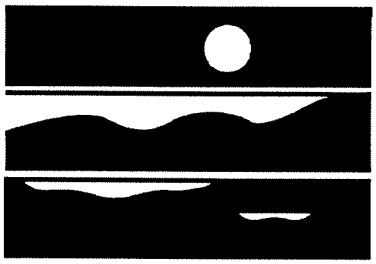

Watershed Briefing Paper for the San Juan Islands Water Resource Inventory Area #2

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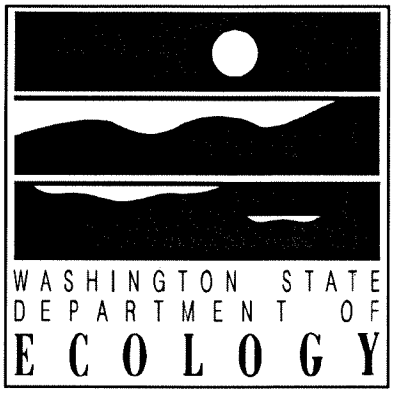

Watershed Briefing Paper for the San Juan Islands Water Resource Inventory Area #2

by
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Art Johnson
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and
Dave Garland
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September 1995

Publication No. 95-347

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Executive Summary

Purpose and Watershed Characterization

This briefing paper summarizes water quality studies conducted in Water Resource Inventory Area (WRIA) #2, the San Juan Islands, by Environmental Investigations and Laboratory Services (EILS) of the Washington State Department of Ecology (Ecology)

The open marine waters of the San Juan Islands, located at the intersection of the Strait of Juan de Fuca and the Strait of Georgia, are well flushed (strong currents, deep channels, tidal mixing). The islands are drained by a number of small, mostly unnamed streams with drainage areas generally less than five square miles. Streams typically are dry in the summer. Numerous small lakes, ponds, pits and reservoirs occur on the islands and are sources of water for drinking, stock watering and irrigation. Ground water provides most of the drinking water in the islands. Productive sand and gravel aquifers exist on Lopez Island but most wells obtain water from less productive bedrock aquifers.

Eight dischargers, seven municipal and one industrial, operate with National Pollutant Discharge Elimination System (NPDES) permits.

The proposed 1996 Section 303(d) List Decision Matrix identifies five impaired marine water bodies. The water bodies are listed for excursions of the following parameters (number of listings are in parentheses): temperature (5), dissolved oxygen (5), pH (3), fecal coliform (3) and ammonia-N (1). All listings with the exception of one, dissolved oxygen at Eastsound, are proposed for removal from the list.

EILS Data and Reports

EILS has conducted few studies in the San Juan Islands. Two intensive surveys in the 1980s were conducted at Friday Harbor to assess the effects of discharges of municipal effluent from the wastewater treatment plant. Class II inspections were conducted at sewage treatment plants at Roche Harbor Resort in 1984, Friday Harbor in 1985, and Orcas Village in 1990.

No toxics or ground water investigations have been conducted by EILS. The Ambient Monitoring Section has no freshwater ambient stations in the San Juans.

The Marine Water Monitoring program of the Ambient Monitoring Section currently monitors one core station and two rotating stations. The core station, which is representative of the Strait of Georgia with some influence from the Fraser River, is sampled monthly. The rotating stations

are scheduled for monthly sampling every third year. Prior to 1989 three other stations were monitored but these have been abandoned.

Issues

Boat waste discharges in moorage areas in Friday Harbor (San Juan Island) and Reid Harbor (Stuart Island) were identified as a source of bacterial contamination for water, sediments and shellfish.

Low dissolved oxygen concentrations have been recorded at the Ambient Marine Monitoring station in Eastsound, Orcas Island and the frequency of excursions appears to be increasing. The data suggests that the low dissolved oxygen may be related to human activity.

Only one permitted discharger in WRIA #2 has received a Class II inspection during the past 10 years. There have been no follow-up Class II inspections for the Roche Harbor Resort STP or Friday Harbor STP facilities.

Seawater intrusion and discharges from onsite septic systems are the main ground water quality concerns for San Juan County.

Recommendations

A cooperative monitoring program with Washington State Department of Health, Washington State Parks, and San Juan County Health Department should be conducted of high-use boat moorage areas with public shellfish beds. Fecal coliform bacteria concentrations in water and shellfish should be analyzed.

The proposed 1996 303(d) listing of Waterbody WA-02-0030, San Juan Channel, for fecal coliform criteria violations should remain until a bacterial survey of Friday Harbor is conducted.

The cause of low dissolved oxygen in marine water near Eastsound should be investigated.

San Juan County should be asked if Ecology technical support is needed to conduct a nonpoint water quality survey of Trout Creek and the False Bay watershed.

Class II inspections are recommended for facilities of concern.

County efforts to characterize the extent of seawater intrusion and the potential for ground water degradation from onsite septic systems should be supported.

