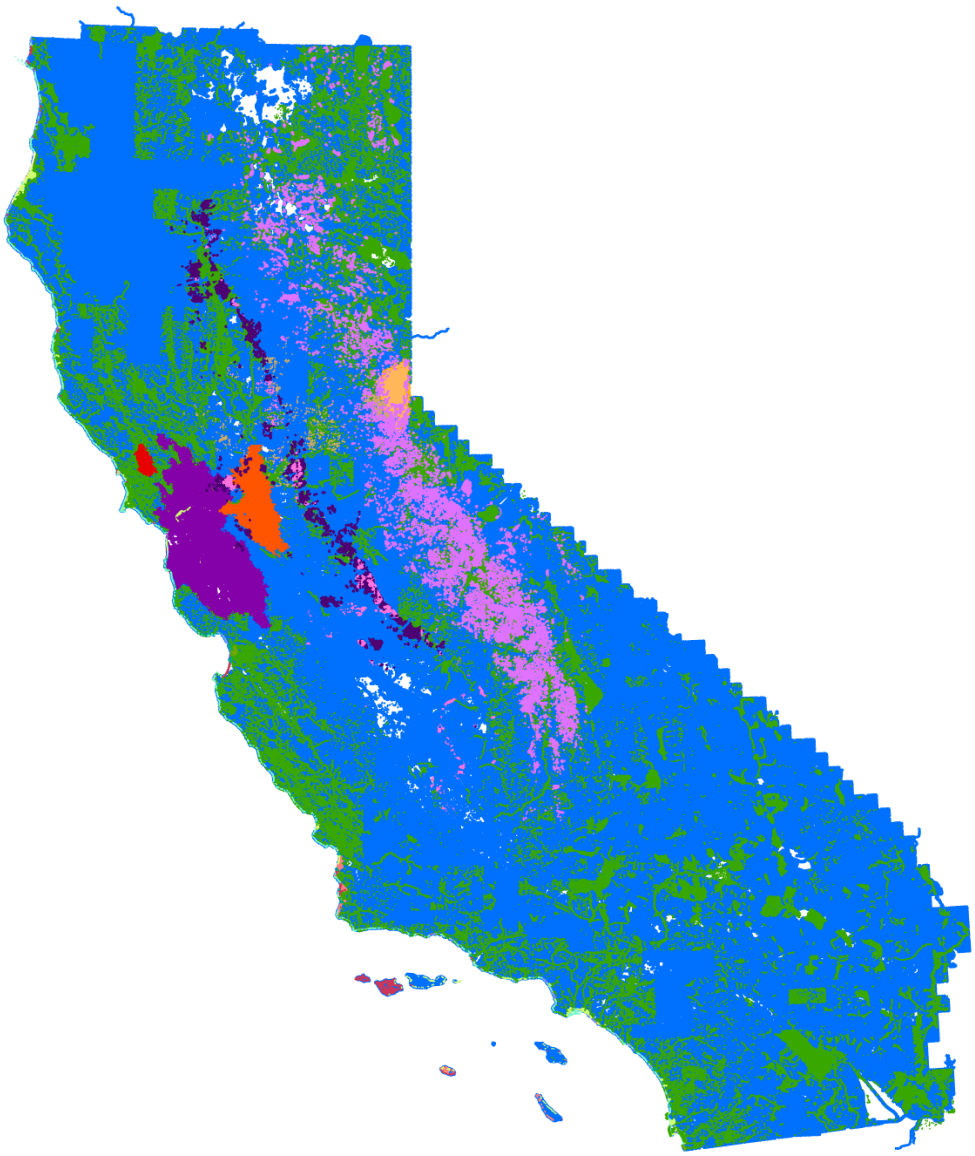
California Aquatic Resource Inventory (CARI)



MAPPING METHODS AND STANDARDS FOR CHANNELS, WETLANDS, AND RIPARIAN AREAS

CARI SOP v.2.0 - December 2023

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List of Acronyms:

CARCS – California Aquatic Resource Classification System

CARI – California Aquatic Resource Inventory

CRAM – California Rapid Assessment Method

CWMW – California Wetlands Monitoring Workgroup

DEM – Digital Elevation Model

DRG – Digital Raster Graphic

ESI – Environmental Sensitivity Index

FGDC – Federal Geographic Data Committee

GIS – Geographical Information System

LIDAR – Light Detection and Ranging - remote sensing technology

NAIP – National Agriculture Imagery Program

NED – National Elevation Dataset

NHD – National Hydrography Dataset of the USGS

NOAA – National Oceanographic and Atmospheric Administration

NWI – National Wetland Inventory of the USFWS

SFEI-ASC – San Francisco Estuary Institute – Aquatic Science Center

TMU – Targeted Mapping Unit

USEPA – US Environmental Protection Agency

USFWS – US Fish and Wildlife Service

USGS – US Geological Survey

WRAMP – Wetland and Riparian Area Monitoring Plan

WRAPP – Wetland and Riparian Area Protection Plan for California

Background and Purpose

CARI is a Geographic Information System (GIS) dataset of wetlands, streams, and their riparian areas consisting of polygon and line features that are standardized to a common wetland classification system. CARI was initiated in 2009 by the California Wetland Monitoring Workgroup (CWMW) with the goal of achieving an updateable, standardized, GIS dataset of aquatic resources in California that could be used by environmental managers, planners and the public to assess the distribution and amount of wetlands at variable landscape scales. This statewide dataset provides the best available map of state surface waters and serves as the base map in EcoAtlas (www.ecoatlas.org). EcoAtlas is a publically accessible online environmental data visualization and access tool that supports local, regional and statewide access to standardized geospatial data, ecological monitoring data, restoration/mitigation project information, and data summary tools that support wetland resource planning and tracking in a watershed or landscape level context.

Accompanying CARI is the CARI Editor, an interactive, online GIS mapping interface that facilitates user-generated updates to information associated with the CARI dataset. When users encounter any discrepancy between CARI and actual landscape conditions, they can submit recommended changes online through the CARI Editor tool. The changes will be reviewed and incorporated into CARI via periodic updates, thereby maintaining CARI's currency and ready applicability to decision making.

CARI was first released in June 2014 (v0.1), and updated in May 2016 (v0.2), December 2017 (v0.3), 2022 (v1.0), April 2023 (v1.1), and Dec 2023 (v2.2). It is a compilation of local, regional, and statewide aquatic resource GIS datasets into a standardized, seamless, statewide coverage of aquatic resources employing a common wetland classification system (Figure 1). Although the dataset varies in detail, and represents different time-periods for different areas across the state, **CARI is the only statewide aquatic resource dataset that has been compiled and standardized to a common classification system. It is being used to develop landscape level profiles of aquatic resources at a local, regional, or broader scale** (as seen with the Landscape Profile tool within EcoAtlas).

The current **CARI dataset (v2.2)** includes data from:

- The National Wetland Inventory (NWI, last released in 2023) of the US Fish and Wildlife Service
- The National Hydrography Dataset (NHD, last updated in Sep, 2023) of the US Geological Survey
- Four regional datasets developed by SFEI's GIS team using CARI's standardized, and more detailed, mapping protocols and used to demonstrate the WRAMP framework:
    - Delta Aquatic Resource Inventory (DARI v1.1) - 2022
    - San Francisco Bay Area Aquatic Resources Inventory (BAARI v2.1) - 2017
    - Lake Tahoe Basin (TARIv2.1) - 2016
    - Laguna de Santa Rosa Plain (near Santa Rosa ,CA. NCARI) - 2013
- Six County Aquatic Resources Inventory (including Sacramento, Placer, Yolo, El Dorado, Yuba, and Sutter Counties, California) developed by the US Army Corps of Engineers (Sacramento District) through federal funding - 2010. Subsequently reviewed and filtered by SFEI to remove duplicates and out of date and lower quality data in 2023.
- Bar-Built Estuaries Lagoons created by the Central Coast Wetlands Group (data published in 2009, 2012, and 2016)
- National Estuarine Research Reserve High Resolution Land Cover (data from 2006, 2008, 2013, and 2016)
- Vernal Pool mapping by Witham, C.W., 2021
- Sierra Nevada Multi-Source Meadow Polygons Compilation (v2.0)
- SFEI Automated Individual Vernal Pools 2023

- Data sources specifically related to Coastal Habitats (Eelgrass, Coastal Dunes, Beaches, and Rocky Intertidal):
    - Eelgrass compilation by National Marine Fisheries Service West Coast Region (data digitized from 2005, 2007, 2009, 2010, 2013, 2014, 2015, 2016, 2017, 2018, 2019, and 2020)
    - SFEI Elevation-Modeled Beach/Rocky Intertidal Habitats classified via Environmental Sensitivity Index (ESI) data from NOAA - 2022. Please see the *CARI Data Compilation Methods And Considerations > Wetland Data Integration/Development > Rocky Intertidal/Beache*s section for more information.
    - Conserving California's Coastal Habitats Coastal Dune and Beach polygons from The Nature Conservancy - 2018
    - CalVeg polygons associated with coastal dune habitats by the U.S. Forest Service - 2018
    - VegCAMP dune habitat data by the California Department of Fish and Wildlife
        - Pt. Reyes NP, Muir Woods, and Golden Gate NRA VegCAMP - 2003
        - Pismo State Beach and Oceano Dunes State Vehicular Recreation Area VegCAMP - 2015
        - San Nicolas Island VegCAMP - 2013
        - Santa Cruz Island VegCAMP - 2007
        - Santa Clara River Parkway VegCAMP - 2007
    - California Natural Diversity Database coastal dune polygons from the California Department of Fish and Wildlife - 2009
    - Additional SF Bay Beaches digitized by SFEI staff and in consultation with RB2 Water Board staff - 2022
    - Humboldt Dunes published by University of California Santa Barbra

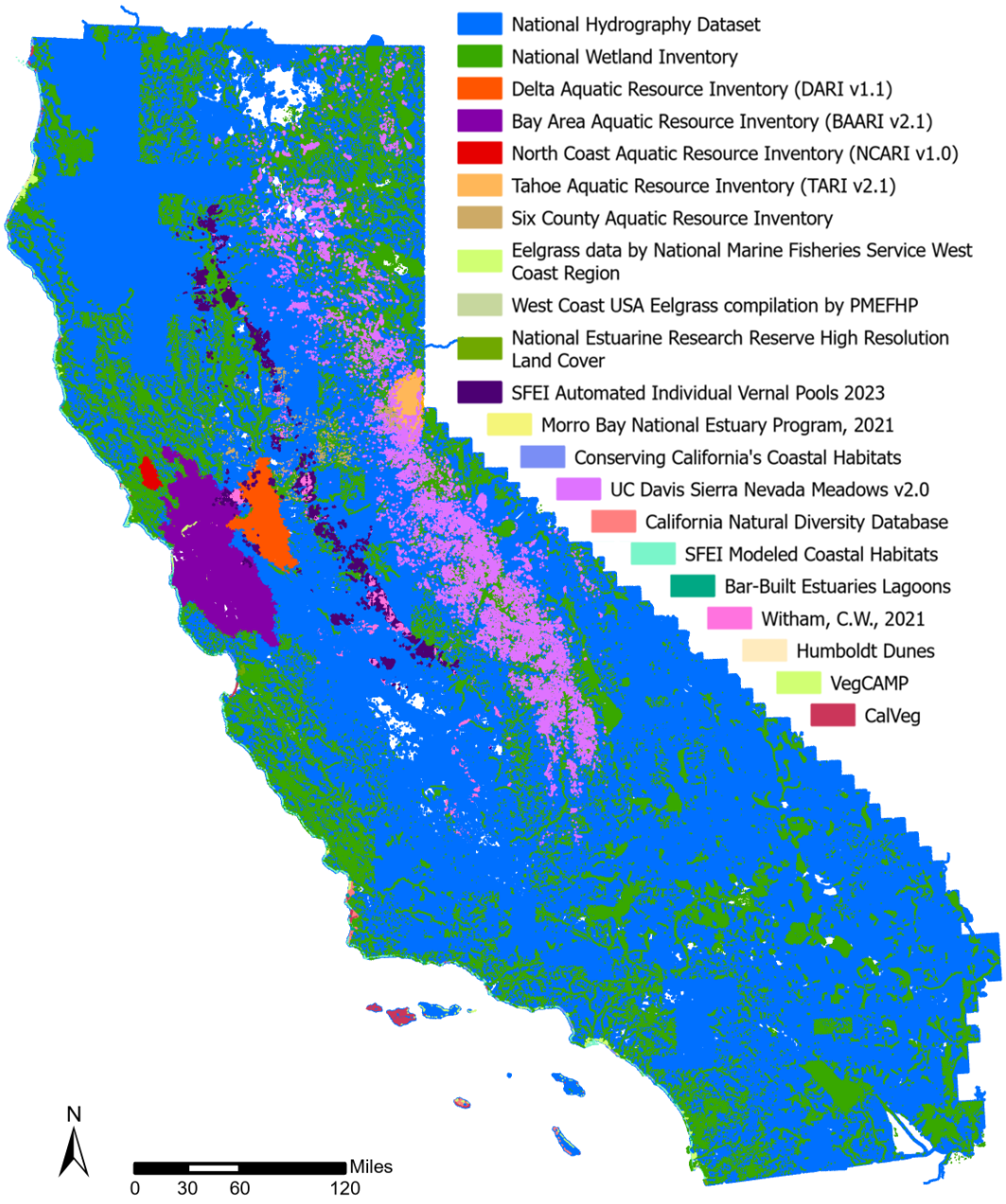

Figure 1. Map of the source datasets that comprise CARI v2.2.

The CARI dataset varies in detail and accuracy across the state, and represents different time periods for different areas. Users are advised to get familiar with the level of detail available for their area/s of interest to understand the level of mapped details represented across their area/s of interest.

The vision for CARI is that it will be used by resource agencies, city and county land-use planners, scientists, and other stakeholders as the go-to map to visualize and summarize aquatic resources in their regions for monitoring, and assessment purposes. As more stakeholders use the online wetland monitoring and assessment tools on EcoAtlas, regional interests will improve the map by editing it. EcoAtlas has an online CARI Editor Tool that allows users to employ the CARI mapping standards and methods to submit suggested updates by submitting direct online edits or by uploading a KML or GIS file.

Definition of Wetlands

CARI is consistent with the following wetland definition[1] recommended by the Technical Advisory Team (TAT) to the State Water Resources Control Board's (SWRCB) Policy Development Team for the *State Wetland Definition and Procedures for Discharges of Dredged or Fill Material to Waters of the State*[2]:

> **An area is wetland if**, under normal circumstances, (1) the area has continuous or recurrent saturation of the upper substrate caused by groundwater or shallow surface water or both; (2) the duration of such saturation is sufficient to cause anaerobic conditions in the upper substrate; and; (3) the area either lacks vegetation or the vegetation is dominated by hydrophytes (SFEI-ASC 2009).

This definition reflects current scientific understanding of the formation and functioning of wetlands (Lewis et al. 1995, Mitsch and Gosselink 2007) and uses field indicators of hydrology, substrate condition, and plant community composition to distinguish wetland areas from other areas of a landscape. This is commonly regarded as the "three-criterion approach" to defining, identifying, and delineating wetland areas in the field (Tiner 1999). Hydrology is the dominant factor in wetland formation because it controls the development of anaerobic chemical conditions, and thus strongly influences the abundance of plant species tolerant of such conditions (Voesenek et al. 2003) or indicative of them (Reed 1988).

This wetland definition recognizes that all three criteria might not be evident or present in some areas that provide wetland functions, beneficial uses, or ecological services at some times of the year or in some years (especially during prolonged dry periods), and that some of these areas lack vegetation and therefore may satisfy only two criteria (i.e., wetland hydrology and hydric substrates). The vegetation criterion in this definition requires dominance by hydrophytes only when the wetland is vegetated. That is, non-vegetated areas that satisfy the hydrology and substrate criteria, such as some tidal flats, playas, and shallow non-vegetated ponds, are still considered wetlands.

It is generally accepted that all wetlands have some amount of adjacent riparian area that reflect various ecological and/or physical processes and local management. For this reason, CARI employs the riparian definition provided by the US National Research Council (NRC):

> "**Riparian Areas** are transitional between terrestrial and aquatic ecosystems and are distinguished by gradients in biophysical conditions, ecological processes and biota. They are areas through which surface and subsurface hydrology connect water bodies with their adjacent uplands. They include those portions of terrestrial ecosystems that significantly influence exchanges of energy and matter with aquatic ecosystems. Riparian areas are adjacent to perennial, intermittent, and ephemeral streams, lakes and estuarine-marine shorelines" (National Research Council 2002).

The same functions typically associated with wetlands are, to varying degrees, also associated with its accompanying riparian areas (National Research Council 2002). The riparian areas adjacent to rivers and stream corridors are particularly connected through various ecological and hydrological processes. Although the term "riparian" has traditionally been synonymous with "woody" vegetation occurring at the edge or margin of a wetland, many wetlands often contain a woody riparian vegetation component within the boundary of the wetland itself. In other instances, riparian areas only occur outside the wetland boundary, where they may function at various distances from the wetland edges to "buffer" wetland conditions. Some wetlands may lack a woody vegetation component entirely.

Are the Aquatic Resources Considered Waters of the US or Waters of CA?

[1] https://www.sfei.org/sites/default/files/biblio_files/TATmemo2_Wetland%20Definition.pdf

[2] *For more information see the State Water Board 401 Certification Program's Wetland and Riparian Area webpage:* https://www.waterboards.ca.gov/water_issues/programs/cwa401/wrapp.html

CARI strives to represent the most complete and current inventory of surface waters throughout California based on a standard mapping procedure consistent with state and federal standards and guided by a statewide technical committee of the CA Water Quality Monitoring Council. It incorporates regional and local data that meet CARI standards. Updates to CARI occur when project funding permits. Updates of national datasets have been scripted and thus can be accomplished with more cost effectively than mapping and incorporating new regional aquatic resource intensifications.

CARI is not jurisdictional. Standardized state and federal procedures are used in the field to determine if the state or federal government has jurisdiction over any particular area of water included in CARI. State jurisdiction is mainly determined by the CA State Water Resources Control Board and its Regional Water Quality Control Boards. However, the CA Coastal Commission has its own definition of wetlands used to determine its jurisdiction. Federal Jurisdiction is determined by the US Army Corps of Engineers and/or the US Environmental Protection Agency.

CARI Mapping Standards

CARI procedures for mapping aquatic resource lines and polygons were adopted from the Bay Area Aquatic Resources Inventory (BAARI) mapping methodology and subsequent regional mapping intensification efforts conducted in the Sierra (TARI), Delta (DARI), and North Coast (NCARI) regions (Figure 1, above). Each of those efforts brought together regional wetland scientists and agencies who developed region-specific protocols for mapping aquatic resources unique to their regions. The BAARI mapping project began in 2009, and was the first GIS-based intensification to develop standardized protocols for mapping aquatic resources in the San Francisco Bay Area. Its purpose was to develop a detailed GIS dataset such that it can serve as a common base map for monitoring and assessment, and to characterize the amount, distribution, and diversity of wetlands in the region.

Source Data Requirements

The kinds of geospatial data used for mapping regional aquatic resource inventories (e.g., BAARI, DARI etc.) in GIS is identified by type and quality, not as specific, named datasets. For example, although BAARI features were digitized on the National Agriculture Imagery Program (NAIP) images and recommendations for the use of this imagery were stated clearly in the BAARI mapping methods documentation, new GIS datasets may be developed with different imagery of higher quality or seasonal relevance. Therefore, the CARI mapping methodology will not require the use of specific data sources, but will state requirements for minimum cell size, band number, etc., and recommendations for data sources will be noted.

