Quality Assurance Project Plan

Project Name: **Volunteer Water Quality Monitoring Program**

Tillamook County Estuary Partnership
June 12, 2002

Project Manager:	Derek Sowers
Signature/Date:	_____
Project Laboratory/QA/Data Management Officer:	Donald F. Reynolds
Signature/Date:	_____
Analytical Laboratory Officer:	Donald F. Reynolds
Signature/Date:	_____
EPA Grant Officer:	John Gabrielson
Signature/Date:	_____
EPA QA Unit Team Leader:	Bruce A. Woods
Signature/Date:	_____

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GROUP A: PROJECT MANAGEMENT ELEMENTS

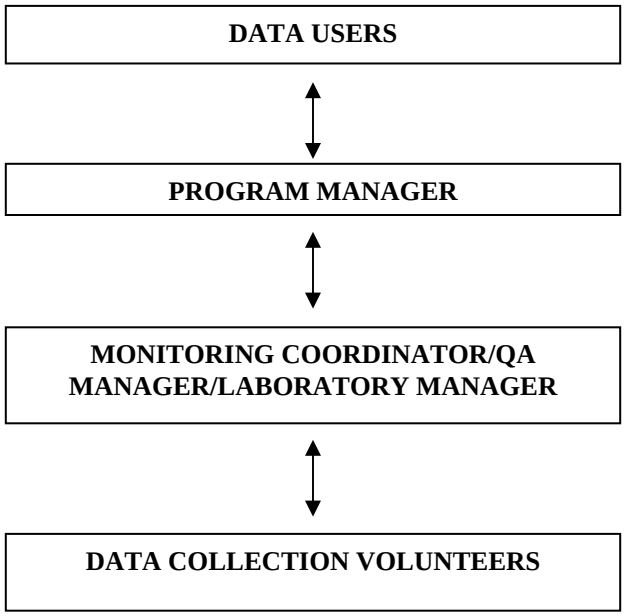
A1. and A2. - refer to pages 1 and 2.

A3. Distribution List: (Names & telephone numbers of all those receiving copies of this plan.)

Mark Trenholm, Director, Tillamook County Estuary Partnership
Derek Sowers, Project Implementation Manager, Tillamook County Estuary Partnership
Don Reynolds, Monitoring Coordinator, Tillamook County Estuary Partnership
Bruce Apple, North Coast Regional Coordinator, DEQ
Karen Font-Williams, DEQ Volunteer Monitoring Coordinator
Bruce A. Woods, EPA QA Team Leader
John Gabrielson, EPA Grant Officer
Shawn Reiersgaard, Environmental Manager, Tillamook County Creamery Association
Charlie Wooldridge, WQ Sampling Volunteer
Leo Adams, WQ Sampling Volunteer
John Gettman, WQ Sampling Volunteer
Sherry Vic, WQ Sampling Volunteer
Ron Kaser, WQ Sampling Volunteer
Richard Felley, WQ Sampling Volunteer
Katrina Symons, WQ Sampling Volunteer
Beth Lambert, Watershed Extension Agent

A4. Project/Task Organization: (List all key personnel and organizations involved in this project.)

Organizational Flow Chart of Volunteer Monitoring Program:



Narrative Description of Participants Roles and Responsibilities:

Data Users:

- Tillamook County Estuary Partnership (TCEP) - Oversees the collection of water quality data in the Tillamook Bay basin as part of the implementation of the Tillamook Bay Comprehensive Conservation and Management Plan (CCMP)
- Tillamook Bay Watershed Council - Participates in data collection by Council volunteers and reviews data as part of their watershed assessments and action planning for the five rivers entering Tillamook Bay.
- Oregon Department of Environmental Quality (DEQ) - Reviews volunteer collected data and stores it on their state-wide LASAR database system.

Program Manager:
TCEP's Project Implementation Manager, Derek Sowers, is responsible for ensuring the dissemination of monitoring data to target user groups, working with technical experts on data analysis and ongoing evaluation of TCEP's monitoring efforts, and seeking funding to support monitoring programs.

Monitoring Coordinator/QA Manager/Laboratory Manager:
Using grant funding, TCEP maintains a personal services agreement contract with a part-time Monitoring Coordinator (MC). This contractor, Don Reynolds, is responsible for overseeing all logistical aspects of the volunteer monitoring program including: ordering all supplies, coordinating training and scheduling for volunteers, conducting/overseeing laboratory processing, equipment calibration and maintenance, implementing QA procedures, performing data validation, entering and managing data spreadsheets, and limited analysis work.

Data Collection Volunteers:
Seven citizen volunteers conduct the field data collection work required under this monitoring program. Volunteers are trained by the Monitoring Coordinator in proper sampling protocols and work closely with the MC on collection scheduling, transportation, and timely delivery of samples to the TCEP laboratory.

A5. Problem Definition/Background:

The Problem: Major reaches of all five rivers entering into Tillamook Bay are identified as water quality limited streams under the standards of the Clean Water Act. Water quality impairment is due primarily to high bacteria concentrations and temperatures.

Purpose of Monitoring Program:

- Provide a long-term, spatially-explicit understanding of the nature and severity of the bacteria contamination problem in the tributary rivers of Tillamook Bay.
- Engage local citizens in the monitoring and remediation of bacteria contamination of local rivers.
- Identify areas of chronic contamination and aid in the prioritization of appropriate actions to address point and non-point source of bacterial pollution.

Specific questions to be addressed by monitoring program:

- What specific reaches of the five rivers chronically exceed bacteria compliance standards, and to what extent?
- How do bacteria concentrations fluctuate by season and between years?
- Is the bacteria contamination problem improving or getting worse over time in response to attempts at corrective action?

