WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

# Grays Harbor Fecal Coliform Total Maximum Daily Load Study

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# Grays Harbor Fecal Coliform Total Maximum Daily Load Study

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# Abstract

This report presents a comprehensive assessment by the Washington State Department of Ecology (Ecology) of fecal coliform bacteria sources to Grays Harbor. This study includes quantification of sources of fecal coliform, levels of contamination, pollutant transport mechanisms, and die-off within Grays Harbor. Shellfish growers in the outer harbor are experiencing repeated temporary closures, due to violations of fecal coliform discharge limits in existing point source and nonpoint sources of fecal coliform.

A numerical model of fate and transport of fecal coliform in Grays Harbor was developed. The model shows the effect of nonpoint loading events due to high runoff, as well as the potential impact of point source discharges of fecal coliform. Results of the model confirm the appropriateness of conditional closure actions taken by the state Department of Health to protect against potential contamination of shellfish that are harvested from Grays Harbor. Model results suggest that expansion of conditional closures to other areas or for longer periods may be justified.

During the study year, May 1, 1997 through April 30, 1998, most of the fecal coliform loading to Grays Harbor came from the Chehalis River. Most of the load from the Chehalis River originates in the upper watershed above the town of Porter. Loading of fecal coliform from tributaries would need to be reduced by approximately 65 percent for Grays Harbor to meet water quality standards. The Chehalis River is the most important single loading source that requires reduction, followed by the Humptulips, Wishkah, and Hoquiam rivers. Collectively these tributaries account for approximately 80 percent of the required reduction in loading for Grays Harbor to meet water quality standards.

The Weyerhaeuser Cosmopolis Outfall 1 (Weyco 1) at times exceeded the combined loading from all other sources, and on average accounted for almost 4 percent of the total load for the study year. During the times when the Weyco 1 discharge was in compliance with its permit, it represented a relatively minor contribution of loading compared with other sources. The highest loading event from Weyco 1 occurred on July 24 and 25, 1997, during which the loading from Weyco 1 accounted for more than 95 percent of the total load from all sources. For Weyco 1, the current permit limit of 20,000 colonies per 100 ml was found to be inadequate to protect water quality in inner Grays Harbor. A daily maximum limit of 14,000 colonies per 100 ml was found to satisfy the requirement of exceeding the $90^{th}$ percentile standard no greater than 10 percent of the time during a 24-hour period.

Acknowledgements

We would like to thank the following people for their contributions to this study:

- ◊ Brady Engvall (Brady's Oysters, Aberdeen) collected samples from Grays Harbor and some tributaries. We are especially appreciative of Brady's sampling work during difficult weather conditions and very early morning hours.
- ◊ Floyd Ruggles helped with the reconnaissance of remote tributary stations in the Elk River and Andrews Creek watersheds.
- ◊ Frank Meriwether (Department of Health, Shellfish Section, Olympia) reviewed the study plan and draft report.
- ◊ Ray Walton (West Consultants, Seattle) wrote the hydrodynamic model that was used and provided consultation for its application.
- ◊ Eric Nelson (U.S. Army Corps of Engineers, Seattle District) contributed digital bathymetry data for the dredging project areas.
- ◊ Mike Meyers (City of Aberdeen) and Fran Eide (City of Hoquiam) provided data on urban stormwater discharge records and catchment areas, and assisted in site reconnaissance.
- ◊ Washington State Department of Ecology staff:
  - o Will Kendra and Karol Erickson provided comments on the draft report.
  - o Nancy Jensen and Kitty Bickle developed and conducted the laboratory methods for determination of fecal coliform and *E. coli*.
  - o Bill Ehinger helped develop the regression methods and reviewed the draft report.
  - o Randy Coots installed and maintained the dataloggers and flow gaging stations.
  - o Clay Keown, Brad Hopkins, and Dale Clark measured discharge rates for the major tributaries.
  - o Jan Newton, Casey Clishe, and Skip Albertson organized and conducted the marine flights, and added several stations to the routine network for this study.
  - o Norm Glenn sampled the point sources.
  - o Eric Siegel provided consultation and references for available data sources for hydrodynamic modeling.
  - o Don Nelson reviewed the sections of the draft report related to the Weyerhaeuser NPDES permit.

# Introduction

Grays Harbor is currently listed under section 303(d) of the federal Clean Water Act as not meeting water quality standards for fecal coliform bacteria because of inadequate controls of point or nonpoint sources (Table 1). Section 303(d) requires the states and U.S. Environmental Protection Agency (EPA) to establish *Total Maximum Daily Loads* (TMDLs) for all waterbodies that are not meeting water quality standards because of inadequate controls of point or nonpoint sources. A complete TMDL includes problem identification, technical analysis to determine the capacity of a waterbody to assimilate pollutant discharges, establishing allocations of pollutant loading to various point and nonpoint sources, public participation, as well as development and implementation of cleanup strategies for the waterbody.

Shellfish growers in the outer harbor are experiencing repeated temporary closures due to violations of fecal coliform discharge limits in existing point source permits. Limited sampling data also indicate that nonpoint sources of fecal coliform may be a concern in outer areas of Grays Harbor. Other examples of potential bacteria pollution sources include failures of pumping stations for sewage collection systems, septic systems, livestock operations, dairy farms, agriculture and hobby farms, urban areas, industrial operations, and wildlife. Infiltration and inflow (I&I) of groundwater and surface water into sewage collection systems can lead to bypasses and overflows of untreated sewage into the harbor. Efforts to reduce I&I have significantly reduced the frequency of sewage bypasses and overflows since the 1980s. The Washington State Department of Health (DOH) has been particularly active with this issue.

Table 1. Washington State 1998 303(d) listings for fecal coliform in the lower Chehalis River and Grays Harbor.

| Waterbody ID Number | Waterbody Name | WRIA (1) | Parameter | Basis for Listing |
|---|---|---|---|---|
| WA-22-0020 | Grays Harbor (outer) | 22 | Fecal coliform | DOH conditionally approved commercial shellfish area near the mouth of the Elk River, based partially on data from station 54 that exceed the criterion (from the Annual Growing Area Review ending December 1996). |
| WA-22-0030 | Grays Harbor (inner) | 22 | Fecal coliform | 5 excursions beyond the criterion at Ecology ambient monitoring station GYS007 between 1984 and 1987.<br>2 excursions beyond the upper criterion out of 93 samples between 1/93 and 10/97 at station GYS004 collected by the Weyerhaeuser Cosmopolis Pump Mill (submitted by Ken Johnson on 10/29/97). 3 excursions beyond the criterion out of 39 samples (8%) at Ecology ambient monitoring station GYS004 between 9/91 and 9/96. |
| WA-22-4040 | Chehalis River | 22 | Fecal coliform | 2 excursions beyond the criterion out of 12 samples (17%) at Ecology ambient monitoring station 22C050 (RM 13.15) between 9/91 and 9/96. |

(1) Water Resource Inventory Area

# Project Objectives

The purpose of this project is to provide a comprehensive assessment of fecal coliform bacteria from all identifiable sources in Grays Harbor. This study includes quantification of sources of fecal coliform, levels of contamination, pollutant transport mechanisms, and die-off within Grays Harbor. The major objectives of the study are to:

- Determine the contribution of all significant tributaries to the fecal coliform loading and concentration of the estuary.
- Compare the levels of fecal coliform contamination to the Ecology and DOH water quality standards for the protection of shellfish and other beneficial uses.
- Model the distribution of fecal coliform within Grays Harbor as it is affected by loads from point and nonpoint sources, tidal circulation and transport, and the natural process of die-off of bacteria.
- Predict the effect of pollution events on water quality at various locations in the harbor.
- Determine the pollution reductions that are needed so that local communities, agencies, and other affected parties can develop and implement appropriate cleanup strategies. This will also provide information for establishing waste load allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources, for establishing a TMDL as required under section 303(d) of the federal Clean Water Act.

# Project Description

## Hydrology

The area of the drainage basin for Grays Harbor is approximately 2,550 square miles. Tributary river basins include the Chehalis, Hoquiam, Wishkah, Humptulips, Johns, and Elk. The Chehalis River and its tributaries drain approximately 2,000 square miles and supply most of the freshwater input into Grays Harbor. Peak discharges from the Chehalis River (greater than 50,000 cfs) occur during winter (December and January), and minimum flows occur from June through September (600-800 cfs). The Elk River has a significant influence on water quality in the inner south region.

Mixing of fresh and salt water in the mid-portion of the estuary creates environments ranging from low salinity (less than 5 parts per thousand [ppt]) to high salinity (greater than 20 ppt) (Figure 1). Greater freshwater flows during winter result in lower salinity throughout the estuary compared with summer conditions. Several studies have evaluated the effect of the Chehalis River on mixing and transport in Grays Harbor. Duxbury (1979) calculated the residence time of waters in the inner harbor to range from 0.6 days in winter to five days in the summer.

Grays Harbor is a shallow estuary with depths averaging less than 20 feet. In the harbor entrance, depths reach a maximum of 80 feet, while the navigation channel is maintained at the 30 feet mean lower low water (MLLW) level by annual dredging of bottom materials. The surface area of the estuary ranges from about 91 square miles at mean higher high water (MHHW) to about 38 square miles at MLLW, with about 53 square miles of intertidal lands. Much of the intertidal land is about 1 to 2 feet above MLLW and is important in the movement, mixing, and re-aeration of harbor waters during tidal ebb and flood.

Grays Harbor is subject to the North Pacific's mixed tide system (diurnal and semi-diurnal combinations with two high tides and two low tides daily). The upper limit of tidal influence is Montesano, approximately 32 miles from the harbor entrance. On an annual basis, the mean daily tidal range is 10 feet in the Aberdeen-Hoquiam area.

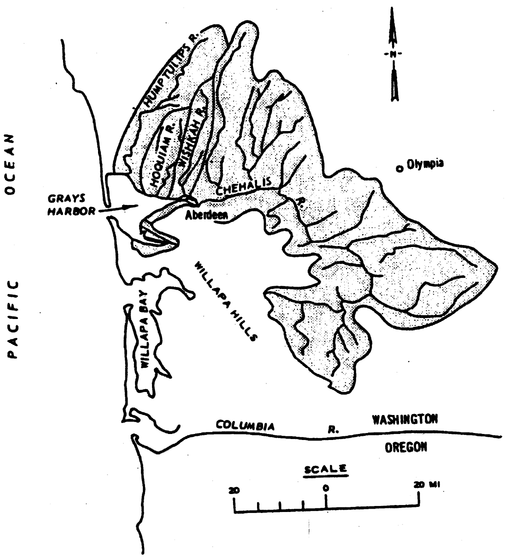
Tides move slowly up the estuary; high tides occur 29 minutes later at Aberdeen than at the harbor mouth. Maximum mean velocities in the upper harbor vary from about 3 feet per second (fps) during flood tide to about 4.5 fps during ebb tide.

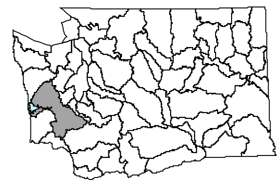
## Summary of Pollution Sources

### Point Sources

A variety of point source dischargers contribute fecal coliform to Grays Harbor (Figure 2).

Figure 1. Grays Harbor drainage basin and seasonal salinity (NOAA, 1987).



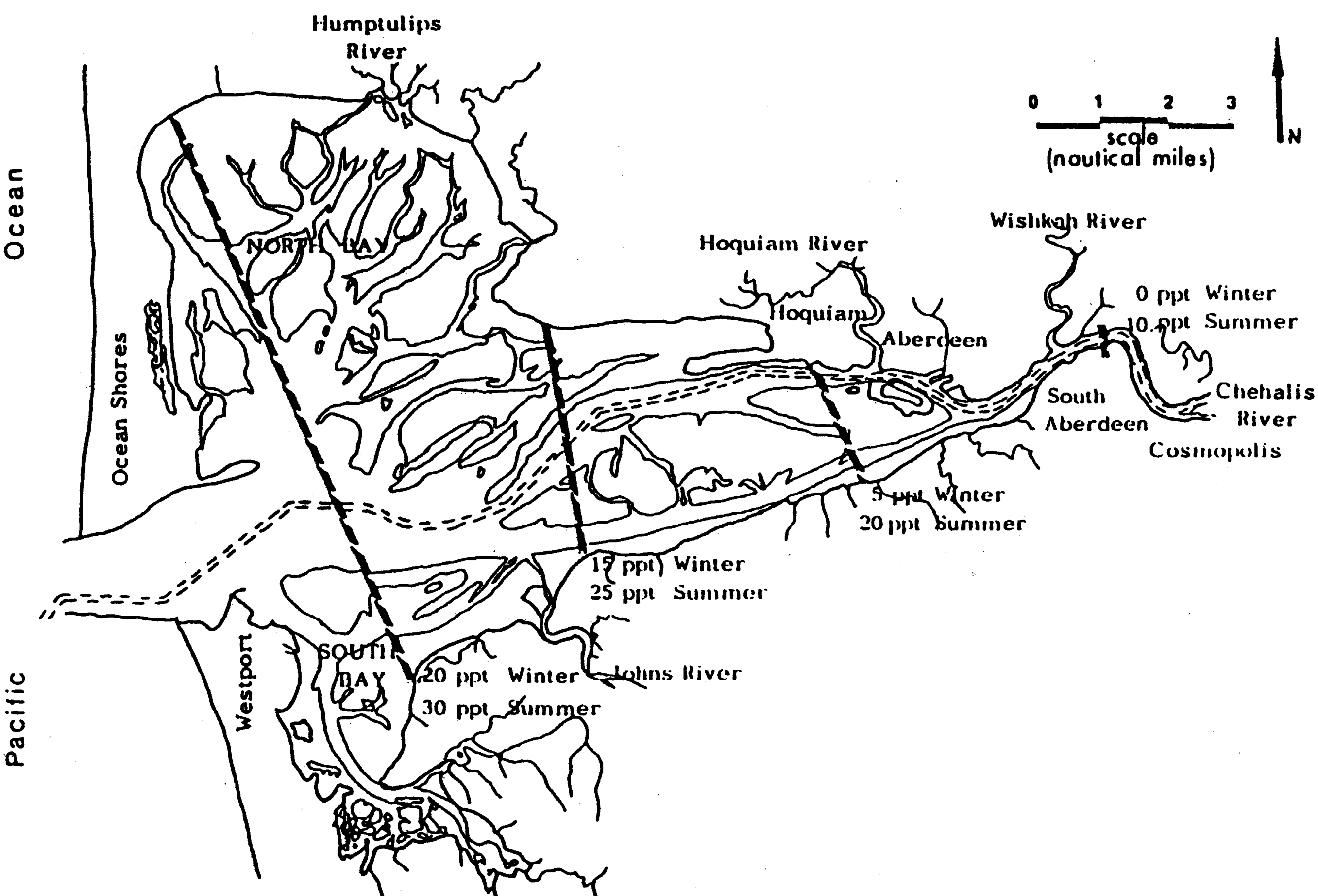
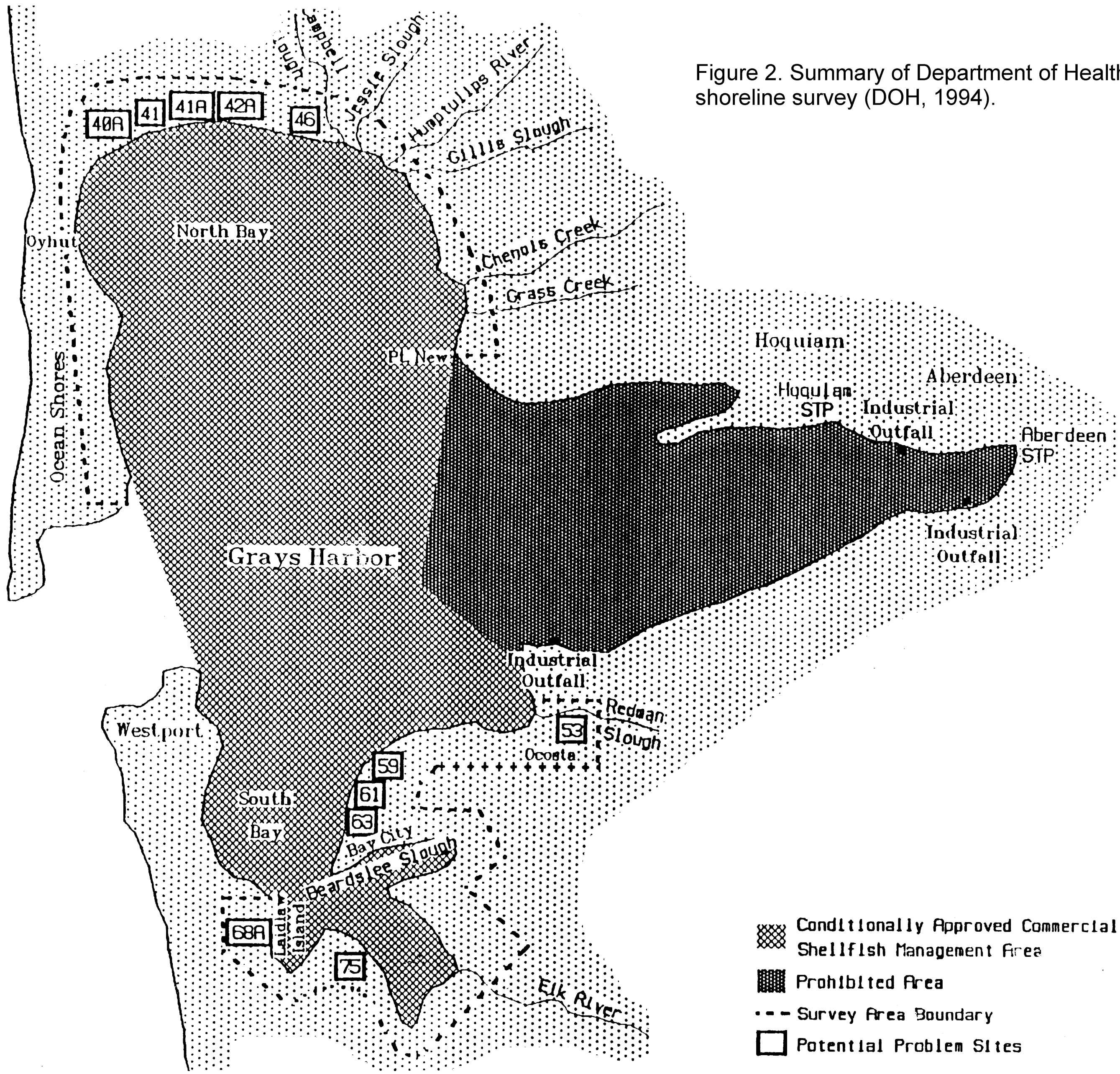


Figure 2. Summary of Department of Health shoreline survey (DOH, 1994).



These point sources include:

- City of Aberdeen Sewage Treatment Plant (STP)
- City of Hoquiam STP
- Lift stations and collection systems for STPs, primarily Cosmopolis Lift Station No. 2 (in the Aberdeen/Cosmopolis collection system at the Chehalis River bridge)
- Ocean Spray (Markham) Wastewater Treatment Plant (WTP)
- Weyerhaeuser (Cosmopolis) pulp and paper mill WTP
- Ocean Shores and Westport STPs
- Ocean Shores and Westport marinas

DOH considers the Ocean Shores and Westport STPs to be a sufficient distance west of the sanitary line at the mouth of Grays Harbor, so that shellfish closures are not a result of upsets at these facilities. In addition, the marinas at Ocean Shores and Westport are within year-round sanitary closure zones defined by DOH.

Over the past few years there has been a decrease in the frequency of upset discharges from the Weyerhaeuser (Cosmopolis) WTP. Upset conditions in the municipal sewage collection system have been ameliorated by infiltration/inflow (I&I) reduction programs by the city of Aberdeen, which has focused on the Cosmopolis and south Aberdeen service areas. Reduction of I&I has led to significantly decreasing frequency of overflows at Cosmopolis Lift Station number 2. Continued control of I&I is important to prevent future increases in sewage bypasses and overflows.

Sanitary surveys were conducted by the U.S. Department of Health and Human Services (HHS) during May and December 1983. The study was intended to evaluate conditions in Grays Harbor during periods of wet and dry weather. Separate study reports were prepared for the May and December surveys (HHS, 1983a; HHS, 1983b). HHS surveys consisted of pollution source evaluation, hydrographic work in May (dye studies on three waste treatment outfalls), shoreline reconnaissance, as well as bacteriological samples of shellfish growing waters, tributaries, pollution sources, and oysters. Fecal coliform Most Probable Number (MPN) values were determined on all samples, and fecal streptococcus tests were done on selected samples. Results of the dye studies indicated that the three waste effluents can reach approved shellfish growing waters within one tidal cycle, and the dilution factor may be relatively low. Effluent quality at the point sources was determined to be critical for proper classification of shellfish growing waters in the outer harbor.

## Rivers and Tributaries

The HHS (1983a and 1983b) surveys found that fecal coliform values in tributaries were similar during the May and December surveys. Higher concentrations in Grays Harbor during December were attributed to the influence of greater freshwater flows. The fecal coliform content of the Chehalis River was found to increase as it flowed past the Cosmopolis, Aberdeen, and Hoquiam areas in December because of storm drainage and local runoff. Grass Creek and Johns River were found to have local influences on bacterial quality. Drainage from the

Grayland area was found to influence the south region of Grays Harbor, and postulated to be because the high water table at Grayland prevents adequate subsurface waste disposal (e.g., septic systems). DOH considers the Elk River to have a larger influence on bacterial quality of the south region compared with drainage from Grayland.

HHS also tested the composition of fecal coliform in selected samples. Fecal coliform found in the estuarine and tributary waters and oyster samples were found to be primarily *E. coli*.

### Miscellaneous Sources

DOH conducted a shoreline survey in 1994 (Figure 2) to identify potential sources of bacterial contamination. Several sources of possible domestic sewage, and a farm operation, were discussed in the report and referred to the appropriate county jurisdictions for corrective action. Eight suspected on-site systems, and one farm with manure contributions to a slough, were identified. Corrections of identified problems have occurred or are expected in the near future.

## Shellfish Management by DOH

DOH (1994) divides Grays Harbor into six regions for management of commercial shellfish beds. Oyster harvesting in Grays Harbor occurs year-round. DOH management zones are as follows (Figure 3):

- The *inner harbor* and the *entrance* to Grays Harbor are prohibited from commercial shellfish harvest because of the proximity of point sources.

- The *north region* is approved. This region is not closed because of point source discharge events in the inner harbor.

- The *central region* is conditionally approved, and will be closed during and for seven days after significant point source discharge events in the inner harbor. Under emergency closure, DOH also closes this section of Grays Harbor to shellfish harvesting based on flooding of the Chehalis River.

- The *south region* is conditionally approved, and will be closed during and for seven days after point source discharge events in the inner harbor that persist for longer than 24 hours. Under emergency closure, DOH also closes this section of Grays Harbor to shellfish harvesting based on flooding of the Chehalis River.

- The *inner south region* (south of highway 105 bridge) is conditionally approved, and will be closed following significant rainfall events (≥1.5 inches in 24 hours) because of local watershed bacterial sources (Elk River is the major tributary to this region). This region is not closed because of point source discharge events in the inner harbor.

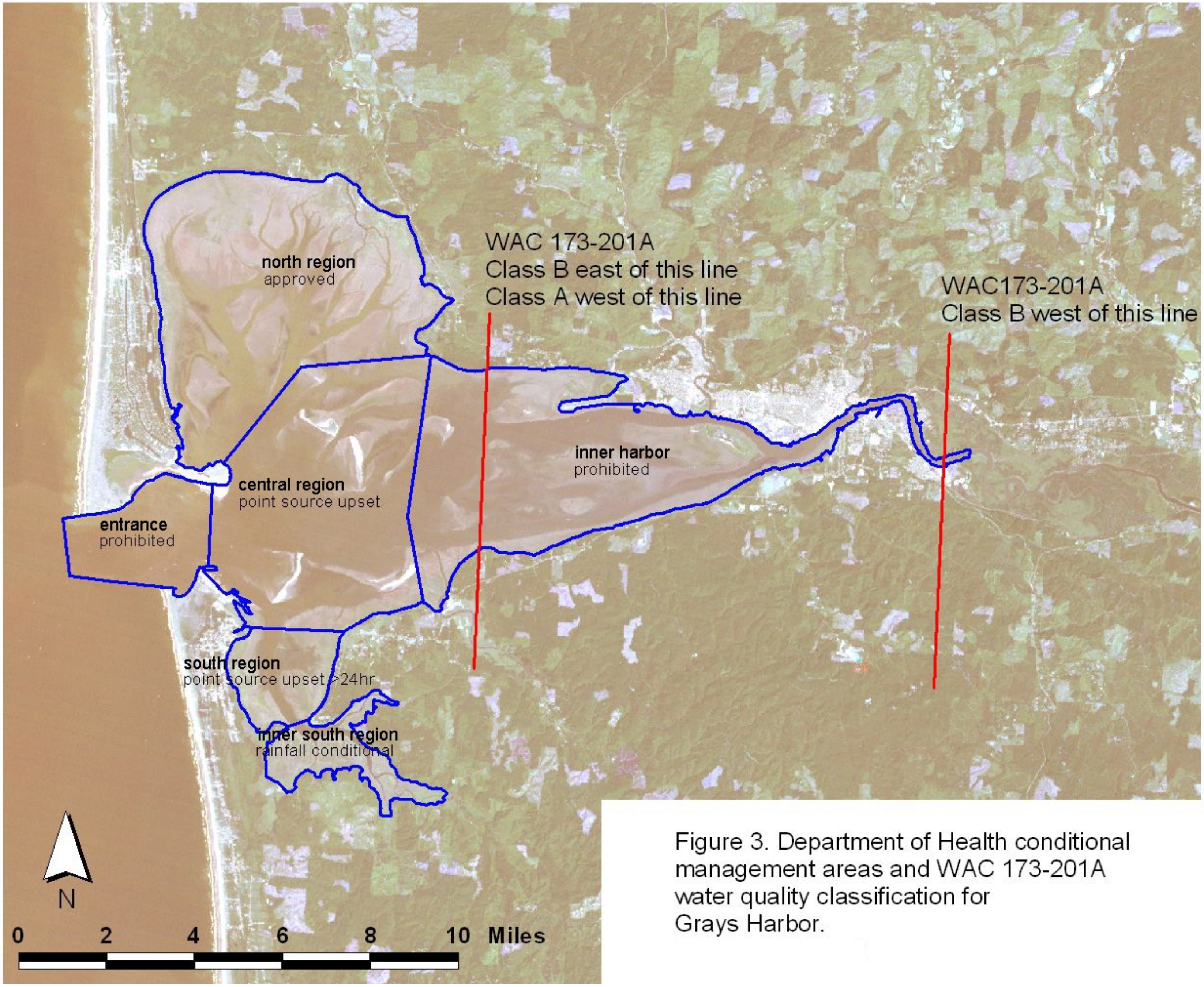



Figure 3. Department of Health conditional management areas and WAC 173-201A water quality classification for Grays Harbor.

The DOH classification is based on a variety of point sources of pollution in the inner harbor. Point source upset conditions which trigger closure of the conditionally approved areas by DOH include the following:

- Greater than 2 million gallons of discharge in 24 hours from Cosmopolis Lift Station number 2 (in the Aberdeen/Cosmopolis collection system at the Chehalis River bridge).
- Greater than 20,000 fecal coliform organisms per 100 ml (daily maximum permit limit) in effluent from the Weyerhaeuser Cosmopolis plant using the MF test.
- Hoquiam STP or collection system bypass, generally in excess of 200,000 gallons in 24 hours.
- Aberdeen STP bypass, generally in excess of 1 million gallons in 24 hours.
- Bypasses of the Ocean Spray plant at Markham, which is generally their full sanitary wastewater flow (around 10,000 gallons per day).

The Ocean Shores and Westport STPs are assumed to be accommodated within the area at the extreme western mouth of Grays Harbor. No closures are a result of upsets from these plants, but DOH is notified in the event of upset or bypass conditions.

# Relevant Studies of Grays Harbor

## Numerical Models

Loehr and Collias (1981) summarized the available mathematical models for Grays Harbor as part of an evaluation of possible effects of the widening and deepening project for dredging of the navigation channel by the U.S. Army Corps of Engineers. No mathematical models have been developed for Grays Harbor since the review by Loehr and Collias.

Three studies have produced mathematical models of Grays Harbor for the prediction of hydrodynamics and water quality: Battelle (1974), Water Resources Engineers (unpublished), and EPA Region 10 (EPA 1980; Cleland, 1978). These models used similar computational methods, were all written in FORTRAN, and represent successive generations in mathematical modeling. The EPA model was a refinement of the Battelle model, and incorporated many of the computational techniques used by the WRE model. After a careful review of the available documentation for each model, Loehr and Collias concluded that the EPA model was the best available model.

The EPA model is a link-node hydrodynamic model combined with a water quality model that simulates fecal coliform, in addition to dissolved oxygen, nutrients, and algae. The EPA model is based on a precursor of EPA's DYNHYD5/WASP5 modeling system and uses similar computational methods (EPA, 1993). The model network is shown in Figure 4.

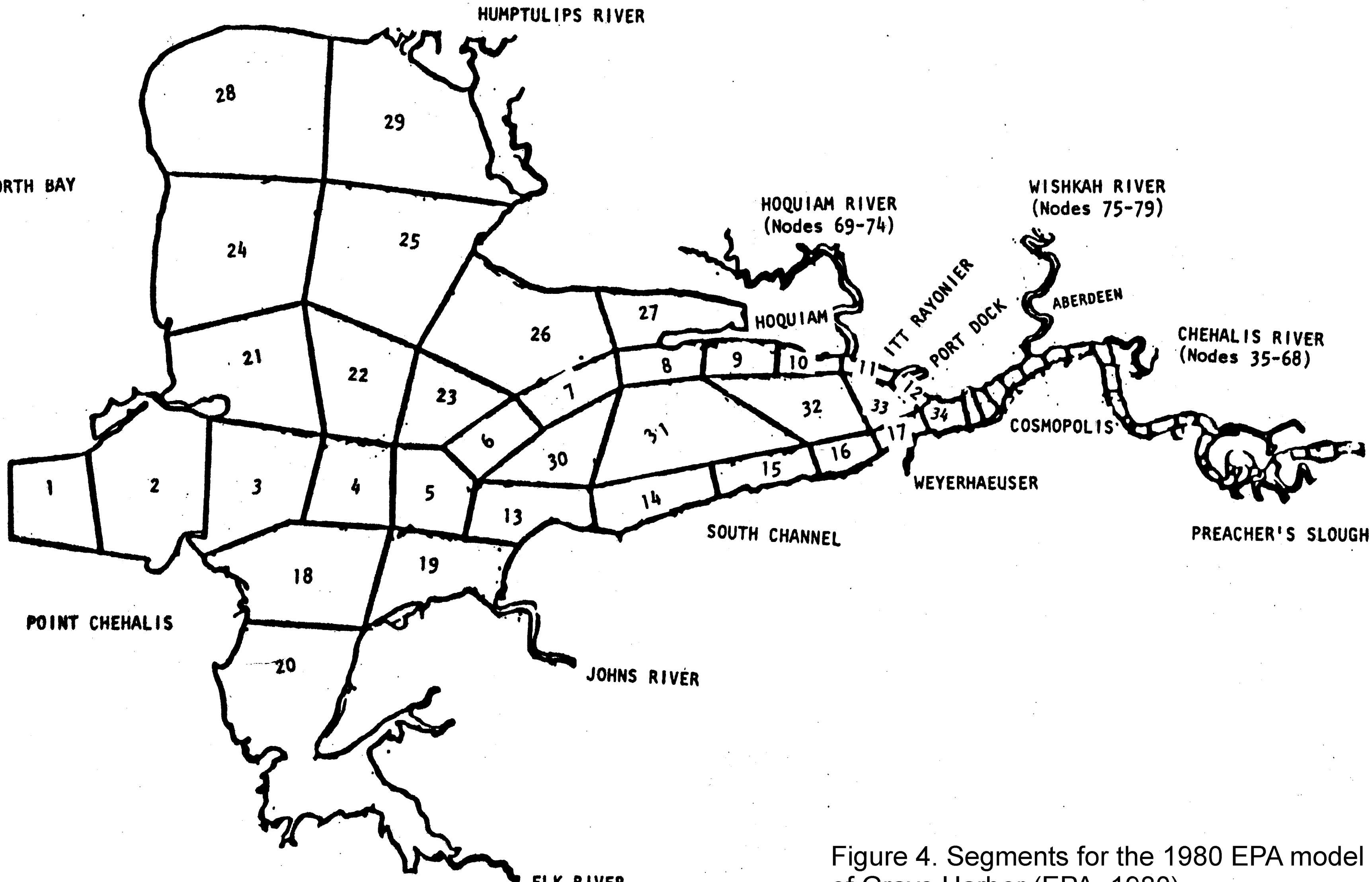



Figure 4. Segments for the 1980 EPA model of Grays Harbor (EPA, 1980).

## Physical Model by the U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers (ACOE) constructed a physical scale model of Grays Harbor in 1968 (Brogdon, 1972a, b, c, d, 1975, and 1976; Brogdon and Fisackerly, 1973). The structure was destroyed in 1980 after completion of model studies. The model was approximately 200 feet long (horizontal scale = 1:500, vertical scale = 1:100). Experiments using the model were conducted by the ACOE under five different scenarios, including low and high river flows. The high river flow used in the model (Chehalis River at 32,000 cfs) is representative of wet weather conditions during the wettest months of the year (December and January).

Dye was injected in the model in the vicinity of point source discharges. DOH concluded that the dye test results indicated that there was adequate dilution in the northern and western parts of the north region, and in the southern parts of the south region, to prevent violation of fecal coliform standards during upset conditions of point sources. This information was an important part of the basis for the delineation of DOH management areas.

## Fecal Coliform Studies by the U.S. Army Corps of Engineers

The ACOE conducted a variety of water column and sediment fecal coliform tests and analyses to assess potential impacts on commercial shellfish beds from dredging/disposal operations in Grays Harbor (Cirone-Storm, 1983). This study was a result of a request by Ecology to assess this potential source of contamination (as well as others) following a closure of shellfish harvesting in the harbor in late 1982. The study found that the primary source of sediment in the harbor is from the Chehalis River. The peak winter loads carry the bacteria as attached particles, picked up from land runoff and point sources. River flow was strongly correlated with bacterial loads in the harbor at Cow Point.

The study concluded the following (sewage bypasses and overflows to the harbor have been significantly reduced since the 1982-83 period due to reductions of I/I):

*"Except for periodic pulp and paper mill treatment failures, the majority of the bacteria are contributed from nonpoint source input, combined sewer overflows, and overflows at sewage treatment plants. After the maximum influx during the winter-spring, the bacteria in the inner harbor either settle into the sediments or are carried out to sea. Those that settle in fine grained, organic sediments in relatively quiescent areas, may persist throughout the summer. The bacteria which are carried out to the outer harbor die off rapidly in the water column, either due to increased salinity or increased temperatures. Those that settle in the sediments in the outer harbor will not survive because of the turbulence and lack of nutrients in the marine sands."*

## Other Studies

A study conducted by the University of Washington (Duxbury, 1979) assessed theoretical flushing rates from the inner harbor area. Using monthly water budgets and various parameters obtained from field measurements, monthly flushing rates were calculated. Flushing of the inner harbor (inside of the line between Point New and the Johns River) varied from 20 percent per day in July, to 166 percent per day in January. A tidal prism approach was used for these estimates, which does not incorporate pollutants that may be re-introduced during subsequent flooding tides (e.g., from sediments or the outer harbor). Therefore, the estimated hydraulic flushing rates may be greater than actual pollutant flushing rates.

Another study (Pearson and Holt, 1960) was conducted in the late 1950's and provides a rough estimate of the amount of new ocean water entering the mouth of the harbor on flooding tides. DOH (1994), using data from Pearson and Holt (1960), estimated the relative amount of new ocean water entering the mouth of the harbor during flood tides to range from approximately 60 percent at the start and 100 percent by the end of a flood tide.

# Ongoing Monitoring

## Washington State Department of Health

DOH collects monthly water samples as required for all conditionally approved areas. Figure 5 shows the locations of DOH stations occupied during the present study. DOH collects surface grab samples for fecal coliform, temperature, and salinity. Electronic database files include data for samples collected between 1988 and the present.

DOH data show that fecal coliform levels in Grays Harbor are generally lowest during June-September and highest during December-February. The north region and outer harbor have the lowest levels. The southern parts of the south region (inside Bay City) and the inner harbor have the highest levels. DOH has discontinued sampling of the inner harbor. The inner harbor is probably influenced largely by the Chehalis River, nonpoint sources, and point source upset events within the inner harbor. Fecal coliform in the southern part of the south region is probably influenced mainly by local tributary sources (e.g., Elk River, Grays Harbor Drainage Ditch, and Andrews Creek).

## Washington State Department of Ecology

Ecology collects monthly samples at five routine stations in Grays Harbor (Figure 6): GYS004, GYS008, GYS009, GYS015, and GYS016. Ecology also collects freshwater samples at two stations in tributaries to Grays Harbor: the Chehalis River at Porter (Ecology station 23A070, shown as station 38-port on Figure 7) and the Humptulips River at Humptulips (Ecology station 22A070, shown as station 02-hump on Figure 7). Stations GYS004, GYS008, GYS016, 23A070, and 22A070 are monitored for fecal coliform, in addition to temperature, salinity, dissolved oxygen, and nutrients. Stations GYS009 and GYS015 are only monitored for temperature, salinity, and dissolved oxygen. The other stations shown on Figures 6 and 7 were added to collect data for this study, as explained later in this report.

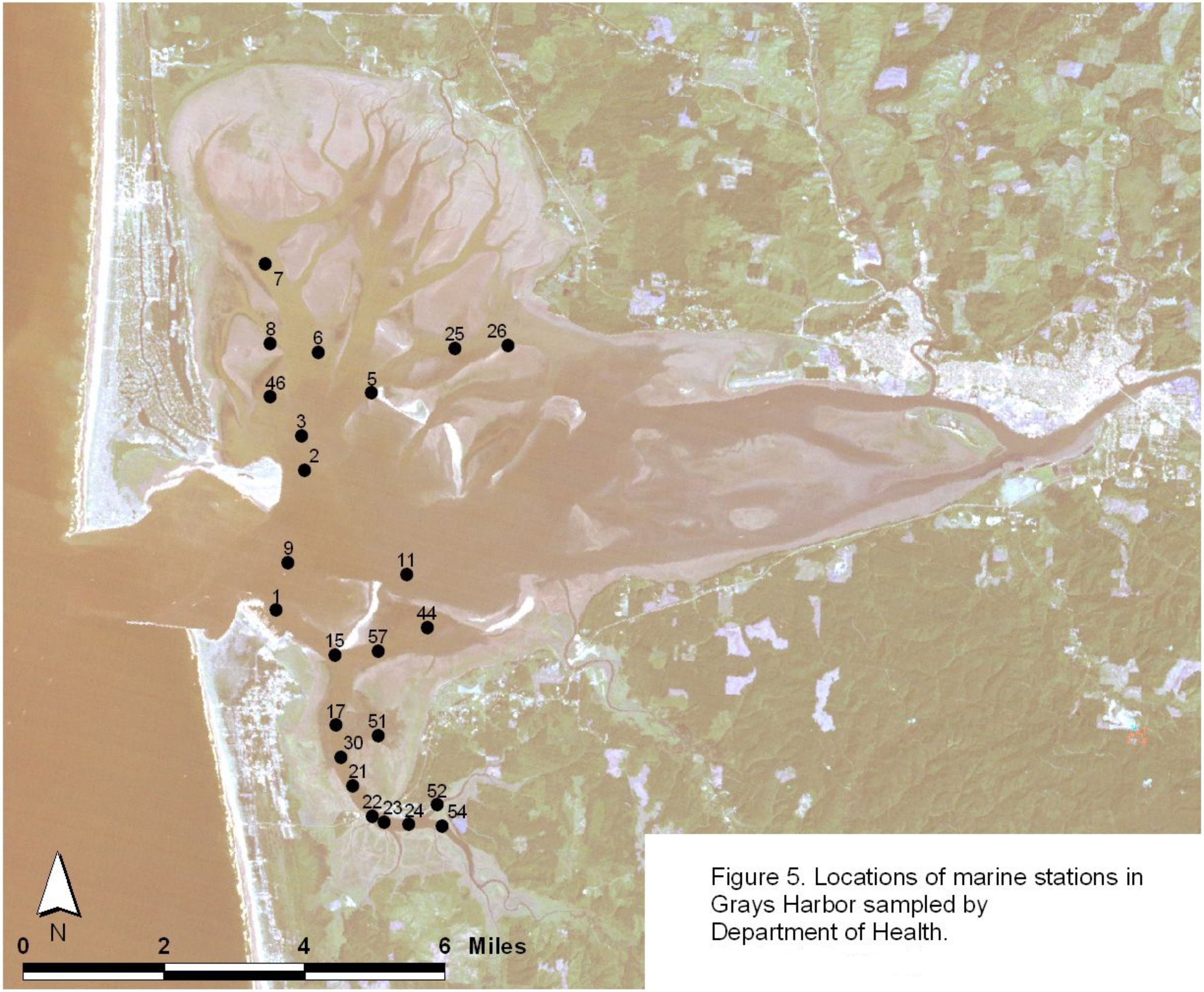



Figure 5. Locations of marine stations in Grays Harbor sampled by Department of Health.

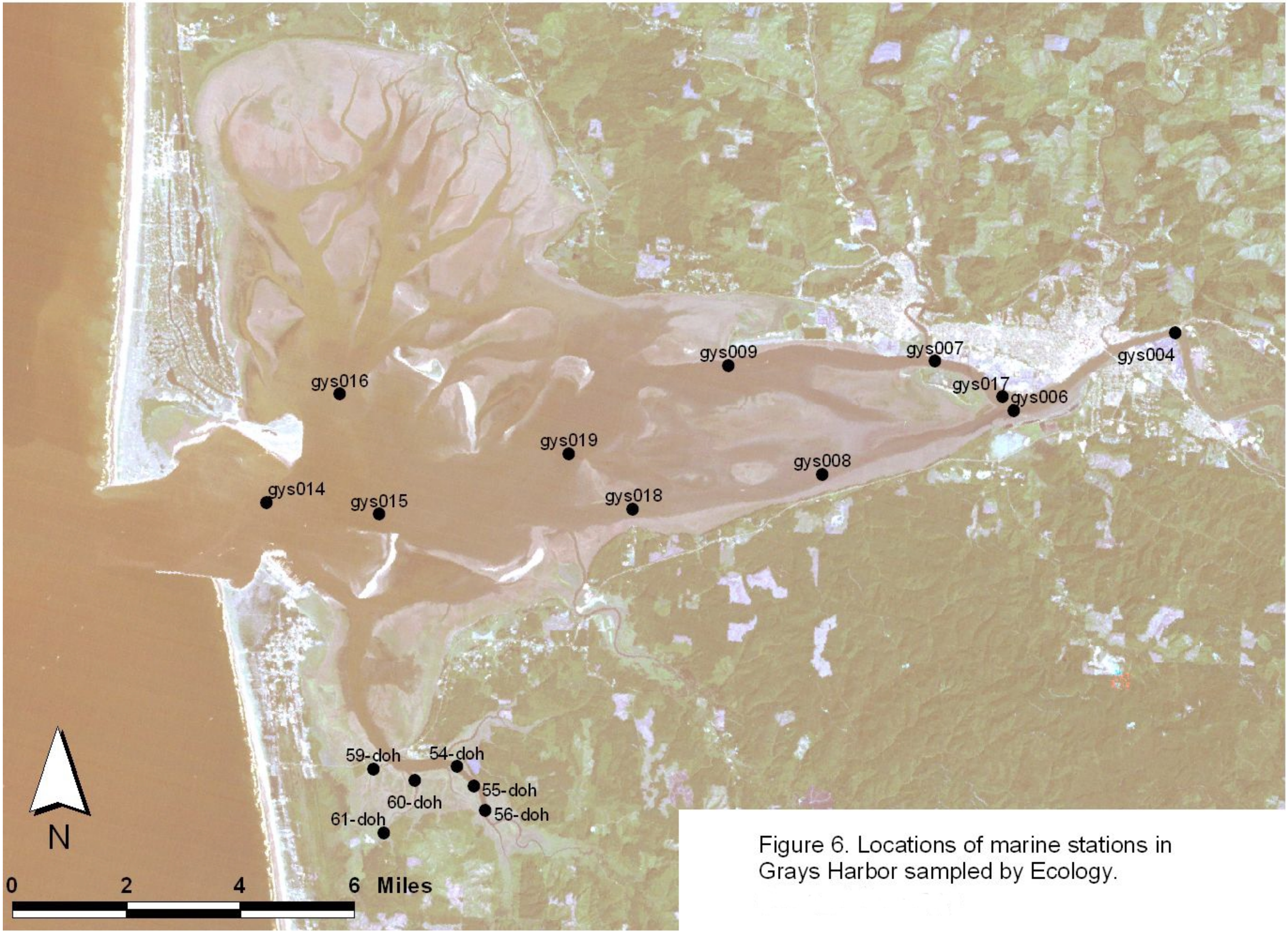



Figure 6. Locations of marine stations in Grays Harbor sampled by Ecology.

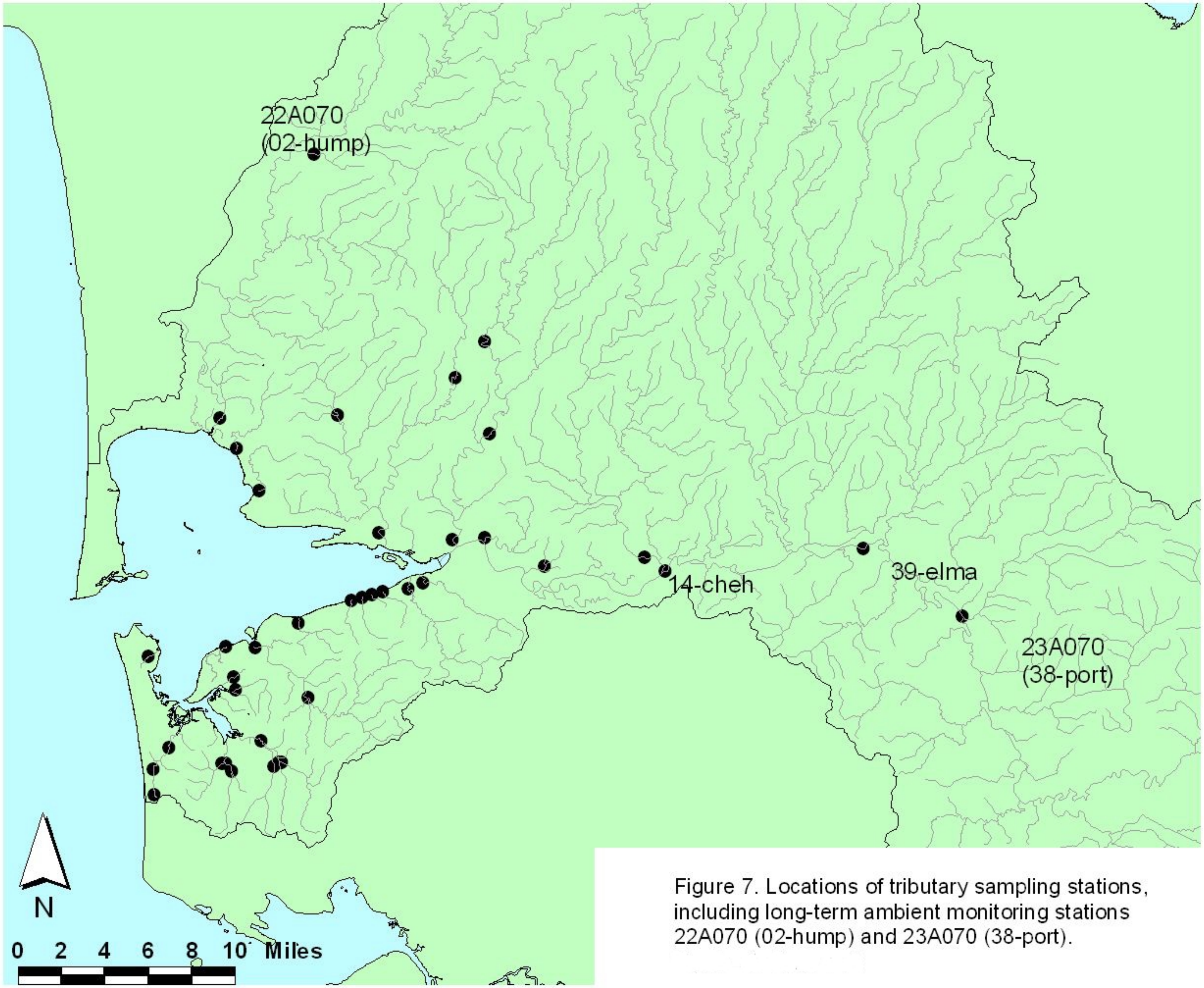



Figure 7. Locations of tributary sampling stations, including long-term ambient monitoring stations 22A070 (02-hump) and 23A070 (38-port).

## U.S. Geological Survey

The U.S. Geological Survey (USGS) measures discharge from the Chehalis River at Porter (station 12031000 at river mile [RM] 33.3), the Satsop River near Satsop (station 12035000 at RM 2.3), and the Wynoochee River above Black Creek (station 12037400 at RM 5.9) (Figure 8). The USGS also estimates discharge for the Humptulips River near Humptulips (USGS station 12039003 and Ecology station 22A070) to support the Ecology ambient monitoring program. Other tributaries to Grays Harbor are not currently gaged by USGS, although several have had periods of monitoring in the past (e.g., Newskah Creek, Charley Creek, and Anderson Creek). The other flow gaging stations shown in Figure 8 were added by Ecology to provide data for this study, as described later in this report.

## Ambient Monitoring by NPDES Dischargers

The Weyerhaeuser Paper Company and Grays Harbor Paper are each required to conduct monitoring of fecal coliform at selected locations within Grays Harbor, as a condition of their National Pollutant Discharge Elimination System (NPDES) discharge permits. Data have been collected since the 1980s. The locations of the stations sampled by NPDES dischargers during the present study are show in Figure 9. The current NPDES permits have reduced the required monitoring to one ambient station each for Weyerhaeuser and Grays Harbor Paper.

# Bacterial Indicators and Water Quality Criteria

The coliform group consists of both fecal and non-fecal components. The fecal coliform group includes mainly the *Escherichia* (*E. coli*) and *Klebsiella* genera. The *Klebsiella* genera do not originate from the feces of humans or other warm-blooded animals. Pulp mill wastewater is an example of a potential source of *Klebsiella*. The non-fecal component of the fecal coliform group is frequently used as a criticism of the test's usefulness to indicate the presence of potential pathogens. However, sources of *Klebsiella* are usually regulated in the same way as sources of other components of fecal coliform, because *Klebsiella* contributes to the fecal coliform group.

Tests for *E. coli* are more specific to the fecal component of the fecal coliform bacteria, and therefore provide a better indicator of the presence of pathogenic organisms. The *E. coli* test may be conducted along with fecal coliform determination at relatively low cost. HHS (1983a and 1983b) found that most of the fecal coliform bacteria in samples from Grays Harbor and its tributaries were *E. coli*. Fecal coliform in oyster samples collected by HHS also contained predominantly *E. coli*.

The U.S. Food and Drug Administration (FDA) currently oversees the National Shellfish Sanitation Program. Under this ongoing program, water quality standards are established for certification of shellfish growing areas, and tissue standards are set to allow the wholesale marketing of shellfish meats. FDA standards apply to shellfish that will be marketed across state boundaries and are based on fecal coliform concentrations. There is no expectation that FDA will be changing indicator organisms.

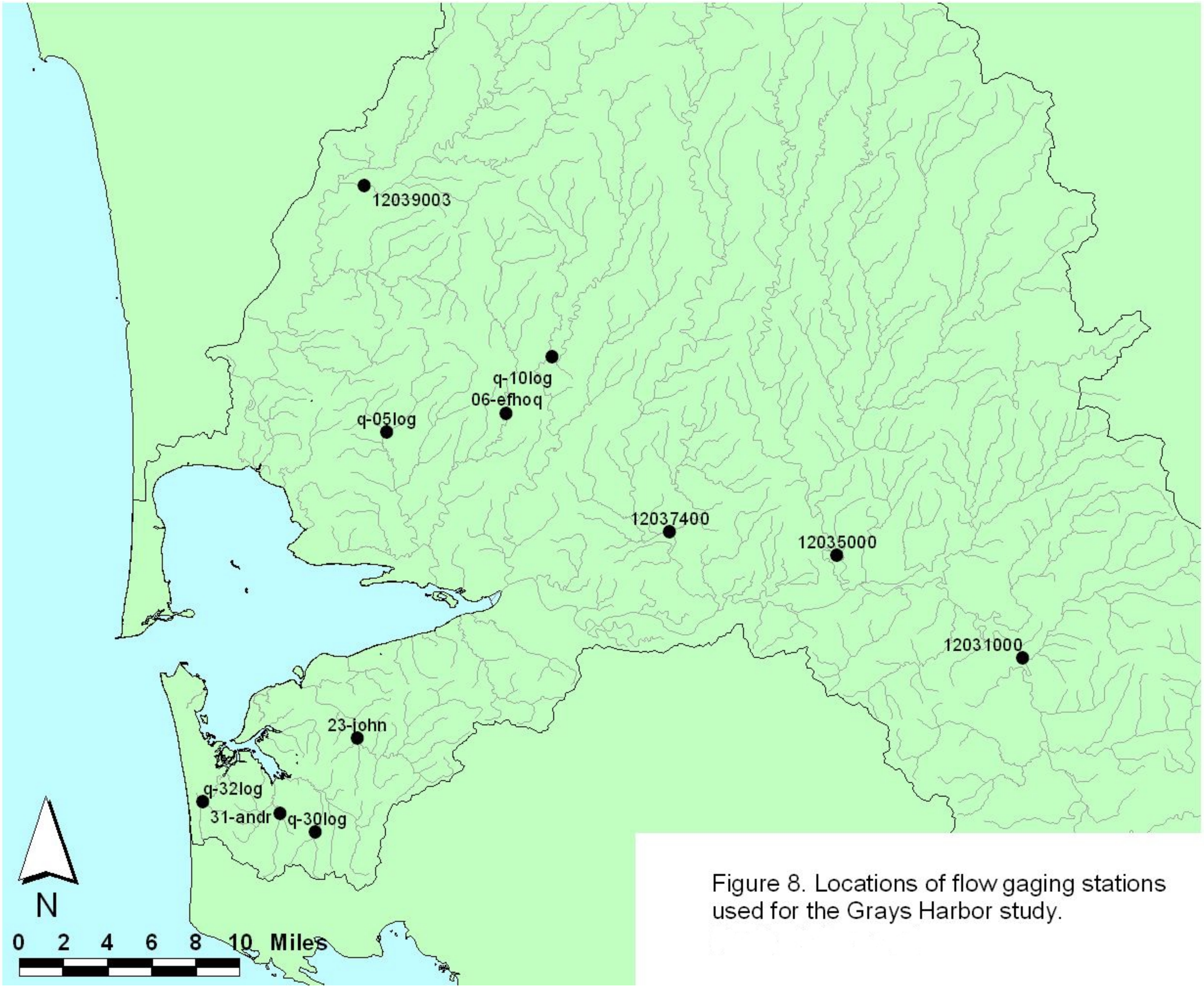



Figure 8. Locations of flow gaging stations used for the Grays Harbor study.

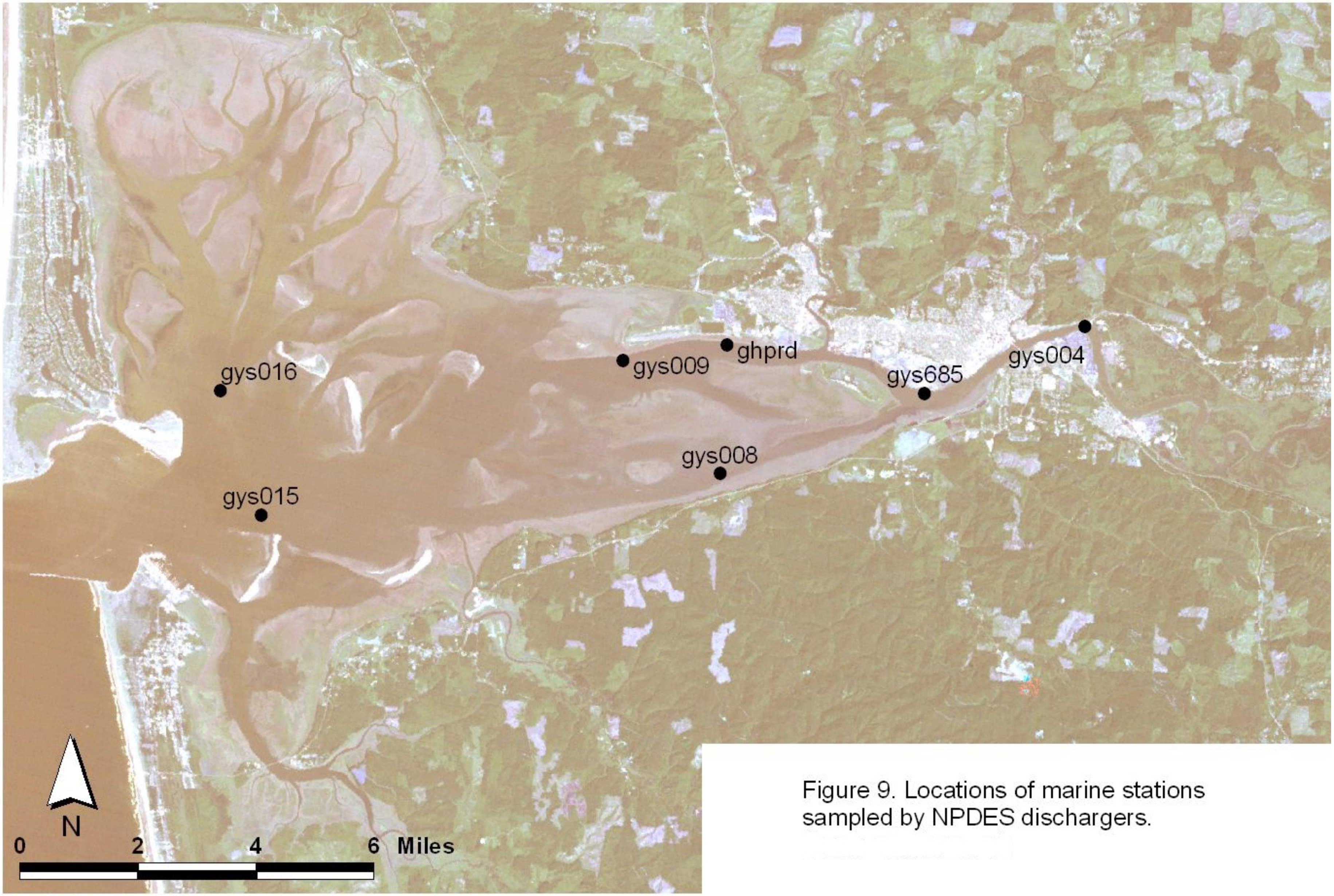



Figure 9. Locations of marine stations sampled by NPDES dischargers.

DOH is charged with the responsibility of enforcing the standards for shellfish. DOH has established rules on the certification of shellfish growing areas for commercial and recreational harvesting. Like the federal program, the state shellfish program is based on the use of fecal coliform as the indicator.

The outer region of Grays Harbor, west of longitude 123º59'W, is designated class A marine water according to Washington State water quality standards (WAC 173-201A) (Figure 3). The class A marine standards contain criteria for fecal coliform to reduce the chance of people becoming ill after eating shellfish or as a result of swimming in natural waterbodies. Ecology's current class A marine standard for bacteriological pollutants is based on the use of fecal coliform as an indicator of fecal contamination by humans and other warm-blooded animals. Ecology's current water quality standards for Class A waterbodies are as follows:

*"Fecal coliform organism levels shall both not exceed a geometric mean value of 14 colonies/ 100 ml, and not have more than 10 percent of all samples obtained for calculating the geometric mean value exceeding 43 colonies/100 ml."*

Ecology's threshold levels of fecal coliform in the water quality standards match those of DOH and FDA for class A marine waters. Ecology standards do not specify a minimum number of samples. Ecology standards specify that averaging of data beyond a 30-day period, or beyond a specific discharge event under investigation, shall not be permitted when such averaging would skew the data set so as to mask non-compliance.

The inner region of Grays Harbor, east of longitude 123°59'W to longitude 123°45'45"W (Cosmopolis Chehalis River, RM 3.1) is designated class B marine water, which allows for a geometric mean concentration of 100 colonies/100 ml, with no more than 10 percent of samples greater than 200 colonies/100 ml.

All tributaries entering Grays Harbor, with the exception of the lower reaches of the Hoquiam and Wishkah rivers, are designated class A freshwater, which allows for a geometric mean concentration of 100 colonies/100 ml, with no more than 10 percent of samples greater than 200 colonies/100 ml.

The Hoquiam River from the mouth to RM 9.3, and the Wishkah River from the mouth to RM 6, are designated class B freshwater which allows for a geometric mean concentration of 200 colonies/100 ml, with no more than 10 percent of samples greater than 400 colonies/100 ml. Upstream reaches of the Hoquiam and Wishkah rivers are designated class A freshwater.

# Methods

The project objectives were met through a combination of (1) monitoring of water quality and flow, (2) modeling of fate and transport of fecal coliform distributions in Grays Harbor, and (3) analysis of various loading scenarios and resulting water quality. Monitoring of water quality and quantity was conducted to quantify seasonal patterns of loading contributions from various sources and water quality in the harbor.

## Monitoring

Table 2 presents the list of stations and parameters used for monitoring of water quality and flow. The locations of monitoring stations are presented in Figures 5 through 10. The list of stations in Table 2 is intended to supplement ongoing monitoring by Ecology's Ambient Monitoring Section and DOH as described above. The purpose of monitoring is to address the following project objectives:

- Determine the contribution of all significant tributaries to the fecal coliform loading and concentration of the estuary.

- Compare the levels of fecal coliform contamination to Ecology and DOH water quality standards for the protection of shellfish and other beneficial uses.

Water quality samples were collected at approximately monthly intervals between March 1997 and April 1998. The list of stations was chosen to represent all significant tributaries to Grays Harbor. Stations were located upstream from tidal effects, if it was considered possible to represent most of the tributary watershed. Several stations were located in the region of tidal effects to represent (1) those tributaries where upstream stations were not feasible or (2) nonpoint contributions between upstream stations and the tributary mouth. Tidal stations were sampled during ebbing tides to represent nonpoint contributions upstream from the sample sites (sampled between one hour after high tide and one hour before low tide). The database of measured water quality variables in Grays Harbor and its tributaries is available in electronic format as described in Appendix A.

Continuous flow gaging stations were installed at selected representative tributary sites (Figure 8 and Table 2). The selected sites for gaging stations were chosen because they are the largest ungaged tributaries with suitable locations for development of accurate rating curves. Flow gaging stations consisted of water level sensors connected to dataloggers for recording of water levels at 15-minute or hourly intervals. Discharge measurements were made at approximately monthly intervals to develop rating curves for estimation of continuous discharge rates versus time. Continuous discharge from ungaged sites was estimated by (1) regression analysis of instantaneous measurements at gaged versus ungaged sites, (2) analysis of historical records of discharge, (3) watershed area, or (4) other appropriate techniques. The database of estimated flows is presented in Appendix B, along with a description of detailed methods that were used to estimate flows.

Table 2. Sampling stations for the Grays Harbor fecal coliform study, Feb-97 through Apr-98.

| station name | station location | abbreviated station ID | lab number | tidal/non-tidal | USGS gaged river | conti-nuous flow gage | instan-taneous flow | temp-erature (field) | salinity (field) | salinity (UW lab) | FC and *E. coli* (MEL) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Northern Tributaries** | | | | | | | | | | | |
| Humptulips River near mouth | at highway 109 bridge near mouth | 01-hump | 6401 | tidal | | | | X | X | | X |
| Humptulips River near Humptulips | Ecology station 22A070 at highway 101 bridge near Humptulips | 02-hump (rep) | 6402/6490 | non-tidal | X | (1) | if wadable | X | X | | X |
| Chenois Creek near mouth | at highway 109 bridge near mouth | 03-chen | 6403 | tidal | | | | X | X | | X |
| Grass Creek near mouth | at highway 109 bridge near mouth | 04-grass | 6404 | tidal | | | | X | X | | X |
| West Fork Hoquiam River near New London | Ecology station 22B070 at Dekay Road bridge | 05-wfhoq | 6405 | non-tidal | | X | | X | X | | X |
| East Fork Hoquiam River below Nisson | at F-line logging road bridge approx 2 mi downstream from Nisson | 06-efhoq | 6406 | non-tidal | | X | | X | X | | X |
| Hoquiam River at Hoquiam | near mouth at Riverside Bridge in Hoquiam/East Hoquiam | 07-hoq | 6407 | tidal | | | | X | X | | X |
| Wishkah River at Aberdeen | near mouth at highway 12 bridge in Aberdeen | 08-wish | 6408 | tidal | | | | X | X | | X |
| Wishkah River at Wishkah | Ecology station 22D070 at Aberdeen Gardens Road bridge at Wishkah | 09-wish | 6409 | non-tidal | | | if wadable | X | X | | X |
| Wishkah River near Greenwood | at Hoquiam-Wishkah Road bridge below confluence with West Fork | 10-wish | 6410 | non-tidal | | X | | X | X | | X |
| Elliot Slough near Aberdeen | near mouth at road bridge near Aberdeen | 11-elli | 6411 | tidal | | | | X | X | | X |
| Central Park Slough near Central Park | near mouth at Central Park Drive bridge near intersection with Fairway Park Drive | 12-cent | 6412 | tidal | | | | X | X | | X |
| Wynoochee River near Montesano | near mouth at Devonshire Road bridge near Montesano | 13-wyno | 6413 | non-tidal | X | | | X | X | | X |
| Chehalis River near Montesano | Ecology station 22C050 at highway 107 bridge near Montesano | 14-cheh (rep) | 6414/6491 | tidal | | | | X | X | | X |
| Chehalis River at South Elma | Road bridge at South Elma | 39-elma | 6439 | non-tidal | | | | X | X | | X |
| Chehalis River at Porter | Road bridge at Porter (Ecology station 23A070) | 38-port | 6438 | non-tidal | X | | | X | X | | X |
| **South Shore Tributaries** | | | | | | | | | | | |
| Charley Creek near mouth | at highway 105 bridge near mouth | 15-char | 6415 | tidal | | | | X | X | | X |
| Newskah Creek near mouth | at highway 105 bridge near mouth | 16-news | 6416 | tidal | | | | X | X | | X |
| Chapin Creek near mouth | at highway 105 bridge near mouth | 17-chap | 6417 | tidal | | | | X | X | | X |
| Campbell Creek near mouth | at highway 105 bridge near mouth | 18-camp | 6418 | tidal | | | | X | X | | X |
| Indian Creek near mouth | at highway 105 bridge near mouth | 19-indi | 6419 | tidal | | | | X | X | | X |
| Stafford Creek near mouth | at highway 105 bridge near mouth | 20-staf | 6420 | tidal | | | | X | X | | X |
| O'Leary Creek near mouth | at highway 105 bridge near mouth | 21-olea | 6421 | tidal | | | | X | X | | X |
| Johns River near mouth | near mouth at Wildlife boat launch above highway 105 | 22-john | 6422 | tidal | | | | X | X | | X |
| Johns River near Western | at Darnell or Doyle residence near Western | 23-john | 6423 | non-tidal | | X | | X | X | | X |
| Dempsey Creek near mouth | at Plum Street bridge near mouth | 25-demp | 6425 | tidal | | | | X | X | | X |
| Barlow Creek near mouth | at Plum Street bridge near mouth | 26-barl | 6426 | tidal | | | | X | X | | X |
| Elk River near mouth | adjacent to logging road nearest to mouth | 27-elk | 6427 | tidal | | | | X | X | | X |
| East Branch Elk River | foot path from logging road | 28-efelk | 6428 | non-tidal | | | if wadable | X | X | | X |
| Middle Branch Elk River | foot path from logging road | 29-mfelk | 6429 | non-tidal | | | if wadable | X | X | | X |
| West Branch Elk River | foot path from logging road | 30-wfelk | 6430 | non-tidal | | X | | X | X | | X |
| Andrews Creek near DNR gate | near DNR gate from foot path from logging road | 31-andr | 6431 | non-tidal | | X | | X | X | | X |
| Grayland Ditch near mouth | above tide gate at hunt club road bridge | 32-ditch | 6432 | tidal | | | | X | X | | X |
| Grayland Ditch at Schmidt Road | at Schmidt Road Bridge | 33-ditch (rep) | 6433/6492 | non-tidal | | X | | X | X | | X |
| Grayland Ditch at Grange Road | at Grange Road Bridge | 34-ditch | 6434 | non-tidal | | | if wadable | X | X | | X |
| Unnamed Creek at Westport | corner of Second and Sprague Streets at Westport | 35-west | 6435 | non-tidal | | | if wadable | X | X | | X |
| **South Bay and Redman Slough (Brady Engvall)** | | | | | | | | | | | |
| DOH station 54 | Dept. of Health station 54 in South Bay upstream from highway 105 | 54-DOH | 6454 | tidal | | | | X | | X | X |
| DOH station 55 | Dept. of Health station 55 in South Bay upstream from highway 105 | 55-DOH (rep) | 6455/6493 | tidal | | | | X | | X | X |
| DOH station 56 | Dept. of Health station 56 in South Bay upstream from highway 105 | 56-DOH | 6456 | tidal | | | | X | | X | X |
| DOH station 59 | Dept. of Health station 59 in South Bay upstream from highway 105 | 59-DOH | 6459 | tidal | | | | X | | X | X |
| DOH station 60 | Dept. of Health station 60 in South Bay upstream from highway 105 | 60-DOH | 6460 | tidal | | | | X | | X | X |
| DOH station 61 | Dept. of Health station 61 in South Bay upstream from highway 105 | 61-DOH | 6461 | tidal | | | | X | | X | X |
| Redman Slough near mouth | at mouth from shore | 24-redm | 6424 | tidal | | | | X | | X | X |
| **Ecology Ambient Monitoring Section Marine Flight** | | | | | | | | | | | |
| Chehalis River near Elliot Slough | Chehalis R in Aberdeen Reach near mouth of Elliot Slough | GYS004 | 6235 | tidal | | | | X | | X | X |
| South Channel near Stafford Cr | South Channel of Grays Harbor near Stafford Creek | GYS008 (rep) | 6236/6237 | tidal | | | | X | | X | X |
| North Channel near Moon Island | North Channel of Grays Harbor "Moon Island" Reach near Moon Island | GYS009 | 6238 | tidal | | | | X | | X | X |
| Grays Harbor N of Whitcomb Flats | Grays Harbor N of Whitcomb Flats | GYS015 | 6239 | tidal | | | | X | | X | X |
| Grays Harbor NE of Damon Point | Grays Harbor NE of Damon Point | GYS016 | 6240 | tidal | | | | X | | X | X |
| Cow Point Reach near Cow Point | Grays Harbor Cow Point Reach off of Cow Point | GYS017 | 6241 | tidal | | | | X | | X | X |
| South Channel near Stearns Bluff | South Channel of Grays Harbor off of Stearns Bluff | GYS018 | 6242 | tidal | | | | X | | X | X |
| Crossover Channel near G "27" | Crossover Channel of Grays Harbor near G "27" | GYS019 | 6243 | tidal | | | | X | | X | X |

(1) The state Department of Fisheries hatchery downstream from highway 101 records daily water level in the Humptulips River. There is also a wire-weight on the highway 101 bridge for Ecology's ambient monitoring station (22A070). The USGS provides a rating curve for the river at the highway 101 bridge.

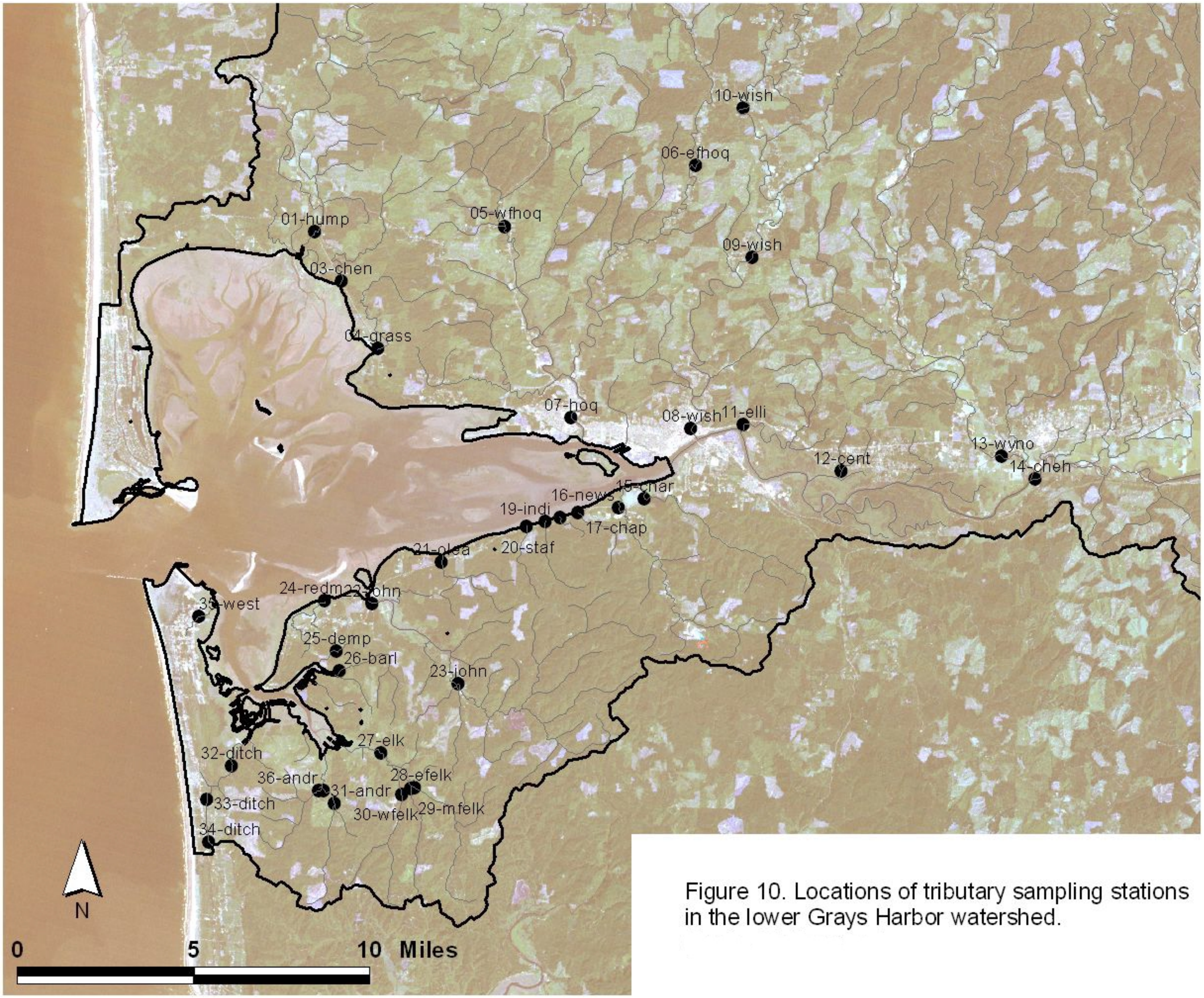



Figure 10. Locations of tributary sampling stations in the lower Grays Harbor watershed.

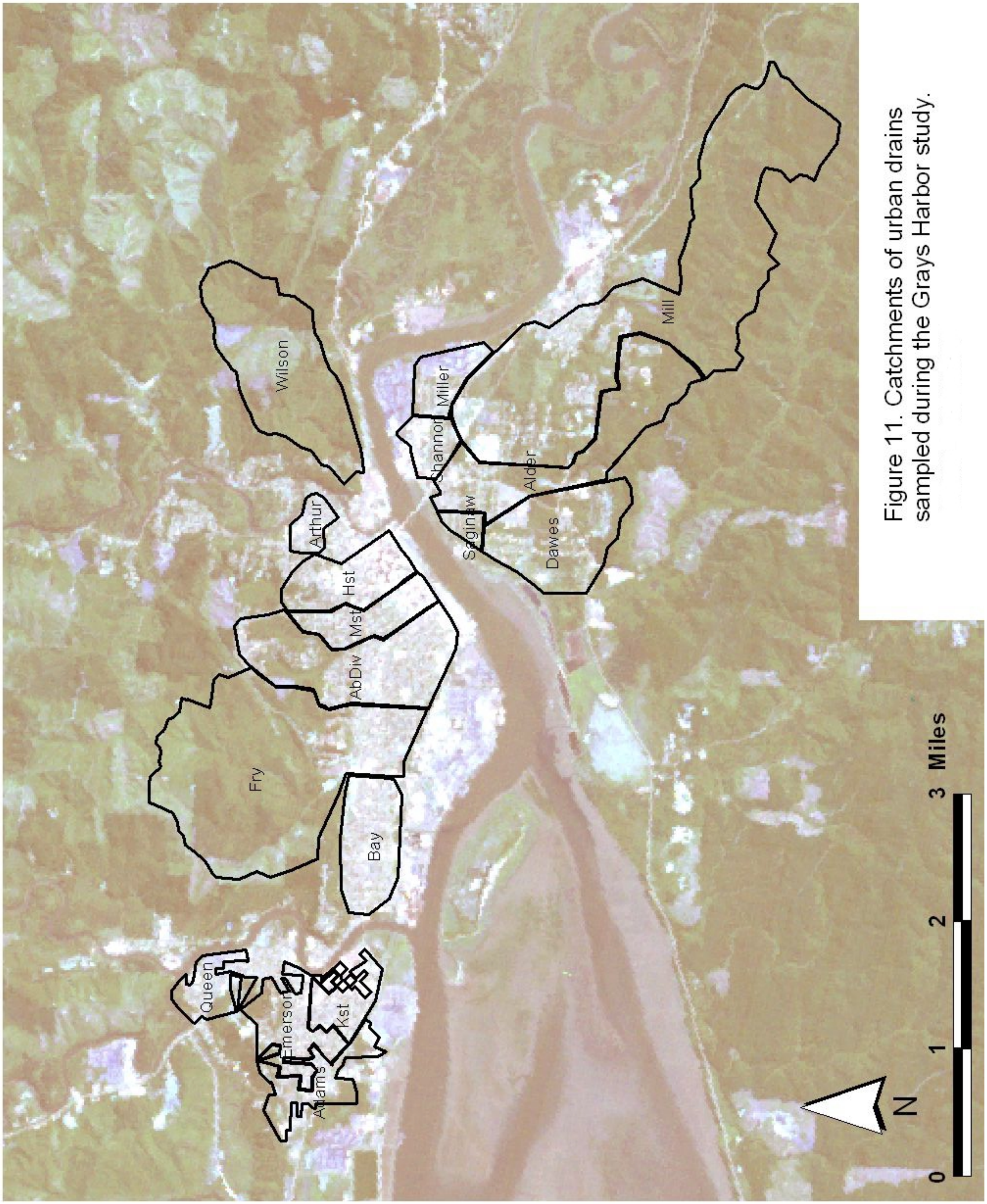



Figure 11. Catchments of urban drains sampled during the Grays Harbor study.

Four teams conducted monitoring as follows:

1. A tributary water quality sampling team led by Greg Pelletier, Keith Seiders, or Norm Glenn collected water quality samples at all tributary stations and flow measurements at some stations (Figures 7 and 10). Flow estimates for all non-tidal stations were made either by direct measurement of discharge on the day of sampling, or by calculation from the discharge gaging record and rating curves developed during the project. Sampling events usually occurred over a three-day period (Monday through Wednesday) at approximately monthly intervals; approximately one-third of the stations were sampled each day of a sampling event. Some sampling events occurred on a Thursday. Tidal stations were sampled during ebbing tides (sampled between 1 hour after high tide and 1 hour before low tide).
2. A tributary flow measurement team led by Clay Keown, Greg Pelletier, or Keith Seiders measured discharge at gaging stations and other non-tidal tributaries.
3. An estuary sampling team led by Brady Engvall (Brady's Oysters) collected samples at six stations that were discontinued by DOH in the southern part of the south region (Figure 6). Samples were collected approximately one hour after high tide at monthly intervals. An effort was made to coordinate the sampling dates with DOH; samples were collected on the same day as other DOH stations whenever possible.
4. An estuary sampling team led by Jan Newton, Casey Clishe, Skip Albertson, or Dale Clark collected samples at Ecology's marine ambient monitoring stations using a floatplane. Samples were collected randomly with respect to tide at approximately monthly intervals. A subset of the major tributary stations was also sampled on the same day as the marine flights by the tributary sampling team.

Sampling of representative urban drains in the Aberdeen-Hoquiam-Cosmopolis area was also conducted during the wet season of November 1997–April 1998. Figure 11 shows the catchment areas of the urban drains that were sampled. Urban drains were sampled for fecal coliform and E. coli using the same methods as for surface water stations in the tributaries and estuary.

Monitoring of effluent quality of point sources was conducted by permittees as required under their NPDES permits. Discharge monitoring reports submitted to Ecology by NPDES dischargers were used as the principal data source to characterize point source loads. It was not considered necessary to supplement the self-monitoring data, because normal loads of fecal coliform from point sources were not suspected of significantly elevating fecal coliform levels in the harbor, provided that the NPDES permittees are operating within the limits contained in their permits. Effluent samples were collected from the NPDES dischargers on five occasions between November 1997 and April 1998 as a check on the NPDES self-monitoring.

## Project Organization

Several Ecology staff and volunteers were involved in the proposed project. This section identifies all individuals with responsibility for supervision or implementation of the project and describes their responsibilities. The following people and organizations were involved in the project. All are employees or volunteers in the Ecology's Environmental Assessment Program, unless otherwise noted:

- *Greg Pelletier*. Principal Investigator responsible for overall project management, preparation of Quality Assurance Project Plan (QAPP), supervision and completion of field sampling, analysis of project data, development of water quality models, and preparation of draft and final reports.

- *Jan Newton, Casey Clishe, Skip Albertson, and Dale Clark*. Responsible for collection of samples at eight ambient monitoring stations in Grays Harbor. Jan Newton supervised field sampling which was usually conducted by Casey Clishe.

- *Brady Engvall. Brady's Oysters, Inc., Aberdeen, WA*. Responsible for collection of samples at six stations in the southern part of the south region in Grays Harbor. Brady Engvall is an oyster grower in the Grays Harbor area, and a volunteer for Ecology. Greg Pelletier supervised sampling activities and provided sample bottles and tags, coolers, thermometers, field notebooks, and laboratory analysis (including delivery of samples from the Grays Harbor area to the Manchester Environmental Laboratory).

- *Randy Coots and Clay Keown*. Responsible for installation and maintenance of flow gaging stations, and development of flow rating curves.

- *Keith Seiders and Norm Glenn*. Back-up leaders for tributary and NPDES sampling. Keith was also responsible for development of flow rating curves, estimation of daily flows, and statistical analysis of flow and water quality data.

- *Bill Kammin, Stewart Magoon, Pam Covey, and Nancy Jensen. Manchester Environmental Laboratory (MEL)*. All bacterial samples collected during field studies were submitted to Ecology's MEL for analysis under the direction of Bill Kammin. Stewart Magoon and Pam Covey coordinated requests for analysis, scheduled processing of analytical samples, and provided submittals of project data. Nancy Jensen conducted laboratory analysis of fecal coliform and *E. coli*.

- *Kathy Krogslund. University of Washington, School of Oceanography, Marine Chemistry Laboratory, Ocean Technical Services, Seattle, WA*. Responsible for analysis of salinity samples.

- *Will Kendra*. Section manager for the Watershed Ecology Section of the Environmental Assessment Program. Responsible for review of the project QAPP and draft final report.

- *Stew Lombard*. Responsible for review of the project QAPP.

- *Keli McKay, Bill Backous, Dave Rountry, and Kahle Jennings. Ecology's Southwest Regional Office (SWRO)*. Section managers and client contacts for the SWRO Water Quality Program. Responsible for review of the draft QAPP and draft final report.

- *Frank Meriwether. DOH Office of Shellfish Programs, Olympia, WA*. Contact for coordination of sampling programs by Ecology with DOH activities, and review of QAPP and draft final report.

# Data Quality Objectives and Analytical Procedures

Analytical methods and the detection or precision limits for field measurements, as well as laboratory analyses of conventional and biological parameters, are listed in Table 3. The laboratory's data quality objectives and quality control procedures are documented in the Manchester Environmental Laboratory *Lab Users Manual* (MEL, 1994).

Table 3. Summary of field and laboratory measurements, target detection limits, and methods.

| Parameter | Sensitivity or Reporting Limit | Method[a] |
|---|---|---|
| **Field Measurements** | | |
| Velocity | ± 0.05 feet/second | Current meter |
| Specific conductance | ± 1 umhos/cm | Conductivity meter |
| Temperature | ± 0.2 degree C | Red liquid thermometer |
| **General Chemistry** | | |
| Specific conductance | ± 1 umhos/cm | Conductivity meter |
| Salinity | ± 0.01 ppt | UNESCO, 1981 |
| Fecal coliform and E. coli | 2/100 ml | Modification of SM18 9221E (MPN/A-1) by FDA. MUG is added to the A-1 media for determination of E. coli. |

[a]SM = Standard methods for the examination of water and wastewater. Eighteenth edition (1992). American Public Health Association, American Water Works Association, and Water Environment Federation. Washington, D.C.

UNESCO, 1981. Background papers and supporting data on the Practical Salinity Scale 1978. UNESCO Technical Papers in Marine Science 37, Paris, 144 pp.

Temperature was measured in the field using either a thermometer or thermistor. Salinity was measured in the field with a conductivity meter or analyzed in the laboratory by the University of Washington School of Oceanography. Fecal coliform and *E. coli* determinations were performed by the Manchester Environmental Laboratory (MEL) using an FDA modification of the MPN method, using A-1 media with MUG added (Jensen, 1999).

Targets for precision of bacterial analyses are difficult to quantify. The coefficient of variation for replicate samples for fecal coliform has been found to increase as the fecal coliform level decreases (*e.g.,* Coots, 1994). For low levels of fecal coliform (less than 10 per 100 ml) the root-mean-squared coefficient of variation (RMSCV) for laboratory duplicates was 90 percent. For higher levels of fecal coliform (greater than 100 per 100 ml) the RMSCV was 34 percent.

# Sampling and Quality Control Procedures

The sampling and field measurement procedures used during this study followed protocols described by WAS (1992). All surface water samples were collected directly into pre-cleaned containers supplied by MEL and described by MEL (1994).

Field measurements at surface water stations included flow and temperature. Conductivity or salinity was measured in the field or by MEL.

Water samples were placed on ice in closed coolers immediately after sampling. Samples for bacterial analysis were transported to MEL the morning after sampling. Laboratory analysis of bacterial samples began within 24 hours after sampling.

Total variation for field sampling and analytical variation was assessed by collecting replicate samples. Duplicate samples were collected at approximately 10 percent of the sample stations during each survey to measure total variability, and were analyzed in duplicate by MEL to determine laboratory variability. Quality control procedures by the laboratory followed standard operating procedures described by MEL (1994).

All meters were calibrated in accordance with the manufacturers' instructions. Samples for laboratory analysis by MEL were stored on ice and delivered to MEL within 24 hours of collection. Samples for salinity analysis by the University of Washington were stored at room temperature in tightly closed brown polyethylene bottles.

The quality of all bacteria data and qualifiers was considered prior to use. Bacteria data in Discharge Monitoring Reports from NPDES permittees' Ecology-accredited laboratories were deemed acceptable as reported. Bacteria data from DOH and Ecology laboratories were deemed acceptable as reported. If bacteria data were qualified as non-detect, one-half of the detection limit was used in statistical analyses and modeling. Most of the bacteria data from Grays Harbor Paper were reported as non-detect at 1,000 cfu/100mL, so a value of 500 cfu/100mL was used. In the few cases where bacteria values of 0 cfu/100mL were reported, a value of 1 cfu/100mL was assigned (half of the detection limit of 2 cfu/100ml).

Bacteria data were later grouped by salinity to help determine whether marine or freshwater water quality standards should be applied. These groupings also helped in establishing correlations between different methods for enumerating bacteria concentrations (e.g., MF vs. MPN, FC vs. EC).

## Data Assessment Procedures

Data reduction, review, and reporting followed the procedures as outlined in the *Lab Users Manual* (MEL, 1994). All data were validated before preparing a final project database. Validation involved review of 100 percent of the data for possible transcription errors, missing data, and improbable values when importing data from MEL submittals to the project database. All laboratory data were entered in Microsoft Excel or Access spreadsheet or database files. Statistical calculations were made using the database spreadsheets and by importing data from the spreadsheets to either SYSTAT or WQHYDRO (Aroner, 1992) statistical software.

Data analysis included estimation of univariate statistical parameters (e.g., arithmetic mean, geometric mean, median, standard deviation, $90^{th}$ percentile). Variability of field replicates and laboratory duplicates was quantified using the standard deviation, coefficient of variation (standard deviation as a fraction of the mean), or relative percent difference.

The paired-sample t-test (Zar, 1984) was used to determine if differences existed between the results from various sets of paired fecal coliform samples. This test helped define which data sets to use in statistical analyses and modeling. Bacteria data were grouped based on salinity and water type (ambient or effluent). The differences between results for each set of paired samples approached a normal distribution in most cases, allowing the use of the paired-sample t-test. The null hypothesis was accepted in most cases, indicating no difference between the means of the paired data sets examined. In most cases, the MF and MPN results were deemed comparable and were pooled for analyses. Where MF and MPN results were available for the same site, the MPN result was usually used.

Ocean Spray Cranberry fecal coliform (FC) values were excluded from statistical comparison tests because of non-detect values. Ocean Spray MF data were considered comparable to Ecology MPN data for study purposes. Ocean Spray FC values were typically low (less than 5 cfu/100mL) so this approach has little, if any, effect on modeling results.

Weyerhaeuser and Ecology results for the MF tests on Weyco1 effluent were inconsistent. Weyerhaeuser results were 2-3 orders of magnitude lower than Ecology results for MF while the MPN results from the two laboratories were comparable. The nature of the MF test, the sample (the effluent), and analytical techniques account for the differences between Weyerhaeuser and Ecology MF results. Most of Ecology's analyses of Weyerhaeuser effluent for FC by the MF method found a high background growth on the filter which interfered with an accurate count of FC colonies on the filter. This high growth can affect the pH of the filter media and resultant color of FC colonies and background growth, thus interfering with an accurate count of FC colonies. When such situations arise, confirmation tests can be done to gain more accurate counts of FC colonies.

The Weyerhaeuser laboratory routinely does confirmation tests on their MF tests while Ecology's laboratory (MEL) does confirmation tests on a percentage of samples. Weyerhaeuser's laboratory did confirmation tests on these samples while MEL did not. It is probable that Ecology MF results for these samples overestimate the true FC value. The MPN results are deemed the most reliable value for these samples. MEL is likely to change its policy and do confirmation tests based on sample characteristics rather than by a percentage (Jensen, 1999). Weyerhaeuser's MF results were used to estimate their effluent loads for modeling and TMDL analyses.

# Modeling and Analysis of Loading Scenarios

A numerical model of fate and transport of fecal coliform bacteria in Grays Harbor was developed to address the following project objectives:

- Model the distribution of fecal coliform within Grays Harbor as it is affected by loads from point and nonpoint sources, tidal circulation and transport, and the natural process of die-off of bacteria.
- Predict the effect of pollution events on water quality at various locations in the harbor.

- Determine the pollution reductions that are needed so that local communities, agencies, and other affected parties can develop and implement appropriate cleanup strategies. This will also provide information for establishing waste load allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources, for establishing a TMDL as required under section 303(d) of the federal Clean Water Act.

The EPA (1980) model was the best numerical model that had been developed for Grays Harbor prior to this study. The EPA model was a link-node hydrodynamic model combined with a water quality model that simulates fecal coliform, in addition to dissolved oxygen, nutrients, and algae. The EPA model was based on a precursor of EPA's DYNHYD5/WASP5 modeling system and uses similar computational methods (EPA, 1993). The model selected for the present study is similar to the EPA model, in that it uses a link-node hydrodynamic model combined with a separate model to evaluate transport of fecal coliform. The segmentation of Grays Harbor for the model developed in the present study was based on the EPA model segmentation (Figure 4), with the exception that added detail of the south region was included and the seaward boundary was extended outside of the harbor entrance (Figures 12, 13, and 14).

Hydrodynamic simulation was done using the U.S. Army Corps of Engineers link-node WDWBM Model (Walton et al., 1995). The segments for the water quality model are the same as the nodes for the hydrodynamic model. Fecal coliform fate and transport was simulated using EPA's WASP/EUTRO model (EPA, 1993) using a calculated rate of fecal coliform die-off that accounts for temperature. The die-off rate was estimated as part of the calibration of the model to observed conditions in Grays Harbor.

A tidally dynamic continuous simulation of the study year (May 1997-April 1998) was developed. Flows were calculated continuously at 30-second intervals, and water quality was calculated at 90-second intervals. Hourly predictions of water quality were extracted from the model output for analysis of results. The mathematical model of Grays Harbor was used to estimate the distribution of fecal coliform bacteria continuously for the study year.

Data for development of the mathematical model were compiled from other available sources in addition to the data collected during this study. The bathymetry was estimated from digital data from the U.S. Army Corps of Engineers. Flows from tributaries were estimated based on data from this study and from the U.S. Geological Survey. Loading of fecal coliform from tributaries, and concentrations in the harbor for calibration of the model, were estimated based on data from this study in addition to the NPDES dischargers and DOH.

The input files and DOS executable model programs for the calibrated hydrodynamic (DOS program wdwbm25p.exe) and water quality transport models (DOS program eutro51s.exe) are available in electronic format, as described in Appendices C and D.

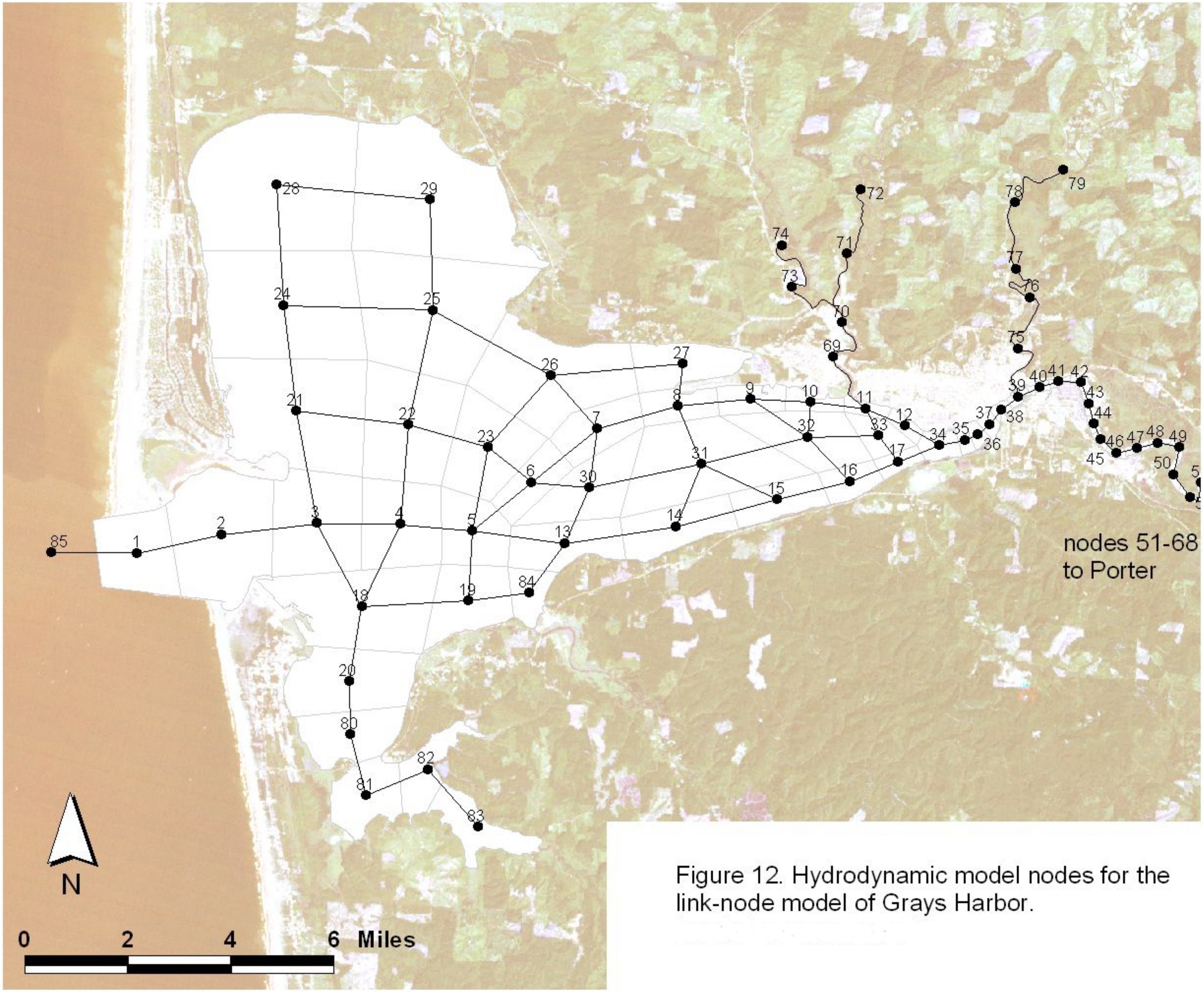



Figure 12. Hydrodynamic model nodes for the link-node model of Grays Harbor.

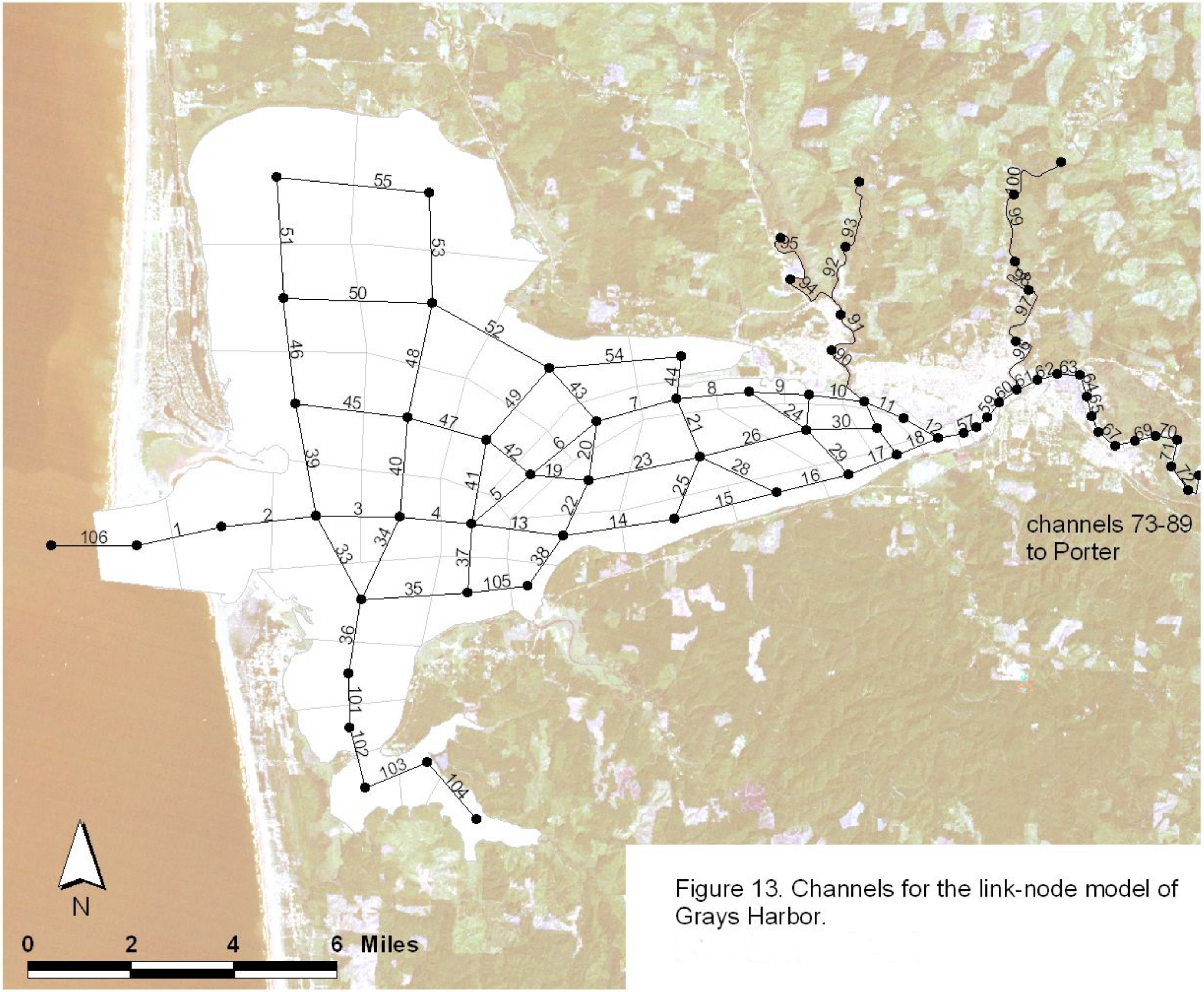



Figure 13. Channels for the link-node model of Grays Harbor.

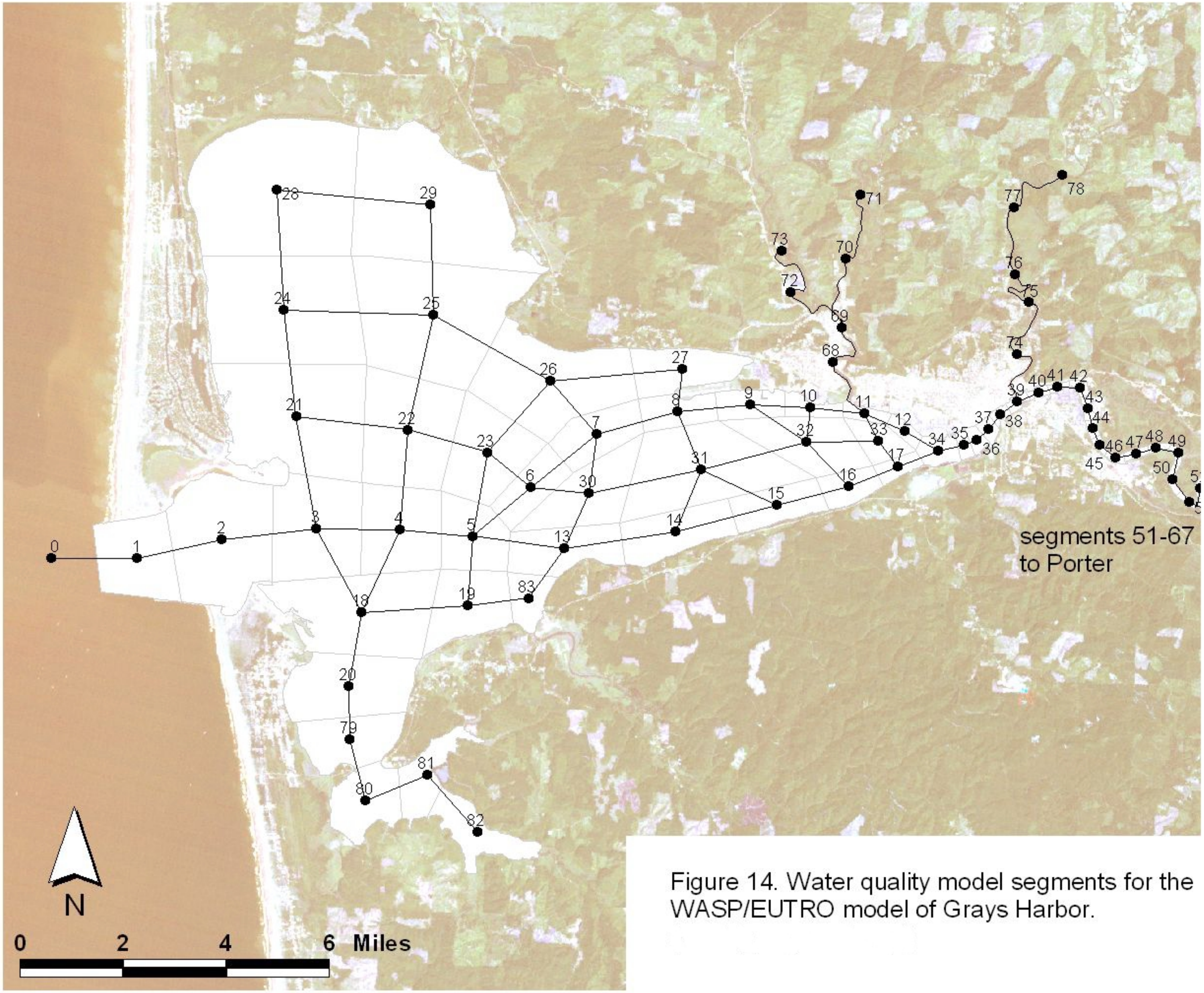



Figure 14. Water quality model segments for the WASP/EUTRO model of Grays Harbor.

# Results and Discussion

## Flow

The daily flows from all tributaries to Grays Harbor are presented in Figure 15. The Chehalis River is the largest source of freshwater to Grays Harbor (Figure 16 and Table 4), followed by the Humptulips, Satsop, and the Wynoochee rivers. Together these rivers accounted for about 84 percent of the total inflow to Grays Harbor. The Wishkah, Hoquiam, Johns, and Elk rivers, and Andrews Creek, accounted for another 12 percent of the inflow. The remaining 4 percent came from several smaller tributaries.

Flows during May 1, 1997 through April 30, 1998 (study year) were approximately 17 percent higher than the average annual flow based on long-term data from the Chehalis River at Porter (Figure 17). The September and October 1997 flows were especially high in comparison with historical averages. Tributary loads of fecal coliform also were probably relatively high during the study year, compared with normal years, because of the relationships between flow, fecal coliform concentrations, and loading.

The database of estimated daily flows from each tributary is presented in Appendix B, along with a description of detailed methods that were used to estimate flows.

## Fecal Coliform Relationships with Flow and Season

The concentration of fecal coliform bacteria in tributary streams was found to depend on the flow rate and time of year. Statistical methods to account for the dependence of pollutant concentrations on flow and season are well established (e.g., Cohn et al., 1992). A multiple regression model was found to explain most of the variability in fecal coliform concentration in tributaries to Grays Harbor. The regression methods and results are presented in Appendix E. The predicted loads using the regression model were found to accurately describe the observed loads.

## Fecal Coliform Loading

The daily loading of fecal coliform to Grays Harbor during the study year is presented in Figure 18 (scientific notation is used in Figure 18: e.g., 1.E+16 is equivalent to $10^{16}$ colonies per day). During the study year, most of the fecal coliform loading to Grays Harbor came from the Chehalis River (Figure 19 and Table 5). Most of the load from the Chehalis River originates in the upper watershed above Porter. The Humptulips, Satsop, Wishkah, and Hoquiam rivers were the next largest sources of fecal coliform and, together with the Chehalis, collectively accounted for nearly 80 percent of the total loading.

Table 4. Annual average flows from all sources to Grays Harbor, 5/1/97 – 4/30/98.

| Source | Average flow during the study year (cms) | Percent of total flow from all sources |
|---|---|---|
| **Tributaries** | | |
| Chehalis River (excluding Wynoochee and Satsop rivers) | 167.0 | 39.0% |
| Humptulips River | 79.4 | 18.6% |
| Satsop River | 67.0 | 15.7% |
| Wynoochee River | 43.5 | 10.2% |
| Wishkah River | 22.8 | 5.32% |
| Hoquiam River | 18.2 | 4.25% |
| Johns River | 6.60 | 1.54% |
| Elk River | 3.62 | 0.85% |
| Newskah Creek | 2.62 | 0.61% |
| Charley Creek | 2.37 | 0.55% |
| Andrews Creek | 1.81 | 0.42% |
| Elliot Slough | 1.48 | 0.35% |
| Chenois Creek | 1.45 | 0.34% |
| Grayland Ditch | 1.16 | 0.27% |
| Grass Creek | 0.91 | 0.21% |
| Oleary Creek | 0.70 | 0.16% |
| Mill Creek | 0.57 | 0.13% |
| Barlow | 0.53 | 0.12% |
| Unnamed Central Park creek | 0.47 | 0.11% |
| Fry Creek | 0.43 | 0.10% |
| Indian Creek | 0.42 | 0.10% |
| Peel/Higgins Slough | 0.40 | 0.09% |
| Chapin Creek | 0.32 | 0.08% |
| Redman Slough | 0.29 | 0.07% |
| Stafford Creek | 0.26 | 0.06% |
| Campbell Creek | 0.25 | 0.06% |
| Wilson Creek | 0.22 | 0.05% |
| Alder Creek | 0.17 | 0.04% |
| Dempsey | 0.16 | 0.04% |
| Dawes Creek | 0.14 | 0.03% |
| Unnamed Westport creek | 0.12 | 0.03% |
| Miller Creek | 0.04 | 0.01% |
| Shannon | 0.03 | 0.01% |
| **Subtotal from tributaries** | **425.3** | **99.4%** |
| **Point Sources** | | |
| Weyco 001 | 1.02 | 0.24% |
| Weyco 002 | 0.33 | 0.08% |
| GH Paper 001 | 0.27 | 0.06% |
| Aberdeen STP | 0.19 | 0.05% |
| Hoquiam STP | 0.08 | 0.02% |
| Montesano STP | 0.01 | 0.003% |
| Elma STP | 0.01 | 0.003% |
| McCleary STP | 0.01 | 0.003% |
| Ocean Shores STP | 0.01 | 0.003% |
| Westport STP | 0.01 | 0.002% |
| Ocean Spray 001 | 0.01 | 0.002% |
| **Subtotal from point sources** | **2.0** | **0.5%** |
| **Urban Drains** | | |
| Bay Ave drain | 0.13 | 0.03% |
| Emerson drain | 0.09 | 0.02% |
| H St. drain | 0.08 | 0.02% |
| Division St. drain | 0.07 | 0.02% |
| Adams drain | 0.06 | 0.01% |
| M St. drain | 0.06 | 0.01% |
| Arthur St drain | 0.05 | 0.01% |
| Queen Ave drain | 0.03 | 0.01% |
| K St drain | 0.03 | 0.01% |
| Saginaw Slough | 0.01 | 0.003% |
| 15th St drain | 0.01 | 0.001% |
| 28th St drain | 0.00 | 0.001% |
| **Subtotal from urban drains** | **0.6** | **0.1%** |
| **Total from all sources** | **428** | **100%** |

Table 5. Estimated total load of fecal coliform from all sources to Grays Harbor, 5/1/97 – 4/30/98.

| Source | Total load of FC during the study year (organisms per yr) | Percent of total load from all sources |
|---|---|---|
| **Tributaries** | | |
| Chehalis River at Porter | 4.87E+15 | 35.8% |
| Chehalis River (lower river excluding Wynoochee and Satsop rivers) | 1.92E+15 | 14.1% |
| Humptulips River | 1.20E+15 | 8.8% |
| Satsop River | 1.08E+15 | 7.9% |
| Wishkah River | 8.60E+14 | 6.3% |
| Hoquiam River | 7.39E+14 | 5.4% |
| Wynoochee River | 4.36E+14 | 3.2% |
| Elk River | 3.82E+14 | 2.8% |
| Johns River | 3.29E+14 | 2.4% |
| Unnamed Central Park creek | 1.64E+14 | 1.21% |
| Grass Creek | 9.56E+13 | 0.70% |
| Chenois Creek | 8.93E+13 | 0.66% |
| Newskah Creek | 7.39E+13 | 0.54% |
| Charley Creek | 6.91E+13 | 0.51% |
| Andrews Creek | 5.78E+13 | 0.43% |
| Elliot Slough | 4.44E+13 | 0.33% |
| Barlow | 4.43E+13 | 0.33% |
| Grayland Ditch | 4.31E+13 | 0.32% |
| Oleary Creek | 3.80E+13 | 0.28% |
| Indian Creek | 3.78E+13 | 0.278% |
| Redman Slough | 1.76E+13 | 0.130% |
| Stafford Creek | 1.75E+13 | 0.128% |
| Chapin Creek | 1.42E+13 | 0.105% |
| Campbell Creek | 1.25E+13 | 0.092% |
| Unnamed Westport creek | 1.22E+13 | 0.090% |
| Peel/Higgins Slough | 7.20E+12 | 0.053% |
| Dempsey | 6.15E+12 | 0.045% |
| Mill Creek | 2.79E+12 | 0.021% |
| Fry Creek | 2.13E+12 | 0.016% |
| Miller Creek | 1.42E+12 | 0.010% |
| Alder Creek | 1.28E+12 | 0.009% |
| Dawes Creek | 4.67E+11 | 0.003% |
| Wilson Creek | 1.86E+11 | 0.001% |
| Shannon Slough | 1.22E+11 | 0.001% |
| **Subtotal from tributaries** | **1.27E+16** | **93.2%** |
| **Point Sources** | | |
| Weyco 001 | 5.14E+14 | 3.8% |
| GH Paper 001 | 4.37E+13 | 0.32% |
| Aberdeen STP | 1.54E+13 | 0.11% |
| Weyco 002 | 5.45E+12 | 0.040% |
| Hoquiam STP | 9.49E+11 | 0.007% |
| Elma STP | 8.21E+11 | 0.006% |
| McCleary STP | 7.51E+11 | 0.006% |
| Ocean Shores STP | 3.70E+11 | 0.003% |
| Westport STP | 1.05E+11 | 0.001% |
| Montesano STP | 5.77E+10 | 0.000% |
| Ocean Spray 001 | 2.58E+09 | 0.00002% |
| **Subtotal from point sources** | **5.82E+14** | **4.3%** |
| **Urban Drains** | | |
| Bay Ave drain | 2.78E+13 | 0.20% |
| Emerson drain | 2.06E+13 | 0.15% |
| H St. drain | 1.67E+13 | 0.12% |
| Division St. drain | 1.59E+13 | 0.12% |
| Adams drain | 1.27E+13 | 0.09% |
| M St. drain | 1.24E+13 | 0.09% |
| Arthur St drain | 1.02E+13 | 0.08% |
| Queen Ave drain | 7.56E+12 | 0.06% |
| K St drain | 7.49E+12 | 0.06% |
| Saginaw Slough | 2.82E+12 | 0.021% |
| 15th St drain | 1.30E+12 | 0.010% |
| 28th St drain | 6.51E+11 | 0.005% |
| other urban drains | 2.04E+14 | 1.5% |
| **Subtotal from urban drains** | **3.40E+14** | **2.5%** |
| **Total from all sources** | **1.36E+16** | **100%** |

Figure 15. Daily average flows from all tributaries to Grays Harbor, 5/1/97 - 4/30/98.

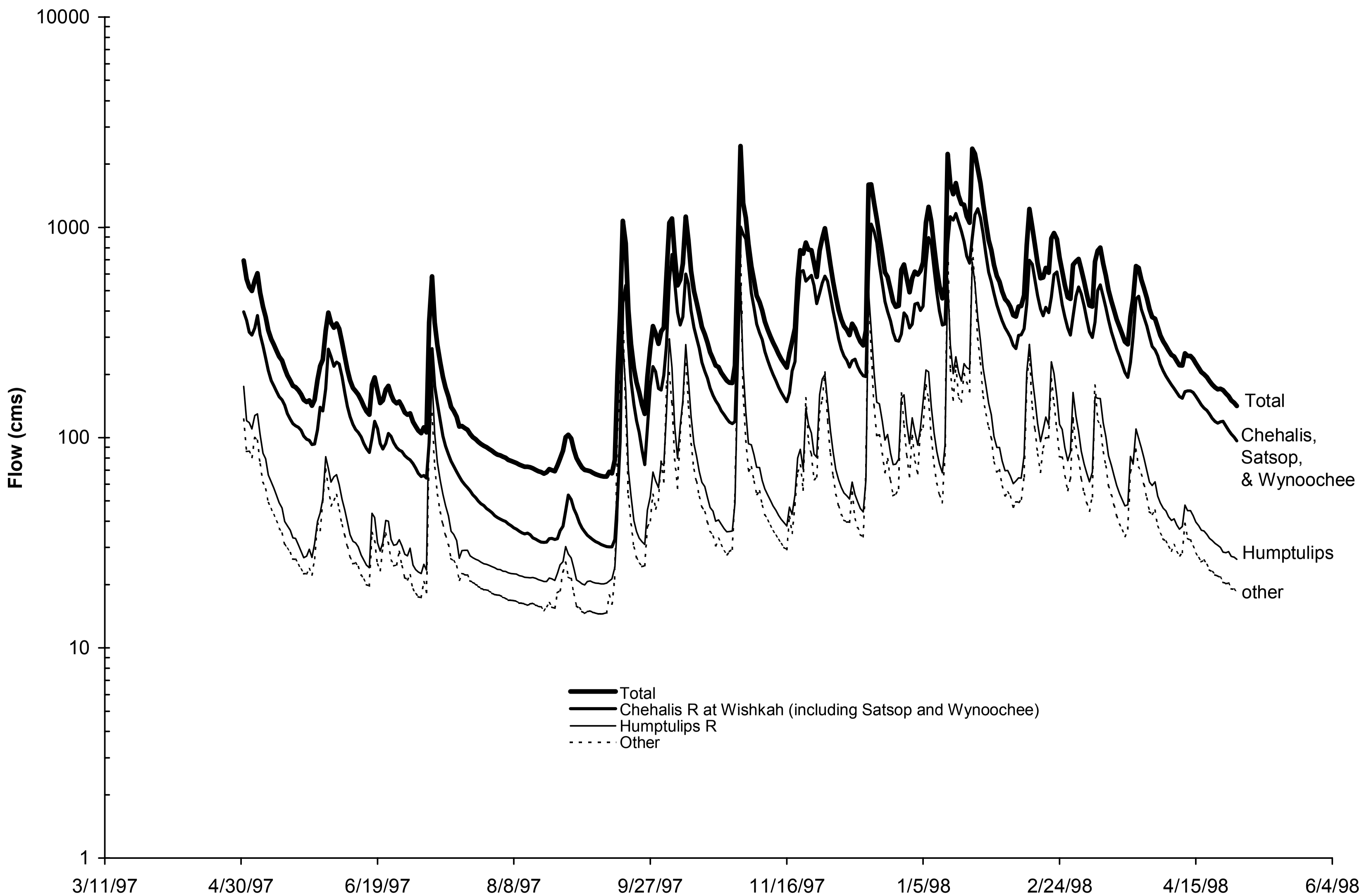


Figure 16. Total flows from tributaries to Grays Harbor, 5/1/97 - 4/30/98.
The average flow from all sources was 428 cms.

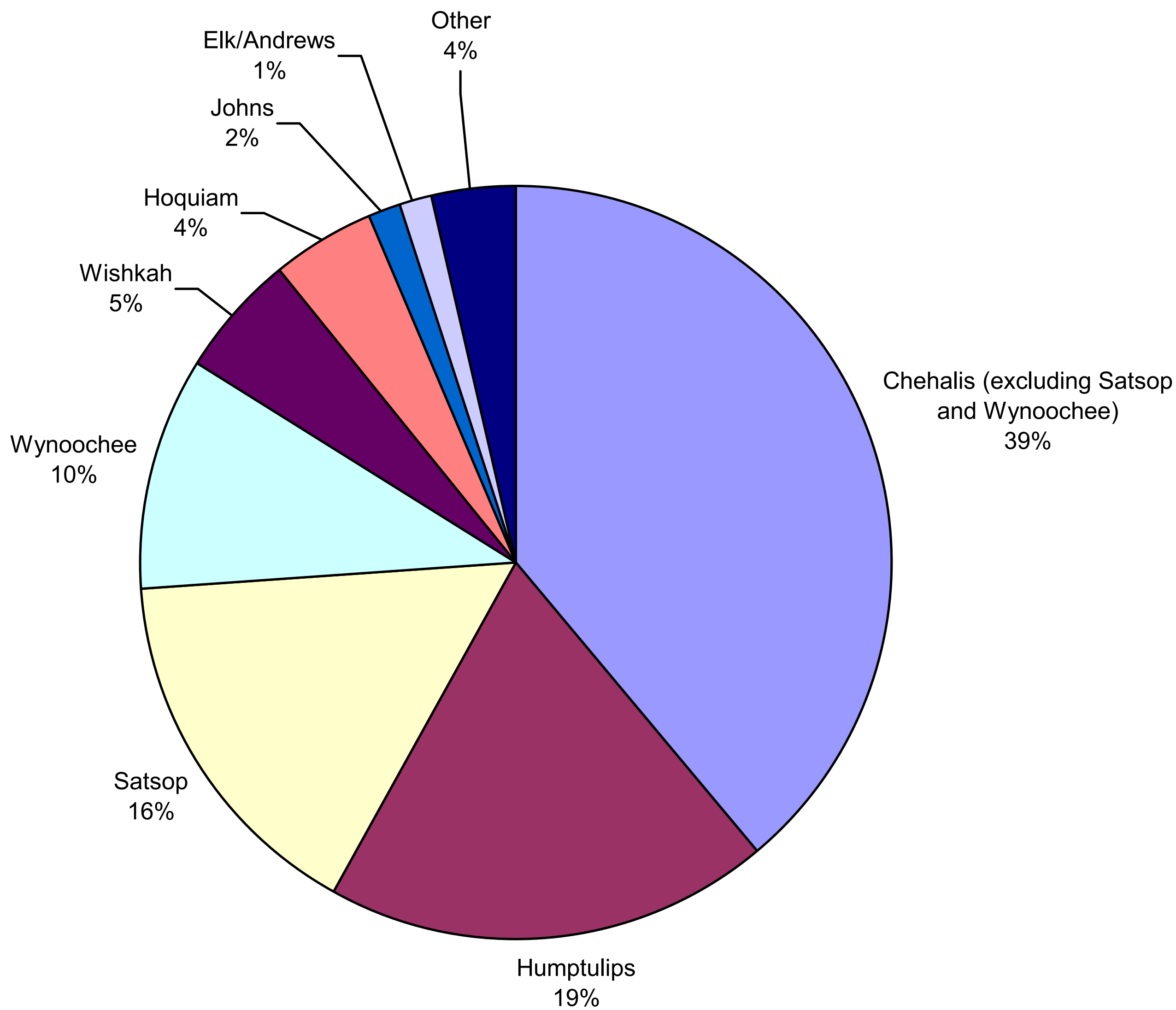


Figure 17. Monthly and annual average flows in the Chehalis River at Porter during the study year (5/1/97 - 4/30/98) compared with averages for water years 1953-1998.

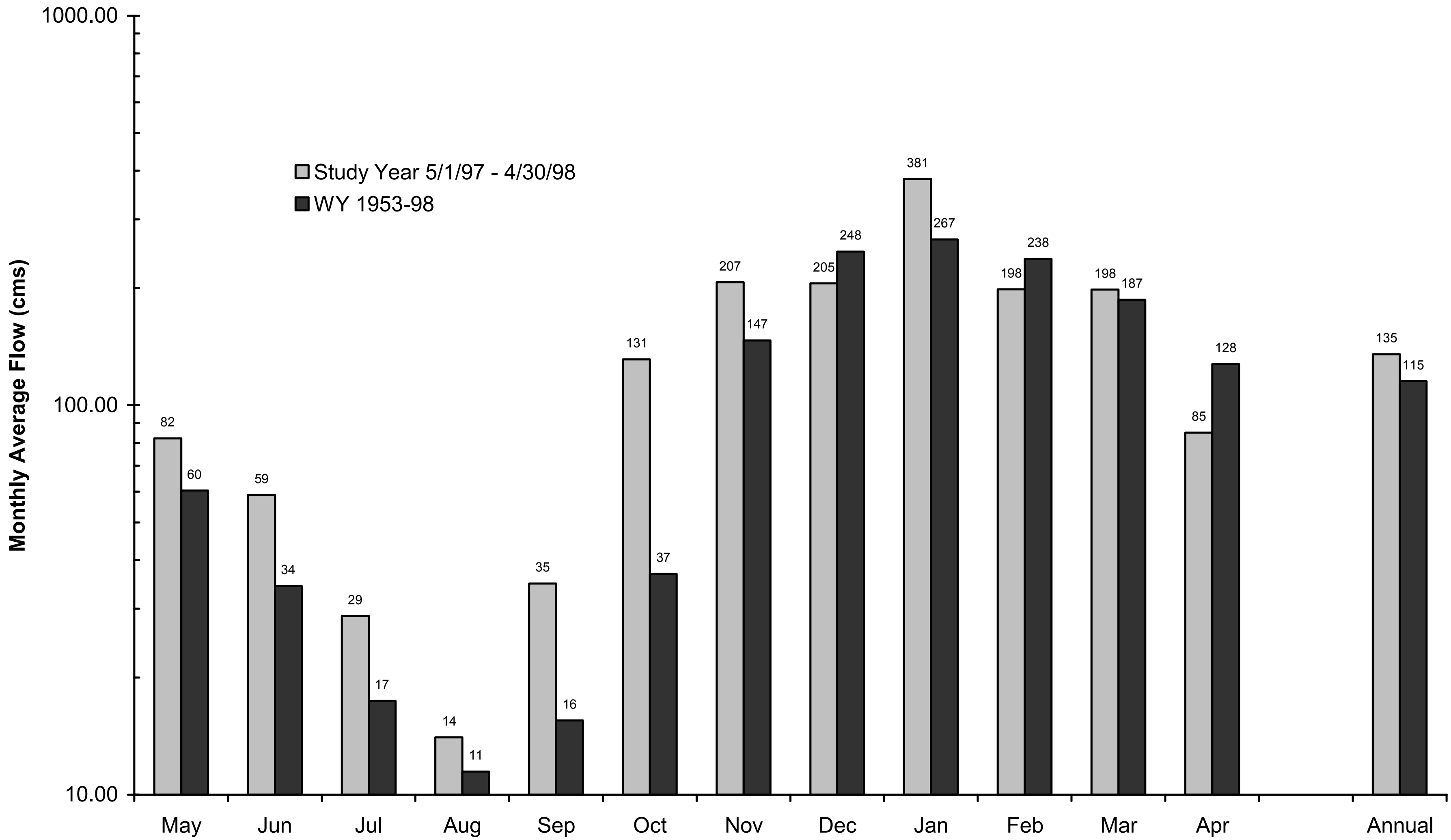


**Figure 18. Daily loading of fecal coliform to Grays Harbor, 5/1/97 - 4/30/98.**

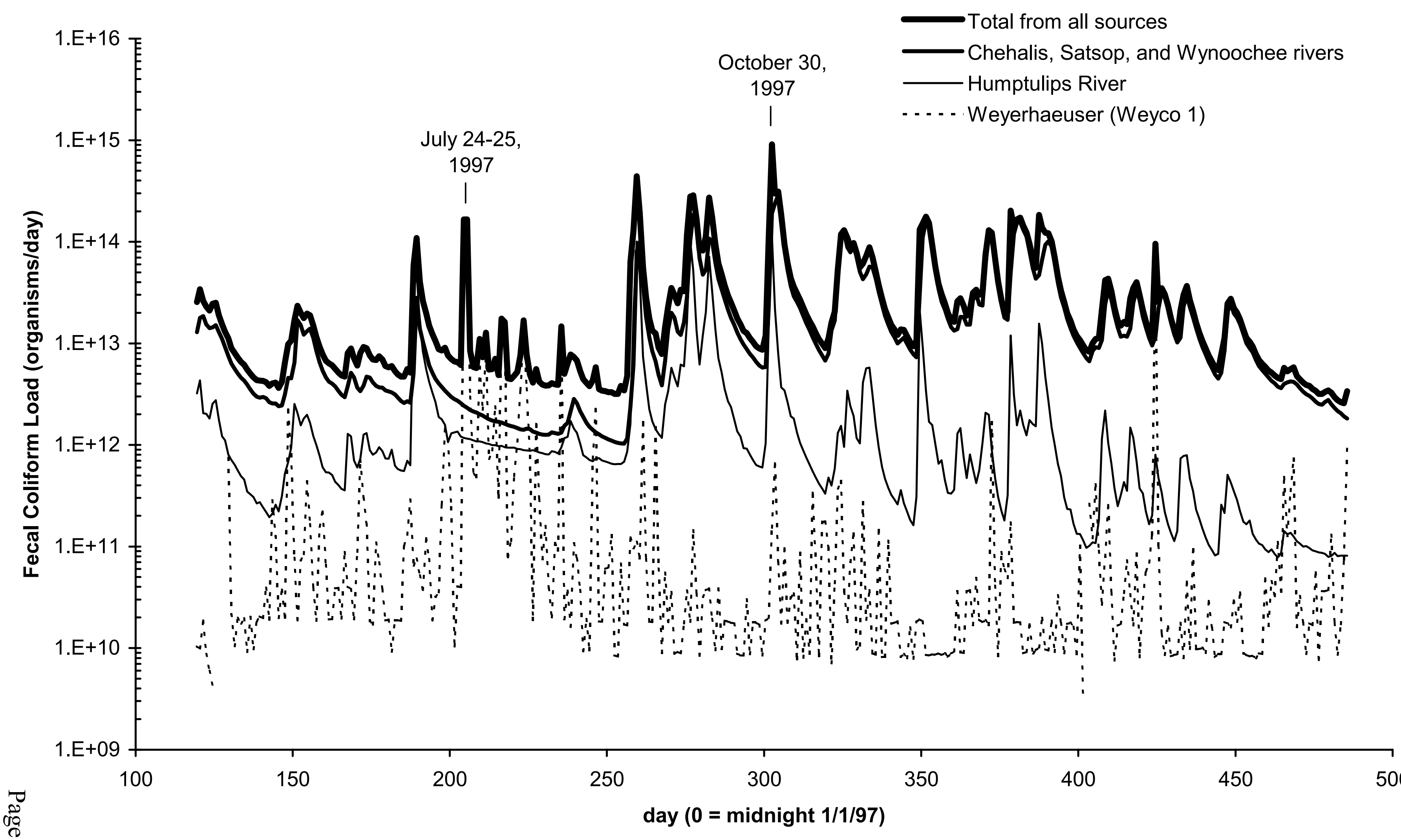
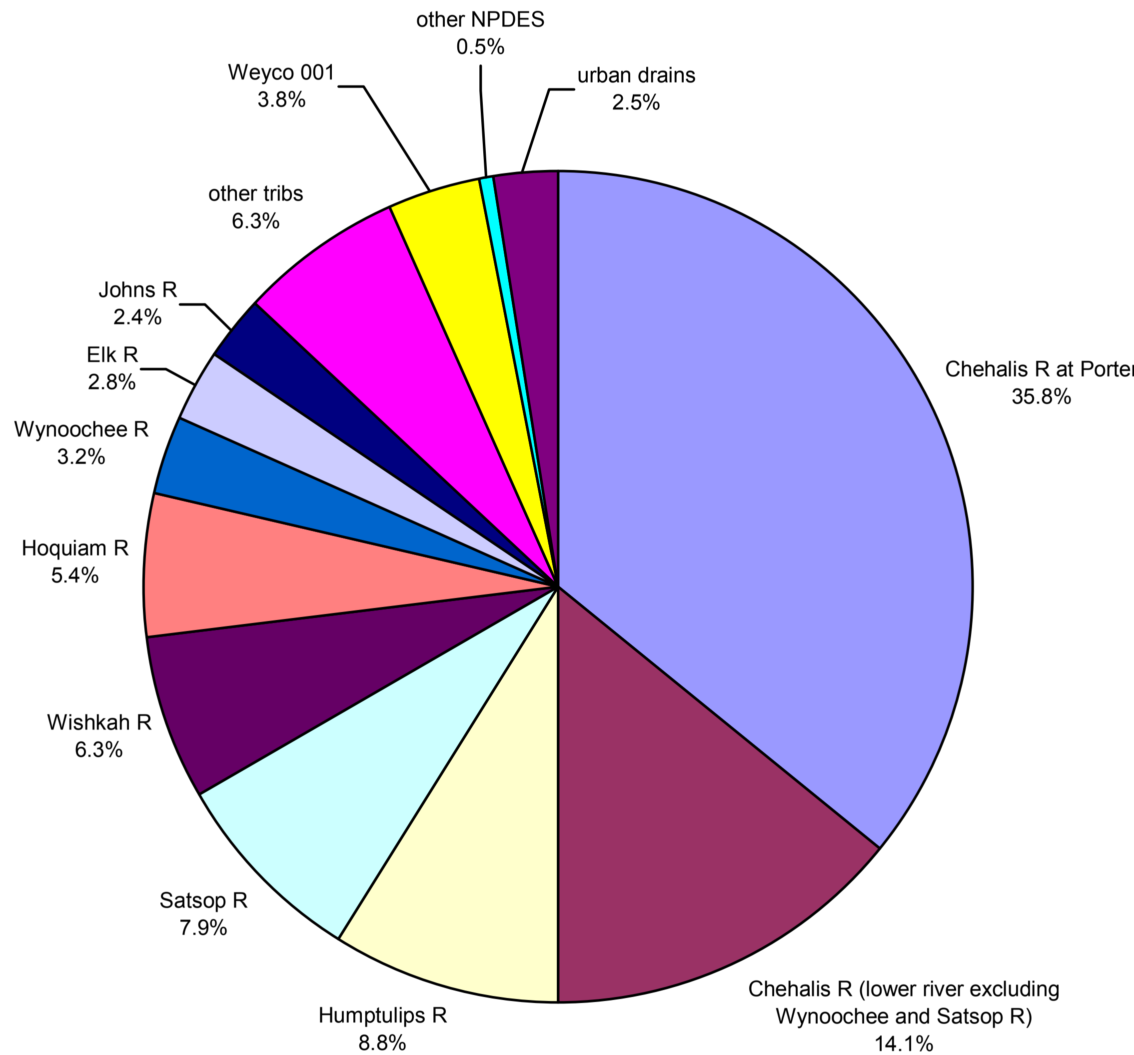


**Figure 19. Total loads of fecal coliform to Grays Harbor, 5/1/97 - 4/30/98. The total load from all sources was 1.36e16 organisms per year.**



Point sources and urban drains typically accounted for a relatively minor portion of the total load of fecal coliform. The daily discharge from the Weyerhaeuser Cosmopolis Outfall 1 (Weyco 1) accounted for almost 4 percent of the total load for the study year. However, the load from Weyco 1 sometimes exceeded the combined loading from all other sources. During the times when the Weyco 1 discharge was in compliance with its permit, it represented a relatively minor contribution of loading compared with other sources. However, on three days during the study year the fecal coliform concentration in the Weyco 1 effluent exceeded its permit limit of 20,000 organisms per 100 ml. The highest loading event from Weyco 1 occurred on July 24 and 25, 1997, when the loading from Weyco 1 accounted for more than 95 percent of the total load from all sources.

The time-series of daily loading (Figure 18) is punctuated by many peaks that occurred in response to rainfall events. The highest daily loading of fecal coliform occurred on October 30, 1997. This loading event was caused mainly by increases in nonpoint sources during a relatively large storm. This event will be discussed in more detail later in this report.

## Water Quality Standards Comparison

### Freshwater

Large reductions in fecal coliform concentrations are needed to meet water quality standards for tributaries to Grays Harbor (Table 6, Figure 20). With the exception of the Wynoochee River, all tributaries discharging to Grays Harbor and the lower Chehalis River require some reduction in loading of fecal coliform to meet freshwater quality standards. The total reduction in loading needed to meet freshwater standards for all sources combined is approximately $7.4 \times 10^{15}$ colonies/year, which is an average of about a 57 percent reduction of the current total loading from tributaries (Table 6).

