped along the marine shoreline of this basin.

Hazardous slopes are mapped along the marine waterfront. However, mapped contours do not reflect hazardous slopes within this basin.

Wetland areas are mapped in the eastern portion of this basin.

6.1.4 Evidence of Processes Disturbed or Potentially Impacted Function

2006 aerial photos of this basin depict bulkheads and removal of vegetation adjacent to the shorelines within this basin.

6.1.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Burns basin:

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.


Totten-Little Skookum Inlet Watershed Action Plan, October 1989. Thurston County Planning Department and Mason County Planning Department. This watershed action plan provides a tool to inform management decisions on controlling non-point pollution for the watershed. The plan identifies the characteristics of the watershed, types and sources of non-point pollution, as well as goals and action recommendations for reducing pollution.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

6.1.6 Enhancement or Restoration Activities Implemented

No enhancement or restoration activities have been identified within this basin.
6.1.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
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</thead>
<tbody>
<tr>
<td>River</td>
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<tr>
<td>Lake</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Marine</td>
<td>MTO</td>
<td>1</td>
</tr>
</tbody>
</table>

6.2 **Eld Inlet (West)**

6.2.1 Basin Characteristics

Eld Inlet (west) basin is located in the northwest portion of the County. The basin is approximately 4,912 acres in size and is located entirely within WRIA 14. Jurisdictional shoreline information for this basin is summarized below.
<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
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<tr>
<td>SMA Marine</td>
<td>13.9644</td>
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<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Eld Inlet (west) basin is bordered by Squaxin Passage basin to the north, Eld Inlet to the east, Perry Creek basin to the south and Schneider Creek and Totten Inlet basins to the west.

Water within Eld Inlet basin generally flows into Eld Inlet.

Primary land use is divided among rural residential, undeveloped land, and designated forest land. The TRPC population forecast indicates that as of 2006 there were 510 dwelling units identified within this basin and projects an increase to 620 dwelling units by 2030.

6.2.2 Public Access

Frye Cove Park provides marine public access within this basin. The public access at this park may be utilized for waterfront, view and swimming access.

In addition to defined public access to the shoreline, informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

6.2.3 Priority Habitats and Critical Areas

The marine environment adjacent to this basin is mapped as supporting rock sole, sand lance and shellfish. The marine shoreline is mapped as providing habitat for seabirds.

This basin is mapped as providing habitat for wood duck, bald eagle, and osprey.

Oak habitat is mapped in this basin near Steamboat Island Road and the Highway 101 interchange.

High ground water flood hazard areas are associated with an unnamed pond in the basin and are also mapped sporadically in the northern portion of the basin. Wetland areas are also mapped throughout the basin.

Hazardous slopes/slides areas are mapped along the majority of the marine shoreline. Known landslide areas are mapped primarily along the northern portions of the marine shoreline.

This basin contains a small number of un-named streams that flow into Eld Inlet. These streams are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.
6.2.4 Evidence of Processes Disturbed or Potentially Impacted Function

A study of fish passage culverts conducted in 1996 by the WDFW noted one fish barrier within this basin. This barrier is located at the intersection of an unnamed stream and Hunter Point Road.

A study of WRIA 14 culverts conducted by South Puget Sound Salmon Enhancement Group in 2003 noted two blocked culverts within this basin. The blocked culverts were identified at the following intersections: an unnamed stream and 61st Avenue, and an unnamed stream and Gravelly Beach Loop.

6.2.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Eld Inlet (west) basin:

Thurston County has identified shoreline development and landslides as concerns for this basin.

Bulkheading in Thurston County: Impacts on Forage Fish Spawning Habitat, 2005. Herrera Environmental and Thurston Regional Planning Council. This study identifies the marine shoreline within this basin as high priority areas for restoration.

Eld Inlet Watershed Action Plan, October 1989. TRPC. This study identifies the marine shoreline within this basin as high priority areas for restoration.

Eld Inlet Watershed Action Plan, October 1989. TRPC. This document provides as a tool to inform management decisions for reducing the pollution affecting Eld Inlet. The plan provides a watershed description, water quality data, sources of non-point pollution and an implementation strategy.

The Relationship of Land Cover to Total and Effective Impervious Area, June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

6.2.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

Eld-Inlet County Park, RCO Project Number 73-025, Thurston County Parks and Recreation, completed

“This project is for the acquisition of 102 acres, including 1,800 lineal feet of waterfront on South Puget Sound and adjoining tidelands to provide for a large urban park.”

Frye Cove Beach Enhancement, RCO Project Number 83-802, WDFW, completed

“This agreement is for the placement of a layer of screened gravel, 6-8” thick on approximately 3 1/2 acres of tidelands in front of Frye Cove on Eld Inlet in southern Puget Sound. The purpose is
to alter to substrate to provide a suitable habitat for hardshell clam production. Upland access is available through undeveloped Thurston County Park property.”

Eason – Frye Cove Creek, RCO Project Number 04-1035, South Puget Sound SEG, completed

“This salmon enhancement project is located on a small independent tributary to Frye Cove in Thurston County. Frye Cove Creek enters Eld Inlet and is about 2000m long. The proposed culvert project is about 300m upstream of the estuary. This watershed provides habitat for coastal cutthroat, coho, chum, and resident trout. This project will provide improved access to over 1700m of habitat. The wetland headwaters for Frye Cove Creek have recently been protected by a landowner conservation easement prepared by Capital Land Trust. Half of the estuary is protected by Frye Cove Park (Thurston County) and the other half of the estuary is protected by one landowner. The existing 4’ culvert was seriously damaged during a significant flooding event in the mid 1990’s. The outlet was crushed and became a total barrier for all species of fish. During stream surveys, SPSSEG field crews identified carcasses downstream but did not observe any fish upstream. During landowner interviews, SPSSEG did talk to several landowners who claimed to see salmon several years prior to the culvert being damaged. This project will remove a significant fish barrier low in the watershed. A low maintenance culvert will be installed using a WDFW stream simulation model design. This proposed 12’ diameter culvert will be large enough to pass high water flows and anticipated debris. The correction of this culvert will provide natural stream function at this site low in the watershed.”

Frye Cove Bulkhead Removal, RCO Project Number 05-1399, South Puget Sound SEG, in progress

“The South Puget Sound Salmon Enhancement Group will use this grant to remove a bulkhead in Eld Inlet directly across from Frye Cove County Park. The bulkhead is 6 feet tall, 110 feet long and encroaches on the beach by 35 feet. The bulkhead limits potential beach spawning habitat for fish that salmon eat. Work will include removing the bulkhead and fill material behind it, restoring the beach and adding rocks and large woody debris to increase the beach diversity and protect the bluff from erosion. The salmon group will contribute $16,500 from a state grant.”

Frye Cove Park Beach Restoration, RCO Project Number 06-2218, South Puget Sound SEG, completed

“The South Puget Sound Salmon Enhancement Group will use this grant to restore the beach at Frye Cove Park. Work will include removing about 1,000 cubic yards of rock armoring along 400 feet of shoreline on Eld Inlet. Crews also will place large woody debris to create complexity and habitat areas at the beach and provide a safe pathway for the public. Many tons of rip-rap had been placed along the shoreline to stop erosion of the upper beach and those rocks have migrated onto the beach. The rocks are hindering the natural process of the beach and limiting forage fish and salmon species use of the area. In total, about 40,000 square feet of beach will be improved and an education sign discussing the project and why shorelines are important for fish will be installed. The enhancement group will contribute $12,200 from a grant.”
6.2.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
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<td>n/a</td>
</tr>
<tr>
<td>Lake</td>
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<td>n/a</td>
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<td>MEL</td>
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</tr>
<tr>
<td>Total</td>
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<td>19</td>
</tr>
</tbody>
</table>

6.3 Kennedy Creek

6.3.1 Basin Characteristics

Kennedy Creek basin is located in the northeastern portion of the County. It is 9,876 acres in size. The majority of the basin, 9,773 acres, is located in WRIA 14. A small portion of the basin, 103 acres, is located in WRIA 23. As the majority of the Kennedy Creek basin is located in WRIA 14, review of it is provided in this chapter. Jurisdictional shoreline information for this basin is summarized below.
6. Basin Analysis – WRIA 14 (Kennedy Goldsborough)

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
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<tbody>
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<td>SSS Stream</td>
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<tr>
<td>SMA Lake</td>
<td>1.1513</td>
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<td>SSS Lake</td>
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</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

The Kennedy Creek basin is defined by the County boundary to the north, Schneider Creek, Summit Lake, and Perry Creek basins to the east, Waddell Creek basin to the south, and Porter Creek basin to the west.

Capitol forest is located within this basin south of Highway 8.

Water within Kennedy Creek basin generally flows into Kennedy Creek and Totten Inlet.

The current primary uses of this basin are rural residential, designated forest and undeveloped land. The TRPC population forecast indicates that as of 2006 there were 60 dwelling units identified within this basin and projects an increase to 90 dwelling units by 2030.

6.3.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

6.3.3 Priority Habitats and Critical Areas

Kennedy Creek is mapped as supporting coho and chum salmon, searun and resident cutthroat trout, and winter steelhead. Kennedy Creek is also mapped as providing spawning habitat for chum salmon.

Riffle sculpin, tailed frogs, and mountain quail habitat are mapped within this basin.

Wetland areas are mapped in the center of the basin.

This basin contains Kennedy Creek as well as several unnamed tributaries. Some portions of Kennedy Creek are contain shoreline jurisdiction and have reaches assigned in section 6.3.7 and described in Appendix A. The remainder of Kennedy Creek as well as the associated tributaries are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.
6.3.4 Evidence of Processes Disturbed or Potentially Impacted Function

A study of fish passage culverts conducted in 1996 by the WDFW noted three fish barriers within this basin. These barriers were noted at the following intersections: an unnamed stream and Summit Lake Shore Road, an unnamed stream and Summit Lake Cut-Off NW, and on Kennedy Creek. There is no road associated with the barrier located on Kennedy Creek.

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

6.3.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Kennedy Creek basin:

Thurston County has identified flooding and fish habitat concerns for this basin.

Green Diamond Resource Company Habitat Conservation Plan (HCP), Simpson Habitat Assessment, 1999. USFWS.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Water Resources Monitoring Report 2003-2005 Water Years. 2006. Thurston County Department of Social Services Environmental Health Division and Thurston County Department of Waste Water Management. This report rates Kennedy Creek as good. This rating is based upon failed Part II of the bacteria standard, and has dissolved oxygen violations during summer low flow periods. Major issues identified for the basin by this study include: (1) Fecal coliform bacteria levels during dry season appear to be increasing. The report further notes that as a result of this increase further studies will be conducted. (2) Kennedy Creek was part of a Washington Department of Ecology Total Maximum Daily Load Study that will require development of a water quality clean-up plan in the next few years. (3) The chum salmon run in Kennedy Creek continues to be a valued local resource. Various private and public entities worked together to build salmon spawning viewing areas for the public along a lower portion of the creek.


Totten-Little Skookum Inlet Watershed Action Plan. October 1989. Thurston County Planning Department and Mason County Planning Department. This plan provides a tool to inform management decisions on controlling non-point pollution for the watershed. The report identifies...
the characteristics of the watershed, types and sources of non-point pollution, as well as goals and action recommendations for reducing pollution.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

6.3.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

Kennedy Creek NAP, RCO Project Number 04-1326, DNR, completed

“The objective of this project is to acquire three priority parcels (approximately 45 acres), for inclusion in the Kennedy Creek NAP. Parcels include the remaining privately owned salt marsh vegetation in the Kennedy Creek estuary, riparian and tidally influenced portions of Schneider Creek and upland forest habitat. Kennedy Creek NAP protects three high quality intertidal salt marsh ecosystems; two are listed as Priority 3 and one is listed as Priority 2 in the 2003 DNR Natural Heritage Plan. High quality estuaries with saltmarsh vegetation dominated by native species are now relatively rare in the Puget Trough ecoregion. This estuary, protected by the Kennedy Creek NAP, provides critical resting, feeding and overwintering habitat for migrating and resident shorebirds and waterfowl including dunlin, greater yellowlegs, black-bellied plovers and sandpipers. The site also supports a healthy population of native salmon, bald eagles and marbled murrelets (both listed as Federally Threatened species), and peregrine falcon (listed as a Federal Species of Concern). In partnership with the South Puget Sound Salmon Enhancement Group and Kennedy Creek Advisory Committee, the Kennedy Creek NAP estuary has been incorporated into the interpretive salmon trail tour during the chum-spawning season.”

6.3.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
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</tr>
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</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pond 2, unnamed</td>
<td>LPO2</td>
<td>1</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no marine reaches in this basin.</td>
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<td>n/a</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

6.4 McLane Creek

The majority of this basin is located in WRIA 13. Please refer to Section 5.22.
6.5 **Perry Creek**

Perry Creek basin is located in the northwestern portion of the County. It is 4,050 acres in size and is located entirely within WRIA 14. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
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</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.9874</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Perry Creek basin is bordered by Schneider Creek and Eld Inlet (west) basins to the north, Eld Inlet (east) basin to the east, McLane Creek and Waddell Creek basins to the south, and Kennedy Creek and Summit Lake basins to the west.

Water within Perry Creek basin generally flows towards Perry Creek and Eld Inlet.
The current primary land use is divided among rural residential, undeveloped land and designated forest land. Capitol Forest is mapped in the southern section of the basin. The TRPC population forecast indicates that as of 2006 there were 140 dwelling units identified within this basin and projects an increase to 190 dwelling units by 2030.

6.5.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

6.5.3 Priority Habitats and Critical Areas

Perry Creek is mapped as supporting chum and coho salmon, winter steelhead, and resident cutthroat trout. A small portion of Perry Creek is mapped as providing spawning habitat for chum salmon.

Wetlands within this basin are associated with the marine shoreline.

Hazardous slopes are mapped adjacent to Perry Creek in the eastern portion of basin.

This basin contains Perry Creek as well as associated tributaries. These streams are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

6.5.4 Evidence of Processes Disturbed or Potentially Impacted Function

A barrier study conducted for the years of 1996-2000 by WDFW noted two barriers within the basin. Both barriers were located on Perry Creek. The mapping does not reflect a road associated with either barrier.

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

6.5.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Perry Creek basin:

Black Lake/Littlerock/Delphi Sub-area. 1981. This report provides recommendations for future residential, commercial, and industrial development. It also provides information of the area’s history, resources and characteristics.