Background Information:

The Tillamook Watershed is located in the northwest coastal portion of Oregon. The watershed is composed of five major rivers that flow into Tillamook Bay: the Wilson, Trask, Tillamook, Kilchis and Miami. One larger community, Tillamook, and several smaller communities, Bay City, Garibaldi and several unincorporated areas, make up the bulk of the urban population. This is mainly a farming community with the bulk of the industry composed of dairy farms. The watershed contains approx. 597 mi^2 area, and has approximately 2500 miles of permanent and intermittent streams. The impact on water quality in the streams in the watershed continues to grow as a result of increased runoff from urban development, agricultural production and logging. Local residents within the watershed have become concerned about the increased threat to water quality and are making plans to work with government agencies and local business and industries to address problems through the development of best management plans.

Very little baseline water quality data is available which could be used to identify specific problems, or be used for planning purposes and future comparisons. The participants in this project have documented the baseline ambient water quality conditions of surface water streams in the basin. In addition to the target of a good baseline, however, we have selected sampling sites that are upstream and downstream from likely bacteria contributors such as wastewater treatment plants, dairy farms, and relatively dense rural residential or urban development. This targeted sample approach provides insight into the portions of the rivers yielding the highest bacterial inputs. The data collected is used by the watershed council, TCEP staff and partners, and state agency staff to characterize current water quality conditions, identify specific water quality problem areas, and pursue the implementation of enhancement and restoration projects. Data is also used by these groups to educate and inform local residents on the connections between land use and water quality.

In addition to intensive bacteria monitoring, TCEP monitors a limited network of sites for turbidity levels. This data is collected to provide a steady record of turbidity levels of the tributary rivers in order to alert us of any significant changes in water clarity over time or between river systems.

A6. Project Task/Description:

1. Collect Samples:

This project involves the collection of water quality samples from 31 sites distributed along the stream networks of the Miami, Trask, Kilchis, and Tillamook rivers. Samples will be collected by trained volunteers five times per month for each of the sampling sites. Each site will be sampled once/week for the first three week of the month, and twice/week during the last week of the month. Minor adjustments to this sampling schedule may be made subject to hazardous weather conditions. Please refer to Figure 1 in section B1 for a map of sampling sites.

2. Analyze Samples:

Volunteers keep samples on ice and transport them to the TCPP laboratory immediately upon completion of the sample run. Samples are then analyzed without delay upon delivery to the lab. At the lab, the Colilert™ system is used to analyze samples. Using this system, the Monitoring Coordinator determines the bacteria concentrations of the samples and records this data on the field data sheets.

3. Enter Data into Spreadsheet:

Once per week, the Monitoring Coordinator enters the data recorded on the paper field sheets into an electronic spreadsheet (Microsoft Excel). Data entry is double-checked to avoid any transcription errors. Backups of data spreadsheets are completed weekly.

4. Data Analysis:

Using statistical and graphical features of Microsoft Excel, bacteria data trend graphs are generated for each sample station over time. The extent to which the DEQ freshwater bacteria standard is exceeded (30 day log mean of 126 *E. coli* per 100 ml based on a minimum of five samples with no single sample exceeding 406 organisms per 100 ml for contact, and fecal coliform median concentration of 14 organisms per 100ml, with not more than ten percent of the samples exceeding 43 organisms per 100ml) is graphed for each station. By comparing graphs of bacteria concentrations with maps of the sampling locations, it is possible to answer our primary monitoring questions which are stated in A5. Data analysis is done by the Monitoring Coordinator and Project Manager with technical assistance as needed from DEQ and Oregon State University's Watershed Extension Agent.

5. Report/Disseminate Results of Monitoring:

Results of water quality monitoring will be reported on an annual basis to funding contributors, the TCEP Board of Directors, and the Tillamook Bay Watershed Council. A brief summary report showing monitoring results, analysis, discussion, and recommendations will be prepared for this purpose, as well as oral presentations to these groups as requested.

Task Implementation Schedule:

MAJOR TASKS	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**
Update volunteers on revised QAPP	X												
Monthly WQ Monitoring (5x/month)	X	X	X	X	X	X	X	X	X	X	X	X	X
Lab Analysis (weekly)	X	X	X	X	X	X	X	X	X	X	X	X	X
Enter data into spreadsheet (weekly)	X	X	X	X	X	X	X	X	X	X	X	X	X
Data Processing, Analysis, Reporting												X	X

A7. Quality Objectives and Criteria:

This project will measure total coliform and *E.coli* using the Colilert™-18 system manufactured by IDEXX. Sample analysis will be conducted using the recommended equipment and protocols for this system. Turbidity will be measured in Nephlometric Turbidity Units (NTUs).

Quality Objective:

Ensure high quality data is collected and eligible for use in watershed assessments, identifying high priority areas for corrective action, and for analysis of trends with respect to Clean Water Act compliance standards. This objective will be fulfilled by meeting Oregon DEQ criteria for class "A" data.

DEQ Data Quality Matrix:

Data Quality Level	**Quality Assurance Plan**	**Turbidity Methods**	***E. Coli* Bacteria Methods**	**Potential Data Uses**
A	QAPP approved by DEQ. QA criteria met.	Nephlometric Turbidity Meter. A = +/- 5% of std.value P= +/-5%	DEQ Approved Methods Split Sample P=+/-0.5 log	Regulatory. Permitting. Compliance with water quality standards

A8. Special Training/Certification: (Identify training and certification requirements for all field staff.)

All data gatherers and processors have received or will receive training from the Monitoring Coordinator on proper sample collection protocols. The Monitoring Coordinator has attended DEQ-sponsored water quality monitoring and data management workshops. In addition, DEQ's Volunteer Monitoring Coordinator conducted an independent comparison between identical split samples processed at the Estuary Partnership laboratory and those processed at DEQ. No significant quality difference was detected between the two laboratories and our laboratory met the criteria for the generation of "A" level quality data.