The geometric means and $90^{th}$ percentiles of fecal coliform were estimated based on monthly summaries of estimated daily concentrations from the regression analysis described above. Therefore, short-term events of high fecal coliform concentrations associated with runoff are probably reflected in these estimates, because the regression analysis accounts for variability that occurs with changes in flow as well as season.

Fecal coliform concentrations in the Chehalis River at Porter, which is the largest loading source to the Grays Harbor system, was examined by three methods (Table 6):

- Monthly summaries of estimated daily concentrations from the regression analysis described above.
- 5-sample running averages of 1997-1998 data estimated as an approximation of seasonal variability during the study year.
- Aggregating monthly data from the past 10 years of monitoring to consider inter-annual variability (Figure 21).

Table 6. Estimated percent reduction in fecal coliform needed in tributaries to Grays Harbor to meet freshwater standards. (The highest monthly geometric means and 90th percentiles were estimated for each station.)

| Tributaries | Geometric means (number/ 100ml) | 90th percentiles (number/ 100ml) | Fresh water quality classification according to WAC 173-201A | Percent reduction to meet the freshwater standard based on maximum month | Target maximum monthly geometric mean after rollback (colonies/ 100 ml) | Percentage of total load to Grays Harbor from all sources before rollback | Total fecal coliform load during 5/1/97 - 4/30/98 (colonies/yr) | Reduction needed to meet water quality standard (colonies/yr) | Load allocation to meet water quality standard (colonies/yr) |
|---|---|---|---|---|---|---|---|---|---|
| **Chehalis River (excluding Satsop and Wynoochee rivers)** | | | | | | 50.0% | | | |
| - regression estimates of conditions during the 1997-98 study year | 163 | 386 | A | 48% | 85 | | 6.79E+15 | 3.27E+15 | 3.52E+15 |
| - 5-sample running averages of 1997-98 data | 95 | 728 | A | 73% | 26 | | 6.79E+15 | 4.93E+15 | 1.87E+15 |
| - based on 1988-98 samples aggregated by month | 112 | 756 | A | 74% | 30 | | 6.79E+15 | 5.00E+15 | 1.80E+15 |
| **Other tributaries (1)** | | | | | | | | | |
| Humptulips River near mouth | 115 | 310 | A | 35% | 74 | 8.8% | 1.20E+15 | 4.27E+14 | 7.76E+14 |
| Satsop River | 134 | 282 | A | 29% | 95 | 7.9% | 1.08E+15 | 3.13E+14 | 7.65E+14 |
| Wishkah River near mouth | 262 | 374 | B | 24% | 200 | 6.3% | 8.60E+14 | 2.05E+14 | 6.56E+14 |
| Wishkah River near mouth (hypothetical class A) | 262 | 374 | A | 62% | 100 | -- | -- | -- | -- |
| Wishkah River above river mile 6 | 452 | 853 | A | 78% | 100 | -- | -- | -- | -- |
| Hoquiam River near mouth | 121 | 480 | B | 17% | 101 | 5.4% | 7.39E+14 | 1.23E+14 | 6.15E+14 |
| Hoquiam River near mouth (hypothetical class A) | 121 | 480 | B | 58% | 50 | -- | -- | -- | -- |
| West Fork Hoquiam River above river mile 9.3 (Dekay Riveroad) | 92 | 319 | A | 37% | 58 | -- | -- | -- | -- |
| East Fork Hoquiam River | 117 | 166 | A | 14% | 100 | -- | -- | -- | -- |
| Wynoochee River | 83 | 90 | A | 0% | 83 | 3.2% | 4.36E+14 | 0.00E+00 | 4.36E+14 |
| Elk River near mouth | 402 | 1029 | A | 81% | 78 | 2.8% | 3.82E+14 | 3.08E+14 | 7.42E+13 |
| Johns River near mouth | 150 | 412 | A | 51% | 73 | 2.4% | 3.29E+14 | 1.69E+14 | 1.60E+14 |
| Unnamed Central Park creek | 516 | 3200 | A | 94% | 32 | 1.2% | 1.64E+14 | 1.54E+14 | 1.02E+13 |
| Grass Creek | 60 | 606 | A | 67% | 20 | 0.70% | 9.56E+13 | 6.40E+13 | 3.15E+13 |
| Chenois Creek | 54 | 316 | A | 37% | 34 | 0.66% | 8.93E+13 | 3.28E+13 | 5.66E+13 |
| Newskah Creek | 97 | 279 | A | 28% | 69 | 0.54% | 7.39E+13 | 2.10E+13 | 5.29E+13 |
| Charlie Creek | 259 | 320 | A | 61% | 100 | 0.51% | 6.91E+13 | 4.25E+13 | 2.67E+13 |
| Andrews Creek near mouth | 134 | 797 | A | 75% | 34 | 0.43% | 5.78E+13 | 4.33E+13 | 1.45E+13 |
| Elliot Slough | 136 | 261 | A | 27% | 100 | 0.33% | 4.44E+13 | 1.18E+13 | 3.25E+13 |
| Barlow Creek | 339 | 974 | A | 79% | 70 | 0.33% | 4.43E+13 | 3.52E+13 | 9.10E+12 |
| Grayland Ditch | 348 | 425 | A | 71% | 100 | 0.32% | 4.31E+13 | 3.07E+13 | 1.24E+13 |
| Oleary Creek | 302 | 633 | A | 68% | 95 | 0.28% | 3.80E+13 | 2.60E+13 | 1.20E+13 |
| Indian Creek | 154 | 897 | A | 78% | 34 | 0.28% | 3.78E+13 | 2.94E+13 | 8.43E+12 |
| Redman Slough | 950 | 964 | A | 89% | 100 | 0.13% | 1.76E+13 | 1.58E+13 | 1.86E+12 |
| Stafford Creek | 339 | 681 | A | 71% | 99 | 0.13% | 1.75E+13 | 1.23E+13 | 5.12E+12 |
| Chapin Creek | 108 | 432 | A | 54% | 50 | 0.10% | 1.42E+13 | 7.63E+12 | 6.58E+12 |
| Campbell Creek | 134 | 581 | A | 66% | 46 | 0.09% | 1.25E+13 | 8.23E+12 | 4.32E+12 |
| Unnamed Westport creek | 1310 | 1335 | A | 92% | 100 | 0.09% | 1.22E+13 | 1.13E+13 | 9.30E+11 |
| Dempsey Creek | 123 | 423 | A | 53% | 58 | 0.05% | 6.15E+12 | 3.24E+12 | 2.91E+12 |
| Other small tributaries | -- | -- | -- | -- | -- | 0.11% | 1.56E+13 | -- | 1.56E+13 |
| **Urban Drains (2)** | 692 | 9103 | | 98% | 15 | 2.5% | 3.40E+14 | 3.33E+14 | 7.48E+12 |
| **Total** | | | | 57% | | | 1.30E+16 | 7.42E+15 | 5.59E+15 |

1) Maximum of 30-day geometric means and 90th percentiles of regression estimates of daily concentrations from 5/1/97 - 4/30/98.

2) Based on geometric means and upper 90th percentiles of all samples during the study from 11 urban drains in the Aberdeen-Hoquiam-Cosmopolis areas. Load allocations were extrapolated to also include urban drains of unsampled developed areas.

**Figure 20. Reduction in fecal coliform loading needed for tributaries to meet water quality standards.**

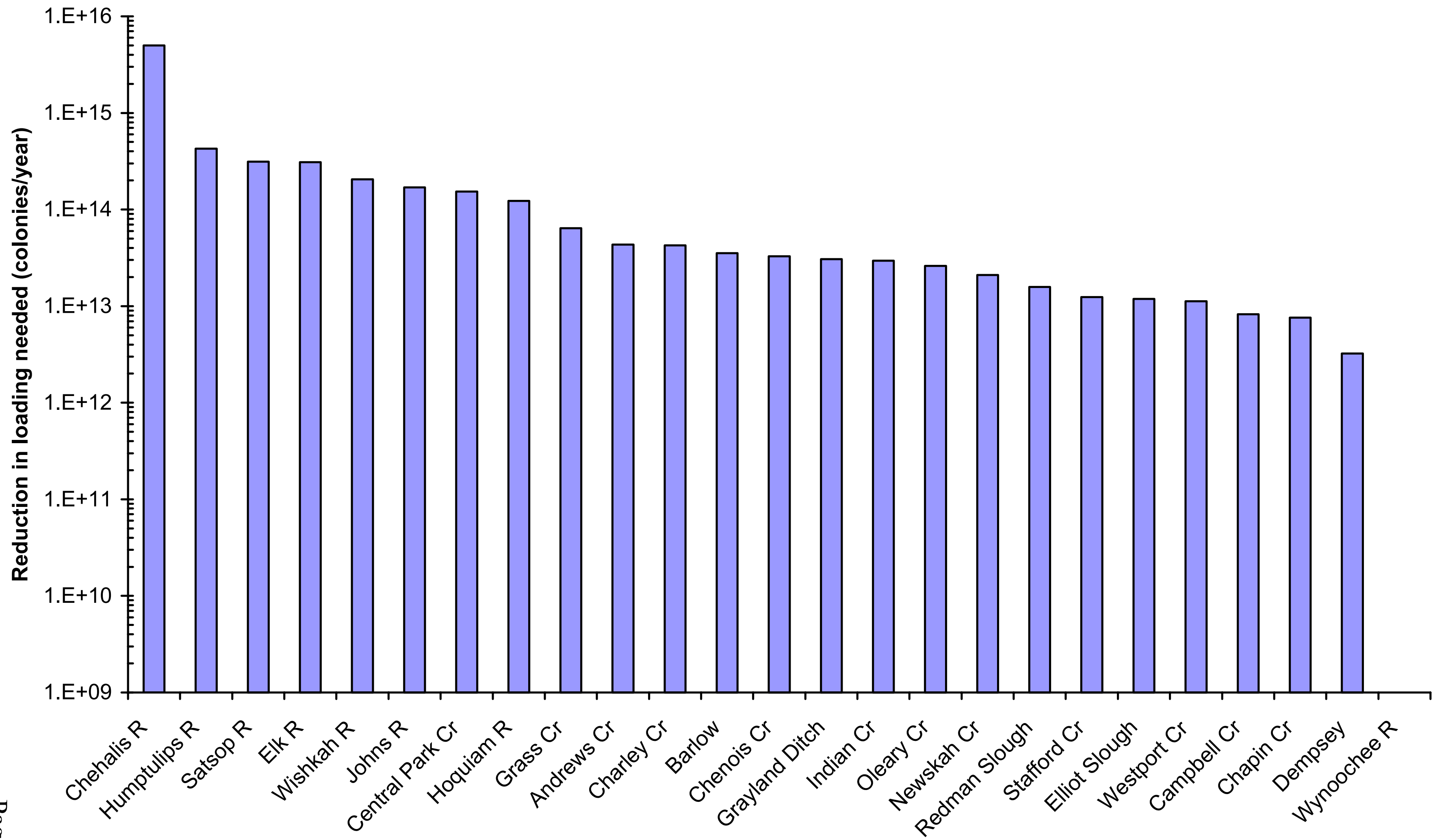


**Figure 21a. Monthly geometric means and 90th percentiles of fecal coliform in the Chehalis R at Porter, 1988-98.**

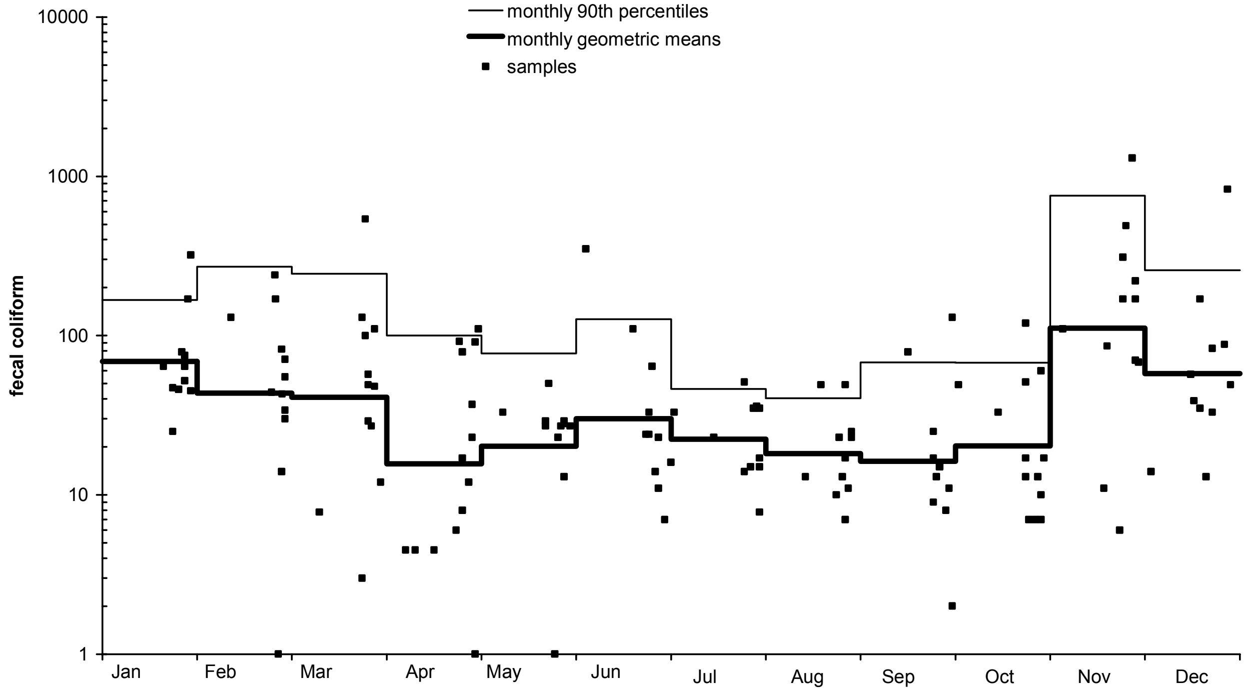
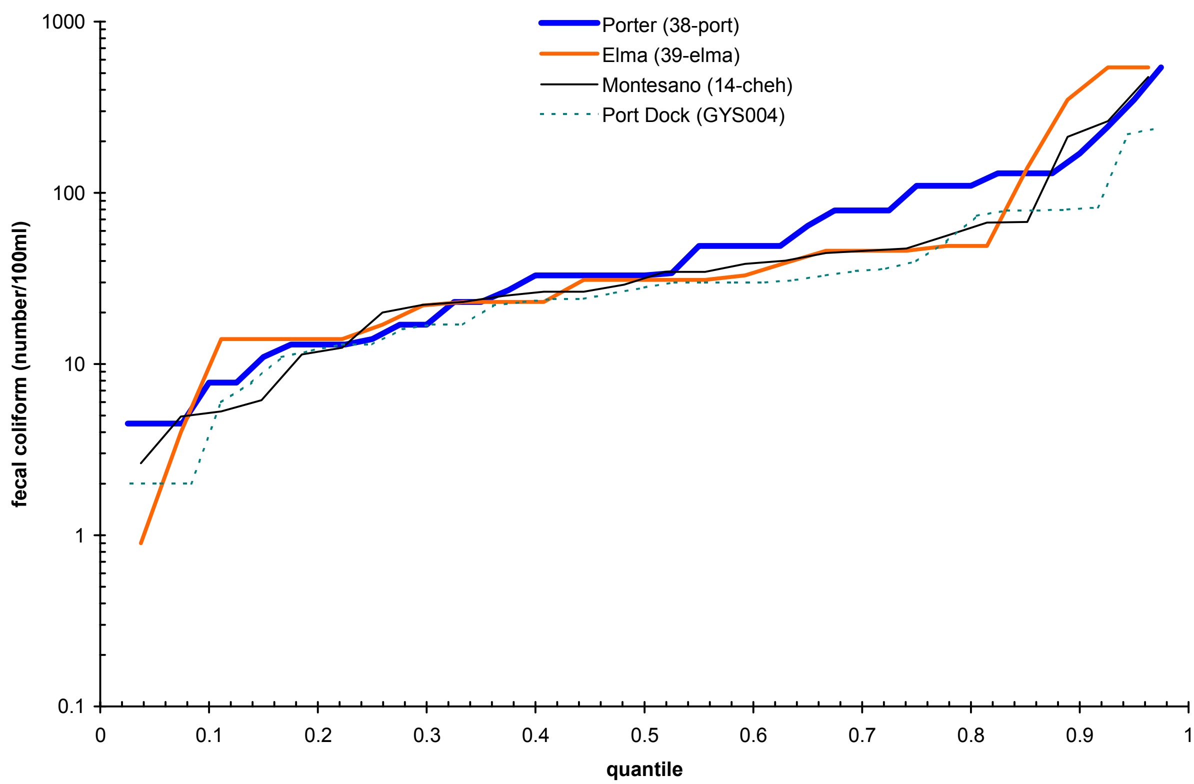



**Figure 21b. Fecal coliform distributions at various locations in the Chehalis River during 5/1/97 - 4/30/98.**



These additional methods were examined for the Chehalis River because of the relatively large (1) amount of data that was available and (2) importance of loading compared with the other tributaries. The analyses of seasonal variability during the study year (5-sample running averages) and long-term conditions for the Chehalis River (Table 6) suggest that a greater reduction in loading (74 percent reduction) may be needed for this source, compared with regression estimates of loads during the study year (48 percent reduction needed to meet freshwater class A standards). The concentration of fecal coliform at Porter was generally equal to or higher than concentrations downstream from Porter (Figure 21). Therefore, reductions in concentrations of fecal coliform that are needed to meet water quality standards in the Chehalis River at Porter are a reasonably safe indicator of the amount of reduction that is also needed in the un-monitored downstream areas of the Chehalis River watershed.

## Marine water

The sampling scheme for Ecology routine ambient monitoring of fecal coliform in marine waters is not optimal for detecting potentially high concentrations that can occur during runoff events (Newton et al., 1998). Ecology generally uses the ambient monitoring data as an indicator of potential chronic contamination, and recognizes that open waters are under-sampled with respect to the probability of identifying short-term episodic events of contamination. Newton et al. (1998) has reported that very high counts of fecal coliform bacteria are recorded year-round in Grays Harbor.

In Chapter 173-201A-060(3) WAC, the state water quality standards say:

*"In determining compliance with the fecal coliform criteria in WAC 173-201A-030, averaging of data collected beyond a thirty-day period, or beyond a specific discharge event under investigation, shall not be permitted when such averaging would skew the data set so as to mask non-compliance periods."*

It is likely that annual or seasonal averaging of the ambient data may mask non-compliance with the standards, since (1) a typical storm event or upset event from point sources is usually less than a week in duration, and (2) it would skew the results and possibly mask non-compliance to extend the averaging period significantly beyond the length of a discharge event. However, the data were summarized using annual and seasonal aggregation to provide a general description of spatial and seasonal trends, with the understanding that exceedence of the water quality standards may have occurred even if exceedence was not detected by such averaging.

The measured concentrations of fecal coliform at stations in Grays Harbor were examined two ways to compare with the marine standard for a geometric mean and 90$^{th}$ percentile (Table 7):

- All samples for the study year (May 1997–April 1998) were aggregated for calculation of an annual geometric mean and 90$^{th}$ percentile.
- Samples from the wet season, October 1997–January 1998, were aggregated for calculation of a seasonal geometric mean and 90$^{th}$ percentile.

Table 7. Comparison of annual and wet season geometric means and 90th percentiles of fecal coliform (number/100ml) at marine stations with marine criteria.

| Station | Marine water quality class in WAC 173-201A | May 1997 through April 1998 (entire study year) | | | | Oct. 1997 through Jan. 1998 (wet season) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | geometric mean (number/ 100ml) | 90th percentile (number/ 100ml) | percent of samples >90%tile criterion | total number of samples | geometric mean (number/ 100ml) | 90th percentile (number/1 00ml) | percent of samples >90%tile criterion | total number of samples |
| **Dept of Health stations** | | | | | | | | | |
| 01-DOH | A | 6.8 | 21 | | 12 | 5.0 | 12 | | 4 |
| 02-DOH | A | 2.5 | 6.5 | | 12 | 3.6 | 18 | | 4 |
| 03-DOH | A | 2.2 | 3.8 | | 12 | 2.3 | 4.1 | | 4 |
| 05-DOH | A | 5.7 | 31 | | 11 | 7.3 | 43 | | 3 |
| 06-DOH | A | 1.9 | 2.0 | | 6 | 1.8 | 1.8 | | 2 |
| 07-DOH | A | 2.4 | 4.6 | | 6 | 3.7 | 11 | | 2 |
| 08-DOH | A | 3.9 | 20 | | 6 | 9.9 | **180** | **50%** | **2** |
| 09-DOH | A | 1.8 | 1.8 | | 12 | 1.8 | 1.8 | | 4 |
| 11-DOH | A | 2.3 | 3.9 | | 11 | 2.2 | 3.7 | | 4 |
| 15-DOH | A | 2.7 | 7.0 | | 12 | 3.4 | 8.2 | | 4 |
| 17-DOH | A | 3.1 | 6.8 | | 12 | 3.4 | 8.2 | | 4 |
| 21-DOH | A | 2.3 | 3.9 | | 12 | 2.4 | 4.1 | | 4 |
| 22-DOH | A | 3.9 | 12 | | 12 | 7.6 | 17 | | 4 |
| 23-DOH | A | 4.1 | 12 | | 12 | 3.7 | 11 | | 4 |
| 24-DOH | A | 7.2 | 31 | | 12 | 6.6 | 19 | | 4 |
| 25-DOH | A | 3.9 | 10 | | 11 | 4.1 | 9.9 | | 3 |
| 26-DOH | A | 3.5 | 11 | | 11 | 5.2 | 22 | | 3 |
| 30-DOH | A | 2.6 | 5.1 | | 12 | 4.1 | 8.9 | | 4 |
| 44-DOH | A | 2.8 | 9.5 | | 12 | 2.3 | 3.7 | | 4 |
| 46-DOH | A | 1.9 | 2.0 | | 6 | 1.9 | 2.1 | | 2 |
| 51-DOH | A | 2.0 | 2.7 | | 12 | 2.4 | 3.7 | | 4 |
| 52-DOH | A | **15** | **75** | **25%** | **12** | 11.1 | 33 | | 4 |
| 54-DOH | A | 8.0 | 37 | | 24 | 9.1 | 25 | | 8 |
| 55-DOH | A | **17** | **160** | **25%** | **12** | **20** | **65** | **25%** | **4** |
| 56-DOH | A | **31** | **230** | **36%** | **11** | **24** | **72** | **25%** | **4** |
| 57-DOH | A | 2.5 | 5.3 | | 12 | 2.3 | 4.1 | | 4 |
| 59-DOH | A | 4.9 | 27 | | 12 | 10 | 41 | | 4 |
| 60-DOH | A | 4.5 | 24 | | 12 | 4.5 | 10 | | 4 |
| 61-DOH | A | **49** | **340** | **42%** | **12** | **21** | 41 | | 4 |
| GHPRD | A | 6.2 | 29 | | 11 | -- | -- | | -- |
| **Dept of Ecology stations** | | | | | | | | | |
| GYS004 | B | **22** | **99** | | **19** | **21** | 31 | | 3 |
| GYS008 | B | 7.4 | 31 | | 20 | 10 | **58** | | **3** |
| GYS009 | B | 6.4 | 22 | | 17 | **20** | **127** | | **3** |
| GYS015 | A | 2.3 | 10 | | 17 | 13 | **350** | **50%** | **2** |
| GYS016 | A | 1.8 | 5.0 | | 16 | 3.9 | **56** | **0%** | **2** |
| GYS017 | B | **32** | **100** | | **10** | **18** | **110** | | **2** |
| GYS018 | B | 4.7 | 28 | | 10 | 8.1 | **100** | | **2** |
| GYS019 | A | 3.8 | 22 | | 9 | 8.1 | **100** | **0%** | **2** |
| GYS685 | B | **19** | **61** | | **10** | -- | -- | | -- |

Shaded values indicate exceedence of the standards at each location, whether class A or B.

**Bold** values without shading indicate exceedence of marine class A criteria in areas that are designated class B, which is not a violation of standards, but is meant to suggest areas where concentrations are relatively high.

The estimated 90th percentiles are based on a log-normal distribution.

Both of these methods of aggregating data are expected to underestimate the potential of episodic high concentrations within time scales ranging from several days to several weeks. However, these comparisons can be used as an indicator of potential problems, provided there is recognition that actual concentrations at smaller time scales are likely to be worse than the aggregated estimates. Therefore, exceedence of criteria in these aggregated periods may be an indicator that actual conditions were even more severe, and conformance with criteria in the aggregated periods does not conclusively indicate that criteria were being met at smaller time scales.

The annual and seasonal comparison with water quality standards (Table 7) shows that concentrations of fecal coliform exceed marine criteria at several locations in Grays Harbor. Typical concentrations in the inner harbor and the inner south region exceed the criteria whether aggregated annually or seasonally. Ecology stations generally show higher concentrations when data are aggregated over the wet season instead of annually.

Concentrations at locations that are designated as marine class B (the inner harbor) frequently exceed the criteria for class A waters. Although no stations were observed to exceed the class B standard, data from stations near the transition line between class B and class A designations suggest that some regions designated class A probably exceed criteria because of relatively high concentrations in adjoining regions designated class B.

# Hydrodynamic and Water Quality Modeling

## Hydrodynamic calibration

Calibration of the hydrodynamic model of Grays Harbor involved the following elements:

- Specification of the bathymetry and geometry of the model network.
- Specification of freshwater inflows at daily intervals.
- Specification of tides at the seaward boundary at the entrance to Grays Harbor at hourly intervals.
- Adjustment of the bottom friction coefficients to match predicted tides.
- Matching of predicted and observed salinity with minor adjustments to model geometry.

The electronic files for the final calibration input files and a DOS executable version of the model are available as described in Appendices C and D.

The bathymetry and geometry were estimated from available data from National Oceanic and Atmospheric Administration (NOAA) and the U.S. Army Corps of Engineers (ACOE). The NOAA data included the nautical chart (NOAA chart number 18502) as well as digital bathymetry data. ACOE provided digital bathymetry data of current conditions from their dredged navigation projects. A Cartesian grid of digital bathymetry was estimated using the Arcview Geographic Information System (GIS) by merging the more recent ACOE data over the more widespread NOAA digital and chart data.

Daily freshwater inflows from all tributaries to Grays Harbor were estimated as explained in other sections of this report (Appendix B). The freshwater tributaries were distributed to 25 locations in the model network (flow boundary nodes) to accurately describe spatial variability of inflows.

Tides at the seaward boundary and interior locations in Grays Harbor were estimated based on predicted hourly tides from NOAA data as implemented in Nautical Software (1996). The hydrodynamic model calibration was checked by comparing predicted tides from the model with predicted tides from the NOAA predictions.

Figure 22 presents the comparison of the hydrodynamic model and NOAA tide predictions. The hydrodynamic model did an excellent job of reproducing the NOAA predictions at Aberdeen and Montesano. The predicted tidal record was also analyzed to extract the various sinusoidal components (Duxbury, 1971). Tidal components or constituents are harmonic elements in a mathematical expression for the tide-producing force and in corresponding formulas for the tide or tidal current. Each constituent represents a periodic change or variation in the relative positions of the earth, moon, and sun. The amplitude of the constituent is a measure of its relative importance. The phase is a measure of the recurrence of the constituent relative to a specific origin. For example, the principal lunar component (M2) typically accounts for most of the variation in tides, followed by the principal solar semi-diurnal constituent (S2), but several other semi-diurnal and diurnal components are superimposed. Figure 23 shows the comparison of seven tidal constituents from the hydrodynamic model with the NOAA predictions. In general, there was excellent agreement between the hydrodynamic model and the NOAA predictions.

The hydrodynamic model was run for the continuous simulation of tidally dynamic conditions for May 1997–April 1998 (study year) using a time step of 30 seconds. Figures 24 through 29 present a comparison of predicted and observed salinity from throughout the harbor. The salinity measurements were made at approximately monthly intervals, in contrast to the much more frequent predictions of the hydrodynamic model (30-second time step). The predicted salinity matched the observed salinity reasonably well throughout the harbor, including representation of variations within the tidal cycles (e.g., the first month of simulation is shown in Figure 24) and seasonal variability (the entire period of the simulation is shown in Figures 25 through 30). The inner south region (segment 81) was the most difficult area for calibration of salinity, possibly because of the shallowness and confinement of this area and the relatively high variability due to the freshwater sources, but the predicted salinity was not significantly different from observed salinity in this region.

Initial predictions of depth-averaged salinity were based on a suggested typical salinity by Duxbury (1979) of about 32.5 parts per thousand (ppt) in nearshore coastal waters. The corresponding predictions of depth-averaged salinity within Grays Harbor were, on average, approximately 7.9 percent greater than the observed surface salinity according to a paired-sample t-test. The mean difference between paired samples of observed and predicted salinity was only 1.3 +/- 4.7 parts per thousand. This difference between predicted and observed salinity is reasonably small, and could be a result of uncertainty in the estimated salinity at the seaward

Figure 22a. Comparison of model and NOAA tide predictions for Aberdeen mid-March through mid-April, 1997 (node 34, run 4)

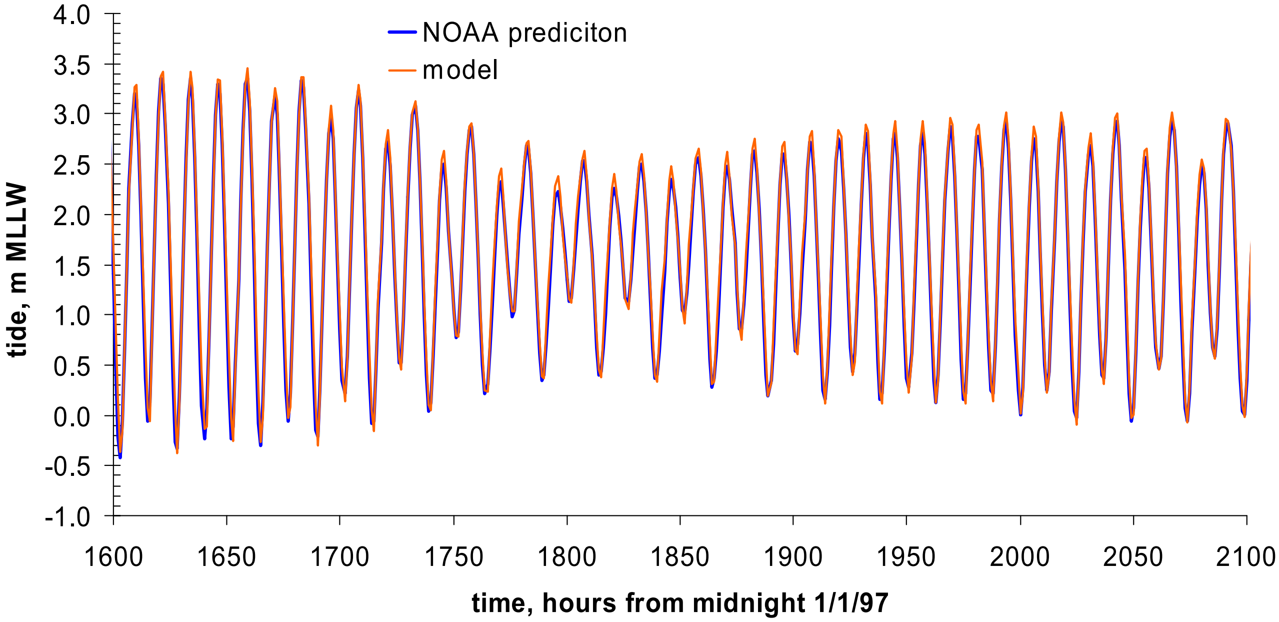



Figure 22b. Comparison of model and NOAA tide predictions for Montesano mid-March through mid-April, 1997, Chehalis R (node 64, run 9)

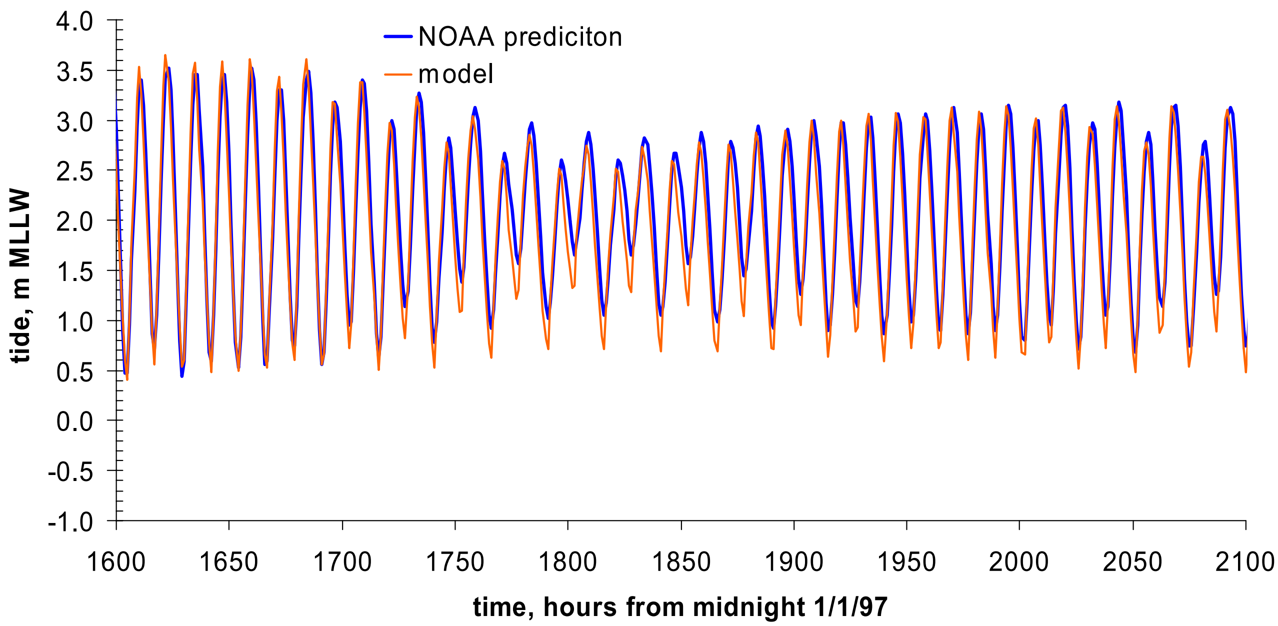


Figure 23a. Comparison of tidal constituents for NOAA's tide predictions with WDWBM predictions for Aberdeen.

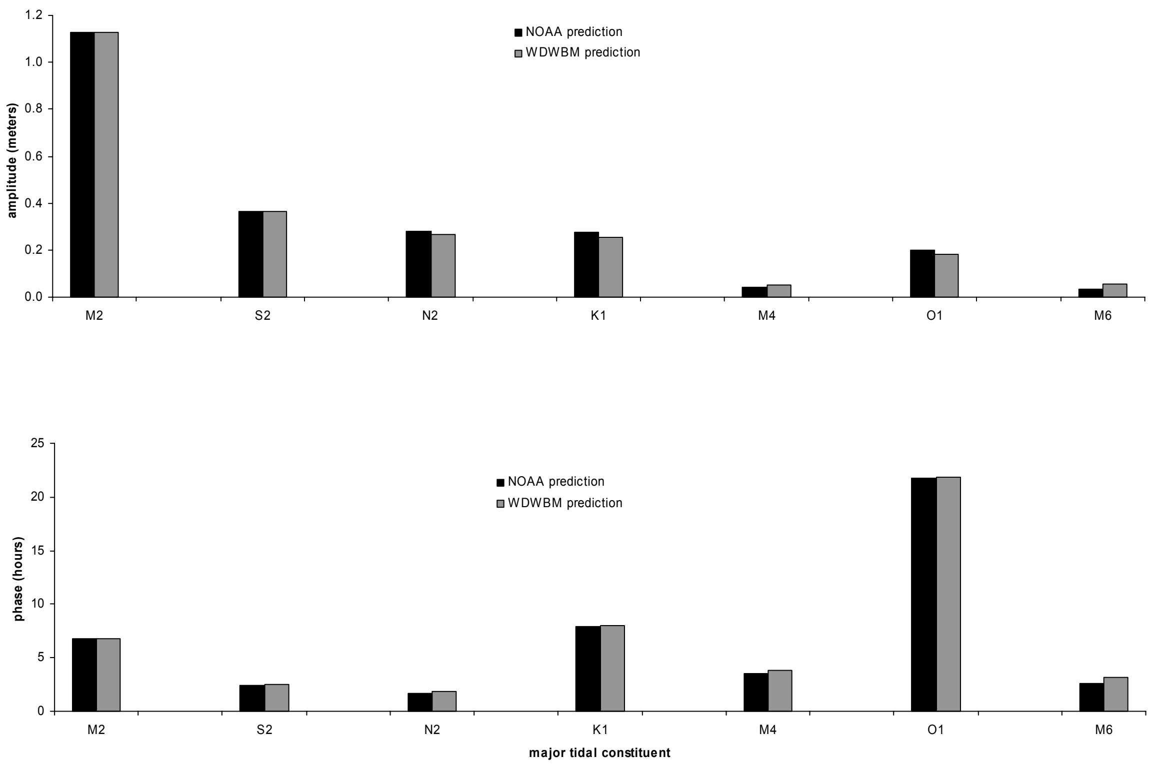



Figure 23b. Comparison of tidal constituents for NOAA's tide predictions with WDWBM predictions for Montesano.

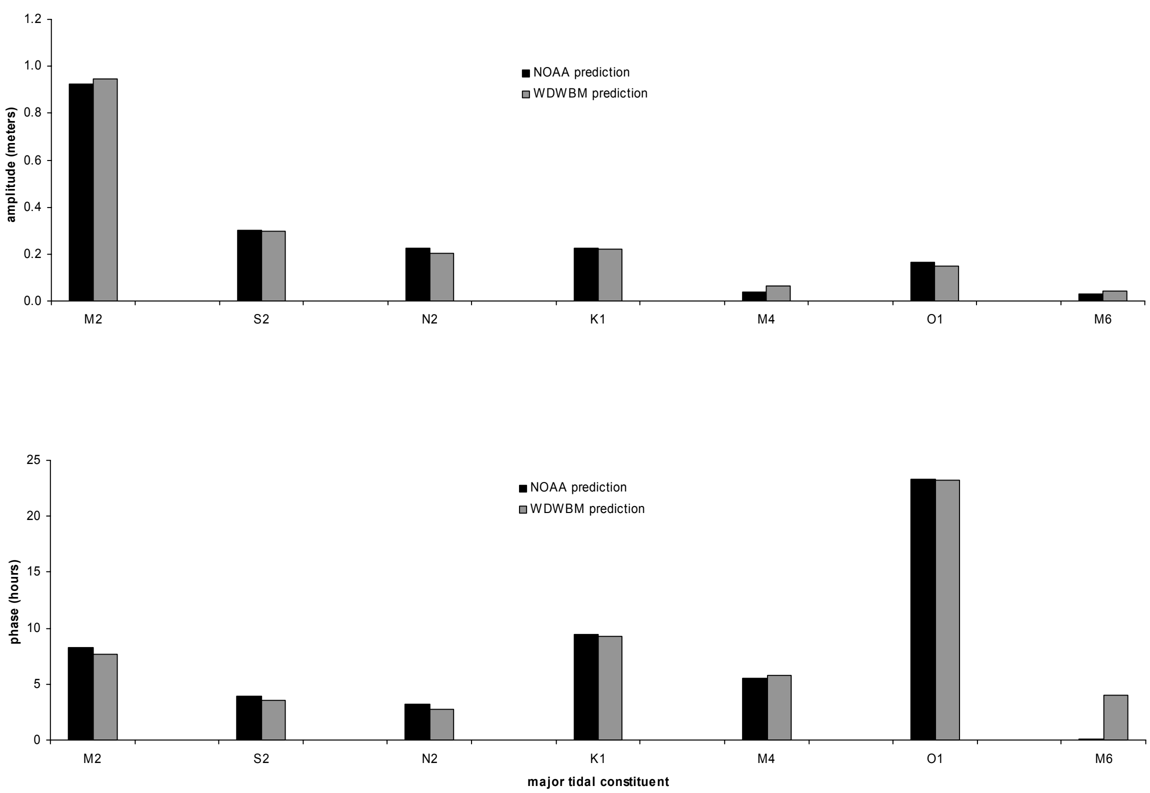


Figure 24. Comparison of predicted and observed salinity at WASP segment 8 during May 1997.

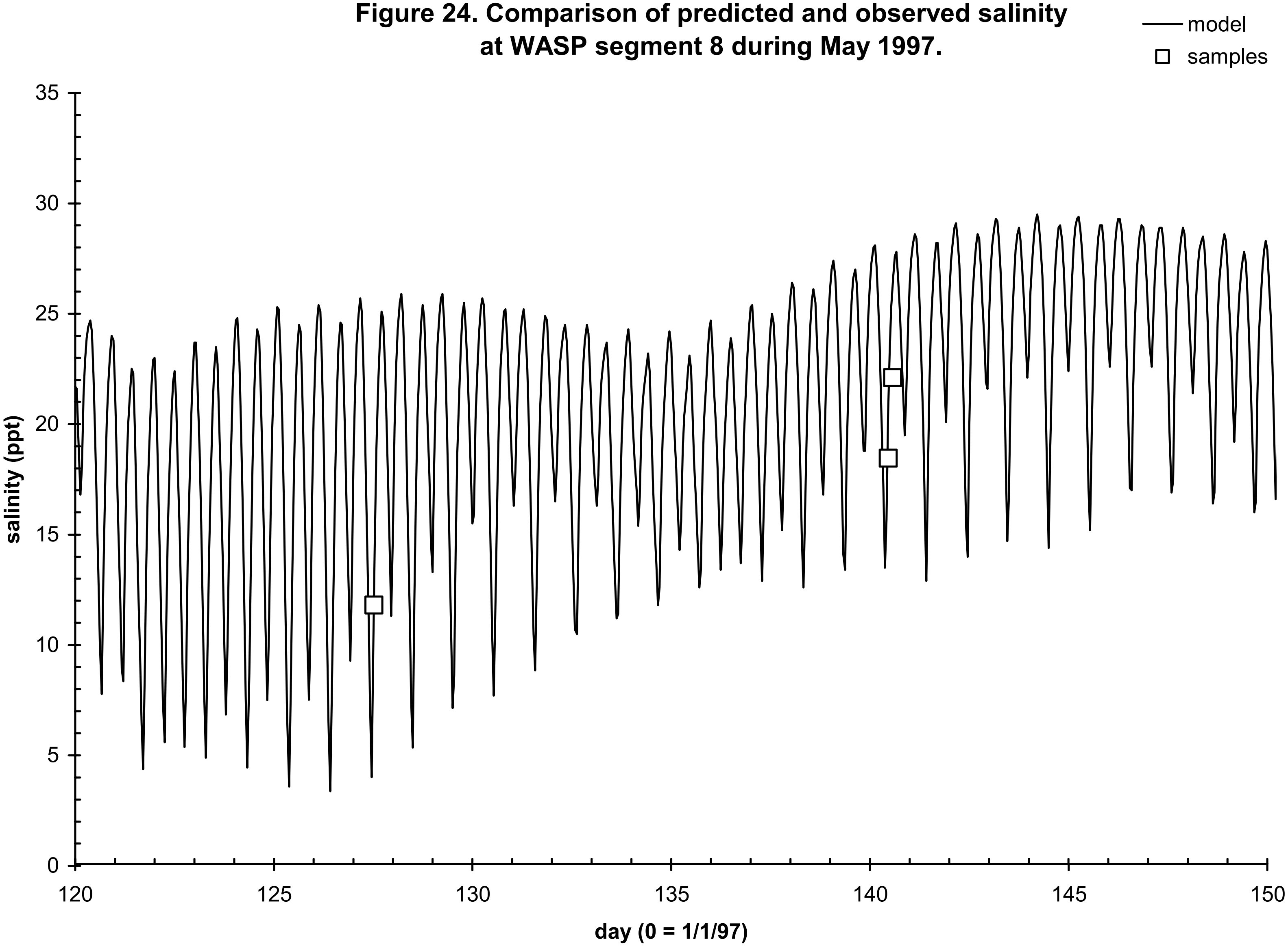


**Figure 25. Comparison of predicted and observed salinity at WASP segment 8 from 5/1/97 - 4/30/98.**

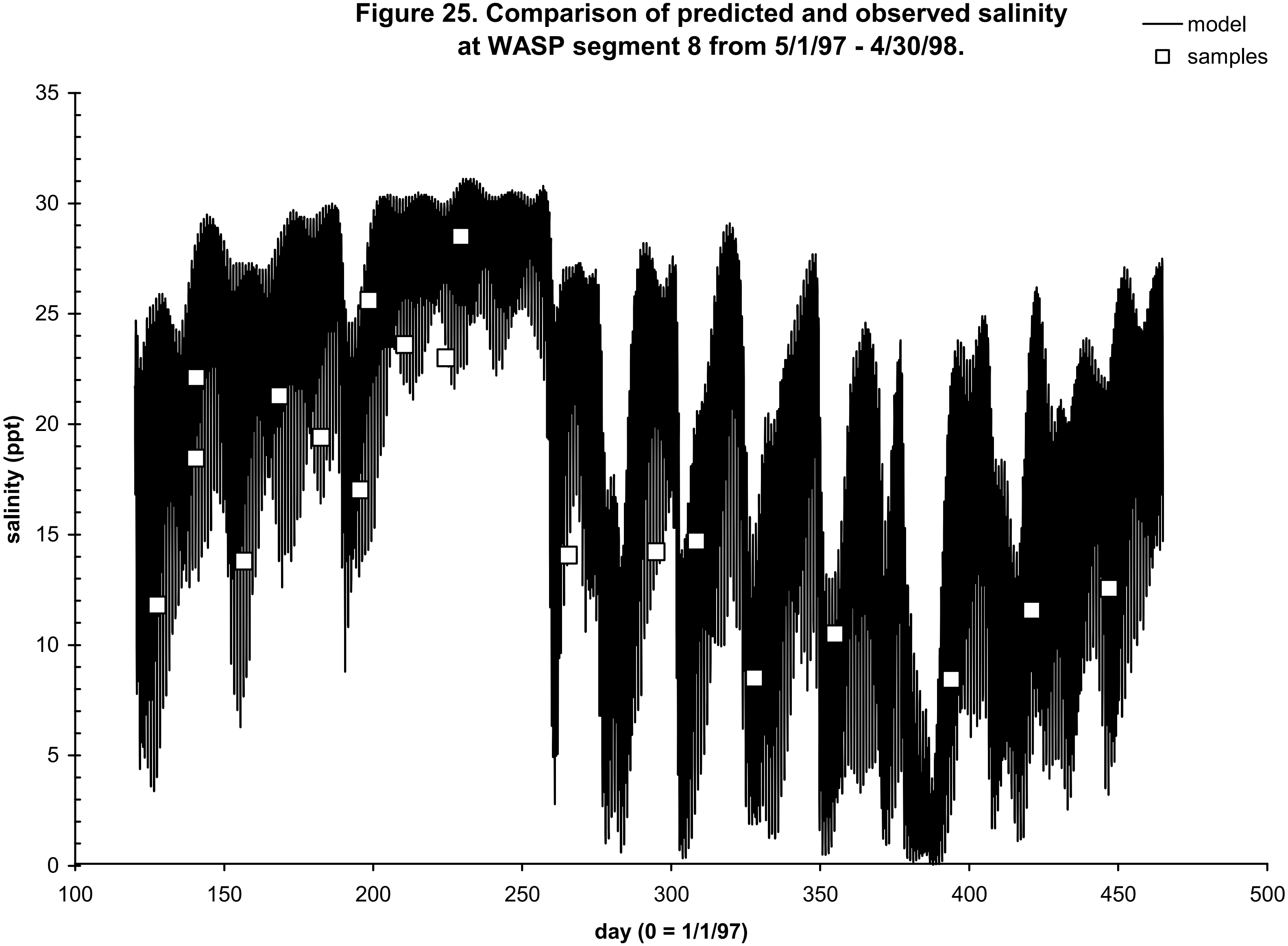


**Figure 26. Comparison of predicted and observed salinity at WASP segment 15 from 5/1/97 - 4/30/98.**

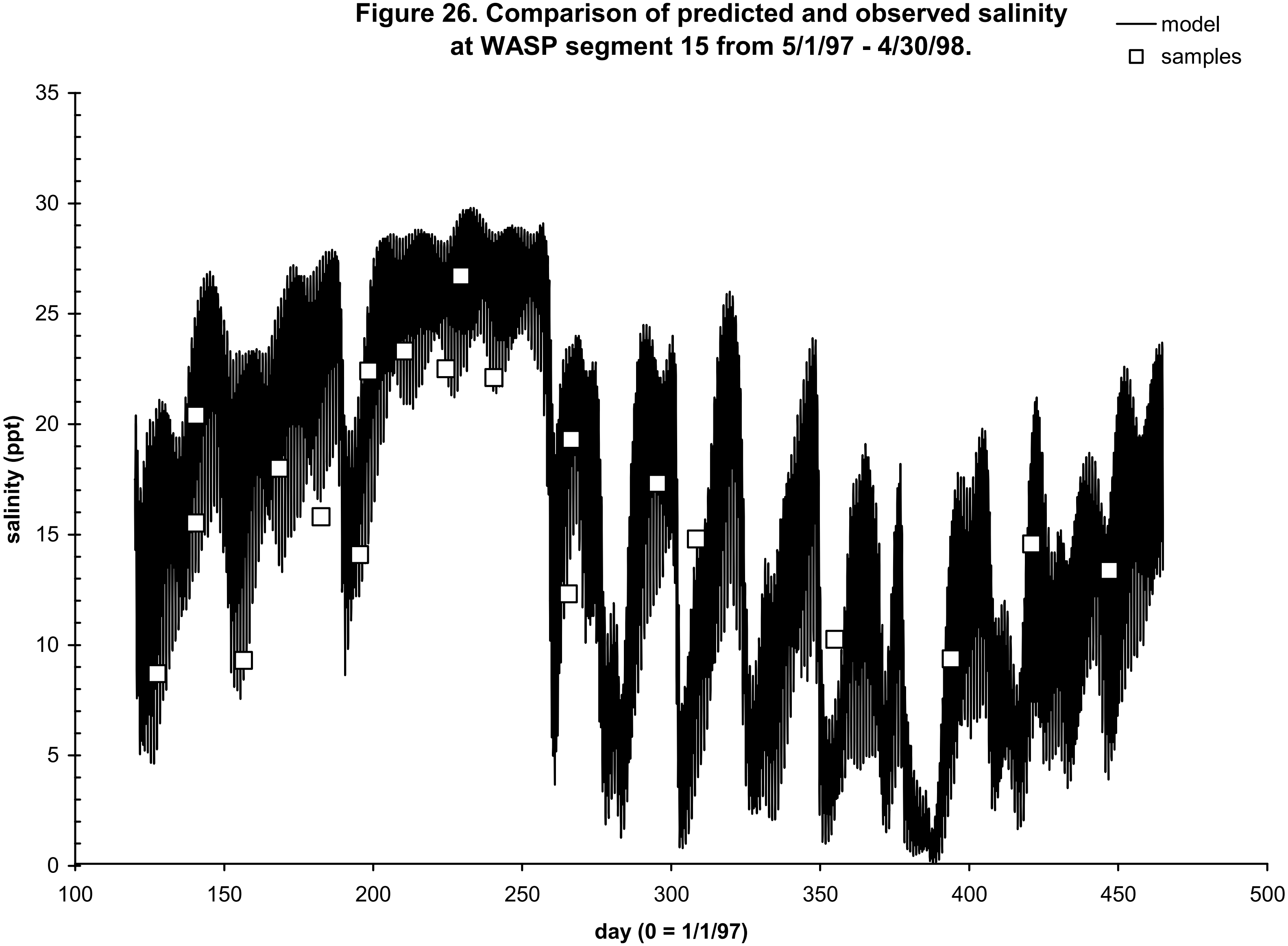


**Figure 27. Comparison of predicted and observed salinity at WASP segment 34 from 5/1/97 - 4/30/98.**

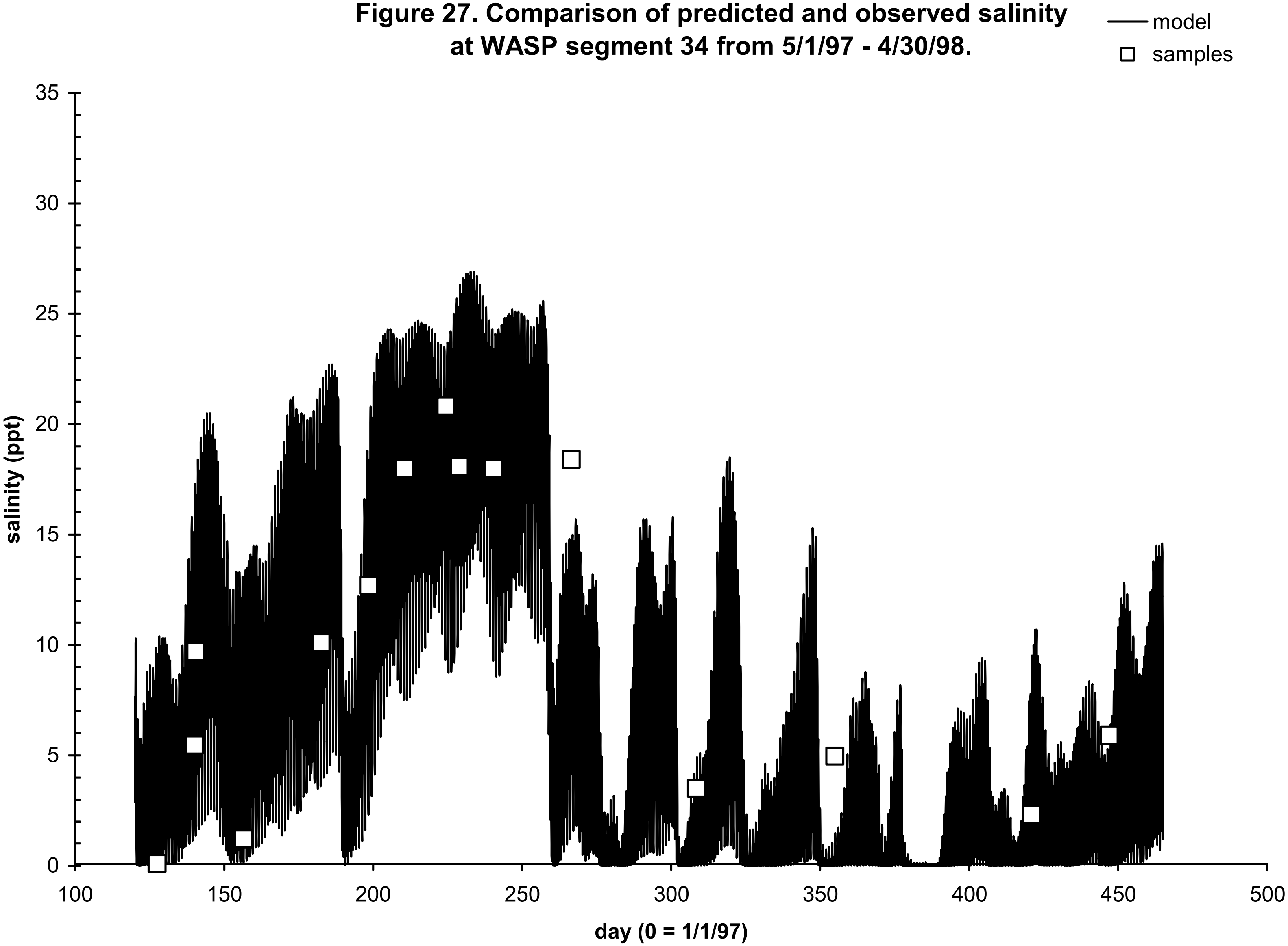


Figure 28. Comparison of predicted and observed salinity at WASP segment 42 from 5/1/97 - 4/30/98.

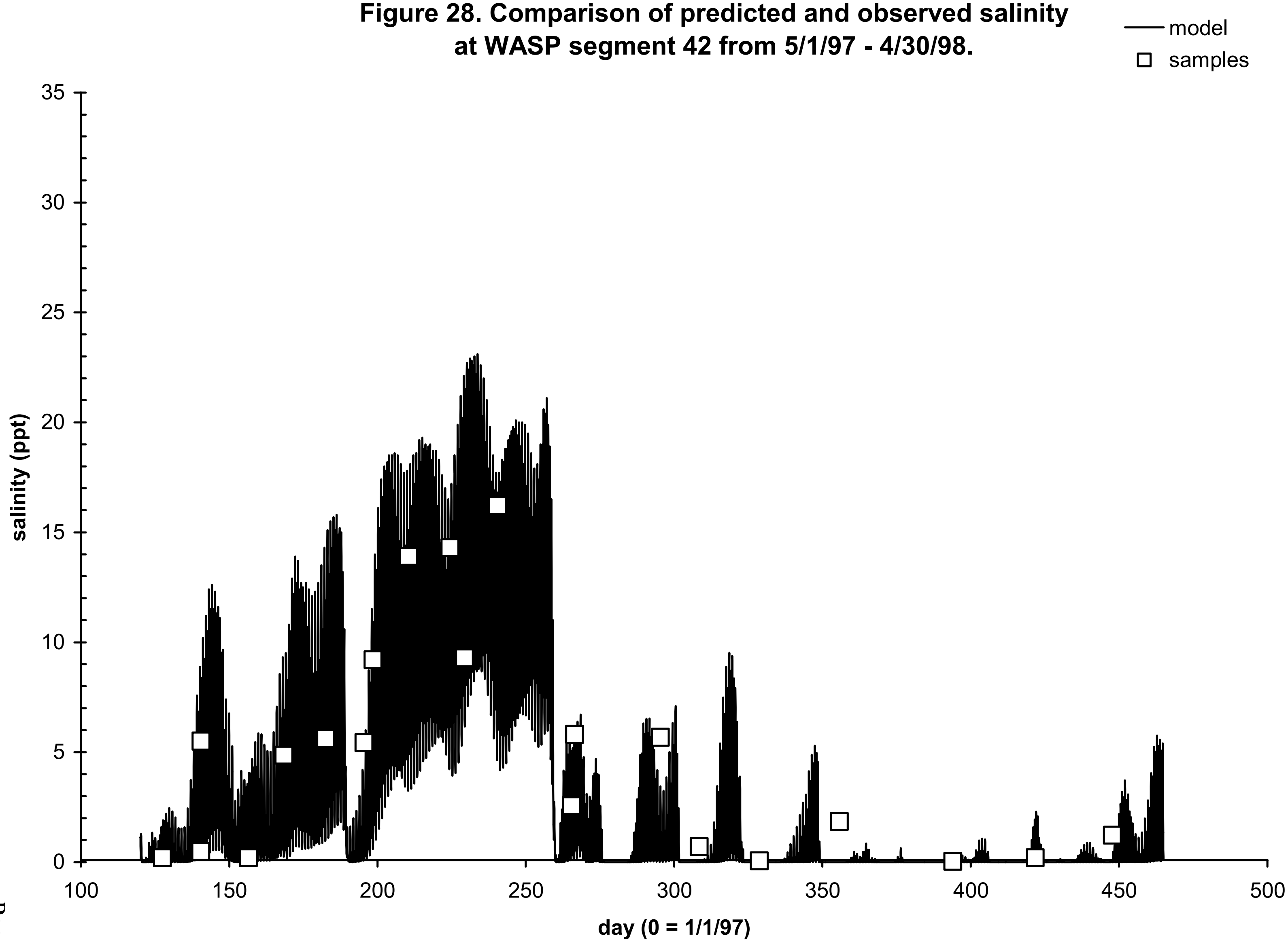


**Figure 29. Comparison of predicted and observed salinity at WASP segment 81 from 5/1/97 - 4/30/98.**

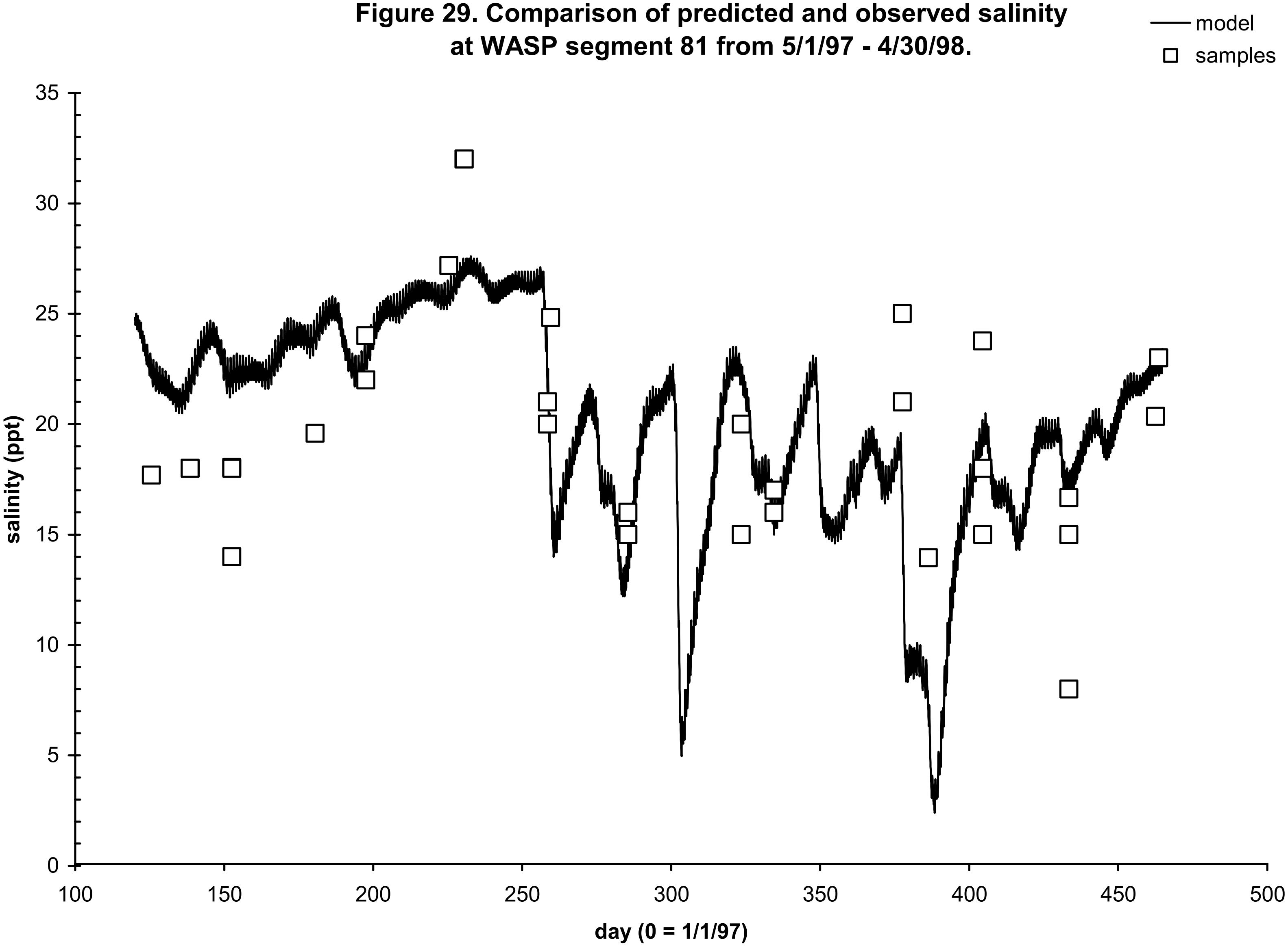


**Figure 30a. Comparison of predicted and observed salinity in Grays Harbor, 5/1/97 - 4/30/98.**

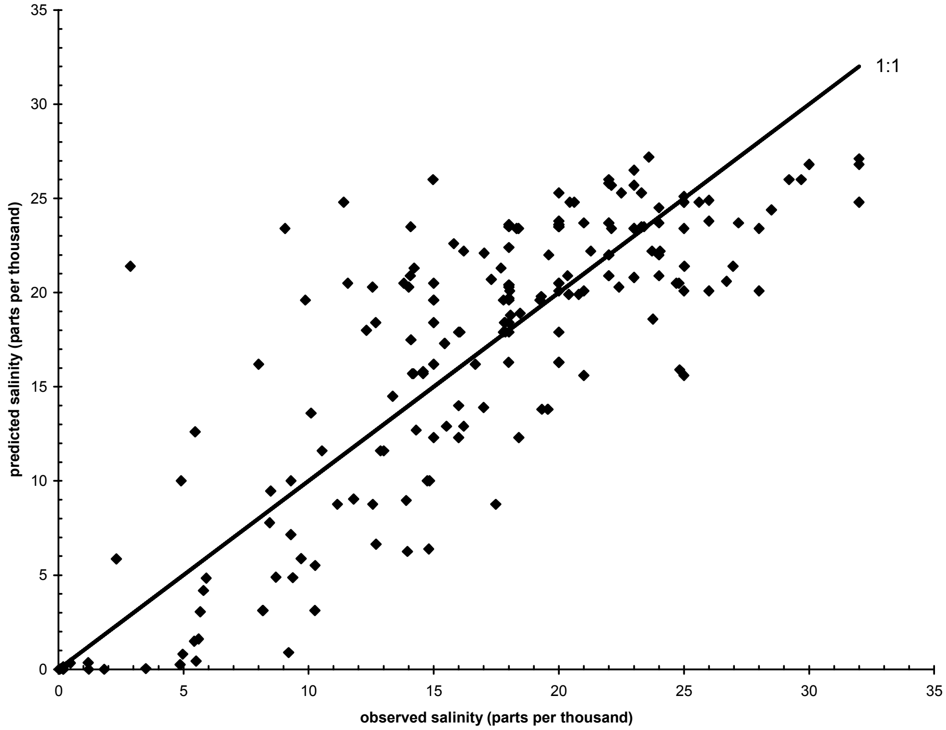
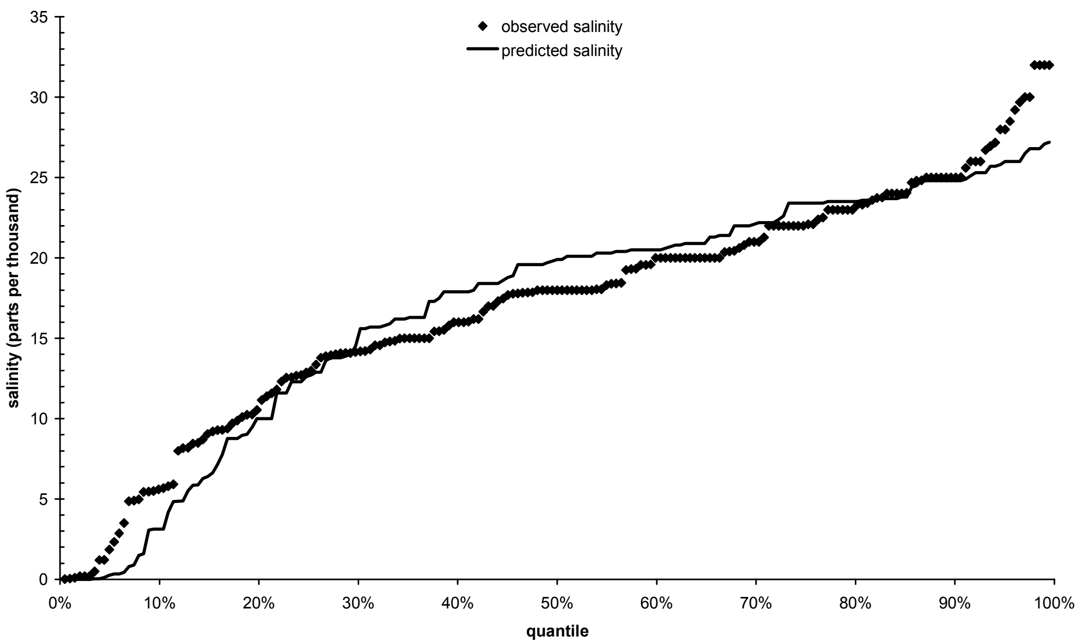



**Figure 30b. Comparison of quantiles of observed and predicted salinity, 5/1/97 - 4/30/98.**



boundary. Predicted salinity was brought into better agreement (no significant difference with observed salinity based on a paired sample t-test; Figure 30) when the assumed boundary salinity was reduced to 30 ppt, which is still within a reasonable range for estimating the boundary condition. Beverage and Swecker (1969) reported a range in salinity near the entrance to Grays Harbor of between about 27 and 34 ppt, and also reported that Grays Harbor is reasonably well-mixed vertically, especially during low-flow periods lasting several weeks or more. Landry and Hickey (1989) also reported a typical range of salinity from about 29 to 32 ppt in nearshore surface coastal waters in the vicinity of Grays Harbor.

The reasonably close agreement between model predictions of depth-averaged salinity and observed surface salinity in Grays Harbor for assumed boundary conditions within the typical range suggests that the use of a depth-averaged model is appropriate. The close agreement of the predictions from the hydrodynamic model, with tides and salinity distributions, indicate that the model provides a reasonably accurate portrayal of transport of water and substances in the water column in Grays Harbor.

## Calibration of fecal coliform

Models of the fate and transport of fecal coliform usually include consideration of disappearance or die-off within the water column. Die-off of fecal coliform is usually represented as a first-order decay process (Bowie et al., 1985). Reported decay rates span about 2 orders of magnitude, and typically range from about 0.05 to 4 $day^{-1}$ as a first-order rate constant (Brown and Barnwell, 1987).

The transport of fecal coliform bacteria within Grays Harbor included consideration of a first-order decay or die-off rate. The die-off rate of fecal coliform within the harbor was estimated by calibration to get the best fit of the model predictions, compared with observed fecal coliform at stations in Grays Harbor. The best-fit die-off rate was a first-order rate constant of 0.4 $day^{-1}$ at 20º C ($K_{20}$). The WASP model was used to represent the ambient die-off rate in the harbor by adjusting the value of $K_{20}$ to the ambient temperature (T in degrees C) using the following equation:

$$\text{Fecal coliform die-off rate at ambient temperature} = K_{20} \text{ X } 1.07^{(T-20)}$$

Figure 31 presents the seasonal changes in temperature in Grays Harbor during the study year. A sinusoidal function was fit to the observed data using multiple regression (in a similar manner as described earlier for the flow-concentrations regressions). The regression estimates of temperature in Figure 31 were used to create a daily time-series of temperature for input to the water quality model. Fecal coliform die-off rates in the model were adjusted to the estimated ambient temperatures according to the equation above.

The water quality model was run for the continuous simulation of tidally dynamic conditions from May 1997–April 1998. A time step of 90 seconds was used for the water quality model, using the predicted time-series of transports and segment volumes from the hydrodynamic model combined with the time-series of estimated daily loading from all tributaries. Tributary loads were distributed over the same 25 flow boundary nodes as for the hydrodynamic model.

Figures 32 through 39 present a comparison of predicted and observed fecal coliform throughout the harbor. The fecal coliform measurements were made at approximately monthly intervals, in contrast to the much more frequent predictions of the water quality model (90-second time step). The predicted fecal coliform matched the observed concentrations reasonably well throughout the harbor, including representation of variations within the tidal cycles (e.g., the first month of simulation is shown in Figure 32) and seasonal variability (the entire period of the simulation is shown in Figures 33 through 38). The predicted fecal coliform concentrations were not significantly different from the observations, according to a paired sample t-test (using log-transformation) and non-parametric paired-sample difference tests.

The calibration of the model implicitly accounts for the contribution of fecal coliform from wildlife within Grays Harbor (e.g., marine mammals and birds). The apparent die-off rate represents a balance between internal processes that could increase the fecal coliform concentration (e.g., wildlife sources) and processes that affect the disappearance rates of fecal coliform. A sensitivity analysis was conducted using various (1) assumed fecal coliform loads from wildlife ranging from $1x10^{12}$ to $1x10^{14}$ colonies per day, spread evenly over the Grays Harbor area, and (2) die-off rates, ranging from 0.4 to 2 per day at 20º C (Appendix F). The sensitivity analysis showed that the effective contribution of fecal coliform from wildlife sources is probably less than $1x10^{12}$ colonies per day, and it is minor in comparison with the combined tributary loading sources of approximately $4x10^{13}$ colonies per day.

The model performed well at representing the total variability of the observed data, especially the mid-range and higher concentrations. The overall root-mean-squared-error (RMSE) of comparisons between observed and predicted geometric means and $90^{th}$ percentiles was +/- 34 percent. This RMSE was approximately of the same magnitude as the variability of replicate measurements of fecal coliform. Minimizing of the RMSE was the primary goal of model calibration.

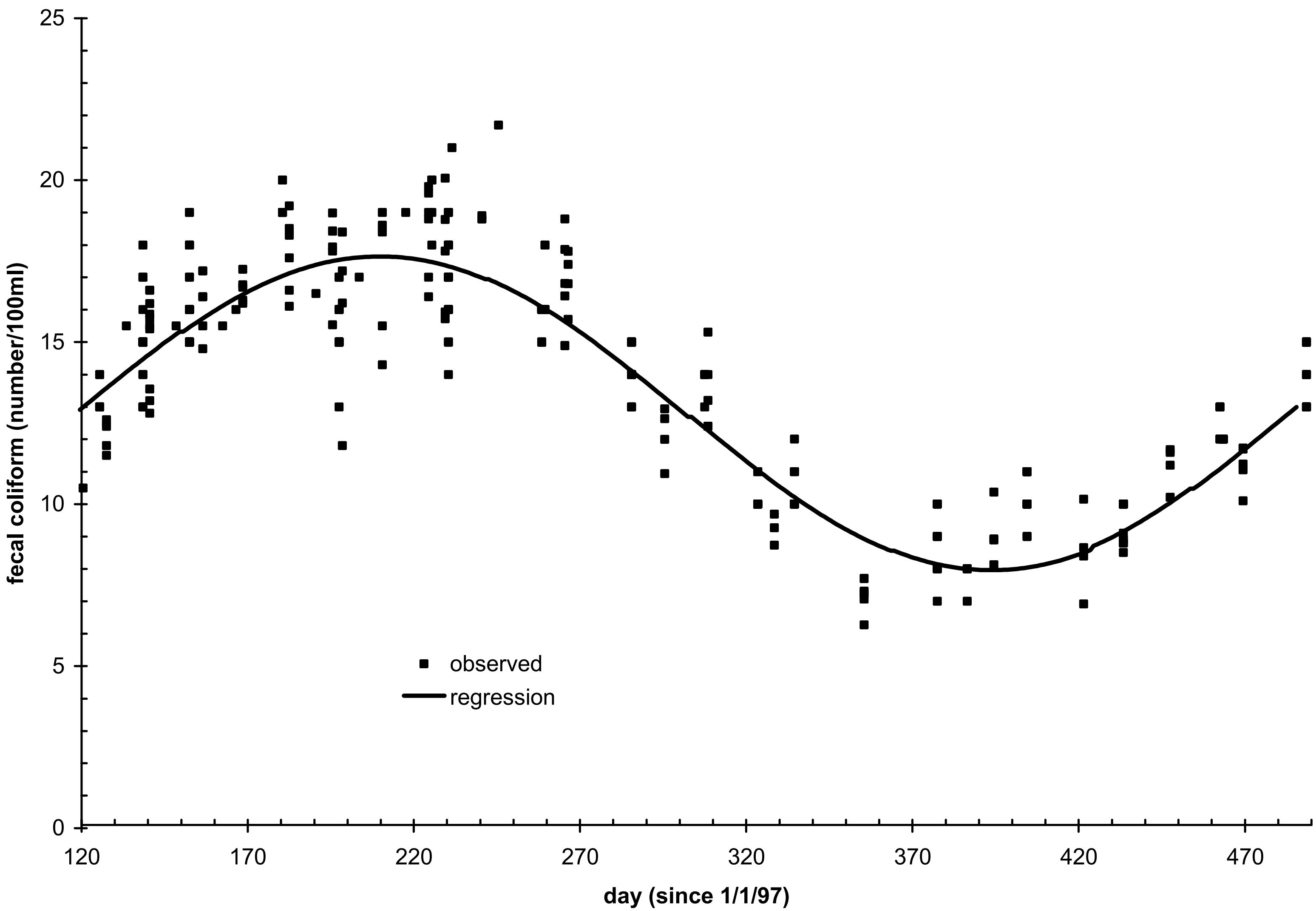
## Summary of model results for the study year

The calibrated water quality model was run for the continuous simulation of tidally dynamic response to existing loading from May 1997–April 1998 (study year). Predicted concentrations at each model segment were saved at hourly intervals. The predicted hourly concentrations were summarized in a variety of ways, to display the results of the model and compare predicted fecal coliform with water quality standards. Animations of the predicted fecal coliform concentrations are presented in Appendices G, H, I, and J.

The following animations were created from the model simulation of the study year:

- Monthly geometric means of predicted hourly concentrations (Appendix G).
- Monthly 90th percentiles of predicted hourly concentrations (Appendix H).
- Daily medians of predicted hourly fecal coliform during and after the rainfall event of October 29-30, 1997 (Appendix I).
- Predicted hourly fecal coliform during and after the high loading event from Weyerhaeuser on July 24-25, 1997 (Appendix J).

**Figure 31. Predicted and observed temperature in Grays Harbor, 5/1/97 - 4/30/98.**



## Figure 32. Comparison of predicted and observed fecal coliform at WASP segment 8 during May 1997.

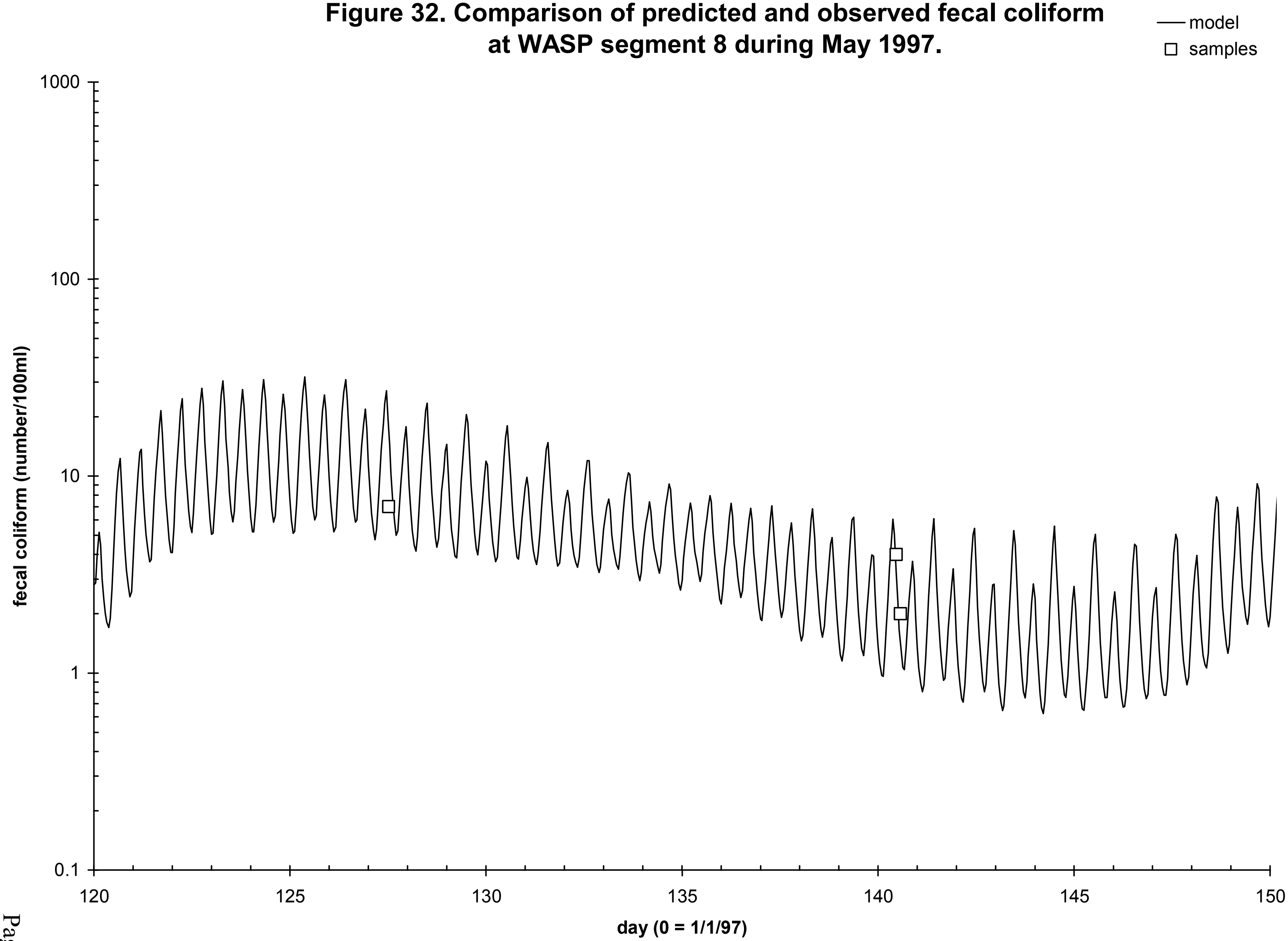


**Figure 33a. Comparison of predicted and observed fecal coliform at WASP segment 8 from 5/1/97 - 4/30/98.**

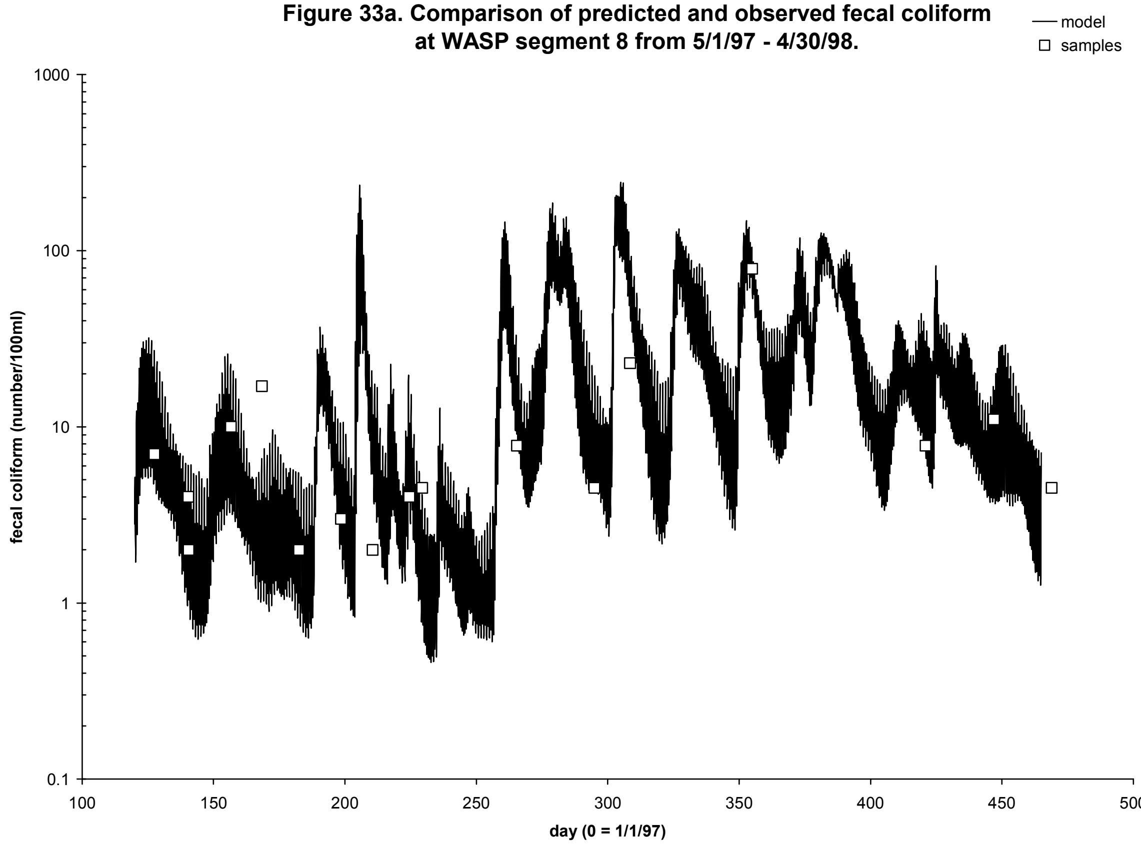



**Figure 33b. Comparison of predicted and observed quantiles of fecal coliform at WASP segment 8 from 5/1/97 - 4/30/98**

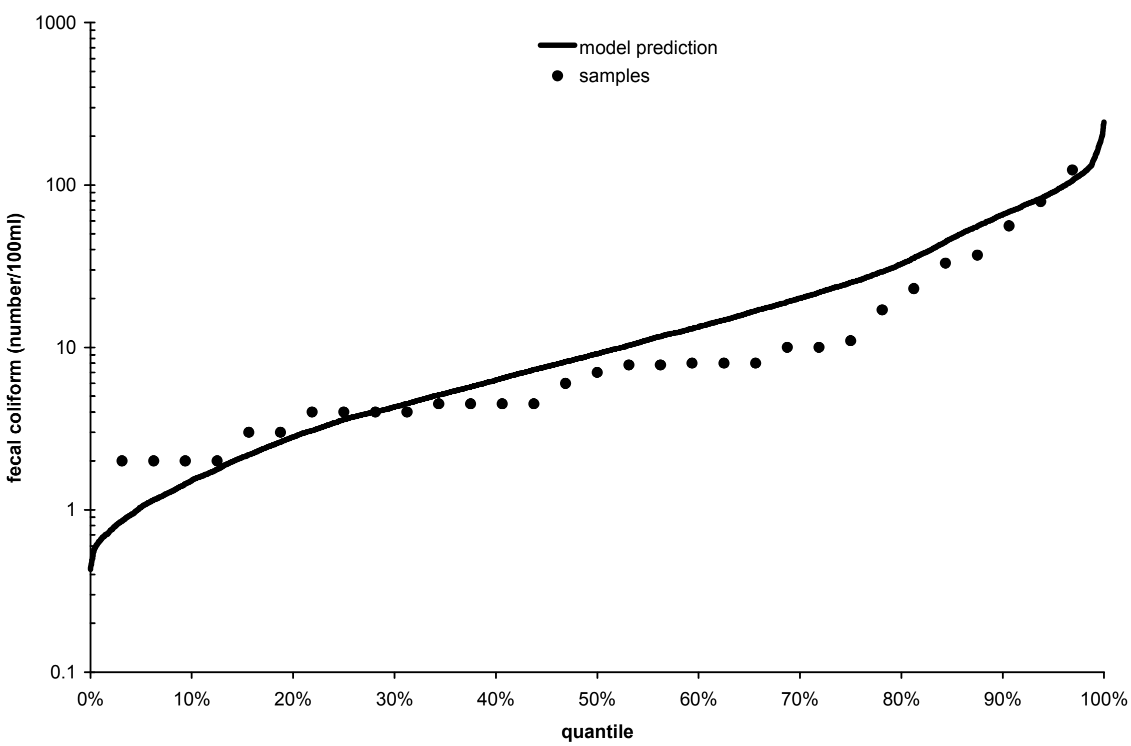


**Figure 34a. Comparison of predicted and observed fecal coliform at WASP segment 15 from 5/1/97 - 4/30/98.**

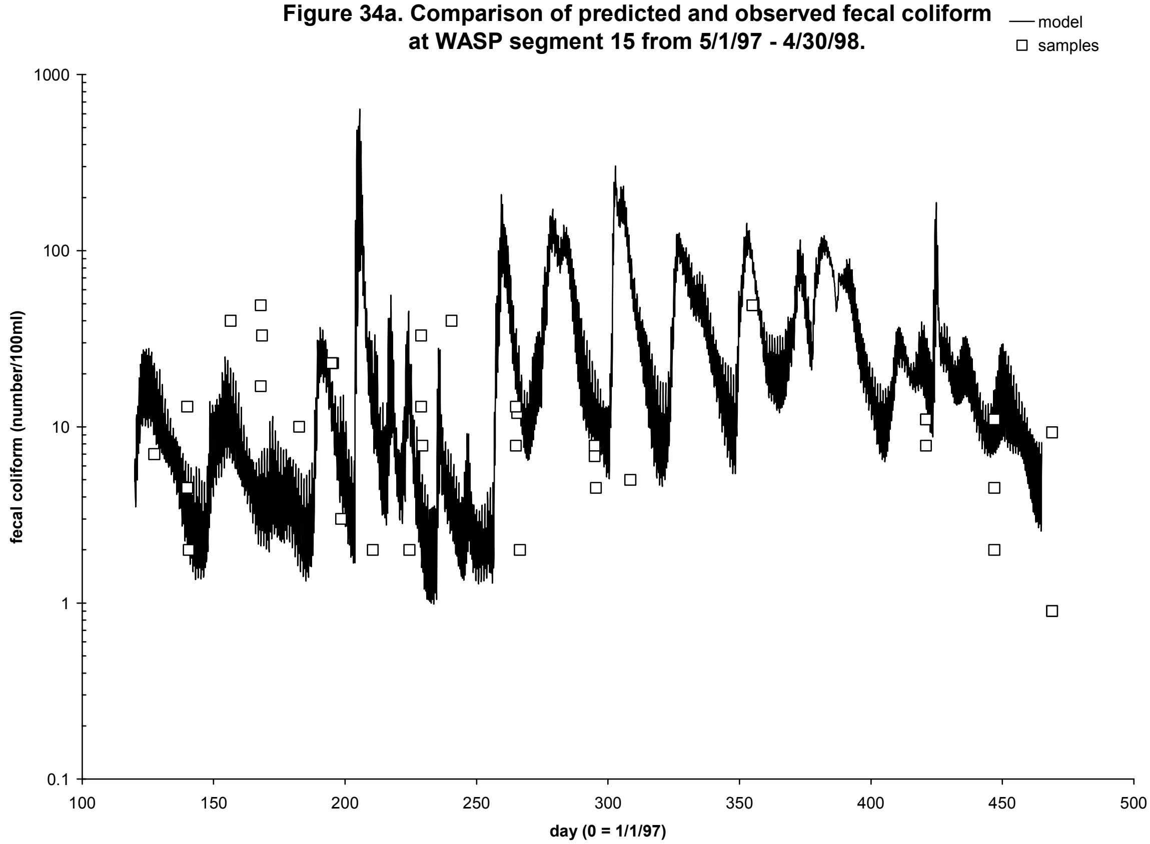



**Figure 34b. Comparison of predicted and observed quantiles of fecal coliform at WASP segment 15 from 5/1/97 - 4/30/98**

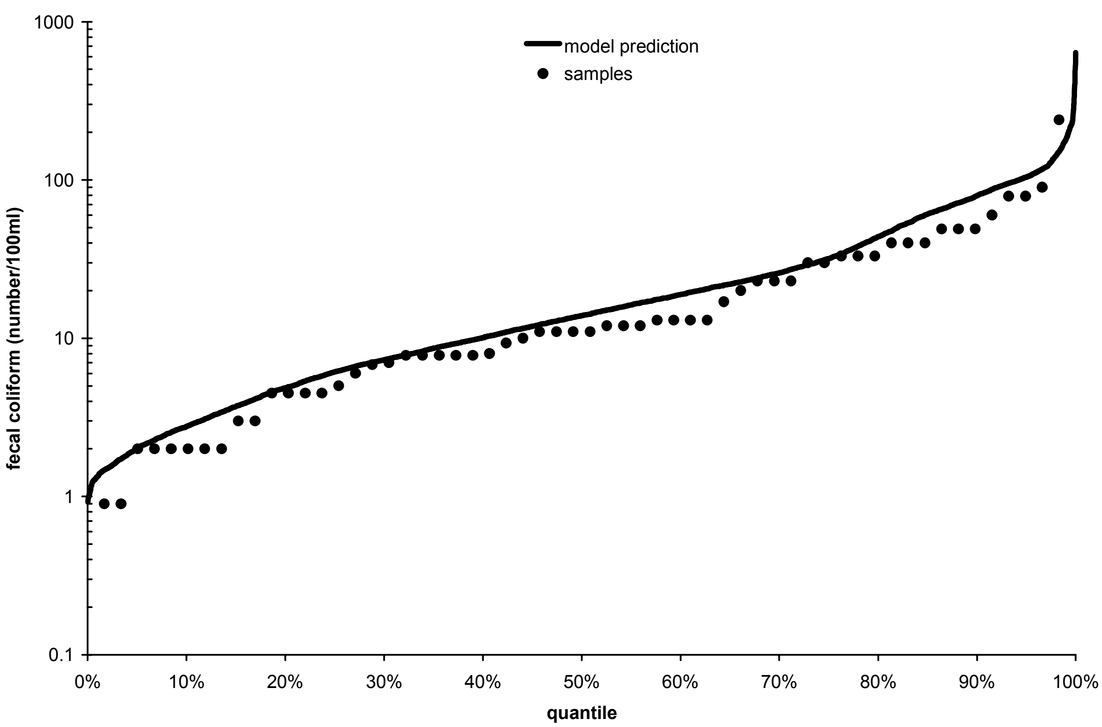


Figure 35a. Comparison of predicted and observed fecal coliform at WASP segment 25 from 5/1/97 - 4/30/98.

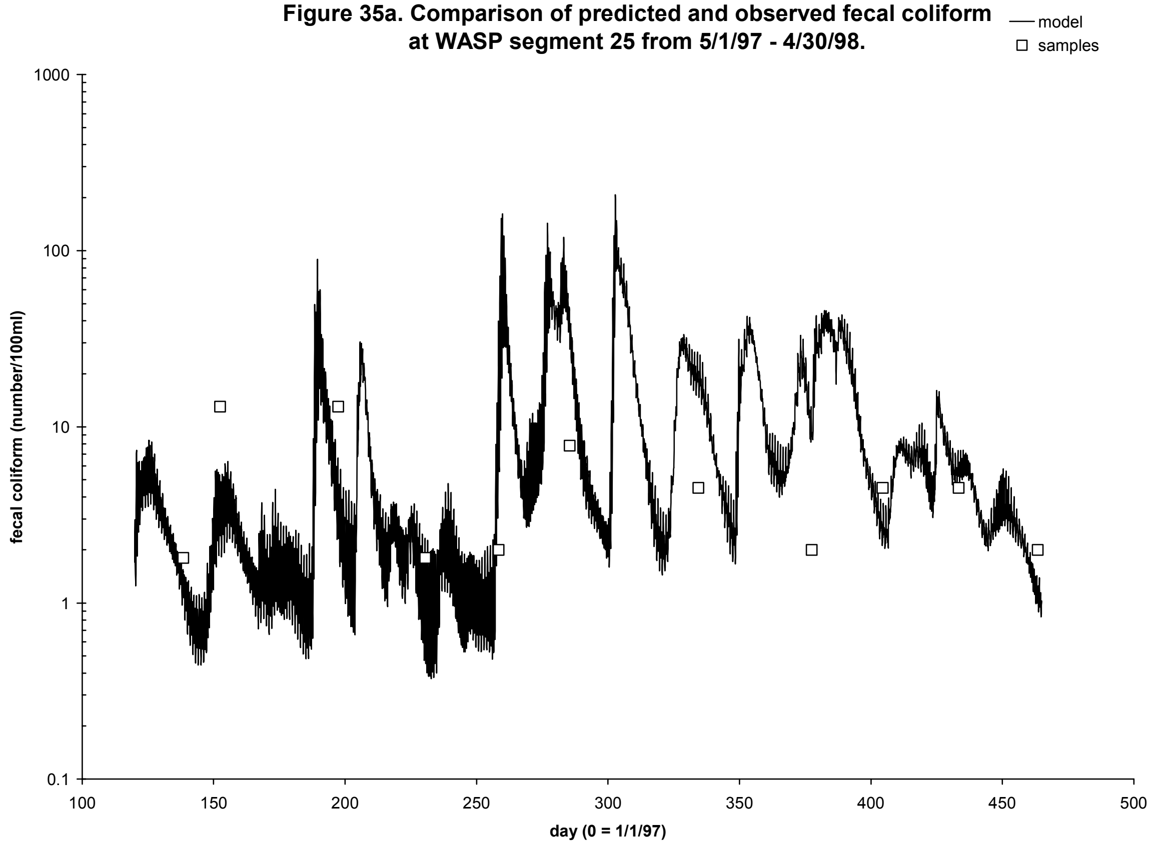



Figure 35b. Comparison of predicted and observed quantiles of fecal coliform at WASP segment 25 from 5/1/97 - 4/30/98

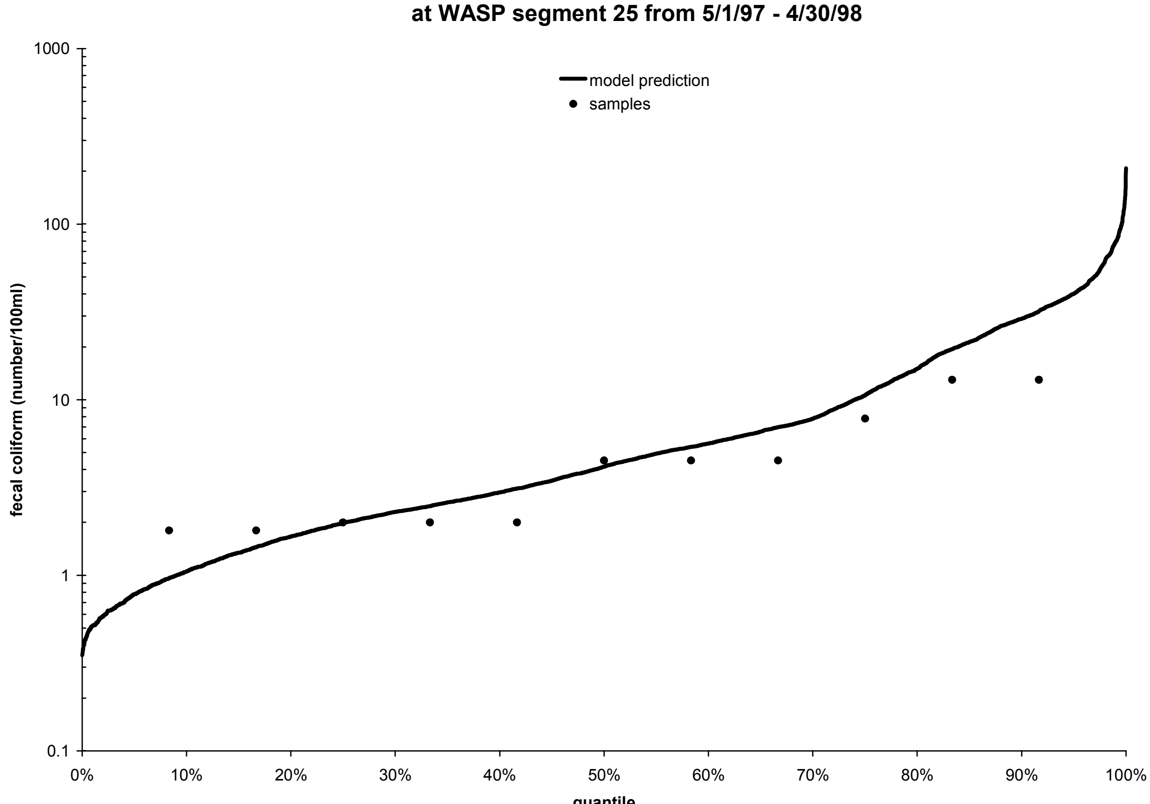


**Figure 36a. Comparison of predicted and observed fecal coliform at WASP segment 34 from 5/1/97 - 4/30/98.**

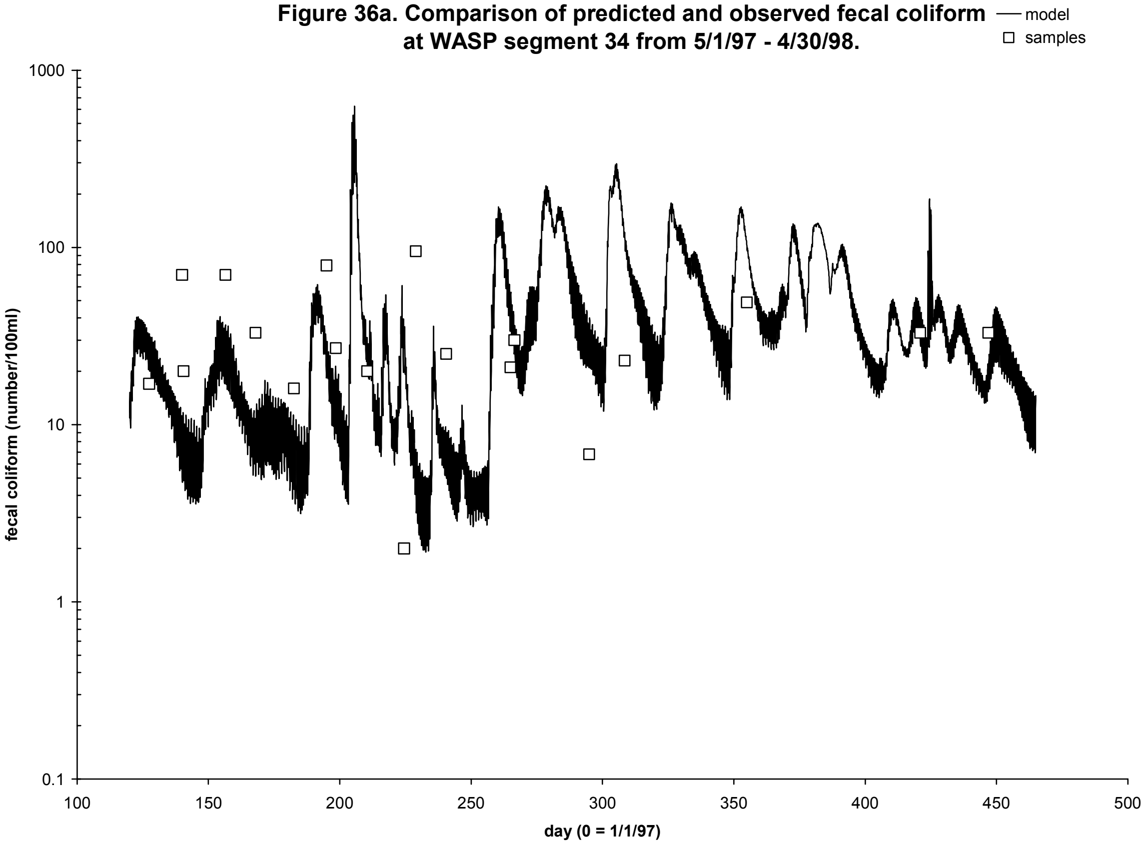



**Figure 36b. Comparison of predicted and observed quantiles of fecal coliform at WASP segment 34 from 5/1/97 - 4/30/98**

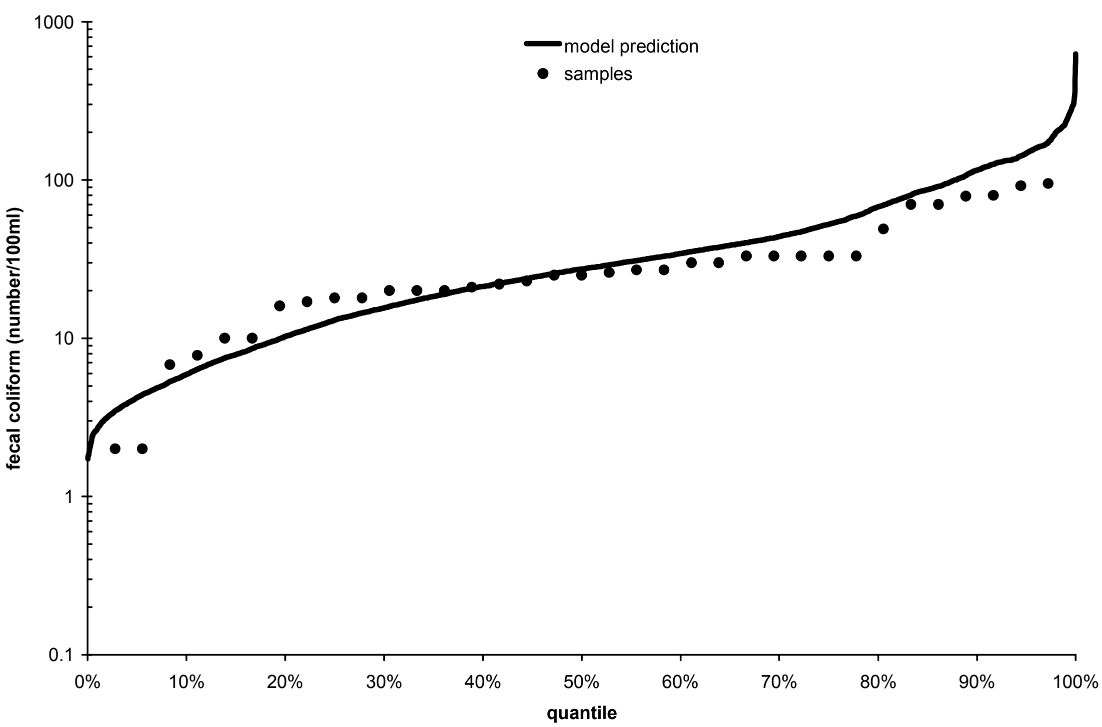


**Figure 37a. Comparison of predicted and observed fecal coliform at WASP segment 42 from 5/1/97 - 4/30/98.**

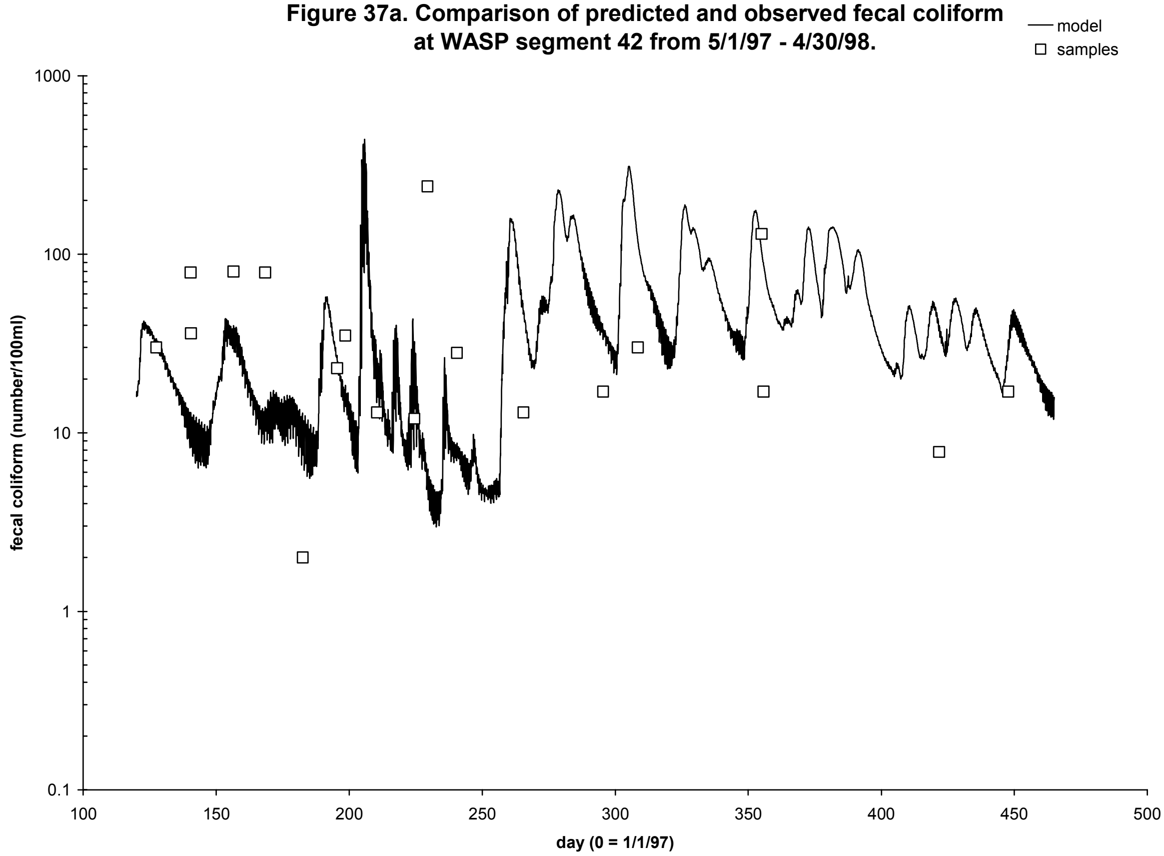



**Figure 37b. Comparison of predicted and observed quantiles of fecal coliform at WASP segment 42 from 5/1/97 - 4/30/98**

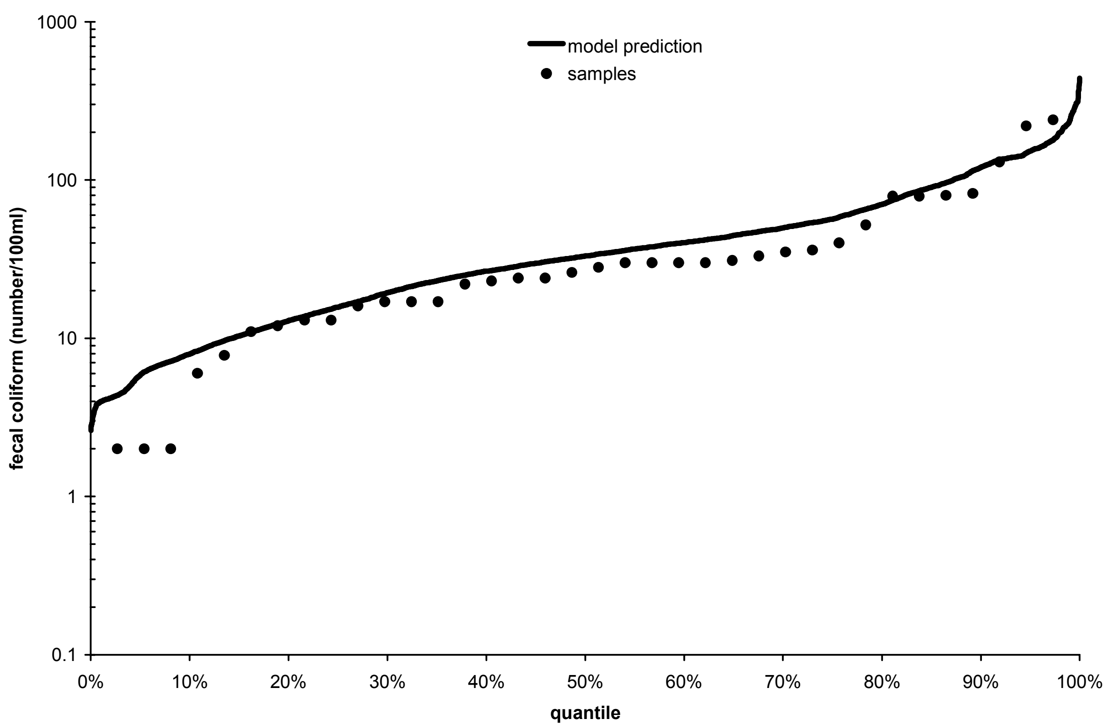


Figure 38a. Comparison of predicted and observed fecal coliform at WASP segment 81 from 5/1/97 - 4/30/98.

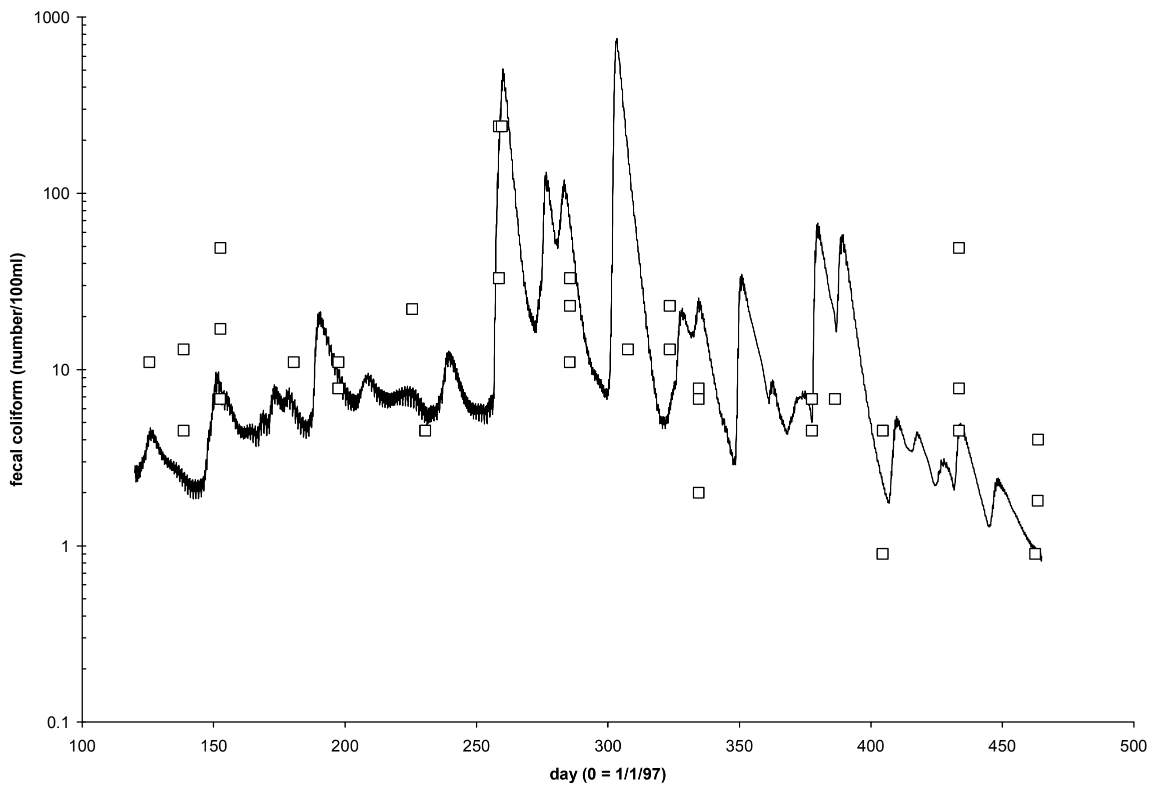



Figure 38b. Comparison of predicted and observed quantiles of fecal coliform at WASP segment 81 from 5/1/97 - 4/30/98

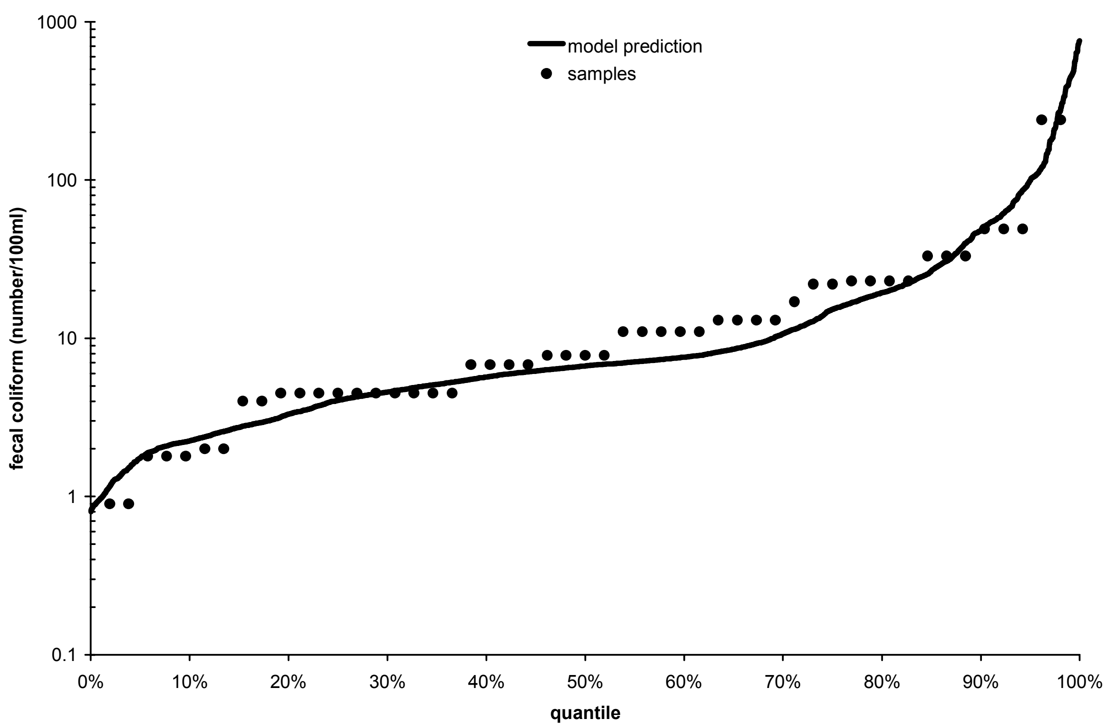


**Figure 39a. Comparison of predicted and observed fecal coliform in Grays Harbor at all stations, 5/1/97 - 4/30/98.**

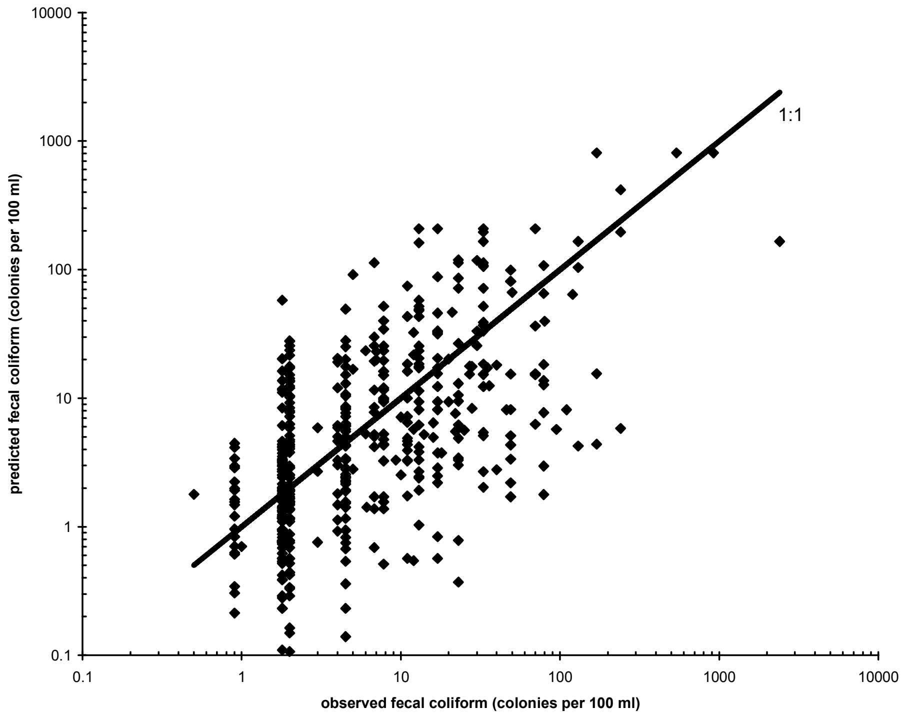
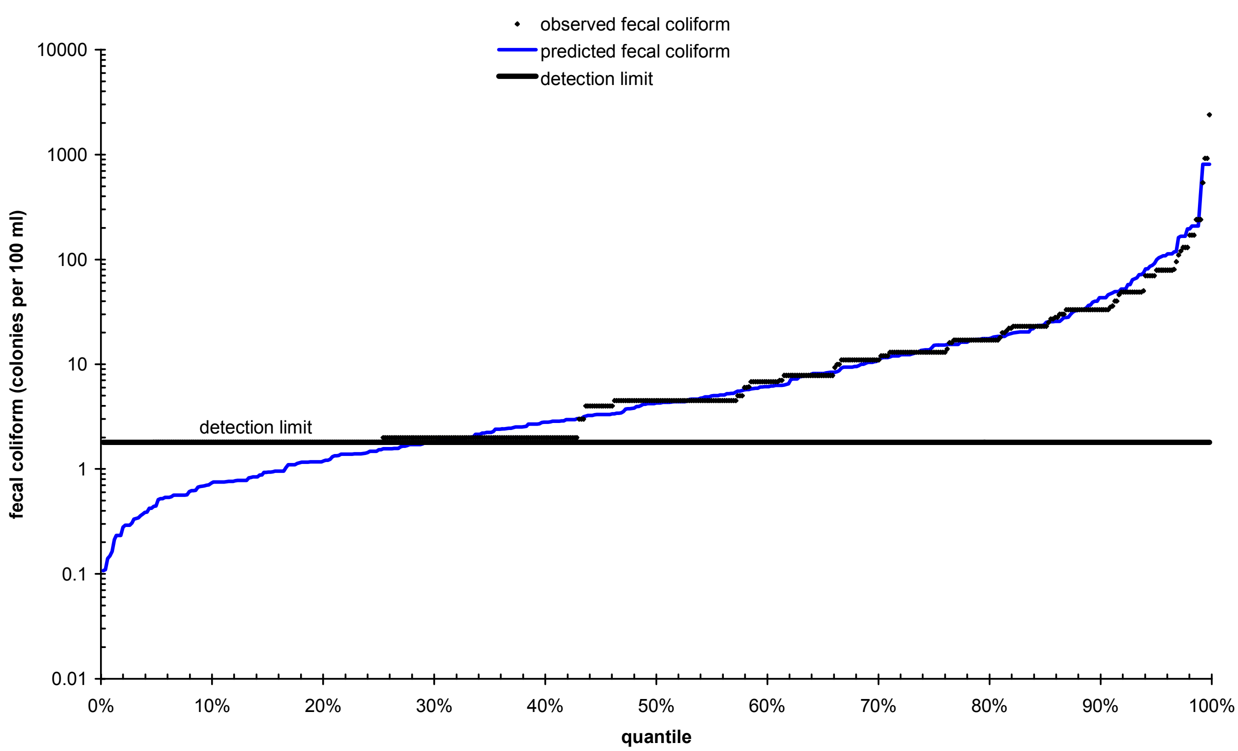



**Figure 39b. Comparison of quantiles of observed and predicted fecal coliform at all stations in Grays Harbor, 5/1/97 - 4/30/98.**



The monthly geometric means and 90$^{th}$ percentiles of the predicted hourly concentrations are also presented in Tables 8 and 9. These results show several problem areas within Grays Harbor where water quality standards would not be met if current rates of fecal coliform loading continue:

- Lower Chehalis River and lower Wishkah River segments (segments 46-67).
- Marine segments in the transition from inner harbor to the central region at the division between marine class A and B, because of loading from the Chehalis River and tributaries to the inner harbor (segments 5, 6, 13, 22, 23, 26, 30).
- The northeast part of north harbor region because of loading from the Humptulips River (segments 24, 25, 28, 29).
- The southern Elk River estuary region because of local tributaries such as the Elk River, Andrews Creek, and Grays Harbor Drainage Ditch (segments 79-82).
- Areas adjacent to loading from the Johns River (segments 19, 83).

## First-cut of loading reductions needed to meet freshwater standards

The model was used to predict the water quality that would result in the harbor if the tributary nonpoint and point source loads were reduced. An iterative approach was used to try various amounts of reduction of loading and run the model to determine whether marine water quality standards would be met in Grays Harbor. The first estimate of loading reduction was as follows:

- Tributary nonpoint sources were reduced by the amount estimated in Table 6 to meet freshwater standards. This approach maintains a constant coefficient of variation (standard deviation divided by the mean) of the pre-control and post-control loading according to the statistical theory of rollback (Ott, 1995). The rollback method is the approach that Ecology typically uses to determine load allocations for fecal coliform TMDL evaluations (e.g., Cusimano and Giglio, 1995; Joy, 1999).
- Point sources were reduced to comply with existing NPDES permit limits (Table 10).

The predicted monthly geometric means and 90$^{th}$ percentiles in response to this loading reduction are presented in Tables 11 and 12. This reduction of loading was predicted to improve water quality significantly in Grays Harbor. However, the predicted monthly 90$^{th}$ percentiles show three problem areas that would remain, where marine standards for fecal coliform would not be met:

- The northeast part of north region because of loading from the Humptulips River (segment 29).
- Marine segments in the transition from inner harbor to the central region at the division between marine class A and B, because of loading from the Chehalis River and tributaries to the inner harbor (segment 30).
- The southern Elk River estuary region, because of local tributaries such as the Elk River, Andrews Creek, and Grays Harbor Drainage Ditch (segments 81, 82).

