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DEPARTMENT OF
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Totten and Eld Inlets Clean Water Projects

1997 Annual Report

March 1999
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DEPARTMENT OF
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Totten and Eld Inlets Clean Water Projects

1997 Annual Report

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Abstract

Five of a planned nine years of monitoring water quality and pollution controls were completed in six sub-basins within the Totten and Eld Inlet watersheds in Puget Sound as part of the U.S. Environmental Protection Agency's Section 319 National Monitoring Program. The goal of the monitoring program is to determine the effectiveness of nonpoint source pollution management programs at improving water quality. Failing on-site sewage systems and small farm livestock-keeping practices cause bacterial contamination of shellfish growing areas in Totten and Eld Inlets. Water quality parameters monitored include fecal coliform bacteria, total suspended solids, turbidity, flow, temperature, conductivity, and precipitation. Monitoring designs used in this study are the paired watershed and single-site-over-time. Tracking the implementation and maintenance of agricultural nonpoint pollution controls has been challenging. Changes within state and local agencies reduced their ability to meet original pollution control objectives.

Acknowledgments

This monitoring project and report were made possible through many individual efforts. I wish to acknowledge all who have played a role in the monitoring project and the larger effort to promote wise stewardship of our land and water resources. I am particularly grateful to:

- Ecology staff who provided guidance and support: Bob Cusimano, Will Kendra, Shirley Rollins, Jeannette Barreca, Marilou Pivirotto, Anna Trombley, Mike Woodall, Joy Denkers, Sally McVaugh, and Randy Coots.

- Local citizens and staff from Ecology and the Puget Sound Water Quality Action Team who assisted with field sampling activities.

- Staff at Ecology/EPA Manchester Environmental Laboratory who processed and analyzed water quality samples with a high level of service: Will White, Nancy Jensen, Catherine Bickle, Pam Covey, and, in memoriam, Dave Thomson.

- The dedicated and hard working stewardship professionals at the Thurston Conservation District who promote stewardship and assist landowners in the installation of pollution controls: Marilyn Mead, John Konovsky, Ward Sagen, Troy Colley, Jeff Swotek (NRCS), Linda Boice, Bill Melton, and others.

- Staff at Thurston County Environmental Health Department whose dedication to water quality and public health is exemplary: Linda Hofstad, Dave Tipton, Tammy Thoemke, Sammy Berg, Cathy Hansen, Jane Hedges, and Sue Davis.

- The guides and supporters of the National Monitoring Program and this project: Steve Dressing, Elbert Moore, and Judith Leckrone of the U. S. Environmental Protection Agency; Jean Spooner and Deanna Osmond of North Carolina State University; and Jill Saligoe-Simmel and Benno Warkentin of Oregon State University.

- Recognition and appreciation are also due the residents of the Totten-Little Skookum and Eld Inlet watersheds whose stewardship activities are the foundation for improvements in water quality.

Summary

The Washington State Department of Ecology (Ecology) is participating in the U.S. Environmental Protection Agency (EPA) National Monitoring Program (NMP). This document has been prepared to fulfill part of the annual project report requirement for states that receive grants under the Clean Water Act (CWA) Section 319 (EPA, 1991). In March 1995 Ecology received EPA approval of the final Quality Assurance Project Plan (QAPP) for this monitoring project (Seiders, 1995). The QAPP and the 1996 Annual Report (Seiders and Cusimano, 1996) provide more detail on project design and characteristics. This report summarizes results of the monitoring effort to date. Topics covered include: (1) quality of water quality and pollution control data; (2) results of water quality and pollution control data collection; and (3) analyses of the water quality data with respect to the installation of pollution controls.

Five of a planned nine years of monitoring water quality and pollution controls were completed in six sub-basins within the Totten and Eld Inlet watersheds in southern Puget Sound (Figure 1). The goal of the monitoring is to determine the effectiveness of nonpoint source pollution management programs at reducing bacterial contamination of shellfish growing areas in Totten and Eld Inlets. While forestry is a major land use in many of the basins (Table 1), residential and agricultural development has occurred along stream corridors and marine shorelines (Figure 2). In 1993 and 1995, nearly $1.2 million in grant funded projects enabled the Thurston County Environmental Health Division (TCEHD) and the Thurston Conservation District (TCD) to focus efforts on nonpoint pollution controls in these two watersheds through 1999. Sources of fecal coliform (FC) bacterial pollution include failing on-site sewage systems (OSSS) and small farm livestock-keeping practices. The monitoring program uses the paired watershed and single-site-over-time monitoring designs.

Participation in pollution control implementation has been variable. Changes within state and local agencies reduced their ability to meet original pollution control objectives. Most of the pollution controls installed in the study basins addressed livestock keeping practices. About 25% to 45% of targeted farms participated in developing farm plans to date. Since 1993, 15 farm plans were developed and about 107 best management practices (BMPs) were installed in five of the six study basins. Before 1993, 15 farm plans existed, resulting in about 73 BMPs being implemented. Surveys to detect failing OSSS is three study basins were completed for 15 of a targeted 36 sites; the remaining sites chose not to participate. All systems were deemed satisfactory except for three suspected failures. Nearly 1,000 OSSS surveys occurred along marine shorelines, outside of the study area.

Mid-project analyses of pre- and post-BMP data sets in three basins suggest that FC levels increased in Pierre basin, did not change in Burns basin, and decreased in Schneider basin. Linking water quality to pollution controls is confounded by poor understanding of: farm management; operation and maintenance of pollution controls; effects of climate; and sources and fate of FC in the study basins.

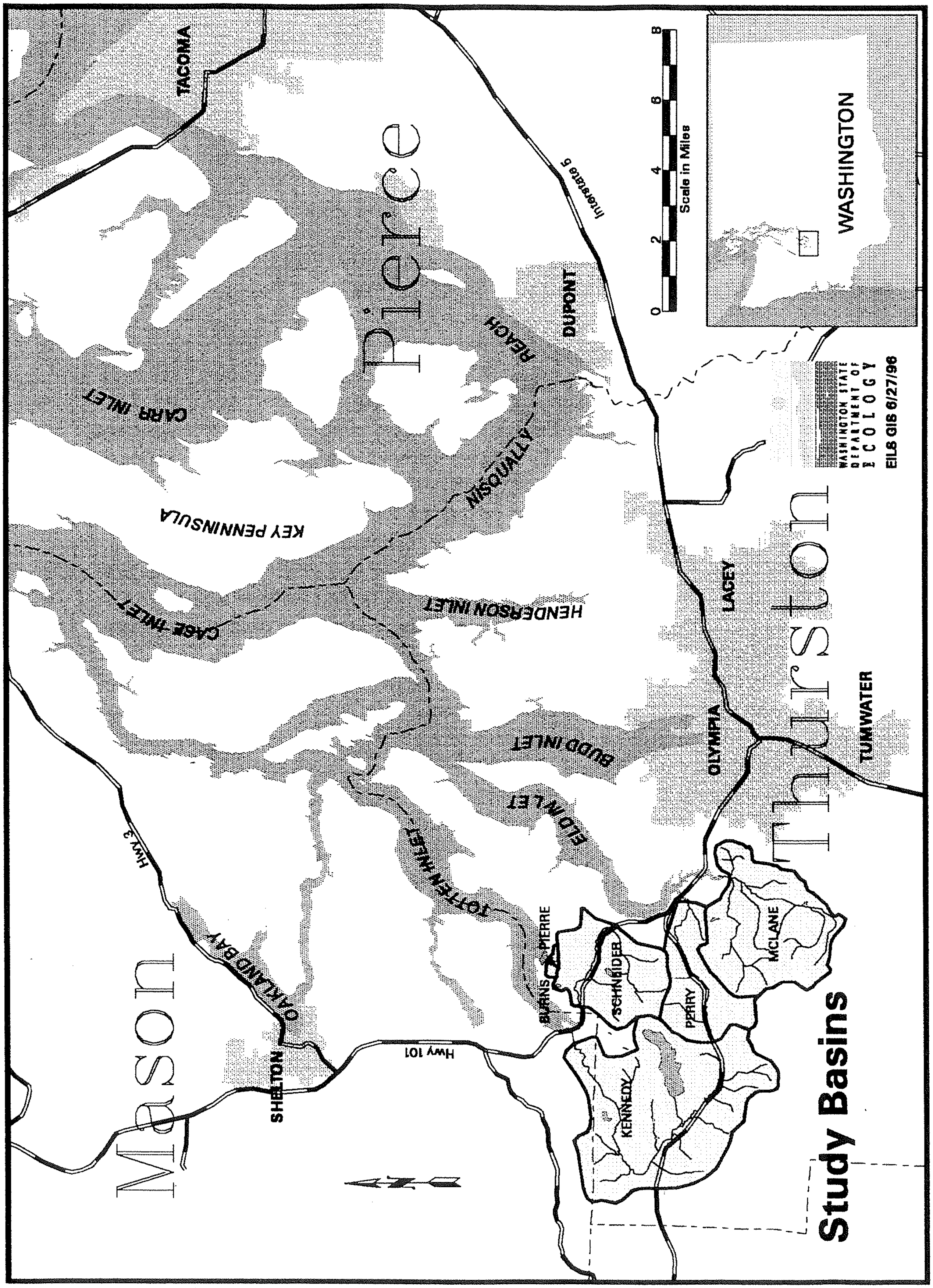

Figure 1. Location of study basins.

Farm planning and BMP implementation efforts will be completed in 1998 in the Totten basins, and continue into 1999 in the Eld Basins. No further OSSS surveys are planned in the study area. Water quality monitoring is planned to continue into 2001 and a final project report is scheduled for completion in 2002.

Table 1. Land-use in the study basins as of 1996.

	Study Basins					
Assessor's Land-use Category *(% of area)*	Kennedy	Schneider	McLane	Perry	Burns	Pierre
residential	4%	8%	9%	3%	37%	34%
undeveloped residential	5%	15%	14%	11%	26%	35%
agriculture	0%	7%	4%	2%	36%	26%
forestry	84%	65%	71%	80%	0%	0%
commercial/public/other	5%	1%	1%	0%	0%	0%
roads	2%	3%	1%	4%	1%	5%
Total Acres	13,046	4,588	7,425	3,857	82	65
Potential Sources of FC Bacteria						
number of farm sites (est.)	3	26	43	8	3	2
wet season animal units (est.)	1.0	93.0	142.0	44.3	7.6	5.0
number of OSSS (est.)	21	118	295	57	13	9

Note: Land use areas based on Thurston County Assessor's tax designations, not true land cover.

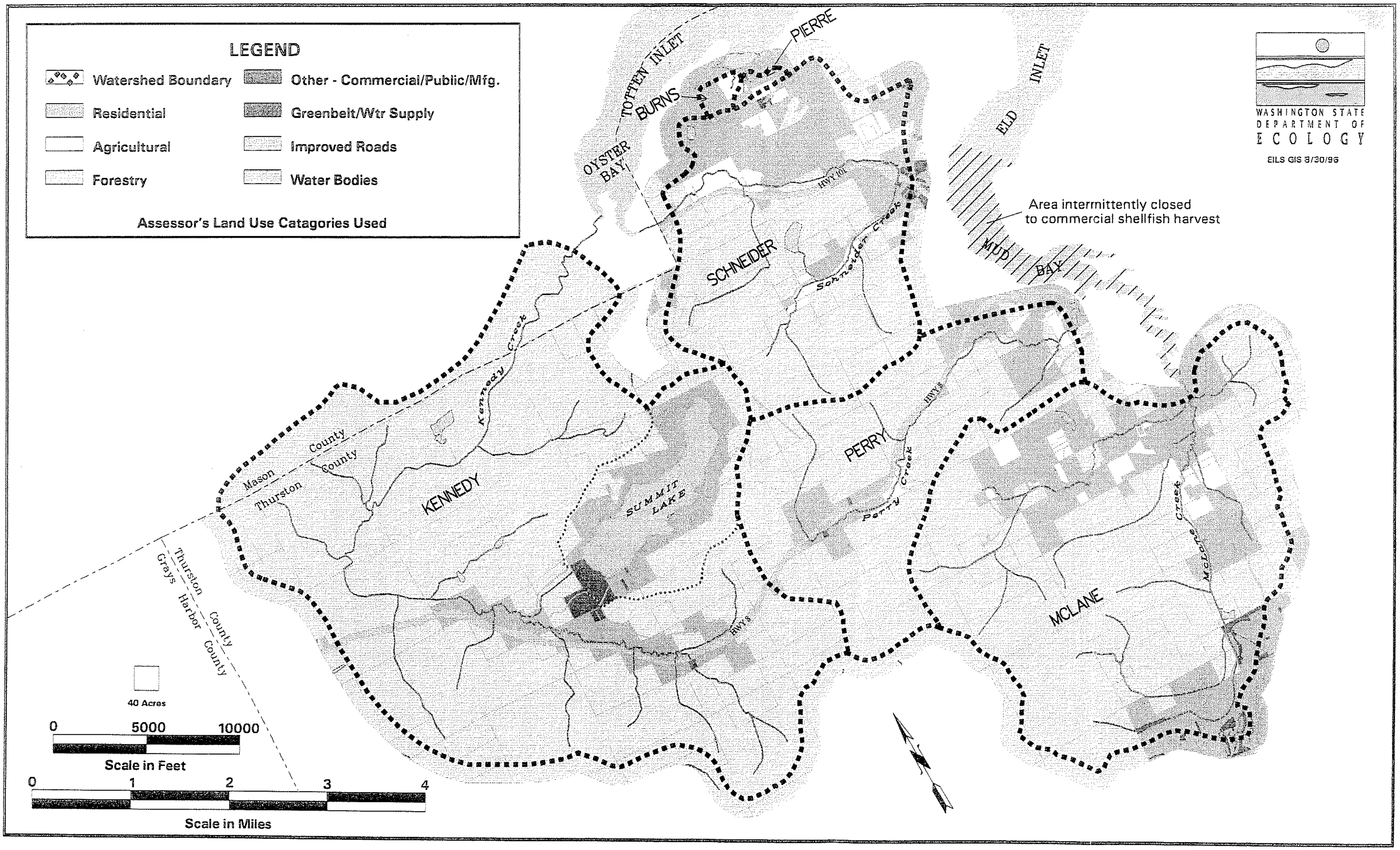

Figure 2. Land use characteristics of study basins in 1995.

Data Quality

Water quality data were collected and analyzed by Ecology as described in the project QAPP. Information about pollution control actions with OSSS and agricultural sources were provided by TCEHD and TCD. Data quality objectives (DQOs) for pollution management practices and water quality data are described in the QAPP and reproduced in Appendix G. Discussion of the quality of water and pollution control data follows.

Quality of Water Quality Data

Water quality data collected by Ecology were reviewed for adherence to sample collection and analytical procedures, as well as meeting DQOs. Water quality data collected by TCEHD in the Totten basins from 1986 to 1992, and in the Eld basins between 1983 and 1992, were considered acceptable as discussed in the QAPP. Most of the water quality data collected by Ecology are meeting DQOs for accuracy, representativeness, and completeness. DQOs for precision have been met for TSS and turbidity, but not for FC. The sampling and laboratory precision attained thus far for FC in this study are not likely to be improved without special efforts, therefore, the precision that has been achieved should be maintained.

Data validation/verification resulted in corrections being made to FC, TSS, and turbidity data for three of the 20 sampling days from the 1993-94 monitoring season. Holding times for all samples were met with one exception: FC samples from January 19, 1993 exceeded holding times by 1 day due to a winter storm preventing sample transport to the laboratory.

The precision of FC, TSS, and turbidity data were estimated from duplicate sample results. Field duplicate samples (two samples taken consecutively at the same location) were taken at one site each weekly outing. Approximately 105 duplicate samples, or about 17% of the total number of laboratory samples, were collected. Each field duplicate sample was split by MEL and two aliquots were analyzed as part of MEL's quality assurance protocols. Estimates of precision for field duplicate and lab split samples for the last five seasons of monitoring are presented in Table 2. FC data were log transformed (base 10). As expected, lab precision was better than field duplicate precision in all but 3 cases.

The precision of FC data was examined more closely to help estimate the detectable trend in FC over time. Table 3 shows means and variances of FC samples and the pooled variances for the laboratory split and field duplicate samples by each station using five years of replicate data. The variances of laboratory splits were smaller than the variances for the field duplicates for four of the six data sets. The proportion of observed variance due to sampling and analytical error (phi) ranged from 2% to 14%. Estimates of precision were used to estimate the minimum detectable trend, using linear regression, for FC to help determine if changes in FC could be distinguished from sampling and analytical variability.

Table 2. Precision (pooled standard deviation) of duplicate results.

		FC (log10) field	FC (log10) Lab	TSS Field	TSS lab	Turbidity field	Turbidity Lab
Year 1	Sp	0.11	0.12	0.90	0.90	0.53	0.33
1992-93	n	17	17	23	23	23	24
Year 2	Sp	0.16	0.10	3.18	0.97	0.51	0.30
1993-94	n	27	24	27	26	27	27
Year 3	Sp	0.15	0.13	6.09	4.56	0.90	1.47
1994-95	n	16	15	16	24	16	24
Year 4	Sp	0.15	0.14	1.67	0.85	1.51	0.76
1995-96	n	23	23	23	23	23	23
Year 5	Sp	0.18	0.15	0.75	0.40	0.37	0.31
1996-97	n	22	22	22	22	22	22
all years	Sp	0.15	0.13	2.94	2.18	0.86	0.77
1992-97	n	105	101	111	118	111	120

Table 3. Quality assurance statistics for log FC data by station.

station (all years)	sample mean	sample n	sample S^2	lab split n	lab split Sp^2	field rep n	field rep Sp^2	lab split Sp^2/field rep Sp^2	phi, as percent: fld rep Sp^2 /sample S^2
Kennedy	0.08	130	0.326	10	0.012	10	0.023	54%	7%
Schneider	1.17	145	0.334	24	0.020	26	0.048	40%	14%
McLane	1.42	137	0.239	17	0.032	18	0.020	165%	8%
Perry	1.07	134	0.316	12	0.023	13	0.032	69%	10%
Burns	2.04	140	0.420	19	0.014	19	0.006	225%	2%
Pierre	2.06	139	0.399	19	0.004	19	0.006	56%	2%

The minimum detectable trend for FC using linear regression was estimated after Ehinger (1996) and McBride and Smith (1997). Autocorrelation was assumed to be absent and seasonality was considered to not be a factor. Variables used in estimating detectable trend include the desired power and confidence levels (β and α), sample size, and the sample mean and standard deviation from the initial year of monitoring. (When applying linear regression, the true sensitivity of detecting a linear trend may be greater or lesser due to changes in the variability of the sampled population from year to year.)

Estimates of detectable trend in FC are given in Table 4. Excluding Kennedy basin, and for β=0.05 and α=0.05, changes in the mean log FC of 27%-61% are needed for a 5-year detectable trend and 19%-43% changes are needed for a 10-year detectable trend. For β=0.10 and α=0.10, changes in the mean log FC of 22%-49% are needed for a 5-year detectable trend and 16%-35% changes are needed for a 10-year detectable trend.

Table 4. Estimate of detectable trend in FC (log10) using linear regression.

station	sample mean 1992-93 season	5yr change in mean	5yr % change in mean	5yr mean at decrease	10yr change in mean	10yr % change in mean	10yr mean at decrease	5yr mean raw FC at decrease	10yr mean raw FC at decrease
For beta= 0.10, alpha=0.10:									
Kennedy	0.74	0.48	64%	0.27	0.33	45%	0.41	1.8	2.5
Schneider	1.38	0.68	49%	0.70	0.48	35%	0.90	5.0	8.0
McLane	1.57	0.35	22%	1.22	0.24	16%	1.32	16.7	21.1
Perry	1.15	0.42	36%	0.73	0.29	26%	0.85	5.4	7.1
Burns	1.98	0.60	31%	1.37	0.43	22%	1.55	23.5	35.5
Pierre	1.71	0.69	40%	1.03	0.48	28%	1.23	10.7	17.0
For beta=0.05, alpha=0.05:									
Kennedy	0.74	0.59	79%	0.15	0.41	56%	0.33	1.4	2.1
Schneider	1.38	0.84	61%	0.54	0.59	43%	0.79	3.5	6.2
McLane	1.57	0.43	27%	1.14	0.30	19%	1.27	13.8	18.5
Perry	1.15	0.51	45%	0.63	0.36	32%	0.78	4.3	6.1
Burns	1.98	0.75	38%	1.23	0.53	27%	1.45	17.0	28.2
Pierre	1.71	0.85	49%	0.87	0.60	35%	1.12	7.3	13.1

While the target DQO for FC was not met, sampling and analytical precision appear to be adequate for this study. The variance due to sample collection and analysis was less than 1% to 40% of the variance of the sample population (Table 3). In practice, it appears that the precision targets for FC used in the project QAPP are likely unattainable. Factors contributing to this might include the nature of the sampled medium, longer holding times (24 hours versus 6 hours), and smaller sample sizes than those used in studies described by Standard Methods 18th Ed. (APHA, 1992). However, improving the currently attainable sampling and analytical precision would have a small effect on the ability to detect trends because natural variability is much larger than sampling error.

Quality of Pollution Control Data

Data on the management of nonpoint source pollution have not met DQOs. Since pollution control efforts focus on OSSS and agricultural BMPs, they are of primary interest. Data quality of OSSS remedial actions is adequate. TCEHD developed a database that allows tracking of various factors related to survey work, repairs, permits, and maintenance actions for individual OSSS. The quality of agricultural remedial actions data is poor. The complex nature of farm management, farm plans, BMP implementation, record keeping, and resource allocation at state and local governments make it difficult to obtain data of adequate quality.

Quantification of the level of BMP planning and implementation in the study basins has been difficult. The original approach was to review farm site inventories and Records of Decision (RODs) for each farm and then tally data on animals, BMP plans and their implementation, and related factors to develop basin-wide summaries of pollution sources and pollution controls. Carrying out this approach was difficult because of inadequate record keeping and reporting practices. Information about the timing and characteristics of BMP implementation was recorded and/or reported in different formats and information between formats frequently disagreed. Information from two reporting formats were examined in order estimate the extent of disagreement in reporting pollution control data. Formats examined were the reports required by grants (quarterly, annual, and final) and the ROD formats used by the Natural Resources Conservation Service (NRCS). BMP implementation characteristics such as the individual practice and its timing, location, and amount were compared. This comparison found that about 20-30% of the reported instances of BMP implementation agreed between the two formats. The remainder of the data (70%-80%) did not agree (Mead, 1996a). To improve the quality of pollution control data, Ecology contracted with TCD to provide complete and accurate RODs for farms assisted under the Shellfish Protection Initiative grants. These RODs were used to derive the pollution control data listed in Appendices A and B and for the discussion of BMPs in this report.

The nature and quality of farm planning and BMP implementation data are discussed in the context of the DQOs found in Appendix G and with respect to their accuracy, completeness, and representativeness.

Parameters and reporting units

Measuring the amount of pollution controls installed in a basin is complicated by changes in NRCS conventions for naming BMPs. Some BMP names and codes are no longer used and/or have been replaced. For example, Prescribed Grazing is now used in place of: Deferred Grazing, Pasture and Hayland Management, and Planned Grazing System. Occasionally, non-standard or localized BMP names are reported, such as winter confinement, restricted winter use, and buffer. The degree to which similarly named BMPs perform and benefit water quality has not been explored.

BMP planning and implementation data which were reported in non-standard units (Table 5) were converted to standard units using farm site information and assumptions. These conversions allowed for data to be compiled and summarized for each basin.

Table 5. BMPs reported with different units.

NRCS BMP #	BMP Description	Units Used for Reporting
412	Grassed Waterway	acres and feet
580	Streambank Protection	acres and feet
575	Livestock Crossing	feet and each
393	Filter Strip	acres and feet
382	Fencing	acres and feet
322	Channel Vegetation	acres and feet
313	Waste Storage Structure	structure and acres
558	Roof Runoff Manangement	system, feet, and acres

The standard reporting units are underlined

Values for animal units (AU) were estimated from various basin and farm site inventories performed by TCD between 1989 and 1996. The numbers and variety of animals were converted to a common term (AU) based on animal weight. Table 6 lists animal types found and the AUs used in compiling these data. Error associated with these estimates is unknown since animal types and numbers may change from year to year.

Table 6. Animal unit values.

Animal	Weight (lbs.)	Animal Unit value
horse	1000	1.00
mule	1000	1.00
Arabian horse	900	0.90
cow	900	0.90
pony	700	0.70
donkey	600	0.60
foal or calf	500	0.50
llama	250	0.25
miniature donkey or pig	150	0.15
sheep or goat	100	0.10
pygmy goat	50	0.05
chicken	5	0.005

Spatial resolution

The location of BMP installation in relation to basin streams is important in evaluating their effect on water quality. BMP data are recorded and reported at two different levels: (1) at the farm site and farm field level, and (2) at the farm level only. For example, a farm plan may indicate that fields numbered 1, 3, 5, and 7 are each planned for 2, 4, 6, and 8 acres of Prescribed Grazing. Another way this BMP effort might be recorded is simply as 20 acres of Prescribed Grazing on that farm; no field numbers are indicated. Assessment of the BMP effort in the first case would result in a tally of four instances of Prescribed Grazing applied for a total of 20 acres. In the second case, the assessment would result in a tally of a single instance of Prescribed Grazing for a total of 20 acres. While the total acreage reported is the same, the frequency or count of discrete BMP applications is different. Appendices A and B, and the data summaries presented below, contain a mixture of such reporting practices and likely result in a biased number of BMPs planned and/or implemented. Consistent recording and reporting practices would greatly help the effort to accurately determine the extent of BMP implementation.

Temporal resolution

The timing of actual BMP implementation and maintenance is needed to link water quality to pollution controls. The common practice has been to record the year of planned implementation as well as the year of actual implementation on the ROD. Occasionally, the month and year of BMP actions is provided. There are instances where the date or amount of BMP implemented is not recorded on the ROD. In order to complete these missing data, the dates and amounts designated in the "planned" column of the ROD were used as the dates and amounts of actual implementation of the corresponding BMP (Mead, 1997). The original data quality objective, to know the week of implementation (because water quality data are collected on a weekly basis), was not met. The current resolution (to the year of implementation) can be used but may not allow as thorough an analysis if resolution to the week or month were available.

Accuracy, representativeness, and completeness

The BMP data are accurate for the time they are installed or implemented. However, the accuracy of the data decreases over time because it is unknown if BMPs are properly operated and maintained after installation. Lack of knowledge about the long-term accuracy of BMPs exists, in part, because state and local efforts have focused on implementing BMPs rather than on determining whether BMPs are adequately operated and maintained. No agency is tasked with determining whether BMPs installed through publicly-funded programs are properly operated or maintained after their initial installation.

The reported BMP data likely represent only the minimum level of pollution control in the study area because: (1) not all OSSS surveys or repairs are reflected in the data, (2) farm site BMP data only represent pollution control efforts where TCD is involved in the development and implementation of farm plans, and (3) only NRCS-approved BMPs are included in farm plans. These data limitations are probably not significant because it seems unlikely that there are many OSSS surveys and repairs done outside the SPI grant program, or many farms that develop farm plans without TCD's involvement. It also seems unlikely that farms with a high potential to pollute were excluded from TCD's priority list.

The locations and survey status of OSSSs are adequately reported. However, the collection of BMP data is incomplete because information about the maintenance and operation of BMPs is not documented. Lack of such information compromises the ability of this study to link water quality changes to the implementation of BMPs and farm plans.

Quality of Land Use and Climate Data

Land-use data are representative of the land use designations developed by the Thurston County Assessor. The Assessor's land use designations approximate actual land cover at the end of 1995. Tax parcel data may be updated in coming years as resources allow. GIS data coverages for streams, roads, zoning, etc. are expected to be adequate for this project.

Climate data are adequate for this project. Precipitation data are collected by the National Weather Service (NWS) at the Olympia Airport. Equipment problems during ice storms from 12/26/96 to 12/30/96 resulted in missing data. The missing daily precipitation values were estimated using hourly and supplemental data provided by NWS. The Olympia Airport is approximately 10 miles southeast from the center of the study area. The spatial variability of rainfall over the study area was reviewed during project design and data from the Olympia site was considered adequate for the study. A small amount of stream hydrograph data over the last 5 years has been lost due to equipment problems or extreme weather events. Overall, streamflow data are adequate and can provide additional information about stream response to rainfall.

Results and Discussion

Nonpoint Source Pollution Management Data

How pollution control efforts are characterized can influence our perceptions of progress in managing nonpoint pollution. The definitions used in characterizing progress or success differs among individuals and institutions, because each uses measurements designed to meet individual reporting or funding needs. Accurate and meaningful measurement of the levels of pollution controls attained and maintained is challenging due to the nature of the pollution sources, their specific controls, and the programs used to install the controls.

Measures of pollution control

A challenge in quantifying pollution controls is using variables or terms that accurately quantify true implementation and environmental benefit. EPA (1997) describes a good variable as one that provides a true measure of the quantity and/or quality of pollution control or BMP implementation. For example, tons of animal waste captured per day tells us about the amount of pollutant actually controlled. A less useful variable is one that measures factors related to BMP implementation yet provides no direct measure of their benefit. An example of this type of variable is the number of waste management structures built. A poor variable is one that relates to pollution control efforts but provides no information on whether the control is actually implemented or provides any benefit to water quality. For example, the number of farm plans written in an area is a poor measure of actual environmental benefit (i.e. a farm plan may not be implemented at all). A range of good to poor variables are used because of their historic and current use by agencies funding and implementing pollution controls. Consequently, descriptors used in this report represent the range from good to poor indicators of real or potential environmental benefits.

One measure of pollution control used in this study is the completeness of farm plan implementation. Completeness is expressed as the percentage of planned BMPs that are actually implemented. A limitation of this expression is that it does not consider the range of effectiveness that different BMPs have in reducing FC bacteria delivery to streams and shellfish harvest areas. For example, suppose farm A has a high level of implementation (90%) and farm B a lower level (45%). A common interpretation of these data might be that farm A has a lower level of pollution potential than does farm B. This may not be the case if the unimplemented 10% of BMPs on farm A would do more to protect water quality (such as fencing to protect a stream) than the 90% of BMPs already implemented.

The effectiveness of any individual BMP, or system of BMPs, is dependent upon many factors (e.g. farm site characteristics, animal keeping practices, and BMPs employed) and requires a level of evaluation not yet pursued. Evaluations of effectiveness at adequate levels appear to be seldom done in Washington, perhaps because efforts have focused on developing farm plans rather than on determining whether farm plans and BMPs remain implemented and effective. However, one effort that has been made in Washington could be useful in developing a system to rate the relative effectiveness of BMPs in the context of individual farm plans. Clark County CD developed a system to rate the status and relative effectiveness of previously installed BMPs in the LaCamas watershed (Franklin, 1996). Unfortunately, this rating assessment was discontinued due to higher than expected costs to perform the assessment. A system for rating the pollution potential of dairy farms was used by Whatcom County CD (Dickes and Merrill, 1990) and used various dairy operations in calculating the rating.

For this report, pollution control data are quantified and summarized in a variety of ways. Appendix A lists each farm, animal units present, acreage, and farm status regarding farm planning and BMP implementation. Specific BMPs planned and implemented on farms are compiled in Appendix B. Figure 3 shows the location of farm sites and OSSS in the study basins. Note that land designated as residential by the county assessor (Figure 2) may be used to keep livestock and thus be designated as "farm" in the context of watershed management efforts. Table 7 uses counts, averages, and percentages to summarize various basin OSSS survey, farm planning, participation, and BMP implementation data.

Participation and results of pollution control efforts

Most of the OSSS survey work occurred outside of the study basins, along the marine shoreline of Totten and Eld Inlets. TCEHD inspected nearly 1,000 OSSS in the shoreline areas since 1992. About 170 OSSS were surveyed in the Summit Lake area within the Kennedy Basin. It is unlikely that corrective actions taken in the Summit Lake area will affect bacteria levels at the Kennedy Creek monitoring site, because in-lake bacteria levels have historically been at or below detection limits for FC (~ 1cfu/100mL).

Table 7 shows the status of OSSS and surveys for each basin. All homeowners in the Burns and Pierre basins participated in the 1994-95 sanitary survey. About 36% of homeowners in Schneider basin participated in the 1997 sanitary surveys (Hofstad, 1997). The option for TCEHD staff to obtain an administrative search warrant for inspecting OSSS was available during the 1994-95 sanitary surveys. This option became unavailable in 1996 when Thurston County's Board of Health decided to no longer use administrative search warrants. This decision followed a Washington State Supreme Court ruling that administrative search warrants could not be obtained for such inspection programs (Hofstad, et. al., 1996).

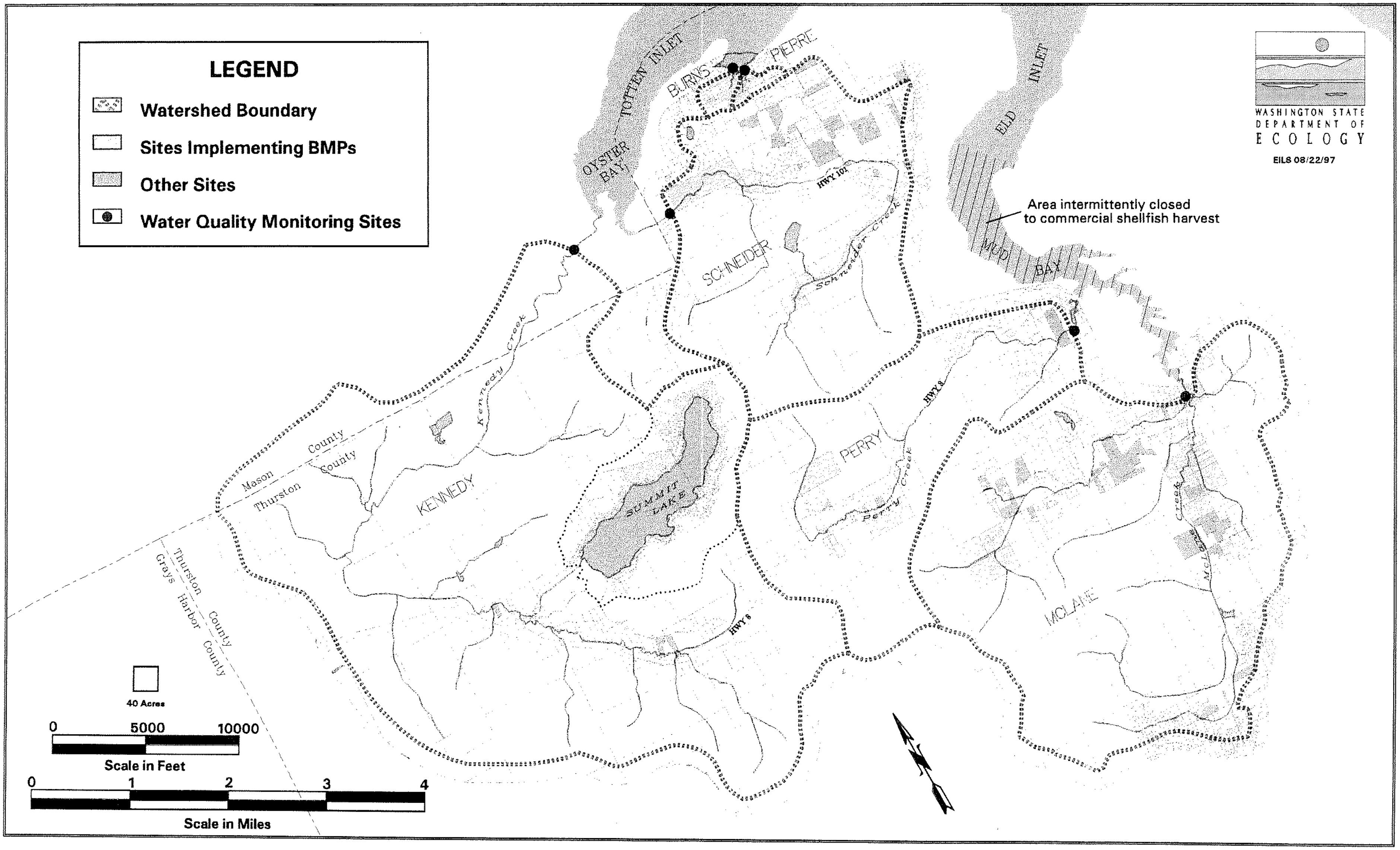

Figure 3. Farm sites in study basins.

