

MassDEP

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| **Massachusetts Department of Environmental Protection**  **Division of Watershed Management**  **Watershed Planning Program** |

STANDARD OPERATING PROCEDURE

**Site Evaluation Guidelines for the Massachusetts Probabilistic Monitoring and Assessment Program (MAP2), Coastal Waters**

CN 527.0

April 2020

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LIST OF REVISIONS

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**NOTICE**

The Massachusetts Probabilistic Monitoring & Assessment Program (MAP2) is a component of the Massachusetts Department of Environmental Protection (MassDEP) water monitoring strategy and was initialized in 2011 to assist in fulfilling the requirements of the Clean Water Act (CWA) Section 305(b). The goal of MAP2 is to provide a comprehensive assessment of the condition of “waters” in Massachusetts through the implementation of probabilistic sampling designs. The focus of MAP2 was wadeable rivers and streams from 2010 to 2015 and lakes from 2016 to 2018. With completion of the wadeable rivers and streams and lakes probabilistic surveys, MAP2 will focus on coastal waters from 2020 to 2023.

The Massachusetts Bays National Estuary Partnership (MassBays) is dedicated to protecting, restoring, and enhancing the estuarine ecosystems of Ipswich Bay, Massachusetts Bay and Cape Cod Bay. As part of its mission, and as mandated by Section 320 of the CWA, MassBays monitors the status and trends of water quality conditions in estuarine waters of those Bays. Considering the shared needs and responsibilities between the two programs, MassDEP and MassBays formed a partnership to conduct a probabilistic Massachusetts Coastal Condition Assessment (MCCA) that meets the needs and responsibilities of both programs.

This document contains an overview of the process involved in evaluating the candidate coastal water sites and selecting appropriate alternate sites when necessary. **It is adapted from the guidelines developed and followed in the 2015 National Coastal Condition Assessment conducted by USEPA (USEPA, 2014).** Methods described in this document are to be used specifically in work relating to probabilistic coastal waters.

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# Abbreviations

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| **Abbreviation** | **Definition** |
| CWA | Clean Water Act |
| GRTS | Generalized Random Tessellation Stratified survey design was used to select the X-sites. |
| MassDEP | Massachusetts Department of Environmental Protection |
| MassBays | Massachusetts Bays National Estuary Program |
| MCCA | Massachusetts Coastal Condition Assessment |
| ppt | Parts per thousand |
| Y-site | Location, identified by GPS coordinated, sampled |
| X-site | Location, identified by GPS coordinates, for a site selected for field sampling. |

# Roles and Contact Information

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| --- | --- | --- |
| **Contact Information** | | |
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# 1 Introduction

The objective of the Massachusetts Coastal Condition Assessment (MCCA) is to monitor and assess all coastal waters of the Commonwealth of Massachusetts. The primary objectives of the MCCA include:

* Determine the percent of coastal waters that are supporting aquatic life use.
* Determine the key stressors impairing aquatic life use in coastal waters.

Here are the major steps in site evaluations:

* Review the Target Population Definition **(Section 2)** and Survey Design **(Section 3)**.
* Interpret the Site Evaluation Spreadsheet **(Section 4)**.
* Conduct a Desktop Evaluation to locate and verify that the X-site is Part of the Target Population and whether it is sampleable **(Section 5)**.
* Seek permission to sample, if necessary **(Section 6)**.
* Conduct Final Site Verification at the Location **(Section 7)**.
* Complete Site Evaluation/Verification Forms **(Section 8)**.

As described in Section 4, a spreadsheet was developed to use in evaluating the sites and planning its sampling activities. The spreadsheet includes location information for each site and asks the evaluator to record whether the site meets the target definition in Section 2; its sampleability (Section 5); and whether landowner permission is necessary (Section 6). The site evaluation spreadsheet must be completed, and it must be submitted prior to field season and every few weeks thereafter as updates are made.

As described in Section 8, field crews must assemble an official site packet containing important locational and access information for each site they are scheduled to visit. The packet must contain the appropriate maps, contact information, copies of permission letters (if applicable), and access instructions.

# 2 Defining Target Population

This section describes the target population for the MCCA. Each statistically selected point is referred to as the “X-site” and defines where sampling activities are targeted. Before collecting water, sediment, and other samples at any site, it is imperative that the field crew correctly assess whether the site is part of the target population.

The target population for this MCCA is a combination of all coastal waters within:

1. Massachusetts Department of Environmental Protection (MassDEP) estuarine assessment units
2. Massachusetts Bays National Estuary Program (MassBays) estuarine assessment units
3. A near-shore seaward boundary defined by a maximum distance from Massachusetts shoreline of 3 miles and a maximum depth of 10 meters

Excluded from the target population are any tidal rivers or streams that are only represented in GIS by polylines versus polygons (i.e. small tidal streams and ditches), any areas classified as intertidal estuarine or marine wetland in the National Wetland Inventory (NWI) and any areas upstream of the head-of-salt, defined as 0.5 parts per thousand (ppt). The term “coastal waters” in the remainder of this document refers to all waters within the target population.

