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WRIA 13 ASSESSMENT

CHAPTER 6 – WATER QUALITY

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Section 1
The Role of Water Quality in WRIA 13 Planning

6.1.1 Introduction

The Watershed Planning Act (RCW 90.82) makes water-quality an *optional* component of watershed plans. If planning committees elect to address water quality in their plans, however, they *must* include certain elements (RCW 90.82.090). These elements are summarized below in italics.

The WRIA 13 Watershed Planning Committee has selected water-quality as a second-tier issue in developing a watershed plan -- behind water quantity. The committee's decision was prompted both by state law, and by the fact that a wide array of water-quality programs are already underway in WRIA 13.

6.1.2 RCW Expectations: Addressing Water Quality Standards and Violations in WRIA Plans

Summary: *Examine whether water quality conditions are being met and examine the documented causes of water quality violations, specifically the impact of fresh water on marine water quality.*

RCW 90.82.090 expects planning groups to use *existing* data and monitoring efforts to examine water quality. Here in WRIA 13, water bodies have already been subject to rigorous monitoring and planning. (By contrast, there have been few watershed-wide plans for water *quantity*.) The water quality in each inlet has been assessed intensely under grant programs. In addition, more than 25 streams and lakes have experienced ambient monitoring over the past decade (generally four wet-weather and two summer samples). (Ambient monitoring reveals the overall health of water bodies over time, and helps identify trends in water quality.)

Water-quality results are discussed further in Section 7.

1.3RCW Expectations: Addressing TMDLs in WRIA Plans

What is a TMDL?

About TMDLs

Technically, TMDLs are mathematical thresholds -- the total amount of a pollutant a water body can accept each day and still meet water-quality standards. This threshold is then divided between the various sources of pollution to identify how much pollution is allowable from each source. The sources are categorized broadly, into areas such as "point" (from a definable pipe or source) and "nonpoint" (from an array of sources, such as stormwater runoff and septic systems). TMDLs must be written for each pollutant that exceeds state standards.

Practically, the term "TMDL" also refers to a broad, DOE-written plan for cleaning up a water body on the 303(d) list. This process includes:

1. Water sampling to verify impairment.
2. Data analysis and mathematical modeling.
3. Set allocations/limits for pollution sources (the technical definition of TMDL).
4. Implementation strategy.
5. Effectiveness monitoring.

TMDL *clean-up plans* play a driving force behind land-use and permitting policies on both the state and local level.

For more information, see attachment 6-1.

Every even-numbered year, the federal Clean Water Act requires states to update what is known as a "303(d) list. This is a list of water bodies that fail to meet the state's own water-quality standards, and are too polluted to support certain uses – human and wildlife – designated by the state. For example, the Washington State Department of Ecology (DOE) designates certain water bodies for drinking, and others for recreation or wildlife habitat.

DOE updates the 303(d) list based on water-sampling results and other documents provided by local governments, tribes, state agencies and other entities. The federal EPA must approve the 303(d) list.

When a water body is placed on the 303(d) list, the Clean Water Act requires states to develop TMDLs. These are watershed-wide cleanup plans written by the state environmental authority – in Washington State's case, the Department of Ecology. The plans are driven by a mathematical formula that determines how much of a given pollutant a water body can bear each day, and then divides that threshold up among the various pollution sources within the watershed.

Example of Department of Ecology 303(d) list

(This is a small segment of the actual 1998 list, and does not include all the WRIA 13 water bodies on the list. See Table 7.3 for a complete summary of the 303(d) list.)

WRIA	Waterbody Name	Parameter	Township	Range	Section	Latitude	Longitude	New ID #	Old ID#
13	AYER (ELWANGER) CREEK	pH	17N	01W	07			XR83PB	WA-13-1015
13	BUDD INLET (INNER)	2-Methylnaphthalene				47.055	122.895	390KRD	WA-13-0030
13	BUDD INLET (INNER)	Acenaphthene				47.055	122.895	390KRD	WA-13-0030
13	BUDD INLET (INNER)	Acenaphthene				47.055	122.905	390KRD	WA-13-0030
13	BUDD INLET (INNER)	Acenaphthylene				47.055	122.895	390KRD	WA-13-0030
13	BUDD INLET (INNER)	Anthracene				47.055	122.895	390KRD	WA-13-0030
13	BUDD INLET (INNER)	Benz(a)anthracene				47.055	122.895	390KRD	WA-13-0030

Summary of RCW 90.82 expectations on TMDLs

Summary: Plan should include Recommend approaches to achieving adopted Total Maximum Daily Load (TMDL) water cleanup plans developed by DOE under the Clean Water Act.

Due to extensive water quality monitoring in WRIA 13, a total of 15 streams and lakes and three marine inlets are included on DOE's 1998 Section 303(d) list (the most recently adopted listing). They are:

- Huckleberry Creek
- Ayer Creek
- Reichel Creek
- Deschutes River
- Capitol Lake
- Ward Lake
- Indian Creek
- Mission Creek
- Moxlie Creek
- McLane Creek
- Dobbs Creek
- Meyer Creek
- Sleepy (Libby) Creek
- Woodard Creek
- Woodland Creek

The 303(d) list also includes marine waters in Budd Inlet, Henderson Inlet, and Nisqually Reach. More information is provided in Table 7.3.
In addition to listing pollutants in water bodies, the 303(d) list includes certain "non-pollutant issues" that affect water quality. These issues – instream flow and woody debris, for example – cannot be mathematically apportioned out through a TMDL process. Nevertheless, DOE anticipates that state and local water-quality efforts will address these "non-pollutant issues.[1] The WRIA 13 Watershed Plan might offer such a forum to address these concerns.

DOE has not yet completed TMDL cleanup plans for WRIA 13. Thus, the planning committee cannot recommend approaches to achieving TMDLs in its watershed plan.
Although TMDLs have not yet been adopted, the process has either been initiated, or is underway, for most of the officially listed "impaired" waters in Henderson Inlet, Nisqually Reach, and Budd/Deschutes. Final TMDLs are anticipated in roughly 2005-2006.

6.1.3 RCW Expectations: Addressing Monitoring in WRIA Plans

Summary: Plan should recommend ways government agencies might monitor whether water-quality efforts are adequately improving water bodies to achieve state standards.

WRIA 13 is already monitored extensively for surface water, ground water, precipitation, and biological factors. A summary of monitoring programs, and possible

[1] Department of Ecology Water Quality Program Policy 1-11 "Assessment of Water Quality for the Section 303(d) List", September 2002

recommendations, is featured in Section 10.

RCW Guidance: Encouragement to Identify Priority Projects

Summary: Planning Committee encouraged to identify priority projects as part of WRIA Plan.

The Watershed Planning Act "encourages" local planning groups to identify priority projects in the recommended Plan. This highlights the potential use of the Plans as an important "index" of projects within the planning area warranting grant funding support.

As described in RCW 90.82.110:

"The planning group is encouraged to identity projects and activities that are likely to serve both the short-term and long-term management goals and that warrant immediate financial assistance from the state, federal and local government. If there are multiple projects, the planning group shall give consideration to ranking projects that have the greatest benefit and schedule those projects that should be implemented first." (RCW 90.82.110)

Section 2
Water Quality Conditions in WRIA 13

6.2.1 Introduction

Water bodies in WRIA 13 have been under intense scrutiny for more than a decade. This section addresses two key questions:

- State Water Quality Standards and the Clean Water Act: *What are the requirements?*
- Water Quality in WRIA 13: *What is the condition of our water bodies?*

6.2.2 State Water Quality Standards and the Clean Water Act

Good water quality is essential to support all the uses we enjoy from the streams, rivers and lakes in WRIA 13. Consequently, DOE assigns a category to every surface water body in the state of Washington depending on the kinds of "beneficial uses" the water is expected to support (WAC 173-201). "Beneficial uses" refers to the various ways in which water is used for the benefit of humans and wildlife. Examples include drinking, recreation, aquatic habitat, and industrial use.

When human-generated pollution causes a water body to fall short of the standards it must meet to support its beneficial uses, DOE must place the water body on a state list of "impaired" water bodies. This list is referred to as Section 303(d), and is required under the federal Clean Water Act.

The state must then write a plan to clean up each water body on the list, using the TMDL process (the exception is where an effective action plan already exists). For more information about TMDLs, see Section 6.

The TMDL process is particularly important to the WRIA 13 Watershed Planning Committee because TMDL efforts are underway, or beginning, in most watersheds of the WRIA.

6.2.3 Water Quality Conditions in WRIA 13

Water-quality conditions for all WRIA 13 water bodies are summarized in Table 7.3, prepared by Thurston County staff. Water bodies that have shaded boxes after their names are on the 1998 303(d) list (the latest EPA-approved list). Within the boxes are footnote numbers pointing readers to more information at the end of the table.

DOE based its 303(d) listings on, among other things, data by Thurston County, Squaxin Island Tribe, and DOE's own assessments. Table 7.3 also lists water bodies that are not on the 303(d) list, so readers can review their overall water quality as well.

Several fresh water bodies on Table 7.3 are not featured on DOE's 303(d) list, but are nevertheless experiencing water-quality problems. For example, Lawrence, Long and Pattison lakes have documented pollution problems, but are not listed because of past lake-restoration programs and existing monitoring. (These efforts qualify the lakes as already having a pollution-control plan, and are therefore not required to be listed on the 303(d) list.