Following an initial training by DEQ's Volunteer Monitoring Coordinator, most of the water quality sampling volunteers have been collecting field samples for several years under this program. New volunteer recruits are trained in sampling protocol through direct field mentoring with long-standing volunteers and the Monitoring Coordinator. Volunteers are given four hours of training and are taken on a run of the river they will be sampling by either the MC or the volunteer they will be sampling with or replacing. Instruction includes how to handle the collection bottles, so as not to contaminate the sample with their hands, and proper procedure for collecting another sample should the one they have collected be contaminated. They are field taught the methods used at each site for sampling and get to try the method on their own. Included in this training are details on how to label samples properly, sample preservation during transport, and familiarity with the overall QAPP.

A9. Documents and Records:

This document is an updated QAPP for the volunteer monitoring program. Following approval by DEQ and EPA, each volunteer on the distribution list will meet with the Monitoring Coordinator to review the plan and receive a copy of the document for reference. Proper sampling protocols will be reviewed with each volunteer to clarify any questions and to ensure consistency in collection methods between different volunteers. This QAPP plan will be dated, and volunteers will be requested to disregard and recycle any former versions of the plan.

Separate field data sheets for monitoring will be maintained for each sampling event. See Attachment A for illustration of typical monitoring field data sheet. Information recorded on data sheets is to include: Project name, data and time of sampling events, water body name, basin name, general weather conditions, names of field staff, time of each sample or measurement, measurement data, and pertinent comments regarding the field conditions.

Field data sheets are given directly to the Monitoring Coordinator along with the samples collected for that sampling day. The MC checks the sheets for completeness and accuracy and puts them into a binder. These sheets are completed by the MC once bacteria samples are processed and total coliform and *E.coli* numbers are determined. At the end of each week, the MC enters the data from the field sheets into an Excel spreadsheet file. This spreadsheet file is backed up into archive files weekly. In addition, old field sheets are permanently stored in a binder organized by sampling date. The Excel spreadsheet files will be slightly reformatted into the standard DEQ format and forwarded to the DEQ Volunteer Monitoring Coordinator for entry into the LASAR database. This database is available to the public over the Internet.

GROUP B: DATA GENERATION AND ACQUISITION

B1. Sampling Process Design:

The sampling process involves the collection of water samples from 30 locations along four of the major tributary streams (Miami, Kilchis, Trask, Tillamook Rivers) entering Tillamook Bay. Samples are taken within the forest lands above human influence to identify background levels (the relative contribution of wildlife). Other sampling site locations have been chosen above and below likely contributors of bacteria (wastewater treatment plants, agriculture, and significant housing developments). The selection of designated sampling sites was chosen in order to attempt to discriminate likely "background" levels of bacteria from human-induced pollution. By choosing sampling sites above and below likely significant pollution sources, it is possible to better understand those reaches where bacteria levels increase dramatically, and to gain insight into likely pollution sources in need of correction. Sampling locations also were chosen with practical considerations in mind, such as relative ease of access and landowner permission. Many sites were specifically chosen to coincide with previously designated DEQ LASAR sites in order to supplement previously collected data. Refer to Figure 1 for a map of sampling locations. Refer to Table 1 for a descriptive list of sampling locations.

Each site will be sampled once/week for the first three weeks of the month, and twice/week during the last week of the month. Excluding replicate samples, this will result in 5 samples per site per month, as called for in DEQ protocols. Minor adjustments to this sampling schedule may be made subject to hazardous weather conditions. Samples are collected on the outgoing tide by a group of trained volunteers using equipment supplied by the Partnership's laboratory.

Bacteria samples are collected at all 31 sites, whereas turbidity is taken only at the following locations:

Name of River	Sampling Site Name
Tillamook	2,9
Trask	1,5
Kilchis	5,8
Miami	2,5

FIGURE 1.

Table 1. Sampling site names and locations.

Miami River sample sites:

Sample Location	Location Description
M1:	Illingsworth Creek
M2:	Miami River at pullout. Site is on Miami River Road 0.5 miles up from Hwy 101.
M3:	Miami River at pullout. Site is on Miami River Road 3.0 miles up from Hwy 101.
M4:	Miami River at Stuart Creek Bridge. Site is on Stuart Creek Road, 50 yards from Miami River Road. Stuart Creek Road is 5.0 miles up from Hwy 101.
M5:	Miami River at bridge on Miami Forest Road. Forest Road is gravel and turns off Miami River Road 5.6 miles up from Hwy 101. Site is 1.9 miles from that point, and is 7.5 miles up from Hwy 101.
M6*:*	*Miami River at Hwy 101 Bridge (Performance Partnership staff will sample this site only during outgoing tide).*
M7:	Prouty creek

Tillamook River sample sites:

Sample Location	Location Description
Ti1:	Tillamook River at Weber Bridge on Tillamook River Road
Ti2:	Tillamook river at Bewley Creek Bridge, near junction of HWY 101 and Tillamook River Road; 1.1 miles up from Weber Bridge.
Ti3:	Bewley Cr 50 yds above Till. R.
Ti4:	Tillamook River at Rest Stop on Hwy 101; 2.3 miles up from Weber Bridge.
(Ti5):	*Previous sampling site - deleted from current program*
(Ti6):	*Previous sampling site - deleted from current program*
Ti7:	Tillamook River from Yellow Fir Bridge, 1.2 miles up Yellow Fir Road from Hwy 101; 7.2 miles up from Weber Bridge.
Ti8:	Upper Bewley Cr. @ culvert
Ti9:	Tillamook River at Five-way junction.

Kilchis River sampling sites:

Sample Location	Location Description
K1:	Kilchis @ Geinger Farm
K2:	Squeedunk @ Geinger Farm
K3:	Hathaway Slough @ Hwy 101 Bridge. Site is on Hwy 101 ¼ mile north of the Kilchis River Bridge on Hwy 101.
K4:	Kilchis River at Alderbrook Bridge. Take Alderbrook Road off Hwy 101. Site is ¼ mile up Alderbrook Road.
K5:	Kilchis River @ Curl Bridge. Take Curl road off of Kilchis River Road. Site is at Bridge.
K6:	Kilchis River @ logging road bridge. Site is at the bridge on a logging road that goes off to the right from Kilchis River Road.
K7:	Sam Downs Cr. @ River Mile 7
K8:	Kilchis River mainstem @ River Mile 7. Take sample from Sam Down's Creek *above* confluence with mainstem Kilchis.
K9:	*Previous sampling site - deleted from current program*
K10:	Barker Bridge.