The minimum source data mapping requirements for CARI are as follows: [3]

- **Primary aerial imagery** – 1 meter resolution, 4 bands, preferably available for multiple timestamps that demonstrate seasonal differences (e.g., NAIP imagery)
- **DEM** – at least 10 meter Digital Elevation Model (DEM), but preferably finer scale, such as LiDAR
- **Ancillary data** – datasets that showcase local knowledge or provide an alternate view (e.g., local vegetation layers, georeferenced field photos, paper maps, etc.)

Ancillary data are used to augment primary data sources in areas where identification of aquatic resources are difficult from the aerial imagery. In general, ancillary data is used to understand topography, temporal and seasonal

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[3] These standards apply to all regional aquatic resource inventories and the majority of mapping in CARI. However, there are some parts of national datasets (e.g., NWI and NHD) that have been incorporated into CARI, that may not meet these standards (e.g., legacy NWI mapped on panchromatic imagery, or NHD mapped using lower resolution DEMs), but nonetheless represent the most detailed and current mapping of aquatic resource inventories for their region.

differences, and subsurface drainage. A list and description of common data sources and ancillary data used to develop the current CARI standard GIS dataset is provided in Appendix A.

Data Development

When mapping GIS features on a landscape, a key question that arises is whether or not the process can and should be fully automated. Many geospatial analyses have been automated, such as calculating mean elevation or computing stream buffers based on proximity to landscape variables. Some classification analyses are also automated, like isolating features with unique spectral characteristics from images using pixel-based and object-oriented approaches (Kim et al., 2009). However, in order to map wetlands on a landscape as ecologically diverse as California, complex logic algorithms would need to be constructed that are tailored to each locality. Even still without manual refinement of automated mapping, accuracy may still not approach a consistent and satisfactory level. As robust automated algorithms are developed that map California wetlands accurately throughout the state, CARI will adopt them. Datasets derived from a combination of automated processes and heads-up digitizing have proved to be the best process for developing the most accurate and detailed GIS dataset.

Thus CARI mapping standards recommend that digitizers modify automated data products. Below are a few methods tested by SFEI GIS staff and other GIS professionals with the pros and cons of each:

1. Digitizing stream lines off an aerial image guided by lines derived from calculated DEM flow paths. Because reducing all errors in automated products is currently not possible, and as algorithmic flow lines that follow raster cells are inherently jagged/blocky and do not perfectly depict features in the imagery, relying on a human digitizer to draw the lines using both the image and flow lines as guides results in a smoother mapped feature that is often better aligned to the image. Further, in the case of stream modeling, algorithms often lose accuracy in flat areas. Along these lines, slight differences in color and shade that are easily discernible with the human eye are often difficult to isolate using an automated mapping process that relies on DEMs alone.

2. Hydroenforcement, or “burning” stream features into a DEM manually by assigning areas of a known stream based on an artificially low elevation value, enable more accurate automated stream paths to be created programmatically. This method has a promising application in generating DEMs that can be modeled after new hydroenforced additions to reproduce updated stream layers for whole watersheds. However, the hydroenforcment adds a new step that often must be automated to make this approach more efficient. Currently limited use of this method may be warranted in especially problematic areas in a DEM. However, further method development and discussion on the role of hydroenforcement in CARI is required before decisions are made to incorporate it into the general methodology.

3. A more automated mapping approach was taken by the Spatial Informatics Group (SIG) for the mapping of aquatic features in the Tahoe Basin (TARI). Initially two subwatersheds within the TARI were mapped as a demonstration project to develop mapping procedures by the Tahoe WRAMP Demonstration Project (2013). SIG subsequently extended the map to the entire basin using an automated approach based on the mapping standards developed by the WRAMP Demonstration Project (see TARI Tahoe Aquatic Resources Inventory. Mapping Standards and Methodology for Channels, Wetlands, and Riparian Areas in the Tahoe Basin). For streams, SIG’s approach consisted of two general phases. In the first phase, a proprietary automated method was used to identify likely locations of streams based on areas of high flow accumulation in the 2010 LiDAR. This automated approach worked by filling sinks within the LiDAR-derived DEM, computing the flow direction using the D-Infinity algorithm, then finding stream segments based on areas of high flow accumulation. In the second phase the stream segments were manually reviewed and edited using the 2010 LiDAR and 201 WorldView-2 imagery. For wetlands, mapping was conducted by SIG’s GIS team trained on the TARI mapping standards. They used multi-band imagery in combination with raster products created from the 2010 LiDAR (DEM, Slope, Aspect, etc.) to identify wetlands and aquatic features in the Tahoe Basin. This automated process was conducted using eCognition and is further

described in the SIG report (Roby et al., 2015). Multiple rounds of reviews were conducted to ensure accuracy and consistency in the data. Additional QAQC was conducted by SFEI to quantify levels of error and then additional heads up digitizing and manual edits were made by SFEI staff to bring the dataset into alignment with CARI standards.

4. In some limited cases, where sufficient coverage of a habitat type is not sufficiently mapped by heads up digitization, automated/modeled outputs have been used with limited manual correction. The primary example of this is CARI coastal Beach and Rocky Intertidal habitat types, which were delineated under work for the Ocean Protection Council. These polygons were classified and have their shoreline linear extents defined by the heads up digitized coastal inventories found in the most recent Environmental Sensitivity Index (ESI) data, however the oceanward and landward extents were modeled from the most recent available bathymetry and elevation data adjusted with then current tidal datum sources that were interpolated along the coast. For more information on the creation of these polygons see the Rocky Intertidal/Beaches subsection under Wetland Data Integration/Development.

Fully automated data products are not generally suitable for integration into a final product for CARI. However, refined automated mapping may be suitable, and DEM-based stream models and other ancillary algorithmically-derived data can and should be used as ancillary datasets.

Watershed Boundary

Watershed boundaries are useful extents for mapping as they represent geographic units that have minimal connections to larger landscapes. Thus watershed boundaries represent good candidates for mapping intensification extents. However, this is not always possible as there are large areas of interest, that are rich in aquatic resources, that do not extend to the tops of their larger watershed boundaries (e.g., the legal Delta Boundary).

A watershed geographically defines the unit of land that drains surface run-off to one location (often known as a pour point in GIS). Standardized methods for delineating watersheds are developed by California Interagency Watershed Mapping Committee (IWMC). As an example, the CalWater 2.2.1 watershed dataset, a product of IWMC, was used as a starting point to define the BAARI watersheds. BAARI used the CalWater 2.2.1 HUC8 level of watershed. This includes Napa River, Coyote Creek, and Guadalupe River watersheds.

It should be noted that the accuracy of watershed boundaries may vary within the watershed and may warrant careful review and adjustments. For example, the accuracy of CalWater 2.2.1 varies within a watershed. Some alteration was required to meet the accuracy of BAARI. CalWater 2.2.1 defines a fairly accurate boundary in the upper watershed. Small and infrequent changes were required there. In these headwater regions accurate DEMs can be used to automatically delineate watershed boundary edges. Lower elevation and more topological uniform urbanized areas were more challenging to quality control without a comprehensive storm drain map. In select areas where these data were available and CalWater 2.2.1 had an incorrect boundary, it was modified. In all other areas BAARI relied on CalWater 2.2.1. Watershed boundaries typically exclude the parts of the tidal zone. In BAARI, tidal marshes were included in the watershed as they have a hydrological connection to the upper watershed through surface run-off and sedimentation (Grenier, personal communication). Though some tidal marshes in the Bay are disconnected from hydrology by levees and other artificial features, for the purposes of BAARI they were not excluded from the watershed. For BAARI purposes the Bayward extent of a watershed is the mean sea level (MSL).

Mapping Scale and Target Mapping Units

CARI employs "target mapping units" (TMU) in line with the NWI standard. This term implies that although an area target has been set, features with smaller areas should be incorporated if the digitizer discovers them while mapping.

CARI's mapping scale and TMU varies based on general habitat type. The TMU is a desired minimum mapping unit but slight exceptions can be made on a case-by-case basis (within $50m^2$ for polygons or 25m length for lines). The goal is to standardize the mapping scale yet maximize the detail of a dataset: capturing small but important wetland areas, such as springs and seeps, while producing a consistent dataset for the region. The consistent determination of the presence or absence of wetland areas depends on making this determination at a standard spatial scale[4]. Presence or absence of wetland features is identified at the standard target scale. However, after a wetland feature is located and classified, a larger scale may be appropriate for digitization.

Non-tidal Wetlands

Non-tidal wetlands are mapped and QA/QCed at a scale of 1:5,000. However, after a wetland area has been identified and classified, a larger scale view (up to 1:1,000) can be used to map the boundary of the area. The targeted mapping unit for non-tidal polygonal features is $100m^2$.

Small non-tidal wetlands, including vernal pools and seeps and springs, defined as $50m^2$ have a mapping scale of 1:2,500.

Non-depressional open water features (e.g., lacustrine) are open water areas greater than 8 hectares (ha) and have an average depth of greater than 2 meters during the growing season.

Non-tidal natural channels have a target mapping length of 50m. Non-tidal unnatural channels, including ditches, engineered, and subsurface channels, have a target mapping length of 25m. However, if an unnatural channel connects a water body, there is no TMU.

Tidal Wetlands

Tidal wetlands are mapped and QA/QCed at a scale of 1:2,500. The TMU for most tidal polygonal features is 50 m^2, except for Lagoons which have a TMU of 8 ha, with the caveat that coastal Lagoons could be smaller. The minimum mapping length of tidal channels, natural and unnatural, is 25 m.

The final GIS dataset should have no overlapping polygons, and no multi-part features.

Feature Geometry and Attribute Considerations

Considerations for linework geometry and attributes:

- Linear stream features will be digitized as lines, and all other features as polygons. However, streams of widths greater than a set value will also be digitized as polygons. This width threshold value may follow the NHD standard of 50 feet, but may also differ regionally depending on regional mapping needs (e.g., 10m in DARI).
- The utility of attributing CARI with stream segment-specific network attributes like NHD is uniformly accepted, but instead of incorporating this into the CARI workflow, network attribution will be added with the integration to NHD. Examples of network attributes would be upstream catchment size, bank-to-bank width, and unique channel IDs.
- CARI does not include Strahler stream order to designate stream hierarchy, however BAARI and other mapping intensifications (often) do. Stream order is an important feature for probabilistic survey of wetland conditions employing the California Rapid Assessment Method as it represents some flexibility in the development of the sample frame and opportunities to stratify a sample.

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[4] *Regional differences in TMUs may be warranted and may warrant further research. Region specific TMUs can be addressed in the Regional Supplements.*

- Dams and other obstructing features to the linear network may be added as point events, as in NHD. These point events would inform network models where flow is impeded.

Considerations for polygonal geometry and attributes:

- Contiguous features should not have gaps between them.
- Slivers should be removed and or merged with adjacent like features
- Contiguous polygons with the exact same values in all fields should be merged.

Projection and Datum

The native projection for CARI data will be the updated California Teale Albers (Meters) with a North American 1983 Datum (updated 2011). Previous versions of CARI used California Teale Albers projection with a North American 1983 Datum (NAD1983). This projection is a well-known standard without bias to area. Users can reproject to other projected coordinate systems or calculate on-the-fly for distances or areas in specific units.

Metadata

The CARI metadata standard will be ISO19115 with FGDC minimum standards and feature-level data. Metadata will be appended to all geospatial data products. CARI metadata is embedded with the GIS download file at: www.sfei.org/data/california-aquatic-resource-inventory-cari-version-11-gis-data

Requirements for Contributing Datasets

CARI uses a standardized database structure. Any wetland datasets that are added to CARI are subjected to QA/QC and standardization before being integrated into the statewide dataset.

The attribute tables of contributing GIS datasets should ideally include:

1. **Mapping effort information:** e.g., project name, funding source, GIS mapper name, and date created or updated.

2. **Source data:** a description of the imagery or other primary data source from which the wetland feature was identified and mapped. The "source_data" field in the CARI GIS dataset describes which data sources were used to identify and map each wetland feature. Certain areas might be digitized with a heavy reliance on ancillary datasets including (in some cases) older imagery and this information is important to document. Local and regional experts may also be used to identify and classify wetland areas that are otherwise very difficult to include.

3. **All classification codes employed by CARI:** CARI intensification mapping projects should include the information for all the CARI classification attributes and codes described in the Aquatic Resource Descriptions and CARI Codes section below including the same or equivalent information for: Major Class, Wetland Class, Anthropogenic Modifiers, Wetland Type (Consistent w/ CRAM), Wetland Subtype, Tidal Modifiers, and Vegetation Modifiers.

4. **Other, non-CARI attributes** can be included in any intensification dataset, but will not necessarily be incorporated into the statewide CARI master dataset. For example, linear stream network datasets could include Flow Direction, and Strahler Stream Order attributes to support wetland monitoring and assessment project sample frames.

The CARI classification system maps directly to the stream or wetland feature ‘clicklabel’ and ‘clickcode’. The ‘click label’ and ’clickcode’ represent the most detailed wetland type code within CARI. The ‘clickcode’ field represents the unique wetland classification code composed of the unique attribute codes that describe each wetland feature.

A ‘leglabel’ and ‘legcode’ provide a more generalized classification legend heading that groups aquatic features together. These legend codes are used in EcoAtlas’ symbology and summary tools.

- For linear stream network GIS datasets: ‘legcode’ groups fluvial riverine vs. tidal riverine features. The ‘clickcode’ is a 3-character code that indicates: “MajorClass”, “CRAM Wetland Type”, and an “Anthropogenic” modifier. Artificial paths are an exception to this format being coded as “AP”. Riverine riparian vegetation features adjacent to streams are mapped and classified separately in the polygonal wetland GIS dataset.
- For polygonal wetland GIS datasets: ‘legcode’ groups estuarine and marine features vs. palustrine and riverine features. The ‘clickcode’ is a 7-character code that indicates: “MajorClass”, “Wetland Class”, “Anthropogenic” modifier, “CRAM Wetland Type”, “Wetland Subtype” (which includes CRAM wetland sub-types), “Tidal” modifier, and a “Vegetation” modifier.

Description of CARI Attribute Fields

CARI consists of 2 feature classes: Wetlands (polygons) and Streams (lines). The feature attributes serve both to classify the wetland type and to provide information about the source of the data.

Wetlands

clickcode: an alphanumeric code based on the CARI wetland classification (as presented in Table 1, below).

clicklabel: a detailed description of a feature's wetland type. Clicklabel is the most detailed classification provided by CARI. Original classifications from component datasets (see “orig_class'') are translated or ''crosswalked” into CARI's classification system. While CARI's component datasets may provide more detail for certain types of wetlands, CARI provides a single statewide classification for wetland types, e.g., ''Depressional Perennial Natural Emergent''. Major classes within the 'click label' field include: wetlands and (deep) open water. Classes and types include: depressions, playas, estuarine, lacustrine, marine, riverine, lagoon, and slope.

name: the name of a particular wetland feature. (e.g., Alpine Lake)

orig_dataset: the original source dataset for a feature that was integrated into CARI

orig_class: original classification of the wetland in the source dataset. Source datasets (e.g., NWI, BAARI) use different classification systems. The 'orig_class' field preserves that information.

organization: the agency or organization that originally mapped the wetland feature

orig_dataset_pubyear: the year that the original dataset was published

process_adjustment: notes indicating how the original dataset was adjusted to fit CARI Standards

source_data: a description of the imagery or other primary data source, including year of collection, from which the wetland feature was identified and mapped

source_estimatedyear: most recent estimated year of source data from source data field

orig_scale: scale that original dataset was digitized at or image scale

legend_headings: In EcoAtlas.org, 'legend_headings' is the value that appears in the legend heading.

legcode: a 1-3 letter code signifying the major wetland class, associated with the 'leglabellevel2' field. Provides less detail than 'clickcode'.

leglabellevel1: common terminology for a feature's wetland type. In EcoAtlas.org, Leglabellevel1 is the value that appears in the legend, when you click on a particular feature to identify it, and in analyses of wetland areas generated by EcoAtlas' Landscape Profile Tool.

leglabellevel2: major classification (less detailed) of the wetland classification provided by the 'click label' field, e.g., "Depressional"

major_class: general category that distinguishes open water from wetland areas; corresponds with the first letter of the "clickcode"

wetland_class: More specific wetland classification than major class. Corresponds with the second letter of "clickcode"

anthropogenic_modifier: Classification that indicates if the aquatic feature's physical structure has been significantly impacted by anthropogenic activities. e.g a depressional wetland occurring due to water backing up behind a man made berm or levee. Corresponds with the third letter of "clickcode"

wetland_type: Wetland type that provides additional wetland classification speciation in the context of the wetland_class. This wetland classification is consistent with CRAM module types. Corresponds with the fourth letter of "clickcode"

wetland_subtype: Wetland type that provides additional wetland classification speciation in the context of the wetland class and wetland types. Corresponds with the fifth letter of "clickcode"

tidal_modifier: Indicates tidal influence on an aquatic resource. Corresponds with the sixth letter of "clickcode"

vegetation_modifier: Indicates the dominant type of vegetation for an aquatic feature. Corresponds with the seventh and last letter of "clickcode"

lastupdate: the date that the CARI integration script was last run to integrate that feature

CARI_id: Unique id for that CARI feature

Salinity_Modifier: Indicates a classification of salinity: Fresh (<0.5 ppt), Oligohaline (0.5 - 5 ppt), Mesohaline (5 - 18 ppt), Saline (>18 ppt), Bar-built (Variable), or Undefined. The value of "N/A" is used for features situated outside the realms of available vegetation datasets or estuary extent.

Salinity_Source: A generalized description of the source data used to assign the salinity modifier. This attribute is meant to swiftly convey the basis on which the feature's salinity was determined through the decision-tree framework.

Salinity_Additional_Information: More detailed information regarding the data used to ascribe the salinity class.

STREAMS

clickcode: an alphanumeric code for the wetland classification (as presented in Table 1, below).

clicklabel: a detailed description of a feature's wetland type. Clicklabel is the most detailed classification provided by CARI. Original classifications from component datasets (see "orig_class") are translated or "crosswalked" into CARI's classification system. Clicklabel values include: "Fluvial Natural", "Fluvial Unnatural", "Tidal Natural", and "Tidal Unnatural".

name: the name of a particular wetland feature. (e.g., Pajaro River)

orig_dataset: the original source dataset for a feature that was integrated into CARI

orig_class: Original classification of the wetland in the source dataset. Source datasets (e.g., NWI, BAARI) use different classification systems. The 'orig_class' field preserves that information.

organization: the agency or organization that originally mapped the wetland feature

orig_dataset_pubyear: The year that the original dataset was published

process_adjustment: Notes indicating how the original dataset was adjusted to fit CARI Standards

source_data: a description of the imagery or other primary data source from which the wetland feature was identified and mapped

source_estimatedyear: Most recent estimated year of source data from source data field

orig_scale: Scale that original dataset was digitized at or image scale

legheader: In EcoAtlas.org, 'legheader' is the value that appears in the legend heading. "Drainage Features" is the only value for legheader.

legcode: a 1 or 2 letter code identifying whether the major stream class has tidal influence (TR) or not (R), associated with the 'leglabel' field. Provides less detail than 'clickcode'.

leglabel: Common terminology for a feature's wetland type. In EcoAtlas.org, Leglabel is the value that appears in the legend, when you click on a particular feature to identify it, and in analyses of wetland area generated by EcoAtlas' Landscape Profile tool. Leglabel values include:"Fluvial" and "Tidal".

major_class: General category that distinguishes open water from wetland areas. Corresponds with the first letter of “clickcode”.

