



Ocean Beach Park, New London

QUALITY ASSURANCE PROJECT PLAN
FOR THE
BEACH MONITORING AND NOTIFICATION PROGRAM
FOR CONNECTICUT COASTAL BEACHES
MARCH 2022



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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

QUALITY ASSURANCE PROJECT PLAN (QAPP)

2022

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APPENDICES OF QUALITY ASSURANCE PROJECT PLAN

Appendix A	<i>Guidelines for Monitoring Bathing Waters and Closure Protocol</i> , Revised March 2016
Appendix B	Connecticut Dept. of Public Health Laboratory Standard Operating Procedures for Determination of Enterococci in Marine Bathing Waters

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 Energy and Environmental Protection (DEEP). The Guidelines have been revised four times, most recently in March 2016. 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 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, DPH has become more involved in marine beach monitoring. The agency works closely with 24 municipalities along the Long Island Sound shoreline and their 17 local health departments plus DEEP to support the consistent use of statewide beach monitoring guidelines and beach closure protocol. DPH hosts spring 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, DPH receives, manages, maintains and uses marine beach data supplied to it by the state laboratory, local health departments and DEEP. 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. DPH custom software is enabled for both incoming and outgoing electronic data interchange and includes utilities to cross check and validate beach data.

DPH tracks 72 regulated marine bathing areas for the US EPA Beach Grant. The local health departments and DEEP 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 DEEP will self-report that each of these beaches was sampled weekly according the recommendation in the State of Connecticut Guidelines for Monitoring Bathing Water and Closure Protocol (revised December 2016).

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 DEEP. This document describes the policies and procedures for the operation of the program.

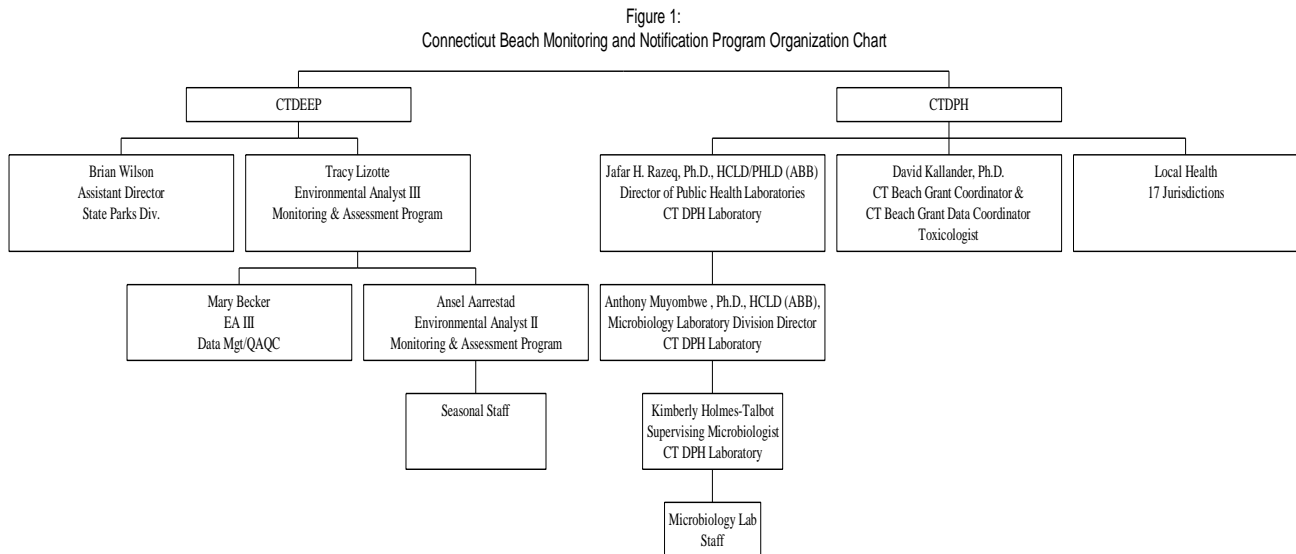
DEEP is responsible for collecting samples from State owned/managed swimming beaches, submitting the samples directly to the DPH laboratory, and notifying the general public of any closure decisions for these beaches. DPH, working in partnership with local health districts or departments, collects, provides 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 DPH, *et.al.* 2016 revision. Questions regarding beach closure protocols and monitoring are directed to DPH Beach Program Staff.

DPH administers Beach Grant Funds, which are used to support coastal beach monitoring functions. The program currently monitors four State owned beaches and 68 municipal beaches from late 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:



2.2 Connecticut DPH & DEEP Personnel Qualifications

Table 1. Personnel Qualifications

Name	Responsibilities	Qualifications
Tracy Lizotte Environmental Analyst III	DEEP Water Beach Program Coordinator	Over 25 years' experience in Water Resources Management.
Brian Wilson Assistant Director	State Beach Management CT DEEP State Parks Div.	Over 15 years' experience in Natural Resources Management
David Kallander, Ph.D. Toxicologist	Beach Program Coordinator CT DPH-Environ. Health Sec.	17 + years with the Environmental Health Section, CT DPH; PhD with 28 years of experience in toxicology including 10 years' experience in water quality standards.
David Kallander, Ph.D. Toxicologist	Beach Grant Data Coordinator	17 + years with the Environmental Health Section, CT DPH; PhD with 28 years of experience in toxicology including 10 years' experience in water quality standards.
Jafar H. Razeq, Ph.D., HCLD/PHLD (ABB). Director of Public Health Laboratories	Director of Public Health Laboratories CT DPH Laboratory	PhD in Microbiology. Over 23 years' experience in Public Health Laboratory Sciences.
Anthony Muyombwe, Ph.D., HCLD(ABB) Infectious Diseases Division Director	Director of Infectious Diseases Division CT DPH Laboratory	PhD in Microbiology. Over 20 years' experience in Public Health Laboratory Sciences
Kimberly Holmes-Talbot Supervising Microbiologist	Environmental Microbiology CT DPH Laboratory	Over 20 years' experience with water quality testing. Over 7 years overseeing the Environmental Microbiology Laboratory.
Mary Becker, Environmental Analyst III	Data Management/ QA-QC officer CT DEEP WPLR	Over 10 years' experience with water quality river/stream sampling. Manages freshwater monitoring data for DEEP Programs.
Ansel Aarrestad Environmental Analyst II	Responsible for hiring and supervision of field crew CT DEEP WPLR	Over 8 years involved with surface water quality monitoring.

3.0 PROGRAM FUNCTIONS

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, DPH and DEEP have coordinated beach monitoring in the state. DEEP assumed the collection of samples at State coastal beaches, all of which are managed as part of DEEP parks systems. DPH, Local Health Departments/Districts, and DEEP 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 FUNCTIONS BY PROGRAM

DPH:

- provides laboratory services for all DEEP 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 sterilized sample containers to DEEP 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 DEEP beach monitoring;
- convenes the coastal beach monitoring meetings for public health officials in the spring;
- 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 March, 2016);
- 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;
- communicates with EPA regarding programmatic issues;
- develops, maintains and enhances custom software that permits the Agency to manage and use beach data sets;

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

Table 2. DPH Beach Grant Staff Activities

Connecticut Department of Public Health Beach Grant Activities	
Activity	Date
Support municipal beach monitoring by providing technical support and outreach to shoreline local health departments and others with questions about beaches	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	revised as necessary
Track Beach Grant budget and expenses	Ongoing and as required
Host the Spring shoreline meeting for public health officials	May
Provide technical support to local health departments and DEEP 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
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
Prepare and mail EPA Beach Surveys	October
Receive and data enter EPA Beach Surveys	November

Connecticut Department of Public Health Beach Grant Activities	
Activity	Date
Process, package and forward beach notification and monitoring data to EPA	December - January
Participate in EPA data conference calls	Monthly, as necessary
Produce the Beach Grant Annual Report for Connecticut	January - March

3.2 Local Health Functions

- collect water samples at municipal beach sites;
- perform sanitary survey prior to bathing season;
- in-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 etc.;
- work cooperatively with DEEP and DPH on contamination issues;
- complete the annual EPA Beach Survey;
- attend the coastal beach monitoring meetings for public health officials.

3.3 DEEP Functions

DEEP:

- performs monitoring at four coastal State beaches (and 18 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 DEEP beach “hotline” and up to date DEEP website information concerning the closure status of any State beach;
- provides technical support to local health officials;
- address corrective actions to eliminate pollution sources;
- serves as the lead state agency for State Park Beach Closure related press releases.

