Standard Operating Procedures

Mapping Land Use and Habitat Change in the National Estuarine Research Reserve System

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National Oceanic and Atmospheric Administration (NOAA)
Office for Coastal Management
www.coast.noaa.gov

This document is a companion document to

Recommended Guidelines for Adoption and Implementation of the NERRS Comprehensive Habitat and Land Use Classification System

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"Coastal management" is the term used by communities and organizations striving to keep the nation's coasts safe from storms, rich in natural resources, and economically strong. The national lead for these efforts is NOAA's Office for Coastal Management, an organization devoted to partnerships, science, and good policy. This agency, housed within the National Ocean Service, oversees major initiatives that include the National Coastal Zone Management Program, Coral Reef Conservation Program, Digital Coast, and National Estuarine Research Reserve System.

The **National Estuarine Research Reserve System** is a network of 28 coastal sites designated to protect and study estuarine systems. Established through the Coastal Zone Management Act, the reserves represent a partnership program between NOAA and the coastal states. NOAA provides funding and national guidance, and each site is managed on a daily basis by a lead state agency or university with input from local partners.

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I. Introduction

A. Goals, Objectives, and Guiding Principles

The goals of the National Estuarine Research Reserve (NERR) habitat mapping and change (HMC) planning effort are to

1. Develop a framework for mapping habitats and reserve and watershed boundaries to characterize and communicate—at site, regional, and system-wide scales—short-term variability (1-10 years) and long-term trends (10+ years) in the spatial changes in reserve habitats; and
2. Examine the impacts of climate change, land use within adjacent watersheds, and changes in local water-level and inundation patterns on reserve habitats.

Towards this end, the HMC planning objectives are to

1. Map land cover and land use and associated land cover changes in reserves and their watersheds; and
2. Enhance capacity within NERRS to map, model, and disseminate information on estuarine habitat trends and associated linkages with anthropogenic and climatic stressors.

The guiding principles embedded in the standard operating procedures:

1. Integrate Coastal and Marine Ecological Classification System (CMECS) classification into the NERRS mapping initiative;
2. Automate the mapping process to enhance the accuracy of change analysis;
3. Maximize standardization of mapping and metadata protocols to enhance data integration, dissemination, and discoverability via search engines;
4. Ensure that the standard operating procedures and classification scheme are dynamic enough to respond to emerging technologies and processes, and the identification of unique habitat assemblages.

B. Background and Elements of Current Standard Operating Procedures

In 2009, the NERRS completed a suite of documents to guide mapping of reserve habitats and boundaries. These documents include the Habitat Mapping and Change (HMC) Plan, the NERRS Classification Scheme and associated documentation and implementation protocols, and the first version of the Standard Operating Procedures, which are updated annually. These documents are available on the NERRS Intranet site and on the NERR Internet site. The purpose of developing the HMC Plan and NERRS Classification Scheme was to establish consistency in mapping habitats and boundaries across the NERRS.

Because of inconsistency in mapping standards and protocols, it has been difficult to characterize or assess changes in habitats contained within our reserve system at a regional or national scale over time. Consistent terminology and standards will support the research, stewardship, education, and outreach priorities of the NERRS and foster collaborations with state, regional, and federal partners.

These revised standard operating procedures provide the nuts and bolts requirements for mapping habitats within the NERRS in accordance with the HMC Plan and associated documents. These procedures incorporate the protocols adopted by the NERRS for monitoring and mapping the spatial distribution of emergent and submerged vegetation in 2003. The methods employ a combination of surveys, remote sensing, ground truth with Global Positioning System (GPS), geo-rectification and mapping with geographic information system (GIS), and GPS mapping. The protocols that are used by the NOAA C-CAP (Coastal Change Analysis Program) Program (Dobson et al. 1995) and by the NERRS Biological Monitoring Workgroup (Moore et. al, 2003) were recommended for use by the reserves. Ground-truth sampling was required for accurate interpretation of the remotely sensed aerial or satellite imagery.

The procedures in this manual allow flexibility in mapping strategies (e.g. heads-up digitizing or semi-automated classification), on accuracy assessment approaches (at the class or subclass level), and in geography (the entire reserve vs. a specific geography or habitat type) based on reserve resources and local mapping applications. The critical principle stressed by these procedures is completeness of ***documentation***. These standard operating procedures recognize the pre-existence of the mapping protocols and have been revised to accept documentation of ground-truthing strategies in lieu of formal accuracy assessment protocols.

Map elevation layers generated by LiDAR, RTK, or digital leveling are valuable GIS data layers that can support habitat classification. In the first iteration of the standard operating procedures, approaches to modeling and mapping tidal datum and elevation were detailed as a critical component of the mapping strategy. However, protocols for establishing vertical control and elevation surveys are addressed in the sentinel site guidance document and associated documents and are no longer addressed in these procedures.

The standard operating procedures detail the method for developing and submitting boundary shapefiles and habitat maps to the Centralized Data Management Office (CDMO)

in compliance with the HMC Plan. Adherence to the standard operating procedures establishes system-wide consistency among reserves and ensures that QA/QC standards are met for all mapping products developed and made publicly accessible by the NERRS. Consistency in standards facilitates analysis of habitat change within and among reserves and communicates trends in habitat change within the NERRS. All reserve boundary and habitat maps must be approved by the Habitat Mapping and Change Technical Committee (HMCTC) as fully complying with these standard operating procedures before they will be accepted by the CDMO.

Mapping within the reserve watersheds is conducted by NOAA's Office for Coastal Management as part of the Coastal Change Analysis Program (C-CAP). Maps and associated protocols can be accessed on the NOAA Digital Coast website. The NERRS does not dedicate funding for mapping, but individual reserves are strongly encouraged to map their areas of perpetual interest (i.e., areas targeted for repeated high-resolution mapping over time to monitor change) in accordance with the requirements in this standard operating procedure document and the approved site-based habitat mapping and change plans. While the standard operating procedures provide guidance on mapping reserve habitats outside areas of perpetual interest, mapping these habitats is voluntary until such time that the NERRS dedicate funding for mapping. Reserves that receive funds for mapping from sources other than the NERRS for specific applications are encouraged to comply with the standards within this document to the extent consistent with funding requirements so that these products can be posted on the CDMO website.

CMECS was designed to provide a national standard for consistent descriptions of coastal and marine ecological features. The standard was fully adopted by the Federal Geographic Data Committee (FGDC) on June 4, 2012, and all federally funded projects are expected to use the classification scheme. A crosswalk that shows the relationship (i.e. equal to, broader, finer, and not included in) between the CMECS and NERRS classification scheme is provided in Appendix A. A cross-walk tool that will generate CMECS attributes layers from NERRS habitat maps is available in the tools section of the Digital Coast website. The CDMO web site is not yet able to maintain the geodatabase file structure that is generated by the NERRS-CMECS cross-walk tool. Until that is accomplished, reserves should include the crosswalk table and reference the availability of the cross-walk tool on Digital Coast in the readme file.

The standard operating procedures focus on the methods, processes, and requirements

for submitting the following mapping products:

- Reserve and watershed boundaries
- Land use and land cover maps of reserves
- Change analysis
- Reserve habitat mapping and change plans

These standard operating procedures revise the original procedures developed in September 2009 in the following ways:

- Supervised semi-automated classification methods are suggested as a classification strategy to hold errors between consecutive mapping efforts constant in situations where a heads-up digitized product has not been done and where supervised semi-automated classification can detect reserve habitats at the subclass level. The methods must be well-documented in the Readme file;
- A detailed structure for submitting and documenting accuracy assessment and ground-truthing data has been included;
- The accuracy assessment attribute table has been amended to include a field identifying the verification strategy;
- Procedures for readme files have been included;
- Nomenclature and processes for submitting photos have been included;
- Processes for submitting high-resolution imagery have been updated
- A QA/QC review process for high-resolution imagery has been included to support reserves in editing their shapefiles and associated metadata to ensure they are standard operating procedure-compliant *before* being submitted for review;
- The attribute field for high-resolution imagery has been amended to include: 1) a field to indicate whether the polygon is inside or outside of reserve boundaries to support mapping of intact ecosystems that extend across reserve boundaries; and2) a field indicating whether the polygon is a habitat of perpetual interest;
- A CMECS excel spreadsheet is provided to enable users to append the table to the NERRS attribute tables.
- Procedures for submitting ground-truthing data in lieu of an accuracy assessment for mapping efforts that pre-date the HMC Plan are included.

The standard operating procedures will be evaluated and updated annually to address lessons learned, emerging issues, or the adoption of new national or NOAA mapping standards.

II. Boundaries

Reserves must submit shapefiles of reserve boundaries, estuarine basin boundaries, and targeted watershed boundaries. Reserve and associated boundaries are located on the CDMO web site.

A. Reserve Boundaries

Reserve boundaries depict the boundaries approved in reserve management plans and are updated after modifications to the boundaries have been published in the Federal Register. Reserve boundaries submitted to the CDMO must adhere to specific requirements or they will not be accepted for posting on the CDMO website:

1. Federal Geographic Data Committee (FGDC) compliant metadata. All reserve boundaries must have complete FGDC-compliant metadata attached that details: (1) the base maps used to develop the boundaries and associated details about the base imagery or products, (2) the methodology for developing the boundaries, (3) projection, (4) the date the boundary was produced, (5) contact information, and (6) other required information. The FGDC-compliant metadata for boundaries is specified in the standard metadata information accessible at the ESRI Support Center (http://support.esri.com/).

2. Projection: All reserve boundaries must be submitted using Transverse Mercator projection which minimizes size and shape distortion within each UTM zone to 1:1000.

3. Standardized attribute tables (see Appendix B).

4. Frequency: Reserve boundaries must be submitted whenever a boundary amendment is made due to acquisition or inclusion of additional lands. Re-submitting the revised boundary map should be the final step in modifying boundaries and can only be completed after the Federal Register notice has been published announcing approval of the boundary amendment. The revised boundary shapefile must adhere to FGDC requirements and projection standards identified above.

B. Watershed Boundaries

There are two, and at some reserves three, scales of watersheds that are mapped as part of the NERRS HMC Plan. The largest scale is the estuarine basin within which the reserve is contained. These larger basin units encompass land uses on a broader landscape scale that

can cumulatively impact reserve habitats. It has been determined either by a flow analysis that most closely corresponds to a U.S. Geological Survey (USGS) 8-10 digit Hydrologic Unit Code (HUC) or by 8-10-digit HUCs. These boundaries have been developed for all reserves and have been uploaded to the CDMO web site. The methodology for creating the estuarine basin is described in the metadata of each reserve's boundary file.

Reserves have also identified a targeted watershed boundary. Targeted watersheds represent those watersheds that directly flow into and impact the habitats within reserves. In some cases, the targeted boundaries may correspond to the estuarine basin described above (e.g. Narragansett Bay NERR, RI), but in most cases, these are distinct boundaries. Targeted watersheds can represent: 1) USGS HUCs that encompass the river systems directly flowing into the reserves; or 2) boundaries based on local knowledge. Targeted watershed boundaries usually correspond to a 12-14 digit USGS Hydrologic Unit Code (HUC). This boundary, determined by reserve staff, represent the watershed basin within which land uses, and water quality and quantity affect reserve habitats. Therefore, the targeted watershed boundary is used as the planning unit for land acquisition by the state's Coastal and Estuarine Land Conservation Program (CELCP) proposals that benefit reserves.

In the case of some reserves, there may even be a finer scale reflecting a small watershed adjacent to a particular reserve component.

Watershed boundaries have all metadata attached to meet the standard FGDC metadata requirements including: (1) the methodology in which boundaries were developed, (2) contact information, and (3) projection. All estuarine and targeted basin boundaries are to be projected using an Albers projection, and small watershed boundaries are projected in a Transverse Mercator projection to preserve alignment with the reserve boundary projections.

III. Land Cover and Land Use Maps

Kutcher et al. (2008) recommended the implementation of a two-level approach to facilitate the objectives identified by Nieder et al. (2002) that require characterization of land cover/land use both within reserve boundaries and in the watersheds that drain into them. The approach utilizes existing resources within NOAA and the US Fish and Wildlife Service (USFWS), using (1) C-CAP moderate-resolution data automatically classified to characterize reserve watersheds, and (2) recently developed classification and collection protocols

(compatible with national wetland mapping standards) to characterize land cover and habitat types on reserve properties at higher resolution. This two-tier approach has the advantage of using consistent, efficient, and readily available C-CAP protocols to track changes in land use/land cover, percent impervious surface, and canopy cover within reserve watersheds at no cost and minimal effort to the NERRS, while also utilizing the NERRS Classification System to provide a standardized format to track habitat change at higher resolution within reserve boundaries. The recommendation for a two-level approach was approved for implementation by the reserve system in 2007 (SWMP Revision, 2007), and the specific data requirements related to mapping at the reserve and watershed scales are detailed below.

A. C-CAP Moderate-Resolution/High Classification Accuracy Land Cover Maps of Watersheds

NOAA's Office for Coastal Management provides moderate-and high-resolution land cover data that can be clipped to each reserve's watershed and/or targeted watershed boundary. Data are acquired and processed through a repeatable semi-automated protocol developed by Dobson et al. (1995) and implemented on a rotating five-year collection cycle since 1996. The protocol uses Landsat TM 30-m resolution, multi-spectral satellite imagery that is run through a series of spectral analyses and field verifications. The protocol is developed to achieve 85% overall mapping accuracy. All of NOAA's land cover datasets are delivered in a pre-processed C-CAP format and no further processing or quality assurance is required. All maps are delivered in a single standardized Albers projection, which enables site as well as system-wide analysis.

NOAA's Digital Coast web site (https://www.csc.noaa.gov/digitalcoast/) also has links to other datasets that characterize impervious cover, canopy cover (produced by the U.S. Forest Service), and land use/land cover change within each reserve's watershed and targeted watershed.