Eld Inlet Watershed Action Plan. October 1989. TRPC. This document provides a tool to inform management decisions for reducing the pollution affecting Eld inlet. This plan provides a watershed description, water quality data, sources of non-point pollution, and an implementation strategy.
Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Water Resources Monitoring Report 2003-2005 Water Years. 2006. Thurston County Department of Social Services Environmental Health Division and Thurston County Department of Waste Water Management. This report notes water quality as good due to the fact that Perry creek met all water quality standards except part II of the bacteria standard in 2004/05. The report identifies the major issues for this creek as agricultural, nonpoint pollution, and segments of stream have on-site septic systems in close proximity.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

### 6.5.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

**Galivan – Perry Creek Trib, RCO Project Number 04-1036, South Puget Sound SEG, completed**

“This salmon enhancement project is located on an unnamed right bank tributary to mainstem Perry Creek in Thurston County (WRIA 14). Mainstem Perry Creek enters Mud Bay and is a productive salmon stream. The mouth of the Perry Creek tributary (14.0002) culvert project is approximately 500m upstream from the estuary and is about 2100m in total length. This project is located on a private road that accesses about 5 acres of forestland on the opposite side of the creek from the landowner's home. The landowner would like to keep access to their property while improving salmon passage and culvert maintenance. This project will remove two inadequate barrier culverts and replace them with a single large squash culvert. The proposed culvert will be 9' wide x 5' tall x 30' long. This culvert will satisfy the "no slope" option outlined by WDFW in their recent 2003 Culvert Manual. The culvert will be large enough to pass high water flows, sediment bed-load material, LWD, and salmon at all life stages. This project is important to create additional spatial distribution for chum, coho, and cutthroat. Perry Creek is a dominant chum stream in the South Sound that produces thousands of chum annually. There is a natural waterfall on mainstem Perry Creek (upstream of the tributary confluence) that prohibits salmon passage. This project will improve existing access on stream 14.0002 that will be used predominantly by rearing species of salmonids.”

**Galivan – Perry Creek Tributary, RCO Project Number 04-1910, South Puget Sound SEG, in progress**

“The purpose of this project is to repair recent storm damage to a completed FFFPP project, Galivan Perry Creek Trib #04-1036. As a result of extremely high flows, and mobilization of debris, during the December 2007 storms, the new culvert was overwhelmed, resulting in over-
topping and erosion of the road prism. The new, existing culvert was virtually undamaged from this high flow event; however, the landowner has lost access to his forested property due to the damage to the road. Based on the recommendations of our consulting engineers, the fish passage team and the FFFPP steering committee have approved opening this new contract to complete the necessary repairs to the road and stream channel. Repairs will include rebuilding the road prism and making it more durable to high flow events, as well as adding two weirs downstream to ensure that the site does not become a fish passage barrier in the future. Repairs will be completed in 2008 and based on the recommendations in Field Review of the Galivan FFFPP project written by Pat Powers, P.E. and attached in PRISM.”

### 6.5.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name</th>
<th>Series</th>
<th>Reaches</th>
</tr>
</thead>
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<td>n/a</td>
</tr>
<tr>
<td>Lake</td>
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<tr>
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<td>MEL</td>
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</tr>
<tr>
<td>Total Reaches</td>
<td></td>
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<td>1</td>
</tr>
</tbody>
</table>
6.6 PIERRE

6.6.1 Basin Characteristics

Pierre basin is located in the northwestern portion of the County. It is 103 acres in size and is located entirely within WRIA 14. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
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<td>SMA Marine</td>
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<td>SSS Marine</td>
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Pierre basin is bordered by Totten Inlet and Totten Inlet basin to the north, Totten Inlet basin to the East, Schneider Creek basin to the south, and Burns and Totten Inlet basins to the west.

Water within Pierre basin generally flows towards Totten Inlet.
Primary use of this land is rural residential, undeveloped land and agricultural. The TRPC population forecast indicates that as of 2006 there were 10 dwelling units identified within this basin and projects an increase to 20 dwelling units by 2030.

6.6.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

6.6.3 Priority Habitats and Critical Areas

There are no priority habitats or critical areas mapped within this basin.

6.6.4 Evidence of Processes Disturbed or Potentially Impacted Function

2006 aerial photos indicate that there are bulkheads located along the marine shoreline of this basin.

6.6.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Pierre basin:

This basin is mapped as containing a water quality sample site along marine shoreline.

The Relationship of Land Cover to Total and Effective Impervious Area, June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Totten-Little Skookum Inlet Watershed Action Plan, October 1989. Thurston County Planning Department and Mason County Planning Department. This plan provides a tool to inform management decisions on controlling non-point pollution for the watershed. The report identifies the characteristics of the watershed, types and sources of non-point pollution, as well as goals and action recommendations for reducing pollution.


Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

6.6.6 Enhancement or Restoration Activities Implemented

No enhancement or restoration activities have been identified within this basin.
6.6.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
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<td>River</td>
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</tr>
<tr>
<td>Lake</td>
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<td>n/a</td>
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</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

6.7 PORTER CREEK

The majority of this basin is located in WRIA 23. Please refer to section 7.26 for information on this basin.

6.8 SCHNEIDER CREEK
6.8.1 Basin Characteristics

Schneider Creek basin is located in the northeast corner of the County. It is 5,243 acres in size. The majority of the basin, 4,563 acres, is located in WRIA 14. A small portion of the basin, 680 acres, is located in WRIA 13. As the majority of the Schneider Creek basin is located in WRIA 14, review of it is provided in this chapter. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.7441</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Schneider Creek basin is bordered by Totten Inlet basin to the north, Eld Inlet basin to the east, Perry Creek basin to the south, and Summit Lake basin, Kennedy Creek basin and the western Thurston county border to the west.

Water in Schneider Creek basin generally flows towards Schneider Creek and Totten Inlet.

Primary land use for this basin is rural residential, undeveloped land and designated forest. The TRPC population forecast indicates that as of 2006 there were 2,140 dwelling units identified within this basin and projects an increase to 2,750 dwelling units by 2030.

6.8.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

6.8.3 Priority Habitats and Critical Areas

Schneider Creek is mapped as supporting resident and searun cutthroat trout, chum and coho salmon, and winter steelhead. Schneider Creek is also mapped as providing spawning habitat for chum salmon.

Wood duck habitat is mapped in this basin.

This basin is mapped as containing hazardous slope areas; however, they are not associated with the creek.

Wetlands are mapped adjacent to Schneider Creek and south of Highway 101 within this basin.
This basin contains Schneider Creek as well as several un-named tributaries. These streams are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

6.8.4 Evidence of Processes Disturbed or Potentially Impacted Function

A barrier study conducted for the years of 1996-2000 by WDFW noted five barriers within the basin. These barriers were located as follows: an unnamed stream and Highway 101 (two instances); three blockages are located on unnamed streams with no associated road(s).

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

6.8.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Schneider Creek basin:

Schneider Creek has a water quality sample site located on it.

Thurston County has identified flooding and high ground water concerns for this basin.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000, January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area, June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Water Resources Monitoring Report 2003-2005 Water Years, 2006. Thurston County Department of Social Services Environmental Health Division and Thurston County Department of Waste Water Management. The study notes that general water quality of Schneider creek was fair. The rating of “fair” was related to the failed Part II of the fecal coliform standard and well as dissolved oxygen, and occasional temperature violations in summer months. In addition, the study indicates that the major issues on this creek are: the creek has the potential to be impacted by animal keeping practices. Logging practices and stream-side development also have the potential to affect water quality within this basin.

Totten-Little Skookum Inlet Watershed Action Plan, October 1989. Thurston County Planning Department and Mason County Planning Department. This action plan provides a tool to inform management decisions on controlling non-point pollution for the watershed. The report identifies the characteristics of the watershed, types and sources of non-point pollution, as well as goals and action recommendations for reducing pollution.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

6.8.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

Kennedy Creek NAP, RCO Project Number 04-1326, Washington State Department of Natural Resources, completed

“The objective of this project is to acquire three priority parcels (approximately 45 acres), for inclusion in the Kennedy Creek NAP. Parcels include the remaining privately owned salt marsh vegetation in the Kennedy Creek estuary, riparian and tidally influenced portions of Schneider Creek and upland forest habitat. Kennedy Creek NAP protects three high quality intertidal salt marsh ecosystems; two are listed as Priority 3 and one is listed as Priority 2 in the 2003 DNR Natural Heritage Plan. High quality estuaries with saltmarsh vegetation dominated by native species are now relatively rare in the Puget Trough ecoregion. This estuary, protected by the Kennedy Creek NAP, provides critical resting, feeding and overwintering habitat for migrating and resident shorebirds and waterfowl including dunlin, greater yellowlegs, black-bellied plovers and sandpipers. The site also supports a healthy population of native salmon, bald eagles and marbled murrelets (both listed as Federally Threatened species), and peregrine falcon (listed as a Federal Species of Concern). In partnership with the South Puget Sound Salmon Enhancement Group and Kennedy Creek Advisory Committee, the Kennedy Creek NAP estuary has been incorporated into the interpretive salmon trail tour during the chum-spawning season.”

Wynne – Schneider Tributary, RCO Project Number 04-1531 South Puget Sound SEG, completed

“The Tom Wynne Schneider Creek Tributary project is located upstream of a large wetland complex on mainstem Schneider Creek located about river mile 3. Schneider Creek is a significant salmon bearing stream in WRIA 14 that offers several types of complex fish habitat including beaver dams and ponds. There are several small tributaries that provide additional spawning and rearing potential for salmonids. The Tom Wynne project is located on a right bank tributary on a small forest landowner road. The existing road crossing is a failing log crossing that is in danger of failing. The log crossing is not passable for any fish species. The proposed project will install a WDFW stream simulation culvert that will provide access for coho, rainbow, and cutthroat. The design will follow all applicable WDFW criteria and provide fish passage and dramatically improve the road crossing. This project will provide access to about 0.7 miles of additional habitat in the watershed. The available habitat has mature cedar and conifer riparian zone. The substrate is mixed with gravels, cobbles, and sand. The overall channel complexity appears to be in good shape. The project will provide increased habitat benefits for the overall watershed connectivity. The Schneider Creek watershed is mostly intact and the estuary is protected by WDNR under the Natural Area Preserve (NAP) program. There are several other larger tracts of land that offers excellent salmon habitat.”
6.8.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Lake</td>
<td>LPO1</td>
<td>1</td>
</tr>
<tr>
<td>Marine</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

6.9 SQUAXIN PASSAGE

6.9.1 Basin Characteristics

Squaxin Passage basin is located on the northern tip of the Steamboat Island peninsula. It is 489 acres in size and is located entirely within WRIA 14. Jurisdictional shoreline information for this basin is summarized below.
6. Basin Analysis – WRIA 14 (Kennedy Goldsborough)

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>3.2044</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Squaxin Passage basin is bordered by Puget Sound to the north, Eld Inlet to the east and Eld Inlet (west) basin to the south, and Totten Inlet basin to the west.

This basin contains the area known as the Carlyon Landslide area. The landslide area is located along the marine shoreline and is approximately 3,000 feet in length and extends inland 900 feet. Landslide scarps associated with the slide reach up to 15 feet high. The landslide area had been largely dormant for the majority of recent history. Residential houses had been built within slide area. The landslide area began to move again in February 1999. The slide was slow moving and homeowners were requested to evacuate because of severe structural damage caused by the slide. In total, 41 homes were damaged by the slide, and 33 homes in the area were declared uninhabitable. Building of new residential homes in this area is not allowed at this time.

Water in this basin generally flows into south Puget Sound.

Primary use of this basin is rural residential and undeveloped land. The TRPC population forecast indicates that as of 2006 there were 450 dwelling units identified within this basin and projects an increase to 510 dwelling units by 2030.

6.9.2 Public Access

There is no defined shoreline access in this basin. The Carlyon Beach Home Owners association provides semi-public access to the community in the form of a beach and marina. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

6.9.3 Priority Habitats and Critical Areas

The marine environment adjacent to this basin is mapped as supporting rock sole, sand lance, herring and shellfish. The marine shoreline is mapped as providing habitat for seabirds.

The basin is also mapped as providing habitat for purple martins and bald eagle.

High ground water flood hazard areas are mapped within in central portion of the basin at the terminus of an unnamed stream extending from Eld Inlet basin. These high ground water flood hazard areas are also mapped as wetland areas.

Hazardous slope areas are mapped along the entire marine bluff area of this basin.
This basin contains one un-named stream that flows into the Puget Sound. This stream is not mapped as meeting the shoreline jurisdiction requirements. However, this stream is likely to qualify as critical areas pursuant to TCC 17.15.

6.9.4 Evidence of Processes Disturbed or Potentially Impacted Function

2006 aerial photos indicate that the majority of the marine shoreline within this basin is armored.

The Carlyon slide area, outlined in section 6.9.1, provides evidence of both disturbed processes and potentially impacted function within this basin.

The TRPC study of Rate of Urbanization and Forest Harvest in Thurston County 1985-2000 indicates that urban cover within this basin as of 2000 was 11%.

6.9.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Squaxin Passage basin:

Bulkheading in Thurston County: Impacts on Forage Fish Spawning Habitat, 2005. Herrera Environmental and Thurston Regional Planning Council. This study identifies the marine shoreline within this basin as high priority areas for restoration.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000, January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area, June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

6.9.6 Enhancement or Restoration Activities Implemented

No enhancement or restoration activities have been identified within this basin.

6.9.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n/a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no riverine reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n/a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no lake reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n/a</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6.10 **SUMMIT LAKE**

6.10.1 **Basin Characteristics**

The Summit Lake basin is located in the northwestern portion of the County. The basin is 1,900 acres in size. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>5.6103</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>
Summit Lake basin is bordered by Schneider Creek basin to the north, Perry Creek basin to the east and Kennedy Creek basin to the west.

The drainages feeding into the lake are steep and rugged with slopes up to 80 percent. There are numerous springs and intermittent streams that flow into the lake. The outlet, at the west end of the lake, is controlled by flash boards and flows into Kennedy Creek.

Water within Summit Lake basin generally flows towards Summit Lake.

Primary use of this basin is undeveloped land and designated forest with dense residential development concentrated along the shoreline. Summit Lake is the primary source for drinking water for the majority of the homes around the lake. The Thurston Regional Planning Council’s population forecast indicates that as of 2006 there were 410 dwelling units identified within this basin and projects an increase to 540 dwelling units by 2030.

**6.10.2 Public Access**

Public access to Summit Lake is available via a WDFW boat launch. In addition to the WDFW boat launch there are three small private community accesses to Summit Lake as well as access from the Boy Scout Camp located at the western end of the lake.

In addition to defined public access to the shoreline, informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

**6.10.3 Priority Habitats and Critical Areas**

Summit Lake is mapped as supporting resident cutthroat trout. In addition, WDFW stocks Summit Lake with kokanee and rainbow trout.

Hazardous slopes/slide areas are mapped around the majority of Summit Lake.

The wetland areas mapped within this basin are associated with the lake and are located primarily at the northern and western ends of the lake.

Summit Lake has an un-named stream mapped as connection to Kennedy Creek. The northern portion of this connection is part of the shoreline jurisdiction. Review of this area is incorporated into the reach review for Summit Lake. Reaches associated with Summit Lake are assigned in section 6.10.7 and described in Appendix A.

**6.10.4 Evidence of Processes Disturbed or Potentially Impacted Function**

A review of 2006 aerial photographs indicates that the majority of lake is armored with bulkheads. In addition to bulkheads, this lake contains a large number of overwater structures, such as docks and boat lifts, as well as modification to shoreline vegetation.
A study of fish passage culverts conducted in 1996 by the WDFW noted one fish barrier within this basin located at the intersection of an unnamed stream and Summit Lake Road.

A barrier study conducted for the years of 1996-2000 by WDFW noted one barrier within the basin located at the intersection of an unnamed stream and Summit Lake Road.

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

6.10.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Summit Lake basin:

Summit Lake has three water quality gauges on it. These gauges include a rain gauge, a level gauge and a water quality sample site.

Thurston County has identified fecal contamination as a concern for this basin.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Summit Lake Sub-area Plan. October 1977. Thurston County Planning Department. This plan addresses the status of the sub-area as of 1977 as well as future plans.