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

Table 3. DEEP Beach Grant Staff Activities

Task	Date
Scoping Meeting/Review of Beach Locations	Spring
Annual State/Local Beach Sanitation Meeting	Spring
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	Winter
Summary Report	Winter

3.4 State Beaches Monitored

Table 4 depicts the State Beaches currently monitored.

Table 4. State Owned/Managed Beaches

Beach Name	Beach ID Code	No. of Samples per Week
Wharton Brook	WBK	2
Silver Sands (1)	SSSP	4
Sherwood Island (1)	SISP	3
Indian Well	INWL	2
Chatfield Hollow	CHH	2
Day Pond	DYP	2
Rocky Neck (1)	RNSP	4
Hammonasset (1)	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
Gardner	GRD	2
Pattanonk Reservoir	PR	2

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

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 along with the number of sampling stations per beach and the beach's length. Each sample station is sampled at least once per week. (And more often during a week when an enterococci result exceeds the threshold.) The number of sample stations is a function of a beach's length. (See the attached document "Guidelines for Monitoring Swimming Waters and Closure Protocol", Inspection and Sampling.)

Table 5. Municipal and State Park Marine Beaches Tracked by DPH

TOWN	BEACH_NAME	# Sampling Stations	Beach Length (meters)
BRANFORD	BRANFORD POINT BEACH	1	137
BRANFORD	STONY CREEK BEACH	1	36
BRANFORD	CLARK AVENUE BEACH	1	68
BRIDGEPORT	SEABRIGHT BEACH	1	39
BRIDGEPORT	SEASIDE PARK BEACH	5	2900
BRIDGEPORT	PLEASURE BEACH-BRIDGEPORT	3	79
CLINTON	TOWN BEACH (CLINTON)	1	138
DARIEN	PEAR TREE POINT BEACH	3	322
DARIEN	WEED BEACH	2	150
EAST HAVEN	EAST HAVEN TOWN BEACH	2	258
EAST LYME	HOLE-IN-THE-WALL BEACH	1	181
EAST LYME	MCCOOK POINT BEACH	1	190
EAST LYME	ROCKY NECK STATE PARK BEACH	4	598
FAIRFIELD	PENFIELD BEACH	2	335
FAIRFIELD	JENNINGS BEACH	2	633
FAIRFIELD	SOUTH PINE CREEK BEACH	1	48
FAIRFIELD	SOUTHPORT BEACH	2	254
FAIRFIELD	SASCO BEACH	2	204
GREENWICH	GREAT CAPTAIN'S ISLAND BEACH	2	357
GREENWICH	ISLAND BEACH	2	291
GREENWICH	GREENWICH POINT BEACH	3	649
GREENWICH	BYRAM BEACH	3	169
GROTON	NOANK DOCK	1	11
GROTON	ESKER POINT BEACH	1	32
GROTON	EASTERN POINT BEACH	1	209
GUILFORD	JACOBS BEACH (TOWN BEACH)	2	139
MADISON	EAST WHARF BEACH	1	117
MADISON	WEST WHARF BEACH	1	155
MADISON	PENT ROAD BEACH	1	99
MADISON	SURF CLUB BEACH	2	330
MADISON	HAMMONASSET BEACH STATE PARK BEACH	5	3100
MILFORD	SILVER SANDS STATE PARK BEACH	4	279
MILFORD	WOODMONT BEACH	1	465
MILFORD	ANCHOR BEACH (MERWIN POINT) #2	1	175

TOWN	BEACH_NAME	# Sampling Stations	Beach Length (meters)
MILFORD	WALNUT BEACH	2	575
MILFORD	GULF BEACH	1	349
MILFORD	ANCHOR BEACH (MERWIN POINT) #1	1	78
NEW HAVEN	LIGHTHOUSE POINT BEACH	3	220
NEW HAVEN	FORT HALE PARK BEACH	2	112
NEW LONDON	OCEAN BEACH PARK	2	463
NEW LONDON	GREEN HARBOR BEACH	1	120
NORWALK	CALF PASTURE BEACH	3	323
NORWALK	HICKORY BLUFF BEACH	1	2
NORWALK	SHADY BEACH	4	341
NORWALK	MARVIN BEACH	1	7
NORWALK	ROWAYTON BEACH	1	33
NORWALK	BELL ISLAND BEACH	2	200
OLD LYME	WHITE SANDS BEACH	1	241
OLD LYME	SOUNDVIEW BEACH	1	331
OLD SAYBROOK	HARVEY'S BEACH	1	74
OLD SAYBROOK	TOWN BEACH (OLD SAYBROOK)	1	57
STAMFORD	EAST (COVE ISLAND) BEACH	3	289
STAMFORD	QUIGLEY BEACH	1	160
STAMFORD	CUMMINGS BEACH	3	413
STAMFORD	WEST BEACH	3	240
STONINGTON	DUBOIS BEACH	1	37
STRATFORD	SHORT BEACH	3	770
STRATFORD	LONG BEACH (MARNICK'S)	1	60
STRATFORD	LONG BEACH (PROPER)	2	499
WATERFORD	PLEASURE BEACH-WATERFORD	1	200
WATERFORD	WATERFORD TOWN BEACH	1	524
WEST HAVEN	SEAVIEW BEACH	1	175
WEST HAVEN	SOUTH STREET BEACH	1	73
WEST HAVEN	OAK STREET A BEACH	1	134
WEST HAVEN	DAWSON BEACH	1	182
WEST HAVEN	ALTSCHULER BEACH	1	140
WEST HAVEN	MORSE BEACH	1	110
WEST HAVEN	SEABLUFF BEACH	1	256
WEST HAVEN	OAK STREET B BEACH	1	141
WEST HAVEN	ROCK STREET BEACH	1	107
WESTBROOK	WESTBROOK TOWN BEACH/WEST BEACH	1	876
WESTPORT	COMPO BEACH	4	862
WESTPORT	SHERWOOD ISLAND STATE PARK BEACH	3	1911
WESTPORT	BURYING HILL BEACH	1	125

BEACH TIER

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.

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 criterion. DPH hosts a meeting in the spring 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*. DEEP and DPH staff provide technical support at this meeting.

3.7 Reporting

Both DPH and DEEP report marine monitoring data directly to EPA. The appropriate monitoring data (State Park beach data for DEEP, 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 five towns 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.

DPH and DEEP separately upload monitoring data and monitoring site location data to the EPA STORET database. At the end of the bathing season DPH reformats, municipal monitoring data to a local instance of an MS Access database (provided by EPA). These records are then reformatted as an XML file which is used to upload the municipal monitoring data to the EPA STORET server.

Notification data (beach closures, beach advisories, 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 DEEP in real time and provided to DPH. These data are validated, reformatted and loaded into an EPA provided Access database that produces an 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.

DPH prepares the annual EPA Beach Survey to collect notification data from shoreline local health departments and DEEP. 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.

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 DEEP 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 timeline 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 March 2016 (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

DQO Indicator	Measurement Performance Criteria	QC Sample or Activity	Action if DQO Exceeded
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

The precision of the sampling program is measured by the submission of duplicate samples. A field duplicate is collected at 2 different sampling locations during each sampling trip for collection of bathing waters from State beaches. Local health districts/departments are required to collect duplicate samples once a month during sampling season and are encouraged to submit duplicate samples for additional sampling trips over the course of the season. DPH supplies bottles for the collection of these duplicate samples. Duplicate samples are collected immediately after the initial sample is collected using the standard sample collection procedure. A relative percent difference (RPD) value of 100% is used as a precision threshold for field duplicates. 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, X₁ and X₂, the RPD is calculated as follows:

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

Accuracy is measured by the submission of field blanks and analytical method checks. A field blank is submitted for each courier trip. The courier fills a sample container with water and submits the field blank to the laboratory for analysis. The data quality objective (DQO) for blanks is zero MPN per 100 mL. 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.

Each day of analysis the laboratory tests one positive and one negative control and performs an analytical method check. 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.

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

Parameter	Criteria
Sample Collection Method	Grab
Sample Volume	100 mL
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 “Marine Bathing Water Submission Form” must be filled out and submitted along with the samples.

Bathing Water Submission Form

- A. Complete submitter information to include; name and address of submitting agency. Affix DPH label in space provided if available. Indicate sample type: regular or resample.
- B. Complete collection information to include; collected by; town collected; town identification number if available; date collected, the individual’s name to contact with significant results and contact telephone number.