B. High-Resolution Maps of Reserve Habitats of Perpetual Interest

High-resolution maps are prepared for small watersheds and the entire reserve. Individual reserves are responsible for the acquisition and processing of high-resolution aerial imagery required for land cover mapping. Reserves will produce a high-resolution map by classifying the habitats to the Subclass level of the NERRS Classification Scheme for those habitats of perpetual interest, referred to as "priority habitats" which are targeted for

mapping change on an approximate ten year cycle. These areas/habitats of perpetual interest can represent a specific geographic area (e.g., Redfish Bay in the Mission-Aransas NERR) or a specific habitat type throughout the entire reserve (e.g., persistent emergent wetlands). Smaller reserves may identify all intertidal and supratidal habitats within the Reserve boundary as "priority habitats", while larger reserves may choose to select representative areas or priority habitats to monitor over the long term. If reserves choose to include non-priority habitats in the high-resolution land cover maps, they have the option of classifying the non-priority habitats to the Class Level. The attribute table has been modified to include a column denoting whether the polygon represents a habitat of perpetual interest or not. For the purposes of producing baseline maps, those reserves not including subtidal habitats as areas of perpetual interest should classify subtidal habitats to the highest level of detail possible, even if this is just a placeholder at the subsystem level (e.g., denoting *estuarine subtidal haline*).

Reserves may include habitats that extend beyond their boundary for the purposes of mapping intact habitats. The attribute table has been amended to include a column denoting whether the location of the majority of the polygon is inside or outside of the boundary.

For maps prepared after the adoption of the NERRS Habitat and Mapping Change Plan, an Accuracy Assessment is required. For Areas of Perpetual Interest, accuracy assessments should, to the extent possible, be conducted at the subclass level of the NERRS Classification Scheme. Reserves can decide based on available resources if an accuracy assessment will be completed at the class level for the entire map and/or at the subclass level for habitats of perpetual interest (see Section D below). For land cover maps prepared prior to the development of the HMC Plan, but prepared in accordance with the bio-monitoring mapping guidelines, information collected during ground-truth surveys is sufficient. The strategy that is used to ground-truth the mapped land cover types or to conduct the accuracy assessment analysis must be recorded in the "High-Resolution Land Cover Readme File" document (see Section V). Methodology applied to acquire and process high-resolution land cover data must be documented in the site-based habitat mapping and change plan.

Compatibility of data among the various reserves, regardless of image acquisition technique, will be achieved through the use of the following standardized mapping, classification, and ground-truthing techniques:

- Regardless of imagery used to support classification, the HMCTC encourages consideration of the use of supervised semi-automated classification mapping techniques combined with field verification to hold errors constant while re-mapping. This process will help standardize classification methods so that change detection is capturing change in habitat and not change in human interpretation. Semi-automated classification techniques may not meet the needs of all reserves. Reserves should choose the strategy that best meets their resource and application needs. It is critical that regardless of the method, that the metadata and readme file provide complete documentation.

- Reserves are required to classify Areas of Perpetual Interest to the subclass level of the NERRS Classification Scheme. Descriptors and modifiers to the extent applicable are highly encouraged as well.

- Accuracy Assessments and ground-truth surveys for areas of perpetual interest should, to the extent possible, be conducted at the subclass level of the NERR Classification Scheme (see Accuracy Assessment section below).

Table 1 below summarizes the data specifications for reserve habitat maps.

	High-Resolution Data Specifications
Resolution	1-meter or 3-meter (Reserves should refer to using highest resolution imagery available)
Scale	1:12,000 or 1:24,000, or higher (i.e. 1:5000)
Minimum mapping requirement	Intertidal, supratidal
Data source	Varies depending on reserve If using automated classification, RGB, and IR is required. LiDAR is helpful.
Data type	vector, polygon (shapefile)
Data processing	Heads-up digitizing or semi-automated process if possible (CSC will support)
Target minimum mapping unit	0.1 ha (0.25 ac)
Classification	NERRS Hierarchical Classification System (subclass level)
Metadata	FGDC-Compliant – produced by reserves
Projection	Transverse Mercator
Collection Interval	Minimum of every 10 years

	High-Resolution Data Specifications
Accuracy Assessment	Conducted at the Sub- Class Level of the NERR Classification scheme if priority habitat (unless prohibitive based on resource availability) and the class level if non-priority habitat

NOAA's Office for Coastal Management is available to provide technical assistance with semi-automated processes to create segments and in some cases classified maps. The extent of support provided will depend upon:

- The needs expressed by reserve staff;
- Availability of reserve staff to dedicate time and resources to the partnership;
- Availability of staff and resources within the Office for Coastal Management to provide technical assistance;
- The degree to which the mapping application of the reserves aligns with other priorities within the Office for Coastal Management.

C. Accuracy Assessment and Ground-Truth Procedures

Ground-truth Surveys

Ground-truth surveys are designed to provide quantitative information during the entire mapping process. Surveys are conducted at the beginning of the mapping process as close to the time of image acquisition as possible to generate a map signature dataset, or library that will be used to identify and characterize each land use and land cover class delineated on the imagery (Congalton 1996; Cunningham 1998). The map signature dataset contains the spectral and spatial characteristics of the mapped land cover types to the actual cover type on the ground. Data should be obtained evenly throughout the mapped area when building the map signature dataset. Throughout the process, the signature dataset is adjusted and refined in order to produce an accurate representation of the land cover and uses on the final map.

For the purposes of these standard operating procedures, any point visited to classify a habitat or edit a map is referred to as a ground-truthing point. Reference points are those points visited solely for the purpose of assessing the accuracy of the map product and are not used for correcting the map. If corrections to a map are made during an accuracy assessment process, the readme file and nomenclature must reflect that a ground-truthing exercise, and not an accuracy assessment, was conducted. Ground-truthing points cannot be used in an error matrix.

Accuracy Assessments

Accuracy assessments are designed to provide quantitative information on the overall accuracy of the entire habitat classification dataset at the class level of the NERRS Habitat Classification Scheme for areas not identified as areas of perpetual interest and at the subclass level for habitats within the areas of perpetual interest. At a minimum, the accuracy assessment analysis will involve the collection of *in situ* reference data with a real time corrected Global Navigation Satellite System (GNSS) or Global Positioning System (GPS) unit capable of real time positioning (≤ 10 feet) and categorizing the habitat using the NERRS Classification Scheme. ***Ground-truthing points should not be used in the Accuracy Assessment.***

Researchers collecting data in the field should be aware of potential issues caused by the GPS data and/or errors in the spatial position of the source imagery. Care should be taken to ensure that the correct polygon is assigned to the reference data. This error can be minimized by using the highest accuracy GPS unit available, collecting GPS data during periods of low PDOP (Dilution of Precision), and minimizing the spatial errors of the initial source dataset. ***The accuracy of the GPS unit used for reference data selection should be noted in the description of the methodology of the accuracy assessment.*** The GPS points in the accuracy assessment should be added to the attribute table and converted to decimal degrees.

At this time, no minimum level of accuracy is required for the accuracy assessment analyses. The only requirement is that an accuracy assessment is conducted, data are used to create a shapefile, and the methodologies used by the reserve are included in the readme file of the land cover dataset.

1. *Methods for selecting reference data points*

   For ground-truth surveys, sampling methodology depends on the intent of the survey. A stratified random sampling methodology is recommended for selecting sites within different land cover classes.

   When conducting the accuracy assessment, a stratified random sampling methodology is recommended for selecting reference points since it will help ensure that all classes and/or subclasses of habitats of interest are accounted for in the accuracy assessment. However, this type of sampling design might not be possible where information on class spatial distribution is unknown prior to field work (see Congalton and Green, 2009 for a complete description of reference site selection).

Fifty samples per subclass is a general rule of thumb for the minimum sample size needed to assess the accuracy of a specific subclass (Congalton and Green, 2009). However, this will most likely not be possible for maps including multiple habitat classes and subclasses due to the time and cost of collecting reference site information. If the reserves use less than 50 samples per subclass, document in the readme file what method was used to select sample sites.

2. Methods for classifying the habitat at reference data points

There are many methods for collecting reference data which vary in validity, reliability, and expense. According to Congalton and Green (2009), there are three steps to data collection: 1) locate the sample sites using the GPS coordinates selected in the lab, 2) determine the sampling size needed to characterize the sites; and 3) collect information. To ensure objectivity and consistency, reference data must be independent of any training data used to create the base map. Data collection considerations include:

- Site Location and Delineation - Spatial coordinates (e.g., latitude/longitude, UTM) and associated projection information (e.g., projection, datum) are necessary to navigate to the appropriate sampling site in the field. See Congalton and Green (2009) or other references for more details on this subject.
- Observation versus Measurement - Simple observation is generally sufficient for describing the site. However, some elements of the NERRS classification scheme may require measurements to differentiate between classes (refer to the classification scheme documentation, Walker and Garfield, 2006).
- Timing of Data Collection - Reference data should be collected as close as possible to the date of the imagery used to make the map. The readme file should include the date in which reference data was collected.
- Information Collected - Collected data need to include all information necessary to correctly classify the sample into one of the categories in the classification scheme. In addition, the following information should be included:
  - Site identification - At a minimum, a unique numerical code for the sampling point; other types of codes include: coding for field (F) or aerial photo (A), regional or management unit description, and sample number. For example: F _LAID_23 = the 23rd field reference site in Laidlaw Park.
  - Observation level - used as an indicator of the potential accuracy of the observations with a '1' being most accurate and '4' being the least accurate. The

readme file should include which of the following observation level was used.

1 = Walk through stand or polygon

2 = Viewed from road or trail adjacent to stand

3 = Viewed from afar (i.e. road or ridge opposite of stand)

4 = Photo interpreted in office

- **Classify habitat** - Each field point will be classified to the Subclass Level in Areas of Perpetual Interest, "Priority Habitats" and to the class level in areas outside "areas of perpetual interest", in accordance with the NERRS Classification Scheme (see Congalton and Green, 2009 for a complete description of methods for classifying habitats at reference point). When selecting points, ensure that you obtain the appropriate number of reference points to support the goals of the assessment (i.e. for class or subclass level assessment).
- **Photo** - Photo or map name or number used to delineate the sampling unit

D. Accuracy Assessment Error Matrix Table and Kappa Statistic

The data collected during the accuracy assessment are used to create an error matrix that ranks the number of test samples assigned to each land cover class against their "correct" assignments as verified through the reference data (Congalton and Green, 2009).

The matrix will provide producer accuracy (errors of omission – due to missing data) and user accuracy (errors of commission – due to misclassification) for the classification level of interest within the habitat dataset (see table III.2). An un-weighted Kappa statistic coefficient must also be computed (Congalton and Green, 2009). This statistic compares the results of the reference dataset and the classified imagery at either the class or subclass level of the habitat classification scheme depending on the purpose of the map. Table 2 below provides an example of the error matrix for habitats classified to the class level.

Table 2. Example of accuracy assessment matrix at the class level. Note that grey cells represent agreement between the classified imagery and the validation dataset; white represents disagreement.

		Reference (Producer)				
		2210. Aquatic Bed	2230. Streambed	2260. Emergent Wetland	2560. Scrub-shrub Wetland	**Total (Users Accuracy %)**
Mapper (User)	2210. Aquatic Bed	15	3	1	1	**20 (75%)**
	2230. Streambed	4	18	3	2	**27 (67%)**
	2260. Emergent Wetland	4	5	16	4	**29 (55%)**
	2560. Scrub-shrub Wetland	1	2	4	17	**24 (71%)**
	Total (Producers Accuracy %)	**24 (63%)**	**28 (64%)**	**24 (66%)**	**24 (71%)**	**100**

The computation method for the Kappa Statistic is:

$$\text{observed agreement } (P_O) = \frac{\text{sum of diagonal}}{\text{sum of matrix}} = \frac{15 + 18 + 16 + 17}{100} = \mathbf{0.66}$$

$$\text{chance agreement } (P_C) = P_1P_1 + P_2P_2 \ldots = [(24/100)*(20/100)] + [(28/100)*(27/100)] + [(24/100)*(29/100)] + [(24/100)*(24/100)] = \mathbf{0.25}$$

$$K = \frac{P_O - P_C}{1 - P_C} = \frac{0.66 - 0.25}{1 - 0.25} = \mathbf{0.55 \text{ (moderate agreement)}}$$

A reserve's shapefile may include areas of perpetual interest mapped to the subclass level and areas that are not of perpetual interest mapped to either the subclass or class level. There are a variety of strategies for conducting the accuracy assessments based on among other things, the method of field verification during the visits to reference ***sites (see section C above-Observation*** level). When more than one strategy is used to verify reference points during an accuracy assessment, two error matrices should be completed.

E. Other Accuracy Considerations

Although the NERRS does not require reserve maps to meet a minimum level of accuracy, the FGDC Wetland Subcommittee has released a draft Wetland Mapping Standard (Heber, 2007), which outlines wetland mapping protocols intended to apply to any federally-funded inventory of geospatial wetland data. This standard is of significance to the NERR System which will be mapping wetland areas. FGDC protocols require vector data output derived from 1:12,000 scale (or less desirable 1:24,000) with source data at 1-m resolution (1:63,360

at 5m for Alaska) to have (1) 68% positional accuracy within 5-m on the ground, (2) 98% producer's accuracy (error of omission) in delineating wetland areas from non-wetland areas, and (3) 85% attribute accuracy (correct wetland classification). Source data can be aerial photography or satellite imagery. These standards will apply to the NERRS mapping standards for mapping wetlands produced with federal dollars. Achieving the FGDC Wetland Subcommittee standards and conducting the associated accuracy assessment for wetlands is highly recommended for reserve system maps uploaded to the CDMO.