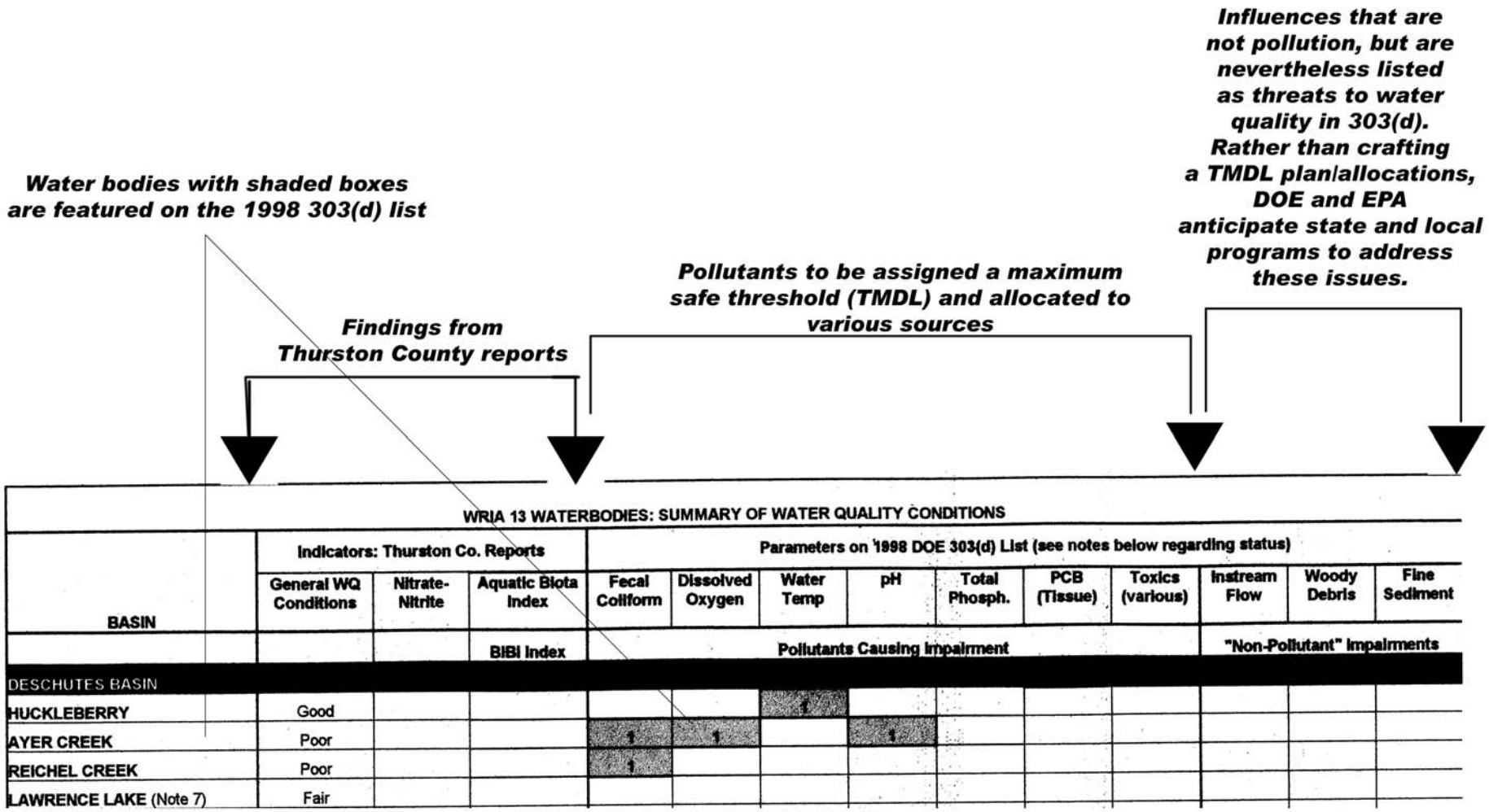
Other water bodies are not on 303(d) list because they already meet water-quality standards.

Note that certain water bodies on the 303(d) list have shaded boxes in the "impaired parameters" category. These categories – instream flow, woody debris, fine sediment – are non-pollutant issues and do not lend themselves to a TMDL-type formula. Therefore, DOE anticipates that state and local water-quality efforts will address these "non-pollutant" issues.[2] These issues may be particularly relevant for WRIA 13 planning.

[2] Department of Ecology Water Quality Program Policy 1-11 "Assessment of Water Quality for the Section 303(d) List", September 2002

HOW TO READ TABLE 2.3

(This is a small segment of the actual table.)



WRIA 13 WATERBODIES: SUMMARY OF WATER QUALITY CONDITIONS

BASIN	Indicators: Thurston Co. Reports			Parameters on 1998 DOE 303(d) List (see notes below regarding status)									
	General WQ Conditions	Nitrate-Nitrite	Aquatic Biota Index	Fecal Coliform	Dissolved Oxygen	Water Temp	pH	Total Phosph.	PCB (Tissue)	Toxics (various)	Instream Flow	Woody Debris	Fine Sediment
			BIBI Index	Pollutants Causing Impairment							"Non-Pollutant" Impairments		
DESCHUTES BASIN													
HUCKLEBERRY	Good					1							
AYER CREEK	Poor			1	1		1						
REICHEL CREEK	Poor			1									
LAWRENCE LAKE (Note 7)	Fair												

Table 2.3

WRIA 13 WATERBODIES: SUMMARY OF WATER QUALITY CONDITIONS

BASIN	Indicators: Thurston Co. Reports			Parameters on 1998 DOE 303(d) List (see notes below regarding status)									
	General WQ Conditions	Nitrate-Nitrite	Aquatic Biota Index	Fecal Coliform	Dissolved Oxygen	Water Temp	pH	Total Phosph.	PCB (Tissue)	Toxics (various)	Instream Flow	Woody Debris	Fine Sediment
			BIBI Index	Pollutants Causing Impairment							"Non-Pollutant" Impairments		
DESCHUTES RIVER													
REICHEL LAKE													
LAKE LAWRENCE													
OFFUT LAKE													
MCINTOSH LAKE													
TEMPO LAKE													
DESCHUTES BASIN													
HUCKLEBERRY	Good					1							
AYER CREEK	Poor			1	1		1						
REICHEL CREEK	Poor			1									
LAWRENCE LAKE (Note 7)	Fair												
OFFUT LAKE	Fair												
SPURGEON CREEK	Good	Low											
CHAMBERS LAKE	Fair-Poor												
CHAMBERS CREEK	Good	High	Poor-Moderate										
DESCHUTES RIVER	Good	Moderate		1		1					6	6	6
PERCIVAL CREEK	Good	Low	Moderate										
CAPITOL LAKE (Note 8)	Fair-Poor			1				1					
HEWITT LAKE	Good												
WARD LAKE	Excellent-Good								1				
BUDD TRIBUTARIES													
ELLIS CREEK	Fair-Good	Moderate	Moderate-Good										
INDIAN CREEK	Poor	Moderate		1									
MISSION CREEK	Poor-Good	High		1									

MOXLIE CREEK	Poor-Fair	Moderate		**1**									
SCHNEIDER (EAST BAY)	Fair-Good	High											
BUTLER CREEK	Fair-Good												
BUDD INLET -MARINE WATERS					**1**		**1**			**4**			
ELD													
GREEN COVE CREEK	Good	Moderate	Moderate-Good										
MCLANE CREEK (Note 9)	Fair-Good	Low	Moderate-Good				**5**						
ELD INLET - MARINE WATERS													
HENDERSON													
DOBBS	Fair	Low		**2**			**2**						
MEYER	Fair	High		**2**									
SLEEPY (LIBBY)	Fair	Medium		**2**	**2**		**2**						
WOODARD	Fair-Good	Moderate	Moderate	**2**	**2**		**2**						
HICKS LAKE	Fair-Good												
PATTISON LAKE (Note 10)	Good												
LONG LAKE (Note 10)	Fair												
WOODLAND	Fair	High	Poor-Moderate		**2**	**2**	**2**	**2**			**6**		
HENDERSON INLET - MARINE				**2**	**2**								
Subtotal & average %													
NISQUALLY REACH													
NISQUALLY REACH													
NISQUALLY REACH - MARINE				**3**	**3**								

NOTES ON LISTING STATUS:

1. Deschutes/Capitol Lake/Budd Inlet is on Priority List for TMDL to be initiated in FY 2003. Five-year process to complete.
2. Henderson Inlet TMDL process initiated in 2002.
3. Nisqually Reach TMDL process initiated in 2002.
4. Cascade Pole toxics problems being addressed through separate action program.
5. Eld Inlet not on DOE Priority List for East Olympic Region.
6. "Non-pollutant" impairments cannot be "allocated" via TMDL. DOE anticipates state/local agency actions will address these impairments.
7. Lake Lawrence excluded from List despite documented impaired condition based on 1992 Lk Restoration Plan & DOE monitoring
8. Capitol Lake1988 Lk Restoration implemented but Listed: Lacks monitoring to assure effectiveness
9. McLane pH listed based on DOE 1992-96 monitoring (exceeded 7 out of 19 samples)
10. Pattison and Long Lakes excluded despite documented impairment based on 1987 Lk Restoration Implementation, DOE & County monitoring

6.2.4 "Biological Integrity" as an Indicator of Water Quality

Surveys of a water body's macro invertebrate community provide an important indicator of water-quality conditions. Macro invertebrates are organisms lacking a backbone and that are visible to the naked eye. Examples include crustaceans, mollusks, worms, and many species of insect larva such as mayflies, stoneflies, caddis flies, and beetles.

By studying the diversity, population, and species-composition of aquatic macro invertebrates, researchers learn about the quality of water in a stream, the health of its riparian areas, and the health of the entire watershed. This approach has emerged as an important indicator of water quality conditions, and an enhancement to the traditional approach to water-quality testing.

When testing for macro invertebrates, small sampling sizes can produce variable results. On the recommendation of experts in the field, Thurston County increased the sample size for macro invertebrate monitoring in 2002.

Biological Condition	1998	1999	2000	2001
Green Cove	Moderate	Moderate	High	Moderate-High
McLane	Moderate	Moderate	High	Moderate-High
Percival	Low	Low	Low-Moderate	Low
Woodard	Moderate	Moderate	High	Moderate-High
Ellis	Moderate	Moderate	High	High
Woodland	Low	Low	Moderate	Moderate
Chambers	---	Low	High	Moderate-High

Section 3
Key Water Quality Concerns in WRIA 13

6.3.1 Key Water Quality Issues

The WRIA 13 Technical Committee examined the long list of water quality issues in the planning area toward identifying the key issues – those problems that could significantly impact important beneficial uses. The identified key issues are:

- Shellfish harvesting in certain WRIA 13 inlets is threatened by bacterial pollution, such as fecal coliform bacteria.
- Fish and trout habitat in the Deschutes River are vulnerable because of the river's increased water temperature over the summer months.
- Fish and other organisms in Budd Inlet and Henderson Inlet sometimes lack adequate dissolved oxygen because of nutrient loading.
- Fish and other organisms experience toxic conditions because of urban stormwater runoff.
- In parts of northern Thurston County, nitrate pollution is threatening the quality of water in upper aquifers.
- Current monitoring programs may be inadequate to guide future water-planning needs.