Acknowledgements

This report is the product of many investigators. Report chapters were written by Joe Joy, Jan Newton, Brad Hopkins, Art Johnson, Steve Golding, Denis Erickson and Dave Garland. Denis Erickson compiled and edited chapters. Joan LeTourneau and Kelly Carruth provided word processing support. Larry Goldstein, Ken Dzinbal, Will Kendra, and Karol Erickson reviewed the report and individual chapters.

Introduction

Purpose

This briefing paper summarizes water quality studies conducted in Water Resource Inventory Area (WRIA) #2, the San Juan Islands, by Environmental Investigations and Laboratory Services (EILS) of the Washington State Department of Ecology (Ecology).

Watershed Description

The San Juan Islands are located in the northwestern part of Washington State between the mainland of Washington and Vancouver Island, British Columbia. WRIA #2 boundaries are shown in Figure 1 and encompasses 624 square miles with a land area of about 175 square miles. Over four hundred islands are visible at low tide but 85% of the county's land area consists of the four largest islands -- Orcas, San Juan, Lopez, and Shaw. The principal city is Friday Harbor with a 1990 population of 1,492. The predominate landuses/landcovers, excluding marine water, are forest (78%), agriculture (16%), urbanization (4%) and rangeland (2%).

The islands are drained by a number of small, mostly unnamed streams. Drainage areas are generally less than 5 square miles. Streams typically are dry in the summer. Numerous small lakes, ponds, pits and reservoirs occur on the islands and are sources of water for drinking, stock watering and irrigation.

The open marine waters of the San Juan Islands, located at the intersection of the Strait of Juan de Fuca and the Strait of Georgia, are well flushed (strong currents, deep channels, tidal mixing). However, enclosed inlets are potentially sensitive to bacterial and nutrient loading.

Ground water provides most of the drinking water in the islands. Productive sand and gravel aquifers exist on Lopez Island but most wells obtain water from less productive bedrock aquifers.

The climate is maritime, characterized by wet, mild winters and dry, cool summers. The average areal annual precipitation is 22 inches but precipitation varies widely over the watershed increasing from 19 inches in the south to 30 inches in the north. The maximum annual precipitation, 45 inches, occurs in the Mt. Constitution area. About 70% of the precipitation falls between the months of October and March.