Trask River sample sites:

Sample Location	Location Description
Tr1:	Trask River at Cedar Creek boat launch
Tr2:	Trask River at Johnson Bridge
Tr3:	Mill Creek @ east end Mill Cr Rd. (private)
Tr4:	Mill Creek @ Long Prairie Rd.
Tr5:	Trask River at Hwy 101
Tr6:	Slough at city of Tillamook
Tr7:	Trask R. @ Carnahan Park
Tr8:	*Previous sampling site - deleted from current program*

Tr9:	*Previous sampling site - deleted from current program*
Tr10:	*Previous sampling site - deleted from current program*
Tr11:	Highway 153 and Trask. This site is 200 yards below Tillamook STP Below Tillamook at Hospital Hole pullout

B2. Sampling Methods:

Bacteria:
Generally, samples are collected using the protocols described in the "Collecting Water Samples for Bacterial Analysis" section of the EPA's Volunteer Estuary Monitoring: A Methods Manual.

Samples are collected in sealed 120ml sterile bottles supplied by IDEXX. These bottles have a trace amount of sodium thiosulfate added to each sample bottle. This compound is used to eliminate any contamination of the sample by chlorine that may be added to the river system in a number of ways. Overflow from septic systems, Grey water additions directly to the river, and possible overflow of STP's is the most common cause of this condition. Each sample bottle is labeled with a waterproof sticker on the cap and bottle. Both the cap and bottle sticker have a line item for the name of the sampling location and time of collection. These line items are filled in with an indelible marker at the time each sample is collected.

Samples are collected in one of two ways. Because of the nature of the local rivers, we have asked the samplers never to enter the river directly. During the rainy season, local rivers have a very heavy flow and it would be unsafe for lone volunteers to be in the water. The first sampling method utilizes a pole with a clamp on the end to secure the bottle and allow us to insert it into the midstream flow. Samples are collected one foot below the surface. Samples are brought up and sealed and logged as to time and site and placed in a cooler for transport to the lab. The second method employs the use of a system to lower the sample bottles from bridges to collect the sample. This is necessary to sample overly steep, confined, or overgrown portions of the river. Fishing poles with specially built metal holding clamps have been designed for sampling in these areas. Samples are always taken from the upstream site of the bridges and in midstream. Samples are collected by lowering the sample bottle to at least one foot below the surface and reeling in the sample, sealing it and marking the time of collection and the sample site on the container. The sample is then placed in a cooler for transport.

Turbidity:
Samples collected following the same protocols as bacteria except that 500 ml bottles are used instead of 100 ml.

B3. Sample Handling and Custody:

Once collected, samples are delivered immediately by the sampler to the Partnership's laboratory facilities at Garibaldi for processing. Transport to the Garibaldi lab is usually accomplished within 30 minutes of taking of the final sample on each run. Samples are stored in a clean cooler for transport. Any samples that will take longer than an hour for delivery to the lab are stored on ice. Sampler will contact lab personnel upon arrival. The samples and log sheet for samples are turned over to one of three qualified lab people for initial processing. Those personnel designated to accept samples are Don Reynolds, Suzan Greenwood, and Mark Trenholm. The lab

personnel log the samples in on the master log sheet, and processed immediately. No samples are shipped off-site for processing.

Specifically, documentation of the samples occurs in the following steps:

Phase of documentation:	Information documented:
Field	Name of sampler, time and date of sample, sample number by site, and if sample is duplicate or not.
Laboratory	Time of entry to the lab, time processing began, time in incubator, time sample is read.
Office	Data entry time, date, and name of person entering data.

B4. Analytical Methods:

Parameters Measured	**Analytical System**	**Equipment**	**Preservation**	**Holding Time**
Turbidity	Hach Model 2100P Turbidimeter	Hach Model 2100P Turbidimeter, Formazin Primary Standard, Gelex Secondary Standards, sample bottles	None required.	Process within 24 hours of sampling
E. Coli bacteria Total coliform	IDEXX Colilert-18	IDEXX Sterile 120ml IDEXX reagent sealed snap packs. Colilert 18 WP200-18 one to each sample IDEXX Quanti-Tray 2000 WQT – 2000 one for each sample IDEXX Quanti-Tray Sealer 2x Thermolyne incubator model 142300 with thermometer Spectroline Model EA-160 Black Light	Store samples on ice until processed.	Process within 6 hours of sampling

Methods for Total Coliform and *E.coli* Measurements:

The IDEXX Colilert-18 system is used for processing the samples for the detection of total coliform and *E.coli*. This system has been approved for use in bacteria monitoring by Oregon DEQ and U.S.EPA., and is described fully in the manual *Standard Methods for Examination of Water and Wastewater.* This system requires no intrusive equipment to be used in processing, therefore minimizing the risk of contamination in the lab. Wearing latex gloves, lab personnel open the sample making sure not to touch the top of the bottle or the inside of the cap, add the reagent powder supplied by IDEXX and quickly reseal the sample. Preparation of the IDEXX 97 well reader cards is accomplished by marking the sample number on the back of the card with an indelible pen taking care never to touch the top of the card. Once the reagent powder has completely dissolved in the sample, (noted by twirling the bottle and looking for the absence of any particles in the swirl column), the sample is reopened and poured into the reader card by squeezing the top half of the card and forming an opening to pour the liquid into. Care is taken not to pour anywhere near the top of the card, but to let the liquid fall down into the opening. The cards are then sealed using the IDEXX sealer. Samples then go directly into one of three

incubators for 18-22 hours @ 35degrees C. (+/- .5 C). The lab technician notes the time of insertion into the sealer on the master log sheet.