CRAM_wetland_type: Wetland type that provides additional wetland classification speciation in the context of the wetland_class. This wetland classification is consistent with CRAM module types. Corresponds with the second letter of “clickcode”

anthropogenic_modifiers: Classification that indicates if the aquatic feature’s physical structure has been significantly impacted by anthropogenic activities. e.g a channel that has been straightened through human engineering efforts. Corresponds with the third letter of “clickcode”

lastupdate: the date that the CARI integration script was last run to integrate that feature

CARI_id: Unique id for that CARI feature

California Aquatic Resource Classification System (CARCS)

CARI uses CARCS. CARCS classifies aquatic resources into an overarching Major Class that distinguishes open water from wetland areas and seven Wetland Classes. Each Wetland Class may be subset into one or more Wetland Types, which is consistent with the California Rapid Assessment Method (CRAM) wetland types. Each feature is further characterized by wetland subtypes, and three additional modifiers that distinguish between natural and unnatural (modified) wetlands, position within the tidal prism, and presence or absence of vegetation.

Table 1 presents the CARI classification code format and options for classifying polygonal wetland features. Table 2 lists a subset of current CARI wetland type codes. The classification system for linear Riverine systems is presented under the Riverine Wetland Class in the Aquatic Resource Descriptions and CARI Classification Codes section below.

The CARCS links to the CRAM wetland types and subtypes because CARI is the recommended base map for the California Wetland and Riparian Monitoring Plan Framework (CWMW 2010). The WRAMP framework outlines a standardized process for monitoring, assessing, and tracking the amount, diversity, and condition of wetlands in California using remote sensed and mapped data, field based rapid assessment data, and additional environmental sampling and analyses as warranted. More information about the CRAM wetland types can be found in the CRAM User’s Manual v6.1 (Section 3.2) that is available on the CRAM website (www.cramwetlands.org).

A classification code crosswalk from CARI wetland types and the national NHD and NWI datasets under development, however significant progress has been made in that SFEI has developed classification code crosswalks and methodologies from national NHD and NWI datasets to CARI wetland click codes. Moving from the classifications of these national datasets to CARI's is not a simple crosswalk and makes use of additional spatial analysis. Refer to NWI & NHD Integration under the CARI Data Compilation and Methods and Considerations section below for more information. SFEI has additionally developed methodologies for crosswalking DARI wetland classes to NWI classes. This work can be adapted for other regional mapping intensifications.

Appendix B contains a crosswalk of CARI classes within "leglabellevel1" and "leglabellevel2" and the definitions below that relate to CARI wetland classes displayed in fields "clickcode" and "click label".

Table 1. List of options available for classifying a polygonal wetland feature using the CARI classification system.

Major Class		Wetland Class		Anthropogenic Modifier		Wetland Type (Consistent w/ CRAM)		Wetland Subtype		Tidal Modifier		Vegetation Modifier	
Open Water Wetland	O W	Depression	D	Natural Unnatural Managed	N U M	Depressional	D	Perennial	P	none unknown Intertidal Subtidal Muted tidal	n u I S M	Non-vegetated vegetated Emergent Forested Herbaceous Shrub-Scrub Unknown Farmed Eelgrass	N v E F H S u f e
								Seasonal	S				
								unknown	u				
						Vernal Pool	V	Individual Vernal Pool	I				
								Vernal Pool Complex	V				
						Playa	P	none	n				
		Estuarine	E			Estuarine	E	Saline	S				
								Non-saline	N				
								none	n				
								Bar-Built	B				
		Lagoon	G			Lagoon	G	none	n				
		Lacustrine	L			Lacustrine	L	none	n				
		Marine	M			none Rocky Intertidal Beach Dune	n r B d	none beach adjacent (dune only)	n a				

		Riverine	R			Riverine	R	none	n				
								Tidal	T				
								unknown	u				
		Slope	S			Slope	S	Forested	F				
								Seeps and Springs	S				
								Wet Meadow	W				

Table 2. Examples of current CARI wetland type codes (click label and clickcode) for polygonal wetland features. All of clickcode attributes listed below are prefaced (in position 1 [not shown]) with the Major Class code of either “O” for Open Water or “W'' for Wetland as defined in this mapping standards and methods document. See Table 1 for the code definitions.

CARI Wetland Type Label	Wetland Class	Anthropogenic Modifiers	CRAM Wetland Type	Wetland Subtype	Tidal Modifiers	Vegetation Modifiers
clicklabel	clickcode classification system (positions 2-7)					
Depressional Natural Non-vegetated	D	N	D	u	u	N
Depressional Natural Vegetated	D	N	D	u	u	v
Depressional Non-vegetated	D	u	D	u	u	N
Depressional Perennial Natural Non-vegetated	D	N	D	P	u	N
Depressional Perennial Natural Vegetated	D	N	D	P	u	v
Depressional Perennial Non-vegetated	D	u	D	P	u	N
Depressional Perennial Unnatural Non-vegetated	D	U	D	P	u	N
Depressional Perennial Unnatural Vegetated	D	U	D	P	u	v
Depressional Seasonal Natural Non-vegetated	D	N	D	S	u	N
Depressional Seasonal Natural Vegetated	D	N	D	S	u	v
Depressional Seasonal Unnatural Non-vegetated	D	U	D	S	u	N
Depressional Seasonal Unnatural Vegetated	D	U	D	S	u	v
Depressional Unnatural Non-vegetated	D	U	D	u	u	N
Depressional Unnatural Vegetated	D	U	D	u	u	v

Playa Natural Non-vegetated	D	N	P	n	n	N
Playa Unnatural Non-vegetated	D	U	P	n	n	N
Playa Vegetated	D	U	P	n	n	v
Individual Vernal Pool	D	u	V	I	u	u
Vernal Pool System	D	u	V	V	u	u
Estuarine Saline Natural Intertidal Non-vegetated	E	N	E	S	I	N
Estuarine Saline Natural Subtidal Non-vegetated	E	N	E	S	S	N
Estuarine Saline Natural Subtidal Vegetated	E	N	E	S	S	v
Estuarine Saline Subtidal Non-vegetated	E	U	E	S	S	N
Estuarine Saline Unnatural Intertidal Non-vegetated	E	U	E	S	I	N
Estuarine Saline Unnatural Intertidal Vegetated	E	N	E	S	I	v
Estuarine Saline Unnatural Muted Tidal Non-vegetated	E	U	E	S	M	N
Estuarine Saline Unnatural Subtidal Vegetated	E	U	E	S	S	v
Lacustrine Natural Non-vegetated	L	N	L	n	u	N
Lacustrine Natural Vegetated	L	N	L	n	u	v
Lacustrine Unnatural Non-vegetated	L	U	L	n	u	N
Lacustrine Unnatural Vegetated	L	U	L	n	u	v
Lagoon Natural Non-vegetated	G	N	G	n	u	N

Lagoon Natural Vegetated	G	N	G	n	u	v
Lagoon Unnatural Non-vegetated	G	U	G	n	u	N
Lagoon Unnatural Vegetated	G	U	G	n	u	v
Marine Natural Intertidal Non-vegetated	M	N	n	n	I	N
Marine Natural Intertidal Vegetated	M	N	n	n	I	v
Marine Unnatural Intertidal Non-vegetated	M	U	n	n	I	N
Riverine Natural Vegetated	R	N	R	u	u	v
Riverine Unnatural Non-vegetated	R	U	R	u	u	N
Riverine Unnatural Vegetated	R	U	R	u	u	v
Slope Natural Vegetated	S	N	S	u	u	v
Slope Natural Forested	S	N	S	F	u	F
Slope Natural Wet Meadow Herbaceous	S	N	S	W	u	H
Slope Unnatural	S	U	S	u	u	u

Aquatic Resource Descriptions and CARI Classification Codes

CARI consists of required core classifying elements that describe the hydrogeomorphology of a linear or polygonal aquatic feature. As described in the Description of CARI Attribute Fields section above:

- Riverine wetlands are mostly mapped as linear, stream network features. They are first characterized as fluvial riverine or tidal riverine features and then classified with a 3-character code that indicates: "MajorClass", "CRAM Wetland Type", and an "Anthropogenic" modifier. Riverine riparian vegetation that is adjacent to streams are mapped and classified separately in the polygonal wetland GIS dataset.

- Non-riverine aquatic resources (and riverine riparian vegetation) are mapped as polygonal features. They are first classified estuarine and marine features vs. palustrine and riverine resources and then described using a 7-character 'clickcode' that indicates the following attributes: "MajorClass", "Aquatic Resource Class", "Anthropogenic" modifier, "CRAM Wetland Type", "Wetland Subtype", "Tidal" modifier, and a "Vegetation" modifier.

Major Class

Major Class
Open Water = O
Wetland = W

Most aquatic resource features consist of open water areas and saturated soils that may or may not be vegetated. All features mapped are required to indicate if it's open water or wetland.

Open Water

Many wetlands consist of two basic elements: an open water area and a vegetated area. Open water areas are at least 90% percent open water using a 100 square meters (m2) search area (meaning they have less than 10% vegetation cover). Floating and submerged aquatic vegetation found in open water wetlands do not count towards the 10% cover. Open water areas of depressional wetlands can include non-vegetated areas that are seasonally flooded and do not support more than 5% vegetation during the growing season (e.g., open water areas of depressional wetlands). Tidal channels and basins that are permanently inundated can be classified as open water.

Wetland

Under normal circumstances, a wetland (1) is saturated by groundwater or inundated by shallow surface water for duration sufficient to cause anaerobic conditions within the upper substrate; (2) exhibits hydric substrate conditions indicative of such hydrology; and (3) either lacks vegetation or the vegetation is dominated by hydrophytes. Some additional classes including Rocky Intertidal, Beaches, and Dunes are currently nested under Wetland.

Wetland Type Modifiers

There are 3 required wetland type modifiers that further classify each mapped wetland feature**. If a modifier is unknown then it is entered as 'u'. If the modifier clearly doesn't apply to the wetland type then it is entered as not-applicable (or none) = 'n'.**

1. Natural, Unnatural or Managed Wetlands

Natural or Unnatural Modifier
Natural = N

Unnatural = U
Managed = M

Natural wetlands owe most of their existing form and structure to natural processes. They might have been created, restored, enhanced, or otherwise modified by the direct or indirect actions of people, and they might be actively protected or otherwise managed. However, natural processes of geology and climate largely control their character, including their shape, size, location, sediment characteristics, hydrology, chemistry, and biology. Unnatural wetlands do not meet these criteria (e.g., a stock pond or drainage ditch). Further, if the open water area of a wetland is unnatural, then all the associated vegetated area(s) is also considered unnatural. Managed aquatic features may exhibit more natural forms and compositions, but exist due to continual direct management of water on the landscape (e.g., duck ponds, flooded agricultural fields, restoration areas).

Deciding whether a wetland area is natural or not requires careful consideration of its apparent form, structure, and hydrological regime, relative to what is expected based on an expert understanding of the likely controlling factors and processes. For any mapping effort, such considerations will evolve into a set of guiding "rules of thumb" that must be applied consistently throughout the mapping effort. Different practitioners must be able to use the same rules in the same way to produce comparable maps. Initial determinations of what is natural might have to be revised as experience is gained. Some general rules governing the designation of areas as natural or unnatural are presented in Table 2.

Table 3: General indicators visible through primary data sources[5] to help distinguish natural from unnatural wetlands.

Riverine Wetlands
Form: A wetland is classified as unnatural if its form in plan view is unnaturally straight. For example, ditches, flumes, and canals tend to lack the sinuosity or curvature of natural channels.
Substrate: A wetland is classified as unnatural if it is mostly man made. For example, channels that are constructed of cement or other materials that would not occur in that location due to natural processes.
Non-riverine Wetland types
Impoundment: A wetland that exists because of the impoundment of water behind a levee, dam, etc., is always classified as unnatural, e.g., reservoirs, channel ponds, lakes. This is based on the assumption that the impoundment will be maintained.
All Wetlands
Wetland areas that were originally unnatural can become naturalized due to the prevailing actions of natural events and processes. This is the case for many very old unnatural channels with natural flow regimes that have developed meanders, point bars, etc., and for successful wetland creation and restoration projects. The review of various temporal datasets is required to determine change over time. These features should be sinuous, have established vegetation or have a developed substrate.

[5] *Primary data sources can include LiDAR, imagery and local knowledge.*

2. Tidal Position

Tidal Modifier
Intertidal = I
Subtidal = S
Muted tidal = M
Non-tidal, not applicable, or none = n
unknown = u

Estuarine and Marine wetlands are further characterized based on their position within the tidal prism. They are classified as Intertidal (I), Subtidal (S), or Muted tidal (M). For non-tidal features the entry is (n) for none. Ancillary data (e.g., NOAA's Continually Updated Shoreline Product (NOAA-CUSP)) may be used to distinguish tidal zones.

3. Vegetated or Non-vegetated Areas

Vegetated Modifier
Vegetated = v
Non-vegetated = N
unknown = u
Emergent = E
Forested = F
Herbaceous = H
Shrub-Scrub = S
Farmed = f
Eelgrass = e

A 'vegetated' modifier is required for riparian aquatic features that are adjacent to other aquatic features. All wetlands and streams have some amount of adjacent riparian area, as defined by the NRC (see section "Definition of Wetlands" above).

Vegetated aquatic features have at least 5% vegetation cover. Non-vegetated areas lack apparent standing water during the dry season and appear to have less than 5% vegetation cover. The non-vegetated modifier is only used for wetlands that fit the definition of open water (see above) or playas (see below). As mentioned above, non-vegetated areas that are seasonally flooded and do not support more than 5% vegetation would be classified as open water.

Vegetated wetland areas can support woody wetland vegetation (e.g., willows and alders) and herbaceous wetland plants (e.g., sedges and rushes), and do not have an upper size limit.

The wetland descriptions below include the core required vegetation modifiers and CARI accepts several additional modifiers (e.g., emergent, forested, herbaceous, shrub-scrub, farmed, and eelgrass) to accommodate more precise vegetation modifiers (such as mapped by NWI).

Emergent vegetation consists of erect rooted herbaceous hydrophytes (excluding mosses and lichens) and is usually dominated by perennial plants[6].

Forested describes areas where woody trees are the dominant life form. Where vegetation information comes from NWI these trees are over 6m (20ft) tall[6]. If vegetation information doesn't provide a localized elevation then an area dominated by tree species without elevation data will be classified as forested.

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[6] *Federal Geographic Data Committee. 2013. Classification of wetlands and deepwater habitats of the United States. FGDC-STD-004-2013. Second Edition. Wetlands Subcommittee, Federal Geographic Data Committee and U.S. Fish and Wildlife Service, Washington, DC.*

Shrub-Scrub typically represents areas where woody plants that are less than 6m (20ft) tall are dominant[6]. If the only vegetation information available (e.g., VegCamp) for an area indicating a tree species, "Forested" may be used even if those specimens are under 6m (20ft).

Herbaceous is a general vegetation classification used to describe areas dominated by vascular plants that have no persistent woody stems above ground. This broad category of plants includes many perennials, and nearly all annuals and biennials.

Farmed is used to describe aquatic features "where the soil surface has been mechanically or physically altered for production of crops, but where hydrophytes would become reestablished if the farming were discontinued"[6].

Eelgrass is used to describe Marine or Estuarine areas that are dominated by eelgrass beds.

Wetland Class, Wetland Type, and Wetland Subtypes

The Wetland Class descriptions below apply to open water and wetland areas defined in the Major Class description above. The Wetland Types and Wetland Subtypes are consistent with CRAM Wetland Modules and their sub-types (if they can be remotely mapped from aerial imagery or other GIS data sources). Each wetland feature is further classified as natural/unnatural, intertidal/subtidal/muted tidal or vegetated/unvegetated using the Wetland Type Modifiers described above. We also included current examples of CARI 'clickcodes'[7] from the master dataset.

Depression (D)

Major Class O or W	**Wetland Class** D	**Anthropogenic Modifiers** Natural = N Unnatural = U Managed = M	**CRAM Wetland Type** Depressional = D Vernal Pool = V Playa = P	**Wetland Subtype** Perennial = P Seasonal = S Individual Vernal Pool = I Vernal Pool Complex = V	**Tidal Modifiers** none or not-applicable = n unknown = u	**Vegetation Modifiers** Vegetated = v Non-vegetated = N unknown = u	**CARI (examples)** ODNDPuN ODNDSuN ODNDSuv ODUDPuN ODUDSuv WDNDPuE WDNDSuE WDNDSuF WDNDSuN WDUDSuE WDUDSuF WDUDSuS WDuVluu WDuVVuu

Depressional Wetlands are features predominantly fed by surface water that form in topographic lows and precipitation, surface runoff, and groundwater are their main sources of water. Some depressions receive and drain water through a channel. If they are connected to surface drainage, the flow is not enough to create an obvious channelized flow of water through the depression, except perhaps during extreme high-water events. Main loss mechanisms are evapotranspiration and/or infiltration. Depressional wetlands have a minimum size of 0.025 acres (100 m2).

Depressional Wetlands can have prominent areas of shallow seasonally open water and areas of adjacent vegetation. These features can be natural, unnatural, or managed. The open water areas can include non-vegetated areas that are seasonally flooded and do not support more than 5% vegetation. The open water areas of a depressional wetland differs from that of lacustrine wetlands by being smaller than 20 acres (8 ha) in area and having an average depth less than 6 feet (ft) (~2 m) during the dry season. The vegetated areas can support woody

[7] *The polygonal wetland clickcodes are a concatenation of the 7 attribute codes. Linear clickcodes are 3 digit codes (see the Linear Aquatic Features section, below).*

wetland vegetation (e.g., willows and alders) and herbaceous wetland plants (e.g., sedges and rushes), and does not have an upper size limit.

These systems can occur on the landscape as isolated basins with distinct boundaries, or as a complex of shallows and seasonally wet depressions created by the slight topographic relief with indistinct boundaries, or as a large complex of interconnected basins. The margins of distinct depressional wetlands are relatively easy to discern in aerial photos and in the field. Ponds on fault traces (e.g., sag ponds, snow melt ponds), valley bottoms (e.g., cutoff ox-bows on floodplains), landslide impoundments, and on broad saddles along ridges (e.g., kettle-holes in moraines) are examples of naturally occurring depressional wetlands. Stormwater treatment ponds, wildlife habitat enhancements (e.g., duck ponds), stock ponds, and water hazards on golf courses are examples of artificially constructed depressional wetlands.

Depressional Wetland Types and Sub-Types

The following Depressional wetland types and sub-types are consistent with CRAM.

Individual Vernal Pool Wetlands

ClickCode = WDuVIuu

Vernal pools are ephemeral wetlands that form in shallow depressions underlain by bedrock or by an impervious, near-surface soil horizon. These depressions fill with rainwater and runoff during the winter and may remain inundated until spring or early summer, sometimes filling and emptying repeatedly during the wet season. Vernal pools undergo four distinct annual phases: (1) the wetting phase with the onset of the first rains; (2) the aquatic phase when the peak rainfall and inundation occurs; (3) the drying phase when many plants flower and produce seed and many animals disperse; and finally (4) the drought phase when the soil dries and cracks, and the plants succumb to extreme dry conditions. Vernal pools typically support a minimum of 30% cover of native plant species during the aquatic or drying phase. Vernal pools in disturbed areas or subjected to abnormal rainfall patterns might not meet this criterion due to invasion by non-native plants. If the wetland is mostly characteristic of a vernal pool but also has characteristics of other kinds of wetlands, such that its classification as a vernal pool is not completely certain, then it should be considered a vernal pool. Individual vernal pools are mapped at maximum water volume.