Registration error, resulting from misalignment or distortion in the imagery, generates false differences during change detection. Therefore an estimate of the source imagery's spatial accuracy must also be included in the accuracy assessment. Commercial vendors of ortho-rectified satellite and aerial imagery typically provide such an assessment. If the spatial accuracy of the source imagery is unknown (e.g., locally geo-referenced aerial photography), a sampling procedure that compares points visible on the imagery with their "true" reference positions should be performed. A spatial accuracy assessment that uses Global Positioning System (GPS) and, if available, high spatial accuracy reference imagery should be reported using a Root Mean Square Error (RMSE) and an associated 95% confidence interval for the horizontal coordinates (x,y) (Congalton and Green, 2009). It is important to understand that reference imagery and GPS coordinates will have their own sources of error and therefore a sufficient number of reference positions need to be collected to derive a meaningful estimate for the RMSE of an image product.

IV. Change Analysis

Every ten years, reserves are expected to conduct a change analysis of the "area/habitats of perpetual interest". No guidelines for conducting a change analysis have been developed, but reserves are encouraged to use well-documented, peer-review methodologies. The reserves can use one of the following two methods for conducting the analysis. The first is to overlay the baseline vector map onto the new source data, and use automated methods for modifying polygons and attributes to reflect actual changes in the landscape in a systematic manner. The other approach is to use imaging software, such as E-cognition or Imagine, to compare the land cover classifications on the baseline and new data sources. Classification of unchanged habitat polygons will remain the same, while dynamic habitats or those under anthropogenic or climate-related stress will require re-classification or boundary changes. The method used to conduct the change analysis must be described in detail in the metadata and readme file. The methods should include relevant information about each map layer.

V. Habitat Mapping Package

The mapping package that will be submitted to the HMCTC for review and approval will contain the following:

1) Land cover/and Accuracy Assessment (or Ground-truth Survey) shapefiles and associated metadata reports, and ArcMap projection file for both shapefiles.
2) One photograph of each habitat type of perpetual interest
3) Readme file that describes the land cover dataset, including information about the geographic extent of the classification, level of the classification (e.g. priority habitats classified to subclass level, non-priority areas classified to class level), and methodology used to produce datasets.
4) Excel spreadsheet with the NERRS-CMECS classification crosswalk.

Consistent data and data standards are critical for accumulating GIS data over time within a reserve, combining data among reserves, and for initiating automated QA/QC processes by the CDMO on the shapefiles. For this reason, the HMCTC has standardized the format for shapefiles, metadata reports, photographs, and readme file that reserves submit. Standards for the required components of the package ARE provided below.

A. Naming Convention for Data Products Submitted to the CDMO

To facilitate the sorting and access of reserve data products on the CDMO website, all data products must be submitted using a standard naming convention. For multiple priority habitat areas (i.e. Iona, Stockport [Hudson River NERR]), a reserve must submit separate shape files and accuracy assessment (or ground-truth survey) files for each habitat area. Also, the reserves are responsible for assigning two-letter codes (e.g., Redfish Bay = RB) to the habitat area and including a description of the codes in the metadata report and "Readme" file. The boundaries of the components of a multi-component reserve should be included within one shapefile. The same standard applies to the watershed boundaries for multi-component reserves as well. The standardized naming conventions are identified in Appendix C.

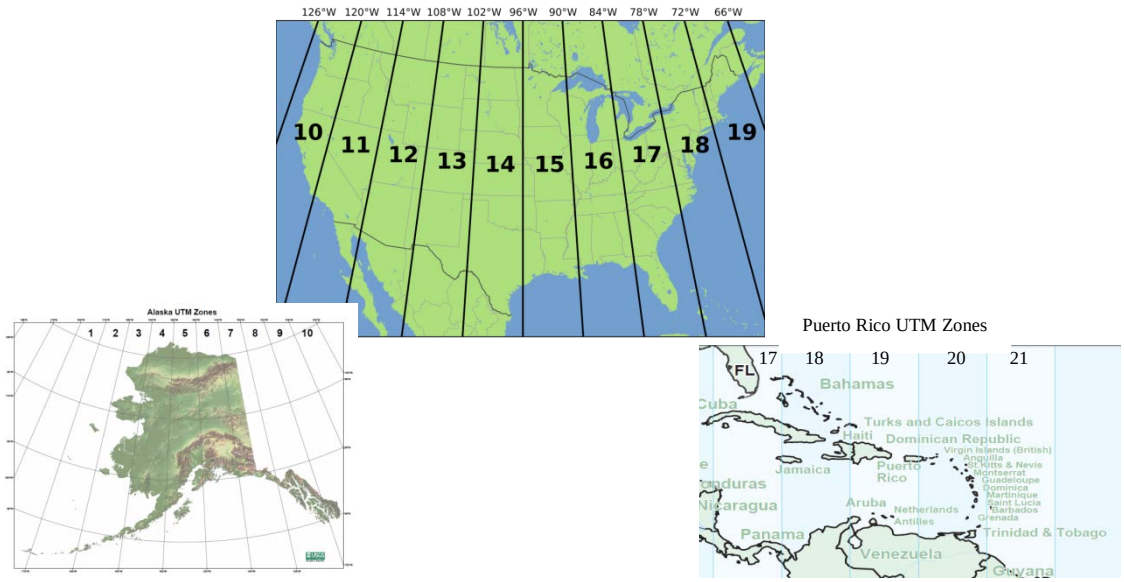
B. GPS Coordinates for <u>All</u> Shapefiles

Hi-Res land use/land cover, Accuracy Assessment and ground-truth survey datasets must be projected in following Coordinate Systems. The original coordinate systems should be listed in the readme file.

Geographic Coordinate System: GCS_North_American_1983

Projection Coordinate System: NAD_1983_UTM_[Reserve Zone]

Use the maps below to locate zone of your reserve.



C. Metadata Reports

The metadata report must be submitted in the FGDC-compliant format because the NERRS is required submit our metadata to FGDC geoportal (Geo.Data.gov). Reserves are required to submit a FGDC-compliant metadata report for the land cover shapefile and for the accuracy assessment (or ground-truth survey) shapefile. Both shapefiles must contain all of the information in the required FGDC sections listed in Appendix E.

The HMCTC committee provides a FGDC-compliant metadata template for the Land Cover and the Accuracy Assessment (or Ground-truth Survey) Shapefile that contains all the standard required information and instructions for adding information about the reserve's mapping efforts and contact information. The committee also provides an instruction manual for entering information into the template, using ArcGIS Metadata Editor, and exporting the metadata as a stand-alone FGDC-compliant file. This instruction manual is provided in Appendix D and the templates are housed on the NERRS intranet.

The metadata reports will be reviewed for conformance with the standard operating procedures during the QA/QC process prior to posting maps to the CDMO website.

D. Attribute Table for Land Cover Shapefile

Consistent data and data standards within attribute tables are critical for accumulating data over time within a reserve, combining data among reserves, and for initiating automated QA/QC processes by the CDMO on the shapefiles. For this reason, the format and data within attribute tables must be consistent across reserves. For habitat maps submitted by the reserves to CDMO, each row of the attribute table represents a habitat unit (i.e., polygon) and each column provides information describing that particular unit. The columnar format of the attribute table is the backbone of the high-resolution land cover inventory, and therefore, is essential in allowing data interoperability between reserves and with other data producers and users. Standardize formatted attribute tables will enable analysis of reserve habitats and associated change over time across the NERRS.

Only the attribute field names listed in Appendix F should be included in the attribute table of the land cover shapefile. The attribute tables will be reviewed for conformance with the standard operating procedures during the QA/QC process prior to posting maps to the CDMO website.

E. Attribute Table for Accuracy Assessment Shapefile

As with the Land Cover table, consistent data and data standards within the Accuracy Assessment attribute table is critical for accumulating data over time within a reserve, combining data among reserves, and for initiating automated QA/QC processes by the CDMO on the shapefile. For Accuracy Assessment maps submitted by the reserves to CDMO, each record (row of the attribute table) represents information about the ground-truthing unit (i.e., polygon) and each column represents the data collect for that particular unit.

Only the attribute field names listed in Appendix G are allowed in the attribute table of the accuracy assessment shapefile. The attribute table will be reviewed for conformance with the standard operating procedures during the QA/QC process prior to posting maps to the CDMO website.

F. Attribute Table for Ground-Truth Survey Shapefile

As with the land cover table, consistent data and data standards within the ground-truth survey attribute table is critical for accumulating data over time within a reserve, combining data among reserves, and for initiating automated QA/QC processes by the CDMO on the shapefiles. For ground-truth survey maps submitted by the reserves to CDMO, each record (row of the attribute table) represents information about the ground-truthing unit (i.e., polygon) and each column represents the data collect for that particular unit.

Only the attribute field names listed in Appendix H are allowed in the attribute table of the ground-truth survey shapefile. The attribute table will be reviewed for conformance with the standard operating procedures during the QA/QC process prior to posting maps to the CDMO website.

G. Error Matrix Table

An error matrix table is only required for accuracy assessment of Areas of Perpetual Interest (priority habitats). For high priority habitats of perpetual interest, accuracy assessment reference points are typically verified with the higher accuracy verification sampling strategies (walking through stand or polygon; viewed from road or trail adjacent to stand; or viewed from afar) described by Congalton and Green (see section III.C. for more details on accuracy of sampling strategies). In some cases, the least accurate strategy, according to Congalton and Green, *Photo Interpreted in Office*, is used to verify the classifications of polygons; this method is acceptable if the mapper has sufficient knowledge of the mapped area. The name of the sampling strategy (walking through stand or polygon; viewed from road or trail adjacent to stand; or viewed from afar; photo Interpreted in office*)* used must be listed under the *Surv_Meth* field in the Accuracy Assessment or ground-truth survey attribute table. The error matrix data will be reviewed for conformance with the standard operating procedures during the QA/QC process prior to posting maps to the CDMO website.

Reserves must submit at least one Error Matrix table per land cover shapefile in the readme file. Description and formulas of components of error matrix are in Section III. Guidelines for error matrix tables are:

- For high priority habitats of perpetual interest, analysis is conducted on land cover classified at subclass level if possible. For non-priority habitats, analysis is conducted on land cover classified at the class level. Only one NERRS classification level (i.e. subclass) is permitted in an error matrix table.

- The field information collected by the higher accuracy verification sampling strategies (walking through stand or polygon; viewed from road or trail adjacent to stand; or viewed from afar) are allowed in the same error matrix table.

- The information interpreted solely from photo-interpretation is not allowed in same error matrix table with information collected by field sampling methods.

- Land cover classes/subclasses listed in the error matrix need to be named according to the NERRS Classification Scheme and both the Numeric Value and associated Nominal Value for land cover types (i.e. Cls_Num: 2260 and Cls_Nom: Emergent Wetland) must be listed. Please refer to format in error matrix table.
- The number of rows (User) must equal the number of columns (Producer), and the NERRS level category in the rows and columns must be the same. For habitats that were identified in the field but not mapped or were mapped incorrectly, should be listed under the Land Cover Classifications section in the readme file.

H. Habitat Photographs

Reserves must submit one photograph of each habitat included in the error matrix table, and listed in the readme file (see Readme file template in Appendix I). The photographs should be submitted as a JPEG format, and a maximum file size of 500 K. Photographs must be named according to the standard naming conventions identified in Appendix C. Photo file name and name of habitat in the photo should be listed in the Readme File. The photographs will be reviewed for conformance with the standard operating procedures during the QA/QC process prior to posting maps to the CDMO website.

I. NERRS – CMECS Crosswalk Table

Coastal and Marine Ecological Classification Standard (CMECS) is fully adopted by FGDC, and now all federally-funded projects are expected to use the classification scheme. A crosswalk that shows the relationship (i.e. equal to, broader, finer, no relationship) between the habitat categories in the CMECS and NERRS classification scheme is provided in Appendix A and in a spreadsheet at the NERRS Intranet. The reserves are expected to include a crosswalk table, which shows the relationship between their NERR classified habitats and CMEC classification names, in the Readme file (Appendix I). After the Land Cover dataset has been approved by the HMCTC, the NERRS information shapefile will be joined with CMECS information using a tool

created by NOAA Office for Coastal Management. The tool and instructions for using it are located at Digital Coast website (http://coast.noaa.gov/digitalcoast/tools/cmecs-crosswalk).

The NERRS – CMECS Crosswalk data will be reviewed for conformance with the standard operating procedures during the QA/QC process prior to posting maps to the CDMO website.

J. Readme File

Reserves must submit a "Readme File" that describes the land cover datasets. A template of the "Readme" file is provided in Appendix I. Readme files should include a description of the land cover dataset, the geographic extent of the classification, level of the classification (e.g. priority habitats classified to subclass Level, non-priority areas classified to class level), methodology used to generate land cover map, references, and information on how to access the references.

The information in the Readme File will be reviewed for conformance with the standard operating procedures during the QA/QC process prior to posting maps to the CDMO website.

VI. GIS Dataset Submission Process

A. Organizational Structure

The Habitat Mapping and Change Technical Committee (**HMCTC**) is a subcommittee of the System-Wide Monitoring Program (SWMP) Data Management Committee (DMC). The key priorities of this subcommittee are to ensure Quality Assurance/Quality Control (QA/QC) compliance with the standards established by the HMC Plan, provide technical assistance, set yearly priorities, and revise the standard operating procedures as necessary. Specifically, the role of this subcommittee will be to:

- **Provide technical assistance to reserves in support of mapping.**
  The committee will support the mapping community by assessing and coordinating training for all aspects of mapping including implementation of the NERR classification scheme, change analysis, accuracy assessment, etc. Committee members will also assist reserves in specific mapping needs.