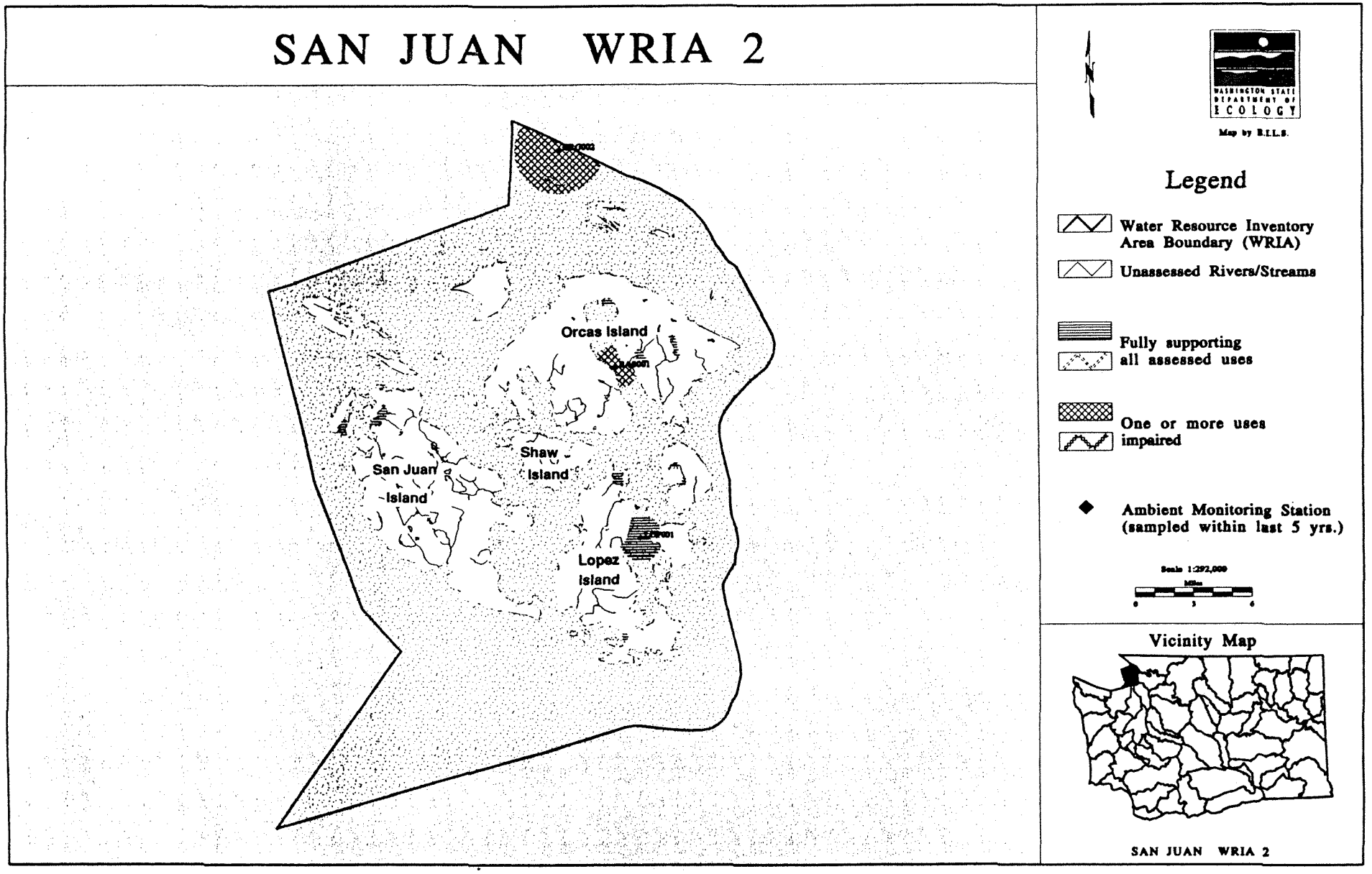

Figure 1. San Juan Islands (WRIA #2) location and vicinity maps.

Chapter 1. Intensive Surveys and TMDLs

by

Joe Joy
Watershed Assessments Section

Watershed Assessment Section Reports

The only surveys performed in the San Juan basin by the Watershed Assessments Section (WAS) have been at Friday Harbor. Two surveys were performed to evaluate the effects of municipal effluent from the Friday Harbor wastewater treatment plant (WTP). Singleton and Joy (1983) concluded the fecal coliform (FC) bacteria concentrations in Friday Harbor water and shellfish were a direct result of poor effluent disinfection and improper boater waste disposal. A post-WTP upgrade survey performed by Determan and Kendra (1986) concluded the WTP no longer significantly contributed to the bacterial problems in the harbor. Boat waste discharges were still a significant contributor to bacteria criteria violations. The continuation of the FC problem resulted in the proposed 1996 303(d) listing of Friday Harbor under Waterbody WA-02-0030.

Other Agency Reports

In 1988, a series of bacterial water quality investigations were performed in boat moorage areas around Puget Sound by the Washington Department of Health (DOH), Shellfish Section (Seabloom, Plews, and Cox, 1989). The only moorage monitored in the San Juan Watershed was Reid Harbor on Stuart Island. Water and shellfish were collected twice: once when few boats were moored (<20 boats/day), and a second time when mooring was active (>40 boats/day). Water FC concentrations remained within Class AA standards during both monitoring periods. However, both water and shellfish FC concentrations increased in inner harbor areas when more boats were present. In addition, 67% of the shellfish tissue FC concentrations exceeded the commercial shellfish standard of 230 organisms/100 grams when more boats were present. Sediment bacterial quality was monitored once (during the active period only), and the results indicated contaminated conditions.

The Puget Sound Cooperative River Basin Team performed an analysis of water quality problems associated with agricultural land use in 13 priority watersheds of San Juan County in 1988 (Verburg and Associates, 1988). Analysis was based on a one-week survey in August 1988, and focused on livestock-keeping practices. Protection of riparian habitats and wetlands, and pasture condition were considered. The following watersheds were identified as having relatively higher present or potential water quality problems associated with livestock practices:

- San Juan Island: False Bay, Friday Harbor, and Westcott/Garrison Bays
- Orcas Island: West Sound
- Lopez Island: Mud/Hunter Bays

The False Bay watershed was of special interest because Trout Creek, a Type II salmon stream, needed protection and monitoring.

Conclusions and Recommendations

Nonpoint source problems associated with boat moorage areas are still worth investigating. A cooperative monitoring program with DOH, Washington State Parks, and San Juan County Health Department should be conducted of high-use boat moorage areas with public shellfish beds. FC concentrations in water and shellfish should be analyzed.

The proposed 1996 303(d) listing of Waterbody WA-02-0030, San Juan Channel, for FC criteria violations should remain until a bacterial survey of Friday Harbor is conducted. The 1996 Section 303(d) List Decision Matrix recommends removal of the listing based on ambient monitoring data. However, the ambient monitoring station, SJI001, is outside Friday Harbor.

San Juan County should be asked if Ecology technical support is needed to conduct a nonpoint water quality survey of Trout Creek and the False Bay watershed.

References

Determan, T. and W. Kendra, 1986. "Post-upgrade Receiving Water Study of the Town of Friday Harbor Sewage Treatment Plant" Washington Department of Ecology memorandum from the Environmental Investigations Program to D. Nunnalee and J. Glynn of the Northwest Regional Office, Olympia, WA. 6 pgs.

Seabloom, R.W., G. Plews, and F. Cox, 1989. The Effects of Sewage Discharges from Pleasure Craft on Puget Sound Waters and Shellfish Quality. Puget Sound Water Quality Authority Task MB-6. Washington Department of Health Shellfish Section, Olympia, WA.

Singleton, L. and J. Joy, 1983. "Friday Harbor Receiving Water Survey". Washington Department of Ecology memorandum from the Environmental Investigations Program to D. Nunnalee of the Northwest Regional Office, Olympia, WA. 4 pgs.