Table 8. Predicted monthly geometric means of fecal coliform (numbers per 100 ml) in Grays Harbor before rollback of loading sources. Bold, shaded values indicate exceedence of the water quality standard.

| WASP Segment | May-97 | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan-98 | Feb | Mar | Apr | Water Quality Standard |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.2 | 0.1 | 0.2 | 0.1 | 0.2 | 0.6 | 0.7 | 0.6 | 1.1 | 0.4 | 0.3 | 0.2 | 14 |
| 2 | 0.3 | 0.2 | 0.5 | 0.2 | 0.4 | 1.7 | 1.9 | 1.5 | 3.2 | 0.8 | 0.7 | 0.3 | 14 |
| 3 | 0.5 | 0.4 | 0.9 | 0.4 | 0.7 | 3.3 | 3.4 | 2.9 | 6.0 | 1.6 | 1.4 | 0.5 | 14 |
| 4 | 0.9 | 0.8 | 1.6 | 0.7 | 1.3 | 6.2 | 6.9 | 5.7 | 11.8 | 3.3 | 2.8 | 1.0 | 14 |
| 5 | 1.5 | 1.2 | 2.4 | 1.0 | 1.9 | 9.2 | 10.5 | 8.6 | **17.8** | 5.0 | 4.3 | 1.6 | 14 |
| 6 | 2.1 | 1.7 | 3.3 | 1.4 | 2.6 | 12.9 | **15.1** | 12.3 | **24.8** | 7.2 | 6.2 | 2.3 | 14 |
| 7 | 2.9 | 2.4 | 4.4 | 1.9 | 3.5 | 17.2 | 20.2 | 16.3 | 32.2 | 9.7 | 8.4 | 3.1 | 100 |
| 8 | 4.2 | 3.4 | 6.1 | 2.7 | 4.8 | 24.0 | 28.4 | 22.6 | 43.3 | 13.6 | 11.9 | 4.5 | 100 |
| 9 | 5.9 | 4.7 | 8.1 | 3.5 | 6.3 | 32.5 | 38.5 | 30.4 | 55.7 | 18.6 | 16.4 | 6.4 | 100 |
| 10 | 9.0 | 7.3 | 11.6 | 5.1 | 9.3 | 46.6 | 53.4 | 41.6 | 69.1 | 25.6 | 23.2 | 9.7 | 100 |
| 11 | 11.2 | 9.3 | 14.4 | 6.2 | 11.5 | 55.4 | 62.1 | 47.5 | 74.0 | 29.0 | 27.1 | 12.1 | 100 |
| 12 | 13.5 | 11.7 | 17.5 | 7.7 | 14.3 | 63.3 | 69.8 | 52.3 | 76.1 | 31.0 | 30.5 | 14.6 | 100 |
| 13 | 2.3 | 2.0 | 3.7 | 1.6 | 3.1 | **14.2** | **15.3** | 12.5 | **25.1** | 7.3 | 6.3 | 2.3 | 14 |
| 14 | 3.4 | 2.9 | 5.5 | 2.5 | 4.5 | 20.4 | 22.7 | 18.3 | 35.2 | 10.8 | 9.6 | 3.6 | 100 |
| 15 | 6.3 | 5.4 | 10.4 | 5.3 | 8.5 | 35.7 | 38.0 | 29.7 | 51.2 | 17.6 | 16.6 | 6.5 | 100 |
| 16 | 9.0 | 7.8 | 15.0 | 7.8 | 11.4 | 46.1 | 50.1 | 38.2 | 61.1 | 22.7 | 22.1 | 9.3 | 100 |
| 17 | 11.9 | 10.6 | 22.3 | 12.4 | 15.6 | 56.0 | 59.0 | 44.0 | 65.8 | 26.4 | 26.6 | 11.6 | 100 |
| 18 | 0.7 | 0.7 | 1.3 | 0.5 | 1.2 | 4.8 | 5.0 | 4.1 | 8.7 | 2.4 | 2.0 | 0.7 | 14 |
| 19 | 1.3 | 1.3 | 2.4 | 1.0 | 2.1 | 8.2 | 8.0 | 6.7 | **14.0** | 3.8 | 3.2 | 1.2 | 14 |
| 20 | 0.9 | 0.9 | 1.7 | 0.9 | 2.1 | 6.7 | 7.0 | 5.2 | 10.2 | 2.8 | 2.3 | 0.9 | 14 |
| 21 | 0.8 | 0.8 | 1.7 | 0.6 | 1.4 | 5.8 | 5.6 | 4.7 | 9.5 | 2.6 | 2.2 | 0.8 | 14 |
| 22 | 1.3 | 1.2 | 2.5 | 1.0 | 2.0 | 8.7 | 8.8 | 7.3 | **14.8** | 4.1 | 3.5 | 1.3 | 14 |
| 23 | 1.7 | 1.5 | 2.9 | 1.2 | 2.3 | 10.9 | 12.5 | 10.2 | **20.8** | 6.0 | 5.1 | 1.9 | 14 |
| 24 | 1.1 | 1.1 | 2.4 | 0.9 | 2.0 | 8.2 | 7.3 | 6.2 | 12.0 | 3.4 | 2.8 | 1.1 | 14 |
| 25 | 2.0 | 1.9 | 4.2 | 1.7 | 3.4 | 13.4 | 11.5 | 9.5 | **18.0** | 5.2 | 4.5 | 1.7 | 14 |
| 26 | 2.4 | 2.1 | 4.1 | 1.7 | 3.2 | **15.0** | **16.8** | 13.7 | **27.2** | 8.0 | 6.9 | 2.6 | 14 |
| 27 | 3.2 | 2.6 | 4.9 | 2.1 | 3.8 | 19.1 | 22.7 | 18.4 | 36.3 | 10.9 | 9.5 | 3.4 | 100 |
| 28 | 1.4 | 1.4 | 3.2 | 1.2 | 2.7 | 10.6 | 8.3 | 7.3 | 13.4 | 3.8 | 3.2 | 1.2 | 14 |
| 29 | 2.9 | 3.2 | 7.5 | 3.1 | 6.5 | **21.0** | 12.6 | 10.2 | **17.2** | 5.1 | 4.5 | 1.7 | 14 |
| 30 | 2.7 | 2.3 | 4.2 | 1.8 | 3.4 | **16.5** | **19.0** | **15.4** | **30.4** | 9.1 | 7.9 | 2.9 | 14 |
| 31 | 4.6 | 3.8 | 6.9 | 3.2 | 5.5 | 26.3 | 30.5 | 24.2 | 44.9 | 14.6 | 13.0 | 4.9 | 100 |
| 32 | 7.1 | 5.8 | 10.0 | 4.5 | 7.7 | 38.1 | 44.2 | 34.5 | 59.9 | 21.0 | 19.1 | 7.6 | 100 |
| 33 | 9.6 | 8.1 | 14.2 | 6.7 | 10.7 | 48.5 | 54.5 | 41.7 | 66.4 | 25.4 | 24.1 | 10.1 | 100 |
| 34 | 13.7 | 12.4 | 20.1 | 9.2 | 15.5 | 64.6 | 69.4 | 51.1 | 74.0 | 29.3 | 29.8 | 14.6 | 100 |
| 35 | 14.7 | 13.4 | 21.0 | 9.5 | 16.5 | 68.5 | 73.7 | 53.6 | 76.8 | 30.7 | 31.0 | 15.6 | 100 |
| 36 | 15.0 | 13.8 | 21.4 | 9.6 | 16.9 | 69.9 | 75.2 | 54.6 | 77.5 | 31.3 | 31.6 | 16.0 | 100 |
| 37 | 15.7 | 14.4 | 22.1 | 9.9 | 17.6 | 71.8 | 76.8 | 55.9 | 78.5 | 32.3 | 32.5 | 16.6 | 100 |
| 38 | 15.8 | 14.6 | 22.3 | 9.8 | 17.6 | 72.6 | 77.6 | 56.2 | 77.9 | 31.6 | 32.4 | 16.9 | 100 |
| 39 | 16.4 | 15.4 | 23.0 | 9.9 | 18.2 | 74.7 | 79.4 | 57.3 | 78.5 | 31.9 | 32.7 | 17.6 | 100 |
| 40 | 16.7 | 15.9 | 21.9 | 9.5 | 17.5 | 72.4 | 80.0 | 56.6 | 79.2 | 32.0 | 33.2 | 18.2 | 100 |
| 41 | 17.1 | 16.5 | 22.1 | 9.4 | 17.8 | 73.7 | 81.2 | 57.2 | 79.6 | 32.2 | 33.4 | 18.7 | 100 |
| 42 | 17.7 | 17.4 | 22.3 | 9.2 | 18.1 | 75.3 | 82.7 | 57.9 | 79.9 | 32.5 | 33.8 | 19.3 | 100 |
| 43 | 18.3 | 18.4 | 22.4 | 9.0 | 18.6 | 77.1 | 84.1 | 58.5 | 80.1 | 32.7 | 34.1 | 19.8 | 100 |
| 44 | 18.6 | 18.9 | 22.1 | 8.6 | 18.4 | 77.8 | 85.3 | 59.1 | 80.9 | 32.9 | 34.5 | 20.2 | 100 |
| 45 | 19.0 | 19.5 | 21.9 | 8.2 | 18.4 | 78.7 | 86.2 | 59.5 | 81.1 | 33.1 | 34.8 | 20.5 | 100 |
| 46 | 19.5 | 20.2 | 21.5 | 7.8 | 18.5 | 80.0 | 87.3 | 60.0 | 81.5 | 33.3 | 35.2 | 20.9 | 100 |
| 47 | 20.0 | 21.0 | 21.1 | 7.4 | 18.7 | 81.6 | 88.4 | 60.6 | 81.9 | 33.6 | 35.6 | 21.3 | 100 |
| 48 | 20.8 | 22.0 | 21.2 | 7.3 | 19.7 | 84.6 | 89.4 | 61.4 | 82.3 | 33.8 | 36.0 | 21.7 | 100 |
| 49 | 20.7 | 22.2 | 20.6 | 7.0 | 18.8 | 81.4 | 89.9 | 60.8 | 79.6 | 33.8 | 36.0 | 21.9 | 100 |
| 50 | 21.3 | 23.0 | 20.4 | 6.9 | 19.0 | 82.3 | 91.1 | 61.2 | 80.0 | 34.1 | 36.5 | 22.3 | 100 |
| 51 | 21.9 | 24.0 | 20.5 | 7.0 | 19.5 | 83.7 | 92.3 | 61.8 | 80.4 | 34.4 | 36.9 | 22.7 | 100 |
| 52 | 22.8 | 25.4 | 21.0 | 7.5 | 20.4 | 85.8 | 93.8 | 62.5 | 80.9 | 34.7 | 37.4 | 23.3 | 100 |
| 53 | 23.8 | 27.0 | 22.0 | 8.3 | 21.7 | 88.2 | 95.4 | 63.3 | 81.4 | 35.0 | 38.0 | 23.9 | 100 |
| 54 | 24.9 | 28.7 | 23.5 | 9.3 | 23.4 | 90.6 | 97.0 | 64.0 | 82.0 | 35.4 | 38.5 | 24.4 | 100 |
| 55 | 25.7 | 30.2 | 24.9 | 10.5 | 25.1 | 92.6 | 98.2 | 64.5 | 82.3 | 35.6 | 38.9 | 24.9 | 100 |
| 56 | 26.6 | 31.7 | 26.7 | 12.0 | 27.2 | 94.5 | 99.3 | 65.0 | 82.7 | 35.9 | 39.3 | 25.3 | 100 |
| 57 | 27.4 | 33.1 | 28.5 | 13.5 | 29.4 | 96.3 | **100.4** | 65.6 | 83.1 | 36.1 | 39.7 | 25.8 | 100 |
| 58 | 28.1 | 34.3 | 30.2 | 15.1 | 31.4 | 97.9 | **101.3** | 66.0 | 83.4 | 36.3 | 40.0 | 26.1 | 100 |
| 59 | 28.7 | 35.5 | 32.0 | 16.8 | 33.5 | 99.4 | **102.2** | 66.4 | 83.6 | 36.5 | 40.2 | 26.4 | 100 |
| 60 | 29.4 | 36.7 | 33.9 | 18.8 | 35.9 | **100.9** | **103.1** | 66.8 | 83.9 | 36.6 | 40.5 | 26.8 | 100 |
| 61 | 30.2 | 38.2 | 36.2 | 21.2 | 38.7 | **102.7** | **104.2** | 67.2 | 84.2 | 36.8 | 40.9 | 27.2 | 100 |
| 62 | 31.0 | 39.6 | 38.5 | 23.8 | 41.7 | **104.5** | **105.2** | 67.7 | 84.6 | 37.0 | 41.2 | 27.6 | 100 |
| 63 | 31.8 | 41.1 | 40.9 | 26.6 | 44.8 | **106.3** | **106.2** | 68.1 | 84.9 | 37.2 | 41.5 | 28.0 | 100 |
| 64 | 32.7 | 43.0 | 44.4 | 30.6 | 49.0 | **107.9** | **107.1** | 68.5 | 85.3 | 37.4 | 41.8 | 28.3 | 100 |
| 65 | 34.2 | 42.3 | 40.9 | 27.2 | 47.0 | **121.9** | **120.2** | 77.7 | 97.0 | 43.4 | 46.4 | 30.7 | 100 |
| 66 | 36.1 | 45.6 | 45.7 | 31.5 | 52.6 | **127.0** | **122.7** | 79.0 | 98.1 | 44.0 | 47.3 | 31.6 | 100 |
| 67 | 44.9 | 50.3 | 38.0 | 23.9 | 42.4 | **137.4** | **151.2** | **100.8** | **127.9** | 59.8 | 59.4 | 39.4 | 100 |
| 68 | 13.6 | 10.7 | 15.9 | 6.4 | 12.4 | 62.0 | 58.2 | 50.8 | 80.7 | 34.4 | 29.0 | 12.8 | 200 |
| 69 | 14.2 | 10.4 | 16.2 | 5.8 | 11.8 | 64.5 | 51.5 | 49.4 | 79.7 | 34.8 | 28.3 | 12.0 | 200 |
| 70 | 15.2 | 10.0 | 16.1 | 5.0 | 11.1 | 68.0 | 45.5 | 47.8 | 81.2 | 35.9 | 28.4 | 11.0 | 200 |
| 71 | 20.0 | 12.4 | 18.4 | 5.1 | 13.0 | 80.4 | 44.7 | 47.3 | 86.8 | 38.2 | 32.0 | 10.5 | 200 |
| 72 | 15.2 | 10.3 | 16.3 | 5.1 | 11.3 | 67.5 | 45.3 | 48.0 | 81.7 | 35.6 | 28.2 | 11.0 | 200 |
| 73 | 20.4 | 13.0 | 19.0 | 5.5 | 13.7 | 80.4 | 44.5 | 47.4 | 87.0 | 37.9 | 31.6 | 10.6 | 200 |
| 74 | 20.3 | 20.5 | 37.8 | 16.2 | 36.5 | 125.3 | 93.0 | 69.5 | 70.3 | 35.5 | 29.6 | 18.8 | 200 |
| 75 | 25.2 | 27.6 | 47.8 | 23.7 | 54.7 | 157.6 | 106.5 | 75.7 | 67.2 | 35.0 | 27.5 | 19.4 | 200 |
| 76 | 31.0 | 37.3 | 60.3 | 37.7 | 80.7 | 187.2 | 121.8 | 82.2 | 67.6 | 36.0 | 28.6 | 21.3 | 200 |
| 77 | 37.7 | 49.8 | 78.3 | 62.9 | 116.8 | **212.6** | 135.3 | 87.4 | 68.6 | 37.1 | 30.4 | 23.8 | 200 |
| 78 | 42.5 | 59.5 | 97.8 | 95.9 | 154.0 | **224.1** | 141.7 | 89.6 | 69.1 | 37.6 | 31.3 | 25.2 | 200 |
| 79 | 1.2 | 1.5 | 2.6 | 1.7 | 5.1 | 11.3 | 10.6 | 6.5 | 11.6 | 3.2 | 2.5 | 1.0 | 14 |
| 80 | 1.8 | 3.0 | 4.5 | 4.0 | 13.1 | **22.0** | **17.0** | 8.3 | 12.9 | 3.4 | 2.4 | 1.0 | 14 |
| 81 | 3.0 | 5.7 | 8.4 | 7.2 | **23.9** | **35.0** | **23.2** | 10.3 | **15.5** | 3.7 | 2.4 | 1.1 | 14 |
| 82 | 5.9 | 11.3 | **16.5** | **15.1** | **45.7** | **64.3** | **36.5** | **14.8** | **21.1** | 4.9 | 3.1 | 1.6 | 14 |
| 83 | 2.3 | 2.3 | 4.0 | 1.9 | 3.9 | 13.4 | 11.4 | 9.5 | **19.4** | 5.3 | 4.5 | 1.7 | 14 |

Table 9. Predicted monthly 90th percentiles of fecal coliform (numbers per 100 ml) in Grays Harbor before rollback of loading sources. Bold, shaded values indicate exceedence of the water quality standard.

| WASP Segment | May-97 | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan-98 | Feb | Mar | Apr | Water Quality Standard |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.0 | 0.7 | 2.6 | 0.6 | 1.9 | 11.9 | 11.0 | 7.3 | 14.8 | 2.9 | 2.4 | 0.2 | 43 |
| 2 | 1.6 | 1.1 | 4.3 | 0.8 | 3.2 | 18.8 | 15.8 | 11.1 | 19.7 | 3.9 | 3.5 | 0.6 | 43 |
| 3 | 2.3 | 1.5 | 6.5 | 1.2 | 5.0 | 26.8 | 22.8 | 15.3 | 27.1 | 5.4 | 4.8 | 1.1 | 43 |
| 4 | 3.9 | 2.4 | 9.5 | 1.9 | 8.1 | 40.9 | 36.7 | 25.2 | 41.5 | 8.8 | 8.1 | 2.0 | 43 |
| 5 | 5.5 | 3.4 | 12.4 | 2.8 | 11.6 | **54.7** | **52.0** | 35.1 | **54.5** | 12.7 | 11.7 | 3.1 | 43 |
| 6 | 7.6 | 4.7 | 16.5 | 3.9 | 16.0 | **70.8** | **68.7** | **47.4** | **67.1** | 17.0 | 16.0 | 4.4 | 43 |
| 7 | 9.5 | 6.3 | 21.4 | 4.8 | 22.2 | 88.1 | 84.5 | 59.8 | 78.1 | 20.1 | 19.4 | 6.0 | 200 |
| 8 | 13.9 | 8.8 | 30.3 | 7.3 | 30.0 | 117.0 | 112.0 | 77.5 | 95.5 | 27.5 | 27.0 | 8.6 | 200 |
| 9 | 18.2 | 12.3 | 41.9 | 9.1 | 38.2 | 141.0 | 141.0 | 96.1 | 111.0 | 33.2 | 33.4 | 11.7 | 200 |
| 10 | 25.8 | 17.6 | 56.1 | 12.1 | 54.5 | 172.0 | 171.0 | 115.0 | 123.0 | 41.3 | 40.1 | 16.5 | 200 |
| 11 | 29.9 | 21.1 | 66.7 | 14.9 | 66.4 | 184.0 | 191.0 | 118.0 | 127.0 | 45.4 | 43.6 | 19.3 | 200 |
| 12 | 32.0 | 24.9 | 80.4 | 17.6 | 77.9 | 188.0 | 193.0 | 118.0 | 129.0 | 45.8 | 45.9 | 22.1 | 200 |
| 13 | 7.3 | 4.8 | 16.8 | 4.3 | 19.3 | **74.2** | **67.8** | **45.7** | **65.1** | 16.4 | 15.6 | 4.6 | 43 |
| 14 | 9.8 | 6.4 | 26.4 | 6.4 | 29.5 | 92.5 | 89.6 | 61.2 | 75.8 | 20.1 | 20.2 | 6.4 | 200 |
| 15 | 16.7 | 12.0 | 58.7 | 16.4 | 52.4 | 129.0 | 132.0 | 86.3 | 96.9 | 28.8 | 30.3 | 10.8 | 200 |
| 16 | 23.0 | 17.6 | 83.9 | 28.3 | 70.0 | 155.0 | 155.0 | 104.0 | 111.0 | 36.6 | 39.0 | 15.5 | 200 |
| 17 | 28.7 | 23.6 | 137.0 | 52.7 | 97.2 | 176.0 | 168.0 | 109.0 | 116.0 | 41.4 | 44.1 | 19.5 | 200 |
| 18 | 2.8 | 1.8 | 7.2 | 1.5 | 7.5 | 32.1 | 27.1 | 18.4 | 31.2 | 6.3 | 5.6 | 1.4 | 43 |
| 19 | 4.0 | 3.1 | 9.6 | 2.5 | 12.8 | **44.6** | 37.6 | 25.3 | 41.6 | 8.6 | 7.9 | 2.3 | 43 |
| 20 | 2.2 | 1.7 | 6.3 | 1.5 | 14.5 | 28.0 | 37.8 | 17.5 | 25.5 | 4.7 | 4.6 | 1.3 | 43 |
| 21 | 2.7 | 1.8 | 9.0 | 1.3 | 8.0 | 32.4 | 25.3 | 17.2 | 25.8 | 5.0 | 4.6 | 1.5 | 43 |
| 22 | 4.4 | 2.9 | 14.2 | 2.4 | 11.7 | **51.1** | 38.4 | 26.8 | 39.6 | 8.6 | 7.7 | 2.6 | 43 |
| 23 | 5.8 | 3.7 | 14.7 | 2.9 | 13.9 | **58.7** | **55.0** | 39.0 | **55.9** | 12.9 | 12.4 | 3.6 | 43 |
| 24 | 3.4 | 2.3 | 12.5 | 1.8 | 12.6 | **44.0** | 33.9 | 20.0 | 27.7 | 5.4 | 5.8 | 1.7 | 43 |
| 25 | 5.5 | 3.8 | 20.2 | 3.1 | 20.2 | **70.8** | **51.0** | 29.4 | 38.8 | 7.8 | 8.9 | 2.5 | 43 |
| 26 | 6.7 | 4.3 | 22.3 | 3.4 | 20.4 | **66.5** | **71.6** | **48.8** | **62.4** | 13.3 | 13.8 | 4.0 | 43 |
| 27 | 9.2 | 5.5 | 23.8 | 4.3 | 24.9 | 83.7 | 92.0 | 62.4 | 77.4 | 17.7 | 18.3 | 5.5 | 200 |
| 28 | 3.7 | 2.6 | 14.3 | 1.9 | 16.1 | **56.3** | 41.0 | 20.5 | 27.8 | 5.3 | 6.3 | 1.7 | 43 |
| 29 | 7.4 | 5.6 | 35.7 | 4.6 | 30.9 | **119.0** | **53.4** | 26.1 | 34.8 | 7.4 | 8.2 | 2.6 | 43 |
| 30 | 9.0 | 5.7 | 20.4 | 4.9 | 20.9 | **84.6** | **81.5** | **54.8** | **73.6** | 19.6 | 18.8 | 5.7 | 43 |
| 31 | 13.9 | 9.2 | 37.0 | 8.2 | 35.2 | 114.0 | 114.0 | 76.5 | 91.9 | 26.6 | 26.2 | 8.9 | 200 |
| 32 | 20.7 | 14.3 | 53.3 | 11.8 | 46.4 | 150.0 | 150.0 | 104.0 | 113.0 | 35.6 | 36.5 | 13.5 | 200 |
| 33 | 25.9 | 18.8 | 78.0 | 21.0 | 66.4 | 166.0 | 168.0 | 111.0 | 118.0 | 40.1 | 40.2 | 16.6 | 200 |
| 34 | 31.6 | 26.8 | 102.0 | 24.9 | 79.2 | 184.0 | 187.0 | 117.0 | 130.0 | 44.4 | 45.8 | 22.0 | 200 |
| 35 | 33.2 | 29.0 | 97.4 | 24.9 | 85.6 | 193.0 | 191.0 | 122.0 | 133.0 | 45.9 | 47.0 | 23.6 | 200 |
| 36 | 33.7 | 29.5 | 96.6 | 24.2 | 86.5 | 196.0 | 191.0 | 122.0 | 133.0 | 46.4 | 47.1 | 23.9 | 200 |
| 37 | 34.1 | 29.8 | 96.6 | 24.1 | 88.1 | 197.0 | 191.0 | 122.0 | 134.0 | 47.3 | 48.2 | 24.3 | 200 |
| 38 | 34.7 | 31.3 | 96.7 | 23.9 | 87.7 | 196.0 | 191.0 | 122.0 | 133.0 | 47.4 | 48.2 | 24.1 | 200 |
| 39 | 35.4 | 32.6 | 96.8 | 23.8 | 89.4 | 198.0 | 191.0 | 122.0 | 134.0 | 47.5 | 47.8 | 24.6 | 200 |
| 40 | 35.7 | 33.6 | 92.7 | 22.5 | 83.3 | 194.0 | 191.0 | 123.0 | 136.0 | 47.4 | 48.3 | 25.0 | 200 |
| 41 | 36.4 | 34.3 | 86.4 | 21.6 | 84.0 | 195.0 | 191.0 | 123.0 | 136.0 | 48.1 | 48.3 | 25.8 | 200 |
| 42 | 36.9 | 35.4 | 74.8 | 20.1 | 84.9 | 196.0 | 190.0 | 123.0 | 137.0 | 48.7 | 48.6 | 26.5 | 200 |
| 43 | 37.7 | 36.9 | 66.7 | 17.9 | 83.7 | 198.0 | 190.0 | 124.0 | 137.0 | 49.0 | 48.8 | 26.8 | 200 |
| 44 | 38.1 | 37.7 | 60.7 | 16.5 | 81.6 | 198.0 | 192.0 | 124.0 | 138.0 | 49.4 | 49.3 | 27.1 | 200 |
| 45 | 38.3 | 38.7 | 59.2 | 14.4 | 78.7 | 199.0 | 193.0 | 124.0 | 138.0 | 49.5 | 49.7 | 27.4 | 200 |
| 46 | 38.8 | 39.7 | 58.5 | 12.5 | 79.0 | **201.0** | 194.0 | 124.0 | 139.0 | 49.7 | 50.2 | 27.9 | 200 |
| 47 | 39.4 | 40.8 | 55.7 | 10.8 | 79.8 | **201.0** | 195.0 | 125.0 | 139.0 | 50.2 | 50.8 | 28.2 | 200 |
| 48 | 40.9 | 41.7 | 53.7 | 10.2 | 87.3 | **204.0** | 196.0 | 125.0 | 140.0 | 50.6 | 51.5 | 28.6 | 200 |
| 49 | 40.1 | 42.2 | 51.5 | 9.5 | 79.9 | 194.0 | 196.0 | 125.0 | 140.0 | 50.9 | 51.7 | 28.7 | 200 |
| 50 | 40.0 | 43.4 | 50.1 | 9.4 | 79.0 | 196.0 | 197.0 | 126.0 | 141.0 | 51.4 | 52.3 | 29.1 | 200 |
| 51 | 40.4 | 44.5 | 45.0 | 9.4 | 79.9 | 198.0 | 198.0 | 126.0 | 142.0 | 52.0 | 52.8 | 29.5 | 200 |
| 52 | 41.1 | 45.9 | 45.1 | 10.0 | 80.9 | **200.0** | **200.0** | 126.0 | 142.0 | 52.7 | 53.4 | 30.1 | 200 |
| 53 | 42.3 | 47.4 | 48.6 | 11.2 | 86.4 | **202.0** | **201.0** | 127.0 | 143.0 | 53.2 | 54.0 | 30.6 | 200 |
| 54 | 43.2 | 48.7 | 52.8 | 12.7 | 88.5 | **204.0** | **203.0** | 128.0 | 144.0 | 53.4 | 54.7 | 31.1 | 200 |
| 55 | 43.8 | 49.7 | 54.2 | 14.3 | 88.6 | **206.0** | **204.0** | 129.0 | 144.0 | 53.7 | 55.2 | 31.5 | 200 |
| 56 | 44.2 | 50.9 | 55.5 | 16.2 | 89.7 | **207.0** | **205.0** | 129.0 | 145.0 | 54.1 | 55.8 | 31.8 | 200 |
| 57 | 44.7 | 52.0 | 57.1 | 18.3 | 90.8 | **209.0** | **206.0** | 130.0 | 145.0 | 54.4 | 56.4 | 32.3 | 200 |
| 58 | 45.0 | 53.0 | 58.3 | 20.0 | 91.9 | **211.0** | **207.0** | 130.0 | 146.0 | 54.6 | 56.8 | 32.6 | 200 |
| 59 | 45.4 | 54.0 | 59.4 | 22.2 | 92.3 | **212.0** | **207.0** | 131.0 | 146.0 | 54.8 | 57.1 | 32.9 | 200 |
| 60 | 45.7 | 54.9 | 60.6 | 24.5 | 93.7 | **214.0** | **208.0** | 130.0 | 147.0 | 55.1 | 57.5 | 33.3 | 200 |
| 61 | 46.2 | 56.2 | 62.8 | 27.3 | 95.5 | **215.0** | **209.0** | 131.0 | 147.0 | 55.5 | 58.0 | 33.8 | 200 |
| 62 | 46.7 | 57.3 | 65.9 | 30.3 | 98.5 | **218.0** | **209.0** | 131.0 | 148.0 | 55.8 | 58.5 | 34.2 | 200 |
| 63 | 47.3 | 58.3 | 67.8 | 33.4 | 102.0 | **219.0** | **211.0** | 132.0 | 148.0 | 56.1 | 58.9 | 34.5 | 200 |
| 64 | 47.9 | 59.3 | 69.1 | 37.5 | 104.0 | **221.0** | **211.0** | 132.0 | 148.0 | 56.6 | 59.3 | 34.5 | 200 |
| 65 | 54.0 | 63.9 | 66.3 | 33.7 | 111.0 | **263.0** | **234.0** | 150.0 | 164.0 | 64.3 | 65.2 | 37.8 | 200 |
| 66 | 55.5 | 66.6 | 71.5 | 38.5 | 117.0 | **269.0** | **236.0** | 152.0 | 166.0 | 65.3 | 66.3 | 38.6 | 200 |
| 67 | 72.1 | 80.5 | 56.8 | 30.8 | 93.9 | **300.0** | **276.0** | 191.0 | 198.0 | 83.4 | 81.3 | 47.6 | 200 |
| 68 | 39.0 | 21.6 | 61.7 | 12.4 | 77.7 | 219.0 | 168.0 | 126.0 | 135.0 | 58.9 | 44.9 | 19.4 | 400 |
| 69 | 48.0 | 21.7 | 69.8 | 10.2 | 85.9 | 258.0 | 151.0 | 126.0 | 148.0 | 68.8 | 47.3 | 18.1 | 400 |
| 70 | 60.3 | 22.0 | 68.6 | 8.1 | 94.8 | 311.0 | 135.0 | 128.0 | 162.0 | 84.4 | 54.9 | 16.9 | 400 |
| 71 | 85.4 | 28.2 | 88.9 | 7.2 | 111.0 | 399.0 | 146.0 | 142.0 | 186.0 | 116.0 | 77.8 | 16.8 | 400 |
| 72 | 58.4 | 22.1 | 68.3 | 8.2 | 94.7 | 304.0 | 132.0 | 127.0 | 171.0 | 82.7 | 54.1 | 16.9 | 400 |
| 73 | 82.7 | 28.5 | 86.9 | 7.5 | 112.0 | 395.0 | 144.0 | 143.0 | 198.0 | 112.0 | 75.2 | 16.7 | 400 |
| 74 | 41.6 | 38.8 | 161.0 | 25.5 | 149.0 | 321.0 | 168.0 | 124.0 | 123.0 | 52.9 | 39.9 | 24.8 | 400 |
| 75 | 47.3 | 48.6 | 150.0 | 36.4 | 194.0 | 342.0 | 164.0 | 128.0 | 121.0 | 55.4 | 38.0 | 25.1 | 400 |
| 76 | 51.8 | 58.0 | 155.0 | 62.1 | 230.0 | 358.0 | 170.0 | 133.0 | 121.0 | 58.5 | 40.5 | 26.7 | 400 |
| 77 | 54.7 | 66.5 | 168.0 | 101.0 | 252.0 | 368.0 | 181.0 | 135.0 | 120.0 | 60.3 | 43.1 | 28.8 | 400 |
| 78 | 56.2 | 71.2 | 174.0 | 135.0 | 262.0 | 373.0 | 185.0 | 136.0 | 119.0 | 61.3 | 44.6 | 29.8 | 400 |
| 79 | 2.6 | 2.4 | 7.3 | 2.5 | 39.7 | 37.0 | **73.0** | 17.7 | 26.5 | 4.5 | 4.5 | 1.4 | 43 |
| 80 | 3.0 | 3.8 | 8.8 | 6.4 | **98.9** | **62.9** | **133.0** | 18.9 | 32.0 | 5.2 | 3.6 | 1.4 | 43 |
| 81 | 4.4 | 7.5 | 16.4 | 10.5 | **196.0** | **113.0** | **210.0** | 24.9 | **51.7** | 6.2 | 4.0 | 1.4 | 43 |
| 82 | 9.2 | 15.0 | 32.1 | 22.5 | **348.0** | **242.0** | **264.0** | **43.8** | **93.0** | 9.6 | 6.3 | 1.9 | 43 |
| 83 | 6.3 | 5.8 | 14.4 | 4.5 | 25.4 | **70.6** | **51.6** | 33.8 | **53.8** | 12.0 | 11.5 | 3.3 | 43 |

Table 10. Summary of Grays Harbor area NPDES permit effluent limits.

| Permittee | Permit number | Issue date | Expiration date | Monthly average flow (mgd) | Daily maximum flow (mgd) | Monthly average FC (colonies per 100 ml) | Weekly average FC (colonies per 100 ml) | Daily maximum FC (colonies per 100 ml) |
|---|---|---|---|---|---|---|---|---|
| Aberdeen | WA0037192 | 6/22/90 | 6/26/00 | 8.750 | -- | 200 | 400 | -- |
| Elma | WA0023132 | 1/25/96 | 2/25/01 | 0.480 | -- | 200 | 400 | -- |
| Hoquiam | WA0020915 | 3/6/96 | 4/6/01 | 4.000 | -- | 200 | 400 | -- |
| McCleary | WA0024040 | 2/5/97 | 6/30/00 | 0.250 | -- | 200 | 400 | -- |
| Montesano | WA0024660 | 1/8/97 | 6/30/00 | 0.360 | -- | 200 | 400 | -- |
| Ocean Shores | WA0023817 | 3/19/79 | 3/19/84 | 6.700 | -- | 200 | 400 | -- |
| Westport | WA0020923 | 7/19/78 | 7/15/83 | 0.800 | -- | 200 | 400 | -- |
| Ocean Spray Cranberries | WA0003271 | 3/7/96 | 3/7/01 | 0.315 | 0.410 | 200 | 400 | -- |
| Grays Harbor Paper 001 | WA0003077 | 9/23/97 | 9/23/02 | -- | -- | 500 | -- | 19200 |
| Grays Harbor Paper 002 | WA0003077 | 9/23/97 | 9/23/02 | -- | -- | -- | -- | -- |
| Weyerhaeuser 001 | WA0000809 | 5/10/91 | 5/10/96 | -- | -- | 5000 | -- | 20000 |
| Weyerhaeuser 002 | WA0000809 | 5/10/91 | 5/10/96 | -- | -- | 5000 | -- | 20000 |

## Second-cut of loading reductions needed to meet marine standards

The next step was to estimate further reductions in tributary loading that would result in water quality standards being met in the harbor. The additional reduction needed was estimated as follows:

- Concentrations of fecal coliform in the Wishkah and Hoquiam rivers were reduced further to comply with marine class B water quality standards for the inner harbor.
- Loading from the Humptulips River was reduced until marine class A standards were met in model segment 29.
- Loading from the Elk River and Andrews Creek was reduced until the marine class A standard was met in model segment 82.

The predicted monthly geometric means and $90^{th}$ percentiles in response to this loading reduction are presented in Tables 13 and 14. This reduction of loading was predicted to meet water quality standards in all model segments in Grays Harbor. The final recommended reductions in tributary loads to Grays Harbor are presented in Table 15.

Large reductions in fecal coliform concentrations are needed to meet water quality standards for tributaries to Grays Harbor. With the exception of the Wynoochee River, all tributaries discharging to Grays Harbor and the lower Chehalis River require some reduction in loading of fecal coliform to meet freshwater quality standards. The total reduction in loading needed from all sources combined is approximately $8.5 \times 10^{15}$ colonies/year, which is an average of about a 65 percent reduction of the current total loading from tributaries.

Table 11. Predicted monthly geometric means of fecal coliform (numbers per 100 ml) in Grays Harbor after rollback of loading sources to meet freshwater standards. Bold, shaded values (none) indicate exceedence of the water quality standard.

| WASP segment | May-97 | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan-98 | Feb | Mar | Apr | Water Quality Standard |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.4 | 0.3 | 0.3 | 0.5 | 0.2 | 0.2 | 0.1 | 14 |
| 2 | 0.2 | 0.1 | 0.3 | 0.2 | 0.3 | 0.9 | 0.8 | 0.6 | 1.1 | 0.3 | 0.3 | 0.1 | 14 |
| 3 | 0.3 | 0.2 | 0.4 | 0.3 | 0.4 | 1.7 | 1.3 | 1.1 | 2.1 | 0.6 | 0.4 | 0.2 | 14 |
| 4 | 0.5 | 0.4 | 0.7 | 0.5 | 0.7 | 3.2 | 2.6 | 2.1 | 4.1 | 1.2 | 0.9 | 0.3 | 14 |
| 5 | 0.8 | 0.6 | 1.1 | 0.7 | 1.1 | 4.7 | 3.9 | 3.2 | 6.2 | 1.8 | 1.4 | 0.5 | 14 |
| 6 | 1.1 | 0.9 | 1.5 | 1.0 | 1.5 | 6.6 | 5.6 | 4.5 | 8.6 | 2.6 | 2.0 | 0.8 | 14 |
| 7 | 1.5 | 1.2 | 2.0 | 1.4 | 2.0 | 8.8 | 7.5 | 6.0 | 11.1 | 3.5 | 2.7 | 1.1 | 100 |
| 8 | 2.2 | 1.7 | 2.8 | 1.9 | 2.8 | 12.2 | 10.5 | 8.3 | 14.9 | 4.9 | 3.9 | 1.5 | 100 |
| 9 | 3.0 | 2.4 | 3.8 | 2.6 | 3.7 | 16.5 | 14.2 | 11.1 | 19.3 | 6.8 | 5.3 | 2.1 | 100 |
| 10 | 4.6 | 3.6 | 5.5 | 3.6 | 5.4 | 23.4 | 19.6 | 15.2 | 23.7 | 9.3 | 7.6 | 3.3 | 100 |
| 11 | 5.7 | 4.7 | 6.9 | 4.5 | 6.7 | 27.8 | 22.8 | 17.3 | 25.0 | 10.5 | 8.8 | 4.1 | 100 |
| 12 | 6.8 | 6.0 | 8.6 | 5.6 | 8.5 | 30.9 | 25.2 | 18.3 | 23.9 | 10.6 | 9.6 | 5.0 | 100 |
| 13 | 1.2 | 1.0 | 1.7 | 1.1 | 1.8 | 7.2 | 5.7 | 4.6 | 8.7 | 2.7 | 2.0 | 0.8 | 14 |
| 14 | 1.8 | 1.4 | 2.5 | 1.8 | 2.5 | 10.3 | 8.4 | 6.7 | 12.1 | 3.9 | 3.1 | 1.2 | 100 |
| 15 | 3.3 | 2.7 | 4.9 | 3.8 | 4.8 | 17.4 | 14.0 | 10.7 | 17.1 | 6.3 | 5.3 | 2.2 | 100 |
| 16 | 4.7 | 4.0 | 7.4 | 5.8 | 6.7 | 22.8 | 18.4 | 13.7 | 20.2 | 8.0 | 7.0 | 3.1 | 100 |
| 17 | 6.3 | 5.5 | 11.4 | 9.4 | 9.4 | 27.9 | 21.9 | 15.7 | 21.8 | 9.4 | 8.4 | 4.0 | 100 |
| 18 | 0.4 | 0.3 | 0.5 | 0.3 | 0.6 | 2.5 | 1.9 | 1.5 | 3.1 | 0.9 | 0.6 | 0.2 | 14 |
| 19 | 0.7 | 0.6 | 1.0 | 0.6 | 1.1 | 4.2 | 3.0 | 2.5 | 4.9 | 1.4 | 1.1 | 0.4 | 14 |
| 20 | 0.4 | 0.4 | 0.7 | 0.5 | 0.9 | 3.0 | 2.4 | 1.9 | 3.5 | 1.0 | 0.8 | 0.3 | 14 |
| 21 | 0.4 | 0.4 | 0.8 | 0.4 | 0.8 | 3.1 | 2.2 | 1.8 | 3.4 | 1.0 | 0.7 | 0.3 | 14 |
| 22 | 0.7 | 0.6 | 1.2 | 0.7 | 1.2 | 4.7 | 3.4 | 2.8 | 5.2 | 1.5 | 1.2 | 0.5 | 14 |
| 23 | 0.9 | 0.7 | 1.3 | 0.8 | 1.3 | 5.6 | 4.7 | 3.8 | 7.2 | 2.2 | 1.7 | 0.6 | 14 |
| 24 | 0.6 | 0.6 | 1.2 | 0.6 | 1.2 | 4.5 | 2.9 | 2.4 | 4.4 | 1.3 | 1.0 | 0.4 | 14 |
| 25 | 1.1 | 1.0 | 2.1 | 1.2 | 2.0 | 7.4 | 4.6 | 3.7 | 6.6 | 2.0 | 1.5 | 0.6 | 14 |
| 26 | 1.3 | 1.1 | 1.9 | 1.2 | 1.9 | 7.9 | 6.3 | 5.1 | 9.5 | 2.9 | 2.3 | 0.9 | 14 |
| 27 | 1.7 | 1.3 | 2.3 | 1.5 | 2.2 | 9.8 | 8.4 | 6.8 | 12.5 | 4.0 | 3.1 | 1.2 | 100 |
| 28 | 0.8 | 0.8 | 1.6 | 0.8 | 1.6 | 5.9 | 3.4 | 2.9 | 5.0 | 1.5 | 1.1 | 0.4 | 14 |
| 29 | 1.7 | 1.9 | 3.9 | 2.1 | 4.0 | 12.3 | 5.5 | 4.3 | 6.8 | 2.1 | 1.6 | 0.7 | 14 |
| 30 | 1.4 | 1.1 | 1.9 | 1.3 | 1.9 | 8.4 | 7.1 | 5.7 | 10.5 | 3.3 | 2.5 | 1.0 | 14 |
| 31 | 2.4 | 1.9 | 3.3 | 2.3 | 3.2 | 13.3 | 11.3 | 8.9 | 15.4 | 5.3 | 4.2 | 1.7 | 100 |
| 32 | 3.7 | 2.9 | 4.7 | 3.3 | 4.5 | 19.3 | 16.3 | 12.6 | 20.6 | 7.6 | 6.2 | 2.6 | 100 |
| 33 | 5.0 | 4.1 | 7.0 | 5.0 | 6.3 | 24.3 | 20.0 | 15.1 | 22.4 | 9.1 | 7.7 | 3.4 | 100 |
| 34 | 6.9 | 6.3 | 9.9 | 6.8 | 9.2 | 31.6 | 25.1 | 17.9 | 23.3 | 10.1 | 9.3 | 4.9 | 100 |
| 35 | 7.3 | 6.8 | 10.4 | 7.0 | 9.7 | 33.3 | 26.4 | 18.6 | 23.9 | 10.4 | 9.6 | 5.2 | 100 |
| 36 | 7.5 | 7.0 | 10.6 | 7.1 | 10.0 | 33.9 | 26.8 | 18.9 | 24.0 | 10.5 | 9.8 | 5.3 | 100 |
| 37 | 7.6 | 7.2 | 10.9 | 7.2 | 10.2 | 34.4 | 27.2 | 19.1 | 24.2 | 10.6 | 9.9 | 5.4 | 100 |
| 38 | 7.8 | 7.4 | 11.1 | 7.2 | 10.4 | 35.1 | 27.6 | 19.4 | 24.3 | 10.7 | 10.0 | 5.6 | 100 |
| 39 | 8.1 | 7.8 | 11.5 | 7.3 | 10.8 | 36.2 | 28.1 | 19.8 | 24.4 | 10.7 | 10.1 | 5.8 | 100 |
| 40 | 8.0 | 7.9 | 10.9 | 7.0 | 10.3 | 33.3 | 27.1 | 18.2 | 22.8 | 10.2 | 10.0 | 5.8 | 100 |
| 41 | 8.1 | 8.2 | 11.0 | 7.0 | 10.5 | 33.7 | 27.4 | 18.3 | 22.9 | 10.2 | 10.0 | 6.0 | 100 |
| 42 | 8.3 | 8.7 | 11.1 | 6.8 | 10.7 | 34.3 | 27.7 | 18.3 | 22.9 | 10.2 | 10.1 | 6.1 | 100 |
| 43 | 8.6 | 9.2 | 11.3 | 6.7 | 11.1 | 35.1 | 28.1 | 18.5 | 23.0 | 10.3 | 10.2 | 6.3 | 100 |
| 44 | 8.7 | 9.4 | 11.2 | 6.3 | 10.9 | 34.9 | 28.3 | 18.5 | 23.0 | 10.3 | 10.2 | 6.4 | 100 |
| 45 | 8.8 | 9.6 | 11.1 | 6.0 | 10.9 | 35.2 | 28.6 | 18.5 | 23.0 | 10.3 | 10.3 | 6.4 | 100 |
| 46 | 9.0 | 10.0 | 11.0 | 5.7 | 10.9 | 35.6 | 28.8 | 18.6 | 23.1 | 10.4 | 10.4 | 6.5 | 100 |
| 47 | 9.2 | 10.4 | 10.9 | 5.3 | 11.0 | 36.1 | 29.1 | 18.8 | 23.2 | 10.4 | 10.5 | 6.6 | 100 |
| 48 | 9.5 | 10.8 | 11.0 | 5.2 | 11.3 | 36.8 | 29.4 | 19.0 | 23.4 | 10.5 | 10.6 | 6.8 | 100 |
| 49 | 9.5 | 11.0 | 11.0 | 5.0 | 11.3 | 36.9 | 29.6 | 19.0 | 23.2 | 10.5 | 10.7 | 6.8 | 100 |
| 50 | 9.8 | 11.5 | 11.3 | 5.0 | 11.7 | 37.6 | 30.0 | 19.2 | 23.3 | 10.6 | 10.8 | 6.9 | 100 |
| 51 | 10.1 | 12.0 | 11.7 | 5.1 | 12.2 | 38.4 | 30.4 | 19.3 | 23.4 | 10.7 | 10.9 | 7.0 | 100 |
| 52 | 10.5 | 12.8 | 12.5 | 5.5 | 13.1 | 39.5 | 30.9 | 19.6 | 23.6 | 10.8 | 11.1 | 7.2 | 100 |
| 53 | 11.0 | 13.6 | 13.6 | 6.1 | 14.3 | 40.6 | 31.4 | 19.8 | 23.7 | 10.9 | 11.2 | 7.4 | 100 |
| 54 | 11.5 | 14.5 | 14.7 | 6.9 | 15.6 | 41.7 | 32.0 | 20.1 | 23.9 | 11.0 | 11.4 | 7.6 | 100 |
| 55 | 11.9 | 15.3 | 15.9 | 7.8 | 17.0 | 42.6 | 32.4 | 20.2 | 24.0 | 11.1 | 11.5 | 7.7 | 100 |
| 56 | 12.3 | 16.0 | 17.1 | 8.9 | 18.5 | 43.5 | 32.7 | 20.4 | 24.1 | 11.2 | 11.6 | 7.9 | 100 |
| 57 | 12.7 | 16.8 | 18.4 | 10.0 | 20.0 | 44.4 | 33.1 | 20.6 | 24.2 | 11.2 | 11.8 | 8.0 | 100 |
| 58 | 12.9 | 17.4 | 19.6 | 11.2 | 21.4 | 45.0 | 33.4 | 20.6 | 24.2 | 11.2 | 11.8 | 8.1 | 100 |
| 59 | 13.2 | 18.0 | 20.8 | 12.5 | 22.9 | 45.7 | 33.7 | 20.8 | 24.3 | 11.3 | 11.9 | 8.2 | 100 |
| 60 | 13.5 | 18.6 | 22.0 | 13.9 | 24.6 | 46.3 | 33.9 | 20.9 | 24.4 | 11.4 | 12.0 | 8.3 | 100 |
| 61 | 13.8 | 19.3 | 23.5 | 15.7 | 26.5 | 47.1 | 34.3 | 21.0 | 24.5 | 11.4 | 12.1 | 8.4 | 100 |
| 62 | 14.1 | 19.9 | 24.9 | 17.6 | 28.5 | 48.0 | 34.6 | 21.2 | 24.6 | 11.5 | 12.2 | 8.5 | 100 |
| 63 | 14.5 | 20.6 | 26.4 | 19.5 | 30.6 | 48.8 | 35.0 | 21.3 | 24.7 | 11.6 | 12.3 | 8.7 | 100 |
| 64 | 15.1 | 22.1 | 29.2 | 22.6 | 33.8 | 49.8 | 35.3 | 21.5 | 24.8 | 11.6 | 12.4 | 8.8 | 100 |
| 65 | 12.0 | 16.1 | 21.0 | 16.8 | 25.8 | 49.1 | 36.6 | 22.7 | 27.1 | 12.4 | 12.8 | 8.6 | 100 |
| 66 | 12.6 | 17.3 | 22.5 | 17.3 | 27.2 | 51.2 | 37.4 | 23.1 | 27.4 | 12.6 | 13.1 | 8.9 | 100 |
| 67 | 11.8 | 13.1 | 10.1 | 7.3 | 12.0 | 35.7 | 39.3 | 26.2 | 33.2 | 15.5 | 15.5 | 10.3 | 100 |
| 68 | 6.9 | 5.1 | 7.4 | 4.3 | 6.9 | 34.1 | 23.4 | 22.1 | 39.6 | 15.2 | 11.2 | 4.3 | 200 |
| 69 | 8.3 | 5.5 | 8.0 | 4.0 | 7.1 | 39.9 | 24.0 | 26.1 | 49.9 | 19.3 | 13.8 | 4.5 | 200 |
| 70 | 9.9 | 6.0 | 8.4 | 3.5 | 7.2 | 46.0 | 24.9 | 29.3 | 58.5 | 23.3 | 17.0 | 4.7 | 200 |
| 71 | 14.9 | 8.7 | 10.8 | 3.7 | 9.3 | 59.5 | 29.5 | 33.4 | 68.4 | 28.3 | 23.1 | 5.6 | 200 |
| 72 | 10.0 | 6.2 | 8.5 | 3.6 | 7.4 | 45.8 | 24.8 | 29.5 | 58.8 | 23.0 | 16.9 | 4.8 | 200 |
| 73 | 15.3 | 9.3 | 11.3 | 4.1 | 10.0 | 59.8 | 29.5 | 33.6 | 68.7 | 28.2 | 22.8 | 5.8 | 200 |
| 74 | 13.1 | 13.0 | 20.9 | 11.8 | 23.9 | 83.1 | 55.6 | 41.7 | 43.9 | 20.3 | 14.6 | 8.8 | 200 |
| 75 | 18.0 | 19.4 | 29.6 | 17.8 | 39.5 | 115.1 | 76.0 | 54.2 | 49.1 | 24.9 | 18.4 | 12.0 | 200 |
| 76 | 23.1 | 27.7 | 41.3 | 28.5 | 60.3 | 141.0 | 91.3 | 61.9 | 51.2 | 27.1 | 21.3 | 15.2 | 200 |
| 77 | 28.5 | 37.6 | 57.6 | 47.8 | 88.4 | 161.4 | 102.7 | 66.4 | 52.1 | 28.2 | 23.1 | 18.0 | 200 |
| 78 | 32.3 | 45.2 | 74.1 | 72.8 | 116.9 | 170.4 | 107.7 | 68.1 | 52.5 | 28.6 | 23.8 | 19.2 | 200 |
| 79 | 0.5 | 0.5 | 0.9 | 0.7 | 1.6 | 4.1 | 3.2 | 2.2 | 3.7 | 1.1 | 0.8 | 0.3 | 14 |
| 80 | 0.6 | 0.8 | 1.2 | 1.1 | 3.3 | 6.2 | 4.4 | 2.4 | 3.6 | 1.1 | 0.7 | 0.3 | 14 |
| 81 | 0.9 | 1.3 | 1.9 | 1.7 | 5.3 | 8.2 | 5.3 | 2.6 | 3.7 | 1.0 | 0.6 | 0.3 | 14 |
| 82 | 1.5 | 2.4 | 3.5 | 3.2 | 9.5 | 13.5 | 7.5 | 3.3 | 4.5 | 1.2 | 0.7 | 0.4 | 14 |
| 83 | 1.2 | 1.1 | 1.7 | 1.1 | 2.1 | 6.8 | 4.3 | 3.6 | 6.9 | 2.0 | 1.5 | 0.6 | 14 |

Table 12. Predicted monthly 90th percentiles of fecal coliform (numbers per 100 ml) in Grays Harbor after rollback c loading sources to meet freshwater standards. Bold, shaded values indicate exceedence of the water quality standard.

| WASP Segment | May-97 | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan-98 | Feb | Mar | Apr | Water Quality Standard |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.6 | 0.4 | 1.0 | 0.4 | 1.1 | 6.4 | 3.8 | 2.8 | 5.1 | 1.1 | 0.8 | 0.1 | 43 |
| 2 | 0.9 | 0.5 | 1.6 | 0.6 | 1.8 | 10.7 | 5.6 | 4.1 | 7.0 | 1.5 | 1.1 | 0.2 | 43 |
| 3 | 1.4 | 0.8 | 2.5 | 0.9 | 2.8 | 15.3 | 7.9 | 6.0 | 9.5 | 2.1 | 1.5 | 0.4 | 43 |
| 4 | 2.2 | 1.2 | 3.8 | 1.5 | 4.7 | 22.4 | 12.8 | 9.5 | 14.3 | 3.4 | 2.6 | 0.7 | 43 |
| 5 | 3.0 | 1.7 | 5.2 | 2.2 | 6.6 | 29.3 | 18.4 | 13.1 | 19.1 | 4.8 | 3.7 | 1.0 | 43 |
| 6 | 4.2 | 2.4 | 7.0 | 3.1 | 9.0 | 38.2 | 23.7 | 17.3 | 23.5 | 6.4 | 5.0 | 1.5 | 43 |
| 7 | 5.3 | 3.1 | 8.7 | 4.0 | 12.2 | 47.3 | 28.9 | 21.5 | 27.0 | 7.6 | 6.3 | 2.0 | 200 |
| 8 | 7.5 | 4.3 | 11.8 | 6.2 | 18.1 | 62.3 | 37.4 | 28.4 | 32.7 | 10.2 | 8.6 | 2.9 | 200 |
| 9 | 10.0 | 5.9 | 15.7 | 7.8 | 22.1 | 75.9 | 45.5 | 35.9 | 37.2 | 12.7 | 10.6 | 3.8 | 200 |
| 10 | 13.8 | 8.4 | 21.2 | 10.6 | 30.2 | 96.4 | 55.8 | 43.0 | 39.8 | 16.1 | 13.1 | 5.3 | 200 |
| 11 | 16.2 | 10.2 | 26.7 | 12.9 | 37.1 | 100.0 | 62.2 | 42.3 | 40.1 | 17.6 | 14.0 | 6.4 | 200 |
| 12 | 15.5 | 12.3 | 30.5 | 15.8 | 41.5 | 92.3 | 61.5 | 38.0 | 37.3 | 15.9 | 14.1 | 7.2 | 200 |
| 13 | 4.2 | 2.3 | 7.1 | 3.5 | 10.8 | 39.2 | 23.0 | 17.2 | 22.5 | 6.1 | 4.8 | 1.5 | 43 |
| 14 | 5.4 | 3.1 | 9.7 | 5.5 | 17.5 | 48.9 | 31.4 | 22.0 | 25.7 | 7.4 | 6.2 | 2.1 | 200 |
| 15 | 9.0 | 5.7 | 18.5 | 14.7 | 32.7 | 67.7 | 43.4 | 30.4 | 30.3 | 10.4 | 9.4 | 3.5 | 200 |
| 16 | 12.3 | 8.7 | 29.1 | 25.9 | 47.5 | 79.1 | 50.4 | 35.1 | 34.3 | 13.0 | 11.9 | 5.0 | 200 |
| 17 | 14.8 | 12.1 | 45.2 | 50.6 | 59.7 | 90.0 | 54.2 | 36.9 | 35.1 | 14.6 | 13.5 | 6.5 | 200 |
| 18 | 1.5 | 0.9 | 2.8 | 1.0 | 3.7 | 17.1 | 9.3 | 6.9 | 10.7 | 2.4 | 1.8 | 0.5 | 43 |
| 19 | 2.2 | 1.4 | 4.0 | 1.6 | 6.9 | 23.6 | 13.1 | 9.7 | 14.7 | 3.3 | 2.5 | 0.8 | 43 |
| 20 | 1.2 | 0.7 | 2.6 | 0.8 | 6.1 | 13.6 | 12.9 | 6.4 | 8.2 | 1.8 | 1.4 | 0.4 | 43 |
| 21 | 1.6 | 0.9 | 4.0 | 1.0 | 4.5 | 18.7 | 10.2 | 6.7 | 9.3 | 2.0 | 1.5 | 0.5 | 43 |
| 22 | 2.5 | 1.6 | 5.5 | 1.8 | 6.8 | 29.2 | 14.8 | 10.4 | 14.5 | 3.4 | 2.6 | 0.8 | 43 |
| 23 | 3.2 | 1.9 | 5.8 | 2.4 | 7.9 | 31.6 | 20.0 | 14.3 | 19.6 | 4.9 | 3.9 | 1.2 | 43 |
| 24 | 2.0 | 1.3 | 6.3 | 1.3 | 7.1 | 27.1 | 13.6 | 8.1 | 10.0 | 2.2 | 1.7 | 0.6 | 43 |
| 25 | 3.2 | 2.1 | 9.5 | 2.3 | 12.2 | 43.0 | 18.7 | 12.0 | 14.0 | 3.2 | 2.7 | 0.9 | 43 |
| 26 | 3.7 | 2.2 | 7.8 | 2.8 | 12.1 | 38.3 | 24.9 | 18.3 | 21.1 | 5.2 | 4.2 | 1.3 | 43 |
| 27 | 5.0 | 2.7 | 9.0 | 3.7 | 14.9 | 47.0 | 31.5 | 23.3 | 26.5 | 6.8 | 5.6 | 1.8 | 200 |
| 28 | 2.3 | 1.4 | 9.2 | 1.3 | 9.9 | 34.1 | 16.2 | 9.0 | 10.7 | 2.2 | 1.9 | 0.6 | 43 |
| 29 | 4.5 | 3.3 | 23.2 | 3.1 | 19.5 | **74.3** | 20.7 | 12.1 | 16.3 | 3.3 | 2.6 | 0.9 | 43 |
| 30 | 5.1 | 2.9 | 8.4 | 4.1 | 11.8 | **44.9** | 27.7 | 20.3 | 26.0 | 7.3 | 5.9 | 1.9 | 43 |
| 31 | 7.5 | 4.4 | 12.9 | 7.1 | 20.9 | 60.9 | 38.8 | 28.4 | 30.7 | 9.8 | 8.2 | 2.9 | 200 |
| 32 | 11.2 | 6.7 | 18.4 | 10.4 | 27.1 | 81.0 | 48.8 | 37.8 | 37.1 | 13.6 | 11.6 | 4.4 | 200 |
| 33 | 13.6 | 9.1 | 27.2 | 19.8 | 45.2 | 88.4 | 54.5 | 38.9 | 36.7 | 15.0 | 12.7 | 5.5 | 200 |
| 34 | 15.2 | 12.8 | 33.5 | 22.8 | 47.8 | 92.8 | 59.5 | 37.9 | 37.4 | 15.3 | 13.9 | 7.1 | 200 |
| 35 | 15.7 | 13.7 | 34.8 | 22.6 | 47.5 | 94.1 | 60.5 | 38.6 | 37.9 | 15.6 | 14.2 | 7.6 | 200 |
| 36 | 15.7 | 14.0 | 34.6 | 22.1 | 48.5 | 94.4 | 60.4 | 38.6 | 37.9 | 15.8 | 14.3 | 7.7 | 200 |
| 37 | 16.0 | 14.0 | 35.7 | 21.7 | 48.5 | 94.6 | 60.2 | 39.1 | 38.0 | 15.9 | 14.3 | 7.8 | 200 |
| 38 | 16.1 | 14.5 | 37.0 | 21.6 | 48.8 | 95.0 | 60.1 | 39.1 | 38.1 | 15.8 | 14.4 | 7.8 | 200 |
| 39 | 16.3 | 15.0 | 38.7 | 21.4 | 48.2 | 95.8 | 59.4 | 39.8 | 38.2 | 15.8 | 14.5 | 7.9 | 200 |
| 40 | 15.4 | 14.9 | 34.2 | 19.9 | 44.5 | 88.2 | 57.9 | 36.3 | 37.7 | 14.9 | 14.2 | 7.9 | 200 |
| 41 | 15.4 | 15.2 | 34.5 | 19.5 | 43.8 | 88.3 | 57.9 | 36.6 | 37.8 | 15.0 | 14.2 | 8.0 | 200 |
| 42 | 15.5 | 15.6 | 34.7 | 17.7 | 41.5 | 88.7 | 57.8 | 36.6 | 37.9 | 15.0 | 14.2 | 8.2 | 200 |
| 43 | 15.6 | 16.0 | 33.5 | 15.6 | 43.5 | 88.9 | 57.6 | 36.9 | 38.0 | 15.1 | 14.3 | 8.3 | 200 |
| 44 | 15.7 | 16.2 | 32.9 | 13.7 | 41.0 | 89.1 | 57.6 | 37.0 | 38.1 | 15.1 | 14.4 | 8.3 | 200 |
| 45 | 15.7 | 16.5 | 32.0 | 11.9 | 41.2 | 89.6 | 57.5 | 37.2 | 38.2 | 15.2 | 14.5 | 8.4 | 200 |
| 46 | 15.9 | 16.9 | 30.3 | 10.2 | 41.9 | 90.0 | 57.3 | 37.4 | 38.4 | 15.3 | 14.6 | 8.5 | 200 |
| 47 | 16.0 | 17.3 | 29.5 | 8.4 | 42.6 | 90.6 | 57.2 | 37.4 | 38.5 | 15.5 | 14.7 | 8.6 | 200 |
| 48 | 16.7 | 17.7 | 29.1 | 7.5 | 43.6 | 91.2 | 56.9 | 37.6 | 38.6 | 15.7 | 14.9 | 8.9 | 200 |
| 49 | 16.3 | 17.9 | 28.9 | 6.8 | 43.9 | 91.3 | 56.9 | 37.6 | 38.7 | 15.7 | 15.0 | 8.7 | 200 |
| 50 | 16.4 | 18.4 | 29.3 | 6.6 | 45.2 | 91.7 | 56.7 | 37.8 | 38.9 | 15.9 | 15.2 | 8.8 | 200 |
| 51 | 16.6 | 19.0 | 29.7 | 6.6 | 46.5 | 92.6 | 56.5 | 37.9 | 39.1 | 16.0 | 15.4 | 9.0 | 200 |
| 52 | 16.9 | 19.7 | 31.5 | 7.0 | 48.2 | 93.7 | 56.2 | 38.0 | 39.3 | 16.2 | 15.6 | 9.1 | 200 |
| 53 | 17.2 | 20.3 | 34.3 | 8.0 | 49.5 | 94.9 | 56.4 | 38.3 | 39.6 | 16.4 | 15.7 | 9.3 | 200 |
| 54 | 17.4 | 21.0 | 35.2 | 9.2 | 51.3 | 97.1 | 56.9 | 38.3 | 39.9 | 16.6 | 16.0 | 9.5 | 200 |
| 55 | 17.6 | 21.5 | 35.8 | 10.4 | 52.4 | 97.4 | 57.3 | 38.5 | 40.1 | 16.7 | 16.2 | 9.6 | 200 |
| 56 | 17.8 | 22.0 | 36.5 | 11.8 | 53.7 | 98.3 | 57.7 | 38.4 | 40.2 | 16.7 | 16.3 | 9.7 | 200 |
| 57 | 18.1 | 22.5 | 37.2 | 13.3 | 54.9 | 98.7 | 58.1 | 38.8 | 40.4 | 16.8 | 16.5 | 9.9 | 200 |
| 58 | 18.2 | 22.9 | 37.8 | 14.7 | 55.8 | 99.5 | 58.3 | 38.7 | 40.5 | 16.8 | 16.5 | 9.9 | 200 |
| 59 | 18.4 | 23.2 | 39.0 | 16.3 | 56.7 | 100.0 | 58.5 | 38.9 | 40.6 | 16.9 | 16.6 | 10.0 | 200 |
| 60 | 18.6 | 23.6 | 41.4 | 18.0 | 57.5 | 101.0 | 58.9 | 39.0 | 40.7 | 17.0 | 16.7 | 10.1 | 200 |
| 61 | 18.8 | 24.1 | 42.9 | 20.0 | 58.8 | 101.0 | 59.1 | 39.0 | 40.8 | 17.1 | 16.9 | 10.2 | 200 |
| 62 | 19.0 | 24.7 | 43.9 | 22.2 | 59.8 | 102.0 | 59.4 | 39.3 | 40.9 | 17.2 | 17.0 | 10.3 | 200 |
| 63 | 19.4 | 25.1 | 45.3 | 23.9 | 61.2 | 103.0 | 59.6 | 39.3 | 41.1 | 17.3 | 17.2 | 10.4 | 200 |
| 64 | 19.8 | 26.1 | 47.2 | 27.3 | 63.1 | 104.0 | 59.9 | 39.5 | 41.2 | 17.3 | 17.3 | 10.6 | 200 |
| 65 | 17.6 | 21.3 | 31.8 | 19.7 | 53.3 | 116.0 | 64.0 | 43.3 | 44.5 | 18.5 | 18.0 | 10.5 | 200 |
| 66 | 18.1 | 22.1 | 33.9 | 20.2 | 56.5 | 119.0 | 64.8 | 43.5 | 45.0 | 18.8 | 18.3 | 10.8 | 200 |
| 67 | 19.2 | 21.0 | 14.8 | 8.5 | 24.6 | 78.1 | 71.8 | 49.5 | 51.6 | 21.7 | 21.1 | 12.4 | 200 |
| 68 | 24.0 | 10.5 | 28.8 | 10.2 | 46.4 | 152.0 | 71.5 | 68.2 | 85.9 | 33.1 | 20.4 | 6.3 | 400 |
| 69 | 34.0 | 12.0 | 36.1 | 8.0 | 59.0 | 205.0 | 79.4 | 88.8 | 115.0 | 48.0 | 28.8 | 6.9 | 400 |
| 70 | 47.0 | 14.0 | 44.9 | 5.9 | 67.8 | 257.0 | 95.7 | 102.0 | 132.0 | 66.7 | 39.6 | 7.5 | 400 |
| 71 | 69.5 | 21.1 | 73.2 | 5.4 | 87.6 | 331.0 | 118.0 | 117.0 | 154.0 | 95.5 | 63.1 | 9.5 | 400 |
| 72 | 45.5 | 14.0 | 44.4 | 6.0 | 67.7 | 251.0 | 92.5 | 101.0 | 138.0 | 64.8 | 38.4 | 7.6 | 400 |
| 73 | 67.3 | 21.4 | 71.5 | 5.8 | 87.2 | 328.0 | 116.0 | 118.0 | 165.0 | 92.9 | 61.3 | 9.6 | 400 |
| 74 | 29.8 | 25.2 | 84.0 | 20.1 | 108.0 | 240.0 | 98.9 | 85.9 | 91.6 | 34.0 | 20.9 | 11.8 | 400 |
| 75 | 35.5 | 35.5 | 111.0 | 26.5 | 145.0 | 260.0 | 115.0 | 96.4 | 91.7 | 41.8 | 26.6 | 15.8 | 400 |
| 76 | 39.4 | 43.7 | 118.0 | 46.8 | 175.0 | 272.0 | 128.0 | 101.0 | 92.1 | 44.5 | 30.5 | 19.5 | 400 |
| 77 | 41.7 | 50.5 | 128.0 | 76.5 | 192.0 | 280.0 | 137.0 | 103.0 | 90.9 | 45.8 | 32.8 | 21.8 | 400 |
| 78 | 42.8 | 54.1 | 133.0 | 103.0 | 199.0 | 283.0 | 140.0 | 103.0 | 90.3 | 46.6 | 33.9 | 22.6 | 400 |
| 79 | 1.4 | 0.9 | 2.7 | 1.0 | 11.6 | 14.5 | 19.0 | 6.2 | 7.9 | 1.6 | 1.3 | 0.4 | 43 |
| 80 | 1.3 | 1.1 | 2.8 | 1.7 | 23.2 | 16.9 | 30.6 | 5.4 | 7.9 | 1.5 | 1.0 | 0.4 | 43 |
| 81 | 1.6 | 1.7 | 4.0 | 2.4 | 42.4 | 24.3 | **43.4** | 5.6 | 10.7 | 1.6 | 1.0 | 0.4 | 43 |
| 82 | 2.9 | 3.3 | 7.0 | 4.7 | **72.3** | **49.3** | **51.8** | 8.8 | 18.1 | 2.1 | 1.4 | 0.4 | 43 |
| 83 | 3.5 | 2.8 | 6.1 | 2.9 | 13.6 | 37.2 | 18.2 | 13.2 | 19.6 | 4.5 | 3.6 | 1.1 | 43 |

Table 13. Predicted monthly geometric means of fecal coliform (numbers per 100 ml) in Grays Harbor after rollback of loading sources to meet freshwater and marine standards (no exceedences of the geometric mean standard are predicted).

| WASP Segment | May-97 | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan-98 | Feb | Mar | Apr | Water Quality Standard |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.3 | 0.3 | 0.3 | 0.4 | 0.2 | 0.1 | 0.1 | 14 |
| 2 | 0.1 | 0.1 | 0.2 | 0.1 | 0.2 | 0.7 | 0.7 | 0.5 | 1.0 | 0.3 | 0.2 | 0.1 | 14 |
| 3 | 0.2 | 0.2 | 0.3 | 0.2 | 0.3 | 1.3 | 1.2 | 0.9 | 1.8 | 0.5 | 0.4 | 0.2 | 14 |
| 4 | 0.4 | 0.3 | 0.6 | 0.4 | 0.6 | 2.5 | 2.3 | 1.8 | 3.5 | 1.0 | 0.8 | 0.3 | 14 |
| 5 | 0.6 | 0.5 | 0.8 | 0.6 | 0.9 | 3.8 | 3.5 | 2.7 | 5.3 | 1.6 | 1.2 | 0.5 | 14 |
| 6 | 1.0 | 0.8 | 1.2 | 0.9 | 1.2 | 5.3 | 5.0 | 3.9 | 7.4 | 2.2 | 1.8 | 0.7 | 14 |
| 7 | 1.3 | 1.0 | 1.6 | 1.2 | 1.6 | 7.2 | 6.7 | 5.1 | 9.5 | 3.0 | 2.4 | 1.0 | 100 |
| 8 | 1.9 | 1.5 | 2.3 | 1.7 | 2.3 | 10.1 | 9.4 | 7.1 | 12.8 | 4.2 | 3.5 | 1.4 | 100 |
| 9 | 2.7 | 2.1 | 3.2 | 2.3 | 3.1 | 13.7 | 12.7 | 9.5 | 16.4 | 5.8 | 4.8 | 2.0 | 100 |
| 10 | 4.0 | 3.3 | 4.6 | 3.3 | 4.6 | 19.5 | 17.6 | 13.0 | 20.2 | 7.9 | 6.7 | 3.0 | 100 |
| 11 | 5.0 | 4.2 | 5.9 | 4.1 | 5.8 | 23.4 | 20.5 | 14.9 | 21.7 | 9.0 | 7.9 | 3.7 | 100 |
| 12 | 6.2 | 5.5 | 7.4 | 5.2 | 7.4 | 27.0 | 23.1 | 16.4 | 22.0 | 9.6 | 9.0 | 4.7 | 100 |
| 13 | 1.0 | 0.8 | 1.4 | 1.0 | 1.5 | 5.9 | 5.1 | 4.0 | 7.5 | 2.3 | 1.8 | 0.7 | 14 |
| 14 | 1.6 | 1.3 | 2.1 | 1.6 | 2.2 | 8.6 | 7.5 | 5.8 | 10.5 | 3.4 | 2.8 | 1.1 | 100 |
| 15 | 3.0 | 2.4 | 4.2 | 3.5 | 4.2 | 14.9 | 12.7 | 9.3 | 15.1 | 5.5 | 4.8 | 2.0 | 100 |
| 16 | 4.3 | 3.6 | 6.4 | 5.4 | 5.9 | 19.7 | 16.7 | 12.0 | 18.0 | 7.1 | 6.4 | 2.9 | 100 |
| 17 | 5.7 | 5.1 | 10.1 | 8.9 | 8.4 | 24.4 | 20.0 | 13.9 | 19.7 | 8.4 | 7.8 | 3.7 | 100 |
| 18 | 0.3 | 0.3 | 0.4 | 0.3 | 0.5 | 1.9 | 1.6 | 1.3 | 2.6 | 0.7 | 0.6 | 0.2 | 14 |
| 19 | 0.6 | 0.5 | 0.8 | 0.5 | 0.9 | 3.4 | 2.7 | 2.1 | 4.3 | 1.2 | 0.9 | 0.4 | 14 |
| 20 | 0.4 | 0.3 | 0.5 | 0.4 | 0.7 | 2.4 | 2.1 | 1.6 | 2.9 | 0.9 | 0.7 | 0.3 | 14 |
| 21 | 0.4 | 0.3 | 0.5 | 0.3 | 0.5 | 2.3 | 1.9 | 1.5 | 2.9 | 0.8 | 0.6 | 0.3 | 14 |
| 22 | 0.6 | 0.5 | 0.8 | 0.6 | 0.8 | 3.5 | 2.9 | 2.3 | 4.4 | 1.3 | 1.0 | 0.4 | 14 |
| 23 | 0.8 | 0.6 | 1.0 | 0.7 | 1.0 | 4.5 | 4.1 | 3.2 | 6.2 | 1.9 | 1.5 | 0.6 | 14 |
| 24 | 0.5 | 0.4 | 0.8 | 0.5 | 0.8 | 3.2 | 2.4 | 2.0 | 3.7 | 1.1 | 0.8 | 0.3 | 14 |
| 25 | 0.8 | 0.7 | 1.4 | 0.9 | 1.4 | 5.3 | 3.8 | 3.0 | 5.5 | 1.6 | 1.3 | 0.5 | 14 |
| 26 | 1.1 | 0.9 | 1.5 | 1.0 | 1.5 | 6.2 | 5.6 | 4.3 | 8.1 | 2.5 | 2.0 | 0.8 | 14 |
| 27 | 1.5 | 1.1 | 1.8 | 1.3 | 1.8 | 8.0 | 7.5 | 5.8 | 10.7 | 3.4 | 2.7 | 1.1 | 100 |
| 28 | 0.6 | 0.5 | 1.0 | 0.6 | 1.1 | 4.1 | 2.8 | 2.3 | 4.1 | 1.2 | 0.9 | 0.4 | 14 |
| 29 | 1.1 | 1.2 | 2.4 | 1.4 | 2.5 | 7.8 | 4.2 | 3.3 | 5.4 | 1.6 | 1.3 | 0.5 | 14 |
| 30 | 1.2 | 1.0 | 1.6 | 1.2 | 1.6 | 6.9 | 6.3 | 4.8 | 9.0 | 2.8 | 2.3 | 0.9 | 14 |
| 31 | 2.1 | 1.7 | 2.7 | 2.1 | 2.7 | 11.1 | 10.1 | 7.6 | 13.3 | 4.5 | 3.8 | 1.5 | 100 |
| 32 | 3.3 | 2.6 | 4.0 | 3.0 | 3.9 | 16.1 | 14.6 | 10.8 | 17.7 | 6.5 | 5.5 | 2.4 | 100 |
| 33 | 4.5 | 3.7 | 6.0 | 4.6 | 5.5 | 20.7 | 18.1 | 13.1 | 19.6 | 7.9 | 7.0 | 3.2 | 100 |
| 34 | 6.3 | 5.8 | 8.7 | 6.3 | 8.0 | 27.6 | 23.0 | 16.0 | 21.4 | 9.1 | 8.7 | 4.6 | 100 |
| 35 | 6.7 | 6.2 | 9.1 | 6.5 | 8.5 | 29.2 | 24.3 | 16.7 | 22.0 | 9.5 | 9.1 | 4.9 | 100 |
| 36 | 6.8 | 6.4 | 9.3 | 6.5 | 8.7 | 29.8 | 24.7 | 17.0 | 22.2 | 9.6 | 9.2 | 5.0 | 100 |
| 37 | 7.0 | 6.6 | 9.5 | 6.6 | 8.9 | 30.3 | 25.1 | 17.3 | 22.4 | 9.7 | 9.3 | 5.1 | 100 |
| 38 | 7.2 | 6.8 | 9.7 | 6.7 | 9.1 | 31.0 | 25.6 | 17.6 | 22.6 | 9.8 | 9.5 | 5.2 | 100 |
| 39 | 7.5 | 7.2 | 10.1 | 6.7 | 9.5 | 32.1 | 26.2 | 18.0 | 22.8 | 10.0 | 9.6 | 5.5 | 100 |
| 40 | 7.6 | 7.6 | 10.0 | 6.6 | 9.5 | 31.7 | 26.4 | 17.6 | 22.6 | 10.0 | 9.8 | 5.6 | 100 |
| 41 | 7.8 | 7.9 | 10.2 | 6.6 | 9.7 | 32.4 | 26.8 | 17.8 | 22.7 | 10.1 | 9.9 | 5.8 | 100 |
| 42 | 8.1 | 8.4 | 10.4 | 6.5 | 10.0 | 33.3 | 27.3 | 18.0 | 22.8 | 10.1 | 10.0 | 6.0 | 100 |
| 43 | 8.4 | 8.9 | 10.7 | 6.3 | 10.5 | 34.3 | 27.8 | 18.3 | 22.9 | 10.2 | 10.2 | 6.2 | 100 |
| 44 | 8.5 | 9.2 | 10.7 | 6.1 | 10.4 | 34.4 | 28.1 | 18.4 | 23.0 | 10.3 | 10.2 | 6.3 | 100 |
| 45 | 8.7 | 9.5 | 10.7 | 5.8 | 10.4 | 34.8 | 28.4 | 18.5 | 23.0 | 10.3 | 10.3 | 6.4 | 100 |
| 46 | 8.9 | 9.9 | 10.7 | 5.5 | 10.6 | 35.4 | 28.7 | 18.6 | 23.1 | 10.4 | 10.4 | 6.5 | 100 |
| 47 | 9.2 | 10.3 | 10.8 | 5.2 | 10.8 | 36.0 | 29.1 | 18.8 | 23.2 | 10.4 | 10.5 | 6.6 | 100 |
| 48 | 9.5 | 10.8 | 10.9 | 5.1 | 11.1 | 36.8 | 29.4 | 18.9 | 23.4 | 10.5 | 10.6 | 6.8 | 100 |
| 49 | 9.5 | 11.0 | 10.9 | 4.9 | 11.2 | 36.9 | 29.6 | 19.0 | 23.2 | 10.5 | 10.7 | 6.8 | 100 |
| 50 | 9.8 | 11.4 | 11.2 | 4.9 | 11.6 | 37.6 | 30.0 | 19.2 | 23.3 | 10.6 | 10.8 | 6.9 | 100 |
| 51 | 10.1 | 12.0 | 11.7 | 5.0 | 12.1 | 38.4 | 30.4 | 19.3 | 23.4 | 10.7 | 10.9 | 7.0 | 100 |
| 52 | 10.5 | 12.8 | 12.5 | 5.4 | 13.1 | 39.5 | 30.9 | 19.6 | 23.6 | 10.8 | 11.1 | 7.2 | 100 |
| 53 | 11.0 | 13.6 | 13.5 | 6.1 | 14.2 | 40.6 | 31.4 | 19.8 | 23.7 | 10.9 | 11.2 | 7.4 | 100 |
| 54 | 11.5 | 14.5 | 14.7 | 6.9 | 15.6 | 41.7 | 32.0 | 20.1 | 23.9 | 11.0 | 11.4 | 7.6 | 100 |
| 55 | 11.9 | 15.3 | 15.9 | 7.8 | 16.9 | 42.6 | 32.4 | 20.2 | 24.0 | 11.1 | 11.5 | 7.7 | 100 |
| 56 | 12.3 | 16.0 | 17.1 | 8.8 | 18.5 | 43.5 | 32.7 | 20.4 | 24.1 | 11.2 | 11.6 | 7.9 | 100 |
| 57 | 12.7 | 16.8 | 18.4 | 10.0 | 20.0 | 44.4 | 33.1 | 20.6 | 24.2 | 11.2 | 11.8 | 8.0 | 100 |
| 58 | 12.9 | 17.4 | 19.6 | 11.2 | 21.4 | 45.0 | 33.4 | 20.6 | 24.2 | 11.2 | 11.8 | 8.1 | 100 |
| 59 | 13.2 | 18.0 | 20.8 | 12.4 | 22.9 | 45.7 | 33.7 | 20.8 | 24.3 | 11.3 | 11.9 | 8.2 | 100 |
| 60 | 13.5 | 18.6 | 22.0 | 13.9 | 24.6 | 46.3 | 33.9 | 20.9 | 24.4 | 11.4 | 12.0 | 8.3 | 100 |
| 61 | 13.8 | 19.3 | 23.5 | 15.7 | 26.5 | 47.1 | 34.3 | 21.0 | 24.5 | 11.4 | 12.1 | 8.4 | 100 |
| 62 | 14.1 | 19.9 | 24.9 | 17.6 | 28.5 | 48.0 | 34.6 | 21.2 | 24.6 | 11.5 | 12.2 | 8.5 | 100 |
| 63 | 14.5 | 20.6 | 26.4 | 19.5 | 30.6 | 48.8 | 35.0 | 21.3 | 24.7 | 11.6 | 12.3 | 8.7 | 100 |
| 64 | 15.1 | 22.1 | 29.2 | 22.6 | 33.8 | 49.8 | 35.3 | 21.5 | 24.8 | 11.6 | 12.4 | 8.8 | 100 |
| 65 | 12.0 | 16.1 | 21.0 | 16.8 | 25.8 | 49.1 | 36.6 | 22.7 | 27.1 | 12.4 | 12.8 | 8.6 | 100 |
| 66 | 12.6 | 17.3 | 22.5 | 17.3 | 27.2 | 51.2 | 37.4 | 23.1 | 27.4 | 12.6 | 13.1 | 8.9 | 100 |
| 67 | 11.8 | 13.1 | 10.1 | 7.3 | 12.0 | 35.7 | 39.3 | 26.2 | 33.2 | 15.5 | 15.5 | 10.3 | 100 |
| 68 | 5.4 | 4.3 | 5.9 | 3.9 | 5.6 | 24.8 | 19.0 | 16.2 | 26.0 | 10.6 | 8.5 | 3.7 | 200 |
| 69 | 5.9 | 4.2 | 6.0 | 3.5 | 5.4 | 26.5 | 17.7 | 17.1 | 29.0 | 12.0 | 9.2 | 3.7 | 200 |
| 70 | 6.3 | 4.1 | 5.9 | 2.9 | 5.1 | 28.2 | 16.5 | 17.6 | 31.7 | 13.3 | 10.1 | 3.5 | 200 |
| 71 | 8.3 | 5.1 | 6.7 | 2.7 | 5.8 | 33.5 | 17.3 | 18.5 | 35.5 | 15.1 | 12.5 | 3.6 | 200 |
| 72 | 6.3 | 4.2 | 5.9 | 3.0 | 5.1 | 28.0 | 16.4 | 17.7 | 31.9 | 13.2 | 10.0 | 3.5 | 200 |
| 73 | 8.5 | 5.4 | 6.9 | 2.9 | 6.1 | 33.5 | 17.3 | 18.6 | 35.6 | 15.0 | 12.3 | 3.7 | 200 |
| 74 | 8.5 | 8.7 | 13.9 | 8.6 | 14.7 | 47.6 | 32.9 | 24.1 | 24.2 | 11.8 | 9.3 | 6.0 | 200 |
| 75 | 10.0 | 11.0 | 17.2 | 10.9 | 21.4 | 60.0 | 39.8 | 28.1 | 25.1 | 12.9 | 9.9 | 6.8 | 200 |
| 76 | 12.0 | 14.4 | 21.9 | 15.5 | 31.0 | 71.2 | 46.1 | 31.1 | 25.6 | 13.6 | 10.8 | 7.9 | 200 |
| 77 | 14.4 | 19.0 | 29.3 | 24.5 | 44.5 | 80.8 | 51.4 | 33.2 | 26.1 | 14.1 | 11.6 | 9.0 | 200 |
| 78 | 16.2 | 22.6 | 37.1 | 36.5 | 58.5 | 85.2 | 53.8 | 34.1 | 26.2 | 14.3 | 11.9 | 9.6 | 200 |
| 79 | 0.4 | 0.4 | 0.7 | 0.6 | 1.2 | 3.2 | 2.6 | 1.8 | 3.0 | 0.9 | 0.7 | 0.3 | 14 |
| 80 | 0.5 | 0.6 | 0.9 | 0.9 | 2.5 | 4.8 | 3.4 | 1.9 | 2.7 | 0.9 | 0.6 | 0.3 | 14 |
| 81 | 0.6 | 0.9 | 1.3 | 1.2 | 3.4 | 5.4 | 3.5 | 1.8 | 2.5 | 0.7 | 0.5 | 0.2 | 14 |
| 82 | 0.9 | 1.3 | 1.9 | 1.7 | 5.1 | 7.4 | 4.3 | 2.0 | 2.6 | 0.7 | 0.5 | 0.2 | 14 |
| 83 | 1.0 | 1.0 | 1.5 | 1.0 | 1.8 | 5.7 | 3.9 | 3.1 | 6.0 | 1.7 | 1.4 | 0.5 | 14 |

Table 14. Predicted monthly 90th percentiles of fecal coliform (numbers per 100 ml) in Grays Harbor after rollback of loading sources to meet freshwater and marine standards (no exceedences of the 90th percentile standard are predicted.)

| WASP segment | May-97 | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan-98 | Feb | Mar | Apr | Water Quality Standard |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.5 | 0.3 | 0.7 | 0.4 | 0.8 | 4.8 | 3.4 | 2.3 | 4.3 | 0.9 | 0.7 | 0.1 | 43 |
| 2 | 0.7 | 0.4 | 1.2 | 0.5 | 1.4 | 7.4 | 5.0 | 3.4 | 6.0 | 1.2 | 1.0 | 0.2 | 43 |
| 3 | 1.1 | 0.6 | 1.7 | 0.8 | 2.2 | 10.5 | 6.9 | 5.1 | 8.1 | 1.7 | 1.4 | 0.3 | 43 |
| 4 | 1.7 | 1.0 | 2.8 | 1.4 | 3.7 | 16.9 | 11.0 | 7.9 | 12.2 | 2.8 | 2.3 | 0.6 | 43 |
| 5 | 2.5 | 1.5 | 3.8 | 2.2 | 5.5 | 23.0 | 16.3 | 11.1 | 16.1 | 4.0 | 3.4 | 0.9 | 43 |
| 6 | 3.5 | 2.0 | 5.1 | 3.0 | 7.6 | 30.3 | 21.6 | 14.7 | 19.9 | 5.3 | 4.5 | 1.3 | 43 |
| 7 | 4.4 | 2.7 | 6.4 | 3.9 | 9.8 | 38.1 | 26.4 | 18.4 | 22.6 | 6.3 | 5.5 | 1.8 | 200 |
| 8 | 6.2 | 3.8 | 9.2 | 6.0 | 14.8 | 50.3 | 34.8 | 23.7 | 27.9 | 8.5 | 7.6 | 2.6 | 200 |
| 9 | 8.4 | 5.2 | 11.7 | 7.6 | 19.0 | 61.8 | 41.6 | 30.3 | 32.2 | 10.5 | 9.5 | 3.5 | 200 |
| 10 | 11.4 | 7.4 | 16.3 | 10.3 | 25.5 | 76.5 | 51.7 | 35.4 | 35.3 | 13.0 | 11.5 | 4.9 | 200 |
| 11 | 13.2 | 8.9 | 20.4 | 12.7 | 30.6 | 82.6 | 58.2 | 36.1 | 35.8 | 14.4 | 12.5 | 5.9 | 200 |
| 12 | 14.1 | 11.1 | 24.1 | 15.5 | 35.7 | 83.8 | 58.6 | 35.7 | 36.2 | 14.4 | 13.3 | 6.7 | 200 |
| 13 | 3.4 | 2.0 | 5.2 | 3.4 | 9.2 | 32.9 | 21.2 | 14.3 | 19.3 | 5.1 | 4.4 | 1.4 | 43 |
| 14 | 4.6 | 2.8 | 7.2 | 5.4 | 14.9 | 40.5 | 28.2 | 18.9 | 22.4 | 6.3 | 5.6 | 1.9 | 200 |
| 15 | 7.8 | 5.2 | 14.8 | 14.5 | 28.9 | 57.2 | 40.2 | 26.6 | 27.6 | 9.0 | 8.7 | 3.3 | 200 |
| 16 | 10.8 | 7.7 | 24.6 | 25.6 | 39.5 | 68.7 | 47.3 | 30.6 | 31.5 | 11.6 | 11.1 | 4.7 | 200 |
| 17 | 13.2 | 10.9 | 44.6 | 50.2 | 51.7 | 79.2 | 50.9 | 32.6 | 33.2 | 13.1 | 12.8 | 6.0 | 200 |
| 18 | 1.2 | 0.7 | 2.0 | 1.0 | 3.0 | 12.8 | 8.1 | 5.8 | 9.1 | 2.0 | 1.6 | 0.4 | 43 |
| 19 | 1.9 | 1.3 | 2.8 | 1.5 | 5.6 | 19.1 | 11.7 | 8.3 | 12.9 | 2.7 | 2.3 | 0.7 | 43 |
| 20 | 1.0 | 0.6 | 1.7 | 0.8 | 4.5 | 10.2 | 10.7 | 5.3 | 6.9 | 1.5 | 1.2 | 0.4 | 43 |
| 21 | 1.2 | 0.7 | 2.2 | 0.8 | 3.3 | 12.7 | 8.8 | 5.3 | 7.8 | 1.6 | 1.3 | 0.4 | 43 |
| 22 | 2.0 | 1.2 | 3.5 | 1.5 | 5.2 | 20.7 | 12.2 | 8.4 | 12.0 | 2.7 | 2.2 | 0.8 | 43 |
| 23 | 2.6 | 1.6 | 4.2 | 2.2 | 6.3 | 24.6 | 17.9 | 12.1 | 16.5 | 4.1 | 3.4 | 1.1 | 43 |
| 24 | 1.5 | 0.9 | 3.4 | 1.0 | 5.3 | 17.0 | 11.6 | 6.3 | 8.3 | 1.7 | 1.5 | 0.5 | 43 |
| 25 | 2.3 | 1.5 | 5.2 | 1.8 | 8.5 | 26.2 | 16.3 | 9.5 | 11.7 | 2.5 | 2.4 | 0.8 | 43 |
| 26 | 3.0 | 1.7 | 5.1 | 2.7 | 9.4 | 28.5 | 22.6 | 15.7 | 18.1 | 4.2 | 3.8 | 1.2 | 43 |
| 27 | 4.1 | 2.3 | 6.1 | 3.6 | 11.7 | 37.3 | 28.6 | 19.6 | 22.5 | 5.6 | 5.0 | 1.7 | 200 |
| 28 | 1.6 | 1.0 | 4.8 | 1.1 | 7.2 | 20.1 | 13.6 | 6.7 | 8.3 | 1.7 | 1.7 | 0.5 | 43 |
| 29 | 3.0 | 2.1 | 12.0 | 2.2 | 13.3 | 42.3 | 17.3 | 8.6 | 12.0 | 2.4 | 2.2 | 0.8 | 43 |
| 30 | 4.1 | 2.4 | 6.2 | 4.0 | 10.0 | 36.2 | 25.6 | 17.2 | 21.8 | 6.2 | 5.2 | 1.7 | 43 |
| 31 | 6.3 | 3.9 | 9.6 | 7.0 | 17.5 | 48.5 | 35.5 | 24.2 | 26.5 | 8.3 | 7.5 | 2.7 | 200 |
| 32 | 9.5 | 6.0 | 14.3 | 10.2 | 23.4 | 66.7 | 45.0 | 31.5 | 32.5 | 11.2 | 10.4 | 4.1 | 200 |
| 33 | 11.8 | 8.2 | 21.9 | 19.6 | 39.0 | 74.3 | 50.7 | 33.6 | 33.6 | 12.6 | 11.7 | 5.1 | 200 |
| 34 | 13.8 | 11.7 | 28.5 | 22.4 | 41.6 | 82.1 | 56.1 | 35.3 | 36.2 | 13.8 | 13.2 | 6.7 | 200 |
| 35 | 14.3 | 12.6 | 28.9 | 22.1 | 40.7 | 87.0 | 58.1 | 36.1 | 36.8 | 14.3 | 13.5 | 7.2 | 200 |
| 36 | 14.4 | 12.8 | 29.7 | 21.7 | 41.5 | 87.9 | 58.0 | 36.1 | 36.9 | 14.4 | 13.7 | 7.2 | 200 |
| 37 | 14.5 | 13.0 | 29.8 | 21.3 | 42.6 | 88.5 | 58.0 | 36.4 | 37.0 | 14.6 | 13.7 | 7.3 | 200 |
| 38 | 14.8 | 13.5 | 29.9 | 21.3 | 43.0 | 89.2 | 58.1 | 36.5 | 37.0 | 14.7 | 13.9 | 7.4 | 200 |
| 39 | 14.9 | 14.0 | 31.3 | 20.9 | 43.1 | 89.3 | 58.0 | 36.4 | 37.1 | 14.8 | 14.0 | 7.5 | 200 |
| 40 | 15.0 | 14.4 | 31.9 | 19.7 | 40.8 | 88.2 | 57.9 | 36.3 | 37.7 | 14.8 | 14.1 | 7.6 | 200 |
| 41 | 15.1 | 14.8 | 32.0 | 19.3 | 41.9 | 88.3 | 57.9 | 36.6 | 37.8 | 14.8 | 14.1 | 7.8 | 200 |
| 42 | 15.3 | 15.2 | 32.5 | 17.4 | 39.2 | 88.7 | 57.8 | 36.6 | 37.9 | 14.9 | 14.2 | 8.0 | 200 |
| 43 | 15.5 | 15.8 | 32.6 | 15.4 | 39.8 | 88.9 | 57.6 | 36.9 | 38.0 | 15.1 | 14.3 | 8.2 | 200 |
| 44 | 15.6 | 16.2 | 32.5 | 13.4 | 40.0 | 89.1 | 57.6 | 37.0 | 38.1 | 15.1 | 14.4 | 8.3 | 200 |
| 45 | 15.7 | 16.4 | 30.7 | 11.6 | 40.8 | 89.6 | 57.5 | 37.2 | 38.2 | 15.2 | 14.5 | 8.4 | 200 |
| 46 | 15.8 | 16.8 | 29.7 | 9.9 | 41.7 | 90.0 | 57.3 | 37.4 | 38.4 | 15.3 | 14.6 | 8.5 | 200 |
| 47 | 16.0 | 17.2 | 29.2 | 8.2 | 42.5 | 90.6 | 57.2 | 37.4 | 38.5 | 15.5 | 14.7 | 8.6 | 200 |
| 48 | 16.7 | 17.7 | 29.0 | 7.3 | 43.6 | 91.2 | 56.9 | 37.6 | 38.6 | 15.7 | 14.9 | 8.9 | 200 |
| 49 | 16.3 | 17.9 | 28.9 | 6.8 | 43.9 | 91.3 | 56.9 | 37.6 | 38.7 | 15.7 | 15.0 | 8.7 | 200 |
| 50 | 16.4 | 18.4 | 29.3 | 6.6 | 45.2 | 91.7 | 56.7 | 37.8 | 38.9 | 15.9 | 15.2 | 8.8 | 200 |
| 51 | 16.6 | 19.0 | 29.7 | 6.5 | 46.5 | 92.6 | 56.5 | 37.9 | 39.1 | 16.0 | 15.4 | 9.0 | 200 |
| 52 | 16.9 | 19.7 | 31.5 | 7.0 | 48.2 | 93.7 | 56.2 | 38.0 | 39.3 | 16.2 | 15.6 | 9.1 | 200 |
| 53 | 17.2 | 20.3 | 34.3 | 7.9 | 49.5 | 94.9 | 56.4 | 38.3 | 39.6 | 16.4 | 15.7 | 9.3 | 200 |
| 54 | 17.4 | 21.0 | 35.2 | 9.2 | 51.3 | 97.1 | 56.9 | 38.3 | 39.9 | 16.6 | 16.0 | 9.5 | 200 |
| 55 | 17.6 | 21.5 | 35.8 | 10.4 | 52.4 | 97.4 | 57.3 | 38.5 | 40.1 | 16.7 | 16.2 | 9.6 | 200 |
| 56 | 17.8 | 22.0 | 36.5 | 11.8 | 53.7 | 98.3 | 57.7 | 38.4 | 40.2 | 16.7 | 16.3 | 9.7 | 200 |
| 57 | 18.1 | 22.5 | 37.2 | 13.3 | 54.9 | 98.7 | 58.1 | 38.8 | 40.4 | 16.8 | 16.5 | 9.9 | 200 |
| 58 | 18.2 | 22.9 | 37.8 | 14.7 | 55.8 | 99.5 | 58.3 | 38.7 | 40.5 | 16.8 | 16.5 | 9.9 | 200 |
| 59 | 18.4 | 23.2 | 39.0 | 16.3 | 56.7 | 100.0 | 58.5 | 38.9 | 40.6 | 16.9 | 16.6 | 10.0 | 200 |
| 60 | 18.6 | 23.6 | 41.4 | 18.0 | 57.5 | 101.0 | 58.9 | 39.0 | 40.7 | 17.0 | 16.7 | 10.1 | 200 |
| 61 | 18.8 | 24.1 | 42.9 | 20.0 | 58.8 | 101.0 | 59.1 | 39.0 | 40.8 | 17.1 | 16.9 | 10.2 | 200 |
| 62 | 19.0 | 24.7 | 43.9 | 22.2 | 59.8 | 102.0 | 59.4 | 39.3 | 40.9 | 17.2 | 17.0 | 10.3 | 200 |
| 63 | 19.4 | 25.1 | 45.3 | 23.9 | 61.2 | 103.0 | 59.6 | 39.3 | 41.1 | 17.3 | 17.2 | 10.4 | 200 |
| 64 | 19.8 | 26.1 | 47.2 | 27.3 | 63.1 | 104.0 | 59.9 | 39.5 | 41.2 | 17.3 | 17.3 | 10.6 | 200 |
| 65 | 17.6 | 21.3 | 31.8 | 19.7 | 53.3 | 116.0 | 64.0 | 43.3 | 44.5 | 18.5 | 18.0 | 10.5 | 200 |
| 66 | 18.1 | 22.1 | 33.9 | 20.2 | 56.5 | 119.0 | 64.8 | 43.5 | 45.0 | 18.8 | 18.3 | 10.8 | 200 |
| 67 | 19.2 | 21.0 | 14.8 | 8.5 | 24.6 | 78.1 | 71.8 | 49.5 | 51.6 | 21.7 | 21.1 | 12.4 | 200 |
| 68 | 16.0 | 8.4 | 20.3 | 9.9 | 33.6 | 93.7 | 53.0 | 43.3 | 49.0 | 20.0 | 13.8 | 5.4 | 400 |
| 69 | 20.3 | 8.7 | 20.8 | 7.6 | 40.7 | 110.0 | 50.4 | 47.9 | 59.5 | 26.2 | 16.9 | 5.3 | 400 |
| 70 | 25.6 | 8.9 | 23.6 | 5.4 | 45.3 | 131.0 | 53.0 | 52.5 | 67.1 | 34.5 | 21.1 | 5.3 | 400 |
| 71 | 35.8 | 11.6 | 37.3 | 4.3 | 50.6 | 168.0 | 60.9 | 59.6 | 78.0 | 48.4 | 32.1 | 5.9 | 400 |
| 72 | 24.9 | 8.9 | 23.2 | 5.4 | 45.2 | 128.0 | 52.1 | 52.3 | 70.8 | 33.5 | 20.7 | 5.3 | 400 |
| 73 | 34.7 | 11.7 | 36.4 | 4.4 | 50.5 | 166.0 | 59.8 | 59.8 | 83.3 | 47.1 | 31.3 | 5.9 | 400 |
| 74 | 16.4 | 15.5 | 45.0 | 16.5 | 62.5 | 122.0 | 58.3 | 45.3 | 45.9 | 18.2 | 12.8 | 7.9 | 400 |
| 75 | 18.3 | 18.8 | 55.5 | 16.2 | 75.3 | 130.0 | 60.4 | 48.6 | 45.9 | 21.0 | 13.8 | 8.9 | 400 |
| 76 | 19.7 | 22.2 | 59.0 | 24.1 | 87.6 | 136.0 | 64.4 | 50.4 | 46.1 | 22.2 | 15.3 | 10.0 | 400 |
| 77 | 20.9 | 25.3 | 64.0 | 38.5 | 95.8 | 140.0 | 68.7 | 51.3 | 45.5 | 22.9 | 16.4 | 10.9 | 400 |
| 78 | 21.4 | 27.1 | 66.3 | 51.4 | 99.5 | 142.0 | 70.1 | 51.7 | 45.2 | 23.3 | 16.9 | 11.3 | 400 |
| 79 | 1.1 | 0.7 | 1.6 | 0.9 | 8.2 | 10.6 | 14.0 | 4.9 | 6.3 | 1.3 | 1.2 | 0.4 | 43 |
| 80 | 1.1 | 0.8 | 1.9 | 1.4 | 15.2 | 13.0 | 20.0 | 4.0 | 5.4 | 1.2 | 0.9 | 0.4 | 43 |
| 81 | 1.4 | 1.1 | 2.5 | 1.7 | 27.7 | 15.6 | 25.5 | 3.6 | 6.3 | 1.2 | 0.7 | 0.3 | 43 |
| 82 | 1.9 | 1.7 | 3.5 | 2.5 | 37.2 | 25.2 | 28.6 | 4.7 | 9.5 | 1.2 | 0.8 | 0.3 | 43 |
| 83 | 3.1 | 2.6 | 4.9 | 2.8 | 11.9 | 31.7 | 16.5 | 10.8 | 17.2 | 3.9 | 3.3 | 1.0 | 43 |

Table 15. Estimated percent reduction in fecal coliform needed in tributaries to Grays Harbor to meet freshwater and marine standards in Grays Harbor.

| Tributaries to Grays Harbor | Recommended % reduction to meet freshwater or marine standard based on maximum month | Target maximum monthly geometric mean after rollback (colonies per 100 ml) | Percent of total load to Grays Harbor from all sources before rollback | Total fecal coliform load during 5/1/97 - 4/30/98 (colonies/ year) | Reduction needed to meet water quality standard (colonies/ year) | Load allocation to meet water quality standard (colonies/ year) |
|---|---|---|---|---|---|---|
| **Chehalis River (excluding Satsop and Wynoochee)** | | | | | | |
| - based on 1988-98 samples aggregated by month | 74% | 30 | 50.0% | 6.79E+15 | 5.00E+15 | 1.80E+15 |
| **Other tributaries (1)** | | | | | | |
| Humptulips R nr mouth (rollback to meet marine WQS) | 67% | 38 | 8.8% | 1.20E+15 | 8.06E+14 | 3.97E+14 |
| Satsop River | 29% | 95 | 7.9% | 1.08E+15 | 3.13E+14 | 7.65E+14 |
| Wishkah R near mouth (hypothetical class A) | 62% | 100 | 6.3% | 8.60E+14 | 5.32E+14 | 3.28E+14 |
| Wishkah R above river mile 6 | 78% | 100 | -- | -- | -- | -- |
| Hoquiam R near mouth (hypothetical class A) | 58% | 50 | 5.4% | 7.39E+14 | 4.31E+14 | 3.08E+14 |
| West Fork Hoquiam R above river mile 9.3 (Dekay Rd) | 37% | 58 | -- | -- | -- | -- |
| East Fork Hoquiam River | 14% | 100 | -- | -- | -- | -- |
| Wynoochee River | 0% | 83 | 3.2% | 4.36E+14 | 0.00E+00 | 4.36E+14 |
| Elk R nr mouth (rollback to meet marine WQS) | 90% | 40 | 2.8% | 3.82E+14 | 3.44E+14 | 3.82E+13 |
| Johns River near mouth | 51% | 73 | 2.4% | 3.29E+14 | 1.69E+14 | 1.60E+14 |
| Unnamed Central Park creek | 94% | 32 | 1.2% | 1.64E+14 | 1.54E+14 | 1.02E+13 |
| Grass Creek | 67% | 20 | 0.70% | 9.56E+13 | 6.40E+13 | 3.15E+13 |
| Chenois Creek | 37% | 34 | 0.66% | 8.93E+13 | 3.28E+13 | 5.66E+13 |
| Newskah Creek | 28% | 69 | 0.54% | 7.39E+13 | 2.10E+13 | 5.29E+13 |
| Charlie Creek | 61% | 100 | 0.51% | 6.91E+13 | 4.25E+13 | 2.67E+13 |
| Andrews Cr nr mouth (rollback to meet marine WQS) | 90% | 13 | 0.43% | 5.78E+13 | 5.21E+13 | 5.78E+12 |
| Elliot Slough | 27% | 100 | 0.33% | 4.44E+13 | 1.18E+13 | 3.25E+13 |
| Barlow Creek | 79% | 70 | 0.33% | 4.43E+13 | 3.52E+13 | 9.10E+12 |
| Grayland Ditch | 71% | 100 | 0.32% | 4.31E+13 | 3.07E+13 | 1.24E+13 |
| Oleary Creek | 68% | 95 | 0.28% | 3.80E+13 | 2.60E+13 | 1.20E+13 |
| Indian Creek | 78% | 34 | 0.28% | 3.78E+13 | 2.94E+13 | 8.43E+12 |
| Redman Slough | 89% | 100 | 0.13% | 1.76E+13 | 1.58E+13 | 1.86E+12 |
| Stafford Creek | 71% | 99 | 0.13% | 1.75E+13 | 1.23E+13 | 5.12E+12 |
| Chapin Creek | 54% | 50 | 0.10% | 1.42E+13 | 7.63E+12 | 6.58E+12 |
| Campbell Creek | 66% | 46 | 0.09% | 1.25E+13 | 8.23E+12 | 4.32E+12 |
| Unnamed Westport creek | 92% | 100 | 0.09% | 1.22E+13 | 1.13E+13 | 9.30E+11 |
| Dempsey Creek | 53% | 58 | 0.05% | 6.15E+12 | 3.24E+12 | 2.91E+12 |
| Other small tributaries | -- | -- | 0.11% | 1.56E+13 | -- | 1.56E+13 |
| **Urban Drains (2)** | 98% | 15 | 2.5% | 3.40E+14 | 3.33E+14 | 7.48E+12 |
| **Total** | 65% | | | 1.30E+16 | 8.48E+15 | 4.53E+15 |

1) maximum of 30-day geometric means and 90th percentiles of regression estimates of daily concentrations from 5/1/97 - 4/30/98.

2) based on geometric means and upper 90th percentiles of all samples during the study from 11 urban drains in the Aberdeen-Hoquiam-Cosmopolis areas.

The Chehalis River is the most important single loading source that requires reduction, followed by the Humptulips, Wishkah, and Hoquiam rivers. Collectively these tributaries account for approximately 80 percent of the required reduction in loading to meet water quality standards.

## Predicted response to storm event loading

Figure 40 presents precipitation at Grayland during the study year in comparison with the load of fecal coliform from tributaries to the inner south region. The inner south region (south of highway 105 bridge) is conditionally approved for shellfish harvesting and is closed following significant rainfall events (≥1.5 inches in 24 hours at Grayland) because of local watershed bacterial sources (the Elk River is the major tributary to this region). The storm event during October 28 – November 14, 1997 was predicted to produce the greatest loading of fecal coliform to the inner south region during the study.

Figure 41 presents a detailed comparison of daily precipitation at Grayland and total loading of fecal coliform from all tributaries to Grays Harbor during October 28 – November 14, 1997. This storm event resulted in the greatest loading to Grays Harbor during the study year (model days 300-317). Daily total precipitation at Grayland was 1.76 inches on October 29 and 1.37 inches on October 30. This event was one of eight storms during the study year that produced 1.5 inches or more of rainfall at the Grayland station. Rainfall events of this magnitude result in closure of the inner south region for shellfish harvesting according to DOH management rules (Figure 3).

The October 28–November 14, 1997 period produced the highest daily loading of fecal coliform to Grays Harbor of the study year, and accounted for approximately 16 percent of the estimated total load for the year. Appendix I presents an animation that shows daily medians of predicted hourly fecal coliform during this period.

The model predictions of fecal coliform in Grays Harbor during this 18-day period suggest that most of the harbor experiences significant elevations in fecal coliform during large storm events. Figures 42, 43, and 44 present predicted fecal coliform in the central, northern, and southern regions of Grays Harbor during this period. The only portions of Grays Harbor that were not predicted to exceed the class A standard were the outermost model segments 1, 2, and 3. The highest concentrations in the class A portion of Grays Harbor were predicted in the inner south region, the northeast portion of the north region, and the transition from the inner harbor to the central region (vicinity of the marine class A/B line). The innermost part of the inner harbor (east of model segments 10, 33, and 16) was also predicted to exceed the marine class B standard during this event. The elevated concentrations from the storm loading were predicted to persist for up to 10-15 days following the rainfall event, partly because the loading was estimated to lag in response to the rainfall.

The model predictions for this 18-day period suggest that the rainfall-conditional closure of the inner south region (Figure 3) is justified. These results also suggest that the period of closure may need to be longer for very large events (up to 15 days in the inner south region). Also, it may be reasonable to establish other regions of rainfall-conditional closure, such as the northeast part of the north region and the eastern part of the central region.

**Figure 40. Precipitation at Grayland and fecal coliform loading from tributaries to the inner south region (WASP segments 80, 81, and 82) from 5/1/97 - 4/30/98.**

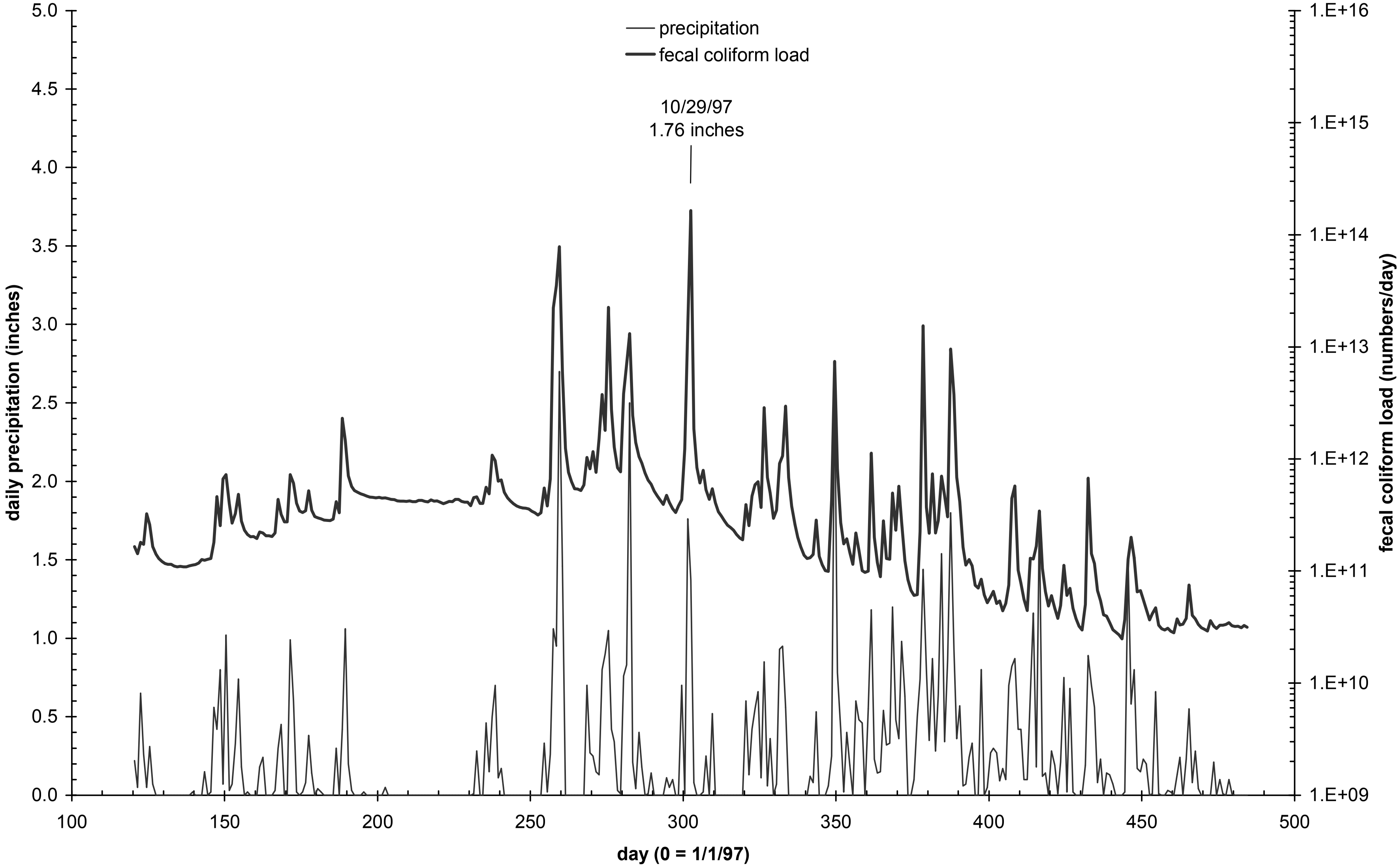


**Figure 41. Fecal coliform load from all tributaries and precipitation at Grayland during the October 28 - November 14, 1997 storm event (day 300-318).**

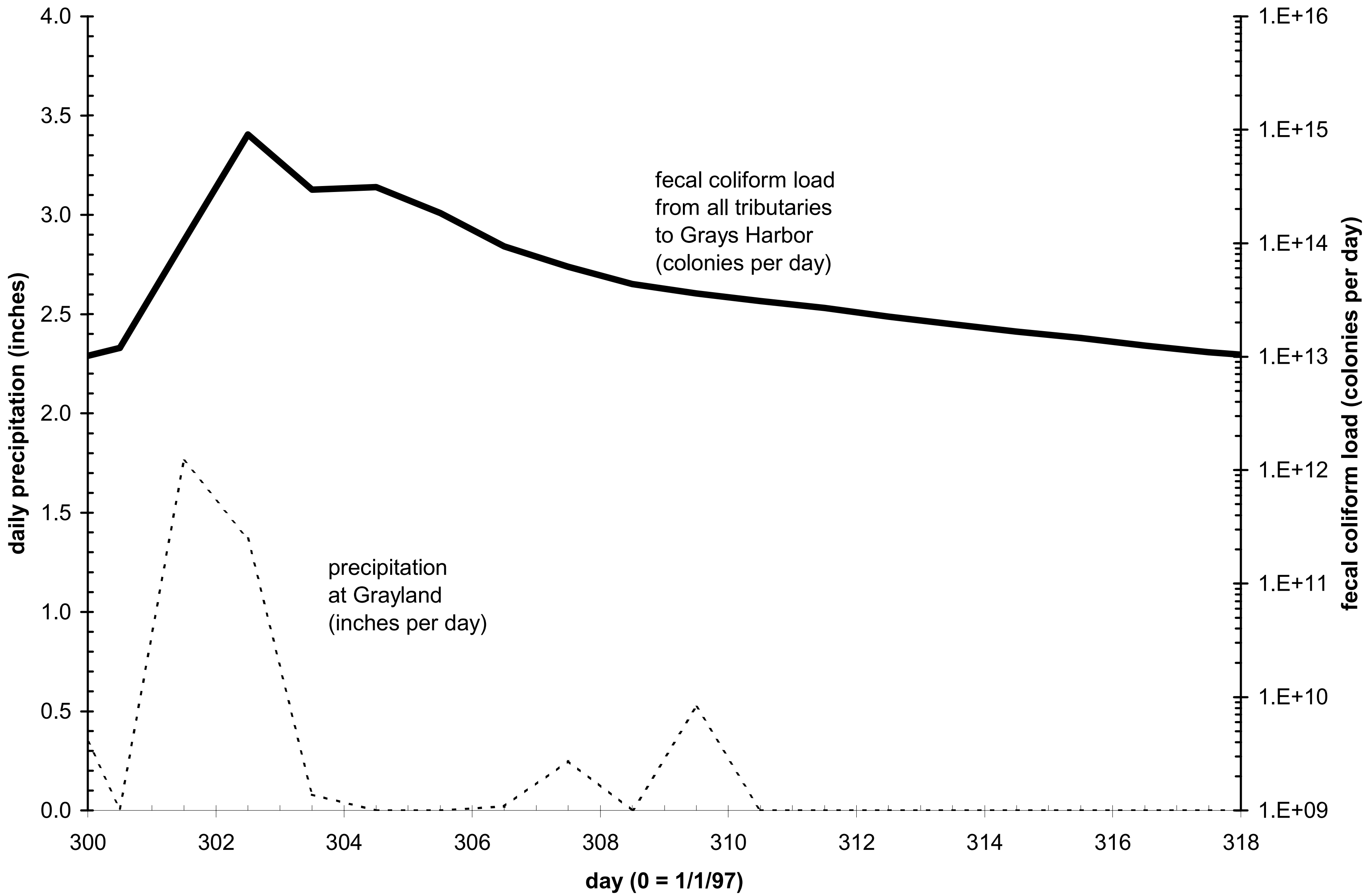


**Figure 42. Predicted fecal coliform in the central region of Grays Harbor during the October 28 - November 14, 1997 storm event (day 300-318).**

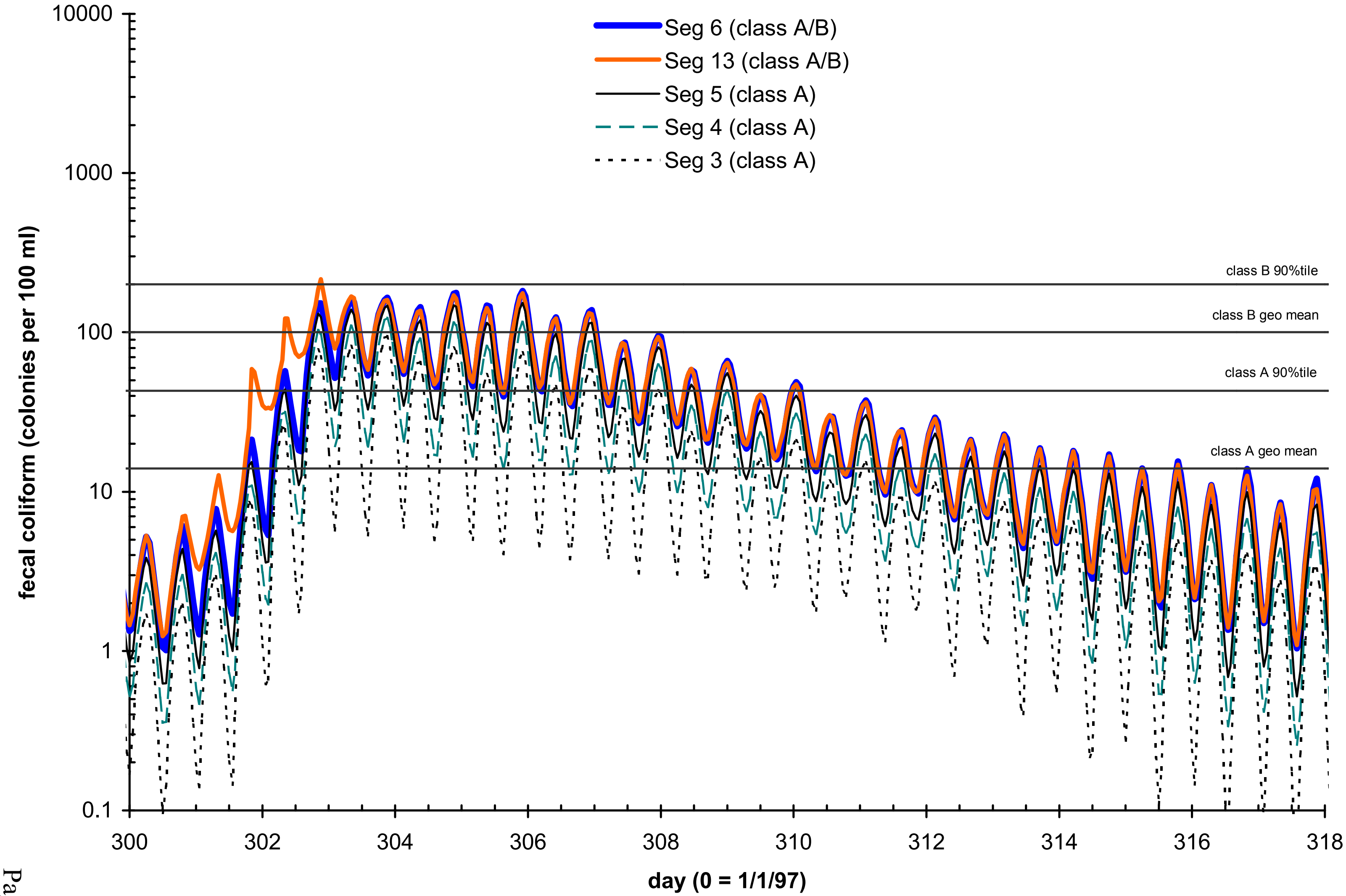


**Figure 43. Predicted fecal coliform in the north region of Grays Harbor during the October 28 - November 14, 1997 storm event (day 300-318).**

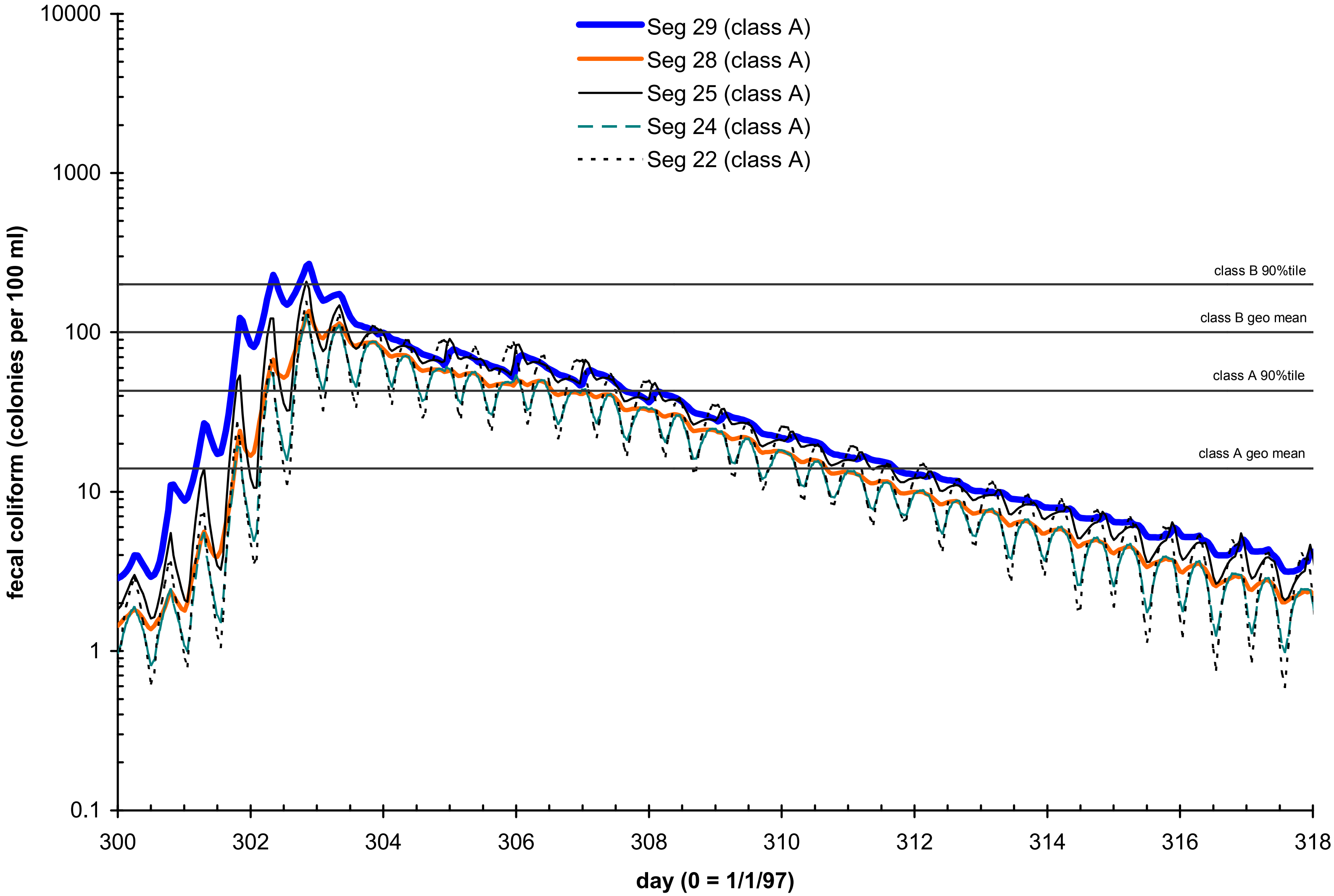
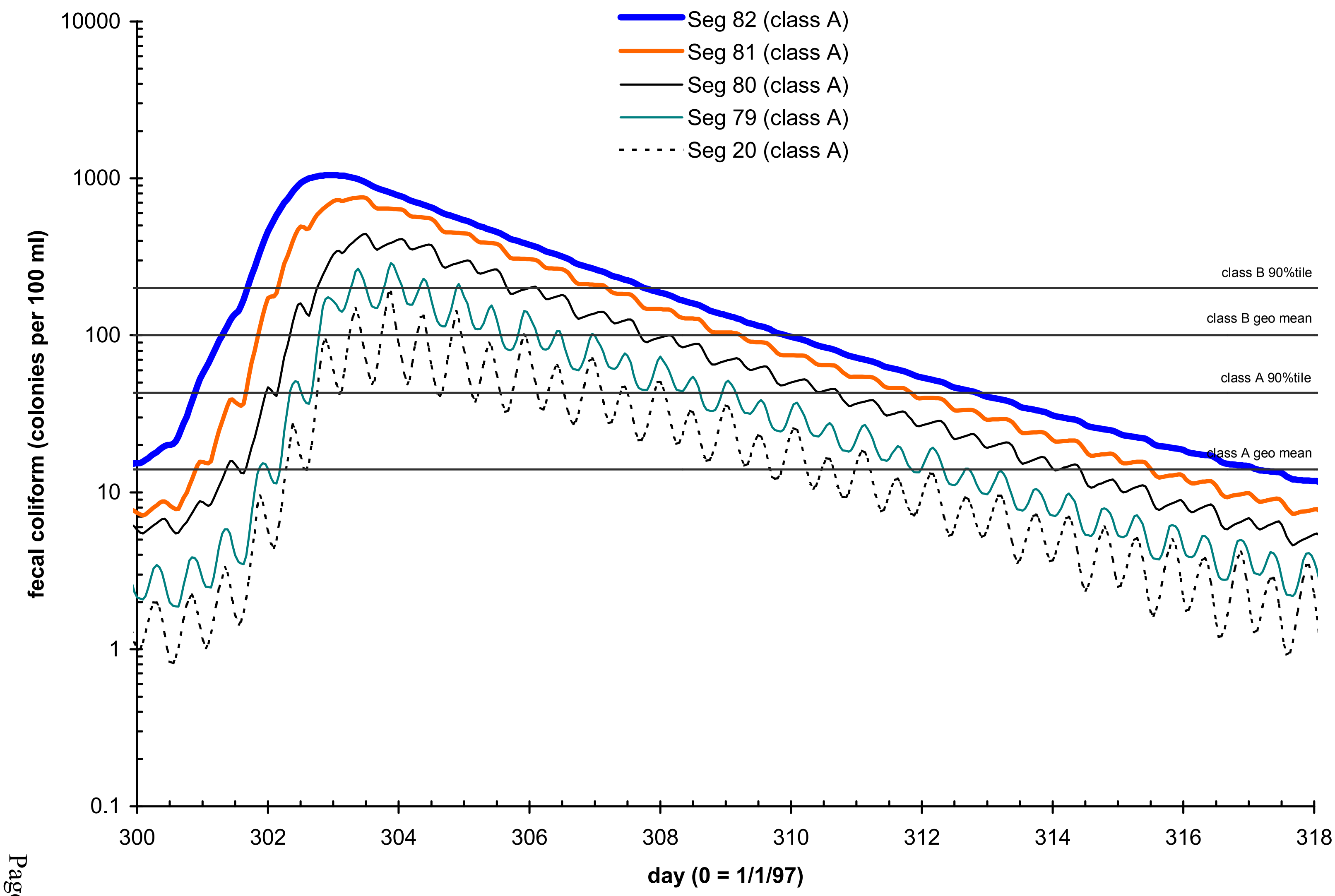


**Figure 44. Predicted fecal coliform in the south region of Grays Harbor during the October 28 - November 14, 1997 storm event (day 300-318).**



## Predicted response to loading from Weyerhaeuser Outfall 1 (Weyco 1) in July-August 1997

Point source upset conditions which trigger closure of the conditionally approved areas by DOH include greater than 20,000 fecal coliform organisms per 100 ml (daily maximum NPDES permit limit) in effluent from the Weyerhaeuser Cosmopolis plant Outfall 1 (Weyco 1). This condition occurred on three days during the study year during two events: July 24-25, 1997, and March 1, 1998. The July 24-25 event resulted in the largest daily load from the Weyco 1 outfall during May 1997–April 1998 (study year).

During the July 24-25 event the load from Weyco 1 accounted for more than 95 percent of the total load to Grays Harbor. During the study year there were nine days when the load from Weyco 1 accounted for more than 50 percent of the total load, and 18 days (5 percent of the time) when the Weyco 1 load accounted for more than 20 percent of the total load. In contrast to these extreme conditions, the average load from Weyco 1 over the entire study year accounted for less than 4 percent of the total load to Grays Harbor.

The water quality model results were used to present predicted conditions in Grays Harbor in response to the loading event of July 24-25, 1997. Figure 45 shows the load from Weyco 1 and the total load from all sources between July 15 and August 31, 1997. A relatively large pulse of loading occurred on July 24-25, and was followed by smaller pulses over the next several days. Figures 46, 47, and 48 show the predicted fecal coliform in the inner, central, north, and south regions.

In response to the loading from Weyco 1, the highest concentrations in Grays Harbor are predicted to occur in model segment 17 in the inner harbor, which is the segment that receives the discharge. Concentrations in segment 17 and several other segments in the inner harbor are predicted to exceed the class B water quality standard during the discharge event.

The loading event from Weyco 1 was also predicted to cause concentrations in the central region to exceed the class A standard. The north region and the outer south regions were also predicted to increase in concentration following the loading event, with some segments predicted to also exceed the class A standard. The inner south region showed some response to the loading event, although concentrations were not predicted to exceed the class A standard. An animation of the predicted water quality during this period is presented in Appendix J.

The model results confirm the appropriateness of shellfish closures by DOH based on point source upset conditions. The model results suggest that it may be advisable for DOH to consider extending the conditional closure to the north region in the event of point source upsets.

## Predicted water quality if Weyco Outfall 1 (Weyco 1) had been discharging at the maximum allowable loading according to the NPDES permit

The period of July 15 – August 31, 1997 was used to predict the improvement in water quality that would result from a reduction of the load from Weyerhaeuser. Two scenarios were evaluated to test the adequacy of existing and proposed NPDES permit limits for Weyco 1:

- Model run G13RUN04: Weyco 1 was assumed to be meeting the existing daily maximum limit of 20,000 colonies per 100 ml from July 15 – August 31 at all times, and otherwise was assumed to be discharging at the lower reported concentrations.

- Model run G13RUN05: Weyco 1 was assumed to be meeting the proposed daily maximum limit of 16,600 colonies per 100 ml from July 15 – August 31 at all times, and otherwise was assumed to be discharging at the lower reported concentrations. The proposed limit is under consideration by Ecology based on a recent dilution zone study (Nelson, 1999).

Following these two runs, additional model runs were made by reducing the daily maximum limit until the water quality standard was predicted to be met. The model results were evaluated on a daily basis, in comparison with the geometric mean and 90$^{th}$ percentile requirements of the water quality standards. The 90$^{th}$ percentile standard was found to be limiting. The 90$^{th}$ percentile limit (marine class B) of 200 colonies per 100 ml was assumed to be met, if less than 10 percent of the predicted hourly concentrations at segment 17 were higher than 200 during any given 24-hour period.

**Evaluation of the current daily maximum limit of 20,000 colonies per 100 ml for Weyco 1**

Figure 49 presents predicted fecal coliform in the inner harbor and in the central region near the transition area from marine class B to class A water quality standards for model run G13RUN04 (daily maximum limit of 20,000 colonies per 100 ml). These results show that the fecal coliform concentrations in Grays Harbor would have been significantly lower if Weyco 1 had not been exceeding its permit limit (see Figure 46 for comparison with predicted response to actual loads during this period). However, Figure 49 shows that the predicted fecal coliform at model segment 17 would exceed the class B standard even if Weyco 1 had been meeting its current permit limit. The concentration of fecal coliform in segment 17 was predicted to exceed the 90th percentile standard up to 21 percent of the time during the worst 24-hour period (5 of 24 hours).

**Evaluation of the proposed daily maximum limit of 16,600 colonies per 100 ml for Weyco 1**

A proposed daily maximum limit of 16,600 colonies per 100 ml is under consideration for Weyco 1 based on a recent dilution zone study (Nelson, 1999). Figure 50 presents predicted fecal coliform in the inner harbor and in the central region near the transition area from marine class B to class A water quality standards for model run G13RUN05 (daily maximum limit of 16,600 colonies per 100 ml). Figure 50 shows that the predicted fecal coliform at model segment 17 would still exceed the class B standard, even if Weyco 1 had been meeting the proposed new permit limit. The concentration of fecal coliform in segment 17 was predicted to exceed the 90th percentile standard up to 12.5 percent of the time during the worst 24-hour period (3 of 24 hours).

**Trial solution of a daily maximum limit for Weyco 1**

Additional model runs were made by reducing the daily maximum limit until the water quality standard was predicted to be met. The trial values for daily maximum limits were run at intervals of 1,000 colonies per 100 ml (i.e., trial values included 16,000, 15,000, 14,000, etc.)

Figure 45. Fecal coliform load from all tributaries and Weyco 1 during July 15 - August 31, 1997 (day 195-242).

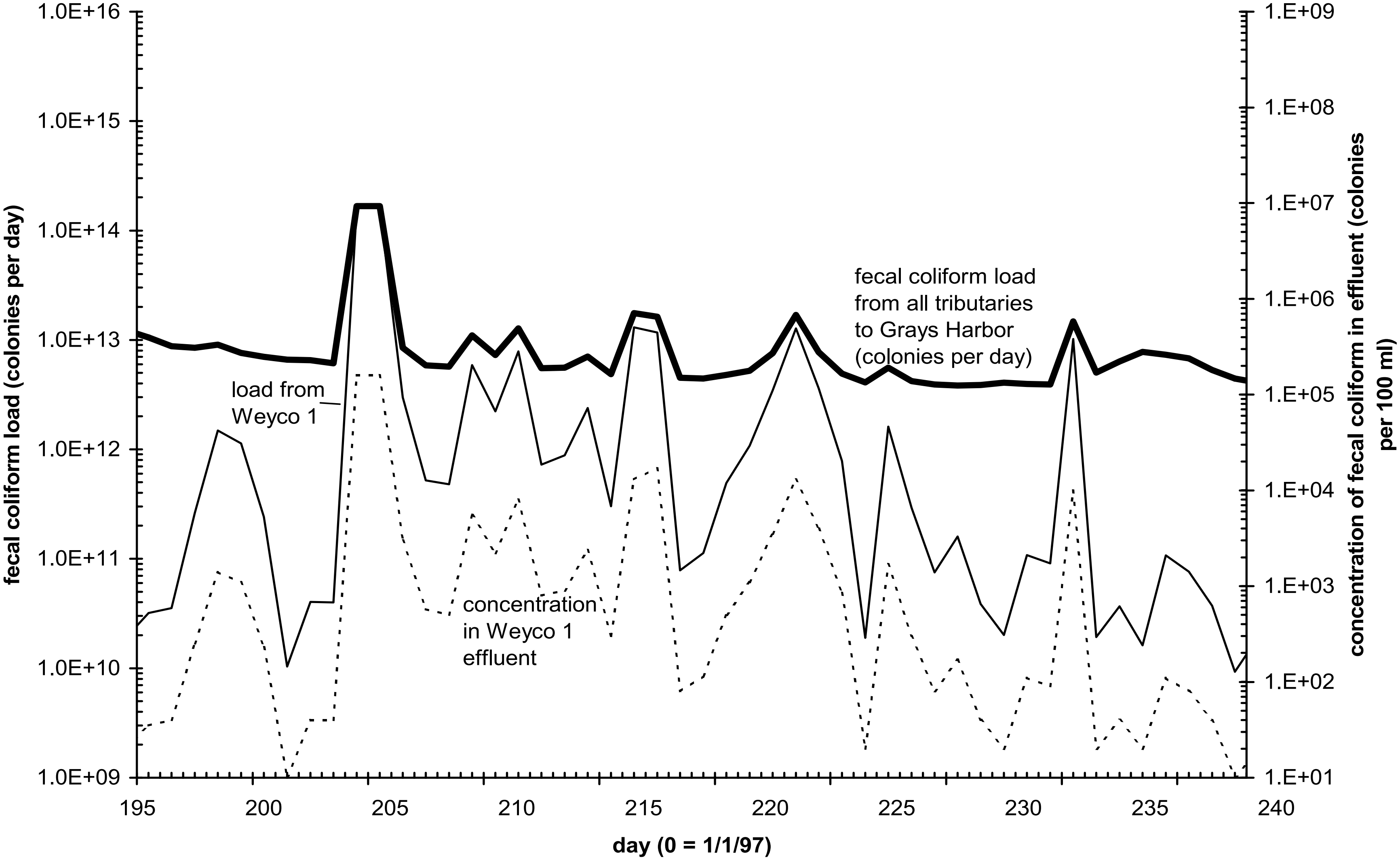


**Figure 46. Predicted fecal coliform in the inner and central region of Grays Harbor during July 15 - August 31, 1997 (day 195-242).**

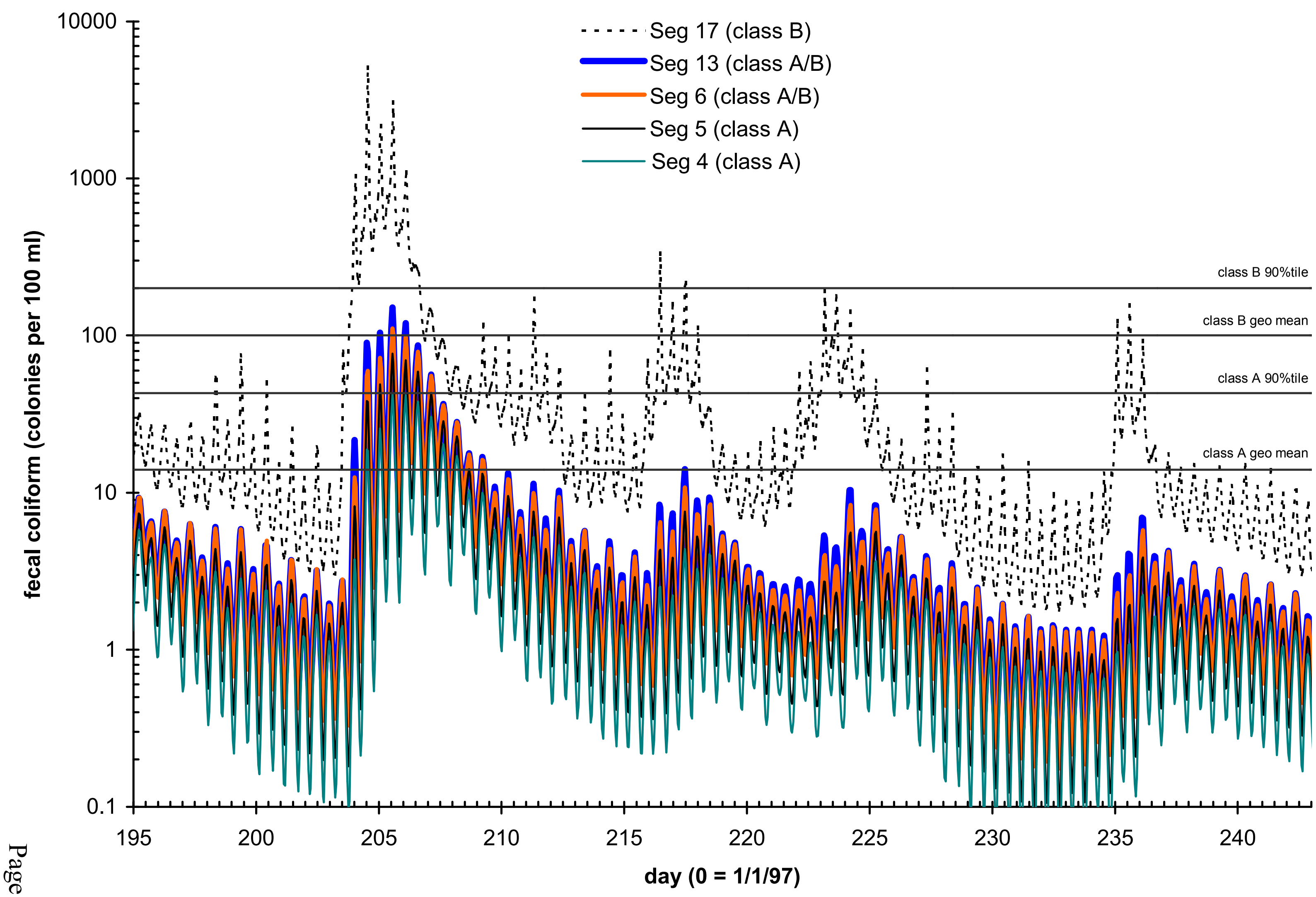


Figure 47. Predicted fecal coliform in the north region of Grays Harbor during July 15 - August 31, 1997 (day 195-242).