- **Ensure that all map products submitted to the CDMO comply with the standards established by the HMC Plan and referenced in this standard operating procedure document**.
  The committee will review all data products submitted by reserves to ensure that it has FGDC-compliant metadata, attribute tables, and appropriate projections, scales, imagery resolution, nomenclature, accuracy assessment, etc. If a map product does not comply with the requirements of the plan, it will be returned for editing. No mapping product will be forwarded to the CDMO that does not meet the standards identified in the HMC Plan standard operating procedures.

- **Provide leadership to improve coordination within the NERR mapping community and with the new** Office for Coastal Management **to identify and address emerging needs and issues.**
  The committee will address emerging needs and issues that relate to mapping. This will include such responsibilities as adoption of new mapping protocols and standards by the FGDC and NOAA. The committee will be responsible for updating any new adopted protocols/standards in these standard operating procedures. The committee will also identify methods for streamlining access to data and enhancing integration within the NERR mapping community. Finally, this committee will establish system-wide priorities that lead to the yearly development of action plan and/or strategic proposals to be

submitted to the NERR Strategic Committee. In drafting these proposals, this committee will integrate to the maximum extent possible with the other DMC committees and the SWMP oversight committee.

- Monitor progress towards meeting annual operating plan goals.
  All reserves are encouraged to develop baseline maps and change maps based on high-resolution imagery every ten years, as identified in the NERRS three year annual operating plan. The committee will be responsible for evaluating progress towards these goals and support reserves having difficulty meeting their goals.
- Foster integration with the other phases of SWMP.
  One of the Co-Chairs of this habitat mapping and change subcommittee will be represented on the SWMP oversight and Sentinel Sites committees and will be responsible for overall coordination with the other SWMP sub-committees.

B. QA/QC Review Process

The reserve must submit the following files in a zip file that should contain the following information:

1) Land cover/and Accuracy Assessment (or ground-truth survey) shapefiles and associated metadata reports, and ArcMap projection file for both shapefiles.

2) One photograph of each habitat type of perpetual interest

3) Readme file that describes the land cover dataset, including information about the geographic extent of the classification, level of the classification (e.g. priority habitats classified to subclass level, non-priority areas classified to class level), and methodology used to produce datasets.

4) Stand-alone FGDC-compliant metadata report.

The reserve is responsible for sending the GIS package as a zip file to the HMCTC chair. The CDMO will conduct the 1st Review of the files (an "Exploder" script that will automatically check the file to ensure that all the required files are attached and nomenclature is in the correct format). The HMC GIS oversight committee representative will send a report to the reserve after each Review stage. The report will either outline the problems with the submission or notify the reserve that the submission has successfully passed the review. If there are problems, corrective steps must be taken by the reserve before the next review stage can be initiated. After the reserve makes the corrections, all of the files must be re-zipped and sent to the HMC GIS oversight committee representative.

Once the files are determined to be in compliance, the next stage of the review will be initiated. The HMC GIS oversight committee representative will perform the 2nd and 3rd Reviews, as outlined in the following section. When the files have successfully passed all the Review stages, the files will be uploaded to the CDMO ftp site by the HMCTC co-chairs, where they will be processed and made available to the public as a shapefile and KML file for Google Earth.

When the files have been approved as fully compliant with the standard operating procedures, the HMCTC Co-Chairs will send a letter acknowledging acceptance of the maps to the reserve (Appendix J).

C. Checklist for Review Process

To enhance the clarity and efficiency of submitting and reviewing the habitat map package, the HMCTC has developed a checklist for reserve staff. Below are the key elements of the check list. A complete checklist template is provided in Appendix K.

1ST QA/QC Review - Completeness of the ZIP file

1. Must submit the following datasets
   - Land Cover (HRLC) shapefile (must be vector format) and associated metadata report
   - Accuracy Assessment (AA) or Ground-truth Survey (GT) shapefile and associated metadata report
   - Hi Resolution Land Cover Readme file in *.doc or *.docx format.
   - Photographs (require one photograph per habitat listed in the Error Matrix table(s))

2. Projection files for HRLC and AA (or GT) shapefiles adhere to following coordinate systems:
   - Geographic Coordinate System: GCS_North_American_1983
   - Projection Coordinate System: NAD 1983 UTM zone [zone where Reserve occurs]

3. File names are consistent with NERRS standardized filename naming conventions (see Appendix C for details)

4. Shapefiles must have following files types: *.dbf, *.prj,*.sbn, *.sbx, *.shp, *.shp.xml, *.shx

5. Photographs are in JPEG format and file is less than 500 K

6.

2nd QA/QC Review - Completeness of the datasets

1. Attribute Tables
   - Required fields for the Land Cover, Accuracy Assessment (or Ground-truth) are included and formatted as outlined in Appendices F thru H, respectively

2. Metadata Reports
   - Required FGDC fields are entered based on the standard operating procedure metadata (See Appendices D and E)

3. Habitat photographs
   - Photograph of each habitat are provided and photograph information included in photograph table (see Readme template in Appendix I for format)

4. High-Resolution Land Cover Readme File
   - Required fields are entered based Readme template in Appendix I)

5. Accuracy Assessment analysis
   - Error Matrix table completed and kappa statistic provided in Readme file
   - NERRS – CMECS crosswalk table completed (see Readme template)

3rd Review - Correctness of information in Files

1. Attribute Tables
   - Correct spellings of classification names (i.e. Nominal)
   - Correct relationship between NERRS Classification Nominal and Numeric Value for each category (i.e. 2200 [CLS_NUM] Intertidal Haline [CLS_NOM])
   - Correct relationship between User and Producer NERRS Classification categories (User: 2220 and Producer: 2230 = Not Agree) is listed in the Agree or Not_Agree field in the Accuracy Assessment shapefile

2. Land Cover (HRLC) and AA Metadata Reports
   - Consistency between information in metadata report and Readme file

4. High-Resolution Land Cover Readme File
   - Consistency between information in metadata report and Readme file
   - Tallies for categories in Error Matrix Table matches tallies in AA attribute table
   - Calculations in Error Matrix Table(s) and associated Kappa Statistics are correct
   - Correct relationship between NERRS – CMECS categories in crosswalk table
   - Correct relationship between habitat name of habitat photograph name
   - Correct relationship between habitat photograph name and NERRS Classification category

VII. Literature Cited

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Appendix A: NERRS-CMECS Classification Crosswalk

Last Update: May 2014
Text in italics means that there is no one-to-one relationship between the NERRS and CMECS classification level.

NERRS Classification Levels	CMECS Classification Levels
Marine System	Marine System
Subtidal Subsystem	*Under Nearshore Subsystem* *Subtidal Tidal Zone*
Intertidal Subsystem	*Under Nearshore Subsystem* *Intertidal Tidal Zone*
No equivalent	*Under Nearshore Subsystem* *Supratidal Tidal Zone*
Estuarine System	Estuarine System
Subtidal Haline Subsystem	*Under Estuarine Coastal Subsystem* *Subtidal Tidal Zone*
Intertidal Haline Subsystem	*Under Estuarine Coastal Subsystem* *Intertidal Tidal Zone*
Supratidal Haline Subsystem	*Under Estuarine Coastal Subsystem* *Supratidal Tidal Zone*
Subtidal Fresh Subsystem	*Under Tidal Riverine Coastal Subsystem* *Subtidal Tidal Zone*
Intertidal Fresh Subsystem	*Under Tidal Riverine Coastal Subsystem* *Intertidal Tidal Zone*
No equivalent	*Under Tidal Riverine Coastal Subsystem* *Supratidal Tidal Zone*
Lacustrine System	Lacustrine System
Limnetic Subsystem	Limnetic Subsystem
Littoral Subsystem	Littoral Subsystem
Riverine System	No equivalent
Lacustrine System	No equivalent
Upland System	No equivalent
Cultural Land Cover	No equivalent

NERRS Classification Levels	CMECS Classification Levels
Rocky Shore/Rock Bottom/Streambed Class	Rock Substrate Class
Bedrock Subclass	Bedrock Subclass
Rubble Subclass	*Under Anthropogenic Substrate Setting Group category*
No equivalent	Megaclast Subclass
Unconsolidated Shore/Unconsolidated Bottom/ Streambed Class	*Under Unconsolidated Mineral Substrate Class*
	Coarse Unconsolidated Substrate Subclass
Cobble Subclass	*Under Gravel Group*
Gravel Subclass	
Unconsolidated Shore/Unconsolidated Bottom/ Streambed Class	*Under Unconsolidated Mineral Substrate Class*
	Fine Unconsolidated Substrate Subclass
Sand Subclass	*Under Sand Group*
Mud Subclass	*Under Mud Group*
Organic Subclass	*Under Organic Substrate Class*
Under Descriptor/Modifier Level	Organic Debris Subclass
Under Descriptor/Modifier Level	Organic Detritus Subclass
Under Descriptor/Modifier Level	Organic Mud Subclass
Vegetated Subclass	**No equivalent**

Streambed*. The Class Streambed includes all wetlands contained within the Intermittent Subsystem of the Riverine System and all channels of the Estuarine System that are completely dewatered at low tide.*

NERRS Classification Levels	CMECS Classification Levels
Aquatic Bed Class	*Under Benthic/Attached Biota Setting and Planktonic Biota Setting*
Rooted Algal Subclass	*Under Benthic/Attached Biota Setting Aquatic Vegetation Bed Class Benthic Macroalgae Subclass Biotic Group category*
Drift Algal Subclass	*Under Planktonic Biota Setting Floating/Suspended Plants Class Floating/Suspended Macroalgae Subclass Biotic Group category*
Rooted Vascular Subclass	*Under Benthic/Attached Biota Setting Aquatic Vegetation Bed Class Aquatic Vascular Vegetation Subclass Biotic Group category*
Floating Vascular Subclass	*Under Planktonic Biota Setting Under Floating/Suspended Plants Class Floating/Suspended Vascular Vegetation Subclass Biotic Group category*
Faunal Subclass	*Under Benthic/Attached Biota Setting Faunal Bed Class Biotic Group category*
Moss Subclass	*Under Benthic/Attached Biota Setting Aquatic Vegetation Bed Class Freshwater Tidal Moss Subclass Biotic Group category*
Reef Class	Reef Biota Class
Mollusk Subclass	Mollusk Reef Biota Subclass
Worm Subclass	Worm Reef Biota Subclass
Artificial Subclass	*Under Anthropogenic Substrate Setting*
Emergent Wetland Class	Emergent Wetland Class
Persistent Subclass	*Under Modifier*
Non-Persistent Subclass	*Under Modifier*
Scrub-Shrub Wetland Class	Scrub-Shrub Wetland Class
BLD/NLD/BLE/NLE/Dead Subclasses	No equivalent
Forested Wetland Class	Forested Wetland Class
BLD/NLD/BLE/NLE/Mixed/Dead Subclasses	No equivalent

Appendix B: Required Attributes for Reserve and Watershed Boundary Shapefiles

Last Update: May 19 2015

Reserve Boundary

Attribute Field Name	Field Description	Field Type	Data Type	Length
FID	Unique Identifier	Numeric	Short Integer	
Shape	Polygon	String	Text	
Res_Name		String	Text	
Comp_Name	Blank if not multi-component reserve	String	Text	
Updat_Date	Date boundary was last updated	String	Date	
Area_sqKM	Area in Square KM	Numeric	Double Integer	Precision: 15 Scale: 5
Area_ha	Area in Hectares	Numeric	Double Integer	Precision: 15 Scale: 5
Parc_Type	Designation of parcel	String	Text	
Comment	Information about parcel	String	Text	

Watershed Boundary

Attribute Field Name	Field Description	Field Type	Data Type	Length
FID	Unique Identifier	Numeric	Short Integer	
Shape	Polygon	String	Text	
Reserve Name		String	Text	
Shape_Area	Area in Square KM	Numeric	Double Integer	Precision: 15 Scale: 5
Hectares	Area in Hectares	Numeric	Double Integer	Precision: 15 Scale: 5
State	Text	String	Text	
County	Text	String	Text	
HUC (may have multiple HUCs)	Text	String	Text	
		String	Text	

Appendix C: Standardized Naming Conventions

Last Update: May 2014

Reserve Name	Reserve Code
Ashepoo-Combahee-Edisto Basin, South Carolina	ACE
Apalachicola Bay, Florida	APA
Chesapeake Bay, Maryland	CBM
Chesapeake Bay, Virginia	CBV
Delaware	DEL
Elkhorn Slough, California	ELK
Grand Bay, Mississippi	GND
Great Bay, New Hampshire	GRB
Guana Tomalato Mantanzas, Florida	GTM
Hudson River, New York	HUD
Jacques Cousteau, New Jersey	JAC
Jobos Bay, Puerto Rico	JOB
Kachemak Bay, Alaska	KAC
Lake Superior, Wisconsin	LKS
Mission-Aransas, Texas	MAR
Narragansett Bay, Rhode Island	NAR
North Carolina	NOC
North Inlet-Winyah Bay	NIW
Old Woman Creek, Ohio	OWC
Padilla Bay, Washington	PDB
Rookery Bay, Florida	RKB
San Francisco Bay, California	SFB
Sapelo Island, Georgia	SAP
South Slough, Oregon	SOS
Tijuana River, California	TJR
Waquoit Bay, Massachusetts	WQB
Weeks Bay, Alabama	WKB
Wells, Maine	WEL
Reserve Component Name (applies if shapefile only contains land cover for a section of the reserve)	**Component Code**
Component Name [i.e. China Camp component of San Francisco Bay NERR]	XX [code created by Reserve]
Land Cover File Type	**File Code**
High-resolution habitat map - entire Reserve	HRLC
Accuracy Assessment of habitats - entire Reserve	HRLC_AA
Ground-truth Survey map of habitats - entire Reserve	HRLC_GT
High-resolution habitat map –component or particular geographic area	HRLC_XX
Accuracy Assessment of habitats - component or particular geographic area	HRLC_XX_AA
Ground-truth Survey of habitats - component or particular geographic area	HRLC_XX_GT
Change analysis of habitats – entire Reserve	HRCA
Accuracy Assessment of change analysis map – entire Reserve	HRCA_AA
Change analysis of habitat maps - component or particular geographic area	HRCA_XX
Accuracy Assessment of change analysis map - component or particular geographic area	HRCA_XX_AA