Water Resources Monitoring Report 2003-2005 Water Years. 2006. Thurston County Department of Social Services Environmental Health Division and Thurston County Department of Waste Water Management. This report lists Summit Lake water quality as excellent. This rating is due to the lake having low nutrient and chlorophyll a levels as well as high visibility. The high water quality is important because the lake is the drinking water source for most of the lake residents. Steep slopes, shallow soils, and generally small lots sizes make siting and functioning of on-site sewage systems around the lake difficult. In addition, the high density residential activities along the shoreline and forestry activities in the upper watershed are a concern for water quality.

Totten-Little Skookum Inlet Watershed Action Plan. October 1989. Thurston County Planning Department and Mason County Planning Department. This action plan provides a tool to inform management decisions on controlling non-point pollution for the watershed. The report identifies the characteristics of the watershed, types and sources of non-point pollution, as well as goals and action recommendations for reducing pollution.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.
6.10.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

Summit Lake, RCO Project Number 75-643, DFW, completed

“This project involves the redevelopment of an existing boat access ramp and parking area to improve the parking and boat launching facilities. Summit Lake is located six miles east of McCleary.”

6.10.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Lake</td>
<td>LSU</td>
<td>2</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>
6.11 TOTTEN INLET

6.11.1 Basin Characteristics

Totten Inlet basin is located in the northwest corner of the county. It is 4,107 acres in size and is located entirely within WRIA 14. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>13.4793</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Totten Inlet basin is adjacent to Totten Inlet to the north, Squaxin Passage and Eld Inlet (west) basins to the east, Schneider Creek basin to the south, and Totten Inlet to the west.

Water within Totten Inlet basin generally flows into Totten Inlet basin.
Primary land use in this basin is divided among rural residential, undeveloped land and designated forest land. The Thurston Regional Planning Council’s population forecast indicates that as of 2006 there were 720 dwelling units identified within this basin and projects an increase to 1,050 dwelling units by 2030.

6.11.2 Public Access

There is no defined shoreline access in this basin. However, Louise H. Meyers Park, currently undeveloped, may be able to provide access in the future. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

6.11.3 Priority Habitats and Critical Areas

Habitat for rock sole, smelt, herring and sand lance is mapped along the entire length of marine shoreline of this basin. Shellfish habit is mapped along the northern marine shoreline of this basin.

Bald eagle and purple martin habitat is mapped near or within the shoreline in several areas in the basin.

Wetlands are mapped throughout the basin.

Hazardous slopes are mapped along the majority of the marine shoreline in this basin.

6.11.4 Evidence of Processes Disturbed or Potentially Impacted Function

Thurston County has identified shoreline development as a concern for this basin.

Timber/forestland use exists within the reaches of this basin.

A study of fish passage culverts conducted in 1996 by the WDFW noted one fish barrier within this basin. This barrier was noted at the intersection of an unnamed stream and Oyster Bay Road.

This basin contains a small number of mapped un-named streams that flow into Puget Sound. These streams are not mapped as a shoreline of the state as they are not currently identified as exceeding a 20 cubic feet per second mean annual flow. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

6.11.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Totten Inlet basin:

Burns Creek contains a water quality sample site.

Bulkheading in Thurston County: Impacts on Forage Fish Spawning Habitat, 2005. Herrera Environmental and Thurston Regional Planning Council. This study identifies the marine shoreline within this basin as high priority areas for restoration.
Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Totten-Little Skookum Inlet Watershed Action Plan. October 1989. Thurston County Planning Department and Mason County Planning Department. This action plan provides a tool to inform management decisions on controlling non-point pollution for the watershed. The report identifies the characteristics of the watershed, types and sources of non-point pollution, as well as goals and action recommendations for reducing pollution.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

6.11.6 Enhancement or Restoration Activities Implemented

No enhancement or restoration activities have been identified within this basin.

6.11.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>There are no riverine reaches in this basin.</td>
<td>n/a</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>There are no lake reaches in this basin.</td>
<td>n/a</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Totten Inlet</td>
<td>MTO</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The data provided in this chapter are divided into subsections focused on the basins located within the Upper Chehalis Water Resource Inventory Area (WRIA 23). Each subsection begins with an overview of the basin and includes information regarding basin characteristics and water bodies, public access, and priority habitats/critical areas. Additional data follows regarding impacts to function, specific sources of basin information, and restoration/enhancement opportunities. In addition to specific sources cited below, the content of this chapter generally is based on documents, mapping information, and other resources described in Appendix B: Shoreline Inventory. That appendix highlights pertinent WRIAs and basins for each source.
7.1 ALLEN CREEK

7.1.1 Basin Characteristics

Allen Creek basin is located in central portion of the County. It is 3,419 acres in size and is located entirely within WRIA 23. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>3.0146</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Allen Creek basin is bordered by Salmon Creek basin to the north, Bloom Ditch basin to the east, Beaver Creek basin to the south and Black River basin to the west.

The basin contains Millersylvania Park. Millersylvania State Park is an 842-acre park. The park contains approximately 3,300 feet of freshwater shoreline on Deep Lake.
Water in Allen Creek basin generally flows toward Allen Creek, Scott Lake, and Deep Lake. Allen Creek flows into Beaver Creek and ultimately Black River.

The primary land uses of this basin are residential, parks, designated forest, and agriculture. The TRPC population forecast indicates that as of 2006 there were 590 dwelling units identified within this basin and projects an increase to 760 dwelling units by 2030.

7.1.2 Public Access

There is public access to the shoreline of Deep Lake from Millersylvania Park. This public access to Deep Lake provides opportunities for boating, fishing and swimming.

In addition to defined public access to the shoreline, informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

7.1.3 Priority Habitats and Critical Areas

Allen Creek is mapped as supporting coho salmon, sea-run cutthroat and resident cutthroat. Additionally, the creek contains spawning and rearing habitat for coho salmon.

WDFW stocks Deep Lake with rainbow trout.

This basin is mapped as containing habitat for wood duck, osprey, peregrine falcon and green heron.

The basin contains high ground water flood hazard areas. The majority of these areas are mapped within two locations in the basin. The first area is west of the Interstate Highway 5 corridor; the second area is associated with Scott Lake.

Wetland areas mapped throughout the basin.

This basin contains several streams including Allen Creek and Blooms Ditch as well as several unnamed tributaries. These streams are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

7.1.4 Evidence of Processes Disturbed or Potentially Impacted Function

Flood damage occurred to Case Road during the 1996 flood event.

Timber and forestland use exists within the reaches of this basin.

This basin contains a superfund site located at 13120 Tilley Road South, Maytown. This parcel sits at the intersection of Allen Creek, Beaver Creek and Bloom Ditch basins. It is therefore listed as evidence of process disturbed or potentially impacted function for all three basins. The site is also known as the former Pacific Powder site. The contamination on the site is related to the manufacturing dynamite and other explosives that occurred on site from the early 1940’s.
until 1994. Clean up activities occurred on site in 1995 and 1997. Additionally, public access to the site is limited by a fence and locked gate, which limits potential exposure to any remaining contaminants on site.

### 7.1.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Allen Creek basin:

Scott Lake has a level gauge.

**Black Lake/Littlerock/Delphi Sub-area, 1981.** TRPC. This report provides recommendations for future residential, commercial, and industrial development. It also provides information of the area’s history, resources and characteristics.

**Rate of Urbanization and Forest Harvest in Thurston County 1985-2000.** January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

**The Relationship of Land Cover to Total and Effective Impervious Area.** June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

**Water Resources Monitoring Report 2003-2005 Water Years.** 2006. Thurston County Department of Social Services Environmental Health Division and Thurston County Department of Waste Water Management. The study notes that general water quality of Deep Lake is good, visibility is usually good, and phosphorus levels are below the state water quality action level. The study notes that the spreading of communicable diseases during the high usage summer months is a major issue for the lake. Additionally, the study notes that Eurasian water milfoil was discovered in the lake in 2003. Washington State Parks and Recreation is taking steps to control this invasive plant species spread in the lake.

The study notes that general water quality of Beaver Creek is good. However, part II of the fecal coliform standard was not met at the Littlerock Rd. site for both water years 2003-04 and 2004-05. Low dissolved oxygen levels occur occasionally at the upstream Case Road site due to low stream gradient and flow. Major issues for this creek identified by the study included livestock access practices may be contributing to pollution and Development pressures are continuing to increase in the area.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

### 7.1.6 Enhancement or Restoration Activities Implemented

No enhancement or restoration activities have been identified within this basin.
7.1.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Lake</td>
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<tr>
<td>Marine</td>
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</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>7</td>
</tr>
</tbody>
</table>

7.2 Beaver Creek

7.2.1 Basin Characteristics

Beaver Creek is located in the central portion of the county. It is 15,854 acres in size. The majority of the basin, 15,181 acres, is located in WRIA 23. A small portion of the basin, 673 acres, is located in WRIA 13. As the majority of the basin is located in WRIA 23, review of it is provided in this chapter. Jurisdictional shoreline information for this basin is summarized below.
7. Basin Analysis – WRIA 24 (Upper Chehalis)

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
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</tr>
</thead>
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<tr>
<td>SMA Stream</td>
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<tr>
<td>SSS Stream</td>
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<td>SMA Lake</td>
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<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Beaver Creek basin is bordered by Allen Creek and Bloom Ditch basins to the north, Deschutes River and Offut Lake basins to the east, Scatter Creek basin to the south, and Black River basin to the west.

Water in Beaver Creek basin generally flows into Beaver Creek and ultimately Black River.

The current primary land use for this basin is divided among residential, undeveloped land, and designated forest land. In addition, light industrial and commercial uses exist near Maytown and Littlerock. The TRPC population forecast indicates that as of 2006 there were 690 dwelling units identified within this basin and projects an increase to 1,560 dwelling units by 2030.

7.2.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

7.2.3 Priority Habitats and Critical Areas

Beaver Creek is mapped as supporting coho salmon, sea-run cutthroat and resident cutthroat. It is also mapped as providing spawning and rearing habitat for coho salmon.

Mazama pocket gopher, mardon skipper, valley silverspot, Puget blues, and Taylor’s (Whulge) checkerspot, Oregon spotted frog, wild turkey, Oregon vesper sparrow and Oregon branded skipper and wood duck habitat are mapped within this basin.

A large, approximately 600 acre Conservation Area owned by WDFW is located within the Beaver Creek basin.

Oak and grasslands are mapped within the northern tip of basin.

The 100-year flood plain is associated with all water bodies in basin.

Wetlands within the basin extend from the southern end to the central portions of the basin.

This basin contains several streams including Beaver Creek as well as several unnamed tributaries. The length of Beaver Creek within this basin is considered part of the shoreline jurisdiction and has reaches assigned in section 7.2.7 and described in Appendix A.
associated tributaries are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

7.2.4 Evidence of Processes Disturbed or Potentially Impacted Function

A study of fish passage culverts conducted in 1996 by the WDFW noted two fish barriers within this basin. These barriers were noted at the following intersections: unnamed stream and Case Road and an unnamed stream and Old Highway 99.

This basin contains a superfund site located at 13120 Tilley Road South, Maytown. This parcel sits at the intersection of Allen Creek, Beaver Creek and Bloom Ditch basins. It is therefore listed as evidence of process disturbed or potentially impacted function for all three basins. The site is also known as the former Pacific Powder site. The contamination on the site is related to the manufacturing dynamite and other explosives that occurred on site from the early 1940’s until 1994. Clean up activities occurred on site in 1995 and 1997. Additionally, public access to the site is limited by a fence and locked gate, which limits potential exposure to humans due to any remaining contaminants on site.

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

7.2.5 Research, Studies, and Available Spatial Information

The following research, studies and spatial information are available for the Beaver Creek basin:

Beaver Creek has a water quality gauge located on it.

Black Lake/Littlerock/Delphi Sub-area. 1981. TRPC. This report provides recommendations for future residential, commercial, and industrial development. It also provides information of the area’s history, resources and characteristics.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

Water Resources Monitoring Report 2003-2005 Water Years. 2006. Thurston County Department of Social Services Environmental Health Division and Thurston County Department of Waste Water Management. This report indicates that the part II fecal coliform standard was not meet for the years of 2003-2004 and 2004-2005 at the water quality testing site. The study also notes that low dissolved oxygen levels occur occasionally at the upstream Case Road water quality testing site due to low stream gradient and flow. The study further noted that major issues threatening water quality in for this basin are: (1) livestock access practices may be contributing to pollution and (2) Development pressures are continuing to increase in the area.
Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

7.2.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

**Robbins-Beaver Creek Riparian Restoration, RCO Project Number 99-1399, Thurston County Conservation District., completed**

“This project will fence and re-vegetate the 5-acre Robbins Family Farm located along Beaver Creek. The landowners plan to put llamas in the lower pasture, which would negatively impact riparian habitat along Beaver Creek. They have agreed to fence off the creek and replant some of the cleared areas with native plants that will benefit wildlife. Approximately 600 feet of fence will be used to exclude livestock from Beaver Creek and the associated wetland. The wetland area associated with the creek is located on the east side of the property and, until recently, was totally devoid of vegetation. The Robbins have already planted 150 native plants in these areas, and this project will plant 600 additional native plants (a diverse section of conifers and shrubs) along stretches of Beaver Creek. Without such planting it is very likely that this area will soon be dominated by reed canary grass. The Robbins will provide labor for the site preparation and planting. They will also continue to maintain the fence and plants for a 10 year period. This maintenance will include fence repairs, removal of weeds to ensure the survival of the plantings, photo documentation of the progress of the plants, and replacement of plant materials if needed.”

**Denney Riparian Planting and Fencing, RCO Project Number 99-1400, Thurston County Conservation District., completed**

“Beaver Creek, a tributary of the Black River, runs through Denney Farm, a 5-acre farm in the Chehalis Watershed near Tenino, WA. This project will fence off segments of Beaver Creek on the Denney Farm, remove reed canary grass in a 2.3-acre area, and establish a 75’ buffer on both sides of Beaver Creek. Both sides of the western end of the property, and one side of the eastern end of the property along the creek will be fenced. Five-strand high tensile wire on line posts will be used for fencing (1500 ft total). Gates will be installed over an existing bridge. The riparian buffer will be planted with native trees and shrubs. The fence and plantings will be maintained by the landowner over a 10 year period. As a result of this project, livestock from the creek will be excluded, thereby reducing erosion, sedimentation, and fecal bacteria levels; the survivability of native plants will increase; clogging of the stream by invasive weeds will be reduced; and native plantings will increase shade and help maintain lower water temperatures, provide a future source of woody debris, stabilize stream banks, provide food & forage for wildlife, and increase nutrient loading to the stream.”

**Millersylvania-Miles Acquisition, RCO Project Number 06-1651, State Parks, in process**

“State Parks will use this grant to buy 70 acres to expand its popular 842-acre Millersylvania State Park on Deep Lake, just south of Olympia. The land, adjacent to the park, includes forests, a large pond suitable for swimming, and an open area. The acquisition would allow for an expanded day-use site with new swimming access, forested trails, play areas, and additional rustic cabins.”
7.2.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td>BL-9</td>
<td>5</td>
</tr>
<tr>
<td>Beaver Creek</td>
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</tr>
<tr>
<td>Lake</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>There are no lake reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Marine</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>There are no marine reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

7.3 BLACK LAKE

7.3.1 Basin Characteristics

This basin is located in the central portion of the county. It is 5,526 acres in size. The majority of the basin, 4,885 acres, is located in WRIA 23. A small portion of the basin, 641 acres, is located in WRIA 13. As the majority of the basin is located in WRIA 23, review of it is provided in this chapter. Jurisdictional shoreline information for this basin is summarized below.
The Black Lake basin is bordered by Percival Creek basin to the northeast, the Deschutes River basin to the east, Salmon Creek basin to the southeast, Dempsey Creek basin to the southwest, and McLane creek basin to the northwest.