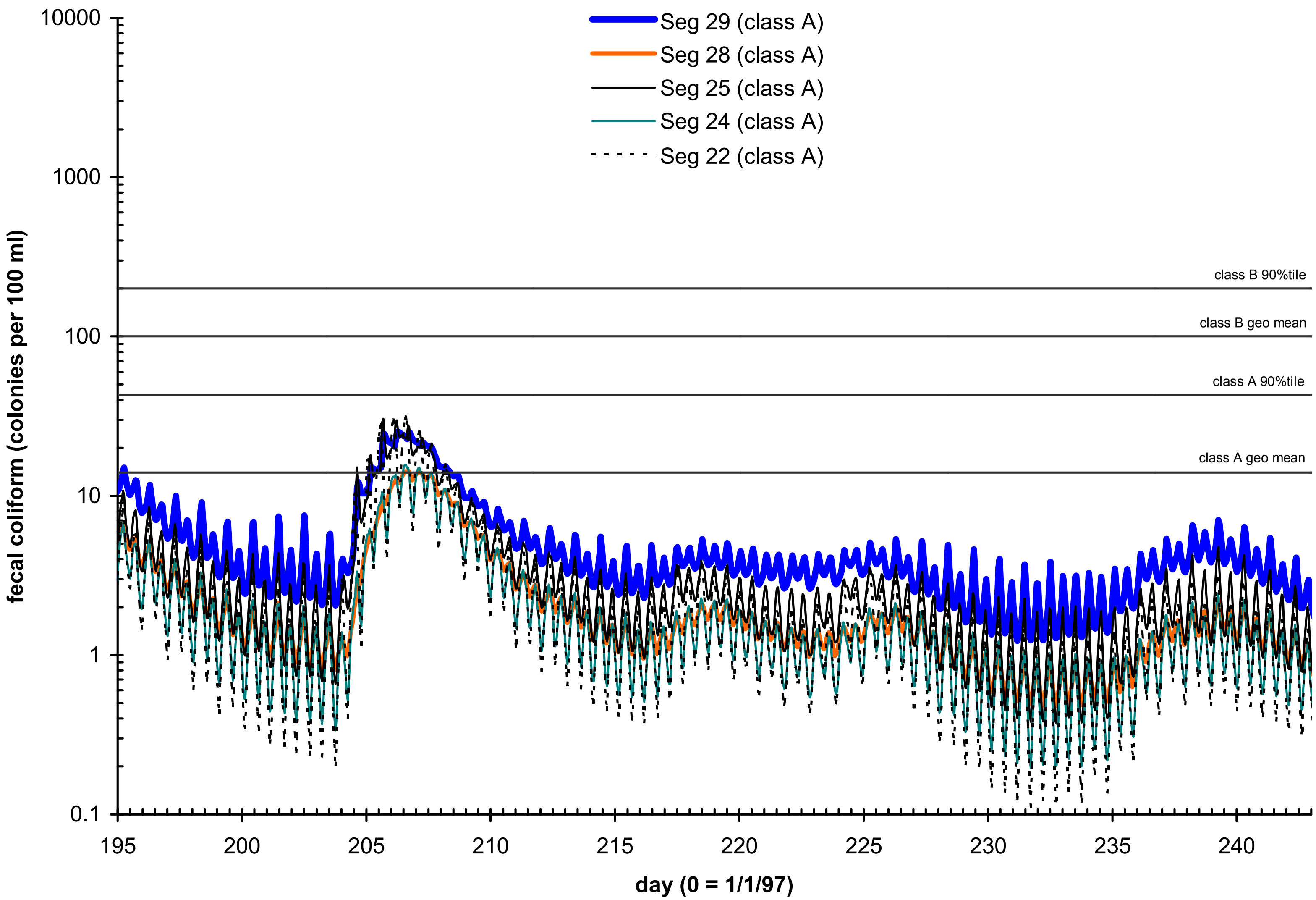


**Figure 48. Predicted fecal coliform in the south region of Grays Harbor during July 15 - August 31, 1997 (day 195-242).**

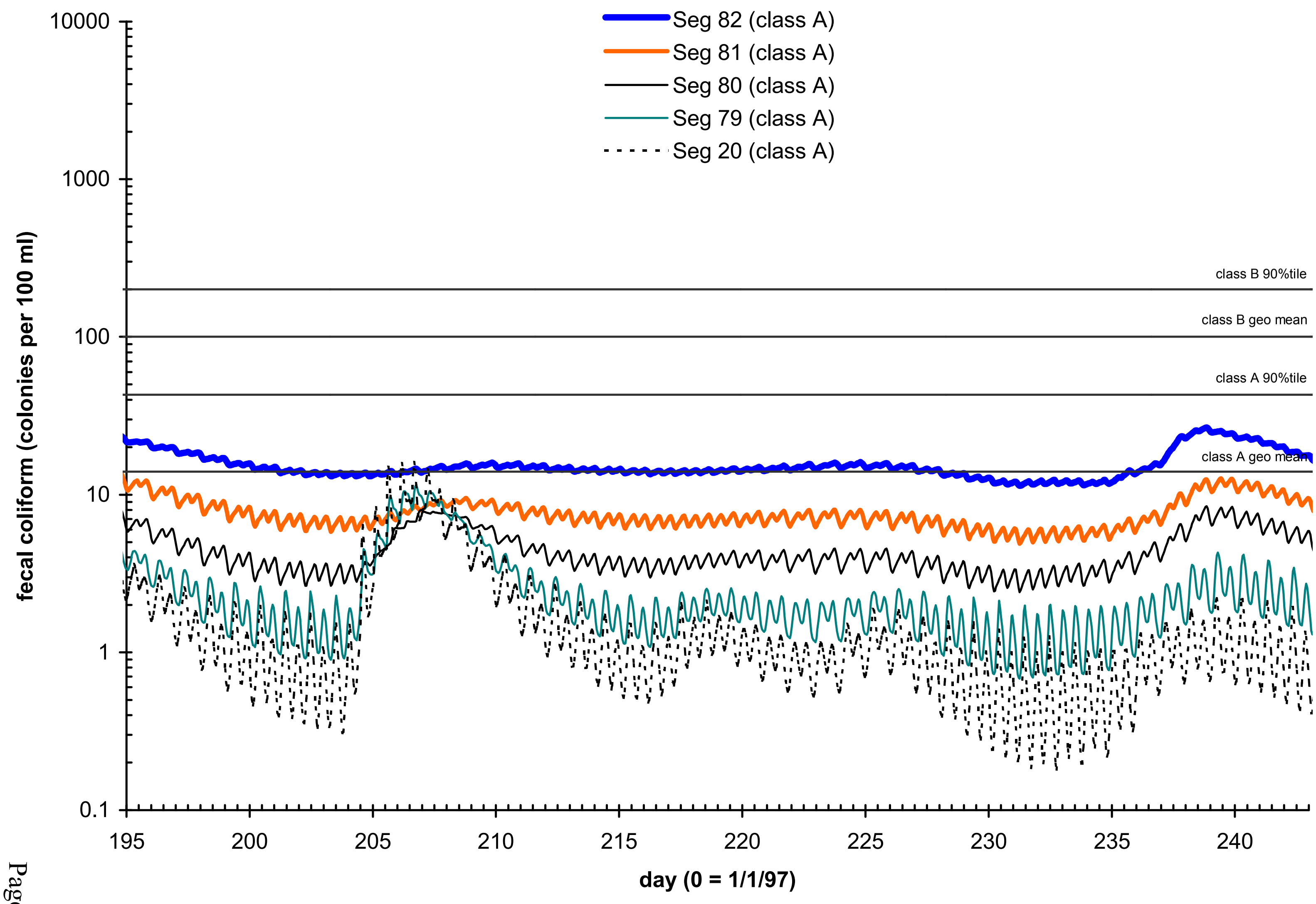


**Figure 49. Predicted fecal coliform in the inner and central region of Grays Harbor, for a hypothetical daily maximum at Weyco 1 of 20,000 colonies per 100 ml, during July 15 - August 31, 1997 (day 195-242).**

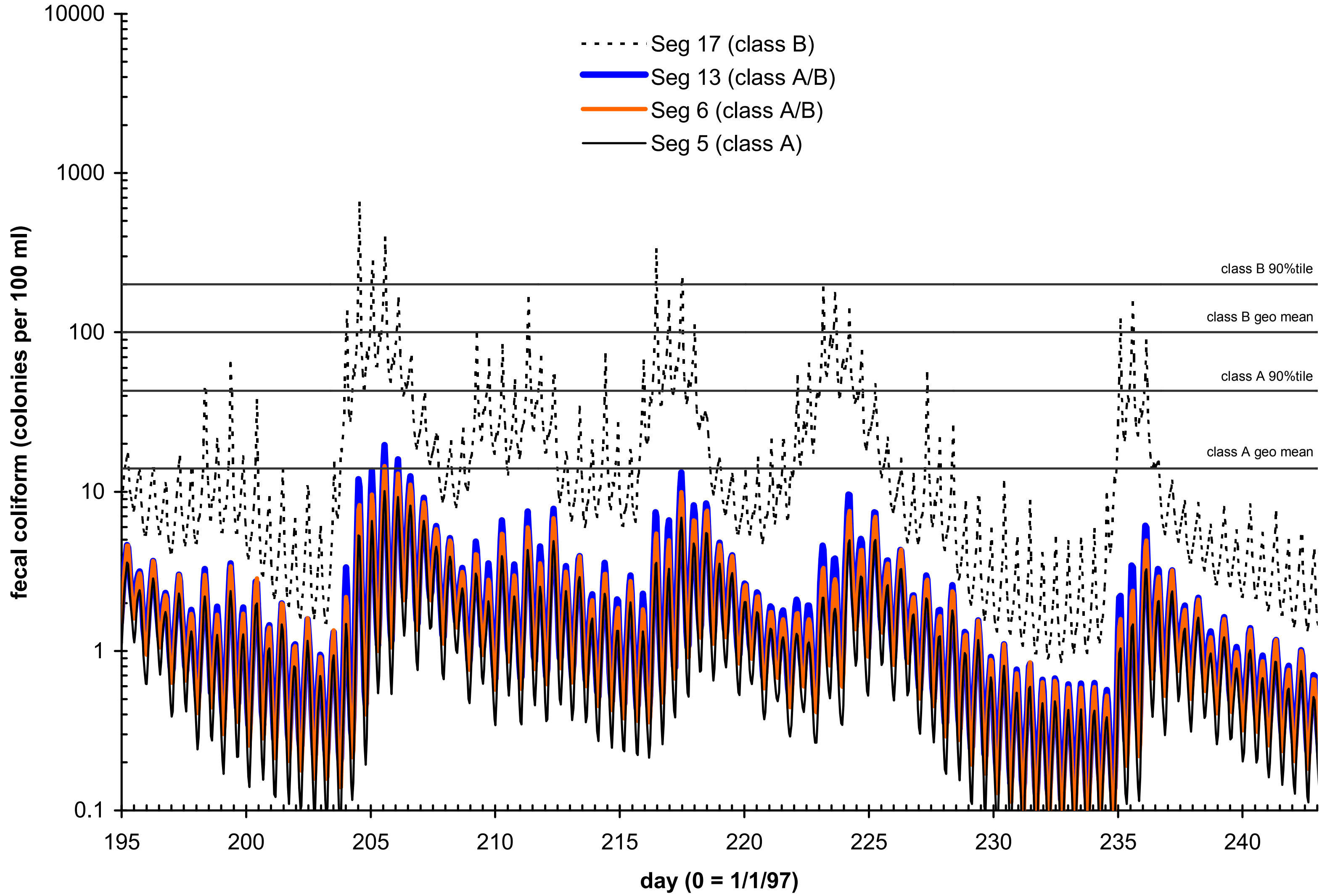
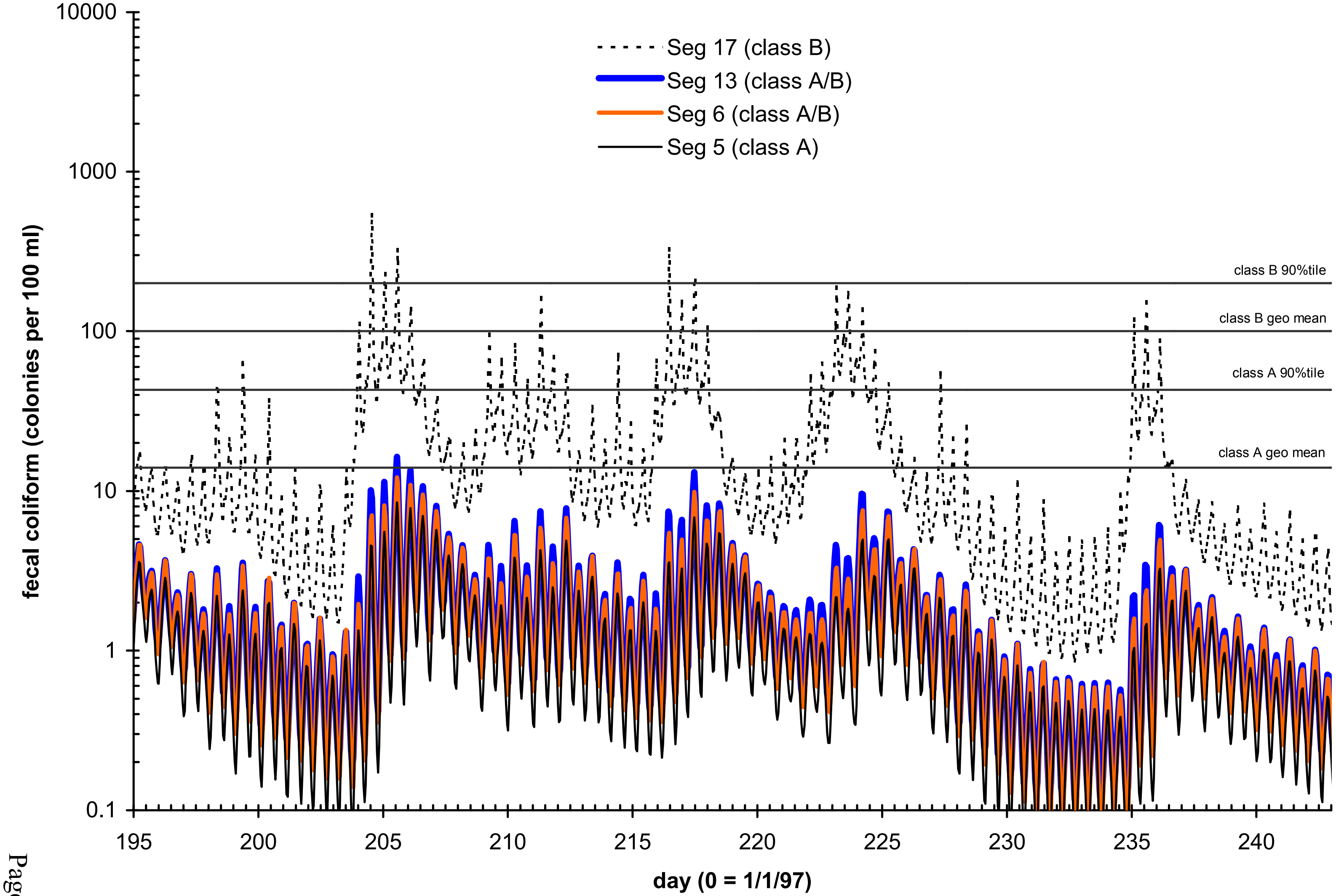


**Figure 50. Predicted fecal coliform in the inner and central region of Grays Harbor for a hypothetical daily maximum at Weyco 1 of 16,600 colonies per 100 ml, during July 15 - August 31, 1997 (day 195-242).**



The 90$^{th}$ percentile limit (marine class B) of 200 colonies per 100 ml was assumed to be met, if less than 10 percent of the predicted hourly concentrations at segment 17 were higher than 200 during any given 24-hour period.

A daily maximum limit of 14,000 colonies per 100 ml was found to satisfy the requirement of exceeding the 90$^{th}$ percentile standard no greater than 10 percent of the time during a 24-hour period. Figure 51 shows the predicted fecal coliform in the inner and central region of Grays Harbor, assuming a daily maximum limit of 14,000. Even though the frequency requirement of the standard was met, the highest hourly concentration was still predicted to be 457 colonies per 100 ml in segment 17, which is more than double the magnitude of the water quality standard.

A more restrictive interpretation of the water quality standard was also examined. Additional trials were run by further reducing the daily maximum limits until all predicted hourly concentrations in segment 17 were less than the 90$^{th}$ percentile standard of 200 colonies per 100 ml. A resulting daily maximum limit of 6,000 colonies per 100 ml was obtained for Weyco 1 (Figure 52). This limit is predicted to result in no more than 200 colonies per 100 ml at all times in the inner harbor during the July 15 – August 31, 1997 period.

## Predicted response to point source loading from Weyerhaeuser Outfall 1 (Weyco 1), Weyerhaeuser Outfall 2 (Weyco 2), and Grays Harbor Paper during the period of lowest freshwater inflows

The period of September 5-14, 1997 represented the lowest total inflows from tributaries to Grays Harbor during May 1997–April 1998 (study year). The Chehalis River flows during September 5-14 were similar to the lowest 60-90 day averages that occur once every two years, and may be considered representative of seasonal low flows during a typical year. September 5-14 was selected to represent a critical condition when potential dilution of point sources would be at a minimum. Water quality during September 5-14 was predicted to be significantly better than the water quality standards (Figure 53).

Three scenarios were evaluated during September 5-14, 1997 to test the adequacy of NPDES limits for point sources:

- Model run G13RUN06: Weyco 1 was assumed to be discharging at a hypothetical concentration of 5,000 colonies per 100 ml (current maximum monthly average limit) on September 5 and September 7-14; and at 14,000 colonies per 100 ml (daily maximum limit to meet marine class B standards) on September 6-7. Effluent flow was assumed to equal the average reported flow during the study year.

- Model run G13RUN09: Weyerhaeuser has a second outfall (Weyco 2) that discharges wastewater to the Chehalis River at segment 48. Weyco 2 discharges less loading than Weyco 1, but the NPDES limits for fecal coliform concentration are the same. Weyco 2 was assumed to be discharging at a hypothetical concentration of 5,000 colonies per 100 ml (current maximum monthly average limit) on September 5 and 7-14; and at 20,000 colonies per 100 ml on September 6-7 (current daily maximum limit). Effluent flow was assumed to equal the reported flow.

- Model run G13RUN08: Grays Harbor Paper was assumed to be discharging at a hypothetical concentration of 500 colonies per 100 ml (current maximum monthly average limit) on September 5 and September 7-14; and at 19,200 colonies per 100 ml (current daily maximum limit) on September 6-7. Effluent flow was assumed to equal the average reported flow during the study year.

All other nonpoint and point source loads were assumed to equal the conditions that would occur following rollback to meet the marine standards in Grays Harbor (model run G13RUN03), and the simulations were run for the entire study year, May 1, 1997 – April 30, 1998.

These model scenarios were predicted to result in meeting the water quality standards in Grays Harbor (Figures 54, 55, and 56). This finding suggests that the current discharge limits for Weyco 2 and Grays Harbor Paper are adequate for protection of the water quality standard in Grays Harbor. The proposed limit of 14,000 colonies per 100 ml as a daily maximum for Weyco 1 was found to be protective under these lower flow conditions of September 5-14, 1997, as well as the somewhat higher flow conditions of July 15 – August 31, 1997.

# Recommended Load Allocations and Waste Load Allocations

The proposed waste load allocations (WLAs) for point sources are presented in Table 16. The proposed load allocations (LAs) for nonpoint sources are presented in Table 17, along with WLAs for point sources. The proposed LAs are based on the reduction in loading that was estimated to result in meeting both the freshwater and marine water quality standards for fecal coliform (Tables 13, 14, and 15).

Table 16. Proposed waste load allocations for fecal coliform from NPDES dischargers to the lower Chehalis River and Grays Harbor.

| NPDES dischargers | NPDES flow basis for calculation of WLAs (m3/sec) (1) | NPDES fecal coliform concentration for calculation of WLA (colonies/100 ml) (2) | Waste load allocation to meet water quality standard (colonies/year) |
|---|---|---|---|
| **Municipal** | | | |
| Aberdeen | 0.3834 | 200 | 2.42E+13 |
| Elma | 0.0210 | 200 | 1.33E+12 |
| Hoquiam | 0.1753 | 200 | 1.11E+13 |
| McCleary | 0.0110 | 200 | 6.91E+11 |
| Montesano | 0.0158 | 200 | 9.95E+11 |
| Ocean Shores | 0.2935 | 200 | 1.85E+13 |
| Westport | 0.0351 | 200 | 2.21E+12 |
| **Industrial** | | | |
| Ocean Spray Cranberries | 0.0138 | 200 | 8.70E+11 |
| Grays Harbor Paper | 0.266 | 500 | 4.19E+13 |
| Weyerhaeuser 001 | 1.024 | 5000 | 1.61E+15 |
| Weyerhaeuser 002 | 0.333 | 5000 | 5.25E+14 |

1) Maximum monthly average design flow for municipal dischargers and average annual flow for industrial dischargers.
2) Maximum monthly average limits.

**Figure 51. Predicted fecal coliform in the inner and central region of Grays Harbor for a hypothetical daily maximum at Weyco 1 of 14,000 colonies per 100 ml, during July 15 - August 31, 1997 (day 195-242).**

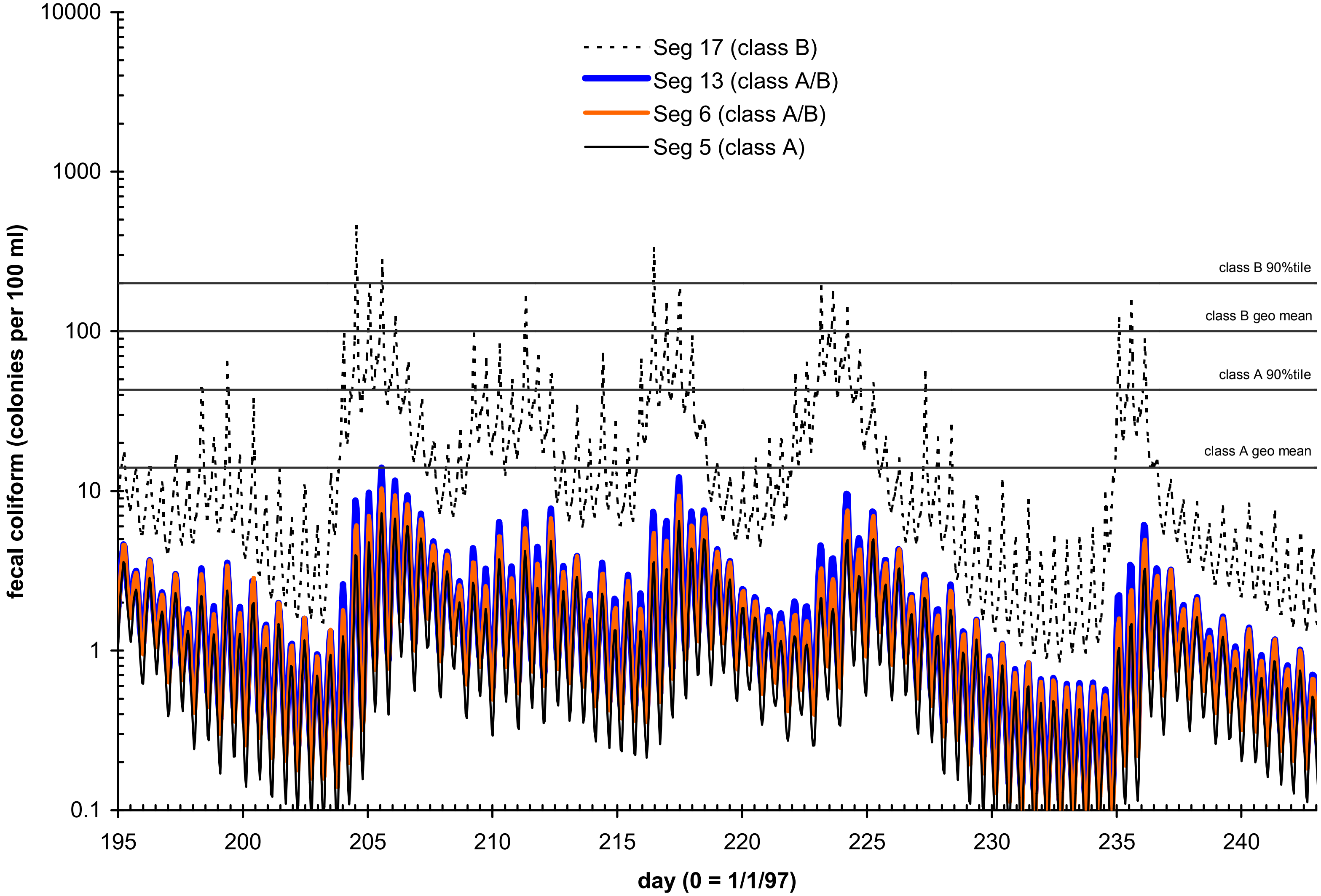


**Figure 52. Predicted fecal coliform in the inner and central region of Grays Harbor for a hypothetical daily maximum at Weyco 1 of 6,000 colonies per 100 ml, during July 15 - August 31, 1997 (day 195-242).**

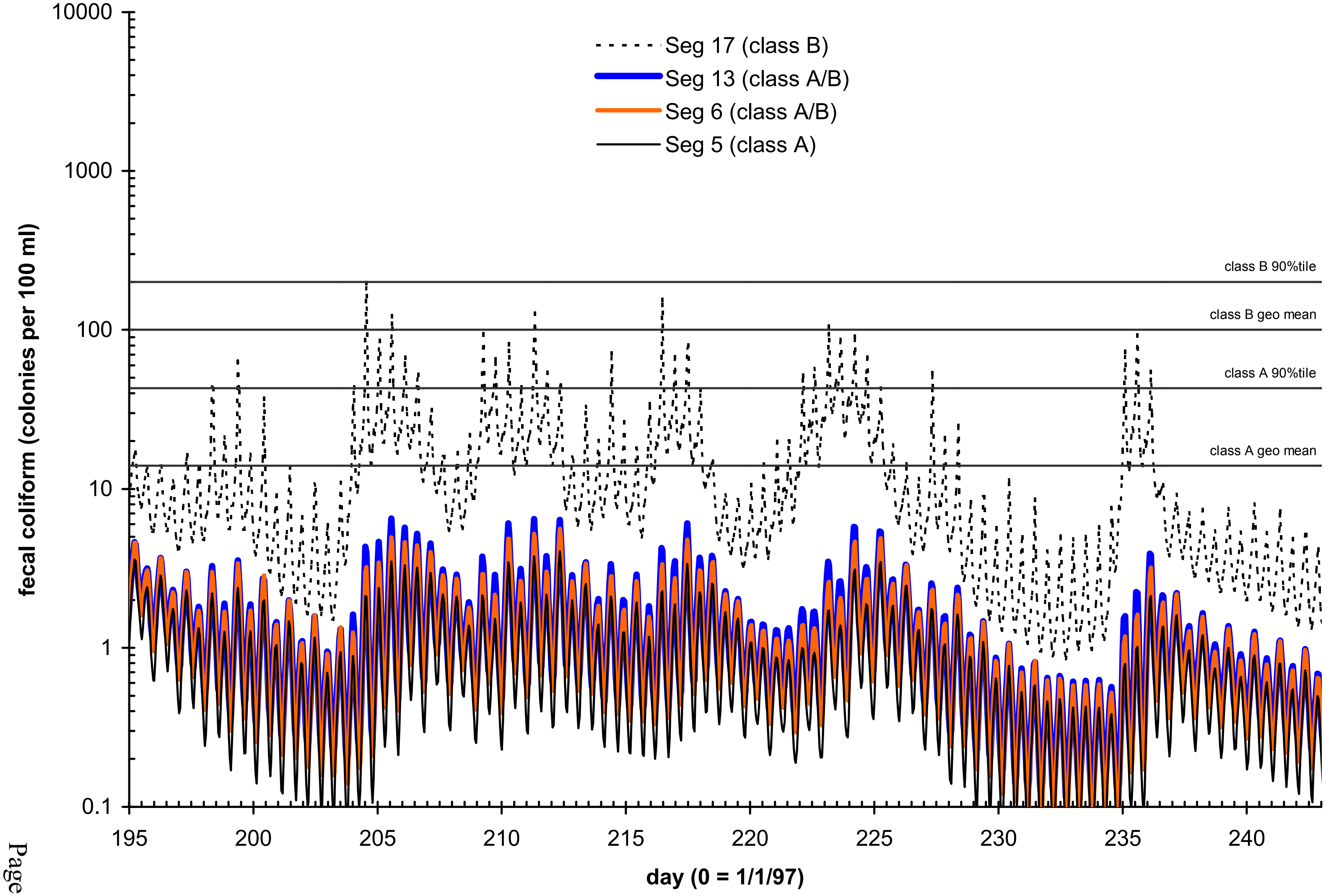


**Figure 53. Predicted fecal coliform in the inner and central region of Grays Harbor during September 5 - 14, 1997 (day 247-256).**

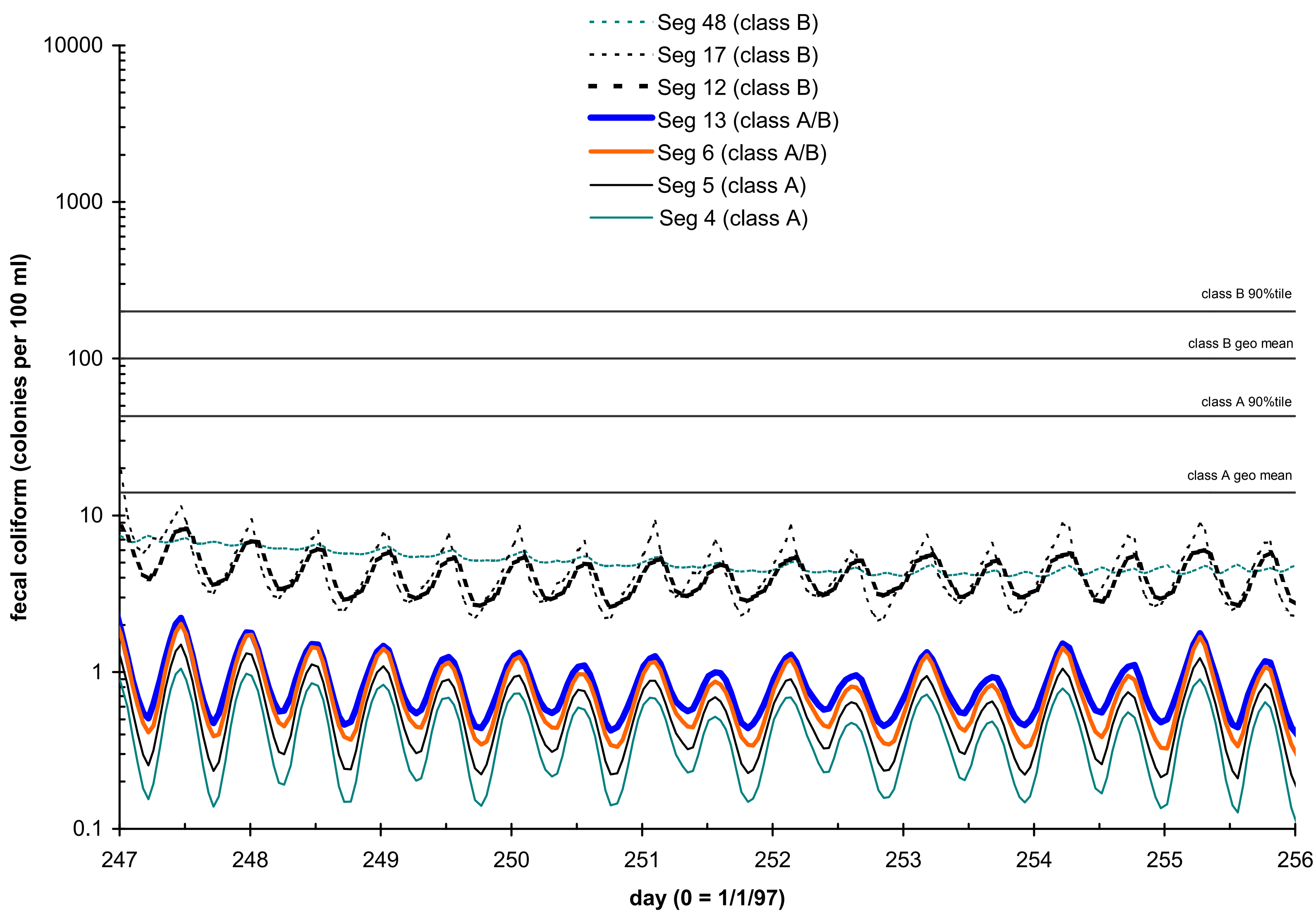


**Figure 54. Predicted fecal coliform in the inner and central region of Grays Harbor for a hypothetical effluent concentration at Weyco 1 of 14,000 colonies per 100 ml, on September 6 - 7, 1997 (day 248-249).**

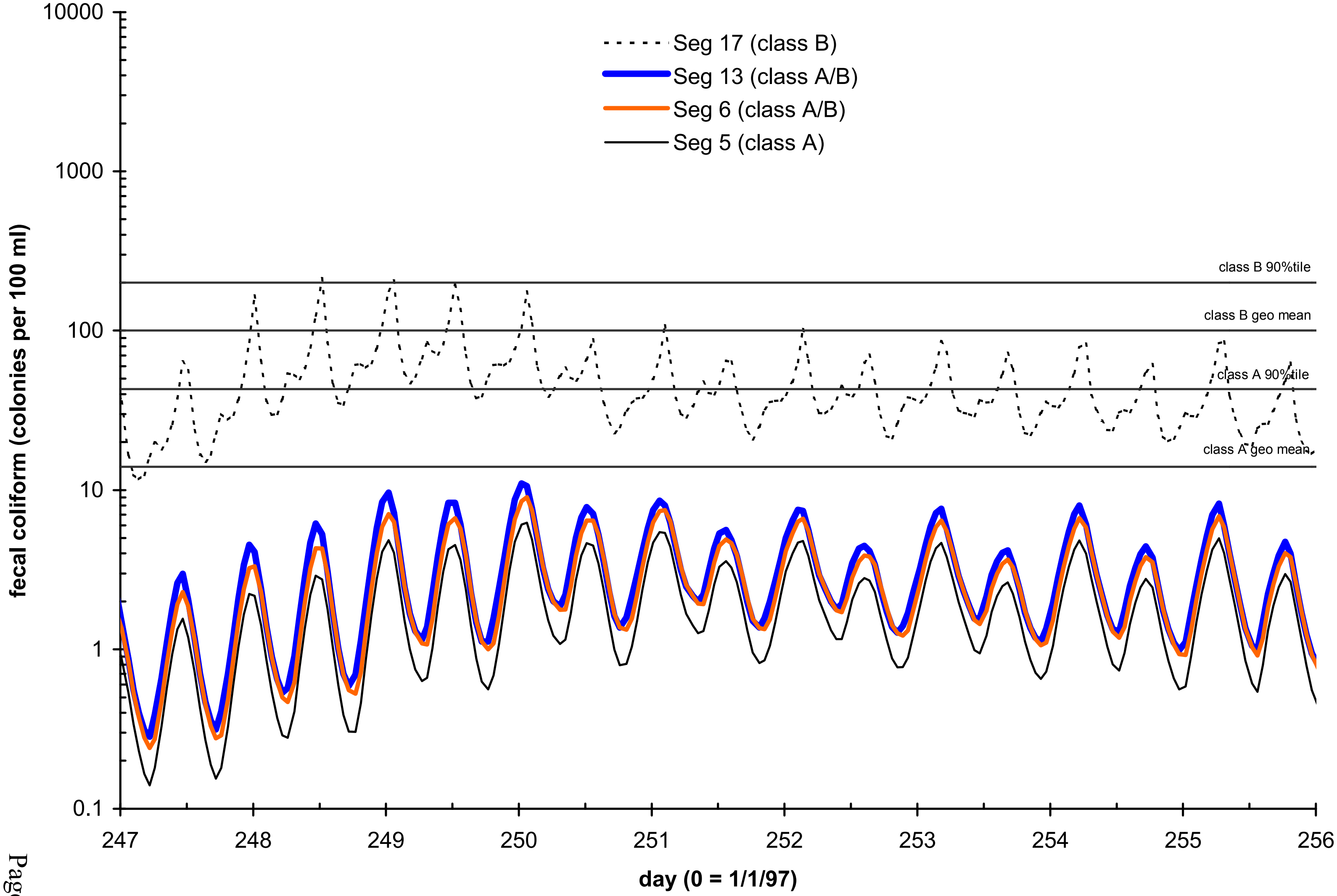


**Figure 55. Predicted fecal coliform in the inner and central region of Grays Harbor for a hypothetical effluent concentration at Weyco 2 of 20,000 colonies per 100 ml, on September 6 - 7, 1997 (day 248-249).**

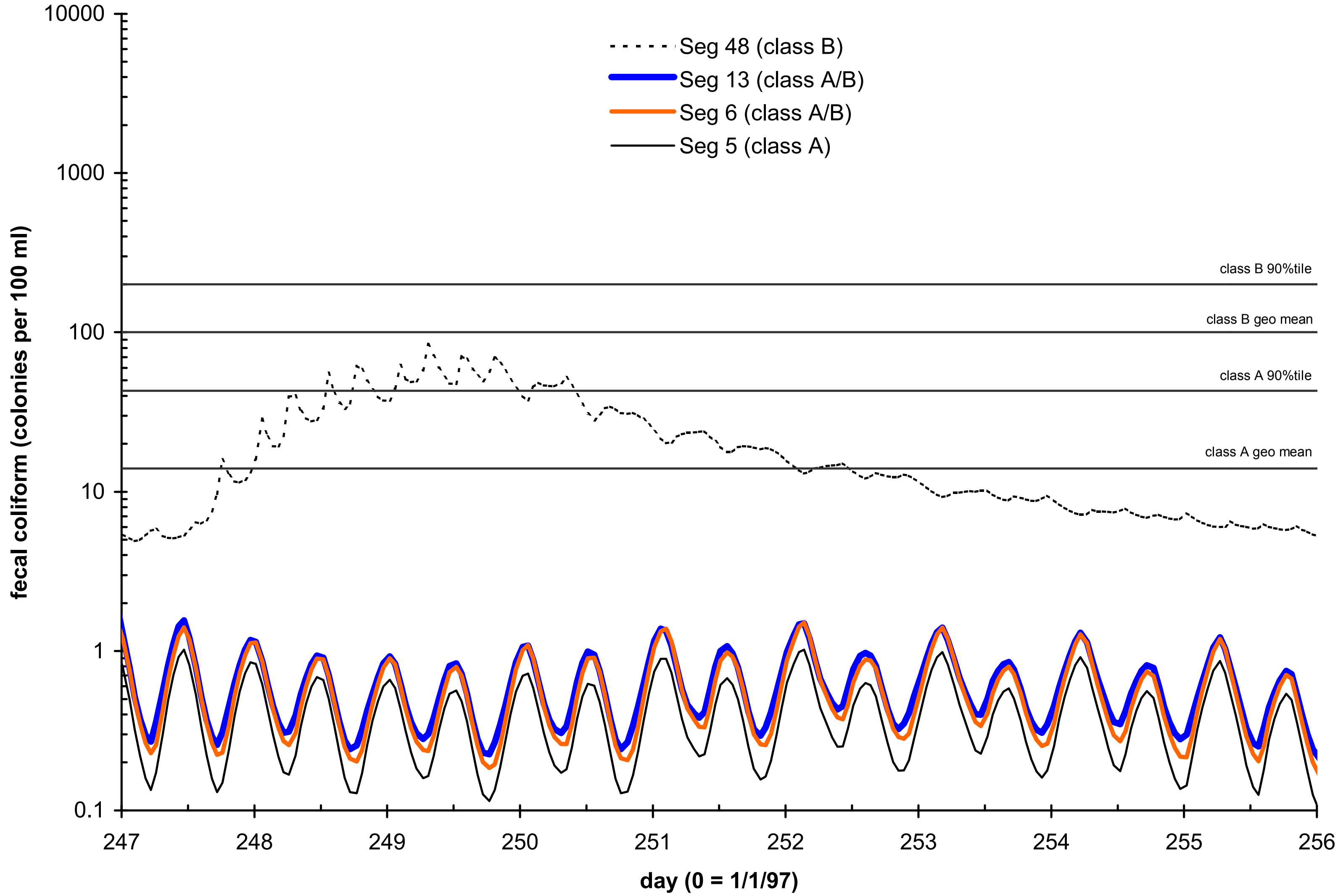


**Figure 56. Predicted fecal coliform in the inner and central region of Grays Harbor for a hypothetical effluent concentration at Grays Harbor Paper of 19,200 colonies per 100 ml, on September 6 - 7, 1997 (day 248-249).**

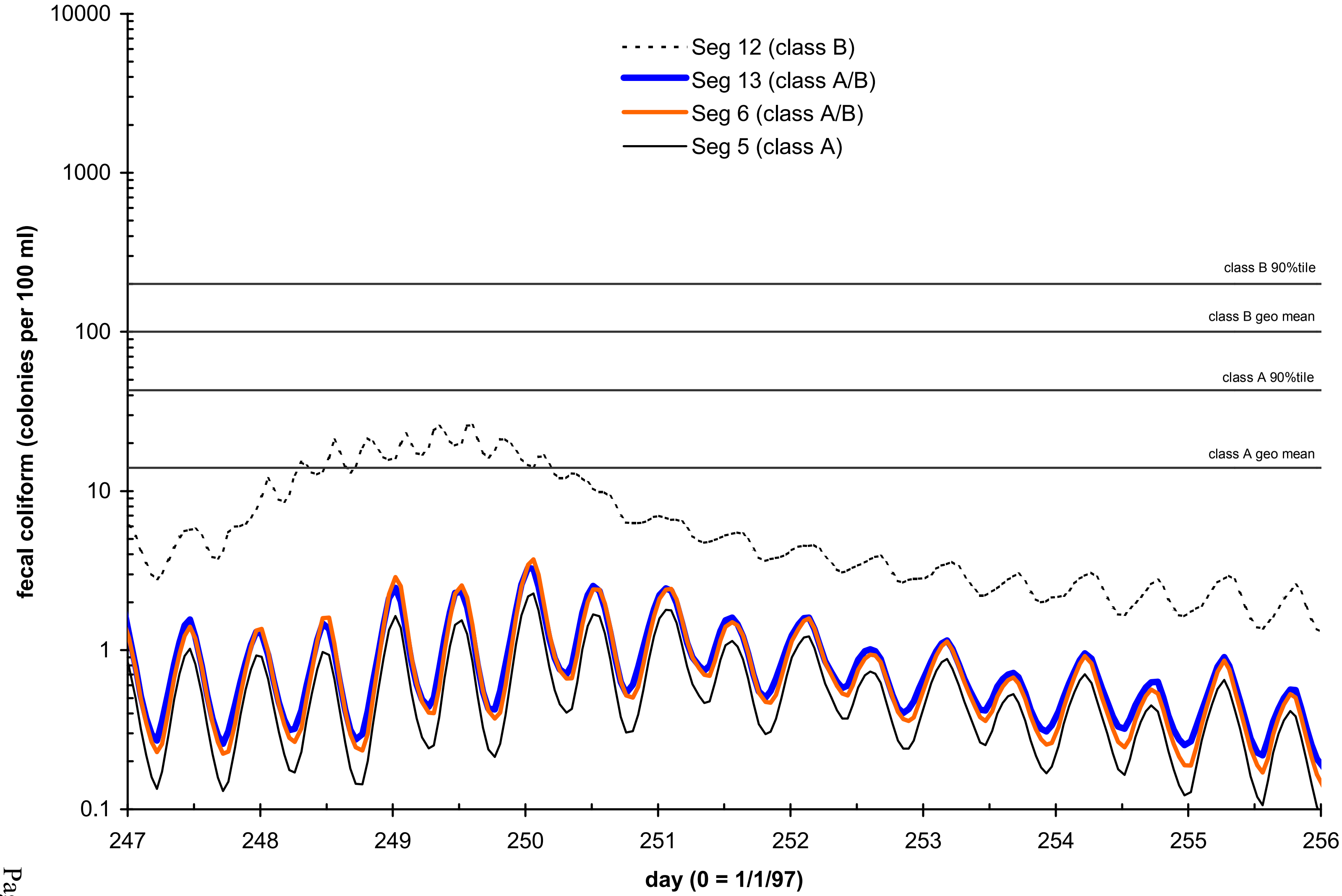


Table 17. Summary of proposed load allocations (LAs) and waste load allocations (WLAs) for fecal coliform from nonpoint and point sources to the lower Chehalis River and Grays Harbor, including targets for maximum monthly geometric means for tributaries after rollback of loads.

| Sources | Target maximum monthly geometric mean after rollback (colonies per 100 ml) | LA or WLA to meet water quality standard (colonies per year) |
|---|---|---|
| **Tributaries** | | |
| Chehalis River (excluding Satsop and Wynoochee rivers) | 30 | 1.80E+15 |
| Satsop River | 95 | 7.65E+14 |
| Wynoochee River | 83 | 4.36E+14 |
| Humptulips River near mouth | 38 | 3.97E+14 |
| Wishkah River near mouth | 100 | 3.28E+14 |
| Hoquiam River near mouth | 50 | 3.08E+14 |
| Johns River near mouth | 73 | 1.60E+14 |
| Chenois Creek | 34 | 5.66E+13 |
| Newskah Creek | 69 | 5.29E+13 |
| Elk River near mouth | 40 | 3.82E+13 |
| Elliot Slough | 100 | 3.25E+13 |
| Grass Creek | 20 | 3.15E+13 |
| Charlie Creek | 100 | 2.67E+13 |
| Grayland Ditch | 100 | 1.24E+13 |
| Oleary Creek | 95 | 1.20E+13 |
| Unnamed Central Park creek | 32 | 1.02E+13 |
| Barlow Creek | 70 | 9.10E+12 |
| Indian Creek | 34 | 8.43E+12 |
| Chapin Creek | 50 | 6.58E+12 |
| Andrews Creek near mouth | 13 | 5.78E+12 |
| Stafford Creek | 99 | 5.12E+12 |
| Campbell Creek | 46 | 4.32E+12 |
| Dempsey Creek | 58 | 2.91E+12 |
| Redman Slough | 100 | 1.86E+12 |
| Unnamed Westport creek | 100 | 9.30E+11 |
| Other small tributaries | - | 1.56E+13 |
| **Urban Drains** | - | 7.48E+12 |
| **Municipal NPDES Dischargers** | | |
| Aberdeen | - | 2.42E+13 |
| Elma | - | 1.33E+12 |
| Hoquiam | - | 1.11E+13 |
| McCleary | - | 6.91E+11 |
| Montesano | - | 9.95E+11 |
| Ocean Shores | - | 1.85E+13 |
| Westport | - | 2.21E+12 |
| **Industrial NPDES Dischargers** | | |
| Ocean Spray Cranberries | - | 8.70E+11 |
| Grays Harbor Paper | - | 4.19E+13 |
| Weyerhaeuser 001 | - | 1.61E+15 |
| Weyerhaeuser 002 | - | 5.25E+14 |
| **Total** | - | 6.77E+15 |

## Margin of Safety

EPA requires consideration of a margin of safety (MOS) when establishing TMDLs. The MOS is needed to account for the uncertainty about the relationship between the pollutant loads and the quality of the receiving waterbody. The MOS is normally incorporated into the conservative assumptions used to develop TMDLs. An alternative is to subtract a MOS from the load allocations for additional protection of water quality.

The MOS for the proposed TMDL for fecal coliform loading to Grays Harbor is partly implicit by using conservative assumptions for the analysis. The loading of fecal coliform to Grays Harbor during the study year was probably greater than the typical annual loading, due to greater than average tributary inflows. Also, compliance with the water quality standard was evaluated based on the most limiting month, whereas reductions in loading are proposed for all months of the study year.

An additional MOS may be incorporated during the public process for acceptance of the TMDL. For example, an additional MOS may be established by (1) subtracting a portion of the proposed load allocations or including an additional percent reduction in existing tributary loads to Grays Harbor, or (2) setting the targets for loading reduction to 75 percent or greater for all tributaries to Grays Harbor, instead of the estimated average of 65 percent reduction that is required.

# Conclusions

- During the study year, May 1, 1997 through April 30, 1998, most of the fecal coliform loading to Grays Harbor came from the Chehalis River. Most of the load from the Chehalis River originates in the upper watershed above Porter. The Humptulips, Satsop, Wishkah, and Hoquiam rivers were the next largest sources of fecal coliform and, together with the Chehalis, collectively accounted for nearly 80 percent of the total loading.

- Large reductions in fecal coliform concentrations are needed to meet water quality standards for tributaries to Grays Harbor. With the exception of the Wynoochee River, all tributaries discharging to Grays Harbor and the lower Chehalis River require some reduction in loading of fecal coliform to meet freshwater quality standards. The total reduction in loading needed from all nonpoint sources combined is approximately $8.5 \times 10^{15}$ colonies/year, which is an average of about a 65 percent reduction of the current total loading from tributaries.

- The Chehalis River is the most important single loading source that requires reduction, followed by the Humptulips, Wishkah, and Hoquiam rivers. Collectively these tributaries account for approximately 80 percent of the required reduction in loading to meet water quality standards.

- Weyerhaeuser Cosmopolis Outfall 1 (Weyco 1) at times exceeded the combined loading from all other sources, and on average accounted for almost 4 percent of the total load for the study year. During the times when the Weyco 1 discharge was in compliance with its permit, it represented a relatively minor contribution of loading compared with nonpoint sources. However, on three days of the study year the fecal coliform concentration in the Weyco 1 effluent exceeded its permit limit of 20,000 organisms per 100 ml. The highest loading event from Weyco 1 occurred on July 24-25, 1997, at which time the loading from Weyco 1 accounted for more than 95 percent of the total load from all point and nonpoint sources.

- For Weyco 1, the current permit limit of 20,000 colonies per 100 ml was found to be inadequate to protect water quality in inner Grays Harbor. The recently proposed new limit of 16,600 colonies per 100 ml was also found to be inadequate. A daily maximum limit of 14,000 colonies per 100 ml was found to satisfy the requirement of exceeding the 90$^{th}$ percentile standard no greater than 10 percent of the time during a 24-hour period.

- Model predictions during storm events suggest that the rainfall-conditional closure by the Washington State Department of Health (DOH) of the inner south region of Grays Harbor is justified. These results also suggest that the period of closure may need to be longer for very large events. Also, it may be reasonable to establish other areas of rainfall-conditional closure, such as the northeastern part of the north region and the eastern part of the central region.

- The model confirms the appropriateness of shellfish closures by DOH based on point source upset conditions. A loading event from Weyco 1 was predicted to cause concentrations in the central region to exceed the class A standard. The north region and the outer south regions were also predicted to increase in concentration following the loading event, with some segments predicted to exceed the class A standard.  The inner part of the south region also showed some response to the loading event, although concentrations were not predicted to exceed the class A standard.  The model results suggest that it may be advisable for DOH to consider extending the conditional closure to the north region in the event of point source upsets.

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# Appendices

# Appendix A.  Water quality database

The water quality database files are available for copying from Ecology's Internet website at the following URL:

http://www.wa.gov/ecology/eils/wrias/tmdl/ghfc/results.html.

The electronic files for the project appendices are also available on request to:

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# Appendix B. Methods for determining continuous streamflow for tributaries of Grays Harbor

A continuous record of flow was established for all streams, point sources, and most urban stormwater basins entering Grays Harbor. These flow data helped characterize bacteria loads to the Grays Harbor estuary. Various methods were used to produce continuous flow records from March 1997 through April 1998. Sources of data included:

- ◊ USGS gaging data for selected streams
- ◊ DMR data from NPDES permittees
- ◊ Stormwater pump records from Aberdeen and Hoquiam
- ◊ Ecology streamflow measurements
- ◊ Continuous stage records for seven sites monitored by Ecology
- ◊ Relationships between flows from gaged sites and ungaged sites
- ◊ Ratio estimators based on watershed areas and precipitation records for sites where no flow data were collected

These methods are described below. Table B-1 contains study site information and methods used to estimate flows.

**USGS, DMR, and stormwater basin flow determinations**

Daily average flows reported from USGS gaging stations and daily flows reported by NPDES permittees were used as reported. Flows in accessible and wadable urban streams were determined by measuring velocity and determining the cross-sectional area for the stream. For sites where stormwater is pumped from collection basins to the estuary, daily flows were estimated using pump capacity information and pump run-time records supplied by the cities of Hoquiam and Aberdeen. Where daily run-time of pumps was missing from the record, daily run-time was estimated by interpolating between known values. A continuous time-series of flow for urban streams was later generated using ratio-estimation techniques discussed below.

**Stream stage records**

Seven streams were selected for continuous monitoring of stream stage. Instrumentation included UNIDATA® capacative probes, pressure transducers, and datalogging units. Depth sensors were attached to a steel post driven into the streambed. Several arbitrary reference points were used to determine the location of the sensor in the vertical plane (e.g., steel post, bridge structure, and point on a nearby tree). Measurements from these reference points were also used to monitor for changes in sensor location or its performance. The accuracy of these reference point measurements was determined by comparing measurements made from two different reference points at each site. Stream stage data were recorded hourly and used the average stage of the previous hour. Instruments were checked about every two weeks and data were downloaded for later processing.

Maintenance of the datalogging system was performed as needed. High flows and accompanying debris sometimes damaged or moved the transducer probe or post. Transducer probes or data recorders failed occasionally. The raw stage record and reference point measurements were used to identify these disturbances and make corrections to establish a continuous record of stream stage over time.

**Transducer data review and correction**

Stream stage data for each site were referenced to the same datum after the raw data were corrected for the time of reference point measurement, system maintenance actions, tidal effects, and instrument drift.

The depth sensor's true reading at the time of reference point measurement was interpolated from the time of observation and the previous and subsequent hourly averages. During times of rapid change in stage, the observed distance between the depth sensor and water level differed from the system's recorded value because of the averaging function used. The corrected estimate of stage at the time of observation was used to help assess instrument drift and develop a stage-flow relationship.

Maintenance actions affected the transducer record and so were examined, and the record was adjusted accordingly. For example:

◊ At the Middle Fork Wishkah (station ID 10-wish), the original transducer post was bent by high flow debris. The transducer was moved to a more protected site about 100 yards upstream. The difference between the two transducer probe locations was reconciled by using measurements from water level to various reference points. Once this "shift" factor was determined, it was applied to the record to produce a continuous stage record related to the same datum.
◊ At the upper Johns River (station ID 23-john), a series of high flow events scoured the streambed upon which the transducer probe rested. The probe shifted downward nearly 14 inches over a three-week period. Examination of reference point measurements and stage record of adjacent streams allowed estimation of the drift and its correction, thus restoring the transducer record to a constant datum.

The peaks of highest tide levels affected the stage record at the upper Johns River site (station ID 23-john). Tidal influence was confirmed by examining tide prediction records and then these tidal "spikes" in the stage record were removed.

Instrument drift, or the precision of the data-logging system over time, was determined by examining the sums of depth sensor readings and the reference point measurements. Ideally, this sum would remain constant over time, as long as the position of the sensor and reference point did not change. The means and standard deviations of these sums were determined, and outliers identified as those greater than 2 standard deviations of the mean. These sums were then plotted and examined for drift. The quality of reference point measurements and site-specific factors were also considered. Outliers and suspect values were removed before fitting a trendline to the plot of sums. Criteria used for determining the presence of drift included: the magnitude, direction, and consistency of drift; accuracy of measurements; site-specific conditions; and statistical significance of trend lines determined from the plot of sums. Plots revealed that most instruments drifted during their 12-14 month deployment. Where two instruments were used during the study period, drift for each instrument was determined and the stage record corrected accordingly.

Various trendlines were fitted to each plot of sums using EXCEL® software. The best-fitting trendlines were determined by (1) visual examination, (2) value of the coefficient of correlation (R squared value), (3) significance of the trendline as determined using SYSTAT®, and (4) examining plots of residuals from the trendline regression for zero slope. Most trendlines were second or third-order polynomials and represented bi-directional instrument drift over time.

A drift factor for each instrument was determined which, when added to the time/maintenance/tide-corrected stage record, would cancel the effect of instrument drift. This drift factor took the form of a constant minus the trendline equation. The constant was usually the mean sum of the sensor's reading and measurement from reference point to water level. The final arbitrary datum for the stage record for all streams was the initial location of the transducer probe. For the East Fork Hoquiam (station ID 06-efhoq), the location of the second probe was used as the final datum. Table B-2 summarizes site history and drift correction information. Figure B-1 shows residuals from applying the drift correction factor to the stream stage data.

**Flow measurement and rating curve development**

Streamflow measurements by Ecology staff were done according to USGS and Ecology procedures (e.g., Ecology, 1995). The cross-sectional areas and velocities were obtained by wading or use of instruments from bridges. Velocities were measured with either a Marsh-McBirney® or Swoffer® meter.

For the sites with stage recorders, flows were measured from 6 to 13 times over a range of flows, in order to determine a rating curve for each site. The characteristics of these rating curve relationships are summarized in Table B-3. These stage-flow relationships were then used to translate continuous stage records into continuous flow records. Where stage data were missing due to instrument problems, flows were estimated using various techniques such as graphical interpretation and linear regressions derived from hourly stage records of nearby streams. Daily average flows were then calculated for gaged streams.

For other sites, flow was measured less frequently, if at all. Measurements from reference points to the water surface were also taken during times of flow measurement or at times of water quality sample collection. Flow and relative stage height data from these sites sometimes helped in developing relationships to the flow record of a nearby gaged site. Flow relationships between ungaged and gaged sites were developed using various methods (precipitation-runoff model, ratio estimators, and regression) to estimate daily average flows for ungaged sites.

**Stormwater drainage basin area approximations**

The areas of the stormwater drainage basins were estimated using topographic maps and stormwater planning documents provided by the cities of Aberdeen and Hoquiam. Basin boundaries were delineated as best possible with topographic maps. Stormwater drainage basin maps for the city of Hoquiam were provided by Tetra Tech/KCM (personal correspondence, Dave Carlton, 6/7/99). For Aberdeen, basin boundaries were estimated using maps and drawings developed during an earlier sewer/stormwater planning effort by the city of Aberdeen (personal communication, Rick Sangder, 5/19/99). Basin boundaries were drawn into a GIS-based map and their areas calculated (see Figure 11 of main report). These areas were then used to supplement estimates of daily flows for these basins.

**Precipitation-weighted watershed area ratio estimator**

Daily flow values were estimated for many unmeasured streams using a precipitation-weighted watershed area ratio-estimator. The areas of each subwatershed were delineated using GIS analysis of digital elevation, using a method developed by the University of Texas Center for Research in Water Resources. The University of Texas method is described at the following website:

http://www.ce.utexas.edu/prof/maidment/ce397/urubamba/peru.htm

Extrapolation of flows from gaged to ungaged areas was based on assumed proportionality of flow with precipitation-weighted watershed areas. Annual average precipitation for the subwatersheds was estimated using GIS coverage of the Precipitation-frequency Atlas of the Western United States Volume IX, Washington U.S. Dept. of Commerce, NOAA. The volumetric rate of average annual precipitation was determined for each sub-watershed based on the product of watershed area (e.g., square kilometers) and precipitation velocity (e.g., inches per year) and appropriate units conversion factors (e.g., to obtain volumetric flow rates in units of cubic meters per second). For extrapolation of flows from gaged to ungaged areas, flows were assumed to be proportional to the volumetric rate of precipitation.

Flows from each stream, stormwater basin, and point source entering Grays Harbor were assigned to a specific node of the hydrodynamic model. Where multiple streams were assigned to the same node, flows were summed. Tables B-4 and B-5 show daily flows from streams, stormwater basins, and point sources. Table B-6 shows node assignments and daily flows for each node. Water quality results and daily flows at nodes were then used to estimate daily bacteria loads to Grays Harbor for input into the water quality model.

**Table B1. Sample station information.**

| Station ID | station description | latitude: decimal degrees | longitude: decimal degrees | Ecology waterbody ID | water-body class | Wash Dept F&W stream # |
|---|---|---|---|---|---|---|
| 01-HUMP | Humptulips R at Hwy 109 bridge nr mouth | 47.05130 | 124.04135 | WA-22-1010 | A | 22.004 |
| 02-HUMP | Humptulips R at Hwy 101 bridge nr Humptulips, Ecology station 22A070 | 47.22961 | 123.96090 | WA-22-1010 | A | 22.004 |
| 03-CHEN | Chenois Cr at Hwy 109 bridge nr mouth | 47.03162 | 124.02424 | none | A | |
| 04-GRASS | Grass Cr at Hwy 109 bridge nr mouth | 47.00449 | 124.00051 | none | A | |
| 05-WFHOQ | WF Hoquiam R nr New London at Dekay Road bridge, Ecology station 22B070 | 47.05703 | 123.92727 | WA-22-2020 | A | 22.0137 |
| 06-EFHOQ | EF Hoquiam R at F-line logging road bridge, about 2 mi downstream from Nisson | 47.08520 | 123.81460 | WA-22-2020 | A | 22.0137 |
| 07-HOQ | Hoquiam R at Riverside Bridge in Hoquiam | 46.97985 | 123.88262 | WA-22-2010 | B | 22.0137 |
| 08-WISH | Wishkah R nr mouth at Hwy 12 bridge in Aberdeen | 46.97738 | 123.81053 | WA-22-3010 | B | 22.0191 |
| 09-WISH | Wishkah River at Aberdeen Gardens Road bridge nr Wishkah, Ecology station 22D070 | 47.04860 | 123.77847 | WA-22-3020 | A | 22.0191 |
| 10-WISH | Wishkah R nr Greenwood at Hoquiam-Wishkah Road bridge | 47.10952 | 123.78762 | WA-22-3020 | A | 22.0191 |
| 11-ELLI | Elliot Slough nr mouth at Junction City Rd bridge | 46.97963 | 123.77945 | WA-22-3900 | B | 22.0238 |
| 12-CENT | Central Park Cr nr mouth at culvert on Central Park Drive bridge, nr Fairway Park Dr | 46.96222 | 123.71981 | none | A | |
| 13-WYNO | Wynoochee R nr mouth at Devonshire Road bridge (downstream of USGS sta 12037400) | 46.97103 | 123.62382 | WA-22-4020 | A | 22.026 |
| 14-CHEH | Chehalis R, Hwy 107 bridge nr Montesano, Ecology station 22C050 | 46.96233 | 123.60297 | WA-22-4040 | A | 22.019 |
| 15-CHAR | Charlie Cr at hwy 105 bridge nr mouth | 46.94768 | 123.83700 | none | A | |
| 16-NEWS | Newskah Cr at Hwy 105 bridge nr mouth | 46.94367 | 123.85183 | none | A | |
| 17-CHAP | Chapin Cr at Hwy 105 bridge nr mouth | 46.94073 | 123.87600 | none | A | |
| 18-CAMP | Campbell Cr at Hwy 105 bridge nr mouth | 46.93841 | 123.88681 | none | A | |
| 19-INDI | Indian Cr at Hwy 105 bridge nr mouth | 46.93656 | 123.89566 | none | A | |
| 20-STAF | Stafford Cr at Hwy 105 bridge nr mouth | 46.93420 | 123.90652 | none | A | |
| 21-OLEA | Oleary Cr at Hwy 105 bridge nr mouth | 46.91792 | 123.95662 | none | A | |
| 22-JOHN | Johns R nr mouth at boat launch nr Hwy 105 bridge | 46.90000 | 123.99722 | WA-22-5000 | A | 22.127 |
| 23-JOHN | Johns R nr Western at private residence | 46.86858 | 123.94373 | WA-22-5000 | A | |
| 24-REDM | Redman Slough at mouth from beach | 46.90010 | 124.02535 | none | A | |
| 25-DEMP | Dempsey Cr at Plum Street bridge nr mouth | 46.87972 | 124.01721 | none | A | |
| 26-BARL | Barlow Cr at end of Plum Street nr mouth | 46.87156 | 124.01470 | none | A | |
| 27-ELK | Elk R at logging road nr mouth | 46.83863 | 123.98785 | WA-22-5700 | A | 22.1333 |
| 28-EFELK | EF Elk R at old logging road | 46.82502 | 123.96707 | WA-22-5700 | A | 22.1333 |
| 29-MFELK | MF Elk R at old logging road | 46.82456 | 123.96930 | WA-22-5700 | A | 22.1333 |
| 30-WFELK | WF Elk R at old logging road | 46.82213 | 123.97446 | WA-22-5700 | A | 22.1333 |
| 31-ANDR | Andrews Cr nr DNR gate | 46.81730 | 124.01454 | none | A | |
| 32-DITCH | Grayland ditch nr mouth at cedar logs bridge | 46.83086 | 124.07649 | none | A | |

| Station ID | station description | latitude: decimal degrees | longitude: decimal degrees | Ecology waterbody ID | water-body class | Wash Dept F&W stream # |
|---|---|---|---|---|---|---|
| 33-DITCH | Grayland ditch at Schmid Rd bridge | 46.81626 | 124.09059 | none | A | |
| 34-DITCH | Grayland ditch at Grange Rd Bridge | 46.79914 | 124.08839 | none | A | |
| 35-WEST | un-named Cr at 2nd & Sprague Streets in Westport | 46.89121 | 124.10052 | none | A | |
| 36-WFAND | WF Andrews Cr at logging road bridge | 46.82217 | 124.02431 | none | A | |
| 37-ANDR | Andrews Cr at logging road bridge | 46.82235 | 124.02097 | none | A | |
| 38-PORT | Chehalis R from bridge at Porter, Ecology station 23A070, USGS Sta 12031000 | 46.93947 | 123.31278 | WA-22-4040 | A | 22.019 |
| 39-ELMA | Chehalis R at Elma Rd bridge nr South Elma | 46.98214 | 123.41125 | WA-22-4040 | A | 22.019 |
| 40-WISH | Wishkah R at Wishkah River Road bridge (aka qwish) | 47.07229 | 123.76899 | WA-22-3020 | A | 22.0191 |
| 41-ALDR | Alder Cr. at Marion St in S Aberdeen | 46.96907 | 123.80332 | none | A | |
| 42-PEEL | Peels Slough on old Montesano-Aberdeen Rd (aka Higgins Slough?) | 46.96244 | 123.67723 | none | A | |
| 43-PORT | Chehalis R from bridge at Porter, close to right bank in Porter Cr plume | 46.93947 | 123.31278 | WA-22-4040 | A | |
| 500-WILS | Wilson Cr nr Hwy 101, at Fleet St, Aberdeen | 46.97798 | 123.80000 | none | A | |
| 501-ABDIV | Division St. Pump Sta at Aberdeen WWTP | 46.96664 | 123.83003 | urban runoff? | | |
| 502-FRY | Fry Cr at N side of Port Industrial Rd, Q usually taken 200 yds upstream nr RR, Aberdeen | 46.97012 | 123.84992 | none | A | |
| 503-MILR | Miller Sl at WeyCo Bay City Sort Yard, downstream of whale's tale tide gate, Cosmopolis | 46.96891 | 123.77977 | none | A | |
| 504-SHAN | Shannon Sl at WeyCo Sawmill, downstream of tide gate closest to river, Cosmopolis | 46.97410 | 123.79399 | none | A | |
| 505-MILL | Mill Cr just upstream of bridge on First St, Cosmopolis | 46.96022 | 123.77473 | none | A | |
| 506-28TH | 18" pipe at 28th and Henderson, adj to 507-G3, Hoquiam | 46.97145 | 123.85910 | urban runoff | | |
| 507-G3 | 28th St. Pump Sta, 36" outlet at 28th and Henderson, Hoquiam (aka Bay Ave Pump Sta) | 46.97138 | 123.85910 | urban runoff | | |
| 508-KST | K St. Pump Sta discharge on K St, at pump sta or downstream at drop to river, Hoquiam | 46.97227 | 123.87899 | urban runoff | | |
| 509-ADAM | ditch at Adams St and Airport Way, outlet from pump sta at 208 Adams St., Hoquiam | 46.97274 | 123.90103 | urban runoff | | |
| 510-MST | M St. stormwater drain, south of RR tracks, Aberdeen | 46.96950 | 123.81697 | urban runoff | | |
| 511-FARR | Farragut St Pump Sta at east end of W Harriman St | 46.96270 | 123.78762 | urban runoff | | |
| 512-DAWS | Dawes Cr. at levee tide gate structure, from levee access road, S Aberdeen | 46.95599 | 123.82040 | none | A | |
| 513-SAG | Saginaw Sl at SW Front and McFarlane St, Aberdeen | 46.96602 | 123.81137 | none | A | |
| 514-HST | H St. stormwater drain on mudflats, 48" pipe with tide-flap, Aberdeen | 46.97250 | 123.81098 | urban runoff | | |
| 515-LEVEE | Levee St. Pump Sta nr 9th and Levee St, nr Rayonier Point Park, Hoquiam | 46.97729 | 123.87947 | urban runoff? | | |
| 516-EMER | Emerson Ave Pump Sta, at riverbank downstream of pump sta, Hoquiam | 46.98097 | 123.88342 | urban runoff | | |
| 517-QEEN | Queen Ave Pump Sta, outlet on riverbank upstream of RR bridge, Hoquiam | 46.99473 | 123.88316 | urban runoff | | |
| 518-15TH | 15th St stormwater,12" drain to beach at 15th and Riverside, Hoquiam | 46.97927 | 123.88102 | urban runoff | | |
| 519-ETRM | East Terminal Way ditch, at culvert under last road to left, Aberdeen | 46.96235 | 123.83514 | urban runoff? | | |
| 70-G2 | same as 509-ADAM, Hoquiam | 46.97274 | 123.90103 | urban runoff | | |
| 71-WSTOUT | at 3' dia tidegates, upstream side of levee at beach, near E end of Elizabeth Ave, Westport | 46.89262 | 124.09508 | none | A | |

| Station ID | station description | latitude: decimal degrees | longitude : decimal degrees | Ecology waterbody ID | water-body class | Wash Dept F&W stream # |
|---|---|---|---|---|---|---|
| arthr-pmp | Arthur St Pump Sta, eastern-most point of Arthur St. on right bank of Wishkah R, Aberdeen | 46.98483 | 123.80796 | urban runoff | | |
| q05log | WF Hoquiam R, stage recorder downstream of Hwy 101 and Hoquiam's water supply dam | 47.06913 | 123.92842 | WA-22-2020 | A | 22.0137 |
| q10log | MF Wishkah R, stage recorder nr W Wishkah Rd bridge, upstream of conf with WF Wishkah | 47.12349 | 123.77302 | WA-22-3030 | AA | 22.0191 |
| q24hwy | Redman Sl at foot bridge to beach, nr Hwy 109 | 46.89278 | 124.04424 | none | A | |
| q30log | WF Elk R stage recorder at logging bridge nr road marker 14 | 46.80576 | 123.97972 | WA-22-5700 | A | 22.1333 |
| q32gate | Grayland ditch at Hunt Club gate at end of road access road | 46.82674 | 124.07904 | none | A | |
| q32log | Grayland ditch, stage recorder at laminated bridge on access road | 46.82219 | 124.08805 | none | A | |
| qefwish | EF Wishkah R at Wishkah-Wynoochee Road bridge | 47.08158 | 123.75344 | WA-22-3025 | A | 22.02 |
| qwish | same as 40-WISH | 47.07229 | 123.76899 | WA-22-3020 | A | 22.0191 |
| wfconf | WF Hoquiam R, at confluence with EF Hoquiam R | 46.99640 | 123.88496 | WA-22-2010 | A | |
| hoqnowf | Hoquiam R excluding WF Hoquiam R | 46.97985 | 123.88262 | WA-22-2010 | A | |
| elkmwth | Elk R at mouth | 46.84088 | 124.01030 | WA-22-2010 | A | |
| andrmwth | Andrews Cr at mouth | 46.83707 | 124.02172 | none | A | |
| ditchmwth | Gray land Ditch at mouth, SE of Roberts Farm | 46.83992 | 124.06991 | none | A | |
| aberdn | Aberdeen STP | 46.96333 | 123.82361 | WA-22-0030 | B | |
| elma | Elma STP | 46.98500 | 123.42556 | WA-22-4040 | A | |
| ghpapr1 | Grays Harbor Paper 001 | 46.96750 | 123.86250 | WA-22-0030 | B | |
| ghpapr2 | Grays Harbor Paper 002 | 46.97083 | 123.87500 | WA-22-0030 | B | |
| hoquiam | Hoquiam STP | 46.97083 | 123.92111 | WA-22-0030 | B | |
| mcleary | McCleary STP | 47.05528 | 123.27583 | WA-22-4045 | A | |
| montesn | Montesano STP | 46.88194 | 123.60083 | WA-22-4040 | A | |
| ocenshr | Ocean Shores STP | 46.93000 | 124.15083 | WA-22-0020 | A | |
| ospray1 | Ocean Spray 001 | 46.90639 | 123.99861 | WA-22-0020 | A | |
| ospray2 | Ocean Spray 002 | 46.90639 | 123.99861 | ospray1 | | |
| westprt | Westport STP | 46.90611 | 124.12278 | WA-22-0020 | A | |
| weyco1 | Weyerhauser Co 001 | 46.95417 | 123.85000 | WA-22-0030 | B | |
| weyco2 | Weyerhauser Co 002 | 46.95889 | 123.75556 | WA-22-0030 | B | |
| GHPRD | Hoquiam Reach off ITT Rayonier dock | 46.96995 | 123.91102 | WA-22-0030 | B | |
| GYS004 | Chehalis River near Elliot Slough | 46.97811 | 123.78335 | WA-22-0030 | B | |
| GYS008 | South Channel near Stafford Cr | 46.93833 | 123.91170 | WA-22-0030 | B | |
| GYS009 | North Channel near Moon Island | 46.96500 | 123.94830 | WA-22-0030 | B | |
| GYS015 | Grays Harbor N of Whitcomb Flats | 46.92333 | 124.07500 | WA-22-0020 | A | |
| GYS016 | Grays Harbor NE of Damon Point | 46.95333 | 124.09170 | WA-22-0020 | A | |
| GYS017 | Cow Point Reach near Cow Point | 46.96000 | 123.84611 | WA-22-0020 | A | |
| GYS018 | South Channel near Stearns Bluff | 46.92750 | 123.98111 | WA-22-0030 | B | |
| GYS019 | Crossover Channel near G "27" | 46.94083 | 124.00583 | WA-22-0020 | A | |
| GYS685 | West End Aberdeen Reach, off Cow Point | 46.96023 | 123.83975 | WA-22-0030 | B | |
| q38-port | USGS station 12031000 (Chehalis R at Porter) | 46.93947 | 123.31278 | WA-22-4040 | A | |

| Station ID | station description | latitude: decimal degrees | longitude : decimal degrees | Ecology waterbody ID | water-body class | Wash Dept F&W stream # |
|---|---|---|---|---|---|---|
| satsopQ | Satsop R nr Satsop, USGS station 12035000 | 47.00083 | 123.49361 | WA-22-4040 | A | |
| 01-DOH | DOH station 01 | 46.91068 | 124.10401 | WA-22-0020 | A | |
| 02-DOH | DOH station 02 | 46.94483 | 124.09642 | WA-22-0020 | A | |
| 03-DOH | DOH station 03 | 46.95328 | 124.09794 | WA-22-0020 | A | |
| 05-DOH | DOH station 05 | 46.96432 | 124.07377 | WA-22-0020 | A | |
| 06-DOH | DOH station 06 | 46.97355 | 124.09337 | WA-22-0020 | A | |
| 07-DOH | DOH station 07 | 46.99432 | 124.11336 | WA-22-0020 | A | |
| 08-DOH | DOH station 08 | 46.97523 | 124.11050 | WA-22-0020 | A | |
| 09-DOH | DOH station 09 | 46.92228 | 124.10062 | WA-22-0020 | A | |
| 11-DOH | DOH station 11 | 46.92081 | 124.05834 | WA-22-0020 | A | |
| 15-DOH | DOH station 15 | 46.90045 | 124.08256 | WA-22-0020 | A | |
| 17-DOH | DOH station 17 | 46.88345 | 124.08119 | WA-22-0020 | A | |
| 21-DOH | DOH station 21 | 46.86901 | 124.07434 | WA-22-0020 | A | |
| 22-DOH | DOH station 22 | 46.86192 | 124.06677 | WA-22-0020 | A | |
| 23-DOH | DOH station 23 | 46.86059 | 124.06252 | WA-22-0020 | A | |
| 24-DOH | DOH station 24 | 46.86024 | 124.05373 | WA-22-0020 | A | |
| 25-DOH | DOH station 25 | 46.97601 | 124.04502 | WA-22-0020 | A | |
| 26-DOH | DOH station 26 | 46.97744 | 124.02637 | WA-22-0020 | A | |
| 30-DOH | DOH station 30 | 46.87577 | 124.07895 | WA-22-0020 | A | |
| 44-DOH | DOH station 44 | 46.90812 | 124.05038 | WA-22-0020 | A | |
| 46-DOH | DOH station 46 | 46.96224 | 124.10974 | WA-22-0020 | A | |
| 51-DOH | DOH station 51 | 46.88138 | 124.06605 | WA-22-0020 | A | |
| 52-DOH | DOH station 52 | 46.86527 | 124.04407 | WA-22-0020 | A | |
| 54-DOH | DOH station 54 | 46.86020 | 124.04201 | WA-22-0020 | A | |
| 55-DOH | DOH station 55 | 46.85553 | 124.03529 | WA-22-0020 | A | |
| 56-DOH | DOH station 56 | 46.84949 | 124.03061 | WA-22-0020 | A | |
| 57-DOH | DOH station 57 | 46.90191 | 124.06725 | WA-22-0020 | A | |
| 59-DOH | DOH station 59 | 46.85869 | 124.07284 | WA-22-0020 | A | |
| 60-DOH | DOH station 60 | 46.85608 | 124.05740 | WA-22-0020 | A | |
| 61-DOH | DOH station 61 | 46.84252 | 124.06768 | WA-22-0020 | A | |

**Note (1)**

| | |
|---|---|
| y | water quality sample site |
| n | not a water quality sample site |
| Qonly | site of instantaneous flow measurement only |
| stgercdr | continuous stage recording site |

**Note (2)**

| | |
|---|---|
| dmr | permittee Discharge Monitoring Report (dmr) data |
| noQ | no flow estimates, no flow reported via dmr |
| pmp,ware | pump records or watershed area ratio extrapolation of reference flow |

| Station ID | station description | latitude: decimal degrees | longitude : decimal degrees | Ecology waterbody ID | water-body class | Wash Dept F&W stream # |
|---|---|---|---|---|---|---|
| pwt-ware | precipitation-weighted watershed area ratio extrapolation of reference flows | | | | | |
| rg-pwt-ware | regression and precipitation-weighted watershed area ratio extrapolation of reference flows | | | | | |
| rg-refQ | regression to reference flow | | | | | |
| smQ | single measured flow | | | | | |
| sQrg | stage-flow regression | | | | | |
| usgs | USGS data | | | | | |
| usgs-e | USGS data extrapolated to include ungaged mainstem | | | | | |
| ware | watershed area ratio extrapolation of reference flows | | | | | |
| | | | | | | |
| **Note (3)** | | | | | | |
| Equation A: | 1.5751*(224.16+2.8218*refQ) | | | | | |
| Equation B: | 224.16+2.8218*refQ | | | | | |
| Equation C: | (1.13942*refQ)+satsopQ | | | | | |
| | | | | | | |
| **Note (4)** | **code explanation** | | | | | |
| dmr_mgd | from Discharge Monitoring Report, reported in million gallons per day (mgd) | | | | | |
| form of: 23john+q30log | sum of daily average flows from stage recorder sites (the indicated Sta IDs), reported in cubic feet per second (cfs) | | | | | |
| form of: USGS 12035000 | daily average flow from USGS site number, reported in cfs | | | | | |

## Table B1. Sample station information.

| Station ID | receiving water | tidal influence | water quality sample site? (1) | Ecology 4-digit lab number | revised2 rcvg node (24fbc) | flow estimating method code (2) | ratio or equation used with reference flow (3) | reference flow used with ratio or equation to get flow at Sta ID (cfs except as noted) (4) | basin area (km2) | basin est. annual area-weighted precip (in) |
|---|---|---|---|---|---|---|---|---|---|---|
| 01-HUMP | outer harbor | tidal | y | 6401 | 29 | rg-pwt-ware | Equation A | q10log+06efhoq+q05log | 620.59 | 134.98 |
| 02-HUMP | | non-tidal | y | 6402 | | rg-pwt-ware | Equation B | q10log+06efhoq+q05log | 341.24 | 155.86 |
| 03-CHEN | outer harbor | tidal | y | 6403 | 29 | pwt-ware | 0.25015 | 23john+q30log+31andr | 17.61 | 86.01 |
| 04-GRASS | outer harbor | tidal | y | 6404 | 29 | pwt-ware | 0.15659 | 23john+q30log+31andr | 12.10 | 78.33 |
| 05-WFHOQ | | non-tidal | y | 6405 | | pwt-ware | 2.09583 | q05log | 46.92 | 96.63 |
| 06-EFHOQ | | non-tidal | y, stgercdr | 6406 | | sQrg | 1.000 | 06efhoq | 61.00 | 111.73 |
| 07-HOQ | inner harbor | tidal | y | 6407 | | pwt-ware | 2.50420 | 06efhoq+q05log | 235.22 | 95.59 |
| 08-WISH | inner harbor | tidal | y | 6408 | 79 | pwt-ware | 2.69640 | q10log | 268.13 | 112.04 |
| 09-WISH | | non-tidal | y | 6409 | | pwt-ware | 2.36131 | q10log | 224.53 | 117.17 |
| 10-WISH | | non-tidal | y | 6410 | | pwt-ware | 1.64435 | q10log | 148.63 | 123.25 |
| 11-ELLI | inner harbor, Chehalis RM 1.4 | tidal | y | 6411 | 43 | pwt-ware | 0.25673 | 23john+q30log+31andr | 18.96 | 81.97 |
| 12-CENT | Max Slough, Chehalis RM 4.0 | tidal | y | 6412 | 48 | pwt-ware | 0.08111 | 23john+q30log+31andr | 6.00 | 81.84 |
| 13-WYNO | | non-tidal | y | 6413 | 64 | usgs | 1.000 | USGS 12037400 | 482.39 | 133.08 |
| 14-CHEH | | tidal | y | 6414 | | pwt-ware | Equation C | 38port | 4576.17 | 69.80 |
| 15-CHAR | inner harbor | tidal | y | 6415 | 17 | pwt-ware | 0.40970 | 23john+q30log+31andr | 27.63 | 89.78 |
| 16-NEWS | inner harbor | tidal | y | 6416 | 17 | pwt-ware | 0.45265 | 23john+q30log+31andr | 29.38 | 93.28 |
| 17-CHAP | inner harbor | tidal | y | 6417 | 15 | pwt-ware | 0.05569 | 23john+q30log+31andr | 4.23 | 79.72 |
| 18-CAMP | inner harbor | tidal | y | 6418 | 15 | pwt-ware | 0.04262 | 23john+q30log+31andr | 3.30 | 78.11 |
| 19-INDI | inner harbor | tidal | y | 6419 | 15 | pwt-ware | 0.07222 | 23john+q30log+31andr | 5.59 | 78.19 |
| 20-STAF | inner harbor | tidal | y | 6420 | 15 | pwt-ware | 0.04571 | 23john+q30log+31andr | 3.59 | 76.99 |
| 21-OLEA | inner harbor | tidal | y | 6421 | 15 | pwt-ware | 0.12062 | 23john+q30log+31andr | 9.77 | 74.77 |
| 22-JOHN | outer harbor | tidal | y | 6422 | 84 | pwt-ware | 1.47360 | 23john | 80.84 | 81.03 |
| 23-JOHN | | tidal | y, stgercdr | 6423 | | sQrg | 1.000 | 23john | 53.47 | 83.14 |
| 24-REDM | outer harbor | tidal | y | 6424 | 19 | pwt-ware | 0.04971 | 23john+q30log+31andr | 4.30 | 70.02 |
| 25-DEMP | outer harbor, South Bay | tidal | y | 6425 | 82 | pwt-ware | 0.02728 | 23john+q30log+31andr | 2.34 | 70.46 |
| 26-BARL | outer harbor, South Bay | tidal | y | 6426 | 82 | pwt-ware | 0.09115 | 23john+q30log+31andr | 7.57 | 72.93 |
| 27-ELK | outer harbor, South Bay | tidal | y | 6427 | | pwt-ware | 0.70518 | 30log | 43.89 | 77.91 |
| 28-EFELK | | non-tidal | y | 6428 | | pwt-ware | 0.96366 | q30log+31andr | 19.39 | 80.00 |
| 29-MFELK | | non-tidal | y | 6429 | | pwt-ware | 0.84891 | q30log | 5.73 | 77.46 |
| 30-WFELK | | non-tidal | y | 6430 | | pwt-ware | 1.33310 | q30log | 9.20 | 75.79 |
| 31-ANDR | | non-tidal | y, stgercdr | 6431 | | sQrg | 1.000 | 31andr | 14.91 | 72.91 |

| Station ID | receiving water | tidal influence | water quality sample site? (1) | Ecology 4-digit lab number | revised2 rcvg node (24fbc) | flow estimating method code (2) | ratio or equation used with reference flow (3) | reference flow used with ratio or equation to get flow at Sta ID (cfs except as noted) (4) | basin area (km2) | basin est. annual area-weighted precip (in) |
|---|---|---|---|---|---|---|---|---|---|---|
| 32-DITCH | outer harbor, South Bay | tidal | y | 6432 | | pwt-ware | 1.00000 | q32gate | 6.99 | 70.00 |
| 33-DITCH | | non-tidal | y | 6433 | | pwt-ware | 0.55421 | q32gate | 3.46 | 70.00 |
| 34-DITCH | | non-tidal | y | 6434 | | pwt-ware | 0.03131 | q32gate | 0.20 | 70.00 |
| 35-WEST | outer harbor | non-tidal | y | 6435 | 18 | pwt-ware | 0.02010 | 23john+q30log+31andr | 1.44 | 70.16 |
| 36-WFAND | | tidal?? | y | 6436 | | pwt-ware | 0.73762 | 31andr | 11.00 | 70.11 |
| 37-ANDR | outer harbor, South Bay | tidal?? | y | 6437 | | pwt-ware | 1.10545 | 31andr | 16.48 | 73.07 |
| 38-PORT | | non-tidal | y | 6438 | 68 | usgs-e | 1.23470 | USGS 12031000, 38port | 3227.74 | 60.56 |
| 39-ELMA | | non-tidal | y | 6439 | | pwt-ware | 1.20107 | 38port | 3643.26 | 61.14 |
| 40-WISH | | non-tidal | n, Q-only | 6440 | | pwt-ware | 1.72670 | q10log | 157.81 | 121.90 |
| 41-ALDR | inner harbor | tidal | y | 6441 | 37 | ware | 0.02983 | 23john+q30log+31andr | 2.25 | |
| 42-PEEL | | non-tidal | y | 6442 | 57 | ware | 0.06880 | 23john+q30log+31andr | 5.73 | 79.94 |
| 43-PORT | | non-tidal | y | 6443 | | | | | | |
| 500-WILS | inner harbor | tidal | y | 6500 | 40 | pwt-ware | 0.03783 | 23john+q30log+31andr | 2.79 | 80.58 |
| 501-ABDIV | inner harbor | tidal | y | 6501 | 37 | pmp,ware | 0.03081 | 23john+q30log+31andr | 2.32 | |
| 502-FRY | inner harbor | tidal | y | 6502 | 12 | pwt-ware | 0.07387 | 23john+q30log+31andr | 4.91 | 80.25 |
| 503-MILR | inner harbor | tidal | y | 6503 | 43 | ware | 0.00725 | 23john+q30log+31andr | 0.55 | |
| 504-SHAN | inner harbor | tidal | y | 6504 | 40 | ware | 0.00540 | 23john+q30log+31andr | 0.41 | |
| 505-MILL | inner harbor | tidal | y | 6505 | 43 | pwt-ware | 0.09939 | 23john+q30log+31andr | 1.66 | 85.50 |
| 506-28TH | inner harbor | tidal | y | 6506 | 12 | ware | 0.00052 | 23john+q30log+31andr | 0.04 | |
| 507-G3 | inner harbor | tidal | y | 6507 | 12 | pmp,ware | 0.01549 | 23john+q30log+31andr | 1.17 | |
| 508-KST | Hoquiam R. mouth | tidal | y | 6508 | 69 | pmp,ware | 0.00714 | 23john+q30log+31andr | 0.54 | |
| 509-ADAM | inner harbor | tidal | y | 6509 | 10 | pwt-ware | 0.01010 | 23john+q30log+31andr | 0.39 | 77.34 |
| 510-MST | inner harbor | tidal | y | 6510 | 37 | ware | 0.00981 | 23john+q30log+31andr | 0.74 | |
| 511-FARR | Mill Creek | tidal | y | 6511 | | noQ | | part of Mill Cr. basin | | |
| 512-DAWS | inner harbor | tidal | y | 6512 | 37 | ware | 0.02371 | 23john+q30log+31andr | 1.78 | |
| 513-SAG | inner harbor | tidal | y | 6513 | 37 | ware | 0.00224 | 23john+q30log+31andr | 0.17 | |
| 514-HST | inner harbor | tidal | y | 6514 | 37 | ware | 0.01320 | 23john+q30log+31andr | 0.99 | |
| 515-LEVEE | Hoquiam R. | tidal | y | 6515 | | noQ | | | | |
| 516-EMER | Hoquiam R. | tidal | y | 6516 | 69 | pmp,ware | 0.01234 | 23john+q30log+31andr | 1.43 | 77.55 |
| 517-QEEN | Hoquiam R. | tidal | y | 6517 | 69 | pmp,ware | 0.00702 | 23john+q30log+31andr | 0.53 | |
| 518-15TH | Hoquiam R. | tidal | y | 6518 | 69 | ware | 0.00103 | 23john+q30log+31andr | 0.08 | |
| 519-ETRM | inner harbor | non-tidal | y | 6519 | | | | | | |
| 70-G2 | inner harbor | tidal | y | 6509 | | pwt-ware | 0.01010 | 23john+q30log+31andr | 0.39 | 77.34 |
| 71-WSTOUT | inner harbor | tidal | y | 6471 | | noQ | | single sample only, no Q | 1.73 | 70.17 |
| arthr-pmp | Wishkah R. | tidal | n | | 75 | pmp,ware | 0.00377 | 23john+q30log+31andr | 0.28 | |
| q05log | | non-tidal | n, stgercdr | | | sQrg | 1.000 | q05log | 21.23 | 101.90 |

| Station ID | receiving water | tidal influence | water quality sample site? (1) | Ecology 4-digit lab number | revised2 rcvg node (24fbc) | flow estimating method code (2) | ratio or equation used with reference flow (3) | reference flow used with ratio or equation to get flow at Sta ID (cfs except as noted) (4) | basin area (km2) | basin est. annual area-weighted precip (in) |
|---|---|---|---|---|---|---|---|---|---|---|
| q10log | | non-tidal | n, stgercdr | | | sQrg | 1.000 | q10log | 89.03 | 125.13 |
| q24hwy | | non-tidal | n, Q-only | | | smQ | | single measured flow | 1.66 | 69.49 |
| q30log | | non-tidal | n, stgercdr | | | sQrg | 1.000 | q30log | 6.92 | 75.58 |
| q32gate | | non-tidal | n, Q-only | | | dlsQrg | 1.000 | q32gate | 6.24 | 70.00 |
| q32log | | non-tidal | n, stgercdr | | | sQrg | 1.000 | q32log | 4.49 | 70.00 |
| qefwish | | non-tidal | n, Q-only | | | pwt-ware | 0.56584 | q10log | 58.39 | 107.96 |
| qwish | | non-tidal | n, Q-only | | | pwt-ware | 1.72670 | q10log | 157.81 | 121.90 |
| wfconf | | tidal | n | | 74 | pwt-ware | 1.26770 | q05log+06efhoq | 125.82 | 90.46 |
| hoqnowf | | tidal | n | | 72 | pwt-ware | 1.62890 | 06efhoq | 109.40 | 101.48 |
| elkmwth | outer harbor, South Bay | tidal | n | | 83 | pwt-ware | 0.74250 | 23john+q30log | 47.55 | 77.58 |
| andrmwth | outer harbor, South Bay | tidal | n | | 83 | pwt-ware | 1.99120 | 31andr | 29.99 | 72.16 |
| ditchmwth | outer harbor, South Bay | tidal | n | | 81 | pwt-ware | 2.13450 | q32gate | 13.63 | 68.39 |
| aberdn | | tidal | y | | 37 | dmr | 1.548 | dmr (in mgd) | | |
| elma | | non-tidal | y | | 66 | dmr | 1.548 | dmr (in mgd) | | |
| ghpapr1 | | tidal | y | | 12 | dmr | 1.548 | dmr (in mgd) | | |
| ghpapr2 | | tidal | n | | | noQ | | | | |
| hoquiam | | tidal | y | | 10 | dmr | 1.548 | dmr (in mgd) | | |
| mcleary | | non-tidal | y | | 66 | dmr | 1.548 | dmr (in mgd) | | |
| montesn | | tidal | y | | 64 | dmr | 1.548 | dmr (in mgd) | | |
| ocenshr | | tidal | y | | 2 | dmr | 1.548 | dmr (in mgd) | | |
| ospray1 | | tidal | y | | 84 | dmr | 1.548 | dmr (in mgd) | | |
| ospray2 | | tidal | n | | | noQ | | | | |
| westprt | | tidal | y | | 2 | dmr | 1.548 | dmr (in mgd) | | |
| weyco1 | | tidal | y | | 17 | dmr | 1.548 | dmr (in mgd) | | |
| weyco2 | | tidal | y | | 48 | dmr | 1.548 | dmr (in mgd) | | |
| GHPRD | | tidal | y | | | | | | | |
| GYS004 | | tidal | y | | | | | | 5163.58 | 75.96 |
| GYS008 | | tidal | y | | | | | | | |
| GYS009 | | tidal | y | | | | | | | |
| GYS015 | | tidal | y | | | | | | | |
| GYS016 | | tidal | y | | | | | | | |
| GYS017 | | tidal | y | | | | | | | |
| GYS018 | | tidal | y | | | | | | | |
| GYS019 | | tidal | y | | | | | | | |
| GYS685 | | tidal | y | | | | | | | |
| q38-port | | non-tidal | n | | | | | | 3330.61 | 60.55 |
| satsopQ | | non-tidal | n | | 66 | usgs | 1.000 | USGS 12035000 | 762.41 | 110.99 |
| 01-DOH | | tidal | y | | | | | | | |
| 02-DOH | | tidal | y | | | | | | | |
| 03-DOH | | tidal | y | | | | | | | |
| 05-DOH | | tidal | y | | | | | | | |
| 06-DOH | | tidal | y | | | | | | | |

| Station ID | receiving water | tidal influence | water quality sample site? (1) | Ecology 4-digit lab number | revised2 rcvg node (24fbc) | flow estimating method code (2) | ratio or equation used with reference flow (3) | reference flow used with ratio or equation to get flow at Sta ID (cfs except as noted) (4) | basin area (km2) | basin est. annual area-weighted precip (in) |
|---|---|---|---|---|---|---|---|---|---|---|
| 07-DOH | | tidal | y | | | | | | | |
| 08-DOH | | tidal | y | | | | | | | |
| 09-DOH | | tidal | y | | | | | | | |
| 11-DOH | | tidal | y | | | | | | | |
| 15-DOH | | tidal | y | | | | | | | |
| 17-DOH | | tidal | y | | | | | | | |
| 21-DOH | | tidal | y | | | | | | | |
| 22-DOH | | tidal | y | | | | | | | |
| 23-DOH | | tidal | y | | | | | | | |
| 24-DOH | | tidal | y | | | | | | | |
| 25-DOH | | tidal | y | | | | | | | |
| 26-DOH | | tidal | y | | | | | | | |
| 30-DOH | | tidal | y | | | | | | | |
| 44-DOH | | tidal | y | | | | | | | |
| 46-DOH | | tidal | y | | | | | | | |
| 51-DOH | | tidal | y | | | | | | | |
| 52-DOH | | tidal | y | | | | | | | |
| 54-DOH | | tidal | y | 6454 | | | | | | |
| 55-DOH | | tidal | y | 6455 | | | | | | |
| 56-DOH | | tidal | y | 6456 | | | | | | |
| 57-DOH | | tidal | y | | | | | | | |
| 59-DOH | | tidal | y | 6459 | | | | | | |
| 60-DOH | | tidal | y | 6450 | | | | | | |
| 61-DOH | | tidal | y | 6461 | | | | | | |

## Table B2. Stage recorder history and instrument drift correction summary.

| Station ID (col 1) | correction case (col 2) | start date/time of drift-corrected PDL file (PST) (col 3) | finish date/time of drift-corrected PDL file (PST) (col 4) | n used in rgression eqn (col 5) | (systat) rgression signif? (col 6) | (excel) r^2 (col 7) | (systat) p-value (col 8) | rgression used for crrctn? (col 9) | mean sum of RP and tnsdcr rdg (col 10) & (col 11) | regression equation (Excel) (col 12) |
|---|---|---|---|---|---|---|---|---|---|---|
| 31-ANDR | anderly | not used | not used | 15 | yes | 0.47 | 0.0227 | no | - | y = -2E-07x^2 + 0.0099x^1 - 155.65 |
| 31-ANDR | andlate | not used | not used | 28 | yes | 0.75 | 0.0000 | no | - | y = 4E-06x^2 - 0.2758x^1 + 4936.5 |
| 31-ANDR | *andall* | *1/30/1997 14:00* | *1m prssr trnsdcr installed* | | | | | | | |
| 31-ANDR | *andall* | *6/17/1997 11:00* | *new trnsdcr installed - could extend correction to 1/30/97* | | | | | | | |
| **31-ANDR** | andall | **2/12/1997 13:00** | **5/7/1998 15:00** | 44 | yes | 0.88 | 0.0000 | **yes** | 6.515 | y = 5.1337746493E-09x^3 - 5.4691113923E-04x^2 + 1.9419992815E+01x^1 - 2.2983762553E+05 |
| q30log | *welkall* | *1/30/1997 12:00* | *no post TDs taken until 3/12/97; could extend crrctn curve to 1/30/97* | | | | | | | |
| **q30log** | welkall | **3/12/1997 14:00** | **5/7/1998 12:00** | 34 | yes | 0.90 | 0.0000 | **yes** | 3.161 | y = -3.6861151599E-08x^3 + 3.9474965745E-03x^2 - 1.4091316739E+02x^1 + 1.6767146835E+06 |
| q32log | *gryall* | *3/4/1997 14:00* | *cap prb at cedar bridge installed* | | | | | | | |
| q32log | *gryall* | *3/12/1997 17:00* | *cap prb moved to lam bridge* | | | | | | | |
| q32log | *gryall* | *3/27/1997 11:00* | *cap prb fails* | | | | | | | |
| q32log | *gryall* | *4/3/1997 12:00* | *new 2m prssr trnsdcr installed* | | | | | | | |
| q32log | *gryall* | *5/8/1997 16:00* | *post TDs started, which are basis for crrctn factor; extended crrctn to 4/3/97 based on bridge TD data* | | | | | | | |
| **q32log** | gryall | **4/3/1997 12:00** | **5/7/1998 15:00** | 26 | yes | 0.64 | 0.0000 | **yes** | 5.552 | y = -2.1565371377E-08x^3 + 2.3142307559E-03x^2 - 8.2781126227E+01x^1 + 9.8703690190E+05 |
| **06-EFHOQ** | ehoqall | **2/28/1997 11:00** | **5/7/1998 12:00** | 30 | no | 0.08 | 0.5193 | **no** | 4.755 | y = -7E-10x^3 + 7E-05x^2 - 2.6648x^1 + 31789 |
| q05log | *whoqall* | *2/28/1997 9:00* | *2m prssr trnsdcr installed; post TDs were outliers for crrctn rgrssn - could extend crrctn record to 2/28/98* | | | | | | | |
| **q05log** | whoqall | **3/27/1997 13:00** | **5/7/1998 11:00** | 28 | yes | 0.43 | 0.0033 | **yes** | 4.667 | y = -2.3148199365E-09x^3 + 2.4769985156E-04x^2 - 8.8349843547E+00x^1 + 1.0504529930E+05 |
| 23-JOHN | *jonerly* | *3/4/1997 16:00* | *2m cap prb installed* | | | | | | | |
| 23-JOHN | *jonerly* | *3/19/1997 22:00* | *2m cap prb fails* | | | | | | | |
| 23-JOHN | *jonerly* | *4/3/1997 13:00* | *2m prsr trnsdcr installed* | | | | | | | |
| **23-JOHN** | jonerly | **4/3/1997 13:00** | **9/11/1997 12:00** | 17 | yes | 0.61 | 0.0014 | **yes** | 7.078 | y = 1.2606635653E-05x^2 - 8.9604736829E-01x^1 + 1.5929192639E+04 |
| 23-JOHN | | | | | | | | | | |

| Station ID (col 1) | correction case (col 2) | start date/time of drift-corrected PDL file (PST) (col 3) | finish date/time of drift-corrected PDL file (PST) (col 4) | n used in rgressn eqn (col 5) | (systat) rgressn signif? (col 6) | (excel) r^2 (col 7) | (systat) p-value (col 8) | rgressn used for crrctn? (col 9) | mean sum of RP and tnsdcr rdg (col 10) & (col 11) | regression equation (Excel) (col 12) |
|---|---|---|---|---|---|---|---|---|---|---|
| **23-JOHN** | jonlate | **10/23/1997 19:00** | **5/7/1998 13:00** | 12 | no | 0.41 | 0.0945 | **no** | - | y = 4E-06x^2 - 0.3069x^1 + 5500.9 |
| q10log | *mfwiall* | *7/23/1997 11:00* | *2m prssr trnsdcr moved to upstream location* | | | | | | | |
| **q10log** | mfwierly | **3/4/1997 11:00** | **7/23/1997 9:00** | 22 | 0.58 | 0.58 | 0.0002 | **yes** | 25.890 | y = -0.0000221670x^2 + 1.5729835249x-27878.8576617548 |
| **q10log** | mfwishlate | **7/23/1997 10:00** | **5/7/1998 7:00** | 41 | 0.38 | 0.38 | 0.0000 | **yes** | 26.266 | y = 0.0000033482x^2-0.2389719716x+4290.2345729123 |

(q10log crrctns done using Bridge + Trnsdcr rdg because post was moved)

**Equation to get a drift factor takes general form: DF = C - (Polynomial)**

1 C is a constant which is the mean sum of RP and trnsdcr rdg (column 10 above)

2 Polynomial is that in column 12 above

3 DF is the drift factor, which when added to the time/maint/tide corrected transducer rdg,
yields the final corrected transducer rdg in the PDL record

(datum for final crrctd stage is initial transducer position (T2 for EF Hoquiam))

(missing data in PDL records filled in from Q-Q relationships between basins)

**Summary of Process used to determine drift and correct it:**

a plot sums of RP and time/maint/tide-corrected trnsdcr rdg
b fit trendline through plot in (a), using Excel
c use systat to run regressions and diagnostics on data sets from (a)
d determine significance of regressions and determine which regression to use for correction
e choose reference point from which to generate a drift correction factor (DF): see #1 at left
f plot DF over time to check fit (magnitude and pattern - is a near mirror image of plot in (b))
g add DF to time/maint/tide-corrected transducer readings to get final corrected PDL record

## Table B3. Summary of stage-flow relationships.

| Stream | Station ID | type of function | stage-Q equation | R squared | n | RMSE | RMSE(CV) | Hi Q | Lo Q | range of Q_obs | RMSE as % of range | reference point (RP) for tapedown * | mean RP+T (T is transducer rdg) * | std dev (RP+T) | n for (RP+T) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Andrews | 31-ANDR | log-log | y = 17.622x^2.0767 | 0.9429 | 9 | 3.6818 | 0.0654 | 68.35 | 19.07 | 49.28 | 7% | spike on tree (spike is below nail) | 6.511 | 0.042 | 45 |
| WF Elk | q30log | semi-log | y = 10^ (0.9427x - 1.2105) | 0.9150 | 13 | 1.8278 | 0.1255 | 39.09 | 5.58 | 33.51 | 5% | bridge (top of notch) | 9.095 | 0.09 | 34 |
| Grayland lam bridge | q32log | linear | y = 15.82x - 12.448 | 0.9395 | 8 | 3.5915 | 0.2983 | 43.15 | 3.43 | 39.72 | 9% | bridge (top of notch) | 8.275 | 0.031 | 28 |
| Grayland gate | q32gate | log-log | y = 6.5348x^1.7599 | 0.8766 | 7 | 5.1068 | 0.1815 | 44.87 | 5.06 | 39.81 | 13% | | | | |
| EF Hoquiam (x<3.8915) | 06-EFHOQ | semi-log | y = 10^ (0.8452x - 0.4775) | 0.8846 | 7 | 88.9202 | 0.2000 | 713.2 | 51.63 | 661.57 | 13% | bridge (nail) | 21.107 | 0.115 | 62 |
| EF Hoquiam (x>3.8916) | 06-EFHOQ | semi-log | y = 10^ (0.1756x + 2.1283) | 0.9377 | 3 | 125.8651 | 0.1559 | 1509.31 | 516.45 | 992.86 | 13% | nail on tree | 8.424 | 0.02 | 29 |
| WF Hoquiam | q05log | log-log | y = 0.6099x^4.5319 | 0.9756 | 6 | 24.7613 | 0.1135 | 459.61 | 17.94 | 441.67 | 6% | bridge (sharpie mark) | 24.81 | 0.099 | 51 |
| Johns | 23-JOHN | semi-log | y = 10^ (0.4566x + 0.7484) | 0.9785 | 6 | 24.8455 | 0.0654 | 468.90 | 70.51 | 398.39 | 6% | nail on tree | 9.012 | 0.084 | 16 |
| MF Wishkah | q10log | log-log | y = 43.892x^2.5328 | 0.9844 | 11 | 41.4918 | 0.0853 | 1128.62 | 64.3 | 1064.32 | 4% | bridge (6th post) | 26.266 | 0.091 | 38 |

* transducer reading (stage) can be estimated from tapedown from reference point: stage = mean (RP+T) - tapedown

## Table B4. Daily average flows (in cms) of streams and stormwater basins (by station ID).

| date PST | 31andr | q30log | q32log | q32gate | 23john | 06efhoq | q05log | q10log | 38port | 13wyno | satsop | 517qeen | 516emer | 509adam | 506-28th | 508Kst | 511farr | arthr_pmp | 501abdiv |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/1/1997 | 0.8211 | 0.3573 | 0.4384 | 0.5032 | 3.5248 | 15.2944 | 2.0709 | 19.3811 | 160.2730 | 77.8713 | 120.9129 | 0.0524 | 0.1388 | 0.0607 | 0.1865 | 0.0230 | | | |
| 5/2/1997 | 0.8190 | 0.3510 | 0.4083 | 0.4708 | 2.9977 | 8.7927 | 1.6430 | 14.0110 | 172.1660 | 54.9347 | 93.7288 | 0.0240 | 0.0781 | 0.0304 | 0.0867 | 0.0230 | | | |
| 5/3/1997 | 0.8688 | 0.3928 | 0.6183 | 0.7226 | 3.2413 | 8.5521 | 1.6923 | 13.5766 | 156.0255 | 44.7406 | 79.5703 | 0.0375 | 0.0998 | 0.0477 | 0.1388 | 0.0230 | | | |
| 5/4/1997 | 0.8382 | 0.3602 | 0.5503 | 0.6358 | 3.1860 | 7.4207 | 1.5214 | 13.1221 | 145.8314 | 44.7406 | 82.1189 | 0.0330 | 0.0954 | 0.0434 | 0.1475 | 0.0230 | | | |
| 5/5/1997 | 0.9669 | 0.4431 | 0.5060 | 0.5827 | 5.2290 | 9.6113 | 1.7650 | 14.4576 | 140.4512 | 74.4733 | 84.1010 | 0.0285 | 0.0824 | 0.0347 | 0.0824 | 0.0230 | | | |
| 5/6/1997 | 0.9332 | 0.4182 | 0.4787 | 0.5495 | 4.2507 | 9.2172 | 1.5953 | 15.5449 | 131.3899 | 117.7981 | 99.9585 | 0.0464 | 0.1214 | 0.0564 | 0.2212 | 0.0320 | | | |
| 5/7/1997 | 0.7525 | 0.3378 | 0.3961 | 0.4569 | 3.1317 | 6.3651 | 1.3777 | 12.8827 | 129.1245 | 67.1109 | 84.1010 | 0.0240 | 0.0737 | 0.0217 | 0.0911 | 0.0320 | | | |
| 5/8/1997 | 0.6998 | 0.3081 | 0.3668 | 0.4260 | 2.7509 | 5.1488 | 1.2274 | 9.9658 | 119.2136 | 54.6515 | 71.0753 | 0.0210 | 0.0607 | 0.0260 | 0.0651 | 0.0320 | | | |
| 5/9/1997 | 0.6727 | 0.2826 | 0.3279 | 0.3861 | 2.5549 | 4.2942 | 1.1125 | 9.8218 | 107.6038 | 44.1743 | 62.2971 | 0.0135 | 0.0477 | 0.0173 | 0.0520 | 0.0320 | | | |
| 5/10/1997 | 0.6505 | 0.2688 | 0.2968 | 0.3556 | 2.4053 | 3.6225 | 1.0437 | 7.7069 | 96.5602 | 33.9802 | 55.5010 | 0.0120 | 0.0434 | 0.0217 | 0.0477 | 0.0320 | | | |
| 5/11/1997 | 0.6367 | 0.2595 | 0.2690 | 0.3294 | 2.3011 | 3.0976 | 0.9926 | 7.2054 | 87.4988 | 28.2319 | 50.4040 | 0.0135 | 0.0347 | 0.0217 | 0.0347 | 0.0061 | | | |
| 5/12/1997 | 0.6336 | 0.2589 | 0.2407 | 0.3033 | 2.2222 | 2.7782 | 0.9445 | 6.6629 | 80.1365 | 30.8654 | 46.4396 | 0.0075 | 0.0304 | 0.0130 | 0.0347 | 0.0061 | | | |
| 5/13/1997 | 0.6160 ϵ | 0.2528 | 0.2455 | 0.3076 | 2.1860 | 2.4938 | 0.9050 | 6.0312 | 74.1900 | 30.8654 | 43.3248 | 0.0075 | 0.0347 | 0.0130 | 0.0347 | 0.0061 | | | |
| 5/14/1997 | 0.5817 ϵ | 0.2474 | 0.2455 | 0.3076 | 2.1011 | 2.2420 | 0.8795 | 5.3765 | 68.8098 | 31.1485 | 40.4931 | 0.0075 | 0.0260 | 0.0130 | 0.0304 | 0.0061 | | | |
| 5/15/1997 | 0.5672 ϵ | 0.2413 | 0.2281 | 0.2920 | 2.0548 | 2.0635 | 0.8465 | 4.9830 | 64.2791 | 33.6970 | 38.2277 | 0.0060 | 0.0260 | 0.0130 | 0.0260 | 0.0061 | | | |
| 5/16/1997 | 0.5694 ϵ | 0.2372 | 0.2143 | 0.2799 | 2.0294 | 1.8848 | 0.8235 | 3.7586 | 60.3147 | 31.9980 | 36.2456 | 0.0075 | 0.0260 | 0.0087 | 0.0260 | 0.0061 | | | |
| 5/17/1997 | 0.5637 ϵ | 0.2316 | 0.2023 | 0.2696 | 1.9691 | 1.7585 | 0.8023 | 3.5012 | 56.9167 | 25.5418 | 34.2634 | 0.0045 | 0.0260 | 0.0130 | 0.0260 | 0.0061 | | | |
| 5/18/1997 | 0.5639 ϵ | 0.2272 | 0.1835 | 0.2537 | 1.9242 | 1.6498 | 0.7755 | 3.2426 | 53.5187 | 23.2481 | 32.8475 | 0.0030 | 0.0173 | 0.0087 | 0.0217 | 0.0078 | | | |
| 5/19/1997 | 0.5647 ϵ | 0.2243 | 0.1795 | 0.2504 | 1.9084 | 1.5456 | 0.7468 | 2.7042 | 50.9702 | 22.4553 | 31.1485 | 0.0045 | 0.0260 | 0.0087 | 0.0217 | 0.0078 | | | |
| 5/20/1997 | 0.5651 ϵ | 0.2253 | 0.1662 | 0.2395 | 1.8819 | 1.5924 | 0.7715 | 2.5989 | 49.5544 | 22.1721 | 30.5822 | 0.0060 | 0.0173 | 0.0087 | 0.0217 | 0.0078 | | | |
| 5/21/1997 | 0.5637 ϵ | 0.2220 | 0.1592 | 0.2338 | 1.8533 | 1.4930 | 0.7216 | 2.2184 | 50.9702 | 19.3970 | 29.7327 | 0.0150 | 0.0520 | 0.0173 | 0.0607 | 0.0078 | | | |
| 5/22/1997 | 0.5581 ϵ | 0.2205 | 0.1636 | 0.2374 | 1.8566 | 1.4010 | 0.7124 | 1.8693 | 50.1207 | 18.0378 | 28.3168 | 0.0075 | 0.0260 | 0.0043 | 0.0217 | 0.0078 | | | |
| 5/23/1997 | 0.5723 ϵ | 0.2281 | 0.1592 | 0.2338 | 1.8943 | 1.3832 | 0.7064 | 1.4414 | 47.2890 | 15.8291 | 27.4673 | 0.0090 | 0.0304 | 0.0130 | 0.0217 | 0.0078 | | | |
| 5/24/1997 | 0.5441 | 0.2186 | 0.1572 | 0.2322 | 1.8700 | 1.3440 | 0.6853 | 1.6220 | 46.7227 | 13.5355 | 26.8161 | 0.0075 | 0.0217 | 0.0087 | 0.0217 | 0.0078 | | | |
| 5/25/1997 | 0.5385 | 0.2189 | 0.1402 | 0.2188 | 1.8634 | 1.2691 | 0.6840 | 2.1846 | 46.1564 | 13.4505 | 26.6178 | 0.0075 | 0.0260 | 0.0087 | 0.0173 | 0.0338 | | | |
| 5/26/1997 | 0.5286 | 0.2132 | 0.1440 | 0.2217 | 1.8616 | 1.2200 | 0.6654 | 1.6884 | 44.1742 | 12.4877 | 25.5418 | 0.0075 | 0.0217 | 0.0043 | 0.0173 | 0.0338 | | | |
| 5/27/1997 | 0.6506 | 0.2565 | 0.2175 | 0.2835 | 2.1019 | 1.4456 | 0.7286 | 2.3478 | 43.6078 | 13.0824 | 26.1931 | 0.0165 | 0.0434 | 0.0217 | 0.0564 | 0.0338 | | | |
| 5/28/1997 | 1.0163 | 0.5236 | 0.3813 | 0.4485 | 3.3077 | 1.8248 | 0.8375 | 3.6203 | 47.0059 | 21.4075 | 29.7327 | 0.0225 | 0.0651 | 0.0347 | 0.0781 | 0.0338 | | | |
| 5/29/1997 | 0.7140 | 0.3090 | 0.4992 | 0.5738 | 2.2869 | 1.8690 | 0.8102 | 4.5980 | 52.6692 | 37.6614 | 36.5287 | 0.0479 | 0.1431 | 0.0520 | 0.1908 | 0.0338 | | | |
| 5/30/1997 | 1.0632 | 0.5702 | 0.4865 | 0.5613 | 4.2618 | 2.7358 | 1.3182 | 4.6469 | 54.9346 | 32.8475 | 33.1307 | 0.0180 | 0.0607 | 0.0130 | 0.0651 | 0.0338 | | | |
| 5/31/1997 | 1.0987 | 0.5236 | 0.6107 | 0.7124 | 4.4958 | 4.8545 | 1.4030 | 9.1640 | 62.8633 | 44.7406 | 48.1386 | 0.1244 | 0.3079 | 0.1605 | 0.4294 | 0.0338 | | | |
| 6/1/1997 | 0.7015 | 0.3211 | 0.4735 | 0.5445 | 3.4504 | 3.7854 | 1.1048 | 8.5344 | 126.8592 | 54.6515 | 52.3862 | 0.0479 | 0.1518 | 0.0304 | 0.1561 | 0.0338 | | | |
| 6/2/1997 | 0.6031 | 0.2617 | 0.3524 | 0.4112 | 2.6061 | 3.0614 | 0.9363 | 7.2388 | 118.6473 | 46.4396 | 50.4040 | 0.0390 | 0.1214 | 0.0607 | 0.1258 | 0.0338 | | | |
| 6/3/1997 | 0.7148 | 0.3059 | 0.3630 | 0.4225 | 2.7517 | 3.2785 | 1.0741 | 7.6850 | 101.9404 | 44.7406 | 47.8555 | 0.0240 | 0.0824 | 0.0304 | 0.0867 | 0.0338 | | | |
| 6/4/1997 | 1.0022 | 0.3538 | 0.5480 | 0.6333 | 2.7749 | 3.1453 | 0.9997 | 8.2222 | 103.6394 | 47.5723 | 53.2357 | 0.0524 | 0.1344 | 0.0520 | 0.1344 | 0.0338 | | | |
| 6/5/1997 | 0.6306 | 0.2588 | 0.4377 | 0.5037 | 2.3264 | 2.4457 | 0.8697 | 7.5779 | 110.7186 | 40.4931 | 47.0060 | 0.0330 | 0.0911 | 0.0304 | 0.1171 | 0.0338 | | | |
| 6/6/1997 | 0.5621 | 0.2357 | 0.3223 | 0.3807 | 2.1105 | 2.0979 | 0.8108 | 5.9932 | 98.8256 | 31.1485 | 41.3426 | 0.0165 | 0.0607 | 0.0304 | 0.0260 | 0.0338 | | | |
| 6/7/1997 | 0.5342 | 0.2237 | 0.2722 | 0.3323 | 1.9783 | 1.8785 | 0.7484 | 5.0765 | 82.9682 | 24.4658 | 37.0951 | 0.0195 | 0.0520 | 0.0173 | 0.0564 | 0.0338 | | | |
| 6/8/1997 | 0.5076 | 0.2149 | 0.2392 | 0.3020 | 1.9121 | 1.7224 | 0.7119 | 4.0118 | 71.0751 | 18.5475 | 33.9802 | 0.0120 | 0.0434 | 0.0130 | 0.0347 | 0.0083 | | | |
| 6/9/1997 | 0.5164 ϵ | 0.2073 | 0.2104 | 0.2766 | 1.8823 | 1.5450 | 0.6949 | 3.0241 | 62.8633 | 16.5370 | 31.7149 | 0.0075 | 0.0347 | 0.0130 | 0.0260 | 0.0083 | | | |
| 6/10/1997 | 0.4883 | 0.2027 | 0.1935 | 0.2621 | 1.8214 | 1.4467 | 0.6685 | 2.6250 | 56.0672 | 16.2822 | 29.7327 | 0.0060 | 0.0347 | 0.0173 | 0.0304 | 0.0083 | | | |
| 6/11/1997 | 0.5363 | 0.2202 | 0.2345 | 0.2984 | 1.8646 | 1.4795 | 0.7005 | 2.4246 | 51.2534 | 17.1600 | 28.8832 | 0.0120 | 0.0347 | 0.0087 | 0.0260 | 0.0083 | | | |
| 6/12/1997 | 0.5014 | 0.2077 | 0.2454 | 0.3075 | 1.8427 | 1.4184 | 0.6677 | 2.2213 | 48.4217 | 17.8962 | 28.2319 | 0.0120 | 0.0434 | 0.0173 | 0.0607 | 0.0083 | | | |
| 6/13/1997 | 0.4763 | 0.1978 | 0.2139 | 0.2796 | 1.7647 | 1.2790 | 0.6370 | 1.8243 | 46.7227 | 16.5654 | 26.6745 | 0.0060 | 0.0260 | 0.0087 | 0.0173 | 0.0083 | | | |
| 6/14/1997 | 0.4682 | 0.1942 | 0.1902 | 0.2593 | 1.7401 | 1.2110 | 0.6239 | 1.5882 | 43.6078 | 14.8097 | 25.2020 | 0.0045 | 0.0173 | 0.0087 | 0.0260 | 0.0083 | | | |

| date PST | 31andr | q30log | q32log | q32gate | 23john | 06efhoq | q05log | q10log | 38port | 13wyno | satsop | 517qeen | 516emer | 509adam | 506-28th | 508Kst | 511farr | arthr_pmp | 501abdiv |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6/15/1997 | 0.4667 | 0.1904 | 0.1803 | 0.2510 | 1.6915 | 1.1478 | 0.6152 | 1.3433 | 41.0593 | 14.1867 | 23.7578 | 0.0060 | 0.0260 | 0.0087 | 0.0217 | 0.0148 | | | |
| 6/16/1997 | 0.4947 | 0.2007 | 0.1827 | 0.2531 | 1.7009 | 1.1842 | 0.6676 | 1.0818 | 38.7940 | 14.1018 | 22.9933 | 0.0045 | 0.0173 | 0.0087 | 0.0217 | 0.0148 | | | |
| 6/17/1997 | 0.7659 | 0.3034 | 0.2863 | 0.3477 | 2.2501 | 1.6652 | 0.8046 | 4.7877 | 39.9267 | 22.5402 | 27.4390 | 0.0150 | 0.0434 | 0.0217 | 0.0477 | 0.0148 | | | |
| 6/18/1997 | 0.5990 | 0.2195 | 0.3133 | 0.3721 | 1.9616 | 1.5708 | 0.7617 | 4.5305 | 43.0415 | 33.1307 | 33.4139 | 0.0300 | 0.0824 | 0.0304 | 0.1344 | 0.0148 | | | |
| 6/19/1997 | 0.5522 | 0.1969 | 0.2325 | 0.2961 | 1.7894 | 1.3258 | 0.6418 | 2.6572 | 43.3247 | 27.8071 | 28.8832 | 0.0090 | 0.0434 | 0.0130 | 0.0520 | 0.0148 | | | |
| 6/20/1997 | 0.5603 | 0.1973 | 0.1934 | 0.2620 | 1.7555 | 1.2388 | 0.6281 | 2.1495 | 39.6435 | 18.4909 | 26.2780 | 0.0120 | 0.0304 | 0.0087 | 0.0347 | 0.0148 | | | |
| 6/21/1997 | 0.9953 | 0.3387 | 0.4176 | 0.4929 | 2.4379 | 1.3348 | 0.6778 | 2.5315 | 37.9445 | 15.7158 | 25.6834 | 0.0195 | 0.0477 | 0.0173 | 0.0824 | 0.0148 | | | |
| 6/22/1997 | 0.7352 | 0.3290 | 0.4690 | 0.5392 | 2.6598 | 1.7101 | 1.1378 | 3.6277 | 40.7762 | 16.6220 | 26.7877 | 0.0270 | 0.0607 | 0.0260 | 0.0867 | 0.0150 | | | |
| 6/23/1997 | 0.6182 | 0.2269 | 0.3259 | 0.3846 | 2.0831 | 1.5823 | 0.9413 | 3.9745 | 45.3068 | 18.8873 | 29.7327 | 0.0180 | 0.0477 | 0.0173 | 0.0434 | 0.0150 | | | |
| 6/24/1997 | 0.5603 | 0.2046 | 0.2543 | 0.3158 | 1.9060 | 1.3612 | 0.7423 | 2.7786 | 45.8732 | 17.8679 | 26.9860 | 0.0090 | 0.0347 | 0.0087 | 0.0390 | 0.0150 | | | |
| 6/25/1997 | 0.5554 | 0.1983 | 0.2147 | 0.2802 | 1.8384 | 1.2610 | 0.6860 | 2.4873 | 42.1920 | 16.9052 | 25.5418 | 0.0120 | 0.0304 | 0.0130 | 0.0390 | 0.0150 | | | |
| 6/26/1997 | 0.5489 | 0.2346 | 0.1942 | 0.2627 | 1.8489 | 1.2723 | 0.6890 | 2.5435 | 38.7940 | 16.7636 | 25.1454 | 0.0060 | 0.0347 | 0.0087 | 0.0304 | 0.0150 | | | |
| 6/27/1997 | 0.6837 | 0.2922 | 0.2495 | 0.3116 | 2.2566 | 1.3357 | 0.6836 | 2.7843 | 36.8118 | 16.0557 | 25.6551 | 0.0135 | 0.0347 | 0.0130 | 0.0564 | 0.0150 | | | |
| 6/28/1997 | 0.5681 | 0.2217 | 0.2410 | 0.3037 | 1.6987 | 1.2700 | 0.6473 | 2.4907 | 36.2455 | 14.9796 | 26.0798 | 0.0330 | 0.1128 | 0.0564 | 0.1995 | 0.0150 | | | |
| 6/29/1997 | 0.5374 | 0.2020 | 0.2034 | 0.2705 | 1.5444 | 1.1793 | 0.6345 | 1.9934 | 35.1128 | 14.0452 | 24.5507 | 0.0105 | 0.0434 | 0.0130 | 0.0520 | 0.0150 | | | |
| 6/30/1997 | 0.5264 | 0.1950 | 0.1876 | 0.2571 | 1.4986 | 1.1396 | 0.6130 | 1.9545 | 34.2633 | 13.6487 | 23.9277 | 0.0090 | 0.0347 | 0.0130 | 0.0347 | 0.0309 | | | |
| 7/1/1997 | 0.5266 | 0.1894 | 0.1712 | 0.2435 | 1.4437 | 1.1530 | 0.5989 | 2.4931 | 33.4138 | 13.4788 | 23.5313 | 0.0090 | 0.0347 | 0.0087 | 0.0000 | 0.0309 | | | |
| 7/2/1997 | 0.5169 | 0.1858 | 0.1590 | 0.2336 | 1.3923 | 1.0648 | 0.5791 | 1.4756 | 32.2811 | 13.1390 | 22.2287 | 0.0090 | 0.0260 | 0.0130 | 0.0607 | 0.0178 | | | |
| 7/3/1997 | 0.5097 | 0.1830 | 0.1539 | 0.2296 | 1.3642 | 1.0108 | 0.5741 | 1.2862 | 30.5821 | 12.3461 | 21.4359 | 0.0060 | 0.0260 | 0.0087 | 0.0217 | 0.0178 | | | |
| 7/4/1997 | 0.5041 | 0.1807 | 0.1438 | 0.2215 | 1.3479 | 0.9716 | 0.5651 | 1.1832 | 28.8831 | 11.2701 | 20.6996 | 0.0060 | 0.0173 | 0.0087 | 0.0173 | 0.0178 | 0.0105 | 0.0090 | 0.0197 |
| 7/5/1997 | 0.5086 | 0.1831 | 0.1293 | 0.2103 | 1.3541 | 0.9414 | 0.5511 | 1.1385 | 27.8920 | 10.6471 | 20.1616 | 0.0075 | 0.0260 | 0.0043 | 0.0217 | 0.0178 | 0.0105 | 0.0146 | 0.0237 |
| 7/6/1997 | 0.6195 | 0.2311 | 0.1546 | 0.2301 | 1.6005 | 0.9922 | 0.5778 | 1.5762 | 27.6938 | 11.0153 | 20.8695 | 0.0090 | 0.0304 | 0.0087 | 0.2082 | 0.0178 | 0.0210 | 0.0269 | 0.0276 |
| 7/7/1997 | 0.5242 | 0.1890 | 0.1444 | 0.2220 | 1.4378 | 0.9299 | 0.5470 | 1.3469 | 27.2124 | 10.5339 | 20.0766 | 0.0060 | 0.0217 | 0.0087 | 0.0173 | 0.0178 | 0.0158 | 0.0146 | 0.0197 |
| 7/8/1997 | 1.3322 | 0.6988 | 0.2685 | 0.3330 | 3.7238 | 7.7660 | 2.2811 | 20.7707 | 29.1663 | 28.8832 | 30.0159 | 0.0240 | 0.0607 | 0.0304 | 0.0781 | 0.0178 | 0.0552 | 0.0567 | 0.1104 |
| 7/9/1997 | 0.9594 | 0.4248 | 0.4402 | 0.5053 | 3.3657 | 9.8552 | 1.7598 | 28.1367 | 37.3781 | 110.7189 | 107.8872 | 0.0779 | 0.1822 | 0.0781 | 0.2776 | 0.0178 | 0.0552 | 0.0567 | 0.1104 |
| 7/10/1997 | 0.6632 | 0.2650 | 0.3618 | 0.4210 | 2.2082 | 3.8353 | 1.0409 | 16.0324 | 49.5544 | 54.9347 | 59.7485 | 0.0420 | 0.0911 | 0.0520 | 0.0954 | 0.0178 | 0.0552 | 0.0567 | 0.0670 |
| 7/11/1997 | 0.5874 | 0.2202 | 0.2733 | 0.3335 | 1.9796 | 2.5689 | 0.8218 | 11.2894 | 51.2534 | 39.9268 | 42.7584 | 0.0225 | 0.1128 | 0.0390 | 0.1214 | 0.0178 | 0.0552 | 0.0567 | 0.0670 |
| 7/12/1997 | 0.5561 | 0.2033 | 0.2127 | 0.2786 | 1.9043 | 1.9901 | 0.7346 | 8.8334 | 47.2890 | 27.0426 | 35.1129 | 0.0135 | 0.0564 | 0.0173 | 0.0564 | 0.0178 | 0.0193 | 0.0216 | 0.0355 |
| 7/13/1997 | 0.5432 | 0.1972 | 0.1756 | 0.2472 | 1.8642 | 1.7183 | 0.6962 | 7.2032 | 40.7762 | 20.7846 | 30.5822 | 0.0105 | 0.0390 | 0.0217 | 0.0347 | 0.0073 | 0.0193 | 0.0216 | 0.0355 |
| 7/14/1997 | 0.5338 | 0.1924 | 0.1586 | 0.2333 | 1.8122 | 1.5341 | 0.6637 | 5.9992 | 36.5286 | 18.4626 | 27.4390 | 0.0090 | 0.0260 | 0.0087 | 0.0347 | 0.0073 | 0.0193 | 0.0216 | 0.0355 |
| 7/15/1997 | 0.5218 | 0.1887 | 0.1522 | 0.2282 | 1.7659 | 1.4032 | 0.6296 | 5.0421 | 33.1306 | 16.8768 | 25.3153 | 0.0060 | 0.0347 | 0.0043 | 0.0260 | 0.0073 | 0.0131 | 0.0190 | 0.0217 |
| 7/16/1997 | 0.5093 | 0.1830 | 0.1352 | 0.2148 | 1.7302 | 1.2984 | 0.6158 | 3.6751 | 30.5821 | 15.6875 | 23.7862 | 0.0075 | 0.0217 | 0.0173 | 0.0217 | 0.0073 | 0.0131 | 0.0190 | 0.0217 |
| 7/17/1997 | 0.5013 | 0.1792 | 0.1253 | 0.2073 | 1.6932 | 1.2402 | 0.6047 | 3.4821 | 28.8831 | 14.7814 | 22.5685 | 0.0060 | 0.0217 | 0.0087 | 0.0217 | 0.0073 | 0.0105 | 0.0140 | 0.0197 |
| 7/18/1997 | 0.4879 | 0.1749 | 0.1347 | 0.2145 | 1.6740 | 1.1527 | 0.5953 | 3.0715 | 27.0425 | 13.8753 | 21.5491 | 0.0075 | 0.0260 | 0.0043 | 0.0173 | 0.0073 | 0.0105 | 0.0140 | 0.0197 |
| 7/19/1997 | 0.4829 | 0.1779 | 0.1259 | 0.2077 | 1.6438 | 1.1009 | 0.5807 | 1.8628 | 25.7400 | 12.6859 | 20.8695 | 0.0060 | 0.0217 | 0.0087 | 0.0260 | 0.0073 | 0.0095 | 0.0125 | 0.0197 |
| 7/20/1997 | 0.4878 | 0.1779 | 0.1256 | 0.2075 | 1.6325 | 1.0560 | 0.5727 | 2.4425 | 24.5790 | 11.4683 | 20.2749 | 0.0060 | 0.0217 | 0.0087 | 0.0390 | 0.0059 | 0.0095 | 0.0125 | 0.0197 |
| 7/21/1997 | 0.4898 | 0.1782 | 0.1162 | 0.2004 | 1.5778 | 1.0384 | 0.5738 | 2.4878 | 23.4746 | 10.8170 | 19.7652 | 0.0075 | 0.0434 | 0.0043 | 0.0260 | 0.0059 | 0.0095 | 0.0125 | 0.0197 |
| 7/22/1997 | 0.4968 | 0.1749 | 0.1203 | 0.2034 | 1.5492 | 1.0108 | 0.5648 | 2.5165 | 22.7101 | 10.5056 | 19.3121 | 0.0045 | 0.0173 | 0.0087 | 0.0347 | 0.0059 | 0.0095 | 0.0125 | 0.0197 |
| 7/23/1997 | 0.4884 | 0.1742 | 0.1105 | 0.1960 | 1.5280 | 0.9574 | 0.5470 | 2.2063 | 22.0021 | 10.0525 | 18.5192 | 0.0045 | 0.0108 | 0.0043 | 0.0304 | 0.0059 | 0.0095 | 0.0125 | 0.0205 |
| 7/24/1997 | 0.4789 | 0.1744 | 0.0895 | 0.1807 | 1.5122 | 0.9299 | 0.5338 | 2.1236 | 21.2376 | 9.6844 | 17.4998 | 0.0060 | 0.0108 | 0.0043 | 0.0347 | 0.0059 | 0.0079 | 0.0123 | 0.0205 |
| 7/25/1997 | 0.4788 | 0.1741 | 0.0912 | 0.1819 | 1.4829 | 0.8992 | 0.5417 | 2.0554 | 20.5863 | 9.3729 | 16.9052 | 0.0030 | 0.0000 | 0.0087 | 0.0173 | 0.0059 | 0.0079 | 0.0123 | 0.0205 |
| 7/26/1997 | 0.4754 | 0.1718 | 0.0827 | 0.1758 | 1.4413 | 0.8881 | 0.5343 | 1.9986 | 19.8784 | 9.0048 | 16.2256 | 0.0030 | 0.0217 | 0.0000 | 0.0173 | 0.0059 | 0.0053 | 0.0134 | 0.0205 |
| 7/27/1997 | 0.4737 | 0.1722 | 0.0844 | 0.1770 | 1.4117 | 0.8607 | 0.5281 | 1.9283 | 19.3120 | 8.8065 | 15.7442 | 0.0045 | 0.0217 | 0.0087 | 0.0173 | 0.0041 | 0.0053 | 0.0134 | 0.0205 |
| 7/28/1997 | 0.4660 | 0.1711 | 0.0754 | 0.1707 | 1.4160 | 0.8517 | 0.5183 | 1.8511 | 18.6608 | 8.9198 | 15.4044 | 0.0030 | 0.0130 | 0.0043 | 0.0173 | 0.0041 | 0.0105 | 0.0140 | 0.0197 |
| 7/29/1997 | 0.4605 | 0.1690 | 0.0818 | 0.1752 | 1.4027 | 0.8274 | 0.5133 | 1.8480 | 18.0944 | 8.6366 | 15.0646 | 0.0030 | 0.0173 | 0.0087 | 0.0130 | 0.0041 | 0.0070 | 0.0140 | 0.0221 |
| 7/30/1997 | 0.4519 | 0.1682 | 0.0902 | 0.1812 | 1.4068 | 0.8118 | 0.4986 | 1.7986 | 17.5847 | 8.5517 | 14.7531 | 0.0030 | 0.0173 | 0.0000 | 0.0173 | 0.0041 | 0.0070 | 0.0140 | 0.0221 |
| 7/31/1997 | 0.4524 | 0.1642 | 0.0905 | 0.1814 | 1.3839 | 0.7817 | 0.5055 | 1.7479 | 17.1883 | 8.2402 | 14.4133 | 0.0015 | 0.0043 | 0.0087 | 0.0130 | 0.0041 | 0.0070 | 0.0140 | 0.0221 |