- C. Complete sample information to include: time collected, collector's number, sample station ID number if available, which will identify coordinates for where the sample was collected, and the beach name. Note that the station number is entered next to the collector's number.
- D. 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.
- E. Data for all State Park Beach samples are logged into DEEP 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 unique identifier, date, and time of collection. Samples are placed in a cooler on ice for transport to the laboratory. A Bathing Water Submission Form is completed and accompanies the samples. This form should contain the submitter's information, 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).

Upon arrival in the Receiving Department of the DPH Laboratory, the sample containers and bathing water submission forms are organized, and sample submission forms are time stamped. Afterwards, upon arrival in the Environmental Microbiology Laboratory, the sample containers and bathing water submission forms are examined for accuracy and any missing information. The analysts process the samples per earliest collection times to avoid exceeding the 8-hour holding time. The analysis start time is recorded on the submission form and every effort is made not to exceed the holding time. If a sample is outside the 8-hour holding time, it is not analyzed, and the sampler is notified to recollect the sample. A unique laboratory identification number (accession number) is assigned to each sample. Each electronic sample record contains the time and date of collection, time and date of receipt and time the test was started.

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 Marine and Fresh Bathing Water Monitoring

Indicator Organism	Enterococcus (Marine Water)	E. coli (Fresh Water)
Method Reference	SM 9230D; Enterolert (1)	SM 9223B; Colilert-18
SOP Reference	Detection of Enterococci in Marine Bathing Water Revision 1.0	Detection of Escherichia Coli in Fresh Surface and Recreational Bathing Waters
Sample Volume	10 mL diluted to 100 mL	10 mL diluted to 100 mL
Incubation time/ temperature	24/28 hrs @ 41° ±0.5° C	18-22hrs@35°±0.5°C
Detection Limit (at 1:10 dilution)	10 MPN/100 mL	10 MPN/100 mL
Comments		

1. Federal Register March 26, 2007 using quanti-tray format, 40 CFR Part 136.3

Both procedures use a proprietary Defined Substrate Technology (DST) nutrient indicator to detect target organisms. The nutrient indicator fluoresces when metabolized by target organisms. 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 B.

6.3 Data Analysis and Assessment

After the analyses are completed (generally the day following sample collection), the DPH Laboratory notifies the appropriate local health staff of criteria exceedances by telephone. 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.

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

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.

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 mL</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^{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.
 $= 1/5 = 0.2$

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.

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. 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 March 2016, 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 DEEP. 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 March 2016. Decisions for Beach Closure for State Beaches are made jointly by DPH and DEEP. Beach closure decisions for municipal beaches are made by the local health department/district. DPH and DEEP are available to provide technical assistance to local health as needed.

- 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 swimming waters.
- 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.
- When a single sample result exceeds the standards for swimming water quality established by this guidance document, 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 swimming area should be closed by the local director of health.
- If sample results exceed the standards and a sanitary survey reveals no evidence of sewage contamination, the swimming area should be examined on an individual basis with consultation from DPH before any decision about closure is made. The swimming area may remain open.
- If the swimming area is impacted by a mass of floating debris, the director of health may close the area to swimming 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.
- The director of health may also want to consider beach closures established by evaluating rainfall data. This can be accomplished by conducting a season long study where swimming 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 swimming 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.

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 blood borne pathogen requirements. These are located at federal regulations 29 CFR 1910.1030 and can be found at 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.

7.4 Signage

A sign, flag or other form of acceptable notification indicating when the beach is closed should be posted in a conspicuous location such as the beach entrance.

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

Municipalities are responsible for notification and the means utilized (internet, phone, newspaper, etc.) are reported to DPH at the end of each season. DPH then includes this information in its Annual Report to EPA.

7.5.1 State Beach Closure

If it is necessary to close a State Beach, DEEP Project Manager or designee contacts DEEP Parks Division and DEEP 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 DEEP's web site and amending the State Beach "Hotline" (866-287-2757).

Updates are accomplished by DEEP Parks or Office of Communications personnel the same day significant sample results are received from the DPH laboratory. DEEP 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, 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 the 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, 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 (phone) or (860-509-7295 (fax), 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 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.

DPH shall be notified when any bathing beach has reopened and the rationale for reopening such beach.

8.0 QUALITY CONTROL

8.1 Analytical Quality Assurance/ Quality Control

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. 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 mL.

9.0 TRAINING AND OUTREACH

9.1 Annual Meeting

The DPH hosts an annual meeting that is attended by local health personnel involved with beach monitoring, the DPH and DEEP beach monitoring staff, EPA Beach Program administrators, and State Beach managers. The meeting is held in the spring and serves to kick-off the beach monitoring season. At this meeting DPH and DEEP 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

During the calendar year Beach Program staff conduct presentations to interested parties about the Connecticut Beach Grant Program and the distributed beach monitoring effort. In years past, DPH Recreation Program staff have presented to audiences at meetings of the Connecticut Environmental Health Association; EPA's National Beaches Conference; the Connecticut Recreation and Parks Association; and to students at Southern Connecticut State University.

9.1 Field Staff Training

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

Table 9. DEEP Field Staff Training

Project Function	Course or Description	Trained by	Training Date	Trainees	Title	Certs/Records
Safety	First Aid/CPR	CT Fire Academy	Every 2 years	All Field Staff	All Field Staff	CT DEEP Health & Safety Office
Safety	Sample Collection Safety	Bureau of Water Protection and Land Reuse (CT DEEP WPLR)	Every Spring	All Seasonal Field Staff	All Field Staff	CT DEEP WPLR
Safety	Defensive Driving	CT DEEP Health & Safety Office	Every Spring	All Field Staff	All Field Staff	CT DEEP Health & Safety Office
Safety	General Seasonal Safety	CT DEEP Health & Safety Office	Every Spring	All Field Staff	All Field Staff	CT DEEP Health & Safety Office
Sample Collection	Sampling SOP	CT DEEP WPLR	Every Spring	All Field Staff	All Field Staff	CT DEEP 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 DEEP WPLR	Ongoing	All Seasonal Field Staff	All Seasonal Field Staff	CT DEEP WPLR

Appendix A

Guidelines for Monitoring Bathing Waters and Closure Protocol,

Revised March 2016

State of Connecticut Guidelines for Monitoring Swimming Water and Closure Protocol



STATE OF CONNECTICUT
DEPARTMENT OF PUBLIC HEALTH
410 Capitol Avenue
Hartford, CT 06134-0308

Raul Pino, M.D., M.P.H.
Commissioner

STATE OF CONNECTICUT
DEPARTMENT OF ENERGY &
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Bureau of Water Protection and Land Reuse
79 Elm Street
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Robert J. Klee
Commissioner

March 2016

INTRODUCTION

This is the fourth major revision of the Guidelines for Monitoring Swimming Waters and Closure Protocol, formally known as the Guidelines for Monitoring Bathing Waters and Closure Protocol, first published in May 1989. 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 Workgroup¹, which was a working group of public health professionals convened by the CT DPH and DEEP in late 1988 in response to public concern 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 swimming water criteria values (1986 EPA bathing water criteria)
- Standardize swimming 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, DEEP 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 swimming beaches. The CT DPH and DEEP have applied for and received funds through the Act for FY 2002 through 2016.

¹Composed of: CT Dept. of Health, CT Dept. of Energy & 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
SWIMMING WATERS & CLOSURE PROTOCOL**

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GUIDELINES FOR MONITORING SWIMMING WATERS & CLOSURE PROTOCOL

WATERSHED SURVEY:

1. The DPH recommends that, prior to each swimming season, the local health department should conduct a sanitary survey of any watershed which drains to a public swimming area. If any source of contamination which may adversely affect the swimming 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 swimming 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 swimming area waters.
3. Large populations of waterfowl on a watershed can be a contributing factor to elevated bacterial levels in the swimming area. Therefore, this information should be noted on the watershed survey report.
4. Harmful Algal Blooms (HABs) may be a concern at beaches on lakes with a history of algal blooms because blue-green algae biomass can contain a mix of toxins, including skin irritants and potent liver toxins. DPH has guidance for local health departments that addresses how to manage a harmful algal bloom at a freshwater beach. This guidance is available on the DPH web site:
<http://www.ct.gov/dph/cwp/view.asp?a=3140&Q=535958&pp=12>.

INSPECTION AND SAMPLING:

1. The DPH recommends that, prior to each swimming season, the local health department should inspect each public swimming 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 Regulations of Connecticut State Agencies Sections 19a-36-B61 Public Swimming Areas for specific requirements (see Appendix 1).
2. All swimming water samples are to be collected under the auspices of the local director of health. **The recommended sampling frequency of both inland and tidal public swimming areas is weekly.** Samples shall be collected at fixed sampling stations to provide consistency of data. The recommended number of sampling stations per swimming 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 swimming 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 swimming

area, configurations which disrupt the contiguity of the beach, etc.). Operational conditions such as heavy patron usage in one portion of the swimming area may also influence the selection of sample stations.

