



Ocean Beach Park, New London

**QUALITY ASSURANCE PROJECT PLAN**  
**FOR THE**  
**BEACH MONITORING AND NOTIFICATION PROGRAM**  
**FOR CONNECTICUT COASTAL BEACHES**

**AUGUST 2011**

[revision 5.1, renewed with limited revisions]



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## APPROVALS

### CONNECTICUT DEPARTMENT OF PUBLIC HEALTH REGULATORY SERVICES BRANCH ENVIRONMENTAL HEALTH SECTION

#### BEACH MONITORING AND NOTIFICATION PROGRAM

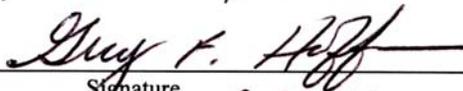
#### FOR CONNECTICUT COASTAL BEACHES

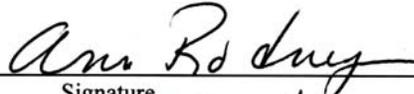
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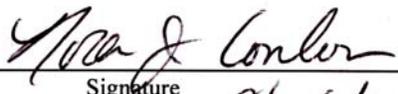
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## 1.0 INTRODUCTION

Connecticut has a distributed beach monitoring program along its coastal waters that operates under the *State of Connecticut Guidelines for Monitoring Bathing Water and Closure Protocol*. The Guidelines were first published in May 1989 by the Public Health Workgroup convened in late 1988 in response to public concern and a rash of beach closures during the summer of 1988, mainly on the western Long Island Sound shoreline. The Workgroup consisted of public health professionals convened by the Connecticut Department of Public Health (DPH) and the Connecticut Department of Environmental Protection (DEP). The Guidelines have been revised three times, most recently in December 2008. They provide public health officials in Connecticut with beach monitoring and closure protocols that are based on United States Environmental Protection Agency (EPA) guidelines.

On October 10, 2000 the "Beaches Environmental Assessment and Coastal Health Act" (i.e. the Beach Act) was signed into law as an extension of the EPA Clean Water Act. The Beach Act through the EPA Beach Grant is intended to promote: comprehensive public beach monitoring; public notification of beach closures and advisories; and improved analytic assessment tools to better protect public health at coastal bathing beaches. In Connecticut the DPH is responsible for the Beach Grant implementation. This includes promoting the Guidelines mentioned above and meeting the EPA Beach Grant data reporting requirements.

With the EPA Beach Grant, the DPH has become more involved in marine beach monitoring. The agency works closely with 24 municipalities along the Long Island Sound shoreline and their 19 local health departments plus the DEP to support the consistent use of statewide beach monitoring guidelines and beach closure protocol. DPH hosts spring and fall meetings for public health officials to: promote standardized beach monitoring practices; provide updates; to review marine beach tracking data for the state; and provide a forum for EPA and public health officials to discuss beach issues.

Using custom software the DPH receives, manages, maintains and uses marine beach data supplied to it by the state laboratory, local health departments and the DEP. Beach data sets are interrelated and include: a roster of beach managers and regulated marine bathing areas; current geospatial location data for these beaches and their sampling stations; a beach tier list that is updated annually; date and time stamped water quality monitoring results; beach closure and advisory events including extent of beach, duration and cause; and ways the public is notified of beach closures and advisories. The DPH custom software is enabled for both incoming and outgoing electronic data interchange (EDI) and includes utilities to cross check and validate beach data.

DPH tracks 66 regulated marine bathing areas for the US EPA Beach Grant. The local health departments and DEP report monitoring frequency for these beaches to DPH at the end of the season using the EPA Beach Survey. It is anticipated the shoreline local health departments and DEP will self-report that each of these beaches was sampled weekly according to the recommendation in the State of Connecticut Guidelines for Monitoring Bathing Water and Closure Protocol (revised December 2008).

This Quality Assurance Project Plan (QAPP) pertains to the Marine Beach Monitoring and Notification Program for Connecticut Coastal Beaches as well as freshwater beaches monitored by DEP. This document describes the policies and procedures for the operation of the program.

The DEP is responsible for collecting samples from all State owned/managed beaches (State Beaches), submitting the samples directly to the DPH laboratory, and notifying the general public of any closure decisions for these beaches. The DPH, working in partnership with local health districts or departments, collects, provides courier service and analyzes all samples submitted from the municipal (e.g. regulated non-State owned or managed) coastal beaches of Connecticut. The local directors of health will make decisions on beach closure based upon the results of the analyses using the *Guidelines for Monitoring Bathing Waters and Closure Protocols*, Connecticut DPHS, *and et.al.* 2008 revision. Questions regarding beach closure protocols and monitoring are directed to the DPH Beach Program Staff.

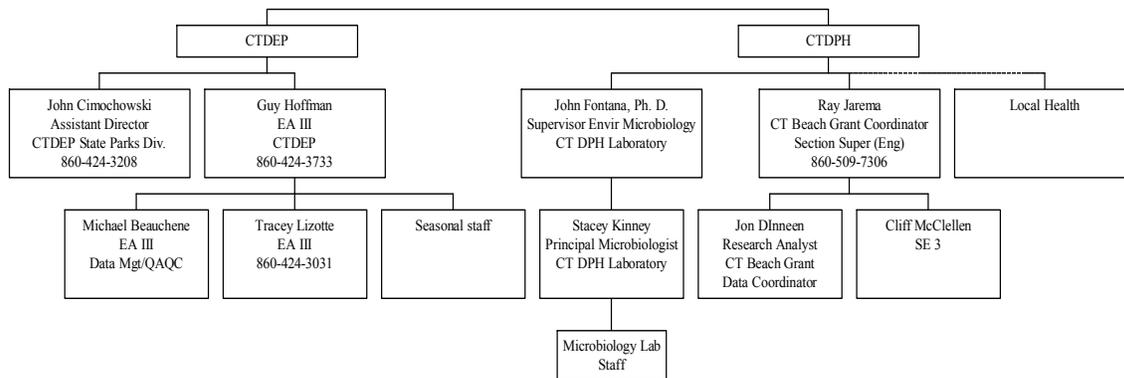
The DPH administers the Beach Grant Funds, which are used to support coastal beach monitoring functions. The program currently monitors four State owned beaches and 62 municipal beaches from May through Labor Day.

## 2.0 MANAGEMENT AND ORGANIZATION

### 2.1 Program Organization

The following organization chart depicts the personnel involved in the beach monitoring and notification program:

**Figure 1**  
**Connecticut Beach Monitoring and Notification Program**



## 2.2 Connecticut DPH & DEP Personnel Qualifications

**Table 1. Personnel Qualifications**

<b>Name</b>	<b>Responsibilities</b>	<b>Qualifications</b>
Guy Hoffman EA III	Monitoring Program Lead CT DEP Bureau of Water Protection and Land Reuse (CT DEP WPLR)	Over 25 years involved with surface water quality and biological monitoring.
John Cimochowski Assistant Director	State Beach Management CT DEP State Parks Div.	Over 15 years experience in Natural Resources Management
Ray Jarema Section Supervisor (Engr)	Beach Program Coordinator CT DPH-Environ. Health Sec.	P.E. in CT, BS Civil Engr. M.S. Environmental/ Sanitary Engineering with over 36 years in the Dept. of Public Health in Drinking Water
Jon Dineen Associate Research Analyst	Beach Grant Data Coordinator	15 years with the Environmental Health Section, CT DPH; develop, maintain and use custom turnkey tracking software
Cliff McClellan, RS Sanitary Engineer III	DPH Recreation Program	BS in microbiology, 34 years in Sanitary Engineering/ Environmental Health specializing in drinking water.
John Fontana, Ph. D. Biological Sciences Section Chief	Acting Supervisor Environmental Microbiology CT DPH Laboratory	PhD in Biomedicine. Over 23 years experience in Public Health Laboratory Sciences.
Stacey Kinney Principal Microbiologist	Environmental Microbiology CT DPH Laboratory Lead Microbiologist	Over 12 years experience with water quality testing. Over 5 years as Principal Microbiologist overseeing the laboratory testing.
Michael Beauchene Environmental Analyst III	Data Management/ QA-QC officer CT DEP WPLR	Over 15 years involved with river/stream sampling. Developed Access database to store water quality and biological data.
Tracey Lizotte Environmental Analyst III	Responsible for hiring and supervision of field crew CT DEP WPLR	Over 25 years involved with surface water quality monitoring, and toxicity testing.
Seasonal Field Staff	Sample Collection Crew CT DEP WPLR	Active interest in pursuing a career related to water quality and or natural resource management.

## 3.0 PROGRAM FUNCTIONS

The Connecticut Department of Public Health (DPH) implemented a near shore coastal indicator organism monitoring program until budget constraints and agency reorganization resulted in the cessation of such monitoring. Since the late 1980's, the DPH and the DEP have coordinated beach monitoring in the state. DEP assumed the collection of samples at State coastal beaches, all of which are managed as part of the DEP parks systems. The DPH, Local Health Departments/Districts, and the DEP share beach monitoring responsibilities for municipal beaches. The following is a brief summary of the functions of the different entities involved with the beach program:

### 3.1 DPH Functions

The DPH:

- provides laboratory services for all DEP beach samples as well as making available this same service for municipal beach monitoring samples through local health departments;
- provides courier service for all municipal beach monitoring samples
- provides presterilized sample containers to DEP and local health departments/districts as needed;
- revises, as needed, the Connecticut Public Health Code criteria for public bathing areas;
- updates, as needed, the laboratory related quality assurance documents;
- oversees monitoring of beaches performed by local public health officials with whom they also share the results of DEP beach monitoring;
- convenes the coastal beach monitoring meetings for public health officials in the spring and fall;
- interprets indicator organism results for State beaches and when requested, assists local health directors with such interpretations;
- is the lead state agency for revisions to the *Guidelines for Monitoring Bathing Water and Closure Protocol* (latest revision December 2008);
- adopted, under the *Guidelines for Monitoring Bathing Water and Closure Protocol*, the EPA Enterococcus and *E. coli* criteria for designated bathing areas (May 2002);
- maintains a complete list of GPS identified municipal and State park regulated marine bathing areas and provides this list annually to EPA;
- maintains a complete list of ArcView GIS identified monitoring site locations at municipal and State park regulated marine bathing areas and provides this list annually to EPA;
- collects, validates, maintains and transmits beach monitoring data from municipal regulated marine bathing areas to the EPA STORET national archive database each year;
- collects, validates, maintains and transmits beach closure, advisory and notification data for municipal and State park regulated marine areas to the EPA PRAWN national archive database each year;
- maintains and updates a Recreation Program website that provides: a list of municipal and state park regulated marine bathing areas, a list of regulated marine bathing areas with tiered monitoring status, access to closure and advisory information, plus additional information that includes beach monitoring and closure policy guidelines for the state;
- sets policy before Regulatory Action is required;
- communicates with EPA regarding programmatic issues;
- conduct sanitary surveys of beaches experiencing chronic indicator organism exceedances;
- develops, maintains and enhances custom software that permits the Agency to manage and use beach data sets;
- encourages and supports the beach monitoring and public notification efforts of shoreline local health departments; and
- upon request presents and explains the Beach Grant implementation in Connecticut.

The following table (Table 2) summarizes the DPH Beach program staff activities:

**Table 2. DPH Beach Grant Staff Activities**

<b>Connecticut Department of Public Health Beach Grant Activities</b>	
<b>Activity</b>	<b>Date</b>
Support municipal beach monitoring by providing technical support and outreach to shoreline local health departments and others with questions about beaches	Ongoing
Education and outreach: present the DPH Beach Grant implementation by invitation from interest third parties	Ongoing
Maintain and update beach contact, beach location and sample station location data as required	Ongoing
Upgrade and enhance custom software used to maintain and process beach data	Ongoing and as required by changes to EPA beach data specification
Provide Beach data upon request to other state agencies, non-governmental organizations, councils, study groups and individuals	Ongoing
Update EPA Region 1 on Connecticut implementation of the Beach Grant	Ongoing
Attend local, regional and national beach related conferences and meetings	Ongoing and as required
Update the EPA Quality Assurance Project Plan (QAPP) for the Beach Grant	Reviewed annually and revised as necessary
Track Beach Grant budget and expenses	Ongoing and as required
Plan the Spring shoreline meeting for public health officials	April
Host the Spring shoreline meeting for public health officials	May
Provide technical support to local health departments and DEP for beach closings and re-opening	June - September
Prepare Beach Grant application and workplan for submittal to EPA	December - March
Provide courier pickup and analyze samples for enterococci	May - September
Maintain telephone support for incoming calls and emails with questions about Connecticut beaches	Ongoing with emphasis during May - September
Plan the Fall shoreline meeting for public health officials	September
Receive and process monitoring data from DPH state laboratory	October
Receive and process monitoring data from local health departments that do not use the DPH state laboratory	October
Host the Fall shoreline meeting for public health officials	October
Prepare and mail EPA Beach Surveys	October
Receive and data enter EPA Beach Surveys	November

<b>Connecticut Department of Public Health Beach Grant Activities</b>	
<b>Activity</b>	<b>Date</b>
Process, package and forward beach notification and monitoring data to EPA	December - January
Participate in EPA data conference calls	Monthly
Participate in EPA Region 1 meetings and conference calls	Quarterly
Produce the Beach Grant Annual Report for Connecticut	January - March

### 3.2 Local Health Functions

The Local Health Departments/Districts:

- collect water samples at municipal beach sites;
- perform sanitary survey prior to bathing season;
- daily inspection of beach area for evidence of contamination;
- issue beach closing, advisory, and re-opening actions;
- are first line responders for beach contamination issues;
- deliver samples to courier pickup locations;
- prepare/issue Beach Closure Notices via news media;
- work cooperatively with DEP and DPH on contamination issues;
- complete the annual EPA Beach Survey; and
- attend the coastal beach monitoring meetings for public health officials.

### 3.3 DEP Functions

The DEP:

- performs monitoring at four coastal State beaches (and 17 inland beaches) and provides its own courier service to the state laboratory;
- transmits annual State beach monitoring information directly to EPA;
- performs as necessary sanitary surveys to identify potential indicator bacteria sources;
- establishes appropriate indicator organism criteria in Connecticut’s Water Quality Standards as required by the Clean Water Act;
- maintains a DEP beach “hotline” and up to date DEP website information concerning the closure status of any State beach;
- provides technical support to local health officials;
- can address corrective actions to eliminate pollution sources; and
- is the lead state agency for State Park Beach Closure related press releases.

The following table (Table 3) summarizes the DEP staff activities in support of the State Beach Monitoring Program:

**Table 3. DEP Beach Grant Staff Activities**

<b>Task</b>	<b>Date</b>
Scoping Meeting/Review of Beach Locations	Spring
Annual State/Local Beach Sanitation Meeting	Spring/Fall
Training of Field Crew	Spring
Indicator Bacteria Collection	Weekly from the week prior to Memorial Day through Labor Day
Data entry/validation	Weekly from the week prior to Memorial Day through Labor Day
Data Evaluation/Assessment	Weekly from the week prior to Memorial Day through Labor Day
Data Reporting	Weekly from the week prior to Memorial Day through Labor Day Winter
Summary Report	Winter

**3.4 State Beaches Monitored**

Table 4 depicts the State Beaches currently monitored.