6.3.2 Fecal Coliform Bacteria Loading to Inlets

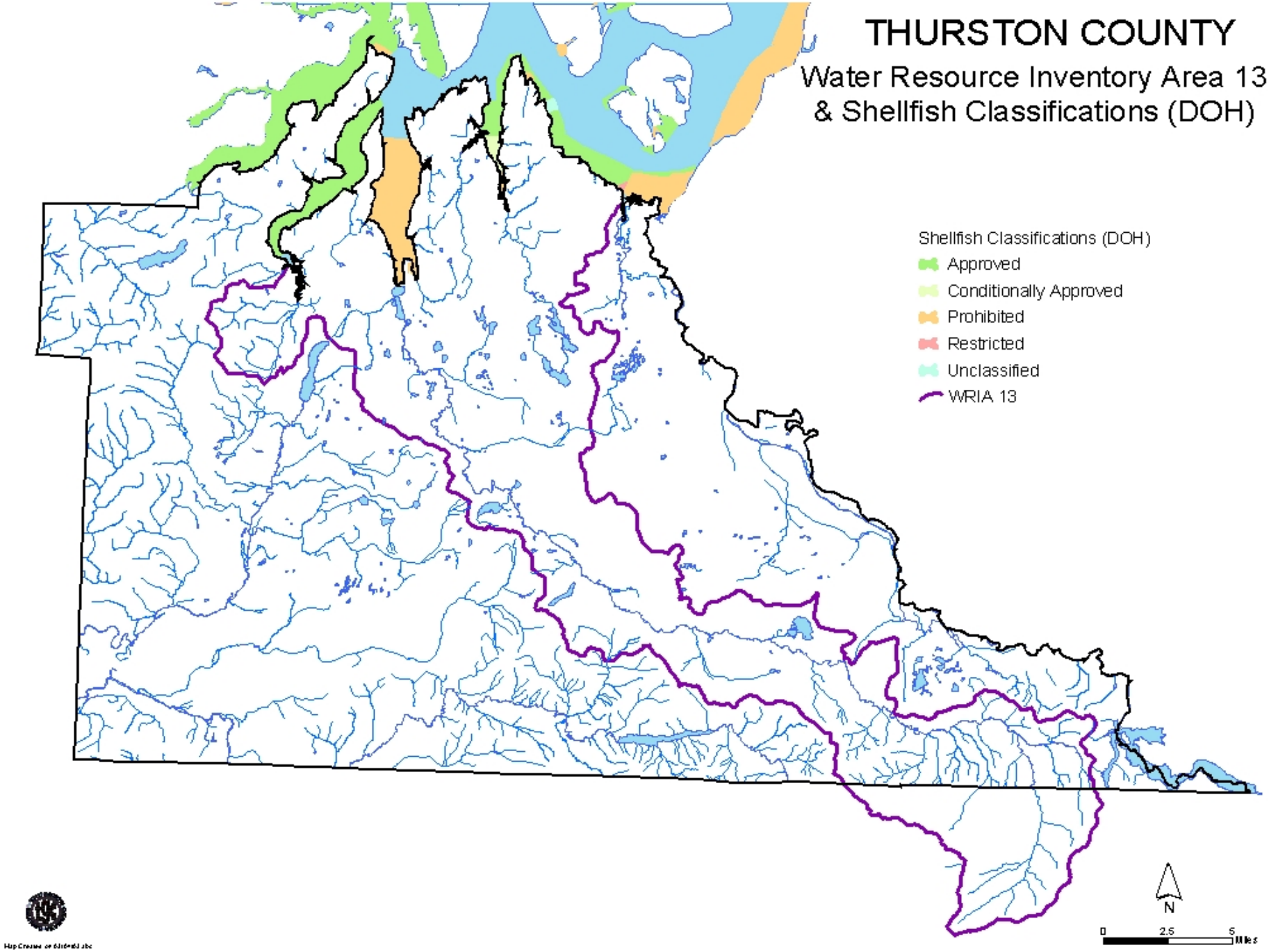
Fecal coliform bacteria are the most common pollutant listed on the 303(d) list for WRIA 13. Fecal coliform bacteria come from warm-blooded animals, such as cows, birds, people and raccoons. Fecal coliform is used as an indicator of potential disease-causing pathogens that could adversely affect human health from eating shellfish. (It is not a problem for the shellfish themselves.) Fecal coliform bacteria are a particular concern for Henderson Inlet and the Nisqually Reach. The Department of Health (DOH) has restricted shellfish harvesting in the two areas because of unacceptably high levels of fecal coliform bacteria. In the Henderson Inlet, the restrictions began in 1984; in Nisqually Reach, restrictions date back to 1992. (In 2002, the department upgraded several hundred acres in Nisqually Reach.) The restrictions triggered a state law that required Thurston County to create "Shellfish Protection Districts" to correct the pollution problems that led to the downgrades. In 2002, county commissioners created the two districts, and appointed stakeholder committees to prepare plans for reducing pollution. More information is available on www.co.thurston.wa.us/shellfish.

Bacteria contamination also threatens Eld Inlet. While the inlet is still open without condition

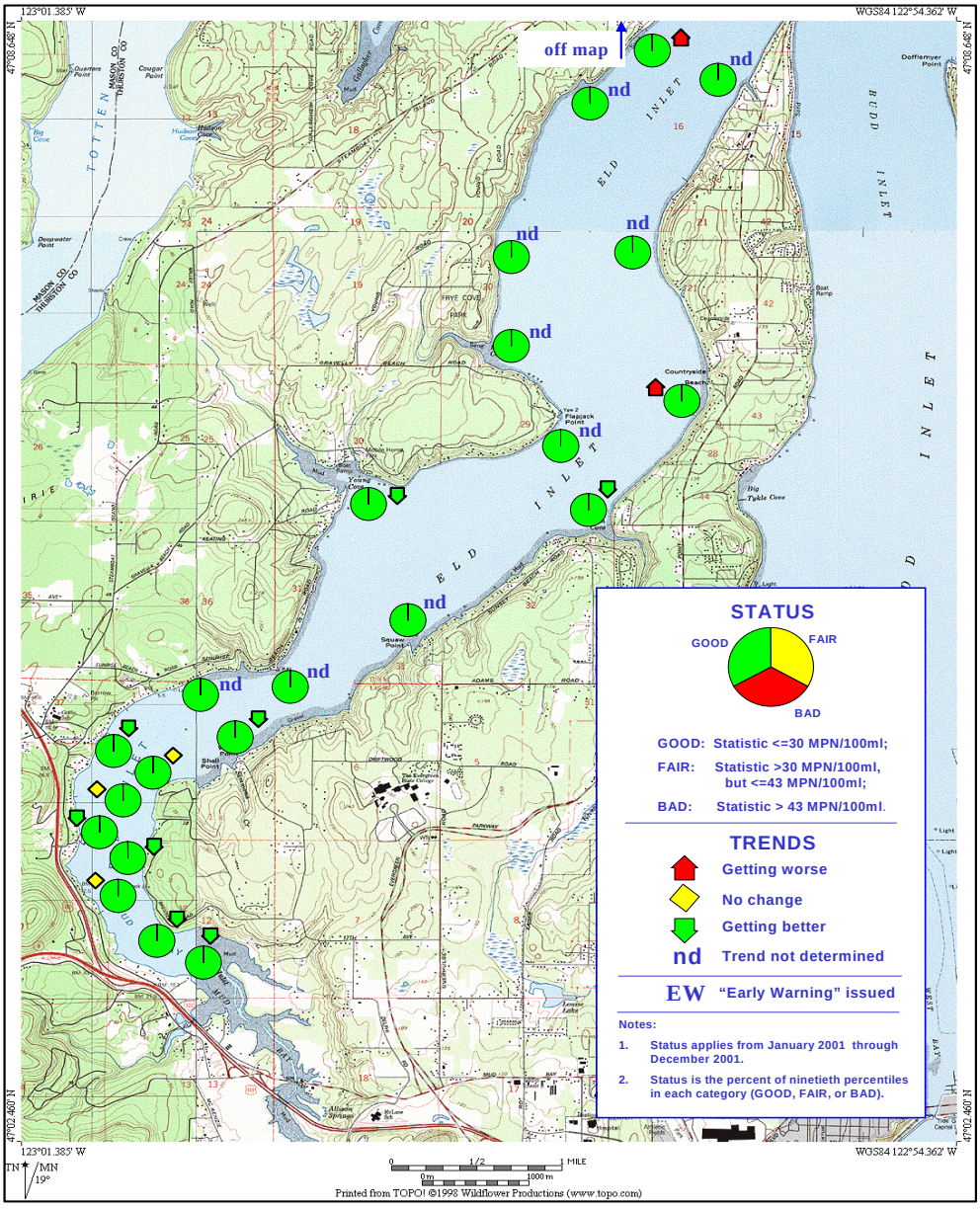
for shellfish harvesting, declining conditions in 2001 led DOH to include Eld on the list of "threatened" harvest areas. In the statewide 2001 survey of shellfish growing areas, Henderson Inlet (area 47) had the greatest percentage of worsening stations[3]. Poor condition of Nisqually Reach in 2001 is also shown (area 43). Eld Inlet (area 48) had some indication of decline and was included on the 2001 list of "threatened" shellfish growing areas. [4]

[3] 2002 Puget Sound Update, Puget Sound Action Team. See http://www.wa.gov/puget_sound/Publications/update_02/03_path_nut.pdf

[4] Washington Department of Health "2001 Annual Inventory of Commercial and Recreational Shellfish Areas of Washington State."


THURSTON COUNTY
Water Resource Inventory Area 13
& Shellfish Classifications (DOH)
Shellfish Classifications (DOH)
Approved
Conditionally Approved
Prohibited
Restricted
Unclassified
WRIA 13
N
0
2.5
5
Miles

Status and trend of fecal pollution in Eld Inlet through 2001

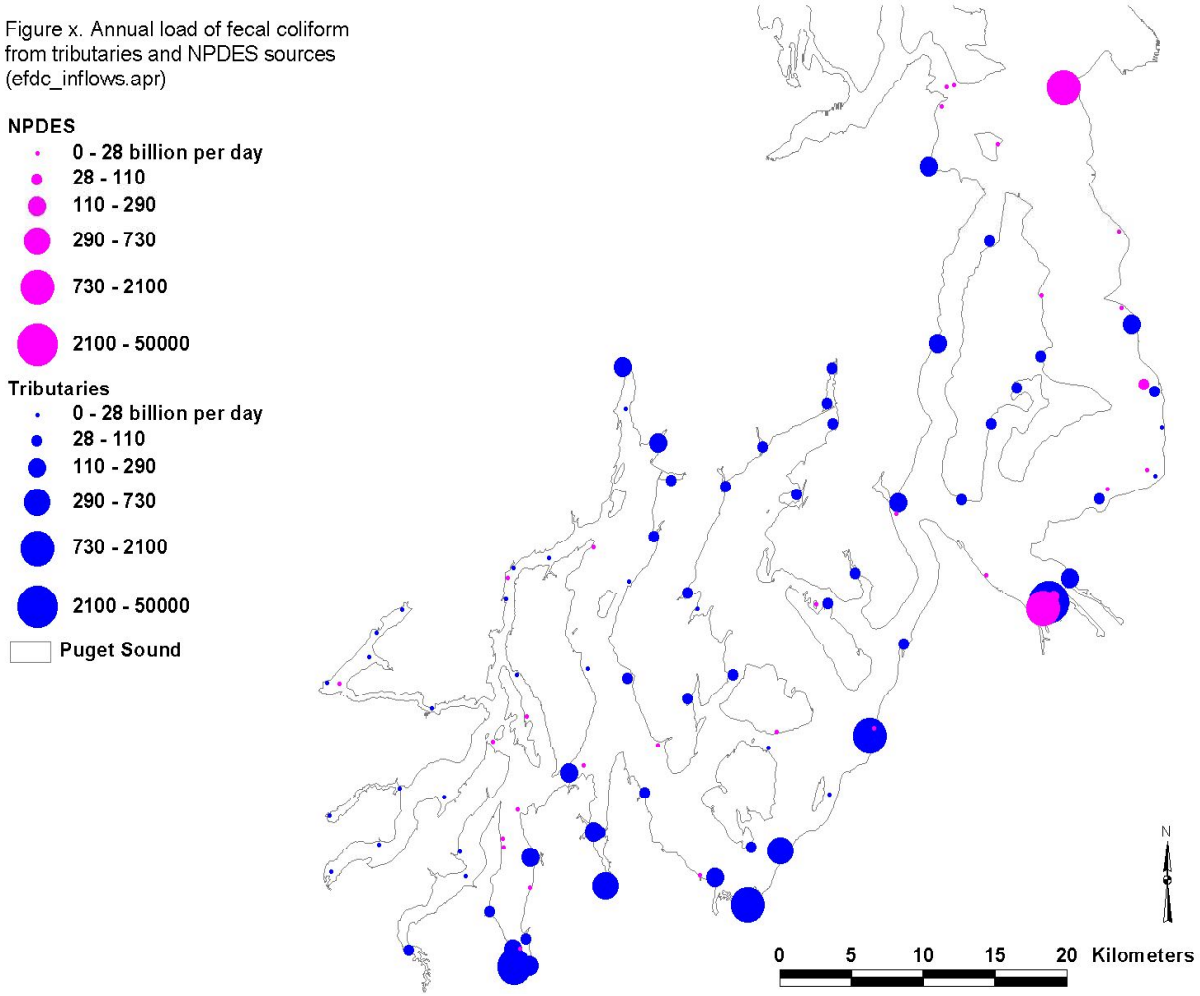


The distinct water quality condition in Eld versus Henderson Inlets is illustrated by results of Washington Department of Health shellfish area monitoring.