Water within the Black Lake basin generally flows towards Black Lake. Black Lake flows north to Percival Creek and Capital Lake, ultimately reaching Budd Inlet.

The majority of the basin is urban and rural residential or undeveloped land. The TRPC population forecast indicates that as of 2006 there were 2,620 dwelling units identified within this basin and projects an increase to 4,660 dwelling units by 2030.

### 7.3.2 Public Access

There are multiple accesses to Black Lake located within this basin. These access points include the following: WDFW public boat launch and Thurston County’s Kenneydell Park. Kenneydell Park provides both swim and waterfront view access areas. In addition to the public access points, there are five (5) semi-public access points. These semi-public access points include: a church camp, two private resorts, and 2 private community access points.

Future access to Black Lake may be provided when an undeveloped park owned by Thurston County Parks and Recreation, Guerin Park, is developed.

In addition to defined public access to the shoreline, informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

### 7.3.3 Priority Habitats and Critical Areas

The streams connected to Black Lake within this basin are mapped as supporting coho salmon, fall Chinook, largemouth bass, and sea-run and resident cutthroat. As such, it is feasible that these species may also be found in Black Lake as well.

WDFW stocks Black Lake with rainbow trout.

This basin is mapped as providing habitat for green heron, wood duck, waterfowl concentrations, mink, and bald eagle.

100-year flood plain is associated with Black Lake.
Hazardous slopes are mapped in the northern section of the basin.

Wetland areas are identified throughout the basin but are most predominant at the southern terminus of Black Lake extending southward.

This basin contains a portion of the Black River as well as several unnamed tributaries. The length of the Black River within this basin is considered a shoreline of the state and has reaches assigned in section 7.3.7 and described in Appendix A. The un-named tributaries are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

### 7.3.4 Evidence of Processes Disturbed or Potentially Impacted Function

A study of fish passage culverts conducted in 1996 by the WDFW noted one fish barrier within this basin. This barrier was identified at the intersection of an unnamed stream and Fairview Road.

The eastern portion of the basin experienced flooding during the 1999 flood event.

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

The TRPC study of *Rate of Urbanization and Forest Harvest in Thurston County 1985-2000* indicates that urban cover within this basin as of 2000 was 9%.

### 7.3.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Black Lake basin:

Thurston County has identified lake water quality as a concern for this basin.

**Black Lake/Littlerock/Delphi Sub-area.** 1981. TRPC. This report provides recommendations for future residential, commercial, and industrial development. It also provides information of the area’s history, resources and characteristics.

**Rate of Urbanization and Forest Harvest in Thurston County 1985-2000.** January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

**The Relationship of Land Cover to Total and Effective Impervious Area.** June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

**Water Resources Monitoring Report 2003-2005 Water Years.** 2006. Thurston County Department of Social Services Environmental Health Division and Thurston County Department of Waste Water Management. This report indicates that water quality of the Black Lake is fair. The “fair” rating is a result of the lake having a moderate to high nutrient concentrations. These nutrient concentrations may result in blue-green algae growth forming thick scums on the water.
in late summer and fall. The algae blooms can interfere with recreational uses of the lake. In addition to the algal blooms, the report identifies major issues within the lake as including occasional beaver activity in the lake outlet ditch to the north which causes lake levels to rise, resulting in flooding of yards and docks.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

7.3.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

Public Fishing – Black Lake, RCO Project Number 73-631, Washington State Department of Fish and Wildlife, completed

“This project is for the construction of two concrete boat launching ramps with associated parking, sanitary facilities and access road as improvements to an existing boat launching facility on Black Lake. The site is located approximately 3 miles southwest of Tumwater.”

Guerin Park, RCO Project Number 75-018, Thurston County Parks and Recreation, completed

“This project is for the acquisition of a 40 acre site to provide, when developed, a public recreational facility on Black Lake. One boat launch on the other side of the lake had been the only public access. When developed, the site provided opportunities for picnicking, field sports, with major emphasis on water-oriented activities such as swimming, boating and water skiing.”

Kenneydell Park Phase 2 Development, RCO Project Number 98-1201, Thurston County Parks and Recreation, completed

“Thurston County is seeking WWRP’s funding assistance to acquire and develop 23 acres of park property next to the existing Kenneydell Park, located southwest of Olympia on Black Lake. In 1992, Thurston County received a WWRP grant to develop this former Girl Scout camp into a community park with a swim beach. The Park has been tremendously popular, with over 90,000 visits in its first year. More parking and field facilities are urgently needed. To expand the opportunities in the area, the county plans to acquire the 23 acres located across the street and to develop that property with a variety of passive and active opportunities. The development portion of the project includes: additional parking, one soccer field, one softball field, restroom building, two picnic shelters, access trails, signing, and site infrastructure.”

Fairview Road/ Michelle Creek, RCO Project Number 99-1441, Washington State Department of Fish and Wildlife, completed

“The stream, crossing consists of a 3’ diameter CMP and two 18” diameter concrete overflow culverts. All culverts are 40’ long. This culvert is a barrier due to velocity, inadequate water depth and a 2’ outfall drop at the downstream end. Immediately upstream is a water intake which supplies a series of private ponds. The existing culverts will be replaced with a single 71” x 103” x 50’ arch pipe. The pipe will be installed at a 5% gradient to maintain existing streambed
elevations and ensure the functioning of the upstream gravity water supply intake. A five weir, pool-chute fishway will be built inside the culvert."

### 7.3.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no riverine reaches in this</td>
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<td>n/a</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black Lake</td>
<td>LBL</td>
<td>13</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no marine reaches in this basin.</td>
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<td>n/a</td>
</tr>
<tr>
<td><strong>Total Reaches</strong></td>
<td></td>
<td>13</td>
</tr>
</tbody>
</table>

### 7.4 Black River

![Map of Black River Basin](image)
7.4.1 Basin Characteristics

The Black River basin is located in the central portion of the county. It is 25,092 acres in size and is located entirely within WRIA 23. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
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<th>Length (in miles)</th>
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<td>48.9468</td>
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<td>SSS Stream</td>
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<td>SSS Lake</td>
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<tr>
<td>SMA Marine</td>
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</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

The Black River basin is bordered by Dempsey Creek, Black Lake, and Salmon Creek (Black River) basins to the north, Bloom Ditch, Allen Creek, and Beaver Creek basins to the east, Scatter Creek and Prairie Creek basins to the south, the Thurston County border, Sherman Creek, Mima Creek, Waddell Creek basins to the west.

Small portions of this basin are located within the Tumwater Urban Growth Area; small portion of the western most tip of the basin is located in the Capitol Forest. This basin also contains three parks. These parks are as follows: Glacial Heritage Preserve, the Mima Mounds Natural Area Preserve, and Black River Park.

The Black River has a large number of associated wetlands. The formation of wetlands along the Black River is primarily associated with two factors. One factor is that the water table within this area is commonly at or above the ground surface. The other factor is flooding along the Black river that occurs due to back-flow from the Chehalis River.

Water within this basin generally flows into Black River. Black River converges with the Chehalis River and ultimately flows into the Pacific Ocean.

Primary Land Use for this basin is residential, designated forestland, agriculture, and undeveloped. General land use also reflects the urban aspects of this basin as the remainder of the basin is utilized for retail, services, transport, utilities, and commercial/industrial applications. The TRPC population forecast indicates that as of 2006 there were 2,190 dwelling units identified within this basin and projects an increase to 3,180 dwelling units by 2030.

7.4.2 Public Access

There are multiple accesses to Black River located within this basin. These access points include two WDFW public boat launches. Additional public access may be possible from Glacial Heritage Preserve and/or Black River Natural Area. Future public access, either direct or view, may occur through the planned “rails to trails” Gate to Belmore trail.
In addition to defined public access to the shoreline, informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

7.4.3 Priority Habitats and Critical Areas

The northern portion of Black River in this basin is mapped as supporting resident cutthroat, largemouth bass, fall Chinook, sea-run cutthroat, and coho salmon. Spawning and rearing habitat for coho salmon is mapped within northern portion of the Black River. However, the spawning and rearing habitat does not reach Black Lake. The southern portion of Black River is mapped as supporting for resident cutthroat, sea-run cutthroat, fall Chinook, largemouth bass, winter steelhead, and coho salmon. The southern portion of Black river is also mapped as containing spawning and rearing habitat for fall Chinook and coho salmon.

Dempsey Creek is mapped as supporting winter steelhead, sea-run cutthroat, coho salmon, and resident cutthroat. Dempsey creek is also mapped as containing spawning and rearing habitat for winter steelhead and coho salmon.

Salmon Creek is mapped as supporting coho salmon, winter steelhead, sea-run cutthroat, and resident cutthroat. Additionally, Salmon Creek is mapped as providing spawning and rearing habitat for coho and winter steelhead.

Bloom Ditch is mapped as supporting winter steelhead, sea-run cutthroat, coho salmon, and resident cutthroat as well as spawning and rearing habitat for winter steelhead and coho salmon.

This basin is mapped as providing habitat for wood duck, harlequin duck, Taylor’s (Whulge) checkerspot, valley silverspot, osprey, mardon skipper, streaked horned lark, Olympic mudminnow, reticulate sculpins, speckled dace, green heron, mink, Oregon spotted frog, Oregon vesper sparrow and waterfowl concentrations.

Wetlands are located throughout the majority of the basin.

Parks within Black River basin, such as Glacial Heritage County Park and Mima Mounds Natural Preserve are recognized as providing quality prairie habitat.

The 100 year flood plain is associated with the majority of the Black River, the central portion of the basin, Dempsey and Salmon Creek.

Only small areas of hazardous slopes are mapped in the basin. These are mapped as being located in the center of the basin, west of the terminus of 88th Ave SW and are likely associated with the functioning of local mining facility.

Oak conifer forests are mapped as associated with the Black River in the southern section of the basin.

Extensive wetland areas are associated with the Black River, Bloom Ditch and an unnamed northwestern tributary in the basin.
This basin contains portions of the Black River, Salmon Creek, Beaver Creek, as well as several unnamed tributaries. The portions of the Black River, Salmon Creek, and Beaver Creek within this basin are considered shorelines of the state and have reaches assigned in section 7.4.7 and are described in Appendix A. The associated tributaries are not mapped as a shoreline of the state as they are not currently identified as exceeding a 20 cubic feet per second mean annual flow. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

7.4.4 Evidence of Processes Disturbed or Potentially Impacted Function

A study of fish passage culverts conducted in 1996 by the WDFW noted one fish barrier within this basin. This barrier was noted at the intersection of an unnamed stream and Littlerock Road.

The majority of the mapped 100-year flood plain flooded during the 1996 flood event. Littlerock Road as well as the area located in the southeastern corner of the basin experience damage as a result of this event.

This basin contains a known or suspected contaminated site. The Hytec Littlerock site located at 13434 S.W. Halo Kuntux Lane, Olympia. Ecology has rated this site as a “four” on a scale of five, with one representing the highest relative risk compared to other sites. In 1990, Ecology contracted with SAIC (Science Application International Corporation) to study the property. As a result of the study it was determined that further study before cleanup of the site can occur. Last update of the Ecology website occurred on April 2006. Review appears to be ongoing at this time.

This basin contains Walentiny Dam. The Primary Coordinates are: Latitude 46.8898 and Longitude -123.0113.

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

7.4.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Black River:

This basin contains the following water quality gauges: a water quality gauge and staff gauge are located on Bloom Ditch, a stream gauge and water quality sample site on Black River, and a rain gauge and water quality sample site on Beaver Creek.

Black Lake/Littlerock/Delphi Sub-area. 1981. TRPC. This report provides recommendations for future residential, commercial, and industrial development. It also provides information of the area’s history, resources and characteristics.

Natural Hazards Mitigation Plan for the Thurston Region. 2003. Andrews, S. et al. The study notes the following on the flooding history of the Black River:

*The Black River is a slow, meandering stream that flows through Thurston County for approximately 19 miles. Extending south from Black Lake, the river is lined by marshland, and the water table is perennially at or above the ground surface. Little development has occurred near the river for this reason. The preponderance of flooding*
along the Black River is caused by back-flow from the Chehalis River and similar recurrence intervals can be expected.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Water Resources Monitoring Report 2003-2005 Water Years. 2006. Thurston County Department of Social Services Environmental Health Division and Thurston County Department of Waste Water Management. The Black River general water quality is listed as good and that summer high temperatures occur, which are a natural condition. The report identifies the major issues for this water body as: High temperatures and low dissolved oxygen levels during summer low flow conditions and Non-point pollution from rural land-uses.

Salmon Creek general water quality for the creek is listed as good. The study notes that the creek met the fecal coliform standard. However, dissolved oxygen is low in dry months. The report identifies the major issues for the creek as the potential for flooding as noted in the following text: During the rainy seasons of 1996-97 and 1998-99, above average rainfall caused localized flooding, failed septic systems, contaminated drinking water and restricted access to property. Flooding is expected to occur again when there is above average rainfall.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

7.4.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

Mima Mounds Completion, RCO Project Number 81-700, DNR, completed

“This project proposal is for the completed development of the 444.85 acre Mima Mounds Natural Area, for educational, scientific research, and public outdoor enjoyment purposes. Development will consist primarily of a loop foot trail, benches, signing, and fencing.”

Black River Access 82, RCO Project Number 82-704, DNR, completed

“This project proposal is for the development of a 1.03 acre parcel of land for the purpose of providing a river access site as part of a float trail complex for canoe, kayak, and small boat enthusiasts.”
Black River Refuge, RCO Project Number 00-1858, The Nature Conservancy, completed

“This project acquired high quality riparian habitat along the Black River and Waddell Creek, one of the largest remaining riparian wetland systems in western Washington. The three properties protect more than 165 acres of wetland and upland habitat and approximately two miles of river frontage along Black River. The Rainbow Valley and Schuetzen properties lie directly across the river from Thurston County's Glacial Heritage Site, providing an important link with the natural area.”

Black River Habitat Protection, RCO Project Number 04-1667, Capitol Land Trust, completed

“Capitol Land Trust will protect through conservation easement, a 75-acre parcel containing a mix of riparian/wetland/floodplain habitat (45-50 acres), and associated conifer forest and oak woodland buffers (15-20 acres). The mainstem and off-channel habitat forms a complex system of waterways for salmonids. A rich native vegetation buffer lines the property's riparian areas, providing excellent protection for salmonids and recruitment source of Large Woody Debris (LWD). Black River is a high priority sub-basin in the Chehalis Watershed and is one of the largest remaining riparian wetland systems in western Washington. One of the most rapidly developing areas in the state, residential development is a primary threat to salmonids. This project addresses both habitat protection and water quality needs by reducing future habitat loss and water quality degradation associated with development. Black River and associated tributaries provide important rearing and spawning habitat for steelhead, coastal cutthroat trout (Fed. Proposed-threatened), and chum, coho (Fed. Candidate) and chinook salmon. The Bergquist parcel is situated between major protected areas including the USFWS's Black River Unit (Nisqually Wildlife Refuge) and other protected areas owned by The Nature Conservancy, Thurston County and Capitol Land Trust. This project has the support of The Nature Conservancy, US Fish and Wildlife Service and the landowners.”