| date PST | 31andr | q30log | q32log | q32gate | 23john | 06efhoq | q05log | q10log | 38port | 13wyno | satsop | 517qeen | 516emer | 509adam | 506-28th | 508Kst | 511farr | arthr_pmp | 501abdiv |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8/1/1997 | 0.4535 | 0.1628 | 0.0782 | 0.1726 | 1.3826 | 0.7664 | 0.4960 | 1.7153 | 16.6786 | 7.7871 | 14.1018 | 0.0015 | 0.0173 | 0.0000 | 0.0130 | 0.0041 | 0.0070 | 0.0140 | 0.0221 |
| 8/2/1997 | 0.4523 | 0.1613 | 0.0927 | 0.1831 | 1.3914 | 0.7639 | 0.4905 | 1.6252 | 16.2821 | 7.7022 | 13.7620 | 0.0045 | 0.0173 | 0.0043 | 0.0087 | 0.0041 | 0.0070 | 0.0140 | 0.0221 |
| 8/3/1997 | 0.4471 | 0.1608 | 0.0945 | 0.1843 | 1.3821 | 0.7505 | 0.4903 | 1.6238 | 15.9707 | 7.6172 | 13.6204 | 0.0030 | 0.0173 | 0.0087 | 0.0130 | 0.0036 | 0.0070 | 0.0112 | 0.0197 |
| 8/4/1997 | 0.4403 | 0.1601 | 0.0934 | 0.1834 | 1.3548 | 0.7371 | 0.4835 | 1.5675 | 15.7441 | 7.6172 | 13.3372 | 0.0045 | 0.0173 | 0.0000 | 0.0130 | 0.0036 | 0.0070 | 0.0118 | 0.0214 |
| 8/5/1997 | 0.4395 | 0.1600 | 0.0851 | 0.1775 | 1.3367 | 0.7336 | 0.4811 | 1.5565 | 15.5176 | 7.5323 | 13.1673 | 0.0015 | 0.0130 | 0.0087 | 0.0087 | 0.0036 | 0.0070 | 0.0118 | 0.0214 |
| 8/6/1997 | 0.4420 | 0.1633 | 0.1253 | 0.2077 | 1.3363 | 0.7110 | 0.4823 | 1.4999 | 14.9513 | 7.4190 | 12.9691 | 0.0030 | 0.0173 | 0.0000 | 0.0173 | 0.0036 | 0.0070 | 0.0118 | 0.0214 |
| 8/7/1997 | 0.4376 | 0.1621 | 0.1032 | 0.1907 | 1.3186 | 0.6971 | 0.4791 | 1.4653 | 14.5265 | 7.2774 | 12.8275 | 0.0030 | 0.0130 | 0.0043 | 0.0087 | 0.0036 | 0.0079 | 0.0118 | 0.0214 |
| 8/8/1997 | 0.4393 | 0.1600 | 0.1057 | 0.1925 | 1.3113 | 0.6953 | 0.4755 | 1.4617 | 14.0451 | 7.1642 | 12.7143 | 0.0015 | 0.0130 | 0.0043 | 0.0087 | 0.0036 | 0.0079 | 0.0118 | 0.0214 |
| 8/9/1997 | 0.4329 | 0.1590 | 0.0812 | 0.1748 | 1.3039 | 0.6931 | 0.4711 | 1.4540 | 13.7903 | 7.0509 | 12.5727 | 0.0030 | 0.0130 | 0.0043 | 0.0087 | 0.0036 | 0.0053 | 0.0118 | 0.0214 |
| 8/10/1997 | 0.4206 | 0.1555 | 0.0738 | 0.1697 | 1.2847 | 0.6754 | 0.4679 | 1.3977 | 13.4505 | 6.9376 | 12.3178 | 0.0000 | 0.0087 | 0.0043 | 0.0130 | 0.0036 | 0.0053 | 0.0127 | 0.0214 |
| 8/11/1997 | 0.4206 | 0.1531 | 0.0718 | 0.1683 | 1.3026 | 0.6699 | 0.4626 | 1.3791 | 13.1956 | 6.8244 | 12.0913 | 0.0030 | 0.0173 | 0.0043 | 0.0130 | 0.0036 | 0.0053 | 0.0127 | 0.0214 |
| 8/12/1997 | 0.4234 | 0.1552 | 0.0945 | 0.1843 | 1.3041 | 0.6688 | 0.4543 | 1.3344 | 12.8841 | 6.8244 | 12.0063 | 0.0030 | 0.0130 | 0.0043 | 0.0130 | 0.0035 | 0.0053 | 0.0127 | 0.0214 |
| 8/13/1997 | 0.4254 | 0.1556 | 0.0869 | 0.1790 | 1.2932 | 0.6688 | 0.4615 | 1.3036 | 12.6293 | 7.6172 | 11.8364 | 0.0000 | 0.0087 | 0.0043 | 0.0173 | 0.0035 | 0.0070 | 0.0131 | 0.0214 |
| 8/14/1997 | 0.4292 | 0.1590 | 0.1181 | 0.2018 | 1.3103 | 0.6728 | 0.4427 | 1.3099 | 12.2612 | 7.6172 | 11.7515 | 0.0015 | 0.0173 | 0.0043 | 0.0173 | 0.0035 | 0.0070 | 0.0131 | 0.0214 |
| 8/15/1997 | 0.4267 | 0.1602 | 0.1019 | 0.1898 | 1.3182 | 0.6758 | 0.4313 | 1.3336 | 11.8930 | 6.9093 | 11.7232 | 0.0015 | 0.0130 | 0.0043 | 0.0173 | 0.0035 | 0.0070 | 0.0131 | 0.0214 |
| 8/16/1997 | 0.4193 | 0.1578 | 0.0976 | 0.1866 | 1.2776 | 0.6578 | 0.4312 | 1.3058 | 11.6948 | 6.7960 | 11.5816 | 0.0030 | 0.0130 | 0.0000 | 0.0173 | 0.0035 | 0.0088 | 0.0123 | 0.0223 |
| 8/17/1997 | 0.4135 | 0.1558 | 0.0833 | 0.1763 | 1.2822 | 0.6469 | 0.4322 | 1.2451 | 11.5249 | 6.6261 | 11.3834 | 0.0030 | 0.0130 | 0.0043 | 0.0087 | 0.0072 | 0.0088 | 0.0123 | 0.0223 |
| 8/18/1997 | 0.4077 | 0.1553 | 0.0876 | 0.1793 | 1.2796 | 0.6347 | 0.4309 | 1.2252 | 11.4117 | 6.5978 | 11.1852 | 0.0060 | 0.0173 | 0.0087 | 0.0130 | 0.0072 | 0.0088 | 0.0123 | 0.0223 |
| 8/19/1997 | 0.4146 | 0.1525 | 0.0790 | 0.1733 | 1.1852 | 0.6374 | 0.4288 | 1.1798 | 11.3550 | 6.5978 | 11.1002 | 0.0060 | 0.0173 | 0.0000 | 0.0130 | 0.0072 | 0.0092 | 0.0129 | 0.0177 |
| 8/20/1997 | 0.4558 | 0.1680 | 0.1088 | 0.1951 | 1.2974 | 0.6524 | 0.4437 | 1.1355 | 11.3267 | 6.6828 | 11.1285 | 0.0045 | 0.0217 | 0.0043 | 0.0087 | 0.0072 | 0.0092 | 0.0129 | 0.0177 |
| 8/21/1997 | 0.4351 | 0.1635 | 0.1332 | 0.2134 | 1.3222 | 0.6772 | 0.4442 | 1.2817 | 12.0063 | 6.9376 | 11.2984 | 0.0105 | 0.0260 | 0.0130 | 0.0347 | 0.0072 | 0.0092 | 0.0101 | 0.0217 |
| 8/22/1997 | 0.4159 | 0.1547 | 0.1016 | 0.1895 | 1.2085 | 0.6401 | 0.4283 | 1.3057 | 12.5727 | 6.5978 | 10.9869 | 0.0045 | 0.0173 | 0.0043 | 0.0087 | 0.0072 | 0.0092 | 0.0101 | 0.0217 |
| 8/23/1997 | 0.4197 | 0.1573 | 0.1141 | 0.1987 | 1.1869 | 0.6320 | 0.4252 | 1.2413 | 12.4877 | 6.4846 | 10.8170 | 0.0045 | 0.0217 | 0.0000 | 0.0173 | 0.0072 | 0.0158 | 0.0317 | 0.0460 |
| 8/24/1997 | 0.4857 | 0.1872 | 0.1563 | 0.2319 | 1.4953 | 0.6906 | 0.4700 | 1.4697 | 12.1196 | 7.2208 | 10.8170 | 0.0120 | 0.0304 | 0.0130 | 0.0694 | 0.0199 | 0.0158 | 0.0317 | 0.0460 |
| 8/25/1997 | 0.4555 | 0.1757 | 0.1735 | 0.2455 | 1.3137 | 0.7015 | 0.4727 | 1.9844 | 12.6010 | 8.5517 | 11.9780 | 0.0090 | 0.0347 | 0.0087 | 0.1214 | 0.0199 | 0.0158 | 0.0213 | 0.0460 |
| 8/26/1997 | 0.8493 | 0.3330 | 0.3007 | 0.3643 | 1.7525 | 0.8459 | 0.6250 | 1.7919 | 13.4788 | 8.5517 | 12.6576 | 0.0300 | 0.0390 | 0.0173 | 0.0651 | 0.0199 | 0.0210 | 0.0336 | 0.0651 |
| 8/27/1997 | 0.6391 | 0.2977 | 0.4168 | 0.4797 | 1.8068 | 0.9522 | 0.5985 | 2.7660 | 15.7724 | 10.9020 | 14.3850 | 0.0315 | 0.1214 | 0.0520 | 0.1691 | 0.0199 | 0.0210 | 0.0336 | 0.0651 |
| 8/28/1997 | 0.4756 | 0.2018 | 0.2982 | 0.3574 | 1.4926 | 0.8045 | 0.4835 | 2.5416 | 18.2926 | 13.3656 | 17.3299 | 0.0150 | 0.0607 | 0.0173 | 0.0781 | 0.0199 | 0.0131 | 0.0325 | 0.0296 |
| 8/29/1997 | 0.4804 | 0.2029 | 0.2507 | 0.3124 | 1.6209 | 0.7135 | 0.4644 | 2.3838 | 18.9439 | 11.0719 | 16.2822 | 0.0105 | 0.0347 | 0.0130 | 0.0477 | 0.0199 | 0.0131 | 0.0325 | 0.0296 |
| 8/30/1997 | 0.4348 | 0.1774 | 0.2017 | 0.2693 | 1.3552 | 0.6744 | 0.4492 | 1.8144 | 18.0378 | 9.0048 | 14.5265 | 0.0060 | 0.0217 | 0.0043 | 0.0304 | 0.0199 | 0.0105 | 0.0406 | 0.0049 |
| 8/31/1997 | 0.4145 | 0.1703 | 0.1695 | 0.2422 | 1.2719 | 0.6442 | 0.4406 | 1.2307 | 17.6980 | 7.9854 | 13.1107 | 0.0060 | 0.0260 | 0.0087 | 0.0260 | 0.0081 | 0.0105 | 0.0406 | 0.0049 |
| 9/1/1997 | 0.4017 | 0.1699 | 0.1431 | 0.2211 | 1.2418 | 0.6321 | 0.4289 | 1.1617 | 15.8008 | 7.5040 | 12.3178 | 0.0060 | 0.0173 | 0.0087 | 0.0260 | 0.0081 | 0.0105 | 0.0406 | 0.0049 |
| 9/2/1997 | 0.3978 | 0.1690 | 0.1280 | 0.2093 | 1.1972 | 0.6217 | 0.4220 | 1.0768 | 14.6115 | 7.1925 | 11.8364 | 0.0075 | 0.0217 | 0.0000 | 0.0260 | 0.0081 | 0.0105 | 0.0406 | 0.0049 |
| 9/3/1997 | 0.3934 | 0.1658 | 0.1133 | 0.1982 | 1.1683 | 0.6078 | 0.4116 | 1.0584 | 13.8752 | 6.9659 | 11.4966 | 0.0030 | 0.0173 | 0.0087 | 0.0217 | 0.0081 | 0.0079 | 0.0172 | 0.0000 |
| 9/4/1997 | 0.3952 | 0.1661 | 0.1032 | 0.1907 | 1.1508 | 0.6053 | 0.4084 | 1.2234 | 13.2239 | 6.7677 | 11.2418 | 0.0015 | 0.0130 | 0.0043 | 0.0173 | 0.0081 | 0.0079 | 0.0172 | 0.0000 |
| 9/5/1997 | 0.3944 | 0.1660 | 0.1001 | 0.1884 | 1.1491 | 0.6039 | 0.4106 | 1.2624 | 12.7709 | 6.6261 | 11.0153 | 0.0000 | 0.0173 | 0.0043 | 0.0217 | 0.0081 | 0.0105 | 0.0172 | 0.0000 |
| 9/6/1997 | 0.3882 | 0.1661 | 0.0909 | 0.1818 | 1.1662 | 0.5996 | 0.4081 | 1.1901 | 12.4027 | 6.4846 | 10.8454 | 0.0030 | 0.0087 | 0.0043 | 0.0217 | 0.0081 | 0.0210 | 0.0187 | 0.0000 |
| 9/7/1997 | 0.3810 | 0.1661 | 0.0774 | 0.1721 | 1.1808 | 0.5795 | 0.4103 | 1.1825 | 12.1196 | 6.3996 | 10.6471 | 0.0015 | 0.0173 | 0.0043 | 0.0173 | 0.0047 | 0.0053 | 0.0187 | 0.0000 |
| 9/8/1997 | 0.3824 | 0.1648 | 0.0582 | 0.1590 | 1.1578 | 0.5739 | 0.4011 | 1.1749 | 11.8930 | 6.2863 | 10.5056 | 0.0030 | 0.0087 | 0.0087 | 0.0173 | 0.0047 | 0.0053 | 0.0187 | 0.0000 |
| 9/9/1997 | 0.3797 | 0.1651 | 0.0357 e | 0.1354 | 1.1801 | 0.5723 | 0.3935 | 1.1520 | 11.6948 | 6.2014 | 10.3356 | 0.0015 | 0.0130 | 0.0000 | 0.0217 | 0.0047 | 0.0039 | 0.0190 | 0.0000 |
| 9/10/1997 | 0.3898 | 0.1676 | 0.0048 e | 0.1127 | 1.1689 | 0.5723 | 0.4053 | 1.1520 | 11.5532 | 6.1448 | 10.2507 | 0.0015 | 0.0087 | 0.0043 | 0.0173 | 0.0047 | 0.0039 | 0.0190 | 0.0968 |
| 9/11/1997 | 0.3848 | 0.1663 | 0.0422 e | 0.1455 | 1.1718 e | 0.5723 | 0.4074 | 1.1944 | 11.3550 | 6.1448 | 10.0808 | 0.0030 | 0.0173 | 0.0087 | 0.0173 | 0.0047 | 0.0039 | 0.0179 | 0.0968 |
| 9/12/1997 | 0.5256 | 0.2122 | 0.0375 e | 0.1447 | 1.7008 e | 0.5907 | 0.4227 | 1.2021 | 11.2984 | 6.0598 | 10.1657 | 0.0015 | 0.0130 | 0.0043 | 0.0173 | 0.0047 | 0.0039 | 0.0179 | 0.0968 |
| 9/13/1997 | 0.4204 | 0.1769 | 0.0434 e | 0.1471 | 1.3311 e | 0.6035 | 0.4279 | 1.3292 | 11.0719 | 6.2014 | 10.3073 | 0.0015 | 0.0130 | 0.0043 | 0.0260 | 0.0047 | 0.0088 | 0.0736 | 0.0968 |
| 9/14/1997 | 0.5748 | 0.2429 | 0.1228 e | 0.2110 | 1.8758 e | 0.6765 | 0.5025 | 1.7639 | 11.9780 | 7.0792 | 10.8454 | 0.0105 | 0.0304 | 0.0087 | 0.0477 | 0.0919 | 0.0088 | 0.0736 | 0.0968 |
| 9/15/1997 | 2.3694 | 1.9850 e | 0.5520 | 0.6653 | 17.7313 e | 0.9869 | 0.7433 | 3.1345 | 16.8202 | 15.3760 | 15.0362 | 0.0345 | 0.0954 | 0.0347 | 0.1344 | 0.0919 | 0.0088 | 0.0736 | 0.0968 |
| 9/16/1997 | 2.9689 e | 2.4721 e | 1.0393 | 1.4085 | 22.9117 e | 6.1571 | 2.7019 | 13.3378 | 24.8621 | 39.9268 | 25.2869 | 0.0659 | 0.1648 | 0.0694 | 0.2169 | 0.0919 | 0.2716 | 0.0736 | 0.0968 |

| date PST | 31andr | q30log | q32log | q32gate | 23john | 06efhoq | q05log | q10log | 38port | 13wyno | satsop | 517qeen | 516emer | 509adam | 506-28th | 508Kst | 511farr | arthr_pmp | 501abdiv |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/17/1997 | 4.5071 e | 3.5511 e | 1.5953 | 2.4590 | 37.5579 e | 21.1194 | 4.9007 | 31.4207 | 77.0216 | 156.5922 | 185.7585 | 0.2817 | 0.6289 | 0.3686 | 0.8240 | 0.0919 | 0.2716 | 0.0736 | 0.0968 |
| 9/18/1997 | 1.3592 | 0.7414 | 1.2675 | 1.7973 | 6.9306 e | 13.3206 | 2.0418 | 20.0430 | 146.1146 | 182.6437 | 165.9367 | 0.1378 | 0.3990 | 0.1518 | 0.4857 | 0.0919 | 0.2716 | 0.1592 | 0.0968 |
| 9/19/1997 | 0.6649 | 0.3460 | 0.6475 | 0.7697 | 2.2197 e | 3.8756 | 0.8570 | 8.4829 | 106.4711 | 77.0218 | 75.3228 | 0.0375 | 0.1561 | 0.0390 | 0.0998 | 0.0363 | 0.1157 | 0.0651 | 0.0467 |
| 9/20/1997 | 0.5493 | 0.2769 | 0.3942 | 0.4554 | 1.7835 e | 2.2949 | 0.6462 | 6.4769 | 71.3583 | 50.1208 | 48.7050 | 0.0285 | 0.0347 | 0.0520 | 0.0781 | 0.0363 | 0.0357 | 0.0651 | 0.0467 |
| 9/21/1997 | 0.5164 | 0.2523 | 0.3129 | 0.3715 | 1.6350 e | 1.7578 | 0.5696 | 4.2590 | 52.6692 | 41.3426 | 37.3782 | 0.0165 | 0.0477 | 0.0173 | 0.0477 | 0.0195 | 0.0357 | 0.0651 | 0.0467 |
| 9/22/1997 | 0.4957 | 0.2409 | 0.2395 | 0.3027 | 1.5696 e | 1.4594 | 0.5288 | 3.6057 | 42.4752 | 37.0951 | 30.8654 | 0.0135 | 0.0434 | 0.0173 | 0.0434 | 0.0195 | 0.0357 | 0.0651 | 0.0467 |
| 9/23/1997 | 0.4900 | 0.2385 | 0.2576 | 0.3188 | 1.5513 e | 1.2865 | 0.4984 | 3.2409 | 35.9623 | 34.5466 | 26.9576 | 0.0105 | 0.0304 | 0.0087 | 0.0347 | 0.0195 | 0.0357 | 0.0651 | 0.0467 |
| 9/24/1997 | 0.4894 | 0.2367 | 0.2445 | 0.3070 | 1.5494 e | 1.1794 | 0.4770 | 3.0714 | 31.7148 | 22.9366 | 24.4941 | 0.0090 | 0.0304 | 0.0173 | 0.0304 | 0.0195 | 0.0357 | 0.0651 | 0.0467 |
| 9/25/1997 | 0.5267 | 0.2484 | 0.2772 | 0.3378 | 1.6866 e | 1.1257 | 0.4964 | 2.8747 | 29.1663 | 15.2345 | 22.9650 | 0.0090 | 0.0347 | 0.0130 | 0.0390 | 0.0195 | 0.0368 | 0.0696 | 0.0426 |
| 9/26/1997 | 0.7250 | 0.3421 | 0.4367 | 0.5016 | 2.4319 e | 2.1427 | 0.7779 | 4.6912 | 31.7148 | 43.8911 | 28.0054 | 0.0270 | 0.0651 | 0.0304 | 0.1084 | 0.0195 | 0.0368 | 0.0696 | 0.0426 |
| 9/27/1997 | 0.6329 | 0.3135 | 0.3778 | 0.4378 | 2.0995 e | 2.3881 | 0.7905 | 6.0898 | 42.4752 | 72.2080 | 51.2535 | 0.0599 | 0.1388 | 0.0564 | 0.1171 | 0.0195 | 0.0368 | 0.0696 | 0.0426 |
| 9/28/1997 | 0.8139 | 0.4050 | 0.4020 | 0.4639 | 2.7857 e | 2.6532 | 0.8366 | 9.3408 | 62.5801 | 74.1901 | 65.9783 | 0.0240 | 0.0651 | 0.0217 | 0.0564 | 0.0580 | 0.0368 | 0.0696 | 0.0426 |
| 9/29/1997 | 0.6163 | 0.3098 | 0.3709 | 0.4310 | 2.0410 e | 2.3597 | 0.7110 | 8.4192 | 52.9524 | 73.6238 | 66.8278 | 0.0150 | 0.0434 | 0.0173 | 0.0477 | 0.0580 | 0.0368 | 0.0696 | 0.0426 |
| 9/30/1997 | 0.9047 | 0.3901 | 0.5600 | 0.6656 | 3.3120 e | 2.6130 | 0.8783 | 6.8586 | 45.3068 | 62.0139 | 53.2357 | 0.0165 | 0.0434 | 0.0217 | 0.0390 | 0.0580 | 0.0315 | 0.0903 | 0.0946 |
| 10/1/1997 | 1.3027 | 0.6468 | 0.8122 | 1.0031 | 6.5164 e | 4.5009 | 1.4331 | 8.0495 | 45.0237 | 64.5624 | 47.8555 | 0.0659 | 0.1431 | 0.0737 | 0.1475 | 0.0580 | 0.0894 | 0.0903 | 0.0946 |
| 10/2/1997 | 0.9755 | 0.4368 | 0.8152 | 1.0009 | 3.3372 e | 4.4411 | 1.2351 | 8.2283 | 59.4652 | 67.9604 | 56.6337 | 0.0734 | 0.1995 | 0.0737 | 0.3470 | 0.0580 | 0.1367 | 0.1070 | 0.1360 |
| 10/3/1997 | 2.8523 | 2.2107 e | 1.0799 | 1.4392 | 21.5507 e | 9.0116 | 2.1317 | 13.2911 | 87.7820 | 81.5525 | 83.5347 | 0.0839 | 0.2559 | 0.1041 | 0.3383 | 0.0580 | 0.1157 | 0.1070 | 0.1360 |
| 10/4/1997 | 1.2520 | 0.5735 | 0.9726 | 1.2494 | 4.6869 e | 22.9822 | 4.0509 | 36.5263 | 145.5482 | 145.8318 | 227.9506 | 0.0944 | 0.2038 | 0.0998 | 0.3209 | 0.0580 | 0.2944 | 0.1344 | 0.1774 |
| 10/5/1997 | 0.7930 | 0.3768 | 0.7150 | 0.8559 | 2.6945 e | 20.3206 | 2.2481 | 23.1392 | 288.8312 | 169.6179 | 215.4912 | 0.0899 | 0.2125 | 0.0998 | 0.2776 | 0.0569 | 0.2103 | 0.1150 | 0.1498 |
| 10/6/1997 | 0.6566 | 0.3163 | 0.5062 | 0.5825 | 2.1746 e | 10.0129 | 1.4212 | 11.6697 | 281.7520 | 84.6674 | 120.9129 | 0.0300 | 0.0998 | 0.0390 | 0.1041 | 0.0569 | 0.0710 | 0.0806 | 0.0631 |
| 10/7/1997 | 0.6540 | 0.3046 | 0.4444 | 0.5103 | 2.1841 e | 5.5241 | 1.1378 | 8.7257 | 189.4393 | 67.9604 | 90.8971 | 0.0240 | 0.0694 | 0.0390 | 0.0694 | 0.0569 | 0.0710 | 0.0761 | 0.1429 |
| 10/8/1997 | 1.4324 | 0.5538 | 0.7447 | 0.9072 | 7.5835 e | 9.4679 | 1.7859 | 11.1887 | 144.4156 | 71.9248 | 93.1624 | 0.0300 | 0.0867 | 0.1388 | 0.1301 | 0.0569 | 0.0789 | 0.1159 | 0.1429 |
| 10/9/1997 | 1.4958 | 0.7891 | 1.0952 | 1.4670 | 11.8294 e | 13.7911 | 2.9292 | 13.4295 | 146.6809 | 80.1367 | 114.4001 | 0.0794 | 0.2082 | 0.2038 | 0.2602 | 0.0569 | 0.1787 | 0.1140 | 0.1429 |
| 10/10/97 | 2.0329 | 1.1572 e | 1.5298 | 2.3224 | 17.5457 | 23.5107 | 5.9008 | 28.6927 | 202.1818 | 155.7427 | 194.8199 | 0.1558 | 0.3730 | 0.0000 | 0.5291 | 0.0569 | 0.2155 | 0.1140 | 0.1429 |
| 10/11/97 | 0.9860 | 0.4530 | 0.9785 | 1.2679 | 5.2032 | 19.5836 | 2.8396 | 17.2453 | 224.8352 | 113.2674 | 147.5308 | 0.0779 | 0.2429 | 0.0998 | 0.2862 | 0.0569 | 0.2944 | 0.0935 | 0.1078 |
| 10/12/97 | 0.8898 | 0.4108 | 0.6798 | 0.8055 | 3.6195 | 11.5796 | 1.9499 | 12.1692 | 176.9799 | 77.8713 | 105.3387 | 0.0360 | 0.1344 | 0.0607 | 0.1301 | 0.0569 | 0.0789 | 0.0935 | 0.1078 |
| 10/13/97 | 0.7965 | 0.3577 | 0.5518 | 0.6378 | 3.0860 | 7.4424 | 1.5953 | 9.3832 | 145.8314 | 67.9604 | 86.0832 | 0.0315 | 0.1041 | 0.0434 | 0.0998 | 0.0569 | 0.0789 | 0.0935 | 0.1078 |
| 10/14/97 | 0.7605 | 0.3360 | 0.4948 | 0.5683 | 2.9121 | 6.0595 | 1.4635 | 8.1607 | 128.2750 | 63.1466 | 75.6060 | 0.0270 | 0.0781 | 0.0390 | 0.0911 | 0.0569 | 0.0447 | 0.0586 | 0.0473 |
| 10/15/97 | 0.7010 | 0.3140 | 0.4220 | 0.4852 | 2.6027 | 4.5691 | 1.2901 | 7.0627 | 114.1166 | 58.3327 | 66.5446 | 0.0210 | 0.0694 | 0.0217 | 0.0694 | 0.0208 | 0.0447 | 0.0586 | 0.0473 |
| 10/16/97 | 0.6685 | 0.2990 | 0.3709 | 0.4301 | 2.4123 | 3.7091 | 1.1720 | 6.3442 | 102.7899 | 41.9089 | 59.4654 | 0.0195 | 0.0477 | 0.0217 | 0.0564 | 0.0208 | 0.0210 | 0.0586 | 0.0473 |
| 10/17/97 | 0.6681 | 0.2954 | 0.3534 | 0.4121 | 2.3005 | 3.1714 | 1.0903 | 6.3441 | 93.4454 | 37.0951 | 54.3683 | 0.0195 | 0.0477 | 0.0217 | 0.0520 | 0.0208 | 0.0210 | 0.0571 | 0.0394 |
| 10/18/97 | 0.6483 | 0.2858 | 0.3064 | 0.3649 | 2.1480 | 2.6954 | 1.0028 | 5.4719 | 85.7998 | 34.5466 | 50.9703 | 0.0165 | 0.0434 | 0.0130 | 0.0434 | 0.0208 | 0.0131 | 0.0541 | 0.0335 |
| 10/19/97 | 0.6307 | 0.2848 | 0.2804 | 0.3399 | 2.0433 | 2.3943 | 0.9391 | 4.6015 | 79.2870 | 26.2780 | 48.1386 | 0.0150 | 0.0390 | 0.0173 | 0.0390 | 0.0211 | 0.0131 | 0.0541 | 0.0335 |
| 10/20/97 | 0.6162 | 0.2809 | 0.2589 | 0.3198 | 1.9557 | 2.1362 | 0.8872 | 4.5110 | 73.3405 | 22.5402 | 45.5901 | 0.0105 | 0.0347 | 0.0130 | 0.0390 | 0.0211 | 0.0105 | 0.0541 | 0.0315 |
| 10/21/97 | 0.6120 | 0.2785 | 0.2425 | 0.3049 | 1.8540 | 1.9382 | 0.8524 | 3.7113 | 68.8098 | 21.1810 | 43.6079 | 0.0090 | 0.0260 | 0.0087 | 0.0304 | 0.0211 | 0.0140 | 0.0599 | 0.0394 |
| 10/22/97 | 0.7004 | 0.3217 | 0.2492 | 0.3111 | 2.2348 | 1.8993 | 0.8754 | 3.8308 | 65.1286 | 19.5669 | 42.4753 | 0.0255 | 0.0564 | 0.0304 | 0.0737 | 0.0211 | 0.0140 | 0.0599 | 0.0394 |
| 10/23/97 | 0.6641 | 0.3140 | 0.2441 | 0.3063 | 1.9881 | 1.7269 | 0.7942 e | 3.6723 | 62.2969 | 16.2256 | 41.0594 | 0.0135 | 0.0477 | 0.0130 | 0.0607 | 0.0211 | 0.0140 | 0.0599 | 0.0394 |
| 10/24/97 | 0.6175 | 0.2951 | 0.2285 | 0.2924 | 1.8330 | 1.5435 | 0.7374 e | 3.5213 | 60.3147 | 14.8947 | 39.3604 | 0.0090 | 0.0347 | 0.0173 | 0.0390 | 0.0211 | 0.0210 | 0.0608 | 0.0365 |
| 10/25/97 | 0.6079 | 0.2886 | 0.2070 | 0.2736 | 1.7963 | 1.4747 | 0.7168 e | 3.3450 | 57.4831 | 13.7903 | 38.2277 | 0.0090 | 0.0304 | 0.0087 | 0.0390 | 0.0211 | 0.0053 | 0.0608 | 0.0365 |
| 10/26/97 | 0.7328 | 0.3172 | 0.2703 | 0.3345 | 1.8404 | 1.4850 | 0.7195 e | 3.3300 | 55.2177 | 12.7709 | 37.3782 | 0.0090 | 0.0260 | 0.0130 | 0.0390 | 0.0211 | 0.0079 | 0.0608 | 0.0365 |
| 10/27/97 | 0.7358 | 0.3173 | 0.3674 | 0.4267 | 1.9400 | 1.5506 | 0.7393 e | 3.2878 | 54.0850 | 12.6859 | 37.0951 | 0.0135 | 0.0390 | 0.0130 | 0.0520 | 0.0211 | 0.0079 | 0.0728 | 0.0365 |
| 10/28/97 | 1.2215 | 0.4615 | 0.4529 | 0.5410 | 4.9322 | 2.6394 | 0.9760 e | 4.5237 | 54.6514 | 13.8753 | 37.6614 | 0.0090 | 0.0304 | 0.0173 | 0.0347 | 0.0211 | 0.0105 | 0.0728 | 0.2228 |
| 10/29/97 | 2.2240 | 1.0767 | 1.1408 | 1.5418 | 29.7838 | 17.0148 | 3.3982 e | 14.7746 | 86.0830 | 54.9347 | 122.6119 | 0.1843 | 0.9845 | 0.2212 | 0.5682 | 0.0211 | 0.2629 | 0.1434 | 0.2228 |
| 10/30/08 | 3.5061 | 1.6291 e | 1.3254 | 1.8984 | 140.5783 e | 29.9852 | 12.1422 e | 61.3873 e | 254.5678 | 215.2080 | 472.8913 | 0.2487 | 0.3383 | 0.4033 | 1.0366 | 0.1518 | 0.4731 | 0.0930 | 0.2602 |
| 10/31/97 | 1.4467 | 0.4635 | 0.8729 | 1.0950 | 6.1123 | 19.8731 | 4.2588 e | 20.9626 e | 427.5834 | 145.8318 | 255.4180 | 0.1064 | 0.1041 | 0.1388 | 0.3643 | 0.1518 | 0.4206 | 0.1938 | 0.2878 |
| 11/1/1997 | 0.8117 | 0.3578 | 0.5794 | 0.6731 | 3.7440 | 11.5834 | 2.5758 e | 12.9322 e | 512.5337 | 101.9406 | 148.0971 | 0.0584 | 0.1214 | 0.0911 | 0.3296 | 0.1518 | 0.1038 | 0.0597 | 0.1249 |
| 11/2/1997 | 0.9110 | 0.3225 | 0.4508 | 0.5176 | 2.9975 | 6.8394 | 1.8629 e | 9.6864 e | 393.6032 | 73.9070 | 110.1525 | 0.0195 | 0.1128 | 0.0434 | 0.1388 | 0.0280 | 0.1038 | 0.0597 | 0.1249 |

| date PST | 31andr | q30log | q32log | q32gate | 23john | 06efhoq | q05log | q10log | 38port | 13wyno | satsop | 517qeen | 516emer | 509adam | 506-28th | 508Kst | 511farr | arthr_pmp | 501abdiv |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11/3/1997 | 1.3685 | 0.3719 | 0.4917 | 0.5680 | 3.3571 | 6.6752 | 1.8314 e | 9.5740 e | 262.4965 | 69.0931 | 93.7288 | 0.0434 | 0.0867 | 0.0390 | 0.0911 | 0.0280 | 0.1038 | 0.0597 | 0.1249 |
| 11/4/1997 | 0.7660 | 0.3321 | 0.4254 | 0.4891 | 2.8866 | 5.5418 | 1.6334 e | 8.7985 e | 203.0313 | 70.2258 | 94.0119 | 0.0345 | 0.0867 | 0.0390 | 0.1301 | 0.0280 | 0.1038 | 0.0537 | 0.0749 |
| 11/5/1997 | 0.7257 | 0.3088 | 0.3719 | 0.4312 | 2.5619 | 4.3096 | 1.3981 e | 7.9555 e | 166.7858 | 62.2971 | 78.4377 | 0.0150 | 0.0824 | 0.0304 | 0.0694 | 0.0280 | 0.0421 | 0.0481 | 0.0394 |
| 11/6/1997 | 0.8987 | 0.3713 | 0.4890 | 0.5623 | 2.7707 | 4.5121 | 1.3133 e | 7.7331 e | 147.2473 | 60.8812 | 71.6416 | 0.0330 | 0.0781 | 0.0304 | 0.0607 | 0.0280 | 0.0421 | 0.0577 | 0.0482 |
| 11/7/1997 | 0.7501 | 0.2989 | 0.4021 | 0.4637 | 2.4027 | 3.6762 | 1.1045 | 6.6947 | 138.7522 | 56.0674 | 65.6951 | 0.0225 | 0.0737 | 0.0304 | 0.1301 | 0.0280 | 0.0421 | 0.0577 | 0.0482 |
| 11/8/1997 | 0.6913 | 0.2769 | 0.3363 | 0.3946 | 2.2168 | 3.1209 | 1.0199 | 6.1248 | 133.3720 | 32.5644 | 59.4654 | 0.0165 | 0.0520 | 0.0217 | 0.0651 | 0.0280 | 0.0223 | 0.0414 | 0.0482 |
| 11/9/1997 | 0.6784 | 0.2705 | 0.3084 | 0.3669 | 2.1592 | 2.7981 | 0.9727 | 5.7001 | 122.3285 | 26.5612 | 54.9347 | 0.0120 | 0.0477 | 0.0173 | 0.0520 | 0.0164 | 0.0223 | 0.0414 | 0.0482 |
| 11/10/1997 | 0.6734 | 0.2602 | 0.2814 | 0.3409 | 2.0831 | 2.5480 | 0.9347 | 5.2939 | 112.7008 | 24.2675 | 51.5367 | 0.0120 | 0.0347 | 0.0130 | 0.0434 | 0.0164 | 0.0223 | 0.0414 | 0.0482 |
| 11/11/1997 | 0.6537 | 0.2547 | 0.2632 | 0.3238 | 2.0025 | 2.3090 | 0.8739 | 4.9575 | 104.2057 | 22.5119 | 48.7050 | 0.0105 | 0.0347 | 0.0173 | 0.0390 | 0.0164 | 0.0223 | 0.0414 | 0.0482 |
| 11/12/1997 | 0.6393 | 0.2495 | 0.2633 | 0.3239 | 1.9564 | 2.1213 | 0.8448 | 4.6488 | 96.2771 | 21.1810 | 46.1565 | 0.0120 | 0.0347 | 0.0130 | 0.0434 | 0.0164 | 0.0053 | 0.0403 | 0.0482 |
| 11/13/1997 | 0.6289 | 0.2460 | 0.2559 | 0.3172 | 1.9286 | 1.9463 | 0.8116 | 4.3514 | 89.1979 | 20.0200 | 43.8911 | 0.0135 | 0.0304 | 0.0173 | 0.0347 | 0.0164 | 0.0084 | 0.0414 | 0.0482 |
| 11/14/1997 | 0.6109 | 0.2375 | 0.2388 | 0.3016 | 1.8589 | 1.7835 | 0.7753 | 4.1231 | 83.2513 | 19.0006 | 42.1921 | 0.0150 | 0.0390 | 0.0087 | 0.0390 | 0.0164 | 0.0084 | 0.0414 | 0.0482 |
| 11/15/1997 | 0.5904 | 0.2335 | 0.2232 | 0.2877 | 1.8225 | 1.6740 | 0.7576 | 3.9328 | 78.1543 | 18.2077 | 40.4931 | 0.0135 | 0.0304 | 0.0087 | 0.0347 | 0.0164 | 0.0084 | 0.0414 | 0.0732 |
| 11/16/1997 | 0.6035 | 0.2387 | 0.2175 | 0.2827 | 1.8124 | 1.5597 | 0.7354 | 3.7510 | 73.9068 | 17.4149 | 39.3604 | 0.0150 | 0.0260 | 0.0087 | 0.0260 | 0.0369 | 0.0084 | 0.0414 | 0.0732 |
| 11/17/1997 | 0.8996 | 0.3576 | 0.3511 | 0.4104 | 3.1916 | 2.0312 | 0.8656 | 4.9438 | 80.7028 | 20.3315 | 43.6079 | 0.0225 | 0.0564 | 0.0173 | 0.0867 | 0.0369 | 0.0084 | 0.0414 | 0.0732 |
| 11/18/1997 | 0.6780 | 0.2764 | 0.3079 | 0.3665 | 2.3101 | 1.8439 | 0.7752 | 4.5461 | 111.8513 | 21.8889 | 47.2891 | 0.0345 | 0.0607 | 0.0304 | 0.1344 | 0.0369 | 0.0263 | 0.0403 | 0.0732 |
| 11/19/1997 | 1.0010 | 0.3818 | 0.4743 | 0.5523 | 3.5566 | 2.6083 | 1.1337 | 5.5777 | 128.2750 | 23.1349 | 48.4218 | 0.0300 | 0.0694 | 0.0173 | 0.1171 | 0.0369 | 0.0000 | 0.0831 | 0.0732 |
| 11/20/1997 | 1.0697 | 0.4398 | 0.5419 | 0.6282 | 4.3871 | 4.3281 | 1.2229 | 9.6176 | 217.1897 | 56.9169 | 96.2773 | 0.0599 | 0.1301 | 0.0651 | 0.2299 | 0.0369 | 0.1551 | 0.0831 | 0.0732 |
| 11/21/1997 | 1.0529 | 0.4654 | 0.6504 | 0.7691 | 4.4277 | 4.8573 | 1.2790 | 10.8581 | 359.6231 | 70.7921 | 100.5248 | 0.0539 | 0.1431 | 0.0564 | 0.2169 | 0.0369 | 0.1551 | 0.0831 | 0.0732 |
| 11/22/1997 | 0.8416 | 0.3594 | 0.5015 | 0.5767 | 3.0181 | 3.9068 | 1.1614 | 8.2181 | 390.7716 | 58.0495 | 82.6852 | 0.0614 | 0.0911 | 0.0390 | 0.1171 | 0.0369 | 0.1437 | 0.1001 | 0.1459 |
| 11/23/1997 | 1.5570 | 0.7674 | 0.7559 | 0.9160 | 16.0060 | 12.1357 | 2.8431 | 12.1048 | 325.6430 | 59.7485 | 93.1624 | 0.0629 | 0.2038 | 0.1214 | 0.3686 | 0.0598 | 0.1437 | 0.1001 | 0.1459 |
| 11/24/1997 | 0.9217 | 0.4246 | 0.5765 | 0.6692 | 5.7333 | 9.2782 | 1.9473 | 11.7687 | 302.9895 | 78.4377 | 120.3466 | 0.0584 | 0.1908 | 0.0911 | 0.2342 | 0.0598 | 0.1437 | 0.1001 | 0.1459 |
| 11/25/1997 | 1.0049 | 0.3956 | 0.5405 | 0.6238 | 4.3784 | 8.0978 | 1.8125 | 10.9130 | 328.4746 | 74.4733 | 109.8694 | 0.0449 | 0.1258 | 0.0651 | 0.1865 | 0.0598 | 0.0894 | 0.0896 | 0.1005 |
| 11/26/1997 | 0.7604 | 0.3076 | 0.4329 | 0.4973 | 2.9926 | 5.5952 | 1.4374 | 9.1466 | 297.3262 | 68.2436 | 93.4456 | 0.0330 | 0.0954 | 0.0390 | 0.1258 | 0.0598 | 0.0683 | 0.0605 | 0.1005 |
| 11/27/1997 | 0.8238 | 0.3536 | 0.3890 | 0.4493 | 3.7930 | 5.2435 | 1.5098 | 8.6860 | 248.6213 | 47.5723 | 79.5703 | 0.0210 | 0.0694 | 0.0260 | 0.0737 | 0.0598 | 0.1086 | 0.0967 | 0.1475 |
| 11/28/1997 | 1.2287 | 0.5355 | 0.7298 | 0.8948 | 7.3707 | 13.7321 | 2.3983 | 16.6924 | 214.3580 | 74.4733 | 146.6813 | 0.0704 | 0.1561 | 0.0824 | 0.2515 | 0.0598 | 0.1086 | 0.0967 | 0.1475 |
| 11/29/1997 | 1.5542 | 0.6475 | 1.0354 | 1.3632 | 7.2556 | 18.1662 | 2.9294 | 18.5296 | 225.6847 | 98.2595 | 166.5031 | 0.0599 | 0.2212 | 0.0998 | 0.3730 | 0.0598 | 0.1086 | 0.0967 | 0.1475 |
| 11/30/1997 | 1.6304 | 0.7458 | 0.9648 | 1.2373 | 18.6379 | 19.0106 | 3.5860 | 18.1691 | 254.0015 | 103.0733 | 170.1842 | 0.1229 | 0.2385 | 0.1084 | 0.3686 | 0.0378 | 0.2103 | 0.1131 | 0.1475 |
| 12/1/1997 | 0.8947 | 0.3960 | 0.6412 | 0.7550 | 6.7200 | 13.6320 | 2.5480 | 14.1140 | 261.6470 | 90.6139 | 141.5842 | 0.0569 | 0.1605 | 0.0694 | 0.1908 | 0.0378 | 0.1209 | 0.0717 | 0.1475 |
| 12/2/1997 | 0.7570 | 0.3293 | 0.4651 | 0.5341 | 4.5298 | 8.0622 | 1.9506 | 11.4342 | 232.7639 | 75.6060 | 107.0377 | 0.0345 | 0.0998 | 0.0477 | 0.1128 | 0.0378 | 0.0499 | 0.0526 | 0.0563 |
| 12/3/1997 | 0.6886 | 0.2982 | 0.3762 | 0.4358 | 3.5084 | 5.6900 | 1.6184 | 9.2824 | 200.1996 | 66.8278 | 86.3664 | 0.0225 | 0.0694 | 0.0260 | 0.0867 | 0.0378 | 0.0499 | 0.0526 | 0.0563 |
| 12/4/1997 | 0.6496 | 0.2701 | 0.3255 | 0.3838 | 2.9300 | 4.4245 | 1.4163 | 7.4400 | 173.5819 | 60.8812 | 72.7743 | 0.0225 | 0.0651 | 0.0260 | 0.0694 | 0.0378 | 0.0237 | 0.0426 | 0.0563 |
| 12/5/1997 | 0.6359 | 0.2547 | 0.2935 | 0.3524 | 2.5555 | 3.6964 | 1.2927 | 6.5958 | 154.3264 | 39.3604 | 63.9961 | 0.0165 | 0.0434 | 0.0173 | 0.0564 | 0.0378 | 0.0237 | 0.0426 | 0.0563 |
| 12/6/1997 | 0.6239 | 0.2488 | 0.2758 | 0.3356 | 2.2358 | 3.1690 | 1.1963 | 6.1329 | 139.8849 | 33.1307 | 57.7664 | 0.0150 | 0.0477 | 0.0130 | 0.0520 | 0.0378 | 0.0158 | 0.0420 | 0.0563 |
| 12/7/1997 | 0.6265 | 0.2520 | 0.2732 | 0.3331 | 2.1328 | 2.8372 | 1.1492 | 5.7567 | 129.1245 | 30.8654 | 53.8020 | 0.0120 | 0.0390 | 0.0217 | 0.0477 | 0.0258 | 0.0158 | 0.0420 | 0.0563 |
| 12/8/1997 | 0.6385 | 0.2567 | 0.2938 | 0.3531 | 2.1662 | 2.6415 | 1.0892 | 5.6105 | 121.4790 | 30.2990 | 52.3862 | 0.0195 | 0.0564 | 0.0217 | 0.0781 | 0.0258 | 0.0210 | 0.0526 | 0.0563 |
| 12/9/1997 | 0.7041 | 0.2881 | 0.3295 | 0.3897 | 2.2299 | 2.5107 | 1.1114 | 5.3020 | 114.1166 | 27.0426 | 48.7050 | 0.0285 | 0.0694 | 0.0477 | 0.0824 | 0.0258 | 0.0710 | 0.0694 | 0.0648 |
| 12/10/1997 | 0.8274 | 0.3456 | 0.4750 | 0.5472 | 4.2326 | 3.3929 | 1.3093 | 6.3661 | 118.3641 | 33.1307 | 52.9525 | 0.0539 | 0.1301 | 0.0651 | 0.2169 | 0.0258 | 0.0710 | 0.0443 | 0.0648 |
| 12/11/1997 | 0.6295 | 0.2533 | 0.3436 | 0.4021 | 2.3179 | 2.6541 | 1.0589 | 5.7784 | 124.5938 | 31.1485 | 50.9703 | 0.0345 | 0.0954 | 0.0390 | 0.1171 | 0.0258 | 0.0683 | 0.0443 | 0.0648 |
| 12/12/1997 | 0.5956 | 0.2410 | 0.2964 | 0.3553 | 2.1063 | 2.3261 | 0.9788 | 5.2976 | 116.6651 | 25.5418 | 48.1386 | 0.0195 | 0.0434 | 0.0173 | 0.0651 | 0.0258 | 0.0315 | 0.0443 | 0.0648 |
| 12/13/1997 | 0.5824 | 0.2329 | 0.2664 | 0.3269 | 1.9981 | 2.1123 | 0.9339 | 4.7896 | 109.5859 | 24.1543 | 46.1565 | 0.0135 | 0.0477 | 0.0217 | 0.0607 | 0.0258 | 0.0315 | 0.0443 | 0.0648 |
| 12/14/1997 | 0.6035 | 0.2378 | 0.2777 | 0.3376 | 1.9720 | 1.9987 | 0.9185 | 4.5360 | 104.2057 | 23.3331 | 44.7406 | 0.0165 | 0.0434 | 0.0130 | 0.0564 | 0.0882 | 0.0237 | 0.0481 | 0.0648 |
| 12/15/1997 | 1.6002 e | 0.8626 e | 0.5283 | 0.6722 | 5.6329 e | 3.3097 | 1.6510 | 6.1816 | 100.8077 | 25.2020 | 45.5901 | 0.0285 | 0.0607 | 0.0304 | 0.0781 | 0.0882 | 0.0237 | 0.0728 | 0.0648 |
| 12/16/1997 | 4.7768 e | 3.6826 e | 1.6412 | 2.5642 | 40.2626 e | 29.3835 | 13.8286 | 61.3164 | 169.6175 | 139.8852 | 267.3110 | 0.2622 | 0.4684 | 0.3556 | 0.8717 | 0.0882 | 0.4363 | 0.1906 | 0.0907 |
| 12/17/1997 | 1.5845 | 0.7307 | 1.2089 | 1.6720 | 8.6641 e | 24.6337 | 6.1242 | 39.4866 | 410.5933 | 176.9803 | 351.1289 | 0.1828 | 0.4988 | 0.2472 | 0.7633 | 0.0882 | 0.5993 | 0.1979 | 0.6387 |
| 12/18/1997 | 0.9939 | 0.3983 | 0.7732 | 0.9410 | 3.6062 e | 19.8579 | 3.1617 | 19.9624 | 540.8505 | 107.3208 | 181.5110 | 0.0839 | 0.2169 | 0.1084 | 0.2212 | 0.0882 | 0.1945 | 0.0649 | 0.0513 |
| 12/19/1997 | 0.8451 | 0.2936 | 0.5594 | 0.6471 | 2.9197 | 14.1269 | 2.3548 | 14.0331 | 521.0287 | 82.6852 | 121.4793 | 0.0375 | 0.1128 | 0.0607 | 0.1475 | 0.0882 | 0.1051 | 0.0649 | 0.0513 |

| date PST | 31andr | q30log | q32log | q32gate | 23john | 06efhoq | q05log | q10log | 38port | 13wyno | satsop | 517qeen | 516emer | 509adam | 506-28th | 508Kst | 511farr | arthr_pmp | 501abdiv |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12/20/1997 | 0.9431 | 0.3382 | 0.5830 | 0.6770 | 3.2966 | 13.9972 | 2.6159 | 13.2530 | 390.7716 | 78.1545 | 103.0733 | 0.0509 | 0.1518 | 0.0564 | 0.1605 | 0.0882 | 0.0946 | 0.1109 | 0.2602 |
| 12/21/1997 | 0.8478 | 0.2953 | 0.5098 | 0.5864 | 2.6654 | 10.5189 | 2.1823 | 11.6134 | 302.9895 | 73.0575 | 92.8793 | 0.0479 | 0.1388 | 0.0564 | 0.2169 | 0.0329 | 0.1051 | 0.0672 | 0.1183 |
| 12/22/1997 | 0.8104 | 0.2763 | 0.4400 | 0.5066 | 2.2352 | 7.4442 | 1.8693 | 10.0650 | 246.6392 | 60.0317 | 79.5703 | 0.0285 | 0.0824 | 0.0434 | 0.0867 | 0.0329 | 0.0368 | 0.0448 | 0.0749 |
| 12/23/1997 | 1.2224 | 0.4137 | 0.7050 | 0.8409 | 3.3776 | 8.3828 | 2.1116 | 10.0633 | 212.0927 | 59.1822 | 76.7387 | 0.0464 | 0.1344 | 0.0607 | 0.1952 | 0.0329 | 0.0841 | 0.0784 | 0.1301 |
| 12/24/1997 | 0.9744 | 0.3153 | 0.6414 | 0.7552 | 2.4143 | 6.1103 | 1.7103 | 8.5656 | 195.1026 | 50.4040 | 68.2436 | 0.0434 | 0.1214 | 0.0520 | 0.1605 | 0.0329 | 0.0841 | 0.0605 | 0.0841 |
| 12/25/1997 | 0.7901 | 0.2582 | 0.4518 | 0.5189 | 2.0358 | 4.9518 | 1.5126 | 7.6952 | 176.4135 | 35.6792 | 62.2971 | 0.0225 | 0.0867 | 0.0347 | 0.0911 | 0.0329 | 0.0421 | 0.0448 | 0.0841 |
| 12/26/1997 | 0.8557 | 0.2932 | 0.4039 | 0.4659 | 2.1588 | 4.9335 | 1.6052 | 7.7330 | 160.5561 | 32.8475 | 58.6159 | 0.0195 | 0.0564 | 0.0260 | 0.0737 | 0.0329 | 0.0421 | 0.0448 | 0.0841 |
| 12/27/1997 | 0.8831 | 0.2963 | 0.4407 | 0.5064 | 2.1458 | 5.5678 | 1.6420 | 8.0012 | 154.0433 | 35.1129 | 62.0139 | 0.0494 | 0.1171 | 0.0564 | 0.1561 | 0.0329 | 0.1157 | 0.1010 | 0.1695 |
| 12/28/1997 | 2.5368 | 1.5950 | 1.0273 | 1.3512 | 14.4033 e | 14.7365 | 4.4531 | 11.4637 | 156.0255 | 44.1743 | 74.4733 | 0.1229 | 0.2559 | 0.1258 | 0.3513 | 0.0664 | 0.1157 | 0.1010 | 0.1695 |
| 12/29/1997 | 1.1318 | 0.3893 | 0.7609 | 0.9229 | 3.5588 | 14.1937 | 3.0621 | 15.8992 | 179.8116 | 66.8278 | 102.5070 | 0.0989 | 0.2732 | 0.1648 | 0.3600 | 0.0664 | 0.1157 | 0.1010 | 0.1695 |
| 12/30/1997 | 0.9155 | 0.3017 | 0.5657 | 0.6554 | 2.4648 | 8.8099 | 2.1811 | 12.7560 | 182.0769 | 54.0852 | 98.5426 | 0.0479 | 0.1431 | 0.0607 | 0.1475 | 0.0664 | 0.0552 | 0.0442 | 0.0808 |
| 12/31/1997 | 0.8074 | 0.2624 | 0.4406 | 0.5060 | 2.1134 | 6.3952 | 1.8390 | 10.2431 | 167.0690 | 43.8911 | 82.1189 | 0.0330 | 0.1041 | 0.0434 | 0.1084 | 0.0664 | 0.0552 | 0.0442 | 0.0808 |
| 1/1/1998 | 1.4154 | 0.5476 | 0.7425 | 0.9054 | 5.5636 | 10.6696 | 2.6922 | 11.6185 | 167.3522 | 50.4040 | 89.1981 | 0.0614 | 0.1388 | 0.0651 | 0.1908 | 0.0664 | 0.1183 | 0.1013 | 0.1887 |
| 1/2/1998 | 0.9535 | 0.3288 | 0.6170 | 0.7225 | 2.7186 | 8.2858 | 2.1437 | 10.8677 | 231.3481 | 51.8198 | 93.7288 | 0.0854 | 0.2169 | 0.0954 | 0.2949 | 0.0664 | 0.1183 | 0.1013 | 0.1887 |
| 1/3/1998 | 1.0311 | 0.3385 | 0.6669 | 0.7907 | 2.4212 | 6.3755 | 1.8873 | 9.8782 | 250.0372 | 45.3070 | 82.1189 | 0.0420 | 0.1128 | 0.0477 | 0.1344 | 0.0664 | 0.1437 | 0.1028 | 0.1887 |
| 1/4/1998 | 2.0661 | 1.3172 | 1.0863 | 1.4529 | 7.6519 | 8.8138 | 2.5944 | 10.1307 | 221.7204 | 45.5901 | 82.9684 | 0.1169 | 0.2515 | 0.1171 | 0.3209 | 0.0735 | 0.1437 | 0.1028 | 0.1887 |
| 1/5/1998 | 1.2546 | 0.4838 | 0.8683 | 1.0831 | 4.6019 | 13.6440 | 3.2232 | 13.4974 | 218.3224 | 53.5188 | 98.5426 | 0.1004 | 0.2515 | 0.1388 | 0.3166 | 0.0735 | 0.1437 | 0.1028 | 0.1887 |
| 1/6/1998 | 1.6721 | 0.8717 | 0.9035 | 1.1464 | 11.0021 | 19.2404 | 4.4733 | 19.8715 | 365.2865 | 73.9070 | 142.7169 | 0.1139 | 0.3079 | 0.1431 | 0.4120 | 0.0735 | 0.2261 | 0.1501 | 0.1887 |
| 1/7/1998 | 1.3751 | 0.5410 | 0.9267 | 1.1786 | 5.5992 | 19.5990 | 3.9593 | 19.7010 | 523.8604 | 79.5703 | 170.1842 | 0.1094 | 0.2949 | 0.1518 | 0.3817 | 0.0735 | 0.2629 | 0.1198 | 0.1887 |
| 1/8/1998 | 0.9821 | 0.3636 | 0.6130 | 0.7171 | 3.1724 | 12.3847 | 2.6982 | 13.8240 | 526.6921 | 60.5981 | 122.0456 | 0.0584 | 0.1822 | 0.0824 | 0.1995 | 0.0735 | 0.1209 | 0.0750 | 0.1301 |
| 1/9/1998 | 0.8495 | 0.3077 | 0.4698 | 0.5392 | 2.4845 | 7.8287 | 2.1333 | 11.0291 | 390.7716 | 49.8376 | 94.8614 | 0.0449 | 0.1171 | 0.0564 | 0.1128 | 0.0735 | 0.0515 | 0.0560 | 0.0899 |
| 1/10/1998 | 0.7825 | 0.2799 | 0.4070 | 0.4687 | 2.1504 | 5.8181 | 1.7976 | 9.1832 | 297.3262 | 42.7584 | 79.2872 | 0.0285 | 0.0607 | 0.0304 | 0.0867 | 0.0735 | 0.0515 | 0.0560 | 0.0899 |
| 1/11/1998 | 0.7781 | 0.2724 | 0.3840 | 0.4438 | 2.0093 | 4.7329 | 1.6006 | 7.9720 | 236.7283 | 38.5109 | 68.8099 | 0.0150 | 0.0911 | 0.0217 | 0.0694 | 0.0874 | 0.0515 | 0.0560 | 0.0899 |
| 1/12/1998 | 0.8152 | 0.2767 | 0.4160 | 0.4803 | 1.9528 | 3.9892 | 1.4602 | 7.2964 | 201.6155 | 31.9980 | 62.0139 | 0.0195 | 0.0564 | 0.0347 | 0.0651 | 0.0874 | 0.0515 | 0.0560 | 0.0899 |
| 1/13/1998 | 1.6911 | 0.7248 | 0.8813 | 1.1113 | 4.8849 | 6.1705 | 1.9558 | 9.6367 | 196.5185 | 35.9624 | 68.5268 | 0.0554 | 0.3296 | 0.0651 | 0.2082 | 0.0874 | 0.0515 | 0.0560 | 0.0899 |
| 1/14/1998 | 4.8578 e | 3.6807 e | 1.5388 | 2.3410 | 114.1849 e | 31.9512 | 13.4658 | 69.7775 | 325.6430 | 157.4417 | 272.9744 | 0.2023 | 0.3296 | 0.2602 | 0.7590 | 0.0874 | 0.4100 | 0.1853 | 0.6151 |
| 1/15/1998 | 1.3856 | 0.5210 | 0.9994 | 1.3074 | 9.0804 | 23.1202 | 5.1435 | 31.0073 | 546.5138 | 158.0080 | 291.6635 | 0.1214 | 0.4294 | 0.1735 | 0.6202 | 0.0874 | 0.5572 | 0.1366 | 0.2287 |
| 1/16/1998 | 1.4891 | 0.6484 | 0.8417 | 1.0438 | 5.5708 | 19.4098 | 3.5935 | 19.3200 | 642.7909 | 108.7367 | 181.5110 | 0.0734 | 0.3123 | 0.0867 | 0.2689 | 0.0874 | 0.2786 | 0.1345 | 0.2129 |
| 1/17/1998 | 1.8229 | 0.7436 | 1.0502 | 1.3894 | 16.0159 | 21.0635 | 4.3258 | 25.1390 | 645.6226 | 129.1248 | 236.1625 | 0.1363 | 0.1214 | 0.1344 | 0.4988 | 0.0874 | 0.2011 | 0.1318 | 0.2901 |
| 1/18/1998 | 1.5087 | 0.5066 | 0.8815 | 1.1020 | 5.8397 | 19.3440 | 3.6436 | 20.2735 | 594.6524 | 114.9664 | 210.3942 | 0.0749 | 0.1258 | 0.1301 | 0.2819 | 0.0874 | 0.2011 | 0.1318 | 0.2901 |
| 1/19/1998 | 1.9593 | 0.7546 | 1.0108 | 1.3163 | 6.5663 | 18.1675 | 3.5527 | 17.0066 | 552.1772 | 99.9585 | 178.3961 | 0.0734 | 0.2082 | 0.0867 | 0.2949 | 0.0874 | 0.2011 | 0.1318 | 0.2901 |
| 1/20/1998 | 3.0194 | 1.6498 | 1.4607 | 2.1759 | 12.0957 | 20.0140 | 4.5636 | 22.1447 | 461.5635 | 111.0020 | 174.7149 | 0.1184 | 0.3036 | 0.1518 | 0.4641 | 0.0874 | 0.2011 | 0.1318 | 0.2901 |
| 1/21/1998 | 2.2450 | 0.9824 | 1.2089 | 1.6797 | 10.4007 | 19.5511 | 4.3867 | 21.0327 | 376.6132 | 105.0555 | 160.8397 | 0.0794 | 0.2082 | 0.1084 | 0.2429 | 0.1263 | 0.2024 | 0.1540 | 0.2901 |
| 1/22/1998 | 1.9058 | 0.8150 | 1.0940 | 1.4623 | 7.3513 | 19.4799 | 4.3745 | 20.3365 | 331.3063 | 104.4892 | 161.9724 | 0.0704 | 0.2385 | 0.1128 | 0.1995 | 0.1263 | 0.2024 | 0.1540 | 0.2901 |
| 1/23/1998 | 5.7114 e | 4.4964 e | 1.7493 | 2.8214 | 88.8113 e | 38.6164 | 20.7237 | 82.9287 | 328.4746 | 181.2278 | 305.8219 | 0.2262 | 0.4771 | 0.2385 | 0.5378 | 0.1263 | 0.4416 | 0.1540 | 0.2901 |
| 1/24/1998 | 2.7712 | 1.3617 | 1.5134 | 2.2834 | 52.6619 e | 31.9815 | 14.0900 | 68.4213 | 387.9399 | 236.4457 | 433.2477 | 0.1873 | 0.4597 | 0.3513 | 0.7633 | 0.1263 | 0.6992 | 0.2456 | 0.5441 |
| 1/25/1998 | 1.8697 | 0.7259 | 1.1441 | 1.5482 | 16.7424 | 25.9848 | 9.5893 | 43.5590 | 492.7120 | 264.1962 | 353.9606 | 0.1783 | 0.4814 | 0.2559 | 1.0235 | 0.0764 | 0.4048 | 0.1612 | 0.3154 |
| 1/26/1998 | 1.6618 | 0.6091 | 0.9807 | 1.2661 | 11.8115 | 23.6503 | 6.8835 | 30.6455 | 529.5238 | 187.7407 | 270.4259 | 0.1288 | 0.3686 | 0.1778 | 0.4857 | 0.0764 | 0.3154 | 0.1340 | 0.2957 |
| 1/27/1998 | 1.2838 | 0.4717 | 0.7275 | 0.8720 | 5.8533 | 20.6331 | 4.5155 | 20.0065 | 504.0387 | 118.3644 | 191.9882 | 0.0779 | 0.2342 | 0.0954 | 0.2038 | 0.0764 | 0.1787 | 0.0739 | 0.1538 |
| 1/28/1998 | 1.2010 | 0.4215 | 0.6025 | 0.7017 | 4.4887 | 18.6143 | 3.5149 | 15.3101 | 416.2567 | 93.7288 | 146.6813 | 0.0434 | 0.1388 | 0.0477 | 0.1561 | 0.0764 | 0.1104 | 0.0717 | 0.1222 |
| 1/29/1998 | 1.4073 | 0.4905 | 0.6061 | 0.7072 | 4.8467 | 14.2208 | 2.9493 | 12.6994 | 328.4746 | 83.5347 | 123.7446 | 0.0449 | 0.1214 | 0.0607 | 0.1344 | 0.0764 | 0.0789 | 0.0644 | 0.1222 |
| 1/30/1998 | 1.3372 | 0.4481 | 0.5870 | 0.6823 | 4.4468 | 11.4062 | 2.4680 | 12.2715 | 275.2391 | 84.3842 | 127.4258 | 0.0539 | 0.1301 | 0.0434 | 0.1822 | 0.0764 | 0.1051 | 0.0644 | 0.1222 |
| 1/31/1998 | 1.1312 | 0.3746 | 0.4836 | 0.5552 | 3.2825 | 7.7709 | 2.0306 | 10.2794 | 243.8075 | 75.3228 | 110.1525 | 0.0390 | 0.0954 | 0.0347 | 0.1258 | 0.0764 | 0.0526 | 0.0459 | 0.0769 |
| 2/1/1998 | 1.2095 | 0.3920 | 0.4692 | 0.5401 | 3.0526 | 6.4360 | 1.8608 | 9.2221 | 213.5085 | 69.6594 | 94.0119 | 0.0300 | 0.0737 | 0.0260 | 0.0867 | 0.0371 | 0.0578 | 0.0459 | 0.0769 |
| 2/2/1998 | 1.2986 | 0.4235 | 0.6338 | 0.7431 | 3.1232 | 6.5711 | 1.8669 | 9.0860 | 191.1383 | 67.9604 | 86.9327 | 0.0434 | 0.1041 | 0.0434 | 0.1344 | 0.0371 | 0.0578 | 0.0649 | 0.3746 |
| 2/3/1998 | 1.0891 | 0.3562 | 0.5176 | 0.5957 | 2.6000 | 5.1289 | 1.5959 | 8.0412 | 174.7145 | 64.2792 | 79.2872 | 0.0300 | 0.0781 | 0.0347 | 0.0911 | 0.0371 | 0.0473 | 0.0448 | 0.0552 |
| 2/4/1998 | 1.0400 | 0.3375 | 0.4481 | 0.5142 | 2.4027 | 4.2914 | 1.4569 | 7.2857 | 162.2551 | 61.1644 | 71.6416 | 0.0255 | 0.0651 | 0.0217 | 0.0911 | 0.0371 | 0.0421 | 0.0647 | 0.0789 |

| date PST | 31andr | q30log | q32log | q32gate | 23john | 06efhoq | q05log | q10log | 38port | 13wyno | satsop | 517qeen | 516emer | 509adam | 506-28th | 508Kst | 511farr | arthr_pmp | 501abdiv |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2/5/1998 | 1.1295 | 0.3560 | 0.4625 | 0.5306 | 2.7167 | 4.3427 | 1.4478 | 7.2877 | 150.9284 | 60.5981 | 69.9426 | 0.0180 | 0.0781 | 0.0347 | 0.1388 | 0.0371 | 0.0657 | 0.0647 | 0.0867 |
| 2/6/1998 | 1.2170 | 0.3908 | 0.5440 | 0.6291 | 2.7511 | 3.8553 | 1.3615 | 6.9060 | 142.1502 | 57.7664 | 66.8278 | 0.0479 | 0.0954 | 0.0390 | 0.1258 | 0.0371 | 0.0657 | 0.0647 | 0.0867 |
| 2/7/1998 | 1.0444 | 0.3372 | 0.4852 | 0.5572 | 2.3339 | 3.3708 | 1.2324 | 6.3920 | 135.0710 | 46.1565 | 61.7307 | 0.0390 | 0.0954 | 0.0390 | 0.1388 | 0.0371 | 0.0736 | 0.0647 | 0.1065 |
| 2/8/1998 | 1.0964 | 0.3788 | 0.4437 | 0.5093 | 2.6106 | 3.3909 | 1.2222 | 6.7213 | 129.9740 | 42.1921 | 62.2971 | 0.0270 | 0.0737 | 0.0260 | 0.0911 | 0.0798 | 0.0631 | 0.0641 | 0.0927 |
| 2/9/1998 | 0.9758 | 0.3404 | 0.4032 | 0.4647 | 2.2652 | 3.3595 | 1.1507 | 7.3777 | 147.2473 | 45.8733 | 79.0040 | 0.0434 | 0.1171 | 0.0477 | 0.1865 | 0.0798 | 0.0631 | 0.0641 | 0.0927 |
| 2/10/1998 | 1.0628 | 0.3746 | 0.4299 | 0.4950 | 2.5898 | 3.3411 | 1.2346 | 7.2301 | 155.7423 | 43.6079 | 72.4911 | 0.0464 | 0.0867 | 0.0260 | 0.1041 | 0.0798 | 0.0526 | 0.0627 | 0.0907 |
| 2/11/1998 | 1.2693 | 0.4312 | 0.6597 | 0.7777 | 2.9914 | 4.8790 | 1.5924 | 9.3063 | 152.6274 | 55.7842 | 84.9505 | 0.0434 | 0.1258 | 0.0737 | 0.1995 | 0.0798 | 0.0946 | 0.0526 | 0.1143 |
| 2/12/1998 | 2.0803 | 0.7729 | 0.9951 | 1.2921 | 13.8437 | 15.5439 | 3.7413 | 22.9115 | 159.1403 | 84.9505 | 150.3625 | 0.1229 | 0.1952 | 0.1778 | 0.3817 | 0.0798 | 0.2865 | 0.1533 | 0.2602 |
| 2/13/1998 | 1.7798 | 0.7127 | 0.9983 | 1.2969 | 17.4953 e | 21.5357 | 3.8965 | 32.9605 | 241.2590 | 141.3011 | 257.6833 | 0.1423 | 0.4337 | 0.1952 | 0.5725 | 0.0798 | 0.2865 | 0.1533 | 0.2602 |
| 2/14/1998 | 1.2730 | 0.4579 | 0.7715 | 0.9344 | 4.1818 | 18.6147 | 2.6839 | 19.1779 | 311.4846 | 107.8872 | 175.5644 | 0.0734 | 0.2342 | 0.1084 | 0.2732 | 0.0798 | 0.1472 | 0.0795 | 0.1143 |
| 2/15/1998 | 1.2086 | 0.4347 | 0.7159 | 0.8546 | 3.1699 | 14.5157 | 2.3135 | 14.6720 | 277.2213 | 88.0654 | 130.5407 | 0.0599 | 0.1648 | 0.0737 | 0.2038 | 0.0616 | 0.0666 | 0.0556 | 0.1143 |
| 2/16/1998 | 1.0456 | 0.3746 | 0.5804 | 0.6739 | 2.5706 | 9.7995 | 1.9331 | 11.9240 | 233.6134 | 77.8713 | 106.1882 | 0.0405 | 0.1214 | 0.0520 | 0.1431 | 0.0616 | 0.0666 | 0.0556 | 0.1143 |
| 2/17/1998 | 0.9584 | 0.3406 | 0.4767 | 0.5470 | 2.2747 | 7.1056 | 1.6511 | 10.2243 | 200.4828 | 70.7921 | 90.3307 | 0.0315 | 0.0911 | 0.0347 | 0.1041 | 0.0616 | 0.0666 | 0.0556 | 0.1143 |
| 2/18/1998 | 1.7579 | 0.5976 | 0.9067 | 1.1886 | 4.2516 | 8.9460 | 2.0509 | 10.6591 | 177.8294 | 71.6416 | 88.3486 | 0.0360 | 0.1084 | 0.0520 | 0.1475 | 0.0616 | 0.0683 | 0.0885 | 0.1025 |
| 2/19/1998 | 1.4878 | 0.5243 | 1.0109 | 1.3241 | 4.3926 | 10.9696 | 2.2113 | 12.2145 | 176.6967 | 79.2872 | 119.2139 | 0.0764 | 0.1952 | 0.0911 | 0.3296 | 0.0616 | 0.1209 | 0.1009 | 0.1893 |
| 2/20/1998 | 1.7376 | 0.7566 | 0.9773 | 1.3031 | 5.7059 | 9.4942 | 2.2980 | 11.0435 | 176.9799 | 75.0396 | 99.6753 | 0.0449 | 0.1301 | 0.0607 | 0.1735 | 0.0616 | 0.4836 | 0.0739 | 0.1183 |
| 2/21/1998 | 1.9780 | 0.7572 | 1.3607 | 1.9814 | 10.5235 | 21.3688 | 5.1568 | 21.5937 | 191.9878 | 97.1268 | 132.2397 | 0.1348 | 0.3383 | 0.2169 | 0.5682 | 0.0616 | 0.2339 | 0.1240 | 0.2221 |
| 2/22/1998 | 1.2159 | 0.4676 | 0.8774 | 1.0967 | 4.3061 | 19.8529 | 3.4338 | 19.3536 | 265.3282 | 104.2060 | 163.1050 | 0.0794 | 0.2385 | 0.1084 | 0.3383 | 0.0616 | 0.2339 | 0.1240 | 0.2221 |
| 2/23/1998 | 1.0575 | 0.3997 | 0.6482 | 0.7629 | 3.0690 | 14.9735 | 2.4773 | 14.8160 | 319.9796 | 82.4020 | 136.7704 | 0.0539 | 0.1648 | 0.0781 | 0.2125 | 0.0703 | 0.1209 | 0.1240 | 0.2221 |
| 2/24/1998 | 0.9745 | 0.3673 | 0.5182 | 0.5962 | 2.5220 | 9.4523 | 2.0029 | 11.8802 | 283.1678 | 62.5802 | 107.6040 | 0.0375 | 0.1041 | 0.0434 | 0.1258 | 0.0271 | 0.0631 | 0.0459 | 0.0946 |
| 2/25/1998 | 1.1532 | 0.4368 | 0.5416 | 0.6246 | 2.9755 | 9.0955 | 1.9687 | 10.8609 | 232.4808 | 48.9881 | 92.8793 | 0.0240 | 0.0954 | 0.0434 | 0.1084 | 0.0366 | 0.0526 | 0.0504 | 0.0710 |
| 2/26/1998 | 1.0043 | 0.3754 | 0.4840 | 0.5556 | 2.4474 | 6.6232 | 1.6770 | 9.2166 | 204.7303 | 42.7584 | 80.1367 | 0.0390 | 0.0867 | 0.0304 | 0.1171 | 0.0214 | 0.0368 | 0.0314 | 0.0710 |
| 2/27/1998 | 0.9237 | 0.3450 | 0.4232 | 0.4864 | 2.1067 | 5.0823 | 1.5014 | 8.3173 | 180.6611 | 37.9446 | 70.2258 | 0.0195 | 0.0607 | 0.0217 | 0.0824 | 0.0196 | 0.0368 | 0.0392 | 0.0710 |
| 2/28/1998 | 1.0999 | 0.4289 | 0.4621 | 0.5305 | 2.5520 | 6.0503 | 1.8164 | 8.6788 | 164.2373 | 37.0951 | 67.9604 | 0.0345 | 0.0867 | 0.0304 | 0.1084 | 0.0296 | 0.0736 | 0.0523 | 0.0946 |
| 3/1/1998 | 1.4393 | 0.5822 | 0.6847 | 0.8133 | 4.8849 | 16.4466 | 3.1392 | 14.3879 | 177.2630 | 53.8020 | 104.4892 | 0.1004 | 0.1822 | 0.0998 | 0.3036 | 0.0814 | 0.0736 | 0.0523 | 0.0946 |
| 3/2/1998 | 1.0927 | 0.4306 | 0.5546 | 0.6406 | 3.0352 | 10.9404 | 2.2104 | 12.5897 | 255.7005 | 51.2535 | 103.6397 | 0.0464 | 0.1344 | 0.0651 | 0.1735 | 0.0467 | 0.0736 | 0.0523 | 0.0946 |
| 3/3/1998 | 1.2616 | 0.4968 | 0.6653 | 0.7859 | 2.9511 | 8.7626 | 1.9182 | 10.6840 | 314.3163 | 45.0238 | 86.9327 | 0.0345 | 0.1301 | 0.0520 | 0.1735 | 0.0423 | 0.0999 | 0.0459 | 0.0946 |
| 3/4/1998 | 0.9937 | 0.4092 | 0.5001 | 0.5751 | 2.3595 | 6.3893 | 1.6700 | 8.7280 | 297.3262 | 39.9268 | 75.8891 | 0.0315 | 0.0911 | 0.0390 | 0.1171 | 0.0315 | 0.0473 | 0.0431 | 0.0828 |
| 3/5/1998 | 0.8987 | 0.3812 | 0.4039 | 0.4653 | 2.1075 | 5.0814 | 1.5363 | 7.6462 | 258.5322 | 35.9624 | 66.5446 | 0.0285 | 0.1041 | 0.0520 | 0.1518 | 0.0435 | 0.0473 | 0.0431 | 0.0828 |
| 3/6/1998 | 0.8532 | 0.3658 | 0.3381 | 0.3966 | 1.9054 | 4.1193 | 1.3607 | 7.1848 | 219.7382 | 32.8475 | 60.0317 | 0.0180 | 0.0694 | 0.0260 | 0.0911 | 0.0202 | 0.0697 | 0.0381 | 0.1065 |
| 3/7/1998 | 0.8534 | 0.3496 | 0.3054 | 0.3645 | 1.7964 | 3.5259 | 1.2663 | 6.5432 | 188.8729 | 30.2990 | 54.9347 | 0.0165 | 0.0651 | 0.0260 | 0.0824 | 0.0151 | 0.0697 | 0.0654 | 0.1065 |
| 3/8/1998 | 1.0309 | 0.4110 | 0.5491 | 0.6438 | 2.3420 | 4.2500 | 1.5119 | 7.0618 | 170.7502 | 31.9980 | 56.3505 | 0.0240 | 0.0651 | 0.0304 | 0.1128 | 0.0227 | 0.0697 | 0.0654 | 0.1065 |
| 3/9/1998 | 2.3383 | 1.4063 | 0.9693 | 1.2704 | 17.7449 e | 13.5074 | 3.4986 | 13.9015 | 176.9799 | 50.1208 | 85.5169 | 0.0674 | 0.1475 | 0.0824 | 0.2299 | 0.0568 | 0.0697 | 0.0654 | 0.1065 |
| 3/10/1998 | 1.5537 | 0.5879 | 0.9042 | 1.1379 | 5.1991 | 14.3798 | 3.2477 | 14.0152 | 257.9659 | 63.9961 | 118.6476 | 0.1333 | 0.2906 | 0.1735 | 0.4164 | 0.1142 | 0.2261 | 0.0806 | 0.1538 |
| 3/11/1998 | 1.5737 | 0.5731 | 0.7812 | 0.9520 | 4.1849 | 15.2723 | 3.5709 | 12.8231 | 297.3262 | 57.7664 | 108.4535 | 0.0569 | 0.1778 | 0.0781 | 0.2515 | 0.0637 | 0.1787 | 0.0717 | 0.1538 |
| 3/12/1998 | 1.1601 | 0.3800 | 0.6005 | 0.6989 | 3.0148 | 10.0291 | 2.5624 | 11.1716 | 258.8154 | 51.5367 | 97.9763 | 0.0434 | 0.1258 | 0.0520 | 0.1388 | 0.0347 | 0.0841 | 0.0437 | 0.0867 |
| 3/13/1998 | 1.0530 | 0.3375 | 0.5244 | 0.6044 | 2.6244 | 7.9107 | 2.0803 | 10.1315 | 226.8174 | 47.2891 | 87.7822 | 0.0345 | 0.1084 | 0.0564 | 0.1518 | 0.0372 | 0.0736 | 0.0504 | 0.1025 |
| 3/14/1998 | 0.9246 | 0.2877 | 0.4353 | 0.4999 | 2.1523 | 5.6578 | 1.7279 | 8.5282 | 199.6333 | 40.7763 | 74.4733 | 0.0330 | 0.0824 | 0.0304 | 0.0998 | 0.0246 | 0.0386 | 0.0340 | 0.0578 |
| 3/15/1998 | 0.9480 | 0.2757 | 0.4090 | 0.4708 | 2.0852 | 4.8125 | 1.5887 | 7.6057 | 175.2809 | 36.8119 | 65.4119 | 0.0240 | 0.0694 | 0.0260 | 0.0911 | 0.0208 | 0.0386 | 0.0340 | 0.0578 |
| 3/16/1998 | 0.8900 | 0.2628 | 0.3761 | 0.4356 | 1.8822 | 3.9973 | 1.4008 | 6.8793 | 158.2908 | 35.9624 | 58.6159 | 0.0195 | 0.0520 | 0.0260 | 0.0781 | 0.0189 | 0.0386 | 0.0340 | 0.0578 |
| 3/17/1998 | 0.8435 | 0.2516 | 0.3037 | 0.3624 | 1.7271 | 3.3429 | 1.2661 | 6.1661 | 143.8492 | 33.4139 | 52.9525 | 0.0180 | 0.0520 | 0.0260 | 0.0651 | 0.0126 | 0.0237 | 0.0526 | 0.0473 |
| 3/18/1998 | 0.8115 | 0.2415 | 0.3068 | 0.3654 | 1.6494 | 2.8791 | 1.1651 | 5.6121 | 131.3899 | 31.1485 | 48.7050 | 0.0120 | 0.0434 | 0.0130 | 0.0607 | 0.0114 | 0.0237 | 0.0172 | 0.0473 |
| 3/19/1998 | 0.7911 | 0.2323 | 0.2803 | 0.3399 | 1.5856 | 2.5509 | 1.1056 | 5.2257 | 121.1958 | 28.0620 | 45.0238 | 0.0090 | 0.0347 | 0.0173 | 0.0564 | 0.0114 | 0.0158 | 0.0172 | 0.0473 |
| 3/20/1998 | 0.7791 | 0.2247 | 0.2268 | 0.2910 | 1.5263 | 2.2777 | 1.0426 | 4.8350 | 112.4176 | 23.1632 | 42.1921 | 0.0120 | 0.0390 | 0.0130 | 0.0520 | 0.0082 | 0.0000 | 0.0172 | 0.0473 |
| 3/21/1998 | 0.9668 | 0.2807 | 0.3383 | 0.4010 | 1.8129 | 2.4064 | 1.0890 | 4.7281 | 106.4711 | 20.7846 | 41.0594 | 0.0120 | 0.0304 | 0.0217 | 0.0520 | 0.0082 | 0.0263 | 0.0325 | 0.1222 |
| 3/22/1998 | 1.5747 | 0.3960 | 0.9034 | 1.1502 | 3.6798 | 6.6285 | 2.0727 | 6.8249 | 111.0018 | 37.0951 | 52.9525 | 0.0779 | 0.1735 | 0.1084 | 0.2169 | 0.0662 | 0.1314 | 0.0933 | 0.1222 |
| 3/23/1998 | 1.5808 | 0.4079 | 0.7982 | 0.9789 | 6.7060 | 5.1854 | 1.6539 | 6.9309 | 143.8492 | 59.7485 | 65.4119 | 0.0584 | 0.1735 | 0.0694 | 0.2125 | 0.0637 | 0.1314 | 0.0933 | 0.1222 |

| date PST | 31andr | q30log | q32log | q32gate | 23john | 06efhoq | q05log | q10log | 38port | 13wyno | satsop | 517qeen | 516emer | 509adam | 506-28th | 508Kst | 511farr | arthr_pmp | 501abdiv |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3/24/1998 | 1.4243 | 0.4051 | 0.9444 | 1.2050 | 4.0225 | 8.2795 | 1.9708 | 11.6652 | 233.8966 | 80.7030 | 87.4991 | 0.1034 | 0.2949 | 0.1388 | 0.3296 | 0.0915 | 0.1787 | 0.0655 | 0.1222 |
| 3/25/1998 | 1.0199 | 0.2840 | 0.6473 | 0.7632 | 2.5494 | 6.4090 | 1.5054 | 11.7548 | 258.5322 | 60.5981 | 91.1802 | 0.0599 | 0.1214 | 0.0781 | 0.2082 | 0.0561 | 0.1787 | 0.0655 | 0.0946 |
| 3/26/1998 | 1.0783 | 0.3133 | 0.5626 | 0.6508 | 2.6623 | 5.7894 | 1.4835 | 10.2162 | 231.3481 | 45.8733 | 76.7387 | 0.0375 | 0.1128 | 0.0520 | 0.1605 | 0.0435 | 0.0894 | 0.0401 | 0.0946 |
| 3/27/1998 | 0.9577 | 0.3025 | 0.4794 | 0.5503 | 2.4288 | 5.3054 | 1.3752 | 8.7005 | 218.6055 | 38.2277 | 66.2614 | 0.0494 | 0.1128 | 0.0477 | 0.1431 | 0.0391 | 0.0789 | 0.0401 | 0.0946 |
| 3/28/1998 | 0.8635 | 0.2738 | 0.4091 | 0.4713 | 2.1167 | 4.3877 | 1.2427 | 7.5025 | 201.8986 | 31.7149 | 58.6159 | 0.0434 | 0.1084 | 0.0434 | 0.1518 | 0.0391 | 0.0789 | 0.0401 | 0.0710 |
| 3/29/1998 | 0.7945 | 0.2482 | 0.3374 | 0.3962 | 1.8154 | 3.5310 | 1.1182 | 6.6528 | 179.5284 | 27.9204 | 52.3862 | 0.0285 | 0.0737 | 0.0304 | 0.0911 | 0.0240 | 0.0342 | 0.0179 | 0.0513 |
| 3/30/1998 | 0.8636 | 0.2679 | 0.4260 | 0.4952 | 1.7507 | 3.2585 | 1.1194 | 6.4304 | 159.4235 | 25.9382 | 48.7050 | 0.0135 | 0.0564 | 0.0217 | 0.0694 | 0.0202 | 0.0342 | 0.0198 | 0.0513 |
| 3/31/1998 | 0.8956 | 0.2763 | 0.5322 | 0.6165 | 1.7345 | 3.3409 | 1.1065 | 6.8910 | 149.5126 | 26.8161 | 49.8376 | 0.0390 | 0.0781 | 0.0347 | 0.1171 | 0.0271 | 0.0342 | 0.0198 | 0.0513 |
| 4/1/1998 | 0.7635 | 0.2411 | 0.3185 | 0.3772 | 1.5693 | 2.6798 | 0.9794 | 5.7002 | 141.8671 | 24.2109 | 45.8733 | 0.0165 | 0.0520 | 0.0260 | 0.0520 | 0.0177 | 0.0342 | 0.0198 | 0.0513 |
| 4/2/1998 | 0.7324 | 0.2330 | 0.2874 | 0.3469 | 1.4932 | 2.3594 | 0.9232 | 5.2302 | 128.2750 | 22.0871 | 42.4753 | 0.0120 | 0.0520 | 0.0130 | 0.0651 | 0.0132 | 0.0184 | 0.0235 | 0.0434 |
| 4/3/1998 | 0.7242 | 0.2299 | 0.2619 | 0.3233 | 1.4666 | 2.1328 | 0.8827 | 4.8854 | 118.9305 | 20.5863 | 39.9268 | 0.0120 | 0.0304 | 0.0217 | 0.0607 | 0.0107 | 0.0184 | 0.0235 | 0.0434 |
| 4/4/1998 | 0.7288 | 0.2329 | 0.2900 | 0.3492 | 1.4419 | 1.9947 | 0.8503 | 4.7481 | 112.4176 | 19.7368 | 37.9446 | 0.0120 | 0.0390 | 0.0217 | 0.0477 | 0.0088 | 0.0140 | 0.0228 | 0.0394 |
| 4/5/1998 | 0.7144 | 0.2347 | 0.2352 | 0.2986 | 1.4063 | 1.8258 | 0.8071 | 4.3736 | 107.3206 | 18.8307 | 36.2456 | 0.0075 | 0.0304 | 0.0130 | 0.0434 | 0.0095 | 0.0140 | 0.0228 | 0.0394 |
| 4/6/1998 | 0.6961 | 0.2339 | 0.2204 | 0.2856 | 1.3577 | 1.7101 | 0.7874 | 4.1100 | 101.9404 | 17.8679 | 34.5466 | 0.0060 | 0.0304 | 0.0173 | 0.0477 | 0.0082 | 0.0140 | 0.0228 | 0.0394 |
| 4/7/1998 | 0.7716 | 0.2764 | 0.2781 | 0.3382 | 1.6208 | 1.7302 | 0.8061 | 4.2158 | 97.1266 | 17.6980 | 33.6970 | 0.0120 | 0.0347 | 0.0130 | 0.0607 | 0.0076 | 0.0158 | 0.0252 | 0.0394 |
| 4/8/1998 | 0.6940 | 0.2560 | 0.2301 | 0.2943 | 1.5466 | 1.5390 | 0.7597 | 3.8779 | 93.7285 | 16.5654 | 31.9980 | 0.0075 | 0.0304 | 0.0173 | 0.0434 | 0.0069 | 0.0158 | 0.0252 | 0.0394 |
| 4/9/1998 | 0.6964 | 0.2496 | 0.2312 | 0.2948 | 1.5350 | 1.4269 | 0.7286 | 3.6159 | 89.4810 | 16.1406 | 30.2990 | 0.0060 | 0.0260 | 0.0087 | 0.0390 | 0.0076 | 0.0105 | 0.0224 | 0.0394 |
| 4/10/1998 | 0.7893 | 0.2778 | 0.2960 | 0.3549 | 1.4217 | 1.4681 | 0.7768 | 3.7785 | 87.2157 | 15.8574 | 30.2990 | 0.0090 | 0.0304 | 0.0173 | 0.0520 | 0.0120 | 0.0105 | 0.0224 | 0.0394 |
| 4/11/1998 | 1.0932 | 0.4202 | 0.4236 | 0.4883 | 2.0777 | 2.1358 | 0.9861 | 5.0378 | 90.8969 | 18.2927 | 34.5466 | 0.0270 | 0.0694 | 0.0304 | 0.1258 | 0.0322 | 0.0368 | 0.0375 | 0.0611 |
| 4/12/1998 | 0.7475 | 0.2819 | 0.3118 | 0.3705 | 1.5031 | 1.8826 | 0.8804 | 4.8620 | 92.0295 | 18.6325 | 34.5466 | 0.0285 | 0.0867 | 0.0434 | 0.0998 | 0.0322 | 0.0368 | 0.0375 | 0.0611 |
| 4/13/1998 | 0.7057 | 0.2630 | 0.2940 | 0.3536 | 1.4251 | 1.9995 | 0.8451 | 4.8104 | 92.8790 | 18.1511 | 33.9802 | 0.0210 | 0.0651 | 0.0217 | 0.0867 | 0.0246 | 0.0315 | 0.0336 | 0.0591 |
| 4/14/1998 | 0.6626 | 0.2515 | 0.2149 | 0.2812 | 1.3784 | 1.8857 | 0.7933 | 4.4265 | 91.7464 | 17.3582 | 33.1307 | 0.0150 | 0.0477 | 0.0217 | 0.0737 | 0.0196 | 0.0158 | 0.0221 | 0.0355 |
| 4/15/1998 | 0.6335 | 0.2444 | 0.1902 | 0.2599 | 1.3053 | 1.6828 | 0.7253 | 4.0772 | 88.3484 | 16.4804 | 31.9980 | 0.0105 | 0.0390 | 0.0130 | 0.0564 | 0.0139 | 0.0158 | 0.0221 | 0.0355 |
| 4/16/1998 | 0.6152 | 0.2404 | 0.1906 | 0.2598 | 1.2488 | 1.5299 | 0.6942 | 3.9109 | 83.8177 | 16.0557 | 30.5822 | 0.0105 | 0.0347 | 0.0130 | 0.0477 | 0.0107 | 0.0158 | 0.0221 | 0.0355 |
| 4/17/1998 | 0.6105 | 0.2397 | 0.1460 | 0.2236 | 1.2265 | 1.4234 | 0.6739 | 3.6382 | 79.8533 | 15.0079 | 29.4495 | 0.0075 | 0.0434 | 0.0173 | 0.0477 | 0.0088 | 0.0158 | 0.0221 | 0.0355 |
| 4/18/1998 | 0.6668 | 0.2575 | 0.2236 | 0.2885 | 1.3055 | 1.3982 | 0.6871 | 3.5543 | 76.7385 | 14.6681 | 28.8832 | 0.0090 | 0.0130 | 0.0043 | 0.0477 | 0.0069 | 0.0158 | 0.0202 | 0.0355 |
| 4/19/1998 | 0.6173 | 0.2478 | 0.1686 | 0.2416 | 1.2446 | 1.3457 | 0.6566 | 3.3522 | 74.4731 | 14.3566 | 28.2885 | 0.0120 | 0.0477 | 0.0260 | 0.0867 | 0.0183 | 0.0158 | 0.0202 | 0.0355 |
| 4/20/1998 | 0.5992 | 0.2401 | 0.1531 | 0.2290 | 1.1859 | 1.2509 | 0.6328 | 3.1434 | 71.9246 | 13.5921 | 26.8727 | 0.0060 | 0.0260 | 0.0130 | 0.0390 | 0.0088 | 0.0158 | 0.0202 | 0.0355 |
| 4/21/1998 | 0.6045 | 0.2470 | 0.1968 | 0.2649 | 1.1688 | 1.2082 | 0.6223 | 3.0131 | 68.5266 | 13.0824 | 25.9665 | 0.0090 | 0.0260 | 0.0087 | 0.0520 | 0.0044 | 0.0070 | 0.0162 | 0.0244 |
| 4/22/1998 | 0.5950 | 0.2545 | 0.1804 | 0.2511 | 1.1617 | 1.1507 | 0.6152 | 2.8681 | 66.2613 | 12.6010 | 25.0887 | 0.0045 | 0.0173 | 0.0130 | 0.0390 | 0.0063 | 0.0070 | 0.0162 | 0.0244 |
| 4/23/1998 | 0.5827 | 0.2661 | 0.1718 | 0.2440 | 1.1602 | 1.0970 | 0.5987 | 2.7868 | 65.1286 | 12.2329 | 24.4374 | 0.0060 | 0.0260 | 0.0043 | 0.0477 | 0.0208 | 0.0070 | 0.0162 | 0.0244 |
| 4/24/1998 | 0.5679 | 0.2697 | 0.1650 | 0.2385 | 1.2005 | 1.0688 | 0.5967 | 2.6463 | 67.3939 | 11.8648 | 23.8711 | 0.0075 | 0.0304 | 0.0173 | 0.0390 | 0.0000 | 0.0105 | 0.0162 | 0.0244 |
| 4/25/1998 | 0.5445 | 0.2647 | 0.1376 | 0.2167 | 1.1506 | 1.0290 | 0.5797 | 2.3748 | 68.8098 | 11.4117 | 23.1632 | 0.0060 | 0.0217 | 0.0130 | 0.0477 | 0.0315 | 0.0042 | 0.0181 | 0.0244 |
| 4/26/1998 | 0.5355 | 0.2580 | 0.1226 | 0.2052 | 1.1192 | 0.9839 | 0.5639 | 2.3998 | 64.5623 | 11.1285 | 22.5119 | 0.0090 | 0.0347 | 0.0087 | 0.0564 | 0.0114 | 0.0042 | 0.0181 | 0.0244 |
| 4/27/1998 | 0.5302 | 0.2369 | 0.1097 | 0.1955 | 1.1341 | 0.9509 | 0.5559 | 2.5277 | 61.1642 | 10.7604 | 21.9739 | 0.0000 | 0.0217 | 0.0087 | 0.0390 | 0.0101 | 0.0042 | 0.0181 | 0.0244 |
| 4/28/1998 | 0.5221 | 0.2233 | 0.0925 | 0.1828 | 1.0991 | 0.9314 | 0.5455 | 2.2285 | 58.3326 | 10.5056 | 21.4925 | 0.0105 | 0.0217 | 0.0130 | 0.0434 | 0.0095 | 0.0042 | 0.0181 | 0.0244 |
| 4/29/1998 | 0.5203 | 0.2155 | 0.1010 | 0.1890 | 1.1209 | 0.8977 | 0.5410 | 2.2049 | 56.0672 | 10.2224 | 20.9828 | 0.0045 | 0.0173 | 0.0043 | 0.0304 | 0.0069 | 0.0042 | 0.0181 | 0.0244 |
| 4/30/1998 | 0.5096 | 0.2080 | 0.1132 | 0.1981 | 1.0385 | 0.8770 | 0.5329 | 2.1248 | 53.8019 | 9.9392 | 20.0483 | 0.0060 | 0.0217 | 0.0087 | 0.0390 | 0.0038 | 0.0000 | 0.0129 | 0.0244 |
| 5/1/1998 | 0.5060 | 0.2128 | 0.1142 | 0.1989 | 1.0294 | 0.8613 | 0.5206 | 2.0505 | 51.8197 | 9.6844 | 19.5103 | 0.0030 | 0.0173 | 0.0087 | 0.0390 | 0.0095 | 0.0000 | 0.0129 | 0.0260 |
| 5/2/1998 | 0.5870 | 0.2519 | 0.1919 | 0.2610 | 1.1569 | 0.9142 | 0.5622 | 2.1536 | 51.5365 | 10.1091 | 19.6802 | 0.0150 | 0.0520 | 0.0217 | 0.0911 | 0.0246 | 0.0032 | 0.0240 | 0.0260 |
| 5/3/1998 | 0.5075 | 0.2200 | 0.1478 | 0.2248 | 1.0467 | 0.8588 | 0.5198 | 2.0268 | 52.9524 | 9.6844 | 19.2555 | 0.0060 | 0.0260 | 0.0130 | 0.0434 | 0.0069 | 0.0032 | 0.0240 | 0.0260 |
| 5/4/1998 | 0.4956 | 0.2180 | 0.1327 | 0.2129 | 1.0302 | 0.8247 | 0.5089 | 1.9638 | 51.8197 | 9.4012 | 18.8873 | 0.0030 | 0.0217 | 0.0043 | 0.0390 | 0.0057 | 0.0032 | 0.0240 | 0.0260 |
| 5/5/1998 | 0.4874 | 0.2179 | 0.1160 | 0.2002 | 1.0168 | 0.8124 | 0.5017 | 1.8823 | 49.2712 | 9.2596 | 18.6042 | 0.0015 | 0.0173 | 0.0087 | 0.0390 | 0.0076 | 0.0032 | 0.0240 | 0.0260 |
| 5/6/1998 | 0.4770 | 0.2175 | 0.1089 | 0.1949 | 1.0049 | 0.7952 | 0.4622 | 1.8676 | 47.5722 | 9.0897 | 18.2644 | 0.0060 | 0.0173 | 0.0043 | 0.0390 | 0.0076 | 0.0032 | 0.0240 | 0.0197 |

e =  estimated value

## Table B5. Daily average flows (in cms) of NPDES dischargers (by station ID).

| date PST | aberdn | elma | hoquiam | mcleary | montesn | ocenshr | westprt | ospray1 | weyco1 | weyco2 | ghpapr1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2/1/1997 | 0.2335 | 0.0193 | 0.0938 | 0.0166 | 0.0143 | 0.0101 | 0.0074 | 0.0103 | 0.9441 | 0.4162 | 0.2418 |
| 2/2/1997 | 0.1985 | 0.0171 | 0.0771 | 0.0171 | 0.0153 | 0.0103 | 0.0076 | 0.0104 | 0.9923 | 0.3592 | 0.2326 |
| 2/3/1997 | 0.1914 | 0.0164 | 0.0688 | 0.0131 | 0.0148 | 0.0088 | 0.0076 | 0.0108 | 0.7303 | 0.3592 | 0.2392 |
| 2/4/1997 | 0.1726 | 0.0158 | 0.0635 | 0.0149 | 0.0145 | 0.0080 | 0.0072 | 0.0099 | 1.0116 | 0.3330 | 0.2388 |
| 2/5/1997 | 0.1647 | 0.0147 | 0.0618 | 0.0149 | 0.0143 | 0.0070 | 0.0074 | 0.0057 | 0.8569 | 0.3768 | 0.2480 |
| 2/6/1997 | 0.1652 | 0.0149 | 0.0622 | 0.0123 | 0.0142 | 0.0071 | 0.0073 | 0.0046 | 0.9581 | 0.4162 | 0.2642 |
| 2/7/1997 | 0.1656 | 0.0147 | 0.0600 | 0.0127 | 0.0141 | 0.0075 | 0.0077 | 0.0047 | 0.9673 | 0.3680 | 0.2883 |
| 2/8/1997 | 0.1608 | 0.0138 | 0.0578 | 0.0127 | 0.0140 | 0.0087 | 0.0077 | 0.0104 | 0.9410 | 0.3943 | 0.2677 |
| 2/9/1997 | 0.1516 | 0.0138 | 0.0596 | 0.0123 | 0.0146 | 0.0098 | 0.0076 | 0.0104 | 0.9537 | 0.4031 | 0.2791 |
| 2/10/1997 | 0.1511 | 0.0125 | 0.0587 | 0.0123 | 0.0136 | 0.0086 | 0.0075 | 0.0104 | 0.9104 | 0.3724 | 0.2309 |
| 2/11/1997 | 0.2204 | 0.0138 | 0.0902 | 0.0136 | 0.0139 | 0.0087 | 0.0070 | 0.0097 | 1.0002 | 0.4206 | 0.3400 |
| 2/12/1997 | 0.2063 | 0.0164 | 0.0841 | 0.0158 | 0.0150 | 0.0086 | 0.0078 | 0.0090 | 0.9708 | 0.4556 | 0.2983 |
| 2/13/1997 | 0.2559 | 0.0169 | 0.1161 | 0.0162 | 0.0150 | 0.0101 | 0.0067 | 0.0085 | 0.9559 | 0.4206 | 0.2848 |
| 2/14/1997 | 0.4390 | 0.0241 | 0.2033 | 0.0184 | 0.0187 | 0.0113 | 0.0085 | 0.0067 | 0.9840 | 0.4819 | 0.2624 |
| 2/15/1997 | 0.2563 | 0.0234 | 0.0951 | 0.0228 | 0.0187 | 0.0124 | 0.0081 | 0.0067 | 0.9485 | 0.4293 | 0.2331 |
| 2/16/1997 | 0.2751 | 0.0191 | 0.1021 | 0.0193 | 0.0170 | 0.0141 | 0.0079 | 0.0067 | 0.9608 | 0.4162 | 0.2436 |
| 2/17/1997 | 0.2738 | 0.0197 | 0.1043 | 0.0153 | 0.0173 | 0.0140 | 0.0101 | 0.0067 | 0.9288 | 0.4206 | 0.2510 |
| 2/18/1997 | 0.3325 | 0.0202 | 0.1525 | 0.0158 | 0.0171 | 0.0148 | 0.0080 | 0.0057 | 0.9673 | 0.4337 | 0.2712 |
| 2/19/1997 | 0.2707 | 0.0258 | 0.1231 | 0.0202 | 0.0188 | 0.0140 | 0.0096 | 0.0057 | 1.0234 | 0.4381 | 0.2843 |
| 2/20/1997 | 0.2756 | 0.0226 | 0.0986 | 0.0250 | 0.0147 | 0.0121 | 0.0074 | 0.0056 | 1.0208 | 0.4600 | 0.2344 |
| 2/21/1997 | 0.1985 | 0.0184 | 0.0705 | 0.0206 | 0.0124 | 0.0112 | 0.0062 | 0.0057 | 0.9691 | 0.4031 | 0.2607 |
| 2/22/1997 | 0.1801 | 0.0166 | 0.0640 | 0.0153 | 0.0131 | 0.0118 | 0.0065 | 0.0038 | 0.9380 | 0.3768 | 0.2261 |
| 2/23/1997 | 0.1625 | 0.0158 | 0.0635 | 0.0166 | 0.0133 | 0.0120 | 0.0081 | 0.0038 | 0.9209 | 0.3505 | 0.2515 |
| 2/24/1997 | 0.1603 | 0.0145 | 0.0605 | 0.0123 | 0.0138 | 0.0103 | 0.0079 | 0.0039 | 0.9108 | 0.3330 | 0.2515 |
| 2/25/1997 | 0.1582 | 0.0142 | 0.0600 | 0.0131 | 0.0129 | 0.0095 | 0.0067 | 0.0047 | 0.9332 | 0.3286 | 0.2545 |
| 2/26/1997 | 0.1638 | 0.0138 | 0.0653 | 0.0136 | 0.0127 | 0.0085 | 0.0064 | 0.0039 | 0.8232 | 0.3154 | 0.2826 |
| 2/27/1997 | 0.1608 | 0.0127 | 0.0635 | 0.0118 | 0.0129 | 0.0077 | 0.0068 | 0.0038 | 0.9594 | 0.3330 | 0.2098 |
| 2/28/1997 | 0.2094 | 0.0145 | 0.0964 | 0.0118 | 0.0143 | 0.0090 | 0.0067 | 0.0038 | 0.9940 | 0.3505 | 0.2707 |
| 3/1/1997 | 0.4201 | 0.0210 | 0.1722 | 0.0127 | 0.0223 | 0.0143 | 0.0081 | 0.0054 | 0.9621 | 0.2891 | 0.2983 |
| 3/2/1997 | 0.2927 | 0.0219 | 0.1030 | 0.0171 | 0.0126 | 0.0132 | 0.0122 | 0.0054 | 0.9866 | 0.4819 | 0.2572 |
| 3/3/1997 | 0.2396 | 0.0191 | 0.0898 | 0.0171 | 0.0169 | 0.0104 | 0.0087 | 0.0054 | 0.9590 | 0.4206 | 0.2410 |
| 3/4/1997 | 0.2085 | 0.0164 | 0.0775 | 0.0166 | 0.0145 | 0.0096 | 0.0068 | 0.0073 | 0.9240 | 0.3724 | 0.2383 |
| 3/5/1997 | 0.2445 | 0.0162 | 0.0929 | 0.0145 | 0.0145 | 0.0084 | 0.0065 | 0.0086 | 0.9822 | 0.3943 | 0.2576 |
| 3/6/1997 | 0.3689 | 0.0197 | 0.1735 | 0.0153 | 0.0165 | 0.0097 | 0.0070 | 0.0091 | 1.0129 | 0.4819 | 0.3080 |
| 3/7/1997 | 0.2900 | 0.0237 | 0.1139 | 0.0228 | 0.0194 | 0.0098 | 0.0090 | 0.0085 | 0.9533 | 0.4819 | 0.2620 |
| 3/8/1997 | 0.3387 | 0.0191 | 0.1511 | 0.0215 | 0.0178 | 0.0136 | 0.0071 | 0.0102 | 1.0151 | 0.4600 | 0.3058 |
| 3/9/1997 | 0.3316 | 0.0232 | 0.1402 | 0.0188 | 0.0179 | 0.0142 | 0.0117 | 0.0102 | 1.0124 | 0.4600 | 0.3198 |
| 3/10/1997 | 0.2388 | 0.0197 | 0.0907 | 0.0171 | 0.0170 | 0.0106 | 0.0090 | 0.0102 | 1.0641 | 0.4819 | 0.3448 |
| 3/11/1997 | 0.2743 | 0.0186 | 0.1297 | 0.0158 | 0.0164 | 0.0092 | 0.0071 | 0.0115 | 1.0922 | 0.4600 | 0.3290 |
| 3/12/1997 | 0.2786 | 0.0188 | 0.1235 | 0.0162 | 0.0166 | 0.0087 | 0.0075 | 0.0116 | 1.0457 | 0.4600 | 0.2563 |
| 3/13/1997 | 0.2304 | 0.0182 | 0.0907 | 0.0158 | 0.0148 | 0.0079 | 0.0070 | 0.0116 | 1.0269 | 0.4381 | 0.2475 |
| 3/14/1997 | 0.2169 | 0.0169 | 0.0828 | 0.0158 | 0.0154 | 0.0086 | 0.0073 | 0.0115 | 1.0379 | 0.4162 | 0.2681 |
| 3/15/1997 | 0.4031 | 0.0258 | 0.1954 | 0.0145 | 0.0184 | 0.0135 | 0.0073 | 0.0079 | 1.0501 | 0.4819 | 0.3382 |
| 3/16/1997 | 0.2747 | 0.0252 | 0.1069 | 0.0228 | 0.0174 | 0.0130 | 0.0116 | 0.0079 | 1.0317 | 0.4819 | 0.3882 |
| 3/17/1997 | 0.4745 | 0.0267 | 0.2212 | 0.0180 | 0.0203 | 0.0138 | 0.0092 | 0.0065 | 1.1886 | 0.4819 | 0.4675 |
| 3/18/1997 | 0.7286 | 0.0407 | 0.3562 | 0.0202 | 0.0438 | 0.0191 | 0.0092 | 0.0053 | 1.0370 | 0.4819 | 0.5113 |
| 3/19/1997 | 0.7185 | 0.0482 | 0.3027 | 0.0386 | 0.0345 | 0.0269 | 0.0312 | 0.0089 | 0.9353 | 0.4819 | 0.3676 |
| 3/20/1997 | 0.3838 | 0.0460 | 0.1476 | 0.0368 | 0.0235 | 0.0194 | 0.0349 | 0.0146 | 1.2149 | 0.4819 | 0.3627 |
| 3/21/1997 | 0.2651 | 0.0394 | 0.0889 | 0.0219 | 0.0209 | 0.0150 | 0.0129 | 0.0117 | 1.1605 | 0.4469 | 0.3947 |
| 3/22/1997 | 0.2055 | 0.0311 | 0.0727 | 0.0175 | 0.0181 | 0.0140 | 0.0082 | 0.0120 | 1.1601 | 0.4206 | 0.2462 |
| 3/23/1997 | 0.1879 | 0.0232 | 0.0657 | 0.0149 | 0.0157 | 0.0131 | 0.0085 | 0.0120 | 1.1281 | 0.4250 | 0.2887 |
| 3/24/1997 | 0.1752 | 0.0202 | 0.0613 | 0.0136 | 0.0147 | 0.0118 | 0.0083 | 0.0120 | 0.9445 | 0.3987 | 0.3378 |
| 3/25/1997 | 0.1796 | 0.0173 | 0.0701 | 0.0127 | 0.0138 | 0.0108 | 0.0076 | 0.0050 | 1.0992 | 0.4775 | 0.3159 |
| 3/26/1997 | 0.2738 | 0.0186 | 0.1319 | 0.0136 | 0.0157 | 0.0109 | 0.0076 | 0.0028 | 0.9112 | 0.4819 | 0.2848 |
| 3/27/1997 | 0.2913 | 0.0212 | 0.1345 | 0.0158 | 0.0164 | 0.0114 | 0.0091 | 0.0028 | 1.1934 | 0.4819 | 0.3216 |
| 3/28/1997 | 0.2239 | 0.0204 | 0.0885 | 0.0153 | 0.0156 | 0.0111 | 0.0092 | 0.0027 | 1.1084 | 0.4819 | 0.2821 |
| 3/29/1997 | 0.2006 | 0.0169 | 0.0754 | 0.0145 | | 0.0111 | 0.0078 | 0.0027 | 1.1382 | 0.4600 | 0.2944 |
| 3/30/1997 | 0.1809 | 0.0162 | 0.0670 | 0.0136 | | 0.0099 | 0.0081 | 0.0027 | 1.1925 | 0.4469 | 0.2725 |
| 3/31/1997 | 0.2269 | 0.0171 | 0.0745 | 0.0118 | 0.0156 | 0.0099 | 0.0081 | 0.0027 | 1.1351 | 0.4425 | 0.2808 |
| 4/1/1997 | 0.1713 | 0.0156 | 0.0653 | 0.0140 | 0.0142 | 0.0099 | 0.0084 | 0.0059 | 1.0922 | 0.3943 | 0.2642 |
| 4/2/1997 | 0.1476 | 0.0145 | 0.0679 | 0.0127 | 0.0137 | 0.0097 | 0.0072 | 0.0067 | 0.9870 | 0.3592 | 0.2900 |
| 4/3/1997 | 0.1691 | 0.0142 | 0.0662 | 0.0123 | 0.0134 | 0.0095 | 0.0074 | 0.0067 | 1.1408 | 0.3943 | 0.2502 |
| 4/4/1997 | 0.1590 | 0.0134 | 0.0600 | 0.0123 | 0.0134 | 0.0096 | 0.0074 | 0.0063 | 0.8468 | 0.3680 | 0.2550 |
| 4/5/1997 | 0.1459 | 0.0123 | 0.0548 | 0.0101 | 0.0090 | 0.0109 | 0.0077 | 0.0054 | 0.6865 | 0.3855 | 0.2493 |
| 4/6/1997 | 0.1415 | 0.0118 | 0.0543 | 0.0092 | 0.0117 | 0.0114 | 0.0090 | 0.0054 | 1.1119 | 0.4031 | 0.2445 |

| date PST | aberdn | elma | hoquiam | mcleary | montesn | ocenshr | westprt | ospray1 | weyco1 | weyco2 | ghpapr1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4/7/1997 | 0.1450 | 0.0114 | 0.0578 | 0.0096 | 0.0124 | 0.0104 | 0.0087 | 0.0054 | 1.1618 | 0.4206 | 0.3654 |
| 4/8/1997 | 0.1507 | 0.0118 | 0.0618 | 0.0110 | 0.0123 | 0.0081 | 0.0082 | 0.0054 | 1.1075 | 0.4381 | 0.3290 |
| 4/9/1997 | 0.1472 | 0.0116 | 0.0578 | 0.0118 | 0.0109 | 0.0092 | 0.0079 | 0.0072 | 1.0953 | 0.3768 | 0.2414 |
| 4/10/1997 | 0.1428 | 0.0114 | 0.0556 | 0.0110 | 0.0111 | 0.0089 | 0.0085 | 0.0071 | 1.0720 | 0.3286 | 0.1901 |
| 4/11/1997 | 0.1393 | 0.0112 | 0.0539 | 0.0114 | 0.0124 | 0.0092 | 0.0077 | 0.0066 | 0.9419 | 0.2979 | 0.2532 |
| 4/12/1997 | 0.1428 | 0.0112 | 0.0578 | 0.0092 | 0.0121 | 0.0111 | 0.0087 | 0.0066 | 1.0887 | 0.3592 | 0.3334 |
| 4/13/1997 | 0.1770 | 0.0129 | 0.0723 | 0.0088 | 0.0131 | 0.0130 | 0.0100 | 0.0066 | 1.0536 | 0.3592 | 0.3706 |
| 4/14/1997 | 0.2186 | 0.0131 | 0.0924 | 0.0101 | 0.0142 | 0.0127 | 0.0094 | 0.0066 | 1.1364 | 0.3943 | 0.2550 |
| 4/15/1997 | 0.2226 | 0.0129 | 0.1047 | 0.0123 | 0.0147 | 0.0133 | 0.0083 | 0.0066 | 1.1145 | 0.4031 | 0.3027 |
| 4/16/1997 | 0.2006 | 0.0134 | 0.0863 | 0.0123 | 0.0149 | 0.0120 | 0.0082 | 0.0073 | 1.1413 | 0.3855 | 0.2970 |
| 4/17/1997 | 0.1787 | 0.0129 | 0.0675 | 0.0118 | 0.0138 | 0.0111 | 0.0079 | 0.0088 | 1.0970 | 0.3592 | 0.2948 |
| 4/18/1997 | 0.1748 | 0.0129 | 0.0653 | 0.0110 | 0.0137 | 0.0118 | 0.0077 | 0.0099 | 1.0970 | 0.3592 | 0.3216 |
| 4/19/1997 | 0.4543 | 0.0164 | 0.2217 | 0.0140 | 0.0162 | 0.0163 | 0.0084 | 0.0096 | 1.1491 | 0.4162 | 0.4762 |
| 4/20/1997 | 0.3141 | 0.0245 | 0.1327 | 0.0180 | 0.0173 | 0.0159 | 0.0130 | 0.0096 | 0.9586 | 0.4425 | 0.2431 |
| 4/21/1997 | 0.2103 | 0.0210 | 0.0784 | 0.0149 | 0.0167 | 0.0121 | 0.0091 | 0.0096 | 1.0795 | 0.3987 | 0.2177 |
| 4/22/1997 | 0.2440 | 0.0177 | 0.1038 | 0.0145 | 0.0153 | 0.0102 | 0.0076 | 0.0104 | 1.0676 | 0.4162 | 0.1730 |
| 4/23/1997 | 0.3483 | 0.0156 | 0.0916 | 0.0145 | 0.0186 | 0.0100 | 0.0083 | 0.0100 | 1.0541 | 0.4031 | 0.2230 |
| 4/24/1997 | 0.1801 | 0.0147 | 0.0697 | 0.0140 | 0.0066 | 0.0089 | 0.0071 | 0.0075 | 1.0523 | 0.3855 | 0.2611 |
| 4/25/1997 | 0.1652 | 0.0136 | 0.0635 | 0.0131 | 0.0149 | 0.0086 | 0.0073 | 0.0075 | 1.0633 | 0.4293 | 0.2226 |
| 4/26/1997 | 0.1704 | 0.0127 | 0.0683 | 0.0131 | 0.0140 | 0.0104 | 0.0078 | 0.0075 | 1.0164 | 0.3067 | 0.2672 |
| 4/27/1997 | 0.1879 | 0.0140 | 0.0754 | 0.0114 | 0.0129 | 0.0116 | 0.0093 | 0.0060 | 1.1553 | 0.3549 | 0.2839 |
| 4/28/1997 | 0.2410 | 0.0160 | 0.1086 | 0.0114 | 0.0145 | 0.0111 | 0.0087 | 0.0057 | 1.1027 | 0.4162 | 0.2948 |
| 4/29/1997 | 0.1856 | 0.0149 | 0.0771 | 0.0145 | 0.0128 | 0.0092 | 0.0079 | 0.0057 | 1.2039 | 0.3899 | 0.2782 |
| 4/30/1997 | 0.2633 | 0.0156 | 0.0990 | 0.0131 | 0.0143 | 0.0088 | 0.0071 | 0.0076 | 1.2052 | 0.4425 | 0.2997 |
| 5/1/1997 | 0.1687 | 0.0142 | 0.0631 | 0.0149 | 0.0140 | 0.0080 | 0.0072 | 0.0077 | 1.1478 | 0.3417 | 0.2357 |
| 5/2/1997 | 0.1871 | 0.0134 | 0.0749 | 0.0127 | 0.0129 | 0.0091 | 0.0068 | 0.0077 | 1.0720 | 0.3417 | 0.2611 |
| 5/3/1997 | 0.2085 | 0.0136 | 0.0789 | 0.0088 | 0.0140 | 0.0111 | 0.0081 | 0.0076 | 1.0094 | 0.3768 | 0.2431 |
| 5/4/1997 | 0.1936 | 0.0140 | 0.0727 | 0.0105 | 0.0143 | 0.0120 | 0.0085 | 0.0050 | 0.6891 | 0.4031 | 0.2467 |
| 5/5/1997 | 0.2449 | 0.0136 | 0.0929 | 0.0110 | 0.0144 | 0.0115 | 0.0083 | 0.0047 | 0.2502 | 0.4600 | 0.2944 |
| 5/6/1997 | 0.2055 | 0.0151 | 0.0732 | 0.0140 | 0.0145 | 0.0099 | 0.0081 | 0.0053 | | 0.4600 | 0.2944 |
| 5/7/1997 | 0.1831 | 0.0134 | 0.0556 | 0.0158 | 0.0142 | 0.0091 | 0.0071 | 0.0068 | | 0.4600 | 0.2817 |
| 5/8/1997 | 0.1674 | 0.0125 | 0.0622 | 0.0131 | 0.0132 | 0.0084 | 0.0072 | 0.0076 | | 0.4031 | 0.3426 |
| 5/9/1997 | 0.1538 | 0.0118 | 0.0587 | 0.0131 | 0.0125 | 0.0082 | 0.0074 | 0.0076 | | 0.3943 | 0.2624 |
| 5/10/1997 | 0.1424 | 0.0105 | 0.0556 | 0.0101 | 0.0122 | 0.0094 | 0.0082 | 0.0052 | 0.8604 | 0.3330 | 0.2602 |
| 5/11/1997 | 0.1419 | 0.0101 | 0.0552 | 0.0101 | 0.0101 | 0.0107 | 0.0087 | 0.0052 | 1.2433 | 0.3680 | 0.2756 |
| 5/12/1997 | 0.1376 | 0.0096 | 0.0565 | 0.0083 | 0.0121 | 0.0102 | 0.0092 | 0.0052 | 1.2065 | 0.3417 | 0.2738 |
| 5/13/1997 | 0.1406 | 0.0103 | 0.0543 | 0.0110 | 0.0115 | 0.0093 | 0.0101 | 0.0050 | 1.1404 | 0.3417 | 0.2655 |
| 5/14/1997 | 0.1279 | 0.0103 | 0.0534 | 0.0105 | 0.0123 | 0.0091 | 0.0083 | 0.0049 | 1.0107 | 0.3505 | 0.2848 |
| 5/15/1997 | 0.1279 | 0.0099 | 0.0534 | 0.0101 | 0.0126 | 0.0089 | 0.0083 | 0.0049 | 1.1334 | 0.2979 | 0.2848 |
| 5/16/1997 | 0.1257 | 0.0099 | 0.0513 | 0.0105 | 0.0127 | 0.0118 | 0.0078 | 0.0050 | 1.0567 | 0.2848 | 0.3246 |
| 5/17/1997 | 0.1235 | 0.0101 | 0.0486 | 0.0105 | 0.0126 | 0.0098 | 0.0078 | 0.0048 | 1.1702 | 0.2716 | 0.3391 |
| 5/18/1997 | 0.1196 | 0.0096 | 0.0499 | 0.0096 | 0.0112 | 0.0108 | 0.0088 | 0.0048 | 1.1255 | 0.2891 | 0.3606 |
| 5/19/1997 | 0.1354 | 0.0101 | 0.0521 | 0.0088 | 0.0120 | 0.0098 | 0.0084 | 0.0048 | 1.0698 | 0.2716 | 0.3776 |
| 5/20/1997 | 0.1525 | 0.0107 | 0.0556 | 0.0105 | 0.0127 | 0.0090 | 0.0073 | 0.0054 | 1.1824 | 0.2891 | 0.3706 |
| 5/21/1997 | 0.1319 | 0.0112 | 0.0517 | 0.0105 | 0.0113 | 0.0081 | 0.0071 | 0.0065 | 1.1382 | 0.3067 | 0.2865 |
| 5/22/1997 | 0.1279 | 0.0103 | 0.0513 | 0.0101 | 0.0123 | 0.0077 | 0.0072 | 0.0074 | 1.1364 | 0.3943 | 0.3189 |
| 5/23/1997 | 0.1284 | 0.0101 | 0.0499 | 0.0092 | 0.0127 | 0.0087 | 0.0080 | 0.0066 | 1.1049 | 0.3592 | 0.2874 |
| 5/24/1997 | 0.1205 | 0.0099 | 0.0464 | 0.0105 | 0.0121 | 0.0122 | 0.0079 | 0.0063 | 1.0961 | 0.3505 | 0.2878 |
| 5/25/1997 | 0.1152 | 0.0092 | 0.0456 | 0.0101 | 0.0112 | 0.0146 | 0.0104 | 0.0038 | 1.1299 | 0.2848 | 0.2878 |
| 5/26/1997 | 0.1297 | 0.0116 | 0.0539 | 0.0096 | 0.0116 | 0.0143 | 0.0115 | 0.0000 | 1.1386 | 0.2804 | 0.2856 |
| 5/27/1997 | 0.1520 | 0.0125 | 0.0613 | 0.0092 | 0.0131 | 0.0115 | 0.0113 | 0.0013 | 1.0825 | 0.2453 | 0.3150 |
| 5/28/1997 | 0.2002 | 0.0149 | 0.0955 | 0.0110 | 0.0142 | 0.0117 | 0.0086 | 0.0012 | 1.1526 | 0.3549 | 0.2830 |
| 5/29/1997 | 0.1678 | 0.0149 | 0.0736 | 0.0127 | 0.0145 | 0.0102 | 0.0090 | 0.0012 | 1.1207 | 0.3242 | 0.2532 |
| 5/30/1997 | 0.2725 | 0.0142 | 0.1437 | 0.0110 | 0.0142 | 0.0110 | 0.0078 | 0.0057 | 1.1671 | 0.3592 | 0.3097 |
| 5/31/1997 | 0.2651 | 0.0156 | 0.1122 | 0.0145 | 0.0143 | 0.0112 | 0.0092 | 0.0024 | 1.1211 | 0.4118 | 0.3220 |
| 6/1/1997 | 0.2182 | 0.0147 | 0.0911 | 0.0149 | 0.0139 | 0.0094 | 0.0089 | 0.0024 | 1.0821 | 0.4162 | 0.2839 |
| 6/2/1997 | 0.1989 | 0.0138 | 0.0727 | 0.0127 | 0.0138 | 0.0090 | 0.0074 | 0.0024 | 1.0536 | 0.3987 | 0.2686 |
| 6/3/1997 | 0.2116 | 0.0136 | 0.0885 | 0.0131 | 0.0138 | 0.0110 | 0.0078 | 0.0048 | 1.0799 | 0.4118 | 0.2830 |
| 6/4/1997 | 0.2024 | 0.0134 | 0.0789 | 0.0149 | 0.0116 | 0.0082 | 0.0084 | 0.0047 | 1.0076 | 0.4162 | 0.2896 |
| 6/5/1997 | 0.1748 | 0.0116 | 0.0552 | 0.0131 | 0.0103 | 0.0077 | 0.0075 | 0.0057 | 0.8714 | 0.4206 | 0.2865 |
| 6/6/1997 | 0.1568 | 0.0116 | 0.0605 | 0.0123 | 0.0125 | 0.0078 | 0.0081 | 0.0057 | 1.1224 | 0.4118 | 0.3014 |
| 6/7/1997 | 0.1503 | 0.0110 | 0.0565 | 0.0127 | 0.0141 | 0.0096 | 0.0080 | 0.0043 | 1.0694 | 0.3330 | 0.3124 |
| 6/8/1997 | 0.1468 | 0.0107 | 0.0552 | 0.0105 | 0.0096 | 0.0101 | 0.0086 | 0.0043 | 1.0681 | 0.2804 | 0.2817 |
| 6/9/1997 | 0.1424 | 0.0107 | 0.0534 | 0.0096 | 0.0120 | 0.0089 | 0.0086 | 0.0043 | 1.1053 | 0.2629 | 0.2966 |
| 6/10/1997 | 0.1376 | 0.0094 | 0.0513 | 0.0118 | 0.0120 | 0.0087 | 0.0081 | 0.0076 | 1.0953 | 0.2672 | 0.2922 |
| 6/11/1997 | 0.1437 | 0.0103 | 0.0570 | 0.0127 | 0.0120 | 0.0085 | 0.0079 | 0.0154 | 1.1045 | 0.2848 | 0.3619 |
| 6/12/1997 | 0.1415 | 0.0103 | 0.0526 | 0.0123 | 0.0113 | 0.0079 | 0.0085 | 0.0164 | 1.1145 | 0.2760 | 0.3172 |
| 6/13/1997 | 0.1244 | 0.0096 | 0.0504 | 0.0105 | 0.0117 | 0.0079 | 0.0076 | 0.0109 | 1.1207 | 0.2497 | 0.3198 |
| 6/14/1997 | 0.1249 | 0.0088 | 0.0473 | 0.0096 | 0.0089 | 0.0093 | 0.0083 | 0.0084 | 1.1272 | 0.2585 | 0.3189 |
| 6/15/1997 | 0.1249 | 0.0090 | 0.0486 | 0.0092 | 0.0103 | 0.0104 | 0.0092 | 0.0025 | 1.1255 | 0.2410 | 0.3242 |

| date PST | aberdn | elma | hoquiam | mcleary | montesn | ocenshr | westprt | ospray1 | weyco1 | weyco2 | ghpapr1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6/16/1997 | 0.1419 | 0.0099 | 0.0578 | 0.0083 | 0.0109 | 0.0105 | 0.0092 | 0.0019 | 1.1303 | 0.2453 | 0.3553 |
| 6/17/1997 | 0.1617 | 0.0105 | 0.0714 | 0.0105 | 0.0111 | 0.0109 | 0.0085 | 0.0085 | 1.1649 | 0.2541 | 0.3728 |
| 6/18/1997 | 0.1533 | 0.0103 | 0.0609 | 0.0118 | 0.0110 | 0.0103 | 0.0077 | 0.0109 | 1.1049 | 0.2541 | 0.2598 |
| 6/19/1997 | 0.1384 | 0.0094 | 0.0543 | 0.0092 | 0.0120 | 0.0099 | 0.0079 | 0.0109 | 1.1080 | 0.2585 | 0.2488 |
| 6/20/1997 | 0.1488 | 0.0090 | 0.0552 | 0.0101 | 0.0110 | 0.0109 | 0.0075 | 0.0127 | 1.1421 | 0.3286 | 0.2615 |
| 6/21/1997 | 0.1840 | 0.0103 | 0.0688 | 0.0105 | 0.0124 | 0.0121 | 0.0087 | 0.0099 | 1.1728 | 0.3768 | 0.2576 |
| 6/22/1997 | 0.1726 | 0.0118 | 0.0587 | 0.0127 | 0.0117 | 0.0128 | 0.0092 | 0.0099 | 1.1575 | 0.3943 | 0.2589 |
| 6/23/1997 | 0.1625 | 0.0120 | 0.0578 | 0.0079 | 0.0120 | 0.0120 | 0.0091 | 0.0099 | 1.1465 | 0.3154 | 0.2769 |
| 6/24/1997 | 0.1507 | 0.0103 | 0.0526 | 0.0105 | 0.0113 | 0.0107 | 0.0080 | 0.0057 | 1.0633 | 0.2585 | 0.2497 |
| 6/25/1997 | 0.1468 | 0.0094 | 0.0504 | 0.0096 | 0.0117 | 0.0100 | 0.0079 | 0.0076 | 0.9827 | 0.2629 | 0.2935 |
| 6/26/1997 | 0.1525 | 0.0099 | 0.0574 | 0.0105 | 0.0120 | 0.0099 | 0.0078 | 0.0086 | 0.9739 | 0.3023 | 0.3075 |
| 6/27/1997 | 0.2314 | 0.0101 | 0.0824 | 0.0206 | 0.0119 | 0.0104 | 0.0092 | 0.0101 | 1.1522 | 0.4206 | 0.3259 |
| 6/28/1997 | 0.1726 | 0.0094 | 0.0578 | 0.0131 | 0.0123 | 0.0109 | 0.0090 | 0.0106 | 1.0926 | 0.2979 | 0.3045 |
| 6/29/1997 | 0.1516 | 0.0092 | 0.0543 | 0.0096 | 0.0115 | 0.0115 | 0.0094 | 0.0106 | 1.0830 | 0.2891 | 0.2537 |
| 6/30/1997 | 0.1520 | 0.0094 | 0.0530 | 0.0088 | 0.0116 | 0.0104 | 0.0089 | 0.0106 | 1.0988 | 0.2804 | 0.2769 |
| 7/1/1997 | 0.1402 | 0.0094 | 0.0513 | 0.0110 | 0.0114 | 0.0096 | 0.0083 | 0.0057 | 1.0655 | 0.2804 | 0.2712 |
| 7/2/1997 | 0.1402 | 0.0092 | 0.0504 | 0.0101 | 0.0141 | 0.0093 | 0.0086 | 0.0082 | 1.0887 | 0.2760 | 0.2983 |
| 7/3/1997 | 0.1257 | 0.0094 | 0.0495 | 0.0105 | 0.0173 | 0.0098 | 0.0086 | 0.0030 | 1.0839 | 0.2716 | 0.2589 |
| 7/4/1997 | 0.1231 | 0.0083 | 0.0451 | 0.0101 | 0.0013 | 0.0123 | 0.0101 | 0.0012 | 1.0712 | 0.2629 | 0.2440 |
| 7/5/1997 | 0.1306 | 0.0081 | 0.0469 | 0.0088 | 0.0082 | 0.0148 | 0.0130 | 0.0012 | 1.0834 | 0.2716 | 0.2480 |
| 7/6/1997 | 0.1398 | 0.0096 | 0.0491 | 0.0092 | 0.0110 | 0.0149 | 0.0136 | 0.0013 | 1.0782 | 0.2585 | 0.2554 |
| 7/7/1997 | 0.1446 | 0.0092 | 0.0552 | 0.0092 | 0.0105 | 0.0131 | 0.0113 | 0.0012 | 1.1154 | 0.2585 | 0.2699 |
| 7/8/1997 | 0.2379 | 0.0129 | 0.1143 | 0.0105 | 0.0128 | 0.0145 | 0.0100 | 0.0013 | 1.1500 | 0.3023 | 0.3067 |
| 7/9/1997 | 0.1919 | 0.0129 | 0.0758 | 0.0162 | 0.0137 | 0.0127 | 0.0101 | 0.0012 | 1.1014 | 0.2979 | 0.2528 |
| 7/10/1997 | 0.2011 | 0.0112 | 0.0911 | 0.0140 | 0.0116 | 0.0110 | 0.0085 | 0.0076 | 1.0935 | 0.2804 | 0.2550 |
| 7/11/1997 | 0.1560 | 0.0103 | 0.0635 | 0.0123 | 0.0117 | 0.0105 | 0.0085 | 0.0120 | 1.0747 | 0.2629 | 0.2786 |
| 7/12/1997 | 0.1490 | 0.0103 | 0.0565 | 0.0105 | 0.0116 | 0.0117 | 0.0094 | 0.0125 | 1.0712 | 0.2497 | 0.2550 |
| 7/13/1997 | 0.1411 | 0.0101 | 0.0534 | 0.0105 | 0.0127 | 0.0127 | 0.0102 | 0.0073 | 1.0839 | 0.2453 | 0.2738 |
| 7/14/1997 | 0.1279 | 0.0099 | 0.0534 | 0.0096 | 0.0110 | 0.0114 | 0.0100 | 0.0073 | 1.0799 | 0.2453 | 0.0548 |
| 7/15/1997 | 0.1402 | 0.0092 | 0.0508 | 0.0110 | 0.0103 | 0.0102 | 0.0122 | 0.0094 | 1.0558 | 0.2453 | 0.0061 |
| 7/16/1997 | 0.1301 | 0.0094 | 0.0486 | 0.0096 | 0.0107 | 0.0097 | 0.0092 | 0.0088 | 1.0212 | 0.2585 | 0.0377 |
| 7/17/1997 | 0.1260 | 0.0099 | 0.0491 | 0.0096 | 0.0107 | 0.0097 | 0.0097 | 0.0088 | 1.2109 | 0.2541 | 0.0434 |
| 7/18/1997 | 0.1266 | 0.0096 | 0.0491 | 0.0092 | 0.0107 | 0.0102 | 0.0105 | 0.0088 | 1.2232 | 0.2585 | 0.0973 |
| 7/19/1997 | 0.1253 | 0.0090 | 0.0460 | 0.0083 | 0.0106 | 0.0120 | 0.0125 | 0.0088 | 1.1929 | 0.2716 | 0.2112 |
| 7/20/1997 | 0.1257 | 0.0090 | 0.0469 | 0.0074 | 0.0101 | 0.0130 | 0.0131 | 0.0088 | 1.2149 | 0.2848 | 0.3724 |
| 7/21/1997 | 0.1205 | 0.0099 | 0.0499 | 0.0074 | 0.0107 | 0.0120 | 0.0135 | 0.0088 | 1.1991 | 0.2804 | 0.3102 |
| 7/22/1997 | 0.1253 | 0.0099 | 0.0486 | 0.0101 | 0.0109 | 0.0121 | 0.0124 | 0.0079 | 1.1693 | 0.2585 | 0.3032 |
| 7/23/1997 | 0.1200 | 0.0096 | 0.0482 | 0.0096 | 0.0106 | 0.0104 | 0.0119 | 0.0075 | 1.1522 | 0.2453 | 0.2686 |
| 7/24/1997 | 0.1196 | 0.0094 | 0.0513 | 0.0088 | 0.0122 | 0.0100 | 0.0121 | 0.0032 | 1.1605 | 0.2453 | 0.2839 |
| 7/25/1997 | 0.1148 | 0.0096 | 0.0473 | 0.0088 | 0.0110 | 0.0107 | 0.0114 | 0.0013 | 1.1627 | 0.2585 | 0.3102 |
| 7/26/1997 | 0.1135 | 0.0094 | 0.0429 | 0.0105 | 0.0101 | 0.0130 | 0.0130 | 0.0012 | 1.1518 | 0.2453 | 0.2848 |
| 7/27/1997 | 0.1170 | 0.0092 | 0.0442 | 0.0074 | 0.0102 | 0.0130 | 0.0145 | 0.0012 | 1.0501 | 0.2410 | 0.3075 |
| 7/28/1997 | 0.1143 | 0.0090 | 0.0460 | 0.0061 | 0.0110 | 0.0120 | 0.0138 | 0.0012 | 1.1088 | 0.2366 | 0.3010 |
| 7/29/1997 | 0.1157 | 0.0099 | 0.0451 | 0.0092 | 0.0101 | 0.0113 | 0.0136 | 0.0012 | 1.2394 | 0.2366 | 0.3102 |
| 7/30/1997 | 0.1135 | 0.0096 | 0.0464 | 0.0088 | 0.0085 | 0.0113 | 0.0096 | 0.0056 | 1.1667 | 0.2410 | 0.3154 |
| 7/31/1997 | 0.1139 | 0.0094 | 0.0447 | 0.0079 | 0.0122 | 0.0106 | 0.0128 | 0.0057 | 1.1386 | 0.2453 | 0.2637 |
| 8/1/1997 | 0.1095 | 0.0092 | 0.0434 | 0.0083 | 0.0114 | 0.0110 | 0.0124 | 0.0094 | 1.0501 | 0.2453 | 0.2348 |
| 8/2/1997 | 0.1062 | 0.0092 | 0.0425 | 0.0083 | | 0.0132 | 0.0142 | 0.0095 | 1.1334 | 0.2585 | 0.2445 |
| 8/3/1997 | 0.1135 | 0.0088 | 0.0442 | 0.0083 | | 0.0139 | 0.0164 | 0.0094 | 1.1509 | 0.2541 | 0.2668 |
| 8/4/1997 | 0.1117 | 0.0090 | 0.0464 | 0.0083 | 0.0108 | 0.0131 | 0.0145 | 0.0099 | 1.1636 | 0.2410 | 0.2537 |
| 8/5/1997 | 0.1069 | 0.0094 | 0.0285 | 0.0096 | 0.0107 | 0.0127 | 0.0120 | 0.0087 | 1.1605 | 0.2366 | 0.2594 |
| 8/6/1997 | 0.1078 | 0.0103 | 0.0456 | 0.0092 | 0.0109 | 0.0120 | 0.0135 | 0.0081 | 0.7987 | 0.2541 | 0.2747 |
| 8/7/1997 | 0.1086 | 0.0094 | 0.0456 | 0.0092 | 0.0101 | 0.0118 | 0.0127 | 0.0082 | 1.1329 | 0.2453 | 0.2563 |
| 8/8/1997 | 0.1056 | 0.0094 | 0.0438 | 0.0096 | 0.0109 | 0.0123 | 0.0145 | 0.0057 | 1.1395 | 0.2322 | 0.2602 |
| 8/9/1997 | 0.1034 | 0.0092 | 0.0416 | 0.0083 | 0.0097 | 0.0141 | 0.0162 | 0.0057 | 1.1413 | 0.2366 | 0.2756 |
| 8/10/1997 | 0.1065 | 0.0094 | 0.0416 | 0.0083 | 0.0102 | 0.0146 | 0.0141 | 0.0057 | 1.1369 | 0.2278 | 0.2602 |
| 8/11/1997 | 0.1100 | 0.0094 | 0.0372 | 0.0074 | 0.0102 | 0.0138 | 0.0150 | 0.0056 | 1.1408 | 0.2366 | 0.2467 |
| 8/12/1997 | 0.1095 | 0.0090 | 0.0000 | 0.0092 | 0.0105 | 0.0123 | 0.0127 | 0.0057 | 1.1373 | 0.2366 | 0.2760 |
| 8/13/1997 | 0.1056 | 0.0090 | 0.0000 | 0.0092 | 0.0112 | 0.0129 | 0.0132 | 0.0075 | 1.0431 | 0.2322 | 0.2804 |
| 8/14/1997 | 0.1114 | 0.0085 | 0.0000 | 0.0092 | 0.0104 | 0.0129 | 0.0130 | 0.0120 | 1.0685 | 0.2410 | 0.2804 |
| 8/15/1997 | 0.1069 | 0.0083 | 0.0000 | 0.0092 | 0.0113 | 0.0130 | 0.0126 | 0.0120 | 1.0922 | 0.3023 | 0.2835 |
| 8/16/1997 | 0.1069 | 0.0083 | 0.0000 | 0.0101 | 0.0117 | 0.0136 | 0.0149 | 0.0126 | 1.0926 | 0.3067 | 0.2817 |
| 8/17/1997 | 0.1060 | 0.0088 | 0.0000 | 0.0070 | 0.0111 | 0.0135 | 0.0144 | 0.0094 | 1.1250 | 0.2935 | 0.3093 |
| 8/18/1997 | 0.1122 | 0.0094 | 0.0000 | 0.0070 | 0.0117 | 0.0123 | 0.0156 | 0.0059 | 1.0847 | 0.3330 | 0.2497 |
| 8/19/1997 | 0.1086 | 0.0096 | 0.0000 | 0.0101 | 0.0118 | 0.0120 | 0.0145 | 0.0094 | 1.0909 | 0.3198 | 0.2291 |
| 8/20/1997 | 0.1130 | 0.0099 | 0.0000 | 0.0088 | 0.0120 | 0.0127 | 0.0135 | 0.0108 | 1.1198 | 0.2891 | 0.2318 |
| 8/21/1997 | 0.1192 | 0.0094 | 0.0127 | 0.0096 | 0.0120 | 0.0122 | 0.0139 | 0.0113 | 1.1588 | 0.2804 | 0.2199 |
| 8/22/1997 | 0.1122 | 0.0094 | 0.0451 | 0.0096 | 0.0118 | 0.0122 | 0.0136 | 0.0113 | 1.1356 | 0.2891 | 0.2322 |
| 8/23/1997 | 0.1100 | 0.0096 | 0.0442 | 0.0088 | 0.0112 | 0.0131 | 0.0157 | 0.0116 | 1.1702 | 0.2760 | 0.2331 |
| 8/24/1997 | 0.1468 | 0.0096 | 0.0574 | 0.0070 | 0.0119 | 0.0143 | 0.0163 | 0.0116 | 1.1802 | 0.3111 | 0.2703 |