Bacterial pollution is also a public health threat to water contact recreation, such as swimming, wading and boating. The Deschutes River, area lakes, creeks and inlets are used for a range of water contact recreation.

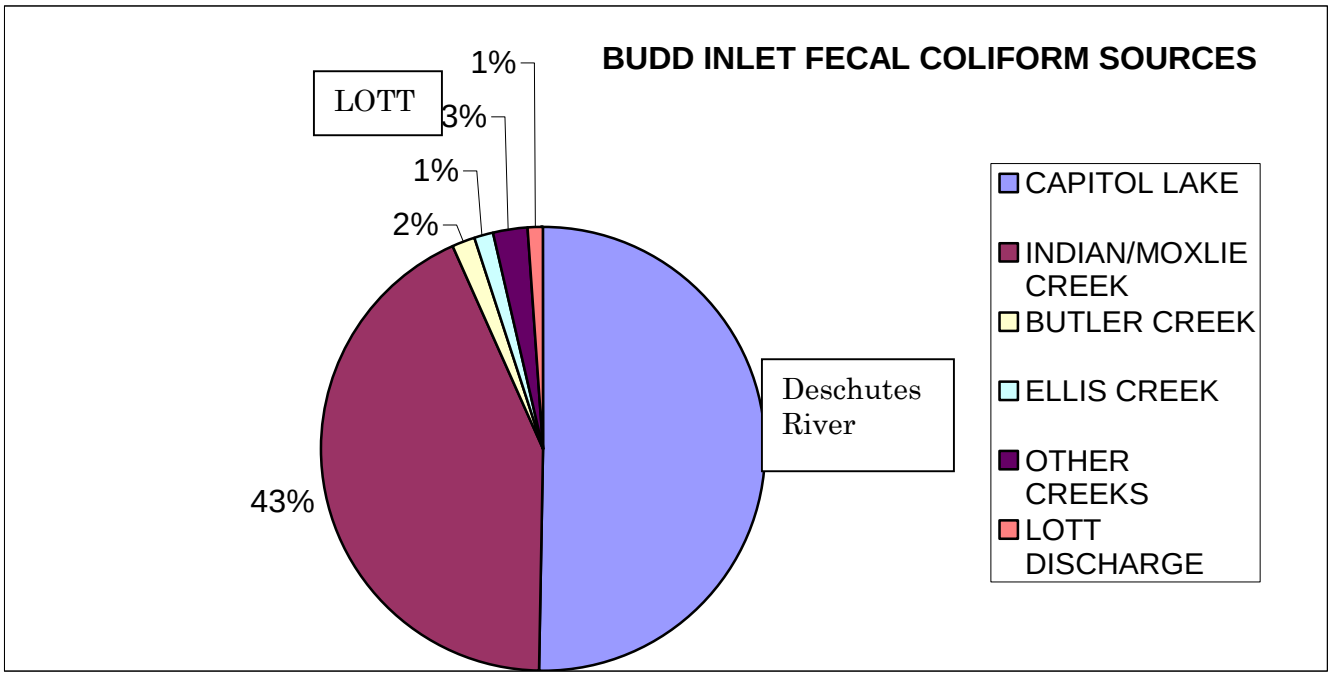
- **Sources of pollutant:** Both urban and rural areas contribute to this pollution problem. Near-shore on-site septic systems; sewer system leaks or miss-connections; livestock; pets; and wildlife are all sources of bacterial loading. In south Puget Sound, streams carry the greatest load of bacterial contamination into marine waters, as shown below.[5]

Figure x. Annual load of fecal coliform from tributaries and NPDES sources (efdc_inflows.apr)



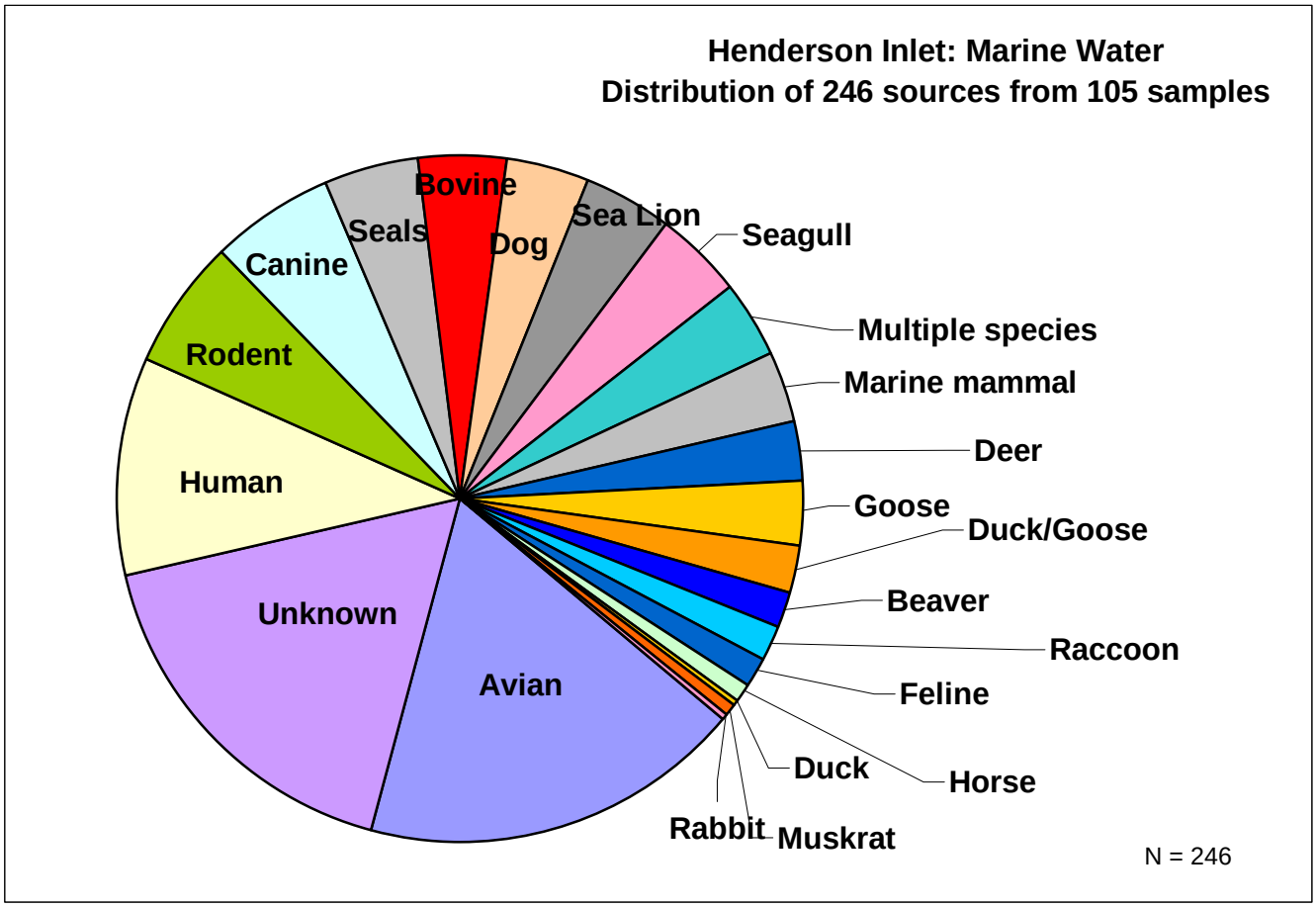
[5] "South Puget Sound Model Nutrient Study" (SPASM). See http://www.ecy.wa.gov/programs/eap/spasm/

The "nonpoint" nature of bacterial pollution sources is illustrated by comprehensive data collection in Budd Inlet.[6] Deschutes/Capitol Lake inflow carried ½ of the total fecal coliform loading, with Moxlie Creek supplying 43%. The LOTT wastewater treatment plant was the source of only 1% of loading.



[6] Budd Inlet Scientific Study Final Report, August 1998, prepared for LOTT Partnership by Aura Nova Consultants and several others.

The broad range of "nonpoint" bacterial pollution sources has been confirmed by recent Henderson Inlet DNA-based sampling.[7] This chart shows the variety of *sources* but does not identify percentage contribution to total loading.



Urban runoff poses a particular challenge for shellfish harvesting. Budd Inlet and most other urban bays are closed to all shellfish harvesting. In moderately urbanized watersheds including Eld Inlet and North Bay near Shelton, action programs have successfully improved water quality. However in urbanizing watersheds like Henderson Inlet our current methods of source control and stormwater treatment may be inadequate to sufficiently reduce bacteria in runoff.

The upcoming Shellfish Protection District and TMDL reports should help determine level of action needed to address urban runoff in the Henderson Inlet watershed.

[7] Bacteriological Contamination Source Identification, Henderson Inlet, 1999-2001 by the Thurston County Environmental Health Division in conjunction with Dr. Mansour Samadpour of the University of Washington. Available at http://www.co.thurston.wa.us/shellfish/publicationsmedia.htm#dnatest

6.3.3 Deschutes River Temperature and Pollutants

The temperature in the Deschutes River violates state standards designed to protect salmon species. The river's water temperature[8] is strongly influenced by riparian (streamside) vegetation, the configuration of channels, the volume of cold ground water entering the river, and air temperature. The Deschutes River is also listed on the 303(d) list for fecal coliform and impaired aquatic habitat conditions, such as: excess fine sediment, impaired in-stream flow, and insufficient amounts of large woody debris.

The Deschutes River is documented to significantly exceed temperature standards set for maintaining healthy salmon populations - a distinct limiting factor for summer residents like coho, Chinook salmon and cutthroat trout. A study in 1995 set continuous recording devices at six stations throughout the river: The State Water Quality standard of 18 degree Celsius (64.4 F) was exceeded for 54 days near Clear Lake and 25 days below Henderson Blvd (temperatures were lower in lower river due to input of cold groundwater.)

Water temperatures from the 1995 season were at or above several important thresholds for salmon habitat identified in a 2002 comprehensive survey of existing studies conducted by DOE.[9] For example, studies indicate that water temperature can be a barrier to salmon migration at 20 – 24.6 degrees C. Peak temperatures measured at the six Deschutes stations during 1995 ranged from 20.9 – 23 degrees. Fish diseases are also linked to elevated water temperature. The threshold for avoiding serious rates of infection and mortality was 12.6 – 16 degrees in various studies cited in the DOE report.