# 3 Survey Design - Site Strata and Panels

MassDEP classified the target population into multiple strata prior to statistically selecting the sites using a Generalized Random Tessellation Stratified (GRTS) survey design for an area resource. The target population was stratified into three geographic regions within Massachusetts to improve sampling logistics (Figure 1). One region will be targeted and sampled each year from 2021 to 2023, starting with the Region A in 2021 and concluding with Region C in 2023 (Table 1). **A pilot project will be conducted in 2020 in multiple strata using a small subset of the selected primary sites to test sampling methodology.**

**Table 3.1.** MCCA target population strata descriptions

|  |  |  |
| --- | --- | --- |
| **Stratum** | **Sample Year** | **Major Basin Description** |
| Region A | 2021 | Merrimack, Parker, Ipswich, North Coastal, Boston Harbor |
| Region B | 2022 | South Coastal, North Cape Cod (Cape Cod Bay) |
| Region C | 2023 | South Cape Cod (Nantucket Sound), Islands, Buzzards Bay, Narragansett Bay, Mount Hope Bay |

Within each stratum, there are two site panels: primary and oversample sites. Primary sites are evaluated first and replaced as necessary from the list oversample sites. Oversample sites used as replacements for rejected primary sites must come from the list of oversample sites in the same strata as the primary site and used in order the sites appear on the list. Replacement procedures are described in more detail in **Section 5**.

Additional details on the MCCA survey design are available in Appendix I.

**Figure 3.1.** MCCA target population strata



# 4 Interpreting Site Evaluation Spreadsheet

Because of its importance in evaluating the target population and documenting information about each site, this section describes the spreadsheet that is proved by MassDEP as part of the site evaluation SOP. The spreadsheet provides the primary sites and oversample sites for any necessary replacements following the rules in the next sections.

The Site Evaluation Spreadsheet has two main parts:

* LOCATION and DESIGN INFORMATION section has column headings that are highlighted in gray. This part of the spreadsheet provides information about the site. This part of the spreadsheet is locked and cannot be edited. See Figure 4.1.
* DESKTOP and ON-SITE EVALUATIONS section has column headings that are highlighted in green. These columns are used by the site evaluator to record findings from the desktop evaluation, and if necessary, the on-site evaluation. See Figure 4.2.

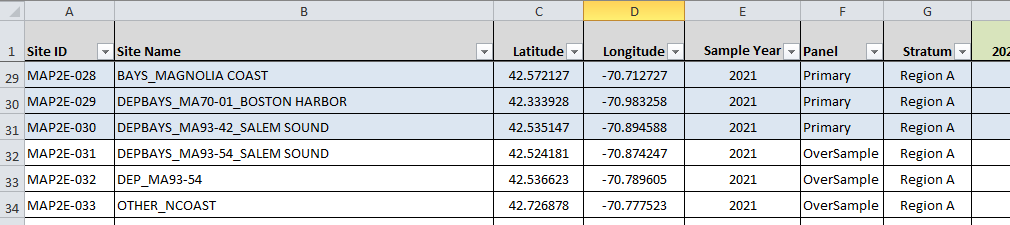
The following two sections describe each part of the spreadsheet.

## 4.1 Interpreting Location and Design Information

**Figure 4.1** displays the left-hand side of the spreadsheet which provides the location and survey design information for each site. The blue highlighted rows identify the primary sites in each the stratum. Immediately below the blue rows in each stratum are white rows identifying replacements, or oversamples, for that stratum. The three strata (Region A, Region B and Region C) are separated by bold border lines. **Figure 4.1** provides an example which shows only 3 rows for base sites and 3 rows for the oversample sites.

As discussed in **Section 5**, within each stratum, the only appropriate replacements for primary sites are the oversample sites identified in the white rows for that stratum.

**Figure 4.1** Site evaluation spreadsheet: location and design information



The left-hand side of the spreadsheet, as shown in Figure 4.1, provides the following information about each site:

1. **Site ID:** Identification code for the site to track sites and samples
2. **Site Name:** Identifies the source and name of the target population area where site was selected (*Source\_Name*). DEPBAYS, DEP, BAYS: Site was selected in an area that is either a MassDEP assessment unit, MassBays assessment unit or both. OTHER: Site was selected in an area that is neither a MassDEP assessment unit nor a MassBays assessment unit.
3. **Longitude:** Longitude of the X-site in Decimal degrees (NAD 1983)
4. **Latitude:** Latitude of the X-site in Decimal degrees (NAD 1983)
5. **Sample Year:** Identifies the year the site is planned to be sampled.
6. **Panel:** Identifies if the site is in the primary or oversample panel.
7. **Stratum:** Identifies which strata the site is located.