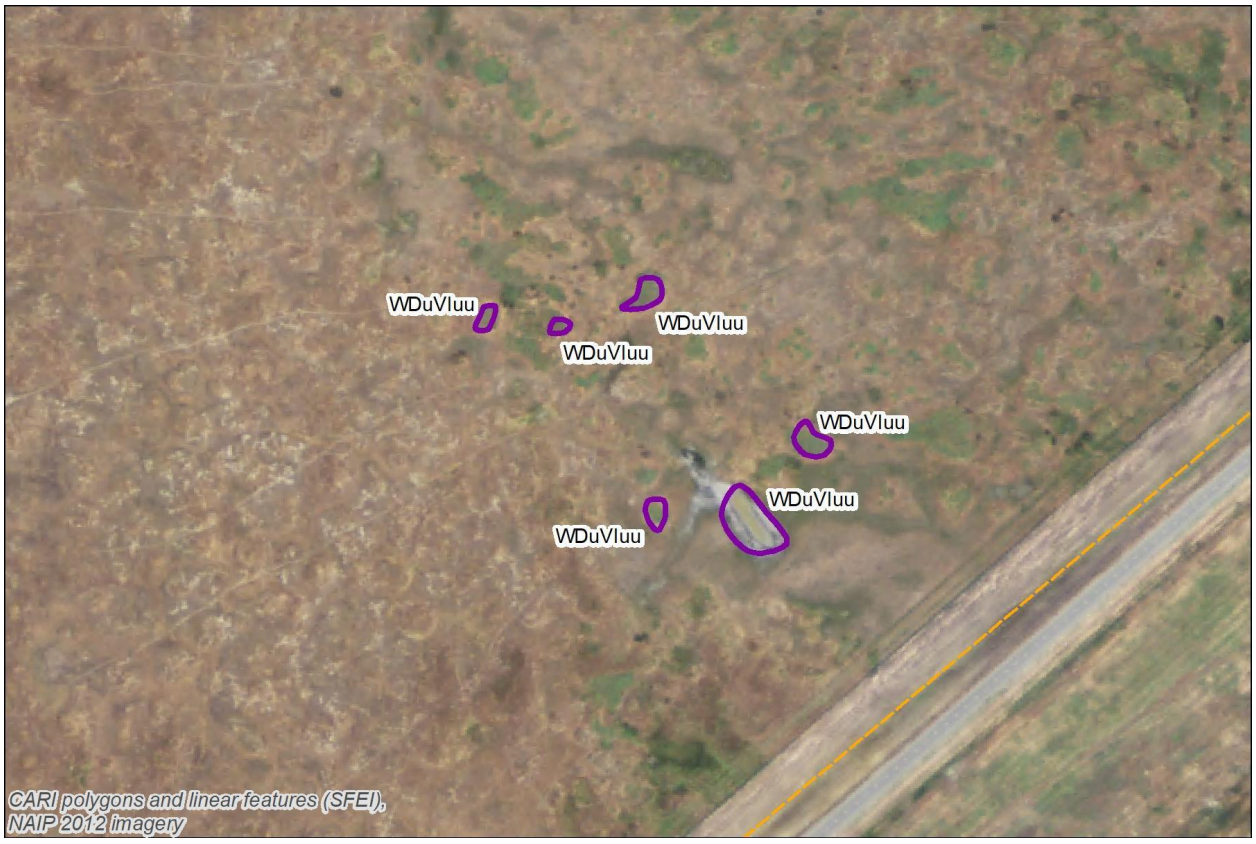

Figure 2: Individual Vernal Pool wetlands.

Vernal Pool Complexes

ClickCode = WDuVVuu

Vernal pools often occur together and with vernal swales as vernal pool complexes. These can have many pools of various sizes and shapes, varying floral and faunal composition, and various hydroperiods. These depressions fill with rainwater and runoff from small catchment areas during the winter and may remain inundated until spring or early summer, sometimes filling and emptying repeatedly during the wet season. Water can move between adjacent pools and swales through the thin soils above the underlying impervious substrate. Vernal pools often occur together with vernal swales as vernal pool systems or complexes that have many pools of various sizes and shapes. The lack of surface flow between pools does not necessarily indicate that they are not hydrologically inter-connected. Vernal pool complexes are several vernal pools that are smaller than the targeted mapping unit that are hydrologically interconnected and mapped as one unit. These features are usually identifiable because of the distinctly textured landscape

Mapped Vernal Pool Complexes include the intervening non-wetland matrix that is an integral component of the overall system. Clues for identifying possible Vernal Pool Complexes include:

- Nearly horizontal and flat topographic slope or gently sloping undulating lands with multiple depressions of generally equal size and shape having no obvious or only partial hydrological connection as viewed in aerial imagery (i.e., land surface resembles the surface of a golf ball);
- Nearly horizontal and flat topographic slope or gently sloping undulating lands with multiple swales that are anastomosing (interconnected) or not, very shallow (seldom deeper than 1-2 feet), much wider than deep, and mostly vegetated from side-to-side and along their length during spring. These swales may

comprise the headward reaches of riverine drainage networks but generally lack the capacity to transport bedload due to their very gradual slope, although water may flow through them during storm events (hence the vegetated condition during spring).

Perennial and Seasonal Depressional Wetlands

ClickCode = WDNDPuv, WDNDSuv

Depressional wetlands other than vernal pools are either seasonal or perennial. Their flora and fauna are mostly not characteristic of vernal pools, and they lack the impervious substrate that controls vernal pool hydrology. They differ from lacustrine wetlands by lacking an adjacent area of open water (at least 2 m deep and 8 ha total area). They differ from playas by lacking an adjacent area larger than the wetland of either alkaline or saline open water less than 2 m deep or non-vegetated, fine-grain sediments. Depressional wetlands can rely on surface water, precipitation, or groundwater. Depressional wetlands are also topographic lows (closed basins), where slope wetlands have a uni-directional slope.

As defined by CRAM, perennially flooded depressional wetlands have surface water year round. Seasonally flooded depressional wetlands are defined as supporting surface ponding for between 4 and 11 months of the year (in greater than 5 out of 10 years), and temporarily flooded depressional wetlands possess surface water between 2 weeks and 4 months of the year.

Figure 3: Depressional wetlands(ODUDuuN, WBUDuuv).

Playa

ClickCode = WDuPnnu, WDUPnnv

The central feature of a playa is a seasonal or perennial body of very sodic (i.e., strongly alkaline) or saline water less than 2m deep that is larger than the adjacent, fringing wetland. Playas are nearly level, shallow, ephemeral (seasonal) or perennial water bodies with very fine grained sediments of clays and silts. Unlike vernal pools, playas have little or no vascular vegetation within the limits of the water body, though they often support sparse grasses and herbaceous plants tolerant of the soluble salts that accumulate along the margins of the playas. And, unlike vernal pools, playas are more dependent on runoff than direct precipitation.

Playas can have open water/unvegetated areas and vegetated areas without standing water. Unlike lacustrine wetlands, playas are less than 2m deep during the dry season, although they can be hundreds of ha in size, and are highly saline or alkaline.

Figure 4: Example of a playa unnatural wetland (WDuPnnu).

Estuarine (E)

Major Class O or W	**Wetland Class** E	**Anthropogenic Modifiers** Natural = N Unnatural = U Managed = M	**CRAM Wetland Type** E	**Wetland Subtype** Saline Estuarine = S Non-saline Estuarine =N	**Tidal Modifiers** Intertidal = I Subtital = S Muted Tidal = M none or not-applicable = n unknown = u	**Vegetation Modifiers** Vegetated = v Non-vegetated = N Unknown = u Eelgrass = e	**CARI (examples)** OEUESSN OEuESSu OEUESSv WENESIE WENESIF WENESIN WEUESME

				Bar-Built Estuarine = B unknown = u			WEUESMN

Estuaries are bodies of water and their surrounding coastal habitats found where saltwater from the ocean and freshwater from rivers and streams mix. Their inlets may be natural or unnatural. Typical sources of freshwater can include rivers, streams, lakes and reservoirs, point discharges (e.g., effluent from sewage treatment facilities), and storm drains.

Estuarine wetlands are intertidal environments that are fully or partially tidal for at least one month during most years. They usually experience periods of wetting and drying during different phases of the hydroperiod, and may be saline or hypersaline, with minimal freshwater influence, or saline with a strong freshwater influence, or even non-saline, or even non-saline (as found in the upper portions of the San Francisco Bay-Delta). They generally consist of the vegetated marsh plain, its pannes, potholes, hummocks, and other habitats. They can be surrounded by natural or unnatural levees, including shell beds, submerged plant beds, and other habitats created or supported by tidal processes. For example within the San Francisco Bay estuary are estuarine wetlands (e.g., including natural and unnatural tidal marsh and salt ponds).

Estuarine wetlands are associated with tidal channels that tend to dewater at low tide. Tidal channels that do not tend to dewater at low tide or and that are wider than 30m are considered to be part subtidal estuarine open water areas and not considered part of the wetland – they can serve to separate one estuarine wetland from another. The presence of water control structures (e.g., levees or tide gates) that prevent full natural tidal access from an area can cause it to no longer be considered tidal. In these instances features may be muted tidal or even be a non-estuarine wetland type. For example, tidal channels upstream of managed tide gates may have muted tidal action. Or areas below mean tide level and isolated by levees may be depressional wetlands rather than estuarine.

In the past, when it was available, NOAA's Continually Updated Shoreline Product (NOAA-CUSP) has served as an ancillary dataset to identify the intertidal zone. This product defined the intertidal zone as between the mean higher high water and the mean lower low water lines as demarcated in the NOAA-CUSP[8]. Note that for rocky intertidal the landward boundary is defined as the epoch based MAX high water (the maximum high water during the last 19 year tidal epoch). Please see the Marine section below for more information. Regardless, the boundary used between estuarine and marine habitats is the mean lower low water line. The boundary between estuarine and riverine habitats should be demarcated based on observed changes in vegetation, topography or elevation, or apparent extent of ponding (e.g., inland limit of tidal vegetation or tidal flat areas), along with the mean higher high water line (if needed). The higher high water line should be identified using higher resolution imagery and/or available lidar based elevation data paired with local tidal datum data.

[8] *It is derived from the diurnal range of the tides: the difference in height between mean higher high water and mean lower low water, the averages for each tidal day observed over the National Tidal Datum Epoch or derived equivalent, and created by comparison of simultaneous observations with a control tide station. (NOS CO-OPS 1 2000).*

Figure 5. Example of estuarine wetlands.

Estuarine Wetland Sub-Types

The following Estuarine wetland sub-types are consistent with CRAM.

It is often infeasible to distinguish between saline and non-saline using aerial imagery and elevation data alone. Ancillary data and or local knowledge is required to make this distinction. There are also instances where vegetation can be used to distinguish between saline and non-saline features. Where this information has been collected previous it has been incorporated into CARI.

Estuarine Saline Wetland

Wetland subtype = S; ClickCode Example = WENESIv, WEUESMS

For the purposes of CRAM, saline estuarine wetlands are distinguished from non-saline estuarine wetlands by the obvious dominance of salt-tolerant species of emergent vascular vegetation, such as cordgrass (Spartina spp.), pickleweed (Salicornia spp.), and salt grass (Distichlis spp.) along the foreshore of the wetland and along the immediate banks of the larger tidal channels that tend to dewater at low tide. Local knowledge can also be used to help inform the characterization of the salinity of features. Features that are known to be brackish are mapped as Saline.

Estuarine Non-saline Wetland

Wetland subtype = N; ClickCode Example = WEUENnv

In non-saline wetlands (i.e., freshwater estuarine wetlands), the plant community along the foreshore of the wetland and along the immediate banks of the larger tidal channels that tend to dewater at low tide is dominated by species that don't tolerate high salinities, such as cattails (Typha spp.), rushes (Scirpus and Bolboschoenus spp.),

and willows (Salix spp.).Local knowledge can also be used to help inform the characterization of the salinity of features.

Estuarine Wetland sub-type unknown

Wetland subtype = u; ClickCode Example = WEUEuuv

There are aquatic features where the salinity is unknown, given available information and remote sensing data. Without ancillary data or local knowledge to determine the salinity of the aquatic feature the subtype is characterized as unknown.

Bar-Built Estuary

Wetland subtype = B; ClickCode Example = OENEBIN, WENEBIv

Bar-built estuaries are the reaches of coastal rivers and streams that are ecologically influenced by seasonal closures of their tidal inlets. For bar-built estuaries the apparent high water line should be used to inform the location of the boundary of the aquatic feature.

The frequency and duration of inlet closure can be natural or managed. The tidal regime can be muted or not (i.e., the tidal range can be the same or less than that of the adjacent marine or estuarine system when the tidal inlet is open). The salinity regime of a bar-built estuary can be highly variable. It can be fresh throughout very wet years or hypersaline during extended droughts. Bar-built estuaries are sometimes colloquially referred to as “lagoons”, however, the CARI classification system has a separate wetland class and specific definition for lagoons (see below). The inland extent of Bar-built estuaries are mapped to the upstream (landward) limit of tidal vegetation or tidal flat combined with the downstream limit of the adjoining fluvial channel, as evidenced by a change in channel-side vegetation or channel plan-form (i.,e, sudden increase or decrease in channel width and/or sinuosity).

If a system has been altered such that hardened structures at its mouth prevent the formation of a sandbar that would close off the system to marine influence, it would be considered to be a perennially saline estuary (see above).

Lacustrine (L)

Major Class O or W	**Wetland Class** L	**Anthropogenic Modifiers** Natural = N Unnatural = U Managed = M	**CRAM Wetland Type** L	**Wetland Subtype** none = n	**Tidal Modifiers** none=n	**Vegetation Modifiers** Vegetated = v Non-vegetated = N unknown = u	**CARI (examples)**

Lacustrine Wetlands are wetlands with areas of open water equal to or greater than 20 acres (8 ha). Natural lacustrine features are commonly called lakes (they do not include dams or other human-made structures that are responsible for creating the open water areas). Unnatural lacustrine features are impoundments behind dams or other manmade structures and are commonly called reservoirs. Lakes tend to vary less in size within and between years than reservoirs, which tend to expand and contract in area due to water management. Lacustrine features have an average depth of at least 6 ft (2 m) during the dry season. Lacustrine wetlands differ from playas and depressional wetlands by being at least 6 feet deep during the dry season.

Lacustrine Wetlands are always composed of two parts: the area of open water that is apparent during the wet season and the area of wetland vegetation that borders the open water area. The open water area should be mapped when the lake is full. The vegetated area does not have an upper size limit, it simply must be hydrologically dependent on the open water feature. These wetlands can also be naturally formed or man-made (unnatural).

All wetland areas of a reservoir are classified as unnatural due to the influence of the unnatural impoundment (**Figure 6**). Lacustrine wetlands can adjoin other wetlands, such as slope wetlands and riverine wetlands.

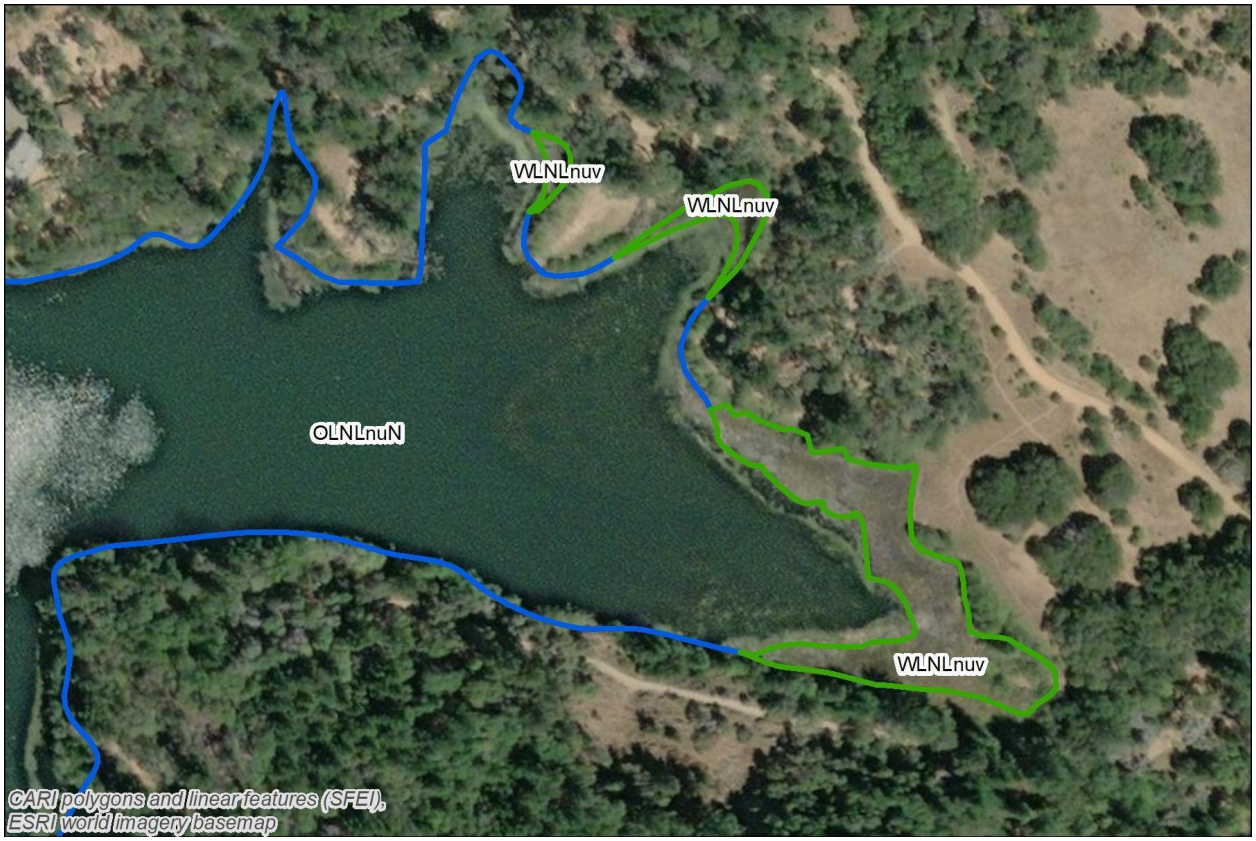

Figure 6. Example map of a reservoir that includes a lacustrine open water unnatural feature (e.g., OLULnuN) and adjoining lacustrine wetlands (e.g., WLULnuv).

Lagoon (G)

Major Class O W	**Wetland Class** G	**Anthropogenic Modifiers** Natural = N Unnatural = U	**CRAM Wetland Type** Lagoon = G	**Wetland Subtype** none=n	**Tidal Modifiers** unknown = u	**Vegetation Modifiers** Vegetated = v Non-vegetated = N Unknown=u	**CARI (examples)** OLNGnuN WLNGnuN WLNGnuv WLUGnuN WLUGnuv

Lagoons are impoundments of water subject to at least occasional or sporadic connection to full or muted tidal action. They can occur naturally due to barrier beaches or dunes or due to modification through levees and tide gates. Typically, they have *limited* fluvial input and may be cut off from a larger estuarine system for significant portions of the year. As a result, the water level may be above or below the adjacent estuary. Lagoons are not

classified as Bar-Built Estuaries (which are subject to direct tidal action much more frequently, are subject to seasonal closure from tidal action due to the formation of a sand bar across the mouth, and exhibit a much stronger fluvial influence). Lagoons are topographic lows that pond, but not because a seasonal sand bar forms. While many of the features of a lagoon are similar to lacustrine features, lagoons are reliant upon different hydrology than lacustrine features. Lagoons experience periodic connection to tidal action (either saline or freshwater) in addition to possible groundwater and precipitation support. Lagoons also do not have the same size and depth requirements that lacustrine systems have.

Lagoons can consist of two habitat areas: open water and vegetated. Open water areas typically have perennial standing water and vegetated portions of a lagoon typically occur along the edges of the open water areas. Lagoons can be natural or unnatural. Natural features can occur due to barrier beaches or dunes whereas unnatural features are modified with levees with tide gates.