| date PST | aberdn | elma | hoquiam | mcleary | montesn | ocenshr | westprt | ospray1 | weyco1 | weyco2 | ghpapr1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 8/25/1997 | 0.1279 | 0.0103 | 0.0539 | 0.0088 | 0.0122 | 0.0133 | 0.0146 | 0.0116 | 1.1088 | 0.2629 | 0.2721 |
| 8/26/1997 | 0.1665 | 0.0114 | 0.0648 | 0.0096 | 0.0132 | 0.0137 | 0.0135 | 0.0127 | 1.0615 | 0.2760 | 0.2940 |
| 8/27/1997 | 0.1406 | 0.0114 | 0.0736 | 0.0114 | 0.0137 | 0.0136 | 0.0135 | 0.0121 | 0.9332 | 0.2891 | 0.2541 |
| 8/28/1997 | 0.1490 | 0.0103 | 0.0508 | 0.0105 | 0.0137 | 0.0120 | 0.0127 | 0.0121 | 1.1334 | 0.2672 | 0.2791 |
| 8/29/1997 | 0.1257 | 0.0101 | 0.0517 | 0.0105 | 0.0127 | 0.0111 | 0.0122 | 0.0106 | 1.1023 | 0.2541 | 0.2519 |
| 8/30/1997 | 0.1231 | 0.0099 | 0.0469 | 0.0088 | 0.0113 | 0.0122 | 0.0123 | 0.0053 | 1.0768 | 0.2629 | 0.2497 |
| 8/31/1997 | 0.1249 | 0.0090 | 0.0451 | 0.0070 | 0.0113 | 0.0140 | 0.0148 | 0.0053 | 1.0777 | 0.2629 | 0.2502 |
| 9/1/1997 | 0.1380 | 0.0088 | 0.0508 | 0.0074 | 0.0125 | 0.0135 | 0.0149 | 0.0053 | 1.1123 | 0.2585 | 0.2629 |
| 9/2/1997 | 0.1170 | 0.0094 | 0.0491 | 0.0070 | 0.0120 | 0.0117 | 0.0144 | 0.0053 | 1.1106 | 0.2453 | 0.2712 |
| 9/3/1997 | 0.1200 | 0.0099 | 0.0473 | 0.0096 | 0.0119 | 0.0099 | 0.0115 | 0.0098 | 1.0584 | 0.2410 | 0.3010 |
| 9/4/1997 | 0.1157 | 0.0101 | 0.0482 | 0.0096 | 0.0124 | 0.0088 | 0.0106 | 0.0087 | 1.0414 | 0.2366 | 0.2729 |
| 9/5/1997 | 0.1178 | 0.0096 | 0.0460 | 0.0083 | 0.0115 | 0.0088 | 0.0109 | 0.0088 | 1.0541 | 0.2366 | 0.2874 |
| 9/6/1997 | 0.1152 | 0.0088 | 0.0429 | 0.0088 | 0.0119 | 0.0096 | 0.0113 | 0.0088 | 1.0523 | 0.2278 | 0.2891 |
| 9/7/1997 | 0.1122 | 0.0088 | 0.0460 | 0.0088 | 0.0114 | 0.0104 | 0.0123 | 0.0088 | 0.9923 | 0.2322 | 0.2646 |
| 9/8/1997 | 0.1152 | 0.0094 | 0.0460 | 0.0088 | 0.0120 | 0.0097 | 0.0123 | 0.0088 | 1.0287 | 0.2322 | 0.2615 |
| 9/9/1997 | 0.1126 | 0.0090 | 0.0473 | 0.0105 | 0.0122 | 0.0092 | 0.0104 | 0.0088 | 0.9993 | 0.2322 | 0.3036 |
| 9/10/1997 | 0.1214 | 0.0085 | 0.0499 | 0.0092 | 0.0115 | 0.0083 | 0.0112 | 0.0088 | 0.9853 | 0.2366 | 0.2983 |
| 9/11/1997 | 0.1065 | 0.0085 | 0.0495 | 0.0083 | 0.0120 | 0.0077 | 0.0115 | 0.0104 | 0.9555 | 0.2453 | 0.2979 |
| 9/12/1997 | 0.1130 | 0.0092 | 0.0469 | 0.0096 | 0.0121 | 0.0086 | 0.0115 | 0.0107 | 0.9835 | 0.2366 | 0.3049 |
| 9/13/1997 | 0.1165 | 0.0090 | 0.0508 | 0.0096 | 0.0121 | 0.0096 | 0.0119 | 0.0096 | 0.9844 | 0.2629 | 0.3137 |
| 9/14/1997 | 0.1568 | 0.0099 | 0.0705 | 0.0127 | 0.0131 | 0.0113 | 0.0129 | 0.0096 | 1.0733 | 0.3636 | 0.3737 |
| 9/15/1997 | 0.2138 | 0.0160 | 0.0876 | 0.0096 | 0.0159 | 0.0117 | 0.0129 | 0.0096 | 1.0900 | 0.4337 | 0.3895 |
| 9/16/1997 | 0.4942 | 0.0169 | 0.2480 | 0.0092 | 0.0205 | 0.0142 | 0.0130 | 0.0112 | 1.0085 | 0.4600 | 0.3925 |
| 9/17/1997 | 0.4911 | 0.0364 | 0.2283 | 0.0166 | 0.0249 | 0.0154 | 0.0216 | 0.0139 | 1.1706 | 0.4819 | 0.3509 |
| 9/18/1997 | 0.2690 | 0.0285 | 0.1178 | 0.0298 | 0.0180 | 0.0127 | 0.0129 | 0.0157 | 1.1101 | 0.4819 | 0.2427 |
| 9/19/1997 | 0.1993 | 0.0173 | 0.0723 | 0.0193 | 0.0202 | 0.0110 | 0.0105 | 0.0158 | 1.0817 | 0.3943 | 0.2440 |
| 9/20/1997 | 0.1735 | 0.0136 | 0.0596 | 0.0149 | 0.0095 | 0.0117 | 0.0120 | 0.0136 | 1.0304 | 0.3286 | 0.2458 |
| 9/21/1997 | 0.1634 | 0.0114 | 0.0622 | 0.0105 | 0.0131 | 0.0122 | 0.0120 | 0.0136 | 1.0479 | 0.2848 | 0.2576 |
| 9/22/1997 | 0.1590 | 0.0105 | 0.0504 | 0.0123 | 0.0131 | 0.0106 | 0.0122 | 0.0136 | 1.0457 | 0.2585 | 0.2580 |
| 9/23/1997 | 0.1582 | 0.0107 | 0.0513 | 0.0127 | 0.0124 | 0.0091 | 0.0109 | 0.0078 | 1.0212 | 0.2541 | 0.2580 |
| 9/24/1997 | 0.1384 | 0.0114 | 0.0526 | 0.0118 | 0.0121 | 0.0091 | 0.0104 | 0.0088 | 1.0028 | 0.2453 | 0.2664 |
| 9/25/1997 | 0.1568 | 0.0112 | 0.0657 | 0.0136 | 0.0128 | 0.0087 | 0.0115 | 0.0101 | 1.0405 | 0.2629 | 0.3207 |
| 9/26/1997 | 0.1783 | 0.0136 | 0.0846 | 0.0101 | 0.0142 | 0.0092 | 0.0116 | 0.0125 | 1.0633 | 0.3417 | 0.3693 |
| 9/27/1997 | 0.1770 | 0.0114 | 0.0697 | 0.0175 | 0.0135 | 0.0105 | 0.0138 | 0.0126 | 1.0379 | 0.3067 | 0.2856 |
| 9/28/1997 | 0.1608 | 0.0110 | 0.0635 | 0.0140 | 0.0128 | 0.0126 | 0.0118 | 0.0126 | 1.0282 | 0.2804 | 0.2874 |
| 9/29/1997 | 0.1529 | 0.0114 | 0.0600 | 0.0140 | 0.0132 | 0.0104 | 0.0117 | 0.0125 | 1.0195 | 0.2848 | 0.3036 |
| 9/30/1997 | 0.2147 | 0.0116 | 0.0898 | 0.0118 | 0.0138 | 0.0102 | 0.0109 | 0.0127 | 1.0676 | 0.3286 | 0.3483 |
| 10/1/1997 | 0.2983 | 0.0153 | 0.1270 | 0.0131 | 0.0149 | 0.0109 | 0.0116 | 0.0131 | 1.0278 | 0.4074 | 0.4066 |
| 10/2/1997 | 0.2804 | 0.0197 | 0.1152 | 0.0145 | 0.0143 | 0.0114 | 0.0146 | 0.0157 | 1.0089 | 0.4381 | 0.3693 |
| 10/3/1997 | 0.3492 | 0.0160 | 0.1652 | 0.0140 | 0.0171 | 0.0133 | 0.0152 | 0.0157 | 1.0659 | 0.4819 | 0.3684 |
| 10/4/1997 | 0.3514 | 0.0206 | 0.1481 | 0.0171 | 0.0187 | 0.0136 | 0.0118 | 0.0127 | 1.0449 | 0.4819 | 0.4359 |
| 10/5/1997 | 0.2502 | 0.0208 | 0.0889 | 0.0223 | 0.0153 | 0.0125 | 0.0091 | 0.0127 | 0.9857 | 0.3943 | 0.3198 |
| 10/6/1997 | 0.1888 | 0.0149 | 0.0688 | 0.0145 | 0.0142 | 0.0105 | 0.0114 | 0.0127 | 0.9897 | 0.3505 | 0.3233 |
| 10/7/1997 | 0.1963 | 0.0131 | 0.0942 | 0.0140 | 0.0132 | 0.0093 | 0.0105 | 0.0127 | 0.9739 | 0.3067 | 0.3557 |
| 10/8/1997 | 0.2808 | 0.0142 | 0.1165 | 0.0131 | 0.0160 | 0.0118 | 0.0102 | 0.0127 | 0.9165 | 0.4381 | 0.4775 |
| 10/9/1997 | 0.3987 | 0.0149 | 0.2020 | 0.0127 | 0.0156 | 0.0146 | 0.0103 | 0.0127 | 1.0729 | 0.4381 | 0.5814 |
| 10/10/1997 | 0.3373 | 0.0175 | 0.1542 | 0.0149 | 0.0155 | 0.0154 | 0.0138 | 0.0127 | 1.1141 | 0.4381 | 0.2988 |
| 10/11/1997 | 0.2567 | 0.0151 | 0.0977 | 0.0175 | 0.0141 | 0.0143 | 0.0106 | 0.0158 | 1.1207 | 0.3943 | 0.2414 |
| 10/12/1997 | 0.2164 | 0.0138 | 0.0797 | 0.0131 | 0.0153 | 0.0135 | 0.0116 | 0.0158 | 1.0996 | 0.3505 | 0.2572 |
| 10/13/1997 | 0.1958 | 0.0129 | 0.0732 | 0.0110 | 0.0121 | 0.0115 | 0.0103 | 0.0158 | 1.1150 | 0.3286 | 0.2423 |
| 10/14/1997 | 0.1827 | 0.0131 | 0.0692 | 0.0127 | 0.0141 | 0.0106 | 0.0093 | 0.0157 | 1.1351 | 0.3505 | 0.2475 |
| 10/15/1997 | 0.1691 | 0.0120 | 0.0631 | 0.0127 | 0.0113 | 0.0092 | 0.0106 | 0.0158 | 1.0773 | 0.3505 | 0.2436 |
| 10/16/1997 | 0.1647 | 0.0116 | 0.0618 | 0.0123 | 0.0125 | 0.0089 | 0.0085 | 0.0156 | 1.0576 | 0.3943 | 0.2431 |
| 10/17/1997 | 0.1634 | 0.0110 | 0.0591 | 0.0114 | 0.0125 | 0.0086 | 0.0102 | 0.0177 | 1.0243 | 0.3855 | 0.2488 |
| 10/18/1997 | 0.1560 | 0.0096 | 0.0561 | 0.0110 | 0.0126 | 0.0096 | 0.0120 | 0.0176 | 1.0081 | 0.3373 | 0.2620 |
| 10/19/1997 | 0.1590 | 0.0096 | 0.0688 | 0.0105 | 0.0132 | 0.0102 | 0.0124 | 0.0176 | 1.0256 | 0.3067 | 0.2922 |
| 10/20/1997 | 0.1529 | 0.0092 | 0.0548 | 0.0105 | 0.0130 | 0.0090 | 0.0114 | 0.0116 | 0.9827 | 0.2848 | 0.2997 |
| 10/21/1997 | 0.1450 | 0.0096 | 0.0561 | 0.0110 | 0.0127 | 0.0079 | 0.0106 | 0.0116 | 0.9796 | 0.2629 | 0.2269 |
| 10/22/1997 | 0.1695 | 0.0101 | 0.0670 | 0.0110 | 0.0127 | 0.0078 | 0.0119 | 0.0101 | 0.9997 | 0.2672 | 0.2940 |
| 10/23/1997 | 0.1511 | 0.0096 | 0.0570 | 0.0110 | 0.0130 | 0.0077 | 0.0122 | 0.0175 | 1.0037 | 0.2541 | 0.3220 |
| 10/24/1997 | 0.1389 | 0.0094 | 0.0526 | 0.0101 | 0.0128 | 0.0076 | 0.0108 | 0.0177 | 1.0348 | 0.2541 | 0.2707 |
| 10/25/1997 | 0.1450 | 0.0096 | 0.0499 | 0.0096 | 0.0130 | 0.0083 | 0.0106 | 0.0175 | 1.0304 | 0.2497 | 0.2410 |
| 10/26/1997 | 0.1577 | 0.0101 | 0.0613 | 0.0101 | 0.0133 | 0.0097 | 0.0105 | 0.0177 | 0.9778 | 0.2629 | 0.2287 |
| 10/27/1997 | 0.1463 | 0.0105 | 0.0561 | 0.0096 | 0.0112 | 0.0089 | 0.0116 | 0.0088 | 0.9792 | 0.2541 | 0.2252 |
| 10/28/1997 | 0.3676 | 0.0116 | 0.1809 | 0.0105 | 0.0145 | 0.0098 | 0.0102 | 0.0088 | 1.0751 | 0.3724 | 0.3141 |
| 10/29/1997 | 0.5152 | 0.0223 | 0.2576 | 0.0140 | 0.0199 | 0.0128 | 0.0137 | 0.0087 | 1.1417 | 0.4819 | 0.3987 |
| 10/30/1997 | 0.4333 | 0.0357 | 0.2024 | 0.0228 | 0.0104 | 0.0125 | 0.0127 | 0.0177 | 1.0453 | 0.4819 | 0.3238 |
| 10/31/1997 | 0.3233 | 0.0256 | 0.1292 | 0.0272 | 0.0219 | 0.0104 | 0.0100 | 0.0176 | 1.0843 | 0.4556 | 0.2773 |
| 11/1/1997 | 0.2651 | 0.0204 | 0.0859 | 0.0188 | 0.0154 | 0.0098 | 0.0096 | 0.0163 | 1.0076 | 0.3680 | 0.2738 |
| 11/2/1997 | 0.2072 | 0.0160 | 0.0732 | 0.0158 | 0.0142 | 0.0099 | 0.0087 | 0.0163 | 1.0019 | 0.3549 | 0.2375 |

| date PST | aberdn | elma | hoquiam | mcleary | montesn | ocenshr | westprt | ospray1 | weyco1 | weyco2 | ghpapr1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 11/3/1997 | 0.2107 | 0.0156 | 0.0824 | 0.0131 | 0.0141 | 0.0100 | 0.0097 | 0.0163 | 1.1110 | 0.3899 | 0.3435 |
| 11/4/1997 | 0.1818 | 0.0145 | 0.0666 | 0.0136 | 0.0124 | 0.0085 | 0.0107 | 0.0120 | 1.0181 | 0.3330 | 0.3343 |
| 11/5/1997 | 0.1871 | 0.0142 | 0.0701 | 0.0127 | 0.0138 | 0.0081 | 0.0088 | 0.0156 | 1.0418 | 0.3023 | 0.2760 |
| 11/6/1997 | 0.1783 | 0.0145 | 0.0736 | 0.0127 | 0.0127 | 0.0087 | 0.0090 | 0.0157 | 0.9932 | 0.3023 | 0.2445 |
| 11/7/1997 | 0.1643 | 0.0127 | 0.0626 | 0.0131 | 0.0132 | 0.0088 | 0.0088 | 0.0158 | 0.8950 | 0.2629 | 0.2304 |
| 11/8/1997 | 0.1538 | 0.0120 | 0.0587 | 0.0110 | 0.0124 | 0.0106 | 0.0086 | 0.0085 | 0.9148 | 0.2629 | 0.2296 |
| 11/9/1997 | 0.1590 | 0.0110 | 0.0605 | 0.0110 | 0.0127 | 0.0111 | 0.0088 | 0.0085 | 0.9310 | 0.2716 | 0.2318 |
| 11/10/1997 | 0.1454 | 0.0110 | 0.0565 | 0.0110 | 0.0131 | 0.0098 | 0.0095 | 0.0085 | 1.1036 | 0.2760 | 0.2353 |
| 11/11/1997 | 0.1608 | 0.0107 | 0.0561 | 0.0136 | 0.0131 | 0.0087 | 0.0097 | 0.0094 | 1.0155 | 0.3067 | 0.2418 |
| 11/12/1997 | 0.1415 | 0.0105 | 0.0543 | 0.0114 | 0.0127 | 0.0080 | 0.0099 | 0.0074 | 0.9765 | 0.3373 | 0.2370 |
| 11/13/1997 | 0.1419 | 0.0120 | 0.0543 | 0.0105 | 0.0127 | 0.0072 | 0.0100 | 0.0075 | 0.8845 | 0.3855 | 0.2296 |
| 11/14/1997 | 0.1411 | 0.0107 | 0.0464 | 0.0110 | 0.0123 | 0.0072 | 0.0101 | 0.0074 | 0.9721 | 0.4074 | 0.2383 |
| 11/15/1997 | 0.1345 | 0.0103 | 0.0513 | 0.0123 | 0.0124 | 0.0088 | 0.0102 | 0.0058 | 0.9669 | 0.4031 | 0.2287 |
| 11/16/1997 | 0.1634 | 0.0110 | 0.0626 | 0.0101 | 0.0132 | 0.0104 | 0.0113 | 0.0075 | 1.0186 | 0.4293 | 0.2401 |
| 11/17/1997 | 0.1897 | 0.0134 | 0.0705 | 0.0096 | 0.0144 | 0.0098 | 0.0119 | 0.0049 | 1.0273 | 0.4425 | 0.2948 |
| 11/18/1997 | 0.1744 | 0.0118 | 0.0657 | 0.0118 | 0.0134 | 0.0085 | 0.0115 | 0.0094 | 0.8179 | 0.3505 | 0.2379 |
| 11/19/1997 | 0.2637 | 0.0147 | 0.0999 | 0.0118 | 0.0138 | 0.0096 | 0.0101 | 0.0093 | 0.7715 | 0.4337 | 0.2646 |
| 11/20/1997 | 0.2580 | 0.0164 | 0.0859 | 0.0145 | 0.0146 | 0.0096 | 0.0108 | 0.0092 | 1.0725 | 0.3943 | 0.2664 |
| 11/21/1997 | 0.2077 | 0.0164 | 0.0754 | 0.0166 | 0.0146 | 0.0090 | 0.0109 | 0.0094 | 1.0265 | 0.3417 | 0.2423 |
| 11/22/1997 | 0.2335 | 0.0151 | 0.1117 | 0.0158 | 0.0138 | 0.0105 | 0.0120 | 0.0083 | 1.0322 | 0.3330 | 0.2747 |
| 11/23/1997 | 0.3571 | 0.0180 | 0.1406 | 0.0136 | 0.0155 | 0.0127 | 0.0113 | 0.0083 | 1.0383 | 0.4556 | 0.2764 |
| 11/24/1997 | 0.2589 | 0.0188 | 0.0994 | 0.0136 | 0.0153 | 0.0116 | 0.0111 | 0.0083 | 1.0177 | 0.3549 | 0.2418 |
| 11/25/1997 | 0.2256 | 0.0171 | 0.0793 | 0.0145 | 0.0148 | 0.0101 | 0.0108 | 0.0061 | 1.0361 | 0.3636 | 0.2283 |
| 11/26/1997 | 0.1928 | 0.0149 | 0.0670 | 0.0145 | 0.0140 | 0.0093 | 0.0100 | 0.0062 | 1.1299 | 0.3505 | 0.2125 |
| 11/27/1997 | 0.2050 | 0.0145 | 0.0815 | 0.0092 | 0.0140 | 0.0101 | 0.0106 | 0.0024 | 1.2306 | 0.3154 | 0.4556 |
| 11/28/1997 | 0.3334 | 0.0156 | 0.1424 | 0.0127 | 0.0149 | 0.0135 | 0.0109 | 0.0025 | 1.0497 | 0.4381 | 0.2970 |
| 11/29/1997 | 0.3430 | 0.0160 | 0.1507 | 0.0136 | 0.0150 | 0.0177 | 0.0141 | 0.0047 | 1.0957 | 0.4819 | 0.3189 |
| 11/30/1997 | 0.3102 | 0.0177 | 0.1214 | 0.0180 | 0.0162 | 0.0157 | 0.0123 | 0.0050 | 1.0690 | 0.4293 | 0.2410 |
| 12/1/1997 | 0.2169 | 0.0164 | 0.0793 | 0.0136 | 0.0152 | 0.0119 | 0.0120 | 0.0049 | 1.0295 | 0.3943 | 0.2256 |
| 12/2/1997 | 0.1954 | 0.0142 | 0.0675 | 0.0140 | 0.0140 | 0.0094 | 0.0105 | 0.0050 | 1.0002 | 0.3768 | 0.2247 |
| 12/3/1997 | 0.1766 | 0.0136 | 0.0618 | 0.0123 | 0.0138 | 0.0075 | 0.0099 | 0.0050 | 0.9822 | 0.3461 | 0.2313 |
| 12/4/1997 | 0.1472 | 0.0129 | 0.0596 | 0.0127 | 0.0128 | 0.0072 | 0.0094 | 0.0050 | 0.9459 | 0.3154 | 0.2256 |
| 12/5/1997 | 0.1560 | 0.0125 | 0.0561 | 0.0110 | 0.0121 | 0.0070 | 0.0100 | 0.0049 | 0.9480 | 0.2891 | 0.2278 |
| 12/6/1997 | 0.1498 | 0.0110 | 0.0539 | 0.0118 | 0.0134 | 0.0075 | 0.0117 | 0.0049 | 0.9621 | 0.2935 | 0.2243 |
| 12/7/1997 | 0.1682 | 0.0118 | 0.0613 | 0.0118 | 0.0138 | 0.0083 | 0.0100 | 0.0049 | 1.0072 | 0.3286 | 0.2318 |
| 12/8/1997 | 0.1665 | 0.0116 | 0.0631 | 0.0092 | 0.0140 | 0.0079 | 0.0086 | 0.0049 | 1.0203 | 0.3111 | 0.2322 |
| 12/9/1997 | 0.2361 | 0.0123 | 0.0938 | 0.0118 | 0.0140 | 0.0086 | 0.0101 | 0.0040 | 1.0532 | 0.3417 | 0.2510 |
| 12/10/1997 | 0.1967 | 0.0162 | 0.0784 | 0.0131 | 0.0145 | 0.0087 | 0.0112 | 0.0132 | 0.9520 | 0.3855 | 0.2440 |
| 12/11/1997 | 0.1893 | 0.0145 | 0.0648 | 0.0140 | 0.0132 | 0.0077 | 0.0105 | 0.0052 | 1.0072 | 0.3417 | 0.2212 |
| 12/12/1997 | 0.1560 | 0.0129 | 0.0583 | 0.0127 | 0.0138 | 0.0072 | 0.0097 | 0.0049 | 0.9187 | 0.3505 | 0.2252 |
| 12/13/1997 | 0.1577 | 0.0118 | 0.0574 | 0.0118 | 0.0140 | 0.0072 | 0.0098 | 0.0050 | 0.9187 | 0.3943 | 0.2221 |
| 12/14/1997 | 0.1783 | 0.0112 | 0.0666 | 0.0114 | 0.0133 | 0.0079 | 0.0105 | 0.0177 | 0.9104 | 0.4425 | 0.2296 |
| 12/15/1997 | 0.4412 | 0.0120 | 0.2006 | 0.0114 | 0.0158 | 0.0134 | 0.0109 | 0.0177 | 1.0462 | 0.3724 | 0.2957 |
| 12/16/1997 | 0.5958 | 0.0289 | 0.2848 | 0.0158 | 0.0239 | 0.0184 | 0.0183 | 0.0177 | 1.1132 | 0.4819 | 0.2799 |
| 12/17/1997 | 0.3733 | 0.0276 | 0.1529 | 0.0280 | 0.0224 | 0.0146 | 0.0145 | 0.0160 | 1.0549 | 0.4819 | 0.2370 |
| 12/18/1997 | 0.2462 | 0.0219 | 0.0885 | 0.0197 | 0.0180 | 0.0108 | 0.0108 | 0.0168 | 0.9919 | 0.3855 | 0.2283 |
| 12/19/1997 | 0.2226 | 0.0193 | 0.0517 | 0.0162 | 0.0168 | 0.0095 | 0.0109 | 0.0125 | 0.9792 | 0.3417 | 0.2423 |
| 12/20/1997 | 0.2567 | 0.0182 | 0.0955 | 0.0149 | 0.0160 | 0.0097 | 0.0123 | 0.0056 | 1.0076 | 0.3768 | 0.2392 |
| 12/21/1997 | 0.2116 | 0.0164 | 0.0740 | 0.0136 | 0.0147 | 0.0090 | 0.0092 | 0.0025 | 0.9927 | 0.3242 | 0.2230 |
| 12/22/1997 | 0.2221 | 0.0158 | 0.0859 | 0.0114 | 0.0145 | 0.0089 | 0.0083 | 0.0024 | 1.0304 | 0.3154 | 0.2383 |
| 12/23/1997 | 0.2379 | 0.0153 | 0.0986 | 0.0145 | 0.0150 | 0.0099 | 0.0093 | 0.0024 | 0.9914 | 0.3417 | 0.2375 |
| 12/24/1997 | 0.1914 | 0.0142 | 0.0315 | 0.0140 | 0.0144 | 0.0099 | 0.0092 | 0.0054 | 1.0234 | 0.3023 | 0.2370 |
| 12/25/1997 | 0.1792 | 0.0120 | 0.0618 | 0.0131 | 0.0131 | 0.0078 | 0.0084 | 0.0056 | 0.9507 | 0.2804 | 0.1687 |
| 12/26/1997 | 0.1932 | 0.0136 | 0.0846 | 0.0092 | 0.0135 | 0.0094 | 0.0078 | 0.0019 | 1.0151 | 0.2979 | 0.2523 |
| 12/27/1997 | 0.2453 | 0.0151 | 0.1187 | 0.0118 | 0.0140 | 0.0124 | 0.0092 | 0.0018 | 1.0685 | 0.3242 | 0.2786 |
| 12/28/1997 | 0.3561 | 0.0182 | 0.1818 | 0.0123 | 0.0162 | 0.0147 | 0.0105 | 0.0018 | 1.0479 | 0.4162 | 0.2668 |
| 12/29/1997 | 0.2396 | 0.0180 | 0.0959 | 0.0166 | 0.0132 | 0.0132 | 0.0099 | 0.0055 | 1.0528 | 0.3899 | 0.2357 |
| 12/30/1997 | 0.2002 | 0.0156 | 0.0754 | 0.0153 | 0.0142 | 0.0119 | 0.0093 | 0.0055 | 1.0352 | 0.3768 | 0.2182 |
| 12/31/1997 | 0.2191 | 0.0149 | 0.0841 | 0.0114 | 0.0142 | 0.0147 | 0.0089 | 0.0037 | 1.0466 | 0.3987 | 0.2427 |
| 1/1/1998 | 0.3172 | 0.0204 | 0.1406 | 0.0131 | 0.0166 | 0.0148 | 0.0095 | 0.0037 | 1.0720 | 0.4819 | 0.2559 |
| 1/2/1998 | 0.2173 | 0.0191 | 0.0841 | 0.0123 | 0.0146 | 0.0134 | 0.0105 | 0.0009 | 0.9765 | 0.4381 | 0.2274 |
| 1/3/1998 | 0.2445 | 0.0173 | 0.1104 | 0.0140 | 0.0152 | 0.0134 | 0.0087 | 0.0024 | 1.0300 | 0.3680 | 0.2392 |
| 1/4/1998 | 0.3308 | 0.0177 | 0.1757 | 0.0114 | 0.0159 | 0.0147 | 0.0113 | 0.0024 | 1.1084 | 0.4425 | 0.2624 |
| 1/5/1998 | 0.3671 | 0.0204 | 0.1709 | 0.0136 | 0.0166 | 0.0121 | 0.0104 | 0.0036 | 1.0392 | 0.4337 | 0.2440 |
| 1/6/1998 | 0.3715 | 0.0243 | 0.1713 | 0.0206 | 0.0173 | 0.0116 | 0.0099 | 0.0065 | 1.0817 | 0.4819 | 0.2589 |
| 1/7/1998 | 0.2694 | 0.0215 | 0.1135 | 0.0223 | 0.0163 | 0.0097 | 0.0134 | 0.0092 | 0.9708 | 0.4074 | 0.2283 |
| 1/8/1998 | 0.2182 | 0.0184 | 0.0824 | 0.0175 | 0.0149 | 0.0085 | 0.0097 | 0.0094 | 0.9691 | 0.3987 | 0.2081 |
| 1/9/1998 | 0.1893 | 0.0160 | 0.0605 | 0.0153 | 0.0142 | 0.0078 | 0.0083 | 0.0094 | 1.0103 | 0.3768 | 0.2226 |
| 1/10/1998 | 0.1761 | 0.0147 | 0.0530 | 0.0136 | 0.0134 | 0.0079 | 0.0075 | 0.0074 | 0.9700 | 0.3592 | 0.2642 |
| 1/11/1998 | 0.2120 | 0.0147 | 0.0613 | 0.0127 | 0.0145 | 0.0083 | 0.0087 | 0.0037 | 0.9726 | 0.3242 | 0.2642 |

| date PST | aberdn | elma | hoquiam | mcleary | montesn | ocenshr | westprt | ospray1 | weyco1 | weyco2 | ghpapr1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/12/1998 | 0.1608 | 0.0153 | 0.0846 | 0.0127 | 0.0154 | 0.0086 | 0.0079 | 0.0035 | 0.9853 | 0.3855 | 0.3084 |
| 1/13/1998 | 0.4631 | 0.0180 | 0.1840 | 0.0136 | 0.0174 | 0.0107 | 0.0111 | 0.0037 | 1.0230 | 0.4644 | 0.2664 |
| 1/14/1998 | 0.5288 | 0.0307 | 0.2423 | 0.0197 | 0.0251 | 0.0136 | 0.0127 | 0.0037 | 1.1680 | 0.4819 | 0.3062 |
| 1/15/1998 | 0.3343 | 0.0272 | 0.1157 | 0.0241 | 0.0133 | 0.0109 | 0.0132 | 0.0087 | 1.0186 | 0.4819 | 0.2383 |
| 1/16/1998 | 0.3636 | 0.0241 | 0.1638 | 0.0197 | 0.0197 | 0.0112 | 0.0087 | 0.0080 | 1.0440 | 0.4644 | 0.3719 |
| 1/17/1998 | 0.3382 | 0.0267 | 0.1310 | 0.0223 | 0.0203 | 0.0121 | 0.0114 | 0.0061 | 1.0308 | 0.4819 | 0.3071 |
| 1/18/1998 | 0.3146 | 0.0228 | 0.1209 | 0.0202 | 0.0179 | 0.0133 | 0.0102 | 0.0060 | 1.0317 | 0.4118 | 0.2532 |
| 1/19/1998 | 0.3413 | 0.0208 | 0.1560 | 0.0184 | 0.0180 | 0.0145 | 0.0109 | 0.0062 | 1.0615 | 0.4031 | 0.2594 |
| 1/20/1998 | 0.3062 | 0.0204 | 0.1174 | 0.0175 | 0.0162 | 0.0136 | 0.0126 | 0.0061 | 0.9875 | 0.3943 | 0.2528 |
| 1/21/1998 | 0.3654 | 0.0199 | 0.1354 | 0.0166 | 0.0164 | 0.0129 | 0.0221 | 0.0122 | 1.0291 | 0.4381 | 0.2563 |
| 1/22/1998 | 0.4092 | 0.0206 | 0.1787 | 0.0166 | 0.0177 | 0.0140 | 0.0120 | 0.0134 | 1.1036 | 0.4293 | 0.2764 |
| 1/23/1998 | 0.6550 | 0.0274 | 0.3010 | 0.0188 | 0.0216 | 0.0201 | 0.0158 | 0.0133 | 1.1745 | 0.4819 | 0.3238 |
| 1/24/1998 | 0.5989 | 0.0289 | 0.2488 | 0.0237 | 0.0239 | 0.0204 | 0.0207 | 0.0157 | 1.1430 | 0.4819 | 0.2870 |
| 1/25/1998 | 0.4315 | 0.0276 | 0.1853 | 0.0237 | 0.0229 | 0.0159 | 0.0138 | 0.0155 | 1.1259 | 0.4819 | 0.3045 |
| 1/26/1998 | 0.3119 | 0.0261 | 0.1152 | 0.0184 | 0.0199 | 0.0131 | 0.0133 | 0.0094 | 1.0957 | 0.4819 | 0.2791 |
| 1/27/1998 | 0.2475 | 0.0226 | 0.0841 | 0.0197 | 0.0177 | 0.0107 | 0.0101 | 0.0036 | 1.0742 | 0.4644 | 0.2712 |
| 1/28/1998 | 0.2186 | 0.0202 | 0.0767 | 0.0171 | 0.0160 | 0.0097 | 0.0093 | 0.0037 | 1.0584 | 0.4600 | 0.2835 |
| 1/29/1998 | 0.2480 | 0.0188 | 0.0872 | 0.0158 | 0.0153 | 0.0098 | 0.0072 | 0.0061 | 0.9572 | 0.4337 | 0.2721 |
| 1/30/1998 | 0.1954 | 0.0177 | 0.0710 | 0.0166 | 0.0147 | 0.0095 | 0.0118 | 0.0062 | 1.0234 | 0.4600 | 0.2462 |
| 1/31/1998 | 0.1840 | 0.0164 | 0.0644 | 0.0140 | 0.0143 | 0.0106 | 0.0090 | 0.0062 | 1.0282 | 0.4381 | 0.2405 |
| 2/1/1998 | 0.2028 | 0.0156 | 0.0740 | 0.0118 | 0.0139 | 0.0121 | 0.0079 | 0.0037 | 0.9993 | 0.4250 | 0.2545 |
| 2/2/1998 | 0.1893 | 0.0156 | 0.0679 | 0.0110 | 0.0142 | 0.0111 | 0.0125 | 0.0036 | 1.0234 | 0.4031 | 0.2488 |
| 2/3/1998 | 0.1722 | 0.0145 | 0.0605 | 0.0131 | 0.0127 | 0.0094 | 0.0106 | 0.0036 | 0.9327 | 0.3592 | 0.2467 |
| 2/4/1998 | 0.1893 | 0.0138 | 0.0692 | 0.0127 | 0.0134 | 0.0099 | 0.0085 | 0.0038 | 1.0138 | 0.3680 | 0.2607 |
| 2/5/1998 | 0.1770 | 0.0142 | 0.0718 | 0.0127 | 0.0140 | 0.0088 | 0.0090 | 0.0061 | 0.9805 | 0.3768 | 0.2410 |
| 2/6/1998 | 0.1923 | 0.0044 | 0.0732 | 0.0118 | 0.0143 | 0.0095 | 0.0089 | 0.0062 | 0.1849 | 0.4469 | 0.2874 |
| 2/7/1998 | 0.1919 | 0.0129 | 0.0653 | 0.0131 | 0.0130 | 0.0106 | 0.0087 | 0.0062 | 0.0000 | 0.4819 | 0.2458 |
| 2/8/1998 | 0.2344 | 0.0160 | 0.0850 | 0.0114 | 0.0152 | 0.0108 | 0.0089 | 0.0045 | 0.5831 | 0.4600 | 0.1770 |
| 2/9/1998 | 0.1844 | 0.0166 | 0.0675 | 0.0114 | 0.0148 | 0.0094 | 0.0094 | 0.0036 | 0.9305 | 0.3592 | 0.2734 |
| 2/10/1998 | 0.2366 | 0.0160 | 0.0907 | 0.0145 | 0.0147 | 0.0099 | 0.0076 | 0.0037 | 0.9441 | 0.4206 | 0.2944 |
| 2/11/1998 | 0.2572 | 0.0158 | 0.1082 | 0.0145 | 0.0150 | 0.0109 | 0.0118 | 0.0037 | 0.9524 | 0.4600 | 0.2861 |
| 2/12/1998 | 0.4512 | 0.0197 | 0.2436 | 0.0131 | 0.0176 | 0.0119 | 0.0099 | 0.0070 | 1.0282 | 0.4819 | 0.4328 |
| 2/13/1998 | 0.2953 | 0.0092 | 0.1292 | 0.0166 | 0.0194 | 0.0116 | 0.0116 | 0.0066 | 0.8302 | 0.4819 | 0.2839 |
| 2/14/1998 | 0.2414 | 0.0184 | 0.0968 | 0.0158 | 0.0169 | 0.0138 | 0.0112 | 0.0069 | 0.9800 | 0.4688 | 0.2594 |
| 2/15/1998 | 0.2195 | 0.0166 | 0.0863 | 0.0131 | 0.0145 | 0.0155 | 0.0103 | 0.0068 | 1.0103 | 0.3724 | 0.2537 |
| 2/16/1998 | 0.1976 | 0.0151 | 0.0714 | 0.0131 | 0.0139 | 0.0143 | 0.0106 | 0.0068 | 0.8731 | 0.3242 | 0.2322 |
| 2/17/1998 | 0.2007 | 0.0145 | 0.0675 | 0.0123 | 0.0146 | 0.0127 | 0.0107 | 0.0069 | 0.9581 | 0.3154 | 0.2401 |
| 2/18/1998 | 0.2903 | 0.0153 | 0.1205 | 0.0131 | 0.0142 | 0.0162 | 0.0100 | 0.0037 | 0.9980 | 0.3680 | 0.2760 |
| 2/19/1998 | 0.2208 | 0.0153 | 0.0824 | 0.0140 | 0.0144 | 0.0139 | 0.0125 | 0.0062 | 1.0068 | 0.3373 | 0.2405 |
| 2/20/1998 | 0.4618 | 0.0149 | 0.1726 | 0.0131 | 0.0153 | 0.0164 | 0.0091 | 0.0062 | 1.0545 | 0.4206 | 0.2839 |
| 2/21/1998 | 0.3290 | 0.0188 | 0.1419 | 0.0136 | 0.0170 | 0.0169 | 0.0089 | 0.0062 | 0.9778 | 0.4469 | 0.2870 |
| 2/22/1998 | 0.2994 | 0.0188 | 0.1104 | 0.0162 | 0.0157 | 0.0150 | 0.0114 | 0.0062 | 0.9634 | 0.3811 | 0.2375 |
| 2/23/1998 | 0.2186 | 0.0162 | 0.0762 | 0.0127 | 0.0144 | 0.0117 | 0.0099 | 0.0061 | 0.9016 | 0.3417 | 0.2226 |
| 2/24/1998 | 0.1958 | 0.0147 | 0.0675 | 0.0145 | 0.0141 | 0.0101 | 0.0091 | 0.0062 | 0.9380 | 0.3286 | 0.2410 |
| 2/25/1998 | 0.1936 | 0.0147 | 0.0683 | 0.0123 | 0.0140 | 0.0094 | 0.0088 | 0.0063 | 1.0046 | 0.3680 | 0.2274 |
| 2/26/1998 | 0.1783 | 0.0138 | 0.0609 | 0.0118 | 0.0143 | 0.0091 | 0.0086 | 0.0062 | 0.9432 | 0.3724 | 0.2221 |
| 2/27/1998 | 0.1669 | 0.0131 | 0.0605 | 0.0118 | 0.0139 | 0.0093 | 0.0085 | 0.0062 | 0.9437 | 0.3680 | 0.2261 |
| 2/28/1998 | 0.2510 | 0.0149 | 0.1030 | 0.0110 | 0.0148 | 0.0123 | 0.0082 | 0.0062 | 1.0164 | 0.4031 | 0.2655 |
| 3/1/1998 | 0.2368 | 0.0188 | 0.1016 | 0.0131 | 0.0155 | 0.0132 | 0.0109 | 0.0062 | 0.9897 | 0.4250 | 0.2423 |
| 3/2/1998 | 0.2227 | 0.0169 | 0.0863 | 0.0149 | 0.0154 | 0.0116 | 0.0096 | 0.0061 | 0.9152 | 0.3987 | 0.2322 |
| 3/3/1998 | 0.2061 | 0.0160 | 0.0732 | 0.0140 | 0.0149 | 0.0097 | 0.0096 | 0.0063 | 0.8762 | 0.3461 | 0.2309 |
| 3/4/1998 | 0.1966 | 0.0171 | 0.0775 | 0.0131 | 0.0144 | 0.0091 | 0.0083 | 0.0062 | 0.9870 | 0.3198 | 0.2414 |
| 3/5/1998 | 0.1755 | 0.0151 | 0.0648 | 0.0131 | 0.0134 | 0.0078 | 0.0088 | 0.0062 | 0.9428 | 0.2891 | 0.2182 |
| 3/6/1998 | 0.1638 | 0.0140 | 0.0570 | 0.0118 | 0.0136 | 0.0084 | 0.0079 | 0.0062 | 0.9621 | 0.2848 | 0.2471 |
| 3/7/1998 | 0.1704 | 0.0131 | 0.0626 | 0.0131 | 0.0140 | 0.0103 | 0.0085 | 0.0062 | 0.9892 | 0.2804 | 0.2449 |
| 3/8/1998 | 0.2261 | 0.0145 | 0.0876 | 0.0092 | 0.0149 | 0.0121 | 0.0090 | 0.0062 | 1.0142 | 0.3242 | 0.2431 |
| 3/9/1998 | 0.3624 | 0.0191 | 0.1678 | 0.0105 | 0.0167 | 0.0130 | 0.0106 | 0.0061 | 1.0212 | 0.4644 | 0.2694 |
| 3/10/1998 | 0.2915 | 0.0199 | 0.0986 | 0.0175 | 0.0170 | 0.0119 | 0.0102 | 0.0062 | 0.9235 | 0.4074 | 0.2572 |
| 3/11/1998 | 0.2331 | 0.0175 | 0.0723 | 0.0162 | 0.0157 | 0.0098 | 0.0103 | 0.0109 | 0.9463 | 0.3724 | 0.1980 |
| 3/12/1998 | 0.2152 | 0.0160 | 0.0780 | 0.0140 | 0.0149 | 0.0099 | 0.0081 | 0.0124 | 1.1360 | 0.3636 | 0.1985 |
| 3/13/1998 | 0.1853 | 0.0158 | 0.0675 | 0.0140 | 0.0144 | 0.0097 | 0.0088 | 0.0126 | 1.0913 | 0.3198 | 0.2094 |
| 3/14/1998 | 0.1792 | 0.0138 | 0.0609 | 0.0136 | 0.0134 | 0.0118 | 0.0084 | 0.0078 | 1.1294 | 0.2979 | 0.2033 |
| 3/15/1998 | 0.1833 | 0.0140 | 0.0613 | 0.0105 | 0.0135 | 0.0131 | 0.0095 | 0.0062 | 1.1342 | 0.3023 | 0.1923 |
| 3/16/1998 | 0.1647 | 0.0131 | 0.0570 | 0.0092 | 0.0147 | 0.0112 | 0.0099 | 0.0062 | 1.1605 | 0.2804 | 0.2138 |
| 3/17/1998 | 0.1560 | 0.0127 | 0.0521 | 0.0118 | 0.0124 | 0.0097 | 0.0086 | 0.0031 | 1.0374 | 0.2716 | 0.2440 |
| 3/18/1998 | 0.1529 | 0.0125 | 0.0513 | 0.0114 | 0.0130 | 0.0086 | 0.0083 | 0.0031 | 0.9191 | 0.2629 | 0.2309 |
| 3/19/1998 | 0.1538 | 0.0120 | 0.0508 | 0.0110 | 0.0127 | 0.0086 | 0.0094 | 0.0062 | 0.9161 | 0.2629 | 0.2383 |
| 3/20/1998 | 0.1345 | 0.0116 | 0.0403 | 0.0101 | 0.0125 | 0.0093 | 0.0104 | 0.0062 | 0.9450 | 0.2585 | 0.2379 |
| 3/21/1998 | 0.1884 | 0.0129 | 0.0863 | 0.0118 | 0.0137 | 0.0132 | 0.0100 | 0.0062 | 1.0116 | 0.3198 | 0.2738 |
| 3/22/1998 | 0.2318 | 0.0136 | 0.1047 | 0.0123 | 0.0148 | 0.0150 | 0.0135 | 0.0030 | 1.0142 | 0.3286 | 0.2580 |

| date PST | aberdn | elma | hoquiam | mcleary | montesn | ocenshr | westprt | ospray1 | weyco1 | weyco2 | ghpapr1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3/23/1998 | 0.2988 | 0.0171 | 0.1336 | 0.0110 | 0.0160 | 0.0148 | 0.0118 | 0.0030 | 1.0418 | 0.4206 | 0.3365 |
| 3/24/1998 | 0.2663 | 0.0193 | 0.1051 | 0.0166 | 0.0160 | 0.0132 | 0.0123 | 0.0031 | 1.0054 | 0.3943 | 0.2559 |
| 3/25/1998 | 0.2169 | 0.0162 | 0.0754 | 0.0166 | 0.0150 | 0.0117 | 0.0112 | 0.0062 | 0.9222 | 0.3636 | 0.2383 |
| 3/26/1998 | 0.2177 | 0.0171 | 0.0727 | 0.0149 | 0.0145 | 0.0111 | 0.0096 | 0.0062 | 0.8468 | 0.3943 | 0.2401 |
| 3/27/1998 | 0.2309 | 0.0164 | 0.0758 | 0.0149 | 0.0156 | 0.0115 | 0.0109 | 0.0064 | 1.0466 | 0.4118 | 0.2357 |
| 3/28/1998 | 0.1862 | 0.0149 | 0.0609 | 0.0136 | 0.0143 | 0.0121 | 0.0100 | 0.0063 | 1.0186 | 0.4031 | 0.2278 |
| 3/29/1998 | 0.1752 | 0.0138 | 0.0574 | 0.0110 | 0.0135 | 0.0131 | 0.0122 | 0.0046 | 1.0291 | 0.3768 | 0.2278 |
| 3/30/1998 | 0.1726 | 0.0145 | 0.0635 | 0.0123 | 0.0145 | 0.0132 | 0.0132 | 0.0045 | 0.9967 | 0.3505 | 0.2414 |
| 3/31/1998 | 0.1656 | 0.0138 | 0.0570 | 0.0123 | 0.0143 | 0.0119 | 0.0150 | 0.0048 | 0.9634 | 0.3242 | 0.2445 |
| 4/1/1998 | 0.1590 | 0.0129 | 0.0534 | 0.0110 | 0.0137 | 0.0113 | 0.0122 | 0.0046 | 0.9752 | 0.2760 | 0.2861 |
| 4/2/1998 | 0.1503 | 0.0125 | 0.0530 | 0.0118 | 0.0121 | 0.0103 | 0.0107 | 0.0062 | 0.9218 | 0.2541 | 0.2607 |
| 4/3/1998 | 0.1389 | 0.0127 | 0.0504 | 0.0118 | 0.0143 | 0.0101 | 0.0120 | 0.0062 | 1.0287 | 0.2497 | 0.2138 |
| 4/4/1998 | 0.1411 | 0.0118 | 0.0482 | 0.0114 | 0.0122 | 0.0109 | 0.0091 | 0.0061 | 1.0111 | 0.2453 | 0.2033 |
| 4/5/1998 | 0.1389 | 0.0107 | 0.0482 | 0.0088 | 0.0129 | 0.0116 | 0.0107 | 0.0059 | 0.9349 | 0.2410 | 0.2138 |
| 4/6/1998 | 0.1415 | 0.0105 | 0.0495 | 0.0101 | 0.0134 | 0.0113 | 0.0110 | 0.0043 | 0.9520 | 0.2410 | 0.2204 |
| 4/7/1998 | 0.1411 | 0.0105 | 0.0473 | 0.0101 | 0.0123 | 0.0111 | 0.0110 | 0.0043 | 0.9586 | 0.2453 | 0.2147 |
| 4/8/1998 | 0.1411 | 0.0101 | 0.0469 | 0.0096 | 0.0126 | 0.0097 | 0.0110 | 0.0044 | 0.9345 | 0.2366 | 0.2151 |
| 4/9/1998 | 0.1349 | 0.0103 | 0.0499 | 0.0096 | 0.0122 | 0.0104 | 0.0111 | 0.0042 | 0.9879 | 0.2453 | 0.2287 |
| 4/10/1998 | 0.1516 | 0.0116 | 0.0605 | 0.0096 | 0.0133 | 0.0112 | 0.0106 | 0.0043 | 1.0431 | 0.2935 | 0.2944 |
| 4/11/1998 | 0.1674 | 0.0125 | 0.0683 | 0.0114 | 0.0142 | 0.0118 | 0.0117 | 0.0042 | 1.1172 | 0.3286 | 0.2664 |
| 4/12/1998 | 0.1717 | 0.0120 | 0.0653 | 0.0096 | 0.0144 | 0.0126 | 0.0127 | 0.0045 | 1.1321 | 0.3154 | 0.2366 |
| 4/13/1998 | 0.1674 | 0.0112 | 0.0605 | 0.0092 | 0.0137 | 0.0114 | 0.0107 | 0.0039 | 1.1456 | 0.2979 | 0.1871 |
| 4/14/1998 | 0.1494 | 0.0110 | 0.0543 | 0.0110 | 0.0130 | 0.0110 | 0.0098 | 0.0045 | 1.0672 | 0.2716 | 0.1897 |
| 4/15/1998 | 0.1503 | 0.0107 | 0.0517 | 0.0110 | 0.0136 | 0.0114 | 0.0094 | 0.0044 | 0.9270 | 0.2410 | 0.2046 |
| 4/16/1998 | 0.1358 | 0.0114 | 0.0504 | 0.0101 | 0.0125 | 0.0118 | 0.0107 | 0.0043 | 0.9415 | 0.1752 | 0.2028 |
| 4/17/1998 | 0.1336 | 0.0105 | 0.0486 | 0.0110 | 0.0129 | 0.0125 | 0.0113 | 0.0043 | 1.0252 | 0.2278 | 0.2151 |
| 4/18/1998 | 0.1546 | 0.0105 | 0.0548 | 0.0110 | 0.0129 | 0.0140 | 0.0108 | 0.0043 | 1.0098 | 0.2366 | 0.2182 |
| 4/19/1998 | 0.1381 | 0.0099 | 0.0513 | 0.0101 | 0.0129 | 0.0133 | 0.0118 | 0.0042 | 1.0146 | 0.2322 | 0.2212 |
| 4/20/1998 | 0.1354 | 0.0101 | 0.0495 | 0.0074 | 0.0129 | 0.0111 | 0.0109 | 0.0041 | 0.9713 | 0.2278 | 0.2488 |
| 4/21/1998 | 0.1358 | 0.0096 | 0.0473 | 0.0088 | 0.0125 | 0.0097 | 0.0099 | 0.0044 | 0.9191 | 0.2234 | 0.2602 |
| 4/22/1998 | 0.1292 | 0.0096 | 0.0469 | 0.0096 | 0.0128 | 0.0100 | 0.0095 | 0.0044 | 0.8823 | 0.2278 | 0.2471 |
| 4/23/1998 | 0.1297 | 0.0103 | 0.0504 | 0.0083 | 0.0115 | 0.0091 | 0.0106 | 0.0043 | 1.0519 | 0.2410 | 0.2480 |
| 4/24/1998 | 0.1301 | 0.0105 | 0.0495 | 0.0110 | 0.0128 | 0.0095 | 0.0098 | 0.0043 | 1.0484 | 0.2585 | 0.2453 |
| 4/25/1998 | 0.1292 | 0.0105 | 0.0482 | 0.0105 | 0.0115 | 0.0106 | 0.0096 | 0.0043 | 1.0773 | 0.2760 | 0.2440 |
| 4/26/1998 | 0.1415 | 0.0103 | 0.0486 | 0.0088 | 0.0124 | 0.0110 | 0.0084 | 0.0031 | 1.0773 | 0.2804 | 0.2480 |
| 4/27/1998 | 0.1331 | 0.0099 | 0.0469 | 0.0079 | 0.0127 | 0.0097 | 0.0115 | 0.0030 | 1.0124 | 0.2804 | 0.2230 |
| 4/28/1998 | 0.1249 | 0.0092 | 0.0456 | 0.0096 | 0.0121 | 0.0086 | 0.0102 | 0.0031 | 0.9927 | 0.2541 | 0.2112 |
| 4/29/1998 | 0.1218 | 0.0088 | 0.0456 | 0.0101 | 0.0123 | 0.0103 | 0.0085 | 0.0031 | 0.9927 | 0.2453 | 0.2085 |
| 4/30/1998 | 0.1200 | 0.0094 | 0.0407 | 0.0096 | 0.0123 | 0.0079 | 0.0108 | 0.0033 | 1.0111 | 0.2410 | 0.2545 |
| 5/1/1998 | 0.1249 | 0.0090 | 0.0425 | 0.0083 | 0.0119 | 0.0083 | 0.0096 | 0.0030 | 1.0203 | 0.2278 | 0.2712 |
| 5/2/1998 | 0.1358 | 0.0096 | 0.0399 | 0.0083 | 0.0125 | 0.0111 | 0.0090 | 0.0031 | 0.9954 | 0.2322 | 0.2379 |
| 5/3/1998 | 0.1319 | 0.0090 | 0.0469 | 0.0079 | 0.0127 | 0.0121 | 0.0115 | 0.0031 | 1.0633 | 0.2191 | 0.2445 |
| 5/4/1998 | 0.1283 | 0.0103 | 0.0469 | 0.0074 | 0.0124 | 0.0106 | 0.0105 | 0.0030 | 1.0865 | 0.2191 | 0.2440 |
| 5/5/1998 | 0.1288 | 0.0096 | 0.0464 | 0.0092 | 0.0120 | 0.0090 | 0.0203 | 0.0031 | 1.0733 | 0.2147 | 0.2458 |
| 5/6/1998 | 0.1214 | 0.0094 | 0.0469 | 0.0092 | 0.0124 | 0.0084 | 0.0097 | 0.0027 | 1.0996 | 0.2191 | 0.2361 |

# Table B6. Daily average flows (in cms) for each model node.

| Sta IDs that flow to model node<br>Node-> | ocenshr<br>westprt<br>**2** | 509-ADAM<br>hoquiam<br>**10** | 502-FRY<br>506-28TH<br>507-G3<br>ghpapr1<br>**12** | 17-CHAP<br>18-CAMP<br>19-INDI<br>20-STAF<br>21-OLEA<br>**15** | 15-CHAR<br>16-NEWS<br>weyco1<br>**17** | 35-WEST<br>**18** | 24-REDM<br>**19** | 01-HUMP<br>03-CHEN<br>04-GRASS<br>**29** | 41-ALDR<br>501-ABDIV<br>510-MST<br>512-DAWS<br>513-SAG<br>514-HST<br>aberdn<br>**37** | 500-WILS<br>504-SHAN<br>**40** | 11-ELLI<br>503-MILR<br>505-MILL<br>**43** | 12-CENT<br>weyco2<br>**48** | 42-PEEL<br>**57** | 13-WYNO<br>montesn<br>**64** | elma<br>mcleary<br>satsopQ<br>**66** | 38-PORT<br>**68** | 508-KST<br>516-EMER<br>517-QEEN<br>518-15TH<br>**69** | hoqnowf<br>**72** | wfconf<br>**74** | arthr-pmp<br>**75** | 08-WISH<br>**79** | ditchmwth<br>**81** | 25-DEMP<br>26-BARL<br>**82** | andrmwth<br>elkmwth<br>**83** | 22-JOHN<br>ospray1<br>**84** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/1/1997 | 0.0152 | 0.1106 | 0.7723 | 1.5853 | 5.2061 | 0.0946 | 0.2339 | 175.3279 | 0.5394 | 0.2034 | 1.7100 | 0.7234 | 0.3238 | 77.8853 | 120.9421 | 197.8874 | 0.2191 | 24.9279 | 22.0272 | | 52.2903 | 1.0748 | 0.5573 | 4.5201 | 5.2050 |
| 5/2/1997 | 0.0159 | 0.1170 | 0.6581 | 1.4048 | 4.6682 | 0.0838 | 0.2073 | 120.4113 | 0.5156 | 0.1803 | 1.5153 | 0.6800 | 0.2869 | 54.9476 | 93.7548 | 212.5717 | 0.1294 | 14.3309 | 13.2371 | | 37.8019 | 1.0055 | 0.4939 | 4.1196 | 4.4277 |
| 5/3/1997 | 0.0192 | 0.1243 | 0.7171 | 1.5177 | 4.8948 | 0.0905 | 0.2240 | 117.7655 | 0.5635 | 0.1948 | 1.6372 | 0.7422 | 0.3100 | 44.7546 | 79.5927 | 192.6431 | 0.1649 | 13.9388 | 12.9946 | | 36.6298 | 1.5432 | 0.5336 | 4.4308 | 4.7869 |
| 5/4/1997 | 0.0205 | 0.1170 | 0.7205 | 1.4778 | 4.4723 | 0.0882 | 0.2181 | 109.9043 | 0.5393 | 0.1896 | 1.5941 | 0.7589 | 0.3018 | 44.7549 | 82.1434 | 180.0566 | 0.1559 | 12.0947 | 11.3427 | | 35.4035 | 1.3580 | 0.5195 | 4.3046 | 4.7027 |
| 5/5/1997 | 0.0197 | 0.1599 | 0.8710 | 2.2378 | 5.9787 | 0.1335 | 0.3302 | 127.5859 | 0.7682 | 0.2872 | 2.4139 | 0.9988 | 0.4570 | 74.4877 | 84.1256 | 173.4137 | 0.1408 | 15.6651 | 14.4303 | | 39.0065 | 1.2445 | 0.7867 | 6.1405 | 7.7148 |
| 5/6/1997 | 0.0180 | 0.1298 | 0.9326 | 1.8883 | 4.8339 | 0.1126 | 0.2786 | 129.4927 | 0.6471 | 0.2423 | 2.0369 | 0.9147 | 0.3856 | 117.8126 | 99.9876 | 162.2257 | 0.2057 | 15.0228 | 13.7152 | | 41.9403 | 1.1735 | 0.6638 | 5.3280 | 6.2729 |
| 5/7/1997 | 0.0162 | 0.0983 | 0.6870 | 1.4231 | 3.6430 | 0.0849 | 0.2100 | 103.4399 | 0.5159 | 0.1826 | 1.5351 | 0.8027 | 0.2906 | 67.1251 | 84.1302 | 159.4287 | 0.1341 | 10.3742 | 9.8213 | | 34.7576 | 0.9759 | 0.5003 | 4.0769 | 4.6245 |
| 5/8/1997 | 0.0156 | 0.1002 | 0.6874 | 1.2670 | 3.2434 | 0.0756 | 0.1870 | 84.2021 | 0.4637 | 0.1626 | 1.3667 | 0.7081 | 0.2588 | 54.6647 | 71.1009 | 147.1919 | 0.1176 | 8.3919 | 8.0879 | | 26.8877 | 0.9098 | 0.4454 | 3.6670 | 4.0638 |
| 5/9/1997 | 0.0155 | 0.0942 | 0.5757 | 1.1832 | 3.0288 | 0.0706 | 0.1746 | 79.1496 | 0.4305 | 0.1518 | 1.2763 | 0.6792 | 0.2416 | 44.1868 | 62.3220 | 132.8573 | 0.0969 | 6.9990 | 6.8582 | | 26.4993 | 0.8246 | 0.4159 | 3.4484 | 3.7748 |
| 5/10/1997 | 0.0176 | 0.0892 | 0.5554 | 1.1206 | 3.7292 | 0.0669 | 0.1654 | 66.3753 | 0.4045 | 0.1438 | 1.2088 | 0.6028 | 0.2289 | 33.9924 | 55.5216 | 119.2219 | 0.0908 | 5.9041 | 5.9187 | | 20.7934 | 0.7594 | 0.3940 | 3.2828 | 3.5518 |
| 5/11/1997 | 0.0194 | 0.0875 | 0.5482 | 1.0777 | 4.0022 | 0.0643 | 0.1590 | 61.5314 | 0.3940 | 0.1383 | 1.1625 | 0.6275 | 0.2201 | 28.2420 | 50.4241 | 108.0340 | 0.0576 | 5.0486 | 5.1881 | | 19.4401 | 0.7034 | 0.3789 | 3.1709 | 3.3981 |
| 5/12/1997 | 0.0194 | 0.0880 | 0.5403 | 1.0498 | 3.8941 | 0.0626 | 0.1549 | 57.4513 | 0.3831 | 0.1347 | 1.1325 | 0.5945 | 0.2144 | 30.8775 | 46.4576 | 98.9437 | 0.0472 | 4.5281 | 4.7220 | | 17.9766 | 0.6477 | 0.3691 | 3.1056 | 3.2818 |
| 5/13/1997 | 0.0194 | 0.0852 | 0.5276 | 1.0296 | 3.7762 | 0.0614 | 0.1519 | 53.1774 | 0.3814 | 0.1321 | 1.1107 | 0.5897 | 0.2103 | 30.8769 | 43.3460 | 91.6016 | 0.0515 | 4.0646 | 4.3113 | | 16.2721 | 0.6570 | 0.3620 | 3.0391 | 3.2281 |
| 5/14/1997 | 0.0174 | 0.0830 | 0.5332 | 0.9877 | 3.5391 | 0.0589 | 0.1457 | 48.9818 | 0.3589 | 0.1267 | 1.0654 | 0.5883 | 0.2017 | 31.1608 | 40.5139 | 84.9587 | 0.0427 | 3.6541 | 3.9594 | | 14.5059 | 0.6570 | 0.3472 | 2.9038 | 3.1030 |
| 5/15/1997 | 0.0173 | 0.0824 | 0.5239 | 0.9651 | 3.6040 | 0.0576 | 0.1424 | 46.2641 | 0.3536 | 0.1239 | 1.0411 | 0.5303 | 0.1971 | 33.7096 | 38.2477 | 79.3647 | 0.0411 | 3.3633 | 3.6912 | | 13.4441 | 0.6237 | 0.3393 | 2.8360 | 3.0347 |
| 5/16/1997 | 0.0196 | 0.0799 | 0.5617 | 0.9559 | 3.5038 | 0.0570 | 0.1411 | 39.9112 | 0.3493 | 0.1227 | 1.0311 | 0.5149 | 0.1952 | 32.0108 | 36.2659 | 74.4700 | 0.0426 | 3.0720 | 3.4354 | | 10.1408 | 0.5977 | 0.3361 | 2.8185 | 2.9973 |
| 5/17/1997 | 0.0176 | 0.0766 | 0.5709 | 0.9318 | 3.5555 | 0.0556 | 0.1375 | 38.0811 | 0.3415 | 0.1196 | 1.0051 | 0.4960 | 0.1903 | 25.5544 | 34.2840 | 70.2745 | 0.0395 | 2.8660 | 3.2482 | | 9.4463 | 0.5757 | 0.3276 | 2.7581 | 2.9082 |
| 5/18/1997 | 0.0196 | 0.0774 | 0.5844 | 0.9152 | 3.4684 | 0.0546 | 0.1351 | 36.3089 | 0.3336 | 0.1174 | 0.9873 | 0.5095 | 0.1869 | 23.2593 | 32.8668 | 66.0790 | 0.0309 | 2.6890 | 3.0764 | | 8.7486 | 0.5419 | 0.3218 | 2.7219 | 2.8421 |
| 5/19/1997 | 0.0182 | 0.0794 | 0.6001 | 0.9092 | 3.3973 | 0.0542 | 0.1342 | 33.3157 | 0.3480 | 0.1167 | 0.9807 | 0.4906 | 0.1857 | 22.4673 | 31.1674 | 62.9324 | 0.0411 | 2.5192 | 2.9078 | | 7.2959 | 0.5348 | 0.3196 | 2.7096 | 2.8188 |
| 5/20/1997 | 0.0164 | 0.0826 | 0.5912 | 0.9007 | 3.4882 | 0.0537 | 0.1329 | 33.1555 | 0.3631 | 0.1156 | 0.9716 | 0.5060 | 0.1840 | 22.1848 | 30.6034 | 61.1843 | 0.0339 | 2.5954 | 2.9985 | | 7.0119 | 0.5115 | 0.3167 | 2.6914 | 2.7802 |
| 5/21/1997 | 0.0152 | 0.0784 | 0.5437 | 0.8895 | 3.4153 | 0.0531 | 0.1313 | 30.7859 | 0.3399 | 0.1141 | 0.9595 | 0.5209 | 0.1817 | 19.4083 | 29.7544 | 62.9324 | 0.0775 | 2.4334 | 2.8091 | | 5.9854 | 0.4993 | 0.3127 | 2.6649 | 2.7392 |
| 5/22/1997 | 0.0149 | 0.0779 | 0.5368 | 0.8882 | 3.4103 | 0.0530 | 0.1311 | 28.7818 | 0.3357 | 0.1140 | 0.9581 | 0.6082 | 0.1814 | 18.0501 | 28.3372 | 61.8835 | 0.0440 | 2.2835 | 2.6808 | | 5.0434 | 0.5070 | 0.3123 | 2.6552 | 2.7449 |
| 5/23/1997 | 0.0167 | 0.0772 | 0.5097 | 0.9083 | 3.4300 | 0.0542 | 0.1340 | 26.7973 | 0.3408 | 0.1166 | 0.9798 | 0.5780 | 0.1855 | 15.8418 | 27.4866 | 58.3873 | 0.0499 | 2.2545 | 2.6506 | | 3.8889 | 0.4992 | 0.3193 | 2.7171 | 2.7997 |
| 5/24/1997 | 0.0200 | 0.0730 | 0.5055 | 0.8874 | 3.3679 | 0.0529 | 0.1309 | 27.3072 | 0.3280 | 0.1139 | 0.9572 | 0.5642 | 0.1812 | 13.5475 | 26.8364 | 57.6880 | 0.0396 | 2.1906 | 2.5742 | | 4.3761 | 0.4958 | 0.3120 | 2.6358 | 2.7636 |
| 5/25/1997 | 0.0251 | 0.0720 | 0.5003 | 0.8834 | 3.3913 | 0.0527 | 0.1304 | 29.4655 | 0.3218 | 0.1134 | 0.9529 | 0.4975 | 0.1804 | 13.4617 | 26.6371 | 56.9888 | 0.0701 | 2.0685 | 2.4775 | | 5.8941 | 0.4672 | 0.3106 | 2.6199 | 2.7514 |
| 5/26/1997 | 0.0258 | 0.0802 | 0.4968 | 0.8775 | 3.3850 | 0.0523 | 0.1295 | 26.9505 | 0.3349 | 0.1126 | 0.9465 | 0.4917 | 0.1792 | 12.4993 | 25.5630 | 54.5414 | 0.0657 | 1.9884 | 2.3916 | | 4.5553 | 0.4735 | 0.3085 | 2.5946 | 2.7448 |
| 5/27/1997 | 0.0228 | 0.0917 | 0.5954 | 1.0142 | 3.6790 | 0.0605 | 0.1497 | 31.3322 | 0.3892 | 0.1302 | 1.0941 | 0.4896 | 0.2071 | 13.0955 | 26.2148 | 53.8422 | 0.0968 | 2.3561 | 2.7578 | | 6.3345 | 0.6056 | 0.3566 | 3.0484 | 3.1005 |
| 5/28/1997 | 0.0202 | 0.1445 | 0.7219 | 1.6339 | 5.3355 | 0.0975 | 0.2411 | 39.9105 | 0.5823 | 0.2097 | 1.7625 | 0.7483 | 0.3337 | 21.4218 | 29.7585 | 58.0377 | 0.1264 | 2.9742 | 3.3771 | | 9.7677 | 0.9580 | 0.5744 | 4.8712 | 4.8784 |
| 5/29/1997 | 0.0192 | 0.1070 | 0.6904 | 1.1157 | 3.9767 | 0.0666 | 0.1646 | 43.7074 | 0.4287 | 0.1432 | 1.2035 | 0.5928 | 0.2279 | 37.6759 | 36.5563 | 65.0301 | 0.2283 | 3.0463 | 3.3985 | | 12.4054 | 1.2255 | 0.3922 | 3.3513 | 3.3733 |
| 5/30/1997 | 0.0188 | 0.2032 | 0.8136 | 1.9871 | 6.2539 | 0.1185 | 0.2932 | 51.0908 | 0.7372 | 0.2550 | 2.1434 | 0.8377 | 0.4058 | 32.8617 | 33.1559 | 67.8271 | 0.1186 | 4.4590 | 5.1423 | | 12.5374 | 1.1989 | 0.6986 | 5.7083 | 6.2897 |
| 5/31/1997 | 0.0204 | 0.1740 | 1.2068 | 2.0622 | 6.4002 | 0.1230 | 0.3043 | 81.0688 | 0.7473 | 0.2646 | 2.2245 | 0.9084 | 0.4212 | 44.7549 | 48.1686 | 77.6166 | 0.4724 | 7.9121 | 7.9373 | | 24.7245 | 1.5215 | 0.7250 | 5.9182 | 6.6314 |
| 6/1/1997 | 0.0183 | 0.1363 | 0.7730 | 1.5077 | 4.9417 | 0.0899 | 0.2225 | 71.5191 | 0.5708 | 0.1935 | 1.6263 | 0.7792 | 0.3079 | 54.6654 | 52.4157 | 156.6318 | 0.2382 | 6.1697 | 6.2030 | | 23.0259 | 1.1629 | 0.5300 | 4.1997 | 5.0899 |

| Sta IDs that flow to model node **Node->** | ocenshr westprt **2** | 509-ADAM hoquiam **10** | 502-FRY 506-28TH 507-G3 ghpapr1 **12** | 17-CHAP 18-CAMP 19-INDI 20-STAF 21-OLEA **15** | 15-CHAR 16-NEWS weyco1 **17** | 35-WEST **18** | 24-REDM **19** | 01-HUMP 03-CHEN 04-GRASS **29** | 41-ALDR 501-ABDIV 510-MST 512-DAWS 513-SAG 514-HST aberdn **37** | 500-WILS 504-SHAN **40** | 11-ELLI 503-MILR 505-MILL **43** | 12-CENT weyco2 **48** | 42-PEEL **57** | 13-WYNO montesn **64** | elma mcleary satsopQ **66** | 38-PORT **68** | 508-KST 516-EMER 517-QEEN 518-15TH **69** | hoqnowf **72** | wfconf **74** | arthr-pmp **75** | 08-WISH **79** | ditchmwth **81** | 25-DEMP 26-BARL **82** | andrmwth elkmwth **83** | 22-JOHN ospray1 **84** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6/2/1997 | 0.0164 | 0.1078 | 0.6527 | 1.1699 | 4.0486 | 0.0698 | 0.1726 | 61.3804 | 0.4725 | 0.1501 | 1.2620 | 0.6804 | 0.2389 | 46.4535 | 50.4305 | 146.4926 | 0.1978 | 4.9897 | 5.0709 | | 19.5303 | 0.8783 | 0.4113 | 3.3323 | 3.8451 |
| 6/3/1997 | 0.0188 | 0.1266 | 0.6506 | 1.2716 | 4.3350 | 0.0759 | 0.1876 | 65.0653 | 0.5090 | 0.1632 | 1.3716 | 0.7180 | 0.2597 | 44.7544 | 47.8822 | 125.8648 | 0.1441 | 5.3435 | 5.5210 | | 20.7341 | 0.9023 | 0.4470 | 3.6958 | 4.0622 |
| 6/4/1997 | 0.0166 | 0.1206 | 0.7315 | 1.3924 | 4.5720 | 0.0831 | 0.2055 | 66.6770 | 0.5280 | 0.1787 | 1.5019 | 0.7515 | 0.2844 | 47.5839 | 53.2639 | 127.9625 | 0.2250 | 5.1264 | 5.2577 | | 22.1835 | 1.3526 | 0.4895 | 4.3211 | 4.0962 |
| 6/5/1997 | 0.0152 | 0.0877 | 0.6430 | 1.0839 | 3.6462 | 0.0647 | 0.1599 | 59.7503 | 0.4283 | 0.1391 | 1.1692 | 0.6816 | 0.2214 | 40.5034 | 47.0307 | 136.7032 | 0.1612 | 3.9862 | 4.2054 | | 20.4453 | 1.0757 | 0.3811 | 3.1770 | 3.4359 |
| 6/6/1997 | 0.0160 | 0.0898 | 0.5439 | 0.9803 | 3.6319 | 0.0585 | 0.1447 | 50.7687 | 0.3861 | 0.1258 | 1.0574 | 0.6479 | 0.2002 | 31.1611 | 41.3665 | 122.0189 | 0.1140 | 3.4193 | 3.6895 | | 16.1696 | 0.8132 | 0.3446 | 2.8630 | 3.1177 |
| 6/7/1997 | 0.0176 | 0.0842 | 0.5724 | 0.9223 | 3.4303 | 0.0550 | 0.1361 | 45.3695 | 0.3660 | 0.1184 | 0.9948 | 0.5550 | 0.1884 | 24.4799 | 37.1187 | 102.4400 | 0.1082 | 3.0617 | 3.3321 | | 13.6965 | 0.7096 | 0.3242 | 2.7003 | 2.9212 |
| 6/8/1997 | 0.0187 | 0.0818 | 0.5125 | 0.8880 | 3.3414 | 0.0530 | 0.1310 | 39.7364 | 0.3544 | 0.1140 | 0.9579 | 0.4942 | 0.1814 | 18.5572 | 34.0015 | 87.7557 | 0.0664 | 2.8072 | 3.0878 | | 10.8238 | 0.6450 | 0.3122 | 2.5916 | 2.8237 |
| 6/9/1997 | 0.0176 | 0.0798 | 0.5166 | 0.8784 | 3.3540 | 0.0524 | 0.1296 | 34.4677 | 0.3478 | 0.1127 | 0.9475 | 0.4744 | 0.1794 | 16.5490 | 31.7352 | 77.6166 | 0.0532 | 2.5181 | 2.8411 | | 8.1591 | 0.5907 | 0.3088 | 2.5813 | 2.7797 |
| 6/10/1997 | 0.0168 | 0.0766 | 0.5096 | 0.8468 | 3.2631 | 0.0505 | 0.1250 | 32.1001 | 0.3356 | 0.1087 | 0.9135 | 0.4711 | 0.1729 | 16.2942 | 29.7539 | 69.2256 | 0.0516 | 2.3579 | 2.6830 | | 7.0822 | 0.5597 | 0.2977 | 2.4766 | 2.6932 |
| 6/11/1997 | 0.0164 | 0.0834 | 0.5830 | 0.8835 | 3.3661 | 0.0527 | 0.1304 | 31.5418 | 0.3503 | 0.1134 | 0.9530 | 0.4975 | 0.1804 | 17.1720 | 28.9062 | 63.2820 | 0.0577 | 2.4114 | 2.7653 | | 6.5415 | 0.6373 | 0.3106 | 2.6174 | 2.7647 |
| 6/12/1997 | 0.0164 | 0.0783 | 0.5678 | 0.8601 | 3.3163 | 0.0513 | 0.1269 | 30.1919 | 0.3427 | 0.1104 | 0.9278 | 0.4831 | 0.1757 | 17.9075 | 28.2545 | 59.7858 | 0.0663 | 2.3119 | 2.6462 | | 5.9931 | 0.6568 | 0.3024 | 2.5222 | 2.7334 |
| 6/13/1997 | 0.0155 | 0.0750 | 0.5187 | 0.8221 | 3.2251 | 0.0490 | 0.1213 | 27.6236 | 0.3167 | 0.1055 | 0.8868 | 0.4477 | 0.1679 | 16.5770 | 26.6946 | 57.6880 | 0.0428 | 2.0845 | 2.4303 | | 4.9220 | 0.5971 | 0.2890 | 2.4071 | 2.6129 |
| 6/14/1997 | 0.0176 | 0.0716 | 0.5238 | 0.8098 | 3.2002 | 0.0483 | 0.1195 | 26.1989 | 0.3142 | 0.1039 | 0.8735 | 0.4535 | 0.1654 | 14.8186 | 25.2204 | 53.8422 | 0.0326 | 1.9739 | 2.3276 | | 4.2851 | 0.5539 | 0.2847 | 2.3698 | 2.5742 |
| 6/15/1997 | 0.0197 | 0.0724 | 0.5207 | 0.7916 | 3.1520 | 0.0472 | 0.1168 | 24.7678 | 0.3100 | 0.1016 | 0.8539 | 0.4316 | 0.1617 | 14.1970 | 23.7760 | 50.6955 | 0.0492 | 1.8708 | 2.2363 | | 3.6243 | 0.5362 | 0.2783 | 2.3279 | 2.4966 |
| 6/16/1997 | 0.0197 | 0.0820 | 0.5553 | 0.8077 | 3.1980 | 0.0482 | 0.1192 | 24.0190 | 0.3308 | 0.1036 | 0.8713 | 0.4398 | 0.1650 | 14.1127 | 23.0115 | 47.8985 | 0.0391 | 1.9301 | 2.3490 | | 2.9186 | 0.5405 | 0.2840 | 2.3984 | 2.5098 |
| 6/17/1997 | 0.0194 | 0.1049 | 0.6676 | 1.1189 | 4.0292 | 0.0667 | 0.1651 | 43.6236 | 0.4233 | 0.1436 | 1.2069 | 0.5235 | 0.2285 | 22.5513 | 27.4601 | 49.2970 | 0.0766 | 2.7141 | 3.1328 | | 12.9173 | 0.7425 | 0.3933 | 3.4231 | 3.3263 |
| 6/18/1997 | 0.0180 | 0.0890 | 0.6012 | 0.9371 | 3.5038 | 0.0559 | 0.1383 | 41.6493 | 0.3725 | 0.1203 | 1.0108 | 0.4797 | 0.1914 | 33.1417 | 33.4360 | 53.1429 | 0.1300 | 2.5601 | 2.9586 | | 12.2232 | 0.7948 | 0.3294 | 2.8140 | 2.9033 |
| 6/19/1997 | 0.0178 | 0.0800 | 0.4898 | 0.8556 | 3.2983 | 0.0510 | 0.1263 | 31.5978 | 0.3385 | 0.1098 | 0.9230 | 0.4645 | 0.1747 | 27.8192 | 28.9018 | 53.4925 | 0.0698 | 2.1609 | 2.4958 | | 7.1690 | 0.6323 | 0.3008 | 2.5759 | 2.6494 |
| 6/20/1997 | 0.0183 | 0.0806 | 0.4833 | 0.8471 | 3.3106 | 0.0505 | 0.1250 | 28.8816 | 0.3469 | 0.1087 | 0.9137 | 0.5325 | 0.1730 | 18.5019 | 26.2971 | 48.9474 | 0.0597 | 2.0191 | 2.3681 | | 5.7992 | 0.5596 | 0.2978 | 2.5671 | 2.6012 |
| 6/21/1997 | 0.0208 | 0.1069 | 0.6208 | 1.2714 | 4.4274 | 0.0758 | 0.1876 | 31.7411 | 0.4813 | 0.1632 | 1.3714 | 0.6829 | 0.2597 | 15.7282 | 25.7042 | 46.8497 | 0.0859 | 2.1756 | 2.5529 | | 6.8300 | 1.0527 | 0.4470 | 4.0459 | 3.6046 |
| 6/22/1997 | 0.0220 | 0.0963 | 0.6229 | 1.2552 | 4.3708 | 0.0749 | 0.1852 | 40.3112 | 0.4662 | 0.1611 | 1.3540 | 0.6965 | 0.2564 | 16.6336 | 26.8123 | 50.3459 | 0.1065 | 2.7873 | 3.6125 | | 9.7876 | 1.1515 | 0.4413 | 3.6853 | 3.9318 |
| 6/23/1997 | 0.0211 | 0.0874 | 0.5382 | 0.9870 | 3.6732 | 0.0589 | 0.1456 | 40.0868 | 0.3934 | 0.1267 | 1.0647 | 0.5531 | 0.2016 | 18.8993 | 29.7526 | 55.9399 | 0.0837 | 2.5789 | 3.2010 | | 10.7231 | 0.8213 | 0.3470 | 2.9479 | 3.0814 |
| 6/24/1997 | 0.0187 | 0.0796 | 0.4876 | 0.9003 | 3.3680 | 0.0537 | 0.1328 | 32.7961 | 0.3613 | 0.1155 | 0.9711 | 0.4753 | 0.1839 | 17.8792 | 27.0068 | 56.6392 | 0.0614 | 2.2186 | 2.6682 | | 7.4967 | 0.6744 | 0.3165 | 2.6844 | 2.8161 |
| 6/25/1997 | 0.0179 | 0.0766 | 0.5255 | 0.8737 | 3.2193 | 0.0521 | 0.1289 | 30.7726 | 0.3511 | 0.1121 | 0.9425 | 0.4732 | 0.1784 | 16.9168 | 25.5609 | 52.0940 | 0.0600 | 2.0553 | 2.4697 | | 6.7107 | 0.5985 | 0.3072 | 2.6198 | 2.7183 |
| 6/26/1997 | 0.0177 | 0.0840 | 0.5338 | 0.8873 | 3.2452 | 0.0529 | 0.1309 | 31.1022 | 0.3600 | 0.1139 | 0.9571 | 0.5159 | 0.1812 | 16.7756 | 25.1657 | 47.8985 | 0.0584 | 2.0737 | 2.4878 | | 6.8624 | 0.5611 | 0.3119 | 2.6414 | 2.7348 |
| 6/27/1997 | 0.0195 | 0.1150 | 0.6229 | 1.0895 | 3.9414 | 0.0650 | 0.1608 | 32.6755 | 0.4863 | 0.1398 | 1.1753 | 0.6829 | 0.2225 | 16.0675 | 25.6857 | 45.4512 | 0.0665 | 2.1770 | 2.5614 | | 7.5122 | 0.6654 | 0.3830 | 3.2559 | 3.3374 |
| 6/28/1997 | 0.0200 | 0.0830 | 0.6892 | 0.8388 | 3.2398 | 0.0500 | 0.1238 | 30.6137 | 0.3688 | 0.1076 | 0.9048 | 0.4999 | 0.1713 | 14.9919 | 26.1024 | 44.7519 | 0.1633 | 2.0700 | 2.4321 | | 6.7200 | 0.6485 | 0.2949 | 2.5586 | 2.5153 |
| 6/29/1997 | 0.0208 | 0.0774 | 0.4757 | 0.7698 | 3.0536 | 0.0459 | 0.1136 | 27.8581 | 0.3316 | 0.0988 | 0.8304 | 0.4745 | 0.1572 | 14.0567 | 24.5695 | 43.3534 | 0.0712 | 1.9221 | 2.3007 | | 5.3781 | 0.5778 | 0.2706 | 2.3682 | 2.2878 |
| 6/30/1997 | 0.0193 | 0.0754 | 0.4768 | 0.7483 | 3.0143 | 0.0446 | 0.1104 | 27.3870 | 0.3270 | 0.0960 | 0.8072 | 0.4606 | 0.1528 | 13.6603 | 23.9459 | 42.3046 | 0.0769 | 1.8575 | 2.2231 | | 5.2731 | 0.5491 | 0.2631 | 2.3070 | 2.2204 |
| 7/1/1997 | 0.0179 | 0.0731 | 0.4319 | 0.7280 | 2.9290 | 0.0434 | 0.1074 | 29.7551 | 0.3104 | 0.0934 | 0.7852 | 0.4557 | 0.1487 | 13.4902 | 23.5517 | 41.2557 | 0.0768 | 1.8793 | 2.2223 | | 6.7265 | 0.5201 | 0.2559 | 2.2625 | 2.1344 |
| 7/2/1997 | 0.0179 | 0.0715 | 0.5150 | 0.7061 | 2.8964 | 0.0421 | 0.1042 | 24.7230 | 0.3053 | 0.0906 | 0.7617 | 0.4460 | 0.1442 | 13.1531 | 22.2480 | 39.8572 | 0.0550 | 1.7354 | 2.0851 | | 3.9813 | 0.4989 | 0.2483 | 2.2023 | 2.0611 |
| 7/3/1997 | 0.0184 | 0.0703 | 0.4337 | 0.6933 | 2.8587 | 0.0414 | 0.1023 | 23.6032 | 0.2878 | 0.0890 | 0.7479 | 0.4386 | 0.1416 | 12.3635 | 21.4558 | 37.7594 | 0.0520 | 1.6475 | 2.0105 | | 3.4702 | 0.4903 | 0.2437 | 2.1650 | 2.0145 |
| 7/4/1997 | 0.0224 | 0.0657 | 0.4127 | 0.6852 | 2.8251 | 0.0409 | 0.1011 | 22.9206 | 0.3031 | 0.0879 | 0.7391 | 0.4278 | 0.1399 | 11.2714 | 20.7180 | 35.6617 | 0.0433 | 1.5835 | 1.9492 | 0.0090 | 3.1923 | 0.4731 | 0.2409 | 2.1400 | 1.9887 |
| 7/5/1997 | 0.0278 | 0.0675 | 0.4219 | 0.6896 | 2.8488 | 0.0411 | 0.1018 | 22.5303 | 0.3155 | 0.0885 | 0.7439 | 0.4377 | 0.1408 | 10.6554 | 20.1785 | 34.4380 | 0.0535 | 1.5344 | 1.8931 | 0.0146 | 3.0715 | 0.4491 | 0.2424 | 2.1555 | 1.9978 |

| Sta IDs that flow to model node Node-> | ocenshr westprt **2** | 509-ADAM hoquiam **10** | 502-FRY 506-28TH 507-G3 ghpapr1 **12** | 17-CHAP 18-CAMP 19-INDI 20-STAF 21-OLEA **15** | 15-CHAR 16-NEWS weyco1 **17** | 35-WEST **18** | 24-REDM **19** | 01-HUMP 03-CHEN 04-GRASS **29** | 41-ALDR 501-ABDIV 510-MST 512-DAWS 513-SAG 514-HST aberdn **37** | 500-WILS 504-SHAN **40** | 11-ELLI 503-MILR 505-MILL **43** | 12-CENT weyco2 **48** | 42-PEEL **57** | 13-WYNO montesn **64** | elma mcleary satsopQ **66** | 38-PORT **68** | 508-KST 516-EMER 517-QEEN 518-15TH **69** | hoqnowf **72** | wfconf **74** | arthr-pmp **75** | 08-WISH **79** | ditchmwth **81** | 25-DEMP 26-BARL **82** | andrmwth elkmwth **83** | 22-JOHN ospray1 **84** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/6/1997 | 0.0285 | 0.0738 | 0.6460 | 0.8262 | 3.1931 | 0.0493 | 0.1219 | 24.9869 | 0.3606 | 0.1060 | 0.8912 | 0.4574 | 0.1687 | 11.0262 | 20.8884 | 34.1933 | 0.0597 | 1.6171 | 1.9915 | 0.0269 | 4.2527 | 0.4915 | 0.2904 | 2.5950 | 2.3612 |
| 7/7/1997 | 0.0244 | 0.0769 | 0.4473 | 0.7250 | 2.9714 | 0.0433 | 0.1070 | 23.4305 | 0.3338 | 0.0930 | 0.7821 | 0.4331 | 0.1481 | 10.5444 | 20.0950 | 33.5989 | 0.0477 | 1.5156 | 1.8733 | 0.0146 | 3.6338 | 0.4741 | 0.2549 | 2.2530 | 2.1213 |
| 7/8/1997 | 0.0245 | 0.1725 | 0.8131 | 1.9397 | 6.1156 | 0.1157 | 0.2862 | 149.3902 | 0.8019 | 0.2489 | 2.0924 | 0.7694 | 0.3962 | 28.8960 | 30.0393 | 36.0113 | 0.1085 | 12.6576 | 12.7443 | 0.0567 | 56.0394 | 0.7112 | 0.6819 | 5.9400 | 5.4919 |
| 7/9/1997 | 0.0227 | 0.1238 | 0.8839 | 1.6010 | 5.1999 | 0.0955 | 0.2363 | 188.7119 | 0.6767 | 0.2055 | 1.7270 | 0.6834 | 0.3270 | 110.7325 | 107.9163 | 46.1504 | 0.2828 | 16.0628 | 14.7332 | 0.0567 | 75.9129 | 1.0791 | 0.5629 | 4.7277 | 4.9638 |
| 7/10/1997 | 0.0195 | 0.1228 | 0.5838 | 1.0572 | 3.7998 | 0.0631 | 0.1560 | 104.2574 | 0.5154 | 0.1357 | 1.1404 | 0.5349 | 0.2159 | 54.9463 | 59.7737 | 61.1843 | 0.1541 | 6.2511 | 6.1853 | 0.0567 | 43.2554 | 0.8991 | 0.3717 | 3.1587 | 3.2636 |
| 7/11/1997 | 0.0190 | 0.0917 | 0.6075 | 0.9394 | 3.4796 | 0.0560 | 0.1386 | 76.4165 | 0.4427 | 0.1206 | 1.0134 | 0.4891 | 0.1919 | 39.9384 | 42.7810 | 63.2820 | 0.1560 | 4.1870 | 4.3010 | 0.0567 | 30.4589 | 0.7124 | 0.3303 | 2.8046 | 2.9309 |
| 7/12/1997 | 0.0211 | 0.0834 | 0.5096 | 0.8979 | 3.3696 | 0.0536 | 0.1325 | 62.4821 | 0.3944 | 0.1152 | 0.9685 | 0.4659 | 0.1834 | 27.0542 | 35.1337 | 58.3873 | 0.0905 | 3.2436 | 3.4561 | 0.0216 | 23.8326 | 0.5951 | 0.3156 | 2.6739 | 2.8204 |
| 7/13/1997 | 0.0229 | 0.0798 | 0.5024 | 0.8779 | 3.3313 | 0.0524 | 0.1295 | 53.8287 | 0.3819 | 0.1127 | 0.9470 | 0.4567 | 0.1793 | 20.7972 | 30.6028 | 50.3459 | 0.0595 | 2.8006 | 3.0627 | 0.0216 | 19.4342 | 0.5279 | 0.3086 | 2.6138 | 2.7560 |
| 7/14/1997 | 0.0214 | 0.0791 | 0.2784 | 0.8556 | 3.2703 | 0.0510 | 0.1263 | 47.4840 | 0.3635 | 0.1098 | 0.9230 | 0.4514 | 0.1747 | 18.4735 | 27.4585 | 45.1016 | 0.0449 | 2.5004 | 2.7878 | 0.0216 | 16.1859 | 0.4983 | 0.3008 | 2.5529 | 2.6793 |
| 7/15/1997 | 0.0224 | 0.0758 | 0.2165 | 0.8347 | 3.1926 | 0.0498 | 0.1232 | 42.4683 | 0.3571 | 0.1071 | 0.9004 | 0.4463 | 0.1705 | 16.8872 | 25.3354 | 40.9061 | 0.0505 | 2.2870 | 2.5785 | 0.0190 | 13.6035 | 0.4873 | 0.2934 | 2.4917 | 2.6132 |
| 7/16/1997 | 0.0189 | 0.0731 | 0.2397 | 0.8165 | 3.1115 | 0.0487 | 0.1205 | 35.8396 | 0.3428 | 0.1048 | 0.8808 | 0.4551 | 0.1668 | 15.6982 | 23.8052 | 37.7594 | 0.0390 | 2.1162 | 2.4280 | 0.0190 | 9.9155 | 0.4588 | 0.2871 | 2.4360 | 2.5599 |
| 7/17/1997 | 0.0194 | 0.0730 | 0.2417 | 0.8001 | 3.2592 | 0.0477 | 0.1181 | 34.6536 | 0.3329 | 0.1027 | 0.8631 | 0.4468 | 0.1634 | 14.7921 | 22.5880 | 35.6617 | 0.0374 | 2.0213 | 2.3402 | 0.0140 | 9.3948 | 0.4427 | 0.2813 | 2.3900 | 2.5054 |
| 7/18/1997 | 0.0207 | 0.0727 | 0.2885 | 0.7877 | 3.2395 | 0.0470 | 0.1162 | 32.3815 | 0.3305 | 0.1011 | 0.8496 | 0.4481 | 0.1609 | 13.8859 | 21.5680 | 33.3891 | 0.0432 | 1.8788 | 2.2173 | 0.0140 | 8.2868 | 0.4581 | 0.2769 | 2.3457 | 2.4771 |
| 7/19/1997 | 0.0245 | 0.0693 | 0.4087 | 0.7768 | 3.1814 | 0.0463 | 0.1146 | 26.6976 | 0.3267 | 0.0997 | 0.8379 | 0.4587 | 0.1586 | 12.6966 | 20.8868 | 31.7809 | 0.0374 | 1.7943 | 2.1330 | 0.0125 | 5.0257 | 0.4436 | 0.2731 | 2.3154 | 2.4326 |
| 7/20/1997 | 0.0261 | 0.0701 | 0.5825 | 0.7746 | 3.1978 | 0.0462 | 0.1143 | 29.0382 | 0.3266 | 0.0994 | 0.8356 | 0.4713 | 0.1582 | 11.4784 | 20.2913 | 30.3474 | 0.0360 | 1.7212 | 2.0660 | 0.0125 | 6.5899 | 0.4431 | 0.2723 | 2.3168 | 2.4159 |
| 7/21/1997 | 0.0254 | 0.0726 | 0.5034 | 0.7570 | 3.1369 | 0.0452 | 0.1117 | 29.1448 | 0.3172 | 0.0971 | 0.8166 | 0.4627 | 0.1546 | 10.8277 | 19.7825 | 28.9839 | 0.0591 | 1.6925 | 2.0450 | 0.0125 | 6.7121 | 0.4280 | 0.2661 | 2.2805 | 2.3353 |
| 7/22/1997 | 0.0246 | 0.0711 | 0.5032 | 0.7486 | 3.0856 | 0.0447 | 0.1105 | 29.0996 | 0.3201 | 0.0961 | 0.8075 | 0.4387 | 0.1529 | 10.5165 | 19.3320 | 28.0399 | 0.0301 | 1.6475 | 1.9986 | 0.0125 | 6.7894 | 0.4344 | 0.2632 | 2.2707 | 2.2922 |
| 7/23/1997 | 0.0223 | 0.0703 | 0.4620 | 0.7384 | 3.0424 | 0.0440 | 0.1090 | 27.3913 | 0.3132 | 0.0948 | 0.7965 | 0.4231 | 0.1508 | 10.0631 | 18.5385 | 27.1658 | 0.0235 | 1.5605 | 1.9083 | 0.0125 | 5.9525 | 0.4186 | 0.2596 | 2.2377 | 2.2606 |
| 7/24/1997 | 0.0221 | 0.0731 | 0.4798 | 0.7299 | 3.0291 | 0.0435 | 0.1077 | 26.8321 | 0.3108 | 0.0937 | 0.7874 | 0.4211 | 0.1491 | 9.6965 | 17.5180 | 26.2218 | 0.0250 | 1.5156 | 1.8566 | 0.0123 | 5.7296 | 0.3860 | 0.2566 | 2.2073 | 2.2328 |
| 7/25/1997 | 0.0222 | 0.0689 | 0.4865 | 0.7199 | 3.0057 | 0.0429 | 0.1062 | 26.4152 | 0.3037 | 0.0924 | 0.7766 | 0.4318 | 0.1470 | 9.3839 | 16.9236 | 25.4177 | 0.0111 | 1.4655 | 1.8277 | 0.0123 | 5.5455 | 0.3885 | 0.2531 | 2.1851 | 2.1878 |
| 7/26/1997 | 0.0260 | 0.0640 | 0.4576 | 0.7040 | 2.9539 | 0.0420 | 0.1039 | 26.0613 | 0.2986 | 0.0903 | 0.7594 | 0.4149 | 0.1438 | 9.0149 | 16.2455 | 24.5436 | 0.0328 | 1.4475 | 1.8043 | 0.0134 | 5.3921 | 0.3755 | 0.2475 | 2.1457 | 2.1264 |
| 7/27/1997 | 0.0275 | 0.0650 | 0.4780 | 0.6935 | 2.8255 | 0.0414 | 0.1023 | 25.5869 | 0.2997 | 0.0890 | 0.7481 | 0.4080 | 0.1416 | 8.8167 | 15.7608 | 23.8444 | 0.0325 | 1.4029 | 1.7617 | 0.0134 | 5.2026 | 0.3780 | 0.2438 | 2.1205 | 2.0828 |
| 7/28/1997 | 0.0258 | 0.0667 | 0.4711 | 0.6920 | 2.8803 | 0.0413 | 0.1021 | 25.1581 | 0.2959 | 0.0888 | 0.7465 | 0.4032 | 0.1413 | 8.9308 | 15.4195 | 23.0403 | 0.0223 | 1.3882 | 1.7378 | 0.0140 | 4.9944 | 0.3645 | 0.2433 | 2.1075 | 2.0890 |
| 7/29/1997 | 0.0248 | 0.0657 | 0.4745 | 0.6850 | 2.9929 | 0.0409 | 0.1011 | 25.0055 | 0.2979 | 0.0879 | 0.7389 | 0.4015 | 0.1399 | 8.6468 | 15.0836 | 22.3410 | 0.0266 | 1.3485 | 1.7006 | 0.0140 | 4.9860 | 0.3743 | 0.2408 | 2.0852 | 2.0694 |
| 7/30/1997 | 0.0209 | 0.0669 | 0.4836 | 0.6832 | 2.9156 | 0.0408 | 0.1008 | 24.6484 | 0.2953 | 0.0877 | 0.7369 | 0.4055 | 0.1395 | 8.5601 | 14.7715 | 21.7117 | 0.0266 | 1.3231 | 1.6621 | 0.0140 | 4.8527 | 0.3870 | 0.2402 | 2.0704 | 2.0799 |
| 7/31/1997 | 0.0234 | 0.0649 | 0.4257 | 0.6743 | 2.8648 | 0.0402 | 0.0995 | 24.3096 | 0.2937 | 0.0865 | 0.7274 | 0.4077 | 0.1377 | 8.2524 | 14.4306 | 21.2222 | 0.0120 | 1.2741 | 1.6328 | 0.0140 | 4.7160 | 0.3875 | 0.2371 | 2.0516 | 2.0463 |
| 8/1/1997 | 0.0235 | 0.0636 | 0.3966 | 0.6737 | 2.7749 | 0.0402 | 0.0994 | 24.0531 | 0.2892 | 0.0865 | 0.7268 | 0.4076 | 0.1376 | 7.7985 | 14.1193 | 20.5929 | 0.0251 | 1.2491 | 1.6012 | 0.0140 | 4.6279 | 0.3687 | 0.2369 | 2.0517 | 2.0480 |
| 8/2/1997 | 0.0274 | 0.0627 | 0.4024 | 0.6758 | 2.8635 | 0.0403 | 0.0997 | 23.6198 | 0.2864 | 0.0867 | 0.7290 | 0.4212 | 0.1380 | 7.7132 | 13.7795 | 20.1034 | 0.0281 | 1.2451 | 1.5911 | 0.0140 | 4.3849 | 0.3911 | 0.2376 | 2.0548 | 2.0610 |
| 8/3/1997 | 0.0302 | 0.0643 | 0.4279 | 0.6708 | 2.8680 | 0.0400 | 0.0990 | 23.5471 | 0.2901 | 0.0861 | 0.7235 | 0.4156 | 0.1370 | 7.6282 | 13.6375 | 19.7188 | 0.0260 | 1.2233 | 1.5739 | 0.0112 | 4.3811 | 0.3936 | 0.2358 | 2.0371 | 2.0473 |
| 8/4/1997 | 0.0276 | 0.0662 | 0.4122 | 0.6590 | 2.8507 | 0.0393 | 0.0972 | 23.1923 | 0.2872 | 0.0846 | 0.7109 | 0.3996 | 0.1346 | 7.6281 | 13.3545 | 19.4391 | 0.0274 | 1.2014 | 1.5482 | 0.0118 | 4.2291 | 0.3918 | 0.2317 | 2.0028 | 2.0076 |
| 8/5/1997 | 0.0247 | 0.0480 | 0.4122 | 0.6526 | 2.8313 | 0.0389 | 0.0963 | 23.1099 | 0.2809 | 0.0838 | 0.7040 | 0.3937 | 0.1333 | 7.5430 | 13.1864 | 19.1594 | 0.0201 | 1.1957 | 1.5408 | 0.0118 | 4.1996 | 0.3792 | 0.2294 | 1.9877 | 1.9797 |
| 8/6/1997 | 0.0255 | 0.0652 | 0.4366 | 0.6545 | 2.4741 | 0.0390 | 0.0966 | 22.7647 | 0.2822 | 0.0840 | 0.7060 | 0.4117 | 0.1337 | 7.4299 | 12.9886 | 18.4602 | 0.0259 | 1.1588 | 1.5136 | 0.0118 | 4.0467 | 0.4437 | 0.2301 | 1.9948 | 1.9785 |
| 8/7/1997 | 0.0245 | 0.0649 | 0.4078 | 0.6466 | 2.7882 | 0.0386 | 0.0954 | 22.5252 | 0.2812 | 0.0830 | 0.6975 | 0.4010 | 0.1321 | 7.2875 | 12.8462 | 17.9357 | 0.0216 | 1.1361 | 1.4919 | 0.0118 | 3.9534 | 0.4073 | 0.2273 | 1.9720 | 1.9524 |
| 8/8/1997 | 0.0268 | 0.0631 | 0.4111 | 0.6440 | 2.7880 | 0.0384 | 0.0950 | 22.4825 | 0.2775 | 0.0826 | 0.6946 | 0.3873 | 0.1315 | 7.1750 | 12.7333 | 17.3414 | 0.0201 | 1.1333 | 1.4851 | 0.0118 | 3.9437 | 0.4112 | 0.2264 | 1.9683 | 1.9391 |

| Sta IDs that flow to model node Node-> | ocenshr westprt 2 | 509-ADAM hoquiam 10 | 502-FRY 506-28TH 507-G3 ghpapr1 12 | 17-CHAP 18-CAMP 19-INDI 20-STAF 21-OLEA 15 | 15-CHAR 16-NEWS weyco1 17 | 35-WEST 18 | 24-REDM 19 | 01-HUMP 03-CHEN 04-GRASS 29 | 41-ALDR 501-ABDIV 510-MST 512-DAWS 513-SAG 514-HST aberdn 37 | 500-WILS 504-SHAN 40 | 11-ELLI 503-MILR 505-MILL 43 | 12-CENT weyco2 48 | 42-PEEL 57 | 13-WYNO montesn 64 | elma mcleary satsopQ 66 | 38-PORT 68 | 508-KST 516-EMER 517-QEEN 518-15TH 69 | hoqnowf 72 | wfconf 74 | arthr-pmp 75 | 08-WISH 79 | ditchmwth 81 | 25-DEMP 26-BARL 82 | andrmwth elkmwth 83 | 22-JOHN ospray1 84 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8/9/1997 | 0.0303 | 0.0608 | 0.4254 | 0.6390 | 2.7771 | 0.0381 | 0.0943 | 22.4126 | 0.2742 | 0.0820 | 0.6893 | 0.3904 | 0.1305 | 7.0606 | 12.5902 | 17.0267 | 0.0215 | 1.1297 | 1.4767 | 0.0118 | 3.9229 | 0.3734 | 0.2246 | 1.9493 | 1.9283 |
| 8/10/1997 | 0.0287 | 0.0604 | 0.4117 | 0.6272 | 2.7425 | 0.0374 | 0.0926 | 22.0551 | 0.2745 | 0.0805 | 0.6765 | 0.3788 | 0.1281 | 6.9478 | 12.3356 | 16.6072 | 0.0142 | 1.1008 | 1.4502 | 0.0127 | 3.7711 | 0.3625 | 0.2205 | 1.9079 | 1.8999 |
| 8/11/1997 | 0.0288 | 0.0562 | 0.3993 | 0.6324 | 2.7597 | 0.0377 | 0.0933 | 21.9306 | 0.2792 | 0.0812 | 0.6822 | 0.3889 | 0.1292 | 6.8345 | 12.1082 | 16.2925 | 0.0259 | 1.0918 | 1.4365 | 0.0127 | 3.7209 | 0.3594 | 0.2223 | 1.9194 | 1.9262 |
| 8/12/1997 | 0.0251 | 0.0190 | 0.4291 | 0.6346 | 2.7617 | 0.0379 | 0.0936 | 21.6925 | 0.2793 | 0.0814 | 0.6845 | 0.3894 | 0.1296 | 6.8348 | 12.0245 | 15.9079 | 0.0215 | 1.0900 | 1.4245 | 0.0127 | 3.6003 | 0.3936 | 0.2231 | 1.9277 | 1.9285 |
| 8/13/1997 | 0.0261 | 0.0189 | 0.4372 | 0.6317 | 2.6603 | 0.0377 | 0.0932 | 21.5838 | 0.2747 | 0.0811 | 0.6814 | 0.3843 | 0.1290 | 7.6284 | 11.8546 | 15.5933 | 0.0141 | 1.0900 | 1.4336 | 0.0131 | 3.5170 | 0.3823 | 0.2221 | 1.9239 | 1.9144 |
| 8/14/1997 | 0.0259 | 0.0192 | 0.4390 | 0.6399 | 2.7067 | 0.0382 | 0.0944 | 21.5564 | 0.2824 | 0.0821 | 0.6903 | 0.3950 | 0.1307 | 7.6277 | 11.7692 | 15.1387 | 0.0243 | 1.0966 | 1.4149 | 0.0131 | 3.5342 | 0.4310 | 0.2250 | 1.9466 | 1.9441 |
| 8/15/1997 | 0.0256 | 0.0192 | 0.4426 | 0.6421 | 2.7360 | 0.0383 | 0.0948 | 21.6271 | 0.2784 | 0.0824 | 0.6927 | 0.4569 | 0.1311 | 6.9207 | 11.7407 | 14.6842 | 0.0200 | 1.1015 | 1.4044 | 0.0131 | 3.5979 | 0.4054 | 0.2257 | 1.9485 | 1.9557 |
| 8/16/1997 | 0.0285 | 0.0187 | 0.4371 | 0.6251 | 2.6930 | 0.0373 | 0.0922 | 21.4024 | 0.2754 | 0.0802 | 0.6743 | 0.4572 | 0.1277 | 6.8077 | 11.6000 | 14.4395 | 0.0215 | 1.0720 | 1.3813 | 0.0123 | 3.5232 | 0.3985 | 0.2198 | 1.9018 | 1.8964 |
| 8/17/1997 | 0.0279 | 0.0187 | 0.4558 | 0.6241 | 2.7227 | 0.0372 | 0.0921 | 21.0867 | 0.2743 | 0.0801 | 0.6732 | 0.4438 | 0.1275 | 6.6373 | 11.3991 | 14.2297 | 0.0251 | 1.0543 | 1.3687 | 0.0123 | 3.3592 | 0.3765 | 0.2194 | 1.8923 | 1.9000 |
| 8/18/1997 | 0.0279 | 0.0186 | 0.3999 | 0.6211 | 2.6747 | 0.0371 | 0.0916 | 20.9349 | 0.2797 | 0.0797 | 0.6699 | 0.4825 | 0.1268 | 6.6095 | 11.2016 | 14.0899 | 0.0325 | 1.0345 | 1.3517 | 0.0123 | 3.3055 | 0.3830 | 0.2183 | 1.8784 | 1.8926 |
| 8/19/1997 | 0.0265 | 0.0177 | 0.3726 | 0.5906 | 2.6028 | 0.0352 | 0.0872 | 20.6988 | 0.2645 | 0.0758 | 0.6371 | 0.4620 | 0.1206 | 6.6097 | 11.1199 | 14.0199 | 0.0324 | 1.0389 | 1.3524 | 0.0129 | 3.1830 | 0.3701 | 0.2076 | 1.8198 | 1.7569 |
| 8/20/1997 | 0.0262 | 0.0194 | 0.3834 | 0.6476 | 2.7776 | 0.0386 | 0.0956 | 20.7039 | 0.2822 | 0.0831 | 0.6986 | 0.4451 | 0.1323 | 6.6948 | 11.1471 | 13.9850 | 0.0354 | 1.0633 | 1.3903 | 0.0129 | 3.0637 | 0.4166 | 0.2277 | 1.9970 | 1.9238 |
| 8/21/1997 | 0.0261 | 0.0321 | 0.3976 | 0.6474 | 2.8162 | 0.0386 | 0.0955 | 21.4664 | 0.2923 | 0.0831 | 0.6984 | 0.4363 | 0.1322 | 6.9496 | 11.3175 | 14.8241 | 0.0457 | 1.1038 | 1.4225 | 0.0101 | 3.4581 | 0.4559 | 0.2276 | 1.9707 | 1.9609 |
| 8/22/1997 | 0.0258 | 0.0631 | 0.3733 | 0.5996 | 2.6706 | 0.0358 | 0.0885 | 21.2798 | 0.2741 | 0.0770 | 0.6468 | 0.4335 | 0.1225 | 6.6097 | 11.0060 | 15.5233 | 0.0309 | 1.0433 | 1.3553 | 0.0101 | 3.5228 | 0.4048 | 0.2108 | 1.8413 | 1.7932 |
| 8/23/1997 | 0.0288 | 0.0621 | 0.3817 | 0.5945 | 2.6921 | 0.0355 | 0.0877 | 20.9371 | 0.2950 | 0.0763 | 0.6413 | 0.4192 | 0.1214 | 6.4958 | 10.8354 | 15.4184 | 0.0352 | 1.0301 | 1.3410 | 0.0317 | 3.3490 | 0.4244 | 0.2090 | 1.8349 | 1.7616 |
| 8/24/1997 | 0.0306 | 0.0793 | 0.5011 | 0.7308 | 3.0511 | 0.0436 | 0.1078 | 22.5771 | 0.3637 | 0.0938 | 0.7883 | 0.4870 | 0.1493 | 7.2327 | 10.8337 | 14.9639 | 0.0645 | 1.1256 | 1.4721 | 0.0317 | 3.9653 | 0.4953 | 0.2569 | 2.2176 | 2.2164 |
| 8/25/1997 | 0.0279 | 0.0735 | 0.5383 | 0.6555 | 2.7870 | 0.0391 | 0.0967 | 24.8362 | 0.3272 | 0.0841 | 0.7071 | 0.4207 | 0.1339 | 8.5639 | 11.9971 | 15.5583 | 0.0656 | 1.1434 | 1.4895 | 0.0213 | 5.3540 | 0.5243 | 0.2305 | 2.0140 | 1.9486 |
| 8/26/1997 | 0.0272 | 0.0945 | 0.5775 | 0.9892 | 3.5938 | 0.0590 | 0.1460 | 25.7020 | 0.4629 | 0.1269 | 1.0670 | 0.5142 | 0.2020 | 8.5649 | 12.6787 | 16.6421 | 0.0919 | 1.3787 | 1.8658 | 0.0336 | 4.8345 | 0.7781 | 0.3478 | 3.2415 | 2.5967 |
| 8/27/1997 | 0.0271 | 0.1013 | 0.6275 | 0.9248 | 3.3005 | 0.0552 | 0.1365 | 30.3111 | 0.4220 | 0.1187 | 0.9975 | 0.5118 | 0.1889 | 10.9157 | 14.4077 | 19.4741 | 0.1756 | 1.5519 | 1.9670 | 0.0336 | 7.4626 | 1.0245 | 0.3251 | 2.8369 | 2.6762 |
| 8/28/1997 | 0.0247 | 0.0727 | 0.5187 | 0.7314 | 3.0058 | 0.0436 | 0.1079 | 27.9117 | 0.3496 | 0.0939 | 0.7890 | 0.4434 | 0.1494 | 13.3793 | 17.3507 | 22.5857 | 0.0979 | 1.3113 | 1.6338 | 0.0325 | 6.8572 | 0.7633 | 0.2571 | 2.2065 | 2.2130 |
| 8/29/1997 | 0.0233 | 0.0750 | 0.4711 | 0.7767 | 3.0905 | 0.0463 | 0.1146 | 26.7749 | 0.3369 | 0.0997 | 0.8378 | 0.4411 | 0.1586 | 11.0846 | 16.3028 | 23.3899 | 0.0675 | 1.1629 | 1.4941 | 0.0325 | 6.4315 | 0.6672 | 0.2730 | 2.3122 | 2.4006 |
| 8/30/1997 | 0.0245 | 0.0668 | 0.4265 | 0.6632 | 2.7745 | 0.0396 | 0.0979 | 23.8637 | 0.2831 | 0.0851 | 0.7154 | 0.4225 | 0.1354 | 9.0161 | 14.5452 | 22.2711 | 0.0496 | 1.0992 | 1.4252 | 0.0406 | 4.8952 | 0.5751 | 0.2331 | 2.0050 | 2.0035 |
| 8/31/1997 | 0.0288 | 0.0639 | 0.4144 | 0.6259 | 2.6799 | 0.0373 | 0.0924 | 21.0508 | 0.2762 | 0.0803 | 0.6751 | 0.4136 | 0.1278 | 7.9966 | 13.1267 | 21.8515 | 0.0420 | 1.0499 | 1.3760 | 0.0406 | 3.3205 | 0.5173 | 0.2200 | 1.8974 | 1.8807 |
| 9/1/1997 | 0.0284 | 0.0691 | 0.4239 | 0.6113 | 2.6771 | 0.0365 | 0.0902 | 20.6204 | 0.2859 | 0.0784 | 0.6594 | 0.4057 | 0.1248 | 7.5165 | 12.3340 | 19.5090 | 0.0333 | 1.0302 | 1.3458 | 0.0406 | 3.1343 | 0.4722 | 0.2149 | 1.8492 | 1.8363 |
| 9/2/1997 | 0.0261 | 0.0669 | 0.4285 | 0.5946 | 2.6327 | 0.0355 | 0.0877 | 20.1458 | 0.2610 | 0.0763 | 0.6414 | 0.3885 | 0.1214 | 7.2044 | 11.8529 | 18.0406 | 0.0391 | 1.0133 | 1.3239 | 0.0406 | 2.9053 | 0.4470 | 0.2090 | 1.8076 | 1.7705 |
| 9/3/1997 | 0.0214 | 0.0648 | 0.4512 | 0.5823 | 2.5490 | 0.0347 | 0.0859 | 19.9409 | 0.2562 | 0.0747 | 0.6281 | 0.3812 | 0.1189 | 6.9779 | 11.5161 | 17.1316 | 0.0302 | 0.9906 | 1.2931 | 0.0172 | 2.8556 | 0.4233 | 0.2047 | 1.7749 | 1.7324 |
| 9/4/1997 | 0.0194 | 0.0655 | 0.4177 | 0.5771 | 2.5187 | 0.0344 | 0.0852 | 20.6429 | 0.2506 | 0.0741 | 0.6225 | 0.3755 | 0.1179 | 6.7801 | 11.2615 | 16.3275 | 0.0244 | 0.9866 | 1.2858 | 0.0172 | 3.3006 | 0.4073 | 0.2029 | 1.7658 | 1.7056 |
| 9/5/1997 | 0.0198 | 0.0633 | 0.4363 | 0.5762 | 2.5291 | 0.0344 | 0.0850 | 20.8190 | 0.2526 | 0.0739 | 0.6215 | 0.3753 | 0.1177 | 6.6376 | 11.0332 | 15.7681 | 0.0272 | 0.9843 | 1.2868 | 0.0172 | 3.4060 | 0.4024 | 0.2026 | 1.7628 | 1.7031 |
| 9/6/1997 | 0.0209 | 0.0603 | 0.4389 | 0.5799 | 2.5369 | 0.0346 | 0.0856 | 20.4717 | 0.2508 | 0.0744 | 0.6256 | 0.3675 | 0.1184 | 6.4964 | 10.8629 | 15.3136 | 0.0216 | 0.9772 | 1.2782 | 0.0187 | 3.2108 | 0.3883 | 0.2039 | 1.7633 | 1.7283 |
| 9/7/1997 | 0.0227 | 0.0635 | 0.4106 | 0.5824 | 2.4832 | 0.0347 | 0.0859 | 20.3616 | 0.2484 | 0.0747 | 0.6282 | 0.3724 | 0.1189 | 6.4110 | 10.6647 | 14.9639 | 0.0253 | 0.9445 | 1.2556 | 0.0187 | 3.1904 | 0.3676 | 0.2047 | 1.7597 | 1.7498 |
| 9/8/1997 | 0.0220 | 0.0632 | 0.4058 | 0.5747 | 2.4999 | 0.0343 | 0.0848 | 20.2526 | 0.2496 | 0.0738 | 0.6199 | 0.3706 | 0.1174 | 6.2983 | 10.5237 | 14.6842 | 0.0181 | 0.9353 | 1.2367 | 0.0187 | 3.1700 | 0.3395 | 0.2020 | 1.7446 | 1.7160 |
| 9/9/1997 | 0.0196 | 0.0647 | 0.4537 | 0.5814 | 2.4877 | 0.0347 | 0.0858 | 20.1179 | 0.2486 | 0.0746 | 0.6272 | 0.3722 | 0.1187 | 6.2136 | 10.3551 | 14.4395 | 0.0210 | 0.9328 | 1.2252 | 0.0190 | 3.1080 | 0.2891 | 0.2044 | 1.7559 | 1.7489 |
| 9/10/1997 | 0.0195 | 0.0674 | 0.4442 | 0.5819 | 2.4748 | 0.0347 | 0.0859 | 20.1713 | 0.3542 | 0.0747 | 0.6276 | 0.3767 | 0.1188 | 6.1562 | 10.2684 | 14.2647 | 0.0166 | 0.9328 | 1.2402 | 0.0190 | 3.1082 | 0.2408 | 0.2046 | 1.7695 | 1.7323 |
| 9/11/1997 | 0.0192 | 0.0669 | 0.4435 | 0.5807 | 2.4421 | 0.0346 | 0.0857 | 20.3677 | 0.3391 | 0.0745 | 0.6264 | 0.3852 | 0.1186 | 6.1567 | 10.0977 | 14.0199 | 0.0268 | 0.9328 | 1.2428 | 0.0179 | 3.2225 | 0.3108 | 0.2042 | 1.7608 | 1.7383 |

| Sta IDs that flow to model node Node-> | ocenshr westprt 2 | 509-ADAM hoquiam 10 | 502-FRY 506-28TH 507-G3 ghpapr1 12 | 17-CHAP 18-CAMP 19-INDI 20-STAF 21-OLEA 15 | 15-CHAR 16-NEWS weyco1 17 | 35-WEST 18 | 24-REDM 19 | 01-HUMP 03-CHEN 04-GRASS 29 | 41-ALDR 501-ABDIV 510-MST 512-DAWS 513-SAG 514-HST aberdn 37 | 500-WILS 504-SHAN 40 | 11-ELLI 503-MILR 505-MILL 43 | 12-CENT weyco2 48 | 42-PEEL 57 | 13-WYNO montesn 64 | elma mcleary satsopQ 66 | 38-PORT 68 | 508-KST 516-EMER 517-QEEN 518-15TH 69 | hoqnowf 72 | wfconf 74 | arthr-pmp 75 | 08-WISH 79 | ditchmwth 81 | 25-DEMP 26-BARL 82 | andrmwth elkmwth 83 | 22-JOHN ospray1 84 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/12/1997 | 0.0201 | 0.0715 | 0.5038 | 0.8220 | 3.0878 | 0.0490 | 0.1213 | 20.8428 | 0.4021 | 0.1055 | 0.8867 | 0.4345 | 0.1679 | 6.0719 | 10.1846 | 13.9500 | 0.0217 | 0.9628 | 1.2854 | 0.0179 | 3.2433 | 0.3091 | 0.2890 | 2.4685 | 2.5185 |
| 9/13/1997 | 0.0215 | 0.0703 | 0.4832 | 0.6500 | 2.6484 | 0.0388 | 0.0959 | 21.2802 | 0.3654 | 0.0834 | 0.7012 | 0.4194 | 0.1328 | 6.2135 | 10.3260 | 13.6703 | 0.0212 | 0.9836 | 1.3083 | 0.0736 | 3.5861 | 0.3141 | 0.2285 | 1.9580 | 1.9724 |
| 9/14/1997 | 0.0242 | 0.0977 | 0.6219 | 0.9079 | 3.3975 | 0.0542 | 0.1340 | 24.1813 | 0.4660 | 0.1165 | 0.9794 | 0.5822 | 0.1854 | 7.0924 | 10.8679 | 14.7891 | 0.1355 | 1.1026 | 1.4955 | 0.0736 | 4.7590 | 0.4506 | 0.3192 | 2.7194 | 2.7755 |
| 9/15/1997 | 0.0246 | 0.3107 | 2.1678 | 7.4443 | 20.1471 | 0.4441 | 1.0985 | 40.6205 | 2.0516 | 0.9553 | 8.0301 | 2.2263 | 1.5204 | 15.3920 | 15.0619 | 20.7677 | 0.2445 | 1.6085 | 2.1947 | 0.0736 | 8.4570 | 1.4209 | 2.6171 | 19.3688 | 26.1541 |
| 9/16/1997 | 0.0272 | 0.5344 | 2.7198 | 9.5566 | 25.4731 | 0.5701 | 1.4102 | 120.2485 | 2.8260 | 1.2264 | 10.3087 | 2.7612 | 1.9518 | 39.9473 | 25.3130 | 30.6970 | 0.3519 | 10.0352 | 11.2372 | 0.0736 | 35.9854 | 3.0082 | 3.3597 | 24.7739 | 33.7939 |
| 9/17/1997 | 0.0371 | 0.6890 | 4.5703 | 15.3754 | 40.5312 | 0.9172 | 2.2688 | 284.0094 | 4.1838 | 1.9731 | 16.5854 | 4.1842 | 3.1401 | 156.6171 | 185.8115 | 95.0978 | 1.0495 | 34.4219 | 33.0053 | 0.0736 | 84.7733 | 5.2520 | 5.4054 | 39.5214 | 55.3921 |
| 9/18/1997 | 0.0256 | 0.2091 | 1.4007 | 3.0441 | 8.9029 | 0.1816 | 0.4492 | 171.1253 | 1.0777 | 0.3906 | 3.2836 | 1.2149 | 0.6217 | 182.6617 | 165.9950 | 180.4062 | 0.6380 | 21.7109 | 19.4865 | 0.1592 | 54.0760 | 3.8385 | 1.0702 | 8.4079 | 10.2348 |
| 9/19/1997 | 0.0215 | 0.1049 | 0.5842 | 1.0889 | 3.8692 | 0.0650 | 0.1607 | 70.0835 | 0.5007 | 0.1397 | 1.1746 | 0.6565 | 0.2224 | 77.0420 | 75.3594 | 131.4588 | 0.2332 | 6.3168 | 6.0031 | 0.0651 | 22.8870 | 1.6439 | 0.3828 | 3.2308 | 3.2886 |
| 9/20/1997 | 0.0236 | 0.0859 | 0.5181 | 0.8796 | 3.2822 | 0.0525 | 0.1298 | 52.9427 | 0.4259 | 0.1129 | 0.9488 | 0.5404 | 0.1796 | 50.1303 | 48.7335 | 88.1054 | 0.1021 | 3.7403 | 3.7306 | 0.0651 | 17.4747 | 0.9727 | 0.3092 | 2.6251 | 2.6433 |
| 9/21/1997 | 0.0242 | 0.0865 | 0.4842 | 0.8102 | 3.1220 | 0.0483 | 0.1196 | 40.2666 | 0.3995 | 0.1040 | 0.8739 | 0.4799 | 0.1655 | 41.3557 | 37.4001 | 65.0301 | 0.0861 | 2.8650 | 2.9523 | 0.0651 | 11.4908 | 0.7935 | 0.2848 | 2.4310 | 2.4243 |
| 9/22/1997 | 0.0228 | 0.0737 | 0.4731 | 0.7774 | 3.0357 | 0.0464 | 0.1147 | 35.8133 | 0.3875 | 0.0998 | 0.8385 | 0.4457 | 0.1588 | 37.1082 | 30.8881 | 52.4437 | 0.0787 | 2.3786 | 2.5220 | 0.0651 | 9.7283 | 0.6464 | 0.2733 | 2.3328 | 2.3279 |
| 9/23/1997 | 0.0200 | 0.0743 | 0.4624 | 0.7684 | 2.9884 | 0.0458 | 0.1134 | 33.2757 | 0.3845 | 0.0986 | 0.8289 | 0.4391 | 0.1569 | 34.5590 | 26.9811 | 44.4023 | 0.0627 | 2.0968 | 2.2640 | 0.0651 | 8.7440 | 0.6809 | 0.2701 | 2.3059 | 2.2953 |
| 9/24/1997 | 0.0196 | 0.0756 | 0.4661 | 0.7669 | 2.9662 | 0.0458 | 0.1132 | 31.9489 | 0.3645 | 0.0984 | 0.8273 | 0.4300 | 0.1566 | 22.9487 | 24.5173 | 39.1579 | 0.0612 | 1.9223 | 2.1011 | 0.0651 | 8.2865 | 0.6557 | 0.2696 | 2.3019 | 2.2933 |
| 9/25/1997 | 0.0202 | 0.0906 | 0.5430 | 0.8298 | 3.1647 | 0.0495 | 0.1224 | 30.9974 | 0.3935 | 0.1065 | 0.8951 | 0.4627 | 0.1695 | 15.2473 | 22.9897 | 36.0113 | 0.0657 | 1.8347 | 2.0575 | 0.0696 | 7.7560 | 0.7215 | 0.2917 | 2.4871 | 2.4969 |
| 9/26/1997 | 0.0208 | 0.1199 | 0.7382 | 1.1794 | 4.0825 | 0.0704 | 0.1740 | 45.2723 | 0.4967 | 0.1513 | 1.2722 | 0.6257 | 0.2409 | 43.9054 | 28.0290 | 39.1579 | 0.1151 | 3.4923 | 3.7046 | 0.0696 | 12.6570 | 1.0713 | 0.4146 | 3.5055 | 3.5983 |
| 9/27/1997 | 0.0243 | 0.1004 | 0.6295 | 1.0266 | 3.6660 | 0.0612 | 0.1515 | 52.4550 | 0.4597 | 0.1317 | 1.1074 | 0.5539 | 0.2097 | 72.2215 | 51.2824 | 52.4437 | 0.2213 | 3.8923 | 4.0319 | 0.0696 | 16.4303 | 0.9351 | 0.3609 | 3.0536 | 3.1082 |
| 9/28/1997 | 0.0244 | 0.1040 | 0.6419 | 1.3498 | 4.4836 | 0.0805 | 0.1992 | 68.6869 | 0.5190 | 0.1732 | 1.4560 | 0.6054 | 0.2757 | 74.2029 | 66.0032 | 77.2670 | 0.1512 | 4.3244 | 4.4267 | 0.0696 | 25.2016 | 0.9907 | 0.4745 | 3.9920 | 4.1200 |
| 9/29/1997 | 0.0221 | 0.0900 | 0.5722 | 1.0001 | 3.5796 | 0.0597 | 0.1476 | 62.3024 | 0.4294 | 0.1283 | 1.0788 | 0.5256 | 0.2042 | 73.6370 | 66.8532 | 65.3798 | 0.1195 | 3.8460 | 3.8951 | 0.0696 | 22.7151 | 0.9205 | 0.3516 | 2.9743 | 3.0219 |
| 9/30/1997 | 0.0211 | 0.1363 | 0.7302 | 1.5528 | 5.0428 | 0.0926 | 0.2291 | 57.9000 | 0.6725 | 0.1993 | 1.6750 | 0.7025 | 0.3171 | 62.0276 | 53.2591 | 55.9399 | 0.1226 | 4.2589 | 4.4286 | 0.0903 | 18.5046 | 1.4216 | 0.5459 | 4.5531 | 4.8962 |
| 10/1/1997 | 0.0225 | 0.2126 | 1.1842 | 2.8535 | 8.3327 | 0.1702 | 0.4211 | 75.6297 | 1.0603 | 0.3662 | 3.0781 | 1.0945 | 0.5828 | 64.5773 | 47.8839 | 55.5903 | 0.2758 | 7.3359 | 7.5270 | 0.0903 | 21.7177 | 2.1424 | 1.0032 | 7.9172 | 9.6214 |
| 10/2/1997 | 0.0261 | 0.1632 | 1.0698 | 1.6009 | 5.1071 | 0.0955 | 0.2362 | 73.7654 | 0.7908 | 0.2054 | 1.7269 | 0.8236 | 0.3269 | 67.9747 | 56.6679 | 73.4211 | 0.3359 | 7.2384 | 7.2000 | 0.1070 | 22.1999 | 2.1376 | 0.5628 | 4.7475 | 4.9364 |
| 10/3/1997 | 0.0284 | 0.4340 | 2.6877 | 8.9705 | 24.0301 | 0.5351 | 1.3237 | 129.4916 | 2.5831 | 1.1512 | 9.6764 | 2.6420 | 1.8321 | 81.5696 | 83.5647 | 108.3836 | 0.4253 | 14.6877 | 14.1347 | 0.1070 | 35.8594 | 3.0739 | 3.1537 | 23.3363 | 31.7917 |
| 10/4/1997 | 0.0254 | 0.2139 | 1.2416 | 2.1951 | 6.6642 | 0.1310 | 0.3239 | 295.3052 | 1.0421 | 0.2817 | 2.3678 | 1.0105 | 0.4483 | 145.8504 | 227.9883 | 179.7070 | 0.3630 | 37.4580 | 34.2903 | 0.1344 | 98.5483 | 2.6685 | 0.7717 | 6.4027 | 6.9235 |
| 10/5/1997 | 0.0216 | 0.1280 | 0.8850 | 1.3025 | 4.3201 | 0.0777 | 0.1922 | 214.8392 | 0.7046 | 0.1671 | 1.4050 | 0.7079 | 0.2660 | 169.6332 | 215.5344 | 356.6169 | 0.3633 | 33.1199 | 28.6273 | 0.1150 | 62.4298 | 1.8281 | 0.4579 | 3.8617 | 3.9858 |
| 10/6/1997 | 0.0219 | 0.1006 | 0.6617 | 1.0609 | 3.7055 | 0.0633 | 0.1565 | 114.0244 | 0.5000 | 0.1361 | 1.1444 | 0.6059 | 0.2167 | 84.6816 | 120.9423 | 347.8763 | 0.1899 | 16.3198 | 14.5037 | 0.0806 | 31.4849 | 1.2442 | 0.3730 | 3.1588 | 3.2191 |
| 10/7/1997 | 0.0198 | 0.1259 | 0.6591 | 1.0593 | 3.6857 | 0.0632 | 0.1563 | 79.7071 | 0.5869 | 0.1359 | 1.1427 | 0.5617 | 0.2163 | 67.9736 | 90.9242 | 233.8988 | 0.1535 | 9.0036 | 8.4503 | 0.0761 | 23.5419 | 1.0899 | 0.3724 | 3.1521 | 3.2332 |
| 10/8/1997 | 0.0219 | 0.2132 | 1.3200 | 3.2256 | 9.1739 | 0.1924 | 0.4760 | 113.6970 | 1.1781 | 0.4139 | 3.4794 | 1.2148 | 0.6588 | 71.9408 | 93.1898 | 178.3085 | 0.1835 | 15.4315 | 14.2750 | 0.1159 | 30.1870 | 1.9376 | 1.1340 | 8.8995 | 11.1944 |
| 10/9/1997 | 0.0249 | 0.3445 | 1.8922 | 4.7574 | 13.2517 | 0.2838 | 0.7020 | 149.8221 | 1.6542 | 0.6105 | 5.1318 | 1.5837 | 0.9716 | 80.1522 | 114.4277 | 181.1055 | 0.3591 | 22.4778 | 21.2090 | 0.1140 | 36.2328 | 3.1332 | 1.6725 | 12.3550 | 17.4550 |
| 10/10/1997 | 0.0291 | 0.3637 | 2.3714 | 6.9893 | 19.0063 | 0.4170 | 1.0314 | 276.8335 | 2.1148 | 0.8969 | 7.5393 | 2.1211 | 1.4274 | 155.7582 | 194.8523 | 249.6319 | 0.6071 | 38.3194 | 37.3071 | 0.1140 | 77.4130 | 4.9600 | 2.4571 | 17.9455 | 25.8835 |
| 10/11/1997 | 0.0249 | 0.1648 | 1.0220 | 2.2389 | 6.8521 | 0.1336 | 0.3304 | 189.1114 | 0.8881 | 0.2873 | 2.4150 | 0.9334 | 0.4572 | 113.2814 | 147.5634 | 277.6018 | 0.3845 | 31.9186 | 28.4427 | 0.0935 | 46.5278 | 2.7078 | 0.7871 | 6.1668 | 7.6878 |
| 10/12/1997 | 0.0251 | 0.1294 | 0.7535 | 1.6584 | 5.3450 | 0.0989 | 0.2447 | 126.2856 | 0.7120 | 0.2128 | 1.7889 | 0.7498 | 0.3387 | 77.8867 | 105.3656 | 218.5153 | 0.2324 | 18.8732 | 17.1616 | 0.0935 | 32.8326 | 1.7204 | 0.5830 | 4.7672 | 5.3526 |
| 10/13/1997 | 0.0218 | 0.1160 | 0.6576 | 1.4292 | 4.7737 | 0.0853 | 0.2109 | 93.6432 | 0.6379 | 0.1834 | 1.5417 | 0.6727 | 0.2919 | 67.9725 | 86.1071 | 180.0566 | 0.1968 | 12.1301 | 11.4639 | 0.0935 | 25.3159 | 1.3622 | 0.5025 | 4.1455 | 4.5660 |
| 10/14/1997 | 0.0199 | 0.1097 | 0.6370 | 1.3512 | 4.5940 | 0.0806 | 0.1994 | 81.3764 | 0.5460 | 0.1734 | 1.4575 | 0.6758 | 0.2759 | 63.1607 | 75.6318 | 158.3799 | 0.1661 | 9.8761 | 9.5425 | 0.0586 | 22.0177 | 1.2138 | 0.4750 | 3.9283 | 4.3096 |
| 10/15/1997 | 0.0197 | 0.0996 | 0.5823 | 1.2194 | 4.1989 | 0.0727 | 0.1799 | 68.9350 | 0.5016 | 0.1565 | 1.3153 | 0.6441 | 0.2490 | 58.3440 | 66.5693 | 140.8987 | 0.1149 | 7.4470 | 7.4321 | 0.0586 | 19.0551 | 1.0363 | 0.4287 | 3.5636 | 3.8534 |

| Sta IDs that flow to model node Node-> | ocenshr westprt **2** | 509-ADAM hoquiam **10** | 502-FRY 506-28TH 507-G3 ghpapr1 **12** | 17-CHAP 18-CAMP 19-INDI 20-STAF 21-OLEA **15** | 15-CHAR 16-NEWS weyco1 **17** | 35-WEST **18** | 24-REDM **19** | 01-HUMP 03-CHEN 04-GRASS **29** | 41-ALDR 501-ABDIV 510-MST 512-DAWS 513-SAG 514-HST aberdn **37** | 500-WILS 504-SHAN **40** | 11-ELLI 503-MILR 505-MILL **43** | 12-CENT weyco2 **48** | 42-PEEL **57** | 13-WYNO montesn **64** | elma mcleary satsopQ **66** | 38-PORT **68** | 508-KST 516-EMER 517-QEEN 518-15TH **69** | hoqnowf **72** | wfconf **74** | arthr-pmp **75** | 08-WISH **79** | ditchmwth **81** | 25-DEMP 26-BARL **82** | andrmwth elkmwth **83** | 22-JOHN ospray1 **84** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10/16/1997 | 0.0173 | 0.0959 | 0.5511 | 1.1392 | 3.9739 | 0.0680 | 0.1681 | 61.2937 | 0.4785 | 0.1462 | 1.2289 | 0.6686 | 0.2327 | 41.9215 | 59.4893 | 126.9137 | 0.0915 | 6.0454 | 6.1915 | 0.0586 | 17.1166 | 0.9186 | 0.4005 | 3.3463 | 3.5725 |
| 10/17/1997 | 0.0188 | 0.0921 | 0.5438 | 1.1002 | 3.8407 | 0.0656 | 0.1623 | 58.4915 | 0.4601 | 0.1412 | 1.1868 | 0.6505 | 0.2247 | 37.1076 | 54.3907 | 115.3761 | 0.0914 | 5.1690 | 5.4058 | 0.0571 | 17.1164 | 0.8801 | 0.3868 | 3.2598 | 3.4097 |
| 10/18/1997 | 0.0216 | 0.0872 | 0.5348 | 1.0389 | 3.6675 | 0.0620 | 0.1533 | 52.0325 | 0.4324 | 0.1333 | 1.1206 | 0.5875 | 0.2122 | 34.5592 | 50.9909 | 105.9362 | 0.0839 | 4.3932 | 4.6910 | 0.0541 | 14.7631 | 0.7793 | 0.3652 | 3.0998 | 3.1848 |
| 10/19/1997 | 0.0226 | 0.0987 | 0.5515 | 0.9973 | 3.5787 | 0.0595 | 0.1472 | 46.4891 | 0.4258 | 0.1280 | 1.0758 | 0.5468 | 0.2037 | 26.2913 | 48.1588 | 97.8948 | 0.0782 | 3.9023 | 4.2282 | 0.0541 | 12.4149 | 0.7260 | 0.3506 | 2.9863 | 3.0305 |
| 10/20/1997 | 0.0204 | 0.0836 | 0.5510 | 0.9616 | 3.4443 | 0.0574 | 0.1419 | 44.6655 | 0.4093 | 0.1234 | 1.0373 | 0.5163 | 0.1964 | 22.5532 | 45.6098 | 90.5527 | 0.0692 | 3.4818 | 3.8351 | 0.0541 | 12.1708 | 0.6830 | 0.3381 | 2.8895 | 2.8953 |
| 10/21/1997 | 0.0184 | 0.0838 | 0.4616 | 0.9251 | 3.3477 | 0.0552 | 0.1365 | 40.0290 | 0.4008 | 0.1187 | 0.9979 | 0.4856 | 0.1889 | 21.1937 | 43.6285 | 84.9587 | 0.0590 | 3.1590 | 3.5396 | 0.0599 | 10.0131 | 0.6513 | 0.3252 | 2.8037 | 2.7452 |
| 10/22/1997 | 0.0198 | 0.0999 | 0.6101 | 1.0978 | 3.8100 | 0.0655 | 0.1620 | 40.6987 | 0.4657 | 0.1409 | 1.1841 | 0.5316 | 0.2242 | 19.5796 | 42.4963 | 80.4136 | 0.1063 | 3.0956 | 3.5196 | 0.0599 | 10.3355 | 0.6644 | 0.3859 | 3.2947 | 3.3052 |
| 10/23/1997 | 0.0200 | 0.0869 | 0.6035 | 0.9998 | 3.5632 | 0.0596 | 0.1475 | 38.7476 | 0.4244 | 0.1283 | 1.0785 | 0.4948 | 0.2042 | 16.2385 | 41.0800 | 76.9174 | 0.0854 | 2.8146 | 3.1978 | 0.0599 | 9.9080 | 0.6542 | 0.3515 | 3.0335 | 2.9489 |
| 10/24/1997 | 0.0184 | 0.0803 | 0.5141 | 0.9254 | 3.4039 | 0.0552 | 0.1366 | 36.9182 | 0.3918 | 0.1188 | 0.9983 | 0.4769 | 0.1890 | 14.9075 | 39.3799 | 74.4700 | 0.0676 | 2.5158 | 2.8933 | 0.0608 | 9.5004 | 0.6245 | 0.3253 | 2.8113 | 2.7204 |
| 10/25/1997 | 0.0188 | 0.0771 | 0.4804 | 0.9076 | 3.3539 | 0.0541 | 0.1339 | 35.7153 | 0.3938 | 0.1165 | 0.9791 | 0.4683 | 0.1854 | 13.8033 | 38.2470 | 70.9738 | 0.0632 | 2.4036 | 2.7798 | 0.0608 | 9.0249 | 0.5843 | 0.3191 | 2.7601 | 2.6661 |
| 10/26/1997 | 0.0202 | 0.0905 | 0.4829 | 0.9742 | 3.4718 | 0.0581 | 0.1438 | 35.7866 | 0.4220 | 0.1250 | 1.0509 | 0.4975 | 0.1990 | 12.7842 | 37.3984 | 68.1768 | 0.0591 | 2.4203 | 2.7963 | 0.0608 | 8.9844 | 0.7144 | 0.3425 | 3.0629 | 2.7313 |
| 10/27/1997 | 0.0204 | 0.0863 | 0.5000 | 1.0089 | 3.5618 | 0.0602 | 0.1489 | 36.0207 | 0.4187 | 0.1295 | 1.0882 | 0.4970 | 0.2060 | 12.6971 | 37.1152 | 66.7783 | 0.0767 | 2.5273 | 2.9046 | 0.0728 | 8.8706 | 0.9113 | 0.3547 | 3.1431 | 2.8692 |
| 10/28/1997 | 0.0200 | 0.2478 | 0.8412 | 2.2297 | 6.7831 | 0.1330 | 0.3290 | 48.8855 | 1.1118 | 0.2861 | 2.4052 | 0.9093 | 0.4554 | 13.8898 | 37.6835 | 67.4775 | 0.0673 | 4.3019 | 4.5860 | 0.0728 | 12.2049 | 1.1555 | 0.7839 | 6.4408 | 7.2812 |
| 10/29/1997 | 0.0265 | 0.5918 | 3.4294 | 11.1515 | 29.6892 | 0.6653 | 1.6455 | 179.9464 | 3.3460 | 1.4310 | 12.0291 | 3.1671 | 2.2775 | 54.9546 | 122.6483 | 106.2858 | 1.2241 | 27.7320 | 25.8930 | 0.1434 | 39.8620 | 3.2929 | 3.9204 | 27.3586 | 43.9243 |
| 10/30/1997 | 0.0252 | 1.6743 | 12.2064 | 49.1145 | 126.7768 | 2.9300 | 7.2475 | 529.6437 | 12.1800 | 6.3027 | 52.9796 | 12.3085 | 10.0307 | 215.2184 | 472.9498 | 314.3124 | 0.8893 | 48.8719 | 53.4367 | 0.0930 | 165.6232 | 4.0545 | 17.2666 | 112.6374 | 207.2973 |
| 10/31/1997 | 0.0204 | 0.2103 | 1.2388 | 2.7041 | 8.0066 | 0.1613 | 0.3990 | 213.8036 | 1.2435 | 0.3470 | 2.9169 | 1.1068 | 0.5523 | 145.8537 | 255.4707 | 527.9329 | 0.3706 | 32.3906 | 30.6102 | 0.1938 | 56.5572 | 2.3387 | 0.9506 | 7.7677 | 9.0300 |
| 11/1/1997 | 0.0194 | 0.1355 | 0.9692 | 1.6562 | 5.2473 | 0.0988 | 0.2444 | 132.4758 | 0.7772 | 0.2125 | 1.7865 | 0.7668 | 0.3382 | 101.9560 | 148.1363 | 632.8202 | 0.3368 | 18.8794 | 17.9602 | 0.0597 | 34.8911 | 1.4375 | 0.5822 | 4.6646 | 5.5368 |
| 11/2/1997 | 0.0185 | 0.1159 | 0.6912 | 1.4261 | 4.6527 | 0.0851 | 0.2104 | 93.4962 | 0.6656 | 0.1830 | 1.5383 | 0.6983 | 0.2913 | 73.9211 | 110.1843 | 485.9780 | 0.1646 | 11.1473 | 11.0385 | 0.0597 | 26.1338 | 1.1055 | 0.5014 | 4.2816 | 4.4360 |
| 11/3/1997 | 0.0197 | 0.1339 | 0.8140 | 1.7182 | 5.5095 | 0.1025 | 0.2535 | 92.4786 | 0.7374 | 0.2205 | 1.8534 | 0.8036 | 0.3509 | 69.1072 | 93.7574 | 324.1019 | 0.1635 | 10.8797 | 10.7901 | 0.0597 | 25.8307 | 1.2132 | 0.6040 | 5.4970 | 4.9663 |
| 11/4/1997 | 0.0192 | 0.1068 | 0.7610 | 1.3431 | 4.4564 | 0.0801 | 0.1982 | 82.6565 | 0.5708 | 0.1724 | 1.4488 | 0.6564 | 0.2743 | 70.2382 | 94.0400 | 250.6807 | 0.1533 | 9.0324 | 9.1014 | 0.0537 | 23.7385 | 1.0447 | 0.4722 | 3.9175 | 4.2683 |
| 11/5/1997 | 0.0169 | 0.1064 | 0.6131 | 1.2122 | 4.1450 | 0.0723 | 0.1789 | 72.2232 | 0.5100 | 0.1556 | 1.3076 | 0.5942 | 0.2476 | 62.3108 | 78.4646 | 205.9288 | 0.1291 | 7.0241 | 7.2400 | 0.0481 | 21.4639 | 0.9209 | 0.4262 | 3.5785 | 3.7930 |
| 11/6/1997 | 0.0177 | 0.1144 | 0.6059 | 1.3620 | 4.4798 | 0.0813 | 0.2010 | 71.9389 | 0.5450 | 0.1748 | 1.4692 | 0.6302 | 0.2782 | 60.8939 | 71.6688 | 181.8047 | 0.1432 | 7.3542 | 7.3893 | 0.0577 | 20.8641 | 1.2010 | 0.4788 | 4.1249 | 4.1011 |
| 11/7/1997 | 0.0176 | 0.0975 | 0.6175 | 1.1634 | 3.8734 | 0.0694 | 0.1717 | 62.4351 | 0.4846 | 0.1493 | 1.2550 | 0.5430 | 0.2376 | 56.0806 | 65.7209 | 171.3160 | 0.1278 | 5.9917 | 6.0641 | 0.0577 | 18.0624 | 0.9904 | 0.4090 | 3.5015 | 3.5585 |
| 11/8/1997 | 0.0193 | 0.0909 | 0.5317 | 1.0735 | 3.6630 | 0.0640 | 0.1584 | 56.9463 | 0.4530 | 0.1378 | 1.1580 | 0.5214 | 0.2192 | 32.5768 | 59.4884 | 164.6731 | 0.0998 | 5.0866 | 5.2524 | 0.0414 | 16.5248 | 0.8428 | 0.3774 | 3.2300 | 3.2772 |
| 11/9/1997 | 0.0199 | 0.0919 | 0.5152 | 1.0477 | 3.6129 | 0.0625 | 0.1546 | 53.3809 | 0.4522 | 0.1344 | 1.1301 | 0.5239 | 0.2140 | 26.5740 | 54.9566 | 151.0378 | 0.0793 | 4.5606 | 4.7831 | 0.0414 | 15.3788 | 0.7835 | 0.3683 | 3.1569 | 3.1923 |
| 11/10/1997 | 0.0193 | 0.0870 | 0.5032 | 1.0168 | 3.7065 | 0.0607 | 0.1500 | 50.2558 | 0.4314 | 0.1305 | 1.0968 | 0.5208 | 0.2077 | 24.2806 | 51.5586 | 139.1505 | 0.0662 | 4.1529 | 4.4176 | 0.0414 | 14.2830 | 0.7281 | 0.3575 | 3.0825 | 3.0799 |
| 11/11/1997 | 0.0184 | 0.0855 | 0.4975 | 0.9812 | 3.5273 | 0.0585 | 0.1448 | 47.3834 | 0.4384 | 0.1259 | 1.0584 | 0.5429 | 0.2004 | 22.5250 | 48.7293 | 128.6618 | 0.0646 | 3.7634 | 4.0373 | 0.0414 | 13.3753 | 0.6916 | 0.3449 | 2.9795 | 2.9621 |
| 11/12/1997 | 0.0179 | 0.0831 | 0.4922 | 0.9590 | 3.4316 | 0.0572 | 0.1415 | 45.0201 | 0.4140 | 0.1231 | 1.0345 | 0.5683 | 0.1959 | 21.1937 | 46.1784 | 118.8723 | 0.0660 | 3.4574 | 3.7624 | 0.0403 | 12.5424 | 0.6918 | 0.3371 | 2.9126 | 2.8921 |
| 11/13/1997 | 0.0171 | 0.0826 | 0.4729 | 0.9449 | 3.3035 | 0.0564 | 0.1394 | 42.7546 | 0.4111 | 0.1213 | 1.0193 | 0.6131 | 0.1930 | 20.0328 | 43.9137 | 110.1317 | 0.0631 | 3.1722 | 3.4982 | 0.0414 | 11.7402 | 0.6774 | 0.3322 | 2.8686 | 2.8511 |
| 11/14/1997 | 0.0173 | 0.0738 | 0.4789 | 0.9125 | 3.3082 | 0.0544 | 0.1347 | 40.8145 | 0.4027 | 0.1171 | 0.9844 | 0.6272 | 0.1864 | 19.0129 | 42.2138 | 102.7896 | 0.0732 | 2.9069 | 3.2457 | 0.0414 | 11.1241 | 0.6440 | 0.3208 | 2.7747 | 2.7483 |
| 11/15/1997 | 0.0190 | 0.0780 | 0.4604 | 0.8920 | 3.2503 | 0.0532 | 0.1316 | 39.3780 | 0.4163 | 0.1145 | 0.9622 | 0.6178 | 0.1822 | 18.2202 | 40.5157 | 96.4963 | 0.0630 | 2.7284 | 3.0843 | 0.0414 | 10.6108 | 0.6144 | 0.3136 | 2.7037 | 2.6930 |
| 11/16/1997 | 0.0217 | 0.0895 | 0.4637 | 0.8948 | 3.3092 | 0.0534 | 0.1320 | 37.9656 | 0.4459 | 0.1148 | 0.9652 | 0.6448 | 0.1827 | 17.4281 | 39.3814 | 91.2520 | 0.0807 | 2.5421 | 2.9112 | 0.0414 | 10.1201 | 0.6039 | 0.3146 | 2.7263 | 2.6799 |
| 11/17/1997 | 0.0218 | 0.1155 | 0.7127 | 1.4995 | 4.8661 | 0.0895 | 0.2213 | 46.6764 | 0.6136 | 0.1924 | 1.6175 | 0.8036 | 0.3062 | 20.3459 | 43.6309 | 99.6430 | 0.1204 | 3.3107 | 3.6745 | 0.0414 | 13.3383 | 0.8766 | 0.5272 | 4.4292 | 4.7107 |
| 11/18/1997 | 0.0200 | 0.0987 | 0.6153 | 1.1004 | 3.6348 | 0.0656 | 0.1624 | 43.1912 | 0.5049 | 0.1412 | 1.1870 | 0.6154 | 0.2247 | 21.9023 | 47.3128 | 138.1017 | 0.1355 | 3.0054 | 3.3223 | 0.0403 | 12.2654 | 0.7827 | 0.3868 | 3.2725 | 3.4156 |