## 4.2 Recording Desktop and On-site Evaluations

**Figure 4.2** displays the right-hand side of the spreadsheet which provides space for evaluators or field crews to complete the desktop and on-site evaluations described in **Section 5**. The following information is collected in the right-hand side of the spreadsheet:

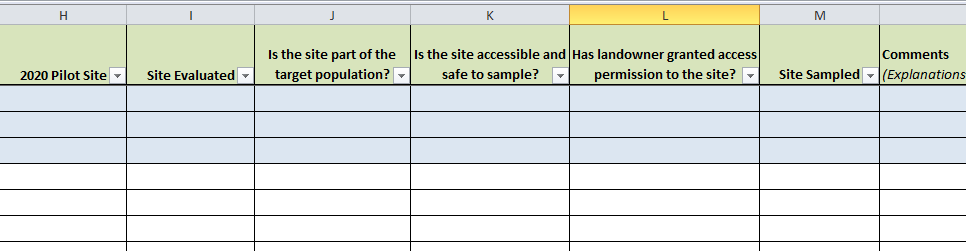
1. **2020 Pilot Site:** Indicate (Yes/No) if the site was sampled in 2020 as part of the pilot project.
2. **Site Evaluated:** Indicate (Yes/No) if the site was evaluated. Oversample sites not needed as a replacement site would be No.
3. **Desktop and On-Site Evaluations:** Use the choices in the dropdown menus to respond to each of the questions in the site evaluation spreadsheet (columns J, K and L). **Figure 4.3** lists the questions and choices in the drop-down menus in the site evaluation spreadsheet. For survey weight calculations, it is important that all three questions have answers for all evaluated sites.

As crews work through the site evaluation process described in **Section 5.1**, any site which receives the following answers:

* + **Yes** responses for all three questions: Must be sampled.
  + **No** for any question, the site would not be sampled (see example categories in **Figure 4.4**
  + **Maybe** for any question: Must have an on-site evaluation or subsequent planned sampling visit.

1. **Comments:** Use the space to provide any information that might be useful for MassDEP and MassBays review such as reasons for dropping a site; comments about target determination; and/or other additional information related to the three questions.

**Figure 4.2** Site evaluation spreadsheet: fields to be completed by evaluator or field crew



**Figure 4.3** Site Evaluation Spreadsheet: Questions and Dropdown Answers

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| --- |
| ***Question 1: Is the site part of the target population?***   1. Yes, Target 2. No, Dry 3. No, Permanent mudflat 4. No, Wetland *(intertidal marine and estuarine)* 5. No, Salinity < 0.5 ppt 6. No, Map Error *(X-site is clearly not target, for example: parking lot)* 7. No, Other *(explain in comments)* 8. Maybe, On-site evaluation required 9. Maybe, tide too low *(return at appropriate time in tidal cycle)* 10. Maybe, mudflat at certain times *(return at appropriate time in tidal cycle)* 11. Maybe, unable to access site *(note in comments if the site appears to be clearly target or probably target)*   ***Question 2: Is the site accessible and safe to sample?***  ***Note that responses to the second question references whether the site would be sampleable if landowner permission is granted.***   1. Yes, Accessible, and safe 2. No, Equipment related inaccessibility *(e.g. draft of boat prevented access)*. 3. No, Permanently inaccessible *(unable/unsafe to reach site)* 4. No, Extreme access effort *(MassDEP and/or MassBays concurred that site should be dropped.)* 5. Maybe, Temporarily inaccessible *(try again later)*   ***Question 3: Has landowner granted access permission to the site?***   1. Yes, Permission granted 2. No, Permission denied 3. N/A, public access available |