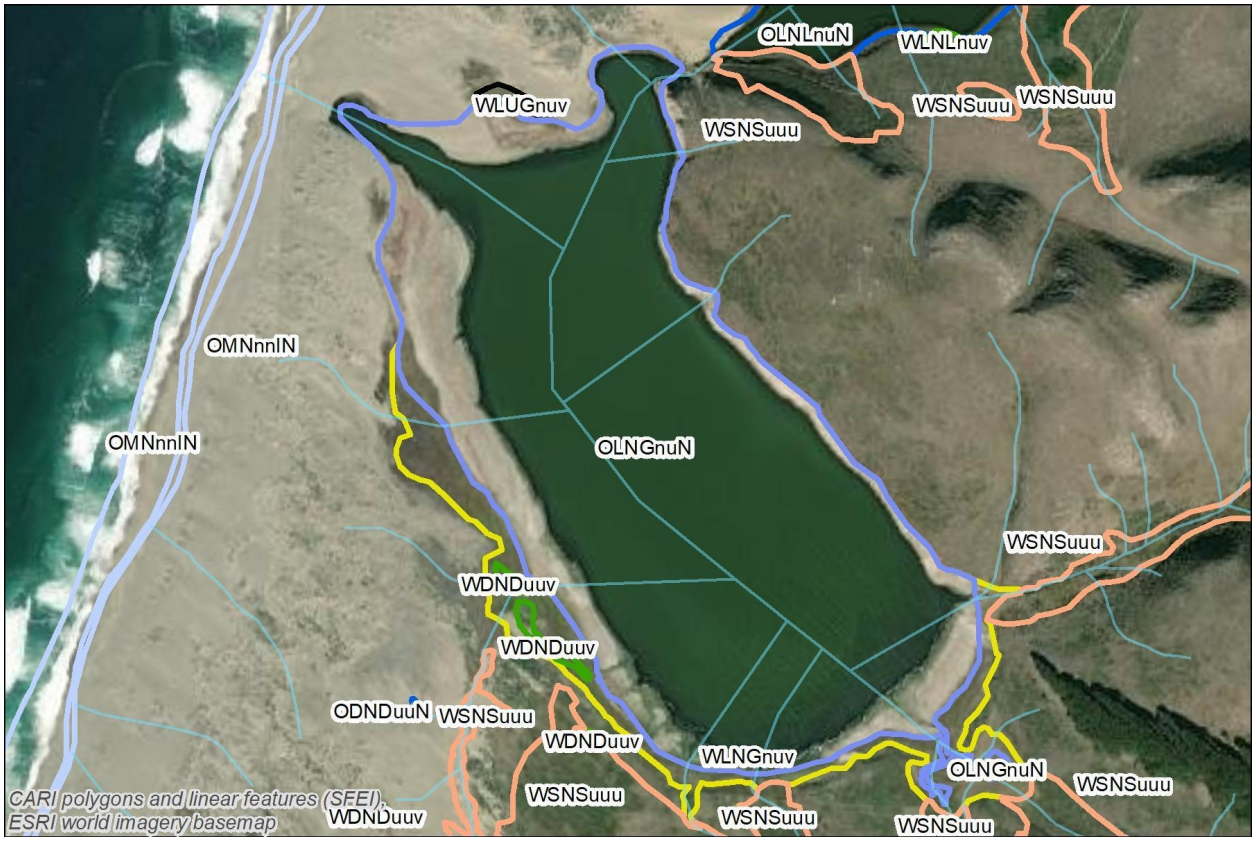

Figure 7. Example map of a lagoon (OLNGnuN).

SLOPE (S)

Major Class	**Wetland Class**	**Anthropogenic Modifiers**	**CRAM Wetland Type**	**CRAM Wetland Subtype**	**Tidal Modifiers**	**Vegetation Modifiers**	**CARI (examples)**
W	S	Natural = N Unnatural = U Managed = M	S	Wet meadow = W Forested Slope = F, Seeps & Springs = S	none = n	Forested = F Vegetated = v Non-vegetated = N	WSNSFuF WSNSuuu WSNSuuv WSNSWuH WSUSuuu

Slope wetlands are groundwater-dominated wetlands inclusive of wet meadows, forested slopes, seeps and springs sub-types. In these wetlands groundwater may emerge into the root zone or across the ground surface seasonally or perennially, but mainly has unidirectional flow. The term “slope” refers to the unidirectional flow of ground and surface water within the wetland, rather than to a geomorphic feature (e.g., hillslope, toe-slope).

Slope wetlands are distinguished from depressional wetlands by having predominantly flow-through hydrology vs. a closed basin. Slope wetlands often exhibit strong dominance by groundwater flow or discharge, although many slope wetlands demonstrate abundant shallow surface or overland flow.

Slope Wetland Types and Sub-Types

The following Slope wetland types and sub-types are consistent with CRAM.

Wet Meadows

Wetland subtype = W

Wet meadows are non-forested slope wetlands larger than 0.5 acres (0.2 ha) in size that support less than 30% cover of tall woody shrubs or trees as evidenced in aerial imagery or any available vegetation dataset. Wet meadows include bogs, fens, and alpine meadows where the hydrology is controlled mainly by fluctuations in ground water levels. They are associated with broad, gentle topographic gradients along which the near-surface groundwater moves advectively, albeit slowly, in one dominant direction. Typically, they are dominated by herbaceous/grass cover or small shrubs. They can include small areas (inclusions) within the slope feature with greater than 30% cover of tall woody shrubs or trees (i.e., forested slopes) if the areas are smaller than 0.5 acres (0.2 ha).

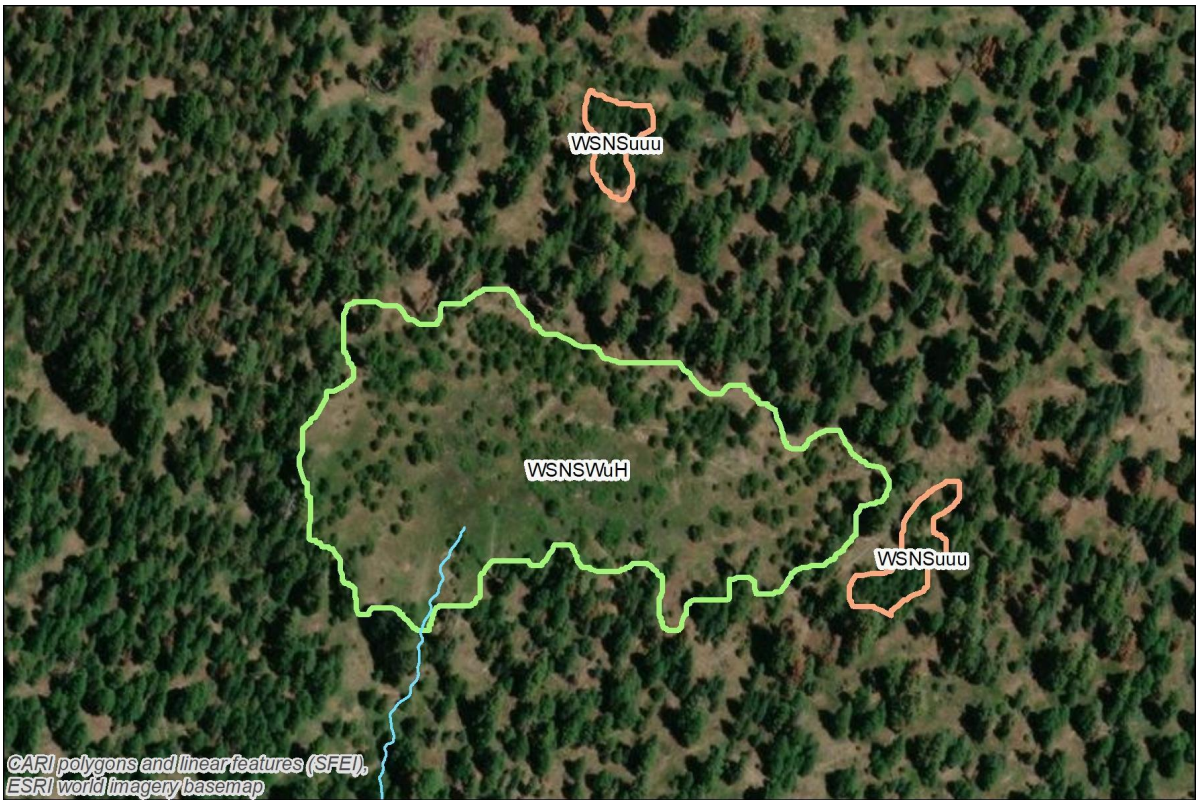

Figure 8. Example map of a wet meadow and slope wetlands.

Forested Slope Wetland

Wetland subtype = F

Forested slope wetlands are separated from wet meadows by the percent coverage of trees. Forested Slope Wetlands are slope wetlands larger than 0.5 acres (0.2 ha) that form due to a seasonal or perennial emergence of groundwater into the root zone and in some cases onto the ground surface. They support more than 30% cover of tall woody vegetation, as evidenced in aerial imagery, or any available vegetation dataset. These wetlands can adjoin non-forested slope wetlands (i.e., wet meadows). They can include wetland areas with less than 30% woody cover (i.e., wet meadows) that are not larger than 0.5 acres (0.2 ha).

Seeps and Springs

Wetland subtype = S

Seeps and springs are a type of slope wetland that tend to be smaller than wet meadows or forested slopes. They form due to seasonal or perennial emergence of groundwater into the root zone, and in some cases onto the ground surface. They form on hillsides, where the contact between an overlying permeable geologic stratum and an underlying impermeable stratum is exposed, or along the base or escarpment of a landslide. They also form along the base of hills, large dunes, or alluvial fans where the water table intercepts the land surface, and can lack well-defined channels. Seeps are similar to springs but lack a single-dominant origin of surface flow. Most of the flow is confined to the root zone and is not evident on the ground surface. Seeps and Springs may have, or may lack woody vegetation.

Seeps and springs have no minimum size and can be natural (N) or unnatural (U). Unnatural seeps are usually associated with leaks from manmade impoundments or water storage structures. For example, earthen dams and water tanks often have seeps along their bases.

Marine (M)

Major Class	**Wetland Class**	**Anthropogenic Modifiers**	**CRAM Wetland Type**	**Wetland Subtype**	**Tidal Modifiers**	**Vegetation Modifiers**	**CARI (examples)**
O	M	Natural = N Unnatural = U	none=n Rocky Intertidal= r Beach = B Dune = d	none = n beach adjacent (dune only) = a	Intertidal = I Subtidal = S unknown = u	Vegetated = v Non-vegetated = N Unknown = u Muted tidal = M Eelgrass = e	OMNnnIN OMNnnIv OMUnnIN

Marine ecosystems are saline habitats without freshwater influence that include sub-tidal and intertidal environments. Subtidal marine areas are generally mapped within intensifications (e.g., BAARI). Intertidal marine wetlands are strongly influenced by wetting and drying from tidal processes. The boundary between intertidal and subtidal marine habitats is the mean lower low tide line as demarcated in the NOAA-CUSP.

The Marine Intertidal zone is defined by NOAA as between the mean higher high water line and the mean lower low water lines in the NOAA-CUSP. It is derived from the diurnal range of the tides: the difference in height between mean higher high water and mean lower low water, the averages for each tidal day observed over the National Tidal Datum Epoch or derived equivalent, and created by comparison of simultaneous observations with a control tide station.

Figure 9. Example map of marine rocky intertidal and beach areas.

Rocky Intertidal

Wetland subtype = r

"The Rocky Intertidal zone is an area between marine and terrestrial habitats where organisms living within this zone are well adapted to alternating exposures to both the air and sea[9]" between high and low tides and contain a number of "zones" defined by the amount of time they are exposed to marine tidal waters and air exposure. These zones include the Slash/Spray Zone, High Tide/Intertidal Zone, Mid Tide/Intertidal Zone and Low Tide/Intertidal Zone[10]. For the purposes of mapping the extents of this habitat type Rocky Intertidal areas were defined as the areas extending from Mean Lower Low Water (MLLW) to epoch based MAX high water (the maximum high water during the last 19 year tidal epoch) along rocky marine intertidal stretches of the California Coast. The exception to this definition is when Beaches are fronted by Rocky Intertidal, during which Rocky Intertidal extends from MLLW to Mean High Water (MHW). This definition was able to be uniformly applied across the state as well as capture the

[9] *National Park Service. Rocky Intertidal Communities Monitoring: www.nps.gov/im/medn/rocky-intertidal-habitat.*
[10] *National Park Service. Oceans, Coasts & Seashores - Intertidal: www.nps.gov/subjects/oceans/intertidal. NOAA. What is the Intertidal Zone?: oceanservice.noaa.gov/facts/intertidal-zone.*

range of zones found in rocky intertidal habitat. See the Rocky Intertidal/Beaches subsection under Wetland Data Integration/Development for additional information on how these tidal ranges were modeled/mapped.

Beach

Wetland subtype = B

Beaches in CARI currently represent coastal beach habitats which are characterized by generally unvegetated open sand/fine gravel areas along the coast that extend from MLLW up to the dune toe. In instances where beaches are fronted by Rocky Intertidal, beaches range from MHW up to the dune toe. See the Rocky Intertidal/Beaches subsection under Wetland Data Integration/Development for additional information on how these tidal ranges were modeled/mapped.

Dunes

Wetland subtype = d

Dunes in CARI currently represent coastal dunes that are characterized by sandy soils that have been formed into mounds or ridges, typically by wind. Some mapped dunes are stabilized by vegetation, and are described as such using the vegetation modifier. Additionally we further differentiate in the Wetland Subtype field if the dune features are adjacent to beaches and thus are likely to be contributing material to the beach. The seaward edge of beach adjacent coastal dunes is defined as the modeled dune toe. See the Dunes subsection under Wetland Data Integration/Development for additional information on how the Due Toe was delineated.

Riverine Aquatic Features (Linear and Polygonal)

Riverine

Wetland subtype = R

Riverine systems primarily have unidirectional flow and fresh water, but some may be intertidal (with bi-directional flow) in the lowest geographical reaches in a watershed, and are subject to mixing of freshwater and saltwater. Riverine systems include channel, active floodplain, and portions of adjacent areas likely to be strongly linked to channel or floodplain through bank stabilization and allochthonous inputs. Active floodplain refers to periodically flooded areas adjacent to and slightly above the active flow zone and can be vegetated or non-vegetated.

Riverine systems in CARI

Riverine systems are mapped in CARI as linear GIS features. Riverine channels >30 meters wide are also mapped in the CARI polygonal wetland layer as riverine features (see below). When streams flow through reservoirs, lakes, or other open water non-riverine features a linear 'artificial path' is drawn through the polygonal feature to connect the whole stream network. These artificial paths are important to map because they maintain the complete flow pathway of surface water within each watershed. Below are descriptions of riverine wetland types and subtypes for CARI's linear and polygonal datasets.

Riverine Sub-Types

Riverine drainage features are largely mapped as linear features in GIS. This data layer serves as the stream network for characterizing the length of streams within a user defined landscape area by reach type. The stream network can also be used for hydrologic modeling, developing survey designs for water quality or habitat monitoring, or other purposes. The GIS data set captures the linear flow path down the thalweg of stream channels within a watershed. Stream reaches are classified as described below using a 3-character classification system. The stream network attributes include describing reaches as fluvial or tidal channels, natural or unnatural, subsurface drainage, or artificial pathways through a lake, reservoir or wetland. Additional optional attributes not included in CARI but that are very useful for resource planning and monitoring include: flow-direction and Strahler Stream

Order (Strahler, 1952 and Strahler, 1957). When a riverine channel is >30 meters wide it is also mapped as a polygonal wetland feature.

The CRAM Riverine module includes three Wetland Subtypes (confined or non-confined channels and tidal riverine). Confined and non-confined channels are classified based on the ratio of valley width to channel bankfull width. However, these ratios often need to be determined in the field. Therefore the CARI Wetland Subtype (in position 5 of the clickcode within the CARI polygonal wetland layer) are often classified as unknown = 'u'. except for Tidal Riverine systems are classified in CARI as Wetland Subtype = 'T' (in position 5 of the polygonal wetland layer).

CARI Classification Codes for Linear Riverine Features: Entire steam network (includes the legcode and 3-character components of the linear dataset clickcode). Note that Artificial Paths (AP) are the only linear features that don't include a CRAM Wetland Type code. Note that ditches, sub-surface drainage and artificial pathways are mapped only in the linear GIS dataset.

Major Class W	**CRAM Wetland Type** Fluvial Riverine = R Tidal Riverine = T	**Anthropogenic Modifiers** Natural = N Unnatural = U Sub-surface Drainage = S Artificial Path = AP*	**CARI (examples)** WRN, WRU WTN, WTU WRS, AP

*Artificial Paths are coded as "AP" only as they are not tidal or fluvial features.

CARI Classification Codes for Polygonal Riverine Features: Riverine channels that are >30 meters wide and vegetated wetland areas adjacent to the stream network.

Major Class O or W	**Wetland Class** R	**Anthropogenic Modifiers** Natural = N Unnatural = U	**CRAM Wetland Type** Riverine = R	**Wetland Subtype** unknown = u Tidal Riverine = T Fluvial Riverine = R	**Tidal Modifiers** Intertidal=I Subtidal =S none=n unknown = u	**Vegetation Modifiers** Vegetated = v Non-vegetated = N Unknown = u	**CARI (examples)** WRNRuuu WRNRuuv WRURTIu WRURuuN WRURuuv WRuRTIu WRuRuuu ORNRuuu ORURuuu ORuRuuu

Natural Channel

Line-layer clickcode: WRN, WTN; polygon layer clickcode: WRNRuuv, WRNRuuu, WRNRTIv, WRNRTIu

Natural channels meander and have variable width due to natural formative processes. These channels may have slight human modifications to them and they may be tidal or fluvial. Natural channels can be >30m wide that would be mapped as polygonal features and with a line feature through it mapped as a Natural Channel. Natural riverine channels that are intertidal (Tidal Position modifier = I) would also indicate the CRAM Tidal Riverine Submodule as 'T' under Wetland Subtype.

Unnatural (Engineered) Channel

Line-layer clickcode: WRU, WTU; polygon layer clickcode: WRURuuu, WRURTIu

Modified channels that include any extensions to straighten or reroute the natural stream network. These features are visibly unnatural (non-sinuous, visible artificial substrate, often no established vegetation). They can include flood control channels as well as canals contributing to watershed drainage. Engineered channels can be >30m wide that would then be mapped as polygonal features and the line feature through it would be mapped as an Unnatural Channel. Unnatural riverine channels that are intertidal (Tidal Position modifier = I) would also indicate the CRAM Tidal Riverine Submodule as 'T' under Wetland Subtype.

Subsurface Drainage

Line-layer clickcode: WRS

Subsurface Drainage features are only mapped as linear features. They are unnatural, below-ground structures that connect upstream with downstream portions of the stream network (e.g., Guadalupe River Watershed in Santa Clara County, CA) or convey stormwater runoff in urban, suburban, or agricultural landscapes. Their locations can be indicated in ancillary datasets, including the DRG and local storm drain datasets. When the location of subsurface drainage is not obvious, channels are extended beneath roads, buildings, playgrounds, or other man-made, non-agricultural land covers as seen on the imagery to connect to the downstream channel network.

Artificial Path

Line-layer clickcode: AP

Artificial pathways are only mapped as linear features. They are used to indicate the connection of non-channelized surface flow through an area of open water or wetland. Artificial pathways are not visible in the primary data but are used to connect defined channel segments to ensure connectivity for hydrology modeling, e.g., flow, sediment transport, etc. The artificial path classification allows these features to be excluded from estimates of channel length for a whole stream network. Channels that are obstructed from view in the imagery by dense vegetation should not be classified as AP. Use the channel classification (above) for these features.