Photos associated with Accuracy Assessment	See examples below
Readme File for land cover maps	See examples below
Boundary File Type	**Boundary Code**
Reserve Boundary	RB
Estuarine Basin Boundary	EBB
Targeted Watershed Boundary	TWB
Small Watershed Boundary	SWB
Date	**Date Code**
Reserve/ Estuarine Basin/Targeted Boundary - Year produced	YYYY
Change Analysis – Baseline imagery year and Current imagery year	YYYY_YYYY
High-resolution land cover maps – Month and year imagery acquired	YYYYMM
Photos associated with Accuracy Assessment - Month and year photo taken	YYYYMM
Readme File - Month and year imagery acquired	YYYYMM

Examples of Standardized Naming Schemes

Land Cover map:

[ReserveCode]_[if applicable, ComponentCode]_[LandCoverFileCode]_[DateCode]

- San Francisco Bay NERR submits a baseline map of China Camp component. The high-resolution imagery was collected in July of 2006. The shapefile is titled **SFB_CC_HRLC_200607**.
- North Inlet – Winyah Bay NERR submits a baseline map for the entire reserve that was generated from high-resolution imagery collected in March of 2006. The shapefile is titled **NIW_HRLC_200603.**

Accuracy Assessment (AA):

[ReserveCode]_[if applicable, ComponentCode]_[LandCoverFileCode]_[AAFileCode]_[DateCode]

- Padilla Bay NERR submits the accuracy assessment of the baseline map for the entire reserve. Map was generated from high-resolution imagery collected in August of 2004. The filename is titled **PDB_HRLC_AA_200408.**
- San Francisco Bay NERR submits the accuracy assessment of the baseline map for China Camp component that was generated from high-resolution imagery collected in July of 2006. The shapefile is titled **SFB_CC_HRLC_AA_200607**.
- Hudson River NERR submits the ground-truth survey of the baseline map for the Tivoli Bays component. Map was generated from high-resolution imagery collected in August of 2008. The filename is titled **HUD_TB_HRLC_GT_200808.**

Change Analysis map:

[ReserveCode]_[if applicable, ComponentCode]_[LandCoverFileCode]_[DateCode]

- San Francisco Bay NERR submits a change analysis of habitats in the China Camp component based on high-resolution imagery acquired in July of 2006 and July of 2016. The shapefile is titled **SFB_CC_HRCA_2006_2016**.
- Elkhorn Slough NERR submits a change analysis of habitats in entire reserve based on high-resolution imagery acquired in June of 2006 and June of 2016. The shapefile is titled **ELK_HRCA_2006_2016**.

Photographs:

[ReserveCode]_[if applicable, ComponentCode]_[LandCoverFileCode]_[NERRS ClassificationLevel]_[Descriptor*****]_[DateCode]

*****Descriptor codes provided by the reserve and definition of codes provided in Photographs section in Readme file

- Hudson River NERR submits a photograph taken in August of 2011 of an Estuarine Intertidal Haline, Persistent Emergent Wetland habitat type in the Tivoli Bays component. The filename is titled

HUD_TB_HRLC_2261_201108.jpg.

- Padilla Bay submits photographs taken in August of 2004 of *Zostera japonica* bed, one of several types of submerged aquatic vegetation (SAV) habitats in the reserve. The filename is titled PDB_HRLC_2261_ZJ_200408.jpg.
- North Inlet – Winyah Bay NERR submits a photograph taken in July of 2009 of an Estuarine Intertidal Haline, Persistent Emergent Wetland habitat type in the reserve. The shapefile is titled NIW_HRLC_2261_200907.jpg.

Readme File:

Readme_[ReserveCode]_[LandCoverFileCode]_[DateCode]

- Hudson River NERR submits a readme file that contains information for all four reserve component maps created with high-resolution imagery taken in August of 2008. The filename is titled HUD_HRLC_200808_Readme.docx.
- San Francisco Bay NERR submits of readme file that contains information only for the China Camp component map created with high-resolution imagery taken in July of 2006. The filename is titled SFB_CC_HRLC_200607_Readme.doc.
- Padilla Bay NERR submits a readme file that contains information for a reserve-wide map created with high-resolution imagery taken in August of 2004. The filename is titled PDB_HRLC_200408_Readme.docx.

Boundary Files:

[ReserveCode]_[BoundaryCode]_[DateCode]

Elkhorn Slough NERR updates its reserve boundary in November of 2008 pursuant to new acquisitions. The shapefile is titled ELK_RB_2008.

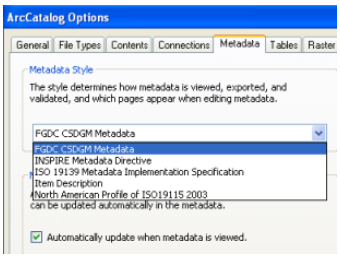
Appendix D: Entering FGDC Metadata Information

Before you begin, select the FGDC CSDGM Metadata style for viewing metadata. Select ArcCatalog Options on the main menu bar and then click the metadata tab from the options window.

Follow the instructions listed below for adding the Metadata template to the HRLC and AA shapefiles; using ERSI Metadata Tool to enter information into the template; and importing and exporting a standalone metadata file to your shapefile metadata report. If you prefer adding metadata information with USGS FGDC Metadata Editor Tool, the tool and instructions for adding it area provided at http://geology.usgs.gov/tools/metadata/.

Last Update: 03/23/2015

More detailed instructions and are available in:
http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#/Creating_and_managing_FGDC_metadata/003t00000031000000/
http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#/Illustrated_guide_to_complete_FGDC_metadata/003t00000037000000/



1. Before importing template, choose the appropriate metadata style in the ***Options*** dialog box of ArcCatalog (see figure to the right)
   a. Click **Customize** > **ArcCatalog Options**.
   b. The ***Options*** dialog box appears.
   c. Click the **Metadata** tab.
   d. Click FGDC CSDGM Metadata in the Metadata Style list.
   e. Click **OK**.

2. Import NERRS metadata template to the HRLC and AA (or GT) metadata reports as follow:
   a. **IMPORTANT:** The metadata template will overwrite any information in your current metadata. So, make a copy of your current metadata if it contains information you will add to the template.
      - Export your current metadata report to a standalone metadata, as described below
        - If info is in the *Read Only FGDC* section: open *ArcToolbox*, select *Conversion Tools*; next, *Metadata*; then *USGS MP Metadata Translator*; in the *Source Metadata* window, add name of your shapefile
        - If info is in the *ArcGIS* section: open *ArcToolbox*, select *Conversion Tools*; next, *Metadata*; then *Export Metadata*; in the *Source Metadata* window, type name of your shapefile and in Translator window, use "ArcGIS2FGDC.xml" as the translator (in "ArcGIS\Desktop10.x\Metadata" directory); in *Output File* window, type name of new metadata (put in folder with other shapefiles).
        - Then "cut and paste" the required metadata information from the exported metadata into the imported metadata template.

   b. To import the metadata template, open *ArcToolbox* and select *Conversion Tools*, next *Metadata* and then *Import Metadata* menu; in the *Import Metadata* window fill in following information
      - Source Metadata – Browse to the template name and highlight it
      - Import Type - Select "FROM_FGDC" from the dropdown menu
      - Target metadata – Browse to your shapefile (in the dropdown menu, select HRLC, HRLC_AA or HRLC_GT) and highlight it

   c. The metadata you just imported may not appear until you go back to "Contents" tab, highlight the *.shp file, and select "Description" tab

   d. **ALSO**, In order for ESRI to add the "Bounding Box" and Projected Coordinates" for the shapefile, you must add shapefile to ArcMap project with imagery of your Reserve

3. General instructions for filling in required FGDC information in the NERRS metadata template.
   a. Type in appropriate info wherever you see a *** in a field (see following example). Delete *** and associated text after you enter info. Blank fields are optional sections

   b. Check all "drop down menus" to make sure you've updated any necessary information. Example: In the "Topics & Keywords" section, click on the downward arrow to see information for "Place Keywords" and type in the required information.
   c. For ESRI to fill in the Bounding and Coordinate System info, you have to open the shapefile in ArcMap before you submit it to the HMCTC.

4. If you have entered all of the FGDC information listed in Step 5 below, it is OK if ESRI says there are errors (denoted by red x's next to the section name) in a metadata field

5. Using ArcGIS metadata editor, add information to the following required FGDC sections (ArcGIS equivalent names are in parenthesis). **NOTE**: More detail descriptions of relationship between FGDC and ArcGIS fields are in ESRI's *Creating and Managing FGDC Metadata*, *Editing FGDC metadata content in the Description tab* chapter

a. Citation (***In ArcGIS metadata, go to Overview section)***

- **Originator (under *Citation Contacts tab)***
  - Type in appropriate info wherever you see ***
- **Publication Date (under *Citation tab)***
  - Date filled in by HMCTC before GIS package is posted to data.gov –(Field under *Dates* tab)
- ***Title (under Citation tab)***
  - Update the title to the appropriate format listed below; input your NERRS site name and the date the imagery was taken. The date can be a year.

    Accuracy Assessment Map of [enter name of NERRS site] for [enter date imagery taken]

    Ground-truth Surveys Map of [enter name of NERRS site] for [enter date imagery taken]

    Land Cover Map of [enter name of NERRS site] for [enter date imagery taken]

b. Description (***In ArcGIS metadata, go to Overview section, Item Description tab)***

- ***Tags*** (same as *Keywords*) – Delete the information in this field. ESRI will re-populate it with information you enter in the Keywords section below.
- ***Abstract*** (equivalent to *Description*) - Type in appropriate info where you see ***
- ***Purpose*** (equivalent to *Summary*) - Type in appropriate info where you see ***
- **Language (*In ArcGIS metadata, go to Resource section, Details tab)***
  - Habitat & Mapping Change Technical Committee filled in details
- ***Supplemental Information*** (***go to Resource section, Details tab)***
  - Type in appropriate info where you see ***
  - If you don't add Supplemental Information, please delete HMCTC's text in the window

c. Time Period (In ArcGIS metadata, go to Resource section, Extents tab) [Mapping time frame] ~~~Refers to time period of mapping process or Accuracy Assessment/Ground-truth surveys~~~

Select either a range of dates or a single date

- **Range of Dates**
  - Select *Temporal Period Extent* dropdown menu
    - Use dropdown calendar to enter Begin Date/Time and End Date/Time
    - Single date
  - Select *Temporal Instant Extent* dropdown menu
    - Use dropdown calendar to enter the Date or Time and Time
- **Current** (equivalent to *Description*)
  - Select "ground condition" or "publication date"

d. Status of the Data (***In ArcGIS metadata, go to Resource section)***

- **Progress** (equivalent to *Status)* ***(Under Details tab)***
  - Habitat & Mapping Change Technical Committee filled in details
- **Update Frequency** (equivalent to *Update Frequency*) **(*Under Maintenance tab*)**
  - Select from the dropdown menu

e. Spatial Domain (***In ArcGIS metadata go to Resource section, Extents tab*)**

- **Bounding Coordinates** (equivalent to *Bounding Box)*
  - ESRI fills in details to the new metadata template when the shapefile is added to ArcMap

f. Keywords (***In ArcGIS metadata, go to Overview section, Topics & Keywords tab)***

- Type in appropriate info in the "Place Theme" window where you see ***

g. Data Storage and Access Information (***In ArcGIS metadata, go to Resource section, Constraints tab)***

- **Access constraints** (equivalent to *Use Limitation*)
  - Select *General Constraints* dropdown menu
  - Habitat & Mapping Change Technical Committee filled in details
- **Use constraints** (equivalent to *Use limitation*)
  - Select 2nd *Legal Constraints* dropdown menu
  - Habitat & Mapping Change Technical Committee filled in details

h. Point of Contact (*In ArcGIS metadata, go to Resource section, Points of Contact tab)*

- **Contact Originator**
  - Select *Contact: (Point of Contact)* dropdown menu
  - Type in appropriate info wherever you see ***
- **Contact Information** (equivalent to *Name or Organization*)
  - Stay in *Contact* dropdown menu **AND** select *Contact Information* dropdown menu
  - Type in appropriate info wherever you see ***

i. Data Quality (*In ArcGIS metadata, go to Resource section, Quality tab)*

Do not have to fill out the following fields:
Conformance Result or Quantitative Result
Value Units
Quantitative Value
Identifier Code
Title
Date (two entries required)