Table 7. Summary of pollution control efforts in study basins

Basin Characteristic	Kennnedy	Schneider	McLane	Perry	Burns	Pierre	All basins
On-site sewage systems							
No. OSSS in basin (est.)	21 (4)	118	295	57	13	9	513
No. OSSS targeted for survey	0	33	0	0	1	2	36
No. OSSS surveyed	0	12	0	0	1	2	15
% of targeted OSSS surveyed	na	36%	na	na	100%	100%	na
Farm plan development							
No. of farms in basin	3	26	43	8	3	2	85
No. of farm plans developed	0	5	16	4	3	2	30
No. of priority farms in basin (2)	2	17	P-12, 27	P-0, 7	3	2	36, 58
No. of priority farms with farm plans (2)	0	4	P-4, 14	na, 3	3	2	13, 26
% of priority farms with farm plans (2)	0%	24%	33%, 52%	na, 43%	100%	100%	25%, 45%
Farm plan signature							
No. of farm plans signed by CD	na	4	8	3	2	1	18
% of farm plans signed by CD	na	80%	50%	75%	67%	50%	60%
No. of farm plans signed by landowner	na	3	6	3	3	1	16
% of farm plans signed by landowner	na	60%	38%	75%	100%	50%	53%
No. farm plans without signature	na	0	7	1	0	0	8
BMP and farm plan implementation							
No. of BMPs planned	0	45	104	42	26	17	234
No. of BMPs implemented	0	39	80	22	26	13	180
% of BMPs implemented (3)	na	87%	77%	52%	100%	76%	77%
Average % implementation of farm plan (1)	na	83%	78%	71%	100%	74%	80%
No. of farm plans 100% implemented	na	4	7	2	3	0	16
Animal units and acreage							
Wet season animal units (A.U.) in basin (est.)	1.0	93.0	142.0	44.3	7.6	5.0	292.9
No. A.U. managed by farm plans (est.)	0.0	25.1	101.2	36.9	7.6	5.0	175.8
% of A.U managed by farm plans (est.)	0%	27%	71%	83%	100%	100%	60%
No. acres identified as farms in basin	23	507	750	191	54	26	1550
No. farm acres managed by farm plans	0	314	462	153	54	26	1007
% farm acres managed by farm plans	0%	62%	62%	80%	100%	100%	65%

(1) Determined as: the average % implementation of farm plans; the % of implementation of an individual farm plan is determined as in (3) below.

(2) Based on farms identified as "priority" in various inventories by TCD as part of scoping for SPI & CCWF work. "P" indicates the 1993 Eld SPI prioritization for McLane and Perry basins only; the second value represents the prioritization from the 1989 inventory.

(3) Determined as: no. BMPs implemented divided by no. BMPs planned.

(4) Excludes systems within the Summit Lake basin

Development of farm plans met targets in some basins but not in others (Table 7). The objective of the agricultural remedial work was to develop and implement farm plans on all identified priority sites. For Burns and Pierre basins, all priority farms entered the farm planning process. In Schneider basin, only 24% of the priority farms entered the farm planning process. Several prioritizations were done in McLane and Perry basins and from 33% to 52% of priority farms entered the farm planning process depending on which prioritization scheme is considered (see Appendix A notes). Appendix E describes the farm planning process used by TCD and illustrates the voluntary nature of participation in agricultural pollution control programs (Mead, 1996b).

The signature record of the farm planning effort provides insight into levels of participation by landowners and local governments. In the farm planning effort in the study basins, about 60% of the farm plans were signed by a representative of TCD (Table 7). The signature of TCD staff indicates that the farm plan has had appropriate technical review and that TCD commits to help the operator implement the plan as resources allow. For all basins, about 53% of the farm operators signed their farm plans. This may or may not represent commitment on their part to implement the farm plan. Some farm operators were reluctant to sign the farm plan for various reasons and others verbally agreed to implement the farm plan (Mead, 1997). Farm plans were signed by both the landowner and the CD for 43% of the plans, while 27% of the plans were signed by only one party. The signature record suggests that different levels of commitment, consistency, and importance are given to the farm planning effort by landowners and TCD over time.

While participation by landowners in OSSS and farm planning efforts was less than expected, participation by state and local governments in pollution control programs was also less than expected. State and local agencies involved in funding and implementing agricultural pollution controls did not meet original grant objectives that were designed to ensure that all identified priority farms in the Totten watershed entered the farm planning process (Ecology, 1992). About 45% of the priority farms in the study basins participated in developing farm plans while 55% did not to participate. The remaining 12 priority farm sites in the Schneider basin are unlikely to receive farm planning efforts in the near future. Expectations for implementing nonpoint pollution controls and measuring related water quality improvements may need to be reduced because planned levels of participation by landowners and agencies may not be reached.

Where participation in stewardship efforts took place, results have been generally positive. Since 1986, about 180 of 234 agricultural BMPs have been implemented on 30 sites in Schneider, McLane, Perry, Burns, and Pierre basins. The percent of planned BMPs actually implemented in each basin ranged from 52% to 100% (Table 7). Within each basin, the average number of BMPs planned per farm ranged from 8 to 10 while the average number of BMPs implemented ranged from 5 to 9. The number of individual practices installed per farm ranged from 1 to 14. For all basins, 53% of farms implemented all of their planned BMPs, while 30% of farms had implementation rates of less than 60%. Over all basins, completeness of farm plan implementation was better than 70%. Whether or not these BMPs are properly maintained and operated is unknown.

The proportion of animals (expressed as animal units) covered by farm plans in each basin range from 27% in Schneider to 100% in Burns and Pierre (Table 7). The proportion of farm acres that are included in farm plans range from 62% in Schneider to 100% in Burns and Pierre. The number of animal units on, or acreage of, farms where farm plans have been 100% implemented has not been determined.

The types and amounts of specific pollution control practices installed in each of the basins are described in Tables 8 and 9. The most frequently applied BMPs include fencing, prescribed grazing, filter strips, livestock exclusion, nutrient management, and watering troughs. Other commonly employed practices include roof runoff management and fish stream improvement. Note that some descriptions of BMPs are no longer used due to: changes in NRCS and TCD terminology, changes in specifications for BMPs, and changes in TCD staff over time.

Regulatory and voluntary factors appear to motivate landowners to participate in pollution control efforts. As described above, participation in OSSS survey programs decreased after a regulatory tool was removed. Of the 10 farm plans developed in Schneider, Burns, and Pierre basins, five of the sites developed farm plans solely through voluntary action. It appears that the remaining five sites were encouraged to develop farm plans prior to the SPI efforts. A referral process was used which proceeded from requests for cooperation towards formal procedures to enforce state water quality laws (Starry, 1990; Hofstad, 1993). This referral process involves the farm operator, TCEHD, TCD, and Ecology, in the progression of farm planning and BMP implementation until water quality threats are mitigated to a satisfactory level.

Physical, managerial, and cost characteristics of BMPs

As Determan (1993) discussed, pollution controls must be maintained if they are to remain effective. For agricultural pollution controls, the cost and effort to maintain particular BMPs can be highly variable. Effective operation and maintenance can depend on site-specific conditions such as: ease and cost of BMP maintenance, skills and equipment resources of the landowner, changes in livestock numbers, availability of technical assistance, changes in farm management, and landowner commitment to the farm plan.

Several physical, maintenance, and cost characteristics of BMPs are given in Table 10. The cost estimates were derived from ACP cost share limits, TCD experience, and actual costs of BMPs implemented (Konovsky and Mead, 1997). These characteristics, as well as various economic, social, and belief factors play a role in the proper and long term adoption of BMPs.

Three types of practices were defined based upon the nature of the BMP: (1) structural, (2) managerial, and (3) managerial/structural. Structural BMPs might be considered as more likely to remain effective for a longer time than are managerial BMPs because they generally depend little on human behavior to maintain their effectiveness. Managerial BMPs may require a larger or more frequent commitment by the landowner to maintain their effectiveness. The third type is a combination of the structural and managerial BMPs.

Table 8. Number of times that individual BMPs were applied in study basins.

BMP#	BMP Description	Kennedy	Schneider	McLane	Perry	Burns	Pierre	Total
322	Channel Vegetation	0	0	1	0	0	0	1
342	Critical Area Planting	0	1	0	0	0	0	1
344	Crop Residue Use	0	0	0	0	1	0	1
352	Deferred Grazing (1)	0	0	2	0	3	1	6
382	Fencing	0	6	12	6	3	1	28
393	Filter Strip	0	4	9	2	1	2	18
395	Fish Stream Improvement	0	4	5	1	0	0	10
654	Forest Harvest Trails	0	1	0	0	0	0	1
490	Forest Site Preparation	0	1	0	0	0	0	1
666	Forest Stand Improvement	0	1	0	0	0	0	1
412	Grassed Waterway	0	0	1	0	0	1	2
561	Heavy Use Area Protection	0	0	2	0	0	0	2
430	Irrigation Pipeline	0	0	1	0	0	0	1
575	Livestock Crossing (2)	0	0	1	0	0	0	1
472	Livestock Exclusion	0	4	8	2	1	2	17
590	Nutrient Mgmt	0	2	2	0	3	1	8
510	Pasture & Hayland Mgmt (3)	0	2	7	0	0	0	9
512	Pasture & Hayland Planting	0	1	0	1	2	1	5
516	Pipeline	0	0	1	1	1	0	3
556	Planned Grazing System (1)	0	0	1	0	1	0	2
528	Prescribed Grazing	0	2	3	0	3	2	10
530	Proper Woodland Grazing	0	0	0	0	0	0	0
558	Roof Runoff Mgmt	0	1	4	2	2	1	10
570	Runoff Mgmt System	0	0	0	0	0	0	0
575	Stock Trails and Walkways	0	1	0	0	0	0	1
580	Streambank Protection	0	1	1	1	0	0	3
612	Tree/Shrub Establishment	0	0	0	0	1	0	1
660	Tree/Shrub Pruning	0	1	0	0	0	0	1
614	Trough	0	0	8	6	1	0	15
620	Underground Outlet	0	0	0	0	0	0	0
312	Waste Mgmt System	0	0	0	0	0	0	0
313	Waste Storage Structure	0	1	3	0	1	1	6
633	Waste Utilization (4)	0	3	4	0	0	0	7
645	Wildlife Upland Habitat Mgmt	0	2	3	0	2	0	7
644	Wildlife Wetland Habitat Mgmt	0	0	1	0	0	0	1
	Total BMPs Installed	0	39	80	22	26	13	180

Notes: (1) Prescribed Grazing (#528) now used.
(2) Streambank Protection (#580) or Stream Channel Stabilization (#584) now used.
(3) Prescribed Grazing (#528) now used unless hayland.
(4) Nutrient Management (#590) now used.

Table 9. Amount of individual BMPs applied in study basins.

BMP#	BMP Description	Units	Kennedy	Schneider	McLane	Perry	Burns	Pierre	Total
322	Channel Vegetation	acres	0	0	2	0	0	0	2
342	Critical Area Planting	acres	0	2	0	0	0	0	2
344	Crop Residue Use	acres	0	0	0	0	23	0	23
352	Deferred Grazing (1)	acres	0	0	25	0	13	6	44
382	Fencing	feet	0	10,072	13,347	2,727	2,000	50	28,196
393	Filter Strip	acres	0	33	12	4	1	2	51
395	Fish Stream Improvement	feet	0	6,200	5,470	220	0	0	11,890
654	Forest Harvest Trails	acres	0	427	0	0	0	0	427
490	Forest Site Preparation	acres	0	427	0	0	0	0	427
666	Forest Stand Improvement	acres	0	427	0	0	0	0	427
412	Grassed Waterway	acres	0	0	0	0	0	6	6
561	Heavy Use Area Protection	acres	0	0	3	0	0	0	3
430	Irrigation Pipeline	feet	0	0	200	0	0	0	200
575	Livestock Crossing (2)	each	0	0	1	0	0	0	1
472	Livestock Exclusion	acres	0	79	59	7	15	5	165
590	Nutrient Mgmt	acres	0	111	42	0	36	6	195
510	Pasture & Hayland Mgmt (3)	acres	0	127	104	0	0	0	231
512	Pasture & Hayland Planting	acres	0	1	0	5	4	6	16
516	Pipeline	feet	0	0	400	1,802	890	0	3,092
556	Planned Grazing System (1)	acres	0	0	28	0	23	0	51
528	Prescribed Grazing	acres	0	111	21	0	28	9	169
558	Roof Runoff Mgmt	system	0	1	4	2	2	1	10
570	Runoff Mgmt System	system	0	0	0	0	0	0	0
575	Stock Trails and Walkways	feet	0	30	0	0	0	0	30
580	Streambank Protection	feet	0	2,000	2,500	300	0	0	4,800
612	Tree/Shrub Establishment	acres	0	0	0	0	15	0	15
660	Tree/Shrub Pruning	acres	0	427	0	0	0	0	427
614	Trough	each	0	0	13	6	1	0	20
620	Underground Outlet	feet	0	0	0	0	0	0	0
312	Waste Mgmt System	system	0	0	0	0	0	0	0
313	Waste Storage Structure	structure	0	1	3	0	1	1	6
633	Waste Utilization (4)	acres	0	111	58	0	0	0	169
645	Wildlife Upland Habitat Mgmt	acres	0	610	207	0	51	0	868
644	Wildlife Wetland Habitat Mgmt	acres	0	0	5	0	0	0	5

Notes: (1) Prescribed Grazing (#528) now used.
(2) Streambank Protection (#580) or Stream Channel Stabilization (#584) now used.
(3) Prescribed Grazing (#528) now used unless hayland.
(4) Nutrient Management (#590) now used.

Table 10. Physical, managerial, and cost characteristics of BMPs.

BMP#	BMP description	unit of measure	type of practice	life expectancy	range of cost per unit	maintenance frequency	maintenance action or comment	cost of maintenance per unit
322	Channel Vegetation	acres	M	10+ years	$4000-$20000	first 2-3 years	weed & water in summer	$500-$2000
352	Deferred Grazing	acres	no longer in use, see Prescribed Grazing					
382	Fencing	feet	S	10+ years	$0.90-$2.07	annual	repair downed fence line	$0.01
393	Filter Strip	acres	M/S	5-10 years	$4000-$20000	5 years	if grass, replant every 5 years	
395	Fish Stream Improvement	feet	M/S	10+ years	no direct cost		uses #322, #393, #472 (maybe #580)	
412	Grassed Waterway	acres	S	10+ years	unknown	annual	replant any erosion	
561	Heavy Use Area Protection	acres	M/S	1-10 years	$200-$1000	annual	replant grass or replenish media	$150-$500
430	Irrigation Pipeline	feet	S	10+ years	unknown	annual	repair leaks	
575	Livestock Crossing	each	#580 or #584 now used		$1000-$10000			$1.00
472	Use Exclusion	acres	M			annual	maintain barriers (fencing) to access	
590	Nutrient Mgmt	acres	M			daily-monthly	collect, store, & apply manure	$150-$2000
510	Pasture & Hayland Mgmt	acres	no longer in use unless hayland, see Prescribed Grazing					
512	Pasture & Hayland Planting	acres	M	5 years	$133-$150		plant, exclude animals for 1 season	
516	Pipeline	feet	S	10+ years	$0.57-$1.80	annual	repair leaks	$0.01
556	Planned Grazing System	acres	no longer in use, see Prescribed Grazing					
528	Prescribed Grazing	acres	M			daily-monthly	maintain healthy grass growth	$25-$1000
558	Roof Runoff Mgmt	system	S	10+ years	$1.50-$3.47	annual	clean gutters (cost is per foot of gutter)	
570	Runoff Mgmt System	system	S	10+ years	unknown	annual	check system	
580	Streambank Protection	feet	S	10+ years	<$15.00	first 2-3 years	weed & water in summer	$1.00
614	Trough	each	S	10+ years	$58-$495	daily	maintain water flow, repair leaks	$1.00
620	Underground Outlet	feet	S	10+ years	$2.70-$3.62	annual	clear any blockage	$0.01
312	Waste Mgmt System	system	M/S		no direct cost		requires #590, #313	
313	Waste Storage Structure	structure	S	10+ years	$50-$4000	daily-annual	maintain roof or tarp	$10-$100
633	Waste Utilization	acres	no longer in use, see Nutrient Management					
645	Wildlife Upland Habitat Mgmt	acres	M/S		variable	annual-permanent	establish food, cover, & water access	
644	Wildlife Wetland Habitat Mgmt	acres	M/S		variable	annual-permanent	establish food, cover, & water access	
654	Forest Harvest Trails	acres	M	1+ years		annual	repair erosion	
666	Forest Stand Improvement	acres	M	10+ years	$41-$146	1-20 years	retain & space preferred species	
660	Tree/Shrub Pruning	acres	M	10+ years	$41-$146	1-20 years	remove selected branches	
490	Forest Site Preparation	acres	M		$49-$188	40-80 years	prepare site for preferred species	
612	Tree/Shrub Establishment	acres	M	10+ years	$0.36-$0.78	7-80 years	establish plants, weed & water	

Type of practice: M - managerial; S - structural; M/S - combination of managerial and structural

A large proportion of the BMPs implemented in these study basins appear to require a long term commitment by landowners for the BMPs to remain effective over time. Of the 180 BMPs implemented in the study basins, about 37% are structural in nature, 43% are managerial, and 20% are managerial/structural. The most frequently applied BMPs are a mixture of the three BMP types. Structural BMPs include fencing, roof runoff management, fish stream improvement, and water troughs. Managerial BMPs include prescribed grazing, use (livestock) exclusion, and nutrient management. Filter strip is typed as a managerial/structural BMP.

While state and local efforts have historically focused on the development of farm plans, more recent efforts have emphasized assisting operators in the initial implementation of those BMPs and farm plans. However, there has been little emphasis on determining whether previously installed BMPs are effectively operated and maintained. Such a level of commitment is, and has been, beyond the priorities or resources available to state and local governments. Unfortunately, while some 180 BMPs were implemented at some point in the past 10 years, information about the continued use of those BMPs is lacking.

Timing of pollution control installation

In order to link the installation of pollution controls to water quality, information about the timing and level of pollution control installation is needed to guide the analyses of water quality data. The timing of agricultural pollution controls are focused on because remedial actions for surveyed OSSS were not needed.

Table 11 shows the number of agricultural BMPs implemented each year from 1986 to 1997. Figure 4 shows the cumulative percent of planned BMPs implemented over time for each basin. The cumulative percent is defined as the number of BMPs implemented at a given time divided by the total number of BMPs planned in that basin as of April 1997. Since the level of agricultural BMP installation needed to fully protect water quality in any one basin is not determined, the cumulative percent value only represents progress towards planned BMPs.

Table 11. Number of BMPs implemented in study basins from 1986 to 1997.

Basin	86	87	88	89	90	91	92	93	94	95	96	97	Total
Kennedy	0	0	0	0	0	0	0	0	0	0	0	0	0
Schneider	0	0	0	0	0	1	0	9	17	11	1	0	39
McLane	0	5	0	16	4	13	1	4	24	13	0	0	80
Perry	0	0	1	0	7	9	0	0	0	5	0	0	22
Burns	1	0	0	0	3	0	0	7	14	0	1	0	26
Pierre	0	0	0	0	12	0	0	1	0	0	0	0	13
Total BMPs	1	5	1	16	26	23	1	21	55	29	2	0	180
Total Farm Plans	0	1	0	0	5	8	1	6	6	3	0	0	30

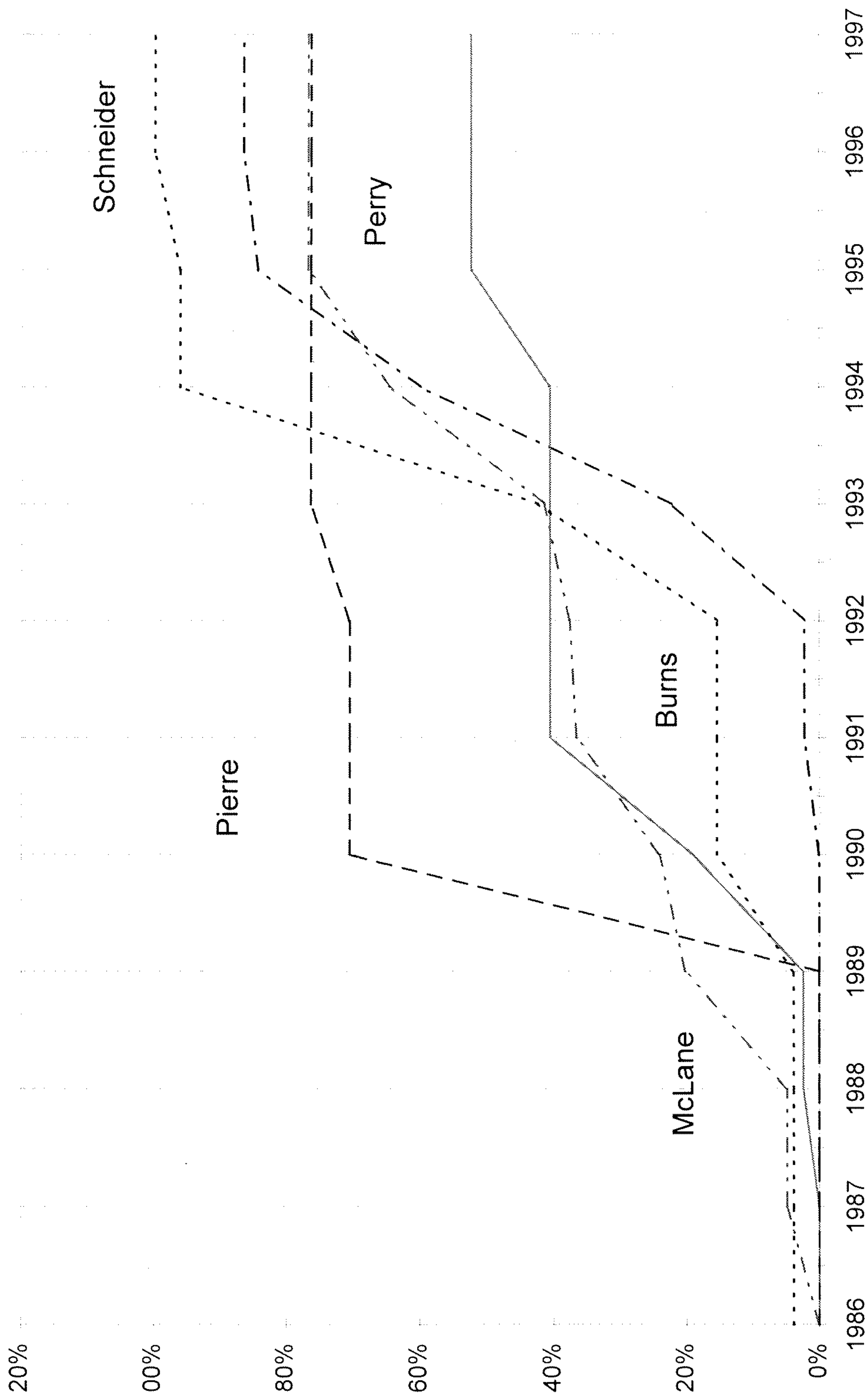

Figure 4. Percent of planned BMPs implemented over time.

Figure 4 shows that most basins achieved BMP implementation levels greater than 70%. A substantial increase in BMP implementation in Burns and Schneider basins coincided with the SPI effort. BMP implementation in McLane and Perry basins show a more gradual increase from 1988 to 1995. For McLane, Perry, and Pierre basins, a fair percentage of BMPs were installed prior to the beginning of the NMP monitoring effort in the fall of 1992 (McLane-38%, Perry-40%, and Pierre-71%). BMP implementation in Pierre peaked in 1990 with a slight increase in 1993.

Pre- and post-BMP periods for each basin are defined in Table 12. Schneider and Burns basins are the only basins where pre- and post-BMP periods can be defined within the time frame of the NMP monitoring effort. (Previous definitions about pre- and post-BMP periods were in error because they were based, in part, on ambiguous data). By including historical water quality data from TCEHD, pre- and post-BMP periods can be defined for Pierre basin as well. Pre- and post-BMP periods for McLane and Perry basins may be more difficult to define because of the more gradual implementation of pollution controls from about 1988 into 1999 (planned).

Table 12. Pre- and post-BMP periods in study basins.

Basin	Pre-BMP period	Post-BMP period
Kennedy	None	none
Schneider	1988-1993, 5 seasons	1995-1997, 2 seasons
McLane	1986-1988, 2 seasons	?? 1999-2001, 2 seasons ??
Perry	1986-1989, 3 seasons	?? 1999-2001, 2 seasons ??
Burns	1989-1993, 4 seasons	1995-1997, 2 seasons
Pierre	1986-1989, 3 seasons	1993-1997, 4 seasons

Water Quality Data

Water quality data and their qualifiers are given in Appendices C and D. Boxplots summarizing the FC, TSS, turbidity, and flow data are presented in Appendix F. Table 13 compares the last five wet seasons of FC data to Washington State water quality standards (Chapter 173-201A Washington Administrative Code). Kennedy, McLane, and Perry Creeks met both parts of the FC standard. Schneider Creek exceeded the second part of the water quality standard for the first three seasons, but met both parts of the standard in the last two seasons. Burns and Pierre Creeks failed to meet either part of the standard for any of the past five years.

Two approaches were used for interim analyses of water quality data to determine if trends in FC exist in Schneider, Burns and Pierre basins: (1) comparison of pre- and post-BMP period FC concentrations using notched boxplots which graphically depict the 95% confidence interval about the median; and (2) comparison of pre- and post-BMP period FC relationships using paired data from the Kennedy and Schneider basins. (Pre- and

Table 13. Comparison of FC data to water quality standards

Site	Class	Geometric Mean Value During wet season					Percent of samples greater Than Part 2 of standard				
		92-93	93-94	94-95	95-96	96-97	92-93	93-94	94-95	95-96	96-97
Kennedy	AA	5	5	5	5	9	0	0	0	0	0
Schneider	AA	24	17	20	11	8	**17**	**11**	**17**	4	0
McLane	A	37	28	37	23	18	4	4	4	0	0
Perry	A	14	10	17	13	7	0	0	4	4	0
Pierre	AA	**52**	**87**	**410**	**120**	**120**	**22**	**42**	**92**	**61**	**45**
Burns	AA	**94**	**230**	**220**	**80**	**62**	**35**	**74**	**79**	**30**	**32**

Bold values indicate violations of water quality standards:

Class AA Standard
Part 1 - geometric mean value (GMV) shall not exceed 50 colonies/100mL
Part 2 - not more than 10% of the samples used for calculating the GMV shall exceed 100 colonies/100mL

Class A Standard
Part 1 - geometric mean value (GMV) shall not exceed 100 colonies/100mL
Part 2 - not more than 10% of the samples used for calculating the GMV shall exceed 200 colonies/100mL

post-BMP periods for Kennedy were defined based on these periods for Schneider). The results of comparing the pre- and post-BMP notched boxplots (Figure 5 and Table 14) suggest that the median FC concentration did not change in Kennedy, Schneider, or Burns Creek, and increased 375% in Pierre Creek.

[Note: Boxplots graphically display information about the range and distribution of data. The "box" displays the inter-quartile range (25th to 75th percentile) while the minimum and maximum values are shown as the end of the line which extends from the box. The median is represented by a line that divides the box. Outliers are shown as small circles or asterisks and are defined as values that lay more than 1.5 times the inter-quartile range beyond the minimum or maximum. The 95% confidence interval about the median is depicted on boxplots by squeezing the box at the median; where the box returns to its normal rectangular shape marks the upper or lower boundary of the 95% confidence interval. These boxplots were produced by the statistical software SYSTAT (Wilkeson, 1990)].

A decrease in Schneider Creek mean log FC concentration was indicated using the paired-watershed analysis. Pre- and post-BMP period regression outputs were examined after Zar (1984) and EPA (1993). The slopes of these regressions were not different while the y-intercepts were different ($P<0.001$). The difference in intercepts, rather than slopes, indicates a parallel shift in the regression equation (Figure 6). This shift in the regression represents a 31% decrease from the pre-BMP period (mean log FC=1.43) to the post-BMP period (mean log FC=0.99).

Linking Water Quality and Pollution Controls

Linking water quality to pollution controls cannot be done at this time due to poor understanding of the management of farms, the operation and maintenance of pollution controls, the effects of climate, and the sources and fate of FC in the study basins. These challenges seem likely to remain until efforts are focused to improve our understanding of these factors.

Farm management and maintenance of pollution controls

In Schneider basin, the decrease in FC may be due to the implementation of farm plans as well as changes in farm ownership and farm management. One farm, just upstream of the sample site, changed ownership after the original farm plan was developed. Fewer horses have been observed at this farm during the last two seasons than were observed in previous years. Interestingly, the historical data (Appendix F) show that FC levels increased about the same time (1990) that the original owners began keeping horses on the farm. Twenty-one of a targeted 33 OSSSs were not surveyed in Schneider basin and the impact on water quality from these OSSSs is unknown. The potential effect on water quality from the farm with 14% of the planned BMPs implemented is also not known.

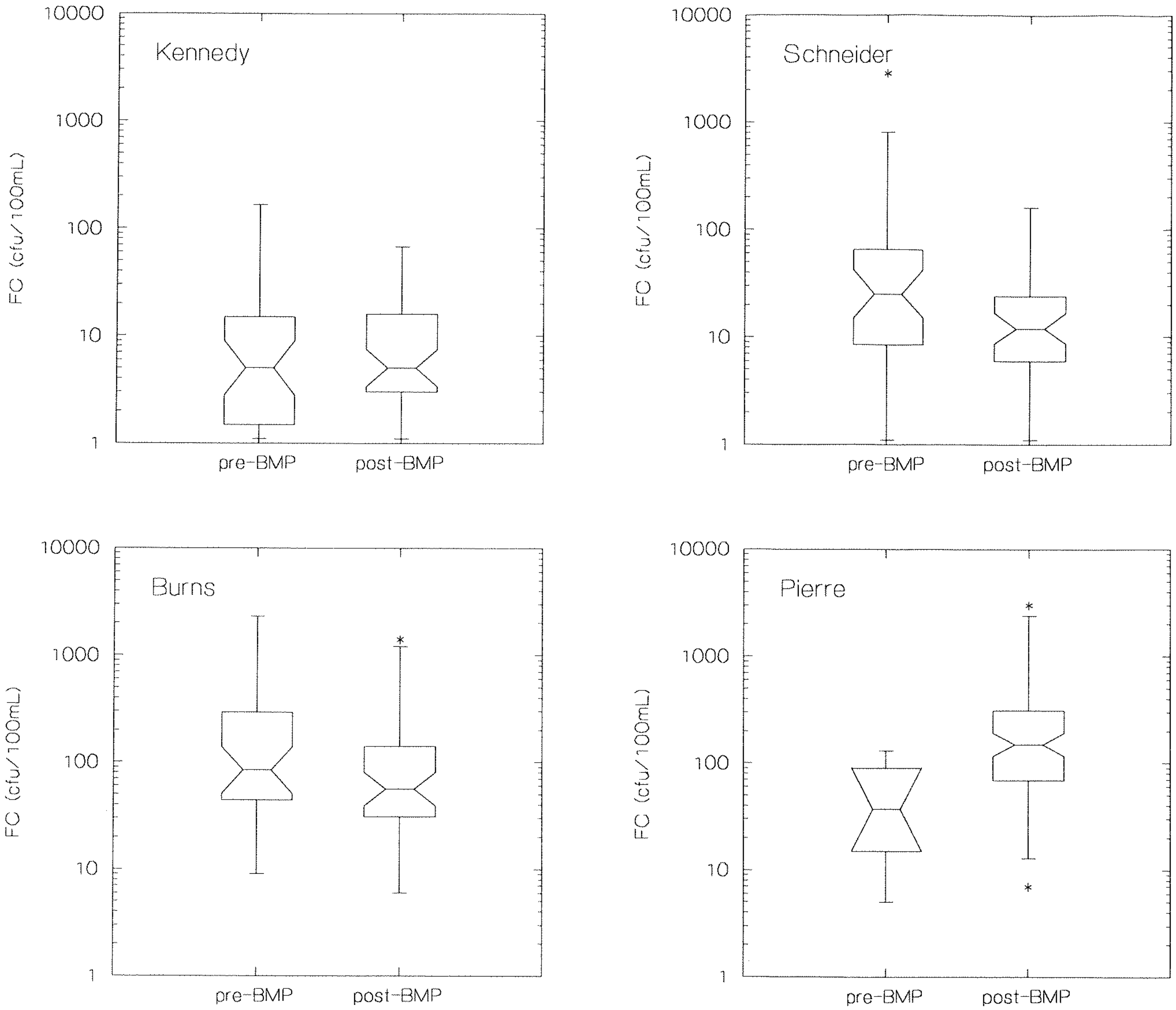

Figure 5. Notched boxplots of pre- and post-BMP FC data.

Table 14. Median FC concentrations from pre- and post-BMP periods.

Basin	Pre-BMP median FC and (n)	Post-BMP median FC and (n)	significant difference
Kennedy	5 (39)	5 (45)	no
Schneider	25 (39)	12 (45)	no*
Burns	84 (35)	56 (45)	no
Pierre	40 (10)	150 (89)	yes

* See discussion of paired-watershed results where a difference in the mean log FC concentration was detected.

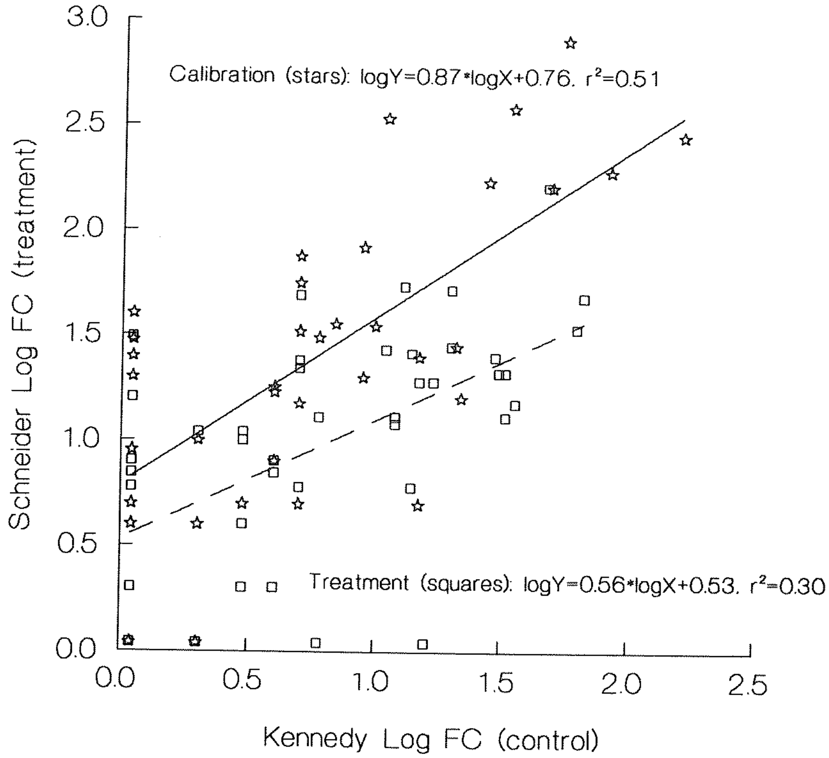

Figure 6. Paired-basin regressions of pre- and post-BMP FC data.