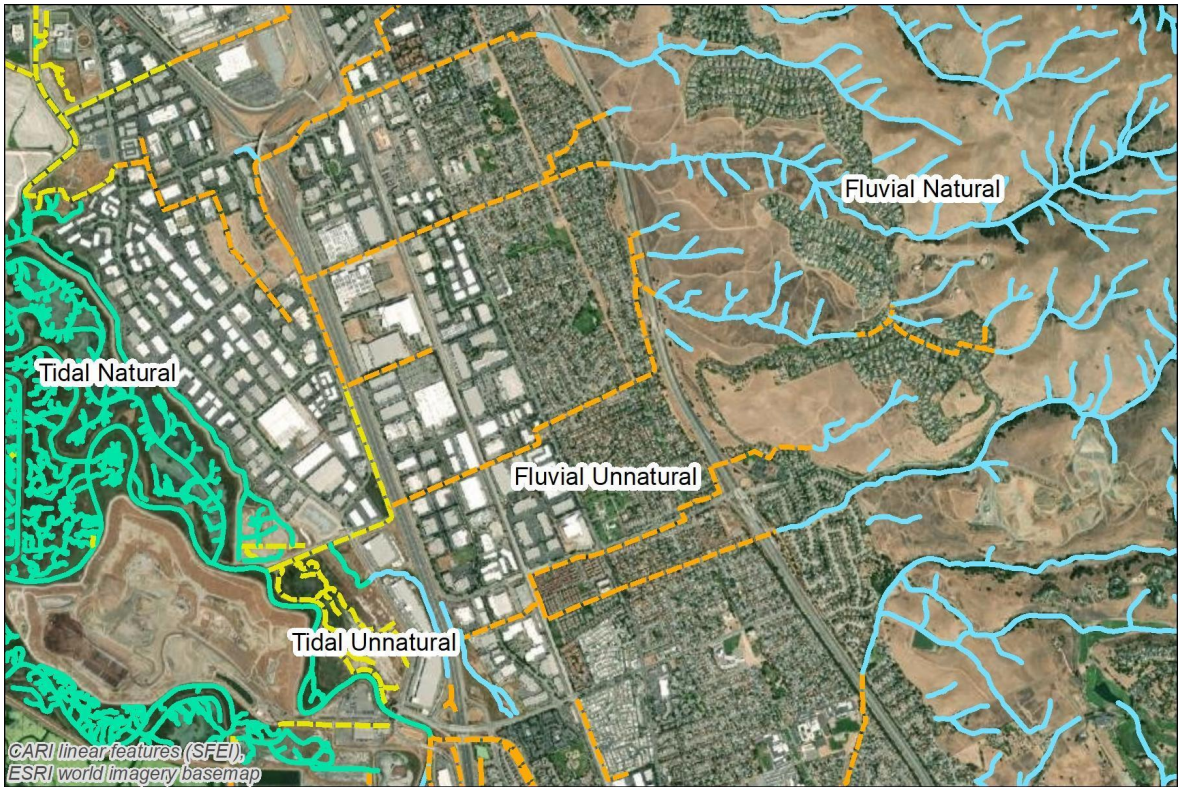

Figure 10. Example map of natural and unnatural tidal and fluvial channels.

Salinity Modifier and Fields

In 2023, SFEI was funded by the Pew Charitable Trusts to add modeled salinity information to the diverse estuarine environments represented in the estuarine aquatic polygonal features in CARI. This dataset is of particular significance for blue carbon quantification, as it differentiates between saline and brackish salinity categories, which function differently with respect to greenhouse gas (GHG) emissions yet until now have been aggregated in a single "Estuarine" class in statewide wetlands mapping datasets. By systematically applying a decision-tree methodology, we identified and prioritized the most reliable sources of salinity data (or proxy data), aligning them with relevant aquatic features cataloged in the California Aquatic Resource Inventory (CARI; San Francisco Estuary Institute, 2023). This endeavor culminated in an enriched version of CARI, where salinity classes were attributed to aquatic resource polygons where reliable salinity data were available. This augmentation enhances the accuracy and utility of CARI, making it a valuable resource for further estuarine research, environmental management, and conservation efforts.

There are six salinity classes applied to the estuarine polygons: Fresh (<0.5 ppt), Oligohaline (0.5 - 5 ppt), Mesohaline (5 - 18 ppt), Saline (>18 ppt), Bar-built (Variable), or Undefined. The value of "N/A" is used for features situated outside the realms of available vegetation datasets or estuary extent. The salinity attribute is intended to reflect dominant salinity conditions and does not capture temporal fluctuations in salinity due to factors such as tidal influence, evaporation, and seasonal variations in freshwater inputs. "Bar-built (variable)" is designated for bar-built estuaries, where salinity is markedly influenced by their hydrological connection to the ocean, leading to substantial fluctuations. The final "Undefined" class is employed in areas where vegetation mapping is available, but does not provide enough information to assign a salinity class. The classification into these six categories serves as a practical means of summarizing and characterizing the prevailing salinity conditions within the habitats under study.

Available alliance level vegetation mapping was crosswalked to the range of salinities it tolerates and the primary salinity in which it is found in California estuaries. Where vegetation mapping was not available, published salinity measurements from water samples were interpolated and used. Vegetation data from both Vegetation Classification and Mapping Program (VegCAMP; California Department of Fish and Wildlife, 2023) and Pacific Veg Map (Tukman Geospatial, 2023) was used. Published salinity measurements were obtained from multiple sources including: Environmental Protection Agency (EPA) Water Quality Portal (which includes USGS National Water Information System (NWIS) data and EPA Storage and Retrieval (STORET) data), California Estuary Marine Protected Area (EMPA) Monitoring Program, National Coastal Condition Assessment (NCCA) / National Wetland Condition Assessment (NWCA), National Estuarine Research Reserve (NERR) System, and California Environmental Data Exchange Network (CEDEN).

A Decision Tree Framework was created to determine if the vegetation salinity layer or the interpolated salinity layer was used to attribute estuarine aquatic features with a salinity class. This analysis resulted in the addition of three fields: "Salinity_Modifier", "Salinity_Source", and "Salninity_Additional_Information". "Salinity_Modifier" provides a classification of salinity using one of the six classes or "N/A" for features situated outside the realms of available vegetation datasets or estuary extent. "Salinity_Source" gives a generalized description of the source data used to assign the salinity modifier. "Salinity_Additional_Information" is used to provide more detailed information regarding the data used to ascribe the salinity class.

More detailed information can be found on the SFEI Blue Carbon Science to Support Climate Action website and in the SFEI Adding Salinity Modifier to the California Aquatic Resource Inventory (CARI) methods document.

Stewardship & Data Dissemination

SFEI is the current custodian of the CARI GIS dataset, which is made available through EcoAtlas and can be downloaded as a feature class in a geodatabase through SFEI's website at www.sfei.org/cari. As funding allows, SFEI

will incorporate new regional datasets into CARI. However, new datasets must meet the minimum data requirements to allow for a successful crosswalk to the CARI classification system.

Regional Stewardship

Transferring mapping capacity to local and regional stewards is necessary to ensure CARI captures the level of detail needed for local planning efforts and accurately reflects the abundance and distribution of aquatic resources on the landscape. Therefore, local stewardship initiatives are vital to the production, refinement, and dissemination of CARI.

To assist with mapping aquatic features, local agencies that are trusted parties with a history of producing solid data will earn the title "data steward". A data steward will be responsible for updating CARI with mapped data from their locality, and may receive certifications based on a good success record in passing QA/QC tests, which follows the OpenStreetMap model.

Ties to Federal Datasets (NHD and NWI)

In order for local and state entities to embrace CARI, it must sync well with nationwide datasets that experience heavy use. Federal datasets serve as the official information that drives project permitting and mitigation ratios. Although present federal datasets for aquatic resources may be relatively coarse compared to the proposed methodology for CARI intensifications, future regional stewardship of CARI can help promulgate an intensification of federal datasets via CARI's richness of local data.

Where regional aquatic resource inventory mapping intensifications have not yet been integrated into CARI, NHD and NWI are used as the primary data sources for aquatic resources. For the Ocean Protection Council (OPC) Coastal Inventory update, these two datasets will be integrated based on metadata information regarding digitizing source resolution, spectral band composition, and year collected, as well as feature digitizing scale. See draft OPC methodology for additional information.

Regional Aquatic Resource Inventory Documents and Mapping Procedures

New mapping is added to CARI as region specific mapping considerations are developed and vetted through the Level-1 mapping workgroup of the statewide California Wetlands Monitoring Workgroup and/or a regional project review process. Region specific considerations are warranted when unique aquatic features have not yet been described in the main CARI Standards and Methods document. Regional mapping standards have been developed to address features such as montane meadows (found in the Sierra) and managed wetlands (such as duck clubs and seasonally flooded farmed fields within the Bay-Delta region). It is expected that regional methods will be added to CARI for other eco-regions across the state. The following documents include specific mapping procedures that could be followed to support standardized mapping across the state.

Bay Area Aquatic Resources Inventory (BAARI)

San Francisco Bay Area Aquatic Resources Inventory (BAARI v2.1) – 2017

Tahoe Aquatic Resources Inventory (TARI)

Lake Tahoe Basin (TARIv2.1) – 2016

Delta Aquatic Resources Inventory (DARI)

San Joaquin and Sacramento Delta Region - in development -2022

North Coast Aquatic Resources Inventory (NCARI)

Laguna de Santa Rosa Plain (near Santa Rosa ,CA. NCARI) – 2013

CARI Data Compilation Methods And Considerations

Developing CARI involves integrating several data sources, including the NHD, NWI, and other trusted ancillary sources, with the goal of producing a comprehensive wetland and hydrology dataset representing the most recent and accurate features from each input source. These data are integrated such that all wetland and hydrologic features in California are represented without duplicates. When the same feature is represented by multiple sources, the most recently digitized feature with the highest spatial resolution is selected for integration. The organizational, decision-making, and processing work involved with producing CARI was automated through a series of files in Python. Automation includes downloading and pre-processing each respective dataset, cross-walking these data to their CARI attributes, using a decision-tree to prioritize data from each source based on accuracy and recency, removing features when more accurate or recent data exists, merging the prioritized features, and outputting the merged products to two final CARI datasets representing wetland and streams.

Wetland Data Integration/Development

NWI & NHD Integration

NWI vs. NHD

The National Wetlands Inventory (NWI) and National Hydrography Dataset (NHD) provide the base structure for CARI where regional Aquatic Resource Inventory mapping intensifications have not been funded. These two datasets provide California state-wide coverage, but their level of detail, recency, and documentation is variable making it difficult to autonomously evaluate the prioritization of every digitized feature. NWI provides a robust dataset of wetland habitat types comparable to the attributes required for CARI. NWI maps mainly wetland areas but also captures streams and waterways in a polygonal form. However, the time and cost-intensive nature of its mapping leads to many parts of the state having data features digitized many years ago, often using technology and imagery outdated relative to today's methods. NWI performs updates on a piecemeal basis, digitizing all wetlands within specific project boundaries which have historically been defined by United States Geological Survey (USGS) quadrangles. NHD provides a detailed mapping of streams and waterways as well as a more limited set of aquatic resource polygons (e.g., lakes and significant open water features). NHD is built on a system that allows for continuous and regular updates. Entire USGS Hydrologic Unit Code 8 (HUC8) watersheds are examined for necessary updates and then are indicated as updated. However, within a HUC8, only significant differences from present mapping may be digitized or re-configured. Therefore, evaluating each NHD features' recency on a large spatial scale provides its challenges. Additionally, the classification of features in NHD does not provide the same type of detail that NWI does nor covers the full range of wetland types NWI includes. As a result, the crosswalk of features from NHD to CARI typically results in a more generalized classification and preference is given to NWI data where appropriate.

Metadata Evaluation

In order to evaluate various methods in which to prioritize or integrate NWI and NHD datasets, specific characteristics associated with different mapping projects were analyzed in relation to the quality and accuracy of the mapped features to present-day conditions. For NWI, this included the imagery source year, resolution/scale, and emulsion type used for digitizing the wetland features. For NHD, we initially obtained information regarding the most recent year in which the HUC 8 watersheds were updated. All of California had been updated within the last 10 years, however this does not translate the same as to updates in NWI and only represent significant differences or ingestion of specific new data. Additionally, deriving the original source year, scale, and emulsion type of the digitized feature from the NHD metadata is a more complicated process that isn't as standardized as

NWI. Considering the variability in which features were digitized in NHD within individual watersheds, it was found that information derived from the NHDPlus Elevation Source metadata was a decent proxy to evaluating NHD features at a large scale. This particular metadata provided insight to the year and type of digital elevation model source (Production Method) used for many of the streams and/or waterbodies within the project boundaries.

The NWI and NHDPlus Elevation Source project metadata boundaries were intersected to enable the evaluation of these two datasets. In this process, roughly 10% of the coastal watersheds were reviewed in relation to a variety of NWI and NHD project metadata attributes. For each iteration, the review area was assigned as either priority-NWI, priority-NHD, or no-priority. These assignments corresponded to NWI or NHD features appearing to be better mapped for the purposes of CARI. For our purposes, if NWI was reasonably comparable to a more up-to-date NHD area, NWI was prioritized considering the greater detail in classification and broader range of wetlands mapped. In cases of no-priority, it varied from areas in which both NWI and NHD had relatively good quality/recency or areas in which NWI and NHD were both lacking high fidelity. A separate grouping, labeled "NWI-NHD Intensive" was used for these areas in which NWI nor NHD provided excellent data and in which both datasets would be leveraged with additional refinement. Once the assignments were made, an effort was made to organize and group the intersections of NWI and NHD data into one of these three groups based upon their specific project metadata characteristics. This resulted in the following decision tree:

1. NWI Image Year > 2002 & NWI Image Scale <= 2
    a. Priority-NWI
2. NWI Image Scale > 58,000
    a. Priority-NHD
3. NWI Image Scale is Null or (NHD Production Method is LiDAR and NWI Image Scale >= 40,000)
    a. Priority-NHD
4. NWI Image Scale <= 12,000 and NWI Emulsion Type is not Black and White
    a. Priority-NWI
5. NWI Image Scale <= 2
    a. No-Priority
6. NWI Image Year > 1990 and NWI Image Year > NHDPlus Elevation Source Date
    a. Priority-NWI
7. NWI Image Year > 1990 and NWI Image Year <= NHDPlus Elevation Source Date
    a. No-Priority
8. NWI Image Year < NHDPlus Elevation Source Date
    a. Priority-NHD
9. Else/Remaining
    a. No-Priority (Intensive)

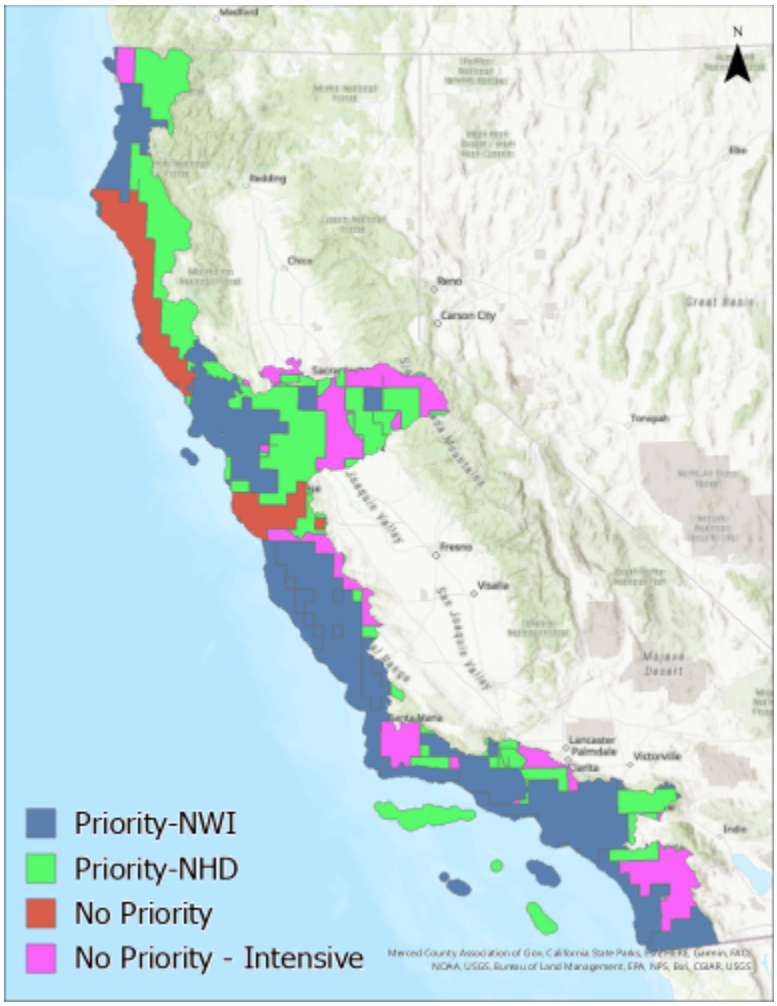

Figure 11. Map of NWI & NHD integration decision tree for CARI v1.0 (2022).

Starting with CARI version 2.2 (2023) onward, This process is done for all of California, pulling in the most recently published NHD and NWI for integration for a baseline of aquatic features across the state before more specific and regional datasets are further integrated.

Crosswalk to CARI

Before integrating either NWI or NHD features, each dataset was crosswalked to CARI based upon their labeled attributes (See Appendix J and K). Neither NWI nor NHD was a simple one-to-one crosswalk to CARI for all features. Some defining characteristics for CARI could not be determined strictly by the codes provided by NWI or NHD and therefore required additional evaluation, either by spatial relationships or geometry characteristics.

NWI to CARI

In large part, most NWI Attribute codes provided enough detail to establish a reasonable CARI clickcode classification. However, the most ambiguous classification pertained to features from NWI defined as Palustrine. In these instances, it was usually not possible to distinguish whether these features were Riverine or Depressional as defined by CARI. Therefore, methods were developed to evaluate their geometry characteristics as well as neighboring features to predict their CARI classification.

An additional challenge with the NWI dataset as it pertains to converting to CARI standards is the polygonal nature of its streams considering CARI does not include polygonal streams that are smaller than 30 meters in width.

Therefore, additional spatial analysis methods were developed to distinguish these stream features and separate out from the polygonal wetland integration process.

NHD to CARI

NHD features were limited to hydrologic features that for the most part needed further refinement to distinguish as either lacustrine or depressional and natural or unnatural. The distinction between lacustrine and depressional was made by acreage (less than 8 hectares = Depressional). The distinction between natural and unnatural was determined by distance to a nearby dam pulled from the National Inventory of Dams. Additionally, inundation areas as defined by NHD were ambiguous in classification. Methods were developed to assign their classification by largest neighboring feature.

The other challenge with NHD features was extracting their individual metadata attributes. NHD proved difficult to automate the true source scale and source year of the digitized feature. In part, this is due to a one-to-many relationship in joining their respective metadata tables, as a record is attached to each feature each time an update occurs. These updates are not necessarily to the feature's shape (i.e., updated Geographic Names Information System (GNIS) Name or Visibility Scale) and do not explicitly always describe the source information in a standardized manner. Therefore, methods related to metadata extraction were developed to automate the best estimate of source year and source scale from the NHD metadata records, largely dependent upon the earliest recorded year in which the feature was mapped at its highest resolution.

Decision Tree

NWI-only

Features assigned to this grouping would only originate from NWI. Their classification has been defined from the CARI crosswalk and unclassified features have been defined by either their spatial relationship and/or their geometric characteristics.