**Table 4. State Owned/Managed Beaches**

<b>Beach Name</b>	<b>Beach ID Code</b>	<b>No. of Samples per Week</b>
Wharton Brook	WBK	2
<b>Silver Sands (1)</b>	SSSP	3
<b>Sherwood Island (1)</b>	SISP	3
Kettletown	KTLT	2
Indian Well	INWL	2
Chatfield Hollow	CHH	2
Day Pond	DYP	2
<b>Rocky Neck (1)</b>	RNSP	4
<b>Hammonasset (1)</b>	HSP	5
Wadsworth Falls	WWF	2
Black Rock	BLKR	2
Burr Pond	BRRP	2
Lake Waramaug	LKW	2
Mount Tom	MTT	2
Stratton Brook	STRB	2
Squantz Pond	SQPD	2
Gay City	GYC	2
Hopeville Pond	HVP	2
Mashamoquet Brook	MMB	2
Quaddick	QDK	2
Pachaug SF	PSF	2

1. Marine beaches. Notification data for these beaches are transmitted to EPA by DPH. Monitoring data for these beaches transmitted to EPA by DEP.

### 3.5 Municipal and State Park Marine Beaches Monitored

The following table (Table 5) lists the municipal and state park marine beaches currently monitored by DPH and local health:

**Table 5. Municipal and State Park Marine Beaches Monitored by DPH**

TOWN	BEACH_NAME	Station count (1)	Beach length (meters)	Beach Length (meters) per station
BRANFORD	BRANFORD POINT BEACH	1	137	137
BRANFORD	CLARK AVENUE BEACH	1	68	68
BRANFORD	STONY CREEK BEACH	1	36	36
BRIDGEPORT	SEASIDE PARK BEACH	5	2900	580
CLINTON	TOWN BEACH (CLINTON)	1	138	138
DARIEN	PEAR TREE POINT BEACH (3)	3	322	107
DARIEN	WEED BEACH (3)	2	150	75
EAST HAVEN	EAST HAVEN TOWN BEACH	2	258	129
EAST LYME	HOLE-IN-THE-WALL BEACH	1	181	181
EAST LYME	MCCOOK POINT BEACH	1	190	190
EAST LYME	ROCKY NECK STATE PARK BEACH	5	598	120
FAIRFIELD	JENNINGS BEACH	2	633	316
FAIRFIELD	PENFIELD BEACH	2	335	168
FAIRFIELD	SASCO BEACH	2	204	102
FAIRFIELD	SOUTH PINE CREEK BEACH	1	48	48
FAIRFIELD	SOUTHPORT BEACH	2	254	127
GREENWICH	BYRAM BEACH (2)	3	169	56.3
GREENWICH	GREAT CAPTAIN'S ISLAND BEACH (2)	2	357	178
GREENWICH	GREENWICH POINT BEACH (2)	3	649	216
GREENWICH	ISLAND BEACH (2)	2	291	146
GROTON	EASTERN POINT BEACH	2	209	104
GROTON	ESKER POINT BEACH	1	32	32
GROTON	NOANK DOCK	1	11	11
GUILFORD	JACOBS BEACH (TOWN BEACH)	2	139	69.5
MADISON	EAST WHARF BEACH	1	117	117
MADISON	HAMMONASSET BEACH STATE PARK BEACH	5	3100	620
MADISON	PENT ROAD BEACH	1	99	99
MADISON	SURF CLUB BEACH	2	330	165
MADISON	WEST WHARF BEACH	1	155	155
MILFORD	ANCHOR BEACH (MERWIN POINT) #1	1	78	78
MILFORD	ANCHOR BEACH (MERWIN POINT) #2	1	175	175
MILFORD	GULF BEACH	1	349	349
MILFORD	SILVER SANDS STATE PARK BEACH	4	279	69.8
MILFORD	WALNUT BEACH	2	575	288
MILFORD	WOODMONT BEACH	1	465	465
NEW HAVEN	LIGHTHOUSE POINT BEACH	3	220	73.3
NEW LONDON	GREEN HARBOR BEACH	2	120	60

TOWN	BEACH_NAME	Station count (1)	Beach length (meters)	Beach Length (meters) per station
NEW LONDON	OCEAN BEACH PARK	3	463	154
NORWALK	BELL ISLAND BEACH (2)	2	200	100
NORWALK	CALF PASTURE BEACH (2)	3	323	108
NORWALK	HICKORY BLUFF BEACH (2)	1	2	2
NORWALK	MARVIN BEACH (2)	1	7	7
NORWALK	ROWAYTON BEACH (2)	1	33	33
NORWALK	SHADY BEACH (2)	4	341	85.2
OLD LYME	SOUNDVIEW BEACH (2)	1	331	331
OLD LYME	WHITE SANDS BEACH (2)	1	241	241
OLD SAYBROOK	HARVEY'S BEACH	1	74	74
OLD SAYBROOK	TOWN BEACH (OLD SAYBROOK)	1	57	57
STAMFORD	CUMMINGS BEACH (2)	3	209	69.7
STAMFORD	EAST (COVE ISLAND) BEACH (2)	3	289	96.3
STAMFORD	QUIGLEY BEACH (2)	1	160	160
STAMFORD	WEST BEACH (2)	3	174	58
STONINGTON	DUBOIS BEACH	2	37	18.5
STRATFORD	LONG BEACH (MARNICK'S)	1	60	60
STRATFORD	LONG BEACH (PROPER)	2	499	249
STRATFORD	SHORT BEACH	3	770	257
WATERFORD	KIDDIE'S BEACH	1	20	20
WATERFORD	PLEASURE BEACH	1	200	200
WATERFORD	WATERFORD TOWN BEACH	3	524	175
WEST HAVEN	WEST HAVEN EAST BEACH	12	3600	300
WEST HAVEN	WEST HAVEN WEST BEACH	6	2208	368
WESTBROOK	MIDDLE BEACH/STANNARD BEACH	1	77	77
WESTBROOK	WESTBROOK TOWN BEACH/WEST BEACH	3	876	292
WESTPORT	BURYING HILL BEACH	1	125	125
WESTPORT	COMPO BEACH	4	862	216
WESTPORT	SHERWOOD ISLAND STATE PARK BEACH	3	1911	637

1. Station counts is equivalent to the recommended number of samples collected per week. One sample per station
2. These towns are responsible for analysis of their own samples. Data are transmitted to DPH, which in turn submits the data to EPA.
3. These samples are submitted to the Stamford Health Department for analysis.

Beach Tier is assigned to each beach at the end of the summer bathing season. Beach Tier is assigned based on sampling frequency and closure count for each beach. In other words the Beach Tier concept as implemented by Connecticut for the EPA Beach Grant does not prescribe sampling frequency as it does in some other Beach Grant states and territories.

The following is a summary of the rules used to generate Beach Tier in Connecticut:

### **Beach Classification Scheme (from Tiered Plan.doc)**

Tier I	Sampled weekly;	and 0 or 1 closure event/season
Tier II	Sampled weekly;	and 2 or 3 closure events/season
Tier III	Not sampled weekly;	or more than 3 closure events/season

### **3.6 Project Schedule**

Sampling of bathing waters commences the week before Memorial Day and continues up to Labor Day weekend. Routine samples are collected on a weekly basis at most beaches. Additional samples may be collected in the event that the indicator organism count exceeds the standard. The DPH host two meetings, one in the Spring and one in the Fall, for local directors of health and beach managers. At the spring meeting sampling and analytical procedures are reviewed to promote uniform methods and practices. Chain of custody and proper documentation procedures are explained and a tentative courier schedule is presented. The Beach Closure protocol is reviewed to ensure conformity with the *Guidelines for Monitoring Bathing Waters and Closure Protocols*.

The fall meeting is held to review the past bathing season results and discuss problems and solutions encountered. The Beach Program QAPP, procedures for submitting the EPA beach survey, and data submission protocols are also reviewed. Both DEP and DPH staff provide technical support at both meetings.

### **3.7 Reporting**

Both DPH and DEP report marine monitoring data directly to EPA. The appropriate monitoring data (State Park beach data for DEP, and municipal marine beach data for DPH) are downloaded from the DPH Laboratory Information Management System (LIMS) by each respective agency. DPH also currently accepts monitoring data from three local health departments that use local health department laboratories for water sample analysis. All the collected and accepted monitoring data are validated, cross checked and stored in separate and distinct local Access databases developed and maintained by each agency. The DPH custom database software is fully documented and includes utilities to generate meta data and interface with software provided by EPA.

At the end of the bathing season the data are reformatted, translated and parsed for upload to a local instance of the EPA STORET/Oracle8i database provided by EPA. The DPH and DEP use the utility named Storet Import Module (SIM) to upload monitoring data and monitoring site location data to STORET/Oracle 8i. Finally, the monitoring data are exported from STORET/Oracle 8i and uploaded to EPA via FTP transfer where they are stored in archive.

Notification data (beach closures, beach advisories, beach contact and organization information) for municipal marine beaches and marine State park beaches are collected and maintained solely by DPH. State Park beach closure data are tracked by DEP in real time and provided to DPH upon request. These data are validated, reformatted and loaded into an EPA provided Access database that produces an eXtensible Markup Language (XML) text file. The text file is uploaded to EPA through the CDX/PRAWN interchange where the data are further checked for errors and validated before being stored in archive.

The DPH is solely responsible for preparing the annual EPA Beach Survey to collect notification data from shoreline local health departments and DEP. Notification data include: beach closures and beach advisories with reason, source and indicator qualifiers; beach contact and organization information; and self reported monitoring frequency for each beach.

Starting with the 2006 beach season, DPH is responsible for preparing and submitting an Annual Report to EPA Region 1. Both the annual EPA Beach Survey and Annual Report formats were developed jointly between EPA Region 1 and DPH. The Annual Report includes program activities, deliverables, performance criteria, and data summaries. The Annual Report explores the relationships between beach closures/advisories and the reported causes for those closures.

DPH uses beach data in a variety of ways to support its programmatic activities notable among them to produce custom datasets in response to requests for beach data that originate with other state agencies and third party non-governmental organizations (e.g. the Long Island Sound Study, the Interstate Environment Commission, and the Natural Resources Defense Council). In addition, DPH provides local health departments and DEP with annual reviews of beach data collected from the prior bathing season. These reviews include a rolling geometric mean report and beach monitoring data combined with beach closure data presented on a common time line for each beach and sampling station. And last, the annual EPA Beach Survey is prepared and printed using beach data.

#### **4.0 Data Quality Objectives**

Sampling design and methods are described in the *Guidelines for Monitoring Bathing Waters and Closure Protocol*, Revised December 2008 (see Appendix A) and the Quality Assurance Project Plan (QAPP) (this document).

Local health departments that utilize the DPH courier system or otherwise participate in the Beach Grant Program are required to follow the approved QAPP. The established bacterial indicator for designated bathing water in Connecticut is Enterococcus for salt water. Single samples should not exceed a criterion of 104 most probable number (MPN) per 100 mL or a geometric mean of 35 MPN per 100 mL based on 5 or more samples collected within a 30-day period. Beginning with the 2002 bathing season, *Escherichia coli* (*E. coli*) became the bacteria indicator for designated bathing area in freshwaters. *Escherichia coli* samples should not exceed a criterion of 235 MPN per 100 mL for a single sample or a geometric mean of 126 MPN per 100 mL based on 5 or more samples collected within a 30-day period (EPA, 1986). See section six for further discussion of the geometric mean.

All analytical quality control is the responsibility of the DPH Laboratory. The USEPA and the USFDA audit the DPH Laboratory every three years. The following table summarizes the data quality objectives (DQO) (See Table 6).

**Table 6. Data Quality Objectives**

<b>DQO Indicator</b>	<b>Measurement Performance Criteria</b>	<b>QC Sample or Activity</b>	<b>Action if DQO Exceeded</b>
Precision	Relative Percent Difference <100%	Duplicate Sample	Review sampling procedure with local health for errors. Check lab QA/QC for errors.
Accuracy	Media performs correctly, positive controls positive for enterococci, negative controls negative.	Positive and negative control samples and sterile field blanks.	If controls out, invalidate corresponding batch. If field blank contaminated, check for errors.
Representativeness	Sampling station locations and sample collection in conformance with CT guidelines.	Review sampling locations and collection procedure annually at shoreline mtg.	Correct sampling locations and review collection procedure as needed.
Completeness	Provide data for 95% of samples submitted to the laboratory.	Total number of results vs. total number of samples collected	Review sampling procedure with local health for errors. Recollect if necessary.
Comparability	Sampling locations are fixed at each beach	Review locations annually	Move sampling location if possible.

**4.1 Precision & Accuracy/Bias**

A field duplicate is collected at 2 different sampling locations during each collection trip, and one sterile-water field blank is tested per trip. Consequently over 10% of samples per trip are QC samples. A relative percent difference (RPD) value of 100% is used as a precision threshold for field duplicates. The laboratory also tests one positive and one negative control on a daily basis. The data quality objective (DQO) for blanks is zero percent. An analytical method check is performed on each day of analysis. Positive control should be positive. Negative control should be negative. If these conditions are not met, the corresponding batch of data is invalidated. No laboratory duplicates are analyzed. RPD can be defined as the absolute value of the difference between a duplicate pair of samples divided by the mean of the same pair. For a given pair of samples, X<sub>1</sub> and X<sub>2</sub>, the RPD is calculated as follows:

$$RPD = \frac{(X_1 - X_2)}{((X_1 + X_2) / 2)} \times 100$$

The state laboratory provides sealed bottles containing “sterile dilution water” to the shoreline health departments that use the state laboratory’s Summer Beach Monitoring Program. To create a QA field blank sample, the local health departments are directed by CT DPH (at the spring shoreline meeting and through hardcopy handouts) to: 1) take the sealed dilution water bottle to a named and regular sampling station; 2) open the seal on the dilution bottle; 3) open the sealed marine water collection bottle (provided by the state laboratory); 4) pour the sterile dilution water into the marine water collection bottle - leaving the recommended air space at the top of the sample collection bottle; and 5) put the top back on the marine water collection bottle and screw the top on tight.

## **4.2 Data Representativeness**

Samples are collected in accordance with the *Guidelines for Monitoring Bathing Waters and Closure Protocols*. The number of samples collected will vary depending upon the physical size of the beach. Table 4 and Table 5 list the beaches and number of samples routinely collected from each beach. Samples should be collected at fixed sampling stations to provide consistency of data. The recommended number of sampling stations per bathing area is dependent upon the size of the area among other factors.

Normally when an area is relatively small in size (300 linear feet of shoreline or less) only one sampling station will be necessary. The location of single sampling stations should be in the middle of the bathing area. A minimum of two sampling stations should be provided at beaches with shorelines up to 700 linear feet in length. Where beach shorelines exceed 700 linear feet, a minimum of three sampling stations is recommended. Multiple sampling stations should normally be located with approximately equal distances between stations and the boundaries of the beach.