In Pierre basin, the increase in FC might be attributable to a combination of factors such as partial implementation of the farm plans, the lack of maintenance of previously installed BMPs, climate effects, or wildlife. One farm in the basin implemented 57% of the recommended BMPs between 1990 and 1993; the remaining BMPs have yet to be implemented. The other farm in Pierre basin implemented 90% of planned BMPs.

In Burns basin, only two seasons of post-BMP water quality data have been collected, and more time may be needed for the effects of BMPs to be measurable. Wildlife, such as waterfowl, may also be affecting levels of FC measured in this basin.

Climate

Precipitation data show that the first two seasons of the NMP monitoring effort coincided with several years of below-average rainfall while the latter three years coincided with rainfall returning to or exceeding the historical average. Table 15 summarizes rainfall and antecedent precipitation index (API) characteristics for the last five wet seasons. Total and average daily rainfall and API show that the past three monitoring seasons were "wetter" than the first two monitoring seasons. Notched boxplots of API values for the sample days showed that the median API values for sample days of the last three years were also higher than those for the first two years. The influence of climate on FC levels is unclear at this time. Linear regression analyses for each site suggest that FC concentrations correlate poorly with streamflow and API (Seiders and Cusimano, 1996).

Table 15. Summary of wet season precipitation (November 1 through April 30). (All units are inches.)

Monitoring Season	Rainfall Total	Rainfall - Daily Average	API Total	API - Daily Average	Sample Day API - Average
1992-93	29.3	0.16	291	1.61	-0.51
1993-94	25.7	0.14	258	1.43	-0.15
1994-95	40.5	0.22	448	2.48	0.08
1995-96	48.6	0.27	471	2.59	0.00
1996-97	52.8	0.29	523	2.89	0.03

Sources and fate of FC bacteria

Farm animals and OSSS are presumed to be the primary sources of FC in the study area. While farm animal numbers and their management have been inventoried in the past, resources are unavailable to monitor the numbers of animals and their management on an annual basis. Animal waste that is deposited or transported to streams may result in temporary storage, and later release, of FC bacteria. Sherer *et. al.* (1992) suggests that for basins with livestock impacts, stream sediments can be a reservoir and subsequent source of water column FC, particularly during periods of disturbance such as during increased runoff. Examination of relationships between FC, turbidity, and total suspended solids in these streams may help explain the role of fine sediments in water column FC concentrations. Wildlife, such as deer and waterfowl, are also potential sources of FC in these basins and their numbers or habits are not known.

Participation needed for evaluation of pollution control programs

Implementing pollution controls and evaluating their effectiveness requires a substantial investment by individuals and institutions alike. In Wisconsin, Wolf (1995) examined the institutional difficulties in determining levels of success of the state's water quality program. Areas reviewed included water quality (before and after BMP implementation), participation in pollution control programs, and the effectiveness of institutional coordination. Wolf concluded that an inadequate level of participation in voluntary programs was the main reason for little or no measurable improvements in water quality.

In Washington, previous attempts to evaluate the effectiveness of pollution control efforts have also been hindered by inadequate participation in voluntary programs or lack of information about the extent of participation that did occur.

Dickes and Merrill (1990) assessed the effectiveness of dairy farm BMP implementation on water quality in the Johnson Creek watershed in northwest Washington. Water quality remained poor after 80% of planned BMPs were implemented on 45 dairy farms. Improper management techniques and/or the influence of non-participating farms were suggested as reasons for continued pollution of watershed streams. More information about the nature, location, and timing of pollution controls may have given a clearer picture as to why farm planning and implementation efforts did not improve water quality.

Bachert (1993) evaluated the status of farm planning for 675 dairies in northwestern Washington. This NRCS study found that 50% of these farms had farm plans while 37% had not developed plans. The remaining 13% of the farms were not contacted. Of the 336 farms with plans, about 39% of the plans were fully implemented, about 46% were partially implemented, and the remaining 15% had no implementation. Bachert also reported on dairy farmer's reasons for implementing and maintaining some BMPs while not adopting others.

Determan (1993) described efforts to clean up contaminated shellfish beds in Puget Sound and reported on factors affecting the integrity of farm plans. Ongoing changes in land use and farm management presented challenges in developing and tracking farm plan implementation. Determan found that no agency tracks such changes or monitors the level of farm plan implementation. Constraints to progress included landowner resistance, staffing and funding difficulties at Conservation Districts, and time needed to "sell" and implement farm plans.

Dickes and Patterson (1994) found that bacterial water quality had declined in the Burley and Minter Creek watersheds after 10 years of rural nonpoint pollution control implementation. A large percent of acreage had been treated with BMPs in these watersheds draining to productive shellfish harvest areas. Reasons for the continued decline in water quality included population increases, changes in the locations and magnitudes of contaminant sources, and failure to focus efforts on priority areas. More information about the nature, location, and timing of pollution controls may have given a clearer picture as to why 10 years of nonpoint control efforts did not result in expected water quality improvements.

Western Washington University (1996) recently completed four years of a five-year study to document changes in water quality as dairy waste pollution controls are installed in the Kamm Creek basin. The NRCS is working with about 25 dairy farms in this USDA Water Quality Special Project area. Improvements in water quality have not yet been seen. Vandersypen (1997) reported that land use and BMP data of sufficient detail are currently not available to assess BMP effectiveness in terms of water quality. As in the Johnson Creek and Burley-Minter Creek studies above, lack of information about the nature, location, and timing of pollution controls limits the ability of this study to measure the success of nonpoint pollution control efforts.

Lack of information about nonpoint pollution controls appears to be a recurring theme, and limiting factor, in Washington's efforts to measure the effects of nonpoint pollution programs on water quality. While the Totten and Eld Inlet Clean Water Projects study has produced data on pollution controls that have been installed, additional efforts are now needed to determine the status of those controls in order to evaluate their effectiveness in terms of water quality. However, the current situation is the same as Determan found in 1993: there is no agency responsible for tracking the durability of rural nonpoint pollution controls installed through publicly-funded programs. Special efforts will be needed to obtain such information in order for this project to meet its objective of evaluating the effectiveness of pollution control efforts of landowners and local, state, and federal programs.

Evolution of the SPI as a nonpoint pollution control effort by Ecology

The history of nonpoint pollution control efforts provides insight into the response and durability of institutional programs designed to address nonpoint pollution. One indicator of society's willingness and ability to successfully deal with nonpoint pollution could be the durability of such programs over years and decades. The history of the SPI is recounted here because of its role in managing nonpoint pollution in the Totten and Eld watersheds.

The SPI grant effort came about due to frustration with efforts that were failing to prevent shellfish harvest restrictions and closures in Washington. In the early 1980s, Ecology helped establish an interagency Shellfish Advisory Committee (SAC). The knowledgeable members of the SAC helped Ecology identify needs and solutions to the continuing decline in water quality of shellfish harvest areas. In 1984, Ecology published its Shellfish Protection Strategy. Heightened concerns of the shellfish industry in 1990 led Ecology to find funds to act on controlling nonpoint pollution. The SAC identified barriers to success of past and current programs and helped design a program that had an excellent chance to succeed at controlling nonpoint pollution. The resultant SPI was designed to get pollution controls on the ground. Grant monies would be awarded to applicants from areas where watershed planning, public outreach, and other "soft" processes had already occurred. Approximately $3 million from the Referendum 39 account were to finance five SPI projects over a 3-5 year period. The SPI projects were selected in the summer of 1992; the Totten project received about $1.2 million.

The grant application and interview process made clear that this was an assertive program. Ecology and the State Department of Health would shepherd the projects towards their objectives. The application process provided substantial information about the water quality problems, the sources of water pollution, and the abilities and readiness of local governments to focus on prioritized pollutant sources through regulatory and voluntary mechanisms. For the SPI projects, Ecology increased its grant oversight activities, required quarterly roundtable meetings to bring project participants together, required quarterly reports that addressed specific topics and progress, and offered technical and enforcement assistance to grant recipients. The SPI was expected to be the most assertive and able program to succeed in getting nonpoint pollution controls on the ground where they were most needed to protect water quality.

Early in 1992, Ecology was narrowing its search for a nonpoint pollution control implementation project for long term monitoring, the NMP. The goal of the monitoring project was to evaluate the effectiveness of such programs. From about a dozen potential watershed projects, comments were solicited from local and state government staff who would be involved with nonpoint pollution control projects. The NMP was characterized as a separate project focused on evaluating the effectiveness of a nonpoint pollution control project. The NMP effort intended to dovetail with a selected watershed project, and monitor water quality and the implementation of pollution controls over a 6-10 year period. The Totten and Eld SPI projects best fit EPA's project selection criteria and were proposed for Washington's NMP project. EPA conditionally approved the NMP proposal in the spring of 1993 and gave final approval in March 1995. Approval assured a long term funding commitment by EPA for NMP monitoring activities.

The SPI grants were managed by Ecology staff from the Shorelands and Coastal Zone Management Program's Shellfish Protection Unit (SPU). SPU staff focused on protecting and restoring shellfish harvest areas around the state by coordinating nonpoint pollution remedial efforts among various local and state governments. A two-phase grant application and interview process occurred from March to July, 1992. Finalists were selected in July, 1992 and grant contracts were developed during the remainder of the year. The Totten/Little Skookum Inlets SPI grant contract was signed in December, 1992, as was the Eld Inlet SPI grant. Both SPI grants were between Ecology and TCEHD. TCEHD then subcontracted with TCD to perform the agricultural remedial tasks of the grant. Although minor differences in wording exist between the Ecology SPI grant and TCD's subcontract, the intent of the agricultural tasks did not change.

As the SPI projects gained momentum and local governments progressed with their pollution control programs, changes within Ecology led to a re-alignment of agency priorities and staff responsibilities. These changes were driven by reductions in staff, changes in upper-level management, and reorganization. In the summer of 1993, the SPU was disbanded. Staff were either cut or reassigned to positions at Ecology Headquarters or Regional offices. An unofficial Shellfish Protection Team, made up former SPU staff who remained at Ecology Headquarters, survived until March of 1994. By January of 1995, Ecology's ongoing shellfish protection efforts were further reduced as staff were reassigned and given work duties unrelated to shellfish protection. Ecology had planned to select a manager for the SPI grants but this never occurred (Pivirotto, 1995). Ecology's role was reduced to disbursing payments to grant recipients. The last SPI roundtable meeting for the Totten and Eld SPI projects occurred in July 1995. Ecology technical support and strong oversight of the SPI projects came to an end.

Other SPI participants also experienced changes in management and staffing since the SPI grants were signed. TCD experienced tremendous growth in staff and resources and also had several changes in upper-level management. TCEHD appears to have remained more stable.

Some of the pollution control efforts in the Totten and Eld watersheds include Ecology-administered grants with a variety of objectives. For the NMP effort, the original objectives of these projects are interpreted as milestones for measuring progress and evaluating the effectiveness of the pollution control program. The distinction between grant objectives and grant requirements is important because each is evaluated differently. Compliance with grant requirements is determined by the Ecology grant manager, not the NMP project. Project objectives are developed by grant applicants and Ecology then funds projects that appear to have a good chance to achieve their objectives. Ecology does not penalize grant recipients for not achieving the goals of the grant as long as a good faith effort is made. While the grant objectives of the Totten SPI were not fully achieved, the grant recipients met the requirements of the grant and performed admirably under the circumstances (Appendix H).

These institutional events seem to have played a role in the varied expectations of the Totten SPI project and the Eld CCWF project. Disagreements among project participants over the interpretation of grant language likely evolved from changes in staff and lesser communication among participants. Changes in grant objectives and mechanisms to achieve those objectives became better known during discussions in the summer of 1998 and the impacts of these changes should be addressed in future reports. For example, enforcement mechanisms that would likely encourage non-cooperating landowners to improve their farm management practices were discontinued in the Totten SPI and Eld CCWF projects. The ability to achieve the original Totten SPI and Eld CCWF project objectives has been affected by institutional changes.

Conclusions and Recommendations

Conclusions

1. Five of nine years of monitoring water quality and pollution controls have been accomplished. Mid-project analyses of pre- and post-BMP data sets in four basins suggests that fecal coliform levels increased in Pierre basin, did not change in Burns or Kennedy basins, and decreased in Schneider basin. Analyses of McLane and Perry basin water quality data were not performed because the installation of pollution controls in these basins will continue into 1999.

2. Changes within state and local government agencies during the project resulted in varied expectations of objectives for controlling agricultural pollution. The decline of Ecology's commitment to project coordination, communication, documentation, and oversight decreased the project's ability to meet original pollution control objectives.

3. Characterizing the progress made towards farm planning targets is hampered by incomplete data. Complete information about farm planning targets and subsequent implementation is needed for an accurate characterization of progress towards controlling agricultural sources of FC bacteria. It is unclear to what degree farm planning targets were met in the study basins.

4. Between 1993 and the spring of 1997, 15 farm plans were developed and about 107 best management practices (BMPs) installed in 5 of the 6 study basins. Prior to 1993, 15 farm plans were developed and about 73 BMPs implemented. Surveys to detect failing on-site sewage systems were completed for 15 of a targeted 36 sites in the Schneider, Burns, and Pierre study basins; the remaining sites in these basins chose not to participate.

5. As of the spring of 1997, the percent of planned BMPs that were implemented in each basin ranged from 52% to 100%. Over all basins, 53% of farms implemented all of their planned BMPs while 30% of farms had implementation rates of less than 60%. The proportion of animals (expressed as animal units) on farms that have farm plans range from 27% in Schneider basin to 100% in Burns and Pierre basins.

6. As of the spring of 1997, about 70% of the farm plans developed contained some record (signature) that they were committed to by either the CD or the landowner. The remaining plans (30%) had no signatures. Farm plans were signed by both the land-owner and the CD for 43% of the plans, while 27% of the plans were signed by only one party.

7. Regulatory and voluntary factors appear to motivate landowners to participate in pollution control efforts. Of the 10 farm plans developed in Schneider, Burns, and Pierre basins as of the spring of 1997, five of the sites developed farm plans when a

formal referral process was initiated prior to the SPI; the other five sites developed farm plans voluntarily. Participation in OSSS survey programs decreased after a regulatory tool was removed: only 36% of targeted landowners in the Schneider basin participated in OSSS surveys.

8. Despite the best efforts of state and local governments, all farms in the study area did not enter the farm planning process. Less than expected voluntary participation in pollution control programs by private landowners and enforcement measures by government institutions affected the ability to achieve and measure meaningful improvements in water quality to date.

9. There is currently no agency responsible for, or systematic program in place to, successfully determine and record whether agricultural BMPs are properly used and maintained during their life expectancy. The status of the 180 of a planned 234 BMPs that were installed on farms since 1986 is largely unknown. The current status of potential pollution sources (i.e. animals) on farms is also largely unknown. Lack of this information prohibits this study to link changes in water quality to the implementation of nonpoint source controls.

10. Expectations for measuring water quality improvement from nonpoint pollution control projects may need to be reduced because desired levels of voluntary participation may not be reached. As of the spring of 1997, about 45% of the priority farms in the study basins participated in developing farm plans, while 55% chose not to participate. About 42% of landowners in the study area participated in OSSS surveys, while 58% chose not to participate.

11. Linking water quality to pollution controls is confounded by poor understanding of farm management, operation and maintenance of pollution controls, effects of climate, and sources and fate of FC in the study basins. More effort is needed in these areas in order to measure the effectiveness of pollution control efforts.

12. Some of these conclusions are not shared by all project participants. TCD has alternative views of the project objectives, processes, and measured progress towards project goals (Appendix I). Discussion and pursuit of a common understanding(s) of these and other topics is needed among Ecology, TCD, and TCEHD in order to resolve conflicts about these pollution control projects.

Recommendations

1. Ecology should continue to monitor water quality and the installation of pollution controls in the study basins as scheduled. Ecology should increase efforts to: (1) manage water quality and pollution controls data more effectively in order to meet EPA's requirements for STORET and NPSMS databases; (2) analyze water quality

and rainfall-runoff relationships to better define the effects of climate on water quality and (3) improve GIS mapping and analytical capabilities for this project. The 1998 annual report should focus on the data management effort.

2. Ecology should convene an internal workgroup to review the conclusions and recommendations of this report. The workgroup should help determine future actions and their relative priority related to these recommendations and the remainder of this project. Participating agencies (i.e. TCEHD, TCD, NRCS, WCC, WDOH, PSWQAT, and EPA) should be considered for inclusion in this workgroup.

3. Ecology should collaborate with TCEHD and TCD to better identify potential sources of FC in selected basins. Source identification could include water quality sampling of tributaries, enumeration of farm animal types and numbers, enumeration of known and potential wildlife sources, and review and characterization of other potential sources. The application of new FC bacteria identification technology should also be considered for use in source identification.

4. Ecology should contract with an appropriate agency (i.e. NRCS, TCD, or WCC) to contact landowners in the study basins in order to determine the status of operation and maintenance of previously installed BMPs and the completeness of farm plan implementation.

5. Ecology should more carefully review the impacts that internal reorganizations have on grant-funded nonpoint pollution control projects. Stability in the management and support of such projects should receive particular attention.

6. Ecology should review its record keeping and reporting requirement policies for grant-funded projects to see if meaningful measurements of progress and success in nonpoint projects or programs can be made. Language used in grant agreements should be specific about what grant recipients are and are not expected to document and report. Measurements of pollution controls installed *and* maintained should be documented and reported for watershed projects. Attempts to measure environmental results (e.g. water quality improvements) should be pursued *only* when project characteristics are conducive to achieving and maintaining a high level of pollution control over a known time frame.

7. Where voluntary participation is relied upon to control pollution, measurement of such participation should be documented and reported in all projects in order to help determine the adequacy of this mechanism to achieve pollution control goals.

8. Ecology should review its grant application and ranking process to specifically address the ability and willingness of grant applicants to follow through on their proposals, particularly for competitive grants where ranking criteria are weighted towards grant applications that promise substantial environmental benefits. Ecology should likewise review its ability and willingness to provide promised support to grant-funded projects.

9. Ecology, EPA, NRCS, WCC, and CDs should collaborate to formulate their needs, willingness, and abilities to track the longevity of nonpoint source controls installed through publicly-funded programs in order to measure the progress and success of their efforts. The Puget Sound Water Quality Action Team (PSWQAT) should also be involved in this effort.

10. Ecology should collaborate with WCC, NRCS, CDs, and EPA to arrive at common definitions for the various expressions of "farm plan" and the level and durability of implementation of such farm plans. A system to weight BMPs based on their influence in protecting water quality should be developed to more accurately express the level of water quality protection afforded by each fully or partially implemented farm plan.

11. Ecology, EPA, NRCS, WCC, and CDs should collaborate in developing approaches and formats that can be consistently used for tracking and summarizing farm planning and implementation decisions and actions. Potential sources and magnitudes of pollution should also be tracked. Temporal and spatial resolution should be considered and a consistent format strived for to ease the reporting burden on CDs. Ecology's nonpoint program guidance, which is under development (e.g. Section 319, CZARA 6217), should specifically address how the installation and durability of pollution controls can be tracked, documented, quantified, and reported.

12. Ecology should reconvene the Agricultural Nonpoint Forum which was created in 1993 and has been inactive for several years. The purpose of the Forum is for various agencies to improve their understanding, communication, coordination, and consistency in addressing agricultural sources of nonpoint pollution, while maintaining a viable agricultural economy. The Forum may be a useful vehicle for addressing meaningful measurement of agricultural pollution control efforts.

13. Ecology should include the entire Eld Inlet watershed in WRIA 14 rather than having it split between WRIA 13 and WRIA 14. (McLane Creek basin and the west side of the Cooper Point Peninsula are included in WRIA 13, which is included in the Budd/Deschutes basin under Ecology's watershed management approach). Redefining these boundaries would be consistent with the watershed approach to managing water resources.

14. Ecology should commit to gaining a common understanding(s) among all participants of the SPI and CCWF grant projects in the study basins. Topics needing particular attention include clear understanding of original and revised project objectives, methods used to measure progress towards project objectives, and mechanisms with which to address these and other issues.

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Appendix A

Status of Farm Planning Efforts in Study Basins

Appendix A. Status of Farm Planning Efforts in Study Basins.

Basin	Farm ID	Acres	Wet Season Animal Units	Priority	Date Farm Plan Developed	Date Farm Plan Signed by TCD	Is Plan Signed by Operator?	Are BMPs Installed?	Percent of BMPs Implemented
Burns	6	10.7	3.5	1	94.2Q		y	y	100%
Burns	7	37.5	0.1	1	90.2Q	91.2Q	y	y	100%
Burns	11	5.6	4.0	1	93.3Q	94.3Q	y	y	100%
Burns Total		**53.8**	**7.6**						
Burns Count	**3**				**3**	**2**	**3**	**3**	
Kennedy	10	8.2	1.0	4					
Kennedy	988	5.0							
Kennedy	996	9.3		4					
Kennedy Total		**22.5**	**1.0**						
Kennedy Count	**3**				**0**	**0**	**0**	**0**	
McLane	1020	40.4	2.7	P,E					
McLane	1024	9.8							
McLane	1025	1.4	2.0						
McLane	1027	4.9							
McLane	1028	8.6	1.0						
McLane	1034	1.1	2.0	P					
McLane	1035	4.9							
McLane	1036	10.1							
McLane	1038	20.9							
McLane	1089	0.9	1.5	P,E					
McLane	1091	0.5	1.8	(3)					
McLane	1092	18.7	3.6	(2)	91.1Q	91.1Q	y	y	60%
McLane	1094	4.3	2.0	(1)	91.1Q	91.2Q	y	y	40%
McLane	1107	18.8	2.0	(1),E					
McLane	1108	5.0	1.0	(1)	93.3Q	94.1Q	y	y	14%
McLane	1121	17.2	3.0	(1),P	93.2Q	94.2Q		y	100%
McLane	1133	162.9	9.0	(1),P,E	93.2Q	94.3Q	y	y	100%
McLane	1134	12.7	2.7	(1)					
McLane	1135	8.5	2.7	(2),P,E					
McLane	1136	5.9	2.0	(3)					
McLane	1137	27.0	2.7	(2),P,E					
McLane	1140	17.8	1.0	(3)					
McLane	1141	33.6	5.4	(3),P,E					
McLane	1142	9.1	7.0	(3),P	94.4Q			y	80%
McLane	1143	18.2	2.0	(1),P	94.3Q			y	57%
McLane	1144	8.6	1.0	(3)					
McLane	1145	6.6	2.0	(3)					
McLane	1146	12.6	1.0						
McLane	1147	0.8	1.0	(3)					
McLane	1148	9.9	2.0		87.4Q			y	100%
McLane	1149	13.5	5.0	(1)	91.4Q	93.4Q	y	y	100%
McLane	1150	18.5	2.0	(1)	91.1Q	91.1Q	y	y	80%
McLane	1152	5.0	0.6	(3)					
McLane	1153	62.5	18.0	(1)	93.4Q	94.3Q		y	100%
McLane	1154	58.8	21.4	(1)	90.4Q			y	93%
McLane	1155	6.5	2.7	(1),P,E					
McLane	1157	15.1	3.0	P					

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Basin	Farm ID	Acres	Wet Season Animal Units	Priority	Date Farm Plan Developed	Date Farm Plan Signed by TCD	Is Plan Signed by Operator?	Are BMPs Installed?	Percent of BMPs Implemented
McLane	1159	28.1	5.4	(1),E	91.4Q			y	75%
McLane	1182	4.6							
McLane	1200	7.2	4.0		95.2Q			y	44%
McLane	1991	1.0							
McLane	1992	19.9	3.6	(1)	90.1Q			y	100%
McLane	1998	8.1	12.2	(1)	94.1Q			y	100%
McLane Total		**750.3**	**142.0**						
McLane Count	**43**				**16**	**8**	**6**	**16**	
Perry	1080	27.0	5.4	(1)	90.4Q	91.1Q	y	y	47%
Perry	1082	75.9	1.8		91.4Q	91.2Q	y	y	100%
Perry	1090	3.0	0.9	(1)					
Perry	1124	27.5	4.5	(1),E					
Perry	1126	18.7	1.8	(1)	94.1Q			y	100%
Perry	1127	2.6	1.0	(3)					
Perry	1129	30.9	27.9	(1)	90.4Q	93.4Q	y	y	37%
Perry	1132	5.5	1.0	(1)					
Perry Total		**191.0**	**44.3**						
Perry Count	**8**				**4**	**3**	**3**	**4**	
Pierre	22	10.0	2.0	1	91.3Q		y	y	57%
Pierre	31	15.5	3.0	1	95.4Q	92.4Q		y	90%
Pierre Total		**25.5**	**5.0**						
Pierre Count	**2**				**2**	**1**	**1**	**2**	
Schneider	1	26.2	6.0	1	93.4Q	94.2Q		y	100%
Schneider	3	10.0	4.0	2					
Schneider	5	121.2	15.0	1	92.4Q	92.4Q	y	y	100%
Schneider	8	3.9	6.0	3					
Schneider	12	160.0	0.0	1	95.3Q		y	y	100%
Schneider	13	8.9	1.0	4					
Schneider	17	1.1		5					
Schneider	18	26.0	19.8	1					
Schneider	19	4.1		5					
Schneider	25	37.6	7.2	5					
Schneider	26	11.8	2.0	4					
Schneider	29	9.3	1.2	2					
Schneider	32	1.4	1.0	4					
Schneider	34	2.9	3.0	3					
Schneider	38	8.0	3.6	4					
Schneider	39	9.3	3.0	4					
Schneider	40	1.1	3.0	1	91.3Q	91.3Q		y	14%
Schneider	602	10.2							
Schneider	989	4.0							
Schneider	990	7.1	4.8						
Schneider	991	0.5	0.6						
Schneider	992	2.2	1.0						
Schneider	993	12.6	2.0						
Schneider	995	5.4	7.7						
Schneider	997	16.8							

Appendix A. Status of Farm Planning Efforts in Study Basins.

Basin	Farm ID	Acres	Wet Season Animal Units	Priority	Date Farm Plan Developed	Date Farm Plan Signed by TCD	Is Plan Signed by Operator?	Are BMPs Installed?	Percent of BMPs Implemented
Schneider	999	5.1	1.1		94.4Q	95.1Q	y	y	100%
Schneider Total		**506.5**	**93.0**						
Schneider Count	**26**				**5**	**4**	**3**	**5**	
Grand Total		**1549.6**	**292.8**						
Grand Count	**85**				**30**	**18**	**16**	**30**	

Notes:

Acres: from Thurston County Assessor's Office; acreage used as farm may be less than stated.

Wet Season Animal Units: Values derived from 1989, 1993, and 1996 and other farm inventories performed by TCD.
Blank cells indicate missing data.
Some farms increase animal units during the dry season: farm # 7 to 10.1 A.U., and farm #12 to 27.0 A.U.

Priority: the prioritization of farms has varied from grant to grant; several formats are combined here.
1989 District-wide inventory: numerals (1) through (3); note parentheses.
1993 Totten SPI inventory: numeral 1 (higher) to 5 (lower).
1993 Eld SPI inventory: letter "P".
1996 Eld CCWF inventory: letter "E".

Date format: uses last two digits of year and the quarter of the year that signature record indicates.

Appendix B

BMPs Implemented on Farms in Study Basins

Appendix B. BMPs Implemented on Farms in Study Basins.								
Basin	Farm ID	BMP#	BMP Description	Units	Amount Applied	Year Applied	Amount Planned	Year Planned
Burns	6	352	Deferred Grazing	acres	4.0	1994	4.0	1994
Burns	6	382	Fencing	feet	550.0	1994	550.0	1994
Burns	6	590	Nutrient Mgmt	acres	11.0	1994	11.0	1994
Burns	6	512	Pasture & Hayland Planting	acres	2.0	1994	4.0	1994
Burns	6	528	Prescribed Grazing	acres	4.0	1994	4.0	1994
Burns	6	645	Wildlife Upland Habitat Mgmt	acres	11.0	1994	11.0	1994
Burns	7	344	Crop Residue Use	acres	23.0	1993	23.0	1993
Burns	7	352	Deferred Grazing	acres	7.5	1990	7.5	1990
Burns	7	382	Fencing	feet	1000.0	1994	1000.0	1994
Burns	7	472	Livestock Exclusion	acres	15.0	1994	15.0	1994
Burns	7	590	Nutrient Mgmt	acres	23.0	1990	23.0	1990
Burns	7	516	Pipeline	feet	890.0	1994	890.0	1994
Burns	7	556	Planned Grazing System	acres	22.5	1994	22.5	1994
Burns	7	528	Prescribed Grazing	acres	22.5	1990	22.5	1990
Burns	7	558	Roof Runoff Mgmt	system	1.0	1986	1.0	1986
Burns	7	612	Tree/Shrub Establishment	acres	15.0	1993	15.0	1993
Burns	7	614	Trough	each	4.0	1993	4.0	1993
Burns	7	645	Wildlife Upland Habitat Mgmt	acres	40.0	1993	40.0	1993
Burns	11	352	Deferred Grazing	acres	1.6	1994	1.6	1993
Burns	11	382	Fencing	feet	450.0	1993	450.0	1993
Burns	11	393	Filter Strip	acres	0.5	1996	0.5	1996
Burns	11	590	Nutrient Mgmt	acres	1.6	1993	1.6	1993
Burns	11	512	Pasture & Hayland Planting	acres	1.6	1994	1.0	1993
Burns	11	528	Prescribed Grazing	acres	1.6	1994	1.6	1993
Burns	11	558	Roof Runoff Mgmt	system	1.0	1994	1.0	1993
Burns	11	313	Waste Storage Structure	structure	1.0	1993	1.0	1993
Burns Count					**26**		**26**	
Kennedy	10							
Kennedy	988							
Kennedy	996							
Kennedy Count					**0**		**0**	
McLane	1020							
McLane	1024							
McLane	1025							
McLane	1027							
McLane	1028							
McLane	1034							
McLane	1035							
McLane	1036							
McLane	1038							
McLane	1089							
McLane	1091							
McLane	1092	322	Channel Vegetation	acres			1.0	1991
McLane	1092	382	Fencing	feet	370.0	1991	370.0	1991
McLane	1092	395	Fish Stream Improvement	feet	370.0	1991	370.0	1991
McLane	1092	472	Livestock Exclusion	acres	1.0	1991	1.0	1991
McLane	1092	644	Wildlife Wetland Habitat Mgmt	acres			1.0	1991
McLane	1094	322	Channel Vegetation	acres	2.0	1991	1.0	1991
McLane	1094	395	Fish Stream Improvement	feet	200.0	1991	200.0	1991
McLane	1094	472	Livestock Exclusion	acres			0.5	1991
McLane	1094	510	Pasture & Hayland Mgmt	acres			2.0	1993

Appendix B. BMPs Implemented on Farms in Study Basins.

Basin	Farm ID	BMP#	BMP Description	Units	Amount Applied	Year Applied	Amount Planned	Year Planned
McLane	1094	633	Waste Utilization	acres			2.0	1992
McLane	1107							
McLane	1108	352	Deferred Grazing	acres			4.0	1994
McLane	1108	382	Fencing	feet			800.0	1993
McLane	1108	393	Filter Strip	acres			0.2	1993
McLane	1108	412	Grassed Waterway	acres	0.1	1993	0.1	1993
McLane	1108	472	Livestock Exclusion	acres			4.0	1994
McLane	1108	313	Waste Storage Structure	structure			1.0	1994
McLane	1108	633	Waste Utilization	acres			4.0	1994
McLane	1121	395	Fish Stream Improvement	feet	400.0	1994	400.0	1994
McLane	1121	472	Livestock Exclusion	acres	10.0	1994	10.0	1994
McLane	1121	510	Pasture & Hayland Mgmt	acres	10.0	1994	10.0	1994
McLane	1121	528	Prescribed Grazing	acres	10.0	1994	10.0	1994
McLane	1121	313	Waste Storage Structure	structure	1.0	1994	1.0	1994
McLane	1121	633	Waste Utilization	acres	10.0	1994	10.0	1994
McLane	1133	382	Fencing	feet	2500.0	1994	2500.0	1994
McLane	1133	393	Filter Strip	acres	2.0	1994	2.0	1994
McLane	1133	395	Fish Stream Improvement	feet	2500.0	1994	2500.0	1994
McLane	1133	558	Roof Runoff Mgmt	system	1.0	1994	1.0	1994
McLane	1133	580	Streambank Protection	feet	2500.0	1993	2500.0	1993
McLane	1133	645	Wildlife Upland Habitat Mgmt	acres	179.0	1994	179.0	1994
McLane	1134							
McLane	1135							
McLane	1136							
McLane	1137							
McLane	1140							
McLane	1141							
McLane	1142	472	Livestock Exclusion	acres	2.0	1994	2.0	1994
McLane	1142	510	Pasture & Hayland Mgmt	acres	8.5	1994	8.5	1994
McLane	1142	558	Roof Runoff Mgmt	system	1.0	1994	1.0	1994
McLane	1142	313	Waste Storage Structure	structure			1.0	1994
McLane	1142	633	Waste Utilization	acres	8.5	1994	8.5	1994
McLane	1143	382	Fencing	feet			660.0	1994
McLane	1143	561	Heavy Use Area Protection	acres			0.2	1994
McLane	1143	472	Livestock Exclusion	acres	9.0	1994	9.0	1994
McLane	1143	590	Nutrient Mgmt	acres	14.0	1994	14.0	1994
McLane	1143	510	Pasture & Hayland Mgmt	acres	14.0	1994	14.0	1994
McLane	1143	313	Waste Storage Structure	structure			1.0	1994
McLane	1143	645	Wildlife Upland Habitat Mgmt	acres	23.0	1994	23.0	1994
McLane	1144							
McLane	1145							
McLane	1146							
McLane	1147							
McLane	1148	382	Fencing	feet	1100.0	1987	1100.0	1987
McLane	1148	393	Filter Strip	acres	0.5	1987	0.5	1987
McLane	1148	430	Irrigation Pipeline	feet	200.0	1987	200.0	1987
McLane	1148	472	Livestock Exclusion	acres	0.5	1987	0.5	1987
McLane	1148	614	Trough	each	1.0	1987	1.0	1987
McLane	1149	528	Prescribed Grazing	acres	7.5	1993	7.5	1993
McLane	1149	558	Roof Runoff Mgmt	system	1.0	1992	1.0	1992
McLane	1149	313	Waste Storage Structure	structure	1.0	1991	1.0	1991

Appendix B. BMPs Implemented on Farms in Study Basins.								
Basin	Farm ID	BMP#	BMP Description	Units	Amount Applied	Year Applied	Amount Planned	Year Planned
McLane	1149	633	Waste Utilization	acres	9.0	1993	9.0	1993
McLane	1150	382	Fencing	feet	800.0	1991	800.0	1991
McLane	1150	393	Filter Strip	acres	1.0	1991	1.0	1991
McLane	1150	614	Trough	each	1.0	1991	1.0	1991
McLane	1150	313	Waste Storage Structure	structure	1.0	1991	1.0	1991
McLane	1150	633	Waste Utilization	acres			13.0	1994
McLane	1152							
McLane	1153	382	Fencing	feet	2000.0	1994	2000.0	1994
McLane	1153	393	Filter Strip	acres	2.0	1995	2.0	1995
McLane	1153	395	Fish Stream Improvement	feet	2000.0	1995	2000.0	1995
McLane	1153	561	Heavy Use Area Protection	acres	3.0	1994	3.0	1994
McLane	1153	472	Livestock Exclusion	acres	15.0	1994	15.0	1994
McLane	1153	510	Pasture & Hayland Mgmt	acres	30.0	1994	30.0	1994
McLane	1153	633	Waste Utilization	acres	30.0	1995	30.0	1995
McLane	1153	645	Wildlife Upland Habitat Mgmt	acres	5.0	1995	5.0	1995
McLane	1153	644	Wildlife Wetland Habitat Mgmt	acres	5.0	1995	5.0	1995
McLane	1154	382	Fencing	feet	566.0	1989	1000.0	1988
McLane	1154	382	Fencing	feet	1429.0	1989	1800.0	1988
McLane	1154	382	Fencing	feet	55.0	1989	55.0	1988
McLane	1154	382	Fencing	feet	1450.0	1990	1405.0	1990
McLane	1154	382	Fencing	feet	334.0	1990	355.0	1990
McLane	1154	393	Filter Strip	acres	1.0	1989	1.0	1988
McLane	1154	393	Filter Strip	acres	1.0	1989	1.0	1988
McLane	1154	393	Filter Strip	acres	1.0	1989	1.0	1988
McLane	1154	393	Filter Strip	acres	1.0	1990	1.0	1990
McLane	1154	575	Livestock Crossing	each	1.0	1989	1.0	1988
McLane	1154	516	Pipeline	feet			100.0	1988
McLane	1154	614	Trough	each	1.0	1989	1.0	1988
McLane	1154	614	Trough	each	1.0	1989	1.0	1988
McLane	1154	614	Trough	each	2.0	1990	1.0	1988
McLane	1155							
McLane	1157							
McLane	1159	352	Deferred Grazing	acres	16.5	1991	16.5	1991
McLane	1159	382	Fencing	feet	1283.0	1989	1200.0	1989
McLane	1159	382	Fencing	feet			1200.0	1993
McLane	1159	393	Filter Strip	acres	2.0	1989	2.0	1989
McLane	1159	528	Prescribed Grazing	acres			14.0	1992
McLane	1159	558	Roof Runoff Mgmt	system	1.0	1991	1.0	1989
McLane	1159	614	Trough	each	1.0	1989	1.0	1989
McLane	1159	614	Trough	each	3.0	1991	3.0	1991
McLane	1182							
McLane	1200	352	Deferred Grazing	acres			3.5	1996
McLane	1200	561	Heavy Use Area Protection	acres	0.3	1995	0.3	1995
McLane	1200	472	Livestock Exclusion	acres	3.5	1995	3.5	1995
McLane	1200	590	Nutrient Mgmt	acres			3.5	1996
McLane	1200	510	Pasture & Hayland Mgmt	acres	3.5	1995	3.5	1995
McLane	1200	512	Pasture & Hayland Planting	acres			3.5	1996
McLane	1200	528	Prescribed Grazing	acres	3.5	1995	3.5	1995
McLane	1200	312	Waste Mgmt System	system			1.0	1996
McLane	1200	313	Waste Storage Structure	structure			1.0	1996
McLane	1991							

Appendix B. BMPs Implemented on Farms in Study Basins.