3. Indicator bacteria sample collection procedure should be as follows:

Samples should be collected at approximately 3 to 4 feet water depth. The 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.

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 swimming 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 forms, titled "Marine Bathing Water Submission Form" or "Fresh Bathing Water Submission Form" (see Appendix 2):

MARINE/FRESH BATHING WATER SUBMISSION FORM

- A. Complete submitter information to include; name and address of submitting agency. Affix DPH label in space provided if available. Circle sample type: regular or resample.
- B. Complete collection information to include; collected by; town collected; date collected, the individual's name to contact with significant results and telephone number.
- C. Make sure you are using the correct form -**Marine** water or **Fresh** water.
- D. Complete sample information to include: time collected, collector's number, sample station ID number if available, which will identify exactly where the sample was collected, and the beach name.
- E. Additional Information: should include but not be limited to, amount of rainfall during the past 24 hours, number of patrons at time of sampling, bird activity near sample site, clarity or turbidity of the water, wind direction.

SANITARY WATER QUALITY (Effective May 20, 2002):

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

1. **Freshwater**

E. coli organism as determined by SM 9223B the Colilert-18 Method or any State of Connecticut or EPA approved method such as the membrane filter techniques: Modified EPA Method 1603 (Modified mTEC Medium) and EPA Method 1103.1 (mTEC medium). Bacterial standard to be used for interpretation of laboratory analyses of single or individual samples from freshwater swimming 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 swimming 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 swimming. A resample is required. A sanitary survey of the surrounding watershed and areas that may impact the swimming area should be conducted immediately to evaluate suitability of the area for swimming if no known sources of contamination have already been identified.
- C. To determine swimming 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 swimming 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 swimming area where seasonal or incidental variations may impact on single sample results.

2. **Marine Water**

Enterococcal organism as determined by SM 9230D the Enterolert Method or any State of Connecticut or EPA approved method such as the membrane filter techniques: EPA Method 1600 (mEI Medium) and EPA Method 1106.1 (mE Medium). Bacterial standard to be used for interpretation of laboratory analyses of single or individual samples from marine swimming waters are as follows for the enterococcal organism:

- A. The DPH is developing a schedule to identify and use a revised beach notification threshold. Until the new beach notification threshold is derived, the DPH will continue to support the existing single-sample threshold (104 enterococci per 100 mL of water).
- 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 swimming. A resample is required. A sanitary survey of the surrounding watershed and areas that may impact the swimming area should be conducted

immediately to evaluate suitability of the area for swimming if no known sources of contamination have already been identified.

- C. To determine swimming 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 swimming 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 swimming 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^{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:

Sampling Station #1	
<u>Sample Results</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.

SOLUTION STEPS FOR CALCULATING GEOMETRIC MEAN

Method 1: Take the n^{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.

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

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.

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

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 “2nd” 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 swimming area should be reviewed with DPH.

BEACH/SWIMMING AREA 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 swimming 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 swimming water quality established by this guidance document, 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 swimming 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 swimming area should be examined on an individual basis with consultation from DPH before any decision about closure is made. The swimming area may remain open.
5. If the swimming area is impacted by a mass of floating debris, the director of health may close the area to swimming 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 beach closures established by evaluating rainfall data. This can be accomplished by conducting a season long study where swimming 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 swimming 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 SWIMMING AREAS:

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

The following formula is used to determine the number of patrons 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 patrons, 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 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 blood borne pathogen requirements. These are located at federal regulations 29 CFR 1910.1030 and can be found at 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 swimming area is recommended.

Elevated lifeguard stands high enough to provide the lifeguard with a complete and unobstructed view of the swimming 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 the Regulations of Connecticut State Agencies Section 19a-113a-1. Communication devices should be provided to the lifeguards for emergency situations. 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.

2. Signage

A sign, flag or other form of acceptable notification 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 swimming 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 swimming 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/Swimming Area Closures

If the local director of health deems it necessary to close a beach and/or swimming area, the DPH should be advised of such closure. Please contact DPH at (860) 509-7296.

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 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/Swimming Area Reopening

Likewise, please advise the DPH when any beach and/or swimming area has been reopened at (860)509-7296.

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 Bypass or Effluent Limit Violations:

A. The local health director will be notified when a sewage treatment plant or a sewer collection transport system experiences a bypass or there is an effluent violation of the effluent at a sewage treatment plant. Once notified, the local health director in that town shall notify the health department 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 incident, number of gallons that have been discharged, impacted water body, steps taken to contain the discharge and an estimate of the duration of the problem (if available). The neighboring towns should also be informed when the problem has been resolved.

APPENDICES

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Appendix 1

Regulations of Connecticut State Agencies Section 19a-36-B61 Public Swimming Areas

Section 19a-36-B61. Public swimming areas:

- (a) **Definitions.** As used in this section:
- (1) "Public swimming area" means a designated location, together with any buildings, toilet facilities, the water and the land area used in connection therewith, at any natural or artificial pond, lake, stream, tidal water or other body of fresh or salt water that is advertised as a place for swimming and is accessible to the public. Public swimming area does not include: (A) swimming areas in connection with or appurtenant to single family dwellings and used solely by persons residing in such dwellings and such person's guests, including but not limited to those swimming areas accessible only as part of a lake association, beach association or condominium; (B) any state owned or operated swimming areas; and, (C) public swimming pools that are regulated under Section 19-13-B33b of the Regulations of Connecticut State Agencies.
 - (2) "Department" means the Connecticut Department of Public Health.
 - (3) "Director of Health" means the director of a local health department or district health department approved by the commissioner as specified in Connecticut General Statutes Sections 19a-200 and 19a-242.
 - (4) "Notification system" means a public information system used to notify the public regarding lifeguard status and the opening or closing of a public swimming area, including but not limited to, signs or flags.
- (b) **General requirements.** No city, town, borough, institution, person, firm, corporation or other entity shall designate or construct a public swimming area until the director of health for the municipality in which the public swimming area is located has approved the location of such public swimming area. A city, town, borough, institution, person, firm, corporation or other entity operating or maintaining a public swimming area shall comply with the following requirements:
- (1) Every public swimming area shall be provided with on-site toilet facilities unless the director of health determines that adequate toilet facilities are already provided elsewhere. Separate toilets for men and women shall be provided, with at least one toilet for every two hundred women and at least one toilet for every three hundred men, and at least one handwashing sink or hand sanitation station shall be provided with each required toilet. All toilets and restroom accommodations shall be constructed and located so that no contamination of the waters used by the swimmers will occur. Toilets shall be installed with the approval of the director of health so as not to create any health or safety issues. Toilets shall be kept in good

repair and maintained at all times in a sanitary condition. The location of all toilets shall be plainly indicated by signs.

- (2) The dressing rooms, hallways, toilet rooms, shower rooms or other rooms to which patrons have access shall be kept clean, well ventilated, and in good repair. The floors shall also be treated daily with a 0.5% chlorine solution, or other equivalent disinfectant.
- (3) The area open for authorized swimming shall be clearly designated.
- (4) Swimming in public swimming areas shall be restricted to designated areas and during assigned hours of operation.
- (5) Diving shall be permitted only off a diving board. No diving boards greater than sixteen feet in length shall be permitted. The owner of the property shall ensure that the diving area is in compliance with the required water depths at all times.
 - (A) For diving boards of a height of no greater than one meter above the water surface, the diving area shall meet the following requirements:
 - (i) Not have any submerged or overhead obstructions;
 - (ii) Have a minimum water depth at all times of eleven feet for at least sixteen feet linear beyond the plummet of the diving board; and,
 - (iii) Have a minimum water depth at all times of eleven feet for at least eight feet horizontal on each side of the plummet of the diving board.
 - (B) For diving boards of a height greater than one meter above the water surface, the diving area shall meet the following requirements:
 - (i) Not have any submerged or overhead obstructions;
 - (ii) Have a minimum water depth at all times of twelve feet for at least sixteen feet linear beyond the plummet of the diving board; and,
 - (iii) Have a minimum water depth at all times of twelve feet for at least eight feet horizontal on each side of the plummet of the diving board.
 - (C) When no diving board is present, a sign stating the following shall be conspicuously posted: "No diving is permitted".
- (6) Lifeguard services.
 - (A) When no lifeguard service is provided, one or more warning signs shall be posted in one or more visible locations. The warning sign shall state "Warning – No Lifeguard on Duty" with letters that are legible and at least four inches high.
 - (B) During the period when the swimming area is open for use, when lifeguard service is provided, the owner of the property shall provide the following:
 - (i) A notification system to alert patrons as to where and when lifeguard services are available;
 - (ii) Each lifeguard on duty shall be provided with appropriate lifesaving equipment that the lifeguard has been trained to use, including but not limited to, a rescue tube;
 - (iii) A telephone or equivalent emergency communication device for emergency use when the area is staffed by a lifeguard; and