**Figure 4.4** Examples of Sampleable and Non-sampleable Categories

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| After you confirm the location of the X-site, evaluate area surrounding the X-site and classify the site into one of four major sampling status categories: Sampleable, Non-Sampleable (temporary), No Access to site, or Non-Target (not sampled).  **Sampleable Categories (Review the target population definition for more specific information)**   * *Coastal Waters*–There is water and the site is within a marine or estuarine environment (or these conditions exist within 0.02 nm or 37m from the X-site as described in Step 6 in Section 5.1).   Note: *a site can still be identified as sampleable even if not all indicators can be collected. For example, kelp beds may hinder a crew’s ability to collect sediment however other indicators can still be collected. In this instance, the site would be sampleable*. Refer to the Field Operations for more information on moving to collect sediment samples.  **Non-Sampleable Temporary Category (site can be revisited)**   * *Non-Sampleable (Temporary)* - The site could not be sampled on that day but is still a target site. Examples might include a recent precipitation event that has caused unrepresentative conditions. The site should be revisited.   **No Access to Site Categories**   * *Access Permission Denied* - You are denied access to the site by the landowners. * *Permanently Inaccessible* - Site is unlikely to be sampled by anyone due to physical barriers that prevent access to the site (e.g., major shipping lane). * *Temporarily Inaccessible* - Site cannot be reached at the present time due to barriers that may not be present at some future date (e.g. high water, extreme weather event) but are expected to exist throughout the index period. * *Equipment-related inaccessibility* - The site could not be sampled due to shallow depth and the draft of the boat not allowing access. No suitable depth could be found within 0.02nm or 37m from the X-site. Before dropping this target site, every attempt should be made to bring a boat of suitable draft for the location.   **Non-Target (Non-Sampleable) Categories** *(permanent condition; site is non-target)*   * *Dry site* - There is no coastal water anywhere within a 0.02nm or 37m radius centered on the X-site. If determined at the time of the sampling visit, note as "Dry-Visited"; if site was determined to be dry from another source and/or field verified before the actual sampling visit, note as "Dry-Not visited.” * *Wetland* - There is standing water present, but site is in a wetland. * *Mudflat* – There is no standing water, but site is clearly a permanent mudflat. (If site is likely to be covered with water at other times during the index period, the site should be classified as non-sampleable (temporary) and rescheduled for another day.) * *Freshwate*r – salinity is less than 0.5 ppt at the X-site. |

# 5 Desktop Evaluation

This section describes the site replacement process during the desktop review, and if necessary, the on-site evaluation of the site to determine whether the site is part of the target population. In order to achieve the most robust results possible with the probabilistic sampling design, every effort must be made to sample the primary sites that were generated. Some sites may be accessed easily while others may require more lengthy or time-consuming trips. It is particularly important not to reject a site based on inconveniences in access.

The objective for the desktop evaluation is to eliminate sites that are clearly not part of the target population or cannot be sampled. By using data that is easily obtainable and verifiable, the desktop evaluation locates the site and determines if the selected site is, or likely will be, in the target population and sampleable during the field sampling season. If information obtained during the desktop evaluation is not conclusive, then an on-site visit is required.

## 5.1 Steps in Desktop Evaluation

Before starting the desktop evaluation, the field crew should retrieve as much information as possible for each site. The desktop process consists of the following steps:

1. **Study the Site Evaluation Spreadsheet** described in **Section 4**.
2. **Gather information about the site.** Several sources of information are available, including aerial images, topographic maps, state, county, or tribal coastal data, the National Hydrography Dataset (NHD), personal and local knowledge, literature and scientific reports, land ownership records, and the internet.
3. **Locate the X-site.** Use the most recent aerial imagery that can be obtained. Using this imagery and any supplemental sources of information, determine if the X-site is within 0.02 nautical mile (nm) or 37 m of coastal waters (marine or estuarine).
4. **Determine if X-site is within the target population.** If the site appears to be outside coastal waters (marine or estuarine), contact a Project Leader at MassBays or MassDEP before dropping the site and replacing it with an oversample site. With their approval, select a replacement site following the protocol described in **Step 8**.
5. **Determine sampleability.** Review maps, other collected information, or enlist the assistance of someone with personal knowledge of the location of the X-site to determine if it is physically accessible by field crews and safe to sample. **Section 4.2** defines various sampleable/non-sampleable categories that are to be used in completing the site evaluation spreadsheet. If a field crew can safely collect samples for any indicator, then the site must be considered sampleable.
6. **Examine nearby area.** Review maps and other sources of information to determine if a sampleable site exists within a circle of 0.02 nm radius (±37 meters) around the X-site. This distance should account for typical “anchor swing” of the sampling vessel. If a sampleable site does not exist within this radius, then follow the procedures for selecting an alternate site in the next step.
7. **Document the findings in the Site Evaluation Spreadsheet.** If the maps and other sources of information indicate conclusively that the site is not accessible, for example the site is in a shipping channel, note the reason(s) for this conclusion and an assessment of whether the X-site is part of the target population. Information provided in this spreadsheet is critical to the statistical analyses of data from the survey. Complete the spreadsheet (see Figure 4.2) to provide MassBays and MassDEP with as much information as possible in its data analysis. Three aspects are especially important and must be completed for all evaluated sites. (See **Section 4.2** for drop-down choices). Provide the evaluation findings for the site:
   1. Is the site part of the target population? Even if the site is not safe to be sampled, provide your best assessment for whether the site is in the target population.
   2. Is the site accessible and safe to sample? If the site will require extreme resources and/or considerable time to sample, contact a MCCA Project Leader for approval before dropping the site. Consider only physical accessibility in this evaluation, and not access or sampling permission (i.e. answer this question with the assumption that permission would be granted).
   3. Has landowner granted access permission to the site (if necessary) (**see Section 6**)?
8. **Select replacement sites following protocol.** The site lists for the MCCA are organized by stratum and panel (primary and oversample) in the Site Evaluation Spreadsheets. The sites are listed on the spreadsheet in the order in which they were randomly selected. All primary sites must be evaluated for potential sampling and should be sampled unless they are determined to be non-target, non-sampleable, or non-accessible. If a primary site is rejected because it is non-target, non-sampleable or not accessible, then it will be replaced by the next oversample site within the same stratum.