Shorelines with unusual configurations or features may require that additional sampling stations be located to monitor these particular conditions (e.g. storm sewer outfalls, waterways discharging into the bathing area, configurations which disrupt the contiguity of the beach, etc.). Operational conditions such as heavy bather usage in one portion of the bathing area may also influence the selection of sample stations.

## **4.3 Comparability**

Each sampling station is fixed and located by reference to a permanent landmark at each beach. The stations do not change throughout the sampling season. Each sampler is trained as to the location of each station and how to collect the sample. All samples are analyzed using EPA approved methodologies to ensure results are comparable. Those municipalities not using the DPH Laboratory must use a laboratory certified by the Connecticut Environmental Laboratory Certification Program (ELCP). These laboratories are inspected at least every three years and must analyze proficiency test samples on an annual basis. The laboratories are audited to ensure conformance with the Safe Drinking Water Act and the Clean Water Act.

## **4.4 Completeness**

It is expected that samples will be collected from each beach sampling location weekly throughout the monitoring season with the addition of approximately 10% QC samples. It is expected that data will be reported from greater than 95% of the samples collected.

## **5.0 SAMPLING**

### **5.1 Procedure**

The sampling protocol is from the *Guidelines for Monitoring Bathing Waters and Closure Protocols* and is summarized as follows: Sampling times and conditions (e.g. tides, time of day, etc.) are based on local operational needs and constraints.

Samples should be collected in water that is approximately 3 to 4 feet deep. The sterile 125-mL bottle provided by the laboratory for surface water sampling must be used. Remove the cap from the sterile collection bottle, being careful not to contaminate either the inside of the cap or bottle.

Grasp the bottle near its base and plunge it in a downward motion into the water to a depth of between 12 and 18 inches, always keeping the mouth of the container ahead of the hand so as not to contaminate the sample. In a sweeping motion invert the bottle to fill. Empty the bottle to approximately one inch from the top (if necessary) to provide air space for laboratory processing and carefully replace the cover. Store the samples on ice for transport to the laboratory.

At the time of sampling, the collector should make a visual observation of the tidal shoreline and tidal waters for any hazardous materials or contamination. If any medical debris is observed it is to be reported immediately to authorized beach personnel and the local health department. The following table (Table 7) summarizes the sampling parameters:

**Table 7. Sampling Parameters**

<b>Parameter</b>	<b>Criteria</b>
Sample Collection Method	Grab
Sample Volume	100 mls
Container Size	125-mL sterile bottle
Preservation Requirements	Ice samples to <6° C
Holding Time	8-hrs from collection

## **5.2 Documentation of Sample Information**

The DPH Laboratory sample submission form, titled “Bathing Water Sample Invoice Form” (see Appendix B) must be filled out and submitted along with the samples.

### Bathing Water Sample Invoice Form

- A. Affix DPH label in space provided.
- B. Complete collection information to include; collected by; town; town identification number; sampling station identifier; date and telephone number. Note that the Station Number is entered next to the Collectors Number. The beach name is entered next to the Extra Info.
- C. Circle **Marine** water or **Fresh** water.
- D. Complete sample information to include: time and sample station ID number, which will identify exactly where the sample was collected.
- E. Additional Information: should include but not be limited to, amount of rainfall during the past 24 hours, bather load at time of sampling, bird activity near sample site, clarity or turbidity of the water, wind direction, and miscellaneous information such as whether the sample is a resample because last sample indicated criteria exceedance, etc.
- F. Metadata for all State Park Beach samples are logged into the DEP Monitoring Program database at the end of each sampling trip. Analytical results are appended electronically by accession number when received.

## 6.0 LABORATORY PROCEDURES AND DATA HANDLING

### 6.1 Sample Receipt and Storage

Sample bottles are labeled in the field with the sampling station identifier, date and time of collection. The samples are placed in a cooler on ice for transport to the laboratory. A Bathing Water Sample Invoice Form is completed and accompanies the samples. This form contains the site number, collection date/time, sample collector, recent weather conditions, 24-hour prior rainfall, tide, general beach condition, and a qualitative assessment of bird activity (Appendix B).

At the DPH Laboratory, the receiving room staff examine the Bathing Water Sample Invoice Form and the sample containers for accuracy and any missing information. A unique laboratory identification number (accession number) is assigned to each sample. This accession number is attached to both the sample bottle and the Bathing Water Sample Invoice Form by means of an adhesive label that contains both the number and a bar code. The Bathing Water Sample Invoice Form is also time stamped in the receiving room at the time of receipt. The sample receiving staff log the samples on a daily sample log sheet and transfer the samples to the microbiology laboratory for analysis.

The microbiology staff then process the samples. The analysis start time is recorded and every effort is made not to exceed the holding time. Each electronic sample record contains the time and date of collection, time delivered to the laboratory and time the test was started. If a sample is outside the 8-hour holding time, it is not analyzed and the sampler is notified to recollect the sample.

### 6.2 Analytical Procedures

The DPH Laboratory is certified by the USEPA for determination of various bacteria in drinking water. While USEPA does not currently approve laboratories for the determination of Enterococcus in ambient water (e.g. bathing water), the laboratory uses EPA approved methods. The laboratory currently uses the following procedures for determination of Enterococcus and *e. coli*: Those municipalities not using the DPH Laboratory must use a laboratory certified by the Connecticut Environmental Laboratory Certification Program (ELCP). These laboratories are inspected at least every three years and must analyze proficiency test samples on an annual basis. The laboratories are audited to ensure conformance with the Safe Drinking Water Act and the Clean Water Act.

**Table 8. DPH Analytical Methods for Indicator Organism Bathing Water Monitoring**

Indicator Organism	Enterococcus (Marine Water)	<i>E. Coli</i> (Fresh Water)
Method Reference	Enterolert (1)	Colilert (1)
SOP Reference	Enterolert® Enterococci Defined Substrate Test for Marine Bathing Water Analysis, 02/02/07	Colilert® Bathing Water Enumeration Method for <i>E. coli</i> Chromogenic Substrate Coliform Test for Bathing Water Analysis
Sample Volume	10 mls diluted to 100 mLs	10 mls diluted to 100 mLs
Incubation time/ temperature	24/28 hrs @ 41° ±0.5° C	18-22 Hrs at 35° ± 0.5°C
Detection Limit (at 1:10 dilution)	10 MPN/100 mLs	10 MPN/100 mLs
Comments		Laboratory uses Colilert-18 media

1. Federal Register March 26, 2007 using quantitray format, 40 CFR Part 136.3

In both procedures the indicator organism metabolizes the media, which contains 4-methylumbelliferyl-B-D-glucuronide (MUG). The MUG is cleaved by the indicator organism releases 4-methyl-umbelliferone which when exposed to ultraviolet light (365 nm), fluoresces. Enumeration is based on the most probable number (MPN) table supplied by the manufacturer. Both procedures are approved by the USEPA. Copies of the DPH laboratory's standard operating procedures for these tests are included in Appendix C.

### 6.3 Data Analysis and Assessment

After the analyses are completed (generally the day following sample collection), the appropriate personnel are notified of criteria exceedances only by the DPH Laboratory. This may be accomplished by telephone, FAX, or e-mail. A hard copy report follows approximately one week later. The established indicator organism for salt water designated bathing waters in Connecticut is Enterococci. Samples should not exceed a criterion of 104 MPN per 100 mL for a single sample or a geometric mean of 35 MPN per 100 mL based on 5 or more samples collected within a 30-day period.

Beginning with the 2002 bathing season, *Escherichia coli* (*E. coli*) was designated as the bacterial indicator for designated bathing areas in freshwaters. *E. coli* samples should not exceed a criterion of 235 MPN per 100 mL for a single sample or a geometric mean of 126 MPN per 100 mL based on 5 or more samples collected within a 30-day period (USEPA 1986). Data analysis consists primarily of calculating exceedance frequency for single sample maximum and geometric mean values.

Within one week of the sampling, the raw indicator organism results are electronically transferred from the DPH Laboratory to the DEP for State beaches. The results for all other beaches are uploaded by DPH at the end of the bathing season. The respective Agency personnel electronically upload the data into the EPA STORET database.

Municipalities that use a laboratory other than the State Health Department laboratory report their results to DPH at the end of the monitoring season. These laboratories are audited by the Environmental Laboratory Certification Program to ensure compliance with EPA approved methodologies.

### 6.4 Calculating Running Geometric Mean

For the purpose of this document a running geometric mean should be based on at least 5 sample results per 30-day period. Therefore, when 5 sample results have been obtained from a sampling station in a 30-day period, a geometric mean can be performed.

The geometric mean can be defined as the nth root of the product of n numbers:

$$G = n^{\text{th}} \text{ root of } [(X_1)(X_2)(X_3)\dots(X_n)] \quad \text{or} \quad G = \sqrt[n]{(X_1)(X_2)(X_3)\dots(X_n)}$$

An example of a running geometric mean is as follows:

Sampling Station #1 Sample Results and Date Collected:

<u>Result, MPN/100 mls</u>	<u>Date Collected</u>
20	06/04/01
40	06/11/01
15	06/18/01
30	06/25/01
29	07/02/01

### Calculating a Geometric Mean

The geometric mean of your samples can be calculated using one of two methods; each one will provide an accurate answer. Taking into consideration that calculators differ and have different function keys, choose the method that is easier for you to follow.

Calculate the geometric mean for the following five samples taken within a 30-day period: 20, 40, 15, 30, and 29.

### **6.5 Solution Steps**

**Method 1:** Take the  $n^{\text{th}}$  root of the product of  $n$  samples.

*Step 1:* Multiply all sample values together.

$$20 \times 40 \times 15 \times 30 \times 29 = 10,440,000$$

*Step 2:* Count the number of samples you are using

$$n = 5$$

*Step 3:* Make the value of *Step 2* the denominator in a fraction with '1' as the numerator.

$$= \frac{1}{5} = 0.2$$

*Step 4:* Take the answer from *Step 1* and raise it to the power of the answer from *Step 3*.

$$= (10,440,000)^{0.2}$$

This calculation can be performed on a scientific calculator in several ways. For example, enter 10,440,000 into the calculator. Press the "x^y" (exponent or power) key and then enter "0.2." This calculation can also be performed by entering 10,440,000, then pressing the power or exponent key, and entering 0.2.

$$\text{Answer: } = 25.336$$

If you have more than five samples collected during a 30-day period, the additional samples should be included in the calculation of the geometric mean (for both methods).

**Method 2:** Take the antilog of the mean of the logarithm of each sample.

*Step 1:* Take the log of each sample. (This calculation can be performed on a scientific calculator using the “log” key. For example, enter “20” into the calculator and then press the “log” key.)

$$\log(20) = 1.30$$

$$\log(40) = 1.60$$

$$\log(15) = 1.17$$

$$\log(30) = 1.47$$

$$\log(29) = 1.46$$

*Step 2:* Take the average, or mean, of the log samples.

$$\text{Average} = \frac{(1.30 + 1.60 + 1.17 + 1.47 + 1.46)}{5} = 1.40$$

*Step 3:* Take the antilog of the answer from *Step 2*.

$$\text{Antilog}(1.40) = 25.336$$

This calculation can be performed on a scientific calculator in several ways. For example, enter “1.40,” press the “Inv” key, and then press the “log” key. This calculation can also be performed by pressing the “2nd” key followed by the “log” key and then typing 1.40.

$$\text{Answer:} = 25.336$$

If the geometric mean of several bacteriological samples exceeds the acceptable limit, the bathing area should be reviewed with DPH.

## **7.0 BEACH CLOSURE AND NOTIFICATION**

### **7.1 General**

Indicator bacteria are used to predict the threat of waterborne illness by detecting potential contamination from fecal material of human or animal origin. However, due to inherent uncertainty involved with sampling and analytical determination of bacteria levels, excursions from established ambient criteria are investigated by means of a field survey of sanitary conditions or other appropriate means to determine sanitary quality (*Water Quality Standards: CT DEP 2002*). Therefore actual beach closure is based upon professional judgment that considers the magnitude of the exceedance and the results of a sanitary survey of the watershed.

The *Connecticut Guidelines for Monitoring Bathing Water and Closure Protocol*, revised December 2008, provides a Bathing Area Closure Notification form to communicate beach notification information to DPH. DPH has requested local health notify DPH of closures via fax within four hours of the closure.

The Beach Program has added an annual EPA Beach Survey to collect organization, beach contact, location updates, closure, advisory and public notification data for the regulated marine bathing areas under the authority of shoreline towns and the DEP. The annual EPA Beach Survey will be mailed following each bathing season.

Following the return of all the surveys at the conclusion of the marine bathing season, data contained in the surveys is validated and stored electronically in an Access database developed and maintained by the Beach Program. These data are then parsed, translated, formatted and moved to a custom Access database application provided by EPA that converts the data to a XML formatted text file. DPH forwards the XML text file to EPA for inclusion in its PRAWN national archive database.

## **7.2 Beach Closure Guidelines**

The following is taken from the *Connecticut Guidelines for Monitoring Bathing Water and Closure Protocol*, revised December 2008. Decisions for Beach Closure for State Beaches are made jointly by DPH and DEP. Beach closure decisions for municipal beaches are made by the local health department/district. DPH and DEP are available to provide technical assistance to local health as needed.

1. If there is a known waste contamination event such as a sewage bypass or mechanical failure at a sewage treatment plant, pump station failure or ruptured sewer pipe, beach closures may be recommended by the local health department prior to receiving any sample results. Such decisions must be based on currents, tides, wind direction or other factors that would transport or direct the contamination into bathing waters.
2. If sampling was conducted in response to apparent or suspected waste contamination and the result exceed the standards, there may be sufficient justification to close a beach prior to receiving results of a resample.
3. When a single sample result exceeds the single sample maximum criterion for bathing water quality established by the Commissioner of Public Health, additional samples should be collected and a survey made to determine if raw or partially treated sewage is contributing to the elevated bacterial levels. The beach may remain open or be closed based on the judgment of the local or State health officials considering the magnitude of the exceedance and the sanitary history of the beach.
4. If two samples from the same beach exceed the single sample maximum criterion for bathing water quality established by the Commissioner of Public Health, the beach should be closed, additional samples collected, and a sanitary survey conducted to determine if raw or partially treated sewage is contributing to the elevated bacteria levels.
5. In either of situations 3 or 4, if the sanitary survey reveals discharges of raw or partially treated sewage then the bathing area should be closed by the local director of health.
6. If sample results exceed the standards and a sanitary survey reveals no evidence of sewage contamination, the bathing area should be examined on an individual basis with consultation from DPH before any decision about closure is made. The bathing area may remain open.
7. If the bathing area is impacted by a mass of floating debris, the director of health may close the area to bathing for safety reasons even if the water quality is good. This especially holds true when there is evidence of grease balls or other indications of sewage treatment plant debris.