- **Logical Consistency Report** (equivalent to *Conceptual Consistency*) [Under the 1st *Report* tab]
  Habitat and Mapping Change Technical Committed entered information. Reserve may enter additional information
  - First Report dropdown menu **THEN** select the *Measure* dropdown menu
- **Completeness Report** (equivalent to *Completeness Omission*) [Under the 2nd *Report* tab]
  Habitat and Mapping Change Technical Committed entered information. Reserve may enter additional information
  - Second Report dropdown menu **THEN** select the *Measure* dropdown menu
- **Quantitative Attribute Report** (equivalent to *Attribute Accuracy Report*) [Under the 3rd *Report* tab]
  Habitat and Mapping Change Technical Committed entered information. Reserve may enter additional information
  - Third Report dropdown menu **THEN** select the *Measure* dropdown menu

j. Lineage (*In ArcGIS metadata, go to Resource section, Lineage tab)*

- **Source Contribution** (equivalent to *Source Description)* -imagery
  - Select Data Source dropdown menu
  - Type in appropriate info where you see ***
- **Title** (equivalent to *Title*)
  - Stay in *Data Source,* select *Source Citation* dropdown menu, **THEN** *Titles* dropdown menu
  - Type in appropriate info where you see ***
- **Source Citation Abbreviation** (equivalent to *Alternate Title)*
  - Stay in *Title* dropdown menu
  - Type in appropriate info where you see ***
- **Originator** (equivalent to *Organization)*
  - Stay in *Source Citation* dropdown menu **AND** select the *Contact* dropdown menu
  - Type in appropriate info where you see ***
- **Source Currentness Reference** (equivalent to *Description)*
  - Stay in *Source Citation* dropdown menu **AND** select the *Source Extent* dropdown menu
  - Select "ground condition" or "publication date"
- **Time Period (*equivalent to Temporal Period Extent) [When imagery was flown]***
  - Stay in *Source Extent* dropdown menu, **THEN** select *Temporal Period Extent* dropdown menu
    OR select *Temporal Instant Extent* dropdown menu
    Input Begin Date/Time and End Date/Time

k. Process Step (*In ArcGIS metadata, go to Resource section, Lineage tab)*

- **Process Description (equivalent to *Process Step Description*)**
  - Select Process Step dropdown menu
  - Type in appropriate info in the *Description* window where you see ***
- **Process Date (equivalent to *Process Step Date*)**
  - Stay in Process Step dropdown menu **AND** click on calendar icon - refers time it took to complete information provided in the "Process Description" window

l. Spatial Data Organization Information (*In ArcGIS metadata, go to Resource section, Details tab)*

Direct Spatial Reference Method (equivalent to *Spatial Representation Type*)
ESRI fills in details to the new metadata template when the shapefile is opened in ArcMap

m. Spatial Reference Information (Can't be viewed in edit mode of *ArcGIS metadata)*

ESRI fills in details about horizontal coordinate system selected by user; details added to the new metadata template when the shapefile is opened in ArcMap
Planar: Grid Coordinate System (i.e. UTM Zone 17)
Geodetic Model: Horizontal Datum Name (i.e. North American Datum of 1983)

n. Entity and Attribute Information (*In ArcGIS metadata, go to Fields section)*
- Habitat & Mapping Change Technical Committee filled in details

o. Distribution (*In ArcGIS metadata, go to Resource section, Distribution tab)*
Format Version *- Do not have to fill out this field*

s. Metadata Reference Information (*In ArcGIS metadata, go to Metadata section, Contacts tab)*
- Habitat & Mapping Change Technical Committee filled in details

6. **Finishing steps:**
- Save the ArcGIS metadata
- Give the metadata a quick review by looking at the information in the Description tab.
  - The Tags section does not seem to get updated so ignore that section
  - If you see any ***'s or unknown dates go back into the editor and update these fields
- Export metadata as a standalone FGDC metadata file (*.xml).
  - Use Export Metadata option in ArcToolbox - select Conversion Tools then Metadata
  - Use "ArcGIS2FGDC.xml" as the translator (in "ArcGIS\Desktop10.x\Metadata" directory).
  - Use following naming nomenclature:
    For land cover maps: [Reserve Code]_HRLC_[YYYYMM]_FGDC.xml
    For accuracy assessment maps: [Reserve Code]_HRLC_AA_[YYYYMM]_FGDC.xml
    For ground-truth survey maps: [Reserve Code]_HRLC_GT_[YYYYMM]_FGDC.xml

Appendix E: Minimum Information Required for the FGDC-Compliant Metadata ReportLast Update: May 2014

The metadata template provided by the HMCTC provides instructions for filling in the appropriate info in the following required fields – just add info wherever you see a *** in a field. Remember to delete *** and associated text after you enter info.

Citation
Originator (name, organization, mailing address, and telephone number)
Publication Date
Geospatial Presentation Form [ESRI fills in details]

Contact
Point of Contact (name, organization, mailing address, and telephone number)

Description

Abstract (A brief narrative summary of the data set)

- At a minimum, include the following information about the mapped areas
  - ✓ The base map (i.e. aerial photography/digital imagery) and scale or resolution of imagery
  - ✓ Date base map was taken

- **For Land cover shapefile**: **Note** if areas were delineated on paper or electronic map or by manual or automated methods; for example, "heads-up" (i.e., on-screen) digitizing, list techniques, i.e. screen viewing scale (e.g., 1:3000 to 1:5:000); and automated techniques, i.e. supervised classification
  - **For the accuracy assessment (or Ground-truth Surveys) shapefile**, at a minimum, include the following information:
  - ✓ Date sampling was done: year month, and day(s)
  - ✓ Brief description of method. Refer user to the Readme file for more details

Purpose (A summary of the intentions with which the data set was developed)
Brief narrative of the data set

Time Period (time frame for which the data is relevant)
Date and time
Currentness reference (The basis on which the time period of content information is determined)

Status of the Data
Progress (state of the dataset)
Maintenance &update frequency (The frequency of update to base map)

Spatial Domain [ESRI fills in details]
Bounding Coordinates
In decimal degrees
In projected or local coordinates

Keywords Theme (Common-use words or phrases used to describe the subject of the data set). We require, at a minimum: the keywords in the metadata template. Thesaurus (Reference to a formally registered thesaurus or a similar authoritative source of theme keywords). At a minimum, **ENTER:** NONE
Data Storage and Access Information Access constraints (Restrictions and legal prerequisites for accessing the data set) Use constraints (Restrictions and legal prerequisites for using the data set after access is granted)
Spatial Data Organization Information [ESRI fills in details]
Spatial Reference Information [ESRI fills in details about coordinate systems entered by user] Horizontal Coordinate System Planar: Grid Coordinate System (i.e. UTM Zone 17) Geodetic Model: Horizontal Datum Name (i.e. North American Datum of 1983)
Entity and Attribute Information (See Appendix ?? for information required for this section) **Entity descriptions** **Entity and Attribute Overview** **References for Entity and Attributes:** **Attribute descriptions and values**

Appendix F: Required Attributes for Land Cover Shapefiles

Last Update: May 2015

List of required attribute columns required for high-resolution habitat shapefiles (modified from Walker and Garfield 2006). If an asterisk is next to field name, see footnote after table.

Attribute Field Name	Field Description	Field Type	Data Type	Length
Res_Code	Full Name: Reserve Code - Code assigned by HMCTC (see table V.1)	Text		
Comp_Code	Full Name: Component Code - Two-letter code assigned by reserve. If only mapping a portion of reserve, use a code that describes that region; if no component code or site specific code, leave blank.	Text		
PolyID*	Full Name: Polygon Identifier - Code assigned by reserve	Text		
Location	Full Name: Polygon Location - Indicates if polygon is inside or outside reserve boundary. **ENTER:** Inside or Outside	Text		
Area_ha	Full Name: Feature Area (Numeric) - Area of polygon in hectares	Numeric	Double Integer	Precision: 15 Scale: 5
Hab_type	Indicate habitat importance of polygon; **ENTER:** Priority or Non-priority for habitat types & Land Use for Cultural types	Text		
Sys_Num	NERRS Name: System (Numeric) - NERRS Level 1 category	Numeric	Short Integer	
Sys_Nom	NERRS Name: System (Nominal) - NERRS Level 1 category	Text		
SubSys_Num	NERRS Name: Subsystem (Numeric) - NERRS Level 2 category	Numeric	Short Integer	
SubSys_Nom	NERRS Name: Subsystem (Nominal) - NERRS Level 2 category	Text		
Cls_Num	NERRS Name: Class (Numeric) - NERRS Level 3 category	Numeric	Short Integer	
Cls_Nom	NERRS Name: Class (Nominal) - NERRS Level 3 category	Text		
SubCls_Num	NERRS Name: Subclass (Numeric) - NERRS Level 4 category	Numeric	Short Integer	
SubCls_Nom	NERRS Name: Subclass (Nominal) - NERRS Level 4 category	Text		
Dsc_Nom	NERRS Name: Descriptor (Numeric) - Common habitat name assigned by mapper	Text		
Dom_Nom	NERRS Name: Dominance (Nominal) - Dominant species listed by mapper	Text		
CMECS_Name	CMECS categories (see Section ***I.*** below.); **ENTER:** See Readme File	Text		
Comments	Reserve remarks	Text		

Format for PolyID Attribute Field Name

PolyID Code: [ReserveCode]]_[if applicable, ComponentCode]_[5-digit Polygon Unique Number]
San Francisco Bay NERR submits a baseline map of China Camp component. The high-resolution imagery was collected in July of 2006. The shapefile contained 1820 polygons, and **PolyID** named for the fifth polygon is SFB_CC_00005.

Appendix G: Required Attributes for Accuracy Assessment Shapefiles

Last Update: May 19, 2015
Definition of NERRS Classification levels are described in Kutcher et al. 2008. If an asterisk is next to field name, see footnote after table.

Attribute Field Code	Description	Field Type	Data Type	Length
Res_Code	Full Name: Reserve Code - Code assigned by HMCTC (see table V.1)	String	Text	
Comp_Code	Full Name: Component Code - Two-letter code assigned by reserve	String	Text	
PolyID	Full Name: Polygon Identifier - Code assigned by reserve - Use code that is in the HRLC attribute table	String	Text	
UCls_Num	Full Name: User Class (Numeric) - NERRS level category assigned by mapper	Numeric	Short Integer	
UCls_Nom	Full Name: User Class (Nominal) - NERRS level category assigned by mapper	String	Text	
USubCl_Num	Full Name User Subclass (Numeric) - NERRS level category assigned by mapper	Numeric	Short Integer	
USubcl_Nom	Full Name: User Subclass (Nominal)NERRS level category assigned by mapper	String	Text	
UDsc_Nom	Full Name: Descriptor (Nominal) - NERRS level category assigned by mapper	String	Text	
UDom_Nom	Full Name: Dominant (Nominal) - NERRS level category assigned by mapper	String	Text	
AA_ID	Full Name: Accuracy Assessment ID - Unique number assigned to ground-truth point by the Reserve	Numeric	Short Integer	
X_coor	Full Name: GPS X-Coordinate - Decimal degree format (5 significant digits)	Numeric	Double	Precision: 15 Scale: 5
Y_coor	Full Name: GPS Y-Coordinate - Decimal degree format (5 significant digits)	Numeric	Double	Precision: 15 Scale: 5
PCls_Num	Full Name: Producer Class (Numeric) - NERRS level category assigned by individual conducting ground-truthing	Numeric	Short Integer	
PCls_Nom	Full Name: Producer Class (Nominal) - NERRS level category assigned by individual conducting ground-truthing	String	Text	
PSubcl_Num	Full Name: Producer Subclass (Numeric) - NERRS level category assigned by individual conducting ground-truthing	Numeric	Short Integer	
PSubcl_Nom	Full Name: Producer Subclass (Nominal) - NERRS level category assigned by individual conducting ground-truthing	String	Text	
Agree	Indicate relationship between mapped and field classification. **ENTER:** 'x' if user & producer classification agree; If they don't agree, leave field blank	String	Text	
Not_Agree	Indicate relationship between mapped and field classification. ENTER: 'x' if user & classification of land cover type **DON'T AGREE**. If they agree, leave field blank	String	Text	
PDsc_Nom	Full Name: Descriptor (Nominal) - NERRS level category assigned by individual conducting ground-truthing	String	Text	
PDom_Nom	Full Name: Dominant (Nominal) - NERRS level category assigned by individual conducting ground-truthing	String	Text	
Surv_Meth*	Full Name: Field Survey method - Field method used to verify classification of mapped habitats; **For each habitat, ENTER one of the** methods listed below	String	Text	
NERR_Level	Finest NERRS level category (i.e. Class, Subclass, Descriptor) assigned to habitat by mapper	String	Text	
Comments	Reserve remarks	String	Text	

Survey Methods

Walk through stand or polygon
Viewed from road or trail adjacent to stand
Viewed from afar (i.e. road or ridge opposite of stand)
Photo interpreted in office

Appendix H: Required Attributes for Ground-Truth Survey Shapefiles

Last Update: May 19, 2015

Definition of classification levels are described in Kutcher et al. 2008. If asterisk is next to field name, see footnote after table.

Attribute Field Code	Description	Field Type	Data Type	Length
Res_Code	Full Name: Reserve Code - Code assigned by HMCTC (see table V.1)	String	Text	
Comp_Code	Full Name: Component Code - Two-letter code assigned by reserve	String	Text	
PolyID	Full Name: Polygon Identifier - Use code that is in the HRLC attribute table	String	Text	
PCls_Num	Full Name: Producer Class (Numeric) - NERRS level category assigned by individual conducting ground-truthing	Numeric	Short Integer	
PClsl_Nom	Full Name: Producer Class (Nominal) -NERRS level category assigned by individual conducting ground-truthing	String	Text	
PSubcl_Num	Full Name: Producer Subclass (Numeric) -NERRS level category assigned by individual conducting ground-truthing	Numeric	Short Integer	
PSubcl_Nom	Full Name: Producer Subclass (Nominal) -NERRS level category assigned by individual conducting ground-truthing	String	Text	
PDsc_Nom	Full Name: Descriptor (Nominal) -Habitat name assigned by individual conducting ground-truthing	String	Text	
PDom_Nom	Full Name: Dominant (Nominal) -Species dominance assigned by individual conducting ground-truthing	String	Text	
GT_ID	Full Name: Ground-truth Survey ID - Unique number assigned to ground-truth point by the Reserve	Numeric	Short Integer	
X_coor	Full Name: GPS X-Coordinate - Decimal degree format (5 significant digits)	Numeric	Double	Precision: 15 Scale: 5
Y_coor	Full Name: GPS Y-Coordinate - Decimal degree format (5 significant digits)	Numeric	Double	Precision: 15 Scale: 5
Surv_Meth	Full Name: Field Survey method - Field method used to verify classification of mapped habitats; **For each habitat, ENTER one of the** methods listed below	String	Text	
NERRS_Level	Finest NERRS level category (i.e. Class, Subclass, Descriptor) assigned to habitat by mapper	String	Text	
Comments	Reserve remarks	String	Text	

Survey Methods

Walk through stand or polygon

Viewed from road or trail adjacent to stand

Viewed from afar (i.e. road or ridge opposite of stand)

Photo interpreted in office

Appendix I: Template and Example for "Readme" File

Last Update: May 2014

High-Resolution Land Cover Readme File
[RESERVE NAME] **NERR**

Date of Last Update:

NOAA/ERD retains the right to analyze, synthesize and publish summaries of the NERRS land cover data. The Principal Investigator of the mapping program at the Reserve retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the PI and NERR site where the data were collected will be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. Manuscripts resulting from the NOAA/OCRM supported research that are produced for publication in open literature, including refereed scientific journals, will acknowledge that the research was conducted under an award from the Estuarine Reserves Division, Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration. The data set enclosed within this package/transmission is only as good as the quality assurance and quality control procedures outlined in this "Readme File' and the land cover and Accuracy Assessment metadata reports. The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons. The Federal government does not assume liability to the Recipient of third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

More detailed information about the GIS dataset can be obtained from the PI of the mapping program at the individual NERR site (see *Metadata Report* for contact information). Data and current contact information are available online at the CDMO homepage: *http://cdmo.baruch.sc.edu*.