Verburg and Associates, 1988. Letter of September 23, 1988 to Puget Sound Cooperative River Basin Team with attached draft report: "Rural/Agricultural Land Assessment for Priority Watersheds in San Juan County." Friday Harbor, WA

Chapter 2. Ambient Monitoring - Marine

by

Jan Newton and the
Marine Water Monitoring Team
Ambient Monitoring Section

The Marine Water Monitoring program of the Ambient Monitoring Section monitors marine waters of Puget Sound. Since 1989, the sampling strategy has been coordinated under the Puget Sound Ambient Monitoring Program (PSAMP). Station coordinates and the data record for all stations sampled by the Marine Water Monitoring Team in the San Juan Basin WRIA #2 are listed in Table 1. In WY 1989, reflecting the coordination with PSAMP, many of the Ambient Monitoring Section's marine water column stations were either abandoned or re-located. Under the Marine Water Monitoring Team's current implementation plan (Janzen, 1992; revised by Newton, 1995), the only core monitoring station in the San Juan Basin WRIA #2 is station GRG002. This station, representative of the Strait of Georgia and occasionally receiving influence from the Fraser River, is presently sampled monthly throughout the year. Rotating stations located in the San Juan Basin are LOP001 and EAS001. Although these stations are scheduled for occupation monthly every third year, in practice occupation has been more frequent.

The types of marine water column data available from Ambient's database for both the historical and current stations are listed in Table 2. The data collected from a particular station have not always included all of the parameters in Table 2. Of note is that no nutrient, fecal coliform bacteria, or pigment data are available for EAS001 from WY 1992-1994.

The marine waters of the San Juan basin are at the intersection of the Strait of Juan de Fuca and the Strait of Georgia. The San Juan basin marine waters are typically of high water quality. These marine waters are rated class AA (WAC, 1992). In reviewing the data from the stations and wateryears listed in Table 1, few water quality concerns arise. This review highlights observations from the fecal coliform bacteria, DO and nutrient data.

Fecal Coliform Bacteria

Only one fecal coliform excursion (# org./100 mL) was observed at each of SJI001 (130 on 11/86), HRO001 (39 on 11/86), GRG002 (21 on 1/92), and GRG001 (16 on 11/76). None of these observations indicate a persistent water quality problem at these stations. The only areas where fecal contamination could be a concern would be enclosed and poorly flushed inlets, bays and harbors with anthropogenic input.

Table 1. Marine water column data available from the Ambient Monitoring Section for San Juan Basin Watershed. An "X" denotes monthly data, although parameters sampled, methods and sampling design has varied to some extent (Table 2). Continuous profiles and winter data were not obtained until WY 1989.

Station Number	Station Name	Latitude (deg min N)	Longitude (deg min W)	WY:	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
East Sound - Orcas Island																											
EAS001	Rosario Point	48 38.6	122 52.9																				X	X	X	X	X
Georgia Strait																											
GRG001	Birch Bay	48 53.7	122 47.8		X	X			X																		
GRG002	N. of Patos Island	48 48.5	122 57.2																	X	X	X	X	X	X	X	X
Haro Strait																											
HRO001	Skipjack Island	48 44.1	123 02.4				X		X	X	X	X	X	X	X	X	X	X	X	X							
Lopez Sound - Lopez Island																											
LOP001	Decatur Island	48 30.8	122 51.0																				X	X	X	X	
San Juan Islands																											
SJI001	SJ Chan. at Reid Ro	48 33.0	122 59.3				X		X	X	X	X	X	X	X	X	X	X	X	X							

Table 2. Data available from the Ambient Monitoring Section. The field name, EPA STORET parameter code, units, and parameter name are listed below. Not all parameters are sampled at every station. Typically, parameter values are available for 0, 10, and 30 m (exceptions are fecal (0 m), pigments (0, 10 m), Secchi disk depth, and stations shallower than 30 m)

DBFIELD	PCODE	UNITS	NAME	
Physical parameters:				
TEMP	P10	°C	temperature* (also contains stn #, date, time, and depth)	
SALIN1	P480	ppt	salinity*†	(Oct 1986 - present)
SALIN2	P70305	mg/L	salinity†	(1973 - Sep 1986)
COND	P95	µmhos	specific conductivity	
light:				
SECCHI	P78	m	Secchi disk depth	
TRANSMIS	P74	%	percent light transmission	(via transmissometer)
Chemical parameters:				
OXYGEN	P300	mg/L	dissolved oxygen*	
PCTSAT	P301	%	percent oxygen saturation	
PH	P400	units	pH*	
nutrients‡:				
NH3_DIS	P608	mg/L	dissolved ammonium-N	(Oct 1990 - present)
NH3_N	P610	mg/L	total ammonium-N	(1973 - Sep 1990)
NO2_DIS	P613	mg/L	dissolved nitrite-N	(Oct 1990 - present)
NO2_N	P615	mg/L	total nitrite-N	(1973 - Sep 1990)
NO23_DIS	P631	mg/L	dissolved nitrate + nitrite-N	(Oct 1990 - present)
NO2_NO3	P630	mg/L	total nitrate + nitrite-N	(1973 - Sep 1990)
NO3_N	P620	mg/L	total nitrate-N	(1973 - Sep 1990)
OP_DIS	P671	mg/L	dissolved ortho-P	(Oct 1990 - present)
OP_TOT	P70507	mg/L	total ortho-P	(1973 - Sep 1990)
TP_P	P665	mg/L	total P	(1973 - Sep 1990)
pigments:				
CHL	P32211	µg/L	chlorophyll *a*	(extracted fluorescence)
PHEO	P32218	µg/L	phaeopigment	" "
Biological parameters:				
FC	P31616	#/100 mL	fecal coliform bacteria	(membrane filter method)