NHD with NWI classes

Features with this grouping would originate from NHD, however, in situations in which an NWI feature overlaps the NHD polygon by greater than 33%, the CARI classification assigned to the NWI feature is transferred to the NHD feature. NHD features without a specific crosswalked CARI classification are evaluated by neighboring features or by area and nearby dams.

NWI & NHD

Features with this grouping originate from both NWI or NHD, but NWI is given prioritization. NHD polygons that have no intersection with NWI are additionally appended into the resulting dataset. NHD features without a specific crosswalked CARI classification are evaluated by area and nearby dams.

NWI & NHD Intensive

Features with this grouping follow initially the workflow described by NHD with NWI classes. In addition, NWI features that intersect NHD flowlines are brought into the dataset for further evaluation. If the NWI feature intersects an NHD Polygon, the intersecting area retains the NHD clickcode. Otherwise, selected NWI features that don't overlap with an NHD Polygon are retained with their NWI to CARI classification. However, if a NWI feature, coded as depressional was digitized off imagery prior to 1982 and does not intersect an NHD polygon, it is removed.

NWI Estuarine features

Considering NHD lacked the distinction of estuarine features, CARI features defined as estuarine from NWI were retained for the entire state.

Ancillary Data Integration (Wetlands)

CARI v0.4 and OPC Coastal Boundary

The update from CARI v0.4 to CARI v1.0 was funded by OPC and represents updates mainly within the 44 contiguous coastal Californian HUC 8 watersheds. Data constructed by the above integration of NWI and NHD within the coastal HUC 8 watersheds was supplemented by first erasing CARI v0.4 data found within the coastal watersheds polygonal boundary and then appending the updated data to the CARI dataset. Areas outside of this study area were not updated from CARI v0.4 due to funding limitations.

CARI v1.0 to 2.2 (full CA state update)

The update from CARI v 1.0 to CARI v2.2 was funded by the California Department of Transportation and helped to bring areas outside of the OPC Coastal Boundary up to date in addition to a few integration processing improvements statewide. These areas outside of the coastal HUC 8 watersheds had previously been last updated in 2017. Note that due to the nature of the many datasets that are integrated (e.g., NWI and NHD) many areas outside of the coastal HUC 8 boundaries represent older mapping than 2017. In the 2023 update to CARI v2.2, the entirety of California was updated to use the most recently available NHD and NWI published data.

Regional Aquatic Resource Inventory Datasets (ARIs) (e.g., BAARI, DARI, TARI, NCARI)

Where mapped, Regional Aquatic Resource Inventory data is used in CARI instead of National datasets. When CARI v1.0, and subsequent versions, were compiled, these datasets include BAARI, DARI, TARI, and NCARI. These regional ARIs were first crosswalked to CARI classifications using SFEI developed crosswalks (See Appendix C-F). The regional ARIs were then subsequently added by first erasing CARI intermediary data found within the regional ARI's extent boundaries and then appending crosswalked regional ARI data to the CARI dataset.

Other Datasets

To enhance the CARI dataset beyond NWI, NHD, and regional ARI's, various ancillary data sources were used as supplementary data. The majority of these datasets were identified as representing critical habitats identified by the Ocean Protection Council that were not as consistently captured by NWI nor NHD. These layers were integrated into the CARI dataset by means of the ArcGIS "Update" geoprocessing tool in which the respective habitat polygons would replace any existing features, but retain and create new borders of any existing features that partially overlapped with the update layer.

Coastal Habitats

Due to the lack of consistent and reliable mapping of coastal habitats across the state of California, methods were developed to semi-automate and estimate a modeled output of these habitats largely dependent upon expert-defined elevation thresholds. Special thanks goes to Professor Peter Raimondi (UCSC), Jenny Dugan (UCSB), Michael Esgro (CNRA), and Lindsay Bonito (CNRA) for their help defining rocky intertidal and beach habitat extents and definitions.

Rocky Intertidal/Beaches

Rocky Intertidal and Beach habitats were specifically modeled based upon digital elevation models (DEMs) and the most recent Environmental Sensitivity Index (ESI) line layer. Importantly, tidal datum reference layers were created to align the tidal variability across the State's coastline into a consistent vertical datum (North American Vertical Datum 1988 - NAVD88). Specifically, Mean Lower Low Water (MLLW), Mean High Water (MHW), and Mean Higher High Water (MHHW) values were derived and converted into NAVD88 using the NOAA VDatum tool (accessed at https://vdatum.noaa.gov/). This process included creating a distribution of converted points spaced 2,000 meters apart and interpolating the adjusted values using an Inverse-Distance Weighted approach with a power of 2 and variable range of 4 points. The output reference layer resulted in cell values roughly 300 meters in size.

An additional Maximum Annual Height (MAH) reference layer was built on top of the MHHW reference layer by collecting the MHHW-referenced maximum annual height values collected at NOAA Center for Operational Oceanographic Products and Services (CO-OPS) tide gauges with established tidal datums over the previous 19 years (18.6 years equating to a tidal epoch). These values were averaged for each specific tide gauge and then interpolated using an Inverse-Distance Weighted approach with a power of 2 and variable range of 2.

For the last elevation threshold, an estimate of Dune Toe elevation was derived from the USGS Characterizing storm-induced coastal change hazards along the U.S. west coast[11], in which the dune toe location and elevation values were estimated along cross-shore elevation-derived transects across the entire West Coast, spaced 100 meters apart. The dune toe elevation reference layer was created by interpolating these values using an Inverse-Distance Weighted approach with a power of 0.5, variable range of 5, and an output cell size of 10 meters.

These elevation-derived reference layers were used in relation to two coast-wide DEM's: the 2016 West Coast El-Nino DEM[12] and the USGS Coastal National Elevation Dataset (CoNED) topobathymetric DEM's composed of a Northern California section with data up to 2019[13], a Central California section with data up to 2017[14], and a Southern California section with data up to 2014[15]. CoNED is developed using different topographic and bathymetric data sources including LiDAR point clouds, hydrographic surveys, single-beam acoustic surveys, and multi-beam acoustic surveys obtained from USGS, NOAA, and USACE. Three separate layers were created for the entire coast, built upon the elevation thresholds set by the above described reference layers. This included Rocky Intertidal, defined from MLLW to MAH, Beach, defined from MLLW to Dune Toe, and Rocky Intertidal with Beach, defined from MLLW to MHW. Both DEMs were used where data was available and were inclusive in design, meaning if a habitat met the criteria in either DEM, it was included in the output polygon.

The ESI layer was then used to classify each segment of the coastline into one of the three categories (Rocky Intertidal, Beach, or Rocky Intertidal with Beach). This was accomplished by first crosswalking the ESI layer attributes to one of these three categories, creating cross-shore transects at each of these category end points, and splitting each of these output polygons by these transects. The largest intersection or nearest ESI-derived category was used to classify the polygon segments. Only the respective habitats within each classification were kept, e.g., a Rocky Intertidal classification removed the segment-associated Beach and Rocky Intertidal with Beach polygons. The initial ESI layer attributes were used to crosswalk the individual habitat segments to their appropriate CARI clickcode (see **Appendix I**).

Manual adjustments and refinements were made to these polygons by visual inspection, including removal of "Beach" polygons that were captured by offshore rocks found between MHW/MAH and the Dune Toe elevation value. Other corrections were made to remove small pixelated polygons and correct for discrepancies in dynamic or artificial areas, particularly inlets and harbors.

Dunes

The dunes layer was initially derived from a variety of data sources, including VegCAMP, CalVeg, California Natural Diversity Database, Conserving Coastal Habitats (The Nature Conservancy), and a provided Humboldt Dunes dataset. Only select classes that demonstrated an active or stabilized dune classification and were near the coastline were used. For example, this included polygons designated as "Sandy Area Other Than Beaches" under USGS Anderson 2 classification and "Dunes" under Regional Dominance Type in the CalVEG dataset were initially

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[11] Shope, J.B., Erikson, L.H., Barnard, P.L., Storlazzi, C.D., Hardy, M.W., and Doran, K.S., 2021, Modeled extreme total water levels along the U.S. west coast: U.S. Geological Survey data release, https://doi.org/10.5066/P95FBGZ1.

[12] Office for Coastal Management: 2016 USGS West Coast El-Nino Lidar DEM (WA, OR, CA), https://www.fisheries.noaa.gov/inport/item/48383.

[13] Tyler, D.J., Danielson, J.J., Hockenberry, R.J., and Beverly, S.D., 2020, Topobathymetric Model of Northern California, 1986 to 2019: U.S. Geological Survey data release, https://doi.org/10.5066/P9KZ3LCV.

[14] Tyler, D.J., Danielson, J.J., Poppenga, S.K., and Gesch, D.B., 2018, Topobathymetric model for the central coast of California, 1929 to 2017: U.S. Geological Survey data release, https://doi.org/10.5066/F7736Q34.

[15] Tyler, D.J., and Danielson, J.J., 2018, Topobathymetric model for the southern coast of California and the Channel Islands, 1930 to 2014: U.S. Geological Survey data release at https://doi.org/10.5066/P9UZIYI8.

selected. These various attributes were used to crosswalk to their appropriate CARI clickcode. This combined layer used the beach polygon derived from the above process to erase dune polygons that extended below the elevation-derived dune toe reference layer. Polygons that did not border the Beach polygon were not classified as "Beach-adjacent" in their CARI classification. Lastly, a manual review of dune polygons was made to delete misclassified features and remove small polygons or slivers.

These polygons were merged with the Beach/Rocky Intertidal modeled polygons into a holistic Coastal Habitats layer, before being integrated into the CARI dataset using the "Update" tool.

Eelgrass

Eelgrass survey mapping has been incorporated into CARI along the California coast and estuaries. SFEI staff manually compared available eelgrass survey GIS mapping data, as of 2022, including NOAA surveys, Pacific Marine Estuarine Fish Habitat Partnership (PMEFHP), and California Department of Fish and Wildlife (CDFW) Eelgrass datasets). During the manual comparison the most recent survey for each area was selected out and then appended into CARI.

Witham Vernal Pools

The Witham, C.W. (2021) dataset of Greater Central Valley Vernal Pool Habitat was most recently updated off 2018 NAIP imagery. Extant features from this dataset were initially separated out by designated vernal pool matrix and individual vernal pool classes. These habitat polygons were assigned a CARI clickcode of WDNVVuu for vernal pool matrices and WDNVIuu for individual vernal pools. If the Witham dataset indicated the polygon had a disturbance type of "Managed wetland (ducks)" or "Mitigation banks (created)", a "Managed" anthropogenic modifier was indicated. Otherwise, if the disturbance area defined by the Witham dataset was greater than or equal to 50%, an "Unnatural" anthropogenic modifier was used. When integrating into the CARI dataset, individual vernal pools were integrated using the "Update" geoprocessing tool. However, vernal pool matrices from Witham's dataset were integrated into CARI in the opposite order as the rest of the ancillary datasets. Therefore, these vernal pool matrices would not supplant other existing data, but rather be present only where no other CARI feature was delineated. The "Update" geoprocessing tool was used, but the existing CARI dataset was processed as the "Update" feature.

NERR HRLC

Through a partnership between NOAA and coastal states, The National Estuarine Research Reserve System (NERRS) has developed High Resolution Land Cover (HRLC) datasets for many of the coastal sites. In California, this includes NERR sites in San Francisco Bay (China Camp and Rush Ranch), Elkhorn Slough, and the Tijuana River. Excluding features labeled "Upland Habitats", This data was ingested, crosswalked to their respective CARI clickcodes, and added to the CARI dataset via the "Update" geoprocessing tool.

Bar-Built Estuaries/Lagoons

The Central Coast Wetlands Group (CCWG) incorporated georeferenced NAIP imagery, NWI, and elevation data to guide the manual digitization of polygons representing the maximum extents of Bar-Built Estuaries and Lagoons. Wetland habitat types and dunes from this dataset were crosswalked with CARI clickcodes (see Appendix G) and integrated into the CARI dataset using the "Update" geoprocessing tool.

Bay Area Beaches

Beaches within the San Francisco Bay Area were not mapped the same way as coastal beaches within CARI. Due to the overlap with BAARI and the lack of an sufficiently inclusive existing beach layer, SFEI staff reviewed NAIP imagery and digitized the extent of beaches using the definition described in Chapter 2 of SFEI's New Life for Eroding Shorelines report[16]. Resulting heads up digitized beach layers were subsequently reviewed by both

[16] *SFEI; Baye, P. 2020. New Life for Eroding Shorelines: Beach and Marsh Edge Change in the San Francisco Estuary. SFEI Contribution No. 984.*

Christina Toms of Region 2 Water Quality Control Board as well as Dr. Peter Baye of San Francisco State University for accuracy and completeness. Edits were then made in response to their comments. However, future efforts could be made to further refine the definition of “beaches” and distinguish them from “wave cut benches” and other beach-like structures that wrap around headlands, but may not be considered “beaches''. There may be some beaches that were missed due to them being obstructed by organic debris wracks or high salt marsh vegetation. If Bay Area Beaches are remapped, GIS professionals may want to consider extending the methodology that was used for Coastal CARI beaches by using a Tidally corrected Bay DEM/bathymetry layer paired with the Bay Area ESI layer for classification. This approach wasn’t used for CARI v1.0 on as there was no currently available Dune Toe line that had been delineated within SF Bay. Once the Bay Area Beach heads-up mapping was completed, it was appended to CARI using the ArcGIS “Update” geoprocessing tool.

Stream Data Integration/Development

NHD

For CARI v2.2, USGS NHD Stream lines for CA were crosswalked to CARI classification (see Appendix J).

ARI’s (BAARI, DARI, TARI, NCARI)

Where mapped, Regional Aquatic Resource Inventory stream GIS data is used in CARI instead of NHD. When CARI v1.0 was compiled, these datasets include BAARI, DARI, TARI, and NCARI. These regional ARIs were first crosswalked to CARI classifications using SFEI developed crosswalks (See Appendix C-F). The regional ARIs were then subsequently added by first erasing CARI intermediary data found within the regional ARI’s extent boundaries and then appending crosswalked regional ARI stream data to the CARI dataset.

Fields Related to Data Integration and How to Use

Estimated Source Year/Source Scale

The estimated source year and source scale can be valuable references to better understand the reliability of the digitized features. They have been provided in integer formats to allow for easy interpretation and symbolization. Please refer to the Metadata Evaluation section above for more information regarding the assumptions made in determining the source year and source scale for features from the NHD. Additionally, some features from the NHD may not have been prioritized and selected despite more recency due to the attribute detail provided by the NWI (refer to the Metadata Evaluation section above). These fields can be used to assess the relative recency and quality of source mapping across the dataset and when evaluating if a different dataset might supplant or be worth incorporating into a subsequent version of CARI.

Clickcode Classes/Modifiers

To enable simpler evaluations, queries, and analysis of the CARI dataset, the clickcode classes and modifiers have been expanded into unique attribute fields. This includes the Major Class, Wetland Class, Wetland Type, Wetland Subtype, Anthropogenic Modifier, Tidal Modifier, and Vegetation Modifier.

Process Adjustment

This field provides insight into how each individual feature may have been processed, adjusted, and/or manipulated throughout the creation of the CARI dataset. This is an important field to determine why a feature might be different than in the source dataset.

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Appendix A: Data Sources

Data Sources for Regional ARI Intensifications (e.g., BAARI and DARI)

Primary Data

National Agricultural Imagery Program (NAIP)

To establish consistency across the project, the National Agriculture Imagery Program (NAIP) available through the US Department of Agriculture (USDA) serves as the base imagery from which all features are mapped. The NAIP images are natural color and color infrared (CIR), 1-m pixel resolution, georectified digital aerial photographs. The choice to use NAIP was based on the spatial coverage, year flown and data availability. NAIP imagery is publicly available without cost from the USDA and covers the entire state of California, which is important to ensure state-wide consistency of these standards. NAIP datasets are flown periodically for California which helps ensure the aquatic resources inventory is current. For more information visit http://www.fsa.usda.gov/FSA/. All wetland areas mapped for WRAMP must be consistent with NAIP imagery. The 2009 NAIP imagery dataset was used for the TARI pilot.

Available Lidar Data

Recent Lidar (sometimes spelled LiDAR) data is particularly helpful as it provides high resolution elevation information that may not be apparent in imagery. This is important as a large task of wetland mapping is determining how water is moving on the landscape which is intrinsically linked to the topography. Lidar can also be used to help provide information about the vegetation structure or texture which is useful to help distinguish vegetation types as well as provide information about where water is likely to flow.

For example, the 2011 LiDAR data for Lake Tahoe Basin were provided by Watershed Sciences through TRPA as a set of three 0.5 m pixel Digital Elevation Models (DEMs) with a vertical accuracy of 3.5 cm: a highest-hit DEM, bare earth DEM, and a Hydrologically enforced DEM. These products were used to create hillshades for topographic visualization. This dataset matched closely with the NAIP temporally and spatially.

These lidar based DEMs can be corrected for hydrologic flow by using breaklines. These are artificial enhancements to the LiDAR DEM that represent features unable to be distinguished by the LiDAR process due to their size or location. For example, LiDAR cannot penetrate solid surfaces, such as bridges, and the channels beneath such features must be indicated by breaklines. Further, the elevations of unnatural channels, including storm drains and culverts, essential to determining flow direction, must be artificially added to the DEM during its production or post-processing.

Lidar data can include first return and last return datasets that can develop two types of DEMs: Digital Surface Models (DSM) and Digital Terrain Models (DTMs). DTMs refer to an elevation product where the data is processed to remove elements (such as trees and built structures) which extrude above the terrain height. DSMs are DEMs where these elements have not been removed. The difference between the two can be used to calculate the height of vegetation (or structures) which can be useful for mapping aquatic features. Additional processing of high resolution lidar based DEMs can be used for creating additional helpful layers such as Topographic Wetness Index, Curvature, and Cartographic Depth-to-Water Index.

Ancillary Data

Ancillary data are used where identification of aquatic resources is inadequate using the primary data alone. In general, ancillary data are used to better understand topography, the effects of NAIP vintage on the visibility of aquatic resources in NAIP imagery, and to help detect subsurface drainage. The following specified ancillary data has been used for TARI. Additional local data can be included as needed.

ArcHydro

ArcHydro is an automated stream network generated from a DEM using GIS. Elevation, flow accumulation, and flow direction determine the initiation and location of a channel or channel network. The ArcHydro channel network was primarily used as a guide to determine the likely locations of first-order (headward) channels.

ArcHydro was performed on the Hydrologically Enforced LiDAR DEM. This DEM was corrected by Watershed Sciences by enforcing flow through water bodies and culverts. Estimation of the initiation (point of origin) of each likely first-order channel was based on a 10,000 cell accumulation or 2,500 square meter uppermost area of the channel's catchment basin. This size basin was used because it captured the majority of first-order channels evident from visual inspection of the LiDAR hillshade, without abundant over-mapping of channels (automated invention of channels not evident in the primary or ancillary data). The use of ArcHydro is discussed further in the section below on the use of LiDAR to map channels.

National Wetlands Inventory (NWI)

NWI is produced by the U.S. Fish and Wildlife Service (USFWS). These data vary markedly in accuracy, in terms of omissions, boundaries, and misclassifications. The NWI data should only be used as a preliminary indication of the likely existence, location, and classification of major areas of aquatic resources.

National Hydrography Dataset (NHD)

NHD is produced by the U.S. Geological Survey (USGS). NHD represents the water drainage network of the United States with features such as rivers, streams, canals, lakes, ponds, coastline, dams, and streamgages. The NHD is the most up-to-date and comprehensive hydrography dataset at the national level.