Description of Dataset
[List how the reserve will use the map i.e. high-resolution priority habitat map – multiple priority areas/habitats].

Purpose
[List the reserve's statement and the following "blanket" statement from the NERRS GIS program]

Spatial Reference Information:
Land Cover Shapefile: [Add Original Projected Coordinate System]
[Add Original Geographic Coordinate System]

Accuracy Assessment (or Ground-truth Survey): [Add Original Projected Coordinate System]
[Add Original Geographic Coordinate System]

Supplemental:
[Provide location of papers that are associated with the reserve's mapping efforts (i.e. technical paper references, location of other Reserve GIS products, photographs of priority habitats). Also provide location of metadata report for the base imagery acquisition specifications, imagery processing, etc.]

Overview of AA-Ground-Truthing Process

Sampling Design:
[State whether an accuracy assessment or ground-truthing survey was performed. Please provide detailed information about how the ground-truthing (accuracy assessment or ground-truthing survey) sampling design (i.e., random, stratified random, stratified aligned random) was developed. Stratified random is the preferred method for accuracy assessment process, so please provide additional justification if another method was used.]. Include

description of field verification strategy(ies) used. Also include accuracy of the GPS unit that was used to obtain ground-truthing and/or accuracy assessment points.]

Level of Classification:
[Describe the level of the NERRS classification scheme (i.e., class, subclass) used to conduct the ground-truthing. Please provide additional justification if something other than the subclass level was used.]

Sampling Method for Field Classification:
[Provide a description of the sampling methods (i.e., quadrat, transect) used to classify land cover at each ground-truthed sampling point. Please list any additional information gathered at each sampling site.]

Land Cover Classifications:
[Provide a brief description of the sampling points assigned to each land cover category (i.e., number of correct classifications, number of misclassifications). For accuracy assessments, explain how this affected the producer, user, and overall accuracy.]

Photographs:
[List the photograph names and associated habitats in following table format. The filename format is: [ReserveCode]_[if applicable, ComponentCode]_[LandCoverFileCode]_[NERRS ClassificationLevel]_[Descriptor*****]_[DateCode]. If descriptor codes are used, provide definition of code after table (i.e. SPAL for *Spartina alterniflora*). Note: You may provide a link or contact information for non-habitat photographs or photographs of habitats not included in error matrix table.]

Photo Name	Habitat Type
NIW _2261_SPAL_200603	Salt Marsh (Subclass Level # 2261)

SPAL = Spartina alterniflora

References: [following citations must be listed in all readme files]

Garfield, N., K. Madden, S. Upchurch, S. Shull, N. Herold, M. Ferner, and C. Weidman. 2013. *Mapping Land Use and Habitat Change in the NERRS: Standard Operating Procedures: Version 2. Amended April, 2013. Companion Document to: Recommended Guidelines for Adoption and Implementation of the NERRS Comprehensive Habitat and Land Use Classification System.* Report for the National Estuarine Research Reserves Division, NOAA/NOS/OCRM, Silver Spring, MD.

Kutcher T. Garfield, N. Van Dyke, E. Schull, S. Walker, N. Herold, G. Scott, P. Hensel, and A. Allen. 2008. *SWMP Phase III: Land Use, Land Cover, and Habitat Change*. Report for the Estuarine Reserves Division, NOAA/NOS/OCRM, Silver Spring, MD.

Walker, S.P. and Garfield, N. 2006. *Recommended Guidelines for Adoption and Implementation of the NERRS Comprehensive Habitat and Land Use Classification System.* Report for the Estuarine Reserves Division, NOAA/NOS/OCRM, Silver Spring, MD.

Error Matrix Table:
[Use one of the following tables as a guide for development of your error matrix. If more than one field verification strategy was used, create two error matrices – one for the high priority habitats visited with higher accuracy field verification strategies and another error matrix for all points.

MAPPED TO CLASS (or SUBCLASS) LEVEL

PDBNERR 2004 Accuracy Assessment Table

Mapped Classification (User)	Reference Data (Producer) 2210. Aquatic Bed	2230. Streambed	2260. Emergent Wetland	2270. Scrub-Shrub Wetland	Total Mapped	User's Accuracy
2210. Aquatic Bed	15	3	1	1	20	
2230. Streambed	4	18	3	2	27	
2260. Emergent Wetland	4	5	16	4	29	
2270. Scrub-Shrub Wetland	1	2	4	17	24	
Total Visited	24	28	24	24	100	
Producer's Accuracy						

Kappa Statistics: [Please complete the following table.]

Observed agreement (P_O)	
Chance agreement (P_C)	
Kappa (K)	

Coastal and Marine Ecological Classification Standard (CMECS)
Below is the crosswalk between the NERRS habitat classification scheme and CMECS. An automated tool to facilitate the cross-walk is available on the Digital Coast website (https://coast.noaa.gov/digitalcoast/tools/cmecs-crosswalk)

CMECS Substrate Origin	CMECS Substrate Class	CMECS Substrate Subclass	CMECS Substrate Group	NERRS Class Nominal	NERRS Class Numeric	NERRS Subclass Nominal	NERRS Subclass Numeric	NERRS Descriptor

CMECS Biotic Setting	CMECS Biotic Class	CMECS Biotic Subclass	CMECS Biotic Group	NERRS Class (nominal)	NERRS Class (numeric)	NERRS Subclass (nominal)	NERRS Subclass (numeric)	NERRS Descriptor

References:
[Please provide full citation of references mentioned in text]

High-Resolution Land Cover Readme File
North Inlet/Winyah Bay NERR

Latest Update: August 5, 2012

NOAA/ERD retains the right to analyze, synthesize and publish summaries of the NERRS land cover data. The Research Coordinator at the Reserve retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the PI and NERR site where the data were collected will be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. Manuscripts resulting from the NOAA/OCRM supported research that are produced for publication in open literature, including refereed scientific journals, will acknowledge that the research was conducted under an award from the Estuarine Reserves Division, Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration. The data set enclosed within this package/transmission is only as good as the quality assurance and quality control procedures outlined in this "Readme File' and the land cover and Accuracy Assessment metadata reports. The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons. The Federal government does not assume liability to the Recipient of third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

More detailed information about the GIS dataset can be obtained from the Research Coordinator at the individual NERR site (see *Metadata Report* for contact information). Data are available on online at the CDMO homepage http://cdmo.baruch.sc.edu.

Overview of Mapping Efforts

Description of Land Cover Dataset:

The area of mapping interest (AMI), or priority habitat areas includes most of the area within the North Inlet and areas outside the boundary that are considered to be of ecological importance to the reserve, which should be monitored for habitat change over time. The areas outside the Reserve include the Debordieu marsh north of the reserve boundary, which is the only area of the North Inlet estuary to be bordered by development; and all of North Island, which is managed by the South Carolina Department of Natural Resources. The extensive maritime forest habitat of North Island is of high concern due to the scarcity of this habitat remaining intact along the southeastern coast. The North Island beach also provides important nesting habitat for species of shorebirds and diamondback terrapins that inhabit the North Inlet estuary. The AMI inland boundary is at the marsh/upland edge, except for where it was extended to include upland areas between the marsh and Marsh Road on Hobcaw Barony.

Mapping of the North Inlet estuary began in 2007 with an inventory of available imagery, methodology and software, and discussions of the mapping boundary. Aerial photo interpretation was chosen as the most accurate method for delineating the marsh habitats within the limited budget for image and software acquisition and availability of GIS and remote sensing expertise and assistance. The images were taken in March of 2006 at low tide at a flying height of 20,000 feet above mean terrain with a 6-inch (152.4 mm) focal-length camera (photo scale= 1:40,000). The color infrared (CIR) images were obtained as digital ortho-photo quadrangle with a 1-meter ground resolution. The projected coordinate system of the digital images is NAD 1983, UTM Zone 17N.

High resolution (1 m) digital ortho-photo quadrangles (DOQ) were used to delineate (on-screen) land cover in the North Inlet-Winyah Bay National Estuarine Research Reserve at a scale of 1:3000 to 1:5000 in accordance with NERR mapping protocols. The minimum map unit is 0.25 acres except for habitats of interest (e.g. shell middens) or structures and roads for which areas as small as 0.1 acre may be mapped. The land cover types were identified by their appearance in the DOQ and verified by field reconnaissance. Land cover types are categorized in accordance with the NERRS habitat classification and mapping protocols. This data will provide North Inlet-Winyah Bay NERR staff, scientists, and resource managers with information that can be used in habitat/species related research and to assess management decisions.

Purpose:

This data will provide North Inlet-Winyah Bay NERR staff, scientists, and resource managers with information that can be used in habitat/species related research and to assess management decisions.

Spatial Reference Information:

Original Coordinate System for both shapefiles:
Projected coordinate system name: NAD_1983_UTM_Zone_17N
Geographic coordinate system name: GCS_North_American_1983

Supplemental:
JPEG images and PDFs of the habitat map are available for general use through the North Inlet-Winyah Bay NERR web site at *www.northinlet.sc.edu/about/maps.html*.

Overview of Accuracy Assessment Process

Sampling Design:

A random point generator was used to assign 50 ground-truthing points distributed over each of the five habitat classes with the greatest area as estimated from the draft habitat map, and a sixth area representing all other habitat class types. The predominant 5 class types were: 1) emergent intertidal wetland (Class # 2260, 48%); 2) scrub-shrub supratidal wetland (Class # 2350, 14%); 3) emergent supratidal wetland (Class # 2340, 11%); 4) subtidal channel (Class # 2120; 11%); 5) upland forest (Class # 6150, 7%); and all other classes accounted for 11% of the area mapped.

Level of Classification:

Habitats were classified to the subclass level in the field except for subtidal habitats, which were classified to class level where bottom type was not known. A detailed description of the mapping and classification effort is available in the *NIWNERR_HRLCPH_methods.pdf* document. The accuracy assessment was performed at the class level.

Sampling Method for Field Classification:

Points were navigated to using printed aerial photographs and a Trimble Juno ST GPS unit with ArcPad software. The location of each ground-truth point visited was recorded on the GPS unit using averaging over 50 points and a maximum PDOP of 6. The datum was WGS 1984. At each point, a quick form was used to enter the date, time, subsystem number, cover of the dominant three vegetative species within 1 m of the point, and any comments about the site. A photograph was also taken and later matched to the point using the time stamp.

Land Cover Classifications:

A total of 124 out of the potential 300 points were collected over 15 days in June and July 2008 and October 2009. In 2008, 124 of the 300 ground-truthing points selected by the random generator were

visited, and the actual numbers of ground-truth points acquired for each of the six habitats at class level were:

56: Intertidal Emergent Wetland (Class Level # 2260)
4: Scrub Shrub Supratidal Wetland (Class Level # 2350)
19: Supratidal Emergent Wetland (Class Level # 2340)
15: Subtidal Unconsolidated Bottom (Class Level # 2120)
0: Upland Forest (Class Level # 6150)

Other:
7: Intertidal Reef (Class Level # 2220)
13: Intertidal Unconsolidated Shore (Class Level # 2250)
2: Supratidal Unconsolidated Bottom (Class Level # 2320)
2: Supratidal Forested Wetland (Class Level # 2360)
3: Developed Upland (Subsystem Level #8100)

An Error Matrix table was constructed using the in-situ data from ground-truthing points (see Error Matrix table). The classifications of two habitats were changed during a review that occurred after the ground-truthing was completed; habitats formerly classified as supratidal unconsolidated sand (2323) that occur on the ocean side of barrier islands were reclassified as marine intertidal sand (1243) and sand dune habitats were reclassified from supratidal persistent emergent wetland (2341) to herbaceous upland grass (6131). Developed upland (classes 8150 and 8130), supratidal forest upland (class #6150), and forested wetland (class 2360) cover types were not included in the analysis due to the limited number of ground-truthing points and coverage of these classes in the habitat map.

The overall accuracy for the class level was 76%, and the Kappa statistics was 60%. The habitats with the greatest accuracy were intertidal oyster reef (2120) and intertidal emergent wetland (2260); however, intertidal reef areas were likely under-represented due to mapping limitations. The results of the accuracy assessment indicate that scrub-shrub supratidal wetland (2351) area may be overestimated in the habitat map as this area was confused with emergent supratidal wetland (2341).

Photographs:

Photographs are named by the site ID shown in the shapefile and the sub-classification number of the habitat shown. JPEG images and PDFs of the habitat map are available for general use through the North Inlet-Winyah Bay NERR web site at *www.northinlet.sc.edu/about/maps.html*. Below are photographs of habitats listed in the *Land Cover Classifications* section.