NOTES

*Since Nov 1989, *in situ* CTD sensors have been used to obtain depth, temperature, salinity, light transmission, DO, and pH data. Prior to Nov 1989, these data were obtained using a variety of methods, except for light transmission which was not measured. Information on sensors and methods used is available upon request.

†Salinity was measured: via conductance using a CTD from Nov 1989 - present,
via refractometer from 1987 - Oct 1989,
and via titration from 1973 - 1987

‡Nutrients were sampled for dissolved rather than total concentrations beginning in Oct 1990. Samples for dissolved nutrient concentrations are filtered through 0.45 µm pore size cellulose filters. As of June 1992, dissolved nitrite-N has been determined in three urban embayments only (Bellingham Bay, Budd Inlet, Commencement Bay).

Dissolved Oxygen

Although the DO standard for class AA waters is set at 7.0 mg/L (WAC, 1992), the natural DO concentrations of the San Juan Basin waters will be lower. This is because the oceanic waters flowing into the region through the Strait of Juan de Fuca are upwelled Pacific Ocean waters that can have naturally low (i.e. between 5 and 7 mg/L) DO concentrations, particularly in late summer. Thus, DO excursions below 7 mg/L but above 5 mg/L are to be expected. Such concentrations were seen at all marine monitoring stations in WRIA #2. In no cases except at EAS001 were DO concentrations below 5 mg/L observed more than once. However, the data from EAS001 indicate anthropogenic inputs may be causing a low DO concentration problem. At EAS001, there has been an increase in the frequency of DO concentrations below 5 mg/L: WY 1991 = 0 occurrences; WY 1992 = 1 occurrence; WY 1993 = 1 occurrence; WY 1994 = 3 occurrences. These DO excursions are well below 5 mg/L; concentrations have been recorded as low as 1.9 mg/L and are often around 3.0 mg/L. The prevalence of low DO concentrations in Eastsound, Orcas Island, appears to be increasing (Figure 2). A citizen alliance (OWEA, 1995) has recently presented data indicating there is sewage input from the village. Further investigation of current and historical conditions is necessary to evaluate this apparent problem. Unfortunately, Ambient does not have fecal coliform or nutrient data from this location except for WY 1992 and 1995 (still being conducted) in order to evaluate anthropogenic inputs.

In summary, the open waters of the San Juan Basin are well-flushed (strong currents, deep channels, tidal mixing) and thus are not prone to develop low DO concentrations. However, enclosed inlets, such as Eastsound and possibly other bays and harbors, may have low DO concentrations especially if these receive anthropogenic nitrogen input. We do not have stations in these areas, e.g., Friday Harbor, Roche Harbor, Deer Harbor, Fisherman's Bay, etc.

Nutrients

The open waters of the San Juan Basin, as mentioned, are well mixed, and thus stratification is reduced. Nutrient levels do not become depleted and a high build-up of phytoplankton biomass does not occur. The enclosed harbors and bays, however, could develop eutrophication problems; however, we have no data from these areas in order to evaluate this.

Alarmingly high dissolved ammonium-N concentrations (>0.20 mg/L) were observed at the SJI001 and HRO001 stations in the summer of 1977, and sporadically during WYs 1979 and 1981. High concentrations (>0.07 mg/L) were also observed during WYs 1982, 1983, and 1985. Neither station has been monitored since WY 1989; however, high ammonium-N concentrations were not present in the WY 1986-7 data (except for one observation of 0.10 on 5/87 at HRO001). Ammonium-N is preferred by phytoplankton and thus rapidly taken up in marine waters; typical concentrations in Admiralty Inlet are 0.03 mg/L. Higher concentrations often imply anthropogenic influence.