Proposed new standards look at conditions to support particular uses (like fish) under more chronic conditions. Proposed new standard for salmon spawning and rearing streams is a *7-day average daily maximum* of 16 degrees. The 1995 Deschutes temperature data has not been analyzed for this 7-day value. However, with over 20 days exceeding 18 degrees during July 1995, the new "use-based" standard would also likely be exceeded at some Deschutes stations.[10] DOE continuous temperature monitoring at Tumwater in 2001 identified maximum water temperature of 19.9 and highest 7-day average daily maximum of 19.4 degrees.[11]

- **Sources of impairment:**
  Groundwater inflow: Reduced streamflow – particularly summer input of cold groundwater – is directly linked to water temperature problems. The Deschutes study funded by the WRIA project in 2001 provides very good data on which sections gain

[8] An Assessment of Stream Temperature, Large Woody Debris Abundance and Spawning Gravel Fine Sediment Levels in the Main Stem Deschutes River, 1995, Dave Schuett-Hames and Ian Child, Squaxin Island Tribe, June 1996. This is the source for temperature data in this section related to Deschutes.
[9] "Evaluating Standards for Protecting Aquatic Life in Washington's Surface Water Quality Standards", Department of Ecology, 2002.
[10] DOE is monitoring Deschutes summer temperature with continuous recording devices near Tumwater. Began in 2001. See http://www.ecy.wa.gov/apps/watersheds/riv/station.asp?sta=13A060
[11] . DOE is monitoring Deschutes summer temperature with continuous recording devices near Tumwater. Began in 2001. See http://www.ecy.wa.gov/apps/watersheds/riv/station.asp?sta=13A060

groundwater input and which sections lose streamflow to groundwater. [12] Withdrawals from wells located in from the upper aquifer are generally considered to have high potential for some impact to instream flow. Less understood is relationship between deeper aquifers and influence on streamflow.

Lack of shade: Sun shining on water is one source of increased water temperature. Poor riparian vegetation limits benefits provided by shade.

Air temperature can be reduced within a dense canopy of vegetation along a waterbody. The 1996 Squaxin study identified a strong correlation between high air temperature and elevated water temperature conditions.[13]

6.3.4 Deschutes River and Woodland Creek Stream Flows

The Deschutes River is listed on the 303(d) list for impaired low flow conditions. Woodland is also listed on the 303(d) list for increased peak in-stream flows. Peak flows are higher -- and low flows, lower – than would occur naturally in the creek.

Summer stream flows are critical to juvenile salmon and other organisms. Stream flow is directly linked to water temperature. Low flows can lead to problems such as decreased habitat area, increased stranding, low dissolved oxygen, increased temperature and increased predation. Juvenile coho are highly territorial and can occupy the same area for long periods. The number of suitable territories available can limit the abundance of coho.[14]

6.3.5 Nitrate Loading to Streams and Inlets

Nitrates are an increasing problem in WRIA 13. Nitrate is a very mobile form of nitrogen---it is not readily retained by the soil and is highly soluble in water. Nitrates come from fertilizers, manure, septic systems and other human activities. At Chambers Creek, nitrates from shallow ground water are flowing into the creek's "base flow." The term "base flow" refers to the portion of stream flow that is caused by groundwater seeping into the creek/river from a channel slowly, over time. During the dry summer months, the water in Chambers Creek is sustained almost entirely from ground water.

The Chambers Creek experience mirrors other Thurston County streams, which are also influenced by nitrate-contaminated shallow groundwater (see graph below). Among these are

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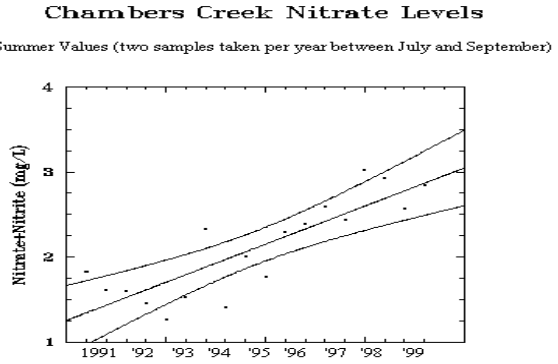
[12] 2001 Deschutes Groundwater Inflow Study, February 2002, Thurston County Environmental Health. Funded by WRIA 13 Watershed Planning Grant funds.

[13] An Assessment of Stream Temperature, LWD Abundance and Spawning Gravel In the Main Stem Deschutes, 1995, Squaxin Island Tribe

[14] "The Relative Role of Habitat in Healthy Populations of Natural Spawning Salmon, Carol Smith, Ph.D., in "Habitat Limiting Factors Final Report: Water Resource Inventory Area 13", WA State Conservation Commission, July 1999.

Woodland Creek and several other urban creeks with documented levels of nitrates. Studies have shown that nitrates are being loaded into shallow groundwater in the Tanglewilde/Martin Way area, among other areas. In the Tanglewilde area, a recent study found very few "failing" septic systems that could directly pollute surface water. The study did, however, find shallow groundwater with nitrate levels above drinking water standards.[15]



Scientists suspect that nitrate loading is contributing to an increase in marine Blue-Green Algae blooms in south Puget Sound including WRIA 13. These algae blooms have the potential to be toxic Increased nitrate levels in Puget Sound have raised alarm about potential damage to the shellfishing industry, which depends on clean water. In 2001, Eld and Totten Inlet were entirely closed for the first time due to presence of paralytic shellfish poisoning toxins or PSP (commonly called "red tide".) The microscopic organisms that create PSP are naturally occurring and are usually present in small numbers. However, when environmental conditions are optimal, "blooms" occur. These create toxins that are concentrated to potentially harmful levels by filter-feeding shellfish.

At the time this publication went to press (January, 2003) DOE was studying nitrogen loading to the South Sound from point sources and streams. The results may lead to an "allocation" of nitrogen from various sources, meaning that DOE might place limits on how much nitrogen sources ranging from wastewater treatment plants to "nonpoint" sources from various land uses can send into the South Sound. Our area's rivers and streams contribute a significant proportion of the nitrogen loading to the South Sound,[16] as shown below. The map illustrates "point" sources (NPDES) and general "nonpoint" sources (tributaries) from just south of Seattle to Budd Inlet at the south end of the Sound.

[15] "Septic System Inventory for Tanglewilde, Thompson Place and Bicentennial Developments", Thurston County Environmental Health for LOTT Partnership, December 1998.

[16] For additional information on the South Puget Sound Nutrient Study see www.ecy.wa.gov/programs/eap/spasm/index.html

6.3.6 Eutrophic Conditions

Most of the lakes in WRIA 13 are “eutrophic.” The term "trophic" means nutrition or growth. A eutrophic ("well-nourished") lake has high nutrients and high plant growth. Note that these lakes feature “poor” or “fair” general water quality conditions in Table 7.3.

Although the lakes are naturally eutrophic because of geological conditions, human influences have accelerated the rate of eutrophication. Urban development along shorelines has brought fertilizers and other nutrient-rich materials closer to water bodies. When it rains, stormwater runoff carries these nutrients into the water from both shoreline properties, and from upland properties throughout the watershed. Nutrients also soak through the soil and enter shallow ground waters, which then flow underground into the lakes.

Long, Pattison, Lawrence, McIntosh, Black, and Offutt Lakes are all nutrient-enriched lakes. They often experience nuisance algae and rooted aquatic plant growth. Capitol Lake (actually a reservoir at the mouth of the Deschutes) violates fecal coliform bacteria and total phosphorus standards. Ward Lake has general water quality conditions of “Excellent-Good.” However, fish tissue samples from Ward Lake contained polychlorinated biphenyls (PCB) above the edible fish tissue criteria -- leading to inclusion on the 303(d) list.

Section 4
Water Quality Action Programs in WRIA 13

6.4.1 Introduction

This section summarizes existing, and emerging, water quality programs in WRIA 13. It also summarizes the limitations of these programs.

6.4.2 Existing and Emerging Water Quality Programs

Table 9.2 summarizes water-quality efforts in WRIA 13. Not featured are the many programs DOE *enforces*, such as:

- water pollution control regulation (RCW 90.48);
- point discharge permitting (WAC 173-220); and
- dairy permitting and inspections (RCW 90.64).

DOE also establishes water quality standards (WAC173-201A) and conducts research. DOE is currently examining the effect of Best Management Practices on water quality. The study is primarily in WRIA 14, but it includes McLane Creek in WRIA 13 as well. It is scheduled for completion in 2003.

DOE is also spearheading a South Sound Nutrient Modeling Study. It is scheduled for completion in 2003. The goal is to develop a computer model that will simulate hydrodynamics and water quality, characterize and evaluate pollutant loading, and identify specific point and nonpoint sources of pollutants to South Sound. Another outcome of the modeling study may be to establish TMDLs for water bodies not meeting water-quality standards.

Table 4.2
Existing or Upcoming Water Quality Programs Affecting WRIA 13

Issue	Area	Parameters	Timeframe
303(d) List – List of "impaired" water bodies issued by DOE per Federal Clean Water Act	Nearly all significant streams; inlets; some lakes	Wide range of pollutants and habitat impairments	2002 – Five-year process for Henderson and Nisqually Reach TMDLS initiated. 2003 - Five-year process for Deschutes/Budd system TMDL scheduled to begin. 2013 – All TMDLs in WA scheduled to be complete.
South Puget Sound Model Nutrient Study (SPASM) – DOE study of loading from treatment plants and tributaries	South Sound	Nutrients, Biochemical Oxygen Demand (BOD), and Dissolved Oxygen	2001 - Calibrated model of loading from various sources 2002 – Final report. Following Final Report - TMDL allocating loading from various sources if needed to restore South Sound water quality.
Shellfish Protection Districts – County-created district to respond to State downgrade of commercial shellfish harvesting area due to documented water pollution (RCW 90.72)	Nisqually Reach and Henderson Inlet watersheds	Fecal coliform bacteria and other associated pollutants such as nutrients and BOD.	Late 2000 – DOH downgraded shellfish status in portions of Henderson Inlet and Nisqually Reach 2001– Shellfish Protection Districts created 2002 -Advisory Committees formed. Recommendations anticipated mid-2003.
LOTT Wastewater Resource Management Plan	Olympia/Lacey/Tumwater Urban Growth Area	Various contaminants in wastewater flow.	December 1998 – LOTT Partners adopt Plan, refer to DOE 2003 – Initial reuse component at Budd Inlet anticipated

Development Regulations – Land use plans and Critical Area Ordinances of the County and cities; design standards for erosion and stormwater control.	County-wide; specific regulations apply to aquifer recharge areas, fish and wildlife areas, geologically unstable and other sensitive areas	Fine sediment, various pollutants associated with residential and commercial development	Currently – All jurisdictions have Growth Management plans and development regulations 2002 – New stormwater design manual anticipated based on new DOE requirements 2/03 – Comprehensive Stormwater Management Programs (NPDES) due 2002-04 – Critical Area Ordinance updates based on "best available science"; cities and county.
Comprehensive Drainage Basin Plans – Hydrologic modeling of alternative futures; recommended capital projects and activities to address water quality & flooding.	All urban-area stream watersheds	Stream flow (replicate pre-development runoff conditions); pollutants from roads and other urban developed areas	Basin Plans have been adopted for each urban-area watershed. Implementation on-going; varies by Basin Plan
Early Warning Levels and Contaminant Action Levels Policy - Groundwater nitrate levels of concern that may warrant a response plan. (Thurston County Board of Health Resolution H-2-96)	County-wide. Applies where well samples document elevated nitrate levels.	Nitrate contamination of groundwater through human activities	1992 – Recommended in Northern Thurston County Groundwater Management Plan 1996 – Adopted by County Board of Health Implementation on-going
Designated Wellhead Protection Areas – Protects the recharge area for wells serving larger "public" water systems. Water systems submit capture area maps and protection plans to DOH for approval. Complemented by special land use regulations adopted by County and cities.	County-wide. State planning requirement applies to all Group A water systems (15 or more hookups).	Groundwater contaminants.	1992 – Recommended in Northern Thurston County Groundwater Management Plan 1997 – Special Thurston County land use standards adopted for wellhead areas serving 1,000 or more customers July 1999 – Original target date for all Group A systems to comply with State DOH WHPA plan requirements. (Only partial compliance to date).