8. The director of health may also want to consider bathing beach closures established by evaluating rainfall data. This can be accomplished by conducting a season long study where bathing water samples are collected after measurable rainfall events occurring within a 24-hour time period. If the study data indicates that the bacterial level is elevated above the acceptable single sample standard after measurable rainfall events in a 24-hour period, then the director of health could recommend beach closures after each such rainfall event based on this study data. If an actual study cannot be performed then the use of historical data at sampling stations may be used to make a determination as to the suitability of the bathing water after rainfall events occurring in a 24-hour period. For this reason it is very important to indicate accurate rainfall information (if available) on the Bathing Water Sample Invoice Form.
9. The reopening of any beach after closure will be based on obtaining satisfactory sample results.

### **7.3 Medical Debris:**

1. Handling Medical Debris  
Syringes with needles or needles alone should be handled so as not to subject the handler to punctures. All such materials and other medical debris should be handled for proper disposal in accordance with OSHA bloodborne pathogen requirements. These are located at federal regulations 29 CFR 1910.1030 and can be found at <http://www.osha.gov/> website. Information can be obtained at Connecticut Department of Labor OSHA at (860) 566-4550.
2. Testing of Medical Debris  
Testing of the contents of vials or syringes containing blood for Hepatitis or HIV is not generally recommended. Testing should only be considered in the event that there is a needlestick or other penetrating physical injury involving a person being exposed to the contents of that vial or syringe.
3. Reporting  
If medical debris is found, this information is to be immediately reported to the local health department.

### **7.4 Signage**

A sign or flag indicating when the beach is closed should be posted in a conspicuous location such as the beach entrance. Signs shall be posted with directions to the nearest public telephone for emergency use. Emergency telephone numbers should also be posted which may simply be the 911 number or the telephone numbers of the closest emergency response service.

### **7.5 Notification to the General Public**

#### **7.5.1 State Beach Closure**

If it is necessary to close a State Beach, the DEP Project Manager or designee contacts the DEP Parks Division and DEP Communications Office by telephone and email. They take appropriate actions to close state beaches and initiate the public notification process. Communication of closure status at State beaches to the general public is presently accomplished by updating the DEP web site and amending the State Beach "Hotline" (860-424-3015). Updates are

accomplished by DEP Parks or Office of Communications personnel the same day significant sample results are received from the DPH laboratory. The DEP also issues press releases on the same day the laboratory results are received that are carried by area radio and television stations, and newspapers. Finally, the DPH immediately communicates the closure status of any State Beach with appropriate local health officials by telephone or email. A voice-mail message is recorded if direct contact is not made at any point in the above sequence. If the caller does not receive a call back within an hour to acknowledge the voice-mail, subsequent calls are made to alternative staff according to a predetermined sequence until a an appropriate person is contacted directly.

### **7.5.2 Municipal Beach Closure**

If the local director of health deems it necessary to close a bathing beach, the DPH should be advised of such closure by telephone or fax as soon after the closure as possible but not later than 4-hours. During normal business hours contact DPH at (860) 509-7296, and at all other times (860) 509-8000. The local health district/department is responsible for the notification of the general public.

Information to be provided to the DPH concerning the closure should include but not limited to the following:

- The reason for such closure, i.e. bacterial water quality results, hazardous or medical debris on the beach;
- Floatables in the bathing water;
- Bypass or mechanical failure at a sewage treatment plant;
- The names of the affected areas; name of beaches involved, and entire coastline within the town boundaries.

The DPH shall be notified when any bathing beach has reopened and the rationale for reopening such beach. Notice shall be provided by: telephone (860) 509-7296, fax (860) 509-7295 or e-mail: [jon.dinneen@ct.gov](mailto:jon.dinneen@ct.gov) within 6 hours of reopening.

## **8.0 QUALITY CONTROL**

### **8.1 Analytical Quality Assurance/ Quality Control**

The DPH Laboratory operates a formal quality assurance/ quality control (QA/QC) program as part of the EPA's requirements for certified laboratories. As part of its program, the DPH Laboratory follows the QA/QC requirements set forth in the Manual for the Certification of Laboratories Analyzing Drinking Water, USEPA 5th ed. January 2005. The requirements of the Certification Manual are too numerous to repeat here, but some of the more important requirements for microbiology are as follows:

- Sterility checks of each lot of either purchased or prepared sample containers;
- Daily documentation of incubator temperatures;
- Documentation of autoclave performance including temperature, time at temperature, use of spore strips, etc.;
- Checking each lot of media and sample containers for fluorescence; and
- Use of positive and negative controls with each lot of media

Duplicate samples are submitted in order to judge the precision of the sampling program. A set of duplicate samples is collected for each sampling trip for collection of bathing waters from State beaches. Local health districts/departments are encouraged to submit duplicate samples for each sampling trip over the course of the season. The DPH supplies bottles for the collection of these duplicate samples. A control limit of  $\pm 100\%$  relative percent difference (RPD) is used for duplicate analyses. Duplicate samples are collected immediately after the initial sample is collected using the standard sample collection procedure.

A field blank is also submitted for each courier trip. The courier fills a sample container with water and submits the field blank to the laboratory for analysis. The control limit for the field blanks is zero MPN per 100 mls.

## **9.0 TRAINING AND OUTREACH**

### **9.1 Annual Meetings**

The DPH hosts two annual meetings that are attended by local health personnel concerned with beach monitoring (i.e. public health officials), the DPH and DEP beach monitoring staff, EPA beach personnel, and State Beach managers. The first meeting is held in the Spring (typically April) and serves to kick-off the beach monitoring season. At this meeting DPH and DEP staff review the following:

- Proper sampling procedures;
- How to Fill Out the Required Forms and Documentation;
- Communication Pathways;
- DPH Courier Schedule;
- Beach Safety;
- Resample Protocol in Event of Exceedances;
- Beach Closure Protocols;
- Public Notification of Closure Protocols;
- QA/QC Requirements; and
- QAPP Review

The second meeting is held in the Fall (typically October) to review the season's results, discuss problems and solutions, hear concerns from local health relating to beach monitoring, and review the procedures and information needed for the EPA Beach Survey. Due to funding constraints, no field training or audits of health departments are performed.

During the calendar year Beach Program staff conduct presentations to interested parties about the Connecticut Beach Grant Program and the distributed beach monitoring effort. This activity is above and beyond the spring and fall shoreline meetings. It includes presentations to: the Connecticut Environmental Health Association (CEHA); National Beaches Conference in Niagara Falls; the Connecticut Recreation and Parks Association; Southern Connecticut State University; etc. Typically the program makes presentations to well over 500 people outside of the two annual meetings in a given year.

### 9.1 Field Staff Training

The following table (Table 9) depicts the training of the DEP Field Staff :

**Table 9. DEP Field Staff Training**

<b>Project Function</b>	<b>Course or Description</b>	<b>Trained by</b>	<b>Training Date</b>	<b>Trainees</b>	<b>Title</b>	<b>Certs/Records</b>
Safety	First Aid/CPR	CT Fire Academy	Every 2 years	All Field Staff	All Field Staff	CT DEP Health & Safety Office
Safety	Sample Collection Safety	Bureau of Water Protection and Land Reuse (CT DEP WPLR)	Every Spring	All Field Staff	All Field Staff	CT DEP WPLR
Safety	Defensive Driving	CT DEP Health & Safety Office	Every Spring	All Field Staff	All Field Staff	CT DEP Health & Safety Office
Safety	General Seasonal Safety	CT DEP Health & Safety Office	Every Spring	All Field Staff	All Field Staff	CT DEP Health & Safety Office
Sample Collection	Sampling SOP	CT DEP WPLR	Every Spring	All Field Staff	All Field Staff	CT DEP WPLR
Analysis	Sample Preparation (Laboratory)	CT DPH Microbiologist	Every Spring	All Field Staff	All Field Staff	CT DPH
Data Management	Sample log-in procedure	CT DEP WPLR	Ongoing	All Seasonal Field Staff	All Seasonal Field Staff	CT DEP WPLR

Appendix A of QAPP

*Guidelines for Monitoring Bathing Waters and Closure Protocol,*

Revised December 2008

# State of Connecticut Guidelines for Monitoring Bathing Water and Closure Protocol



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## INTRODUCTION

This is the third major revision of the Guidelines for Monitoring Bathing Waters and Closure Protocol first published in May 1989 and revised in June 1992. Development of the “Guidelines” was one of the primary recommendations contained in the Coastal Sanitation Report also published in May 1989. Both documents were products of the Public Health Workgroup<sup>1</sup>, which was a working group of public health professionals convened by the CT DPH and DEP in late 1988 in response to public hysteria and a rash of beach closures during the summer of 1988, mainly in western Long Island Sound. These conditions resulted from the mistaken public perception that incidents involving medical waste, “sewage slicks” and floatable trash (usually attributed to New York City) were common occurrences. The perception was further aggravated by the general lack of standardized beach monitoring and closure practices available to local public health officials. The original “Guidelines” were drafted to:

- Establish guidance for dealing with “medical waste”
- Adopt a better bacterial indicator (Enterococci vs. Total coliform in Beach Guidance and CT Water Quality Standards.)
- Adopt uniform bathing water criteria values (1986 EPA bathing water criteria)
- Standardize bathing water sampling methodology
- Improve interagency and public communication and notification practices
- Initiate an annual meeting on beach sanitation for state and local officials

In addition to the recommendation for development and adoption of these “Guidelines”, the Public Health Workgroup initiated an annual meeting of public health officials to promote the “Guidelines”. This annual beach sanitation meeting continues and has been instrumental in fostering communication between the CT DPH, DEP and local officials in matters related to beach and shoreline sanitation.

On October 10, 2000, the “Beaches Environmental Assessment and Coastal Health Act” (a.k.a. Federal Beach Act) was signed into law and is administered by the US Environmental Protection Agency (USEPA). This act provides considerable financial resources to state and local health agencies through the federal government. The Act is intended to promote comprehensive public beach monitoring and public notification to protect public health at coastal bathing beaches. The CT DPH and DEP have applied for and received funds through the act for FY 2002 through 2009 with the intention of furthering these goals and objectives.

<sup>1</sup>Composed of: CT Dept. of Health, CT Dept. of Environmental Protection, Stamford Health Dept., Fairfield Health Dept. representing the CT Environmental Health Association, West Haven Health Dept. representing the CT Association of Directors of Health, Chesprocott Health District.

**GUIDELINES FOR MONITORING  
BATHING WATERS & CLOSURE PROTOCOL**

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## GUIDELINES FOR MONITORING BATHING WATERS & CLOSURE PROTOCOL

### WATERSHED SURVEY:

1. Annually prior to the bathing season, the local health department should conduct a sanitary survey of any watershed which drains to a public bathing area. If any source of contamination which may adversely affect the bathing area is observed, the local director of health shall take appropriate action under his/her authority to correct the violation.
2. When conducting a watershed survey for a coastal bathing area special consideration should be given to sewage treatment plant location, pump station location, industrial plant discharge points and other areas that may impact the bathing area waters.
3. Large populations of waterfowl on a watershed can be a contributing factor to elevated bacterial levels in the bathing area. Therefore, this information should be noted on the watershed survey report.

### INSPECTION AND SAMPLING:

1. Annually, prior to bathing season, the local health department should inspect each public bathing place and/or establishment within its jurisdiction. The inspection should include but not be limited to the beach, grounds, bathhouses, toilets, drinking water supply, sewage disposal, safety equipment and signage. Refer to Public Health Code Sections 19-13-B34 and 19-12-B36 for specific requirements.
2. All bathing water samples are to be collected under the auspices of the director of health. **The recommended sampling frequency of both inland and tidal public bathing areas is weekly.** Samples shall be collected at fixed sampling stations to provide consistency of data. The recommended number of sampling stations per bathing area is dependent upon the size of the area among other factors.

Normally when an area is relatively small in size (300 linear feet of shoreline or less) only one sampling station will be necessary. The location of single sampling stations should be in the middle of the bathing area. A minimum of two sampling stations should be provided at beaches with shorelines up to 700 linear feet in length. Where beach shorelines exceed 700 linear feet, a minimum of three sampling stations is recommended. Multiple sampling stations should normally be located with approximately equal distances between stations and the boundaries of the beach.

Shorelines with unusual configurations or features may require that additional sampling stations be located to monitor these particular conditions (e.g. storm sewer outfalls, waterways discharging into the bathing area, configurations which disrupt the contiguity of the beach, etc.). Operational conditions such as heavy bather usage in one portion of the bathing area may also influence the selection of sample stations.

3. Sample collection procedure should be as follows:

Samples should be collected at approximately 3 to 4 feet water depth. The 125ml bottle provided by the laboratory for surface water sampling must be used. Remove the cap from the sterile collection bottle, being careful not to contaminate either the inside of the cap or bottle. Grasp the bottle near its base and plunge it in a downward motion into the water to a depth of between 12 and 18 inches, always keeping the mouth of the container ahead of the hand so as not to contaminate the sample. In a sweeping motion invert the bottle to fill. Empty the bottle to approximately one inch from the top (if necessary) to provide air space for laboratory processing and carefully replace the cover. Store the samples on ice for transport to the laboratory.

At the time of sampling, the collector should make a visual observation of the tidal shoreline and tidal waters for any hazardous materials or contamination. If any medical debris is observed it is to be reported immediately to authorized beach personnel and the local health department.

4. Designated beach personnel (e.g. lifeguards) should physically inspect the entire beach shoreline from the high tide mark to the water's edge each morning for any evidence of hazardous debris such as broken glass, needles, wood with nails or debris indicating possible contamination, including but not limited to biomedical waste, medical waste, sewage grease balls, dispensed condoms, tampon applicators, and other floatable trash. The local health department is to be contacted if any biomedical or medical debris are observed. Other appropriate agencies are to be contacted based upon the local health department's evaluation of the situation.

Designated beach personnel who have access to a motorboat should make a daily inspection of the waters surrounding the beach for any signs of slicks, floatable or other debris which could impact the bathing waters at that beach. Any confirmed sightings should be reported to the local health department, for their inspection. Other appropriate agencies are to be contacted by the local health department if follow-up inspection results produce issues of concern.

5. Required information to be indicated on the laboratory sample submission form, titled "Bathing Water Sample Invoice Form" (see Appendix 1 on page 12):

## BATHING WATER SAMPLE INVOICE FORM

- A. Affix DPH label in space provided.
- B. Complete collection information to include; collected by; town; town identification number; date and telephone number.
- C. Circle **Marine** water or **Fresh** water.
- D. Complete sample information to include: time and collector's number, which will identify exactly where the sample was collected.
- E. Additional Information: should include but not be limited to, amount of rainfall during the past 24 hours, bather load at time of sampling, bird activity near sample site, clarity or turbidity of the water, wind direction, information such as, resample because last sample indicated criteria exceedance.

### SANITARY WATER QUALITY (Effective May 20, 2002):

The indicator organisms to be used for monitoring bathing water quality as established by the Connecticut Department of Public Health are:

#### 1. **Freshwater**

*E. coli* organism as determined by the membrane filter techniques: Modified EPA Method 1603 (Modified mTEC Medium) and EPA Method 1103.1 (mTEC medium). Also, Colilert 18 Method and any State of Connecticut or EPA approved or recommended method. Bacterial standard to be used for interpretation of laboratory analyses of single or individual samples from freshwater bathing waters are as follows for the *E. coli* organism:

- A. A concentration of *E. coli* organisms less than or equal to 235 per 100 ml is generally considered satisfactory for a single sample from a bathing area.
- B. A single sample with a concentration of *E. coli* organisms greater than 235 per 100 ml is in excess of that which is normally considered acceptable for bathing. A resample is required. A sanitary survey of the surrounding watershed and areas that may impact the bathing area should be conducted immediately to evaluate suitability of the area for bathing if no known sources of contamination have already been identified.
- C. To determine bathing water quality when using the *E. coli* organism as an indicator, a running geometric mean for each sampling station is to be used.