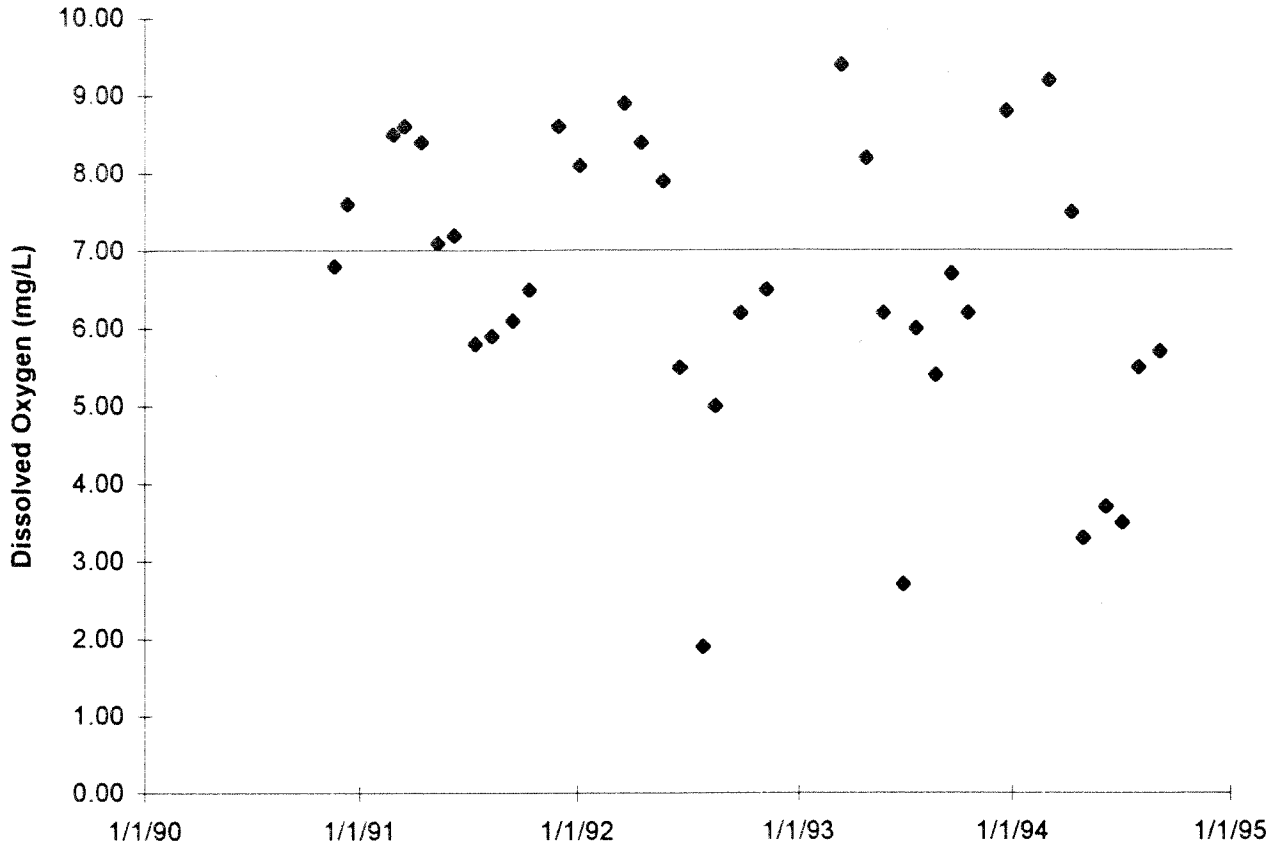

Figure 2. Dissolved oxygen concentrations at 30 m from marine water monitoring station EAS001 in Eastsound, Orcas Is. Also plotted is the WAC (1992) standard for class AA waters.

Miscellaneous Notes

Station GRG002, in the north of WRIA #2, receives influence from the Fraser River, but this is sporadic in time. Current and wind patterns affect the direction that the river plume extends (cf., Newton, in press). Thus the conditions at this station can be very different at times.

The occurrence of harmful or toxic phytoplankton in these waters is not well-documented, though outbreaks have occurred. To some extent the lack of data indicates a lack of outbreaks, but it also indicates a lack of monitoring.

References

Janzen, C.D., 1992. Marine Water Column Ambient Monitoring Plan. Washington State Department of Ecology, Publication #92-23, Olympia, WA.

Newton, J.A. 1995. Marine Water Column Ambient Monitoring Wateryear 1995 Long-term Monitoring Implementation Plan. Washington State Department of Ecology, Publication #95-324, Olympia, WA.

Newton, J.A., in press. Observations of El Nino weather conditions reflected in the temperatures and salinities of monitoring stations in Puget Sound. *In* Puget Sound Research '95 Proceedings, Puget Sound Water Quality Authority, Olympia, WA.

OWEA (The Orcas Watershed Education Alliance), 1995. Eastsound Village Watershed Project: Quarterly Report, February 1995. Eastsound, WA.

Chapter 3. Ambient Monitoring-Freshwater

by

Brad Hopkins
Ambient Monitoring Section

Existing AMS Data

Ambient Monitoring Section (AMS) has not collected any water quality information on streams in WRIA #2 or lakes (Rector, 1995).

Monitoring Needs

All of the streams within San Juan County are below the resolution of the existing Ambient Monitoring Program. Ambient stations, if required, should be established based on the requirements of specific water quality permits and should give consideration to the isolated nature of WRIA 2.