After 18-22 hours of incubation, the samples are read using a color comparator provided by IDEXX. Each sample is read twice, once for total coliform determination and again for *E.coli*. The lab technician notes the number of yellow wells out of the 49 large wells and the 48 small wells and records this number next to the sample number on the log sheet. The second reading is done using the black light and counting the wells again, this time counting only the wells that fluoresce. The 49 large wells and 48 small wells are each examined with the black light. After all samples have been examined and counted the technician uses the charts provided by IDEXX to ascertain the Most Probable Number (MPN) from the number derived from the counting. When splitting samples to provide additional clarity, the maximum count to be derived from samples is 49 x 40 which translates to <2419 MPN. Greater clarity of total numbers can be obtained by splitting samples by 50% with deionized water or even 90% with deionized water. This additional splitting is done for some samples with extremely high bacteria concentrations in order to get an idea of the total numbers we are dealing with. Performance standards and methods have been approved by EPA (see 40 CFR 141.21(f)(6) (iii)).

Methods for Turbidity Measurements:
(*from Water Quality Monitoring Guidebook, OWEB, 2001***)**

Accuracy Check
Field check the turbidimeter against the Gelex Secondary Standards at the start of each set of measurements. If numerous samples are to be processed, periodically check the instrument against the calibration standards and adjust accordingly.

Steps:
1. Place the first Gelex Standard (0 to 10 range) in the cell compartment of the meter with the white diamond on the vial aligning with the orientation mark on the meter. Close the lid.
2. Press **" POWER"** , and when 0 .00 shows in the display window, press **" READ."** If the reading is not within 5% of the Standard, recalibrate the instrument with the primary Formazin Standard (see below).
3. Repeat this procedure with the remaining two Gelex Standards (0 to 100 and 0 1 to 1000 ranges).

Turbidity Measurement Procedure:

1. Collect a representative sample in a clean container. Fill one of the sample bottles (included with the turbidimeter kit) to the line (approx. 15-ml), taking care to handle the sample bottle by the top to avoid fingerprints and dirt on the bottle. Cap the bottle.
2. Wipe the bottle with a soft, lint-free cloth to remove water spots and fingerprints.
3. Press the **" I/O"** button to turn the instrument on. Place the instrument on a flat, steady surface.
4. Put the sample bottle in the instrument cell compartment so the diamond mark on the bottle aligns with the orientation mark on the instrument.

5. Select the manual or automatic range by pressing the **" RANGE"** key. " **AUTO RN**G" is recommended and will be displayed. Press **" READ."** The display will show " **------- NT**U" then the turbidity reading in **NT**U. Record the turbidity after the lamp symbol turns off.

B5. Quality Control:

Quality Control is obtained in several ways:

- Duplicate Samples:
  Each sampler is required to take a duplicate sample on at least one randomly-chosen site on each run. Duplicate quality assurance (QA) samples for all measurements will be taken at a minimum of 10% of the total number of monitoring sites (1 duplicate for every 10 sites) during each sampling period. This sample is treated the same as any other sample except that it is marked as a duplicate for identification. Samples are run and analyzed to obtain the MPN for each sample and then a comparison is done between the original and duplicate sample. Use of the IDEXX system allows a <10 % variance in sample MPN for confirmation of acceptance. Each sampler is identified and it is noted by the Monitoring Coordinator if duplicates exceed or comply with acceptance standards.
- Split Samples:
  In order to gauge the precision of our laboratory processing procedures, split samples are processed on a routine basis. For a split sample, the same field collection procedure is followed - with the exception that a 500 ml sample is collected in one grab instead of the usual 100 ml sample. (Please refer to Attachment A for a discussion of the DNA genetic marker study for an explanation of why 500 ml bottles are used). Upon initial processing in the laboratory, two 100ml splits are taken from the 500 ml bottle. The two identical samples are then run through our standard laboratory procedures, and total coliform and *E.coli* counts are completed for each. We then calculate the log of the resulting bacteria numbers for *E.coli*. The log of these numbers are then compared with each other to gauge the precision of our lab testing. As identified in their Data Quality Matrix, the DEQ criteria for level "A" quality data is to have a precision of P= +/- 0.5 log. Split samples are run for each of the five rivers twice a month.
- Blanks
  Blanks are also run on each ten samples processed to ensure no contamination is being introduced to the samples during laboratory processing.

If the cause of a QA problem is found to be equipment failure, calibration and/or maintenance techniques will be reassessed and improved. If the problem is found to be sampling team error, team members will be retrained to reinforce proper sampling and handling protocols.

B6. Instrument/Equipment Testing, Inspection, and Maintenance:

Little maintenance is required of the equipment used in this process. The most critical item we maintain is the temperature settings on the incubators, which we monitor by use of standard laboratory thermometers provided by IDEXX as part of their product package. Temperatures are checked daily to be sure they are maintaining 35 degrees C (+/- .5 C). All equipment, including the sealers, is cleaned after daily use with a 10% chlorine bleach solution to maintain cleanliness. In case of a break down in the sealer equipment, we have a second sealer (model 1x) to ensure that we do not lose samples on any given run. In the case of other equipment failure, turn around

from the factory is usually two days as they will send us a reconditioned unit when we ship back the broken unit in the same box.

B7. Instrument/Equipment Calibration and Frequency:

No calibration of the IDEXX equipment is required except for the temperature in the incubators and this is checked daily for proper functioning. Sealer is checked daily during use to be sure that proper seals are made on the Quanti-Trays.

The Model 2100P Turbidimeter is calibrated with Formazin Primary Standard at the factory and does not require recalibration before use. With steady field use, however, the HACH Company recommends recalibration every three months, or as often as experience dictates. Refer to the Instrument Manual for complete instructions.

B8. Inspection/Acceptance of Supplies and Consumables:

All supplies are ordered directly from IDEXX and are shipped via UPS to our lab. Upon arrival at the lab all packages are inspected for damage and accepted by one of the lab technicians if appropriate. Any damage is noted for further interior inspection. Inspection of interior sealed packages is made during processing to ensure sterility has not been compromised.