South Sound Prairie and Grassland Bald Restoration, RCO Project Number 08-1535, WDFW, proposed

“The Washington Department of Fish and Wildlife will use this grant to develop and plant seeds of rare plants in the Scatter Creek, Mima Mounds, Bald Hill, Rocky Prairie, and West Rocky Prairie areas. These areas are home to rare plants, animals, and plant communities of concern to both the Department of Fish and Wildlife and the Department of Natural Resources. The project goal is to develop cooperative actions to restore these rare habitats, including developing genetically appropriate seed sources for use in restoration work. To date, restoration has relied on propagation and transplanting of plugs from seeds collected by hand, which does not generate enough seed to meet the restoration needs. The two agencies are entering into a partnership to build the seed production capacity to allow for direct seeding in grassland and oak woodland restoration in western Washington. The department will contribute $15,000 in equipment.”

### 7.4.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Thurston County Shoreline Master Program Update  
Shoreline Analysis and Characterization  
July 14, 2009  
253
7.5 **BLOODY RUN**

### Basin Characteristics

Bloody Run basin is located in the southern central section of the county. It is 2,062 acres in size and is located entirely within WRIA 23. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.3963</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>Black River</td>
<td>BL 15</td>
</tr>
<tr>
<td>Salmon Creek</td>
<td>BL-5 2</td>
</tr>
<tr>
<td>Beaver Creek</td>
<td>BL-9 1</td>
</tr>
<tr>
<td>Lake</td>
<td>n/a n/a</td>
</tr>
<tr>
<td>Marine</td>
<td>n/a n/a</td>
</tr>
<tr>
<td>Total Reaches</td>
<td>18</td>
</tr>
</tbody>
</table>
The basin is bordered by Deschutes River basin to the north, Reichel Lake basin to the northeast, Thompson Creek basin to the south, and Johnson Creek basin to the northwest.

Water within Bloody Run basin generally flows towards Bloody Run and the Skookumchuck River.

The current primary land use for this basin is designated forest and undeveloped land. The TRPC population forecast indicates that as of 2006 there were no dwelling units identified within this basin and no projected increase by 2030.

7.5.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

7.5.3 Priority Habitats and Critical Areas

The portion of Skookumchuck River located in this basin is mapped as supporting fall chinook, spring chinook, winter steelhead, sea-run cutthroat, and coho salmon. Additionally, this basin is mapped as providing spawning and rearing habitat for coho salmon, fall Chinook, spring Chinook, and winter steelhead. Bloody Run is mapped as supporting resident cutthroat.

Elk habitat is mapped in this basin.

Hazardous slopes are mapped adjacent to Bloody Run on both sides of the run for the majority of the basin.

Wetland areas within this basin are located within the southern tip and are associated with approximately a mile of Bloody Run.

This basin contains a portion of a Skookumchuck River reach (SK-15-SK-16), Bloody Run, as well as several un-named tributaries. Only the portion of the Skookumchuck River reach located within this basin is considered a shoreline of the state. Bloody Run and the associated tributaries are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

7.5.4 Evidence of Processes Disturbed or Potentially Impacted Function

No evidence of processes disturbed or potentially impacted function was noted for this basin.

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.
7.5.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Bloody Run basin:

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

7.5.6 Enhancement or Restoration Activities Implemented

No enhancement or restoration activities have been identified within this basin.

7.5.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skookumchuck River*</td>
<td>SK</td>
<td>1</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no lake reaches in this basin</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no marine reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

* A portion of reach SK-15-SK-16 extends into Bloody Run basin.
7.6 **BLOOM DITCH**

Bloom Ditch basin is located in the center of the county. It is 5,010 acres in size and is located entirely within WRIA 23. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.8405</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Bloom Ditch basin is bordered by Salmon Creek basin to the north, Beaver Creek basin to the east, Allen Creek basin to the south, and Black River basin to the west.

A portion of Millersylvania State Park is located in the central area of this basin.
Water within Bloom Ditch basin generally flows towards Bloom Ditch and the Black River.

Primary land use within this basin is residential, undeveloped and designated forest land. The TRPC population forecast indicates that as of 2006 there were 340 dwelling units identified within this basin and projects an increase to 630 dwelling units by 2030.

7.6.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

7.6.3 Priority Habitats and Critical Areas

Bloom Ditch is mapped as supporting resident cutthroat, winter steelhead, sea-run cutthroat, and coho Salmon. In addition, Bloom Ditch is mapped as providing spawning and rearing habitat for coho salmon.

This basin is mapped as providing habitat for Olympic mud minnow, peregrine falcon, wood duck, waterfowl concentrations, and mink.

Wetland areas are mapped throughout the basin.

The 100-year flood plain is associated with Bloom Ditch and extends the length of the basin. The 100-year flood plain also extends to the north and connects to Hopkins Ditch.

High ground water flood hazard areas are mapped for the majority of the basin located to the east of the I-5 corridor. In addition, a large high ground water flood hazard area is associated with Pitman Lake.

Small area of hazardous slopes is located in the northern section of the basin. Additionally, hazardous slide areas border this basin to the east.

This basin contains Bloom Ditch as well as several un-named tributaries. These majority of Bloom Ditch, with the exception of those portions of the ditch associated with Pitman Lake, are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15. Those portions of Bloom Ditch associated with Pitman Lake have reaches defined in section 7.6.7 and described in Appendix A.

7.6.4 Evidence of Processes Disturbed or Potentially Impacted Function

Portions of McCorkle Road and 113th Ave SW experienced some damage during the 1996 flood event.

This basin contains a superfund site located at 13120 Tilley Road South, Maytown. This parcel sits at the intersection of Allen Creek, Beaver Creek and Bloom Ditch basins. It is therefore listed as evidence of process disturbed or potentially impacted function for all three basins. The site is also known as the former Pacific Powder site. The contamination on the site is related to
the manufacturing dynamite and other explosives that occurred on site from the early 1940’s until 1994. Clean up activities occurred on site in 1995 and 1997. Additionally, public access to the site is limited by a fence and locked gate, which limits potential exposure to humans due to any remaining contaminants on site.

7.6.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Bloom Ditch basin:

Thurston County has identified flooding and high ground water as concerns for this basin.

Black Lake/Littlerock/Delphi Sub-area, 1981. TRPC. This report provides recommendations for future residential, commercial, and industrial development. It also provides information of the area’s history, resources and characteristics.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

7.6.6 Enhancement or Restoration Activities Implemented

No enhancement or restoration activities have been identified within this basin.

7.6.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>There are no riverine reaches in this basin.</td>
<td>n/a</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pitman Lake</td>
<td>LPI</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>There are no marine reaches in this basin.</td>
<td>n/a</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>
7. Basin Analysis – WRIA 24 (Upper Chehalis)

7.7 Dempsey Creek

7.7.1 Basin Characteristics

The Dempsey Creek basin is located in the western portion of the county. It is 5,844 acres in size. The majority of the basin, 5,832.1 acres, is located in WRIA 23. A small portion of the basin, 11.1 acres, is located in WRIA 13. As the majority of the basin is located in WRIA 23, review of it is provided in this chapter. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>3.2787</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

The basin is bordered by McLane Creek basin to the north, Black Lake and Salmon Creek basins to the east, Black River basin to the south, and Waddell Creek basin to the west.
A portion of the eastern border of Capitol Forest is located in this basin.

Water within Dempsey Creek basin generally flows towards Dempsey Creek, Stoney Creek, Pants Creek and Lake Lucinda. Dempsey Creek ultimately flows into the Black River.

The current primary use for this basin is rural residential and long term forestry. The TRPC population forecast indicates that as of 2006 there were 480 dwelling units identified within this basin and projects an increase to 790 dwelling units by 2030.

7.7.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

7.7.3 Priority Habitats and Critical Areas

Dempsey Creek within this basin is mapped as supporting winter Steelhead, sea-run cutthroat, coho salmon and resident cutthroat. Additionally, Dempsey Creek is mapped as providing spawning and rearing habitat for winter steelhead and coho salmon.

Dempsey Creek is mapped as providing habitat for waterfowl concentrations as well as Oregon spotted frog, Olympic mudminnow, green heron, osprey and wood duck.

Lower elevation riparian wetlands are mapped within the southeast portion of the basin. The wetland areas are primarily located near the confluence of Dempsey Creek and the Black River.

The 100-year flood plain is mapped in the eastern portion of the basin. In addition the majority of Dempsey Creek basin is associated with the 100-year flood plain.

High ground water flood hazard areas are mapped along the majority of the tributaries in the south.

Hazardous slides and slope areas are mapped along the northern portion of the basin.

This basin contains several streams including Dempsey Creek, Stoney Creek, Darlin Creek and Pants Creek as well as several unnamed tributaries. Some portions of Dempsey Creek are within shoreline jurisdiction and have reaches assigned in section 7.7.7 and described in Appendix A. The remainder of Dempsey Creek as well as the associated tributaries are not mapped as a shoreline of the state as they are not currently identified as exceeding a 20 cubic feet per second mean annual flow. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

7.7.4 Evidence of Processes Disturbed or Potentially Impacted Function

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.
7.7.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Dempsey Creek basin:

**Black Lake/Littlerock/Delphi Sub-area**, 1981, TRPC. This report provides recommendations for future residential, commercial, and industrial development. It also provides information of the area’s history, resources and characteristics.

**Rate of Urbanization and Forest Harvest in Thurston County 1985-2000**, January 2002, TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

**The Relationship of Land Cover to Total and Effective Impervious Area**, June 2003, TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

7.7.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

**Huber Fish Barrier Correction/ Pants Creek**, RCO Project Number 05-1329, Chehalis Basin FTF, completed

“This is a fish barrier correction on a private forest road in Capital Forest, over Pants Creek, WRIA # 230691, a tributary to Stony Creek which flows into the Black River. The current culvert is undersized with a 36" diameter round steel culvert elevated at the downstream end 3'. The bankfull width of Pants Creek is 10ft. The correction will be a manufactured bridge with a 50ft. span, 14ft. wide. This correction will open 1.29 miles of excellent fish spawning and rearing habitat for coho, native and sea-run cutthroat, trout. The Chehalis Basin Fisheries Task Force will manage, design and construct the project in cooperation with William Huber and other neighboring landowners.”

7.7.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dempsey Creek</td>
<td>BL-4</td>
<td>2</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no lake reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no marine reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>
7.8 **DESHUTES RIVER**

The majority of this basin is located in WRIA 13. Please refer to section 5.11 for further information.

7.9 **EAST FORK INDEPENDENCE CREEK**

This basin has no mapped shoreline jurisdiction and is therefore not reviewed in this document.

7.10 **FALL CREEK**

This basin has no mapped shoreline jurisdiction and is therefore not reviewed in this document.

7.11 **FROST PRAIRI**

<table>
<thead>
<tr>
<th>Total Reaches</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

7.11.1 **Basin Characteristics**

Frost Prairie basin is located in the southern portion of the County. It is 1,844 acres in size and is located entirely within WRIA 23. Jurisdictional shoreline information for this basin is summarized below.
Frost Prairie basin is bordered by Scatter Creek basin to the north, Skookumchuck basin to the east and south and O’Connor basin to the west.

The basin is located to the north of the northern limits of the city of Bucoda.

Water in Frost Prairie basin generally flows towards Frost Prairie and ultimately the Skookumchuck River.

The current primary use of this basin is rural residential and designated forest. The TRPC population forecast indicates that as of 2006 there were 10 dwelling units identified within this basin and projects an increase to 40 dwelling units by 2030.

### 7.11.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

### 7.11.3 Priority Habitats and Critical Areas

This basin is mapped as providing habitat for harlequin duck.

Oak habitat is mapped in the eastern portion of the basin and associated with the streams.

Wetland areas are mapped throughout the basin.

Hazardous slopes are mapped along the western portion of the basin as well as in a smaller strip along the western side of the basin. Majority of basin is mapped as containing wetlands.

This basin contains Frost Prairie as well as several un-named tributaries. These streams are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15. This basin also contains a small portion of a reach associated with Scatter Creek, CH-4-7-CH-4-8.

### 7.11.4 Evidence of Processes Disturbed or Potentially Impacted Function

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.
7.11.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Frost Prairie basin:

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

7.11.6 Enhancement or Restoration Activities Implemented

No enhancement or restoration activities have been identified within this basin.

7.11.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scatter Creek</td>
<td>CH-4*</td>
<td>1</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pond 4, Unknown</td>
<td>LPO4</td>
<td>1</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no marine reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

* A portion of reach CH-4-7-CH-4-8 extends into the Scatter Creek basin.

7.12 Hanaford Creek

This basin has no mapped shoreline jurisdiction and is therefore not reviewed in this document.
7.13 JOHNSON CREEK

7.13.1 Basin Characteristics

Johnson Creek basin is located in the south center portion of the County. It is 6,496 acres in size. The majority of the basin, 6,477 acres, is located in WRIA 23. A small portion of the basin, 19 acres, is located in WRIA 13. As the majority of the basin is located within WRIA 23, review of it is located in this chapter. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>9.2875</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>
Johnson Creek basin is bordered by Deschutes River basin to the northeast, Bloody Run basin to the southeast, and Thompson Creek basin to the south, Salmon Creek basin to the west, and Scatter Creek and McIntosh basins to the northwest.

Water within the Johnson Creek basin generally flows towards Johnson Creek and the Skookumchuck River.

Primary land use for this basin includes designated forest and residential land. The TRPC population forecast indicates that as of 2006 there were 30 dwelling units identified within this basin and projects an increase to 40 dwelling units by 2030.

7.13.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

7.13.3 Priority Habitats and Critical Areas

Johnson Creek is mapped as supporting coho salmon, sea-run cutthroat, and resident cutthroat. In addition, Johnson Creek is mapped as providing spawning and rearing habitat for coho salmon.

This basin is mapped as providing habitat for elk, wood duck, wild turkey and osprey.

Hazardous slopes are located throughout the majority of the basin. Wetland areas are mapped in the southern portion of the basin.

Wetlands mapped within this basin are primarily associated with Johnson Creek.

This basin contains several streams including Johnson Creek, a portion of Thompson Creek and a portion of the Skookumchuck River as well as several unnamed tributaries. The portions of Thompson Creek, the Skookumchuck River and the central stem of Johnson Creek within the basin are considered shorelines of the state and have reaches assigned in section 7.10.7 and are described in Appendix A. The remainder of Johnson Creek as well as the associated tributaries are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

7.13.4 Evidence of Processes Disturbed or Potentially Impacted Function

A study of fish passage culverts conducted in 1996 by the WDFW noted one fish barrier within this basin. This barrier was noted at the intersection of an unnamed stream and Johnson Creek Road.

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

Several portions of Johnson Creek Road were damaged during the 1996 flood.
7.13.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Johnson Creek basin:

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

7.13.6 Enhancement or Restoration Activities Implemented

No enhancement or restoration activities have been identified within this basin.