An acceptable running geometric mean for *E. coli* indicator organism density for bathing waters is less than or equal to 126. A running geometric mean is to be used when evaluating the long-term microbiological suitability of recreation water quality. The geometric mean can provide a better indication of water quality over time. This holds especially true when evaluating a proposed bathing area where seasonal or incidental variations may impact on single sample results.

## 2. Marine Water

Enterococcal organism as determined by the membrane filter techniques: EPA Method 1600 (mEI Medium) and EPA Method 1106.1 (mE Medium). Also, Enterolert Method and any State of Connecticut or EPA approved or recommended method. Bacterial standard to be used for interpretation of laboratory analyses of single or individual samples from marine bathing waters are as follows for the enterococcal organism:

- A. A concentration of enterococcal organisms less than or equal to 104 per 100 ml is generally considered satisfactory for a single sample from a bathing area.
- B. A single sample with a concentration of enterococcal organisms greater than 104 per 100 ml is in excess of that which is normally considered acceptable for bathing. A resample is required. A sanitary survey of the surrounding watershed and areas that may impact the bathing area should be conducted immediately to evaluate suitability of the area for bathing if no known sources of contamination have already been identified.
- C. To determine bathing water quality when using the enterococcal organism as an indicator, a running geometric mean for each sampling station is to be used.

An acceptable running geometric mean for enterococcal indicator organism density for bathing waters is less than or equal to 35. A running geometric mean is to be used when evaluating the long-term microbiological suitability of recreation water quality. The geometric mean can provide a better indication of water quality over time. This holds especially true when evaluating a proposed bathing area where seasonal or incidental variations may impact on single sample results.

3. For the purpose of this document a running geometric mean should be based on at least 5 sample results per 30-day period. Therefore, when 5 sample results have been obtained from a sampling station in a 30-day period, a geometric mean can be performed.

The geometric mean can be defined as the  $n^{\text{th}}$  root of the product of  $n$  numbers:

$$G = \sqrt[n]{(X_1)(X_2)(X_3)\dots(X_n)}$$

4. An example of a running geometric mean is as follows:

<u>Sampling Station #1</u>	<u>Sample Results</u>	<u>Date Collected</u>
1	20	06/04/01
2	40	06/11/01
3	15	06/18/01
4	30	06/25/01
5	29	07/02/01

### Calculating a Geometric Mean

The geometric mean of your samples can be calculated using one of two methods; each one will provide an accurate answer. Taking into consideration that calculators differ and have different function keys, choose the method that is easier for you to follow.

Calculate the geometric mean for the following five samples taken within a 30-day period: 20, 40, 15, 30, and 29.

### SOLUTION STEPS

**Method 1:** Take the  $n^{\text{th}}$  root of  $n$  samples.

*Step 1:* Multiply all sample values together.

$$20 \times 40 \times 15 \times 30 \times 29 = 10,440,000$$

*Step 2:* Count the number of samples you are using.

$$= 5$$

*Step 3:* Make the value of *Step 2* the denominator in a fraction with '1' as the numerator.

$$= 1/5 = 0.2$$

*Step 4:* Take the answer from *Step 1* and raise it to the power of the answer from *Step 3*.

$$= (10,440,000)^{0.2}$$

This calculation can be performed on a scientific calculator in several ways. For example, enter 10,440,000 into the calculator. Press the "x^y" key and then enter "0.2." This calculation can also be performed by entering 10,440,000, pressing the "^" key, and entering 0.2.

**Answer: = 25.336**

If you have more than five samples collected during a 30-day period, the additional samples should be included in the calculation of the geometric mean (for both methods).

**Method 2:** Take the antilog of the mean of the logarithm of each sample.

*Step 1:* Take the log of each sample. (This calculation can be performed on a scientific calculator using the “log” key. For example, enter “20” into the calculator and then press the “log” key.)

$$\log(20) = 1.30$$

$$\log(40) = 1.60$$

$$\log(15) = 1.17$$

$$\log(30) = 1.47$$

$$\log(29) = 1.46$$

*Step 2:* Take the average, or mean, of the log samples.

$$1.40 = \frac{(1.30 + 1.60 + 1.17 + 1.47 + 1.46)}{5}$$

*Step 3:* Take the antilog of the answer from *Step 2*.

$$25.336 = \text{antilog}(1.40374)$$

This calculation can be performed on a scientific calculator in several ways. For example, enter “1.40,” press the “Inv” key, and then press the “log” key. This calculation can also be performed by pressing the “2<sup>nd</sup>” followed by the “log” key and then typing 1.40.

**Answer: = 25.336**

If the geometric mean of several bacteriological samples exceeds the acceptable limit, the bathing area should be reviewed with DPH.

## BEACH CLOSURE:

1. If there is a known waste contamination event such as a sewage bypass or mechanical failure at a sewage treatment plant, pump station failure or ruptured sewer pipe, beach closures may be recommended by the local health department prior to receiving any sample results. Such decisions must be based on currents, tides, wind direction or other factors that would transport or direct the contamination into bathing waters.
2. If sampling was conducted in response to apparent or suspected waste contamination and the results exceed the standards, there may be sufficient justification to close a beach prior to receiving results of a resample.
3. When a single sample result exceeds the standards for bathing water quality established by the commissioner, a resample should be taken and a survey made to determine if raw or partially treated sewage is contributing to the elevated bacterial levels. If the survey reveals discharges of raw or partially treated sewage then the bathing area should be closed by the local director of health.
4. If sample results exceed the standards and a sanitary survey reveals no evidence of sewage contamination, the bathing area should be examined on an individual basis with consultation from DPH before any decision about closure is made. The bathing area may remain open.
5. If the bathing area is impacted by a mass of floating debris, the director of health may close the area to bathing for safety reasons even if the water quality is good. This especially holds true when there is evidence of grease balls or other indications of sewage treatment plant debris.
6. The director of health may also want to consider bathing beach closures established by evaluating rainfall data. This can be accomplished by conducting a season long study where bathing water samples are collected after measurable rainfall events occurring within a 24 hour time period.

If the study data indicates that the bacterial level is elevated above the acceptable single sample standard after measurable rainfall events in a 24-hour period, then the director of health could recommend beach closures after each such rainfall event based on this study data.

If an actual study cannot be performed then the use of historical data at sampling stations may be used to make a determination as to the suitability of the bathing water after rainfall events occurring in a 24-hour period. For this reason it is very important to indicate rainfall information on the laboratory sample submission form.

7. The reopening of any beach after closure will be based on obtaining satisfactory sample results.

## DILUTION WATER FOR INLAND BATHING AREAS:

It is generally recognized that inland bathing water quality is dependent on the amount of dilution water available.

Section 19-13-B34(e) of the Connecticut Public Health Code states that a minimum of 1,000 gallons of dilution water per bather per day be available to help maintain bathing water quality. This dilution water may be from inflowing water or from natural circulation in large bodies of impounded water.

The following formula is used to determine the number of bathers per day that should be allowed to utilize a water body:  $N = (V/180 + F)/1,000$  [after Theodore C. Willerford, Connecticut Health Bulletin, June Vol 87, No.6, pp 162-163].

where: N = the number of bathers, V = the volume of the water body in gallons and F = the inflow in gallons per day provided by streams or other sources. 180 is an average turnover time in days for a typical lake. You can substitute 180 with a known turnover rate (days).

See Appendix 5 on page 17 for several examples.

## MEDICAL DEBRIS:

### 1. Handling Medical Debris

Syringes with needles or needles alone should be handled so as not to subject the handler to punctures. All such materials and other medical debris should be handled for proper disposal in accordance with OSHA bloodborne pathogen requirements. These are located at federal regulations 29 CFR 1910.1030 and can be found at [www.OSHA.gov](http://www.OSHA.gov) website. Information can be obtained at Connecticut Department of Labor OSHA at (860) 263-6900.

### 2. Testing of Medical Debris

Testing of the contents of vials or syringes containing blood for Hepatitis or HIV is not generally recommended. Testing should only be considered in the event that there is a needle stick or other penetrating physical injury involving a person being exposed to the contents of that vial or syringe.

### 3. Reporting

If medical debris is found, this information is to be immediately reported to the local health department.

## SAFETY AND INJURY CONTROL:

### 1. Lifeguards

When lifeguard service is in effect a minimum of one lifeguard for every 100 yards of beach immediately adjacent to the occupied bathing area is recommended.

Elevated lifeguard stands high enough to provide the lifeguard with a complete and unobstructed view of the bathing and beach area are required.

A first aid kit and lifesaving equipment are to be available at the lifeguard duty station. All lifeguards are required to be certified in cardiopulmonary resuscitation (C.P.R.) by the American Heart Association or the American Red Cross per regulation Section 19a-113a-1. Where lifeguard service is not provided, a warning sign shall be placed in plain view and shall state "WARNING – NO LIFEGUARD ON DUTY" with legible letters at least 4 inches high. Communication devices should be provided to the lifeguards for emergency situations.

### 2. Signage

A sign or flag indicating when the beach is closed should be posted in a conspicuous location such as the beach entrance.

Signs shall be posted with directions to the nearest public telephone for emergency use. Emergency telephone numbers should also be posted which may simply be the 911 number or the telephone numbers of the closest emergency response service.

### 3. Injury Control

Each morning before normal hours of operation, beach personnel should clean the beach of any objects which could cause injury to beach patrons. If lifeguards are on duty, a brief but thorough inspection of the bathing area for submerged objects which may have been carried into the area during the night by currents, tides, wave action, wind or other means should be conducted.

No fishing or boat launching should be allowed in the bathing area to prevent the possibility of related accidents.

Inflatable or buoyant devices should not be allowed except for U.S. Coast Guard approved personal floatation devices worn by swimmers.

Glass containers, fires, charcoal or gas grills, ball or Frisbee playing, the possession or drinking of alcoholic beverages should be prohibited on the beach.

### 4. Notification of Beach Closures

(Refer to "Bathing Area Closure Notification" see Appendix 2 on page 13)

If the local director of health deems it necessary to close a bathing beach, the DPH should be advised of such closure by telephone as soon after the closure as possible but not later than 4-hours. During normal business hours contact DPH at (860) 509-7296, and at all other times, (860) 509-7321.

Information to be provided to the DPH concerning the closure should include but not limited to the following:

The reason for such closure, i.e. bacterial water quality results, hazardous or medical debris on the beach, floatables in the bathing water, bypass or mechanical failure at a sewage treatment plant.

The names of the affected areas; name of beaches involved, entire coastline within the town boundaries.

5. Notification of Beach Reopenings

The DPH shall be notified when any bathing beach has reopened and the rationale for reopening such beach. Notice shall be provided by: telephone (860) 509-7296, fax (860) 509-7295 or Email: Raymond.Jarema@ct.gov within 6 hours of reopening.

6. Notification of Shellfish Bed Closures

The local health department should consult with the Connecticut Department of Agriculture, Aquaculture Division at (203) 874-0696 on appropriate action.

7. Notification of Sewage Treatment Plant Bypass or Mechanical Failure: (Refer to DEP bypass notification regulations - see Appendix 3 on page 14)

A. When a sewage treatment plant or a sewer collection transport system experiences either a bypass or mechanical failure where partially treated or raw sewage is discharged to the receiving waters, the local health director in that town shall, immediately after being advised of the discharge, notify the health departments in neighboring towns whose waters may be impacted by the discharge.

B. Information which should be transmitted should include but not be limited to the following:

Type of problem at the sewage treatment plant, number of gallons that have been discharged and what type of treatment, if any, that has been applied to the discharged material. Additionally an estimate of the duration of the problem should be provided. The neighboring towns should also be informed when the problem has been resolved.

# APPENDICES OF GUIDELINES FOR MONITORING BATHING WATERS & CLOSURE PROTOCOL

1. Bathing Water Sample Invoice Form
2. Bathing Area Closure Notification
3. Sewage Treatment By-Pass Notification
4. Clam Digger's/Swimmer's Itch Information
5. Dilution Water Per Bather Per Day
6. Revision History

# Appendix 1 of Guidelines

## Connecticut Department of Public Health Laboratory

### BATHING WATER SAMPLE INVOICE FORM

**Telephone (860) 509-8562**

<p><b>Place a DPH Lab submitter address/account label in this space. Call 860-509-8501 for additional labels</b></p>	<p><b>Collected By:</b> _____</p> <p><b>Town:</b> _____ <b>Town#:</b> _____</p> <p><b>Date Collected</b> _____ <b>Phone#(____)</b> _____</p>
--	--

Please Circle One:    **MARINE WATER**  
 TEST NUMBER 559M  
 Enterolert

**FRESH WATER**  
 TEST NUMBER 558M  
 Colilert

<p><b>Time:</b> _____</p> <p><b>Collector's No.</b> _____</p> <p><b>Additional Info:</b> _____</p>	<p>Accession No. _____</p> <p>Enterococci Count/100ml: _____ Initials _____  <small>Positive Wells:</small></p> <p><i>E. coli</i> Count/100ml: _____ Initials _____  <small>Positive Wells:</small></p>
<p><b>Time:</b> _____</p> <p><b>Collector's No.</b> _____</p> <p><b>Additional Info:</b> _____</p>	<p>Accession No. _____</p> <p>Enterococci Count/100ml: _____ Initials _____  <small>Positive Wells:</small></p> <p><i>E. coli</i> Count/100ml: _____ Initials _____  <small>Positive Wells:</small></p>
<p><b>Time:</b> _____</p> <p><b>Collector's No.</b> _____</p> <p><b>Additional Info:</b> _____</p>	<p>Accession No. _____</p> <p>Enterococci Count/100ml: _____ Initials _____  <small>Positive Wells:</small></p> <p><i>E. coli</i> Count/100ml: _____ Initials _____  <small>Positive Wells:</small></p>
<p><b>Time:</b> _____</p> <p><b>Collector's No.</b> _____</p> <p><b>Additional Info:</b> _____</p>	<p>Accession No. _____</p> <p>Enterococci Count/100ml: _____ Initials _____  <small>Positive Wells:</small></p> <p><i>E. coli</i> Count/100ml: _____ Initials _____  <small>Positive Wells:</small></p>
<p><b>Time:</b> _____</p> <p><b>Collector's No.</b> _____</p> <p><b>Additional Info:</b> _____</p>	<p>Accession No. _____</p> <p>Enterococci Count/100ml: _____ Initials _____  <small>Positive Wells:</small></p> <p><i>E. coli</i> Count/100ml: _____ Initials _____  <small>Positive Wells:</small></p>

DATE AND TIME ANALYZED:

ANALYZED BY:

METHOD:

ENTEROLERT / COLILERT

rev. 3/03

## Appendix 2 of Guidelines

### **BATHING AREA CLOSURE NOTIFICATION**

Connecticut DPH Telephone Number: (860) 509-7296 Fax Number: (860) 509-7295

Date: \_\_\_\_\_ Time: \_\_\_\_\_

Town: \_\_\_\_\_ Health Department: \_\_\_\_\_

Bathing Area(s) Affected by Closure:

1. \_\_\_\_\_ 4. \_\_\_\_\_

2. \_\_\_\_\_ 5. \_\_\_\_\_

3. \_\_\_\_\_ 6. \_\_\_\_\_

Reason for Closure:

Date and Time Closure Effective:

Date and Time Reopened:

Total Number of Days Closed:

Any other local and/or state agencies notified:

Any news/TV media involved:

Information Provided By:

Name:

Title:

Telephone Number:

## Appendix 3 of Guidelines

### Section 22a-430-3 Regulations of Connecticut State Agencies (RCSA)

#### BYPASS NOTIFICATION

##### K. Bypass

1. The permittee shall not at any time bypass the collection system or treatment facilities or any part thereof unless (A) (i) such bypass is unanticipated, unavoidable, and necessary to prevent loss of life, personal injury or severe property damage, and (ii) there were no feasible alternatives to the bypass, including but not limited to the use of auxiliary or back-up treatment facilities, retention of untreated wastes, stopping the discharges, or maintenance during normal periods of equipment downtime; or (B) the permittee receives prior written approval of the bypass from the commissioner in order to perform essential maintenance, and the bypass does not cause effluent limitations to be exceeded. The commissioner may impose any conditions on such an approval which he or she deems necessary to protect the waters of the state, including but not limited to requirements for special monitoring or reductions in the release of pollutants and water to the treatment system. Condition (A) (ii) is not satisfied if the permittee, in the exercise of reasonable engineering judgment, should have installed adequate backup equipment to prevent a bypass.
2. In the event such a bypass is necessary, the permittee shall to the extent possible minimize or halt production and/or all discharges until the facility is restored or an alternative method of treatment is provided.
3. In order to prevent a bypass, the permittee may schedule maintenance during periods when no discharge is occurring or employ any other necessary means, including but not limited to duplicate units and systems or alternative collection and treatment or pretreatment schemes. Any such other means shall (A) insure that the effluent limitations specified in the permit are achieved; (B) be approved by the director in writing prior to its use, which approval shall include an alternative schedule for monitoring if appropriate; and (C) be discontinued upon completion of the performance of the essential maintenance. The permittee shall provide notice to the director not less than twenty-four (24) hours prior to the use of any alternative scheme and monitor and record the quality and quantity of the discharge in accordance with permit terms and conditions or an approved alternative schedule. Such monitoring shall be submitted with the next monitoring report required by the permit, and shall not be used to meet routine scheduled monitoring report requirements of the permit.
4. If any bypass occurs or may occur, the permittee shall, within two hours of becoming aware of such condition or need, notify the director during normal business hours, and the CT DEP's Emergency Response Unit at all other times (860) 424-3338 and submit within five days a written report including the cause of the problem, duration including dates and times and corrective action taken or planned to prevent other such occurrences. In addition, if the permittee has reason to believe that any effluent limitation specified in the permit may be violated, the permittee shall immediately take steps to prevent or correct such violation, including but not limited to employing an alternative scheme of collection or treatment, and/or control the production of the wastewater and shall monitor and record the quality and quantity of the discharge in accordance with the permit terms and conditions or an approved alternative

schedule. Such monitoring shall be submitted with the next monitoring report required by the permit, and shall not be used to meet the routine monitoring requirements of the permit.

#### 5. Recording and Reporting of Violations, Additional Testing Requirements

Section 22a-430-3(k) of the RCSA shall apply in all instances of bypass including a bypass of the treatment plant or a component of the sewage collection system planned during required maintenance. The Department of Environmental Protection, Bureau of Water Management, Planning and Standards Division (860) 424-3704, the Department of Public Health, Water Supply Section (860) 509-7333 and Recreation Section (860) 509-7296, and the local Director of Health shall be notified within 2 hours by telephone during normal business hours and a written report submitted to the Department of Environmental Protection, Bureau of Water Management, Planning and Standards Division, Municipal Facilities Section within five days of each occurrence, or potential occurrence, of an emergency diversion or bypass of untreated or partially treated sewage. If the diversion or bypass occurs outside normal working hours (8:30 a.m. to 4:30 p.m. Monday through Friday), within two hours notification shall be made to the CT DEP Emergency Response Unit at (860) 424-3338 and the Department of Public Health at (860) 509-8000.

The written report shall contain:

- 1) the nature and cause of the bypass;
- 2) the time the incident occurred and the anticipated time which it is expected to continue or, if the condition has been corrected, the duration;
- 3) the estimated volume of the bypass or discharge of partially treated sewage;
- 4) the steps being taken to reduce or minimize the effect on the receiving waters; and
- 5) the steps that will be taken to prevent reoccurrence of the condition in the future.

# Appendix 4 of Guidelines

## CONNECTICUT DEPARTMENT OF PUBLIC HEALTH

### **Clam Digger's/Swimmer's Itch (Schistosome Dermatitis)**

#### **What is Clam Digger's/Swimmer's Itch?**

Clam Digger's/Swimmer's Itch is a skin rash caused by a parasite. This parasite is released from infected snails and migrates through waters including those used for recreational swimming. Clam Digger's Itch is contacted in salt water and Swimmer's Itch in fresh water. Both occur during the summer and may be more common during periods of especially hot weather.

#### **Who gets Clam Digger's/Swimmer's Itch?**

People who swim or wade in water infested with the parasite may experience this itchy rash. All age groups and both sexes can be involved, but children are most often affected.

#### **How is Clam Digger's/Swimmer's Itch Spread?**

A person may get the skin rash by swimming or wading in infested water and then allowing water on the skin to air dry instead of drying off with a towel. Person to person transmission does not occur.

#### **What are the Symptoms of Clam Digger's/Swimmer's Itch?**

When water infested with the parasite is allowed to air dry, an initial tingling sensation may be felt when the parasite enters the skin. A mild itching may occur within one to two hours after exposure and last for around an hour. Ten (10) to fifteen (15) hours later the rash appears along with itching, which may be extremely intense. The rash reaches a peak in 3 to 4 days and usually disappears within a week.

A person's first exposure to infested water may not result in the itchy rash. Repeated exposures increase a person's sensitivity to the parasite and increase the likelihood of getting a rash.

#### **What is the Treatment for Clam Digger's/Swimmer's Itch?**

While all cases do not require treatment, some people may seek relief by applying specific skin lotions or creams to minimize the itching.

#### **What can be done to Prevent Clam Digger's/Swimmer's Itch?**

Prevention is limited to the protective measures taken by the person. The most practical solution is to avoid bathing in waters known to be infected with the parasite. The use of chemicals to control the snail population is neither feasible nor environmentally sound. Toweling off vigorously immediately after emerging from the water can prevent the rash. Do not air dry.

Cases of Clam Digger's/Swimmer's Itch should be reported to the local health department or the lifeguard on duty. Affected areas should be posted to warn bathers of the presence of the parasites and precautions for preventing the rash.

## Appendix 5 of Guidelines

### DILUTION WATER PER BATHER PER DAY

Willerford argued in the Connecticut Health Bulletin (June Vol 87, No. 6, pp 162-163) that there are two contributors to daily dilution water at an inland bathing area. They are: 1) the natural turnover of a body of water as measured in gallons per day; and 2) any inflow coming from external sources also measured in gallons per day.

If you know the volume of a water body and the annual turnover rate in days, then you can calculate the daily turnover rate in gallons per day. For example: a 1,000 gallon waterbody with a 180 day turnover, would have  $1,000/180$  or 5.56 gallons of turnover per day that could be counted toward the total daily dilution water for the waterbody. The daily turnover in gallons can be added to the inflow - also in gallons per day - to find the total gallons of daily dilution water for the water body.

Once you know the daily dilution water (turnover gallons per day plus daily inflow gallons), you can divide the daily dilution water by the recommended 1,000 gallons of dilution water per day per bather to find the allowable bather loading.

Here are several examples based on the formula:  $N = (V/180 + F)/1,000$

where: N = the number of bathers, V = the volume of the water body in gallons and F = the inflow in gallons per day provided by streams or other sources. 180 is an average turnover time in days for a typical lake. You can substitute 180 with a known turnover rate (days).

EXAMPLE 1: For a 2000 gallon water body with a 180 day turnover and 1,000 gallons/day inflow.

$$\begin{aligned} N &= (2,000/180 + 1,000)/1,000 \\ N &= (11.11 + 1,000)/1,000 \quad \text{Note: daily turnover is 11.11 gallons per day} \\ N &= (1,011.11)/1,000 \\ N &= 1.011 \text{ bathers} \end{aligned}$$

EXAMPLE 2: For a 180,000 gallon waterbody with 180 day turnover and a 1,000 gallons/day inflow.

$$\begin{aligned} N &= (180,000/180 + 1,000)/1,000 \\ N &= (1,000 + 1,000)/1,000 \quad \text{Note: daily turnover is 1,000 gallons per day} \\ N &= (2,000)/1,000 \\ N &= 2 \text{ bathers} \end{aligned}$$

EXAMPLE 3: For a 180,000 gallon waterbody with a 60 day turnover and a 1,000 gallons/day inflow.

$$\begin{aligned} N &= (180,000/60 + 1,000)/1,000 \\ N &= (3,000 + 1,000)/1,000 \quad \text{Note: daily turnover is 3,000 gallons per day} \\ N &= (4,000)/1,000 \\ N &= 4 \text{ bathers} \end{aligned}$$

## Appendix 6 of Guidelines

### REVISION HISTORY

April 2003 - third major revision

December 2008 - minor update with current contact information

Appendix B of QAPP

Bathing Water Sample Invoice Form  
(following page)

DATE RECEIVED

**Connecticut Department of Public Health Laboratory**  
**BATHING WATER SAMPLE INVOICE FORM**  
**Telephone (860) 509-8562**

Place a DPH Lab submitter address/account label in this space. Call 860-509-8501 for additional labels	Collected by: _____
	Town: _____ Town#: _____
	Date Collected: _____ Phone ( ) _____

*Please Circle One:*

**MARINE WATER**

**FRESH WATER**

TEST NUMBER 559M

TEST NUMBER 558M

Enterolert

Colilert

Time _____	Accession No. _____
<b>Collector's No.</b> _____	Enterococcal Count/100ml: _____ Initials _____
<b>Additional Info</b> _____	E.Coli Count/100ml: _____ Initials _____

Time _____	Accession No. _____
Collector's No. _____	Enterococcal Count/100ml: _____ Initials _____
Additional Info: _____	E.Coli Count/100ml: _____ Initials _____

Time _____	Accession No. _____
Collector's No. _____	Enterococcal Count/100ml: _____ Initials _____
Additional Info: _____	E.Coli Count/100ml: _____ Initials _____

Time _____	Accession No. _____
Collector's No. _____	Enterococcal Count/100ml: _____ Initials _____
Additional Info: _____	E.Coli Count/100ml: _____ Initials _____

Time _____	Accession No. _____
Collector's No. _____	Enterococcal Count/100ml: _____ Initials _____
Additional Info: _____	E.Coli Count/100ml: _____ Initials _____

DATE AND TIME ANALYZED

ANALYZED BY:

METHOD:

ENTEROLERT / COLILERT

LAB\_INVOICE\_A.DOC

## Appendix C of QAPP

Connecticut Department of Public Health Laboratory Standard Operating  
Procedure for Determination of Enterococci in Bathing Waters

1 Document ID	Title <b>Enterolert® Enterococci Defined Substrate Test for Marine Bathing Water Analysis</b>			Issuing Dept. <b>Environmental Microbiology</b>
Approval <u>Dr. Kelley</u>	Revision no.	Effective date	Copy of	Page 1 of 13

Connecticut Department of Public Health  
 Division of Laboratory Services  
 10 Clinton Street; Hartford CT 06106

Procedure:

Enterolert®

Enterococci Defined Substrate Test

For Marine Bathing Water Analysis  
 Environmental Microbiology

PREPARED BY: Aristea Kinney                      DATE: 02/07/07

REVIEWED BY: \_\_\_\_\_                      DATE: \_\_\_\_\_

APPROVED BY: \_\_\_\_\_                      DATE: \_\_\_\_\_

2 Document ID	Title <b>Enterolert® Enterococci Defined Substrate Test for Marine Bathing Water Analysis</b>			Issuing Dept. <b>Environmental Microbiology</b>
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## **1.0 PRINCIPLE:**

1.1 The Enterolert® Reagent is used for the detection of enterococci such as E.faecium and E.faecalis in water. It is based on IDEXX's patented Defined Substrate Technology and utilizes a nutrient indicator substrate, 4-methyl-umbelliferyl β-D-glucoside that fluoresces when metabolized by enterococci enzyme B-glucosidase. When the reagent is added to the sample and incubated, it can detect these bacteria at 1 MPN/100ml within 24 hours. The IDEXX Quanti-trays are designed to give quantitative bacterial counts of 100 ml samples using IDEXX Defined Substrate Technology reagent products. Add the reagent/sample mixture to a Quanti-Tray, seal it in a Quanti-Tray Sealer and incubate per the reagent directions. Then count the number of positive wells and use the MPN table to determine the Most Probable Number (MPN)/100 ml of sample.

## **2.0 SAMPLE:**

2.1 The Enterolert test is used for the analysis of Marine bathing water samples.

2.2 Sampling, transport, and holding time procedures are found in 40 CFR Part 136. Samples must be analyzed within 8 hours of collection or the sample is not tested and reported as "Unsatisfactory for Examination".

2.3 Guidelines for rejecting samples are found in the "Quality Manual" Connecticut Department of Public Health, Division of Laboratory Services.

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### 3.0 SAFETY:

- 3.1. Treat all biological material as potentially infective.
- 3.2 Wash hands with soap immediately if they become contaminated. Wash hands with soap after removing lab coat. Wash hands with soap before leaving laboratory.
- 3.3 No mouth pipeting. No eating, smoking, or chewing gum in the laboratory.
- 3.4 Always wear a laboratory coat or gown when working in the laboratory. Remove Laboratory coats of gowns before leaving the laboratory.
- 3.5 Decontaminate laboratory work surfaces with freshly prepared chemical germicide when work activities are completed.
- 3.6 Refer to *Connecticut Department of Public Health Laboratory Safety Manual-Laboratory Health and Safety Plan* for additional safety information.

### 4.0 EQUIPMENT:

- 4.1 Temperature Monitoring Device - Use glass thermometers
  - 4.1.1 Thermometers are graduated in 0.5°C increments.
  - 4.1.2 There should be no separation in fluid column of glass thermometer.
  - 4.1.3 Calibrate thermometers annually at the temperature used, against a NIST certified thermometer or one meeting the requirements of NBS Monograph SP 250-23.
  - 4.1.4 Check NIST certified thermometer annually for accuracy by ice point determination. Record and maintain results.