- (iv) A raised stand at least four feet in height for the lifeguard, placed such that all areas of the public swimming area are visible from the stand to the one or more lifeguard on duty. The director of health may approve an appropriate alternative to the four foot high raised stand if said director of health determines that all points of the public swimming area can still be visible to the lifeguard on duty.
- (7) All public swimming areas shall have a sign posted in at least one visible location, with signage not less than a half-inch type in size, containing the following information:
 - (A) Hours of lifeguard coverage if applicable;
 - (B) Emergency phone information indicating whether a phone is available; and
 - (C) Location of the nearest first aid unit if one is provided on the premises.
- (8) Whenever a public swimming area is closed or reopened pursuant to the provisions of this section, the director of health shall:
 - (A) Closure: immediately have put in place a notification system, in one or more conspicuous location, including the immediate swimming area, notifying patrons of the sections of the public swimming area that are closed.
 - (B) Reopening: have removed all closure postings.
- (9) The following shall be prohibited in all public swimming areas: (A) boats, unless used for rescue purposes; (B) washing of persons and articles; (C) littering; and (D) glass containers.
- (10) Domestic animals shall be prohibited in the water and on the immediate shoreline associated with the water of a public swimming area when the public swimming area is open for use.
- (11) The director of health may:
 - (A) Inspect all public swimming areas to determine compliance with the provision of this section.
 - (B) Issue an order which may result in a closure of the public swimming area, in part or in whole, to the owner of the public swimming area, when the director of health determines:
 - (i) There is a violation of the provisions of this section; or
 - (ii) The public swimming area is not being maintained in acceptable sanitary conditions; or
 - (iii) A condition is found that constitutes a public health hazard, safety hazard or a health nuisance to the patrons; or
 - (iv) There is evidence of communicable disease being transmitted in order to end the transmission of the disease.

The public swimming area shall remain closed until such time as the director of health determines that the cause for closure has been corrected.

Appendix 2



MARINE BATHING WATER SUBMISSION FORM

Environmental Microbiology
 Connecticut Department of Public Health
 Katherine A. Kelley State Public Health Laboratory
 395 West St. Rocky Hill, CT 06067
 PH (860) 920-6699 FAX (860) 920-6703

For Lab Use Only: Called significant results: _____ (Initials)
Contact name: _____ Voice mail: Yes No (circle one)
Date/Time: _____

PROFILE NO./NAME AND ADDRESS: _____	COLLECTED BY: _____ TOWN: _____ DATE COLLECTED: _____ CONTACT INFORMATION: _____ PHONE # (_____) _____
Sample Type: REGULAR RESAMPLE (Circle One)	

MARINE BATHING WATER

Date/Time Received _____

Test A-Code: ENT-BW

Enterolert/Enterococci

For Lab Use Only: Accession # _____ Test: _____	Time Collected: _____ Collector's No. _____ Beach Name: _____ Additional Info: _____	For Lab Use Only: # POSITIVE WELLS _____ Enterococci MPN/100ml: _____
Accession # _____ Test: _____	Time Collected: _____ Collector's No. _____ Beach Name: _____ Additional Info: _____	# POSITIVE WELLS _____ Enterococci MPN/100ml: _____
Accession # _____ Test: _____	Time Collected: _____ Collector's No. _____ Beach Name: _____ Additional Info: _____	# POSITIVE WELLS _____ Enterococci MPN/100ml: _____
Accession # _____ Test: _____	Time Collected: _____ Collector's No. _____ Beach Name: _____ Additional Info: _____	# POSITIVE WELLS _____ Enterococci MPN/100ml: _____
Accession # _____ Test: _____	Time Collected: _____ Collector's No. _____ Beach Name: _____ Additional Info: _____	# POSITIVE WELLS _____ Enterococci MPN/100ml: _____

For Lab Use Only:

Results Recorded

Date/Time/Initials: _____

Date/Time/Initials Analyzed: _____

Method (Select test performed): ENTEROLERT

Rev. 12/8/2020



FRESH BATHING WATER SUBMISSION FORM

Environmental Microbiology
 Connecticut Department of Public Health
 Katherine A. Kelley State Public Health Laboratory
 395 West St. Rocky Hill, CT 06067
 PH (860) 920-6699 FAX (860) 920-6703

For Lab Use Only:
 Called significant results: _____
 (Initials)
 Contact name: _____
 Voice mail: Yes No (circle one)
 Date/Time: _____

PROFILE NO./NAME AND ADDRESS:		COLLECTED BY: _____
		TOWN: _____
		DATE COLLECTED: _____
		CONTACT INFORMATION: _____
Sample Type: (Circle One)	REGULAR RESAMPLE	PHONE # (_____) _____

FRESH BATHING WATER

Date/Time Received _____

Test A-Code: EC-BW

Colilert/*E. coli*

For Lab Use Only: Accession # Test:	Time Collected: _____ Collector's No. _____ Beach Name: _____ Additional Info: _____	For Lab Use Only: # POSITIVE WELLS _____ <i>E. coli</i> MPN/100ml: _____
Accession # Test:	Time Collected: _____ Collector's No. _____ Beach Name: _____ Additional Info: _____	# POSITIVE WELLS _____ <i>E. coli</i> MPN/100ml: _____
Accession # Test:	Time Collected: _____ Collector's No. _____ Beach Name: _____ Additional Info: _____	# POSITIVE WELLS _____ <i>E. coli</i> MPN/100ml: _____
Accession # Test:	Time Collected: _____ Collector's No. _____ Beach Name: _____ Additional Info: _____	# POSITIVE WELLS _____ <i>E. coli</i> MPN/100ml: _____
Accession # Test:	Time Collected: _____ Collector's No. _____ Beach Name: _____ Additional Info: _____	# POSITIVE WELLS _____ <i>E. coli</i> MPN/100ml: _____

For Lab Use Only: Results Recorded
 Date/Time/Initials Analyzed: _____ Date/Time/Initials: _____

Method (Select test performed): COLILERT-18 COLILERT-24 COLISURE

Rev. 12/8/2020

Appendix 3

DILUTION WATER PER PATRONS 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 swimming 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 patron to find the allowable user loading.

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

where: N = the number of patrons, 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.

$$N = (2,000/180 + 1,000)/1,000$$

$$N = (11.11 + 1,000)/1,000 \quad \text{Note: daily turnover is 11.11 gallons per day}$$

$$N = (1,011.11)/1,000$$

$$N = 1.011 \text{ patrons}$$

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

$$N = (180,000/180 + 1,000)/1,000$$

$$N = (1,000 + 1,000)/1,000 \quad \text{Note: daily turnover is 1,000 gallons per day}$$

$$N = (2,000)/1,000$$

$$N = 2 \text{ patrons}$$

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

$$N = (180,000/60 + 1,000)/1,000$$

$$N = (3,000 + 1,000)/1,000 \quad \text{Note: daily turnover is 3,000 gallons per day}$$

$$N = (4,000)/1,000$$

$$N = 4 \text{ patrons}$$

Appendix 4

General Guidelines for Response and Administrative Closures at State Swimming Areas Due to Swimmer Fecal and Vomit Accidents.

During the 2011 swimming season, lifeguard staff from the Connecticut Department of Energy and Environmental Protection (DEEP) asked how they should respond to a fecal accident at State beaches. This started the process moving to best answer a question that has not previously been officially addressed in our various beach protocols. This process included discussions among DEEP staff, Connecticut Department of Public Health (DPH) staff, literature searches and contacting the Center for Disease Control. We found no existing procedures that we could just adopt for Connecticut State beaches. We ended up having three reported incidents this past season that fall under these guidelines. While these are not an official policy level yet, they have been reviewed by officials at both DEEP and DPH, and are the procedures that we followed this swimming season. The guidelines address swimmer accidents for vomit, solid fecal matter, and diarrhea. The closure procedures vary based on the type of accident and the characteristics of the swimming beach.