B9. Non-direct Measurements:

During data analysis, GIS data coverages will be used to examine land use, roads, tributary streams, aerial photos, etc. These coverages help to provide a landscape context to the water quality data and therefore aid in interpreting potential pollution sources and areas for corrective actions. Data coverages used for this analysis are stored at the Tillamook Coastal Watershed Resource Center. Each coverage has limitations on how it can be used based on its resolution and how it was generated. Information guiding appropriate use of these coverages is found in a metadata file that describes who created the coverage, how they did it, the projection of the map, quality of associated data, etc. This information will be used in accordance with its limitations.

B10. Data Management:

Volunteer samplers record field measurements on field sheet forms for the river they are sampling. Name of sampler, date of sampling run, time of sample collection, and any relevant comments are recorded in the field. These field sheets are given to the Monitoring Coordinator with the sample bottles collected for that day and filed into a chronologically organized binder. Following lab analyses, the Monitoring Coordinator records the lab data on the field data sheets. Once per week, the Monitoring Coordinator enters the data recorded on the paper field sheets into an electronic spreadsheet (Microsoft Excel). The completed spreadsheet columns are then compared a second time with the field data sheets to correct any transcription errors. Backups of data spreadsheets are completed weekly.

Data generated by this program is delivered to DEQ for inclusion in their LASAR database. This database is accessible by the public over the Internet. Data is transmitted to DEQ in Excel spreadsheets via e-mail attachment, and is confirmed upon receipt.

GROUP C: ASSESSEMENT AND OVERSIGHT

C1. Assessment and Response Actions:

The Project Manager and the Monitoring Coordinator/Quality Assurance Management Officer will be responsible for reviewing the entire monitoring project on an annual basis. In addition to quality control considerations, this will be a practical necessity in responding to potential fluctuations in the availability of monitoring funds. An evaluation of QA considerations will be conducted concurrent with the annual summary report of water quality monitoring results (May/June of each year).

The MC will coordinate the training of all volunteers before any monitoring activities are conducted, and schedule refresher training sessions as needed. Any sampling round not certified as meeting DEQ "A" level quality standards will be evaluated for the reason for the quality problem, and corrective action will be sought with sampling volunteers or in laboratory procedures.

C2. Reports to Management:

As stated earlier in this plan, an annual data analysis and conclusions report will be prepared (May/June) and distributed to funding contributors, the TCEP Board of Directors, and the Tillamook Bay Watershed Council. A brief summary report showing monitoring results, results of QA/QC assessments, data analysis, discussion, and recommendations will be prepared for this purpose, as well as oral presentations to these groups as requested.

GROUP D: DATA VALIDATION AND USABILITY ELEMENTS

D1. Data Review, Validation, and Verification:

During the process of entering field and laboratory data into the computer spreadsheet, the MC is required to assign a data quality level to each data entry. In assigning this ranking, the MC will apply DEQ's Data Quality Matrix for bacteria methods (listed in this plan under A7 - Quality Objectives and Criteria) as well as a "reasonableness" determination. This determination is based on the Monitoring Coordinator's intimate knowledge of the local sampling sites and the range of data values that can be expected for that particular sampling location. For instance, the sampling locations in the uppermost reaches of the watershed have never exceeded a given range of bacteria levels during the last 4 years of monitoring - a bacteria reading well outside of this range would likely be an indicator that contamination of the sample had occurred during handling or processing and the data would be considered for rejection.

Prior to rejecting this data as invalid, the location would be re-sampled as soon as possible and any obvious new sources of bacteria contamination would be investigated. Data that continue to be outside expected values will be further investigated to determine the cause, using alternate methodology, if available. The Monitoring Coordinator routinely informs representatives of DEQ, ODA, Tillamook County, the Tillamook County Creamery Association, an the Tillamook

Bay Watershed Council when unusually high bacteria concentrations are detected. This network helps to identify potential factors for unusually high measurements.

Unlike some other monitoring parameters for rivers (temperature for example) bacteria levels can fluctuate dramatically between weekly sampling efforts. This variability limits the amount of data that can be deemed unacceptable simply based on its relationship to the typical observed range. Due to this fact, data validation checks through the use of replicates, split samples, and laboratory blanks becomes particularly important. Data collected which does not meet the acceptance criteria for these QA measures (refer to section B5) are rejected by the Monitoring Coordinator.

D2. Validation and Verification Methods:

Excel spreadsheet files of the bacteria monitoring data will be slightly reformatted into the standard DEQ format and forwarded to the DEQ Volunteer Monitoring Coordinator for entry into the LASAR database. Data is checked by DEQ for concurrence with the data quality level assigned by the local Monitoring Coordinator. Questions about data quality or documentation are directed to the local MC for resolution. Once integrated into DEQ's LASAR database, the volunteer monitoring data can be used to help track the implementation of the Total Maximum Daily Load and Water Quality Management Plan for the Tillamook Bay watershed.

D3. Reconciliation with User Requirements:

The Program Manager and Monitoring Coordinator will receive guidance and advice from state agencies, during periodic water quality interagency meetings. These meetings are coordinated by Partnership staff in order to facilitate data exchange and peer review among the various groups conducting monitoring in the Tillamook Basin. While this group has been meeting several times a year on an as needed basis, a technical working group is currently being formed to help interpret data being collected and identify specific projects to remediate pollution sources. This group includes representatives from DEQ, ODA, NRCS, Oregon State University Extension Service, Tillamook County, Tillamook Bay Watershed Council, environmental consultants, and the Tillamook County Creamery Association. This group serves as a technical oversight committee and represents those agencies and community interests who will utilize data generated by the monitoring program. Advice from this group will be used to modify the monitoring approach as necessary to meet the program objectives.

Data analysis is conducted using standard statistical and graphical features of Microsoft Excel software. The Partnership utilizes the expertise of the technical oversight committee for support with data analysis. In September of 2002, the Partnership is coordinating a "State of the Bay" conference that will include a comprehensive reporting of the water quality monitoring results up to the present time.