**Exception for Pilot Year 2020 ONLY:** If a primary site is rejected because it is non-target, non-sampleable or not accessible, it can be replaced by any of the primary site within the same stratum and scheduled for sampling in a different year (see site evaluation spreadsheet).

1. **Prepare the official site packet.** The field crew should keep information and data sources used in the desktop evaluation as part of the official site packet for each site. For each site deemed sampleable or inconclusive, the site packet also should include forms, any necessary research permits (if applicable), and site access instructions. The packet also should include the appropriate maps, aerial images, contact information, and copies of landowner permission for access.

# 6 Obtaining Landowner Access Permission

An important step is to determine, and obtain if necessary, landowner access permission and any other requirement. MCCA sites are generally accessible by boat from the open waterway. To access the waterway, the field crew should first determine if a public dock or ramp will provide suitable access for the boat. If a private dock or ramp is more convenient, then the field crew must obtain landowner access permission before using the dock. In addition, the field crew must comply with any special conditions and requirements for accessing and sampling on state, tribal or federal lands/waters.

The field crew is responsible for obtaining any necessary permission to access MCCA sites. Landowner information can be obtained from the MassGIS Standardized Assessors' Parcels coverage (<https://docs.digital.mass.gov/dataset/massgis-data-standardized-assessors-parcels>) or the appropriate town/city assessor’s office. Tax assessor maps will display parcel boundaries and associated metadata will contain landowner names and addresses. This information enables the field crew to contact and obtain access permission from the landowners before the sampling day, and identifies which landowner owns which portions of the shoreline.

The field crew should obtain any necessary access permissions prior to the sampling day to minimize loss of time during field sampling. The field crew can contact the landowner either through an in-person reconnaissance visit or through mailing access permission request letters to the landowner. Field crews should also consider requesting landowner permission for oversample sites in case of dropped primary sites. **Figure 6.1** provides a sample letter and permission form that can be modified as appropriate. In either case, a signed permission slip, such as the one shown in **Figure 6.1** is important to use as documentation on the day of sampling.

Field crews should work with appropriate state, tribal and federal agencies to determine any permits or special conditions that apply to the access points and the coastal waters. As needed, MassDEP or MassBays will assist field crews in coordinating efforts with state agencies. Field crews should work with the appropriate tribal and federal agencies to determine any permits or special conditions that apply to tribal or federal lands.

In many cases, it will be appropriate to address access issues on the day of the sampling event. This method is usually adequate if a desk-top reconnaissance shows that the area around the site includes enough public land to gain access to the waterway. If the site is in an area that is largely privately owned land, waiting until the day of sampling could pose unnecessary delays and access issues that should have been resolved prior to the scheduled sampling day.

**Figure 6.1** Example landowner letter and permission form

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| --- |
| (Date)  Dear Landowner:    The Massachusetts Department of Environmental Protection (MassDEP) and Massachusetts Bays National Estuary Program (MassBays) are working with [contractor] to conduct an environmental assessment of coastal waters across throughout the Commonwealth of Massachusetts. The Massachusetts Coastal Condition Assessment (MCCA) when completed will provide an unbiased assessment of coastal waters in Massachusetts. Approximately 90 coastal sites were statistically (randomly) selected for sampling from 2020 - 2023. Water quality chemistry, aquatic life, and habitat will be evaluated at each site.    We are contacting you prior to the site visit to obtain permission (form enclosed) to access the sampling site. We have enclosed a copy of a map(s) with the site(s) identified by an “X” at the specific point to be sampled. We realize that working on your property is a privilege and we will respect your rights and wishes at all times.    Please return the completed Access Permission Form in the enclosed envelope by (date). If you have any questions concerning this request, please contact me (phone number). We are looking forward to hearing from you.  Sincerely,    (Name)      I grant permission to the field crew from [contractor] to access the coastal target site located on my property as part of the Massachusetts Coastal Condition Assessment (MCCA).    \_\_\_\_\_\_\_\_\_\_ Do grant permission    \_\_\_\_\_\_\_\_\_\_ Do grant permission but with the following restrictions:  \_\_\_\_\_\_\_\_\_\_ Do not grant permission    Landowner Name (Please print): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Landowner Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Phone Number: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Address: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

# 7 Final Site Verification

The final step is to visit the site, usually as part of site reconnaissance or the first field sampling visit. Complete a Verification Form for each site visited with the intent to sample (regardless of whether it is sampled), following the procedures described below.