6.4.3 Thurston County Water Quality Regulations and Activities

Thurston County provides a wide array of programs and regulations aimed at protecting water quality. These programs are summarized in the following sections.

Critical Areas Ordinance
Thurston County's Critical Areas Ordinance and local Shoreline Regulations are intended to protect sensitive areas from alterations that would diminish function and water quality.

Stormwater Drainage Manual
Adopted by Thurston County and the cities of Lacey, Olympia, and Tumwater, the "Drainage Design and Erosion Control Manual" sets standards for how new developments manage stormwater runoff. The goal is to reduce pollutants in stormwater runoff and manage the volume of runoff that flows into rivers and streams. The manual was first adopted in 1991 and revised in 1994.

At the time this publication went to press (January, 2003), technical staff from Thurston County and its cities were reviewing the 1994 drainage manual to bring it in-line with the Department of Ecology's "Stormwater Management Manual for Western Washington." Any project that requires either state funding, or permitting, will likely be required to comply with the standards set forth in the DOE manual. Thurston County and its jurisdictions are taking a proactive role in revising the regional 1994 manual, recognizing that DOE's version will take on added importance in the future as the federal government places new expectations on how our region manages stormwater runoff.

The 1994 Drainage Design and Erosion Control Manual is available on www.co.thurston.wa.us/wwm.

Stormwater Facilities: Basin Plan Implementation
Several stormwater facilities have been constructed in the Woodland, Woodard, Schneider, and Percival Creek systems. These construction projects are designed to control peak flows and help remove pollutants from stormwater runoff. These projects were first identified in comprehensive Stormwater Basin Plans developed for all urban-area streams in WRIA 13. Basin plans already exist for the following watersheds: Green Cove Creek; Chambers/Ward/Hewitt; McAllister/Eaton Creek; Woodland/Woodard Creek; Percival Creek; and Indian/Moxlie Creek. A basin plan for the Salmon Creek Drainage Basin is scheduled for completion in 2004.

Comprehensive Stormwater Basin plans are thorough investigations into the water problems and potential solutions within a given area. The plans involve gathering data about the topography of the land and the way water moves throughout the soil. Often, the planning process includes "modeling" certain scenarios. This practice enables engineers to determine how, and if, certain water solutions will work, and whether the solutions will send water onto other properties. Basin plans are usually multi-jurisdictional projects, involving the cities of Lacey, Olympia and Tumwater (depending on where the basin is located). Elected officials typically use basin plans as a tool to decide which stormwater-construction projects to finance. Thurston County and its

cities have already enacted many of the plans' recommendations for improving water quality.

Education

Thurston County's environmental educators teach people how to protect watersheds, reduce the use of hazardous products, and dispose of hazardous products safely. Their programs cover a wide range of audiences, including neighborhoods, businesses, and schools. The "Stream Team" program organizes volunteers to clean-up streams and plant vegetation.

Non-point Ordinance

Thurston County's Non-point Source Pollution Ordinance was adopted in 1992. It addresses agricultural practices and moderate-risk waste handling practices that inadequately protect water quality.

Non-Point Pollution Watershed Action Plans

Water quality in the Budd/Deschutes, Henderson, and Eld, Inlet watersheds has been examined as part of the grant-supported Puget Sound Nonpoint Pollution Watershed Action Plans program (WAC 400-12). Oriented to protecting marine water quality and shellfish harvesting in particular, the entire range of nonpoint pollution sources are considered in these plans – from farms and septic systems to boaters. Wide-ranging action programs were identified and partially implemented.

In 2003, proposed Shellfish Protection District proposals are anticipated for Henderson Inlet and the Nisqually Reach. Shellfish harvesting downgrades in these two areas triggered these watershed-oriented, citizen-based efforts. Thurston County is lead for these efforts.

Basin Planning: On-Site Systems

One notable accomplishment of watershed non-point pollution planning was a comprehensive survey of on-site (septic) systems along all the marine shorelines of WRIA 13. Researchers used dye and water-sampling to identify failing septic systems as sources of fecal coliform bacteria.

Table 9.3.7 summarizes the results of the septic system survey. Overall, 17 percent of shoreline systems were failing (both dye and coliform thresholds were exceeded) and another 15 percent were "suspect" (dye detected but water-quality standards not exceeded). Virtually all the failing septic systems detected at the time have been repaired. Moreover, Thurston County broke ground in 2002, on a new treatment plant for the Tamoshan and Beverly Beach communities.

Table 4.3.7

MARINE SHORELINE ON-SITE WASTEWATER SYSTEM SURVEYS

SUMMARY OF RESULTS: WRIA 13 INLETS

WATERSHED	YEAR	TOTAL SYSTEMS	SYSTEMS SURVEYED	PERCENT SURVEYED	NUMBER FAILING	PERCENT FAILING	NUMBER SUSPECT	PERCENT SUSPECT	% FAILING OR SUSPECT BY DISTANCE FROM WATER		
									< 50 FT	50-100 FT	> 100 FT
ELD INLET	1992-96	616	564	92%	93	16%	78	14%	39%	32%	20%
BUDD INLET	1996-99	105	37	35%	5	14%	4	14%	33%	0%	25%
HENDERSON	1996-99	210	25	27%	9	14%	14	25%	71%	67%	26%
NISQUALLY REACH	1994-96	271	165	61%	44	27%	21	13%	65%	44%	33%
TOTALS		931	626	67%	107	17%	96	15%	54%	40%	28%

Thurston County aggressively pursues grant funding to help finance water-quality response projects. For example, the county secured grant funding to help finance water-quality planning efforts in the Henderson Inlet and Nisqually Reach Shellfish Protection Districts.

Thurston Conservation District

The Thurston Conservation District works with landowners to improve agricultural practices to protect water quality.

The Effectiveness of Water-Quality Programs

Clearly, many programs and regulations seek to protect water quality in WRIA 13. However, the list of water bodies violating water quality standards is growing, demonstrating that the status quo is not effective. . Below are some reasons why existing programs might be falling short of their desired goals.

- **Higher density development.** Approved by the state Legislature in 1990 and amended in 1992, the Growth Management Act (GMA) seeks to prevent unplanned, urban sprawl in Washington State. The GMA requires all cities and counties in the state to plan for growth, and places more extensive requirements on the largest and fastest-growing counties and cities in the state. Among other things, the GMA requires local jurisdictions to provide consistency between their land-use plans, and the transportation and capital-facilities plans that affect land use.

  Now that growth-management plans are in effect, land development within urban growth boundaries is occurring at a higher density. The impact of such intense land use cannot be completely mitigated. Development brings with it more impervious surfaces and a greater need for water supplies. Changes to natural water systems diminish base-stream flows, while runoff worsens peak winter flows and pollutes surface water bodies.

- **Older, "grand fathered" developments.** Most existing water quality regulations apply only to new development that occurs after the regulations became law. Older developments are often exempt or "grand fathered" from new, improved design standards.

  For example, many developments in Thurston County were built before the 1994 Drainage Design and Erosion Control Manual took effect. (See Section 8.3 for more information about the manual.) These developments were not required to retrofit their stormwater facilities (such as infiltration ponds) to meet the 1994 standards. As a result, Thurston County must now focus its stormwater-construction projects in areas where older developments exist. These projects are usually designed to "treat" (clean) stormwater runoff before it enters the ground or nearby water bodies.

- **Weak penalties.** The penalties for violating water quality regulations are often of little consequence; they have not been much of a deterrent to pollution. Thurston County and its cities lack adequate resources to effectively enforce existing regulations.

- **Limited environmental review process.** Although new development is put through an environmental-review process, the process basically examines how the project will affect the surrounding environment at the time it is built. There is little ability to assess how those affects might cumulate, or worsen, over time. On a more positive note…

Section 5
Water Quality Monitoring in WRIA 13

6.5.1 Introduction

Beginning in the mid-1980's, Thurston County has performed ambient monitoring in local streams and lakes. Virtually all significant streams and lakes in Thurston County have been monitored. Funding comes mostly from an interlocal agreement between city and county stormwater utilities.

This section addresses:

- Existing ambient surface water quality monitoring within WRIA 13.
- Upcoming monitoring efforts associated with DOE-led Water Quality Cleanup Plans (TMDLs).
- Potential recommendations for improving water monitoring for inclusion in the WRIA 13 Watershed Plan.

6.5.2 Existing Monitoring Programs

Table 10.2 summarizes current ambient surface water, ground water, and precipitation monitoring programs in WRIA 13. In brief:

- About eight streams and ten lakes in WRIA 13 are currently monitored for water quality, quantity or both.
- About half of the 40 wells in the North Thurston County Ambient Groundwater Monitoring Network are in the WRIA.
- Precipitation is measured at five stations throughout the planning area.

Table 10.2
Current Ambient Water Quality and Quantity Monitoring (2002) **(performed by Thurston County and USGS)**

Note: All streams, except the Deschutes, are monitored for biological indicators.	**Stream flow Recorders**	**Lake Level Staff Gages**	**Surface Water Quality Monitoring**	**Groundwater Ambient Monitoring (3)**	**Precipitation Stations (1)**	**Special Study**
DESCHUTES				TC - 3 wells		
Lower Deschutes ("E" St. Station)	USGS		TC		TC (Cths) and NOAA (Airport)	Low flow
Upper Deschutes (Vail Road Station)	USGS				TC (Lake Lawrence)	
Chambers Creek			TC			
Ellis Creek			TC			
Percival Creek	TC		TC			
Capitol Lake			TC			
Chambers Lake		TC				
Hewitt Lake		TC				
Lawrence Lake		TC				
Offutt Lake		TC				
Sunwood Lake		TC				
Ward Lake		TC				
ELD INLET (EAST SIDE)				TC - 5 wells		
Green Cove Creek	TC		TC			

Note: All streams, except the Deschutes, are monitored for biological indicators.	**Stream flow Recorders**	**Lake Level Staff Gages**	**Surface Water Quality Monitoring**	**Groundwater Ambient Monitoring (3)**	**Precipitation Stations (1)**	**Special Study**
McLane Creek	TC		TC		TC (To be installed winter '02)	
HENDERSON INLET BASIN				TC -12 wells		
Woodard Creek	TC		TC		TC (12th Ave NW)	
Woodland Creek	TC		TC		TC (Fairgrnds)	
Hicks Lake		TC	TC			
Long Lake		TC	TC			
Pattison Lake		TC	TC			

6.5.3 Surface Water Monitoring

Thurston County monitors several surface water bodies for indicators such as stream flow, lake level, surface water-quality, and precipitation. Volunteers read gages and report findings to Thurston County.