7.13.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Johnson Creek</td>
<td>SK-11</td>
<td>4</td>
</tr>
<tr>
<td>Thompson Creek</td>
<td>SK-12</td>
<td>1</td>
</tr>
<tr>
<td>Skookumchuck River</td>
<td>SK</td>
<td>1</td>
</tr>
<tr>
<td>Lake</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Marine</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Total Reaches</strong></td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

7.14 Kennedy Creek

The majority of this basin is located in WRIA 14. Please refer to section 6.3 for further information.

7.15 Lincoln Creek

This basin has no mapped shoreline jurisdiction and is therefore not reviewed in this document.
7.16 **Lost Valley**

This basin has no mapped shoreline jurisdiction and is therefore not reviewed in this document.

7.17 **Mcintosh Lake**

The majority of this basin is located in WRIA 13. Please refer to section 5.21 for additional information.

7.18 **McLane Creek**

The majority of this basin is located in WRIA 13. Please refer to section 5.22 for additional information.

7.19 **Michigan**

This basin has no mapped shoreline jurisdiction and is therefore not reviewed in this document.

7.20 **Mima Creek**
7.20.1 Basin Characteristics

Mima Creek basin is located in the southwestern portion of the county. The basin is approximately 7,941 acres in size and is located entirely within WRIA 23. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>5.1566</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Mima Creek basin is bordered by Waddell Creek basin to the north, Black River basin to the south, Sherman Creek basin and Lost Valley basin to the west.

Water within Mima Creek basin generally flows towards Mima Creek and Black River.

The entire basin is located in Capitol Forest. The TRPC population forecast indicates that as of 2006 there were 40 dwelling units identified within this basin and projects an increase to 90 dwelling units by 2030.

7.20.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

7.20.3 Priority Habitats and Critical Areas

Mima Creek is mapped as supporting coho salmon, resident cutthroat, and sea-run cutthroat. In addition, Mima Creek is mapped as providing spawning and rearing habitat for coho salmon.

This basin has areas of mapped oak and prairie grassland habitat.

The 100-year flood plain is mapped in the southern portion of this basin. The same area is also mapped as having flooded in 1996.

The northern portion of the basin is encumbered by hazardous slope/slide areas.

The majority of the wetlands mapped within this basin are located on the southern tip of the basin. These wetlands are mapped near the confluence of Mima Creek and Black River.

This basin contains several streams including Mima Creek, Mill Creek as well as several unnamed tributaries. The southern portion of the central stem of Mima Creek is considered a
shoreline of the state and has reaches assigned in section 7.14.7 and described in Appendix A. The remainder of Mima Creek as well as the associated tributaries are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

7.20.4 Evidence of Processes Disturbed or Potentially Impacted Function

A barrier study conducted for the years of 1996-2000 by WDFW noted two barriers within the basin. One barrier was located on Mill Creek with no associated road; one barrier was located on Mima Creek with no associated road.

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

7.20.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Mima Creek basin:

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

7.20.6 Enhancement or Restoration Activities Implemented

No enhancement or restoration activities have been identified within this basin.

7.20.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mima Creek</td>
<td>CH-12</td>
<td>2</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

There are no lake reaches in this basin.

There are no marine reaches in this basin.

Total Reaches 2
7.21 MONROE CREEK

7.21.1 Basin Characteristics

Monroe Creek basin is located along the western border of Thurston County. It is 1,072 acres in size and is located entirely within WRIA 23. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.0476</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Monroe Creek basin is bordered by Fall Creek basin to the northeast, Sherman Creek basin to the southeast, and the Thurston County border to the west.

Water within Monroe Creek basin generally flows towards Monroe Creek. Monroe Creek flows into Sherman Creek and Cedar Creek.
7. Basin Analysis – WRIA 24 (Upper Chehalis)

The primary land use for this basin is Capitol Forest. The TRPC population forecast indicates that as of 2006 there were no dwelling units identified within this basin and no projected increase in dwelling units by 2030.

7.21.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

7.21.3 Priority Habitats and Critical Areas

Monroe Creek is mapped as supporting coho salmon, winter steelhead, and resident cutthroat. In addition, this creek is mapped as providing spawning and rearing habitat for coho salmon. The tributaries of Monroe Creek are mapped as supporting resident cutthroat only.

Hazardous slide areas are mapped along the western border of the basin. Hazardous slopes are mapped throughout the basin.

This basin contains Monroe Creek as well as several un-named tributaries. These streams are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.1. A small portion of reach SH-1-SH-2 extends into the Monroe Creek basin.

7.21.4 Evidence of Processes Disturbed or Potentially Impacted Function

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

7.21.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Monroe Creek basin:

Black Lake/Littlerock/Delphi Sub-area. 1981. TRPC. This report provides recommendations for future residential, commercial, and industrial development. It also provides information of the area’s history, resources and characteristics.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.
7.21.6 Enhancement or Restoration Activities Implemented

No enhancement or restoration activities have been identified within this basin.

7.21.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sherman Creek*</td>
<td>SH</td>
<td>1</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

There are no lake reaches in this basin.

Marine

<table>
<thead>
<tr>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

There are no marine reaches in this basin.

Total Reaches 1

* A small portion of reach SH-1-SH-2 extends into the Monroe Creek basin.

7.22 O’Connor

This basin has no mapped shoreline jurisdiction and is therefore not reviewed in this document.

7.23 Offut Lake

This basin is located primarily in WRIA 13. Please refer to section 5.27 for further information on this basin.

7.24 Percival Creek

This basin is located primarily in WRIA 13. Please refer to section 5.28 for further information on this basin.

7.25 Perry Creek

This basin is located primarily in WRIA 14. Please refer to section 6.5 for further information on this basin.
7.26 PORTER CREEK

7.26.1 Basin Characteristics

Porter Creek is located in the western panhandle of the county. It is 9,427 acres in size. The northern portion of this basin is located within WRIA 22 – Lower Chehalis. As noted in Chapter 3, WRIA 22 does not have any jurisdictional shoreline within Thurston County. As such, review of this basin including those areas located within WRIA 22 is located within this chapter. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>0.0654</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Porter Creek basin is bordered by Kennedy Creek basin and Waddell Creek basin to the east, Fall Creek basin to the south and the Thurston County border to the west.
Highway 8 traverses through the central portion of the basin. The majority of the basin south of Highway 8 is located within the Capitol Forest.

Water within Porter Creek basin generally flows into Porter Creek, Bozy Creek, and Swan Creek. These waters ultimately flow into the Chehalis River in Grays Harbor County.

The current primary uses of the basin are rural residential and designated forest. The TRPC population forecast indicates that as of 2006 there were 10 dwelling units identified within this basin with no projected increase in dwelling units by 2030.

7.26.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

7.26.3 Priority Habitats and Critical Areas

Porter Creek and the tributaries within this basin are mapped as supporting resident cutthroat.

The majority of the basin is mapped as hazardous slopes/slides areas with the exception of the low lying areas containing the State Highway 8 corridor within the basin.

This basin contains several streams including Porter Creek, Swan Creek, Bozy Creek as well as several unnamed tributaries. A small portion of Porter Creek is considered a shoreline of the state and has reaches assigned in section 7.19.7 and described in Appendix A. The remainder of Porter Creek as well as the associated tributaries are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

7.26.4 Evidence of Processes Disturbed or Potentially Impacted Function

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

7.26.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Porter basin:

Black Lake/Littlerock/Delphi Sub-area, 1981. TRPC. This report provides recommendations for future residential, commercial, and industrial development. It also provides information of the area’s history, resources and characteristics.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for
the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

**7.26.6 Enhancement or Restoration Activities Implemented**

No enhancement or restoration activities have been identified within this basin.

**7.26.7 Reach Data**

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>River</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Fork Porter Creek</td>
<td>NP</td>
<td>1</td>
</tr>
<tr>
<td><strong>Lake</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no lake reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Marine</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no marine reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Total Reaches</strong></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>
7.27 **PRAIRIE CREEK**

![Diagram of Prairie Creek basin]

### 7.27.1 Basin Characteristics

Prairie Creek basin is located in the southwest corner of the county. It is 13,552 acres in size it is located entirely within WRIA 23. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>21.3583</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>20.8721</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Prairie Creek basin is bordered by Black River and Scatter Creek basins to the north, O’Connor and Zenkner basins to the east, the Thurston County border to the south, and Lincoln Creek basin, Michigan basin and the Thurston County border to the west.
The western tip of this basin contains a portion of the Chehalis Indian Reservation. Additionally, this basin also contains portions of the Grand Mound urban growth area.

Waters within Prairie Creek basin generally flows into Prairie Creek and the Chehalis River.

Primary land use for this basin includes: residential, undeveloped, forestland, and timberland. The TRPC population forecast indicates that as of 2006 there were 1,240 dwelling units identified within this basin and projects an increase to 2,610 dwelling units by 2030.

### 7.27.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

### 7.27.3 Priority Habitats and Critical Areas

The Chehalis River is mapped as supporting fall Chinook, chum salmon, coho salmon, spring chinook, winter steelhead, sea-run cutthroat, resident cutthroat and largemouth bass. In addition, the Chehalis River is mapped as providing spawning and rearing habitat for fall Chinook. Scatter Creek is mapped as supporting coho salmon, sea-run cutthroat, and winter steelhead. Prairie Creek is mapped as supporting coho salmon and sea-run cutthroat.

This basin is also mapped as providing habitat for osprey, Mazama pocket gopher, wild turkey and Roosevelt Elk.

There are mapped areas of Oregon white oak woodlands and prairie habitat.

Small area of hazardous slides/slopes mainly located on the eastern side of the basin.

Small areas of high groundwater flood hazard areas located throughout the portion of the basin associated with Interstate Highway 5. In addition the majority of the basin is mapped as containing wetland and wetland buffer area.

Wetlands within this basin are primarily associated with the Chehalis River, Prairie Creek and the associated tributaries.

This basin contains a portion of the Chehalis River, Prairie Creek, as well as several unnamed tributaries. The portions of the Chehalis River within this basin are considered shorelines of the state and have reaches assigned in section 7.20.7 and described in Appendix A. Prairie Creek as well as the associated tributaries are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.
7.27.4 Evidence of Processes Disturbed or Potentially Impacted Function

Dunlap Pond Dam (also referred to as Wanoname Dam) is located in Thurston County, WA. The Primary Coordinates are: Latitude 46.7998 and Longitude -122.9696. Variant (nonofficial) names for Dunlap Pond Dam:

Railroads are adjacent to the Chehalis River and as such are located within mapped 100-year flood plain and wetland areas.

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

The Chehalis River area was impacted during the 1996 flood event. During the event, flood water extended outward approximately 6000 feet from the riverbed in some places.

7.27.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Prairie Creek basin:

This basin contains the following water quality gauges: stick gauge (2), rain gauge, stream gauge, and water quality gauge.

Thurston County notes flooding as a concern for this basin.

Natural Hazards Mitigation Plan for the Thurston Region. 2003. Andrews, S. et al. The study notes the following on the flooding history of the Chehalis River:

The Chehalis River extends for only 8.6 miles in Thurston County, but has an extensive floodplain, covering over eight square miles. Land use is primarily agricultural, houses are scattered sparsely over the area. Some flooding occurs nearly every year, but damage is usually light. Historically, nuisance flooding occurs when the flow rate exceeds about 14,000 cfs. Since 1972, the river has exceeded the flow rate 48 times. The typical year will have a flood in November or December and a second flood in January or February. Moderate flooding occurs when the flow rate exceeds about 26,000 cfs. Since 1972, this has occurred 21 times. Major flooding occurs when the rate exceeds about 45,000 cfs. This has happened six times since 1972: January 1972, December 1975, November 1986, January 1990, November 1990, and February 1996. The flood of record was established in February 1996 when the flow rate reached nearly 75,000 cfs.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.
Water Resources Monitoring Report 2003-2005 Water Years, 2006. Thurston County Department of Social Services Environmental Health Division and Thurston County Department of Waste Water Management. The report identifies the water quality of Prairie Creek as good. This rating is based on two pH measurements outside of the water quality standard in 2004/05 and that Nitrate values are often elevated in this creek. No major issues are identified for Prairie Creek.

The report identifies the water quality of the Chehalis River as good. This rating is based upon a pH standard violation in 2004-2005. Additionally, summer high temperatures occur, which are a natural condition. The major issues for the Chehalis River are identified as summer low-flow conditions, high water temperatures and low dissolved oxygen levels, as well as non-point pollution from rural land-uses and point discharges to the river in the Centralia and Chehalis area contributes to water quality problems.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

7.27.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

Doleman/ Lawton Riparian Restoration, RCO Project Number 99-1357, Chehalis Confederated Tribes, completed

“The streams & rivers of the Upper Chehalis Watershed provide spawning habitat for anadromous fish including chinook, coho, chum, steelhead, and cutthroat trout. In nearly all of the watershed's streams low summer flows & resulting high temperatures coupled with habitat degradation & siltation are critical factors limiting fish populations. These projects are aimed at restoring 1600' of actively eroding river bank devoid of any substantial stabilizing riparian vegetation. Each winter & spring, tons of fine sediment enter the Chehalis River at each site & threaten chinook & steelhead redds. The following techniques will be utilized: (1) bioengineering of degrading stream banks; (2) revegetation of degraded riparian areas; and (3) placement of LWD. These projects are part of the Chehalis Tribe's Nonpoint Source Pollution Management Plan. To date the Tribe has completed 40 successful restoration projects.”

Chehalis Watertype Assesment, RCO Project Number 08-1328, Wild Fish Conservancy, in progress

“The Wild Fish Conservancy will use this grant to document and correct water type classifications in about 40 miles of streams in the Chehalis River watershed. Washington water type maps under-represent the fish-bearing stream network. When streams are mapped incorrectly, it limits the effectiveness of state and local habitat protection regulations. This project will map previously unmapped and incorrectly mapped streams. The assessment also will generate data to help identify opportunities to restore lesser-known tributaries of the Chehalis River. Assessment data will be available to the public and resource managers on the conservancy’s Web site. The conservancy also will submit results to the state Department of
Natural Resources so state regulatory water type maps can be corrected. The conservancy will contribute $14,700 in donations of equipment and materials.”

7.27.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chehalis River</td>
<td>CH</td>
<td>10</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no lake reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no marine reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>10</td>
</tr>
</tbody>
</table>

7.28 Reichel Lake

This basin is located primarily in WRIA 13. Please refer to section 5.30 for further information.

7.29 Salmon Creek (Black)
7.29.1 Basin Characteristics

Salmon Creek (Black) basin is located in the central portion of the county. It is 4,631 acres in size. The majority of the basin, 4,624 acres, is located in WRIA 23. A smaller portion of the basin, 7 acres, is located in WRIA 13. As the majority of the basin is located in WRIA 23, review of it is located here. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>2.2753</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

The Salmon Creek (Black) basin is bordered by the Black Lake and Deschutes River basins to the north, Beaver Creek basin to the east, Bloom Ditch basin to the south, and Black River basin to the west.

This basin contains portions of the City of Tumwater and the Tumwater Urban Growth Area.

Waters within Salmon Creek (Black) basin generally flows Hopkins Ditch, Salmon Creek, and ultimately the Black River.

Primary land use for this basin is residential, current timberland, and undeveloped. The TRPC population forecast indicates that as of 2006 there were 2,750 dwelling units identified within this basin and projects an increase to 5,250 dwelling units by 2030.