**Site Verification Equipment:**

* Sampling permit and landowner access (if required)
* Field Operations Manual and/or laminated quick reference guide
* Site dossier, including access information, site spreadsheet with map coordinates, street, and/or topographic maps with “X-site” marked
* GPS unit (preferably one capable of recording waypoints) with manual, reference card, extra battery pack

1. **Confirm location.** Upon reaching the target site, confirm that the field crew is located at the same latitude and longitude identified in spreadsheet for the X-site. Sampling site verification is based on map coordinates and locational data from the GPS.
   1. **Navigate to the X-site.** Navigate the sampling vessel as close as possible to the target X-site using GPS (you must be no more than 0.02 nautical miles (nm) or 37 meters from the target X-site). Compare the target X-site coordinates with the GPS coordinates displayed at the sampling site.
   2. **Record, in the Site Verification Form, the actual coordinates** of the vessel after anchorage, not the initial intended coordinates, on the field data sheet. Make sure the GPS unit is set to reference the NAD 83 geospatial data set. This new location is where sampling will begin and is called the Y-location.
2. **Assess sampleability** as described in **Section 2** and **Section 5**. In addition, verify that the water is deep enough so that samples can be collected from the boat otherwise the site is non-sampleable. Questions about wading to sample shallow water should be directed to either the MassDEP or MassBays Project Leader.
3. **Assess relocations** if the X-site itself is not sampleable. Every attempt should be made to relocate to a sampleable area within a 0.02 nm (37m) radius of the intended location. In searching for a suitable relocation site, the field crew leader should choose a specific compass heading (e.g., north, south, east, west) and slowly motor the vessel in that direction for approximately 15-20 m. Assess the potential relocated site as described in **Section 5.1**. Should the relocated site fail to meet the operational definition sampleable, then this process may be continued using the same heading out to the 37 m mark or using a new heading until an acceptable sampling location is found. If after enough effort is expended and no suitable site is found, then the determination may be made that the site is non-sampleable.
4. **Check the appropriate box** on the Site Verification Form (Appendix II). Do not sample non-target or "Non-sampleable" or "No Access" sites. Check the "NO" box for "Did you sample this site?" and check the appropriate box in the "Non-Sampleable - Permanent" or "Non-Sampleable-Temporary" section of the Verification Form; provide detailed explanation in comments section. In the site evaluation spreadsheet of base and oversample sites (e.g., **Figure 4.2**), provide comments in the last column.

# 8 Submission of Site Evaluation/Verification Forms

The final step is to provide MassDEP and MassBays with the necessary documentation. For all primary sites and all oversample sites selected as replacements (sampled and non-sampleable), the field crew must provide the two documents identified below. The information is critical for the statistical evaluations for the final report.

1. **Site Evaluation Spreadsheet** – submitted to MassDEP and MassBays Project Leaders via email prior to the start of the sampling index period for information collected during desktop and site reconnaissance and at the conclusion of the sampling index period or first round of sampling visits at all sites for new information collected during sampling. The final completed Site Evaluation Spreadsheets must be submitted to MassDEP and MassBays Project Leader via email no later than September 30 of the sampling year.
2. **Site Verification Forms** – submit scanned copies of completed evaluation forms (with other field forms as appropriate) for the sites via email to MassDEP and MassBays Project Leaders. Forms should be submitted within 2 weeks of completing the first sampling event.

# 9 Cited Sources

USEPA. 2014. *National Coastal Condition Assessment: Site Evaluation Guidelines*. U.S. Environmental Protection Agency, Washington, DC. EPA 841-R-14-006.

# Appendix I: MCCA Survey Design

**Massachusetts Department of Environmental Protection**

**Massachusetts Bays National Estuary Program**

**Massachusetts Coastal Condition Assessment (MCCA)**

**Survey Design 2020 – 2023**

**Target Population**

The target population for this survey is a combination of all coastal waters within:

1. Massachusetts Department of Environmental Protection (MassDEP) estuarine assessment units
2. Massachusetts Bays National Estuary Program (MassBays) estuarine assessment units
3. A near-shore seaward boundary defined by a maximum distance from Massachusetts shoreline of 3 miles and a maximum depth of 10 meters

Excluded from the target population are any tidal rivers or streams that are only represented in GIS by polylines versus polygons (i.e. small tidal streams and ditches) and any areas classified as intertidal estuarine or marine wetland in the National Wetland Inventory (NWI). The term “coastal waters” in the remainder of this document refers to all waters within the target population.