Monitoring is generally performed six times per year: four samples during the web season, and two during the dry season. Thurston County also monitors for biological indicators on all streams except Deschutes. (See section 7.5 for a description of biological indicators. Stream Team volunteers perform about half of all the biological indicator sampling.

Monitoring data is reported in the Water Resources Monitoring Report: Water Year Annual Report. Thurston County's web site features the annual report, along with other data, including water quality data collected by the Environmental Health Division. The site also offers precipitation, stream flow and lake level data collected by the Department of Water and Waste Management. (Visit the stormwater button of www.co.thurston.wa.us/wwm and www.geodata.org/swater.)

Funding for Surface Water Monitoring

The Storm and Surface Water utilities of Thurston County, Olympia, Lacey, and Tumwater fund ambient water-quality monitoring. The utilities contribute funding based on the number of monitoring stations in, or benefiting, each jurisdiction. In Thurston County, funding also comes from grants, Lake Management District assessments. Results are reported in an annual Water Resource Monitoring Report. The report is available on www.co.thurston.wa.us/wwm. The Thurston County Environmental Health Division writes the reports and submits them to the Department of Ecology, along with supporting data.

Funding for ambient surface water-quality monitoring is relatively stable. In recent years, Thurston County has decreased the number of streams it monitors through water chemistry methods, and increased its biological monitoring. Stormwater program managers for the jurisdictions have discussed whether their programs benefit enough from long-term ambient monitoring to merit continued funding in the future.

6.5.4 Deschutes Surface Water Monitoring

USGS operates gaging stations #12080010 (E Street in Tumwater) and #12079000 (Vail Road in Rainier). Both stations gage water-depth in the Deschutes River. A calculation is then applied to determine water-flow at the various heights. The Rainier gage has satellite telemetry that reports findings every 15 minutes when the river exceeds a stage of 8.5 feet, which is equivalent to 2,300 cubic feet of water per second. This is the average peak flow per year. The E Street station does not have satellite linkage. Real-time and historical data is available on the USGS web site: www.usgs.gov.

6.5.5 Upcoming Monitoring Related to TMDLs

DOE is in the process of writing water cleanup plans for Henderson Inlet, Nisqually Reach and the Budd/Deschutes. Also known as "Total Maximum Daily Loads" or TMDLs, these plans seek to reduce pollutants in water bodies that are listed on the "303-d" list. (This list features water bodies that are too polluted to support the uses, such as swimming, that DOE has designated for them. For a full explanation, see Section 6.2.)

Schedule for Henderson Inlet and Nisqually Reach

- 2002-2003: Thurston County Environmental Health and DOE will conduct water quality sampling and analysis. Information collected by early 2003 will also be useful for Stakeholder Committees in the Henderson Inlet and Nisqually Reach Shellfish Protection Districts. (Plans for restoring water quality to shellfishing standards are due by June, 2003.)

- 2003-2004: DOE will analyze data and submit recommendations for comment by the public and local staff.

- Early 2005: DOE is expected to issue water cleanup plans (TMDLs), comprised of a technical report and summary implementation strategy. DOE will schedule opportunities for public comment and then submit the TMDLs for EPA approval.

  Thurston County's participation in the initial phase of the Henderson TMDL process is being financed by a Centennial Clean Water Fund grant. The county's ability to remain active will depend on further grant support and/or local funding.

6.5.6 Schedule for Deschutes/Capitol Lake/Budd Inlet

The Deschutes River and associated water bodies are about one year behind the Henderson/Nisqually Reach areas in a similar TMDL effort.

- Fall 2003: Monitoring plan adopted and monitoring initiated
- 2004-2005: Data collection and analysis
- 2006: Technical report and summary implementation strategy

ATTACHMENT 1:
SUMMARY TABLE OF WATER QUALITY AND QUANTITY DATA AVAILABLE IN WRIA 13 FROM 1993 – 2003 *(with projected data collection for 2004)*
(See footnotes for data sources)

Thurston County W&WM 3/21/03

DESCHUTES BASIN

	2004 prelim.	**2003**	**2002**	**2001**	**2000**	**1999**	**1998**	**1997**	**1996**	**1995**	**1994**	**1993**
"E" ST. STATION (LOWER DESCHUTES)												
Water Quality	TMDL (8) DOE(20	TC(1) DOE(20	TC(1) DOE(20	TC(1) DOE(20	TC(1) DOE(2	TC(1) DOE(2	TC(1) DOE(2	TC(1) DOE(2	TC(1) DOE(2	TC(1) DOE(2	TC(5)	TC(5) DOE(2
Temperature:	*TMDL (8) DOE(20*	DOE(20	DOE(20	DOE(20						SIT(3)		
Flow con't recording	*GS(4)*	GS(4)	GS(4)	GS(4)	GS(4)	GS(4)	GS(4)	GS(4)	GS(4)	GS(4)	GS(4)	GS(4)
VAIL ROAD STATION (MIDDLE)												
Water Quality	*TMDL (8) DOE(20*	DOE (20	DOE (20	DOE (20							TC(5)	TC(5) DOE(2
Temperature	*TMDL (8) DOE(20*	DOE (20	DOE (20	DOE (20						SIT(3)		
Flow con't recording	*GS(4)*	GS(4)	GS(4)	GS(4)	GS(4)	GS(4)	GS(4)	GS(4)	GS(4)	GS(4)	GS(4)	GS(4)
OTHER DESCHUTES MAINSTEM DATA RELATED TO WATER QUALITY PARAMETERS												
Other mainstem sites	*DOE(20*	DOE (20	DOE (20	DOE (20							TC(5)	TC(5)
Canopy Cover	*TMDL*									SIT(3)		SIT(11

	2004 prelim.	**2003**	**2002**	**2001**	**2000**	**1999**	**1998**	**1997**	**1996**	**1995**	**1994**	**1993**
	(8)??											TC(10
Fine Sediment	**TMDL (8)?**									SIT(3)	SIT (18	SIT (11
Large Woody Debris									TC (16)	SIT(3)	SIT (18	SIT (11
Low flow studies			TC(16	TC(16)						TC (7)		TC (12)
Toxics				Tumwa t(25								
HARD CREEK												
Water Quality											TC(5)	TC(5)
HUCKLEBERRY												
Water Quality	*TMDL (8)*										TC(5)	TC(5)
LINCOLN CREEK												
Water Quality											TC(5)	TC(5)
THURSTON CREEK												
Water Quality											TC(5)	TC(5)
WARE CREEK												
Water Quality											TC(5)	TC(5)
AYER CREEK												
Water Quality	*TMDL (8)*							TC(1)	TC(1)	TC(1)	TC(5)	TC(5)

	2004 prelim.	**2003**	**2002**	**2001**	**2000**	**1999**	**1998**	**1997**	**1996**	**1995**	**1994**	**1993**
CHAMBERS CREEK												
Water Quality	*TC(1)*	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(5)	TC(5) TC(14
Macroinvertabrate	*TC(1)*	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)						
Flow con't recording	*SWM (6)*	SWM (6)	SWM (6)		SWM (6)	SWM (6)	SWM (6)	SWM (6)	SWM (6)	SWM (6)	SWM (6)	SWM (6)
REICHEL CREEK												
Water Quality	*TMDL (8)*										TC(5)	TC(5)
SPURGEON CREEK												
Water Quality								TC(1)	TC(1)	TC(1)	TC(5)	TC(5)
BUTLER CREEK												
Water Quality								TC(1) LOTT(12	TC(1)	TC(1)	TC(5)	TC(5)
ELLIS CREEK												
Water Quality		TC(1)	SIT(28)					TC(1) LOTT(12	TC(1)	TC(1)	TC(5)	TC(5)
Macroinvertabrate	*VOL(1*	VOL (1	VOL(1)	VOL(1)	VOL(1)	VOL(1)	VOL(1)					
INDIAN CREEK												
Water Quality	*TMDL (8)*	TC(1)						TC(1) LOTT(	TC(1)	TC(1)	TC(5)	TC(5)

	2004 prelim.	**2003**	**2002**	**2001**	**2000**	**1999**	**1998**	**1997**	**1996**	**1995**	**1994**	**1993**
								12				
Toxics								DOE (26				
Macroinvertabrate	*VOL(1*	VOL(1)	VOL(1)									
MISSION CREEK (East Bay)												
Water Quality	*TMDL (8)*	TC(1)						TC(1) LOTT(12	TC(1)	TC(1)	TC(5)	TC(5)
Macroinvertabrate	*VOL(1*	VOL(1)	VOL(1)									
MOXLIE CREEK												
Water Quality	*TMDL (8)*	TC(1)						TC(1)	TC(1)	TC(1)	TC(5)	TC(5)
Toxics								DOE (26				
Macroinvertabrate	*VOL(1*	VOL(1)	VOL(1)									
PERCIVAL CREEK												
Water Quality	*TC(1)*	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(5)	TC(5)
Macroinvertabrate - Lower	*TC(1)*	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)					
Macroinvertabrate - Mid	*VOL(1*	VOL(1)	VOL(1)	VOL(1)	VOL(1)	VOL(1)	VOL(1)					
Flow con't recording	SWM(6	SWM(6	SWM(6					SWM(6	SWM(6	SWM(6	SWM(6	SWM(6

	2004 prelim.	**2003**	**2002**	**2001**	**2000**	**1999**	**1998**	**1997**	**1996**	**1995**	**1994**	**1993**
SCHNEIDER CREEK (West Bay)												
Water Quality		TC(1)						TC(1) LOTT(12	TC(1)	TC(1)	TC(5)	TC(5)
Macroinvertabrate	*VOL(1*	VOL(1	VOL(1)				TC(1)					
CAPITOL LAKE												
Water Quality	*TMDL (8)*	TC(1)	TC(1)	TC(1)	TC(1)	TC(1) DOE 23)		LOTT(12	TC(16)		TC(5)	TC(5)
Toxics		Oly(24										
CHAMBERS LAKE												
Water Quality												TC(14
HEWITT LAKE												
Water Quality												TC(14
MCINTOSH LAKE												
Water Quality											TC(1)	
Toxics				DOE (22)								
OFFUT LAKE												
Toxics				DOE (22)								
WARD LAKE												

	2004 prelim.	**2003**	**2002**	**2001**	**2000**	**1999**	**1998**	**1997**	**1996**	**1995**	**1994**	**1993**
Water Quality	*TC(1)*	TC(1)	TC(1)	TC(1)	TC(1)	TC(1) DOE (19	TC(1)	TC(1)	TC(1)	TC(1)		TC(14
BUDD INLET												
Marine Water Quality					DOE (7	DOE (7	DOE (7	LOTT1 2 DOE (7	DOE (7	DOE 7	DOE (7	DOE 7