Basin	Farm ID	BMP#	BMP Description	Units	Amount Applied	Year Applied	Amount Planned	Year Planned
McLane	1992	382	Fencing	feet	1460.0	1989	1460.0	1989
McLane	1992	510	Pasture & Hayland Mgmt	acres	10.0	1989	10.0	1989
McLane	1992	516	Pipeline	feet	400.0	1989	400.0	1989
McLane	1992	614	Trough	each	3.0	1989	3.0	1989
McLane	1998	352	Deferred Grazing	acres	8.0	1995	8.0	1994
McLane	1998	472	Livestock Exclusion	acres	18.0	1995	18.0	1994
McLane	1998	590	Nutrient Mgmt	acres	28.0	1995	28.0	1994
McLane	1998	510	Pasture & Hayland Mgmt	acres	28.0	1994	28.0	1994
McLane	1998	556	Planned Grazing System	acres	28.0	1995	28.0	1994
McLane Count					**80**		**104**	
Perry	1080	352	Deferred Grazing	acres			6.5	1994
Perry	1080	382	Fencing	feet	178.0	1990	200.0	1990
Perry	1080	382	Fencing	feet	550.0	1990	600.0	1990
Perry	1080	382	Fencing	feet	439.0	1990	500.0	1990
Perry	1080	393	Filter Strip	acres	1.0	1990	1.0	1990
Perry	1080	561	Heavy Use Area Protection	acres			2.0	1994
Perry	1080	561	Heavy Use Area Protection	acres			3.0	1994
Perry	1080	510	Pasture & Hayland Mgmt	acres			6.0	1994
Perry	1080	512	Pasture & Hayland Planting	acres			6.0	1994
Perry	1080	556	Planned Grazing System	acres			13.5	1994
Perry	1080	530	Proper Woodland Grazing	acres			7.5	1994
Perry	1080	614	Trough	each	1.0	1990	1.0	1990
Perry	1080	614	Trough	each	1.0	1990	1.0	1990
Perry	1080	614	Trough	each	1.0	1990	1.0	1990
Perry	1080	633	Waste Utilization	acres			8.5	1994
Perry	1082	395	Fish Stream Improvement	feet	220.0	1991	220.0	1991
Perry	1082	472	Livestock Exclusion	acres	4.0	1991	4.0	1991
Perry	1090							
Perry	1124							
Perry	1126	382	Fencing	feet	600.0	1995	600.0	1995
Perry	1126	472	Livestock Exclusion	acres	3.0	1995	3.0	1989
Perry	1126	512	Pasture & Hayland Planting	acres	5.0	1995	5.0	1988
Perry	1126	558	Roof Runoff Mgmt	system	1.0	1988	1.0	1988
Perry	1126	558	Roof Runoff Mgmt	system	1.0	1995	1.0	1995
Perry	1126	580	Streambank Protection	feet	300.0	1995	3.0	1995
Perry	1127							
Perry	1129	352	Deferred Grazing	acres			14.0	1994
Perry	1129	382	Fencing	feet	332.0	1991	250.0	1991
Perry	1129	382	Fencing	feet	628.0	1991	700.0	1991
Perry	1129	382	Fencing	feet			860.0	1992
Perry	1129	382	Fencing	feet			900.0	1992
Perry	1129	382	Fencing	feet			900.0	1992
Perry	1129	393	Filter Strip	acres	3.0	1991	4.0	1991
Perry	1129	393	Filter Strip	acres			0.4	1992
Perry	1129	575	Livestock Crossing	each			300.0	1992
Perry	1129	510	Pasture & Hayland Mgmt	acres			66.0	1994
Perry	1129	512	Pasture & Hayland Planting	acres			66.0	1994
Perry	1129	516	Pipeline	feet	1802.0	1991	1802.0	1991
Perry	1129	556	Planned Grazing System	acres			66.0	1994
Perry	1129	558	Roof Runoff Mgmt	system			1.0	1991
Perry	1129	614	Trough	each	1.0	1991	1.0	1991

Appendix B. BMPs Implemented on Farms in Study Basins.

Basin	Farm ID	BMP#	BMP Description	Units	Amount Applied	Year Applied	Amount Planned	Year Planned
Perry	1129	614	Trough	each	1.0	1991	1.0	1991
Perry	1129	614	Trough	each	1.0	1991	1.0	1991
Perry	1129	313	Waste Storage Structure	structure			1.0	1994
Perry	1129	633	Waste Utilization	acres			40.0	1994
Perry	1132							
Perry Count					**22**		**42**	
Pierre	22	382	Fencing	feet	50.0	1990	50.0	1990
Pierre	22	393	Filter Strip	acres	0.5	1993	0.5	1993
Pierre	22	472	Livestock Exclusion	acres	3.0	1990	3.0	1990
Pierre	22	528	Prescribed Grazing	acres	3.0	1990	3.0	1990
Pierre	22	558	Roof Runoff Mgmt	system			1.0	1992
Pierre	22	313	Waste Storage Structure	structure			1.0	1991
Pierre	22	633	Waste Utilization	acres			3.0	1992
Pierre	31	352	Deferred Grazing	acres	6.0	1990	6.0	1990
Pierre	31	393	Filter Strip	acres	1.0	1990	1.0	1990
Pierre	31	412	Grassed Waterway	acres	6.0	1990	6.0	1990
Pierre	31	472	Livestock Exclusion	acres	2.2	1990	10.0	1990
Pierre	31	590	Nutrient Mgmt	acres	6.0	1990	6.0	1990
Pierre	31	512	Pasture & Hayland Planting	acres	6.0	1990	6.0	1990
Pierre	31	528	Prescribed Grazing	acres	6.0	1990	6.0	1990
Pierre	31	558	Roof Runoff Mgmt	system	1.0	1990	1.0	1990
Pierre	31	313	Waste Storage Structure	structure	1.0	1990	1.0	1990
Pierre	31	644	Wildlife Wetland Habitat Mgmt	acres			16.0	1995
Pierre Count					**13**		**17**	
Schneider	1	382	Fencing	feet	482.0	1996	482.0	1994
Schneider	1	472	Livestock Exclusion	acres	7.0	1994	7.0	1994
Schneider	1	510	Pasture & Hayland Mgmt	acres	17.0	1994	17.0	1994
Schneider	1	313	Waste Storage Structure	structure	1.0	1994	1.0	1994
Schneider	1	633	Waste Utilization	acres	17.0	1994	17.0	1994
Schneider	3							
Schneider	5	382	Fencing	feet	600.0	1993	600.0	1993
Schneider	5	382	Fencing	feet	1800.0	1993	1800.0	1993
Schneider	5	382	Fencing	feet	1800.0	1994	1800.0	1994
Schneider	5	393	Filter Strip	acres	12.0	1993	12.0	1993
Schneider	5	393	Filter Strip	acres	1.0	1993	1.0	1993
Schneider	5	393	Filter Strip	acres	15.0	1994	15.0	1994
Schneider	5	395	Fish Stream Improvement	feet	1800.0	1993	1800.0	1993
Schneider	5	395	Fish Stream Improvement	feet	600.0	1993	600.0	1993
Schneider	5	395	Fish Stream Improvement	feet	1800.0	1994	1800.0	1994
Schneider	5	472	Livestock Exclusion	acres	25.0	1993	25.0	1993
Schneider	5	472	Livestock Exclusion	acres	2.0	1993	2.0	1993
Schneider	5	472	Livestock Exclusion	acres	45.0	1994	45.0	1994
Schneider	5	633	Waste Utilization	acres	93.0	1993	93.0	1993
Schneider	8							
Schneider	12	342	Critical Area Planting	acres	2.0	1995	2.0	1995
Schneider	12	382	Fencing	feet	5270.0	1995	5270.0	1995
Schneider	12	393	Filter Strip	acres	5.0	1995	5.0	1995
Schneider	12	395	Fish Stream Improvement	feet	2000.0	1995	2000.0	1995
Schneider	12	654	Forest Harvest Trails	acres	427.0	1994	427.0	1994
Schneider	12	490	Forest Site Preparation	acres	427.0	1994	427.0	1994
Schneider	12	666	Forest Stand Improvement	acres	427.0	1994	427.0	1994

Appendix B. BMPs Implemented on Farms in Study Basins.

Basin	Farm ID	BMP#	BMP Description	Units	Amount Applied	Year Applied	Amount Planned	Year Planned
Schneider	12	590	Nutrient Mgmt	acres	110.0	1995	110.0	1995
Schneider	12	510	Pasture & Hayland Mgmt	acres	110.0	1995	110.0	1995
Schneider	12	528	Prescribed Grazing	acres	110.0	1995	110.0	1995
Schneider	12	575	Stock Trails and Walkways	feet	30.0	1994	30.0	1994
Schneider	12	580	Streambank Protection	feet	2000.0	1995	2000.0	1995
Schneider	12	660	Tree/Shrub Pruning	acres	427.0	1994	427.0	1994
Schneider	12	645	Wildlife Upland Habitat Mgmt	acres	600.0	1994	600.0	1994
Schneider	13							
Schneider	17							
Schneider	18							
Schneider	19							
Schneider	25							
Schneider	26							
Schneider	29							
Schneider	32							
Schneider	34							
Schneider	38							
Schneider	39							
Schneider	40	322	Channel Vegetation	acres			1.0	1993
Schneider	40	352	Deferred Grazing	acres			1.0	1993
Schneider	40	395	Fish Stream Improvement	feet			300.0	1993
Schneider	40	510	Pasture & Hayland Mgmt	acres			1.0	1992
Schneider	40	512	Pasture & Hayland Planting	acres			0.1	1992
Schneider	40	313	Waste Storage Structure	structure			1.0	1991
Schneider	40	633	Waste Utilization	acres	1.0	1991	1.0	1991
Schneider	602							
Schneider	989							
Schneider	990							
Schneider	991							
Schneider	992							
Schneider	993							
Schneider	995							
Schneider	997							
Schneider	999	382	Fencing	feet	120.0	1995	120.0	1995
Schneider	999	590	Nutrient Mgmt	acres	1.0	1994	1.0	1994
Schneider	999	512	Pasture & Hayland Planting	acres	1.0	1994	1.0	1994
Schneider	999	528	Prescribed Grazing	acres	1.0	1995	1.0	1995
Schneider	999	558	Roof Runoff Mgmt	system	1.0	1994	1.0	1994
Schneider	999	645	Wildlife Upland Habitat Mgmt	acres	10.0	1995	10.0	1995
Schneider Count					**39**		**45**	
Grand Count					**180**		**234**	

Appendix C

Water Quality Data from Totten Eld Inlet Study Basins

Appendix C. Water Quality Data from the Totten and Eld Inlet Study Basins. (Explanatory notes are provided in Appendix D).

SITE	DATE	TIME	FC	K-FC	FLOW	K-	GAGE	K-	TSS	K	TURB	K	TEMP	K	COND	K	PH	K	T-PH	K	DO	K	T-DO	K	PREC	API	A24HR	APISLP
BCUL	11/29/94	835	3200						18		26		6.2		55													
BCUL	12/06/94	1440	200						2		9		4		55													
BCUL	12/13/94	905	320		0.19				5		15		4.4		47													
BCUL	12/19/94	1245	770						11		18		8.3		43													
BCUL	02/21/95	1455	60						5		7.8		9.8		81													
BCUL	03/14/95	1100	240						9		16		9.8		70													
BCUL	04/18/95	1450	69						6		8		13.2		68													
BUR	07/29/86	1145	240																									
BUR	12/12/86	1500	55		0.050								6.4												0.04	1.73	0.12	-0.08
BUR	02/04/87	1345	55		0.25								8.3												0.06	4.03	0.11	-0.37
BUR	04/06/87	950	1100		0.090								9.2												0.14	0.67	0.12	0.07
BUR	07/27/87																											
BUR	12/07/87	1250	285		0.18								7.5												0.46	4.14	0.64	0.26
BUR	01/06/88	1045	255		0.11								3.25												0.01	0.57	0.00	-0.07
BUR	02/01/88	1018	60		0.080								1.8												0.00	1.14	0.00	-0.14
BUR	02/29/88	1000	56		0.12								9.5												0.07	0.51	0.00	-0.05
BUR	07/05/88	1445	50										10.4															
BUR	12/06/88	925	725		0.53								9												0.33	1.85	0.23	0.07
BUR	12/06/88	925	740		0.53								9												0.33	1.85	0.23	0.07
BUR	01/03/89	852	385		0.65								7.2												0.40	2.82	0.14	-0.14
BUR	01/03/89	852	480		0.65								7.2												0.40	2.82	0.14	-0.14
BUR	01/03/89	1435	190		0.20								7												0.40	2.82	0.14	-0.14
BUR	03/06/89	1000	3125		1.3								6.5												0.19	1.92	0.51	0.35
BUR	03/06/89	1000	3750		1.3								6.5												0.19	1.92	0.51	0.35
BUR	04/04/89	1155	100		0.62								8.5												0.55	2.93	0.25	-0.02
BUR	04/04/89	1155	135		0.62								8.5												0.55	2.93	0.25	-0.02
BUR	07/03/89	1222	120		0.030								17															
BUR	07/03/89	1222	135		0.030								17															
BUR	08/07/89	1355	455																									
BUR	11/06/89	855	1150										10												0.80	1.69	0.00	-0.11
BUR	12/04/89	1430	250		1.9								5.9												2.27	5.25	0.81	0.53
BUR	01/03/90	1435	190		0.20								7												0.22	1.06	0.01	-0.09
BUR	03/05/90	1525	85		0.18								6.2												0.02	1.20	0.02	-0.12
BUR	07/09/90	1339	320																									
BUR	07/09/90	1339	370																									
BUR	08/13/90	1500																										
BUR	11/13/90	1030	710		0.93								9.25												0.91	3.44	0.49	0.23
BUR	12/10/90	1400	45		0.70								9.2												0.32	4.10	0.34	-0.09
BUR	01/10/91	803	80		0.59								5												0.48	2.47	0.41	0.21
BUR	02/06/91	1410	30		0.57								7												0.00	2.36	0.02	-0.27
BUR	03/05/91	1325	50		0.51								7												0.10	2.71	0.22	-0.08
BUR	07/07/91	918	800																									
BUR	08/06/91																											
BUR	12/16/91	830	205		0.080								4.8												0.00	1.61	0.00	-0.20
BUR	12/16/91	830	900		0.080								4.8												0.00	1.61	0.00	-0.20
BUR	01/28/92	1446	940		2.5								9												1.32	4.50	1.48	1.25
BUR	02/18/92	1130	345		0.73								6.7												0.54	2.24	0.27	0.09
BUR	07/21/92	1600																										
BUR	08/17/92	1100																										
BUR	11/11/92	1300	2300		0.14				10		19		8.6		360										0.48	1.93	0.01	0.32
BUR	11/11/92	1300	2400						13		21		8.6		360													
BUR	11/17/92	1555	400		0.080				104		35		10.3		800		7.3		10.5						0.61	2.00	0.29	0.46
BUR	11/23/92	1105	190		0.090				4		11		6.4		555										0.00	3.03	0.05	-0.34
BUR	12/01/92	710	100		0.14				3		12		5.4		195										0.05	2.23	0.52	-0.19
BUR	12/08/92	1055	1000		0.34				50		18		5.3		163										0.68	1.87	0.06	0.55
BUR	12/15/92	1635	69		0.10				3		8.5		5		430		7.3		5.1		12.8		2.0		0.00	1.88	0.11	-0.21
BUR	12/21/92	935	150		0.36				3		8		4.5		162										0.27	2.28	0.27	0.05
BUR	12/28/92	1450	450		0.49				8		9.5		5.4		190										0.20	1.81	0.34	0.02
BUR	01/05/93	955	54		0.16				8		7.7		3.2		133										0.00	1.72	0.36	-0.19
BUR	01/12/93	1425	130		0.040				23		8.2		0.3		79		7.4		2.0		15.0	J	0.5		0.00	0.82	0.00	-0.09
BUR	01/19/93	950	2000	JH >	1.6				113		41		1.3		110										0.50	0.92	0.00	0.45
BUR	01/26/93	1345	52		0.74				5		6.9		7.1		178										0.07	3.08	0.79	-0.26
BUR	02/02/93	1625	44		0.060	g			3		6.7		6.1		248		6.8		6.9		9.5		6.5		0.00	1.60	0.00	-0.18
BUR	02/09/93	1320	61		0.080				11		7.8		8.2		950													
BUR	02/09/93	1320	36		0.070				10		8.3		8.2		950										0.10	0.88	0.02	0.01
BUR	02/16/93	845	37		0.040				20		8.7		1.5		340										0.00	0.44	0.00	-0.05
BUR	02/23/93	1220	17		0.050				5		6.9		3.8		925										0.00	0.27	0.00	-0.03
BUR	03/02/93	1425	52		0.040				4		7.1		6.7		545										0.11	0.46	0.25	0.07
BUR	03/09/93	1220	27		0.040				3		6.8		8.7		880		6.7		10.1		11.7		8.9		0.00	0.65	0.00	-0.07

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SITE	DATE	TIME	FC	K-FC	FLOW	K-	GAGE	K-	TSS	K	TURB	K	TEMP	K	COND	K	PH	K	T-PH	K	DO	K	T-DO	K	PREC	API	A24HR	APISLP
BUR	03/16/93	1500	51		0.080				12		9.1		7.3		308										0.61	1.46	0.04	0.52
BUR	03/23/93	1315	84		0.71				7		9		11.1		185										0.17	2.57	1.56	-0.10
BUR	03/30/93	1355	9		0.11				8		6.4		11.5		900										0.16	1.40	0.01	0.02
BUR	04/06/93	1215	19		0.080				7		7		9.3		790													
BUR	04/06/93	1215	32		0.090				10		9.3		9.3		825										0.10	1.34	0.03	-0.04
BUR	04/13/93	1450	26		0.20				15		8.2		9.9		488										0.18	2.44	0.00	-0.07
BUR	11/16/93	1330	2700	J	0.055				36		32		7.2		3940	L									0.13	0.50	0.21	0.09
BUR	11/22/93	1030			0.030	r																			0.04	0.55	0.27	-0.02
BUR	11/30/93	1315	2200		0.065				61		54		5.8		1300	J									0.85	1.90	0.58	0.73
BUR	12/07/93	740	2500		0.61				23		35		5.1		140		7.6		7.2		11.6		7.0		0.50	2.30	0.05	0.30
BUR	12/14/93	1300	200						6		18		8		285													
BUR	12/14/93	1300	210		0.24				6		18		8		290										0.01	2.55	0.18	-0.27
BUR	12/21/93	725	165		0.047	r			5		15		4.8		265										0.00	1.25	0.00	-0.14
BUR	12/21/93	750	120						6		14		4.9		250													
BUR	12/28/93	1140	180		0.021				22		16.3		4.8		1880										0.08	0.68	0.00	0.01
BUR	01/04/94	1650	630		1.5				20		21		8.2		115		7.0		8.4		10.6		8.2		0.45	2.76	0.31	0.19
BUR	01/11/94	1145	300		0.26				29		31		8.5		290										0.04	2.07	0.30	-0.19
BUR	01/18/94	1500	170		0.068				7		13		6.4		500										0.00	1.05	0.00	-0.12
BUR	01/23/94	930	250		0.14	r			14		21		8.3		142										0.12	1.22	0.41	0.00
BUR	01/25/94	1045	180		0.14	r			12		18		7.8		168										0.00	1.25	0.30	-0.14
BUR	02/01/94	1430	190		0.052	r			5		11		5.6		590										0.00	0.60	0.00	-0.07
BUR	02/08/94	1045	150		0.043	r			43		14		1.8		2200	J	6.6		3.6		12.8		1.9		0.00	0.29	0.00	-0.03
BUR	02/08/94	1100	170						28		12		1.9		1300													
BUR	02/14/94	1515	77		0.20	r			6		13		6.9		155										0.04	1.68	1.50	-0.14
BUR	02/15/94	1555	630		2.0				24		28		7.2		84										1.10	2.62	0.04	0.93
BUR	02/22/94	945	42		0.26				5		11		5		170										0.55	2.87	0.43	0.29
BUR	02/22/94	1100	1						4		4.6		5.7		68													
BUR	03/01/94	1455	310		0.23	r			10		15		10		144		6.1		10.5		10.5		10.5		0.00	2.35	0.07	-0.26
BUR	03/01/94	1455	260						13		16																	
BUR	03/02/94	1540	310		0.87	r			16		21		10.6		110										0.83	2.94	0.00	0.60
BUR	03/08/94	945	56						6		7.4																	
BUR	03/08/94	945	63		0.066	r			5		7.9		5.5		168										0.00	2.18	0.00	-0.24
BUR	03/15/94	1410	100						8		8.2																	
BUR	03/15/94	1410	120		0.047	r			6		8.6		10.3		350		6.0		10.4						0.07	1.23	0.00	-0.06
BUR	03/21/94	1525	210		0.28	r			9		12		8.8		115										0.29	2.42	0.47	0.05
BUR	03/21/94	1525	200						10		12																	
BUR	03/22/94	850	180		0.32				4		8.1		5.4		126										0.40	2.57	0.29	0.16
BUR	03/29/94	1320	28		0.043	r			12		8		14.7		560										0.00	1.23	0.00	-0.14
BUR	04/05/94	935	40		0.040	r			11		8.1		8.5		690										0.27	0.87	0.00	0.20
BUR	04/06/94	1055	2100	J	0.058	r			16		18		9.3		355										0.36	1.14	0.27	0.27
BUR	04/06/94	1055	1800	J					16		18																	
BUR	04/12/94	1340	60		0.047	r			9		12		13.9		380										0.17	1.19	0.00	0.06
BUR	04/19/94	1500	130		0.037	r			15		12		13.9		660										0.00	0.65	0.02	-0.07
BUR	05/04/94	1000			0.062																							
BUR	11/15/94	945	2000		0.26	r			146		90		7.7		490										0.25	2.06	0.10	0.05
BUR	11/21/94	555	300		0.26	r			10		16		3.8		2000	>									0.00	1.86	0.00	-0.21
BUR	11/29/94	820	3000		2.55	r			26		30		6.2		85										1.05	2.87	0.24	0.85
BUR	12/06/94	1435	120		0.26	r			4		9.2		4		370										0.00	3.37	0.09	-0.37
BUR	12/13/94	850	310		0.19				8		18		4.4		50										0.00	2.34	0.00	-0.26
BUR	12/19/94	1240	1000		5.1	r			11		19		8.3		58										1.37	4.52	0.27	1.02
BUR	12/20/94	1340	270		6.5	r			8		13		8.4		49										1.35	5.42	1.37	0.90
BUR	12/27/94	750	370		15	r			13		17		8.4		37		6.3		10.2		11.1		8.8		1.11	6.30	2.45	0.53
BUR	01/03/95	1315	45		0.19	r			3		6.4		3.2		275										0.00	3.03	0.00	-0.34
BUR	01/10/95	755	120		0.41	r			3		11		5.8		55										0.19	2.34	0.38	-0.05
BUR	01/17/95	1250	400		0.25	r			7		12		5.7		150		6.3		6.5		12.0		5.7		0.20	1.99	0.04	0.00
BUR	01/24/95	1650	180		0.14				2		9.1		4.9		455										0.00	1.04	0.00	-0.12
BUR	01/31/95	1235	200		2.3				54		40		9.8		135										1.36	3.43	0.79	1.13
BUR	02/07/95	1615	220		0.20	r			4		8.8		9.2		185		7.1		9.9		11.1		9.2		0.00	1.74	0.00	-0.19
BUR	02/14/95	1220	78		0.19	r			6		10		3.6		50										0.01	1.07	0.00	-0.11
BUR	02/21/95	1455	40		0.26	r			5		7.7		9.8		81										0.00	4.50	0.07	-0.50
BUR	02/28/95	1040	220		0.17	r			5		6.6		4.6		220										0.00	2.20	0.00	-0.24
BUR	03/07/95	1630	200		0.16	r			6		8.5		8.1		275		6.5		8.7		12.3		8.2		0.00	1.27	0.00	-0.14
BUR	03/14/95	1100	200		0.95	r			10		16		9.8		70										0.45	3.23	0.32	0.14
BUR	03/21/95	1430	110		0.78				5		11		10		90										0.49	3.56	0.57	0.15
BUR	03/28/95	1115	53		0.15				4		6.6		9.2		175										0.00	1.76	0.00	-0.20
BUR	04/04/95	1350	1200		0.10				8		10		13		270										0.20	1.10	0.00	0.10
BUR	04/11/95	1005	220		0.11				4		8.3		8.4		218										0.00	1.29	0.28	-0.14
BUR	04/18/95	1440	51	X	0.13	r			7		8.2		13.2		450										0.05	1.04	0.04	-0.06
BUR	11/14/95	710	320		0.36				6		15		10.8		90										0.00	4.87	0.40	-0.43

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SITE	DATE	TIME	FC	K-FC	FLOW	K-	GAGE	K-	TSS	K	TURB	K	TEMP	K	COND	K	PH	K	T-PH	K	DO	K	T-DO	K	PREC	API	A24HR	APISLP
BUR	11/20/95	845	89		0.090				7		16		7.3		525										0.00	3.41	0.01	-0.27
BUR	11/28/95	1535	260		0.80				8		14		11.4		135										0.54	4.93	1.07	0.16
BUR	12/05/95	1130	130		0.35				4		7.5		6.9		100		7.2		6.9		11.7		7.0		0.00	5.19	0.00	-0.47
BUR	12/12/95	1520	320						6		11																	
BUR	12/12/95	1520	230		1.2				6		12		9.1		64										0.72	5.09	0.34	0.35
BUR	12/19/95	925	46		0.50				4		9		7.8		105										0.00	3.85	0.14	-0.32
BUR	12/26/95	1440	56		0.11				2		7.6		5		375										0.00	2.36	0.00	-0.15
BUR	01/02/96	940	87		0.28				5		12		8.7		106										0.41	3.31	0.03	0.20
BUR	01/09/96	1510	88		0.62				6		12		8.3		112										0.07	3.95	0.00	-0.25
BUR	01/16/96	1725	53		0.55				4		10		7.5		118		7.6		8.0		11.8		7.7		0.13	3.82	1.09	-0.17
BUR	01/23/96	1335	32		0.89				4		8.8		6.1		110										0.38	4.13	0.22	0.07
BUR	01/30/96	1700	34		0.21				233		60		1.7		275										0.00	2.87	0.01	-0.21
BUR	02/06/96	1420	1400		8.9				43		36		6.4		45		6.5		7.0		12.5		6.2		2.95	5.29	1.32	2.69
BUR	02/13/96	1550	29		0.50				3		8.4		7		148										0.00	5.73	0.00	-0.53
BUR	02/13/96	1550	29						3		8.4																	
BUR	02/20/96	1410	33		0.40	g			4		13		8.4		135										0.35	4.57	0.24	-0.01
BUR	02/27/96	1700	28						16		10																	
BUR	02/27/96	1700	22		0.28				17		11		4.5		160										0.00	3.33	0.00	-0.26
BUR	03/05/96	1245	35		0.28				3		12		6.5		210										0.18	2.99	0.33	-0.02
BUR	03/12/96	1610	51		0.28				6		13		10.4		152										0.02	2.55	0.07	-0.15
BUR	03/12/96	1610	53						6		13																	
BUR	03/19/96	1230	22		0.11				6		11		11.5		385										0.07	0.81	0.00	-0.01
BUR	03/26/96	1625	12		0.080				7		10		10.2		340		6.8		10.4		10.9		10.1		0.00	0.65	0.00	-0.07
BUR	04/02/96	1130	25		0.070				5		11		9.9		480										0.00	0.86	0.32	-0.10
BUR	04/09/96	1515	620		0.080				12		13		14		840										0.00	0.52	0.00	-0.06
BUR	04/16/96	1255	1200		0.24				7		16		13.4		289										0.20	2.65	0.73	0.04
BUR	11/12/96	1225	330		0.070				18		40		11.2		1280	lab									0.39	1.55	0.17	0.26
BUR	11/19/96	815	1400		0.39				20		33		5.2		275										0.86	2.11	0.00	0.72
BUR	11/25/96	1200	71		0.22				11		20		7.4		324										0.25	2.34	0.28	0.02
BUR	12/03/96	740	92	X	0.32				3		14		5.2		113		6.9		4.3		13.5		5.1		0.00	2.56	0.56	-0.28
BUR	12/10/96	1100	180		0.89				6		15		7.5		90										0.70	3.87	0.09	0.35
BUR	12/17/96	700	31		0.24				7		12		3.8		208										0.00	2.67	0.00	-0.30
BUR	12/22/96	1100	60		0.41				2		13		5.6		120										0.20	2.47	0.26	-0.05
BUR	12/22/96	1100	81						3		14				118										0.20	2.47	0.26	-0.05
BUR	01/07/97	1005	40		0.78				4		10		6.9		97										0.04	6.00	1.01	-0.62
BUR	01/14/97	1510	16		0.27				4		11		3.0		272										0.00	2.97	0.00	-0.33
BUR	01/21/97	1035	69		0.62				4		11		6.5		109										0.03	3.43	0.46	-0.35
BUR	01/28/97	1410	130		0.39				6		13		5.4		185		6.6		6.4		11.8		5.3		0.17	2.59	0.51	-0.10
BUR	02/04/97	1000	6		0.22				4		11		3.8		78		6.5		3.7		12.1		3.8		0.00	2.40	0.00	-0.27
BUR	02/11/97	1435	17		0.30				8		16		4.8		275										0.64	2.01	0.00	0.49
BUR	02/18/97	1020	36		0.32				3		11		6.8		112										1.06	3.32	0.25	0.81
BUR	02/18/97	1030	27						3		12		6.8		114										1.06	3.32	0.25	0.81
BUR	02/25/97	1415	22		0.16				4		9.5		7.6		140										0.01	1.95	0.00	-0.21
BUR	03/04/97	1640	14		1.1	g			3		11		7.0		142										0.01	2.79	0.17	-0.30
BUR	03/11/97	1310	75		0.33				3		10		8.5		227										0.23	3.23	0.00	-0.10
BUR	03/18/97	930	140		1.42				8		17		8.4		57										1.90	5.03	0.24	1.55
BUR	03/25/97	1350	8		0.28				5		10		13.3		105										0.00	3.26	0.00	-0.36
BUR	04/01/97	1420	32		0.14				5		11		10.5		86		6.4		11.3		11.4	e	10.4		0.00	2.35	0.26	-0.26
BUR	04/08/97	1410	270		0.090				24		24		10.2		320										0.07	1.21	0.00	-0.06
BUR	04/08/97	1410	260						23		25														0.07	1.21	0.00	-0.06
BUR	04/15/97	855	480		0.13				9		13		9.8		265										0.18	0.84	0.09	0.11
BUR	04/15/97	855	650						12		13		9.8		267										0.18	0.84	0.09	0.11
BUR	04/28/95	1345			0.10																				0.11	0.83	0.28	0.03
KND	07/29/86	1240	20										16.2															
KND	12/12/86	1609	15		60	g							7.9												0.04	1.73	0.12	-0.08
KND	02/04/87	1232	1		150	g							7.7												0.06	4.03	0.11	-0.37
KND	04/06/87	917	1		30	g							8.9												0.14	0.67	0.12	0.07
KND	07/27/87	1401	5		4.1								16.1															
KND	12/07/87	1450	55		135								7.75												0.46	4.14	0.64	0.26
KND	01/06/88	1041	15		22								6.5												0.01	0.57	0.00	-0.07
KND	02/01/88	930	5		54								3												0.00	1.14	0.00	-0.14
KND	02/29/88	1130	4		32								9												0.07	0.51	0.00	-0.05
KND	07/05/88	1304	5		9.2								10.4															
KND	08/03/88	1323	1		4.4								15															
KND	08/03/88	1328	10		4.4								15															
KND	12/06/88	1310	1		86								7.3												0.33	1.85	0.23	0.07
KND	01/03/89	1040	1		163								12												0.40	2.82	0.14	-0.14
KND	03/06/89	1115	5		123								6												0.19	1.92	0.51	0.35
KND	04/03/89	1030	1		204								6												0.12	1.85	0.19	0.00