In smaller, inland beaches, for both vomit and fecal matter (solid & diarrhea), the lifeguard should:

- get swimmers out of the water, avoiding the affected area
- remove solids from the water (only if lifeguard has the proper protection and equipment to do so), following their blood borne pathogen protocol
- close the swimming area for the rest of the day
- notify appropriate supervisor, so that staffs from DEEP Parks, DEEP Water and DPH are notified and can discuss re-opening steps and provide proper public notification, including notification to the local health authority

For Long Island Sound beaches and Indian Well State Park:

- get swimmers out of the water in a zone (100 feet or so each way), avoiding the affected area
- remove solids from the water (only if lifeguard has the proper protection and equipment to do so), following their blood borne pathogen protocol
- determine direction of water flow
- get swimmers out of the water and close area down from affected area for the rest of the day
- if remaining beach area is not large enough to handle all swimmers, or closed area is too large to manage, consider closing the whole beach
- notify appropriate supervisor, so that staffs from DEEP Parks, DEEP Water and DPH are notified and can discuss re-opening steps and provide proper public notification, including notification to the local health authority

Based on discussions and supported by limited data from the 2011 incidents, most swimming areas would open the following day. Special considerations should be given to very small inland beaches, if they were closed due to a diarrhea accident since they have very limited dilution. Under this scenario, we would not open the beach until it was re-tested and indicator bacteria results met the criteria. We believe that the administrative closure for the rest of the day, for both types of accidents, provides a conservative approach, and best protects human health. Clearly exposure of swimmers to fecal matter poses a more extensive risk from pathogens than does an exposure to reverse peristalsis, but the major infectious disease related to

exposure to reverse peristalsis, norovirus, is the most common cause of acute gastroenteritis. Also, the presence of norovirus is not detectable by our routine indicator bacteria sampling.

Appendix 5

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 swimming 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 patrons of the presence of the parasites and precautions for preventing the rash.

Appendix B

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

Document ID: EMS-W-0005-01	Title: Detection of Enterococci in Marine Bathing Water	Issuing Dept. Environmental Microbiology
Approved By: Dr. Muyombwe	Effective Date: May 21, 2019	Copy No. Page 1 of 16

STATE OF CONNECTICUT
Dr. Katherine A. Kelley State Public Health Laboratory
Connecticut Department of Public Health
Environmental Microbiology Section
395 West Street
Rocky Hill, CT 06067

Procedure:
Detection of Enterococci in Marine Bathing Water

Revision: 1.0
 Supersedes: EMS-W:0005:00

Uncontrolled Copy

REVIEWED BY: Kim Holmes-Talbot DATE: 05/21/2019

REVIEWED BY: [Signature] DATE: 05/21/2019

APPROVED BY: [Signature] DATE: 5/21/2019

Document ID: EMS-W-0005-01	Title: Detection of Enterococci in Marine Bathing Water	Issuing Dept. Environmental Microbiology
Approved By: Dr. Muyombwe	Effective Date: May 21, 2019	Copy No. Page 2 of 16

1.0 Principle

- 1.1 Coastal waters are susceptible to contamination with many types of microbial pathogens and can serve as a vehicle for the transmission of diseases to people by contact with or ingestion of water during recreational use. The greatest public health threat is present when these waters are contaminated with sewage. An essential responsibility of health officials to protect the public against waterborne diseases led to the establishment of recreational water quality standards. In 1972, Congress passed the Clean Water Act (Public Law 92-500) which established the formation of the U.S. Environmental Protection Agency (USEPA) and the formulation of national water quality standards for all states to follow. USEPA recommends that the marine recreational standard be set at a geometric mean of 35 enterococci per 100mL based on five or more samples collected within a 30 day period.
- 1.2 Connecticut has a distributed beach monitoring program along its coastal waters that operates under the *State of Connecticut Guidelines for Monitoring Swimming Water And Closure Protocol* and a *Quality Assurance Project Plan (QAPP)*. The guidelines provide public health officials in Connecticut with beach monitoring and closure protocols that are based on the USEPA guidelines. The Connecticut Department of Public Health and the Connecticut Department of Energy and Environmental Protection coordinate the beach monitoring in the state. The established bacterial indicator for marine bathing water in Connecticut is enterococci. Enterococci are common inhabitants of the intestinal flora of humans and animals and are useful indicators of microbiological water quality.
- 1.3 The Enterolert® Reagent is used for the detection of enterococci including *Enterococcus faecium* and *Enterococcus 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 β-glucosidase. When the reagent is added to the sample and incubated, it can detect *enterococcus* bacteria at 1 CFU/100mL within 24 hours. The IDEXX Quanti-Trays are designed to give quantitative bacterial counts of 100mL 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. After incubation, count the number of positive wells and use the MPN table to determine the Most Probable Number (MPN)/100mL of sample and calculate the result.
- 1.4 Samples should not exceed a criterion of 104 Most Probable Number (MPN) per 100mL for a single sample or a geometric mean of 35 per 100mL based on five or more samples collected within a 30 day period.

2.0 Safety

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- 2.1 All samples, cultures and inoculated products should be treated as infectious and handled appropriately using universal precautions.
- 2.2 No mouth pipetting, eating, drinking, smoking or chewing gum in the laboratory.
- 2.3 Safety Data Sheets (SDS) sheets are available in the laboratory and electronically.
- 2.4 Always wear a buttoned lab coat or gown when working in the laboratory. Lab coat or gown must remain in the laboratory area.
- 2.5 Safety equipment including biological and chemical safety cabinets are available for use in the laboratory.
- 2.6 Dispose of hazardous waste properly. Dispose of broken glass and sharps in a sharps container. Ensure chemicals are disposed of properly.
- 2.7 Report all accidental exposures to Supervising Microbiologist or designee.
- 2.8 Decontaminate laboratory work surfaces with freshly prepared chemical germicide when work activities are completed.
- 2.9 Wash hands with soap and water immediately if they become contaminated. Wash hands with soap and water after removing lab coat and before leaving the laboratory.
- 2.10 Refer to the *Connecticut Department of Public Health Laboratory Safety Manual* for additional safety information.

3.0 Equipment

- 3.1 Temperature Monitoring Device
 - 3.1.1 Use glass spirit thermometers graduated in 0.5°C or smaller increments. There should be no separation in the fluid column of glass thermometer.
 - 3.1.2 Calibrate thermometers annually at or near the temperature used, against a NIST certified thermometer. Document calibrations and tag thermometers with identification, corrections factor and date at a minimum. Refer to SOP QAS-0004: *Calibration Verification of Working Liquid-in-Glass Thermometers*.

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3.1.3 Place thermometers for incubators and refrigerator on top and bottom shelves of use area. Partially submersible thermometers must have the bulb and stem immersed in liquid to the mark on the stem. Fully submersible thermometers for water baths must be fully submerged when in use.

3.1.4 Check and record calibration corrected temperatures twice per day with readings separated by at least 4 hours. Document temperature checks on the appropriate forms and retain records for a minimum of five years.

3.2 Incubator

3.2.1 Maintain temperature at $41^{\circ} \pm 0.5^{\circ}\text{C}$.

3.3 Autoclave

3.3.1 The Support Services Division has responsibility for the autoclave operation. Infectious waste is turned over to the Support Services Division for proper disposal.

3.4 Quanti-Tray sealer and rubber insert from IDEXX Laboratories, Inc.

3.5 Long Wavelength Ultraviolet Light (365-366nm), 6 watts.

4.0 Materials, Reagents and Control Strains

4.1 Quanti-Tray 51 well from IDEXX Laboratories, Inc.

4.2 Butterfield's buffer dilution blanks 90mL

4.3 10mL Pipettes

4.4 Sterile distilled water

4.5 Sterile vessels from IDEXX Laboratories, Inc.

4.6 Sterile collection bottles

4.7 Commercially prepared substrate from IDEXX Laboratories, Inc.

4.7.1 Enterolert® Reagent

4.7.2 Store at 4° - 25°C away from light.

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- 4.8 Bromthymol blue or food coloring dye
- 4.9 Trypticase soy broth (TSB)
- 4.10 General microbiology laboratory supplies
- 4.11 Control organisms

4.11.1 *Enterococcus faecalis* ATCC # 51299

4.11.2 *Serratia marcescens* ATCC # 48362

4.11.3 *Aerococcus viridans* ATCC # 10400

5.0 Quality Control

- 5.1 Perform quality control on each new lot and shipment of Enterolert® reagent.
 - 5.1.1 Check each lot of Enterolert® for auto-fluorescence and color change on receipt.
 - 5.1.1.1 Add 100mL of sterile distilled water to a sterile vessel.
 - 5.1.1.2 Add Enterolert® reagent, invert to mix and wait until reagent is dissolved.
 - 5.1.1.3 If reagent exhibits a color change before incubation, reject as unacceptable.
 - 5.1.1.4 Check the reagent mixture by placing it under a long wavelength ultraviolet light (365-366nm), 6 watts. If reagent exhibits any fluorescence, the reagent lot is unacceptable; reject lot.
 - 5.1.1.5 Record results on form, *Enterolert® Reagent QC Form*, EMS-FORM-0026.
 - 5.1.1.6 If quality control does not perform as expected inform Supervising Microbiologist or designee.
 - 5.1.2 Test each new lot and shipment of Enterolert® reagent for sterility on receipt.
 - 5.1.2.1 Add 100mL of sterile distilled water to a sterile vessel.