ELD INLET (EAST ½)												
GREEN COVE CREEK												
Water Quality – Mouth	*TC(1)*	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)
Macroinvertabrate –Mouth	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC (1)					
Macroinvertabrate – 36th	*VOL(1)*	VOL(1)	VOL(1)	VOL(1)	VOL(1)	VOL(1)	VOL(1)					
Flow con't recording	SWM (6)	SWM (6)	SWM (6)	SWM (6)			SWM (6)	SWM (6)	SWM (6)	SWM (6)	SW M (6)	SWM (6)
McLANE CREEK												
Water Quality	*TC(1)*	TC(1) SIT(27)	TC(1) DOE 18	TC(1) DOE 18	TC(1) DOE 18	TC(1) DOE 18	TC(1) DOE 18	TC(1) DOE 18	TC(1) DOE 18	TC(1) DOE 18	TC(1) DOE 18	TC(1) DOE 18
Macroinvertabrate - Lower	*TC(1)*	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC (1)					

Macroinvertabrate – DNR Trail	*VOL(1)*	VOL(1)	VOL(1)	VOL(1)	VOL(1)	VOL(1)	VOL(1)					
Flow con't recording	SWM (6)	SWM (6)	SWM (6)	SWM (6)		SWM (6)	SWM (6)	SWM (6)	SWM (6)	SWM (6)	SW M (6)	SWM (6)
SIMMONS CREEK												
Water Quality								TC(1)	TC(1)	TC(1)	TC(1)	TC(1)
ELD INLET MARINE												
Water Quality	*DOH (21*	*DOH (21*	DOH (21	DOH (21	DOH (21	DOE (7 DOH (21	DOH (21	DOH (21	DOE (7 DOH (21	DOH (21	DOH (21	DOE 7 DOH 21

HENDERSON INLET

LOCATION	*2004* *prelim*	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993
DOBBS CREEK												
Water Quality		TMDL (8)						TC(1)	TC(1)	TC(1)	TC(1)	TC(1)
MEYER CREEK												
Water Quality		TMDL (8)						TC(1)	TC(1)	TC(1)	TC(1)	TC(1)
SLEEPY CREEK												
Water Quality		TMDL (8)						TC(1)	TC(1)	TC(1)	TC(1)	TC(1)
WOODARD CREEK												

LOCATION	*2004 prelim*	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993
Water Quality	*TC(1)*	TMDL (8) TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)
Macroinvertabrate	*TC(1)*	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)					
Flow con't recording	*SWM(6*	SWM(6	SWM(6	SWM(6	SWM(6		SWM(6	SWM(6	SWM(6	SWM(6	SWM(6	SWM(6
WOODLAND CREEK												
Draham Rd: Water Quality:	*Lacey (9*	Lacey (9	Lacey (9)	Lacey(9								
Macroinvertabrate	*VOL(1)*	VOL(1)	VOL(1)	VOL(1)	VOL(1)	TC(1)	VOL(1)					
Flow con't recording		DOE (17)										
Pl Glade: Water Quality:	*TC(1)*	TMDL (8) TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1) DOE(13
Macroinvertabrate:	*VOL(1)*	VOL(1)	VOL(1)	VOL(1)	VOL(1)	TC(1)	VOL(1)					
Flow con't recording	SWM(6	DOE (17) SWM	DOE (17)							SWM(6	SWM(6	SWM(6
HICKS LAKE												
Water Quality	*TC(1)*	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)		

LOCATION	*2004 prelim*	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993
LONG LAKE												
Water Quality	*TC(1)*	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1) TC(15	TC(1)
PATTISON LAKE												
Water Quality	*TC(1)*	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)	TC(1)			
HENDERSON INLET												
Marine Water Quality	*DOH (21*	TMDL *DOH (21*	DOH (21	DOH (21	DOH (21	DOH (21	DOH (21	DOH (21	DOE (7 DOH (21	DOH (21	DOH (21	DOE (7 DOH (21

References:

1. Water Resources Monitoring Report: Water Year Annual Report issued for 1992-93 and each water year since. Thurston County SWM & Environmental Health. Data for year included along with summary of data for period of record. Includes overview of each water body. Macroinvertabrate data collected by Thurston County Environmental Health staff and Stream Team volunteers is both reported. Some County water quality data also available from DOE Environmental Information website at http://www.ecy.wa.gov/eimreporting.

2. Department of Ecology EILS data for DOE Monitoring Stations 13A060 (E Street) and 13A150 (Vail Road). 1970s and earlier data collected at 13A050 ("Near Tumwater") and 13A080 ("Near Olympia"). Available from DOE. All except oldest water quality data available at DOE Environmental Information website at http://www.ecy.wa.gov/eimreporting.

3. An Assessment of Stream Temperature, LWD Abundance and Spawning Gravel In the Main Stem Deschutes, 1995, Squaxin Island Tribe. Includes continuous monitoring of water temperature at six stations throughout the middle and lower river; and habitat parameters at five stations in middle and lower river.

4. USGS Streamflow Data for 12080010 (E Street) and 12079000 (Vail Road). Years of record identified in Estimated Baseflow Characteristics of Selected WA Rivers, DOE Water Supply Bulletin No. 60

5. Budd Inlet/Deschutes River Watershed Characterization Water Quality Study: Addendum, October 1995, Thurston County Health Department.

Six mainstem stations and numerous tributaries were sampled as part of Non-Point Pollution Watershed Plan effort. Data also included in Water Resources Monitoring Report: 1992-1993 Water Year and 1993-94 Water Year reports.

6. Thurston County Storm and Surface Water Utility continuous gaging data for streamflow and precipitation. Since 1992, data is reported in Annual Report, reference 1 above.

Percival flow data: Collected at Black Lake ditch at Mottman and Percival Creek proper until 1997. Station now is at mouth of combined creek/ditch system.

7. DOE Long Term Marine Waters Monitoring Data (by water year) contains monthly sampling data at http://www.ecy.wa.gov/services/as/iip/eim/index.html For Budd data see http://www.ecy.wa.gov/apps/eap/marinewq/mwdataset.asp?ec=no&scrolly=146&htmlcsvpref=csv&estuarycode=1&staID=35&theyear=2000&themonth=7

8. 2004-2005 Deschutes/Budd TMDL process anticipated to include sampling in listed waterbodies.

2003-2005 Henderson TMDL process includes sampling in listed waterbodies.

9. Lacey samples Woodland Creek at Draham Road monthly for water quality and flow. Also collects water quality data on Eagle Creek, a Woodland tributary. Data available from City of Lacey Water Resources.

10. Cramer, Darin for Thurston County Deschutes Reach Scale Analysis, comprehensive habitat data collected in 1993; flow data collected at 11 sites on 9/21/93.

11. Final Report: The Squaxin Island Tribe/Thurston County Streambed Characterization Contract; 1992-1993, Schuett-Hames et al, 1993. Six segments on mainstem Deschutes for sediment, four segments for habitat. Also several tributaries.

12. Budd Inlet Scientific Study Final Report, August 1990, LOTT Partnership.

13. Woodland Creek Water Quality Assessment Final Report: Ecology Building Project, DOE Report #94-62, April 1994, Patterson and Dickes. Data on upper Woodland Creek.

14. Chambers/Ward/Hewitt Comprehensive Drainage Basin Plan, July 1995, Thurston County Storm and Surface Water Program. Chambers Creek intensive sampling was performed for multiple stream segments. Lakes were samples for basic lake parameters and characterized by trophic (enrichment) status.

15. “Long Lake Phosphorus Control Strategy”, 1994, Entranco for Thurston County. Updated phosphorus budget included in this re-assessment of control options.

16. 2001 Deschutes Groundwater Inflow Study, February 2002, Thurston County Environmental Health. Funded by WRIA 13 Watershed Planning Grant funds. Flow also measured at same locations in summer 2002.

17. DOE established continuous recording flow station on Woodland Creek just upstream of the I-5 culvert for the Henderson TMDL process. Initiated 6/02. To run to January 2004. See http://www.ecy.wa.gov/apps/watersheds/flows/station.asp?sta=13B170

18. Totten and Eld Inlets National Monitoring Program: DOE EAP program sampled McLane from 1992-2002 weekly from November through April to study the effectiveness of best management practices. Fecal coliform and flow data collected. Available at DOE Environmental Information website at http://www.ecy.wa.gov/eimreporting.

19. PCB Concentrations in Fish from Ward Lake (Thurston County) and the Lower Elwha River,, DOE, 1999. PCBs were detected in Ward Lake fish; recommendation is to retain as 303(d) parameter. Available at DOE Environmental Information website at http://www.ecy.wa.gov/eimreporting.

20. DOE “Salmon Recovery Index Watersheds Program (SRIW)”. DOE collected data beginning in 2000/2001 water year to establish long-term benchmark in systems being used by WDFW as salmon population index streams. Deschutes was one of five such streams. Water quality data is collected at E Street and 507 bridge. Temperature recorders are installed at Weyco Bridge, Woodbrook Lane, Waldrick Road and E Street. E Street temperature is at http://www.ecy.wa.gov/apps/watersheds/riv/station.asp?sta=13A060 Also see Salmon Recovery Index Watershed Monitoring Program Water Quality Index Report, October 2000 – September 2001 December 2001 DOE Publication No. 01-03-046. Available at DOE Environmental Information website at http://www.ecy.wa.gov/eimreporting.

21. Status and Trends in Fecal Coliform Pollution in Puget Sound Year 2000 A Report for the Puget Sound Ambient Monitoring Program Tim Determan Washington State Department of Health Office of Food Safety and Shellfish Programs August, 2001 at http://www.doh.wa.gov/ehp/sf/Pubs/fecalreport00.pdf Very clear graphics of trends in commercial harvest areas in WRIA 13: Eld, Henderson and Nisqually Reach.

22. “WA State Toxics Monitoring Program – Exploratory Monitoring”, 2001. Fish tissues analyzed for range of toxics in Offut and McIntosh Lakes. Available at DOE Environmental Information website at http://www.ecy.wa.gov/eimreporting.

23. DOE SPASM Nutrient TMDL Study of South Puget Sound. Included approximately monthly sampling of Capitol Lake outlet in 1999. Available at DOE Environmental Information website at http://www.ecy.wa.gov/eimreporting.

24. Stormwater discharges from downtown area to Capitol Lake being sampled in comprehensive water quality investigation by Olympia Storm and

Surface Water Utility.

25. Tumwater stormwater discharging to lower Deschutes and other waterbodies sampled for wide range of toxic pollutants. Reported in "City of Tumwater Comprehensive Stormwater Implementation Program."

26. DOE WSMP "1997 Pesticides in Surface Water." Report included Indian and Moxlie Creeks. Available at DOE Environmental Information website at http://www.ecy.wa.gov/eimreporting.

27. Squaxin Island Tribe staff monthly sampling near the confluence of McLane, Swift, Perkins, and Cedar Creeks. Intent is improve understanding of fecal coliform sources. Increasing fecal coliform pollution previously identified by sampling near McLane mouth at Thurston County station.

28. Squaxin Tribe staff installed continuous recorder for Ellis Creek water temperature for summer of 2002.