Reference

Rector, J., 1995. Personal Communication.

Chapter 4. Surface Water Toxics Investigations

by

Art Johnson
Toxics Investigations Section

Existing Data

EILS has collected no data on the occurrence of chemical contaminants within the watershed and are not aware of any data having been obtained by others.

Limited analyses have been conducted for bioaccumulative pollutants in marine organisms from the San Juans. In 1987, Ecology found only low concentrations of metals in fillets from Atlantic salmon being pen-reared along the Cypress Island east shoreline (Johnson, 1988). PSAMP data from contaminant monitoring of quillback rockfish in the Patos-Sucia Island area show modest elevations in mercury and PCBs, attributed primarily to this being a long-lived species (O'Neill et al., 1995 draft). PSAMP samples of little neck clams from Spencer Spit on Lopez Island had no significant chemical contamination (Glen Patrick, Wash. Dept. Health, personal communication).

EPA assessed the potential for toxics-related problems in 12 marine areas in the San Juans by reviewing information on sources, sediment contamination, and toxicity indices (sediment and water column bioassays, fish kills, fish histopathology, and bioaccumulation) (EPA, 1988). Except for West Sound, Orcas Island, all sites were ranked as having a low potential for toxics problems. West Sound was given a medium rating, due to a suspected hazardous waste storage site (Victim Island) and large marina.

Information Needs

No significant needs identified.

References

Johnson, A. 1988. Port Townsend Pen-reared Salmon Mortality. Wash. Dept. Ecology, Olympia.

EPA. 1988. Assessment of Potential Toxic Problems in Non-Urban Areas of Puget Sound. EPA 503/3-88-002.

O'Neill, S.M., J.E. West, and S. Quinnell. 1995 draft. Contaminant Monitoring in Fish: Overview of the Puget Sound Ambient Monitoring Program Fish Task. Wash. Dept. Fish and Wildlife, Olympia.

Chapter 5. Compliance Inspections

by

Steve Golding
Toxics Investigation Section

EILS Data and Reports

There are currently eight dischargers in the San Juan WRIA that have permits under the National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge Permit Program (WAC 173-216). These include:

NPDES Major Permits - None
NPDES Minor Permits - 1 Industrial, 7 Municipal

The following summarizes information from three municipal discharge facilities that have had EILS Class II inspections. It is important to note that Class II inspections more than 5 years old may not be representative of the facility today.

The Orcas Village STP was inspected in 1990. BOD_5 and TSS removal were good during the inspection. All parameters were within NPDES permit limits. An effort to reduce the chlorine residual while still maintaining low fecal coliform counts was recommended. BOD_5 loading and flow approximated 80% of design capacity.

The Roche Harbor Resort Sewage Treatment Plant was inspected in 1984. The facility met permit limits except for flow. A high coliform count was found. The receiving water samples collected showed negligible impacts, if any, associated with the discharge for the parameters measured (Heffner, 1985).

The Friday Harbor Sewage Treatment Plant was inspected in 1985. The inspection was a follow-up to a 1983 inspection conducted prior to upgrading the facility to an extended aeration secondary plant (Heffner, 1986).

Summary of Issues

No discharges in the WRIA have received Class II inspections during the past 10 years. There have been no follow-up Class II inspections for the Roche Harbor Resort STP or Friday Harbor STP facilities.

Needs and Recommendations

With the exception of Orcas Village STP, there have been no Class II inspections of the municipal minor dischargers in the watershed during the last 10 years: Roche Harbor Resort, Friday Harbor STP, Friday Harbor Water Department, Rosario Resort, Eastsound Water District, and Fisherman Bay STP. There has been no inspection at any time of the industrial minor discharger in the watershed: J.J. Theodore Co. Class II inspections are recommended for facilities of concern.

References

Heffner, M., 1985. Roche Harbor Resort Sewage Treatment Plant Class II Inspection and Receiving Water Study, August 14-15, 1984. Memo to John Glynn. 19 pp.

Heffner, M., 1986. Friday Harbor Sewage Treatment Plant Class II Inspection of August 13 and 14, 1985. Memo to John Glynn and Dave Nunnallee.

Heffner, M., 1991. Orcas Village STP Class II Inspection, July 1990. Memo to Dave Nunnallee.

Chapter 6. Ground Water

by

Denis Erickson
Toxics Investigations Section
and
Dave Garland
Water Quality Program, NWRO

General

Ground water supplies most of San Juan County's water needs. Whiteman and others (1983) estimated that 220 million gallons of ground water were withdrawn for all uses in 1980. Most of the published ground water studies for San Juan County have been conducted by the U.S. Geological Survey or Ecology's Water Resource Program. These studies are one of two types: either part of a regionally based assessment or an isolated local study such as a pumping test and analysis. EILS has not conducted any ground water quality projects in San Juan County.

Hydrogeology

The geology of the San Juan Islands is characterized by sedimentary, metamorphic and volcanic bedrock with low permeability that in some locations is covered by unconsolidated glacial and some alluvial deposits of higher permeability (Russell, 1975; Whiteman and others, 1983).