**Sample Frame**

The sample frame was derived from GIS coverages of the 2016 MassDEP estuarine assessment units, 2017 MassBays estuarine assessment units, 1999 MassGIS Bathymetry of the Gulf of Maine, MassGIS Massachusetts shoreline, and a 3-mile buffer of the shoreline. The bathymetric map and 3-mile buffer coverages were used to identify areas seaward of the shoreline that are less than 10 meters in depth and less than 3 miles from shore. Any polygons not contiguous with the shoreline (i.e. isolated shallow locations within the 3-mile buffer) where eliminated from the sample frame. The sample frame contains some areas (approx. 130 sq. km) classified as intertidal estuarine or marine wetland in the National Wetland Inventory (NWI) that were not removed due to uncertainty regarding the delineated boundaries. Target population determinations for sites selected in these areas will be determined on a case-by-case during site evaluations.

**Survey Design**

A Generalized Random Tessellation Stratified (GRTS) survey design for an area resource is used with regional stratification and unequal probability of selection based on polygon classification. The details are given below.

**Stratification**

The survey design is stratified by three geographic regions within Massachusetts to improve sampling logistics (Figure 1). One region will be targeted and sampled each year from 2021 to 2023, starting with the Region A in 2021 and concluding with Region C in 2023. A pilot project will be conducted in 2020 in multiple strata using a small subset of the selected primary sites to test sampling methodology.

**Table 1.** Regional strata descriptions

|  |  |
| --- | --- |
| **Stratum** | **Major Basin Description** |
| Region A | Merrimack, Parker, Ipswich, North Coastal, Boston Harbor |
| Region B | South Coastal, North Cape Cod (Cape Cod Bay) |
| Region C | South Cape Cod (Nantucket Sound), Islands, Buzzards Bay, Narragansett Bay, Mount Hope Bay |

**Figure 1.** Regional strata



**Unequal Probability Categories**

The MAP2 estuaries design is an unequal probability design within each regional stratum. Unequal probability categories were created based on the area of each polygon/estuary segment to ensure the selection of sites in smaller polygon/estuary segments. Region B and C were divided into 4 size categories while Region A was divided into just 3 size categories (Figure 2). Unequal probability category targets categories were set to allow enough sites for analysis with and without the XL size category.

**Panels**

This survey design has a single panel.

**Figure 2.** Unequal Probability Categories



**Expected Sample Size**

The designed sample size is a total of 90 sites for the state with 30 sites in each stratum. In addition, 60 oversample sites were selected in each stratum. It is expected that 10-15 of the sites (approx. 3-5 in each strata) will be sampled during the pilot project in 2020. The remaining 75 – 80 sites will be sampled from 2021 – 2023 (approx. 25 sites per year), starting with the Region A in 2021 and concluding with Region C in 2023.

**Site Use and Replacement**

Each site selected to be sampled is given unique site identification (siteID). Site numbers consist of the project abbreviation (MAP2E) and a number between 001 and 270. Within each regional stratum, the total list of sites evaluated for potential sampling must have all site IDs from the largest to the lowest number evaluated (i.e. none can be skipped). For example, if MAP2E-178 is the largest site ID evaluated within the Region C stratum, then all site IDs that are lower than 178 within the Region C stratum must be evaluated. Even more critical is that if MAP2E-178 is the largest site ID that is actually sampled in the field, then all lower site IDs within the Region C stratum that are evaluated to be within the target population and are accessible must also be sampled in the field.

**Sample Frame Summary**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Categories (sq. km)** | | | | |
| **Stratum** | **Small**  **(0-0.4 km2)** | **Medium**  **(0.4-2.9 km2)** | **Large**  **(2.9-100 km2)** | **X – Large**  **(>100 km2)** | **Total** |
| Region A | 5 | 55 | 294 | 0 | 354 |
| Region B | 4 | 40 | 278 | 101 | 423 |
| Region C | 12 | 74 | 180 | 998 | 1264 |
| Total | 5 | 55 | 294 | 0 | 354 |

**Site Selection Summary**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | **Categories** | | | | |
| **Stratum** | **Small**  **(0-0.4 km2)** | **Medium**  **(0.4-2.9 km2)** | **Large**  **(2.9-100 km2)** | **X – Large**  **(>100 km2)** | **Total** |
| Primary | Region A | 5 | 10 | 15 | NA | 30 |
| Region B | 4 | 16 | 8 | 2 | 30 |
| Region C | 5 | 8 | 9 | 8 | 30 |
| Total | 14 | 34 | 32 | 10 | 90 |
| Oversample | Region A | 10 | 25 | 25 | NA | 60 |
| Region B | 11 | 22 | 22 | 5 | 60 |
| Region C | 13 | 21 | 18 | 8 | 60 |
| Total | 34 | 68 | 65 | 13 | 180 |