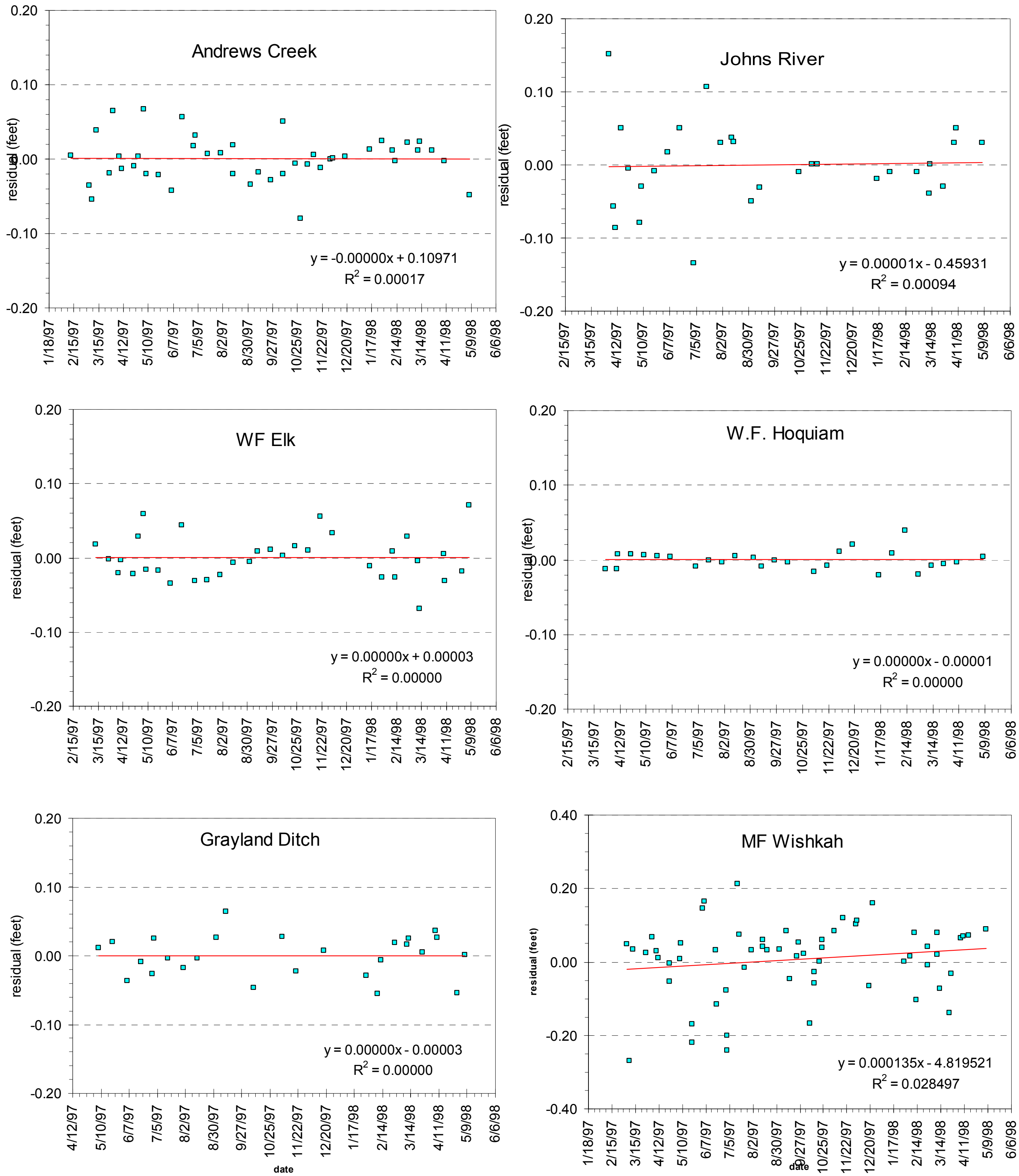
| Sta IDs that flow to model node Node-> | ocenshr westprt 2 | 509-ADAM hoquiam 10 | 502-FRY 506-28TH 507-G3 ghpapr1 12 | 17-CHAP 18-CAMP 19-INDI 20-STAF 21-OLEA 15 | 15-CHAR 16-NEWS weyco1 17 | 35-WEST 18 | 24-REDM 19 | 01-HUMP 03-CHEN 04-GRASS 29 | 41-ALDR 501-ABDIV 510-MST 512-DAWS 513-SAG 514-HST aberdn 37 | 500-WILS 504-SHAN 40 | 11-ELLI 503-MILR 505-MILL 43 | 12-CENT weyco2 48 | 42-PEEL 57 | 13-WYNO montesn 64 | elma mcleary satsopQ 66 | 38-PORT 68 | 508-KST 516-EMER 517-QEEN 518-15TH 69 | hoqnowf 72 | wfconf 74 | arthr-pmp 75 | 08-WISH 79 | ditchmwth 81 | 25-DEMP 26-BARL 82 | andrmwth elkmwth 83 | 22-JOHN ospray1 84 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11/19/1997 | 0.0196 | 0.1498 | 0.7494 | 1.6649 | 5.0336 | 0.0993 | 0.2457 | 53.4535 | 0.7263 | 0.2137 | 1.7959 | 0.8346 | 0.3400 | 23.1486 | 48.4483 | 158.3799 | 0.1414 | 4.2511 | 4.7465 | 0.0831 | 15.0487 | 1.1796 | 0.5853 | 4.9204 | 5.2535 |
| 11/20/1997 | 0.0204 | 0.1454 | 0.9351 | 1.9875 | 6.1605 | 0.1186 | 0.2933 | 79.8542 | 0.7961 | 0.2551 | 2.1439 | 0.8729 | 0.4059 | 56.9315 | 96.3082 | 268.1620 | 0.2331 | 7.0542 | 7.0412 | 0.0831 | 25.9484 | 1.3418 | 0.6987 | 5.7175 | 6.4779 |
| 11/21/1997 | 0.0199 | 0.1354 | 0.9017 | 2.0042 | 6.1571 | 0.1196 | 0.2957 | 87.9935 | 0.7496 | 0.2572 | 2.1619 | 0.8243 | 0.4093 | 70.8067 | 100.5579 | 444.0230 | 0.2401 | 7.9168 | 7.7836 | 0.0831 | 29.2951 | 1.6426 | 0.7046 | 5.7331 | 6.5380 |
| 11/22/1997 | 0.0225 | 0.1543 | 0.7058 | 1.4221 | 4.6727 | 0.0848 | 0.2098 | 70.8001 | 0.7120 | 0.1825 | 1.5340 | 0.6754 | 0.2904 | 58.0633 | 82.7161 | 482.4817 | 0.1938 | 6.3676 | 6.4287 | 0.1001 | 22.1723 | 1.2316 | 0.4999 | 4.1861 | 4.4584 |
| 11/23/1997 | 0.0239 | 0.3258 | 2.0095 | 6.1785 | 16.8550 | 0.3686 | 0.9117 | 137.9018 | 1.9479 | 0.7929 | 6.6647 | 1.9434 | 1.2618 | 59.7640 | 93.1940 | 402.0681 | 0.3455 | 19.7796 | 18.9999 | 0.1001 | 32.6588 | 1.9563 | 2.1721 | 15.5639 | 23.6088 |
| 11/24/1997 | 0.0227 | 0.1710 | 1.0030 | 2.3863 | 7.1265 | 0.1424 | 0.3521 | 115.1371 | 0.9629 | 0.3062 | 2.5741 | 0.9295 | 0.4873 | 78.4530 | 120.3790 | 374.0982 | 0.3164 | 15.1223 | 14.2391 | 0.1001 | 31.7520 | 1.4292 | 0.8389 | 6.4114 | 8.4619 |
| 11/25/1997 | 0.0209 | 0.1377 | 0.8449 | 1.9478 | 6.0225 | 0.1162 | 0.2874 | 104.9536 | 0.7817 | 0.2500 | 2.1011 | 0.8327 | 0.3978 | 74.4881 | 109.9009 | 405.5644 | 0.2365 | 13.1984 | 12.5708 | 0.0896 | 29.4434 | 1.3322 | 0.6848 | 5.5490 | 6.4620 |
| 11/26/1997 | 0.0193 | 0.1080 | 0.6405 | 1.3687 | 4.6336 | 0.0816 | 0.2020 | 83.6014 | 0.6134 | 0.1756 | 1.4764 | 0.6800 | 0.2795 | 68.2576 | 93.4749 | 367.1057 | 0.1924 | 9.1195 | 8.9206 | 0.0605 | 24.6776 | 1.0621 | 0.4812 | 3.9668 | 4.4187 |
| 11/27/1997 | 0.0207 | 0.1317 | 0.8993 | 1.6753 | 5.5194 | 0.0999 | 0.2472 | 80.6812 | 0.7443 | 0.2150 | 1.8072 | 0.7188 | 0.3422 | 47.5863 | 79.5940 | 306.9703 | 0.1553 | 8.5462 | 8.5663 | 0.0967 | 23.4349 | 0.9596 | 0.5890 | 4.7220 | 5.5951 |
| 11/28/1997 | 0.0244 | 0.2347 | 1.2285 | 3.0790 | 8.9319 | 0.1837 | 0.4543 | 159.6825 | 1.2009 | 0.3951 | 3.3213 | 1.1795 | 0.6288 | 74.4882 | 146.7095 | 264.6657 | 0.2958 | 22.3815 | 20.4607 | 0.0967 | 45.0361 | 1.9110 | 1.0825 | 8.3219 | 10.8704 |
| 11/29/1997 | 0.0318 | 0.2462 | 1.3959 | 3.1877 | 9.2562 | 0.1902 | 0.4704 | 190.0648 | 1.2360 | 0.4091 | 3.4386 | 1.2495 | 0.6510 | 98.2745 | 166.5326 | 278.6507 | 0.3507 | 29.6085 | 26.7588 | 0.0967 | 49.9930 | 2.9115 | 1.1207 | 8.9682 | 10.7030 |
| 11/30/1997 | 0.0280 | 0.3336 | 2.1738 | 7.0830 | 19.2013 | 0.4225 | 1.0452 | 199.8402 | 2.1141 | 0.9089 | 7.6404 | 2.1349 | 1.4466 | 103.0895 | 170.2200 | 313.6131 | 0.4209 | 30.9848 | 28.6627 | 0.1131 | 49.0203 | 2.6426 | 2.4901 | 17.6492 | 27.4861 |
| 12/1/1997 | 0.0239 | 0.1602 | 1.0127 | 2.7001 | 7.9417 | 0.1611 | 0.3984 | 147.9788 | 0.9958 | 0.3465 | 2.9126 | 1.0445 | 0.5514 | 90.6291 | 141.6142 | 323.0530 | 0.2634 | 22.2184 | 20.5235 | 0.0717 | 38.0795 | 1.6126 | 0.9492 | 7.0693 | 9.9134 |
| 12/2/1997 | 0.0199 | 0.1242 | 0.7555 | 1.8930 | 5.8462 | 0.1129 | 0.2793 | 107.6604 | 0.6944 | 0.2429 | 2.0420 | 0.8326 | 0.3866 | 75.6200 | 107.0659 | 287.3913 | 0.1778 | 13.1403 | 12.7007 | 0.0526 | 30.8494 | 1.1407 | 0.6655 | 5.1183 | 6.6841 |
| 12/3/1997 | 0.0174 | 0.1072 | 0.6527 | 1.5152 | 4.8610 | 0.0904 | 0.2236 | 85.6085 | 0.5872 | 0.1944 | 1.6344 | 0.7109 | 0.3094 | 66.8416 | 86.3922 | 247.1845 | 0.1343 | 9.2739 | 9.2703 | 0.0526 | 25.0441 | 0.9309 | 0.5327 | 4.2001 | 5.1780 |
| 12/4/1997 | 0.0167 | 0.0985 | 0.5816 | 1.2976 | 4.2676 | 0.0774 | 0.1915 | 70.6258 | 0.5070 | 0.1665 | 1.3997 | 0.6279 | 0.2650 | 60.8940 | 72.7999 | 214.3198 | 0.1293 | 7.2113 | 7.4088 | 0.0426 | 20.0732 | 0.8196 | 0.4562 | 3.6716 | 4.3252 |
| 12/5/1997 | 0.0170 | 0.0909 | 0.5407 | 1.1616 | 3.9216 | 0.0693 | 0.1714 | 62.9195 | 0.4839 | 0.1491 | 1.2530 | 0.5688 | 0.2372 | 39.3726 | 64.0195 | 190.5453 | 0.1012 | 6.0246 | 6.3284 | 0.0426 | 17.7954 | 0.7526 | 0.4084 | 3.3548 | 3.7729 |
| 12/6/1997 | 0.0192 | 0.0853 | 0.5077 | 1.0478 | 3.6443 | 0.0625 | 0.1546 | 57.9500 | 0.4512 | 0.1345 | 1.1302 | 0.5458 | 0.2140 | 33.1441 | 57.7891 | 172.7145 | 0.1037 | 5.1651 | 5.5373 | 0.0420 | 16.5466 | 0.7167 | 0.3683 | 3.0890 | 3.3016 |
| 12/7/1997 | 0.0183 | 0.0918 | 0.5036 | 1.0150 | 3.6056 | 0.0606 | 0.1498 | 54.5520 | 0.4619 | 0.1303 | 1.0949 | 0.5730 | 0.2073 | 30.8792 | 53.8257 | 159.4287 | 0.0799 | 4.6243 | 5.0566 | 0.0420 | 15.5315 | 0.7115 | 0.3568 | 3.0200 | 3.1497 |
| 12/8/1997 | 0.0166 | 0.0940 | 0.5381 | 1.0319 | 3.6619 | 0.0616 | 0.1523 | 52.7854 | 0.4641 | 0.1324 | 1.1131 | 0.5595 | 0.2107 | 30.3130 | 52.4070 | 149.9889 | 0.1048 | 4.3053 | 4.7323 | 0.0526 | 15.1372 | 0.7541 | 0.3628 | 3.0723 | 3.1989 |
| 12/9/1997 | 0.0187 | 0.1263 | 0.5733 | 1.0860 | 3.8334 | 0.0648 | 0.1603 | 50.9956 | 0.5549 | 0.1394 | 1.1715 | 0.6032 | 0.2218 | 27.0566 | 48.7291 | 140.8987 | 0.1270 | 4.0921 | 4.5944 | 0.0694 | 14.3050 | 0.8324 | 0.3818 | 3.2735 | 3.2919 |
| 12/10/1997 | 0.0199 | 0.1330 | 0.8632 | 1.8220 | 5.6163 | 0.1087 | 0.2689 | 61.4195 | 0.6876 | 0.2338 | 1.9654 | 0.8243 | 0.3721 | 33.1452 | 52.9819 | 146.1430 | 0.2154 | 5.5299 | 5.9645 | 0.0443 | 17.1757 | 1.1686 | 0.6405 | 5.0497 | 6.2540 |
| 12/11/1997 | 0.0182 | 0.0972 | 0.5766 | 1.0788 | 3.7690 | 0.0644 | 0.1592 | 53.5098 | 0.5063 | 0.1384 | 1.1637 | 0.6015 | 0.2203 | 31.1618 | 50.9988 | 153.8348 | 0.1590 | 4.3258 | 4.7097 | 0.0443 | 15.5903 | 0.8588 | 0.3793 | 3.1645 | 3.4228 |
| 12/12/1997 | 0.0169 | 0.0880 | 0.5093 | 0.9919 | 3.4580 | 0.0592 | 0.1464 | 49.4522 | 0.4527 | 0.1273 | 1.0700 | 0.5893 | 0.2026 | 25.5556 | 48.1643 | 144.0453 | 0.0917 | 3.7913 | 4.1922 | 0.0443 | 14.2931 | 0.7588 | 0.3487 | 2.9305 | 3.1105 |
| 12/13/1997 | 0.0170 | 0.0858 | 0.4923 | 0.9483 | 3.3464 | 0.0566 | 0.1399 | 45.9896 | 0.4443 | 0.1217 | 1.0230 | 0.6226 | 0.1937 | 24.1682 | 46.1801 | 135.3047 | 0.0899 | 3.4428 | 3.8640 | 0.0443 | 12.9224 | 0.6981 | 0.3334 | 2.8180 | 2.9511 |
| 12/14/1997 | 0.0184 | 0.0950 | 0.4954 | 0.9483 | 3.3379 | 0.0566 | 0.1399 | 44.2885 | 0.4649 | 0.1217 | 1.0229 | 0.6708 | 0.1937 | 23.3464 | 44.7632 | 128.6618 | 0.1510 | 3.2577 | 3.7005 | 0.0481 | 12.2383 | 0.7211 | 0.3334 | 2.8442 | 2.9253 |
| 12/15/1997 | 0.0243 | 0.2824 | 0.9764 | 2.7288 | 8.0317 | 0.1628 | 0.4027 | 62.8441 | 1.1441 | 0.3502 | 2.9435 | 1.0295 | 0.5573 | 25.2178 | 45.6136 | 124.4663 | 0.1858 | 5.3944 | 6.2925 | 0.0728 | 16.6781 | 1.4357 | 0.9593 | 8.0139 | 8.3232 |
| 12/16/1997 | 0.0367 | 0.7769 | 4.7783 | 16.4223 | 43.1538 | 0.9797 | 2.4233 | 494.6783 | 4.5272 | 2.1074 | 17.7147 | 4.4363 | 3.3540 | 139.9091 | 267.3557 | 209.4250 | 0.8691 | 47.8913 | 54.8126 | 0.1906 | 165.4321 | 5.4765 | 5.7734 | 42.1659 | 59.3839 |
| 12/17/1997 | 0.0291 | 0.2638 | 1.8176 | 3.7007 | 10.5286 | 0.2208 | 0.5461 | 326.8522 | 1.8775 | 0.4749 | 3.9919 | 1.3730 | 0.7558 | 177.0027 | 351.1845 | 506.9554 | 0.7811 | 40.1498 | 39.0150 | 0.1979 | 106.5349 | 3.5710 | 1.3010 | 10.1366 | 12.7910 |
| 12/18/1997 | 0.0216 | 0.1390 | 0.8215 | 1.6848 | 5.3048 | 0.1005 | 0.2486 | 203.1783 | 0.6915 | 0.2162 | 1.8173 | 0.7912 | 0.3441 | 107.3388 | 181.5526 | 667.7827 | 0.3941 | 32.3658 | 29.1993 | 0.0649 | 53.8586 | 2.0099 | 0.5923 | 4.9553 | 5.3341 |
| 12/19/1997 | 0.0205 | 0.0927 | 0.6918 | 1.3679 | 4.4810 | 0.0816 | 0.2019 | 147.3526 | 0.5937 | 0.1755 | 1.4756 | 0.6711 | 0.2794 | 82.7020 | 121.5148 | 643.3090 | 0.2426 | 23.0251 | 20.9063 | 0.0649 | 37.8614 | 1.3821 | 0.4809 | 4.0710 | 4.3176 |
| 12/20/1997 | 0.0220 | 0.1417 | 0.7404 | 1.5430 | 4.9577 | 0.0921 | 0.2277 | 144.6790 | 0.8778 | 0.1980 | 1.6644 | 0.7483 | 0.3151 | 78.1705 | 103.1064 | 482.4817 | 0.2957 | 22.8137 | 21.0730 | 0.1109 | 35.7566 | 1.4459 | 0.5425 | 4.5794 | 4.8663 |
| 12/21/1997 | 0.0182 | 0.1125 | 0.7233 | 1.2837 | 4.2789 | 0.0766 | 0.1894 | 119.6779 | 0.6301 | 0.1647 | 1.3847 | 0.6333 | 0.2622 | 73.0722 | 92.9093 | 374.0982 | 0.2236 | 17.1444 | 16.1110 | 0.0672 | 31.3330 | 1.2524 | 0.4513 | 3.8888 | 3.9325 |
| 12/22/1997 | 0.0172 | 0.1194 | 0.5723 | 1.1197 | 3.8968 | 0.0668 | 0.1652 | 97.5281 | 0.5589 | 0.1437 | 1.2078 | 0.5850 | 0.2287 | 60.0462 | 79.5975 | 304.5229 | 0.1472 | 12.1331 | 11.8138 | 0.0448 | 27.1553 | 1.0819 | 0.3936 | 3.4805 | 3.2981 |

| Sta IDs that flow to model node Node-> | ocenshr westprt 2 | 509-ADAM hoquiam 10 | 502-FRY 506-28TH 507-G3 ghpapr1 12 | 17-CHAP 18-CAMP 19-INDI 20-STAF 21-OLEA 15 | 15-CHAR 16-NEWS weyco1 17 | 35-WEST 18 | 24-REDM 19 | 01-HUMP 03-CHEN 04-GRASS 29 | 41-ALDR 501-ABDIV 510-MST 512-DAWS 513-SAG 514-HST aberdn 37 | 500-WILS 504-SHAN 40 | 11-ELLI 503-MILR 505-MILL 43 | 12-CENT weyco2 48 | 42-PEEL 57 | 13-WYNO montesn 64 | elma mcleary satsopQ 66 | 38-PORT 68 | 508-KST 516-EMER 517-QEEN 518-15TH 69 | hoqnowf 72 | wfconf 74 | arthr-pmp 75 | 08-WISH 79 | ditchmwth 81 | 25-DEMP 26-BARL 82 | andrmwth elkmwth 83 | 22-JOHN ospray1 84 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12/23/1997 | 0.0192 | 0.1492 | 0.8058 | 1.6900 | 5.3176 | 0.1008 | 0.2494 | 103.4607 | 0.7632 | 0.2169 | 1.8229 | 0.7487 | 0.3451 | 59.1972 | 76.7684 | 261.8687 | 0.2190 | 13.6628 | 13.3116 | 0.0784 | 27.1509 | 1.7959 | 0.5941 | 5.2523 | 4.9826 |
| 12/24/1997 | 0.0192 | 0.0690 | 0.6732 | 1.2485 | 4.2194 | 0.0745 | 0.1842 | 84.3768 | 0.5675 | 0.1602 | 1.3467 | 0.6029 | 0.2550 | 50.4184 | 68.2719 | 240.8912 | 0.2016 | 9.9589 | 9.9201 | 0.0605 | 23.1101 | 1.6129 | 0.4389 | 3.9693 | 3.5652 |
| 12/25/1997 | 0.0162 | 0.0929 | 0.4893 | 1.0395 | 3.6118 | 0.0620 | 0.1534 | 74.2224 | 0.5064 | 0.1334 | 1.1213 | 0.5307 | 0.2123 | 35.6924 | 62.3223 | 217.8160 | 0.1453 | 8.0708 | 8.1998 | 0.0448 | 20.7617 | 1.1082 | 0.3654 | 3.2784 | 3.0073 |
| 12/26/1997 | 0.0172 | 0.1180 | 0.5723 | 1.1149 | 3.8692 | 0.0665 | 0.1645 | 74.8120 | 0.5381 | 0.1431 | 1.2026 | 0.5664 | 0.2277 | 32.8610 | 58.6387 | 198.2371 | 0.1122 | 8.0409 | 8.2941 | 0.0448 | 20.8637 | 0.9950 | 0.3920 | 3.5266 | 3.1850 |
| 12/27/1997 | 0.0216 | 0.1523 | 0.6823 | 1.1208 | 3.9377 | 0.0669 | 0.1654 | 78.9960 | 0.6770 | 0.1438 | 1.2090 | 0.5941 | 0.2289 | 35.1269 | 62.0408 | 190.1957 | 0.2029 | 9.0748 | 9.1453 | 0.1010 | 21.5872 | 1.0816 | 0.3940 | 3.5738 | 3.1657 |
| 12/28/1997 | 0.0252 | 0.3690 | 1.9977 | 6.2475 | 17.0412 | 0.3727 | 0.9219 | 153.8603 | 1.9867 | 0.8017 | 6.7391 | 1.9206 | 1.2759 | 44.1905 | 74.5038 | 192.6431 | 0.4643 | 24.0186 | 24.3412 | 0.1010 | 30.9292 | 2.8858 | 2.1963 | 16.9400 | 21.2391 |
| 12/29/1997 | 0.0230 | 0.1473 | 0.9738 | 1.7122 | 5.4360 | 0.1021 | 0.2527 | 159.5094 | 0.8096 | 0.2197 | 1.8470 | 0.8022 | 0.3497 | 66.8410 | 102.5416 | 222.0115 | 0.4438 | 23.1339 | 21.8881 | 0.1010 | 42.8962 | 1.9712 | 0.6020 | 5.1883 | 5.2528 |
| 12/30/1997 | 0.0213 | 0.1125 | 0.6397 | 1.2411 | 4.2124 | 0.0740 | 0.1831 | 117.1024 | 0.5713 | 0.1593 | 1.3388 | 0.6756 | 0.2535 | 54.0993 | 98.5735 | 224.8085 | 0.2613 | 14.3590 | 13.9416 | 0.0442 | 34.4158 | 1.3999 | 0.4363 | 3.8794 | 3.6399 |
| 12/31/1997 | 0.0236 | 0.1163 | 0.5881 | 1.0729 | 3.7933 | 0.0640 | 0.1583 | 93.4642 | 0.5508 | 0.1377 | 1.1574 | 0.6570 | 0.2191 | 43.9054 | 82.1451 | 206.2784 | 0.2068 | 10.4234 | 10.4448 | 0.0442 | 27.6360 | 1.0806 | 0.3772 | 3.3736 | 3.1198 |
| 1/1/1998 | 0.0243 | 0.2167 | 1.0069 | 2.5370 | 7.5666 | 0.1513 | 0.3744 | 124.1516 | 1.0992 | 0.3256 | 2.7366 | 1.0928 | 0.5181 | 50.4206 | 89.2316 | 206.6280 | 0.2744 | 17.3901 | 16.9489 | 0.1013 | 31.3467 | 1.9337 | 0.8919 | 7.3604 | 8.2071 |
| 1/2/1998 | 0.0238 | 0.1245 | 0.8201 | 1.3485 | 4.4287 | 0.0804 | 0.1990 | 106.3373 | 0.7214 | 0.1731 | 1.4547 | 0.7628 | 0.2754 | 51.8345 | 93.7601 | 285.6432 | 0.3728 | 13.5048 | 13.2293 | 0.1013 | 29.3212 | 1.5431 | 0.4741 | 4.1637 | 4.0094 |
| 1/3/1998 | 0.0221 | 0.1487 | 0.6558 | 1.2777 | 4.3010 | 0.0762 | 0.1885 | 92.2158 | 0.7320 | 0.1640 | 1.3783 | 0.6757 | 0.2610 | 45.3222 | 82.1502 | 308.7184 | 0.2250 | 10.3913 | 10.4810 | 0.1028 | 26.6515 | 1.6888 | 0.4492 | 4.1046 | 3.5725 |
| 1/4/1998 | 0.0260 | 0.2871 | 1.4048 | 3.7196 | 10.6304 | 0.2219 | 0.5489 | 110.2751 | 1.3894 | 0.4773 | 4.0123 | 1.3381 | 0.7597 | 45.6060 | 82.9975 | 273.7559 | 0.4533 | 14.3653 | 14.4708 | 0.1028 | 27.3327 | 3.1030 | 1.3076 | 10.7801 | 11.2850 |
| 1/5/1998 | 0.0225 | 0.2349 | 1.0326 | 2.1371 | 6.5101 | 0.1275 | 0.3154 | 147.6137 | 1.0556 | 0.2742 | 2.3053 | 0.9483 | 0.4365 | 53.5354 | 98.5766 | 269.5604 | 0.4320 | 22.2380 | 21.3954 | 0.1028 | 36.4161 | 2.3132 | 0.7513 | 6.2781 | 6.7891 |
| 1/6/1998 | 0.0215 | 0.3081 | 1.6792 | 4.5658 | 12.7701 | 0.2724 | 0.6737 | 209.3395 | 1.6280 | 0.5859 | 4.9252 | 1.5813 | 0.9325 | 73.9243 | 142.7618 | 451.0155 | 0.5093 | 31.3594 | 30.0798 | 0.1501 | 53.6133 | 2.4485 | 1.6052 | 12.1531 | 16.2289 |
| 1/7/1998 | 0.0231 | 0.1894 | 1.1693 | 2.5332 | 7.4556 | 0.1511 | 0.3738 | 205.4357 | 1.0506 | 0.3251 | 2.7325 | 1.0174 | 0.5174 | 79.5866 | 170.2281 | 646.8052 | 0.4856 | 31.9438 | 29.8826 | 0.1198 | 53.1534 | 2.5172 | 0.8906 | 7.3017 | 8.2652 |
| 1/8/1998 | 0.0182 | 0.1280 | 0.7439 | 1.5229 | 4.8675 | 0.0908 | 0.2247 | 140.3889 | 0.7044 | 0.1954 | 1.6427 | 0.7654 | 0.3110 | 60.6129 | 122.0815 | 650.3015 | 0.3188 | 20.1854 | 19.1319 | 0.0750 | 37.2972 | 1.5315 | 0.5354 | 4.5837 | 4.6870 |
| 1/9/1998 | 0.0161 | 0.0972 | 0.6064 | 1.2275 | 4.1526 | 0.0732 | 0.1811 | 104.8302 | 0.5662 | 0.1575 | 1.3241 | 0.6723 | 0.2507 | 49.8518 | 94.8928 | 482.4817 | 0.2393 | 12.7598 | 12.6364 | 0.0560 | 29.7566 | 1.1516 | 0.4315 | 3.7669 | 3.6727 |
| 1/10/1998 | 0.0154 | 0.0855 | 0.5901 | 1.0829 | 3.7423 | 0.0646 | 0.1598 | 86.0122 | 0.5193 | 0.1390 | 1.1682 | 0.6200 | 0.2212 | 42.7718 | 79.3154 | 367.1057 | 0.1660 | 9.4827 | 9.6602 | 0.0560 | 24.7764 | 1.0010 | 0.3807 | 3.3647 | 3.1782 |
| 1/11/1998 | 0.0170 | 0.0922 | 0.5613 | 1.0314 | 3.6128 | 0.0615 | 0.1522 | 74.8613 | 0.5431 | 0.1324 | 1.1125 | 0.5725 | 0.2106 | 38.5254 | 68.8373 | 292.2860 | 0.1966 | 7.7140 | 8.0338 | 0.0560 | 21.5084 | 0.9479 | 0.3626 | 3.2455 | 2.9664 |
| 1/12/1998 | 0.0165 | 0.1153 | 0.6001 | 1.0263 | 3.6125 | 0.0612 | 0.1514 | 67.9189 | 0.4907 | 0.1317 | 1.1070 | 0.6326 | 0.2096 | 32.0135 | 62.0419 | 248.9326 | 0.1664 | 6.5019 | 6.9123 | 0.0560 | 19.6858 | 1.0258 | 0.3608 | 3.2806 | 2.8829 |
| 1/13/1998 | 0.0218 | 0.2577 | 1.0180 | 2.4608 | 7.3226 | 0.1468 | 0.3631 | 91.9631 | 1.1285 | 0.3158 | 2.6545 | 1.0569 | 0.5026 | 35.9798 | 68.5583 | 242.6394 | 0.4800 | 10.0571 | 10.3078 | 0.0560 | 25.9998 | 2.3734 | 0.8651 | 7.5370 | 7.2064 |
| 1/14/1998 | 0.0263 | 1.4819 | 10.2000 | 41.3654 | 107.0621 | 2.4677 | 6.1040 | 572.2287 | 10.8180 | 5.3083 | 44.6207 | 10.4425 | 8.4481 | 157.4668 | 273.0248 | 402.0681 | 0.7460 | 52.0763 | 57.6095 | 0.1853 | 188.2600 | 4.9998 | 14.5424 | 97.2460 | 168.3668 |
| 1/15/1998 | 0.0241 | 0.2266 | 1.6763 | 3.7033 | 10.4989 | 0.2209 | 0.5465 | 278.0546 | 1.4290 | 0.4752 | 3.9947 | 1.3736 | 0.7563 | 158.0213 | 291.7148 | 674.7752 | 0.6494 | 37.6829 | 35.8512 | 0.1366 | 83.6577 | 2.7922 | 1.3019 | 9.8939 | 13.3975 |
| 1/16/1998 | 0.0199 | 0.2417 | 1.2146 | 2.5982 | 7.6952 | 0.1550 | 0.3834 | 201.3515 | 1.1842 | 0.3334 | 2.8026 | 1.0900 | 0.5306 | 108.7564 | 181.5548 | 793.6475 | 0.4810 | 31.6354 | 29.1785 | 0.1345 | 52.1255 | 2.2292 | 0.9134 | 7.5874 | 8.2220 |
| 1/17/1998 | 0.0235 | 0.3187 | 2.1890 | 6.2634 | 17.0649 | 0.3736 | 0.9242 | 242.2662 | 2.0931 | 0.8038 | 6.7563 | 1.9901 | 1.2792 | 129.1451 | 236.2116 | 797.1437 | 0.3643 | 34.3307 | 32.2051 | 0.1318 | 67.8253 | 2.9674 | 2.2019 | 16.0831 | 23.6211 |
| 1/18/1998 | 0.0235 | 0.2003 | 1.1198 | 2.6476 | 7.8095 | 0.1579 | 0.3907 | 205.5826 | 1.2238 | 0.3398 | 2.8560 | 1.0493 | 0.5407 | 114.9843 | 210.4371 | 734.2113 | 0.2962 | 31.5282 | 29.1588 | 0.1318 | 54.6981 | 2.3537 | 0.9308 | 7.7208 | 8.6166 |
| 1/19/1998 | 0.0255 | 0.2497 | 1.2450 | 3.1280 | 9.0691 | 0.1866 | 0.4616 | 185.9974 | 1.3629 | 0.4014 | 3.3742 | 1.1563 | 0.6388 | 99.9765 | 178.4353 | 681.7677 | 0.3785 | 29.6106 | 27.5511 | 0.1318 | 45.8838 | 2.8113 | 1.0997 | 9.3427 | 9.6880 |
| 1/20/1998 | 0.0262 | 0.2868 | 1.9647 | 5.6508 | 15.4533 | 0.3371 | 0.8338 | 224.6006 | 1.9179 | 0.7252 | 6.0955 | 1.7550 | 1.1541 | 111.0182 | 174.7528 | 569.8878 | 0.5266 | 32.6202 | 31.1755 | 0.1318 | 59.7465 | 4.6471 | 1.9866 | 16.2278 | 17.8409 |
| 1/21/1998 | 0.0350 | 0.2730 | 1.5136 | 4.5935 | 12.7883 | 0.2740 | 0.6778 | 215.5335 | 1.7297 | 0.5895 | 4.9550 | 1.5442 | 0.9381 | 105.0719 | 160.8763 | 465.0005 | 0.4280 | 31.8657 | 30.3640 | 0.1540 | 56.7462 | 3.5874 | 1.6149 | 12.9299 | 15.3478 |
| 1/22/1998 | 0.0259 | 0.2805 | 1.2256 | 3.3949 | 9.7944 | 0.2025 | 0.5010 | 210.6192 | 1.4932 | 0.4357 | 3.6621 | 1.2468 | 0.6933 | 104.5069 | 162.0096 | 409.0606 | 0.4457 | 31.7497 | 30.2582 | 0.1540 | 54.8680 | 3.1231 | 1.1935 | 9.8641 | 10.8527 |
| 1/23/1998 | 0.0359 | 1.3012 | 8.2319 | 33.3756 | 86.6151 | 1.9911 | 4.9250 | 682.9844 | 8.7506 | 4.2830 | 36.0021 | 8.5186 | 6.8163 | 181.2494 | 305.8682 | 405.5644 | 0.9319 | 62.9398 | 75.2703 | 0.1540 | 223.7420 | 6.0258 | 11.7335 | 80.7017 | 130.9636 |
| 1/24/1998 | 0.0411 | 0.8225 | 5.2777 | 19.1434 | 50.1495 | 1.1420 | 2.8249 | 542.2757 | 5.6201 | 2.4566 | 20.6499 | 5.0916 | 3.9097 | 236.4696 | 433.3003 | 478.9855 | 0.8320 | 52.1256 | 58.4395 | 0.2456 | 184.6009 | 4.8768 | 6.7300 | 45.6577 | 77.6645 |
| 1/25/1998 | 0.0297 | 0.3807 | 2.7674 | 6.5181 | 17.8120 | 0.3888 | 0.9618 | 369.7830 | 2.2713 | 0.8364 | 7.0310 | 2.0514 | 1.3312 | 264.2191 | 354.0118 | 608.3465 | 0.7561 | 42.3519 | 45.1242 | 0.1612 | 117.5225 | 3.3067 | 2.2915 | 16.7030 | 24.7017 |

| Sta IDs that flow to model node Node-> | ocenshr westprt 2 | 509-ADAM hoquiam 10 | 502-FRY 506-28TH 507-G3 ghpapr1 12 | 17-CHAP 18-CAMP 19-INDI 20-STAF 21-OLEA 15 | 15-CHAR 16-NEWS weyco1 17 | 35-WEST 18 | 24-REDM 19 | 01-HUMP 03-CHEN 04-GRASS 29 | 41-ALDR 501-ABDIV 510-MST 512-DAWS 513-SAG 514-HST aberdn 37 | 500-WILS 504-SHAN 40 | 11-ELLI 503-MILR 505-MILL 43 | 12-CENT weyco2 48 | 42-PEEL 57 | 13-WYNO montesn 64 | elma mcleary satsopQ 66 | 38-PORT 68 | 508-KST 516-EMER 517-QEEN 518-15TH 69 | hoqnowf 72 | wfconf 74 | arthr-pmp 75 | 08-WISH 79 | ditchmwth 81 | 25-DEMP 26-BARL 82 | andrmwth elkmwth 83 | 22-JOHN ospray1 84 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/26/1998 | 0.0264 | 0.2575 | 1.8130 | 4.7466 | 13.2469 | 0.2832 | 0.7004 | 287.8011 | 1.7177 | 0.6091 | 5.1202 | 1.6249 | 0.9694 | 187.7606 | 270.4703 | 653.7977 | 0.5885 | 38.5469 | 38.7308 | 0.1340 | 82.6817 | 2.7041 | 1.6687 | 12.5387 | 17.4251 |
| 1/27/1998 | 0.0207 | 0.1610 | 1.0414 | 2.5646 | 7.6396 | 0.1530 | 0.3784 | 213.9046 | 1.0011 | 0.3291 | 2.7665 | 1.0819 | 0.5238 | 118.3822 | 192.0305 | 622.3315 | 0.3964 | 33.6293 | 31.8999 | 0.0739 | 53.9775 | 1.8623 | 0.9016 | 7.2570 | 8.6343 |
| 1/28/1998 | 0.0189 | 0.1384 | 0.8945 | 2.0598 | 6.3316 | 0.1229 | 0.3040 | 178.9822 | 0.8226 | 0.2643 | 2.2219 | 0.9560 | 0.4207 | 93.7448 | 146.7185 | 513.9479 | 0.2650 | 30.3389 | 28.0699 | 0.0717 | 41.3068 | 1.4986 | 0.7242 | 6.0408 | 6.6222 |
| 1/29/1998 | 0.0170 | 0.1553 | 0.9085 | 2.2733 | 6.7769 | 0.1356 | 0.3355 | 145.5761 | 0.9019 | 0.2917 | 2.4522 | 0.9811 | 0.4643 | 83.5500 | 123.7792 | 405.5644 | 0.2498 | 23.1781 | 21.7795 | 0.0644 | 34.2630 | 1.5104 | 0.7992 | 6.7692 | 7.1525 |
| 1/30/1998 | 0.0213 | 0.1339 | 0.8922 | 2.1006 | 6.4009 | 0.1253 | 0.3100 | 128.8073 | 0.8089 | 0.2696 | 2.2659 | 0.9658 | 0.4290 | 84.3989 | 127.4602 | 339.8350 | 0.2669 | 18.5906 | 17.5988 | 0.0644 | 33.1086 | 1.4572 | 0.7385 | 6.3008 | 6.5629 |
| 1/31/1998 | 0.0196 | 0.1128 | 0.7227 | 1.6139 | 5.1599 | 0.0963 | 0.2382 | 101.2487 | 0.6383 | 0.2071 | 1.7409 | 0.8267 | 0.3296 | 75.3371 | 110.1830 | 301.0266 | 0.2157 | 12.6655 | 12.4328 | 0.0459 | 27.7338 | 1.1857 | 0.5674 | 4.9708 | 4.8461 |
| 2/1/1998 | 0.0200 | 0.1211 | 0.6877 | 1.5687 | 5.0152 | 0.0936 | 0.2315 | 89.8005 | 0.6466 | 0.2013 | 1.6922 | 0.8027 | 0.3204 | 69.6734 | 94.0393 | 263.6168 | 0.1456 | 10.4898 | 10.5241 | 0.0459 | 24.8813 | 1.1534 | 0.5515 | 4.9689 | 4.5047 |
| 2/2/1998 | 0.0237 | 0.1168 | 0.7439 | 1.6332 | 5.2043 | 0.0974 | 0.2410 | 89.9009 | 0.9458 | 0.2096 | 1.7617 | 0.7963 | 0.3335 | 67.9746 | 86.9592 | 235.9965 | 0.1897 | 10.7101 | 10.7032 | 0.0649 | 24.5141 | 1.5871 | 0.5742 | 5.2223 | 4.6087 |
| 2/3/1998 | 0.0200 | 0.1013 | 0.6388 | 1.3635 | 4.4233 | 0.0813 | 0.2012 | 77.3104 | 0.5463 | 0.1750 | 1.4708 | 0.6876 | 0.2785 | 64.2920 | 79.3148 | 215.7183 | 0.1493 | 8.3594 | 8.5301 | 0.0448 | 21.6953 | 1.2724 | 0.4794 | 4.3662 | 3.8373 |
| 2/4/1998 | 0.0184 | 0.1074 | 0.6331 | 1.2742 | 4.2756 | 0.0760 | 0.1880 | 69.5003 | 0.5661 | 0.1635 | 1.3744 | 0.6748 | 0.2602 | 61.1778 | 71.6681 | 200.3348 | 0.1316 | 6.9945 | 7.2916 | 0.0647 | 19.6568 | 1.0982 | 0.4479 | 4.1079 | 3.5466 |
| 2/5/1998 | 0.0178 | 0.1143 | 0.6925 | 1.4164 | 4.6064 | 0.0845 | 0.2090 | 69.8684 | 0.5950 | 0.1818 | 1.5279 | 0.7178 | 0.2893 | 60.6121 | 69.9696 | 186.3498 | 0.1375 | 7.0780 | 7.3450 | 0.0647 | 19.6622 | 1.1333 | 0.4979 | 4.5333 | 4.0118 |
| 2/6/1998 | 0.0184 | 0.1172 | 0.7376 | 1.4692 | 3.9460 | 0.0876 | 0.2168 | 65.6831 | 0.6227 | 0.1885 | 1.5848 | 0.8006 | 0.3001 | 57.7806 | 66.8440 | 175.5115 | 0.1850 | 6.2836 | 6.6172 | 0.0647 | 18.6325 | 1.3436 | 0.5165 | 4.7589 | 4.0627 |
| 2/7/1998 | 0.0193 | 0.1028 | 0.6611 | 1.2524 | 3.2060 | 0.0747 | 0.1848 | 60.4069 | 0.5912 | 0.1607 | 1.3509 | 0.7835 | 0.2558 | 46.1695 | 61.7568 | 166.7709 | 0.1753 | 5.4939 | 5.8389 | 0.0647 | 17.2458 | 1.1901 | 0.4403 | 4.0653 | 3.4475 |
| 2/8/1998 | 0.0197 | 0.1263 | 0.5722 | 1.3772 | 4.1086 | 0.0822 | 0.2032 | 62.0659 | 0.6491 | 0.1767 | 1.4855 | 0.7916 | 0.2813 | 42.2073 | 62.3244 | 160.4776 | 0.1847 | 5.5267 | 5.8515 | 0.0641 | 18.1341 | 1.0877 | 0.4842 | 4.4055 | 3.8538 |
| 2/9/1998 | 0.0188 | 0.1036 | 0.7264 | 1.2072 | 4.0208 | 0.0720 | 0.1781 | 64.3222 | 0.5594 | 0.1549 | 1.3022 | 0.6499 | 0.2465 | 45.8881 | 79.0320 | 181.8047 | 0.2440 | 5.4756 | 5.7210 | 0.0641 | 19.9050 | 0.9925 | 0.4244 | 3.8800 | 3.3436 |
| 2/10/1998 | 0.0175 | 0.1314 | 0.6983 | 1.3574 | 4.4191 | 0.0810 | 0.2003 | 64.1385 | 0.6447 | 0.1742 | 1.4642 | 0.7474 | 0.2772 | 43.6227 | 72.5216 | 192.2934 | 0.2171 | 5.4455 | 5.8041 | 0.0627 | 19.5069 | 1.0572 | 0.4772 | 4.3199 | 3.8222 |
| 2/11/1998 | 0.0227 | 0.1556 | 0.8348 | 1.5815 | 5.0010 | 0.0943 | 0.2334 | 82.0725 | 0.7414 | 0.2030 | 1.7060 | 0.8408 | 0.3230 | 55.7992 | 84.9808 | 188.4476 | 0.2538 | 7.9521 | 8.2086 | 0.0526 | 25.1085 | 1.6611 | 0.5560 | 5.0719 | 4.4145 |
| 2/12/1998 | 0.0218 | 0.4122 | 2.0573 | 5.6279 | 15.4354 | 0.3357 | 0.8305 | 204.4470 | 2.0277 | 0.7222 | 6.0708 | 1.8371 | 1.1494 | 84.9682 | 150.3953 | 196.4889 | 0.4150 | 25.3345 | 24.4623 | 0.1533 | 61.8155 | 2.7596 | 1.9785 | 15.0040 | 20.4192 |
| 2/13/1998 | 0.0232 | 0.3311 | 2.3441 | 6.7371 | 18.0770 | 0.4019 | 0.9941 | 277.8122 | 2.1311 | 0.8646 | 7.2673 | 2.1042 | 1.3759 | 141.3204 | 257.7091 | 297.8800 | 0.6764 | 35.1005 | 32.2596 | 0.1533 | 88.9276 | 2.7698 | 2.3685 | 17.0735 | 25.8030 |
| 2/14/1998 | 0.0250 | 0.1565 | 0.9727 | 1.9929 | 6.0818 | 0.1189 | 0.2941 | 192.4084 | 0.8218 | 0.2557 | 2.1497 | 0.9487 | 0.4070 | 107.9041 | 175.5986 | 384.5869 | 0.3935 | 30.3396 | 27.0164 | 0.0795 | 51.7421 | 1.9957 | 0.7006 | 5.9832 | 6.1728 |
| 2/15/1998 | 0.0258 | 0.1349 | 0.8158 | 1.6224 | 5.1634 | 0.0968 | 0.2394 | 152.0466 | 0.7132 | 0.2082 | 1.7500 | 0.7630 | 0.3313 | 88.0799 | 130.5705 | 342.2823 | 0.2913 | 23.6587 | 21.3471 | 0.0556 | 39.5853 | 1.8253 | 0.5704 | 5.0860 | 4.6808 |
| 2/16/1998 | 0.0249 | 0.1117 | 0.6724 | 1.3451 | 4.3166 | 0.0802 | 0.1985 | 116.8257 | 0.6265 | 0.1726 | 1.4510 | 0.6481 | 0.2747 | 77.8852 | 106.2164 | 288.4402 | 0.2276 | 15.9719 | 14.8823 | 0.0556 | 32.1710 | 1.4394 | 0.4729 | 4.2712 | 3.7970 |
| 2/17/1998 | 0.0233 | 0.1036 | 0.6102 | 1.2046 | 4.0418 | 0.0719 | 0.1777 | 95.8631 | 0.5968 | 0.1546 | 1.2994 | 0.6055 | 0.2460 | 70.8067 | 90.3575 | 247.5341 | 0.1878 | 11.5812 | 11.1075 | 0.0556 | 27.5853 | 1.1683 | 0.4235 | 3.8525 | 3.3610 |
| 2/18/1998 | 0.0261 | 0.1872 | 0.9152 | 2.2270 | 6.6990 | 0.1329 | 0.3286 | 108.9934 | 0.9137 | 0.2858 | 2.4022 | 0.9042 | 0.4548 | 71.6558 | 88.3770 | 219.5642 | 0.2128 | 14.5808 | 13.9490 | 0.0885 | 28.7584 | 2.5386 | 0.7829 | 7.1050 | 6.2725 |
| 2/19/1998 | 0.0265 | 0.1471 | 1.0469 | 2.1588 | 6.5332 | 0.1288 | 0.3186 | 125.5406 | 0.9150 | 0.2770 | 2.3287 | 0.8572 | 0.4409 | 79.3015 | 119.2433 | 218.1657 | 0.3397 | 17.8789 | 16.7193 | 0.1009 | 32.9547 | 2.8280 | 0.7589 | 6.6173 | 6.4830 |
| 2/20/1998 | 0.0254 | 0.2554 | 1.0677 | 2.7639 | 8.1301 | 0.1649 | 0.4079 | 114.8880 | 1.2264 | 0.3547 | 2.9815 | 1.0861 | 0.5645 | 75.0549 | 99.7033 | 218.5153 | 0.2451 | 15.4743 | 14.9578 | 0.0739 | 29.7955 | 2.7832 | 0.9717 | 8.2633 | 8.4194 |
| 2/21/1998 | 0.0258 | 0.2759 | 1.8420 | 4.4690 | 12.4183 | 0.2666 | 0.6595 | 229.3862 | 1.5963 | 0.5735 | 4.8207 | 1.5230 | 0.9127 | 97.1438 | 132.2721 | 237.0454 | 0.5484 | 34.8283 | 33.6464 | 0.1240 | 58.2600 | 4.2319 | 1.5711 | 12.3218 | 15.5228 |
| 2/22/1998 | 0.0264 | 0.1709 | 1.0216 | 2.0189 | 6.1316 | 0.1204 | 0.2979 | 202.0622 | 0.9937 | 0.2591 | 2.1777 | 0.8673 | 0.4123 | 104.2217 | 163.1401 | 327.5981 | 0.3857 | 32.3576 | 29.5381 | 0.1240 | 52.2161 | 2.3423 | 0.7097 | 5.9691 | 6.3554 |
| 2/23/1998 | 0.0216 | 0.1219 | 0.7720 | 1.5256 | 4.8071 | 0.0910 | 0.2251 | 155.3340 | 0.7975 | 0.1958 | 1.6457 | 0.7091 | 0.3116 | 82.4164 | 136.7993 | 395.0756 | 0.2937 | 24.4048 | 22.1355 | 0.1240 | 39.9735 | 1.6294 | 0.5363 | 4.6839 | 4.5313 |
| 2/24/1998 | 0.0191 | 0.1065 | 0.6543 | 1.3024 | 4.2719 | 0.0777 | 0.1922 | 115.3460 | 0.5950 | 0.1671 | 1.4048 | 0.6422 | 0.2660 | 62.5943 | 107.6331 | 349.6244 | 0.1727 | 15.4061 | 14.5305 | 0.0459 | 32.0529 | 1.2733 | 0.4579 | 4.0882 | 3.7249 |
| 2/25/1998 | 0.0182 | 0.1145 | 0.6756 | 1.5388 | 4.9439 | 0.0918 | 0.2271 | 109.3594 | 0.6245 | 0.1975 | 1.6599 | 0.7385 | 0.3143 | 49.0022 | 92.9062 | 287.0417 | 0.1607 | 14.8245 | 14.0345 | 0.0504 | 29.3027 | 1.3340 | 0.5410 | 4.8327 | 4.3936 |
| 2/26/1998 | 0.0177 | 0.0996 | 0.6241 | 1.2900 | 4.2455 | 0.0770 | 0.1904 | 89.4544 | 0.5510 | 0.1655 | 1.3915 | 0.6830 | 0.2635 | 42.7727 | 80.1623 | 252.7785 | 0.1511 | 10.7949 | 10.5284 | 0.0314 | 24.8664 | 1.1866 | 0.4535 | 4.0982 | 3.6148 |
| 2/27/1998 | 0.0178 | 0.0946 | 0.5597 | 1.1377 | 3.8563 | 0.0679 | 0.1679 | 77.6377 | 0.5040 | 0.1460 | 1.2273 | 0.6420 | 0.2324 | 37.9585 | 70.2508 | 223.0604 | 0.1032 | 8.2834 | 8.3510 | 0.0392 | 22.4401 | 1.0389 | 0.4000 | 3.6619 | 3.1125 |
| 2/28/1998 | 0.0206 | 0.1442 | 0.6777 | 1.3755 | 4.5376 | 0.0821 | 0.2030 | 85.2388 | 0.6673 | 0.1765 | 1.4837 | 0.7343 | 0.2809 | 37.1099 | 67.9863 | 202.7822 | 0.1551 | 9.8612 | 9.9786 | 0.0523 | 23.4156 | 1.1331 | 0.4836 | 4.4061 | 3.7691 |

| Sta IDs that flow to model node Node-> | ocenshr westprt **2** | 509-ADAM hoquiam **10** | 502-FRY 506-28TH 507-G3 ghpapr1 **12** | 17-CHAP 18-CAMP 19-INDI 20-STAF 21-OLEA **15** | 15-CHAR 16-NEWS weyco1 **17** | 35-WEST **18** | 24-REDM **19** | 01-HUMP 03-CHEN 04-GRASS **29** | 41-ALDR 501-ABDIV 510-MST 512-DAWS 513-SAG 514-HST aberdn **37** | 500-WILS 504-SHAN **40** | 11-ELLI 503-MILR 505-MILL **43** | 12-CENT weyco2 **48** | 42-PEEL **57** | 13-WYNO montesn **64** | elma mcleary satsopQ **66** | 38-PORT **68** | 508-KST 516-EMER 517-QEEN 518-15TH **69** | hoqnowf **72** | wfconf **74** | arthr-pmp **75** | 08-WISH **79** | ditchmwth **81** | 25-DEMP 26-BARL **82** | andrmwth elkmwth **83** | 22-JOHN ospray1 **84** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3/1/1998 | 0.0241 | 0.1714 | 1.0599 | 2.3279 | 6.9489 | 0.1389 | 0.3435 | 163.8937 | 0.8759 | 0.2987 | 2.5110 | 0.9855 | 0.4754 | 53.8175 | 104.5211 | 218.8649 | 0.3710 | 26.8058 | 24.8437 | 0.0523 | 38.8185 | 1.7370 | 0.8184 | 6.9293 | 7.2089 |
| 3/2/1998 | 0.0212 | 0.1324 | 0.7450 | 1.5365 | 4.8485 | 0.0917 | 0.2267 | 126.3245 | 0.6767 | 0.1972 | 1.6574 | 0.7686 | 0.3138 | 51.2689 | 103.6714 | 315.7109 | 0.2323 | 17.8314 | 16.6813 | 0.0523 | 33.9672 | 1.3683 | 0.5402 | 4.7519 | 4.4814 |
| 3/3/1998 | 0.0193 | 0.1207 | 0.7549 | 1.5874 | 4.9399 | 0.0947 | 0.2342 | 106.9265 | 0.6720 | 0.2037 | 1.7123 | 0.7283 | 0.3242 | 45.0387 | 86.9627 | 388.0831 | 0.2117 | 14.2819 | 13.5482 | 0.0459 | 28.8255 | 1.6785 | 0.5581 | 5.0751 | 4.3577 |
| 3/4/1998 | 0.0174 | 0.1155 | 0.6385 | 1.2682 | 4.2336 | 0.0757 | 0.1871 | 86.1844 | 0.5760 | 0.1627 | 1.3680 | 0.6252 | 0.2590 | 39.9411 | 75.9194 | 367.1057 | 0.1580 | 10.4137 | 10.2229 | 0.0431 | 23.5482 | 1.2284 | 0.4458 | 4.0369 | 3.4852 |
| 3/5/1998 | 0.0166 | 0.0991 | 0.6221 | 1.1417 | 3.8656 | 0.0681 | 0.1685 | 74.8098 | 0.5253 | 0.1465 | 1.2316 | 0.5641 | 0.2332 | 35.9758 | 66.5728 | 319.2071 | 0.1796 | 8.2821 | 8.3943 | 0.0431 | 20.6295 | 0.9938 | 0.4014 | 3.6394 | 3.1136 |
| 3/6/1998 | 0.0163 | 0.0885 | 0.5707 | 1.0531 | 3.6580 | 0.0628 | 0.1554 | 67.5912 | 0.5166 | 0.1351 | 1.1360 | 0.5383 | 0.2151 | 32.8612 | 60.0576 | 271.3086 | 0.1108 | 6.7140 | 6.9511 | 0.0381 | 19.3846 | 0.8470 | 0.3702 | 3.3872 | 2.8157 |
| 3/7/1998 | 0.0187 | 0.0929 | 0.5506 | 1.0110 | 3.5773 | 0.0603 | 0.1492 | 61.6285 | 0.5133 | 0.1297 | 1.0905 | 0.5238 | 0.2065 | 30.3130 | 54.9610 | 233.1995 | 0.0998 | 5.7468 | 6.0787 | 0.0654 | 17.6537 | 0.7786 | 0.3554 | 3.2947 | 2.6549 |
| 3/8/1998 | 0.0211 | 0.1258 | 0.6376 | 1.2754 | 4.2792 | 0.0761 | 0.1882 | 68.5664 | 0.6308 | 0.1637 | 1.3758 | 0.6313 | 0.2605 | 32.0129 | 56.3742 | 210.8235 | 0.1156 | 6.9269 | 7.3087 | 0.0654 | 19.0529 | 1.3749 | 0.4484 | 4.0992 | 3.4594 |
| 3/9/1998 | 0.0235 | 0.3849 | 2.0988 | 7.2433 | 19.5638 | 0.4321 | 1.0688 | 156.1933 | 2.1628 | 0.9295 | 7.8133 | 2.2085 | 1.4793 | 50.1375 | 85.5464 | 218.5153 | 0.2938 | 22.0153 | 21.5714 | 0.0654 | 37.5064 | 2.7133 | 2.5464 | 18.8871 | 26.1706 |
| 3/10/1998 | 0.0221 | 0.1727 | 1.2199 | 2.4743 | 7.2576 | 0.1476 | 0.3651 | 153.7047 | 1.0239 | 0.3175 | 2.6690 | 1.0032 | 0.5053 | 64.0131 | 118.6850 | 318.5079 | 0.5457 | 23.4373 | 22.3598 | 0.0806 | 37.8132 | 2.4303 | 0.8699 | 7.3950 | 7.6721 |
| 3/11/1998 | 0.0201 | 0.1362 | 0.9209 | 2.1342 | 6.4098 | 0.1273 | 0.3149 | 153.3984 | 0.8860 | 0.2739 | 2.3021 | 0.8863 | 0.4359 | 57.7821 | 108.4873 | 367.1057 | 0.3050 | 24.8918 | 23.9017 | 0.0717 | 34.5968 | 2.0333 | 0.7503 | 6.6704 | 6.1814 |
| 3/12/1998 | 0.0180 | 0.1240 | 0.6763 | 1.5353 | 5.0663 | 0.0916 | 0.2266 | 117.5291 | 0.6610 | 0.1970 | 1.6561 | 0.7333 | 0.3136 | 51.5516 | 98.0063 | 319.5567 | 0.2086 | 16.3462 | 15.9718 | 0.0437 | 30.1410 | 1.4926 | 0.5397 | 4.8336 | 4.4577 |
| 3/13/1998 | 0.0185 | 0.1080 | 0.6600 | 1.3532 | 4.5555 | 0.0807 | 0.1997 | 101.1188 | 0.6043 | 0.1737 | 1.4597 | 0.6457 | 0.2764 | 47.3035 | 87.8120 | 280.0492 | 0.1843 | 12.8934 | 12.6731 | 0.0504 | 27.3348 | 1.2909 | 0.4757 | 4.2984 | 3.8821 |
| 3/14/1998 | 0.0202 | 0.0949 | 0.5535 | 1.1341 | 4.0327 | 0.0677 | 0.1674 | 82.1385 | 0.5022 | 0.1455 | 1.2233 | 0.5710 | 0.2316 | 40.7896 | 74.5007 | 246.4852 | 0.1434 | 9.2215 | 9.3685 | 0.0340 | 23.0092 | 1.0676 | 0.3987 | 3.6550 | 3.1813 |
| 3/15/1998 | 0.0226 | 0.0948 | 0.5297 | 1.1153 | 3.9893 | 0.0665 | 0.1646 | 73.6343 | 0.5019 | 0.1431 | 1.2031 | 0.5708 | 0.2278 | 36.8254 | 65.4364 | 216.4175 | 0.1176 | 7.8437 | 8.1195 | 0.0340 | 20.5201 | 1.0056 | 0.3921 | 3.6428 | 3.0807 |
| 3/16/1998 | 0.0212 | 0.0876 | 0.5178 | 1.0230 | 3.7793 | 0.0610 | 0.1510 | 65.8319 | 0.4618 | 0.1313 | 1.1035 | 0.5267 | 0.2089 | 35.9771 | 58.6382 | 195.4401 | 0.0936 | 6.5150 | 6.8472 | 0.0340 | 18.5605 | 0.9304 | 0.3596 | 3.3668 | 2.7814 |
| 3/17/1998 | 0.0183 | 0.0806 | 0.5191 | 0.9512 | 3.4726 | 0.0567 | 0.1404 | 59.0643 | 0.4257 | 0.1221 | 1.0261 | 0.5007 | 0.1943 | 33.4262 | 52.9770 | 177.6092 | 0.0856 | 5.4485 | 5.8463 | 0.0526 | 16.6361 | 0.7740 | 0.3344 | 3.1506 | 2.5496 |
| 3/18/1998 | 0.0168 | 0.0786 | 0.4928 | 0.9109 | 3.2510 | 0.0543 | 0.1344 | 54.0403 | 0.4132 | 0.1169 | 0.9826 | 0.4822 | 0.1860 | 31.1615 | 48.7289 | 162.2257 | 0.0695 | 4.6926 | 5.1299 | 0.0172 | 15.1415 | 0.7804 | 0.3202 | 3.0218 | 2.4351 |
| 3/19/1998 | 0.0180 | 0.0772 | 0.4889 | 0.8794 | 3.1672 | 0.0525 | 0.1298 | 50.5602 | 0.4067 | 0.1128 | 0.9486 | 0.4746 | 0.1796 | 28.0747 | 45.0468 | 149.6393 | 0.0577 | 4.1577 | 4.6382 | 0.0172 | 14.0991 | 0.7260 | 0.3092 | 2.9267 | 2.3441 |
| 3/20/1998 | 0.0197 | 0.0659 | 0.4783 | 0.8528 | 3.1281 | 0.0509 | 0.1258 | 47.2950 | 0.3813 | 0.1094 | 0.9199 | 0.4638 | 0.1742 | 23.1757 | 42.2138 | 138.8009 | 0.0618 | 3.7124 | 4.2116 | 0.0172 | 13.0449 | 0.6215 | 0.2998 | 2.8531 | 2.2567 |
| 3/21/1998 | 0.0231 | 0.1172 | 0.5537 | 1.0316 | 3.6523 | 0.0615 | 0.1522 | 47.8144 | 0.5519 | 0.1324 | 1.1127 | 0.5682 | 0.2107 | 20.7983 | 41.0842 | 131.4588 | 0.0537 | 3.9222 | 4.4338 | 0.0325 | 12.7565 | 0.8565 | 0.3627 | 3.4817 | 2.6793 |
| 3/22/1998 | 0.0285 | 0.1618 | 0.8955 | 1.9046 | 5.8898 | 0.1136 | 0.2810 | 81.3439 | 0.7994 | 0.2444 | 2.0545 | 0.7872 | 0.3890 | 37.1098 | 52.9784 | 137.0528 | 0.3235 | 10.8037 | 11.0371 | 0.0933 | 18.4136 | 2.4565 | 0.6696 | 6.1655 | 5.4288 |
| 3/23/1998 | 0.0266 | 0.2214 | 1.1962 | 2.9306 | 8.5442 | 0.1748 | 0.4325 | 74.7740 | 1.1064 | 0.3761 | 3.1613 | 1.1263 | 0.5985 | 59.7645 | 65.4400 | 177.6092 | 0.3046 | 8.4515 | 8.6753 | 0.0933 | 18.6997 | 2.0907 | 1.0303 | 8.4348 | 9.8908 |
| 3/24/1998 | 0.0255 | 0.1643 | 1.0210 | 1.9725 | 6.0549 | 0.1177 | 0.2911 | 109.8403 | 0.8498 | 0.2531 | 2.1277 | 0.8692 | 0.4028 | 80.7190 | 87.5350 | 288.7898 | 0.4958 | 13.4945 | 13.0021 | 0.0655 | 31.4727 | 2.5737 | 0.6934 | 6.1272 | 5.9341 |
| 3/25/1998 | 0.0229 | 0.1143 | 0.7333 | 1.2988 | 4.2471 | 0.0775 | 0.1917 | 99.0369 | 0.6152 | 0.1667 | 1.4010 | 0.6764 | 0.2653 | 60.6131 | 91.2131 | 319.2071 | 0.2415 | 10.4458 | 10.0390 | 0.0655 | 31.7144 | 1.6300 | 0.4566 | 4.1370 | 3.7652 |
| 3/26/1998 | 0.0207 | 0.1137 | 0.7023 | 1.3664 | 4.3449 | 0.0815 | 0.2016 | 89.4240 | 0.6319 | 0.1754 | 1.4740 | 0.7233 | 0.2791 | 45.8878 | 76.7706 | 285.6432 | 0.1979 | 9.4359 | 9.2254 | 0.0401 | 27.5634 | 1.3900 | 0.4804 | 4.3592 | 3.9318 |
| 3/27/1998 | 0.0224 | 0.1131 | 0.6534 | 1.2434 | 4.2298 | 0.0742 | 0.1835 | 79.9005 | 0.6163 | 0.1596 | 1.3413 | 0.7112 | 0.2539 | 38.2433 | 66.2927 | 269.9101 | 0.2051 | 8.6470 | 8.4739 | 0.0401 | 23.4741 | 1.1754 | 0.4371 | 3.9374 | 3.5876 |
| 3/28/1998 | 0.0222 | 0.0938 | 0.6218 | 1.0968 | 3.8264 | 0.0654 | 0.1618 | 69.7259 | 0.5137 | 0.1408 | 1.1831 | 0.6672 | 0.2240 | 31.7292 | 58.6443 | 249.2822 | 0.1943 | 7.1515 | 7.1420 | 0.0401 | 20.2418 | 1.0066 | 0.3856 | 3.4964 | 3.1273 |
| 3/29/1998 | 0.0253 | 0.0863 | 0.5316 | 0.9634 | 3.4953 | 0.0575 | 0.1422 | 61.4223 | 0.4518 | 0.1236 | 1.0392 | 0.6087 | 0.1967 | 27.9339 | 52.4109 | 221.6619 | 0.1291 | 5.7550 | 5.8973 | 0.0179 | 17.9493 | 0.8461 | 0.3387 | 3.1161 | 2.6814 |
| 3/30/1998 | 0.0264 | 0.0926 | 0.5253 | 0.9715 | 3.4836 | 0.0580 | 0.1434 | 59.2366 | 0.4511 | 0.1247 | 1.0479 | 0.5844 | 0.1984 | 25.9527 | 48.7317 | 196.8386 | 0.0930 | 5.3109 | 5.5531 | 0.0198 | 17.3493 | 1.0575 | 0.3415 | 3.2204 | 2.5858 |
| 3/31/1998 | 0.0270 | 0.0863 | 0.5779 | 0.9796 | 3.4712 | 0.0584 | 0.1446 | 61.6038 | 0.4460 | 0.1257 | 1.0567 | 0.5601 | 0.2001 | 26.8304 | 49.8637 | 184.6017 | 0.1471 | 5.4453 | 5.6413 | 0.0198 | 18.5920 | 1.3168 | 0.3444 | 3.2782 | 2.5624 |
| 4/1/1998 | 0.0235 | 0.0794 | 0.5297 | 0.8676 | 3.1962 | 0.0518 | 0.1280 | 52.6675 | 0.4132 | 0.1113 | 0.9359 | 0.4849 | 0.1772 | 24.2246 | 45.8972 | 175.1618 | 0.0888 | 4.3677 | 4.6415 | 0.0198 | 15.3791 | 0.8056 | 0.3050 | 2.8663 | 2.3186 |
| 4/2/1998 | 0.0210 | 0.0778 | 0.5087 | 0.8287 | 3.0432 | 0.0494 | 0.1223 | 48.8557 | 0.3874 | 0.1063 | 0.8939 | 0.4536 | 0.1692 | 22.0993 | 42.4996 | 158.3799 | 0.0798 | 3.8455 | 4.1638 | 0.0235 | 14.1111 | 0.7409 | 0.2913 | 2.7416 | 2.2079 |
| 4/3/1998 | 0.0220 | 0.0748 | 0.4547 | 0.8159 | 3.1174 | 0.0487 | 0.1204 | 46.1191 | 0.3731 | 0.1047 | 0.8802 | 0.4462 | 0.1666 | 20.6007 | 39.9513 | 146.8423 | 0.0556 | 3.4761 | 3.8250 | 0.0235 | 13.1808 | 0.6904 | 0.2869 | 2.7034 | 2.1686 |

| Sta IDs that flow to model node Node-> | ocenshr westprt **2** | 509-ADAM hoquiam **10** | 502-FRY 506-28TH 507-G3 ghpapr1 **12** | 17-CHAP 18-CAMP 19-INDI 20-STAF 21-OLEA **15** | 15-CHAR 16-NEWS weyco1 **17** | 35-WEST **18** | 24-REDM **19** | 01-HUMP 03-CHEN 04-GRASS **29** | 41-ALDR 501-ABDIV 510-MST 512-DAWS 513-SAG 514-HST aberdn **37** | 500-WILS 504-SHAN **40** | 11-ELLI 503-MILR 505-MILL **43** | 12-CENT weyco2 **48** | 42-PEEL **57** | 13-WYNO montesn **64** | elma mcleary satsopQ **66** | 38-PORT **68** | 508-KST 516-EMER 517-QEEN 518-15TH **69** | hoqnowf **72** | wfconf **74** | arthr-pmp **75** | 08-WISH **79** | ditchmwth **81** | 25-DEMP 26-BARL **82** | andrmwth elkmwth **83** | 22-JOHN ospray1 **84** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4/4/1998 | 0.0199 | 0.0725 | 0.4299 | 0.8101 | 3.0851 | 0.0483 | 0.1195 | 44.7432 | 0.3700 | 0.1040 | 0.8739 | 0.4404 | 0.1655 | 19.7491 | 37.9678 | 138.8009 | 0.0623 | 3.2511 | 3.6087 | 0.0228 | 12.8104 | 0.7458 | 0.2848 | 2.6962 | 2.1321 |
| 4/5/1998 | 0.0223 | 0.0720 | 0.4325 | 0.7940 | 2.9674 | 0.0474 | 0.1172 | 42.1152 | 0.3640 | 0.1019 | 0.8564 | 0.4321 | 0.1621 | 18.8436 | 36.2651 | 132.5077 | 0.0497 | 2.9757 | 3.3397 | 0.0228 | 11.8001 | 0.6377 | 0.2791 | 2.6427 | 2.0795 |
| 4/6/1998 | 0.0223 | 0.0726 | 0.4384 | 0.7711 | 2.9260 | 0.0460 | 0.1138 | 40.3129 | 0.3613 | 0.0990 | 0.8318 | 0.4266 | 0.1575 | 17.8813 | 34.5671 | 125.8648 | 0.0469 | 2.7872 | 3.1679 | 0.0228 | 11.0888 | 0.6099 | 0.2711 | 2.5694 | 2.0062 |
| 4/7/1998 | 0.0220 | 0.0743 | 0.4740 | 0.8995 | 3.2614 | 0.0537 | 0.1327 | 41.1108 | 0.3909 | 0.1154 | 0.9703 | 0.4619 | 0.1837 | 17.7103 | 33.7176 | 119.9212 | 0.0570 | 2.8199 | 3.2171 | 0.0252 | 11.3742 | 0.7223 | 0.3162 | 2.9468 | 2.3941 |
| 4/8/1998 | 0.0207 | 0.0721 | 0.4443 | 0.8415 | 3.0887 | 0.0502 | 0.1242 | 38.4820 | 0.3773 | 0.1080 | 0.9077 | 0.4392 | 0.1719 | 16.5780 | 32.0178 | 115.7257 | 0.0474 | 2.5084 | 2.9158 | 0.0252 | 10.4627 | 0.6286 | 0.2958 | 2.7219 | 2.2849 |
| 4/9/1998 | 0.0215 | 0.0750 | 0.4524 | 0.8362 | 3.1286 | 0.0499 | 0.1234 | 36.6732 | 0.3699 | 0.1073 | 0.9020 | 0.4467 | 0.1708 | 16.1528 | 30.3190 | 110.4813 | 0.0421 | 2.3256 | 2.7341 | 0.0224 | 9.7557 | 0.6297 | 0.2940 | 2.7133 | 2.2675 |
| 4/10/1998 | 0.0218 | 0.0856 | 0.5317 | 0.8389 | 3.1906 | 0.0500 | 0.1238 | 37.7976 | 0.3872 | 0.1077 | 0.9049 | 0.4955 | 0.1713 | 15.8707 | 30.3203 | 107.6843 | 0.0539 | 2.3928 | 2.8476 | 0.0224 | 10.1945 | 0.7581 | 0.2949 | 2.8352 | 2.1007 |
| 4/11/1998 | 0.0236 | 0.1046 | 0.6594 | 1.2104 | 4.2158 | 0.0722 | 0.1786 | 47.7465 | 0.5115 | 0.1553 | 1.3057 | 0.6200 | 0.2472 | 18.3069 | 34.5704 | 112.2294 | 0.1322 | 3.4811 | 3.9601 | 0.0375 | 13.5920 | 1.0428 | 0.4255 | 4.0338 | 3.0678 |
| 4/12/1998 | 0.0252 | 0.0909 | 0.5248 | 0.8536 | 3.3173 | 0.0509 | 0.1260 | 44.9375 | 0.4325 | 0.1095 | 0.9208 | 0.5210 | 0.1743 | 18.6469 | 34.5682 | 113.6279 | 0.1500 | 3.0684 | 3.5047 | 0.0375 | 13.1176 | 0.7912 | 0.3001 | 2.8154 | 2.2208 |
| 4/13/1998 | 0.0221 | 0.0846 | 0.4520 | 0.8069 | 3.2112 | 0.0481 | 0.1191 | 45.0151 | 0.4152 | 0.1035 | 0.8704 | 0.4922 | 0.1648 | 18.1648 | 34.0006 | 114.6768 | 0.1131 | 3.2590 | 3.6083 | 0.0336 | 12.9786 | 0.7551 | 0.2837 | 2.6602 | 2.1052 |
| 4/14/1998 | 0.0208 | 0.0775 | 0.4341 | 0.7727 | 3.0453 | 0.0461 | 0.1140 | 42.5296 | 0.3656 | 0.0992 | 0.8335 | 0.4577 | 0.1578 | 17.3712 | 33.1526 | 113.2783 | 0.0846 | 3.0734 | 3.3981 | 0.0221 | 11.9428 | 0.6006 | 0.2717 | 2.5311 | 2.0369 |
| 4/15/1998 | 0.0208 | 0.0737 | 0.4235 | 0.7359 | 2.8109 | 0.0439 | 0.1086 | 39.7274 | 0.3579 | 0.0944 | 0.7938 | 0.4182 | 0.1503 | 16.4940 | 32.0197 | 109.0828 | 0.0657 | 2.7428 | 3.0546 | 0.0221 | 11.0004 | 0.5551 | 0.2587 | 2.4136 | 1.9291 |
| 4/16/1998 | 0.0225 | 0.0716 | 0.4072 | 0.7093 | 2.7572 | 0.0423 | 0.1047 | 38.1371 | 0.3372 | 0.0910 | 0.7651 | 0.3460 | 0.1449 | 16.0682 | 30.6037 | 103.4888 | 0.0581 | 2.4935 | 2.8212 | 0.0221 | 10.5516 | 0.5549 | 0.2494 | 2.3320 | 1.8456 |
| 4/17/1998 | 0.0238 | 0.0696 | 0.4174 | 0.7000 | 2.8170 | 0.0418 | 0.1033 | 36.3489 | 0.3328 | 0.0898 | 0.7550 | 0.3964 | 0.1430 | 15.0208 | 29.4710 | 98.5941 | 0.0618 | 2.3199 | 2.6602 | 0.0221 | 9.8158 | 0.4776 | 0.2461 | 2.3056 | 1.8128 |
| 4/18/1998 | 0.0248 | 0.0773 | 0.4319 | 0.7516 | 2.9338 | 0.0448 | 0.1109 | 35.9852 | 0.3659 | 0.0964 | 0.8107 | 0.4176 | 0.1535 | 14.6810 | 28.9047 | 94.7482 | 0.0312 | 2.2789 | 2.6451 | 0.0202 | 9.5897 | 0.6161 | 0.2642 | 2.4898 | 1.9292 |
| 4/19/1998 | 0.0250 | 0.0726 | 0.4650 | 0.7111 | 2.8351 | 0.0424 | 0.1049 | 34.6681 | 0.3399 | 0.0913 | 0.7671 | 0.4034 | 0.1452 | 14.3695 | 28.3085 | 91.9512 | 0.0802 | 2.1932 | 2.5398 | 0.0202 | 9.0442 | 0.5160 | 0.2500 | 2.3388 | 1.8394 |
| 4/20/1998 | 0.0220 | 0.0700 | 0.4386 | 0.6826 | 2.7187 | 0.0407 | 0.1007 | 33.1782 | 0.3305 | 0.0876 | 0.7363 | 0.3922 | 0.1394 | 13.6050 | 26.8902 | 88.8046 | 0.0429 | 2.0388 | 2.3894 | 0.0202 | 8.4809 | 0.4891 | 0.2400 | 2.2533 | 1.7527 |
| 4/21/1998 | 0.0196 | 0.0677 | 0.4627 | 0.6810 | 2.6624 | 0.0406 | 0.1005 | 32.3597 | 0.3195 | 0.0874 | 0.7346 | 0.3874 | 0.1391 | 13.0949 | 25.9849 | 84.6091 | 0.0415 | 1.9691 | 2.3218 | 0.0162 | 8.1294 | 0.5659 | 0.2394 | 2.2563 | 1.7278 |
| 4/22/1998 | 0.0194 | 0.0672 | 0.4358 | 0.6779 | 2.6177 | 0.0404 | 0.1000 | 31.4241 | 0.3122 | 0.0870 | 0.7312 | 0.3910 | 0.1384 | 12.6138 | 25.1080 | 81.8121 | 0.0302 | 1.8755 | 2.2400 | 0.0162 | 7.7380 | 0.5363 | 0.2383 | 2.2375 | 1.7172 |
| 4/23/1998 | 0.0197 | 0.0707 | 0.4452 | 0.6772 | 2.7854 | 0.0404 | 0.0999 | 30.7499 | 0.3125 | 0.0869 | 0.7304 | 0.4040 | 0.1383 | 12.2444 | 24.4561 | 80.4136 | 0.0549 | 1.7880 | 2.1510 | 0.0162 | 7.5188 | 0.5212 | 0.2381 | 2.2206 | 1.7149 |
| 4/24/1998 | 0.0192 | 0.0701 | 0.4361 | 0.6870 | 2.8070 | 0.0410 | 0.1014 | 30.0024 | 0.3152 | 0.0882 | 0.7410 | 0.4239 | 0.1403 | 11.8776 | 23.8926 | 83.2106 | 0.0400 | 1.7421 | 2.1127 | 0.0162 | 7.1397 | 0.5094 | 0.2415 | 2.2238 | 1.7745 |
| 4/25/1998 | 0.0202 | 0.0680 | 0.4376 | 0.6606 | 2.7684 | 0.0394 | 0.0975 | 28.5104 | 0.3082 | 0.0848 | 0.7126 | 0.4351 | 0.1349 | 11.4232 | 23.1842 | 84.9587 | 0.0612 | 1.6772 | 2.0406 | 0.0181 | 6.4072 | 0.4628 | 0.2322 | 2.1364 | 1.7008 |
| 4/26/1998 | 0.0194 | 0.0680 | 0.4467 | 0.6447 | 2.7277 | 0.0385 | 0.0951 | 28.3310 | 0.3167 | 0.0827 | 0.6955 | 0.4356 | 0.1317 | 11.1410 | 22.5310 | 79.7144 | 0.0570 | 1.6036 | 1.9632 | 0.0181 | 6.4746 | 0.4382 | 0.2267 | 2.0902 | 1.6533 |
| 4/27/1998 | 0.0212 | 0.0661 | 0.4035 | 0.6408 | 2.6529 | 0.0382 | 0.0946 | 28.7129 | 0.3075 | 0.0822 | 0.6912 | 0.4347 | 0.1309 | 10.7731 | 21.9916 | 75.5189 | 0.0337 | 1.5498 | 1.9112 | 0.0181 | 6.8196 | 0.4176 | 0.2253 | 2.0749 | 1.6752 |
| 4/28/1998 | 0.0188 | 0.0642 | 0.3918 | 0.6217 | 2.5843 | 0.0371 | 0.0917 | 27.2265 | 0.2947 | 0.0798 | 0.6707 | 0.4038 | 0.1270 | 10.5177 | 21.5113 | 72.0226 | 0.0435 | 1.5180 | 1.8733 | 0.0181 | 6.0124 | 0.3905 | 0.2186 | 2.0227 | 1.6237 |
| 4/29/1998 | 0.0188 | 0.0643 | 0.3771 | 0.6258 | 2.5948 | 0.0373 | 0.0923 | 26.9569 | 0.2926 | 0.0803 | 0.6750 | 0.3960 | 0.1278 | 10.2346 | 21.0016 | 69.2256 | 0.0307 | 1.4632 | 1.8249 | 0.0181 | 5.9490 | 0.4037 | 0.2200 | 2.0294 | 1.6558 |
| 4/30/1998 | 0.0187 | 0.0585 | 0.4243 | 0.5919 | 2.5264 | 0.0353 | 0.0873 | 26.4311 | 0.2829 | 0.0760 | 0.6385 | 0.3835 | 0.1209 | 9.9515 | 20.0674 | 66.4286 | 0.0333 | 1.4293 | 1.7883 | 0.0129 | 5.7326 | 0.4230 | 0.2081 | 1.9414 | 1.5345 |
| 5/1/1998 | 0.0179 | 0.0602 | 0.4403 | 0.5892 | 2.5288 | 0.0352 | 0.0870 | 25.9735 | 0.2887 | 0.0756 | 0.6356 | 0.3697 | 0.1203 | 9.6963 | 19.5276 | 63.9813 | 0.0316 | 1.4038 | 1.7529 | 0.0129 | 5.5323 | 0.4247 | 0.2072 | 1.9310 | 1.5209 |
| 5/2/1998 | 0.0202 | 0.0600 | 0.4775 | 0.6727 | 2.7175 | 0.0401 | 0.0993 | 26.9528 | 0.3192 | 0.0863 | 0.7257 | 0.3942 | 0.1374 | 10.1216 | 19.6982 | 63.6316 | 0.0937 | 1.4901 | 1.8727 | 0.0240 | 5.8103 | 0.5575 | 0.2365 | 2.2162 | 1.7090 |
| 5/3/1998 | 0.0237 | 0.0648 | 0.4199 | 0.5980 | 2.5942 | 0.0357 | 0.0882 | 25.8642 | 0.2978 | 0.0767 | 0.6451 | 0.3631 | 0.1221 | 9.6971 | 19.2723 | 65.3798 | 0.0408 | 1.3998 | 1.7488 | 0.0240 | 5.4682 | 0.4801 | 0.2102 | 1.9522 | 1.5465 |
| 5/4/1998 | 0.0211 | 0.0645 | 0.4129 | 0.5878 | 2.5912 | 0.0351 | 0.0867 | 25.3713 | 0.2918 | 0.0754 | 0.6340 | 0.3606 | 0.1200 | 9.4136 | 18.9051 | 63.9813 | 0.0322 | 1.3441 | 1.6916 | 0.0240 | 5.2983 | 0.4547 | 0.2066 | 1.9148 | 1.5221 |
| 5/5/1998 | 0.0294 | 0.0638 | 0.4130 | 0.5805 | 2.5593 | 0.0346 | 0.0857 | 24.9135 | 0.2906 | 0.0745 | 0.6261 | 0.3544 | 0.1185 | 9.2717 | 18.6230 | 60.8347 | 0.0282 | 1.3242 | 1.6670 | 0.0240 | 5.0783 | 0.4276 | 0.2041 | 1.8884 | 1.5024 |
| 5/6/1998 | 0.0180 | 0.0640 | 0.4017 | 0.5728 | 2.5660 | 0.0342 | 0.0845 | 24.5864 | 0.2750 | 0.0735 | 0.6179 | 0.3570 | 0.1170 | 9.1021 | 18.2830 | 58.7369 | 0.0327 | 1.2960 | 1.5950 | 0.0240 | 5.0387 | 0.4162 | 0.2014 | 1.8585 | 1.4843 |




Appendix B, Figure 1. Residuals from applying drift correction to sum of reference point and time/maintenance/tide-corrected depth transducer readings.

# Appendix C. Hydrodynamic model files

The hydrodynamic model files are available for copying from Ecology's Internet website at the following URL:

http://www.wa.gov/ecology/eils/wrias/tmdl/ghfc/results.html.

The electronic files for the project appendices are also available on request to:

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# Appendix D. Water quality model files

The water quality model files are available for copying from Ecology's Internet website at the following URL:

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# Appendix E. Summary of multiple regression results for prediction of fecal coliform in tributaries.

Log linear regression models have been found to accurately represent fluvial loads of pollutants (Cohn *et al*., 1992). A multiple regression model was found to explain most of the variability in fecal coliform concentration in tributaries to Grays Harbor. The regression model requires estimation of several parameters: a constant; a linear and quadratic fit to the logarithm of flow; and sinusoidal (Fourier) functions to remove the effect of annual seasonality. The regression model can be written in the following form:

$$\begin{aligned} \text{Log}[FC] = \quad & \beta_0 + \beta_1 \log[Q] + \beta_2 \log[Q]^2 \\ & + \beta_3 \sin[2 \pi T] + \beta_4 \cos[2 \pi T] \\ & + \beta_5 \sin[4 \pi T] + \beta_6 \cos[4 \pi T] + \varepsilon \end{aligned}$$

Log[FC] is the logarithm of fecal coliform (number of organisms per 100 ml), log[Q] is the logarithm of flow (cubic meters per second), and T is time measured in years. The error term ($\varepsilon$) is assumed to be independent and normally distributed with zero mean. The $\beta$ terms are the parameters of the model that must be estimated from multiple regression. In general the $\beta_2$, $\beta_5$, and $\beta_6$ terms were not found to be statistically significant, so they were omitted from the regression model. The simplified regression model was therefore:

$$\text{Log}[FC] = \quad \beta_0 + \beta_1 \log[Q] + \beta_3 \sin[2 \pi T] + \beta_4 \cos[2 \pi T] + \varepsilon$$

To estimate daily and annual loading of fecal coliform, the regression model is first used to predict daily fecal coliform concentrations from the record of daily flows. This requires re-transformation of the predicted logarithm of fecal coliform back into the original real units of fecal coliform concentration. Thomas (1985), and Koch and Smillie (1986) also recommend Duan's (1983) "smearing estimate,'" a nonparametric re-transformation function appropriate for non-normal error distributions to correct the re-transformed predicted concentrations for potential biases that can otherwise occur due to log-transformation. The "smearing estimate" ($K_{se}$) is estimated as the mean value of the antilogs of the regression residuals. The predictive form of the regression equation is therefore:

$$FC = \quad K_{se} \left(10^{\beta_0 + \beta_1 \log[Q] + \beta_3 \sin[2 \pi T] + \beta_4 \cos[2 \pi T]}\right)$$

Daily loads were estimated as the product of daily flow and estimated daily concentration. Seasonal or annual loads were estimated as the sum of estimated daily loads. The resulting regression equations for tributaries to Grays Harbor, and comparisons of predicted and observed concentrations and loads, are presented in Table E-1, Figures E-1, E-2, and E-3 show a comparison of predicted and observed loads of fecal coliform from tributaries to Grays Harbor. Figures E-4 through E-32 present the regression estimates of daily fecal coliform concentrations in comparison with observed fecal coliform for the tributaries to Grays Harbor.

The potential bias of predicted versus observed total loads, integrated over all sampling days, was tested using the t-test method described by Cohn *et al.* (1992). The predicted loads were found to be not significantly different from the observed loads.

**Table E-1. Summary of multiple regression results for prediction of the log (base 10) of fecal coliform concentrations in tributaries to Grays Harbor as a function of the log of flow and a seasonal sinusoidal function (Cohn et al., 1992). The smearing factor was applied to predicted fecal coliform concentrations in un-transformed units (numbers/100 ml) to remove potential statistical bias of log transformation.**

| | | | Regression Coefficients for SYSTAT model effects (SYSTAT model lfc5 = constant + lflow + sin2piyf + cos2piyf) (1) | | | | |
|---|---|---|---|---|---|---|---|
| Tributary | Sampling station | Adjusted squared multiple R | constant | lflow | sin2piyf | cos2piyf | smearing bias correction factor |
| Humptulips R near mouth | 01-hump | 0.69 | -0.859391 | 1.062002 | -0.693539 | -0.652921 | 1.581515 |
| Chenois Cr | 03-chen | 0.86 | 1.278188 | 1.165098 | -0.248028 | -0.400685 | 1.078297 |
| Grass Cr | 04-grass | 0.75 | 1.525709 | 1.532301 | -0.227256 | -0.555829 | 1.272173 |
| West Fork Hoquiam R | 05-wfhoq | 0.34 | 0.598392 | 1.308759 | -0.589308 | -0.527119 | 1.625692 |
| East Fork Hoquiam R | 06-efhoq | 0.30 | 1.208508 | 0.265893 | -0.463041 | -0.10244 | 1.626561 |
| Hoquiam R near mouth at Hoquiam | 07-hoq | 0.37 | 0.338779 | 1.139839 | -0.267913 | -0.364401 | 1.240763 |
| Wishkah R at near mouth at Aberdeen | 08-wish | 0.20 | 1.19318 | 0.386959 | -0.456839 | -0.134352 | 1.712448 |
| Wishkah R near Wishkah | 09-wish | 0.40 | 0.533613 | 0.729482 | -0.696469 | -0.63231 | 2.901822 |
| Elliot Slough | 11-eli | 0.52 | 1.608886 | 0.452177 | -0.360131 | -0.432457 | 1.211691 |
| Un-named creek at Central Park | 12-cent | 0.17 | 2.644938 | 1.702121 | -0.358074 | -0.79367 | 2.329117 |
| Wynoochee R | 13-wyno | 0.34 | 0.854719 | 0.168177 | -0.408129 | -0.431863 | 2.120944 |
| Charlie Cr | 15-char | 0.86 | 1.408713 | 0.373324 | -0.653055 | -0.726927 | 1.184588 |
| Newskah Cr | 16-news | 0.81 | 1.094655 | 0.783584 | -0.45986 | -0.68865 | 1.16258 |
| Chapin Cr | 17-chap | 0.76 | 1.815663 | 0.946202 | -0.549534 | -0.719623 | 1.355305 |
| Campbell Cr | 18-camp | 0.79 | 1.758801 | 0.971425 | -0.847977 | -0.494894 | 1.337106 |
| Indian Cr | 19-indi | 0.60 | 1.687488 | 1.159637 | -0.686552 | -0.367042 | 1.869011 |
| Stafford Cr | 20-staf | 0.37 | 1.861893 | 0.468808 | -0.601149 | -0.323232 | 2.205641 |
| Oleary Cr | 21-olea | 0.54 | 1.633114 | 0.545129 | -0.638896 | -0.626121 | 1.868885 |
| Satsop R | 22g070 | 0.70 | 0.034287 | 0.725703 | -0.592003 | -0.46654 | 1.480836 |
| Johns R near mouth | 22-john | 0.41 | 0.953067 | 0.680854 | -0.391091 | -0.597919 | 1.848309 |
| Johns R near Western | 23-john | 0.62 | 0.674302 | 1.351071 | -0.29467 | -0.523058 | 1.333272 |
| Redman Slough | 24-redm | 0.74 | 2.059454 | 0.298446 | -0.44792 | -0.983047 | 1.342417 |
| Dempsey Cr | 25-demp | 0.69 | 2.213333 | 1.050835 | -0.45009 | -0.89749 | 1.362099 |
| Barlow Cr | 26-barl | 0.67 | 1.56648 | 0.954618 | -0.753509 | -1.079464 | 2.131403 |
| Elk R | 27-elk | 0.70 | 1.574122 | 0.599768 | -0.618747 | -0.4221 | 1.225211 |
| Grayland Ditch | 32-ditch | 0.69 | 1.753561 | 0.229854 | -0.667156 | -0.143646 | 1.209385 |
| Un-named creek at Westport | 35-west | 0.46 | 2.26895 | 0.204421 | -0.564867 | -0.749891 | 1.60784 |
| West Fork Andrews Cr | 36-wfand | 0.73 | 1.311815 | 1.144424 | -0.760215 | -0.760127 | 1.427513 |
| Andrews Cr | 37-andr | 0.61 | 1.312401 | 1.979922 | -0.579082 | -0.891922 | 1.553279 |
| Chehalis R at Porter | 38-port | 0.36 | -0.115304 | 0.90494 | -0.314983 | -0.189279 | 1.534041 |

1) codes for regression variables:
lfc5 = log10 of fecal coliform concentration in numbers per 100 ml
lflow = log10 of flow in cubic meters per second
sin2piyf = Sin(2 * Pi * T)
cos2piyf = Cos(2 * Pi * T)
T = time in years
smearing bias correction factor = mean of antilogs of regression residuals

**Figure E1. Comparison of observed and predicted median loads of fecal coliform from tributaries to Grays Harbor during 5/1/97 - 4/30/98. Data labels indicate the sampling station.**

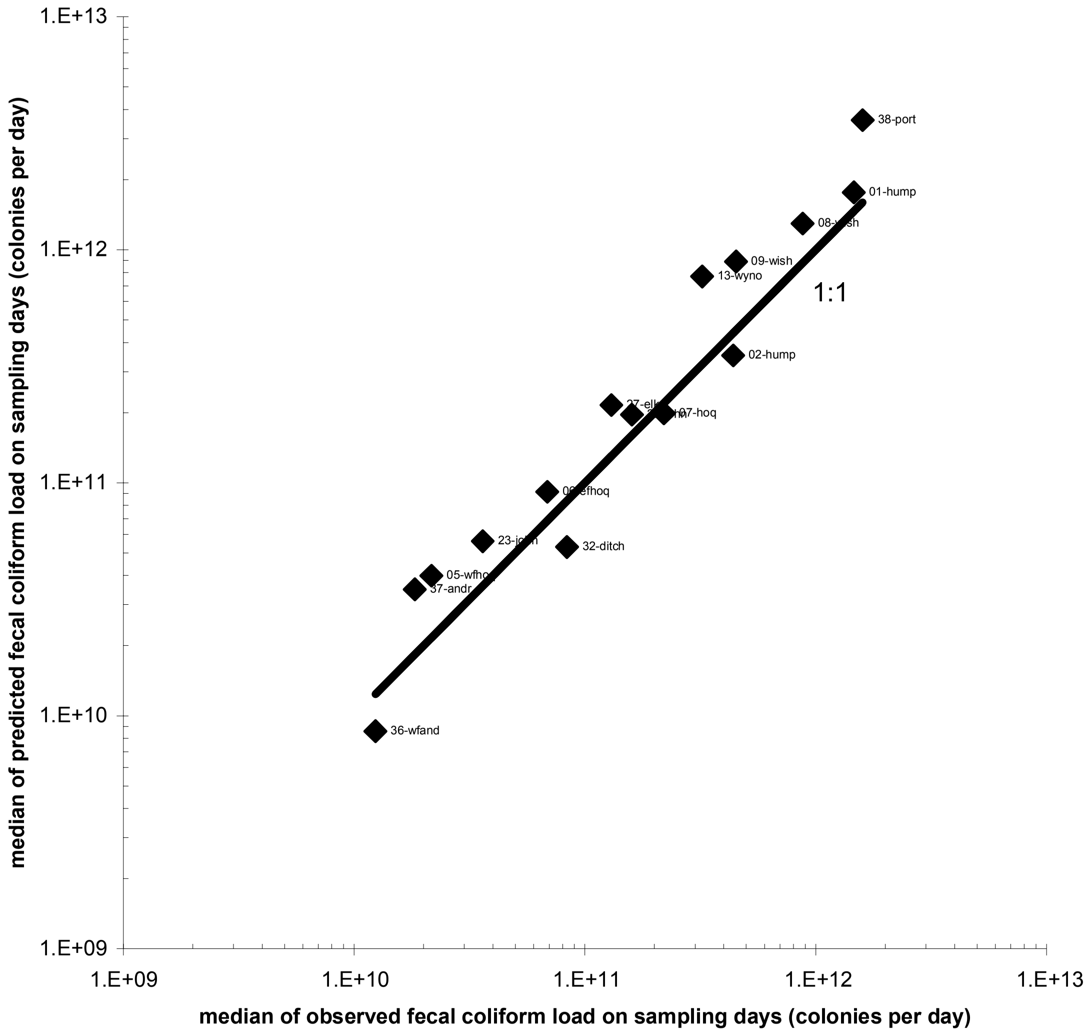


**Figure E2. Comparison of observed and predicted 90th percentiles of loads of fecal coliform from tributaries to Grays Harbor during 5/1/97 - 4/30/98. Data labels indicate the sampling station.**

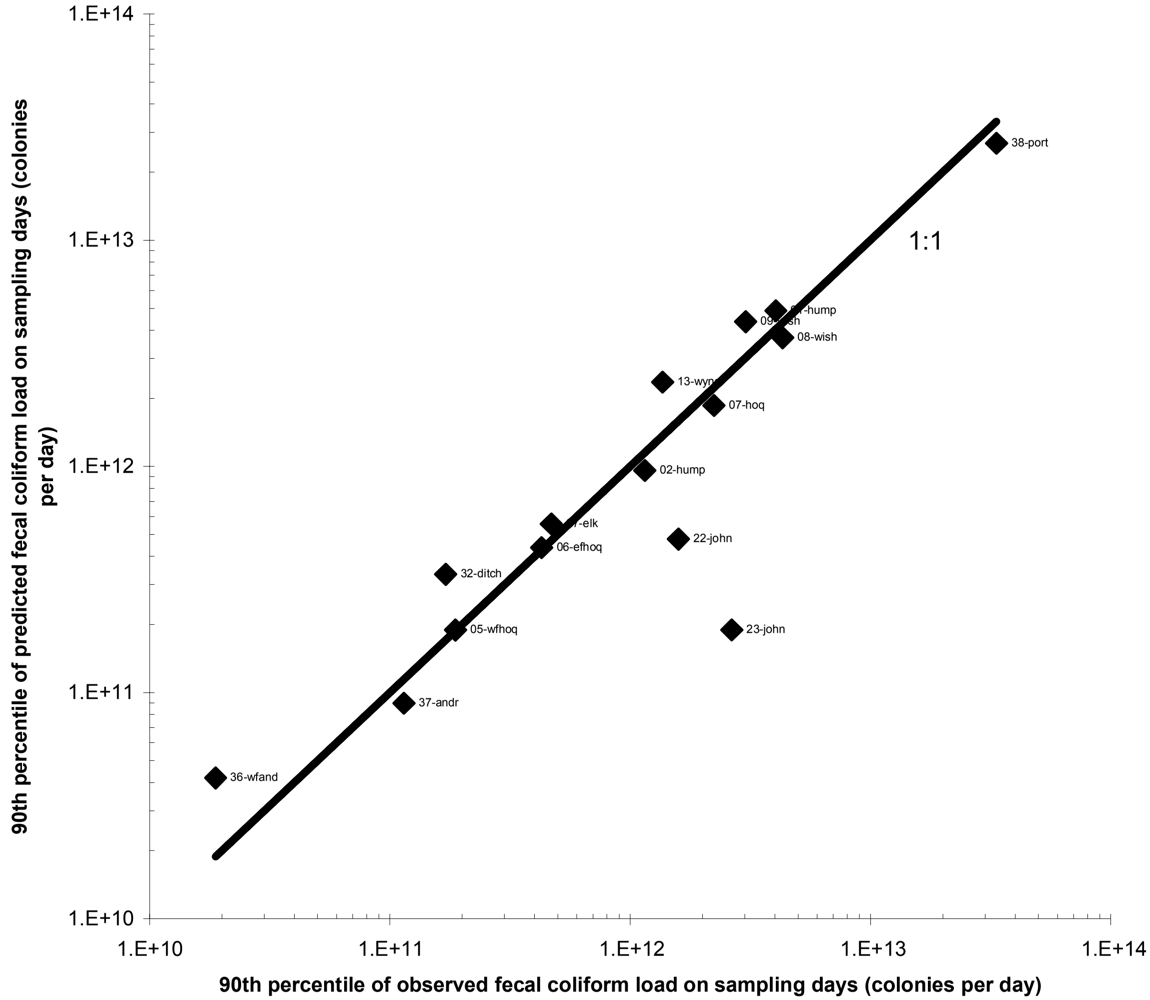


**Figure E3. Comparison of observed and predicted total loads of fecal coliform for all samples from tributaries to Grays Harbor during 5/1/97 - 4/30/98. Data labels indicate the sampling station.**

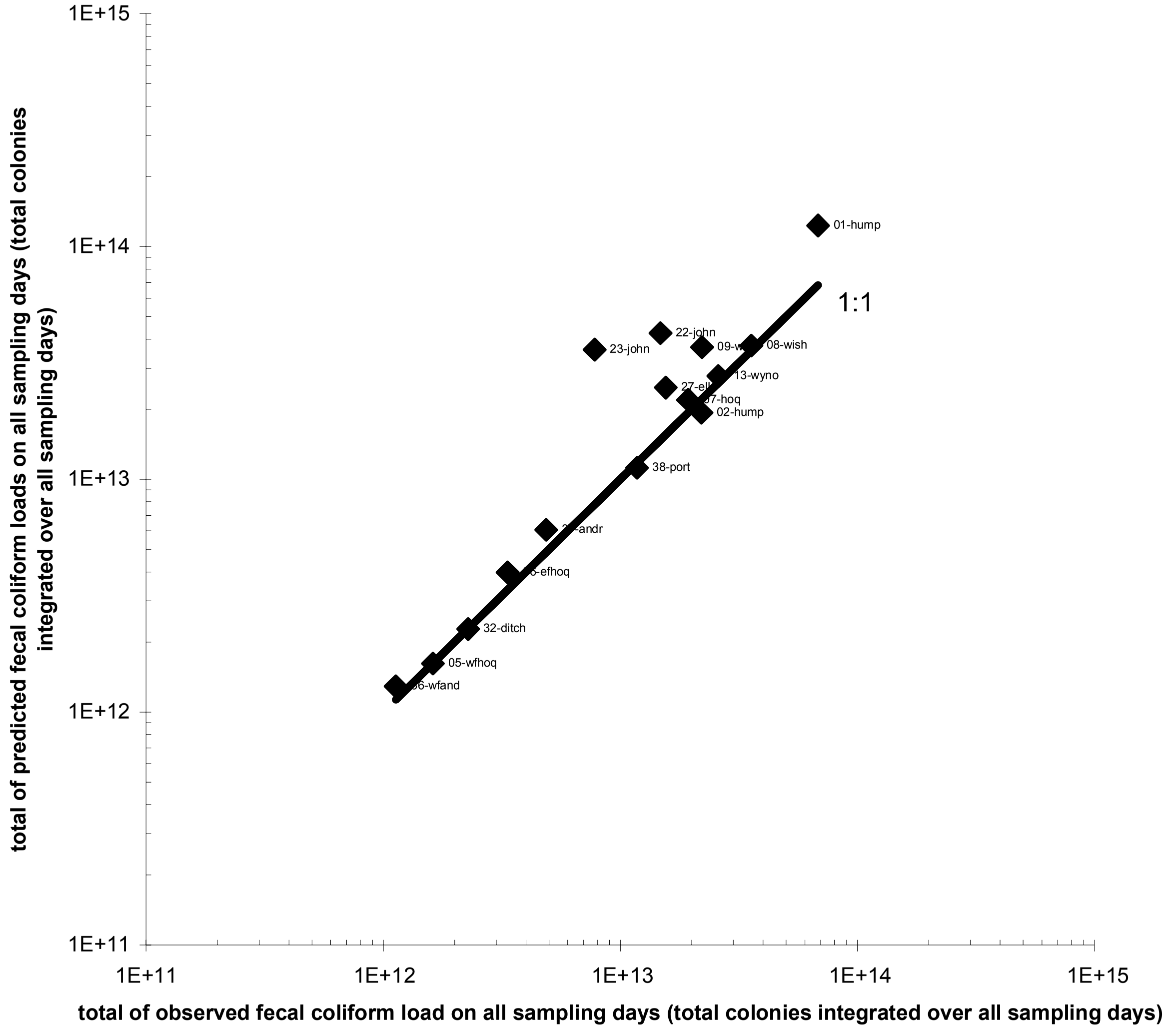


**Figure E4. Predicted and observed fecal coliform in the Humptulips River from 5/1/97 - 4/30/98 (station 01-hump).**

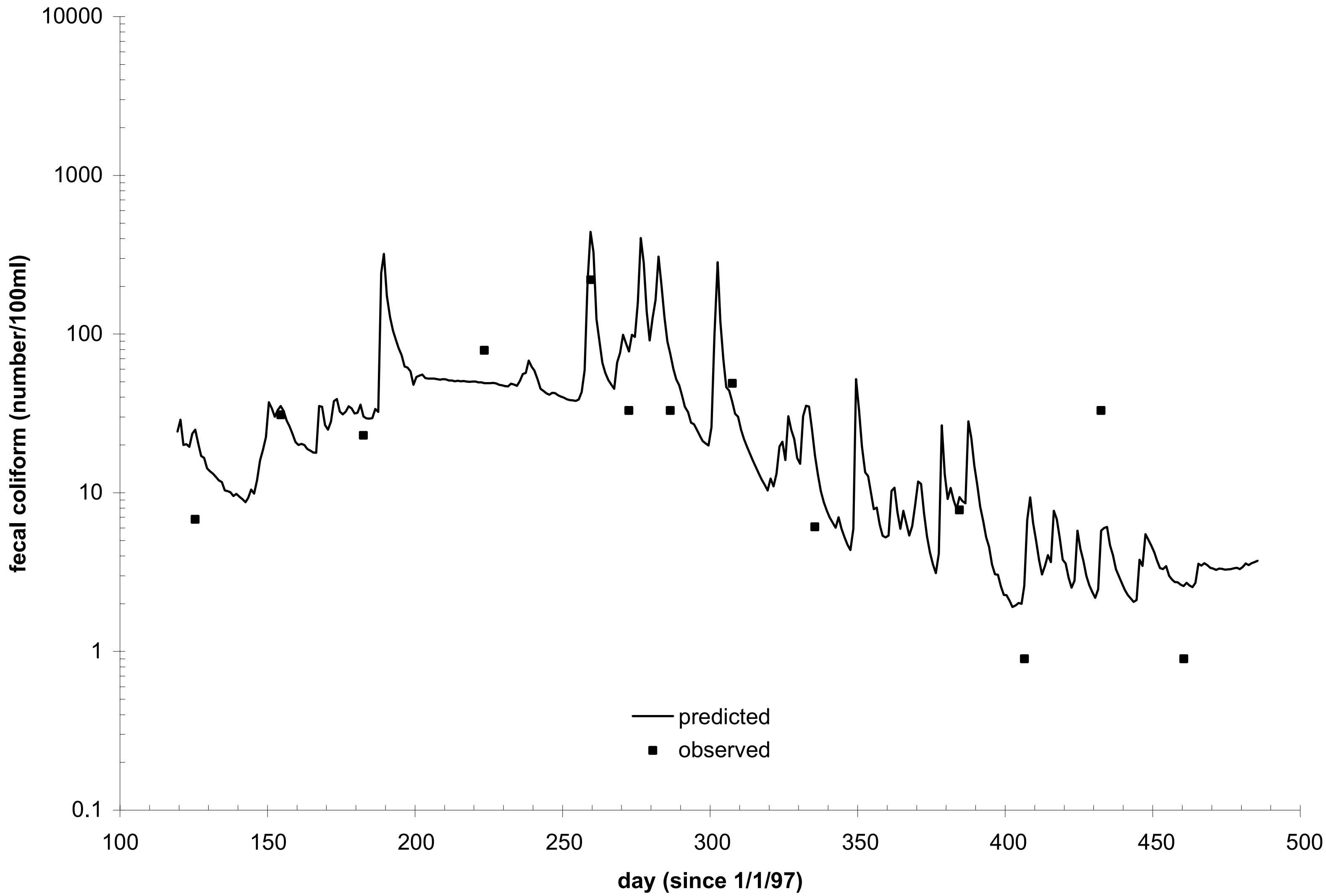


**Figure E5. Predicted and observed fecal coliform in Chenois Creek from 5/1/97 - 4/30/98 (station 03-chen).**

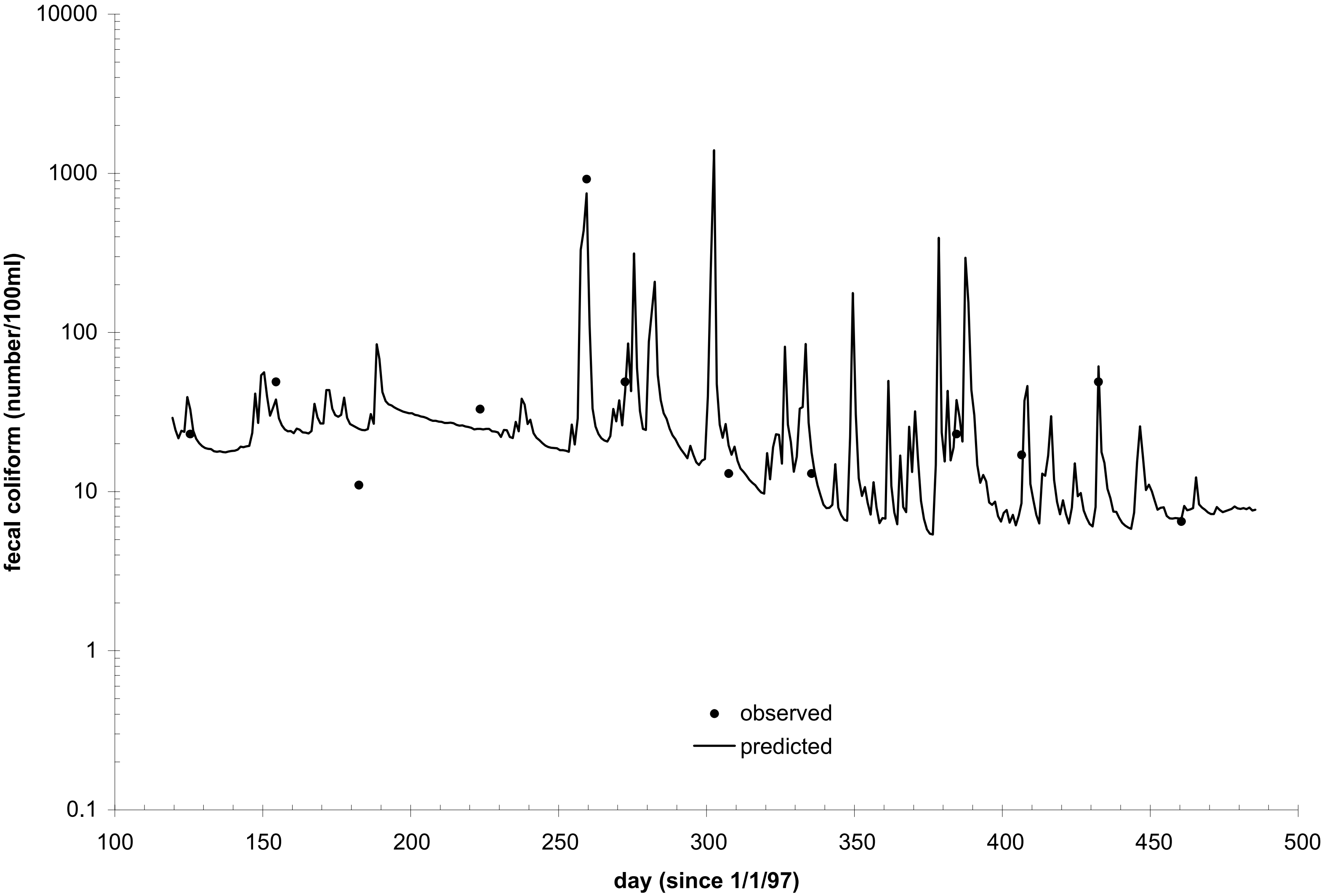


**Figure E6. Predicted and observed fecal coliform in Grass Creek from 5/1/97 - 4/30/98 (station 04-grass).**

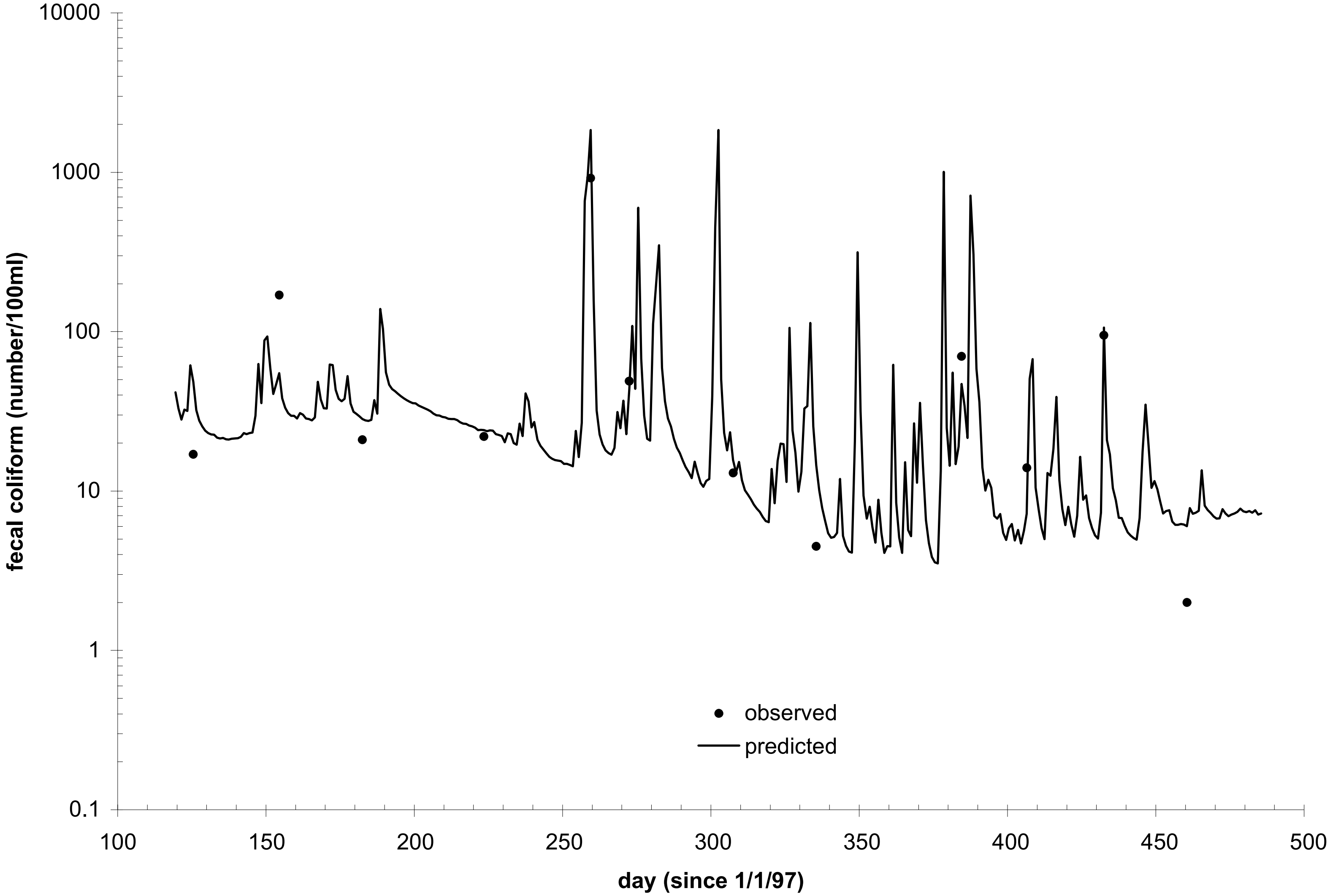


**Figure E7. Predicted and observed fecal coliform in the West Fork Hoquiam River from 5/1/97 - 4/30/98 (station 05-wfhoq).**