Ground water is recharged largely from infiltrated precipitation and surface water. In general, ground water flows radially outward from the island's interior toward the coasts. Because fresh ground water is less dense than seawater, it occurs as a lens atop seawater. The interface between freshwater and seawater may be sharp or broad depending on a number of factors including seasonal variations of ground water flow and withdrawals, hydrogeologic complexity, and tidal fluctuations.

Two types of aquifers are identified in San Juan County: bedrock aquifers and glacial drift aquifers. Characteristics of each as they relate to this paper are summarized below.

Bedrock Aquifers

About three fourths of the wells in the county are completed in bedrock. The occurrence and movement of ground water in the bedrock aquifers is controlled by fractures. The number, size and continuity of the fractures control the amount of water that can be pumped from the aquifer. Typically fracture flow is complex and difficult to characterize. It is important to note that there is little natural attenuation of contaminants in bedrock aquifers, making aquifer protection a high priority.

Glacial Drift Aquifers

Glacial drift aquifers consist of saturated sand and gravel layers and are the most productive aquifers in the county. The greatest productivity occurs where the sand and gravel deposits are thickest. The glacial drift deposits are most extensive on Lopez Island where local accumulations of greater than 250 feet thick are reported. Glacial drift aquifers are locally significant on other islands as well, notably northern Orcas Island and southern San Juan Island near Cattle Point.

Ground Water Quality Issues

The two most cited ground water quality concerns are seawater intrusion and the potential for ground water contamination from onsite septic systems (Garland, 1995; Heater, 1995; Whiteman and others, 1983). In recent years land application of municipal sludge has also been a concern (Vicki Heater, 1995).

Seawater Intrusion

Seawater intrusion in coastal wells is a widespread problem on the principal islands of San Juan County. Seawater intrusion is the landward and/or vertical upward migration of the freshwater/seawater interface. Commonly seawater intrusion is caused by increased ground water withdrawals associated with population growth. Reduced recharge, resulting from increased impermeable surfaces such parking lots, may also be a factor. Typically the extent of seawater intrusion is determined by measuring chloride concentrations of well samples. Chloride concentration in seawater is about 14,000 mg/L. The secondary drinking water standard for chloride is 250 mg/L.

Two comprehensive studies which included sampling and testing wells for chloride have been conducted in San Juan County. Dion and Sumioka (1984) sampled 94 wells in 1978, and 15 showed signs (>100 mg/L chloride) of seawater intrusion. Nine of the 15 wells were on Lopez Island; the remainder were on Orcas, San Juan, and Shaw Islands. Dion and Sumioka also

reported that numerous wells drilled in coastal areas or to depths below sea level encountered water too salty for the intended purpose and these wells are abandoned or destroyed. Whiteman and others (1983) reported that 9% of 279 wells sampled in 1981 appeared to be affected by seawater intrusion. Most of these wells occurred within 1/4 mile of the shoreline. The occurrence of seawater intrusion, in some cases, coincides with heavy pumping such as northern and southern Lopez Island but also occurs in areas where heavy pumping is not occurring.

Onsite Septic Discharges

Usually nitrate is the primary contaminant of concern for onsite septic discharges to ground water. Recent nitrate data for San Juan County were not readily available in the published literature and may not exist. Whiteman and others (1983) tested 56 wells for nitrate in 1981. Thirty seven bedrock aquifer wells showed a mean concentration of 0.3 mg/L and a range of 0.0 to 3.1 mg/L. Nitrate concentrations for 19 wells completed in glacial drift showed a range of 0.0 to 1.5 mg/L and mean of 0.6 mg/L. These concentrations are low and the data do not suggest that a nitrogen loading problem exists. However, the data are 14 years old and additional sampling is needed.

Bacteria may also be an indicator of ground water degradation due to onsite septic system discharges. Whiteman and others (1983) reported 16% (28) of 171 wells tested for indicator bacteria (total and fecal coliforms) showed contamination. The contaminated wells were distributed throughout the study area but mostly on Orcas Island. All wells were completed in the drift aquifers. Twenty-one of the 28 wells showed positive detections of fecal streptococcus. Results suggest, but do not confirm, a distant source; the source was not identified.

Future Work Planned

San Juan County has applied for and received a Centennial Clean Water Grant to assess the effects of onsite septic systems on ground water quality. A part of this assessment will include an inventory of onsite systems in one-third of the county.

San Juan County also is working with the US Geological Survey to resample and test wells for chloride to define the extent of sea water intrusion in the county. Funding is provided through the Conservation District and sampling slated for next spring.

Cross-Program Issues

Seawater intrusion is linked closely to water appropriation and use. Water rights are administered by the Water Resources Program in Ecology.

Conclusions

The main ground water issues are seawater intrusion and potential contamination from onsite septic systems.

There appears to be little recent ground water quality data for the county.

Recommendations

Ecology should support County activities to assess the status of seawater intrusion and the potential of onsite septic systems to contaminate ground water. Ecology can provide technical assistance as needed.

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