**Description of Sample Design Output**

|  |  |
| --- | --- |
| **Variable Name** | **Description** |
| siteID | Unique identification label for each site in the sample |
| Longitude | Site location longitude in decimal degrees coordinates (see projection below for datum). |
| Latitude | Site location latitude in decimal degrees coordinates (see projection information below). |
| xcoord | X-coordinate of the site (see projection information below) |
| ycoord | Y-coordinate of the site (see Albers projection information below) |
| mdcaty | Multi-density categories used for unequal probability selection |
| weight | Weight, inverse of inclusion probability, to be used in statistical analyses |
| stratum | Strata used in the survey design |
| panel | Identifies and Oversample |
| EvalStatus | Site evaluation decision for site: TS: target and sampled, LD: landowner denied access, etc. (see below) |
| EvalReason | Site evaluation text comment |
| auxiliary variables | Remaining columns are from the sample frame provided |

# Appendix II: Site Verification Form

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **General Information** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Site ID:** | |  | | | | | | | | | | | **Date:** | | | | | | |  | | | | | | | | | | | | |
| **Stratum:** | |  | | | | | | | | | | | **Site Name:** | | | | | | |  | | | | | | | | | | | | |
| **Verification Information** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **DID YOU SAMPLE THIS SITE?** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * **YES** | | | **If Yes, check one below:** | | | | | | | | | | | | | * **NO** | | | | | | | | **If NO, check one below:** | | | | | | | | |
| **SAMPLEABLE (Choose Type)**   * Marine * Estuarine | | | | | | | | | | | | | | | | **NON-SAMPLEABLE – Permanent – Replace Site**   * Map Error * Site too shallow for navigating/sampling * Unsafe * No Access * Other (Explain in comments)   **NON-SAMPLEABLE – Temporary – Reschedule Visit**   * Temporarily Inaccessible * Other (Explain in comments) | | | | | | | | | | | | | | | | |
| **Arrival Time (hh:mm):** | | | | | |  | | | | | | | | | |
| **Depart Time (hh:mm):** | | | | | |  | | | | | | | | | |
| **Station Depth (m):** | | | | | |  | | | | | | | | | |
| **Site Verification Method:** | | | | * GPS | | | * Local Contact | | | | | | | | * Signs | | | | | | * Roads | | | | | | * Map/Chart | | | | * None | |
| * Other, explain: | | | | |  | | | | | | | | | | | | | | | | | | | | | | | |
| **Y-Location**  **(Decimal Degrees)** | | | | **Latitude:** | | | |  | | | | | | | | | | | | | | | | | | **Y-Location is within 37m of X-site?** | | | | | | |
| **Longitude:** | | | |  | | | | | | | | | | | | | | | | | | * Yes | | | | * No | | |
| **Site Characteristics** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Habitat Type:** | | | | | * Tidal River | | | | | | * Open Water | | | | | | | | * Embayment | | | | | | * Inter-tidal | | | | * River mouth | | | |
| * Other, explain: | | | | | | |  | | | | | | | | | | | | | | | | | | | | |
| **Bottom Type:** | | | | | * Oyster Bed | | | | | * Grass Bed | | | | | | | | * Sand | | | | | * Rocky | | | | | * Hardpan | | | | * Mud |
| * Other, explain: | | | | | | |  | | | | | | | | | | | | | | | | | | | | |
| **Debris Present:** | | | | | * None | | | | | | * Glass | | | | | | | | * Plastic | | | | | | * Wood | | | | * Cans | | | |
| * Other, explain: | | | | | | |  | | | | | | | | | | | | | | | | | | | | |
| **Submerged Aquatic Vegetation:** | | | | | * None   (<1%) | | | | | | * Sparse   (1-25%) | | | | | | | | * Moderate (25-50%) | | | | | | * Dense   (50-75%) | | | | * Very Dense (>75%) | | | |
| **Macroalgae:** | | | | | * None   (<1%) | | | | | | * Sparse   (1-25%) | | | | | | | | * Moderate (25-50%) | | | | | | * Dense   (50-75%) | | | | * Very Dense (>75%) | | | |
| **General Comments** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **General Information** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Site ID:** | |  | | | | | | | | | | | **Date:** | | | | | | |  | | | | | | | | | | | | |
| **Sketch Map** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Arrow Indicates North  Label Sketch: L=Launch, S=Sediment Area, Y=Y-location | | | | | | | | | | | | | | Note: If an outline map is attached here, use a continuous strip of clear tape across the top edge. You can also attach a separate sheet with the outline map on it. | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Personnel** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Crew Lead:** |  | | | | | | | | | | | | | | | | **Name 3:** | | | | |  | | | | | | | | | | |
| **Name 1:** |  | | | | | | | | | | | | | | | | **Name 4:** | | | | |  | | | | | | | | | | |
| **Name 2:** |  | | | | | | | | | | | | | | | | **Name 5:** | | | | |  | | | | | | | | | | |