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SITE	DATE	TIME	FC	K-FC	FLOW	K-	GAGE	K-	TSS	K	TURB	K	TEMP	K	COND	K	PH	K	T-PH	K	DO	K	T-DO	K	PREC	API	A24HR	APISLP
KND	07/03/89	1050	20		20								12															
KND	08/07/89	1500	45		4.5								17															
KND	11/06/89	1015	85		17								9.5												0.80	1.69	0.00	-0.11
KND	12/04/89	1200	165										6.8												2.27	5.25	0.81	0.53
KND	01/03/90	1323	1		47								3.2												0.22	1.06	0.01	-0.09
KND	03/05/90	1400	10		64								4.2												0.02	1.20	0.02	-0.12
KND	07/09/90	1030	70		12								14															
KND	08/13/90	1308	30		4.1								16.5															
KND	11/13/90	858	50										11												0.91	3.44	0.49	0.23
KND	12/10/90	910	15		188								9												0.32	4.10	0.34	-0.09
KND	01/10/91	945	5		219								6												0.48	2.47	0.41	0.21
KND	02/06/91	1210	5		179								6												0.00	2.36	0.02	-0.27
KND	03/05/91	1200	1		178								6												0.10	2.71	0.22	-0.08
KND	07/09/91	1021	20		9.1								13.8															
KND	08/06/91	1010	15		6.4								14.7															
KND	12/16/91	1045	1		87								6												0.00	1.61	0.00	-0.20
KND	01/28/92	1125	50										8.8												1.32	4.50	1.48	1.25
KND	02/18/92	1415	15		91								7.1												0.54	2.24	0.27	0.09
KND	07/21/92	1510	40		3.8								15															
KND	08/17/92	1235	20		3.1								16.1															
KND	11/11/92	1145	35		21		0.8		15		3.2		8.2		109										0.48	1.93	0.01	0.32
KND	11/17/92	1010	9		23		0.9		10		2.5		9.3		108		7.3		9.4						0.61	2.00	0.29	0.46
KND	11/23/92	1320	11		98				8		2.5		7		82										0.00	3.03	0.05	-0.34
KND	11/23/92	1320	10		101				8		3				81													
KND	12/01/92	1105	22		55		1.39		2		1.1		6.4		85										0.05	2.23	0.52	-0.19
KND	12/08/92	1235	28		41		1.14		2		0.4		6.1		90										0.68	1.87	0.06	0.55
KND	12/15/92	1500	6		107		2.01		3		1.5		6.2		72		7.4		6.3		12.2		3.2		0.00	1.88	0.11	-0.21
KND	12/21/92	1200	21		190		2.45		14		4.6		5.8		70										0.27	2.28	0.27	0.05
KND	12/28/92	1230	10		100		1.91		2		0.7		4.9		74													
KND	12/28/92	1230	5		97		1.91		2		1.4		4.9		74										0.20	1.81	0.34	0.02
KND	01/05/93	1215	5		80		1.76		1		0.5		4		75										0.00	1.72	0.36	-0.19
KND	01/12/93	1255	4		38		1.04		2		0.5		2.2		84		7.3		2.4		15.0	J	1.0		0.00	0.82	0.00	-0.09
KND	01/19/93	1200	57	JH	42		1.07		5		1.4		3.8		83										0.50	0.92	0.00	0.45
KND	01/26/93	1220	9		260	r	3.22		21		6.4		7		65										0.07	3.08	0.79	-0.26
KND	02/02/93	1410	1	U	84		2.08		3		1.1		5.7		71		6.7		6.8		9.3		5.9		0.00	1.60	0.00	-0.18
KND	02/09/93	1200	1		50		1.64		2		0.6		7.2		80										0.10	0.88	0.02	0.01
KND	02/16/93	1035	2		23		1.12		2		0.5		3.1		84										0.00	0.44	0.00	-0.05
KND	02/23/93	1420	3		20		0.95		2		0.7		4.3		90										0.00	0.27	0.00	-0.03
KND	03/02/93	1230	4		17		0.84		1		3.6		5.4		91										0.11	0.46	0.25	0.07
KND	03/09/93	1445	1	U	25		0.96		1		0.4		7.4		88		6.9		8.9		12.6		7.5		0.00	0.65	0.00	-0.07
KND	03/09/93	1445	1	U	25		0.96		2		0.5				88		6.9		8.8									
KND	03/16/93	1300	4		33		1.08		2		0.5		6.3		82										0.61	1.46	0.04	0.52
KND	03/23/93	1525	7		196	r	2.78		21		5.9		8.8		67										0.17	2.57	1.56	-0.10
KND	03/30/93	1215	2		58		1.46		3		1.1		7.6		77										0.16	1.40	0.01	0.02
KND	04/06/93	1350	1	U	40		1.24		1		1.7		8.5		82										0.10	1.34	0.03	-0.04
KND	04/13/93	1310	2		94		1.8		3		0.8		8.1		75										0.18	2.44	0.00	-0.07
KND	11/16/93	1550	52				0.1		10		5.2		6.6		111													
KND	11/16/93	1550	96		6.5		0.1		11		5.4		6.6		112										0.13	0.50	0.21	0.09
KND	11/22/93	1200	53		10		0.26		14		5.1		4.8		88										0.04	0.55	0.27	-0.02
KND	11/30/93	1525	20		13		0.3		9		3.8		5.7		100										0.85	1.90	0.58	0.73
KND	12/07/93	940	16		54		1.43		5		3.5		5.9		68		7.8		8.7		11.2		7.0		0.50	2.30	0.05	0.30
KND	12/14/93	1415	12		134		2.28		6		3.6		8		66										0.01	2.55	0.18	-0.27
KND	12/21/93	1015	9		50		1.28		2		1		6.4		72										0.00	1.25	0.00	-0.14
KND	12/28/93	1035	8		14	r	0.72		1		0.8		4.9		79										0.08	0.68	0.00	0.01
KND	01/04/94	1515	19		202		2.56		32		16		8.6		57		6.9		8.8		10.8		9.0		0.45	2.76	0.31	0.19
KND	01/11/94	1220	4		74	r	1.68		3		2.2		8.3		65										0.04	2.07	0.30	-0.19
KND	01/18/94	1340	2		55		1.12		2		1		6.5		71										0.00	1.05	0.00	-0.12
KND	01/23/94	1015	24		30	r	1.06		3		1.6		8.5		75										0.12	1.22	0.41	0.00
KND	01/25/94	1155	8		30	r	1.06		2		1.6		7.8		71										0.00	1.25	0.30	-0.14
KND	02/01/94	1100	28		14	r	0.72		1		1		4.8		73										0.00	0.60	0.00	-0.07
KND	02/08/94	1235	6		7.8	r	0.52		1		0.7		3.2		78		6.4		3.8		12.6		3.1		0.00	0.29	0.00	-0.03
KND	02/14/94	1555	12						6		3.6																	
KND	02/14/94	1555	13		84	r	1.8		6		4		6.4		63										0.04	1.68	1.50	-0.14
KND	02/15/94	1430	10		152		2.2		18		12		6.8		60										1.10	2.62	0.04	0.93
KND	02/22/94	1120	6		101	r	1.98		20		2.6		6		61										0.55	2.87	0.43	0.29
KND	03/01/94	1345	1	U	114	r	2.11		6		4.4		8.8		61		6.0		9.4		10.8		10.0		0.00	2.35	0.07	-0.26
KND	03/02/94	1630	1		135	r	2.3		12		6.4		9.3		60										0.83	2.94	0.00	0.60
KND	03/08/94	925	1		81	r	1.76		7		3.3		6.3		63										0.00	2.18	0.00	-0.24
KND	03/15/94	1455	1		32	r	1.08		3		1.3		9.2		65		6.0		9.4						0.07	1.23	0.00	-0.06

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SITE	DATE	TIME	FC	K-FC	FLOW	K-	GAGE	K-	TSS	K	TURB	K	TEMP	K	COND	K	PH	K	T-PH	K	DO	K	T-DO	K	PREC	API	A24HR	APISLP
KND	03/21/94	1500	2		117	r	2.14		7		4.1		6.9		58										0.29	2.42	0.47	0.05
KND	03/22/94	1045	1		99	r	1.96		5		3.1		6.1		58										0.40	2.57	0.29	0.16
KND	03/29/94	1440	1	U	29	r	1.04		3		1.5		10.4		70										0.00	1.23	0.00	-0.14
KND	04/05/94	1015	1	U	12	r	0.66		2		1		8.1		74										0.27	0.87	0.00	0.20
KND	04/06/94	1020	9		18	r	0.8		3		1.7		8.4		71										0.36	1.14	0.27	0.27
KND	04/12/94	1305	1	U	27	r	1		3		2		10		65										0.17	1.19	0.00	0.06
KND	04/19/94	1415	1		13	r	0.67		2		1.1		12		85										0.00	0.65	0.02	-0.07
KND	05/04/94	1140			21		0.5																					
KND	11/15/94	1015	25		27	r	1.06		9		4.3		8.3		67										0.25	2.06	0.10	0.05
KND	11/21/94	645	4		29	r	1.1		6		2.7		5.4		60										0.00	1.86	0.00	-0.21
KND	11/29/94	935	59		146	r	2.14		40		15		6.8		57										1.05	2.87	0.24	0.85
KND	12/06/94	1400	6		92	r	1.84		6		3		5.1		57										0.00	3.37	0.09	-0.37
KND	12/13/94	1040	22		108		1.66		3		2.4		5.7		65										0.00	2.34	0.00	-0.26
KND	12/19/94	1205	15		655	r	3.1		13		8.2		8		50										1.37	4.52	0.27	1.02
KND	12/20/94	1320	29		3500	r	4.85		186		110		8.4		37										1.35	5.42	1.37	0.90
KND	12/27/94	915	57		2200	r	4.6		179		120		8.5		38		6.6		10.6		12.2		8.4		1.11	6.30	2.45	0.53
KND	01/03/95	1235	4		137	r	2.1		5		3.5		4.2		55										0.00	3.03	0.00	-0.34
KND	01/10/95	1030	10		92		1.93		4		3		6.8		57										0.19	2.34	0.38	-0.05
KND	01/17/95	1355	3		118	r	2		3		2		5.2		55		6.6		7.0		7.0		6.1		0.20	1.99	0.04	0.00
KND	01/24/95	1550	2		65		1.66		2		2.1		5.4		58										0.00	1.04	0.00	-0.12
KND	01/31/95	1455	17		896	r	3.3		86		45		8.8		45										1.36	3.43	0.79	1.13
KND	02/07/95	1530	1		97	r	1.88		4		2.2		8.3		58		7.0		9.4		11.1		8.2		0.00	1.74	0.00	-0.19
KND	02/14/95	1140	1		43	r	1.36		2		2		3.8		60										0.01	1.07	0.00	-0.11
KND	02/21/95	1425	3		924	r	3.32		32		20		8.3		46										0.00	4.50	0.07	-0.50
KND	02/28/95	950	1		144	r	2.13		4		2.4		5.5		56										0.00	2.20	0.00	-0.24
KND	03/07/95	1540	1		74	r	1.7		2		1.5		6.6		61		6.5		7.6		12.0		6.8		0.00	1.27	0.00	-0.14
KND	03/14/95	1015	11		709	r	3.15		21		11		8.2		45										0.45	3.23	0.32	0.14
KND	03/21/95	1325	18		709	r	3.15		17		13		8		45										0.49	3.56	0.57	0.15
KND	03/21/95	1325	10				3.15		18		13		8		45													
KND	03/28/95	1000	1		88		2.08		4		2.2		7.2		55										0.00	1.76	0.00	-0.20
KND	04/04/95	1225	3		39		1.41		3		1.5		10.9		63										0.20	1.10	0.00	0.10
KND	04/11/95	1125	1	U	55		1.48		2		1.7		7.9		60										0.00	1.29	0.28	-0.14
KND	04/18/95	1615	1		40	r	1.31		2		1.1		9.6		64										0.05	1.04	0.04	-0.06
KND	04/28/95	1440			38		1.11																		0.11	0.83	0.28	0.03
KND	11/14/95	850	33		200	r	2.46		13		6.9		10.8		57										0.00	4.87	0.40	-0.43
KND	11/20/95	1035	4		73		1.68		5		3.6		8.3		62										0.00	3.41	0.01	-0.27
KND	11/28/95	1215	40						25		14																	
KND	11/28/95	1215	20		350	r	3.07		26		15		10.7		52										0.54	4.93	1.07	0.16
KND	12/05/95	1500	3		193		2.34		10		7		7.8		54		7.5		7.7		11.1		7.8		0.00	5.19	0.00	-0.47
KND	12/12/95	1410	20		291		2.92		13		8.9		9		49										0.72	5.09	0.34	0.35
KND	12/19/95	1125	5		173		2.2		7		4.1		8.5		54										0.00	3.85	0.14	-0.32
KND	12/26/95	1330	14		71		1.5		3		1.7		4.6		61										0.00	2.36	0.00	-0.15
KND	01/02/96	1115	14		127		1.88		4		3		8.8		55										0.41	3.31	0.03	0.20
KND	01/09/96	1630	12		200	r	2.44		10		5.8		8.4		48										0.07	3.95	0.00	-0.25
KND	01/16/96	1555	5		244		2.49		8		6		7.7		49		7.5		9.0		11.5		7.8		0.13	3.82	1.09	-0.17
KND	01/23/96	1500	12		305		2.8		7		5.8		6.4		45										0.38	4.13	0.22	0.07
KND	01/30/96	1520	5		95		1.62		4		2.7		3		58										0.00	2.87	0.01	-0.21
KND	02/06/96	1620	48		1000	r	3.45		135		70		6.8		45		6.5		7.2		12.0		6.4		2.95	5.29	1.32	2.69
KND	02/13/96	1355	3		159		2.35		9		5.1		6.6		57										0.00	5.73	0.00	-0.53
KND	02/20/96	1330	3		190	r	2.34		7		5.1		7.6		54										0.35	4.57	0.24	-0.01
KND	02/27/96	1445	1		116		2.02		4		2.7		5.3		56										0.00	3.33	0.00	-0.26
KND	03/05/96	1410	2		81		1.7		3		2		6.8		60										0.18	2.99	0.33	-0.02
KND	03/12/96	1410	1	U	79		1.7		3		2		9		60										0.02	2.55	0.07	-0.15
KND	03/19/96	1500	1		50		1.39		2		1.7		9.5		66										0.07	0.81	0.00	-0.01
KND	03/26/96	1430	1		35		1.22		2		1.1				75		6.7		8.3		11.9		7.9		0.00	0.65	0.00	-0.07
KND	04/02/96	1320	1	U	36		1.24		2		1.2		8.3		71										0.00	0.86	0.32	-0.10
KND	04/09/96	1355	1		24		1.12		2		1.1		11.8		78										0.00	0.52	0.00	-0.06
KND	04/16/96	1545	5		82		1.68		4		3.3		11.2		63										0.20	2.65	0.73	0.04
KND	04/16/96	1545	11						4		3.4																	
KND	11/12/96	1350	67		26		0.81		15		9.4		10.2		69										0.39	1.55	0.17	0.26
KND	11/19/96	945	31		92		1.64		12		5.5		5.8		51										0.86	2.11	0.00	0.72
KND	11/25/96	1300	63		211	r	2.21		26		10		7.4		63										0.25	2.34	0.28	0.02
KND	12/03/96	1040	17		183		2.02		13		6.6		6.3		58		6.5		5.9		11.6		6.2		0.00	2.56	0.56	-0.28
KND	12/10/96	1305	36		244		2.48		11		7.0		7.9		55										0.70	3.87	0.09	0.35
KND	12/17/96	930	16		128		1.58		5		3.0		5.4		60										0.00	2.67	0.00	-0.30
KND	12/17/96	930	19						5		3.1				60										0.00	2.67	0.00	-0.30
KND	12/22/96	1340	15	X	119		1.58		5		3.2		6.2		58										0.20	2.47	0.26	-0.05
KND	01/07/97	1255	30		369	r	3.30		14		8.6		7.5		48										0.04	6.00	1.01	-0.62
KND	01/14/97	1400	14		102		1.50		7		4.1		4.2		56										0.00	2.97	0.00	-0.33

Appendix C. Water Quality Data from the Totten and Eld Inlet Study Basins. (Explanatory notes are provided in Appendix D).

SITE	DATE	TIME	FC	K-FC	FLOW	K-	GAGE	K-	TSS	K	TURB	K	TEMP	K	COND	K	PH	K	T-PH	K	DO	K	T-DO	K	PREC	API	A24HR	APISLP
KND	01/21/97	1235	11		200		2.06		5		2.7		7.0		52										0.03	3.43	0.46	-0.35
KND	01/21/97	1235	15						4		3.1														0.03	3.43	0.46	-0.35
KND	01/28/97	1300	33		113		1.56		2		2.8		5.3		55		6.4		5.6		11.5		5.3		0.17	2.59	0.51	-0.10
KND	02/04/97	1145	1		123		1.68		3		2.1		5.3		56		6.4		5.6		11.7		5.2		0.00	2.40	0.00	-0.27
KND	02/11/97	1625	1		68		1.23		2		1.3		5.4		55										0.64	2.01	0.00	0.49
KND	02/18/97	1150	4		155		1.86		4		2.3		7.2		54										1.06	3.32	0.25	0.81
KND	02/25/97	1530	6		100		1.50		4		2.7		7.8		58										0.01	1.95	0.00	-0.21
KND	03/04/97	1540	3		160	r	1.86		3		2.3		6.5		52										0.01	2.79	0.17	-0.30
KND	03/11/97	1412	3		184		1.90		3		2.2	J	7.5		50										0.23	3.23	0.00	-0.10
KND	03/18/97	1110	13		241	r	2.42		8		4.2		7.8		49										1.90	5.03	0.24	1.55
KND	03/25/97	1450	2		133		1.53		6		3.0		9.7		57										0.00	3.26	0.00	-0.36
KND	04/01/97	1530	2		81		1.26		2		1.9		8.4		58		6.5		8.9		12.0	e	8.3		0.00	2.35	0.26	-0.26
KND	04/08/97	1620	6		50		1.08		3		1.4		9.3		64										0.07	1.21	0.00	-0.06
KND	04/15/97	1035	4		52		1.08		3		1.4		9.3		64										0.18	0.84	0.09	0.11
MCL	08/22/83		170	MP									16.8															
MCL	09/06/83		1600	MP	2.9								13.5												0.00	1.04	0.00	-0.12
MCL	09/19/83		170	MP	6.1								10.3												0.00	1.27	0.75	-0.14
MCL	10/03/83		1600	MP	3.4								10.7												0.05	0.32	0.00	-0.03
MCL	10/17/83		540	MP	3.7								10.2												0.22	0.32	0.03	0.02
MCL	10/31/83		79	MP	4.8								10.1												0.00	0.76	0.27	0.21
MCL	11/28/83		33	MP									8.9												0.09	3.64	0.00	-0.44
MCL	12/12/83		79	MP	113								7.2												0.42	3.57	0.02	-0.37
MCL	12/27/83		33	MP	32								3.1												0.40	1.63	0.26	0.14
MCL	01/10/84		7.8	MP	67								7.4												0.30	2.48	0.00	-0.27
MCL	01/23/84		79	MP	68								6.1												0.92	2.04	0.46	0.37
MCL	02/06/84		7.8	MP	33								7.2												0.00	1.14	0.00	-0.14
MCL	02/21/84		49	MP	64								5.8												0.09	2.04	0.55	0.37
MCL	03/05/84		4.5	MP	45								5.7												0.00	1.41	0.00	-0.17
MCL	03/21/84		110	MP	80								7.8												0.44	3.50	0.57	0.26
MCL	04/05/84		1.8	MP	37								8.2												0.01	1.32	0.12	-0.03
MCL	04/18/84		46	MP	55								8.8												0.32	1.55	0.00	-0.15
MCL	04/25/84			MP																					0.00	1.08	0.17	0.06
MCL	05/03/84		7.8	MP	68								8.2															
MCL	05/16/84		33	MP	28								10.3															
MCL	05/31/84		4.5	MP	37								10.9															
MCL	06/12/84		1.8	MP	16								12.9															
MCL	06/25/84		79	MP	10								15.7															
MCL	07/09/84		79	MP	8.2								12.8															
MCL	07/23/84		170	MP									16.6															
MCL	08/06/84		79	MP	4.1								14.8															
MCL	05/29/85		142		7.7								11.2															
MCL	06/16/86	915	10										12.4															
MCL	12/10/86	1000	10		24								4.1												0.00	1.95	0.00	-0.24
MCL	02/03/87	1403	15		100																				0.11	4.41	0.23	-0.27
MCL	04/06/87	1718	20		22								10.3												0.14	0.67	0.12	0.07
MCL	07/27/87	1225	315		2.3								14.7															
MCL	12/01/87	1015	1000		33								9.5												1.44	2.54	0.13	0.01
MCL	01/05/88	1122	65		13								3.8												0.00	0.63	0.00	-0.08
MCL	02/02/88	1410	30		25								3.5												0.09	1.12	0.00	-0.13
MCL	03/01/88	1330	250		24								9												0.02	0.47	0.07	0.02
MCL	07/05/88	1115	250		5.6								11.8															
MCL	08/02/88	1240	320		2.8								14															
MCL	12/07/88	1303	5		48								9												0.00	1.67	0.33	0.16
MCL	01/04/89	1039	1		104								7.2												0.11	2.65	0.40	0.13
MCL	03/07/89	1000	45		72								3.5												0.12	1.85	0.19	0.00
MCL	04/04/89	1100	15		90								7												0.55	2.93	0.25	-0.02
MCL	07/05/89	1017	180		7.5								11															
MCL	08/08/89	1055	375		3.4								14.5															
MCL	11/07/89	1130	150		20								9												0.04	1.56	0.80	0.70
MCL	12/05/89	1525	35										6												0.01	4.73	2.27	1.94
MCL	01/02/90	1030	115		22								5												0.01	0.94	0.35	0.27
MCL	03/07/90	1100	210		99								7.8												0.33	1.76	0.51	0.39
MCL	07/10/90	1338	150		6.1								15.5															
MCL	08/14/90	1335	150		4.0								15															
MCL	08/14/90	1335	175		4.0								15															
MCL	11/06/90	940	20		88								8												0.05	1.54	0.00	-0.18
MCL	12/10/90	1110	30		88								8.5												0.32	4.10	0.34	-0.09
MCL	01/10/91	1220	70		131								5												0.48	2.47	0.41	0.21
MCL	02/06/91	1020	10		129								5.5												0.00	2.36	0.02	-0.27

Appendix C. Water Quality Data from the Totten and Eld Inlet Study Basins. (Explanatory notes are provided in Appendix D).

SITE	DATE	TIME	FC	K-FC	FLOW	K-	GAGE	K-	TSS	K	TURB	K	TEMP	K	COND	K	PH	K	T-PH	K	DO	K	T-DO	K	PREC	API	A24HR	APISLP
MCL	03/05/91	950	1		117								5.5												0.10	2.71	0.22	-0.08
MCL	07/09/91	1605	105		5.1								13.5															
MCL	08/07/91	1500	425		2.9								15.8															
MCL	11/18/91	1455	55		20								8.59												0.10	1.78	0.31	0.14
MCL	12/10/91	1045	40		54								6.1												0.06	2.43	0.31	0.05
MCL	01/28/92	1159	80										9												1.32	4.50	1.48	1.25
MCL	02/18/92	930	45		68								7												0.54	2.24	0.27	0.09
MCL	07/14/92	1400	170		3.0								14.9															
MCL	08/13/92	1510	405		2.3								19															
MCL	11/11/92	915	110		15				11		3.5		7.5		95										0.48	1.93	0.01	0.32
MCL	11/17/92	1140	240		11				17		4.9		9.3		99		7.2		9.3						0.61	2.00	0.29	0.46
MCL	11/23/92	1000	60		53				11		4		6.3		78										0.00	3.03	0.05	-0.34
MCL	12/01/92	1405	26		27				5		2.1		6.6		82										0.05	2.23	0.52	-0.19
MCL	12/08/92	940	79		21		0.51		4		1.9		5.4		82										0.68	1.87	0.06	0.55
MCL	12/15/92	1110	47		41	r	0.72		2		1.6		5.1		79		6.8		5.3		12.1		2.2		0.00	1.88	0.11	-0.21
MCL	12/21/92	1435	27		99		1.5		7		2.5		6.6		67										0.27	2.28	0.27	0.05
MCL	12/28/92	1540	27		69		1.04		2		1.5		6		71										0.20	1.81	0.34	0.02
MCL	01/05/93	915	57		43		0.76		2		1.6		3.7		72										0.00	1.72	0.36	-0.19
MCL	01/12/93	1135	21		21		0.44		4		0.8		2.7		80		7.1		2.8		14.9		1.5		0.00	0.82	0.00	-0.09
MCL	01/12/93	1135	28				0.44		3		1.6		2.7		80		7.1		3.2									
MCL	01/19/93	930	83	JH	20		0.46		4		1.8		3.65		80										0.50	0.92	0.00	0.45
MCL	01/26/93	1105	13		191		1.96		18		6.5		7.2		62										0.07	3.08	0.79	-0.26
MCL	02/02/93	1015	6		43		0.68		2		1.1		5.5		70		6.7		5.6		9.5		5.8		0.00	1.60	0.00	-0.18
MCL	02/09/93	1010	39		27		0.3		2		1.1		7.1		76										0.10	0.88	0.02	0.01
MCL	02/16/93	1155	25		16		0.1		2		1.4		3.2		78										0.00	0.44	0.00	-0.05
MCL	02/23/93	955	31		15		0.05		1		0.6		3.3		78										0.00	0.27	0.00	-0.03
MCL	03/02/93	940	10		14		0.04		1		0.9		4.9		80										0.11	0.46	0.25	0.07
MCL	03/02/93	940	14		14		0.04		2		0.9				82													
MCL	03/09/93	1110	80		25		0.22		2		1.1		6.3		75		6.9		7.5		12.5		6.0		0.00	0.65	0.00	-0.07
MCL	03/16/93	1115	13		24		0.22		1		0.7		6		75										0.61	1.46	0.04	0.52
MCL	03/23/93	1200	55	S	136		1.56		19		6.3		8.8		65										0.17	2.57	1.56	-0.10
MCL	03/30/93	1100	27		34		0.38		1		0.5		7.2		72										0.16	1.40	0.01	0.02
MCL	04/06/93	1030	64		28		0.22		1		2.1		8.1		74										0.10	1.34	0.03	-0.04
MCL	04/13/93	1025	36		75		0.78		6		2.8		7.75		72													
MCL	04/13/93	1025	43		75		0.78		6		3.1		7.75		72										0.18	2.44	0.00	-0.07
MCL	11/16/93	1230	65		4.3		-0.04		15		6.4		5.9		94										0.13	0.50	0.21	0.09
MCL	11/22/93	1320	33		4.3		0.03		10		7.7		3.8		90										0.04	0.55	0.27	-0.02
MCL	11/22/93	1325	47						11		7.1		3.8		90													
MCL	11/30/93	1055	120		8.4		0.03		23		9		5		91										0.85	1.90	0.58	0.73
MCL	12/07/93	1310	40		28		0.46		11		7.7		5.9		80		7.0				11.1		7.8		0.50	2.30	0.05	0.30
MCL	12/14/93	1040	55		48		0.75		6		4.7		7.8		65										0.01	2.55	0.18	-0.27
MCL	12/21/93	815	12		19		0.27		5		1.2		5.5		73										0.00	1.25	0.00	-0.14
MCL	12/28/93	1000	20		12	r	0.14		3		2.1		4.2		77										0.08	0.68	0.00	0.01
MCL	01/04/94	1255	76		190		2.16		36		16		8.8		53		6.7		9.5		10.5		9.0		0.45	2.76	0.31	0.19
MCL	01/11/94	1110	8		80	r	0.98		3		2.5		8.3		60										0.04	2.07	0.30	-0.19
MCL	01/18/94	1220	31		34		0.52		9		3.8		6.3		65										0.00	1.05	0.00	-0.12
MCL	01/23/94	905	31		48	r	0.59		3		2.4		8.4		66										0.12	1.22	0.41	0.00
MCL	01/25/94	950	27		46	r	0.56		2		2.3		7.5		64										0.00	1.25	0.30	-0.14
MCL	02/01/94	1305	12		25	r	0.3		1		1.1		5.2		69		6.1				11.5				0.00	0.60	0.00	-0.07
MCL	02/08/94	1325	8		16	r	0.2		2		1.5		3.1		50		6.3		3.7		12.4		3.1		0.00	0.29	0.00	-0.03
MCL	02/14/94	1455	51	S	81	r	1		5		4		6.4		60										0.04	1.68	1.50	-0.14
MCL	02/15/94	1300	260		157		1.72		40		24		6.8		52										1.10	2.62	0.04	0.93
MCL	02/22/94	820	49		81	r	1		4		3.4		5.5		58										0.55	2.87	0.43	0.29
MCL	03/01/94	1250	16		107	r	1.32		6		3		9.1		57		6.0		9.7		10.6		9.8		0.00	2.35	0.07	-0.26
MCL	03/02/94	1520	80		151	r	1.86		28		14		9.6		52										0.83	2.94	0.00	0.60
MCL	03/08/94	850	12		67	r	0.83		4		2.6		5.8		58										0.00	2.18	0.00	-0.24
MCL	03/15/94	1215	6		34	r	0.42		3		2		8.9		65		5.9		9.2						0.07	1.23	0.00	-0.06
MCL	03/21/94	1425	80		112	r	1.38		5		3.6		7.1		56										0.29	2.42	0.47	0.05
MCL	03/22/94	1135	16		102	r	1.26		3		2.9		6.5		50										0.40	2.57	0.29	0.16
MCL	03/22/94	1135	12						3		2.8																	
MCL	03/29/94	1545	21		42	r	0.52		3		1.6		11.2		64										0.00	1.23	0.00	-0.14
MCL	04/05/94	1050	16		25	r	0.3		3		1.5		8.4		65										0.27	0.87	0.00	0.20
MCL	04/05/94	1050	12						2		1.5																	
MCL	04/06/94	945	92		45	r	0.55		5		3.2		8.4		62										0.36	1.14	0.27	0.27
MCL	04/12/94	1220	12		42	r	0.52		3		2		9.8		64										0.17	1.19	0.00	0.06
MCL	04/19/94	1320	9		25	r	0.3		3		1.5		11.2		81										0.00	0.65	0.02	-0.07
MCL	05/04/94	1245			16		0.21																					
MCL	11/15/94	840	37		6.0	r	0.32		11		4		7.6		63										0.25	2.06	0.10	0.05
MCL	11/21/94	805	35				0.48		8		4.2		4.3		58													

Appendix C. Water Quality Data from the Totten and Eld Inlet Study Basins. (Explanatory notes are provided in Appendix D).

SITE	DATE	TIME	FC	K-FC	FLOW	K-	GAGE	K-	TSS	K	TURB	K	TEMP	K	COND	K	PH	K	T-PH	K	DO	K	T-DO	K	PREC	API	A24HR	APISLP
MCL	11/21/94	805	35		6.3	r	0.48		7		4.5		4.3		54										0.00	1.86	0.00	-0.21
MCL	11/29/94	1025	310		503	r	2.35		67		38		6.7		47										1.05	2.87	0.24	0.85
MCL	12/06/94	1300	35		33	r	0.96		11		6		5		52										0.00	3.37	0.09	-0.37
MCL	12/13/94	1220	12		58		1		16		7.6		5.6		60										0.00	2.34	0.00	-0.26
MCL	12/19/94	1050	84	S	413	r	2.25		29		15		8.2		43										1.37	4.52	0.27	1.02
MCL	12/20/94	1140	40		2100	r	4.11		126		75		8.4		34		6.2		9.4		10.9				1.35	5.42	1.37	0.90
MCL	12/27/94	1030	124	JS			4.94		204		130		8		27													
MCL	12/27/94	1030	116		3500	r	4.94		238		140		8		27										1.11	6.30	2.45	0.53
MCL	01/03/95	1055	20		49	r	1.16		4		2.7		3.9		48										0.00	3.03	0.00	-0.34
MCL	01/10/95	1225	23		56		1.1		3		3		7.1		52										0.19	2.34	0.38	-0.05
MCL	01/17/95	1535	100		62	r	1.28		7		5.2		6.4		48		6.7		7.1		11.3		6.5		0.20	1.99	0.04	0.00
MCL	01/24/95	1325	10		44		1		2		1.8		5.6		52										0.00	1.04	0.00	-0.12
MCL	01/31/95	1050	92		800	r	2.94		64		35		8.9		39										1.36	3.43	0.79	1.13
MCL	02/07/95	1425	8				1.05		4		2.3		8.6		52		6.6		9.6		10.6		8.5					
MCL	02/07/95	1425	13		39	r	1.05		4		2.7		8.6		52		6.6		9.6		10.6		8.5		0.00	1.74	0.00	-0.19
MCL	02/14/95	1005	51		22	r	0.75		3		2.2		3.2		52										0.01	1.07	0.00	-0.11
MCL	02/21/95	1345	40		375	r	2.2		23		14		8.5		40										0.00	4.50	0.07	-0.50
MCL	02/28/95	900	16		41	r	1.07		4		2.6		4.7		49										0.00	2.20	0.00	-0.24
MCL	03/07/95	1425	8		32	r	0.95		1		1.4		6.8		54		6.3		8.1		11.5		6.8		0.00	1.27	0.00	-0.14
MCL	03/07/95	1425	8				0.95		2		1.5		6.8		54		6.3		8.1		11.5		6.8					
MCL	03/14/95	905	100	S	340	r	2.15		19		11		8.1		42										0.45	3.23	0.32	0.14
MCL	03/21/95	1050	35	JS	154		1.93		8		5.5		7.6		42										0.49	3.56	0.57	0.15
MCL	03/28/95	1310	8		48		1.16		2		1.3		8.7		50										0.00	1.76	0.00	-0.20
MCL	03/28/95	1310	12		48		1.16		2		1.4		8.7		50													
MCL	04/04/95	945	160		32		1.02		3		1.9		8.8		57										0.20	1.10	0.00	0.10
MCL	04/11/95	1255	49		32		1.04		1	U	1.6		8.2		56										0.00	1.29	0.28	-0.14
MCL	04/18/95	1340	24		32	r	0.94		2		1.2		8.6		57										0.05	1.04	0.04	-0.06
MCL	04/28/95	1215			23		0.9																		0.11	0.83	0.28	0.03
MCL	11/14/95	1055	27		121		1.75		10		6		10.8		50										0.00	4.87	0.40	-0.43
MCL	11/20/95	1225	10						6		3.7				55													
MCL	11/20/95	1225	21		52		1		6		4.5		8.4		55										0.00	3.41	0.01	-0.27
MCL	11/28/95	1325	76		194		2.3		14		8.9		10.9		45										0.54	4.93	1.07	0.16
MCL	12/05/95	920	19		103		1.68		10		6.1		7.3		46		6.9		7.2		10.4		7.4		0.00	5.19	0.00	-0.47
MCL	12/12/95	1235	22		160		2.14		10		6.6		9		45										0.72	5.09	0.34	0.35
MCL	12/19/95	750	56		83		1.28		5		2.9		8.2		48										0.00	3.85	0.14	-0.32
MCL	12/26/95	1050	57		37		0.59		3		1.7		4.2		53										0.00	2.36	0.00	-0.15
MCL	01/02/96	815	17		67		1.08		4		3		8.7		53										0.41	3.31	0.03	0.20
MCL	01/09/96	1315	14		126		1.76		13		9		8.4		44										0.07	3.95	0.00	-0.25
MCL	01/16/96	1245	23		147		1.78		9		6.4		7.8		45		7.2		8.8		11.1		5.5		0.13	3.82	1.09	-0.17
MCL	01/23/96	1140	44		190	r	2.15		7		5.4		5.8		40										0.38	4.13	0.22	0.07
MCL	01/30/96	1240	10		53		0.75		2		2.2		3		52										0.00	2.87	0.01	-0.21
MCL	02/06/96	1210	160		380	r	3.12		68		40		6.3		40		6.2		7.2		11.6		6.2		2.95	5.29	1.32	2.69
MCL	02/13/96	1145	2		79		1.54		6		3.7		6.3		50										0.00	5.73	0.00	-0.53
MCL	02/20/96	1250	33		110	r	1.68		6		4.9		7.7		48										0.35	4.57	0.24	-0.01
MCL	02/27/96	1200	8		69		1.24		2		2		5		52										0.00	3.33	0.00	-0.26
MCL	03/05/96	1055	18		53		1.05		2		2.1		6.7		54										0.18	2.99	0.33	-0.02
MCL	03/12/96	1235	19		60		1.1		3		2.6		9.1		54										0.02	2.55	0.07	-0.15
MCL	03/19/96	1035	8		37		0.8		2		2.5		8.7		60										0.07	0.81	0.00	-0.01
MCL	03/26/96	1220	14		26		0.62		2		1.6		7		62		6.6		8.2		11.9		6.9		0.00	0.65	0.00	-0.07
MCL	04/02/96	940	28						2		2																	
MCL	04/02/96	940	27		28		0.67		2		2.1		7.5		62										0.00	0.86	0.32	-0.10
MCL	04/09/96	1200	22	X	18		0.5		2		1.9		11.8		69										0.00	0.52	0.00	-0.06
MCL	04/16/96	1015	120		53		0.98		2		2.3		10.1		59										0.20	2.65	0.73	0.04
MCL	11/12/96	1020	37		27		0.76		13		6.3		10.2		64										0.39	1.55	0.17	0.26
MCL	11/19/96	1055	92		55		1.18		13		8.2		5.0		58										0.86	2.11	0.00	0.72
MCL	11/25/96	1005	77		112		1.74		20		9.8		7.2		54										0.25	2.34	0.28	0.02
MCL	11/25/96	1005	60				1.74		21		10		7.2		54										0.25	2.34	0.28	0.02
MCL	12/03/96	1215	19		114		1.62		8		4.5		6.3		51		6.6		6.4		11.3		6.1		0.00	2.56	0.56	-0.28
MCL	12/03/96	1215	17						7		4.6														0.00	2.56	0.56	-0.28
MCL	12/10/96	930	65		127		1.74		8		5.4		7.8		49										0.70	3.87	0.09	0.35
MCL	12/17/96	1015	29		66		1.07		4		2.5		5.0		55										0.00	2.67	0.00	-0.30
MCL	12/22/96	900	36		75		1.29		4		2.6		6.0		52										0.20	2.47	0.26	-0.05
MCL	01/07/97	825	38		188	r	2.42		8		4.7		6.8		41										0.04	6.00	1.01	-0.62
MCL	01/14/97	1135	24		49		1.06		3		2.8		3.4		51										0.00	2.97	0.00	-0.33
MCL	01/21/97	915	30		110		1.66		3		2.7		7.0		47										0.03	3.43	0.46	-0.35
MCL	01/28/97	1000	66		90		1.42		3		4.1		5.2		47		6.5		5.9		11.0		5.1		0.17	2.59	0.51	-0.10
MCL	01/28/97	1020	58						3		3.1		5.3		48		8.1		5.8		11.2		5.1		0.17	2.59	0.51	-0.10
MCL	02/04/97	810	31	X	65		1.26		3		2.2		5.2		48		6.7		5.0		11.2		5.2		0.00	2.40	0.00	-0.27
MCL	02/11/97	1200	14		41		0.90		2		1.5		5.4		55										0.64	2.01	0.00	0.49

Appendix C. Water Quality Data from the Totten and Eld Inlet Study Basins. (Explanatory notes are provided in Appendix D).