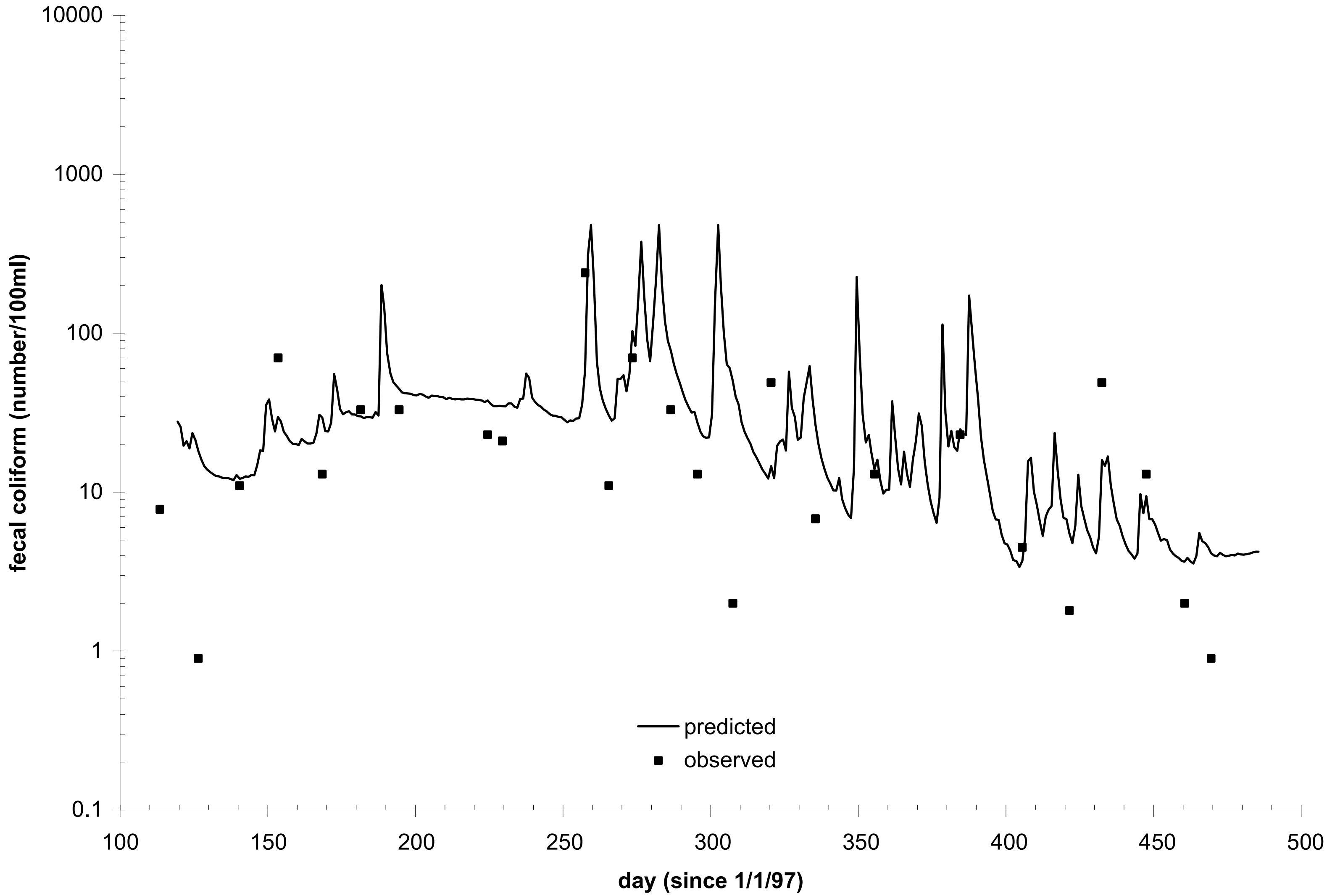


**Figure E8. Predicted and observed fecal coliform in the East Fork Hoquiam River from 5/1/97 - 4/30/98 (station 06-efhoq).**

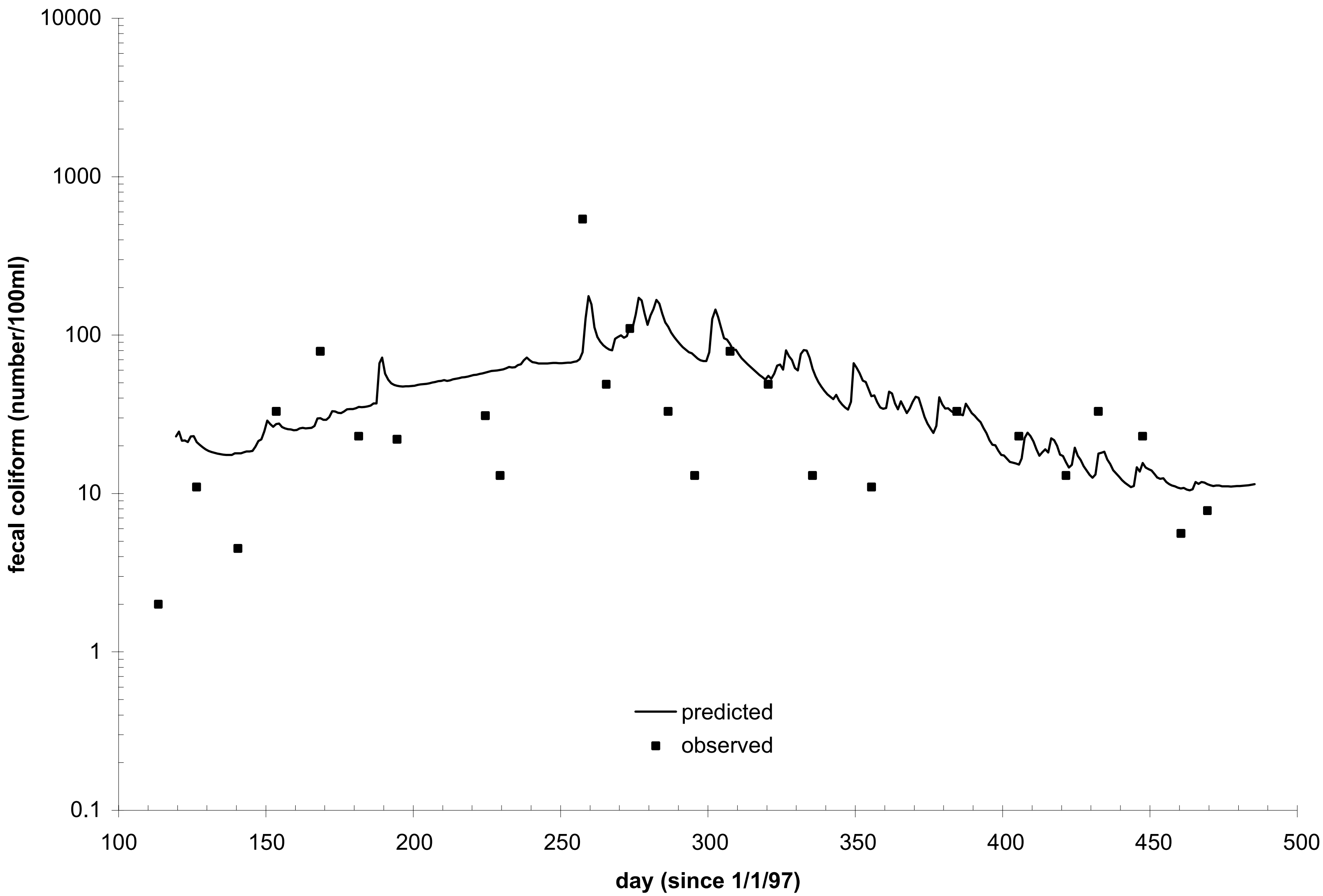


**Figure E9. Predicted and observed fecal coliform in the Hoquiam River at Hoquiam from 5/1/97 - 4/30/98 (station 07-hoq).**

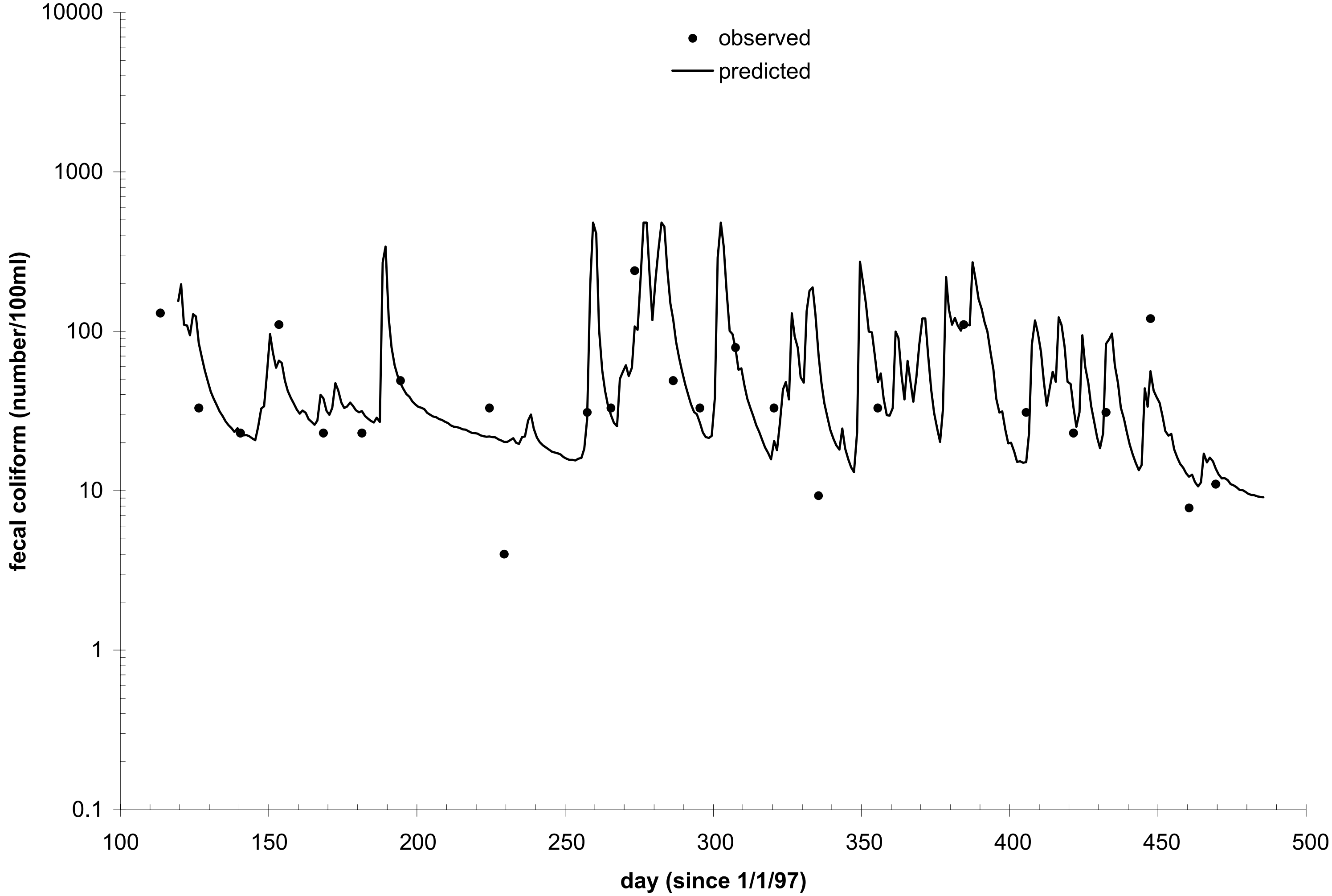


**Figure E10. Predicted and observed fecal coliform in the Wishkah River at Aberdeen from 5/1/97 - 4/30/98 (station 08-wish).**

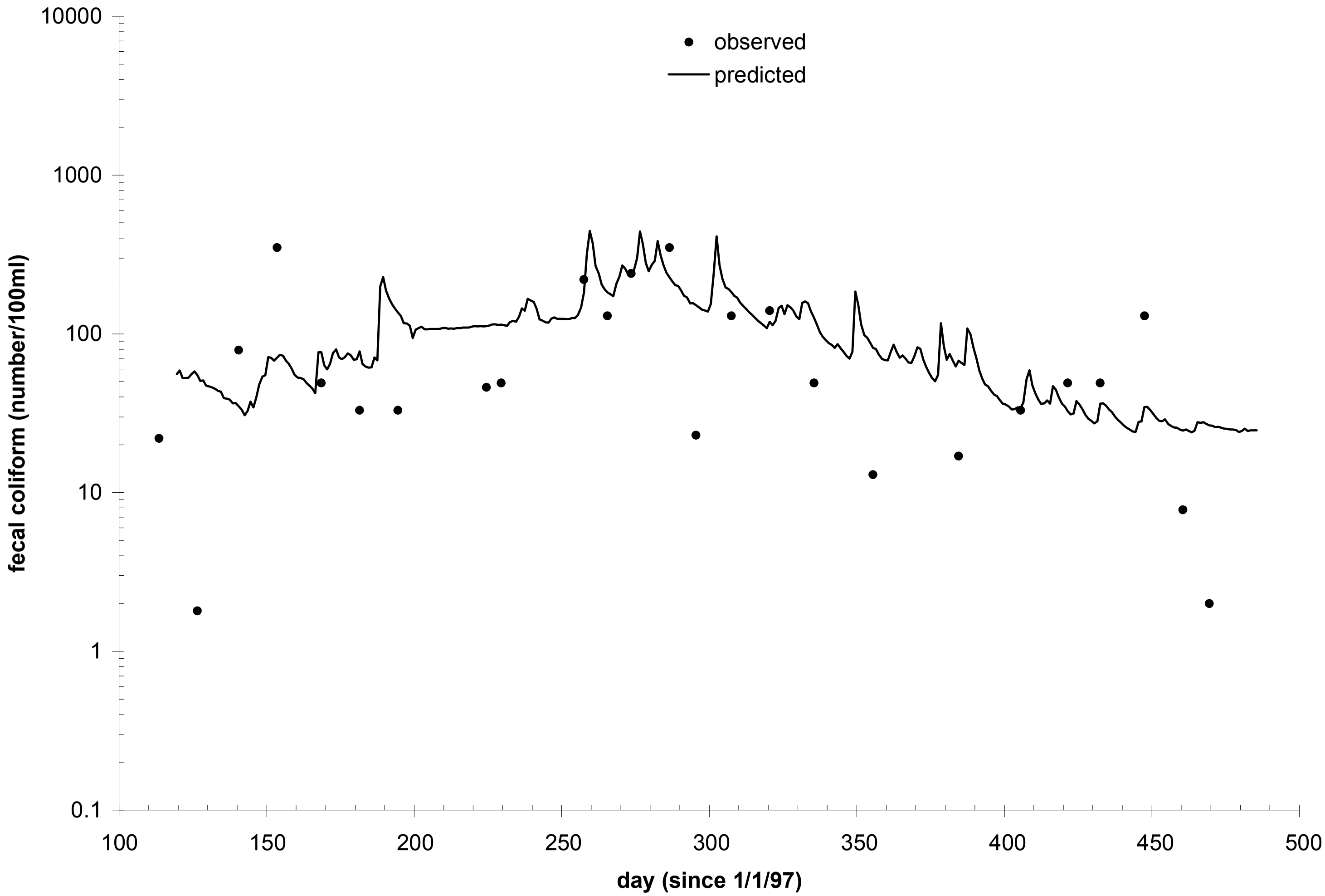


**Figure E11. Predicted and observed fecal coliform in the Wishkah River at Wishkah from 5/1/97 - 4/30/98 (station 09-wish).**

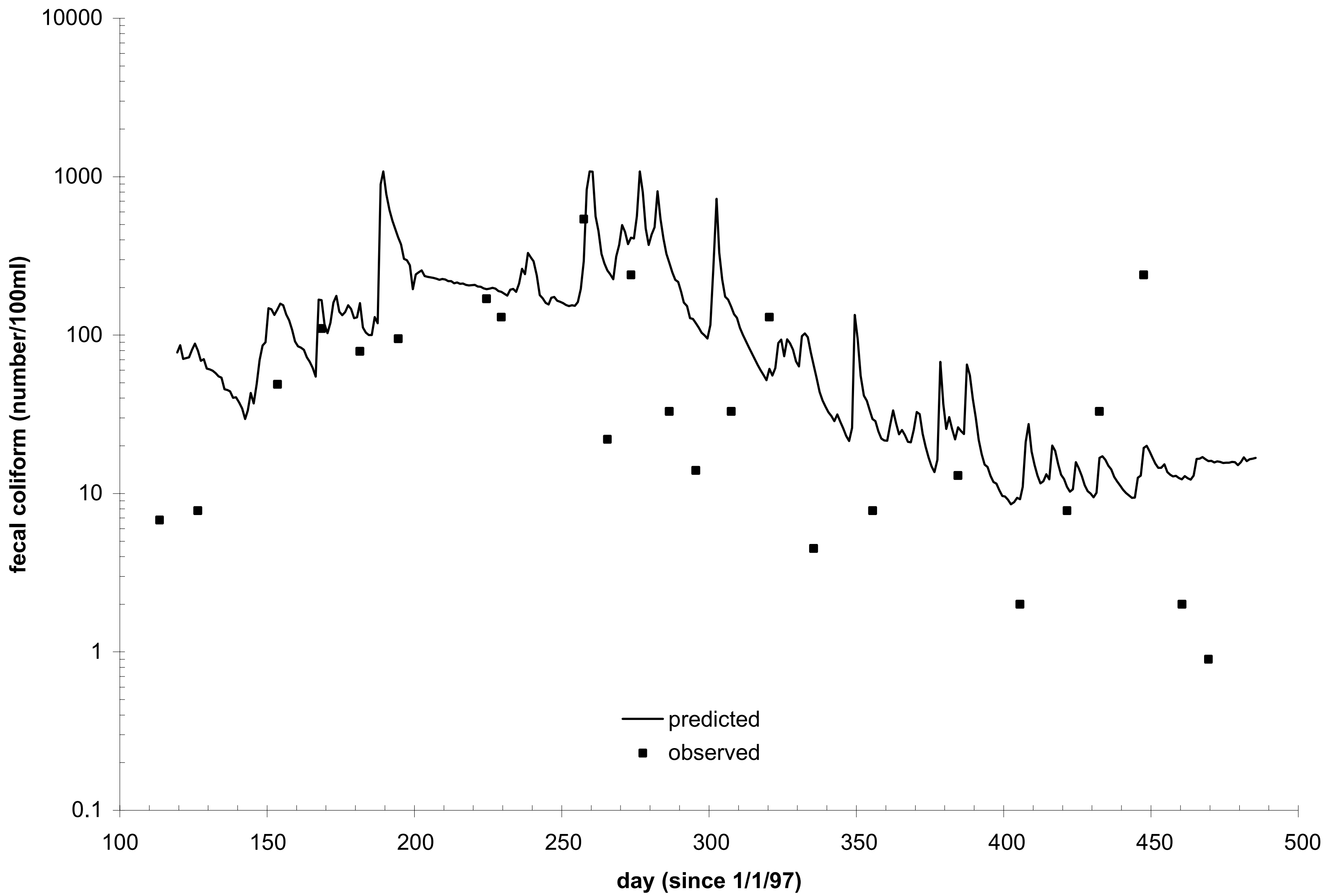


**Figure E12. Predicted and observed fecal coliform in Elliot Slough from 5/1/97 - 4/30/98 (station 11-elli).**

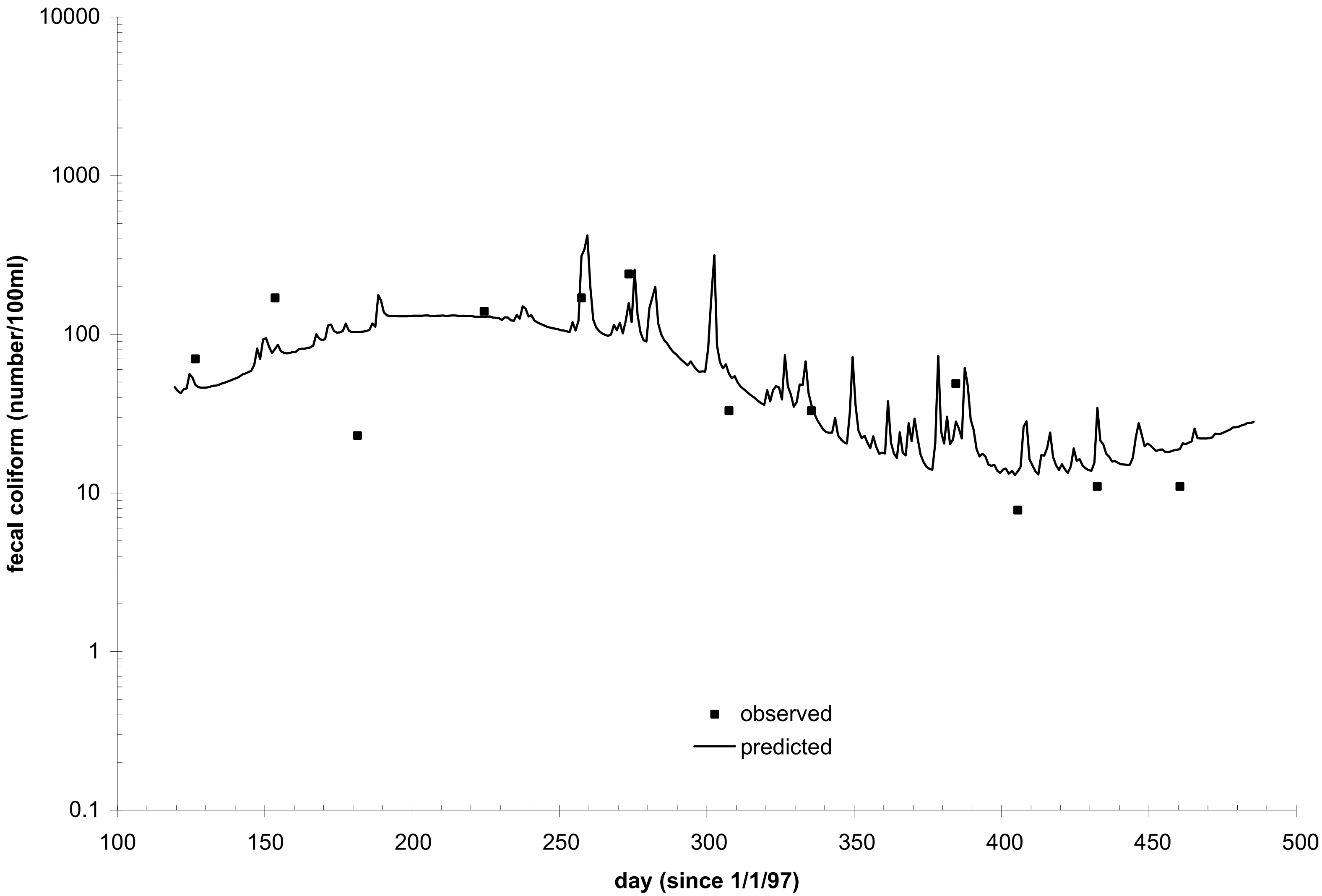


**Figure E13. Predicted and observed fecal coliform in Central Park Cr from 5/1/97 - 4/30/98 (station 12-cent).**

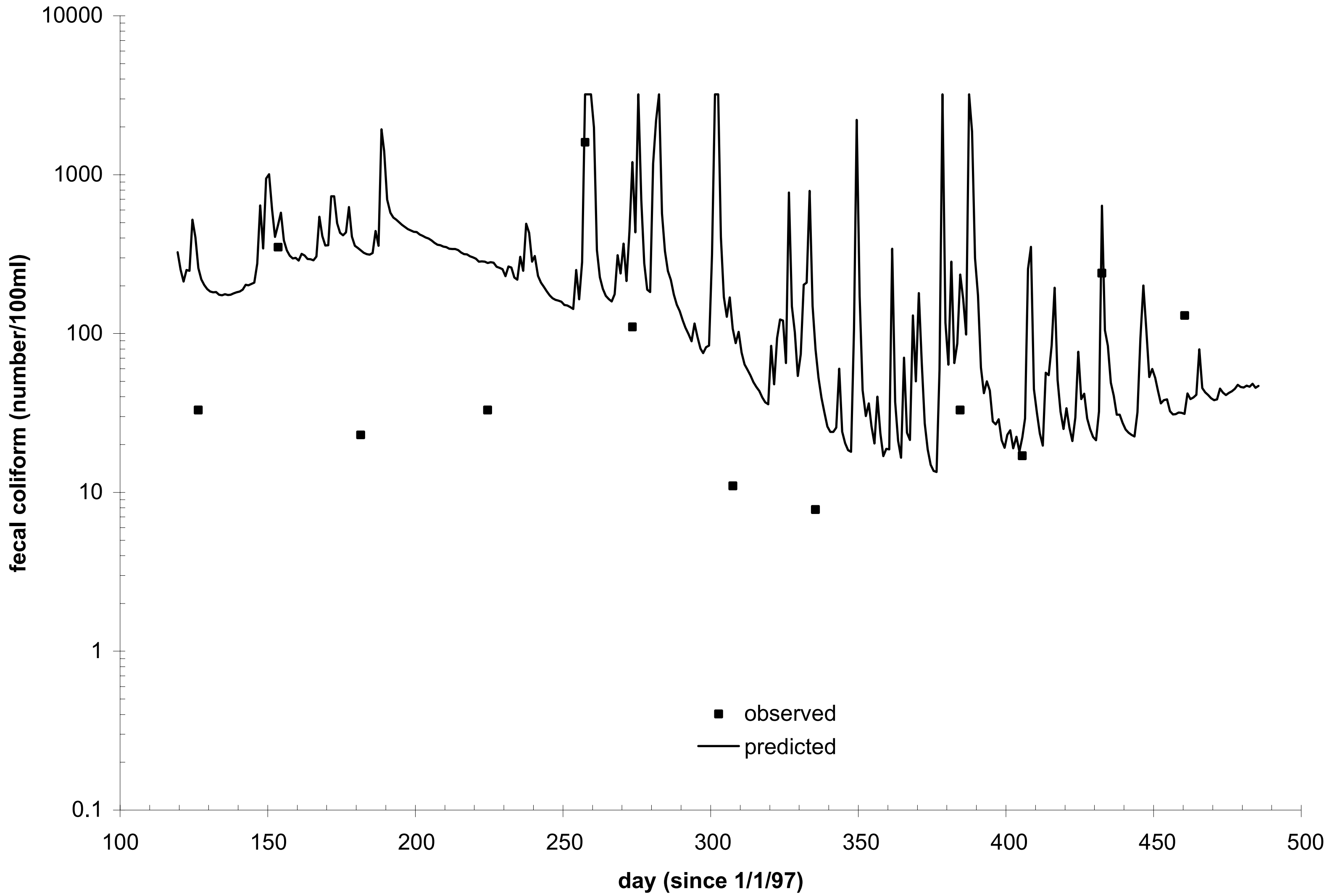


**Figure E14. Predicted and observed fecal coliform in the Wynoochee River from 5/1/97 - 4/30/98 (station 13-wyno).**

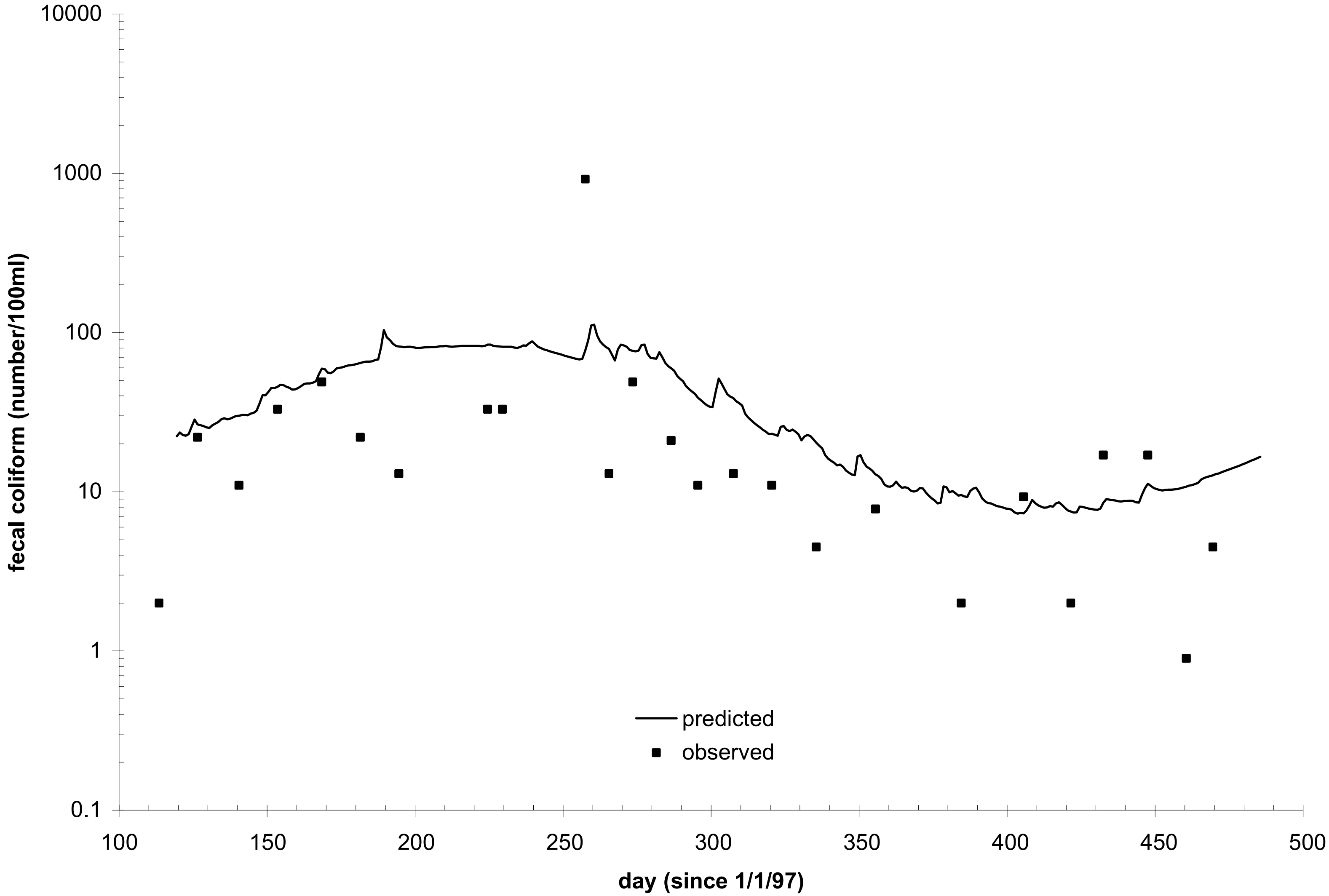


Figure E15. Predicted and observed fecal coliform in Charley Creek from 5/1/97 - 4/30/98 (station 15-char).

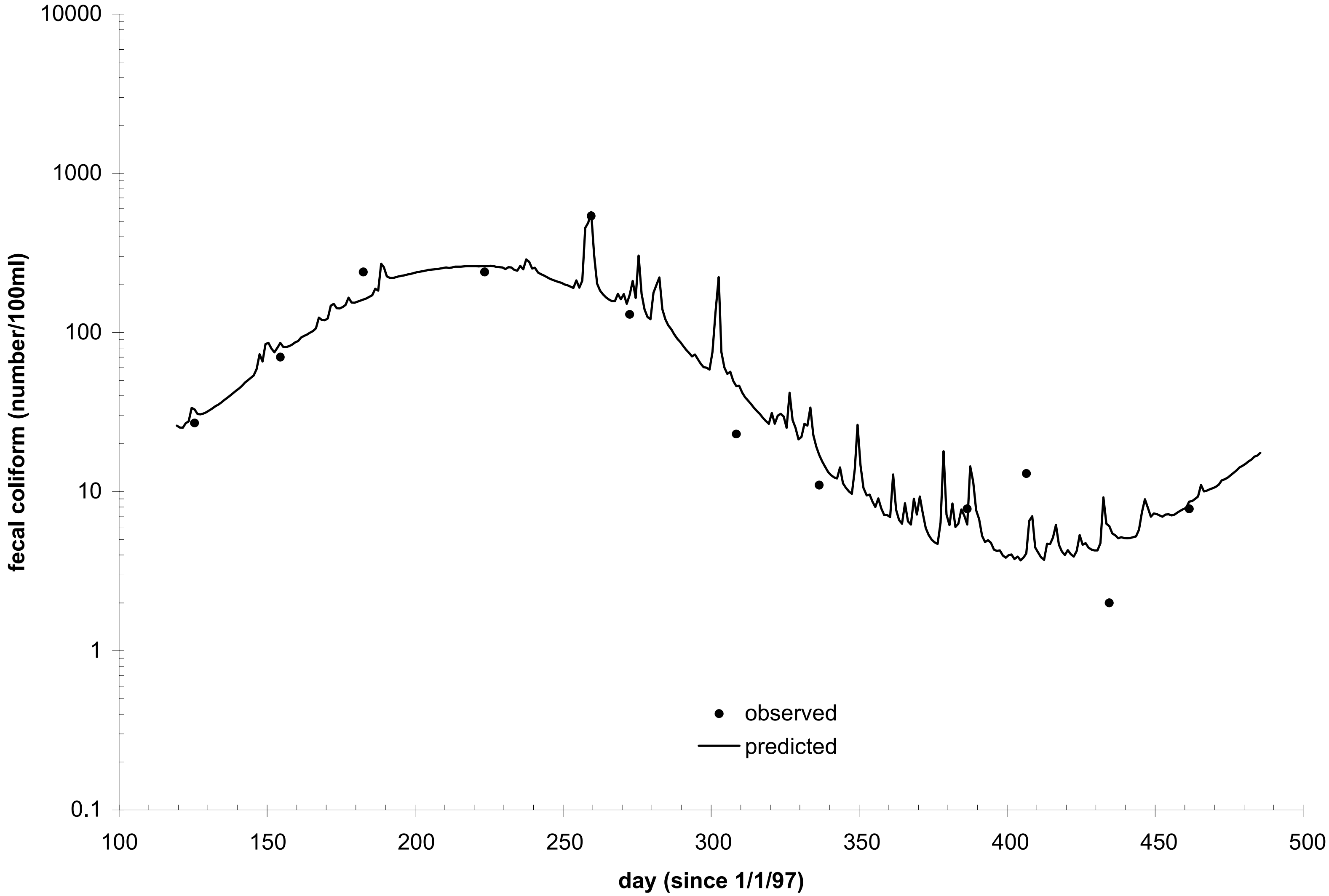


**Figure E16. Predicted and observed fecal coliform in Newskah Creek from 5/1/97 - 4/30/98 (station 16-news).**

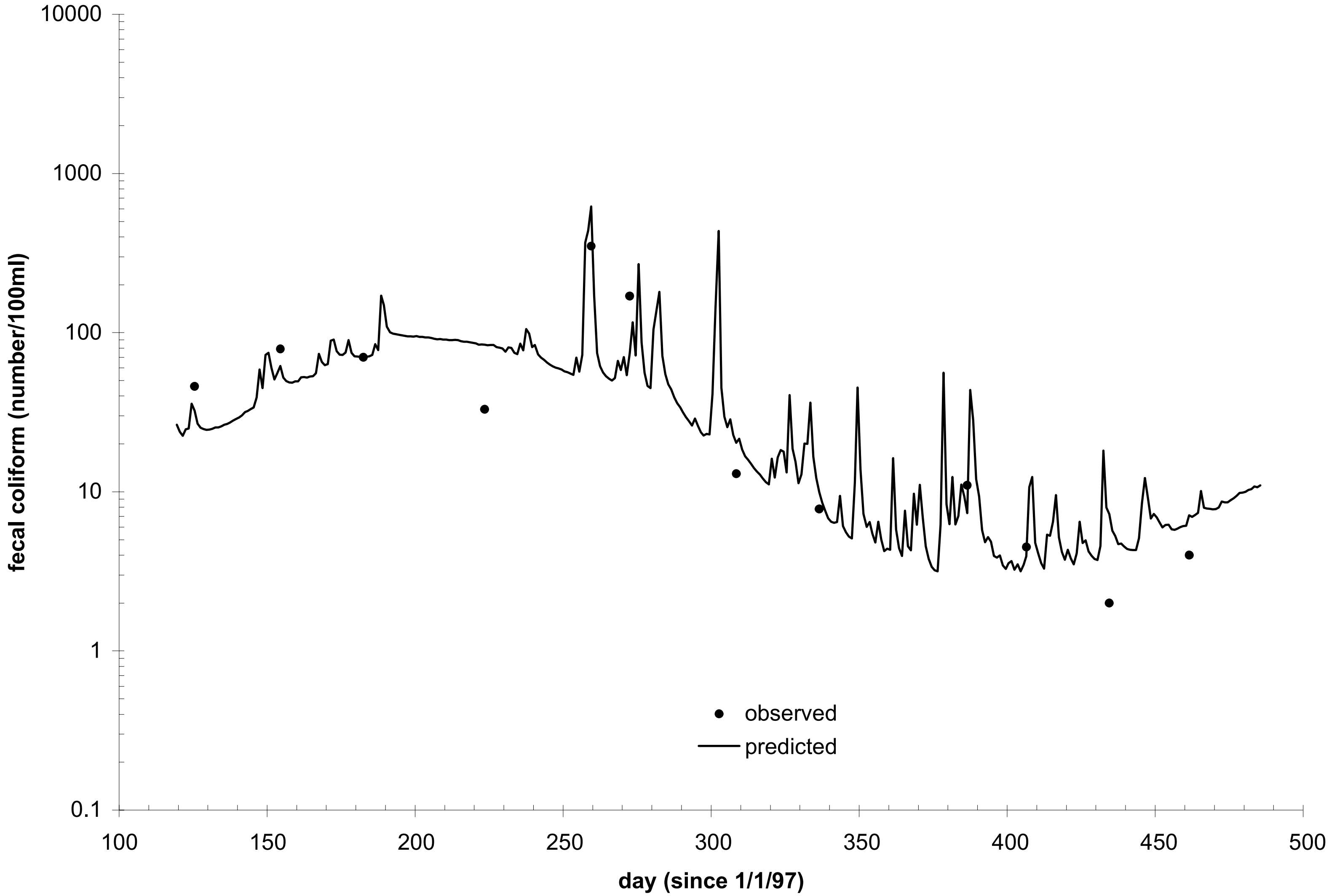


**Figure E17. Predicted and observed fecal coliform in Chapin Creek from 5/1/97 - 4/30/98 (station 17-chap).**

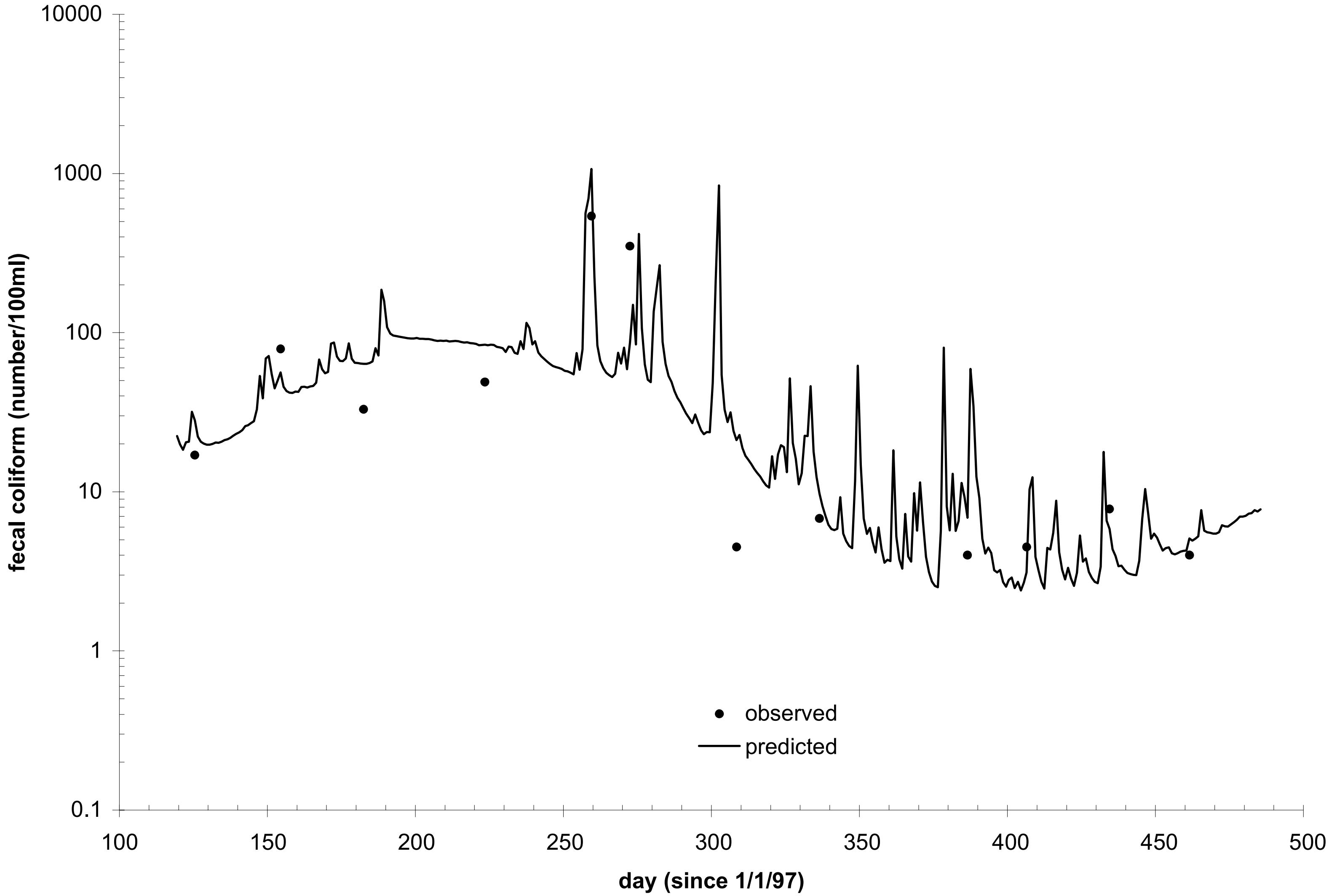


**Figure E18. Predicted and observed fecal coliform in Campbell Creek from 5/1/97 - 4/30/98 (station 18-camp).**

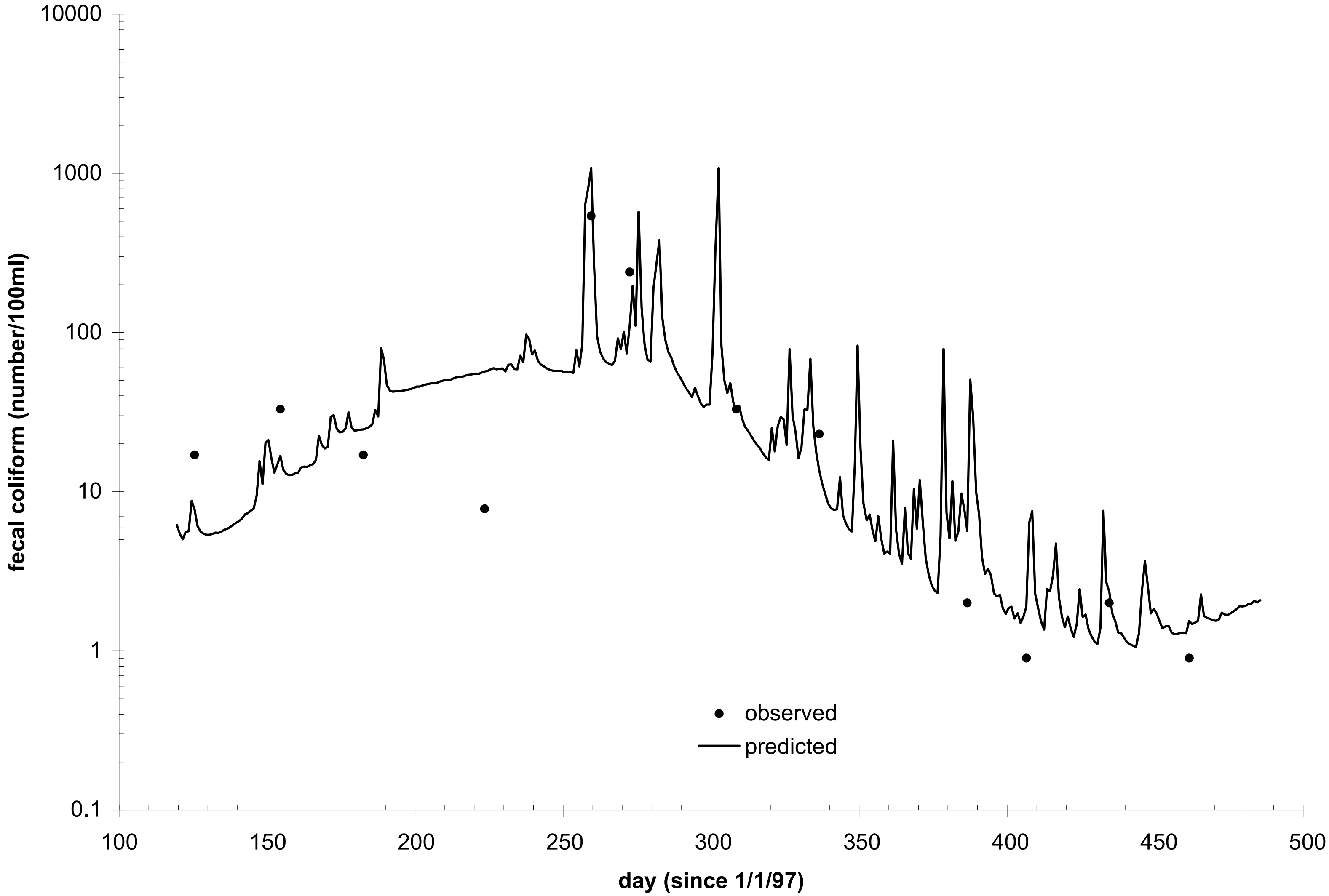


**Figure E18. Predicted and observed fecal coliform in Campbell Creek from 5/1/97 - 4/30/98 (station 18-camp).**

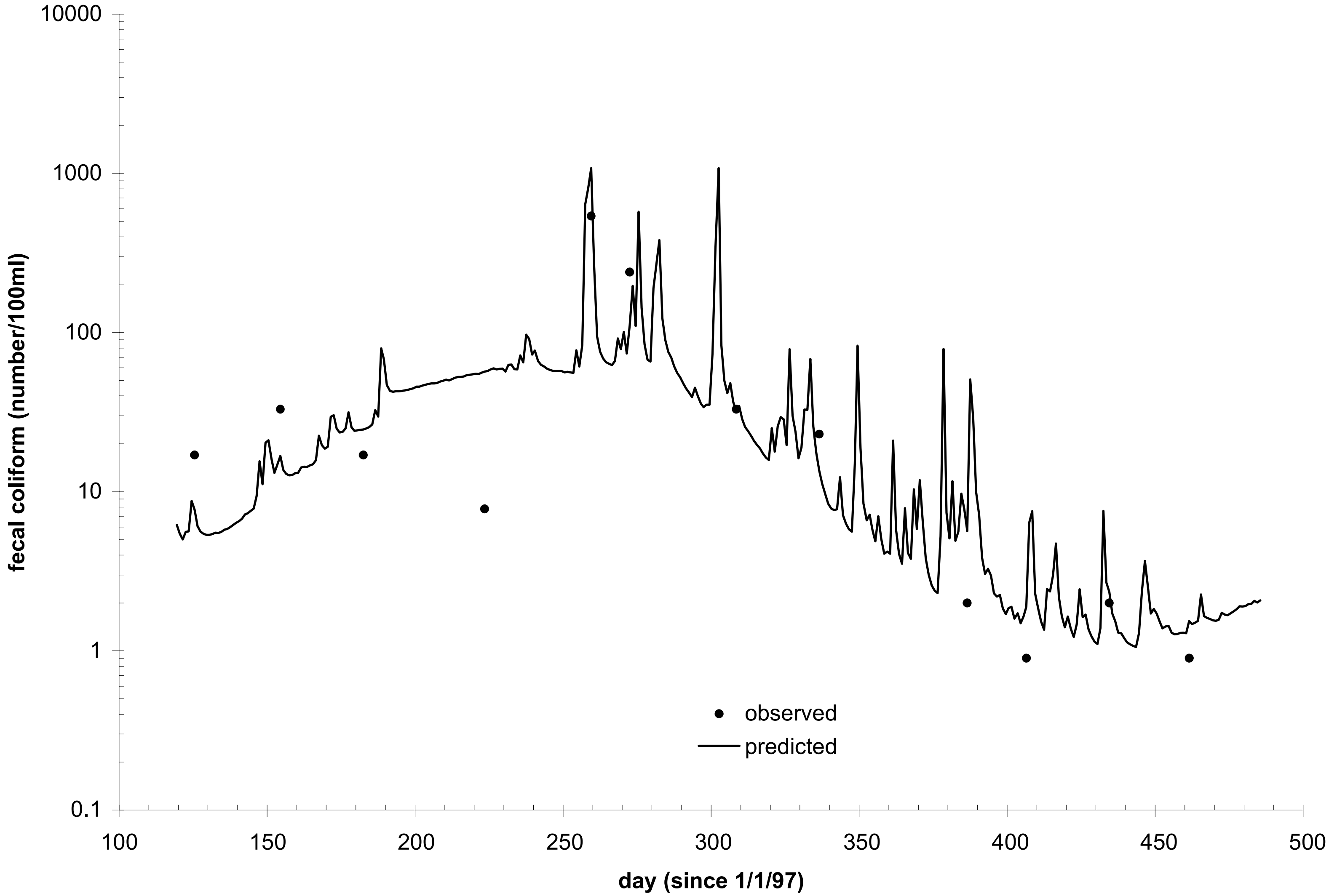


Figure E20. Predicted and observed fecal coliform in Stafford Creek from 5/1/97 - 4/30/98 (station 20-staf).

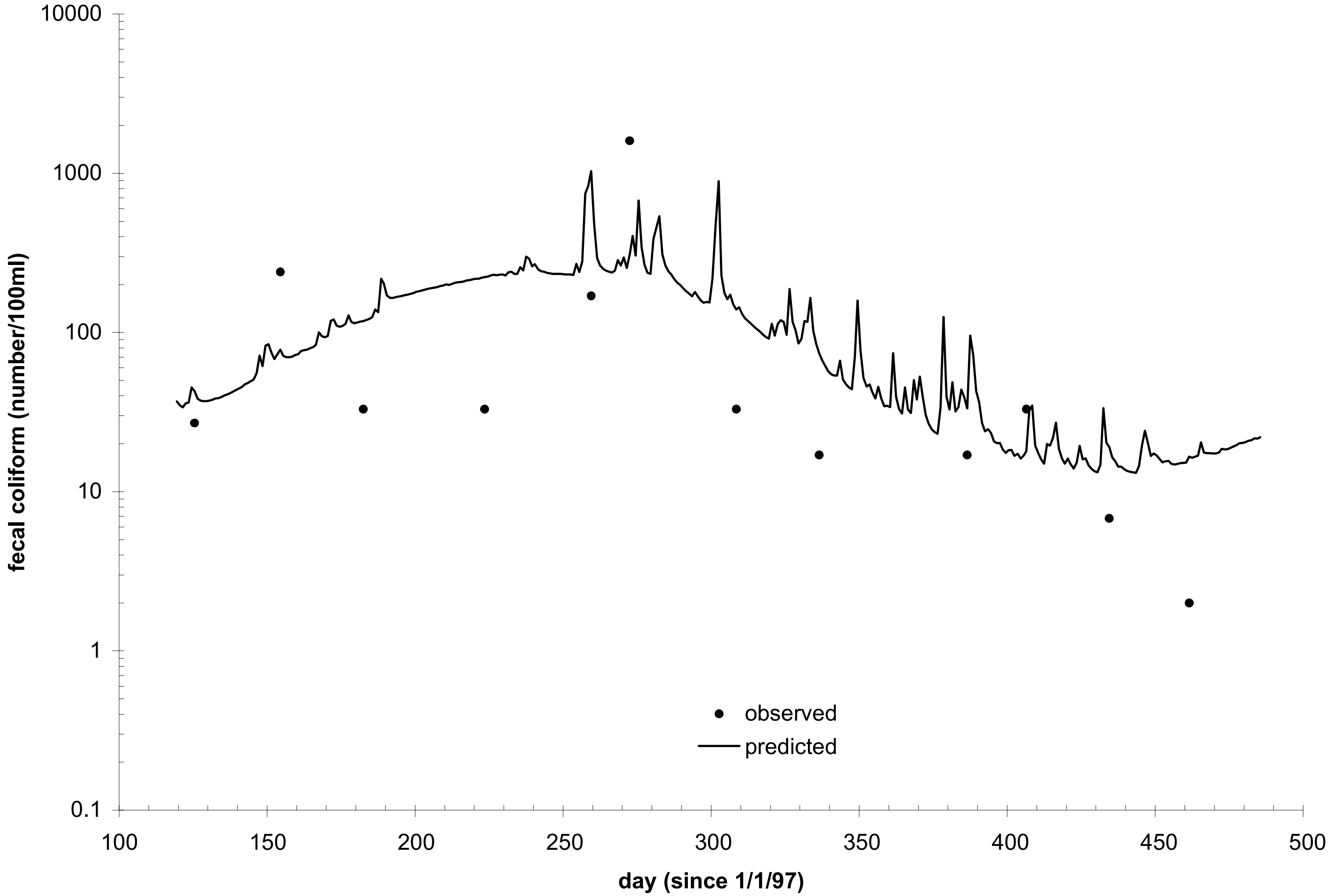


**Figure E21. Predicted and observed fecal coliform in Oleary Creek from 5/1/97 - 4/30/98 (station 21-olea).**

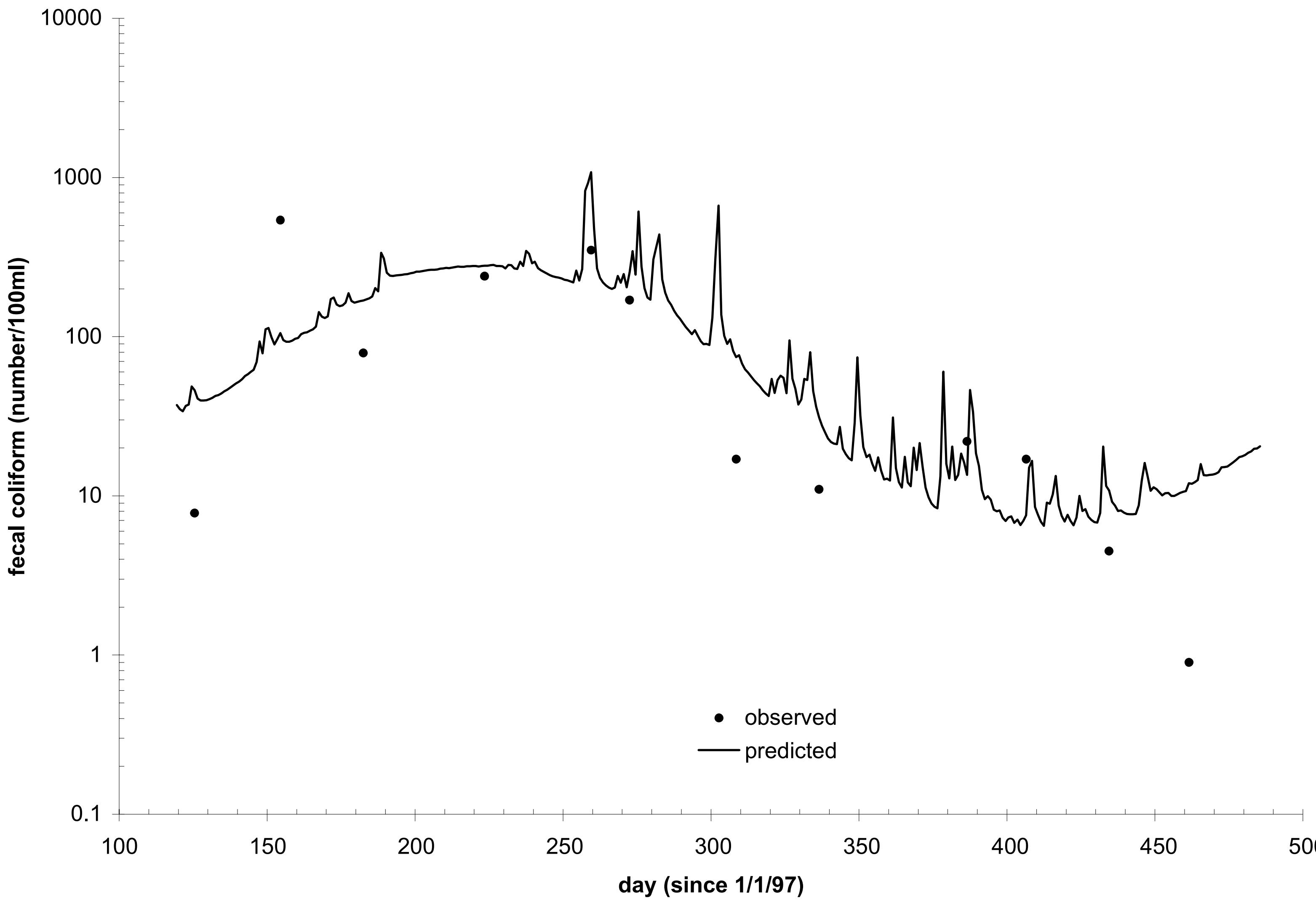


Figure E22. Predicted and observed fecal coliform in the Johns River from 5/1/97 - 4/30/98 (station 22-john).

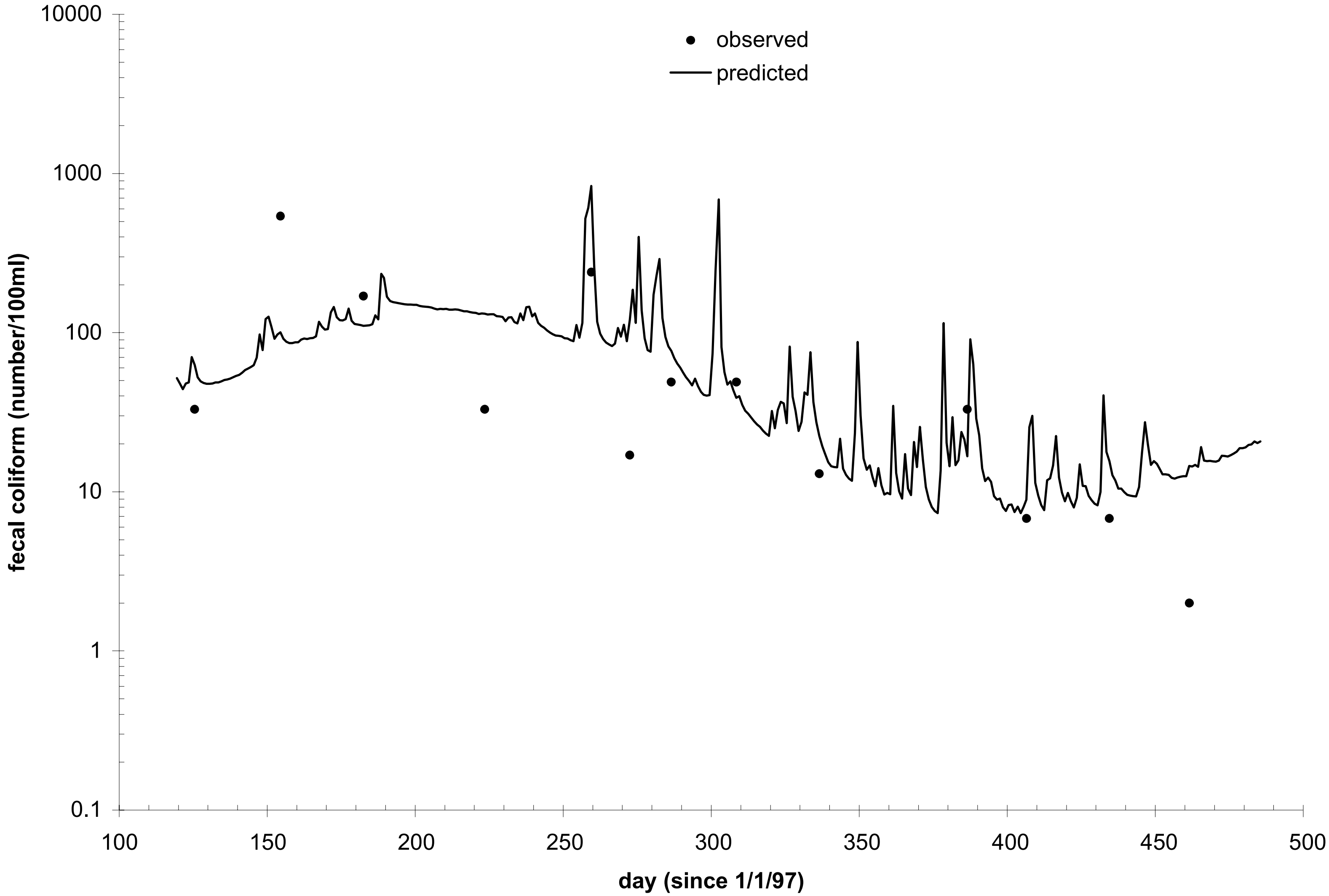


**Figure E23. Predicted and observed fecal coliform in the Johns River from 5/1/97 - 4/30/98 (station 23-john).**

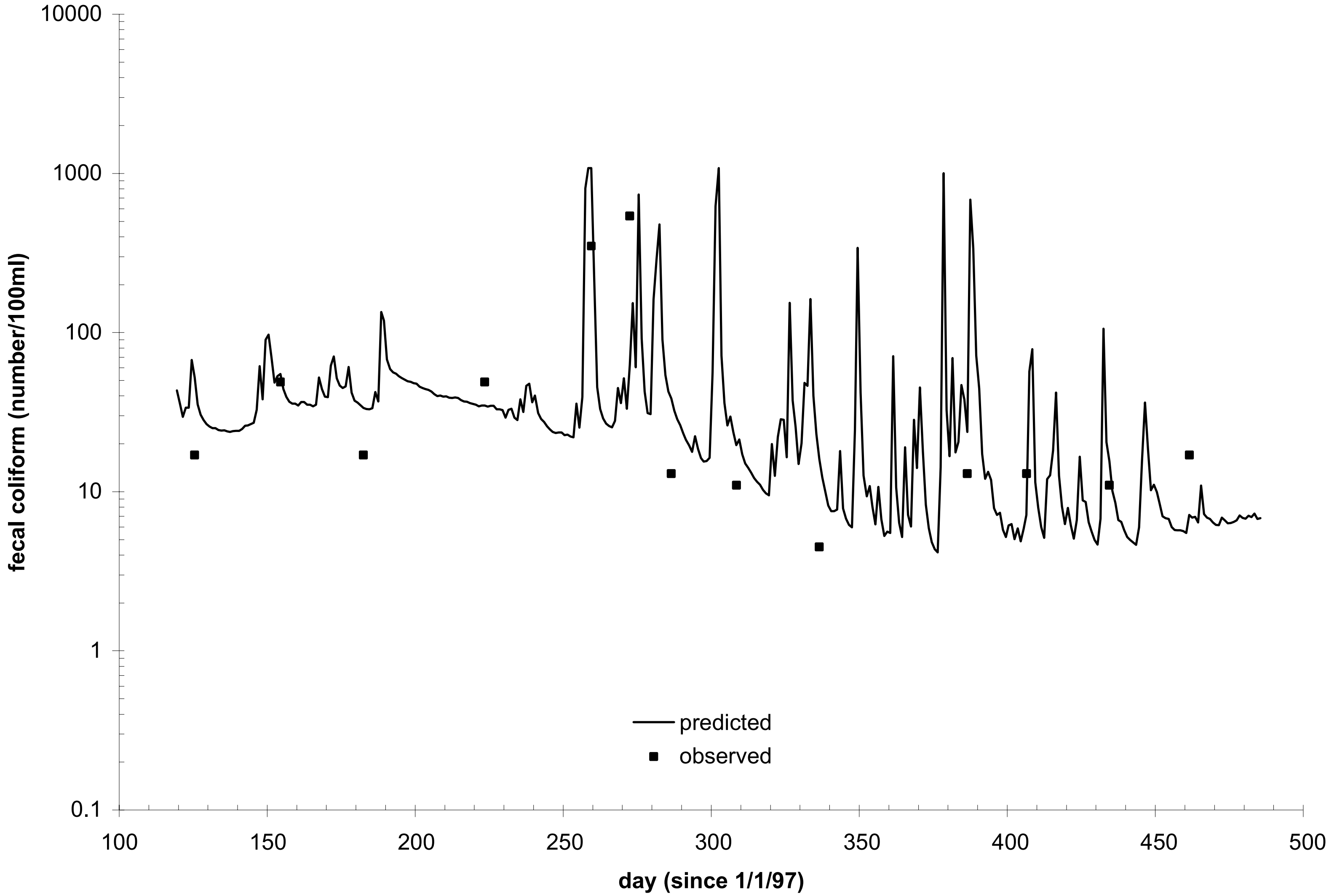


**Figure E24. Predicted and observed fecal coliform in Redman Slough from 5/1/97 - 4/30/98 (station 24-redm).**

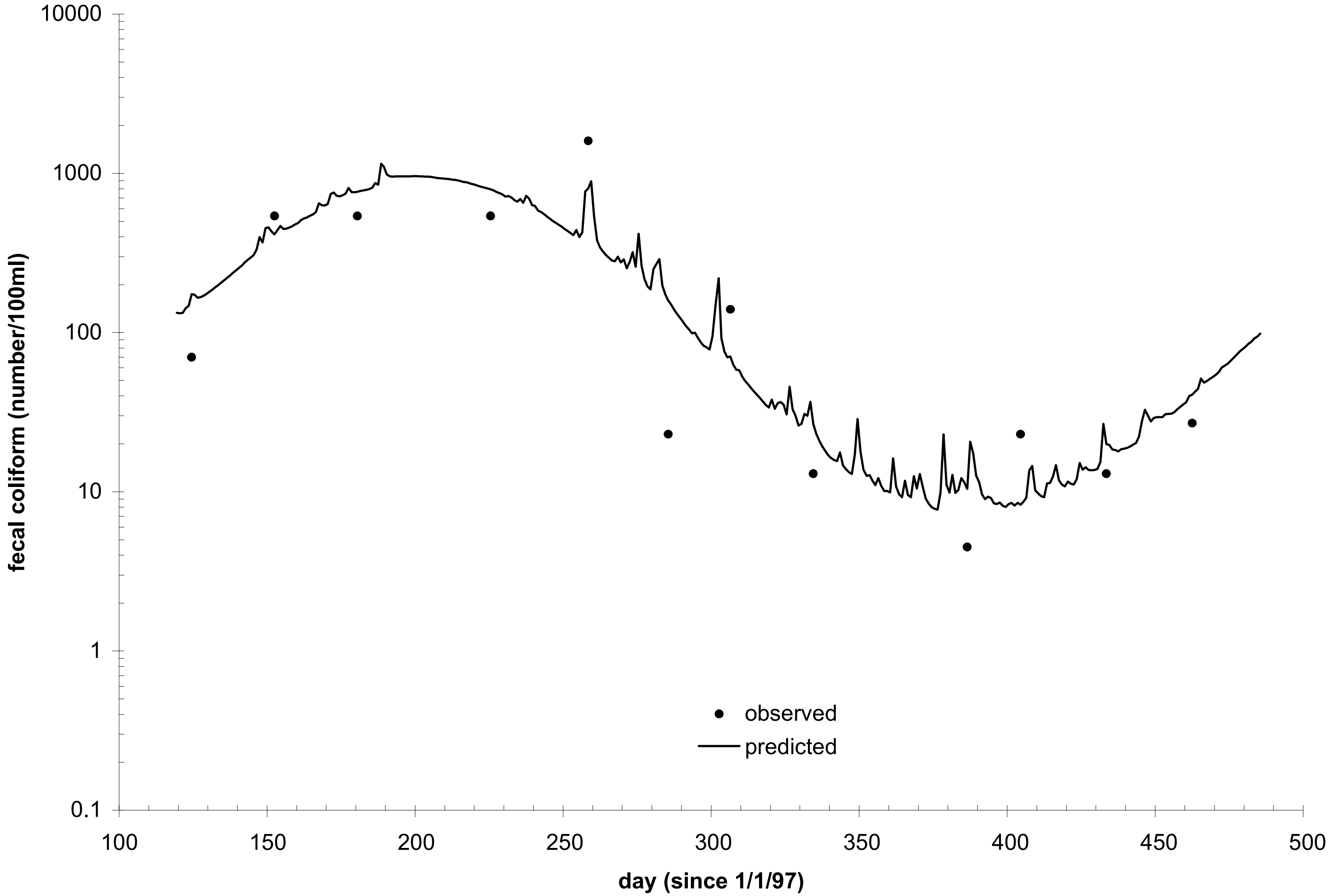


Figure E25. Predicted and observed fecal coliform in Dempsey Cr from 5/1/97 - 4/30/98 (station 25-demp).

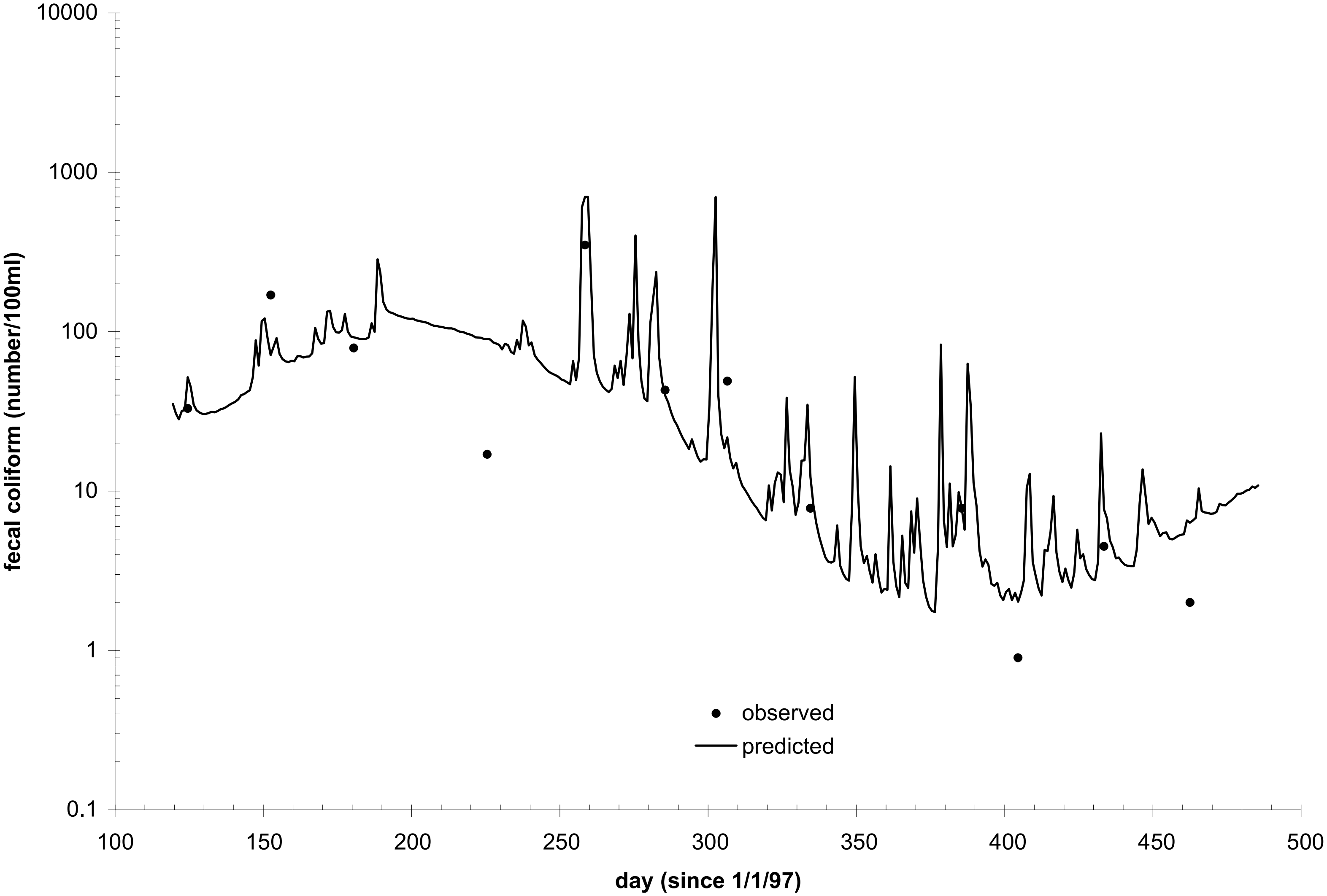


**Figure E26. Predicted and observed fecal coliform in Barlow Cr from 5/1/97 - 4/30/98 (station 26-barl).**

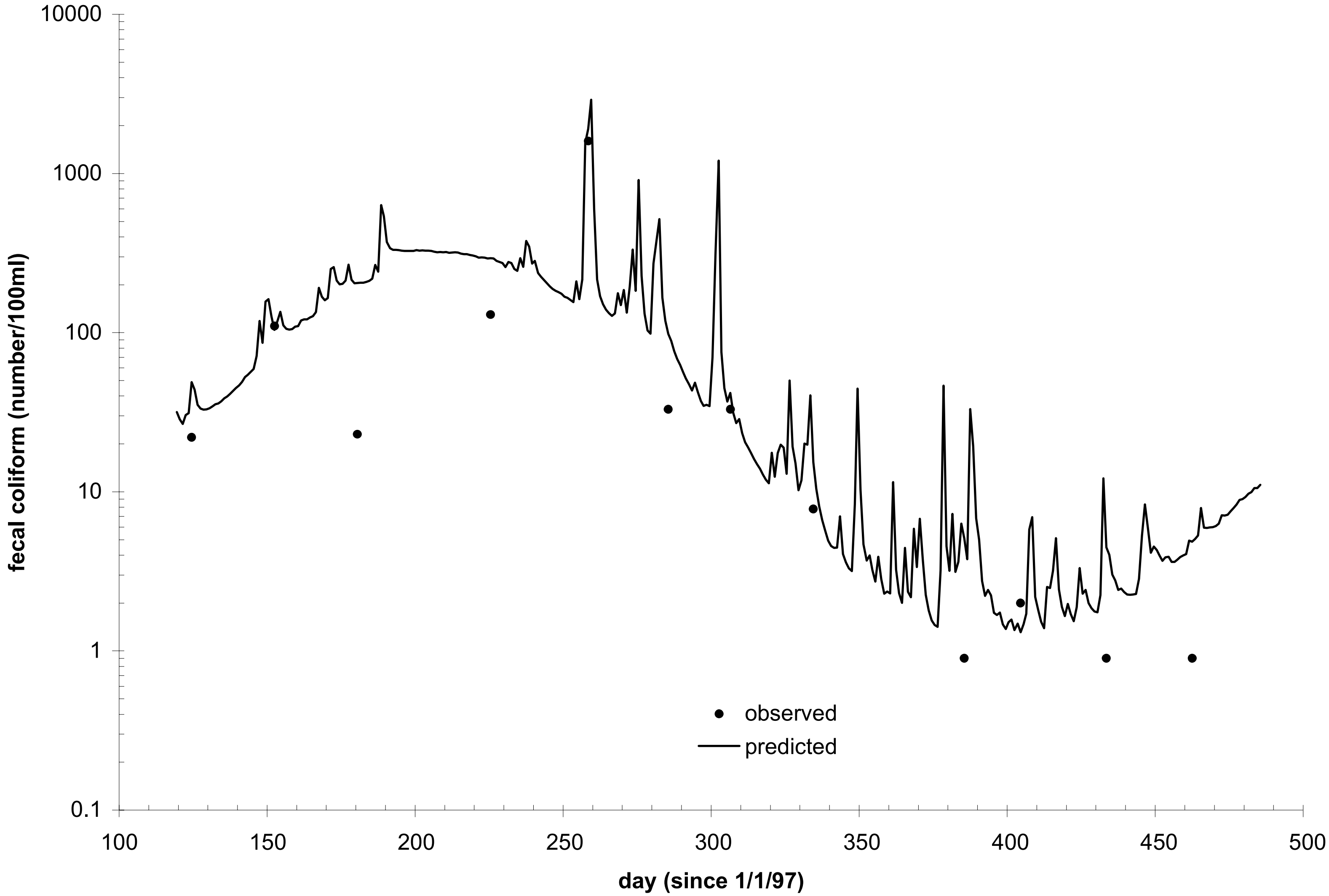


**Figure E27. Predicted and observed fecal coliform in the Elk River from 5/1/97 - 4/30/98 (station 27-elk).**

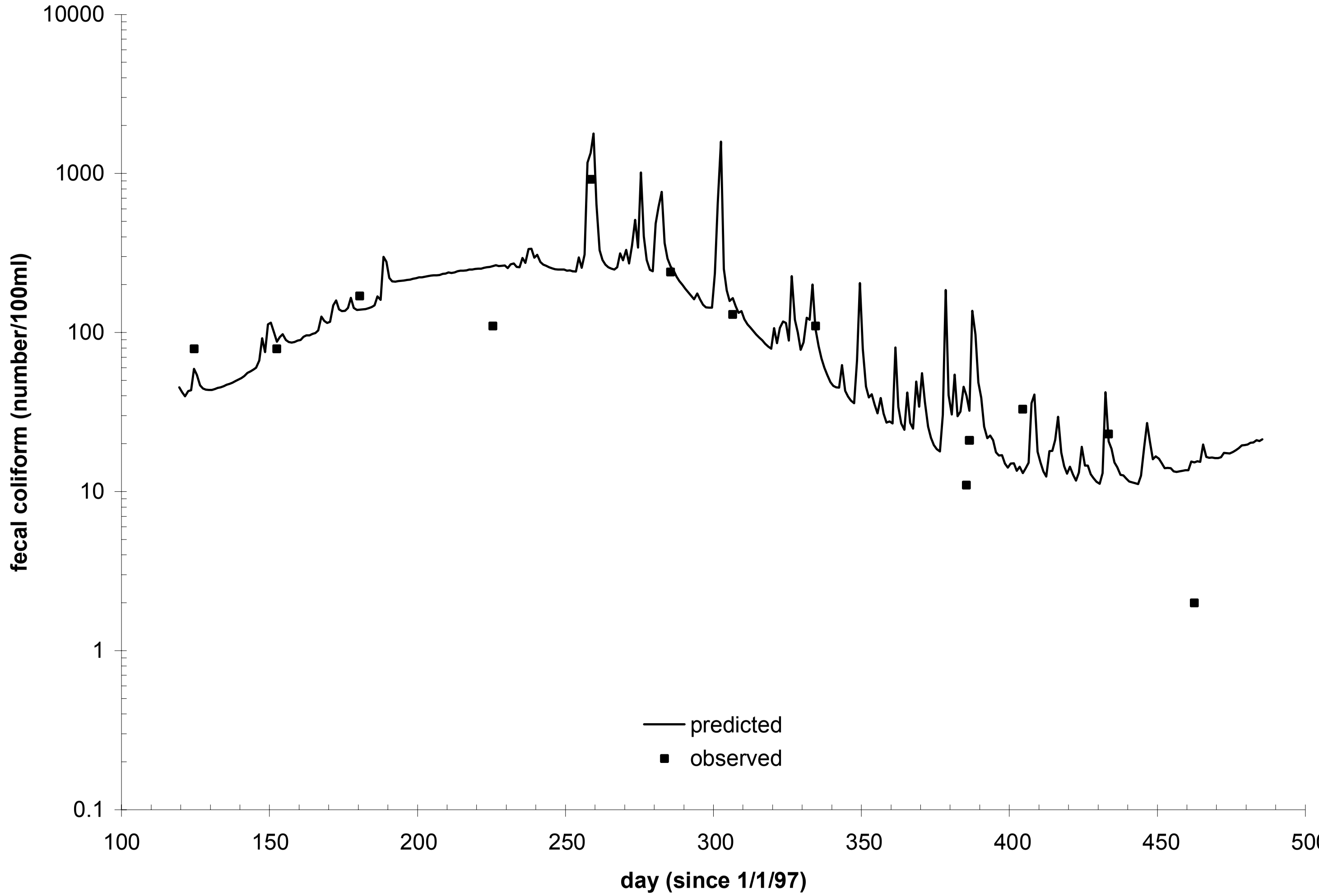


**Figure E28. Predicted and observed fecal coliform in the Grayland Ditch from 5/1/97 - 4/30/98 (station 32-ditch).**

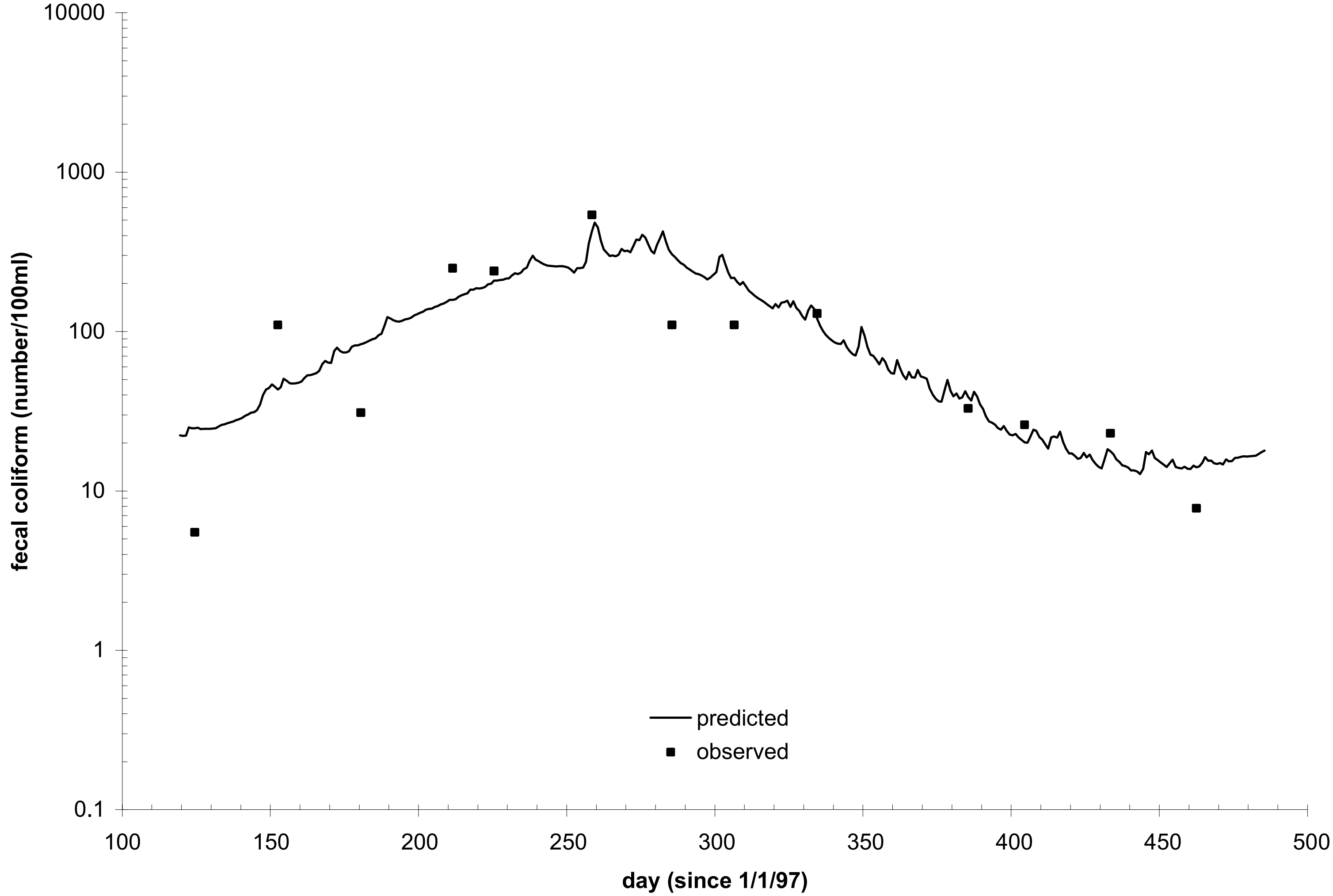


Figure E29. Predicted and observed fecal coliform in the West Fork Andrews Cr from 5/1/97 - 4/30/98 (station 36-wfand).

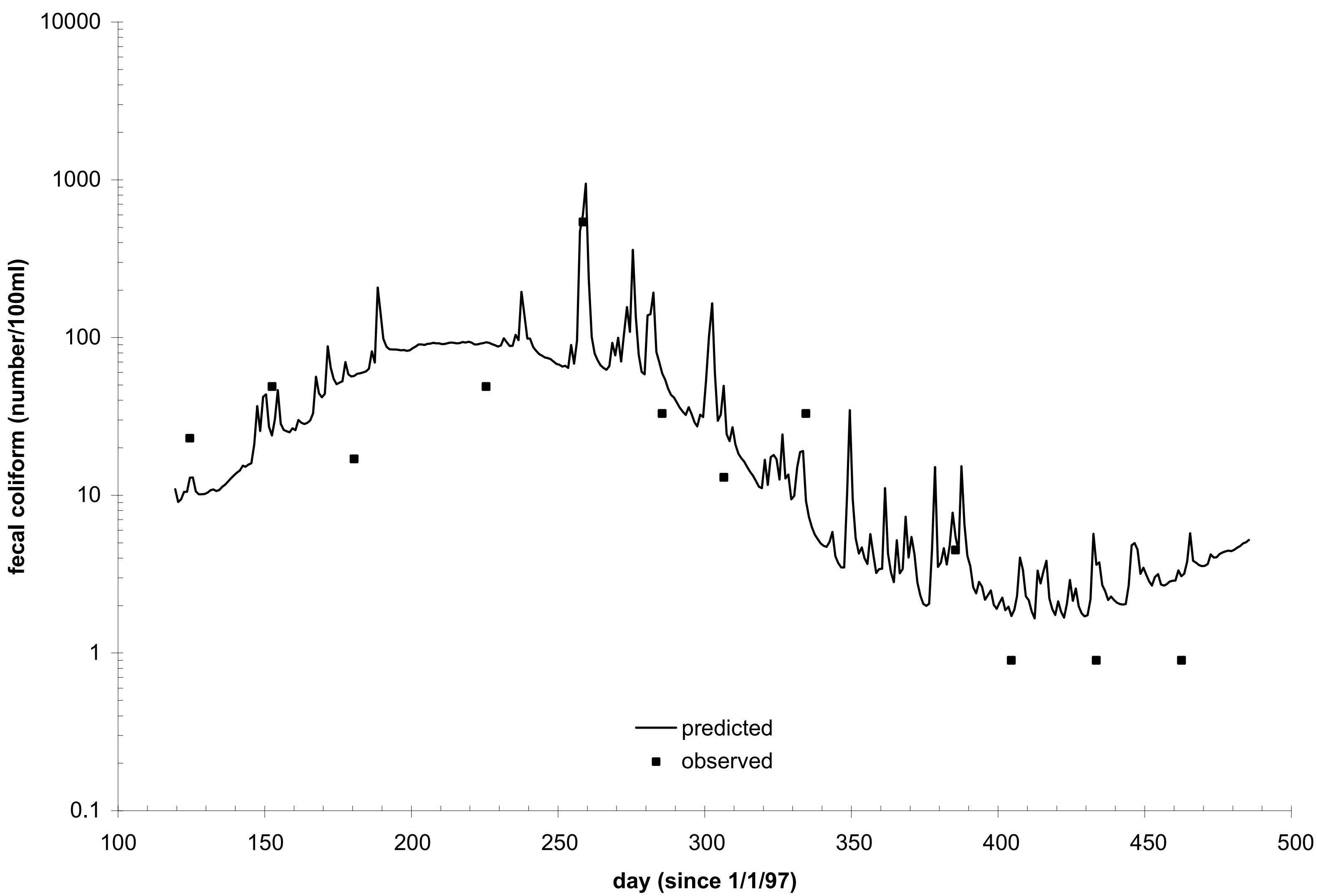


**Figure E30. Predicted and observed fecal coliform in un-named creek in Westport from 5/1/97 - 4/30/98 (station 35-west).**

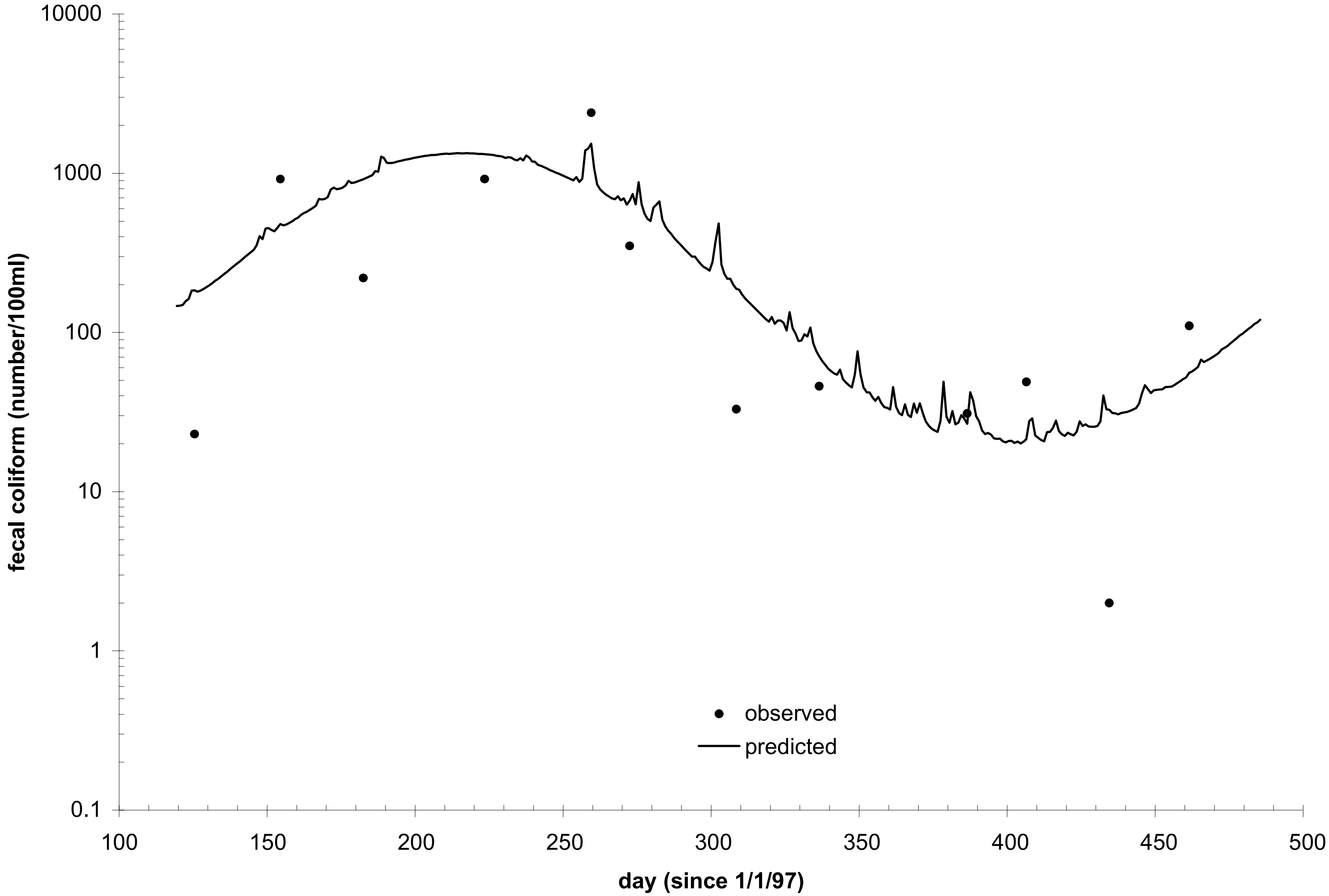


Figure E31. Predicted and observed fecal coliform in the Andrews Cr from 5/1/97 - 4/30/98 (station 37-andr).

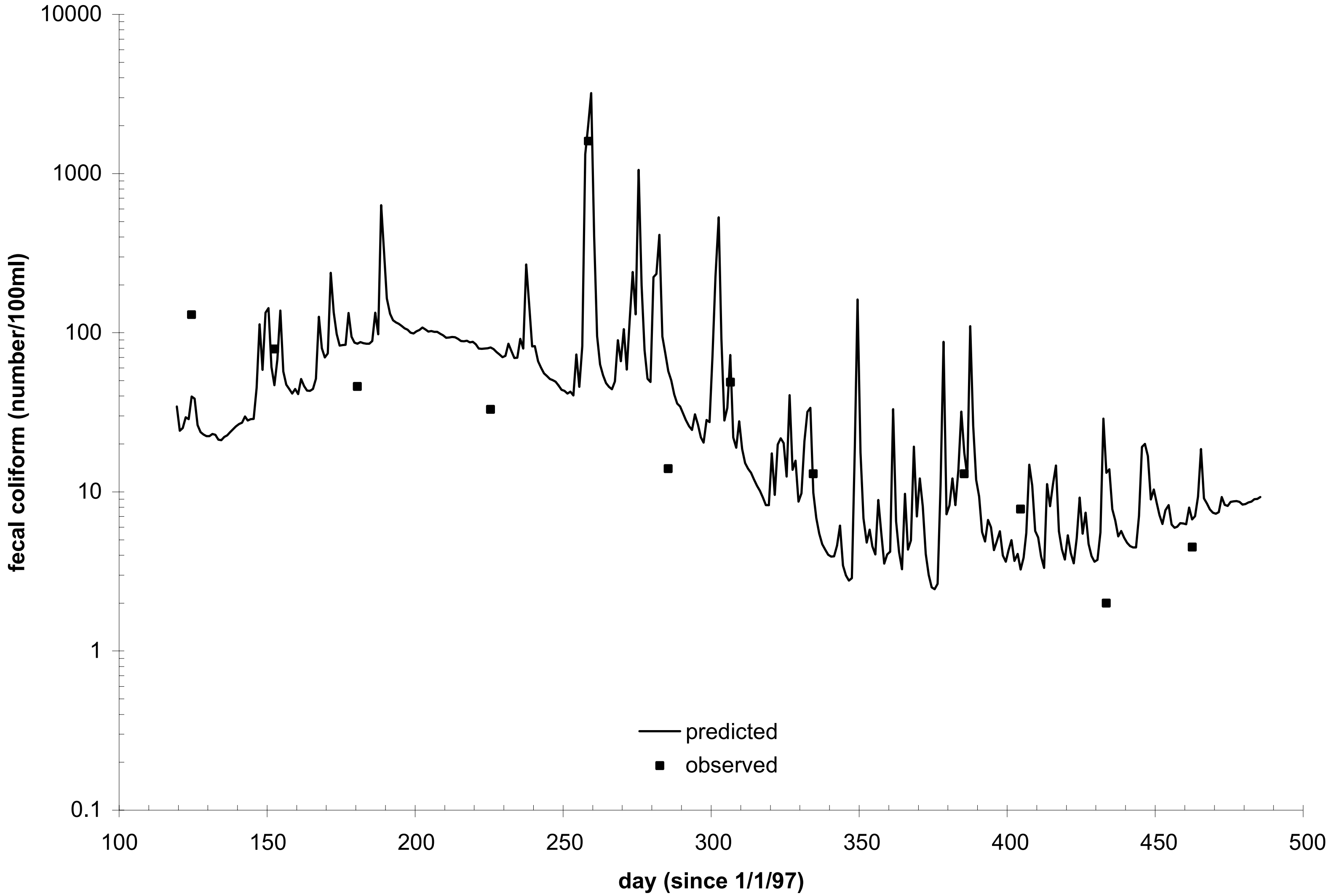
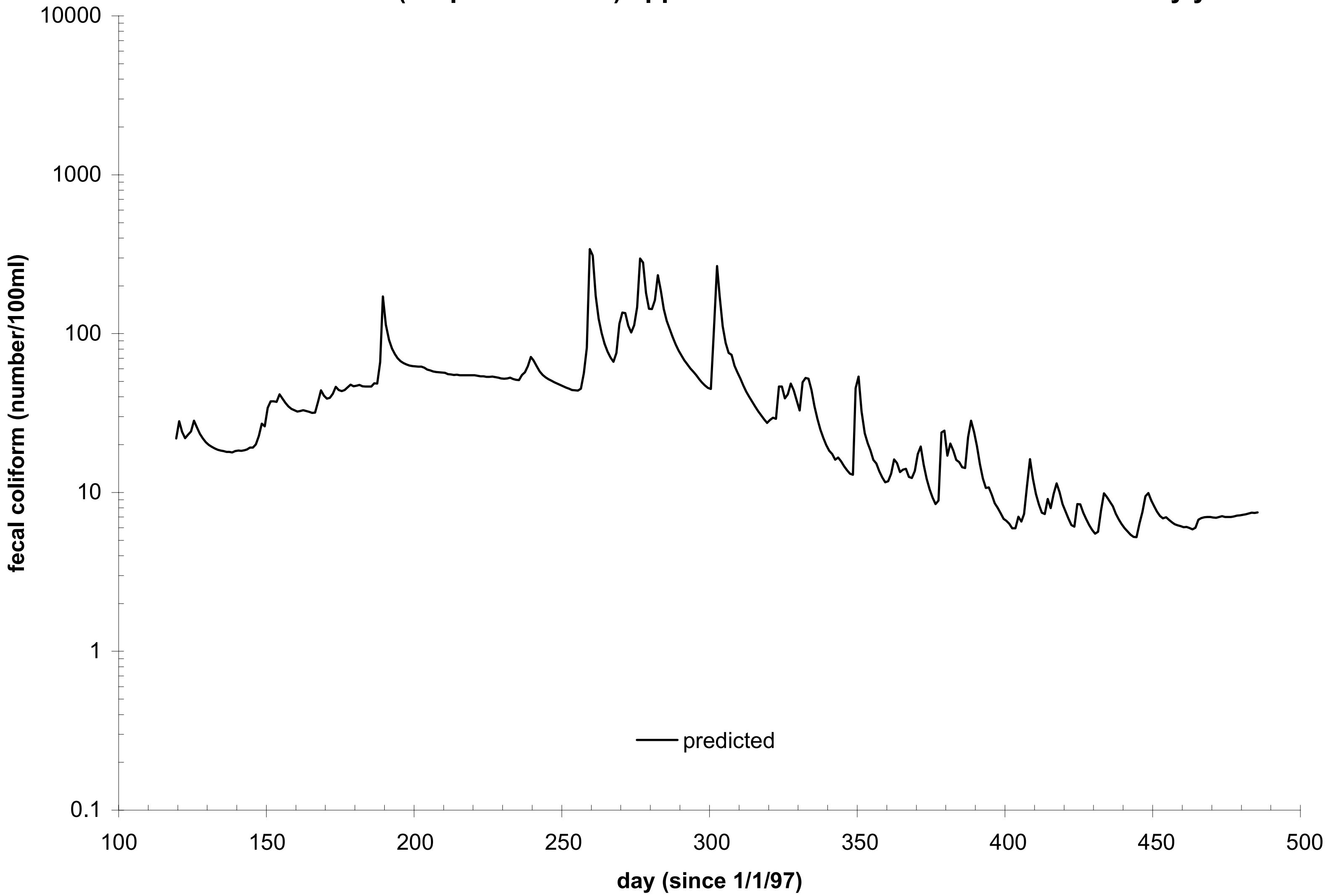


**Figure E32. Predicted fecal coliform in the Satsop River during the 5/1/97 - 4/30/98 (station 22G070). Predicted fecal coliform is based on a regression model of data from 1988-93 (r-squared = 0.45) applied to the flow time series for the study year.**



# Appendix F. Sensitivity analysis of the water quality model predictions to various estimated contributions of fecal coliform from wildlife within Grays Harbor.

Weyerhaeuser provided an estimate of fecal coliform loading from wildlife within Grays Harbor of $1 \times 10^{14}$ colonies per day, based on the estimated population of seals, and estimates of the fecal coliform loading per animal. Weyerhaeuser also suggested that the wildlife contribution could be significantly higher than $1 \times 10^{14}$ colonies per day after other species are accounted for.

Ecology attempted to recalibrate the model of Grays Harbor using Weyerhaeuser's estimate of loading from wildlife. The estimated wildlife load of $1 \times 10^{14}$ colonies per day of fecal coliform was divided evenly based on surface areas of the model segments within Grays Harbor to approximate a uniform loading per unit of area across the harbor. Various fecal coliform die-off rates were then used in an attempt to re-calibrate the model. The tributary flows and loads, and all other conditions, were kept the same as the estimates for the study year as presented in the report.

Figure F-1 presents a comparison of predicted and observed distributions of fecal coliform in Grays Harbor for the 5/1/97 – 4/30/98 calibration period, assuming that wildlife in Grays Harbor contributes approximately $1 \times 10^{14}$ colonies per day. Predicted fecal coliform is shown for assumed die-off rates of 0.4, 1.0, and 2.0 per day (at 20 degrees C) in Figure F-1b. Die-off rates were adjusted to the ambient temperature in the model of Grays Harbor.

The results in Figure F-1 show that the predicted fecal coliform distribution does not match the observed fecal coliform using Weyerhaeuser's estimated wildlife loads. In general, the estimated wildlife load causes an over-estimation of the fecal coliform concentrations in Grays Harbor when reasonable estimates of die-off are used. When a very high estimate of die-off of 2 per day was used in an attempt to decrease the predicted concentrations, the model under-estimated the highest concentrations and over-estimated the lowest concentrations. These results, and subsequent model runs using estimated wildlife loading of $1 \times 10^{13}$ and $1 \times 10^{12}$ colonies per day (Figures F-2 and F-3), show that Weyerhaeuser's estimate of wildlife loading greatly over-estimates the effective contribution from wildlife, probably by a factor of about 100 or more. Possible explanations for the over-estimation of the wildlife contribution include uncertainty in estimating the loads per animal, and possible rapid settling of fecal material.

In contrast to the results in Figure F-1 of this appendix, the model calibration shown in Figure 39 of the report shows that Ecology's model predictions represent the observed data very well. Ecology's calibration of the model presented in the report implicitly accounts for the contribution of wildlife by solving for the apparent die-off rate that represents a balance between internal processes that could increase the fecal coliform concentration (for example wildlife sources), and processes that affect the disappearance rates of fecal coliform. Comparison of Figure 39 in the report with Figures F-1, F-2, and F-3 shows that Ecology's implicit method of accounting for wildlife sources is more accurate than attempting to directly estimate loads based on estimated populations of various species of animals. The model calibration presented in the report is considered to adequately represent wildlife sources, and wildlife sources are probably not significant compared with tributary loading sources, considering that:

- the model calibration presented in the report shows good agreement between predicted and observed concentrations,
- the apparent die-off rate of 0.4 per day is within a reasonable range reported in the literature,
- direct estimates of wildlife loading were shown to greatly over-estimate the effective loading and would probably have an uncertainty of about a factor of 100 or more,
- Ecology does not recommend reductions in wildlife populations within Grays Harbor.

**Figure F-1a. Comparison of predicted and observed fecal coliform in Grays Harbor at all stations, 5/1/97 - 4/30/98, assuming that the wildlife load is 1e14 colonies per day and the die-off rate is 2 per day at 20 deg C.**

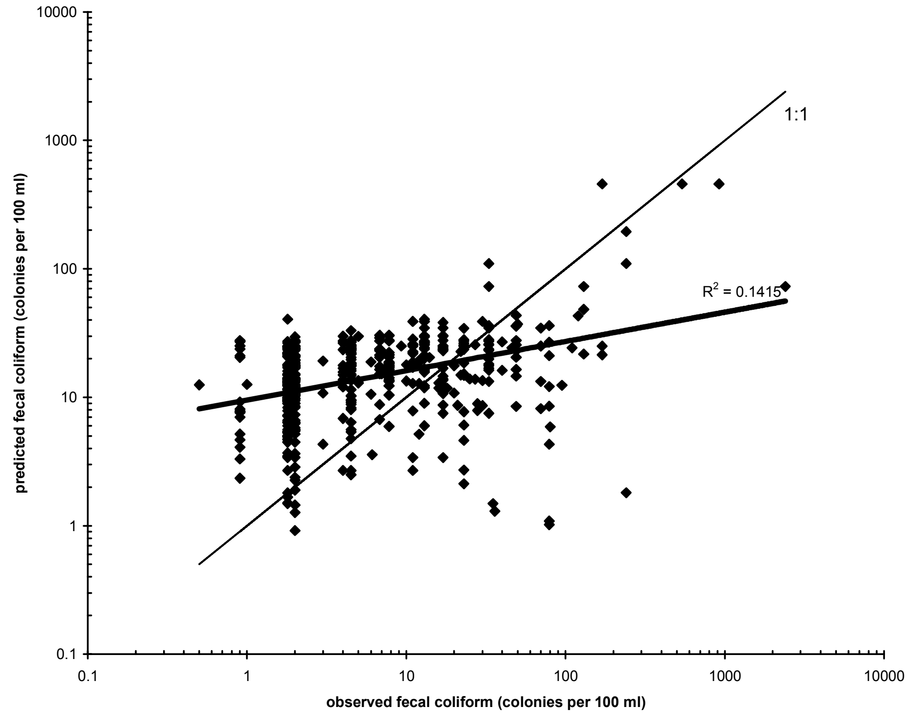



**Figure F-1b. Comparison of quantiles of observed and predicted fecal coliform at all stations in Grays Harbor, 5/1/97 - 4/30/98, assuming that the wildlife fecal coliform loading is 1e14 colonies per day.**

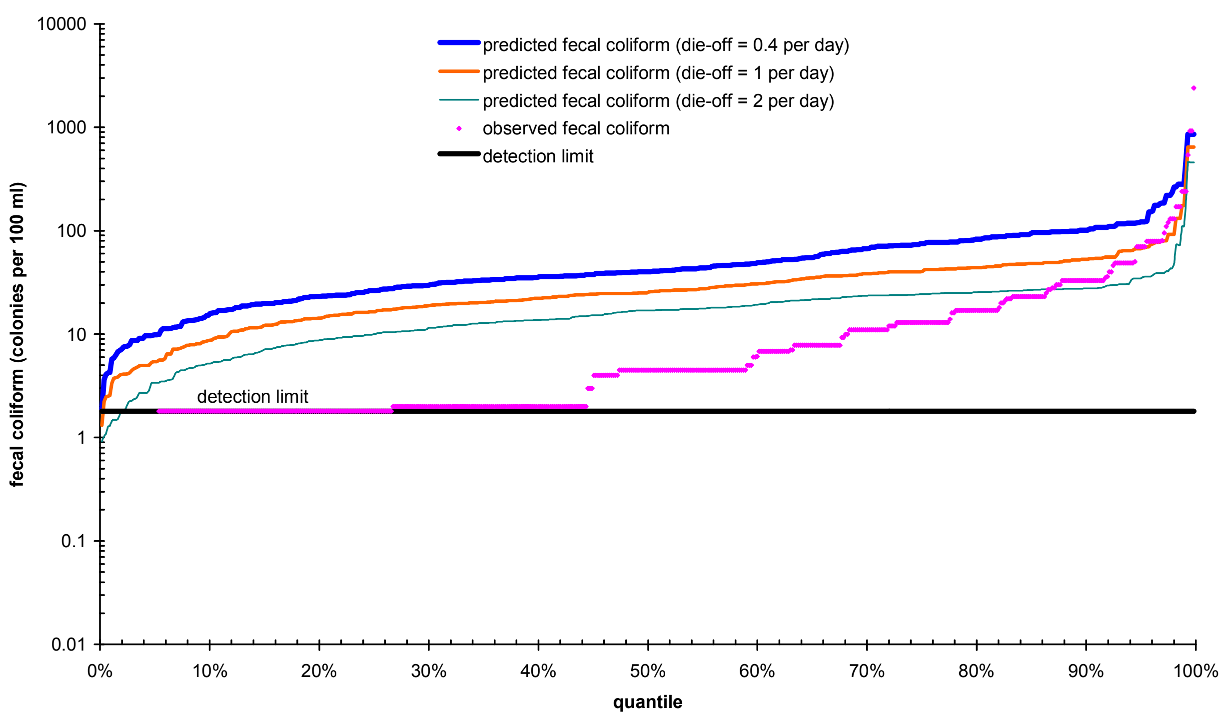


**Figure F-2a. Comparison of predicted and observed fecal coliform in Grays Harbor at all stations, 5/1/97 - 4/30/98, assuming that the wildlife load is 1e13 colonies per day and the die-off rate is 1 per day at 20 deg C.**

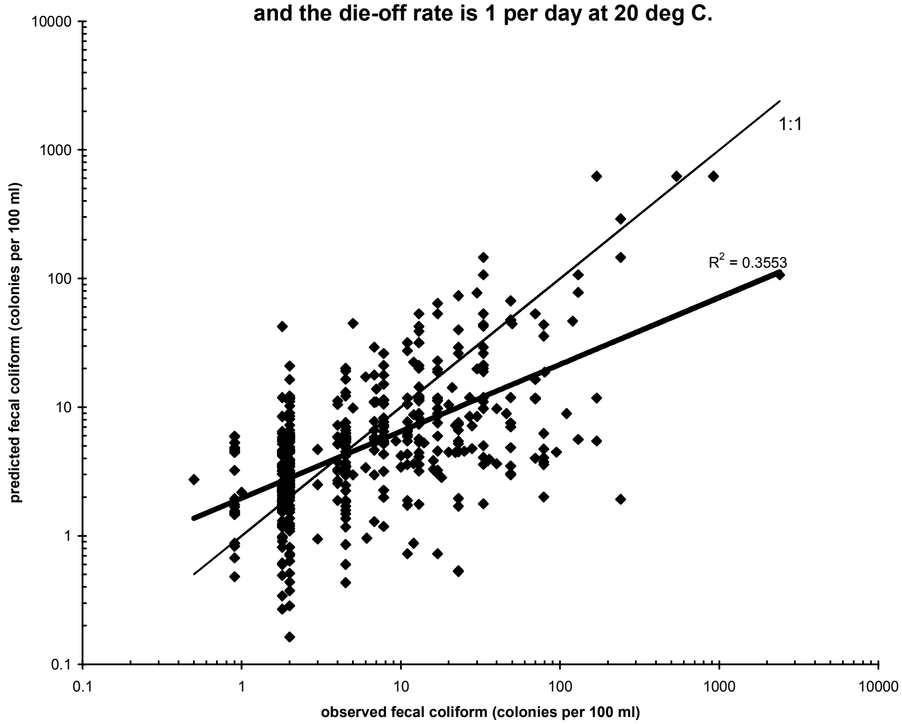



**Figure F-2b. Comparison of quantiles of observed and predicted fecal coliform at all stations in Grays Harbor, 5/1/97 - 4/30/98, assuming that the wildlife fecal coliform loading is 1e13 colonies per day.**

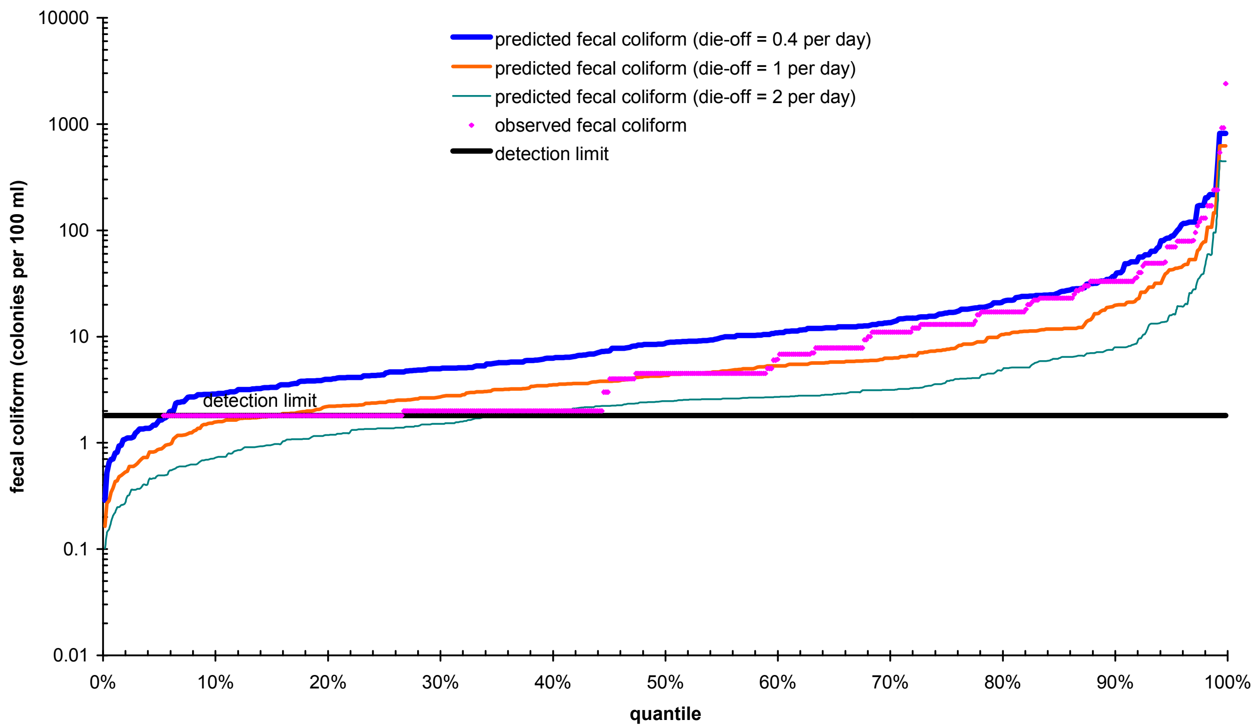


**Figure F-3a. Comparison of predicted and observed fecal coliform in Grays Harbor at all stations, 5/1/97 - 4/30/98, assuming that the wildlife load is 1e12 colonies per day and the die-off rate is 0.4 per day at 20 deg C.**

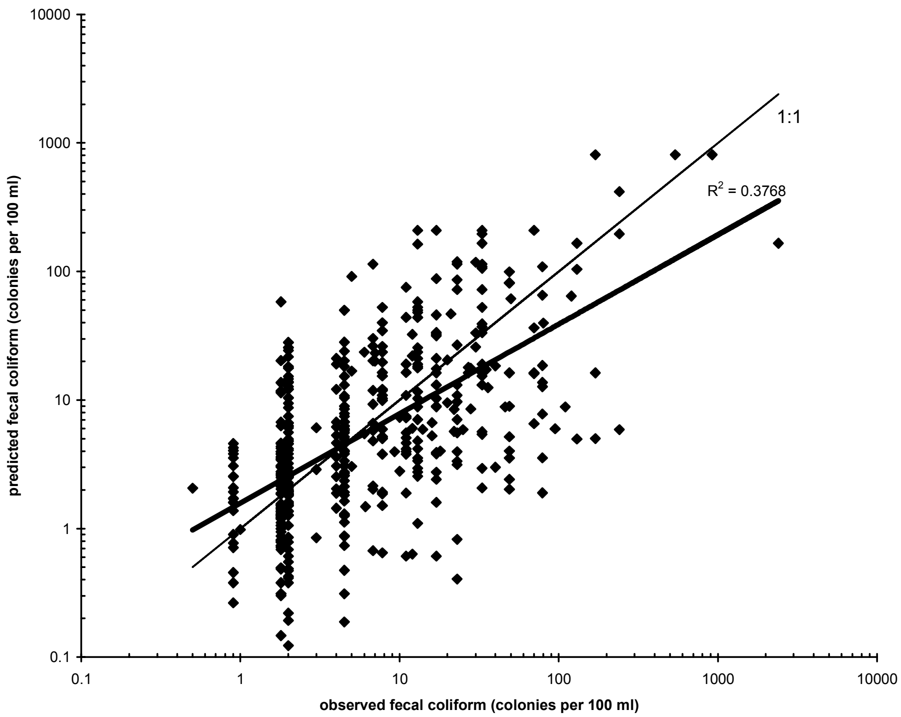
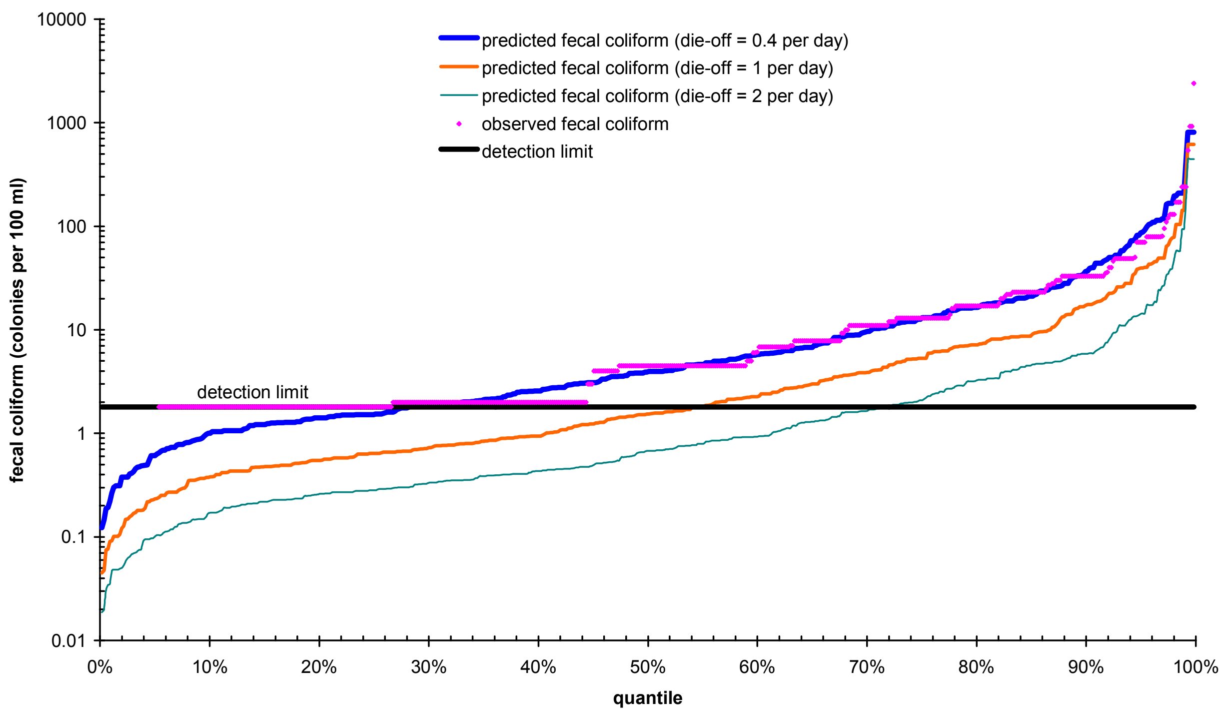



**Figure F-3b. Comparison of quantiles of observed and predicted fecal coliform at all stations in Grays Harbor, 5/1/97 - 4/30/98, assuming that the wildlife fecal coliform loading is 1e12 colonies per day.**



# Appendix G. Animation of monthly geometric means of predicted hourly fecal coliform during the study period of May 1997 through April 1998.

The color printouts in this appendix show selected frames of an animation of the monthly geometric means of predicted hourly fecal coliform during the study period of May 1997 through April 1998. The animations are available for viewing on the Internet at Ecology's website at the following URL:

http://www.wa.gov/ecology/eils/wrias/tmdl/ghfc/results.html

The electronic files for the project appendices are also available on request to:

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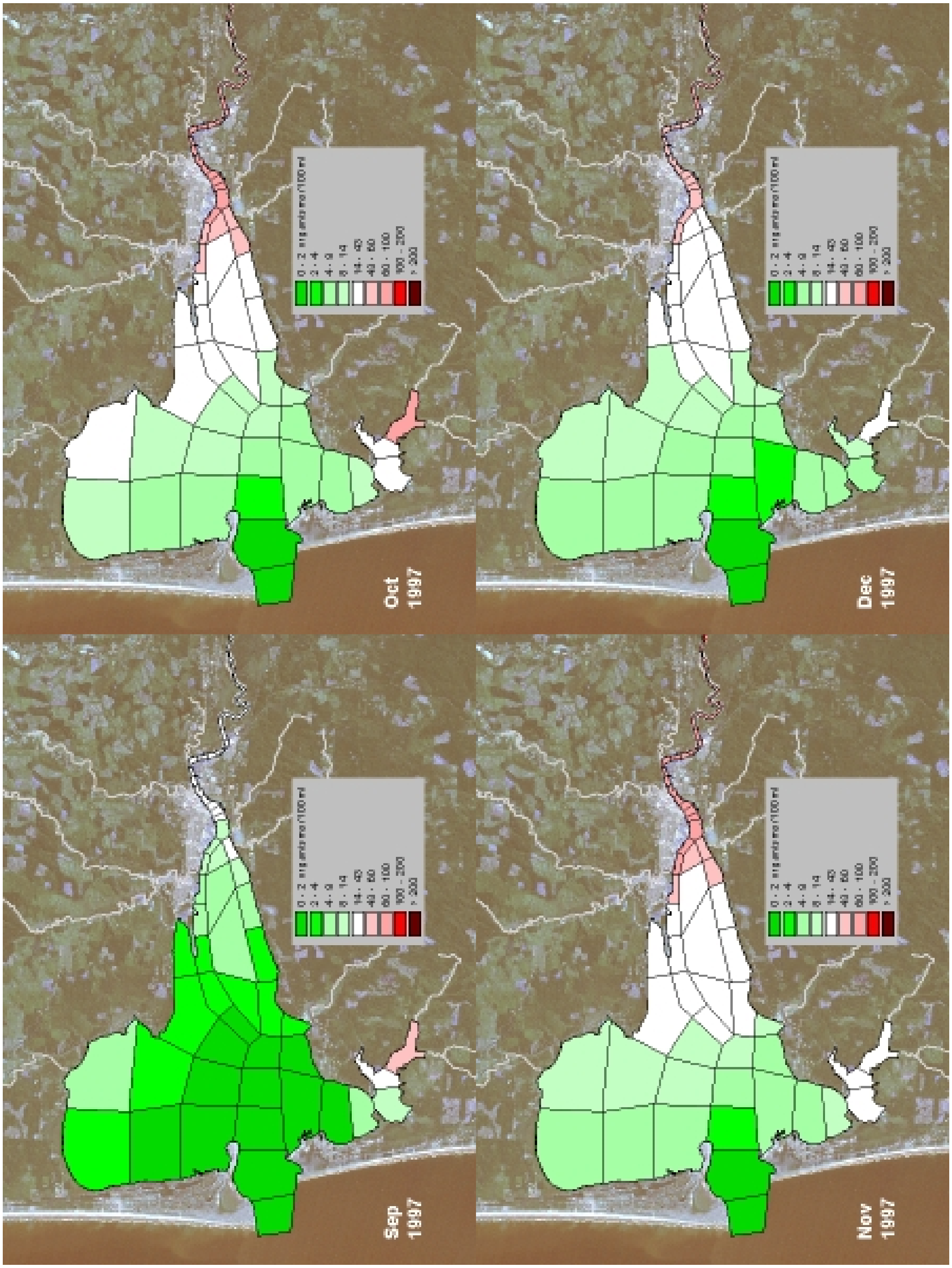
e-mail: gpel461@ecy.wa.gov


Oct 1997
Sep 1997
Dec 1997
Nov 1997

# Appendix H. Animation of monthly 90th percentiles of predicted hourly fecal coliform during the study period of May 1997 through April 1998.

The color printouts in this appendix show selected frames of an animation of the monthly 90$^{th}$ percentiles of predicted hourly fecal coliform during the study period of May 1997 through April 1998. The animations are available for viewing on the Internet at Ecology's website at the following URL:

http://www.wa.gov/ecology/eils/wrias/tmdl/ghfc/results.html

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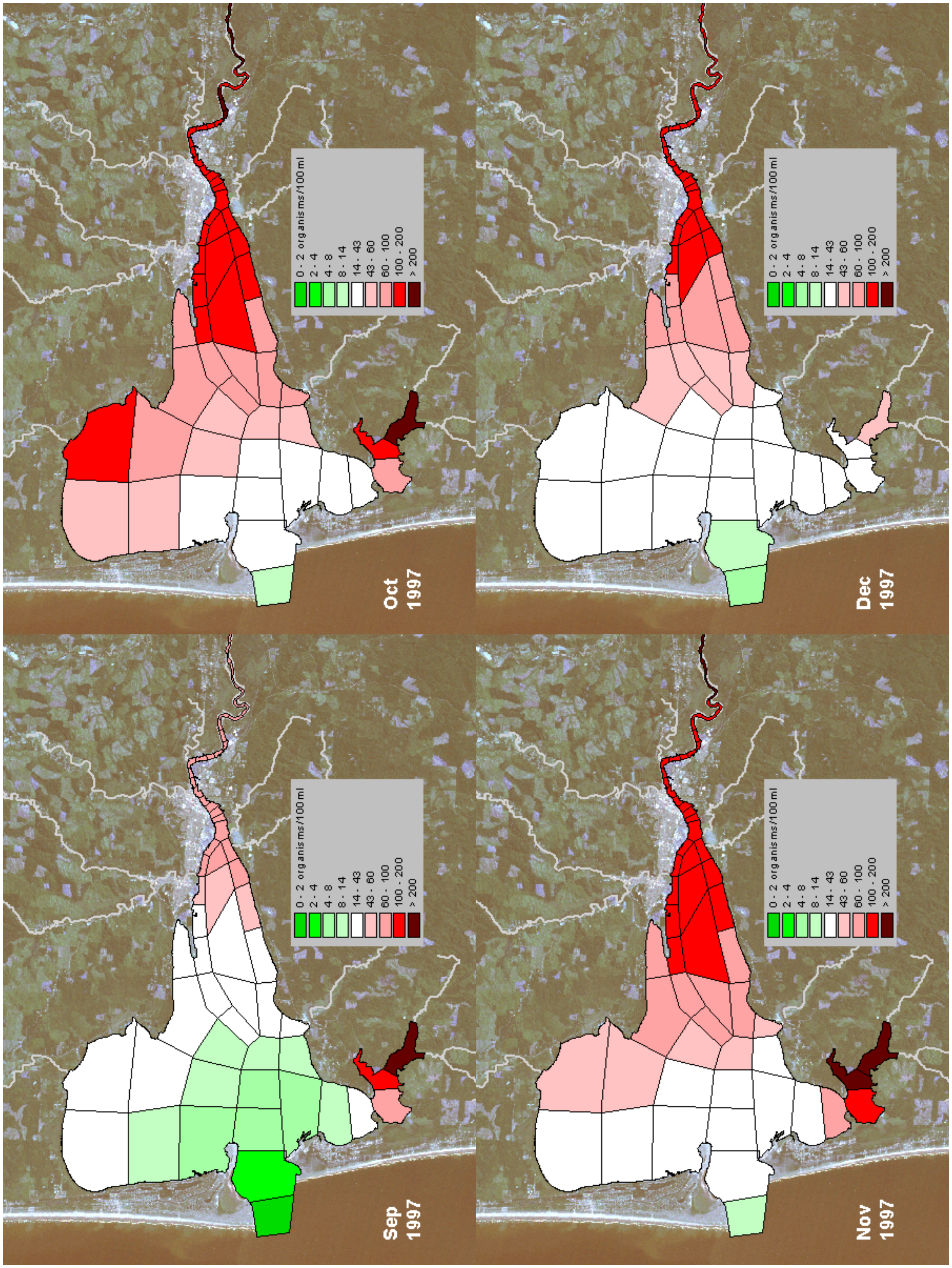
e-mail: gpel461@ecy.wa.gov


Oct
1997
0 - 2 organisms/100ml
2 - 4
4 - 8
8 - 14
14 - 43
43 - 60
60 - 100
100 - 200
> 200
Dec
1997
Sep
1997
Nov
1997

# Appendix I. Animation of daily medians of predicted hourly fecal coliform during and after the rainfall event of October 29-30, 1997.

The color printouts in this appendix show selected frames of an animation of daily medians of predicted hourly fecal coliform during and after the rainfall event of October 29-30, 1997. The animations are available for viewing on the Internet at Ecology's website at the following URL:

http://www.wa.gov/ecology/eils/wrias/tmdl/ghfc/results.html

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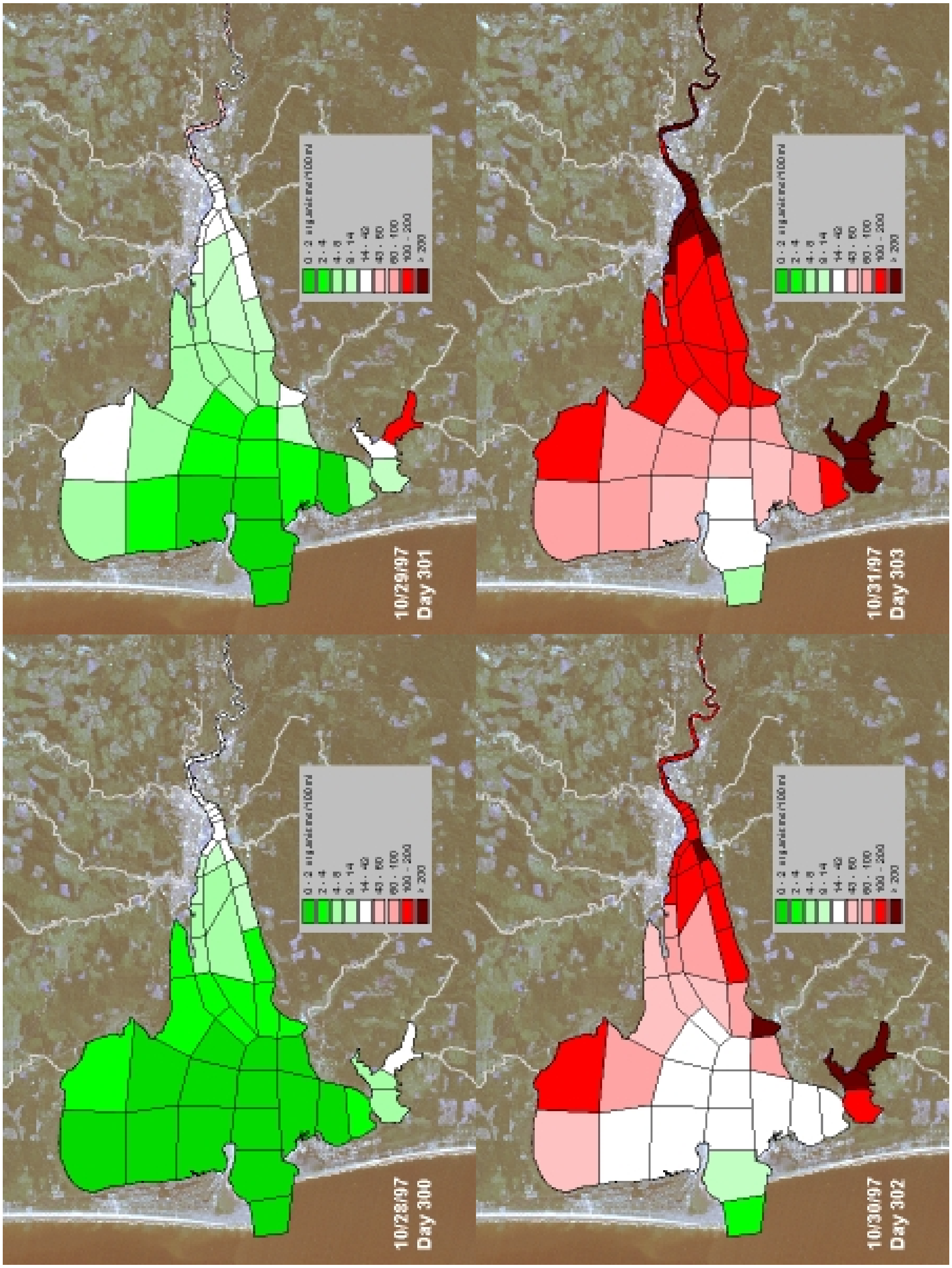
10/29/97
Day 301
10/31/97
Day 303
10/28/97
Day 300
10/30/97
Day 302

# Appendix J. Animation of predicted hourly fecal coliform during and after the high loading event from Weyerhaeuser on July 24-25, 1997.

The color printouts in this appendix show selected frames of an animation of predicted hourly fecal coliform during and after the high loading event from Weyerhaeuser on July 24-25, 1997. The animations are available for viewing on the Internet at Ecology's website at the following URL:

http://www.wa.gov/ecology/eils/wrias/tmdl/ghfc/results.html

The electronic files for the project appendices are also available on request to:

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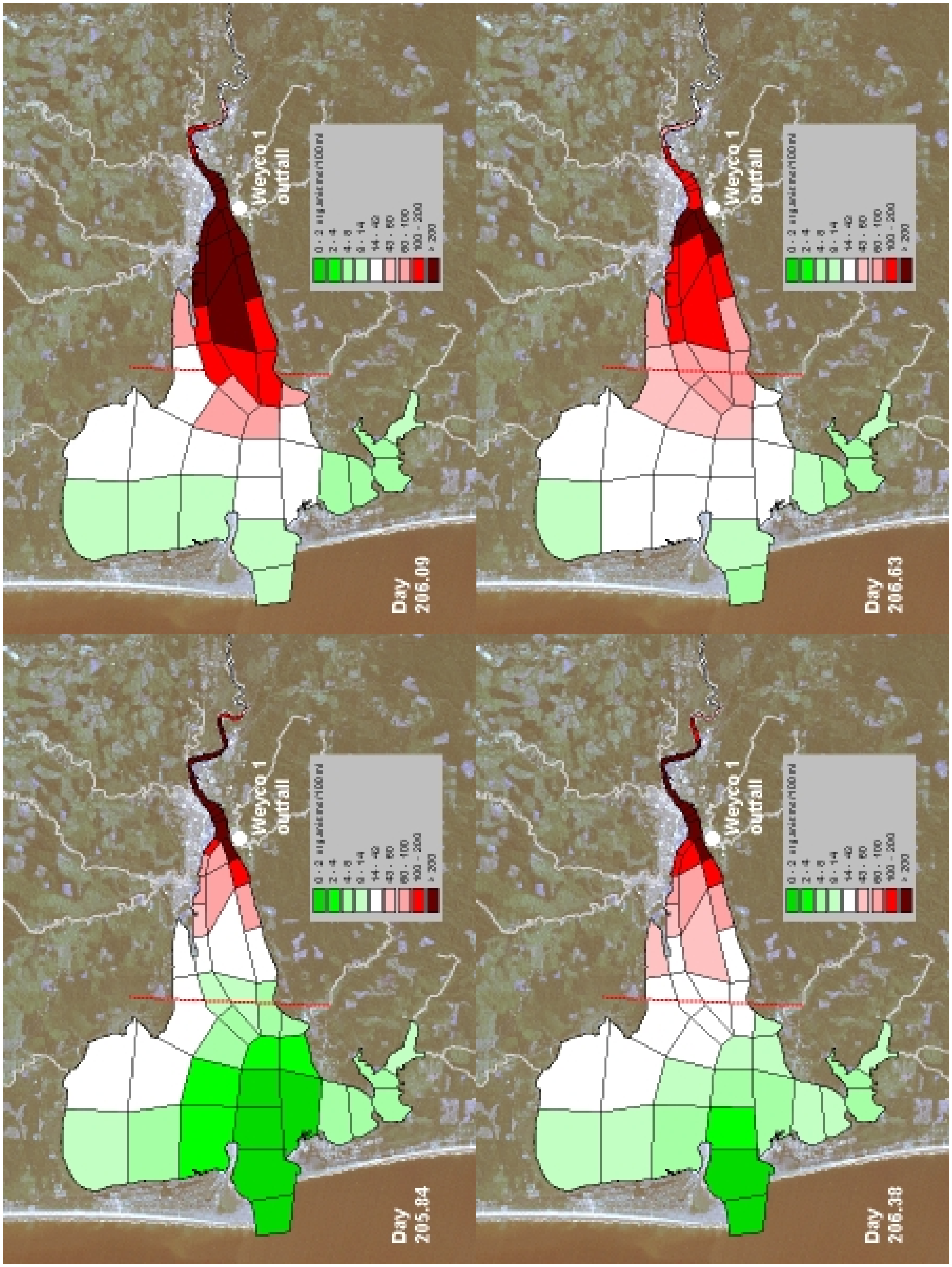
Weyco 1
outfall
Day
205.84
Day
206.09
Day
206.38
Day
206.63