Photo Name	**Habitat Type**
NIW_2120_200603	Estuarine Subtidal Unconsolidated Bottom (Class Level # 2120)
NIW_2221_200603	Estuarine Intertidal Reef (Class Level # 2220)
NIW_2253_200603	Estuarine Intertidal Unconsolidated Shore (Class Level # 2250)
NIW_2254_200603	Estuarine Intertidal Unconsolidated Shore (Class Level # 2250)
NIW_2255_200603	Estuarine Intertidal Unconsolidated Shore (Class Level # 2250)
NIW_2261_200603	Estuarine Intertidal Emergent Wetland (Class Level # 2260)
NIW_2341_200603	Estuarine Supratidal Emergent Wetland (Class Level # 2340)
NIW_2351_200603	Estuarine Scrub Shrub Supratidal Wetland (Class Level # 2350)
NIW_2362_200603	Estuarine Supratidal Forested Wetland (Class Level # 2360)
NIW_6154_200603	Supratidal Upland Narrow-leaved Evergreen Forest (Class Level # 6150)
NIW_6155_200603	Supratidal Upland Mixed Forest (Class Level # 6150)
NIW_8163_200603	Developed Upland (Class Level #8160)

Habitats Not Listed in Class-level Error Matrix Table

Photo Name	Habitat Type
NIW_1243_200603	Marine Intertidal Unconsolidated Shore (Class Level# 1240)
NIW_2324_200603	Estuarine Supratidal Unconsolidated Bottom (Class Level # 2320)
NIW_6131_200603	Supratidal Upland Grassland (Class Level # 6130)
NIW_6143_200603	Supratidal Broad-leaved Evergreen Scrub Shrub Upland (Class Level # 6140)

Accuracy Assessment Analysis:

NIWNERR 2006 Error Matrix Table

Mapped Classification (User)	Reference Data (Producer) 2120 Unconsolidated Bottom (Subtidal)	2220 Reef (Intertidal)	2250 Unconsolidated Shore (Intertidal)	2260 Emergent Wetland (Intertidal)	2340 Emergent Wetland (Supratidal)	2350 Scrub-Shrub Wetland (Supratidal)	Total Mapped	User's Accuracy (%)
2120. Unconsolidated Bottom (Subtidal)	14	1	1	6	1	0	23	61
2220. Intertidal Reef	0	5	0	0	0	0	5	100
2250. Unconsolidated Shore (Intertidal)	2	0	7	0	0	0	9	78
2260. Emergent Wetland (Intertidal)	0	1	1	47	1	0	50	94
2340. Emergent Wetland (Supratidal)	0	0	0	3	9	2	14	64
2350. Scrub-Shrub Wetland (Supratidal)	0	0	1	0	6	1	8	13
Total Visited	16	7	10	56	17	3	109	
Producer's Accuracy (%)	88	71	70	84	53	33		

Kappa Statistic:

Observed agreement (%)	76%
Chance agreement (%)	41%
Kappa (%)	60%

Supplemental Data:

The following Error Matrix Table contains the Subclass Level classification data collected at all mapped habitats. The results of the analysis are not valid because there was insufficient data for mapped habitat.

Reference Data (Producer)

Mapped Classification (User)	1243	2120	2221	2253	2254	2261	2323	2324	2341	2351	2353	2354	2361	2362	6131	6155	8151	8161	**TOTAL MAPPED**	User's Accuracy (%)
1243	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	**3**	0
2120	0	14	1	1	0	6	0	0	1	0	0	0	0	0	0	0	0	0	**23**	61
2221	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**5**	100
2253	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**3**	100
2254	0	1	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	**6**	83
2261	0	0	1	0	1	47	0	0	2	0	0	0	0	0	0	0	0	0	**51**	92
2323	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0
2324	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	0
2341	0	0	0	0	0	3	0	0	8	0	2	0	1	1	0	0	0	0	**15**	53
2351	0	0	0	1	0	0	0	0	4	0	0	0	0	0	0	0	0	0	**5**	0
2353	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**	100
2354	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	**3**	0
2361	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0
2362	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0
6131	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**1**	0
6155	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	**1**	0
8151	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	**2**	100
8161	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**	100
TOTAL Visited	**0**	**15**	**7**	**6**	**7**	**56**	**2**	**0**	**19**	**0**	**3**	**1**	**1**	**1**	**0**	**0**	**2**	**1**	**121**	
Producer's Accuracy (%)	0	93	71	50	71	84	0	0	42	0	33	0	0	0	0	0	100	100		

Kappa Statistic:

Observed agreement (P_O)	71%
Chance agreement (P_C)	25%
Kappa (K)	0.613

CMECS – NERRS Habitat Crosswalk Table for North Inlet-Winyah Bay NERR tidal habitats

CMECS Substrate Origin	CMECS Substrate Class	CMECS Substrate Subclass	CMECS Substrate Group	NERRS Class Nominal	NERRS Class Numeric	NERRS Subclass Nominal	NERRS Subclass Numeric	NERRS Descriptor
Geologic Substrate	Unconsolidated Mineral Substrate	Fine Unconsolidated Substrate	Sand	Unconsolidated Shore	1240	Sand	1243	Coastal Beach
			N/A	Unconsolidated Bottom	2120	Not done	Not done	Not classified
			Mud	Streambed	2230	Mud	2236	Tidal Channel
			Sand	Unconsolidated Shore	2250	Sand	2253	Intertidal Flat
			Mud	Unconsolidated Shore	2250	Mud	2254	Intertidal Flat
			Sand	Unconsolidated Bottom	2320	Sand	2323	Creekside Beach
Biogenic Substrate	Organic Substrate	Organic Debris	No match	Unconsolidated Shore	2250	Organic	2255	*Spartina* Wrack

CMECS Biotic Setting	CMECS Biotic Class	CMECS Biotic Subclass	CMECS Biotic Group	NERRS Class (nominal)	NERRS Class (numeric)	NERRS Subclass (nominal)	NERRS Subclass (numeric)	NERRS Descriptor
Benthic/ Attached Biota	Reef Biota	Mollusk Reef Biota	Oyster Reef	Reef	2220	Mollusk	2221	Oyster Reef
Benthic/ Attached Biota	Emergent Tidal Wetland	Vegetated Tidal Flats	Vegetated Salt Flat and Panne	Unconsolidated Bottom	2320	Mud	2324	*Salicornia* Panne
Benthic/ Attached Biota	Emergent Tidal Wetland	Emergent Tidal Marsh	Low & Intermediate Salt Marsh	Emergent Wetland	2260	Persistent	2261	Low *Spartina* Marsh
			High Salt Marsh	Emergent Wetland	2260	Persistent	2261	High *Juncus* Marsh
Benthic/ Attached Biota	Scrub-Shrub Wetland	Tidal Scrub-Shrub Wetland	Saltwater Tidal Scrub-Shrub Wetland	Scrub-Shrub Wetland	2350	BLD	2351	*Baccharis halimifolia*
Benthic/ Attached Biota	Forested Wetland	Tidal Forest/Woodland	Freshwater Tidal Forest/Woodland	Scrub-Shrub Wetland	2350	BLE	2353	Myrica/ Juniperus
			Freshwater Tidal Forest/Woodland	Forested Wetland	2360	BLE	2363	*Borrichia/ Quercus/ Juniperus*
No match	No match	No match	No match	Aquatic Bed	2230	Perennial Water	2335	Pool

Appendix J: Acknowledgement Letter of Acceptance of Habitat Map

Date

Dear _____[Manager]

This letter is to formally acknowledge that the Habitat Mapping and Change Technical Committee has approved the baseline habitat maps of the _____[Reserve]. We would like to thank you and your staff for submitting these maps. The maps will be forwarded to the CDMO for public access.

Sincerely,

Nina Garfield and Kiersten Madden, HMCTC Co-Chairs

CC: Research Coordinator
GIS Specialist

Appendix K: Checklist for QA/QC Review of GIS Dataset Submissions

Last Updated May 19, 2015

Item	Task	Y/N
	Submission of Land Use/Land Data Elements - (1st Review Stage) (Please refer to requirements in section V of Standard Operating Procedures, or SOPs)	
1	Were all of the required files in the Zip file? (Shapefiles of land cover dataset and associated metadata with all required fields per these SOPs ; Accuracy Assessment (AA) or Ground-truth Survey dataset and associated metadata; Land Cover-AA/GT Readme file; photographs)	
2	Is coordinate system correct for the files uploaded to the CDMO?	
3	Is naming convention correct for Land Cover Shapefile (three letter reserve code, two-letter sampling site code, data file type code, and file map date MMDDYY)?	
4	Is naming convention correct for Accuracy Assessment OR Ground-truth Survey Shapefile (the letter reserve code, two-letter sampling site code, data file type code, and file map date MMDDYY)?	
5	Is naming convention correct for "Readme File" (three letter reserve code, two-letter sampling site code, data file type code, and file map date MMDDYY)?	
6	Is naming convention correct for photographs ([Reserve Code]_[Habitat Subclass level]_[YYYYMM])?	
7	Photographs submitted in JPEG format and not greater than 500 K in size?	
8		
9		
10		
	Attribute Table Completeness Section - (2nd Review Stage) (Please refer to requirements in section V of SOP)	
11	Land Cover Shapefile (HRLC) contain the required field names that are listed in Appendix F (*Required Attributes for Land Cover Shapefiles*)	
12		
13	Accuracy Assessment (AA) Shapefile contain the required field names that are listed in Appendix G (*Required Attributes for Accuracy Assessment Shapefiles*)	
14	Ground-truth Survey (GT) Shapefile contain the required field names that are listed in Appendix H (*Required Attributes for Ground-truth Survey Shapefiles*)	
15		
16	All of the data rows in HRLC, AA (or GT) Shapefiles contain the required NERRS Classification numeric and nominal categories. (See Kutcher et al. 2008 for details)	
17	"Agree" or "Not Agree" column checked for each record in AA table	
18		
19		
20		
	Metadata Completeness Section - (2rd Review Stage) (Please refer to requirements in section V of SOP). Complete following sections for the Land Cover, AA (or GT) Shapefiles	
21	Section 1: Citation (Originator & Publication Date)	
22	Section 2: Description (Abstract, Purpose and Supplemental Information [NERRS disclaimer])	
23	Section 3: Time Period (Date & Time and Currentness Reference fields)	
24	Section 4: Status of the Data (Progress and Maintenance & Update frequency fields)	
25	Section 5: Spatial Domain (ESRI fills in details)	
26	Section 6: Keywords (Theme and Thesaurus [NONE is acceptable entry])	
27	Section 7: Data Storage and Access Information (Access constraints and Use constraints fields)	
28	Section 8: Spatial Data Organization Information (ESRI fills in details)	
29	Section 9: Spatial Reference Information (ESRI fills in details about projections)	
30	Section 10: Entity and Attribute Information (Detailed description and Overview description fields)	
	Habitat Photographs Completeness Section - (2nd Review Stage**)** (Please refer to requirements in section V of SOP)	
31	One photograph of each priority habitat type provided	

	Land Cover Readme File Completeness Section - (2nd Review Stage**)** (Please refer to requirements in section V of SOP)(see Appendix I (*Template for "Readme File" for more details)*	
	Overview of Mapping Efforts	
41	Description of land cover dataset provided	
42	Purpose of mapping project provided, including "blanket" statement from NERRS GIS program	
43	Original Spatial Reference Information	
44	Supplemental: Provide information associated with the reserve's mapping efforts (i.e. technical paper references, location of other Reserve GIS products, photographs of priority habitats	
	Overview of AA-Ground-truthing Process	
45	Sampling design described. (i.e. random, stratified random, stratified aligned random	
46	Level of Classification Provided	
47	Sampling Method for Field Classification described	
48	Land Cover Classifications provided (including the results of the error matrix analysis)	
49	Table with photograph information provided	
50	Error Matrix Table(s) and Kappa Statistics completed	
51	Blank references provided	
52	NERRS – CMECS crosswalk table provided	
	GIS Dataset Correctness Section - (3rd Review Stage) (Please refer to requirements in section V of SOP)	
	Land Use - Land Cover Shapefile	
61	Correct spellings of classification nominal categories (i.e. Intertidal Haline) and Reserve habitat names and dominant species	
62	Correct values of classification numeric categories (i.e. 2200)	
63	Correct relationship between Nominal and Numeric categories (i.e. 2200 and Intertidal Haline)	
64	Correct relationship between Numeric categories and Reserve habitat names (Dsc_Nom)	
	Accuracy Assessment Shapefile	
65	Correct spellings of classification nominal categories (i.e. Intertidal Haline)	
66	Correct values of classification numeric categories (i.e. 2200)	
67	Correct relationship between Nominal and Numeric categories (i.e. 2200 and Intertidal Haline)	
68	Correct relationship between User and Producer category recorded in Agree and "Not_Agree fields (i.e. User: 2220 - Producer -2230 = Not Agree)	
69	Correct relationship between Numeric categories and Reserve habitat names (PDom & UDom)	
	Metadata Reports	
70	Information in Description field in both shapefiles is **clearly communicated**	
	Readme File	
72	Information in Readme file is **clearly communicated**	
73		
	Error Matrix Table	
74	Values in Error Matrix Table (s) corresponds with values in Agree and "Not_Agree fields	
75	Calculations in Error Matrix Table(s) and associated Kappa Statistics correct	
76	Table only contains data of one NERRS classification level (i.e. Subclass)	
77		
	Habitat Photographs	
78	Habitat photo corresponds with filename (i.e. emergent wetland - filename: NIW_2260_200604.jpg)	
79		
	Overall Dataset Correctness	
80	Consistency between information in metadata reports and Readme file	
81	Consistency in spelling of NERRS and Reserve nomenclature among shapefiles, documents and error matrix table	