SITE	DATE	TIME	FC	K-FC	FLOW	K-	GAGE	K-	TSS	K	TURB	K	TEMP	K	COND	K	PH	K	T-PH	K	DO	K	T-DO	K	PREC	API	A24HR	APISLP
MCL	02/18/97	850	13		83		1.40		3		2.5		7.0		70										1.06	3.32	0.25	0.81
MCL	02/25/97	1225	4		59		1.18		3		1.4		7.2		73										0.01	1.95	0.00	-0.21
MCL	03/04/97	1210	4		105		1.66		3		2.4		6.5		47										0.01	2.79	0.17	-0.30
MCL	03/04/97	1305	1						3		1.8		6.5		47										0.01	2.79	0.17	-0.30
MCL	03/11/97	1125	4		114		1.62		4		2.6	J	7.5		47										0.23	3.23	0.00	-0.10
MCL	03/18/97	735	28		137		2.01		8		6.0		7.8		44										1.90	5.03	0.24	1.55
MCL	03/25/97	1215	1		78		1.44		4		2.4		9.3		51										0.00	3.26	0.00	-0.36
MCL	04/01/97	1220	2		50		1.16		2		1.9		7.5		54		6.6		7.8		12.2	e	7.5		0.00	2.35	0.26	-0.26
MCL	04/01/97	1225	1						1		2.0		7.6		54		6.6		7.8		11.6	e	7.6		0.00	2.35	0.26	-0.26
MCL	04/08/97	1235	13		27		0.91		2		1.6		8.8		58										0.07	1.21	0.00	-0.06
MCL	04/15/97	700	19		42		0.98		6		3.8		9.1		59										0.18	0.84	0.09	0.11
PIE	07/29/86	1145	79										18.1															
PIE	12/12/86	1520	25		0.030								5.9												0.04	1.73	0.12	-0.08
PIE	02/04/87	1325	15		0.34								8.2												0.06	4.03	0.11	-0.37
PIE	04/06/87	1004	90		0.060								8.3												0.14	0.67	0.12	0.07
PIE	07/27/87		360																									
PIE	12/07/87	1320	115		0.45								7.75												0.46	4.14	0.64	0.26
PIE	01/06/88	1100																							0.01	0.57	0.00	-0.07
PIE	02/01/88	1045	5		0.078								3.5												0.00	1.14	0.00	-0.14
PIE	02/29/88	1018	24		0.011								8.25												0.07	0.51	0.00	-0.05
PIE	07/05/88	1402	160		0.10								15.7															
PIE	08/03/88	1400	35		0.095								25.5															
PIE	08/03/88	1405	45		0.095								25.5															
PIE	12/06/88	1010	60		0.74								9.5												0.33	1.85	0.23	0.07
PIE	01/03/89	820	55		0.47								7												0.40	2.82	0.14	-0.14
PIE	01/03/89	1445	20		0.11								8.5												0.40	2.82	0.14	-0.14
PIE	03/06/89	1025	130		1.6								6.5												0.19	1.92	0.51	0.35
PIE	04/04/89	1130	10		1.3								8.5												0.55	2.93	0.25	-0.02
PIE	07/03/89	1037	140										16															
PIE	08/07/89	1325	545										26															
PIE	11/06/89	830	125										9.75												0.80	1.69	0.00	-0.11
PIE	12/04/89	1530	215										6.2												2.27	5.25	0.81	0.53
PIE	01/03/90	1445	200		0.11								7												0.22	1.06	0.01	-0.09
PIE	03/05/90	1545	10		0.12								4.8												0.02	1.20	0.02	-0.12
PIE	07/09/90	1230	100										16.5															
PIE	08/13/90	1500																										
PIE	11/13/90	1010	730		2.2								9.5												0.91	3.44	0.49	0.23
PIE	12/10/90	1425	35		0.77								8.5												0.32	4.10	0.34	-0.09
PIE	01/10/91	830	205		0.60								4.3												0.48	2.47	0.41	0.21
PIE	02/06/91	1440	85		0.47								7.4												0.00	2.36	0.02	-0.27
PIE	02/06/91	1440	85		0.47								7.4												0.00	2.36	0.02	-0.27
PIE	02/06/91	1440	120		0.47								7.4												0.00	2.36	0.02	-0.27
PIE	03/05/91	1305	50		0.36								7.5												0.10	2.71	0.22	-0.08
PIE	03/05/91	1305	105		0.36								7.5												0.10	2.71	0.22	-0.08
PIE	07/07/91	935	80																									
PIE	08/06/91																											
PIE	12/16/91	922	15		0.10								4.2												0.00	1.61	0.00	-0.20
PIE	01/28/92	1418	70		2.5								9.8												1.32	4.50	1.48	1.25
PIE	02/18/92	1145	180		1.0								7												0.54	2.24	0.27	0.09
PIE	07/21/92	1545	355		0.030								22															
PIE	08/17/92	1145			0.00																							
PIE	11/11/92	1330	3000	J	0.070				4		31		8.3		108										0.48	1.93	0.01	0.32
PIE	11/17/92	1530	77		0.030				2		21		9.8		100		7.4		9.8						0.61	2.00	0.29	0.46
PIE	11/23/92	1130	84	S	0.15				3		14		5.3		66										0.00	3.03	0.05	-0.34
PIE	12/01/92	1140	51		0.15				2		14		5.1		68										0.05	2.23	0.52	-0.19
PIE	12/01/92	1215	75		0.16				2		14		5.3		68													
PIE	12/08/92	1025	1200	J	0.38		0.41		5		20		4.7		68										0.68	1.87	0.06	0.55
PIE	12/15/92	1720	22		0.090		0.33		1		9		4.5		69		7.5		4.7				1.5		0.00	1.88	0.11	-0.21
PIE	12/21/92	1010	96		0.64		0.44		1		9.5		4		68										0.27	2.28	0.27	0.05
PIE	12/28/92	1425	180		0.85		0.45		3		9		4.9		67										0.20	1.81	0.34	0.02
PIE	01/05/93	1035	32		0.17		0.36		1		6.5		1.5		67										0.00	1.72	0.36	-0.19
PIE	01/12/93	1400	32		0.040		0.28		1		4.8		1.2		1300	J	7.1		3.1		14.8		0.2		0.00	0.82	0.00	-0.09
PIE	01/19/93	1030	2000	JH>	2.8		0.6		28		27		0.6		55										0.50	0.92	0.00	0.45
PIE	01/26/93	1425	49		0.78		0.46		2		7.6		7.7		62													
PIE	01/26/93	1425	35		0.87		0.46		1		7.7		7.7		62										0.07	3.08	0.79	-0.26
PIE	02/02/93	1605	20		0.084	r	0.32		1	U	6.3		6.4		70		6.8		7.8		9.5		6.8		0.00	1.60	0.00	-0.18
PIE	02/09/93	1350	16		0.070		0.3		1	U	6.5		7.5		85										0.10	0.88	0.02	0.01
PIE	02/16/93	820	20		0.030		0.27		21		4.8		1.9		70										0.00	0.44	0.00	-0.05
PIE	02/23/93	1200	12		0.030		0.28		2		4.7		2.1		76										0.00	0.27	0.00	-0.03

Appendix C. Water Quality Data from the Totten and Eld Inlet Study Basins. (Explanatory notes are provided in Appendix D).

SITE	DATE	TIME	FC	K-FC	FLOW	K-	GAGE	K-	TSS	K	TURB	K	TEMP	K	COND	K	PH	K	T-PH	K	DO	K	T-DO	K	PREC	API	A24HR	APISLP
PIE	03/02/93	1400	18		0.030		0.28		2		4.8		4.5		76										0.11	0.46	0.25	0.07
PIE	03/09/93	1255	6		0.080		0.3		1		5.2		6.8		75		7.1		8.5		11.8		6.9		0.00	0.65	0.00	-0.07
PIE	03/16/93	1435	22		0.080		0.32		3		6.4		7.2		76										0.61	1.46	0.04	0.52
PIE	03/23/93	1345	110	S	1.0		0.48		6		12		12.3		65													
PIE	03/23/93	1345	130	S	0.92		0.48		7		12		12.3		65										0.17	2.57	1.56	-0.10
PIE	03/30/93	1330	19		0.050		0.3		3		4.5		8.8		77										0.16	1.40	0.01	0.02
PIE	04/06/93	1150	12		0.080		0.32		2		3.5		8.8		80										0.10	1.34	0.03	-0.04
PIE	04/13/93	1430	14		0.21		0.36		4		5.7		10.1		75										0.18	2.44	0.00	-0.07
PIE	11/16/93	1415			0.00		0.24																		0.13	0.50	0.21	0.09
PIE	11/22/93	1040			0.00		0.26																		0.04	0.55	0.27	-0.02
PIE	11/30/93	1410	3000		0.005		0.34		3		34		5.5		122										0.85	1.90	0.58	0.73
PIE	12/07/93	825	1600		0.67		0.43		6		25		4.6		66		7.5		7.2		12.3		6.0		0.50	2.30	0.05	0.30
PIE	12/07/93	850	1300				0.42		4		24		4.6		70		7.0		7.4		12.3		6.0					
PIE	12/14/93	1225	160		0.35		0.38		2		11		7.7		67										0.01	2.55	0.18	-0.27
PIE	12/21/93	740	31		0.057	r	0.3		1	U	7.2		4.6		76										0.00	1.25	0.00	-0.14
PIE	12/28/93	1205	28		0.038	r	0.28		1		7		3.6		81										0.08	0.68	0.00	0.01
PIE	01/04/94	1620	100		2.2		0.54		10		17		8.6		55		7.0		8.7		10.9		9.5		0.45	2.76	0.31	0.19
PIE	01/04/94	1620	150				0.54		11		17																	
PIE	01/11/94	1200	63		0.20	r	0.37		3		10		8.7		66										0.04	2.07	0.30	-0.19
PIE	01/18/94	1440	37		0.053		0.32		1		6.5		6.1		76										0.00	1.05	0.00	-0.12
PIE	01/23/94	940	130		0.24	r	0.38		5		14		8.3		72										0.12	1.22	0.41	0.00
PIE	01/25/94	1110	68		0.24	r	0.38		3		11		7.5		70										0.00	1.25	0.30	-0.14
PIE	02/01/94	1405	140		0.070	r	0.31		1		5.3		4.6		75										0.00	0.60	0.00	-0.07
PIE	02/01/94	1405	140				0.31		1		5.3																	
PIE	02/08/94	1130	210		0.047	r	0.29		2		4.7		0.9		87		6.6		1.7		12.5		0.9		0.00	0.29	0.00	-0.03
PIE	02/14/94	1325	80	X	0.33	r	0.4		5		13		7.4		63										0.04	1.68	1.50	-0.14
PIE	02/15/94	1625	100		3.1		0.57		21		25		7.5		50										1.10	2.62	0.04	0.93
PIE	02/15/94	1700	120	S					19		25		7.4		49													
PIE	02/22/94	1020	110		0.22		0.37		2		8.4		5.9		60										0.55	2.87	0.43	0.29
PIE	03/01/94	1520	140		0.38	r	0.41		6		12		11.3		62		6.1		11.5		10.2		11.5		0.00	2.35	0.07	-0.26
PIE	03/02/94	1550	76		1.1	r	0.49		13		18		12.2		57										0.83	2.94	0.00	0.60
PIE	03/08/94	1000	80		0.10	r	0.33		3		5.8		5.2		66										0.00	2.18	0.00	-0.24
PIE	03/15/94	1345	200		0.057	r	0.3		4		6.9		10.7		86		6.0		10.7						0.07	1.23	0.00	-0.06
PIE	03/21/94	1530	63		0.44	r	0.42		5		11		9.7		63										0.29	2.42	0.47	0.05
PIE	03/22/94	940	31		0.40		0.39		4		8.1		5.7		62										0.40	2.57	0.29	0.16
PIE	03/29/94	1340	17		0.047	r	0.29		7		8		12.9		80										0.00	1.23	0.00	-0.14
PIE	04/05/94	945	13		0.038	r	0.28		5		8.9		7.2		82										0.27	0.87	0.00	0.20
PIE	04/06/94	1040	690		0.085	r	0.32		14		18		8.8		80										0.36	1.14	0.27	0.27
PIE	04/12/94	1330	19		0.057	r	0.3		10		12		12.6		76										0.17	1.19	0.00	0.06
PIE	04/19/94	1445	7		0.030	r	0.27		9		14		13.3		98										0.00	0.65	0.02	-0.07
PIE	05/04/94	1020			0.022		0.28																					
PIE	11/15/94	930	1000		0.25	r	0.36		3		8.1		7.3		47										0.25	2.06	0.10	0.05
PIE	11/21/94	615	470		0.25	r	0.36		1		6		2.4		41										0.00	1.86	0.00	-0.21
PIE	11/29/94	855	2400		4.4	r	0.6		9		14		5.8		45										1.05	2.87	0.24	0.85
PIE	12/06/94	1425	830		0.25	r	0.36		2		4.7		2.5		48										0.00	3.37	0.09	-0.37
PIE	12/13/94	830	180		0.18		0.36		1	U	5.1		3.4		55										0.00	2.34	0.00	-0.26
PIE	12/19/94	1225	590		7.5	r	0.66		8		17		8.8		35										1.37	4.52	0.27	1.02
PIE	12/20/94	1350	480		7.5	r	0.68		4		9.3		8.5		35										1.35	5.42	1.37	0.90
PIE	12/20/94	1350	590				0.68		4		10		8.5		35													
PIE	12/27/94	810	460		12	r	0.75		7		10		8.9		32		6.4		10.0		11.5		9.1		1.11	6.30	2.45	0.53
PIE	01/03/95	1300	440		0.12	r	0.3		1	U	5		1.3		52										0.00	3.03	0.00	-0.34
PIE	01/10/95	820	1100		0.62		0.42		2		7.6		5.5		44										0.19	2.34	0.38	-0.05
PIE	01/17/95	1225	310		0.22	r	0.35		2		6.2		5.1		44		6.5		5.9		12.1		5.2		0.20	1.99	0.04	0.00
PIE	01/24/95	1635	390		0.10		0.3		1		5.5		5.5		47										0.00	1.04	0.00	-0.12
PIE	01/31/95	1050	270		4.0		0.64		7		13		11.1		35										1.36	3.43	0.79	1.13
PIE	02/07/95	1600	1200		0.14	r	0.31		2		6.8		10.2		51		7.2		10.9		10.7		10.5		0.00	1.74	0.00	-0.19
PIE	02/14/95	1220	480	J			0.3		1		5.3		2															
PIE	02/14/95	1235	540		0.12	r	0.3		1		6		2												0.01	1.07	0.00	-0.11
PIE	02/21/95	1445	680		0.25	r	0.36		3		8.3		11.8		42										0.00	4.50	0.07	-0.50
PIE	02/28/95	1030	730		0.070	r	0.26		2		4.7		3.2		50										0.00	2.20	0.00	-0.24
PIE	03/07/95	1610	1400		0.060	r	0.24		2		4.9		7.8		52		6.6		8.7		12.2		7.8		0.00	1.27	0.00	-0.14
PIE	03/14/95	1040	230		1.5	r	0.51		8		13		11.1		37										0.45	3.23	0.32	0.14
PIE	03/21/95	1400	270		1.3		0.41		5		10		11		43										0.49	3.56	0.57	0.15
PIE	03/28/95	1200	390		0.090		0.25		3		5.8		8.8		55										0.00	1.76	0.00	-0.20
PIE	04/04/95	1310	150		0.050		0.24		6		10		11.5		67										0.20	1.10	0.00	0.10
PIE	04/04/95	1310	150		0.050		0.24		6		11		11.5		67													
PIE	04/11/95	925	66		0.080		0.28		5		11		7.4		59										0.00	1.29	0.28	-0.14
PIE	04/18/95	1500	14		0.00	r	0.23		5		10		10.3		60										0.05	1.04	0.04	-0.06
PIE	04/28/95	1320			0.070		0.25																		0.11	0.83	0.28	0.03

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SITE	DATE	TIME	FC	K-FC	FLOW	K-	GAGE	K-	TSS	K	TURB	K	TEMP	K	COND	K	PH	K	T-PH	K	DO	K	T-DO	K	PREC	API	A24HR	APISLP
PIE	11/14/95	800	310		0.54		0.36		4		13		10.3		48										0.00	4.87	0.40	-0.43
PIE	11/20/95	910	80		0.080		0.28		2		8.8		6.4		57										0.00	3.41	0.01	-0.27
PIE	11/28/95	1500	210		1.1		0.42		3		12		11.9		52										0.54	4.93	1.07	0.16
PIE	12/05/95	1145	76						2		7.3																	
PIE	12/05/95	1205	100		0.26		0.34		2		7.4		5.9		50		7.3		5.9		12.0		6.0		0.00	5.19	0.00	-0.47
PIE	12/12/95	1500	170		1.6		0.46		5		14		9.3		42										0.72	5.09	0.34	0.35
PIE	12/19/95	1000	160		0.42		0.35		5		9.2		7.1		48										0.00	3.85	0.14	-0.32
PIE	12/26/95	1410	150		0.10		0.27		1		7.5		4.1		57										0.00	2.36	0.00	-0.15
PIE	12/26/95	1425	240						2		7.3																	
PIE	01/02/96	1010	210		0.18		0.32		4		11		8.7		54										0.41	3.31	0.03	0.20
PIE	01/09/96	1535	240		0.39		0.37		3		14		8.3		47										0.07	3.95	0.00	-0.25
PIE	01/16/96	1650	230						3		11																	
PIE	01/16/96	1650	210		0.51		0.37		4		11		7.7		48		7.5		8.0		11.8		7.8		0.13	3.82	1.09	-0.17
PIE	01/23/96	1300	100		0.85		0.4		3		11		5.8		40										0.38	4.13	0.22	0.07
PIE	01/30/96	1645	230		0.14		0.3		1		8.8		1.4		55										0.00	2.87	0.01	-0.21
PIE	02/06/96	1530	450	S	13		0.8		42		39		6.4		34		6.4		7.5		12.6		6.6		2.95	5.29	1.32	2.69
PIE	02/13/96	1515	120		0.24				2		11		8.2		51										0.00	5.73	0.00	-0.53
PIE	02/20/96	1400	110		0.50	g			3		15		9.2		48										0.35	4.57	0.24	-0.01
PIE	02/20/96	1425	88						3		15		9.2		47													
PIE	02/27/96	1640	84		0.19				2		8.2		4.7		53										0.00	3.33	0.00	-0.26
PIE	03/05/96	1230	88		0.40				4		12		7		52										0.18	2.99	0.33	-0.02
PIE	03/12/96	1535	150		0.38				4		11		11.4		57										0.02	2.55	0.07	-0.15
PIE	03/19/96	1300	52		0.090				3		8.6		10.9		61										0.07	0.81	0.00	-0.01
PIE	03/26/96	1605	23		0.060				4		7.1		9.4		70		6.7		9.5		11.1		9.3		0.00	0.65	0.00	-0.07
PIE	04/02/96	1155	28		0.090				3		11		8.6		73										0.00	0.86	0.32	-0.10
PIE	04/09/96	1450	20		0.040				6		11		13.3		89										0.00	0.52	0.00	-0.06
PIE	04/09/96	1450	22						6		11																	
PIE	04/16/96	1320	120		0.39				7		16		14.3		71										0.20	2.65	0.73	0.04
PIE	11/12/96	1145	630		0.090		0.26		2		22		10.5		60										0.39	1.55	0.17	0.26
PIE	11/19/96	835	930		0.57		0.35		4		22		3.4		46										0.86	2.11	0.00	0.72
PIE	11/25/96	1140	450		0.55		0.32		2		14		7.1		51										0.25	2.34	0.28	0.02
PIE	12/03/96	900	280		0.51		0.34		1		9.3		3.7		55		6.5		4.0		13.0		3.7		0.00	2.56	0.56	-0.28
PIE	12/10/96	1120	210						2		12				49										0.70	3.87	0.09	0.35
PIE	12/10/96	1120	270		1.5		0.48		2		12		7.4		49										0.70	3.87	0.09	0.35
PIE	12/17/96	725	55		0.18		0.26		1		7.5		2.0		56										0.00	2.67	0.00	-0.30
PIE	12/22/96	1150	200		0.57		0.37		2		9.9		5.3		50										0.20	2.47	0.26	-0.05
PIE	01/07/97	1130	120						2		9.7				40										0.04	6.00	1.01	-0.62
PIE	01/07/97	1130	80		1.2		0.48		2		9.9		7.5		40										0.04	6.00	1.01	-0.62
PIE	01/14/97	1450	660		0.19		0.30		1		8.3		1.6		51										0.00	2.97	0.00	-0.33
PIE	01/21/97	1110	120		0.75		0.41		2		9.6		6.4		42										0.03	3.43	0.46	-0.35
PIE	01/28/97	1340	160		0.52		0.36		3		12		6.2		43		6.7		7.6		11.6		6.1		0.17	2.59	0.51	-0.10
PIE	02/04/97	1025	69		0.20		0.30		2		7.7		2.1		49		6.6		2.8		13.0		2.1		0.00	2.40	0.00	-0.27
PIE	02/11/97	1415	96		0.35		0.34		6		11		4.8		48										0.64	2.01	0.00	0.49
PIE	02/18/97	1050	100		0.32		0.36		1		8.3		6.9		51										1.06	3.32	0.25	0.81
PIE	02/25/97	1355	96						4		7.7		8.2		53										0.01	1.95	0.00	-0.21
PIE	02/25/97	1355	120		0.13		0.30		5		7.8		8.2		53										0.01	1.95	0.00	-0.21
PIE	03/04/97	1625	36		0.54	r	0.36		3		8.4		8.0		49										0.01	2.79	0.17	-0.30
PIE	03/11/97	1250	65		0.37		0.38		2		10		9.3		49										0.23	3.23	0.00	-0.10
PIE	03/18/97	955	57		1.9		0.58		8		16		9.2		31										1.90	5.03	0.24	1.55
PIE	03/18/97	1000	47				0.58		9		17		9.2		30										1.90	5.03	0.24	1.55
PIE	03/25/97	1330	69		0.12		0.30		5		9.8		14.2		52										0.00	3.26	0.00	-0.36
PIE	04/01/97	1455	35		0.13		0.32		4		9.9		10.7		57		6.4		11.2		10.8	e	10.7		0.00	2.35	0.26	-0.26
PIE	04/08/97	1430	24		0.050		0.27		5		11		10.2		60										0.07	1.21	0.00	-0.06
PIE	04/15/97	925	88		0.11		0.32		7		14		10.2		69										0.18	0.84	0.09	0.11
PRY	08/22/83		23	MP									15															
PRY	09/06/83		7	MP	0.7								13.3												0.00	1.04	0.00	-0.12
PRY	09/19/83		79	MP	2.2								10.7												0.00	1.27	0.75	-0.14
PRY	10/03/83		7	MP	1.1																				0.05	0.32	0.00	-0.03
PRY	10/17/83		33	MP	1.1								8.8												0.22	0.32	0.03	0.02
PRY	10/31/83		4.5	MP	0.7								9.9												0.00	0.76	0.27	0.21
PRY	11/14/83		35	MP	34								9.3												0.87	4.18	0.61	0.27
PRY	11/28/83		79	MP									8.9												0.09	3.64	0.00	-0.44
PRY	12/12/83		17	MP	68								7.3												0.42	3.57	0.02	-0.37
PRY	12/27/83		170	MP	16								2.9												0.40	1.63	0.26	0.14
PRY	01/09/84		27	MP	33								7.8												0.00	2.42	0.03	-0.27
PRY	01/23/84		33	MP	20								6												0.92	2.04	0.46	0.37
PRY	02/06/84		6.8	MP	15								7.1												0.00	1.14	0.00	-0.14
PRY	02/21/84		33	MP	31								5.6												0.09	2.04	0.55	0.37
PRY	03/05/84		7.8	MP	24								5.6												0.00	1.41	0.00	-0.17

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SITE	DATE	TIME	FC	K-FC	FLOW	K-	GAGE	K-	TSS	K	TURB	K	TEMP	K	COND	K	PH	K	T-PH	K	DO	K	T-DO	K	PREC	API	A24HR	APISLP
PRY	03/12/84		13	MP	112								7.7												0.92	1.79	0.13	0.04
PRY	04/05/84		33	MP	15								7.9												0.01	1.32	0.12	-0.03
PRY	04/18/84		79	MP	25								8.7												0.32	1.55	0.00	-0.15
PRY	04/25/84			MP	25								8.7												0.00	1.08	0.17	0.06
PRY	05/03/84		49	MP	46								7															
PRY	05/16/84		33	MP	14								9.2															
PRY	05/31/84		23	MP	18								11															
PRY	06/25/84		33	MP	3.5								15.2															
PRY	07/10/84		33	MP	3.4								12.9															
PRY	07/23/84		33	MP									15.9															
PRY	08/06/84		33	MP	1.6								13.8															
PRY	06/16/86	940	1										12.4															
PRY	12/10/86	930	30		8.9								3.7												0.00	1.95	0.00	-0.24
PRY	02/03/87	1405	65		76								7.8												0.11	4.41	0.23	-0.27
PRY	04/06/87	1655	10		3.5								9.8												0.14	0.67	0.12	0.07
PRY	07/27/87	1208	75		0.8								13.7															
PRY	12/01/87	1105	1000		16								8												1.44	2.54	0.13	0.01
PRY	01/05/88	1149	5		5.5								3.2												0.00	0.63	0.00	-0.08
PRY	02/02/88	1344	10		13								3												0.09	1.12	0.00	-0.13
PRY	03/01/88	1430	10		9.0								9												0.02	0.47	0.07	0.02
PRY	07/05/88	1045	55		1.7								11.8															
PRY	08/02/88	1207	210		0.9								13															
PRY	12/07/88	1217	50		18								9												0.00	1.67	0.33	0.16
PRY	01/04/89	1000	40		38								6												0.11	2.65	0.40	0.13
PRY	03/07/89	930	25		42								5												0.12	1.85	0.19	0.00
PRY	04/04/89	1025	10		51								7.5												0.55	2.93	0.25	-0.02
PRY	07/05/89	930	85		2.2								11															
PRY	08/08/89	1030	95		0.1								13															
PRY	11/07/89	1030	80		0.9								8												0.04	1.56	0.80	0.70
PRY	12/05/89	1450	20		116								10												0.01	4.73	2.27	1.94
PRY	01/02/90	950	45		9.0								7												0.01	0.94	0.35	0.27
PRY	03/07/90	1015	25		38								7.7												0.33	1.76	0.51	0.39
PRY	07/10/90	1415	15		2.6								15															
PRY	08/14/90	1410	45		0.6								14															
PRY	11/06/90	855	25		33								8												0.05	1.54	0.00	-0.18
PRY	12/10/90	1054	85		45								8												0.32	4.10	0.34	-0.09
PRY	01/10/91	1145	25		71								6.1												0.48	2.47	0.41	0.21
PRY	02/06/91	1105	10		87								6												0.00	2.36	0.02	-0.27
PRY	03/05/91	1030	65		64								5.5												0.10	2.71	0.22	-0.08
PRY	07/09/91	1525	85		1.2								13.5															
PRY	08/07/91	1525	80		0.7								15															
PRY	08/07/91	1525	85		0.7								15															
PRY	11/18/91	1536	20		9.2								8.4												0.10	1.78	0.31	0.14
PRY	12/10/91	1007	15		33								6.1												0.06	2.43	0.31	0.05
PRY	01/28/92	1230	40										9												1.32	4.50	1.48	1.25
PRY	01/28/92	1230	60										9												1.32	4.50	1.48	1.25
PRY	02/18/92	1510	75		39								7												0.54	2.24	0.27	0.09
PRY	02/18/92	1510	110		39								7												0.54	2.24	0.27	0.09
PRY	07/14/92	1440	30		1.0								14.9															
PRY	08/13/92	1436	35		0.5								16.8															
PRY	11/11/92	945	140		4.5		1.08		16		2.7		7.3		103										0.48	1.93	0.01	0.32
PRY	11/17/92	1050	46		4.5		1		18		3		8.7		108		7.2		8.9						0.61	2.00	0.29	0.46
PRY	11/23/92	1025	10		29		1.42		9		3		6.1		82										0.00	3.03	0.05	-0.34
PRY	12/01/92	1305	6		16		1.08		4		1.6		6.4		85										0.05	2.23	0.52	-0.19
PRY	12/08/92	850	35		16		1.14		5		1.9		5		76										0.68	1.87	0.06	0.55
PRY	12/15/92	1320	4		27		1.34		3		1.5		5.7		60		7.3		6.1		12.8		2.8		0.00	1.88	0.11	-0.21
PRY	12/21/92	1340	16		59		1.76		5		2		6.5		71										0.27	2.28	0.27	0.05
PRY	12/21/92	1350	12				1.76		4		2		6.4		71													
PRY	12/28/92	1050	22		28		1.37		3		1.1		4.9		75										0.20	1.81	0.34	0.02
PRY	01/05/93	1455	9		21		1.24		1		0.6		3.5		75										0.00	1.72	0.36	-0.19
PRY	01/12/93	1105	7		11		0.93		1		0.5		1.7		82		6.7		2.5		15.0	J	0.4		0.00	0.82	0.00	-0.09
PRY	01/19/93	1310	84	JH	34		1.42		10		5.4		3.5		70										0.50	0.92	0.00	0.45
PRY	01/26/93	1010	7		111		2		7		2.7		7.3		66										0.07	3.08	0.79	-0.26
PRY	02/02/93	1055	5		24		1.24		1	U	0.6		5.4		74		6.8		5.7		10.0		5.5		0.00	1.60	0.00	-0.18
PRY	02/09/93	1040	10		12		1		1		0.5		7.1		80										0.10	0.88	0.02	0.01
PRY	02/16/93	1230	8		6.5		0.88		1	U	0.3		2.7		82										0.00	0.44	0.00	-0.05
PRY	02/16/93	1230	5				0.88		1	U	0.4		2.7		82													
PRY	02/23/93	1105	14		6.1		0.86		1		0.4		3.2		81										0.00	0.27	0.00	-0.03
PRY	03/02/93	1010	7		5.5		0.84		1		0.3		4.5		83										0.11	0.46	0.25	0.07

Appendix C. Water Quality Data from the Totten and Eld Inlet Study Basins. (Explanatory notes are provided in Appendix D).