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4.1.5 Record calibration checks in quality control (QC) record and on thermometer. Mark thermometer with identification, NBS calibration correction factor, calibration temperature, calibration date, on each thermometer.

4.1.6 Use partial Immersion Thermometer.

4.1.7 Discard thermometer if off by more than 1°.

#### 4.2 Incubator

4.2.1 Maintain temperature at 41°C ± 0.5°C.

4.2.2 Place thermometers on top and bottom shelves of use area.

4.2.3 If partially-submersible glass thermometer is used, bulb and stem must be immersed in water to the mark on the stem.

4.2.4 Check and record calibration corrected temperature twice per day with readings separated by at least 4 hours.

4.2.5 Record daily temperature checks in the daily temperature book and keep for at least five years.

#### 4.3 Autoclave

The purpose of the autoclave in this procedure is to decontaminate infectious material. The Support Services Division has responsibility for the autoclave operation.

4.3.1 Autoclave has internal heat source, a temperature gauge with a sensor on the exhaust, pressure gauge, and operational safety valve.

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4.3.2 Autoclave maintains sterilization temperature during the sterilizing cycle and completes an entire cycle within 45 minutes when a 15 minute sterilization period is used.

4.3.3 Record date, contents, sterilization time, temperature, total cycle time, and analysts initials for each cycle.

4.3.4 Establish service contract or internal maintenance protocol, and maintain records. Conduct maintenance weekly with records of most recent service performed. Keep door seals and drain screen clean.

4.3.5 Avoid overcrowding.

4.3.6 Test spore strips weekly. Record results on sterilization records. Take corrective action if positive.

4.3.7 Check automatic timing mechanism with stopwatch quarterly.

4.4 Ultraviolet Lamp Box with a 365 nm and 6 watt.

4.4.1 Maintenance

4.4.2 QA

## **5.0 MATERIALS:**

5.1 Substrate

5.1.1 Purchase Enterolert® Reagent from Idexx Laboratories, Inc. (Catalog # WENT200) in snap packs for 100 mL water samples for the Quanti-Tray Enumeration Procedure.

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5.1.2 Marine water samples must be diluted ten-fold with sterile Butterfield's Buffer.

See 7.3. Store at 4-25°C away from light. Avoid prolonged exposure of substrate to direct sunlight.

5.1.3 Discard expired substrate.

5.2 Quanti-Tray 51 well

5.2.1 Purchase the 51 Well Quanti-Tray from Idexx Laboratories, Inc. (Catalog #WQT-100)

5.3 Butterfield's dilution blanks, 90 ml

5.3.1 Purchase Butterfield's dilution blanks from Biotrace (Redmond, WA. Catalog # FT-BFD-99.)

5.4 Quanti-Tray Sealer

5.4.1 Purchase from IDEXX Laboratories, Inc. (Catalog # WQTS2X-115)

5.5 Pipets, 10 ml

5.5.1 Purchase from Fisher Scientific ( Catalog # 13-678-14A).

5.6 Sterile vessel, Disposable

5.6.1 Purchase from IDEXX Laboratories, Inc. (Catalog # WV12SB-200)

## **6.0 QUALITY CONTROL:**

6.1 Check each lot of Enterolert® Reagent for autofluorescence and color change on receipt.

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6.1.1 Add 100 ml. of sterile distilled water to a sterile vessel (see 5.6). Add Enterolert reagent, shake to mix and wait until reagent is dissolved. If reagent exhibits a color change before incubation, reject as unacceptable. Check the reagent mixture by placing in a Ultraviolet Light box (365-nm ultraviolet light with 6 watt bulb). If reagent exhibits faint fluorescence, the reagent lot is unacceptable; reject lot. Record results in Water QC book.

6.2 Test each lot of Enterolert® Reagent for sterility on receipt.

6.2.1 Add 100 ml. of sterile distilled water to a sterile vessel. Add Enterolert reagent, shake to mix and incubate at  $41^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$  for 24 hrs and check for growth. Record in Water QC Book as acceptable if no growth and not acceptable if growth is present. Reject the lot if contamination is indicated.

6.3 Test each lot of Enterlert reagent when received for proper reactions. Use the following organisms recommended by the manufacturer Idexx Laboratories, Inc: *Enterococcus faecium*, *Serratia marcescens* and *Aerococcus viridans*.

6.3.1 Label three sterile vessels "EF", "SM" and "AV".

6.3.2 Add 100 ml. of Butterfield' Buffer to each of three vessels, then add Enterolert reagent and mix thoroughly.

6.3.3 Aseptically inoculate the respective vessels with growth from 18-24 hr. slants of each organism.

6.3.4 After sample has been inoculated and Enterolert has dissolved, pour into 51 Well Quanti-Tray, seal and incubate inoculated Quanti-trays at  $41^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$  for 24 hrs. (see 7.7).

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6.3.5 Read and record results after incubation time by placing Quanti-Tray in Ultraviolet Light box, looking for fluorescence.

6.3.6 Reject lot if results do not match the following:

<b>Organism</b>	<b>Appearance</b>	<b>Result</b>
<i>Enterococcus faecium</i>	Fluorescence	Positive for enterococcus
<i>Serratia Marcescens</i>	No Fluorescence	Negative For Enterococcus
<i>Aerococcus viridans</i>	No fluorescence	Negative for enterococcus

6.4 Each day of Bathing Water Testing, perform the Enterolert test on a know positive, negative and sterile sample. Use the following ATTC organisms recommended by the manufacturer Idexx Laboratories, Inc for the Positive and Negative sample: *Enterococcus faecium*, and *Serratia marcescens*, and use the 90ml Butterfield's Buffer for the sterile sample.

6.4.1 Label three sterile vessels "*EF*", "*SM*" and "*Sterility*"

6.4.2 Add 100 ml. of Buttersfield's buffer to each sterile vessel. Then add Enterolert reagent and mix thoroughly.

6.4.3 Aseptically inoculate the respective vessels with growth from 18-24 hr. slants of each organism. Do not inoculate the vessel marked "Sterility"

6.4.4 After sample has been inoculated and after Enterolert has dissolved, pour into 51 Well Quanti-Tray and seal (see 7.7) Incubate inoculated trays and Sterility tray at 41°C ± 0.5°C for 24 hrs.

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6.4.5 Read and record results in Water QC book after incubation time by placing Quanti-Tray in Ultraviolet Light box, looking for fluorescence.

6.4.6 Reject all results for that day that do not match the following results:

<b>Organism</b>	<b>Appearance</b>	<b>Result</b>
<i>Enterococcus faecium</i>	Fluorescence	Positive for enterococcus
<i>Serratia Marcescens</i>	No Fluorescence	Negative For Enterococcus
<i>Sterility</i>	No fluorescence	Negative for enterococcus

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## **7.0 PROCEDURE: Quanti-Tray Enumeration Procedure**

7.1 Label 90 ml Butterfield's dilution blank with accession number and test (ENT).

7.2 Label 50 well Quanti-Tray with accession number, date, and test (ENT).

7.3 Aseptically open a pack of Enterolert reagent by snapping back the top at the scoreline and add the contents of the Enterolert to the labeled 90 ml Butterfield's dilution blank.

7.2 Shake the Bathing water sample bottle vigorously (25 times in one foot arc in 7 seconds).

7.3 Aseptically pipet 10ml of the sample to the labeled 90ml sterile Butterfield's dilution blank containing the Enterlert reagent.

7.4 Aseptically cap the dilution blank and mix.

7.6 Once the reagent is dissolved, aseptically pour this sample directly into the labeled 51-well Quanti-Tray avoiding contact with the foil tab.

7.7 Seal Quanti-Tray in a preheated Quanti-Tray Sealer by placing Quanti-tray in the rubber insert, aligning holes to fit Quanti-Tray and gently pushing until the rubber insert is grabbed and is drawn into the sealer.

7.8 Once sealed, the Quanti-Tray will be partially ejected from rear of the Sealer. Remove the rubber insert and Quanti-tray from the rear of the sealer and mark the time on the tray.

7.9 Incubate the sealed Quanti-Tray at  $41 \pm 0.5^{\circ}\text{C}$  for 24 hours.

7.9.1 Enterolert results are definitive at 24-28 hours.

7.10 Read the results at 24 hours by placing the Quanti-Tray in the Ultraviolet Light box with the 6 watt, 365 nm wavelength UV light turned on. Blue fluorescence indicate the presence of Enterococci.

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7.11 Count the number of fluorescent Quanti-Tray wells and record on the sample invoice form. Refer to the 51-Well Quanti-Tray MPN table to find the Most Probable Number (MPN)/100ml.

7.12 Calculate the Most Probable Number (MPN)/100ml by referring to the 51-well Quanti-Tray MPN table (See Appendix 1). Multiply the MPN value on the table by the dilution factor (10).

7.13 Record on sample invoice form.

## **8.0 REPORTING:**

8.1 Report results in computer by worklist.

8.2 Report results as MPN/100ml .

8.3 Call results of every Enterococci result over the value of 104/100ml to the submitter.

8.4 Review results for accuracy before filing.

## **9.0 REFERENCES:**

9.1 Clesceri, Greenberg, Eaton 2000, Standard Methods for the Examination of Water and Wastewater, APHA, AWWA, WEF, 20<sup>th</sup> Edition

9.2 Idexx, Inc., Enterolert® product insert

9.3 Connecticut Department of Public Health, Division of Laboratory Services QA Manual

9.4 U.S. Environmental Protection Agency (USEPA), 40 CFR Part 136

9.5 IDEXX 51-Well Quanti-Tray MPN Table

9.6 Connecticut Department of Public Health Laboratory Safety Manual-Laboratory Health And Safety Plan.

## IDEXX 51-Well Quanti-Tray® MPN Table

No. of wells giving positive reaction	MPN per 100 ml sample	95% Confidence Limits Lower Upper	
0	<1.0	0.0	3.7
1	1.0	0.3	5.6
2	2.0	0.6	7.3
3	3.1	1.1	9.0
4	4.2	1.7	10.7
5	5.3	2.3	12.3
6	6.4	3.0	13.9
7	7.5	3.7	15.5
8	8.7	4.5	17.1
9	9.9	5.3	18.8
10	11.1	6.1	20.5
11	12.4	7.0	22.1
12	13.7	7.9	23.9
13	15.0	8.8	25.7
14	16.4	9.8	27.5
15	17.8	10.8	29.4
16	19.2	11.9	31.3
17	20.7	13.0	33.3
18	22.2	14.1	35.2
19	23.8	15.3	37.3
20	25.4	16.5	39.4
21	27.1	17.7	41.6
22	28.8	19.0	43.9
23	30.6	20.4	46.3
24	32.4	21.8	48.7
25	34.4	23.3	51.2
26	36.4	24.7	53.9
27	38.4	26.4	56.6
28	40.6	28.0	59.5
29	42.9	29.7	62.5
30	45.3	31.5	65.6
31	47.8	33.4	69.0
32	50.4	35.4	72.5
33	53.1	37.5	76.2
34	56.0	39.7	80.1
35	59.1	42.0	84.4
36	62.4	44.6	88.8
37	65.9	47.2	93.7
38	69.7	50.0	99.0
39	73.8	53.1	104.8
40	78.2	56.4	111.2
41	83.1	59.9	118.3
42	88.5	63.9	126.2
43	94.5	68.2	135.4
44	101.3	73.1	146.0
45	109.1	78.6	158.7
46	118.4	85.0	174.5
47	129.8	92.7	195.0
48	144.5	102.3	224.1
49	165.2	115.2	272.2
50	200.5	135.8	387.6
51	> 200.5	146.1	infinite

Appendix D of QAPP

Connecticut Department of Public Health Laboratory Standard Operating  
Procedure for Determination of *Escherichia coli* in Bathing Waters

Document ID	Title <b>Procedure: Colilert Bathing Water Enumeration for E. coli</b>			Issuing Dept. <b>Environmental Microbiology</b>
Approval <u>Dr.Fontana</u>	Revision no. <b>5</b>	Revision date Dec. 29, 2008	Copy <b>1 of 4</b>	Page 1 of 9

**Connecticut Department of Public Health  
Division of Laboratory Services  
Environmental Microbiology Section**

**DRAFT**

**Procedure:**

**Colilert Bathing Water Enumeration  
Method for *E.coli***

**Chromogenic Substrate Coliform Test**

**For Bathing Water Analysis  
Environmental Microbiology**

PREPARED BY: \_\_\_\_\_ DATE: \_\_\_\_\_

REVIEWED BY: \_\_\_\_\_ DATE: \_\_\_\_\_

APPROVED BY: \_\_\_\_\_ DATE: \_\_\_\_\_

Document ID	Title <b>Procedure: Colilert Bathing Water Enumeration for E. coli</b>			Issuing Dept. <b>Environmental Microbiology</b>
Approval <u>Dr.Fontana</u>	Revision no. <b>5</b>	Revision date Dec. 29, 2008	Copy <b>1 of 4</b>	Page 2 of 9

## 1.0 PRINCIPLE:

- 1.1 This procedure provides instructions for the enumeration of *Escherichia coli* (*E.coli*), the indicator organism in Fresh Bathing Water samples. The Colilert® reagents are used for the simultaneous detection and confirmation of total coliforms and *E.coli* in water. It is based on IDEXX's patented Defined Substrate Technology and utilizes a nutrient indicator that produces color (for Total coliform) and/or fluorescence (for *E.coli*) when metabolized by total coliforms and *E.coli*. When the reagent is added to the sample and incubated, it can detect these bacteria at 1 MPN/100ml within 18 hours with as many as 2 million heterotrophic bacteria present. The IDEXX Quanti-trays are designed to give quantitative bacterial counts of 100 ml samples using IDEXX Defined Substrate Technology reagent products. Add the reagent/sample mixture to a Quanti-tray, seal it in a Quanti-tray Sealer and incubate per reagent directions. Then count the number of positive wells and use the MPN table to determine the Most Probable Number (MPN).
- 1.2 *Escherichia coli*: A substrate such as the fluorogenic substrate 4-methylumbelliferyl- $\beta$ -D-glucuronide (MUG) is used to detect the enzyme  $\beta$ -glucuronidase, which is produced by *E. coli*. The  $\beta$ -glucuronidase enzyme hydrolyzes the substrate and produces a fluorescent product when viewed under long-wavelength (366-nm) ultraviolet (UV) light. The number of fluorescent wells are counted and the MPN table is used to determine the Most Probable Number (MPN).

## 2.0 SAMPLE:

- 2.1 The chromogenic substrate coliform test is recommended for the analysis of Fresh Bathing water samples.
- 2.2 Sampling, transport and holding time procedures are found in the State of Connecticut, Guidelines for Monitoring Bathing Water and Closure Protocol", April 2003. Connecticut Department of Public Health, Division of Laboratory Services and Connecticut Department of Environmental Protection and Standard methods for the Examination of Water and Wastewater, 20<sup>th</sup> ed.
- 2.3 Guidelines for rejecting samples are found in the "QA Manual", Connecticut Department of Public Health, Division of Laboratory Services.