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5.1.2.2 Add Enterolert® reagent, invert to mix.

5.1.2.3 Incubate at $41^{\circ} \pm 0.5^{\circ}\text{C}$ for 24 hours. Check for growth.

5.1.2.4 Check vessel for fluorescence by placing under a long wavelength ultraviolet light.

5.1.2.5 Record as acceptable if no growth and not acceptable if growth is present.

5.1.2.6 Reject the lot if contamination is indicated.

5.1.2.7 Record results on form, *Enterolert® Reagent QC Form*, EMS-FORM-0026.

5.1.2.8 If quality control does not perform as expected inform Supervising Microbiologist or designee.

5.1.3 Test each new lot and shipment of Enterolert® reagent when received for proper reactions. Use control organisms listed in 4.6.

5.1.3.1 Label one each Butterfield's dilution buffer 90mL and one each Quanti-Tray: "*Enterococcus faecalis*", "*Serratia marcescens*" and "*Aerococcus viridans*".

5.1.3.2 Add one Enterolert® reagent to each Butterfield's dilution buffer and mix thoroughly.

5.1.3.3 Aseptically inoculate the respective vessels with growth from slants of each organism.

5.1.3.4 After sample has been inoculated and Enterolert® has dissolved, pour into a 51 well Quanti-Tray, seal Quanti-Tray using Quanti-Tray sealer and incubate inoculated Quanti-Trays at $41^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$ for 24 hrs.

5.1.3.5 Read each Quanti-Tray by placing it under a long wavelength ultraviolet light (365-366nm), 6 watts. Refer to Table 1 for reaction interpretations.

5.1.3.6 Reject lot if results do not match reactions in Table 1.

5.1.3.7 Record results on form, *Enterolert® Reagent QC Form*, EMS-FORM-0026.

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5.1.3.8 If quality control does not perform as expected inform Supervising Microbiologist or designee.

Table 1 Enterolert® Quality Control Reaction Interpretations

Organism	Test	Appearance	Result
<i>Enterococcus faecium</i>	Enterolert®	Fluorescence	Positive for enterococcus
<i>Serratia marcescens</i>	Enterolert®	No Fluorescence	Negative for enterococcus
<i>Aerococcus viridans</i>	Enterolert®	No Fluorescence	Negative for enterococcus

5.2 Perform quality control on each new lot and shipment of 90mL Butterfield's dilution buffer.

5.2.1 Visually inspect each case of dilution blanks for damage. Discard and do not use containers that are broken, damaged or leaking. Measure and record the volume of one blank per case using a Class A graduated cylinder. Volumes must be 90mL ± 2mL. If any blanks are out of tolerance notify the Supervising Microbiologist or designee. Record visual inspection as acceptable or not acceptable and the measured volume on form, *Butterfield's Buffer 90mL QC and pH*, EMS-FORM-0034.

5.2.2 Check the pH of one dilution blank per case. The pH must be 7.2±0.2. If any blanks are out of tolerance notify Supervising Microbiologist or designee. Record pH measurement on form, *Butterfield's Buffer 90mL QC and pH*, EMS-FORM-0034.

5.2.3 Check the sterility of one blank per lot and shipment using double strength TSB broth. Prepare a 1:1 dilution by aseptically combining 50mL of dilution buffer with 50mL of double strength TSB broth. Incubate at 35°C for 24hours. Check for growth. Record results as acceptable or not acceptable on form, *Butterfield's Buffer 90mL QC and pH*, EMS-FORM-0034. If quality control does not perform as expected inform Supervising Microbiologist or designee.

5.2.4 Check the growth performance by testing one blank per lot and shipment. Prepare a 1:1 dilution by aseptically combining 50mL of dilution buffer with 50mL of double strength TSB broth. Inoculate the vessel with *Escherichia coli* ATCC#25922. Incubate at 35°C for 24hours. Check for growth. Record results as acceptable or not acceptable on form, *Butterfield's Buffer 90mL QC and pH*,

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EMS-FORM-0034. If quality control does not perform as expected inform Supervising Microbiologist or designee.

5.2.5 If quality control does not perform as expected inform Supervising Microbiologist or designee. Discard and do not use any lot that does not pass all of the above QC tests.

5.3 Perform quality control on each lot of Quanti-trays.

5.3.1 Check one Quanti-tray per lot and shipment for sterility. Add 100mL of sterile TSB or other non-selective media to tray, seal tray, and incubate at $35^{\circ} \pm 0.5^{\circ}\text{C}$ for 24 to 48 hours. There should be no growth or turbidity. Record results as acceptable or not acceptable on form EMS-FORM-0205.

5.3.2 Check one Quanti-tray per lot and shipment for auto-fluorescence.

5.3.3 Quality control is performed on Quanti-Trays when processing the daily method controls. Refer to SOP *Chromogenic Substrate Presence Absence/Quantification Daily Method Quality Control Assay for Potable and Non-Potable Waters*, EMS-QA-0003.

5.4 Perform monthly quality control on Quanti-Tray sealers, when in use, to check for sample leakage.

5.4.1 Add 0.1g of bromthymol blue to 100mL of deionized water or 50 μl food coloring dye to 100ml deionized water.

5.4.2 Pour solution into a Quanti-Tray and seal using Quanti-Tray sealer.

5.4.3 Check Quanti-Tray for the presence of dye outside of the sealed tray.

5.4.4 If dye is observed outside of the Quanti-Tray discontinue using the sealer and notify Supervising Microbiologist or designee.

5.4.5 Record results for each sealer as acceptable, not acceptable, or not in use on form, *Quanti-Tray Sealer QA Check*, EMS-FORM-0032.

5.4.6 If quality control does not perform as expected inform Supervising Microbiologist or designee.

5.5 Test each new lot and shipment of sterile culture vessels and sterile collection bottles for sterility when put into use.

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5.5.1 Remove one vessel per case and add 50 mL of trypticase soy broth to each bottle.

5.5.2 Incubate the bottles at $35^{\circ} \pm 0.5^{\circ}\text{C}$ for 48 hours. After 48 hours incubation, observe for the presence of bacterial growth or turbidity in the broth.

5.5.3 Record result as acceptable, if no growth, and not acceptable, if growth is present. Use form, *Colilert®/Colisure® Sterile Vessel QC*, EMS-FORM-0025 for sterile culture vessels and form EMS-FORM-0201 for sterile sample bottles.

5.5.4 If quality control does not perform as expected inform Supervising Microbiologist or designee.

5.6 Check each case of sterile culture vessels for auto-fluorescence

5.6.1 Expose a vessel from each case to a long wavelength ultraviolet light (365-366nm), 6 watts. Reject sample bottles that auto-fluoresce.

5.6.2 Record results on form, *Colilert®/Colisure® Sterile Vessel QC*, EMS-FORM-0025.

5.6.3 If quality control does not perform as expected inform Supervising Microbiologist or designee.

5.7 Check the 100mL fill line accuracy on each case of sterile culture vessels

5.7.1 Add water to the vessel fill line, then pour off into a Class A graduated cylinder. Acceptable volume is 97.5-102.5 mL ($\pm 2.5\%$).

5.7.2 Record result as acceptable or not acceptable on form, *Colilert®/Colisure® Sterile Vessel QC*, EMS-FORM-0025.

5.7.3 If quality control does not perform as expected inform Supervising Microbiologist or designee.

5.8 Perform quality control on each new lot of 10mL pipets

5.8.1 Perform and document delivery volume accuracy for each new lot and shipment of 10mL serological pipets used for water testing.

5.8.2 Check the accuracy at 10mL and 1mL and record 10 data points for each volume.

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5.8.3 Using distilled/deionized water dispense the desired volume into a clean vessel on a tared balance. Use a balance readable to 10^{-3} g. Record each data point on form, *10mL Pipet Volume Check*, EMS-FORM-0086. Tare the balance between measurements.