SITE	DATE	TIME	FC	K-FC	FLOW	K-	GAGE	K-	TSS	K	TURB	K	TEMP	K	COND	K	PH	K	T-PH	K	DO	K	T-DO	K	PREC	API	A24HR	APISLP
PRY	03/09/93	1145	19		12		1.01		1		0.4		6		80		7.0		7.2		13.3		6.1		0.00	0.65	0.00	-0.07
PRY	03/16/93	1045	7		11		1		1		0.5		5.6		78										0.61	1.46	0.04	0.52
PRY	03/23/93	1235	40		67		1.8		8		3.4		8.3		69										0.17	2.57	1.56	-0.10
PRY	03/30/93	1025	21		18		1.16		2		2		6.8		77										0.16	1.40	0.01	0.02
PRY	04/06/93	1105	2		13		1.04		1	U	1.8		7.8		80										0.10	1.34	0.03	-0.04
PRY	04/13/93	1110	31		36		1.4		3		1.4		7.5		74										0.18	2.44	0.00	-0.07
PRY	11/16/93	1135	28		1.6				3		1.2		6.1		97										0.13	0.50	0.21	0.09
PRY	11/17/93	1150			1.4		0.88																					
PRY	11/22/93	1245	3		1.9		0.9		3		2.3		3.9		94										0.04	0.55	0.27	-0.02
PRY	11/30/93	1220	33		3.2		0.94		16		6.9		4.9		90										0.85	1.90	0.58	0.73
PRY	11/30/93	1230	17						33		9.3				95													
PRY	12/07/93	1120	65		20		1.35		9		8.7		5.5		77		7.7				11.3		7.2		0.50	2.30	0.05	0.30
PRY	12/14/93	1050	7		35		1.62		7		4.3		7.2		67										0.01	2.55	0.18	-0.27
PRY	12/21/93	925	8		11		1.28		4		0.8		5.7		74										0.00	1.25	0.00	-0.14
PRY	12/28/93	945	27		6.4		1.16		2		0.9		3.8		75										0.08	0.68	0.00	0.01
PRY	01/04/94	1215	63		119		2.18		38		17		8.7		56		6.1		9.4		11.1		9.1		0.45	2.76	0.31	0.19
PRY	01/11/94	1050	1		36		1.67		2		1.7		8.3		65										0.04	2.07	0.30	-0.19
PRY	01/18/94	1155	6		18		1.42		1		1.1		6		68										0.00	1.05	0.00	-0.12
PRY	01/18/94	1205	3				1.42		2		1		6		70													
PRY	01/23/94	850	22		18	r	1.44		3		1.7		8.5		71										0.12	1.22	0.41	0.00
PRY	01/25/94	1020	4		17		1.42		1		1.3		7.5		71										0.00	1.25	0.30	-0.14
PRY	02/01/94	1235	9		12	r	1.32		1		0.8		4.7		68		6.4				12.2		5.0		0.00	0.60	0.00	-0.07
PRY	02/08/94	1425	5		7.1		1.24		1		0.7		2.9		75		6.4		3.5		13.1		2.6		0.00	0.29	0.00	-0.03
PRY	02/14/94	1440	20		43	r	1.75		3		2.5		6.4		64										0.04	1.68	1.50	-0.14
PRY	02/15/94	1235	96		89		2.05		37		21		6.7		57										1.10	2.62	0.04	0.93
PRY	02/22/94	855	1	U	33		1.8		2		1.6		5.7		67										0.55	2.87	0.43	0.29
PRY	03/01/94	1220	4		61	r	1.89		3		2.4		9.1		62		5.7		9.3		11.0		10.0		0.00	2.35	0.07	-0.26
PRY	03/02/94	1500	52		88	r	2.05		14		8.2		9.6		58										0.83	2.94	0.00	0.60
PRY	03/02/94	1500	61						13		8.4																	
PRY	03/08/94	840	4		41	r	1.73		2		1.5		5.7		64										0.00	2.18	0.00	-0.24
PRY	03/15/94	1315	1		22		1.47		2		1.2		9		71		6.0		9.1						0.07	1.23	0.00	-0.06
PRY	03/21/94	1430	5		79	r	2		4		2.8		6.7		60										0.29	2.42	0.47	0.05
PRY	03/22/94	1110	15		69	r	1.94		2		2		6.3		62										0.40	2.57	0.29	0.16
PRY	03/29/94	1515	3		24	r	1.54		2		1		9.8		72										0.00	1.23	0.00	-0.14
PRY	03/29/94	1515	5						2		1																	
PRY	04/05/94	1035	2		15	r	1.4		2		1.3		8.4		70										0.27	0.87	0.00	0.20
PRY	04/06/94	930	88		24	r	1.54		10		3.5		8.1		67										0.36	1.14	0.27	0.27
PRY	04/12/94	1200	32		28	r	1.6		2		1.4		9.2		65										0.17	1.19	0.00	0.06
PRY	04/19/94	1300	3		17	r	1.43		2		1		10.8		84										0.00	0.65	0.02	-0.07
PRY	05/04/94	1415			7.7		1.33																					
PRY	11/15/94	905	33		10	r	1.24		7		3.7		7.5		65										0.25	2.06	0.10	0.05
PRY	11/21/94	745	14		10	r	1.28		8		3.3		3.9		62										0.00	1.86	0.00	-0.21
PRY	11/29/94	1000	380		198	r	2.13		64		38		6.7		50										1.05	2.87	0.24	0.85
PRY	12/06/94	1240	14		54	r	1.62		15		6.2		4.8		58										0.00	3.37	0.09	-0.37
PRY	12/13/94	1155	9		37		1.61		10		5.3		5.6		65										0.00	2.34	0.00	-0.26
PRY	12/19/94	1115	52		276	r	2.26		25		15		8.2		48										1.37	4.52	0.27	1.02
PRY	12/20/94	1225	53		1500	r	3.22		211		130		8.5		38		6.7		9.2		11.6		8.8		1.35	5.42	1.37	0.90
PRY	12/27/94	1000	116	JS	4000	r	3.8		266		160		8.9		34										1.11	6.30	2.45	0.53
PRY	01/03/95	1120	4		21	r	1.26		3		1.9		3.8		52										0.00	3.03	0.00	-0.34
PRY	01/10/95	1115	26		30		1.26		3		2.6		7.2		55										0.19	2.34	0.38	-0.05
PRY	01/10/95	1155	45		30		1.24		2		1.9		7.2		55													
PRY	01/17/95	1440	19				1.42		3		2.8		6.4		52		6.6		7.3		12.0		6.5		0.20	1.99	0.04	0.00
PRY	01/17/95	1500	21				1.42		4		3		6.3		51		6.6		7.2		12.0		6.3					
PRY	01/24/95	1205	4		23		1.18		1	U	1		5.2		55										0.00	1.04	0.00	-0.12
PRY	01/31/95	1150	27		148		2.04		34		20		8.9		46										1.36	3.43	0.79	1.13
PRY	02/07/95	1445	11		18	r	1.2		1		1.3		8.1		56		6.7		9.3		11.3		8.2		0.00	1.74	0.00	-0.19
PRY	02/14/95	1040	32		11	r	1		1		1.5		2.9		57										0.01	1.07	0.00	-0.11
PRY	02/21/95	1400	2		104	r	1.88		8		5.3		8.2		47										0.00	4.50	0.07	-0.50
PRY	02/28/95	920	1		19	r	1.22		1		1.6		4.7		55										0.00	2.20	0.00	-0.24
PRY	03/07/95	1450	5		14	r	1.09		1	U	0.6		6.3		58		6.3		7.0		12.5		6.3		0.00	1.27	0.00	-0.14
PRY	03/14/95	930	200		149	r	2.02		19		11		8.1		45										0.45	3.23	0.32	0.14
PRY	03/21/95	1220	29	JS	98		1.86		5		4		7.5		45										0.49	3.56	0.57	0.15
PRY	03/28/95	1245	9		22		1.24		1		0.9		7.9		56										0.00	1.76	0.00	-0.20
PRY	04/04/95	1030	5		13		1.09		1	U	1		8.9		60										0.20	1.10	0.00	0.10
PRY	04/11/95	1215	19		18		1.19		1	U	1.2		7.9		58										0.00	1.29	0.28	-0.14
PRY	04/11/95	1215	29		18		1.19		1		1.3		7.9		58													
PRY	04/18/95	1410	13		15	r	1.12		1		0.6		8.1		59										0.05	1.04	0.04	-0.06
PRY	04/28/95	1245			12		1.07																		0.11	0.83	0.28	0.03
PRY	11/14/95	1025	31	S	43		1.55		6		3.2		10.7		58										0.00	4.87	0.40	-0.43

Appendix C. Water Quality Data from the Totten and Eld Inlet Study Basins. (Explanatory notes are provided in Appendix D).

SITE	DATE	TIME	FC	K-FC	FLOW	K-	GAGE	K-	TSS	K	TURB	K	TEMP	K	COND	K	PH	K	T-PH	K	DO	K	T-DO	K	PREC	API	A24HR	APISLP
PRY	11/14/95	1040	31	S			1.55		6		3.9		10.8		58													
PRY	11/20/95	1210	11		20		1.22		4		2.6		8		62										0.00	3.41	0.01	-0.27
PRY	11/28/95	1310	59	S	98		1.85		11		6.6		10.8		53										0.54	4.93	1.07	0.16
PRY	12/05/95	1030	6		63		1.67		6		3.9		7.4		54		7.2		7.2		10.6		7.5		0.00	5.19	0.00	-0.47
PRY	12/12/95	1215	44		112		1.94		8		5.6		9.2		48										0.72	5.09	0.34	0.35
PRY	12/19/95	850	61		50		1.62		4		2.7		8.2		54										0.00	3.85	0.14	-0.32
PRY	12/26/95	1205	33		15		1.33		1	U	0.8		4.2		60										0.00	2.36	0.00	-0.15
PRY	01/02/96	915	6		40		1.56		2		1.7		8.8		56										0.41	3.31	0.03	0.20
PRY	01/09/96	1425	33		71		1.75		3		3.5		8.5		52										0.07	3.95	0.00	-0.25
PRY	01/16/96	1405	6		58		1.7		2		2.7		7.5		50		7.5		8.2		12.2		7.5		0.13	3.82	1.09	-0.17
PRY	01/23/96	1205	15		96		1.92		3		2.7		6.2		47										0.38	4.13	0.22	0.07
PRY	01/23/96	1225	7				1.92		2		2.8		6.2		38													
PRY	01/30/96	1340	4		23		1.42		1		1.3		2.5		59										0.00	2.87	0.01	-0.21
PRY	02/06/96	1320	73		161		2.15		111		60		6.8		45		6.6		7.1		12.4		6.8		2.95	5.29	1.32	2.69
PRY	02/13/96	1255	9		37		1.52		2		2.1		6.3		55										0.00	5.73	0.00	-0.53
PRY	02/20/96	1230	110		61	r	1.7		5		5.6		7.5		52										0.35	4.57	0.24	-0.01
PRY	02/27/96	1330	2		36		1.5		2		1.5		5		56										0.00	3.33	0.00	-0.26
PRY	03/05/96	1145	11		22		1.34		2		1.7		6.4		58										0.18	2.99	0.33	-0.02
PRY	03/12/96	1325	2		30		1.45		2		2.7		8.8		60										0.02	2.55	0.07	-0.15
PRY	03/19/96	1155	4		16		1.27		1		1		8.7		63										0.07	0.81	0.00	-0.01
PRY	03/26/96	1315	1		11		1.14		1		0.7		7.2		66		6.6		7.8		12.3		7.0		0.00	0.65	0.00	-0.07
PRY	04/02/96	1045	5		10		1.16		1	U	1.2		7.5		66										0.00	0.86	0.32	-0.10
PRY	04/09/96	1250	2		6.1		1.08		1		0.9		11.7		72										0.00	0.52	0.00	-0.06
PRY	04/16/96	1145	410		23		1.38		5		4.4		9.9		64										0.20	2.65	0.73	0.04
PRY	11/12/96	1115	10		11		1.38		12		5.9		10.3		71										0.39	1.55	0.17	0.26
PRY	11/19/96	1135	25		18		1.59		9		4.4		4.6		64										0.86	2.11	0.00	0.72
PRY	11/19/96	1145	6						9		4.5		4.6		64										0.86	2.11	0.00	0.72
PRY	11/25/96	1050	36		56		2.05		18		6.8		7.1		61										0.25	2.34	0.28	0.02
PRY	12/03/96	1155	17		61		1.98		6		3.7		6.0		57		6.6		6.0		12.9		5.9		0.00	2.56	0.56	-0.28
PRY	12/10/96	1030	18		81		2.08		5		4.0		7.9		55										0.70	3.87	0.09	0.35
PRY	12/17/96	1120	4		34		1.79		2		1.9		5.3		58										0.00	2.67	0.00	-0.30
PRY	12/22/96	1005	32		32		1.79		3		1.6		6.0		57										0.20	2.47	0.26	-0.05
PRY	01/07/97	935	9		85		2.32		4		3.4		7.0		49										0.04	6.00	1.01	-0.62
PRY	01/14/97	1245	10		25		1.80		1		1.4		3.4		53										0.00	2.97	0.00	-0.33
PRY	01/21/97	1010	6		62		2.16		2		1.9		7.0		51										0.03	3.43	0.46	-0.35
PRY	01/28/97	1105	7		39		1.96		1	U	2.0		5.7		48		7.8		6.1		10.8		5.2		0.17	2.59	0.51	-0.10
PRY	02/04/97	845	4		38		1.91		2		1.5		5.1		54		6.4		4.9		11.3		4.8		0.00	2.40	0.00	-0.27
PRY	02/11/97	1310	2		19		1.70		1		1.7		5.3		58										0.64	2.01	0.00	0.49
PRY	02/11/97	1325	2						1	U	1.3		5.4		58										0.64	2.01	0.00	0.49
PRY	02/18/97	940	10	S	42		2.00		1		1.7		7.2		54										1.06	3.32	0.25	0.81
PRY	02/25/97	1310	8		32		1.87		2		1.1		7.5		56										0.01	1.95	0.00	-0.21
PRY	03/04/97	1345	7		63		2.15		2		1.7		6.5		51										0.01	2.79	0.17	-0.30
PRY	03/11/97	1210	5		50		2.09		2		1.9	J	7.2		52										0.23	3.23	0.00	-0.10
PRY	03/18/97	835	30		104		2.42		9		6.4		7.9		43										1.90	5.03	0.24	1.55
PRY	03/25/97	1255	1	U	30		1.90		2		2.0		9.0		55										0.00	3.26	0.00	-0.36
PRY	04/01/97	1320	1		19		1.74		1	U	1		7.7		57		6.4		7.6		10.2	e	7.8		0.00	2.35	0.26	-0.26
PRY	04/08/97	1330	1		12		1.60		1		0.7		8.7		59										0.07	1.21	0.00	-0.06
PRY	04/15/97	800	1	U	15		1.58		1		1		8.9		61										0.18	0.84	0.09	0.11
SHN	07/29/86	1210	70										13.1															
SHN	12/12/86	1643	10		9.2								6.1												0.04	1.73	0.12	-0.08
SHN	02/04/87	1205	2		32								7.7												0.06	4.03	0.11	-0.37
SHN	04/07/87	855	5		7.7								8.4												0.47	1.07	0.14	0.08
SHN	07/27/87	1306	75		0.6								14.8															
SHN	12/07/87	1413	45		33								7.75												0.46	4.14	0.64	0.26
SHN	01/06/88	1020	1		5.2								3.5												0.01	0.57	0.00	-0.07
SHN	02/01/88	900	1		8.8								2.5												0.00	1.14	0.00	-0.14
SHN	07/05/88	1230	230		1.1								11															
SHN	08/03/88	1305	160		0.7								13.7															
SHN	12/06/88	1125	1		16								8.7												0.33	1.85	0.23	0.07
SHN	01/03/89	935	5		34								12.5												0.40	2.82	0.14	-0.14
SHN	01/03/89	1402	30		7.0								1.8												0.40	2.82	0.14	-0.14
SHN	03/06/89	930	5		38								5.5												0.19	1.92	0.51	0.35
SHN	04/03/89	915	20		49								6.5												0.25	2.65	0.52	0.28
SHN	07/03/89	1007	185		2.6								13															
SHN	08/07/89	1418	320		1.0								16															
SHN	11/06/89	935	190		2.7								9.5												0.80	1.69	0.00	-0.11
SHN	12/04/89	1245	280										6.3												2.27	5.25	0.81	0.53
SHN	01/03/90	1402	30		7.0								6												0.22	1.06	0.01	-0.09
SHN	03/05/90	1445	35		12								9												0.02	1.20	0.02	-0.12

Appendix C. Water Quality Data from the Totten and Eld Inlet Study Basins. (Explanatory notes are provided in Appendix D).

SITE	DATE	TIME	FC	K-FC	FLOW	K-	GAGE	K-	TSS	K	TURB	K	TEMP	K	COND	K	PH	K	T-PH	K	DO	K	T-DO	K	PREC	API	A24HR	APISLP
SHN	07/09/90	1136	70		1.0								14.5															
SHN	08/13/90	1402	130		0.6								16.5															
SHN	11/13/90	925	2812		32								10.5												0.91	3.44	0.49	0.23
SHN	12/10/90	950	5		45								8												0.32	4.10	0.34	-0.09
SHN	01/10/91	1045	75		44								5												0.48	2.47	0.41	0.21
SHN	02/06/91	1310	15		48								6.2												0.00	2.36	0.02	-0.27
SHN	03/05/91	1115	40		50								5.5												0.10	2.71	0.22	-0.08
SHN	07/09/91	1145	10		1.6								14															
SHN	08/06/91	920	150		1.1								14.5															
SHN	08/06/91	920	150		1.1								14.5															
SHN	12/16/91	1002	20		10								3.6												0.00	1.61	0.00	-0.20
SHN	01/28/92	1345	160										9												1.32	4.50	1.48	1.25
SHN	02/18/92	1330	25		24								7												0.54	2.24	0.27	0.09
SHN	07/21/92	1450	335		0.8								15.5															
SHN	08/17/92	1200	65		0.6								16															
SHN	11/11/92	1115	380		3.5				11		3.8		7.75		118										0.48	1.93	0.01	0.32
SHN	11/17/92	930	83		3.7				4		2.4		8.8		129		7.2		8.8						0.61	2.00	0.29	0.46
SHN	11/23/92	1340	340	XS	17				6		5.5		6.3		90										0.00	3.03	0.05	-0.34
SHN	12/01/92	1010	16	SX	10				6		5.2		5.5		95										0.05	2.23	0.52	-0.19
SHN	12/08/92	1320	170	X	11		0.86		4		3.9		5.1		92										0.68	1.87	0.06	0.55
SHN	12/08/92	1340	120	S	11		0.86		4		4.5		5.1		92													
SHN	12/15/92	1425	31		16		0.95		1		3.9		5.5		84		7.2		5.7		12.4		2.2		0.00	1.88	0.11	-0.21
SHN	12/21/92	1250	28	X	35		1.38		5		5		5.3		74										0.27	2.28	0.27	0.05
SHN	12/28/92	1125	33		27		1.16		4		4.9		4.3		76										0.20	1.81	0.34	0.02
SHN	01/05/93	1245	56		19		1.04		2		2.9		3.3		79										0.00	1.72	0.36	-0.19
SHN	01/05/93	1300	41		18		1.04		1		3.1		3.3		79													
SHN	01/12/93	1225	8		7.0		0.8		1		1.8		1.5		90		7.3		2.1		15.0	J	0.2		0.00	0.82	0.00	-0.09
SHN	01/19/93	1230	800	JH	37		1.4		37		18		2.4		68										0.50	0.92	0.00	0.45
SHN	01/26/93	1150	20		87		2.18		16		6.7		7		64										0.07	3.08	0.79	-0.26
SHN	02/02/93	1235	9		16		1.1		2		2.1		5.5		80		6.6		5.0		9.5		5.8		0.00	1.60	0.00	-0.18
SHN	02/09/93	1120	25		8.4		0.95		2		1.9		7		90										0.10	0.88	0.02	0.01
SHN	02/16/93	1110	10		6.0		0.86		1	U	1.4		2.9		94										0.00	0.44	0.00	-0.05
SHN	02/23/93	1450	5		5.7		0.85		1		1.6		4		97										0.00	0.27	0.00	-0.03
SHN	02/23/93	1505	3		5.7		0.84		1	U	1.5		4.1		98													
SHN	03/02/93	1200	18		4.1		0.82		1		1.8		4.8		100										0.11	0.46	0.25	0.07
SHN	03/09/93	1515	4		7.5		0.87		2		1.5		8		95		6.9		9.0		11.7		8.1		0.00	0.65	0.00	-0.07
SHN	03/16/93	1240	17		9.3		0.88		1		2.7		6.4		92										0.61	1.46	0.04	0.52
SHN	03/23/93	1600	36	S	56		1.7		18		9.5		9.9		70										0.17	2.57	1.56	-0.10
SHN	03/30/93	1145	4		11		0.94		1		1.7		7.5		86										0.16	1.40	0.01	0.02
SHN	04/06/93	1430	4		8.9		0.9		1		2.6		9.1		91										0.10	1.34	0.03	-0.04
SHN	04/13/93	1240	1		21		1.1		3		2.2		8.5		82										0.18	2.44	0.00	-0.07
SHN	11/16/93	1440	40		1.1		0.59		1	U	0.9		5.9		120										0.13	0.50	0.21	0.09
SHN	11/22/93	1120	8		1.6		0.6		1		2.3		4		112										0.04	0.55	0.27	-0.02
SHN	11/30/93	1445	27	S	1.6		0.61		4		3.2		5		120										0.85	1.90	0.58	0.73
SHN	12/07/93	1025	440	S	13		0.95		7		7.9		4.8		96		7.5				11.4		7.2		0.50	2.30	0.05	0.30
SHN	12/14/93	1455	31	X	27		1.36		5		6		7.7		77										0.01	2.55	0.18	-0.27
SHN	12/21/93	945	22	S	8.5	r	0.98		3		2		5.4		86										0.00	1.25	0.00	-0.14
SHN	12/28/93	1110	12		3.6		0.88		1		1.4		4.1		93										0.08	0.68	0.00	0.01
SHN	12/28/93	1110	26				0.88		1	U	1.4		4.1		94													
SHN	01/04/94	1500	56	S	68		1.7		18		15		8.7		62		6.8		8.9		10.4		8.8		0.45	2.76	0.31	0.19
SHN	01/11/94	1235	14				1.19		3		4.4		8.1		75													
SHN	01/11/94	1235	8		18	r	1.19		3		4.7		8.2		72										0.04	2.07	0.30	-0.19
SHN	01/18/94	1405	3		8.8	r	0.99		2		2.5		6.3		82										0.00	1.05	0.00	-0.12
SHN	01/23/94	1000	11	S	11	r	1.05		4		4.9		8.3		82										0.12	1.22	0.41	0.00
SHN	01/25/94	1130	17	S	13	r	1.09		4		6		7.7		80										0.00	1.25	0.30	-0.14
SHN	01/25/94	1140	14	S			1.09		4		5.8		7.7		80													
SHN	02/01/94	1150	45		7.0	r	0.93		1		1.9		4.5		84										0.00	0.60	0.00	-0.07
SHN	02/08/94	1205	4		5.2	r	0.86		1		2.2		2.2		88		6.4		2.8		13.1		2.0		0.00	0.29	0.00	-0.03
SHN	02/14/94	1540	150	S	31	r	1.38		8		9.3		6.7		66										0.04	1.68	1.50	-0.14
SHN	02/15/94	1515	110	S	55		1.6		24		16		6.9		60										1.10	2.62	0.04	0.93
SHN	02/22/94	1055	7		25	r	1.3		3		4.4		5.7		68										0.55	2.87	0.43	0.29
SHN	02/22/94	1100	1						4.6		4.0																	
SHN	03/01/94	1415	14		29	r	1.36		7		3.9		9.9		70		6.0		10.3		10.2		10.2		0.00	2.35	0.07	-0.26
SHN	03/02/94	1605	40		42	r	1.5		15		10		10.2		67										0.83	2.94	0.00	0.60
SHN	03/08/94	910	13		19	r	1.22		5		3.8		6.2		70										0.00	2.18	0.00	-0.24
SHN	03/15/94	1435	2		9.2	r	1		3		2.2		9.8		85		5.9		9.8						0.07	1.23	0.00	-0.06
SHN	03/21/94	1510	66		47	r	1.54		10		7.9		7.1		65										0.29	2.42	0.47	0.05
SHN	03/22/94	1030	5		39		1.46		5		5.3		6		65										0.40	2.57	0.29	0.16
SHN	03/29/94	1405	5		10	r	1.02		3		2.3		11.3		80										0.00	1.23	0.00	-0.14

Appendix C. Water Quality Data from the Totten and Eld Inlet Study Basins. (Explanatory notes are provided in Appendix D).

SITE	DATE	TIME	FC	K-FC	FLOW	K-	GAGE	K-	TSS	K	TURB	K	TEMP	K	COND	K	PH	K	T-PH	K	DO	K	T-DO	K	PREC	API	A24HR	APISLP
SHN	04/05/94	1000	3		6.7	r	0.92		3		2.1		7.7		85										0.27	0.87	0.00	0.20
SHN	04/06/94	1010	24	SX	9.2	r	1		5		3.2		8.5		82										0.36	1.14	0.27	0.27
SHN	04/12/94	1245	7		11	r	1.05		4		2.5		11		78										0.17	1.19	0.00	0.06
SHN	04/12/94	1255	12	S					4		2.7																	
SHN	04/19/94	1350	9						2		2																	
SHN	04/19/94	1350	15		6.4	r	0.91		2		2		12.6		100										0.00	0.65	0.02	-0.07
SHN	05/04/94	1110			4.7		0.86																					
SHN	11/15/94	1030	18	S	10	r	0.93		3		2.8		7.6		74										0.25	2.06	0.10	0.05
SHN	11/21/94	705	53		12	r	1.01		2		3.8		3.5		74										0.00	1.86	0.00	-0.21
SHN	11/29/94	915	150	S	37	r	1.61		49		34		6		61										1.05	2.87	0.24	0.85
SHN	12/06/94	1335	21		24	r	1.4		5		4.5		3.5		63										0.00	3.37	0.09	-0.37
SHN	12/13/94	955	6		25		1.43		4		4		4.8		67										0.00	2.34	0.00	-0.26
SHN	12/19/94	1145	49	S	186	r	2.46		24		17		8.2		46										1.37	4.52	0.27	1.02
SHN	12/20/94	1300	260		1800	r	4.26		94		100		8.7		37										1.35	5.42	1.37	0.90
SHN	12/27/94	850	180	JS	1500	r	4.1		78		55		8.8		37		6.4		10.3		10.8		9.0		1.11	6.30	2.45	0.53
SHN	01/03/95	1155	7		16	r	1.17		3		3.8		3.1		58										0.00	3.03	0.00	-0.34
SHN	01/03/95	1155	15				1.17		3		4		3.1		59													
SHN	01/10/95	940	38		33		1.32		5		5.9		6		58										0.19	2.34	0.38	-0.05
SHN	01/17/95	1325	13				1.3		4		4		6		57		6.4		6.9		11.5		6.2		0.20	1.99	0.04	0.00
SHN	01/24/95	1430	10		17		1.1		2		2.8		5.1		62										0.00	1.04	0.00	-0.12
SHN	01/24/95	1500	31		17		1.1		2		3		5.2		62													
SHN	01/31/95	1405	150		131		2.45		52		34		9.5		45										1.36	3.43	0.79	1.13
SHN	01/31/95	1440	69	S	131		2.46		57		39		9.6		45													
SHN	02/07/95	1510	17		19	r	1.28		4		3.5		8.7		62		6.9		9.7		11.2		8.5		0.00	1.74	0.00	-0.19
SHN	02/14/95	1105	14		15	r	1.13		1		2.7		2.8		66										0.01	1.07	0.00	-0.11
SHN	02/21/95	1415	23		97	r	2.12		30		17		8.5		47										0.00	4.50	0.07	-0.50
SHN	02/28/95	940	5		19	r	1.26		3		2.9		4.6		62										0.00	2.20	0.00	-0.24
SHN	02/28/95	945	6				1.26		3		3		4.6		62													
SHN	03/07/95	1515	3		15	r	1.16		1		2		6.7		68		6.5		7.5		12.2		6.5		0.00	1.27	0.00	-0.14
SHN	03/14/95	1000	30	S	93	r	2.1		24		17		9		45										0.45	3.23	0.32	0.14
SHN	03/21/95	1300	20		81		1.95		15		11		8.4		48										0.49	3.56	0.57	0.15
SHN	03/28/95	1030	2		19		1.24		3		2.6		7.9		63										0.00	1.76	0.00	-0.20
SHN	04/04/95	1120	16		13		1.11		3		2.4		10.3		71										0.20	1.10	0.00	0.10
SHN	04/11/95	1040	9		13		1.11		1		2.7		8.4		71										0.11	0.83	0.28	0.03
SHN	04/18/95	1530	5		13	r	1.05		2		1.8		10.3		69										0.00	1.29	0.28	-0.14
SHN	04/28/95	1405			9.3		1.02																		0.05	1.04	0.04	-0.06
SHN	11/14/95	910	21		35		1.46		11		9.4		10.3		63										0.00	4.87	0.40	-0.43
SHN	11/20/95	1110	7		14		1.16		4		4.2		8		70										0.00	3.41	0.01	-0.27
SHN	11/28/95	1135	52	S	62		1.76		14		13		10.4		56										0.54	4.93	1.07	0.16
SHN	12/05/95	1310	4		53		1.76		9		7.9		6.3		55		7.4		6.2		11.1		6.1		0.00	5.19	0.00	-0.47
SHN	12/12/95	1340	28		102		2.25		24		17		8.9		48										0.72	5.09	0.34	0.35
SHN	12/19/95	1030	12						7		6																	
SHN	12/19/95	1030	6		40		1.71		6		6.3		7.9		56										0.00	3.85	0.14	-0.32
SHN	12/26/95	1245	6		13		1.33		2		2.6		4.1		68										0.00	2.36	0.00	-0.15
SHN	01/02/96	1050	16						5		4.6																	
SHN	01/02/96	1050	26		30		1.54		6		4.6		8.7		60										0.41	3.31	0.03	0.20
SHN	01/09/96	1605	13		52		1.88		11		9.8		8		53										0.07	3.95	0.00	-0.25
SHN	01/09/96	1615	10				1.88		10		9.8		8		53													
SHN	01/16/96	1500	24		61		1.86		9		10		7.6		42		7.4		9.0		11.1		7.6		0.13	3.82	1.09	-0.17
SHN	01/23/96	1410	12		93		2.2		16		12		5.5		47										0.38	4.13	0.22	0.07
SHN	01/30/96	1410	22		25		1.38		3		3.1		2.3		64										0.00	2.87	0.01	-0.21
SHN	01/30/96	1435	15				1.38		3		3.4		2.3		66													
SHN	02/06/96	1600	160		250	r	2.9		119		60		5.9		45		6.5		6.5		11.8		6.0		2.95	5.29	1.32	2.69
SHN	02/06/96	1600	110						108		70																	
SHN	02/13/96	1435	4		37		1.85		6		5.9		6.4		60										0.00	5.73	0.00	-0.53
SHN	02/20/96	1315	11		60	r	1.95		8		8.8		7.8		57										0.35	4.57	0.24	-0.01
SHN	02/27/96	1530	7		36		1.72		5		4.2		4.7		60										0.00	3.33	0.00	-0.26
SHN	03/05/96	1325	11		24		1.58		3		3.2		6.9		69										0.18	2.99	0.33	-0.02
SHN	03/05/96	1335	6						3		3.4		7		69													
SHN	03/12/96	1455	16		30		1.7		5		5.9		10.1		65										0.02	2.55	0.07	-0.15
SHN	03/19/96	1350	1	U	15		1.45		3		2.6		10.2		75										0.07	0.81	0.00	-0.01
SHN	03/19/96	1415	2						3		2.7		10.3		75													
SHN	03/26/96	1505	1		11		1.36		2		2		8.7		80		6.7		9.2		11.3		8.7		0.00	0.65	0.00	-0.07
SHN	03/26/96	1520	2						2		1.7		8.8		80		6.8		9.2		11.3		8.7					
SHN	04/02/96	1235	31		12		1.36		2		2		9.1		83										0.00	0.86	0.32	-0.10
SHN	04/09/96	1325	2		8.1		1.29		2		2		12.6		90										0.00	0.52	0.00	-0.06
SHN	04/16/96	1430	49		20		1.52		5		4.9		12.3		77										0.20	2.65	0.73	0.04
SHN	11/12/96	1310	48		4.8		1.29		8		5.8		10.2		90										0.39	1.55	0.17	0.26
SHN	11/12/96	1315	29						7		6.1		10.2		90										0.39	1.55	0.17	0.26

Appendix C. Water Quality Data from the Totten and Eld Inlet Study Basins. (Explanatory notes are provided in Appendix D).

SITE	DATE	TIME	FC	K-FC	FLOW	K-	GAGE	K-	TSS	K	TURB	K	TEMP	K	COND	K	PH	K	T-PH	K	DO	K	T-DO	K	PREC	API	A24HR	APISLP
SHN	11/19/96	915	21		14		1.40		7		7.6		4.2		74										0.86	2.11	0.00	0.72
SHN	11/25/96	1230	34		27		1.56		13		11		6.1		72										0.25	2.34	0.28	0.02
SHN	12/03/96	955	19	X	43		1.75		4		6.1		4.8		60		6.3		4.8		12.2		4.9		0.00	2.56	0.56	-0.28
SHN	12/10/96	1225	15	X	62		2.06		9		7.3		7.4		56										0.70	3.87	0.09	0.35
SHN	12/17/96	810	1		28		1.64		4		3.7		4.5		58										0.00	2.67	0.00	-0.30
SHN	12/22/96	1310	19		31		1.64		2		4.0		5.4		63										0.20	2.47	0.26	-0.05
SHN	01/07/97	1220	25		78		2.20		8		7.5		7.0		50										0.04	6.00	1.01	-0.62
SHN	01/14/97	1320	6		19		1.52		3		3.4		3.1		63										0.00	2.97	0.00	-0.33
SHN	01/14/97	1325	7				1.52		2		3.6				63										0.00	2.97	0.00	-0.33
SHN	01/21/97	1150	27	S	59		2.00		5		5.2		6.7		53										0.03	3.43	0.46	-0.35
SHN	01/28/97	1205	13		31		1.72		2		4.3		4.3		59		7.8		4.9		11.0		4.1		0.17	2.59	0.51	-0.10
SHN	02/04/97	1105	6		27		1.68		3		3.1		5.0		57		6.2		5.2		11.0		4.9		0.00	2.40	0.00	-0.27
SHN	02/04/97	1130	7						3		3.2		5.1		59		6.4		5.2		11.0		4.9		0.00	2.40	0.00	-0.27
SHN	02/11/97	1535	8		18		1.52		2		2.6		5.2		64										0.64	2.01	0.00	0.49
SHN	02/18/97	1130	8		35		1.79		3		3.9		7.3		45										1.06	3.32	0.25	0.81
SHN	02/25/97	1445	13		24		1.67		3		2.7		7.7		62										0.01	1.95	0.00	-0.21
SHN	03/04/97	1520	2		53		1.90		4		3.7		6.2		53										0.01	2.79	0.17	-0.30
SHN	03/11/97	1340	10		41		1.90		3		3.7	J	7.7		54										0.23	3.23	0.00	-0.10
SHN	03/11/97	1345	11				1.90		4		3.7	J	7.7		55										0.23	3.23	0.00	-0.10
SHN	03/18/97	1045	54		67		2.36		10		7.9		8.4		38										1.90	5.03	0.24	1.55
SHN	03/25/97	1425	1		28		1.74		5		3.4		10.5		62										0.00	3.26	0.00	-0.36
SHN	03/25/97	1430	4						6		3.5														0.00	3.26	0.00	-0.36
SHN	04/01/97	1455	1	U	19		1.64		2		2.3		9.3		68		6.4		9.4		11.8	e	9.3		0.00	2.35	0.26	-0.26
SHN	04/08/97	1500	1	U	12		1.52		2		1.7		9.5		75										0.07	1.21	0.00	-0.06
SHN	04/15/97	1000	2		12		1.52		2		2.2		9.7		77										0.18	0.84	0.09	0.11

Appendix D

Explanatory Notes for Water Quality Data

Appendix D. Explanatory Notes for Water Quality Data.