7.29.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

7.29.3 Priority Habitats and Critical Areas

Hopkins Ditch and associated tributaries within this basin are mapped as supporting resident cutthroat. There is no anadromous fish presence mapped in this basin.

This basin is mapped as providing habitat for Olympic mudminnow, waterfowl concentrations, peregrine falcon, and Mazama pocket gopher.

The 100-year flood plain is mapped as being associated with Hopkins Ditch.
Wetlands mapped within this basin are primarily located in the southern portion of the basin and are associated with Hopkins Ditch.

This basin contains several streams including Salmon Creek, Hopkins Ditch as well as several unnamed tributaries. A portion of Salmon Creek is considered a shoreline of the state and has reaches assigned in section 7.22.7 and described in Appendix A. The remainder of Salmon Creek as well as the associated tributaries are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

7.29.4 Evidence of Processes Disturbed or Potentially Impacted Function

The majority of the shoreline jurisdiction within this basin is associated with wetlands and 100-year flood plain and is undeveloped. However, 2006 aerial photographs reflect that there has been modification to shoreline vegetation as well as residential structures and appurtenances built directly adjacent to the shoreline jurisdiction.

The TRPC study of Rate of Urbanization and Forest Harvest in Thurston County 1985-2000 indicates that urban cover within this basin as of 2000 was 7%.

7.29.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Salmon Creek (Black) basin:

Thurston County identifies flooding and high ground water as concerns for this basin.

Black Lake/Littlerock/Delphi Sub-area, 1981. TRPC. This report provides recommendations for future residential, commercial, and industrial development. It also provides information of the area’s history, resources and characteristics.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.


actions by the City of Tumwater, Thurston County, and other entities to reduce and prevent flooding impacts to individual property owners as well as city and county roads within the basin.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

### 7.29.6 Enhancement or Restoration Activities Implemented

No enhancement or restoration activities have been identified within this basin.

### 7.29.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td>BL-5</td>
<td>2</td>
</tr>
<tr>
<td>Salmon Creek</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lake</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Marine</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>
7.30 **Salmon Creek (Skookumchuck)**

7.30.1 Basin Characteristics

Salmon Creek (Skookumchuck) basin is located southern central portion of the county. It is 2,831 acres in size and is located entirely within WRIA 23. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>2.2753</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Salmon Creek (Skookumchuck) basin is bordered by Scatter Creek basin to the north, Johnson Creek basin to the east, and Skookumchuck River basin to the west.

Water within the Salmon Creek (Skookumchuck) basin generally flows into un-named tributaries that flow into the Skookumchuck River.
Primary land use for this basin is residential, current timberland, and undeveloped. The TRPC population forecast indicates that as of 2006 there were no dwelling units identified within this basin and no projected increase in dwelling units by 2030.

7.30.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

7.30.3 Priority Habitats and Critical Areas

Salmon Creek is mapped as supporting coho salmon, sea-run cutthroat, and resident cutthroat. In addition, Salmon Creek is mapped as providing spawning and rearing habitat for coho salmon.

This basin is mapped as providing habitat for harlequin duck and riffle sculpin.

The majority of the basin is mapped as containing hazardous slope/slide areas.

Wetlands are primarily mapped in the southern tip of the basin and are associated with an un-named tributary that flows into the Skookumchuck River from this basin.

This basin contains Hopkins Ditch as well as several un-named tributaries. These streams are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

7.30.4 Evidence of Processes Disturbed or Potentially Impacted Function

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

7.30.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Salmon Creek (Skookumchuck) basin:

Thurston County identifies flooding and high ground water as concerns for this basin.

Black Lake/Littlerock/Delphi Sub-area. 1981. TRPC. This report provides recommendations for future residential, commercial, and industrial development. It also provides information of the area’s history, resources and characteristics.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for
the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

**Salmon Creek Drainage Basin Conceptual Hydrologic Model.** June 2001. Pacific Groundwater Group. This study describes factors influencing groundwater and surface-water flow of the Salmon Creek Drainage basin.

**Salmon Creek Comprehensive Drainage Basin Plan: Phase II: Alternatives Analysis and Recommendations.** June 2004. Thurston County Department of Water and Waste Management. The plan is a comprehensive analysis of flood-relief alternatives and recommendations for future actions by the City of Tumwater, Thurston County, and other entities to reduce and prevent flooding impacts to individual property owners as well as city and county roads within the basin.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

### 7.30.6 Enhancement or Restoration Activities Implemented

No enhancement or restoration activities have been identified within this basin.

### 7.30.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skookumchuck River*</td>
<td>SK</td>
<td>2</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no lake reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no marine reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Total Reaches</strong></td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

* A small portion of the Skookumchuck River on either side of SK-10 extends into the Salmon Creek (Skookumchuck) basin.
7.31 Scatter Creek

7.31.1 Basin Characteristics

Scatter Creek basin is located in the southwestern portion of the county. It is 27,423 acres in size. The majority of the basin, 27,185 acres, is located in WRIA 23; a small portion of the basin, 238 acres, is located within WRIA 13. As the majority of the basin is located in WRIA 23, review of it is provided in this chapter. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>38.2502</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>2.1250</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

This basin is bordered by Beaver Creek and Offut Lake basins to the north, the Deschutes River, McIntosh Lake, Johnson Creek and Salmon Creek basins to the east, Skookumchuck, Frost Prairie, O’Connor, Zenkner and Prairie Creek basins to the south.
The City of Tenino as well as its associated urban growth areas are located within the eastern portion of the basin.

The waters within the Scatter Creek basin generally flow into Scatter Creek. Scatter Creek flows into the Chehalis River.

The primary use of this basin is rural residential. The TRPC population forecast indicates that as of 2006 there were 3,350 dwelling units identified within this basin and projects an increase to 5,720 dwelling units by 2030.

7.31.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

7.31.3 Priority Habitats and Critical Areas

Scatter Creek is mapped as supporting resident cutthroat, sea-run cutthroat and coho salmon. In addition, this creek is mapped as containing spawning and rearing habitat for coho salmon.

Scatter Creek basin is generally recognized as containing quality prairie including oak habitat as well as habitat for mink, wood duck breeding areas, Taylor’s (Whulge) Checkerspot, Puget blue, valley silverspot, mardon skipper, Mazama western pocket gopher, gray squirrel, Olympic mudminnow, reticulate sculpin, three spine stickleback, pumpkinseed, and Oregon vesper sparrow.

Hazardous slopes are mapped in the eastern section of the basin south of the City of Tenino.

The majority of the basin is mapped as wetland or associated buffer.

This basin contains several streams including Scatter Creek as well as several unnamed tributaries. The central stem of Scatter Creek as well as a few of the tributaries are considered shorelines of the state and have reaches assigned in section 7.24.7 and described in Appendix A. The remainder of Scatter Creek as well as the associated tributaries are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

7.31.4 Evidence of Processes Disturbed or Potentially Impacted Function

A study of fish passage culverts conducted in 1996 by the WDFW noted one fish barrier within this basin. This barrier was noted at the intersection of an unnamed stream and Vantine Road.

Scatter Creek experienced some flooding during the 96 flood event. In addition, areas around the City of Tenino experienced flood damage during the 1996 flood event.

Berger Dam is located in this basin. The Primary Coordinates are: Latitude 46.8665 and Longitude -122.8029.
Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

7.31.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Scatter Creek basin:

Thurston County has identified flooding as a concern for this basin.

This basin contains multiple water quality gauges. These gauges are as follows: a rain gauge on Scatter Creek near the City of Tenino, a water quality sample site on Gibson Road, a water quality sample site on Scatter Creek near Sergeant Road SW, and a water quality sample site and stream gauge on Scatter Creek near James Road SW.

**Rate of Urbanization and Forest Harvest in Thurston County 1985-2000**, January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

**The Relationship of Land Cover to Total and Effective Impervious Area**, June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

**Water Resources Monitoring Report 2003-2005 Water Years**, 2006. Thurston County Department of Social Services Environmental Health Division and Thurston County Department of Waste Water Management. The basin identifies the Scatter Creek water quality as good. This rating is based upon the creek meeting both parts of the fecal coliform standard and other water quality standards in both water years. However, the study notes that the creek has elevated nitrates in the lower reaches. Major issues for this creek are identified as non-point source pollution from agriculture, septic systems, and rural residential land uses, habitat loss from sedimentation and reed canary grass infestations and native riparian vegetation is lacking in some areas.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

7.31.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

**Scatter Creek WRA 80, RCO Project Number 80-602, WDFW, completed**

“This agreement consists of the construction of a parking area along the Case Road boundary of Scatter Creek WRA. Sanitary facilities and fencing are also included. The project is designed to provide a variety of wildlife-oriented recreation activities, including pheasant hunting, bird watching and field trailers. The site is easily available to urban populations.”
**Vantine Road Culvert Replacement, RCO Project Number 99-1432, Thurston County Roads and Transportation, completed**

“This barrier consists of two culverts, a smooth concrete culvert built on top of a squashed CMP culvert. The Washington Department of Fish and Wildlife described this as a total barrier. The top culvert is perched 1’ above the stream and water must flow over the CMP. This project will replace the two existing culverts with a four foot diameter corrugated polyethylene pipe, countersunk to eliminating the plunge pool and restoring the natural stream bed.”

**Cozy Valley Creek Enhancement, RCO Project Number 00-1861, Thurston County Conservation District, completed**

“The project objectives are the restoration of the stream, riparian and upland area around Scatter Creek on the property of Chris Platter. This project will demonstrate land management activities which have beneficial effects on salmon habitat. The Platter project is a participant in the Scatter Creek Habitat Conservation Plan (HCP) effort. This plan will be a long-term management tool authorized under the Endangered Species Act (ESA) to conserve threatened and endangered species and will protect salmonids which utilize the creek and which may be listed under the ESA. The HCP partnership between local landowners, agencies and organizations is working to develop conservation measures to protect creek habitat and receive protection under the ESA. The areas of Scatter Creek on the Platter property are currently degraded and provide minimal habitat for salmonids. Demonstration Project activities include fencing for livestock exclusion, riparian planting and rehabilitation, roof-run-off systems, waste management systems, and in-stream structures to restore channel function. The stream provides habitat to several salmon is species. Coho, Chum, Cutthroat and Steelhead all spawn and rear in Scatter Creek. Bull trout may reside there. Currently bull trout is threatened, chum is threatened, steelhead is threatened, coho is a candidate species for listing and cutthroat trout id proposed for listing.”

**PB Lumber – Scatter Creek Trib, 04-1122 PB Lumber, completed**

“The project site is located northeast of Tenino on a tributary stream of Scatter Creek. Scatter Creek is a tributary to the Chehalis River. Species benifited include chum, coho, resident trout. The project will open 2.35 miles of habitat. Description: This 0.5m diameter, 6.7m long, round PVC culvert is under 0.33m of fill on a 5m wide road. The pipe is considered to be a barrier to fish passage. The area has been logged except for the buffer required by forest practices. Upstream habitat consists of wetlands on a low gradient depression within an area that has recently been reforested. Upstream beaver dams and wetland area would provide good juvenile coho and cutthroat rearing habitat. The area appears to have water throughout the year. Once the replanted trees start to provide cover and water retention by raising the groundwater levels, this would be an excellent water storage and ground water recharge location as well as fish habitat. Ground water recharge and water storage is a primary limiting factor in the Upper Chehalis and especially the Scatter Creek watershed. The proposed fix calls for a 5’ round corrugated metal pipe using the no-slope design option.”

**Vance Creek Riparian Planting and Fencing, RCO Project Number 04-1698, Chehalis Basin FTF, completed**
“This project provides 12,500 ft. of fencing and 16,000 ft. of riparian planting to improve fish habitat in Vance Cr., tributary to the Chehalis R. The creek is 8.6 mi. long with 6 mi. of documented salmonid spawning and rearing habitat. It originates in forest lands NW of Elma, flows through residential lands, an abandoned gravel mine which is now a county park, then through farmlands, entering the Chehalis R. at river mile 20. Vance Cr. supports cutthroat trout, coho and possibly chum salmon, as well as lamprey eels, sculpins, mudminnows, and other aquatic life. It has been historically manipulated to accommodate agriculture, mining, and residential development. Despite this, coho and cutthroat continue to use the stream in limited numbers. Two primary limiting factors are high sediment input and lack of riparian cover. Local landowners have agreed to allow fencing and riparian planting on a 25 ft. buffer on both sides of the stream. With the help of volunteer and student labor from the local school district and support of the Chehalis Basin Education Consortium, the lower portion of the stream will be replanted and fences installed to exclude livestock. The Chehalis Basin Fisheries Task Force will be project sponsor. The CBFTF and teachers will provide technical expertise. The local school districts have science programs, FFA groups, special education and science classes, which are already monitoring stream functions”

Sampson Acquisition, RCO Project Number 07-1749, Heernett Environmental Foundation, completed

“The Heernett Environmental Foundation will use this grant to buy 80 acres of wetlands and upland forest to conserve an intact, biologically significant portion of the Scatter Creek headwaters. All of the headwater tributaries, which cross this property, are used by coho and cutthroat. This is a vital piece of property for protection because of its strategic location and future phased wetland restoration possibilities. The foundation already owns 700 acres adjacent to this property and there are successful, ongoing, stream restoration projects upstream. Preserving the property will help the water quality and quantity of Scatter Creek and prevent degradation by development, fragmentation and compaction of soils. The foundation has a five-year enhancement plan that will include creating water storage areas, encouraging proper wetland function and establishing a new streamside buffer. The foundation will contribute $100,000.”

7.31.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scatter Creek</td>
<td>CH-4</td>
<td>16</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lake 2, unnamed</td>
<td>LUNK2</td>
<td>2</td>
</tr>
<tr>
<td>Pond 3, unknown</td>
<td>LPO3</td>
<td>1</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no marine reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>19</td>
</tr>
</tbody>
</table>
7.32 **Sherman Creek**

Sherman Creek basin is located along the western border of the county. It is 6,187 acres in size and is located entirely within WRIA 23. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>6.5776</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Sherman Creek basin is bordered by Monroe Creek and Fall Creek basins to the northwest, Waddell Creek basin to the northeast, Lost Valley and Mima Creek basins to the east, and Black River basin to the south.
Waters from the Sherman Creek basin generally flow into Sherman Creek. Sherman Creek ultimately flows into the Chehalis River.

The majority of the basin located in Capitol Forest. The TRPC population forecast indicates that as of 2006 there were no dwelling units identified within this basin and no projected increase by 2030.

7.32.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

7.32.3 Priority Habitats and Critical Areas

Sherman Creek is mapped as supporting coho, sea-run cutthroat, and resident cutthroat. Winter steelhead and fall Chinook may also utilize these waters; however, they are only mapped in the vicinity of the confluence with Cedar Creek. These areas may also provide spawning and rearing habitat for fall chinook, coho salmon and winter steelhead. The majority of the tributaries are mapped as containing resident cutthroat.

The basin has a small number of mapped wetlands. The wetland areas are primarily associated with the creeks within the basin.

Majority of the basin is mapped as containing hazardous slopes.

Small wetland areas are mapped in the northern portion of this basin and are associated with Sherman Creek.

This basin contains several streams including Sherman Creek, Cedar Creek as well as several unnamed tributaries. Some portions of Sherman Creek are considered shorelines of the state and have reaches assigned in section 7.25.7 and described in Appendix A. The remainder of Sherman Creek as well as the associated tributaries are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

7.32.4 Evidence of Processes Disturbed or Potentially Impacted Function

2006 aerials of this basin indicate that logging, roads and bridges occur within this basin and in the shoreline zone.