5.8.4 Calculate the average and record on the form. An acceptable result is a delivery volume average within a 2.5% tolerance ($10 \text{ mL} = 10\text{g} \pm 0.25\text{g}$ and $1 \text{ mL} = 1\text{g} \pm 0.025\text{g}$).

5.8.5 Record result as acceptable (A) or not acceptable (NA) on the form.

5.8.6 If quality control does not perform as expected inform Supervising Microbiologist or designee.

5.9 Replace long wavelength ultraviolet light (365-366nm), 6 watts yearly. Document change on form EMS-FORM-0204.

5.10 Discard reagents if any change is noted in appearance or hydration regardless of manufacturer's expiration date.

5.11 Verify all reagents and materials are not expired prior to use. Do not use reagents or materials beyond the expiration date.

5.12 If quality control does not perform as expected inform Supervising Microbiologist or designee.

5.13 Perform daily methodology quality control check when samples are tested using Enterolert®. Refer to SOP *Chromogenic Substrate Presence-Absence/Quantification Daily Method Quality Control Assay for Potable and Non-Potable Waters*, EMS-QA-0003.

6.0 Sample Receipt

6.1 Sampling, transport, and holding time procedures are found in *the U.S Environmental Protection Agency U.S. Federal Register and the Quality Assurance Project Plan for the Beach Monitoring and Notification Program for Connecticut Coastal Beaches*, August 2011

6.2 Samples must be analyzed within 8 hours of collection. If testing cannot be completed within this time frame, the sample is not tested and is reported as "Unsatisfactory for Examination".

6.3 There must be an air space of approximately one inch from the top of the collection bottle to the water level for proper mixing of samples during processing. If

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insufficient air space is observed code “W104” must be documented on the submission sheet. Code “W104” must be entered into the Laboratory Information Management System (LIMS), HORIZON, with the final results. Refer to Standard Operating Procedure (SOP), *Data Entering and Reporting Fresh and Marine Bathing and Surface Water Samples* EMS-W-0013. Code “W104” states “bacteriological results may be unreliable. Insufficient air space was left in the sample container. A one inch air space is needed for proper mixing”.

- 6.4 Guidelines for rejecting samples are found in the “Quality Assurance Manual” Connecticut Department of Public Health, Division of Laboratory Services. Samples must be submitted in appropriate collection containers to proceed with testing.
- 6.5 Upon arrival in the receiving room of the laboratory the sample containers and bathing water submission forms are organized and sample submission forms are time stamped.
- 6.6 Upon arrival in the Environmental Microbiology Laboratory the sample containers and bathing water submission forms are examined for accuracy and any missing information. The analysts process the samples per earliest collection times to avoid exceeding the 8-hour holding time.
- 6.7 An accession number is assigned to each sample. Refer to Standard Operating Procedure (SOP), *Data Entering and Reporting Bathing Water Samples*, EMS-W-0013 for data entry and reporting of bathing water samples.

7.0 Quanti-Tray Enumeration Procedure

- 7.1 Label 90mL Butterfield’s dilution buffer with the sample identifier.
- 7.2 Label 51 well Quanti-Tray with sample identifier, date, and “ENT” for Enterolert® test.
- 7.3 Aseptically open a pack of Enterolert® reagent by snapping back the top at the scored line and add the Enterolert® reagent to the labeled 90mL Butterfield’s dilution blank.
- 7.4 Shake the bathing water sample bottle 25 times in a one foot arc in 7 seconds.
 - 7.4.1 Check to ensure each sample has a one-inch air space. See section 6.3 of this procedure.
- 7.5 Aseptically pipet 10mL of the sample to the labeled 90mL Butterfield’s dilution buffer containing the Enterolert® reagent.

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- 7.5.1 The 10mL aliquot must be removed from the sample bottle within three (3) minutes of shaking.
- 7.6 Aseptically cap the dilution blank and invert to mix.
- 7.7 Once the reagent is dissolved, aseptically pour the sample directly into the labeled 51-well Quanti-Tray avoiding contact with the foil tab.
- 7.7.1 Use one hand to hold a Quanti-Tray upright with the well side facing the palm.
- 7.7.2 Squeeze the upper part of the Quanti-Tray so that it bends towards the palm.
- 7.7.3 Gently pull foil tab to separate the foil from the tray. Avoid touching the inside of the foil or tray.
- 7.7.4 Pour the reagent/sample mixture directly into the Quanti-Tray. Allow foam to settle. For the Quanti-Tray/2000 top the small wells 2-3 times to release any air bubbles.
- 7.8 Place the Quanti-Tray into a rubber insert; align the holes of the rubber insert to the Quanti-Tray wells.
- 7.9 Seal the Quanti-Tray in preheated Quanti-Tray sealer by introducing the rubber insert containing the tray into the Quanti-Tray sealer. Push gently on the insert until the rubber is grabbed and is drawn into the sealer.
- 7.10 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. Sealed trays should be removed promptly from the sealer.
- 7.11 Record the time the Quanti-Trays enter the incubator on the back of the first tray of each stack of trays placed in the incubator.
- 7.11.1 Quanti-Trays can be stacked no more than ten (10) trays high in the incubator.
- 7.12 Record in the appropriate fields on the sample submission form the date and time sample incubation was initiated, the method used (ENT) and the technician's initials.
- 7.13 Incubate the Quanti-Trays at $41^{\circ}\pm 0.5^{\circ}\text{C}$ for 24-28 hours.

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7.13.1 Enterolert® results are definitive at 24-28 hours.

7.13.2 Positives for enterococci observed before 24 hours and negatives observed after 28 hours are valid.

7.14 Read the results by placing the Quanti-Tray under a long wavelength ultraviolet light (365-366nm), 6 watts. Blue fluorescence indicates the presence of enterococci.

7.15 Count the number of fluorescent Quanti-Tray wells and record on the sample submission form.

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

7.17 Record MPN on the sample submission form. Record date and time read and technician's initials.

7.18 Result MPNs over 104/100mL exceed acceptable criterion.

7.18.1 Add the code W100 next to the criteria exceedances and use a highlighter to highlight W100 and the MPN.

7.18.2 Call the submitter with criteria exceedances. Caller must record on the submission form the date, the time, their initials, and the name of the person contacted or if a voicemail was left.

8.0 REPORTING

8.1 Report results into the laboratory information management system, HORIZON.

8.2 Refer to SOP *Data Entering and Reporting Bathing Water Samples*, EMS-W-0013 for data entry and resulting of bathing water samples.

8.3 Report results as MPN/100mL.

8.4 Ensure results are verbally reported for samples with MPNs over the acceptable of 104/100mL.

9.0 REFERENCES

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- 9.2 Standard Methods for the Examination of Water and Wastewater, 22nd edition online subscription.
- 9.3 IDEXX Laboratories Inc., Enterolert® product insert.
- 9.4 IDEXX Laboratories Inc., Quanti-Tray System:
<https://www.idexx.com/water/products/quant-tray.html>
- 9.5 Connecticut Department of Public Health, Division of Laboratory Services Quality Assurance Manual, current version.
- 9.6 Connecticut Department of Public Health *Laboratory Safety Manual*, most current version
- 9.7 *Quality Assurance Project Plan for the Beach Monitoring and Notification Program for Connecticut Coastal Beaches*, August 2011.
- 9.8 Budnick, Gary; Howard, Robert; Marco, Donald. *Comparison of Colilert-18 to the mTEC Agar Method for the Enumeration of Escherichia coli in Recreational Waters*. American Society of Microbiologists Annual Convention. May 2001.
- 9.9 *State of Connecticut Guidelines for Monitoring Swimming Water and Closure Protocol*, March 2015.
- 9.10 U.S. Environmental Protection Agency (USEPA), U.S. Federal Register 40 CFR Part 136

10.0 History

- 10.1 Initial edition, February 2017
- 10.2 Revision one, May 9, 2019
 - 10.2.1 In 5.2.1, changed the volume inspection to measuring one per case instead of every twenty-fifth blank for filling accuracy. Added a general physical inspection of each case and contents and, disposal of damaged or leaking containers.
 - 10.2.2 In 5.3 added Quanti-Tray quality control information.

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10.2.3 In 6.3 added sample air space information.

10.2.4 In 7.4.1 added sample air space information.

10.2.5 In 7.7 expanded instructions on how to fill Quanti-Tray.

10.2.6 Clarified and updated language throughout procedure.

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Appendix A

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
8	8.7	4.5	17
9	9.9	5.3	18.3
10	11.1	6.1	20
11	12.4	7.0	22
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	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	68.8
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	108.1	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

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