References:

American Water Works Association. 1995. *Standard Methods for Examination of Water and Wastewater:19th Edition.*. Hardback, 1200 pp.

Ohrel, R.L. and Register, K.M. 2001. *Volunteer Estuary Monitoring: A Methods Manual Second Edition*. Center for Marine Conservation and the U.S. Environmental Protection Agency.

Oregon Watershed Enhancement Board. 2001. *Water Quality Monitoring Guidebook. (http://www.oweb.state.or.us/pdfs/monitoring_guide/monguide2001.pdf)*

ATTACHMENT A:
Example of Water Quality Monitoring Field Data Sheet

(formatting different from actual field sheet)

Kilchis River

Name: **Date:**

Site	Description	Time	Total Coliform	*E.coli*	Temp (^{0}C)	Turbidity (NTU)	Notes
K1	Kilchis @ Geinger Farm						
K2	Squeedunk @ Geinger Farm						
K3-1	Hathaway Slough @ Hwy 101						
K3-2							
K3-3							
K4-1	Kilchis R. @ Alderbrook Bridge						
K4-2							
K4-3							
K5-1	Kilchis @ Curl Bridge						
K5-2							
K5-3							
K6-1	Kilchis @ Logging Bridge						
K6-2							
K6-3							
K7	Sam Downs Cr. @ River Mile 7						

ATTACHMENT B:
OSU DNA Genetic Marker Study

Explanatory Note: Information about this research effort has been included as an attachment to the volunteer water monitoring program because TCEP's role in the study is limited primarily to collecting samples. Samples taken for this study are integrated into the standard sampling regime of the volunteer program. QA/QC procedures are identical to the normal sampling program described in this QAPP.

Summary Description:

The Tillamook County Estuary Partnership is currently a participating partner with Oregon State University and the U.S Department of Agriculture in an innovative study to determine the relative contribution of various bacteria sources to water quality impairment of Tillamook Bay and its major tributaries. This three year study tests water samples from 24 sites in the rivers of Tillamook Bay and six sites within the bay to determine and track DNA genetic markers associated with fecal coliform bacteria contamination. Fecal coliform testing is conducted at a local lab, and the genetic marker testing is performed at Oregon State University. Start-up funding was derived from a combination of the USDA base grant awarded to OSU Dept of Microbiology, and DEQ 319 funding. Long-term funding sources are anticipated to be USDA, OWEB, DEQ, and the Port of Garibaldi.

Results from the DNA testing will provide information on the relative contributions of fecal coliform from human, bovine, and other specific sources. Information gained from the fecal coliform bacteria testing will support ODA's TMDL compliance efforts throughout the basin. These data will enable the TCEP and local water quality managers to better identify and address the causes of fecal coliform bacteria contamination of the rivers and bay and form action strategies for remediation.

Sampling Protocols

This study entails collection of samples from a sub-set of the typical sampling sites collected by the TCEP's water quality monitoring volunteers, as well as an additional 5 sites in Tillamook Bay. A total of 30 samples are collected in sterilized 500 ml sample bottles.
The following work is done by TCEP water quality monitoring volunteers for the DNA study:

A) Water samples are collected at designated sites (refer to site list below). Collection protocols are identical to those described in section B2 of this QAPP. As directed by OSU, volunteers also collect an in-situ water temperature with a pocket digital thermometer.

B) 100 ml of each 500 ml sample is processed at the TCEP lab for turbidity, and E. coli for most probable numbers using the IDEXX system. This processing follows the standard protocols described in this QAPP.

C) 100 ml of the sample is processed at TCEP by filtering and placement in test tubes with GIFC buffer and then frozen for later transport to OSU.

The sample at OSU is then processed and DNA identifiers are extracted. These are matched with known DNA identifiers that will identify the sample as, human, bovine, equine, porcine, avian, canine, or feline. By identifying the specific amount of each identifier in each sample we will be

able to identify the highest known cause for the *E.coli* in each section of the river. This should lead us to treating the highest known contributor first in each section. Details on OSU protocols can be obtained from Dr. Kate Field, (503) 737-1837.

The following information is provided to all samplers who are working on this study with us:

Samples will be:
1) Taken on the 2nd and 4th Wednesdays of the month.

2) Taken in three (3) 500ml bottles at each site. Mark bottles clearly with indelible marker and they will be sterilized and returned to you the week after your study run.

3) Taken during ebb flow. We will set a time based on the tides to get samples each sample day. Samplers should arrange to make their trips as quickly as possible during that time. All sample must be taken close to the same time.

4) Taken at a depth of 1 foot beneath the surface.

5) Take samples from the upper reaches of the river first, and work your way downstream.

6) Take samples quickly and do not lose time in getting them into the lab. Transport in the usual manner in an iced cooler.

In addition to the samples you need to have a thermometer (I will provide) to take a temperature reading at the site. You only need to do this once at each site. Write it on your sheet next to the first sample.

For those sites not selected as study sites take your regular one (1) sample for our continued monitoring. You do not have to do any extra sampling on these site as we will have extras of the study sites each week. For those weeks we are not doing study sites, still provide an extra sample from one site.

Continue to collect turbidity samples at your selected sites and do the turbidity testing. Do not plan on using any of the water collected for the study for this purpose.