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

7.32.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Sherman Creek basin:
Black Lake/Littlerock/Delphi Sub-area, 1981. TRPC. This report provides recommendations for future residential, commercial, and industrial development. It also provides information of the area’s history, resources and characteristics.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000, January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

7.32.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

Sherman Creek Bridge Replacement, RCO Project Number 04-1798, DNR, completed

“This project will remove an old 55 foot log stringer bridge over Sherman Creek, located within the Capitol State Forest. The wooden bridge installed in the late 1980s is decaying and quickly becoming a safety hazard to horse riders, hikers, mountain bikers and mountain runners using the nonmotorized trail system. After the removal of the old wooden bridge a new 65 foot metal or composite material bridge will be installed. The new bridge will be set atop concrete footings and be designed as to have a minimal impact to the Sherman Creek. It will also be constructed out of the range of the 100-year flood level, thus making the structure safe in high flood level conditions. This bridge provides an important connection for the nonmotorized trail system within Capitol Forest by linking the northern and southern halves of the trail system. It is estimated that this project serves 11,000 visitors per year. 30% of which are mountain bikers, 65% are horseback riders and 5 % are hikers and mountain runners. This proposal includes all of the labor and materials necessary to complete this project.”

7.32.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sherman Creek</td>
<td>SH</td>
<td>2</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no lake reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no marine reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>
7.33 SKOOKUMCHUCK

7.33.1 Basin Characteristics

Skookumchuck basin is located in the southern central portion of the county. It is 9,472 acres in size and is located entirely within WRIA 23. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>27.3107</td>
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<td>SSS Stream</td>
<td>0.0000</td>
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<td>SMA Lake</td>
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<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Skookumchuck basin is bordered by Scatter Creek basin to the north, Salmon Creek, Johnson Creek, and Thompson Creek basins to the east, Hanford Creek basin to the south, and Zenkner,
O’Connor, and Frost Prairie basins to the west. In addition, a portion of the basin’s southernmost boundary coincides with the southern boundary of the county.

The basin contains the City of Bucoda as well as the associated Urban Growth Area.

Water within the Skookumchuck basin generally flows towards Skookumchuck River.

Current use of the basin rural residential, agriculture and designated forestry. The TRPC population forecast indicates that as of 2006 there were 630 dwelling units identified within this basin and projects an increase to 1,030 dwelling units by 2030.

7.33.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

7.33.3 Priority Habitats and Critical Areas

The Skookumchuck River is mapped as supporting resident cutthroat, fall Chinook, sea-run cutthroat, spring Chinook, coho salmon, and winter steelhead. The majority of the tributaries are mapped as supporting only resident cutthroat. Spawning and rearing habitat for spring Chinook, fall Chinook and winter steelhead is mapped for the extent of the river in the basin. Rearing habitat for coho salmon is also mapped within the basin northeast of Bucoda.

This basin is mapped as providing habitat for elk, harlequin duck, wild turkey, osprey, and Oregon vesper sparrow.

Oak conifer forests are associated with the Skookumchuck River north of Bucoda and north of Skookumchuck road.

Wetlands are mapped along the majority of the river within this basin. High ground water flood hazard areas are associated with the river south of Bucoda.

This basin contains portions of the Skookumchuck River as well as several unnamed tributaries. The length of the Skookumchuck River within this basin is considered a shoreline of the state and has reaches assigned in section 7.26.7 and described in Appendix A. The associated tributaries within this basin are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

7.33.4 Evidence of Processes Disturbed or Potentially Impacted Function

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

7.33.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Skookumchuck basin:
A water quality sample site is located on Skookumchuck River.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Water Resources Monitoring Report 2003-2005 Water Years. 2006. Thurston County Department of Social Services Environmental Health Division and Thurston County Department of Waste Water Management. The report identifies the water quality of the Skookumchuck River as good. This rating is based on the river having met all water quality standards for water year 2003/04 and 2004/05 except for a slight pH violation in October 2004. Major issues for the river are identified as non-point source pollution, habitat loss from erosion and sedimentation and native riparian vegetation is lacking in some areas.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

7.33.6 Enhancement or Restoration Activities Implemented

No enhancement or restoration activities have been identified within this basin.

7.33.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skookumchuck River</td>
<td>SK</td>
<td>10</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no lake reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no marine reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10</td>
</tr>
</tbody>
</table>
7.34 Thompson Creek (Skookumchuck)

7.34.1 Basin Characteristics

The Thompson Creek (Skookumchuck) basin is located in the southern portion of the county. It is 21,174 acres in size. The majority of the basin, 20,967 acres, is located in WRIA 23; a small portion, 207 acres, of this basin is located in WRIA 13. As the majority of the basin is located in WRIA 23, review of it is provided in this chapter. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>23.1018</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>9.2163</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

The primary water body within this basin is the Skookumchuck River. During the inventory process extensive information was identified regarding the flooding history of the Skookumchuck River: The Skookumchuck River extends for approximately 24.7 miles in south-
central Thurston County and has a wide floodplain from the county line upstream for 15 miles. The majority of the reports on the flooding of this area note that land use on the floodplain is mostly agricultural and therefore flooding of the area results in little damage.

Waters within the Thompson Creek (Skookumchuck) basin generally flows into Skookumchuck River, Skookumchuck Lake and associated tributaries.

Primary land use for this basin is forestland, undeveloped and residential. The TRPC population forecast indicates that as of 2006 there were 150 dwelling units identified within this basin and projects an increase to 230 dwelling units by 2030.

7.34.2 Public Access

There is a public boat launch located on Skookumchuck Lake.

In addition to defined public access to the shoreline, informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

7.34.3 Priority Habitats and Critical Areas

The Skookumchuck River is mapped as supporting winter steelhead, coho salmon, and sea-run cutthroat, fall Chinook, spring Chinook, and resident cutthroat. The majority of the tributaries in this system are mapped as supporting resident cutthroat and rainbow trout. Thompson Creek is mapped as providing spawning and rearing habitat for winter steelhead and coho salmon.

This basin is mapped as providing habitat for elk, harlequin duck, wood duck, wild turkey, osprey, and Van Dykes salamander.

Hazardous slope areas are mapped in the eastern portion of the basin.

Wetlands are mapped throughout the basin.

This basin contains portions of Thompson Creek, Skookumchuck River, Johnson Creek, Troller Run, Turvey Creek, Fall Creek, Baugaro Creek, Pheeny Creek, Laramie Creek, Hospital Creek as well as several unnamed tributaries. The length of the Skookumchuck River as well a Thompson Creek within this basin contain shoreline jurisdiction and have reaches assigned in section 7.27.7 and are described in Appendix A. The remainder of the associated tributaries within this basin are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

7.34.4 Evidence of Processes Disturbed or Potentially Impacted Function

A study of fish passage culverts conducted in 1996 by the WDFW noted one fish barrier within this basin. This barrier was noted at the intersection of Thompson Creek and Thompson Creek Road.
Skookumchuck Lake was formed by an impoundment of the Skookumchuck River and contains 550 acres. The Skookumchuck Dam, completed in 1971 and located approximately 8 miles upstream of Bucoda, has a storage capacity of 42,000 acre-feet. Its major function is water supply for the Centralia Steam-Electric Project and it provides little protection from large floods.

Thompson Creek Road experienced some flood damage during the 1996 flood event.

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.

### 7.34.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Thompson Creek (Skookumchuck) basin:

- Thurston County identifies low stream flow as a concern for this basin.

A USGS gauge located on the Skookumchuck River. USGS gauges provide real time data on parameters such as stream flow, reservoir, water-quality, meteorological, and groundwater sites. The website at which this data may be obtained is: [http://waterdata.usgs.gov/wa/nwis/rt](http://waterdata.usgs.gov/wa/nwis/rt).

- **Rate of Urbanization and Forest Harvest in Thurston County 1985-2000**, January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

- **The Relationship of Land Cover to Total and Effective Impervious Area**, June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

### 7.34.6 Enhancement or Restoration Activities Implemented

No enhancement or restoration activities have been identified within this basin.

### 7.34.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skookumchuck River</td>
<td>SK</td>
<td>6</td>
</tr>
<tr>
<td>Thompson Creek</td>
<td>SK-12</td>
<td>5</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skookumchuck Lake</td>
<td>LSK</td>
<td>2</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no marine reaches in this basin.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>13</td>
</tr>
</tbody>
</table>
7.35 **WADDELL CREEK**

![Map of Waddell Creek basin](image)

### 7.35.1 Basin Characteristics

The Waddell Creek basin is located in the central western portion of the county. It is 11,182 acres in size. The majority of this basin, 11,148 acres, is located in WRIA 23. A small portion, 34 acres, is located in WRIA 13. As the majority of the basin is located in WRIA 23, review of it is provided in this chapter. Jurisdictional shoreline information for this basin is summarized below.

<table>
<thead>
<tr>
<th>Shoreline Jurisdiction</th>
<th>Length (in miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA Stream</td>
<td>18.1989</td>
</tr>
<tr>
<td>SSS Stream</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Lake</td>
<td>0.0000</td>
</tr>
<tr>
<td>SMA Marine</td>
<td>0.0000</td>
</tr>
<tr>
<td>SSS Marine</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Waddell Creek basin is bordered by Perry Creek and Kennedy Creek basins to the north, McLane Creek, Dempsey Creek and Black River basins to the east, Lost Valley, Mima Creek...
and Black River basins to the south, and Sherman Creek, Fall Creek and Porter Creek basins to the west.

A portion of the state natural area for Mima Mounds is located in this basin. However, it is not associated with any shoreline jurisdiction.

Water within Waddell Creek basin generally flows into Waddell Creek. Waddell Creek flows into the Black River.

Primary land use for this basin is residential, undeveloped and forestland. The TRPC population forecast indicates that as of 2006 there were 170 dwelling units identified within this basin (as a whole) and projects an increase to 200 dwelling units by 2030.

7.35.2 Public Access

There is no defined shoreline access in this basin. Informal access to the shoreline may be available in locations where public roads intersect with the shoreline jurisdiction. Intersections of public roads and shoreline jurisdiction are identified within the reach analysis.

7.35.3 Priority Habitats and Critical Areas

Waddell Creek is mapped as supporting resident cutthroat, fall Chinook, coho salmon, winter steelhead, and sea-run cutthroat. In addition, Waddell Creek is also mapped as providing spawning and rearing habitat for coho salmon, fall Chinook, and winter steelhead. The tributaries are mapped as supporting resident cutthroat only.

This basin is also mapped as providing habitat for riffle sculpin, torrent sculpin, western brook lamprey, and wild turkey.

The majority of the basin is mapped as containing hazardous slopes/ slide areas with the exception of a small portion of the southern tip of the basin.

Oak-conifer forests are located in the southeastern portion of the basin adjacent to Waddell Creek.

The 100-year flood plain is associated with the majority of Waddell Creek.

This basin contains several streams including Waddell Creek as well as several unnamed tributaries. Some portions of Waddell Creek contain shoreline jurisdiction and have reaches assigned in section 7.28.7 and described in Appendix A. The remainder of Waddell Creek as well as the associated tributaries are not mapped as meeting the shoreline jurisdiction requirements. However, these streams are likely to qualify as critical areas pursuant to TCC 17.15.

7.35.4 Evidence of Processes Disturbed or Potentially Impacted Function

Timber and forestland use is mapped within the shoreline jurisdiction of this basin.
7.35.5 Available Resources, Studies, and Spatial Information

The following research, studies and spatial information are available for the Waddell Creek basin:

Waddell Creek contains both a rain gauge and stream gauge.

Black Lake/Littlerock/Delphi Sub-area, 1981. TRPC. This report provides recommendations for future residential, commercial, and industrial development. It also provides information of the area’s history, resources and characteristics.

Rate of Urbanization and Forest Harvest in Thurston County 1985-2000. January 2002. TRPC. This report studies the decrease in forest cover as well as the increase in urban cover that occurred within Thurston County during the years of 1985-2000.

The Relationship of Land Cover to Total and Effective Impervious Area. June 2003. TRPC. This report uses remote sensing data to determine total and effective impervious surface area for the basins of Thurston County with additional focus on Green Cove Creek and the Woodland basins.

Additional research, studies or spatial information regarding this basin may have been referenced for the creation of this document. Please reference Appendix B: Inventory.

7.35.6 Enhancement or Restoration Activities Implemented

The following enhancement or restoration activities have been implemented in this basin:

DNR – Multiple Site Development 69, RCO Project Number 69-709, DNR, completed

“This project developed basic outdoor recreation facilities at the following 11 DNR locations: Porter Creek, Camp Bob, Hollywood, Winston Creek, Leader Lake, North Creek, Camp Spillman, Bird Creek, Elk Creek, Wilson Creek and Sherman Valley Y. Facilities included camping, picnicking, boating, fishing, hiking and sight seeing with provisions for necessary water, sanitation, and other public use facilities.”

Unnamed Tributary to Waddell Creek, RCO Project Number 99-1426, WDFW, completed

“Remove a rock barrier dam at the outlet of a pond and construct a formal fishway in addition to removing two barrier culverts on the property (same stream & tributary) and replacing the culverts with passable culverts meeting WDFW Fish Passage Criteria.”

Capitol Forest ORV Bridge 2000, RCO Project Number 00-1637, DNR, completed

“This proposal is to design and construct 1 new ORV trail bridge. The purpose of this project is to ensure safety of trail users and protect the quality of stream habitat and/or salmon bearing streams. The stream crossing this project affects is a tributary into Waddell Creek. The proposed new bridge location is on the Capitol State Forest trail system. The new bridge would replace an existing culverted water crossing on the North Rim #1 trail. This project includes the design,
permitting, purchase and installation (including concrete footings and approaches) of the proposed bridge. The new bridge is planned to be constructed out of steel or aluminum and have wood decking.”

**Noschka Road North Fish Passage Project, RCO Project Number 01-1207, Thurston County Roads and Transportation Department, completed**

“This project will replace two existing culverts with an 8 foot diameter culvert installed at a 1% slope and countersunk 20% to provide more natural stream flow characteristics and unimpeded fish passage. According to Todd Walker, DNR Regional Biologist, this project would open up approximately one mile of upstream habitat. DNR has replaced several upstream culverts and has other fish enhancement projects in this drainage, so this project would mesh well with their upstream work.”

**Noschka Road South Fish Passage Project, RCO Project Number 01-1320, Thurston County Roads and Transportation Department, completed**

“This project will replace an existing 1.5 foot diameter culvert with an 8 foot diameter culvert installed at a 1% slope and countersunk 20% to provide more natural stream flow characteristics and unimpeded fish passage. Weirs will be added in-stream to reduce the possibility of head cutting. According to Todd Welker, DNR fish biologist, approximately 3/4 mile of upstream habitat would be opened by removal of this barrier. DNR has replaced their culvert upstream of this site and has other fish enhancement projects within this drainage that would complement this project.”

### 7.35.7 Reach Data

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Reach Name Series</th>
<th>Reaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waddell Creek</td>
<td>BL-8</td>
<td>6</td>
</tr>
<tr>
<td>Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lake</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marine</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Total Reaches</td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

### 7.36 ZENKNER

This basin has no mapped shoreline jurisdiction and is therefore not reviewed in this document.