## 3.0 SAFETY:

- 3.1 Treat all biological material as potentially infective.
- 3.2 Wash hands with soap immediately if they become contaminated. Wash hands with soap after removing lab coat. Wash hands with soap before leaving the laboratory

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- 3.3 No mouth pipeting. No eating, smoking, or chewing gum in the laboratory.
- 3.4 Always wear a laboratory coat, apron or gown when working in the laboratory. Remove uniforms before leaving the laboratory.
- 3.5 Decontaminate laboratory work surfaces at least daily with freshly prepared chemical germicide when work activities are completed.
- 3.6 Immediately decontaminate fluid culture spills.

#### **4.0 EQUIPMENT:**

##### 4.1 Temperature Monitoring Device - Use glass thermometers

- 4.1.1 Thermometers are graduated in 0.5°C increments or less (0.1°C increments for tests incubated at 44.5°C)
- 4.1.2 There should be no separation in fluid column of glass thermometer.
- 4.1.3 Calibrate thermometers annually at the temperature used, against a NIST certified thermometer or one meeting the requirements of NBS Monograph SP 250-23.
- 4.1.4 Check NIST certified thermometer annually for accuracy by ice point determination. Record and maintain results.
- 4.1.5 Record calibration checks in quality control (QC) record and on thermometer. Mark thermometer with identification, NBS calibration correction factor, calibration temperature, calibration date, on each thermometer.
- 4.1.6 All working thermometers must be appropriately immersed.
- 4.1.7 Discard thermometer if off by more than 1°
- 4.1.8 Record daily temperature checks in the daily temperature book and keep for at least five years. Continuous recording devices are not used to monitor temperatures.

##### 4.2. Incubator

- 4.2.1 Maintain temperature at 35°C ± 0.5°C.
- 4.2.2 Place thermometers on top and bottom shelves of use area.
- 4.2.3 If partially-submersible glass thermometer is used, bulb and stem must be immersed in water to the mark on the stem.
- 4.2.4 Check and record calibration corrected temperature twice per day with readings separated by at least 4 hours.
- 4.2.5 Waterbath must be equipped with gable cover and pump used to circulate water.

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### 4.3 Autoclave

The purpose of the autoclave in this procedure is to decontaminate infectious material. The Support Services division has responsibility for the autoclave operation.

- 4.3.1 Autoclave has internal heat source, a temperature gauge with a sensor on the exhaust, pressure gauge, and operational safety valve.
- 4.3.2 Autoclave maintains sterilization temperature during the sterilizing cycle and completes an entire cycle within 45 minutes when a 15-minute sterilization period is used.
- 4.3.3 Autoclave should depressurize slowly to ensure media does not boil over and bubbles do not form in inverted tubes.
- 4.3.4 Record date, contents, sterilization time, temperature, total cycle time, and analysts initials for each cycle.
- 4.3.5 Establish service contract or internal maintenance protocol, and maintain records. Conduct maintenance weekly with records of most recent service performed. Keep door seals and drain screen clean.
- 4.3.6 Use maximum-temperature-registering thermometer during each autoclave media run. Record temperature.
- 4.3.7 Avoid overcrowding.
- 4.3.8 Use spore strips weekly.
- 4.3.9 Check automatic timing mechanism with stopwatch quarterly.

4.4 Long wavelength (366 nm) ultraviolet lamp.

### 4.5 Quanati-Tray Sealer

- 4.5.1 Purchase from IDEXX Laboratories, Inc

## 5.0 MATERIALS:

### 5.1 Substrate

- 5.1.1 Purchase Colilert® Reagent from IDEXX Laboratories, Inc. in snap packs for 100 mL water samples for the Enumeration Procedure. Fresh Water Bathing water samples are diluted at least ten-fold with sterile Butterfield's buffer water (see procedures 7.0)
- 5.1.2 Store at 4-25°C away from light. Avoid prolonged exposure of substrate to direct sunlight.

### 5.2 Quanti-tray 51 well

- 5.2.1 Purchase the 51 Well Quanti-tray from IDEXX Laboratories, Inc.

### 5.3 Butterfield's dilution blanks, 90 ml

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5.4 Pipets, 10 ml.

5.5 Colilert® Quanti-tray Comparator  
Purchase from Idexx Laboratories, Inc.

## 6.0 QUALITY CONTROL:

6.1 Check each lot of Colilert® Reagent for autofluorescence and color change on receipt.

Add 100 ml. of sterile distilled water to a sterile vessel. Add Colilert reagent, shake to mix and wait until reagent is dissolved. If reagent exhibits a color change before incubation, lot is unacceptable. Check the reagent with 366-nm ultraviolet light with 6 watt bulb. If reagent exhibits faint fluorescence, the reagent lot is unacceptable; reject lot. Record results.

6.2 Test each lot of Colilert® Reagent for sterility on receipt.

6.2.1 Add 100 ml. of sterile distilled water to a sterile vessel. Add Colilert reagent, shake to mix and incubate at  $35^{\circ} \pm 0.5^{\circ}$  C for 24 hrs (18 hrs. for Colilert-18) and check for growth. Record as acceptable if no growth and not acceptable if growth is present. Reject the lot if contamination is indicated.

6.3 Test each lot of Colilert reagent when received for proper reactions.

6.3.1 Label three sterile vessels "*Escherichia coli*", "*Klebsiella pneumoniae*" and "*Pseudomonas aeruginosa*".

6.3.2 Add 100 ml. of sterile distilled water to each of three vessels, then add Colilert reagent and mix thoroughly.

6.3.3 Aseptically inoculate the respective vessels with growth from 18-24 hr. slants of each organism.

6.3.4 Incubate inoculated vessels at  $35^{\circ} \pm 0.5^{\circ}$  C for 24 hrs (18 hrs. for Colilert-18). Read and record results.

6.3.5 Reject lot if results do not match the following:

<b>Organism</b>	<b>Appearance</b>	<b>Result</b>
<i>Escherichia coli</i>	Yellow and Fluorescence	Positive for <i>Escherichia coli</i>
<i>Klebsiella Pneumoniae</i>	Yellow And No Fluorescence	Positive For Total Coliform
<i>Pseudomonas aeruginosa</i>	Colorless or slight tinge	Negative for <i>E. coli</i> and Total Coliform

6.4 Each day of Bathing Water Testing, perform the Colilert® Test on a known positive, negative and sterile sample. Use the following ATTC (American Type Culture Collection) organisms recommended by the manufacturer IDEXX Laboratories, inc. For Positive samples use ATCC 25922

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or 11775 (*E.coli*), for Negative samples use ATCC 31488 *Klebsiella pneumoniae* and use the 90 ml Butterfield's buffer for the sterile sample.

- 6.4.1 Label three Butterfield's buffer vessels "EC" (*E.coli*), "KP" (*Klebsiella pneumoniae*) and "Sterility"
- 6.4.2 Add Colilert® Reagent to each marked vessel.
- 6.4.3 Aseptically inoculate the respective vessels with ATTC growth from 18-24 hours. Slants of each organism. Do not inoculate the vessel marked "sterility"
- 6.4.4 After sample has been inoculated and after Colilert® has dissolved, pour into the 51 Well Quanti-tray and seal. Incubate inoculated trays and sterility tray at  $35^{\circ} \pm 0.5^{\circ} \text{C}$  for minimum of 18 hours but not more than 22 hours. Read and record results.

## 7.0 PROCEDURE: Quanti-tray Enumeration Procedure

- 7.1 Label 90 ml Butterfield's dilution blank with accession number and test "C-18".
- 7.2 label 51 well Quanti-tray with accession number, date and test "C-18"
- 7.3 Aseptically open a pack of Colilert® reagent by snapping back the top of the scoreline and add the contents of the Colilert® to the labeled 90 ml Butterfield' dilution blank.
- 7.4 Shake the Bathing water sample bottle vigorously (25 times in one foot arc in 7 seconds.)
- 7.5 Aseptically pipet 10 ml of the mixed Bathing water sample to the labeled 90ml sterile Butterfield's buffer dilution blank containing the Colilert® Reagent.
- 7.6 Aseptically cap the dilution blank and mix.
- 7.7 Once the reagent is dissolved, pour this sample directly into the 51- well Quanti-tray avoiding contact with the foil tab.
- 7.8 Seal tray in Quanti-tray sealer that has been pre-heated and label tray with the time sealed and incubated.
- 7.9 Incubate the sealed Quanti-tray at  $35^{\circ} \pm 0.5^{\circ}$  for 18-22 hours.
  - 7.9.1. Colilert®-18 results are definitive at 18-22 hours. Do not read before 18 hours of incubation or after 22 hours of incubation.
- 7.10 Read the results at 18-22 hours by placing a 6-watt, 365 nm wavelength UV light within 5 inches of the 51 well Quanti-tray in a dark environment. Be sure the light is facing away from your eyes and towards the Quanti-tray. Fluorescence indicates the presence of *E. coli*.

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- 7.10.1 Count of number of fluorescent Quanti-tray wells and refer to the 51 well Quanti-tray MPN table to find the Most probable number (MPN). Multiply the number on the chart by 10 to obtain the MPN/100ml (see 8.0 Reporting).
- 7.10.2 Autoclave Colilert® Quanti-tray vessel as infectious waste for proper disposal.

## 8.0 REPORTING:

- 8.1 Record the number of positive wells (fluorescence) and the corresponding MPN values for *E.coli* on the sample invoice. To obtain the MPN value, multiply the MPN value on the chart by the dilution factor, 10 to obtain the proper quantitative result.
- 8.2 Report results in the computer by worklist.
- 8.3 Report results as MPN/100ml
- 8.4 Call the submitter and relevant agencies (Department of Environmental Protection, Local Health Departments and Laboratories) for every *E.coli* result over the value of 235/ 100ml.
- 8.4.1 Record on the laboratory invoice the name of person, date and time called.
- 8.5 Submit the completed sample invoice form to the supervisor or designee to check results.
- 8.6 Report checked results in computer by workboard.
- 8.6.1 Report results as per 100 ml.
- 8.6.2 Review results for accuracy before filing.

## 9.0 REFERENCES:

2004, Connecticut Department of Public Health, Division of Laboratory Services QA Manual

Clesceri, Greenberg, Eaton 2000, Standard Methods for the Examination of Water and Wastewater, APHA, AWWA, WEF, 20th edition

IDEXX, Inc., Colilert® product inserts.

State of Connecticut, “Guidelines for Monitoring Bathing Water and Closure Protocol”, April 2003. Connecticut Department of Public Health, Division of Laboratory Services and Connecticut Department of Environmental Protection.

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(REFERENCES continued)

USEPA (U.S. Environmental Protection Agency (1999) Action Plan for Beaches and Recreational Waters  
EPA 600/R-98-079. U.S. Environmental Protection Agency, Washington, DC.

## IDEXX 51-Well Quanti-Tray® MPN Table

No. of wells giving positive reaction	MPN per 100 ml sample	95% Confidence Limits Lower Upper	
<b>0</b>	<b>&lt;1.0</b>	<i>0.0</i>	<i>3.7</i>
1	<b>1.0</b>	<i>0.3</i>	<i>5.6</i>
2	<b>2.0</b>	<i>0.6</i>	<i>7.3</i>
3	<b>3.1</b>	<i>1.1</i>	<i>9.0</i>
4	<b>4.2</b>	<i>1.7</i>	<i>10.7</i>
5	<b>5.3</b>	<i>2.3</i>	<i>12.3</i>
6	<b>6.4</b>	<i>3.0</i>	<i>13.9</i>
7	<b>7.5</b>	<i>3.7</i>	<i>15.5</i>
8	<b>8.7</b>	<i>4.5</i>	<i>17.1</i>
9	<b>9.9</b>	<i>5.3</i>	<i>18.8</i>
<b>10</b>	<b>11.1</b>	<i>6.1</i>	<i>20.5</i>
11	<b>12.4</b>	<i>7.0</i>	<i>22.1</i>
12	<b>13.7</b>	<i>7.9</i>	<i>23.9</i>
13	<b>15.0</b>	<i>8.8</i>	<i>25.7</i>
14	<b>16.4</b>	<i>9.8</i>	<i>27.5</i>
15	<b>17.8</b>	<i>10.8</i>	<i>29.4</i>
16	<b>19.2</b>	<i>11.9</i>	<i>31.3</i>
17	<b>20.7</b>	<i>13.0</i>	<i>33.3</i>
18	<b>22.2</b>	<i>14.1</i>	<i>35.2</i>
19	<b>23.8</b>	<i>15.3</i>	<i>37.3</i>
<b>20</b>	<b>25.4</b>	<i>16.5</i>	<i>39.4</i>
21	<b>27.1</b>	<i>17.7</i>	<i>41.6</i>
22	<b>28.8</b>	<i>19.0</i>	<i>43.9</i>
23	<b>30.6</b>	<i>20.4</i>	<i>46.3</i>
24	<b>32.4</b>	<i>21.8</i>	<i>48.7</i>
25	<b>34.4</b>	<i>23.3</i>	<i>51.2</i>
26	<b>36.4</b>	<i>24.7</i>	<i>53.9</i>
27	<b>38.4</b>	<i>26.4</i>	<i>56.6</i>
28	<b>40.6</b>	<i>28.0</i>	<i>59.5</i>
29	<b>42.9</b>	<i>29.7</i>	<i>62.5</i>
<b>30</b>	<b>45.3</b>	<i>31.5</i>	<i>65.6</i>
31	<b>47.8</b>	<i>33.4</i>	<i>69.0</i>
32	<b>50.4</b>	<i>35.4</i>	<i>72.5</i>
33	<b>53.1</b>	<i>37.5</i>	<i>76.2</i>
34	<b>56.0</b>	<i>39.7</i>	<i>80.1</i>
35	<b>59.1</b>	<i>42.0</i>	<i>84.4</i>
36	<b>62.4</b>	<i>44.6</i>	<i>88.8</i>
37	<b>65.9</b>	<i>47.2</i>	<i>93.7</i>
38	<b>69.7</b>	<i>50.0</i>	<i>99.0</i>
39	<b>73.8</b>	<i>53.1</i>	<i>104.8</i>
<b>40</b>	<b>78.2</b>	<i>56.4</i>	<i>111.2</i>
41	<b>83.1</b>	<i>59.9</i>	<i>118.3</i>
42	<b>88.5</b>	<i>63.9</i>	<i>126.2</i>
43	<b>94.5</b>	<i>68.2</i>	<i>135.4</i>
44	<b>101.3</b>	<i>73.1</i>	<i>146.0</i>
45	<b>109.1</b>	<i>78.6</i>	<i>158.7</i>
46	<b>118.4</b>	<i>85.0</i>	<i>174.5</i>
47	<b>129.8</b>	<i>92.7</i>	<i>195.0</i>
48	<b>144.5</b>	<i>102.3</i>	<i>224.1</i>
49	<b>165.2</b>	<i>115.2</i>	<i>272.2</i>
<b>50</b>	<b>200.5</b>	<i>135.8</i>	<i>387.6</i>
51	<b>&gt; 200.5</b>	<i>146.1</i>	<i>infinite</i>

[END OF QUALITY ASSURANCE PROJECT PLAN]