Site Descriptions and Selection Criteria: Tillamook County Performance Partnership/OSU Genetic Marker Study

Miami River sample sites:

M2:	N45 33 .927 W123 52 .965	Miami River at pullout. Site is on Miami River Road 0.5 miles up from Hwy 101.
M3:	N45 35 .829 W123 52 .081	Miami River at pullout. Site is on Miami River Road 3.0 miles up from Hwy 101.
M4:	N45 36 .775 W123 51 .595	Miami River at Stuart Creek Bridge. Site is on Stuart Creek Road, 50 yards from Miami River Road. Stuart Creek Road is 5.0 miles up from Hwy 101.
M5:	N45 37 .103	Miami River at bridge on Miami Forest Road. Forest Road is gravel and turns off Miami

	W123 50 .848	River Road 5.6 miles up from Hwy 101. Site is 1.9 miles from that point, and is 7.5 miles up from Hwy 101.
M*6:*	*N45 33 601 W123 53 .544*	*Miami River at Hwy 101 Bridge (Performance Partnership staff will sample this site only during outgoing tide).*

Tillamook River sample sites:

Ti1:	N45 25 .559 W123 50 .316	Tillamook River at Weber Bridge on Tillamook River Road
Ti2:	N45 24 .290 W123 49 .285	Tillamook river at Bewley Creek Bridge, near junction of HWY 101 and Tillamook River Road; 1.1 miles up from Weber Bridge.
Ti4:	N45 23 .530 W123 48 .263	Tillamook River at Rest Stop on Hwy 101; 2.3 miles up from Weber Bridge.
Ti7:	N45 21 .100 W123 50 .070	Tillamook River from Yellow Fir Bridge, 1.2 miles up Yellow Fir Road from Hwy 101; 7.2 miles up from Weber Bridge.
Ti9:	N45 21 .339 W123 54 .093	Tillamook River at Five-way junction.

Kilchis River sampling sites:

K3:	N45 50 .052 W123 85 .954	Hathaway Slough @ Hwy 101 Bridge. Site is on Hwy 101 ¼ mile north of the Kilchis River Bridge on Hwy 101.
K4:	N45 49 .587 W123 84 .516	Kilchis River at Alderbrook Bridge. Take Alderbrook Road off Hwy 101. Site is ¼ mile up Alderbrook Road.
K5:	N45 50 .762 W123 83 .679	Kilchis River @ Curl Bridge. Take Curl road off of Kilchis River Road. Site is at Bridge.
K6:	N45 51 .877 W123 82 .935	Kilchis River @ logging road bridge. Site is at the bridge on a logging road that goes off to the right from Kilchis River Road.
K8:	N45 53 .484 W123 78 .630	Sam Down's Creek @ River Mile 7. Follow logging road up 2.8 miles from site K6. Take sample from Sam Down's Creek *above* confluence with mainstem Kilchis.

Wilson River Sampling Sites (all sites on Wilson River mainstem):

WR1	N45 28 .195 W123 44 .130	Mills Bridge at the Guide Shop. Site is 200 yards downstream from Hwy 6 bridge, 40 yards downstream and across the river from mouth of Little North Fork Wilson River.
WR5	N45 28 .405 W123 48 .273	Sollie Smith. Take Wilson River Loop Road to Sollie Smith Bridge/boat launch. Take sample from base of boat launch.
WR6	N45 28 .421 W123 50 .417	Hwy 101 Bridge at Boquist Road.
WR7	N45 28 .486 W123 51 .02	Milk Hole. Take Boquist Road and proceed approximately ½ mile downstream from Hwy 101. Milk Hole is on the left, where there is a ladder. This is the outfall of the TCCA's treated effluent.
WR8	N45 28 58.2 W123 52	Geinger's farm. Park at Geinger's and walk down to dock on river.

	15.5	

Trask River sample sites:

Tr1:	N45 33 16.9 W123 54 50.2	Trask River at Cedar Creek boat launch
Tr2:	N45 26 27.9 W123 46 37.8	Trask River at Johnson Bridge
Tr5:	N45 21 101 W123 50 075	Trask River at Hwy 101
Tr6:	N45 26 525 W123 50 403	Slough at city of Tillamook
Tr11	N45 27.386 W123 51.572	Highway 153 and Trask. This site is 200 yards below Tillamook STP

Bay Sites

B1		50 yards above confluence of Trask with Tillamook
B2:		200 yrds west and near piling of Wilson Bypass and Tillamook
B3:	N45 31 18.9 W123 54 37.7	Just east of Bay City Dolphin Trask River at Hwy 101
B4	N45 33 17.1 W123 55 45.4	Half way between Markers 11 & 12 in north end of bay
B5	N45.32.114 W123.56.202	East end of Oyster beds on a line between Bay City dolphin and Cape Meares Parking lot

Rational for selection of sites for DNA testing. Sites were selected by review by Don Reynolds and Richard Felley and reviewed by Dr. Kate Fields for applicability

A. Pick at least one site on each river above most habitation and agricultural influence.
B. Pick sites on each river that have CAFO permits above site.
C. Pick sites on each river that have STP plants above site
D. Pick sites on each river, if possible, to sample urban influence.
E. Pick sites close to Estuary.
F. Try to get sites both on main stems and sloughs

Miami River
Site M5 - Highest site on the river, conforms to A.
Site M4 - Site picked as it is along Miami River Road and has human influence
Site M3 - Site picked for human influence.
Site M2 - Site selected as CAFO permits above.
Site M6 - Site is on Highway 101 and lowest of sites.

Tillamook River
Site Ti1 - Lowest site. Tidewater influence Below several CAFO permits
Site Ti2 - Human influence along with CAFO
Site Ti4 - Human influence at Rest stop
Site Ti7 - Human and CAFO influence
Site Ti9 - Above human and CAFO Highest site we test

Kilchis River
K3 - Hathaway slough is below CAFO permits and has Tidal influence
K4 - Alderbrook bridge. Below CAFO's and on main stem to conform with F.
K5 - Away from human influence but heavily agricultural.
K6 - Human influence at logging road bridge.
K8 - Above human and agricultural influence

Wilson River
WR1 - Above most agriculture, and has human influence above
WR5 - Below CAFO's and good human influence
WR6 - At highway 101 bridge human and agricultural influence
WR7 - Milk hole, Creamery STP outfall at this point.
WR8 - Below WR7 and has tidal influence.

Trask River
Tr1 - High site above agricultural influence. Has some human influence above this site.
Tr2 - CAFO influences above
Tr5 - Human and CAFO influences picks up Port of Tillamook STP
Tr6 - Slough with much human influence and some CAFO
Tr11 - Below Tillamook STP