Field Position	Field Name	Description
A	SITE	site name
B	DATE	date of sample collection
C	TIME	time of sample collection
D	FC	fecal coliform (colony forming units per 100 milliliters)
E	K-FC	FC qualifier
F	LGFC	log10 of FC value
G	FCW	FC load (colony forming units per day)
H	LGFCW	log10 of FCW
I	FLOW	streamflow (cubic feet per second)
J	K-FLOW	FLOW qualifier
K	LGQRAW	log10 of streamflow value
L	GAGE	stream gage reading (feet of elevation - arbitrary zero)
M	K-GAGE	GAGE qualifier
N	TSS	total suspended solids (milligrams per liter)
O	K-TSS	TSS qualifier
P	LGTSS	log10 of TSS value
Q	TSSW	TSS load (pounds per day)
R	LGTSSW	log10 of TSSW
S	TURB	turbidity (Nephelometric Turbidity Units)
T	K-TURB	TURB qualifier
U	LGTRB	log10 of TURB value
V	ENT	enterococci (colony forming units per 100 milliliters)
W	K-ENT	ENT qualifier
X	LGENT	log10 of ENT value
Y	ENTW	ENT load (colony forming units per day)
Z	LGENTW	log10 of ENTW value
AA	EC	Escherichia coli (colony forming units per 100 milliliters)
AB	K-EC	EC qualifier
AC	LGEC	log10 of EC
AD	ECW	EC load (colony forming units per day)
AE	LGECW	log10 of ENTW value
AF	TEMP	stream temperature (degrees Celsius)
AG	K-T-HG	TEMP qualifier
AH	COND	conductivity (micromhos per centimeter)
AI	K-COND	COND qualifier
AJ	PH	pH (Standard units)
AK	K-PH	PH qualifier
AL	T-PH	temperature that pH thermister read at time of pH measurement (degrees Celcius)
AM	K-T-PH	T-PH qualifier
AN	DO	dissolved oxygen (milligrams per liter)
AO	K-DO	DO qualifier
AP	T-DO	temperature that DO meter read at time of DO measurement (degrees Celsius)
AQ	K-T-DO	T-DO qualifier
AR	WEEKID	identifier for week of year
AS	SDGTLBID	single digit sample identification number (may be called 1DGTLBID)
AT	LABID	four digit sample identification number (may be six digits)
AU	REPLCATE$	identifier for replicate samples
AV	SEASON	numerical identifier for season that sample was collected
AW	SEASON2$	character identifier for season that sample was collected
AX	MNTHCRIT$	identifier for month of year criteria
AY	MONTH	month that sample was collected
AZ	DAY	day that sample was collected
BA	YEAR	year that sample was collected
BB	PREC	24 hour precipitation for the day that sample was collected (inches)
BC	API	antecedent precipitation index (inches)
BD	A24HR	antecedent 24 hour precipitation (inches)

Appendix D. Explanatory Notes for Water Quality Data.

BE	A48HR	antecedent 48 hour precipitation (inches)
BF	A72HR	antecedent 72 hour precipitation (inches)
BG	APISLP	API slope - derived from the API values for the day before and day of sample collection
BH	APICRIT$	identifier for API criteria being met
BI	DRYSPL00	number of dry days (24 hour rainfall of 0.00 inches) into a dry spell
BJ	DRYSPL05	number of dry days (24 hour rainfall less than 0.05 inches) into a dry spell
BK	DRYSPL10	number of dry days (24 hour rainfall less than 0.10 inches) into a dry spell
BL	DDPR00	number of dry days (24 hour rainfall of 0.00 inches) preceeding rainfall
BM	DDPR05	number of dry days (24 hour rainfall of 0.05 inches) preceeding rainfall
BN	DDPR10	number of dry days (24 hour rainfall of 0.10 inches) preceeding rainfall

Site Name		Latitude	Longitude	Waterbody ID	Class
BCUL-	Burns Creek, culvert at bay side of road	47 06.33' N	123' 02.69 W	WA-14-1195	AA
BUR -	Burns Creek, on beach below culvert	47 06.33' N	123' 02.69 W	WA-14-1195	AA
KND -	Kennedy Creek	47 05.93' N	123 05.56' W	WA-14-1300	AA
MCL -	McLane Creek	47 01.92' N	122 59.40' W	WA-13-1100	A
PIE -	Pierre Creek	47 06.28' N	123 02.56' W	WA-14-1190	AA
PRY -	Perry Creek	47 02.95' N	123 00.28' W	WA-14-1100	A
SHN -	Schneider Creek	47 05.51' N	123 04.21' W	WA-14-1200	AA

Data Qualifiers

U - the analyte was not detected at or above the reported result
X - high background count: plate crowded by other non-motile bacteria
S - spreader: plate crowded by other motile bacteria
J - analyte was positively identified, the reported result is an estimate
H - sample holding time was exceeded, result should be used with caution
> - greater than the reported result
MP - the MPN method was used rather than the MF method
r - estimated from rating curve
g - estimated from similar previous hydrologic/meteorologic conditions and interbasin flow relationships

NOTE: bacteria, tss, and turb values of 1 or 0 set to 1.1 for this table and for calculations;
where values were undetected, the detection limit was used in calculations and analyses

Appendix E

The Conservation Plan Process

The Conservation Plan Process

A guide for cooperating agencies

Conservation Plans - This integrated approach to resource management is developed in cooperation with voluntary landowners. The Conservation District has no regulatory abilities to force clients to develop a plan. At anytime the client may decide not to continue and drop the plan. Violators of the nonpoint ordinance that have been referred by a regulatory agency are under no obligation to develop or implement a plan. They can chose a fine or face a civil infraction instead.

Surveys - Priority sites are determined by a watershed survey. Sites are inspected from an automobile and compared to past surveys or records. Among things noted on the survey forms are: address, farm size, livestock number & type, slope of land, water resources (streams, wetlands, tidelands), riparian areas, manure storage and pasture condition. The site is given a preliminary priority rating from the field.

Once the survey is complete, the sites are evaluated with information from files, watershed committees and other agencies. A final rating is then assigned according to the water quality impact of the site.

Outreach - An outreach letter is sent to all priority sites with information on the services the District offers. Posters are placed at all feed stores in the watershed. The technician visits sites to explain District services if the owners are home.

District workshops are given in the spring and summer and many attendees request conservation plans. If they are on the list or are a new potential water quality problem, they can start work on a plan.

Resource inventory - Once the client requests a plan the first visit is scheduled. The inventory on the visit includes any potential water quality problems, acreage, pasture condition and yield, manure handling, checks for gutters and downspouts, riparian condition, livestock.

The technician discusses the landowner's goals; commercial or private use, pasture production, exercise for animals, stocking rates, future. All water quality issues are explained to the landowner. Typical landowner goals are to eliminate weeds and mud or increase production. Water quality is not generally a goal but is sometimes a peripheral interest.

Cost share, if available, is discussed and can be requested from the District Board at the next monthly meeting if desired. The board may or may not decide to approve the cost share based on several guidelines and their personal judgment.

Evaluation - The technician evaluates the potential water quality impact based on several criteria: landowners goals, computer spreadsheets that determine forage yields and nutrient requirements, Natural Resources Conservation Service Best Management Practices, present and future manure production and requirements, riparian strip health, management level, winter confinement, financial and other abilities of client. The priorities to address in the plan will be identified. Alternatives to solve the water quality problems are researched and considered.

Draft Plan - A draft Conservation Plan is written to protect natural resources and achieve the landowner's goals. Several alternative decisions are included so the landowner may pick which ones are most feasible and achievable.

The technician presents the plan to the landowner and explains the alternatives. The landowner may review the plan and either decide at a later date, decide on this visit or decide not to do anything. The process is totally under the control of the landowner. All water quality issues are addressed in the draft but the landowner does not have to do any of them.

Natural Resources Conservation Service personnel help is available at any time to offer technical assistance. If possible, the NRCS District Conservationist will review the plan. Another district employee with NRCS job approval authority may also be asked to review the plan and sign off the technical decisions.

Final Plan - Once the landowner decides what he/she wants to do, the technician rewrites a final Conservation Plan. Time lines are set by the landowner, not the technician. These are not binding since the District has no regulatory powers. The landowner may choose whether or not the time lines are followed.

The landowner is asked to sign the plan as a good faith gesture to insure future District time is well spent. It is not mandatory since the District has no authority. The plan is submitted at the next board meeting for District approval.

Follow-up - The technician checks on the client periodically to check progress and offer assistance. Some clients forge ahead alone and need little future help. Many call with occasional questions. Others do nothing.

If the plan seems at a standstill, the technician offers help to move things along. If the client refuses, there is nothing that can be done.

If the scenario has drastically changed, the technician offers to rewrite the plan for the new goals. Nothing can be done if the landowner is not interested.

Appendix F

Boxplots of Water Quality Data

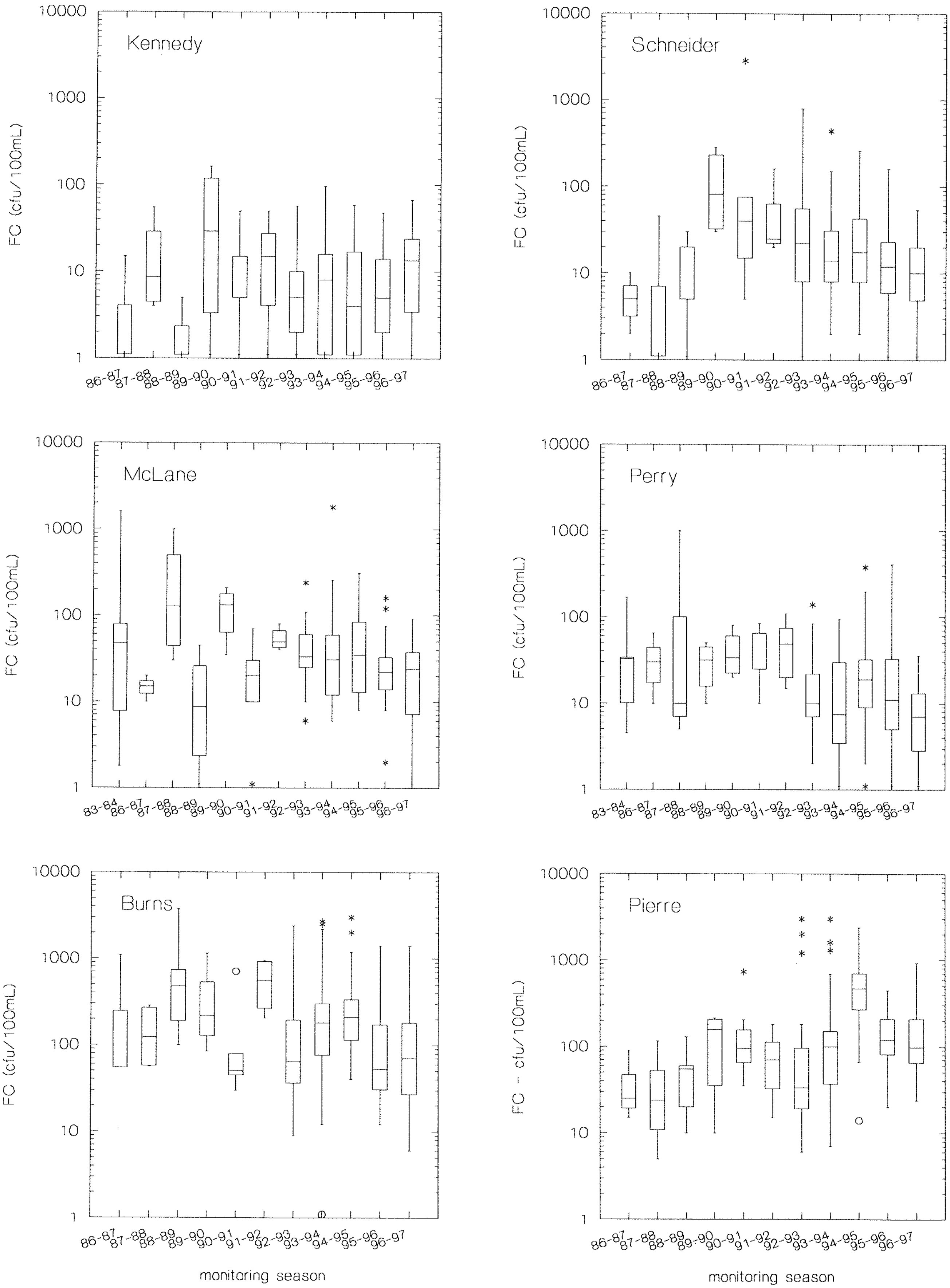

Figure F-1. Box-plots of fecal coliform (FC) data. (Seasons 92-93 to 96-97 are NMP data).

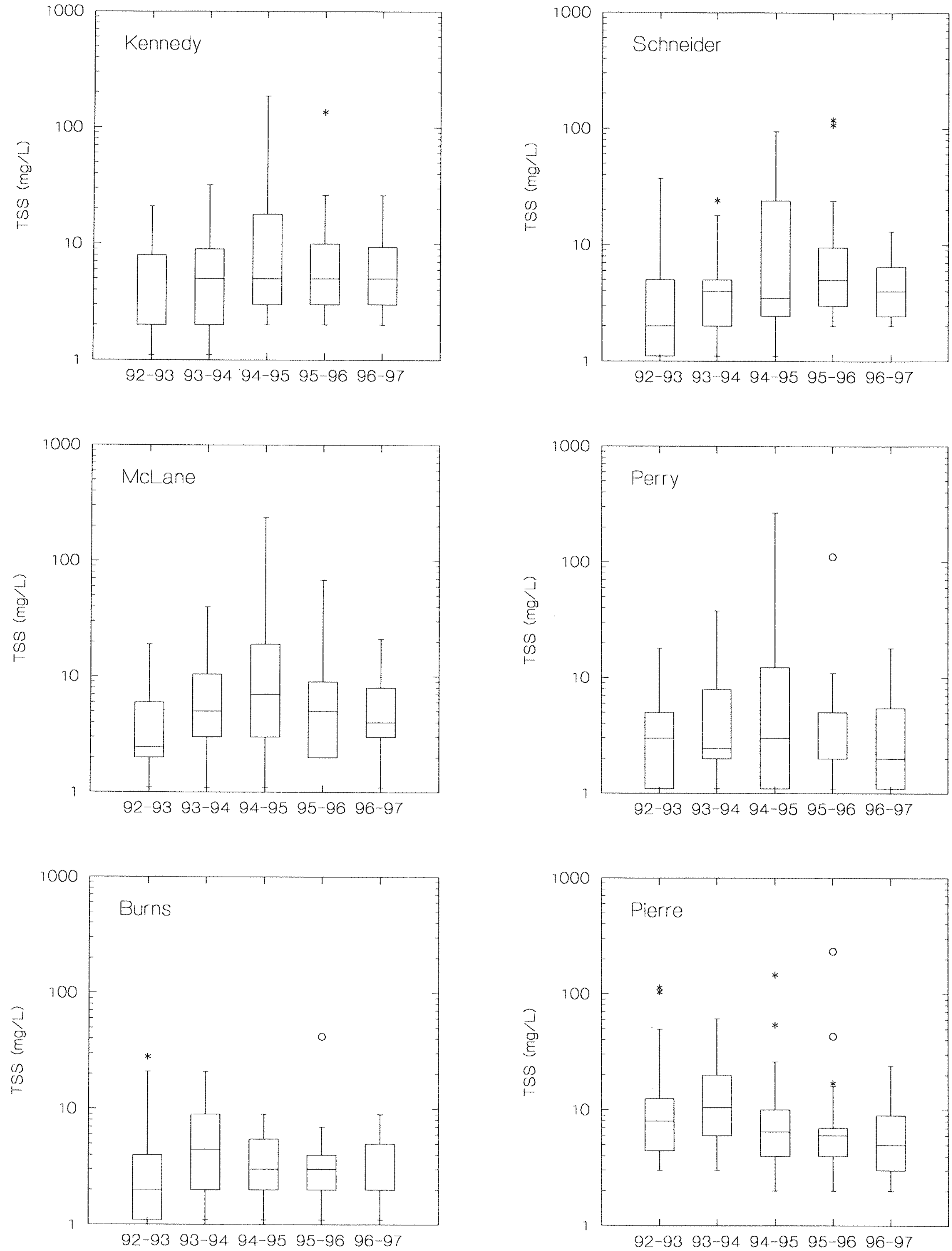

Figure F-2. Box-plots of total suspended solids (TSS) data.

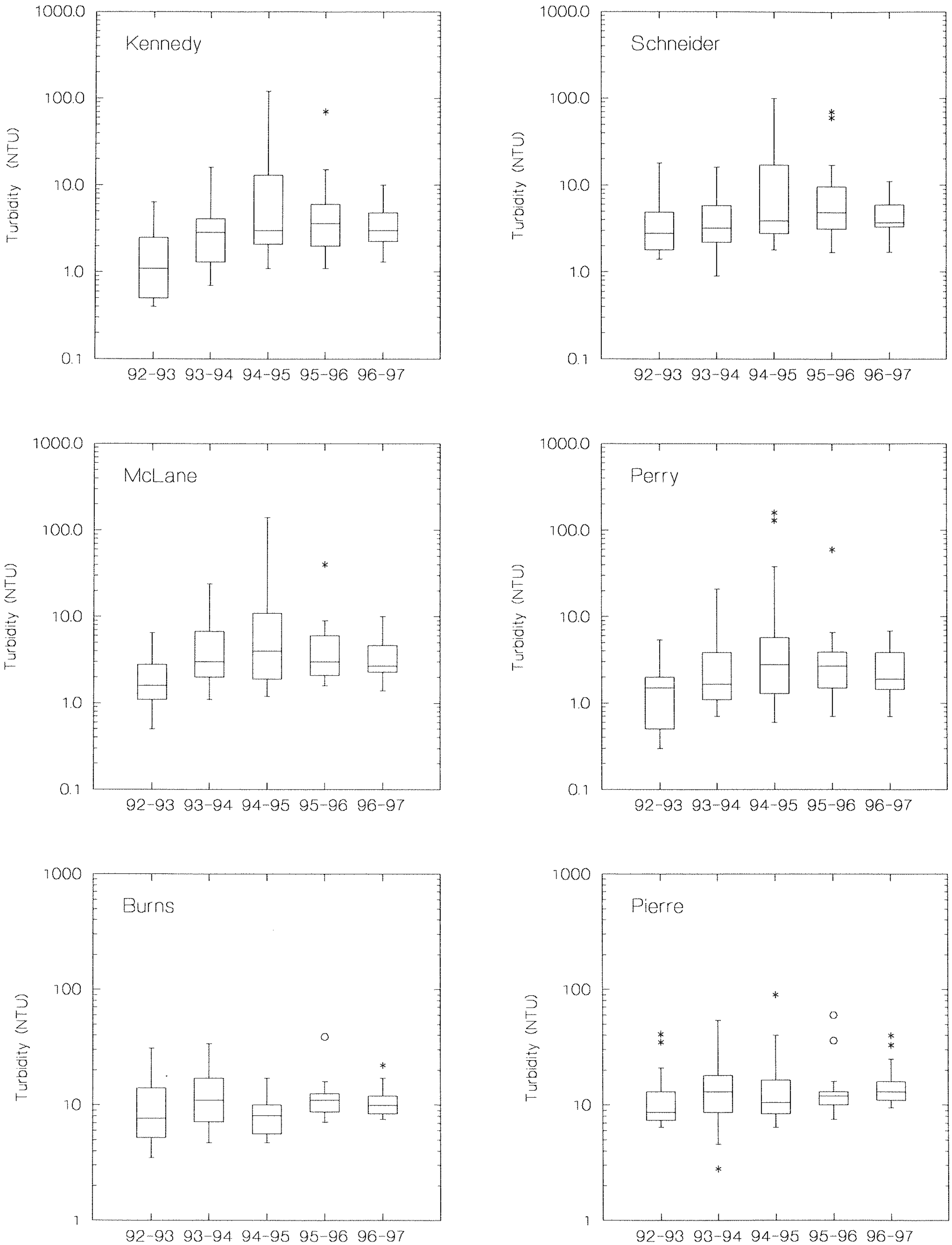

Figure F-3. Box-plots of turbidity data.

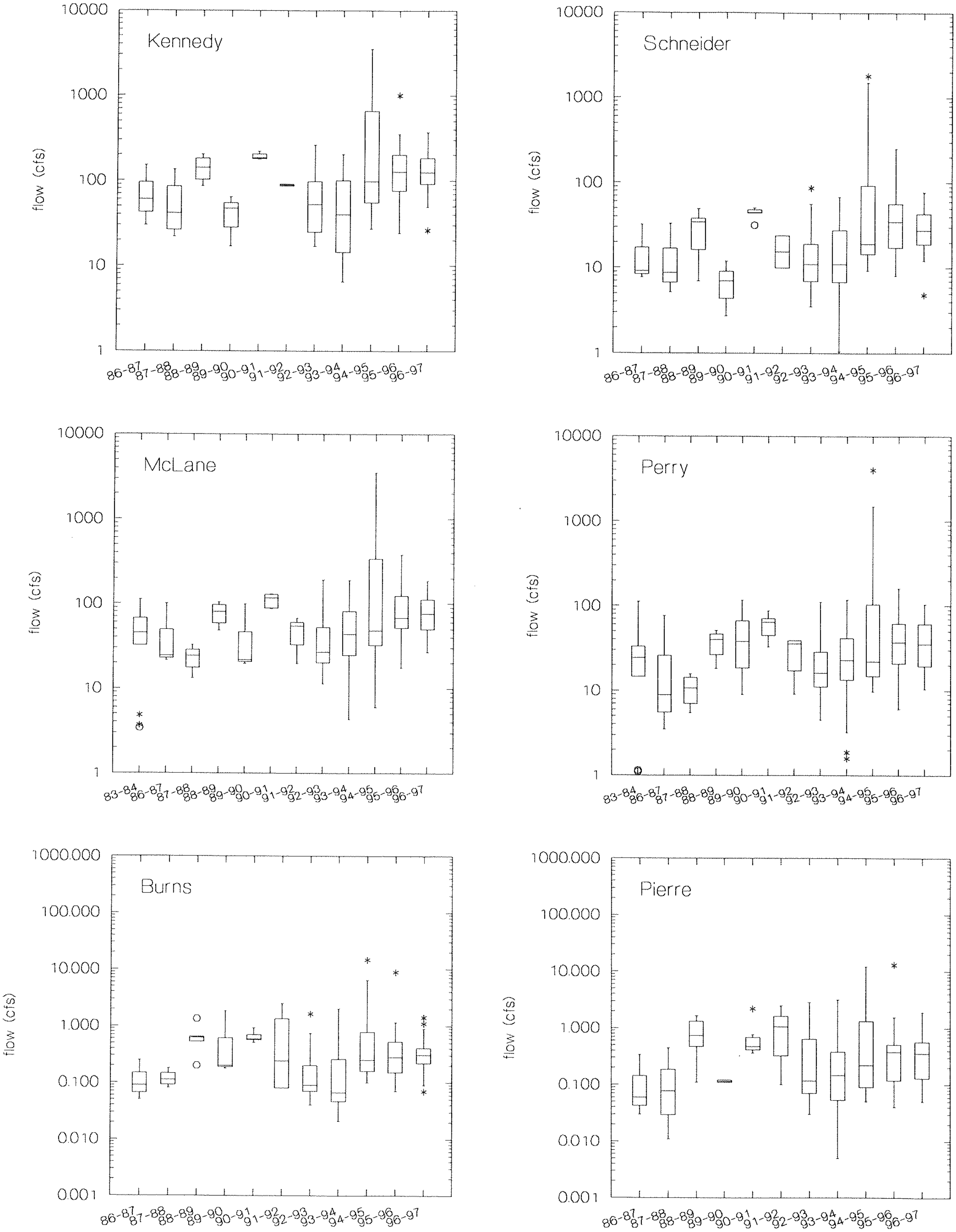

Figure F-4. Box-plots of flow data. (Seasons 92-93 to 96-97 are NMP project data).

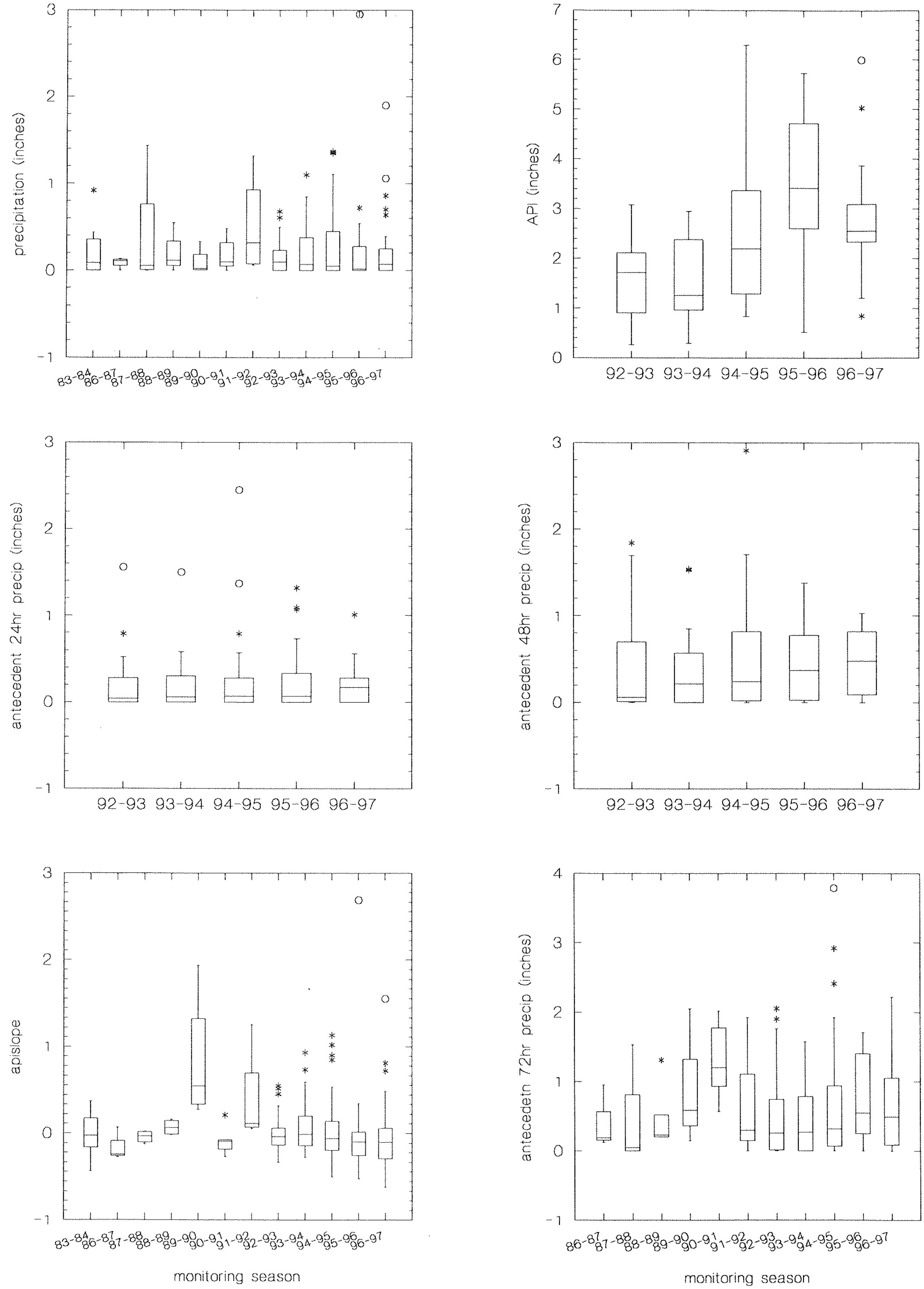

Figure F-5. Box-plots of precipitation data. (Seasons 92-93 to 96-97 are NMP project data).

Appendix G

Data Quality Objectives

Appendix G-1. Data Quality Objectives for Water Quality Parameters.

Parameter	Method and Reference	Precision	Bias	Required Lower Reporting Limit	Expected Range
Fecal Coliform*	SM-17 9222-D (MF)	approximate 95% CI as below:	N A	1 cfu/100 mL	0 - 1000 cfu/100 mL for most samples (< 5% of samples >1000 cfu)
Turbidity	EPA 180.1	s = ± 0.6 @ 26 NTU s = ± 4.7 @ 180 NTU	N A	0.1 NTU	0.2 - 50 NTU
TSS	SM-17 2540-D EPA 160.2	s = ± 5.2 @ 15 mg/L s = ± 24 @ 242 mg/L s = ± 13 @ 1707 mg/L	N A	1 mg/L	1 - 100 mg/L
Conductivity	EPA 120.1 SM-17 2510-B	s = ± 6 @ 536 umho/cm RSD = 8% @ 147 - 228 umho/cm	N A	1 umho/cm @ 25 C	20 - 1500 umho/cm (common range 60 - 200 umho/cm)
Temperature	SM-17 2550-B	+/- 0.3 degrees C	N A	0.0 C	0.0 - 15.0 C
Water Velocity	PSP-Freshwaters	+/- 0.05 feet per second	N A	0.05 fps	0.00 - 4.00 fps
Precipitation	National Weather Service Rain Gages	+/- 0.01 inch	N A	0.01 inch	0.00 to 3+ inches/day

Fecal Coliform approximate 95% CI:

	ORIGINAL PLAN OCT 92	LAB SPLITS 92-93	FIELD REPS 92-93
@ 20 cfu:	11 - 29	1 - 42	1 - 53
@ 50 cfu:	36 - 64	28 - 72	17 - 83
@ 100 cfu:	80 - 120	78 - 122	67 - 133
@ 150 cfu:	126 - 174	128 - 172	117 - 183
@ 200 cfu:	172 - 228	178 - 222	167 - 233

* - adapted from Ecology, 1991
** - highly turbid samples to be diluted prior to analysis
s - standard deviation
cfu - colony forming units
RSD - relative standard deviation (standard deviation/mean)
SM-17 - Standard Methods for the Examination of Water and Wastewater, 17th Ed. (APHA, 1989)
PSP - Puget Sound Protocols (Tetra Tech, 1986 + updates)

Appendix G-2. Data Quality Objectives for Managment Measures and Land Use.

Management Measures Parameter	Unit of Measure	Method of Collection	Collection Frequency	Temporal Accuracy
inventory on-site sewage system	each	door to door survey, county records	once during project life	month
repair on-site sewage system	each	surveys and repair orders	when repair completed	week
farm inventory	each	survey	when completed	week
pasture/grazing management	acres and # animals	farm plan & review	annually	week
stream fencing	feet	farm plan & review	annually	week
stream buffer	feet	farm plan & review	annually	week
gutters/downspouts	rainwater diverted	farm plan & review	annually	week
manure management	# animals, systems, acres	farm plan & review	annually	week
forest harvest	acres	forest practices appications	annually	week

Land Use Parameter	Unit of Measure	Method of Collection		
agriculture	acre	farm inventory, tax assessments	annually	year
pasture	acre	farm inventory, revisits	annually	year
other	acre	farm inventory, revisits	annually	year
residential	acre	tax assessments	annually	year
suburban	acre	tax assessments	annually	year
urban	acre	tax assessments	annually	year
rural	acre	tax assessments	annually	year
forestry	acre	tax assessments	annually	year
undeveloped	acre	tax assessments	annually	year
commercial	acre	tax assessments	annually	year
industrial	acre	tax assessments	annually	year
other	acre	tax assessments	annually	year

management measures data will be expressed as numbers and percentage of that item or sources controlled in that study basin

Appendix H

Grant Performance Evaluation

Appendix H

October 12, 1998

TO: David Batts, EILS

FROM: Marilou M. Pivirotto, SWRO

SUBJECT: Totten/Little Skookum Shellfish Protection Initiative Grant (Ref 39)
Performance Evaluation of Thurston Conservation District

The Shellfish Protection Initiative (SPI) process was initiated in 1992 as an intense and focused effort to reduce and/or eliminate nonpoint pollution sources that were threatening the state's commercial shellfish resources. While the process included awarding Referendum 39 funds to local governments to implement nonpoint pollution remedial activities, it additionally included a heightened participation of Ecology and local conservation districts in planning the activities and in their execution. The environmental goal of the SPI projects was clean water and opened shellfish beds, and the manner by which this was to occur was though interactive participation and communication of all project participants.

Thurston County was awarded a SPI grant to conduct a project in the Totten Inlet Watershed; the Thurston Conservation District (TCD) was awarded a sub-contract under the grant. During the first year of the project, Ecology's Shellfish Protection Unit, chaired a quarterly roundtable meeting of all project participants to evaluate the progress of the project, as well as to direct future project work. I was the Shellfish Protection Unit's lead staff person on the SPI process. The TCD participated in these meetings. TCD's performance during this first year of the project was exemplary.

During 1993, the second year of the project, Ecology management made the decision to dismantle the Shorelands Program Shellfish Protection Unit. The eight members of the Unit were dispersed throughout Ecology and assigned new duties. I was assigned to the Southwest Region Water Quality Program. At this point, there was no Ecology directive as to who would now be assigned to manage the SPI process and the Totten Project. After my assignment to the Water Quality Program, I raised this issue to my new supervisor. I was told continue overseeing the project, but only in the aspect of signing grant vouchers submitted by Thurston County. I was informed that this was the only activity I was permitted to devote time to in regard to the SPI process as I now had other duties assigned to me. I notified all the SPI grantees of this turn of events.

The termination of the Shellfish Protection Unit and Ecology's active oversight of the SPI process negated the original intent of the process. Grantees were left in the lurch, so to speak. In regard to the Totten Project, Thurston County and the TCD must be congratulated for pursuing the completion of the project under conditions very unfavorable to all participants and certainly less than they initially agreed to in the grant contract. After mid-1993, I was the grant officer in name only, however, in my estimation, TCD's performance remained outstanding.

Appendix I

Alternative Opinion by Thurston Conservation District

Thurston
Conservation District

APPENDIX I.

Local solutions to local problems

Conservation Planning • Habitat Restoration • Bio-engineering • Soils Analysis • Conservation Education • South Sound GREEN • Nutrient Management

TO: Will Kendra, *Watershed Ecology Section*
FROM: Troy Colley, *District Administrator*
DATE: 10 December 1998

RE: NMP 1997 Annual Report: dissenting opinion

The Thurston Conservation District does not concur with several of the conclusions reached in the *Totten and Eld Inlets Clean Water Projects: 1997 annual report*. The differences are rooted in the adaptive management approach used by the quarterly roundtable described in Marilou Pivirotto's memo dated October 12, 1998. This approach was necessary because of the ever changing pattern of land ownership and livestock use in the watersheds. The quickening pace of suburban development in the 90's meant that any farm survey quickly became obsolete and the list of landowners with highest potential to pollute was continually updated. The use of an adaptive management model was not an accident or the result of change in staff, but an integral part of the project design.

While the roundtable was fully functioning, the project responded to changes in the watershed. The discussion and agreement of the participants to future work directions essentially superceded the grant contract language. The District would not have had the successes it did if it maintained a strict interpretation of the grant.

These grant dynamics preclude the Shellfish Protection Initiative from meeting the analytical standards of the National Monitoring Program. The SPI project was designed before the NMP selected the Eld/Totten project. The essential nature of the adaptive management process used prohibits it from being molded to meet the goals and objectives of EPA. It does not allow for the type of statistical analysis required of NMP projects.

The District does agree that the multiple recordkeeping and reporting practices used have contributed to the disagreement. We are working with our conservation partners to try to improve the situation.

One reoccurring issue is the interpretation of the word *priority*. There is considerable disagreement over the meaning of the word in the grant contract. While DOE maintains that the District was required to provide conservation plans to all priority farms identified, the District understood that we were to provide conservation plans to the landowners with highest potential to pollute. The grant language calls for the District to *prioritize problems and work to apply voluntary solutions to the highest priority problems*....

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The District asserts that we accomplished this task, but a reading of DOE statistics would lead one to believe we did not. For example, the report cites that 24% of the priority farms in Schneider Creek basin and 33%-52% of the priority farms in McLane/Perry Creek basins entered the conservation planning process. It concludes that conservation planning targets, and thereby, grant objectives, were not met. The District asserts that 100% of the landowners with highest potential to pollute entered the conservation planning process in these basins and the grant objectives were met.