Classification and Assessment with Landsat of Visible Ecological Groupings (CALVEG)

Visible Ecological Groupings (CALVEG) comprise the only regional set of vegetation data for TARI and are derived from recently completed interpretation of 2005 1:24,000 scale LANDSAT imagery. The 2005 data are an update of the vintage 2000, 1:100,000 scale version originally done for the U.S. National Forest Service administrative areas within the Basin, including private land inholdings. These data are mainly used in TARI to help identify wet meadows and forested slopes.

Vegetation Classification and Mapping Program (VegCAMP)

The Vegetation Classification and Mapping Program (VegCAMP) develops and maintains California's expression of the National Vegetation Classification System. We implement its use through assessment and mapping projects in high-priority conservation and management areas, through training programs, and through working continuously on best management practices for field assessment, classification of vegetation data, fine-scale vegetation mapping, and archiving of vegetation data. Completing a state-wide vegetation map and classification in collaboration with other agencies and organizations is the current goal of the program.

Digital Raster Graphic (DRG)

The DRG is a scanned image of the 1:24,000 scale Topographic Quadrangle (7.5 minute quadrangle or "quad sheet") provided by the U.S. Geological Survey (USGS). These data are used to help view major roads and buildings, as well as topography and major water bodies, including large channels. The contour lines provided with the DRG can be helpful for visualizing topography and estimating the flow directions of channels and channel networks.

Google Earth and Google Earth Pro

Google Earth (free) and Google Earth Pro (requires license fee) are publically accessible, online GIS tools. Google Earth provides access to high-resolution aerial imagery and topography, as well as local ground-based photography and local place names. Google Earth Pro provides non-georectified downloads of this same aerial imagery. Google Earth imagery is digitized in areas where it shows major landscape changes, such as large developments, fires, etc.,

that are more recent than the primary vintage imagery data or other ancillary data. In these circumstances, the high-resolution imagery for the recently altered area is downloaded from Google Earth Pro and georeferenced in ArcGIS to meet the standards of the primary data sources.

Other Local Data

Local data can be used to spot-check areas for classification. However, pre-existing maps and classifications of aquatic resources using these data apart from this TARI SOP should not be assumed to be correct. Local maps of aquatic resources often reflect particular objectives and methodologies that are not entirely inconsistent with TARI. Examples of local data that have been used to produce the current version of TARI include maps of storm drains and road culverts provided by Caltrans, and maps of wet meadows and other slope wetlands provided by local cities and counties within the Basin.

Appendix B: Crosswalk from "Leglabel" Class to Wetland Class

Polygonal Features

leglabellevel1	leglabellvel2	CARI Class (Wetland Type and modifier)
Lagoon	Lagoon	Lagoon
Subtidal Water	Estuarine Subtidal	Estuarine Open Water
Tidal Channel	n/a	Estuarine Tidal Riverine
Tidal Flat and Marsh Panne	Estuarine Intertidal	Estuarine (non-vegetated)
Tidal Marsh	Estuarine Intertidal Vegetated	Estuarine (vegetated)
Fluvial Channel	n/a	Riverine
Lake, Reservoir and associated vegetation	Lacustrine	Lacustrine
Playa	n/a	Playa
Pond and associated vegetation	Depressional	Depressional
Slope and Seep Wetlands	n/a	Slope and Seep Wetlands
Vernal Pool	n/a	Vernal Pool (individual and vernal pool complexes)

Linear Features

legcode	leglabel	clickcode	clicklabel
R	Fluvial	WRN	Fluvial Natural
R	Fluvial	WRU	Fluvial Unnatural
TR	Tidal	WTN	Tidal Natural
TR	Tidal	WTU	Tidal Unnatural

Appendix C: Crosswalk from DARI to CARI Classification

Table 4. Crosswalk from DARI polygon classes to CARI classes as of the compilation of CARIv1.0.

DARI orig_code	DARI clicklabel	DARI WetTypeOther	DARI Depth	DARI Managed	DARI Tidal	DARI Natural	DARI Veg	CARI clickcode	CARI Clicklabel	CARI LegCode	CARI LegLabel Level 1	CARI LegLabel Level 2
TC	Tidal Channel Natural		Deep or Shallow	Managed or Null	Tidal	Natural		ORNRTSN	Riverine Natural Subtidal Open Water	ES	Subtidal Water	Estuarine Subtidal
TCU	Tidal Channel Unnatural		Deep or Shallow	Managed or Null	Tidal	Unnatural		ORURTSN	Riverine Unnatural Subtidal Open Water	ES	Subtidal Water	Estuarine Subtidal
TV	Tidal Vegetated Natural	Restoration or Null		Managed or Null	Tidal	Natural or Unnatural	Vegetated	WENENIv	Estuarine Non-saline Natural Intertidal Vegetated	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
TVw	Tidal Vegetation Woody Natural	Restoration or Null		Managed or Null	Tidal	Natural	Vegetated Woody	WENENIF	Estuarine Non-saline Natural Intertidal Forested	EIF	Forested Tidal Wetland	Estuarine Intertidal Vegetated
TGPOWU	Lagoon Perennial Open Water Unnatural	Restoration or Null		Managed or Null	Tidal	Unnatural		OGUGnSN	Lagoon Unnatural Non-vegetated	ES	Subtidal Water	Estuarine Subtidal
TP	Tidal Marsh Panne Natural			Managed or Null	Tidal	Natural		WENENIN	Estuarine Non-saline Natural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
C	Channel Natural	Restoration or Null		Managed or Null	Nontidal	Natural		WRNRnnu	Riverine Natural	R	Fluvial Channel	Fluvial Channel
CU	Channel Unnatural	Restoration or Null		Managed or Null	Nontidal	Unnatural		WRURnnu	#N/A	R	#N/A	#N/A
CV	Channel Vegetated Natural	Restoration or Null		Managed or Null	Nontidal	Natural	Vegetated	WRNRnnv	Riverine Natural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
CVU	Channel Vegetated Unnatural	Restoration or Null		Managed or Null	Nontidal	Unnatural	Vegetated	WRURnnv	Riverine Unnatural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
CVw	Channel Vegetated woody Natural	Restoration or Null		Managed or Null	Nontidal	Natural	Vegetated Woody	WRNRnnF	#N/A	RV	#N/A	#N/A
CVwU	Channel Vegetated woody Unnatural	Restoration or Null		Managed or Null	Nontidal	Unnatural	Vegetated Woody	WRURnnF	#N/A	RV	#N/A	#N/A
CE	Channel Engineered			Managed or Null	Nontidal	Unnatural		ORURuuN	Riverine Unnatural Open Water	R	Fluvial Channel	Fluvial Channel

DOWN	Depressional Open Water Natural	Restoration or Null		Managed or Null	Nontidal	Natural		ODNDuuN	Depressional Natural Non-vegetated	D	Pond and associated vegetation	Depressional
DOWU	Depressional Open Water Unnatural	Restoration, Livestock Waste Pond, Duck Club, or Null		Managed or Null	Nontidal	Unnatural		ODUDuuN	Depressional Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
DVN	Depressional Vegetated Natural	Restoration or Null		Managed or Null	Nontidal	Natural	Vegetated	WDNDuuv	Depressional Natural Vegetated	D	Pond and associated vegetation	Depressional
DVU	Depressional Vegetated Unnatural	Restoration, Livestock Waste Pond, or Null		Managed or Null	Nontidal	Unnatural	Vegetated	WDUDuuv	Depressional Unnatural Vegetated	D	Pond and associated vegetation	Depressional
LOWN	Lacustrine Open Water Natural							OLNLnuu	Lacustrine Natural	L	Lake, Reservoir and associated vegetation	Lacustrine
LOWU	Lacustrine Open Water Unnatural	Restoration or Null		Managed or Null	Nontidal	Unnatural		OLULnuu	Lacustrine Unnatural	L	Lake, Reservoir and associated vegetation	Lacustrine
LVN	Lacustrine Vegetated Natural							WLNLnuv	Lacustrine Natural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
LVU	Lacustrine Vegetated Unnatural			Managed or Null	Nontidal	Unnatural	Vegetated	WLULnuv	Lacustrine Unnatural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
SU	Seep Unnatural			Managed or Null	Nontidal	Unnatural		WSUSSnv	Slope Unnatural Vegetated	S	Slope and Seep Wetlands	Forested Slopes, Wet Meadows, and Seeps
FS	Woody Slope Natural			Managed or Null	Nontidal	Natural		WSNSFuF	Slope Natural Forested	S	Slope and Seep Wetlands	Forested Slopes, Wet Meadows, and Seeps

FSU	Woody Slope Unnatural	Restoration or Null		Managed or Null	Nontidal	Unnatural		WSUSFuF	Slope Unnatural Forested	S	Slope and Seep Wetlands	Forested Slopes, Wet Meadows, and Seeps
WM	Non-woody Slope Natural	Restoration, Duck Club, or Null		Managed or Null	Nontidal	Natural		WSNSWuH	Slope Natural Wet Meadow Herbaceous	S	Slope and Seep Wetlands	Forested Slopes, Wet Meadows, and Seeps
WMU	Non-woody Slope Unnatural	Restoration, Duck Club, or Null		Managed or Null	Nontidal	Unnatural		WSUSWuH	Slope Unnatural Wet Meadow Herbaceous	S	Slope and Seep Wetlands	Forested Slopes, Wet Meadows, and Seeps
VP	Vernal Pool				Nontidal	Natural		WDUVIuu	Individual Vernal Pool	VP	Vernal Pool	Vernal Pool
VPC	Vernal Pool Complex			Managed or Null	Nontidal	Natural		WDUVVuu	Vernal Pool System	VP	Vernal Pool	Vernal Pool
M Restoration	Managed Wetland	Restoration		Managed or Null	Nontidal	Unnatural		WDMDSnu	Depressional Seasonal Managed	D	Pond and associated vegetation	Depressional
M Duck Club	Managed Wetland	Duck Club		Managed or Null	Nontidal	Unnatural		WDMDSnu	Depressional Seasonal Managed	D	Pond and associated vegetation	Depressional
M Rice Field	Managed Wetland	Rice Field		Managed or Null	Nontidal	Unnatural		WDMDSnf	Depressional Seasonal Managed Farmed	FI	Irrigated	Farmed Irrigated
M Flooded Agriculture	Managed Wetland	Flooded Agriculture		Managed or Null	Nontidal	Unnatural		WDMDSnf	Depressional Seasonal Managed Farmed	FI	Irrigated	Farmed Irrigated
M	Managed Wetland			Managed or Null	Nontidal	Unnatural		WDMDSnf	Depressional Seasonal Managed Farmed	FI	Irrigated	Farmed Irrigated

Table 5. Crosswalk from DARI line classes to CARI classes as of the compilation of CARIv1.0.

DARI orig_class	DARI Clicklabel	CARI clickcode	CARI Clicklabel	CARI LegLabel
AP	Artificial Path	AP	not shown	n/a
C	Channel	WRN	Fluvial Natural	Fluvial
CE	Channel Engineered	WRU	Fluvial Unnatural	Fluvial
CSD	Channel Subsurface Drainage	WRS	Fluvial Subsurface	Fluvial
CU	Channel Unnatural	WRU	Fluvial Unnatural	Fluvial

TC	Tidal Channel	WTN	Tidal Natural	Tidal
TCU	Tidal Channel Unnatural	WTU	Tidal Unnatural	Tidal

Appendix D: Crosswalk from BAARI to CARI Classification

Table 6. Crosswalk from BAARI polygon classes to CARI classes as of the compilation of CARIv1.0.

BAARI orig_class	BAARI Clicklabel	CARI clickcode	CARI Clicklabel	CARI LegCode	CARI LegLabel Level 1	CARI LegLabel Level 2
BD	Deep Bay	OENESSN	Estuarine Saline Natural Subtidal Non-vegetated	ES	Subtidal Water	Estuarine Subtidal
BS	Shallow Bay	OENESSN	Estuarine Saline Natural Subtidal Non-vegetated	ES	Subtidal Water	Estuarine Subtidal
DOWN	Depressional Open Water Natural	ODNDuuN	Depressional Natural Non-vegetated	D	Pond and associated vegetation	Depressional
DOWU	Depressional Open Water Unnatural	ODUDuuN	Depressional Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
DVN	Depressional Vegetated Natural	WDNDuuv	Depressional Natural Vegetated	D	Pond and associated vegetation	Depressional
DVU	Depressional Vegetated Unnatural	WDUDuuv	Depressional Unnatural Vegetated	D	Pond and associated vegetation	Depressional
FC	Fluvial Channel	WRNRuuu	Riverine Natural	R	Fluvial Channel	Fluvial Channel
FD	Fluvial Ditch	WRURuuu	Riverine Unnatural	R	Fluvial Channel	Fluvial Channel
FEC	Fluvial Engineered Channel	WRURuuu	Riverine Unnatural	R	Fluvial Channel	Fluvial Channel
FUF	Fluvial Unvegetated Flat (in-channel)	WRURuuN	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
FV	Fluvial Vegetated (in-channel)	WRNRuuv	Riverine Natural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
GPOWN	Lagoon Perennial Open Water Natural	OGNGnuN	Lagoon Natural Non-vegetated	EP	Pond	Estuarine Pond
GPOWU	Lagoon Perennial Open Water Unnatural	OGUGnuN	Lagoon Unnatural Non-vegetated	EP	Pond	Estuarine Pond
GPUFN	Lagoon Perennial Unvegetation Flat Natural	WGNGnuN	Lagoon Natural Non-vegetated	EP	Pond	Estuarine Pond
GPUFU	Lagoon Perennial Unvegetation Flat Unnatural	WGUGnuN	Lagoon Unnatural Non-vegetated	EP	Pond	Estuarine Pond
GPVN	Lagoon Perennial Vegetation Natural	WGNGnuv	Lagoon Natural Vegetated	EP	Pond	Estuarine Pond

GPVU	Lagoon Perennial Vegetation Unnatural	WGUGnuv	Lagoon Unnatural Vegetated	EP	Pond	Estuarine Pond
LOWN	Lacustrine Open Water Natural	OLNLnuN	Lacustrine Natural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
LOWU	Lacustrine Open Water Unnatural	OLULnuN	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
LVN	Lacustrine Vegetated Natural	WLNLnuv	Lacustrine Natural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
LVU	Lacustrine Vegetated Unnatural	WLULnuv	Lacustrine Unnatural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
POWU	Playa Open Water Unnatural	ODUDuuN	Depressional Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
PUN	Playa Unvegetated Flat Natural	WDNPnnN	Playa Natural Non-vegetated	P	Playa	Playa
PUU	Playa Unvegetated Flat Unnatural	WDUPnnN	Playa Unnatural Non-vegetated	P	Playa	Playa
PVU	Playa Vegetated Unnatural	WDUPnnv	Playa Vegetated	P	Playa	Playa
SN	Seep or Spring Natural	WSNSuuu	Slope Natural	S	Slope and Seep Wetlands	Forested Slopes, Wet Meadows, and Seeps
SU	Seep or Spring Unnatural	WSUSuuu	Slope Unnatural	S	Slope and Seep Wetlands	Forested Slopes, Wet Meadows, and Seeps
TBF	Tidal Bay Flat	WENESIN	Estuarine Saline Natural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
TD	Tidal Ditch	WRURTuu	Riverine Tidal Unnatural	ES	Subtidal Water	Estuarine Subtidal
TEC	Tidal Engineered Channel	WRURTuu	Riverine Tidal Unnatural	ES	Subtidal Water	Estuarine Subtidal
TMF	Tidal Marsh Flat	WENESIN	Estuarine Saline Natural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
TNV	Tidal Nascent Vegetation	WENESIE	Estuarine Saline Natural Intertidal Emergent	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
TP	Tidal Panne	WENESIN	Estuarine Saline Natural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
TV	Tidal Vegetation	WENESIE	Estuarine Saline Natural Intertidal Emergent	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
VP	Vernal Pool	WDuVIuu	Individual Vernal Pool	VP	Vernal Pool	Vernal Pool

VPC	Vernal Pool Complex	WDuVVuu	Vernal Pool System	VP	Vernal Pool	Vernal Pool

Table 7. Crosswalk from BAARI line classes to CARI classes as of the compilation of CARIv1.0.

BAARI orig_class	BAARI Clicklabel	CARI clickcode	CARI Clicklabel	CARI LegLabel
FC	Fluvial Channel	WRN	Fluvial Natural	Fluvial
FD	Fluvial Ditch	WRU	Fluvial Unnatural	Fluvial
FEC	Fluvial Engineered Channel	WRU	Fluvial Unnatural	Fluvial
FSD	Fluvial Subsurface Drainage	WRU	Fluvial Unnatural	Fluvial
TC	Tidal Channel	WTN	Tidal Natural	Tidal
TD	Tidal Ditch	WTU	Tidal Unnatural	Tidal
TEC	Tidal Engineered Channel	WTU	Tidal Unnatural	Tidal

Appendix E: Crosswalk from TARI to CARI Classification

Table 8. Crosswalk from TARI polygon classes to CARI classes as of the compilation of CARIv1.0.

TARI orig_class	TARI clicklabel	CARI clickcode	CARI Clicklabel	CARI LegCode	CARI LegLabel Level 1	CARI LegLabel Level 2
DOWN	Depressional Open Water Natural	ODNDuuN	Depressional Natural Non-vegetated	D	Pond and associated vegetation	Depressional
DOWU	Depressional Open Water Unnatural	ODUDuuN	Depressional Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
DVN	Depressional Vegetated Natural	WDNDuuv	Depressional Natural Vegetated	D	Pond and associated vegetation	Depressional
DVU	Depressional Vegetated Unnatural	WDUDuuv	Depressional Unnatural Vegetated	D	Pond and associated vegetation	Depressional
FS	Forested Slope	WSNSFuF	Slope Natural Forested	S	Slope and Seep Wetlands	Forested Slopes, Wet Meadows, and Seeps
LOWN	Lacustrine Open Water Natural	OLNLnuu	Lacustrine Natural	L	Lake, Reservoir and associated vegetation	Lacustrine
LOWU	Lacustrine Open Water Unnatural	OLULnuu	Lacustrine Unnatural	L	Lake, Reservoir and associated vegetation	Lacustrine
LVN	Lacustrine Vegetated Natural	WLNLnuv	Lacustrine Natural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
SN	Seep or Spring Natural	WSNSuuu	Slope Natural	S	Slope and Seep Wetlands	Forested Slopes, Wet Meadows, and Seeps
WM	Wet Meadow	WSNSWuH	Slope Natural Wet Meadow Herbaceous	S	Slope and Seep Wetlands	Forested Slopes, Wet Meadows, and Seeps

Table 9. Crosswalk from TARI line classes to CARI classes as of the compilation of CARIv1.0.

TARI orig_class	TARI Clicklabel	CARI clickcode	CARI Clicklabel	CARI LegLabel
AP	Artificial Path	AP	not shown	n/a
C	Fluvial Channel	WRN	Fluvial Natural	Fluvial
CS	Stream Segment	AP	not shown	n/a
CU	Channel Unnatural	WRU	Fluvial Unnatural	Fluvial

SD	Subsurface Drainage	WRS	Fluvial Subsurface	Fluvial

Appendix F: Crosswalk from NCARI to CARI Classification

Table 10. Crosswalk from NCARI polygon classes to CARI classes as of the compilation of CARIv1.0.

NCARI orig_class	WetlandType	CARI clickcode	CARI ClickLabel	CARI LegLabel Level 1	CARI LegLabel Level 2
COWN	Channel Open Water Natural	ORNRuuN	Riverine Natural Open Water	Fluvial Channel	Fluvial Channel
COWU	Channel Open Water Unnatural	ORURuuN	Riverine Unnatural Open Water	Fluvial Channel	Fluvial Channel
CVN	Channel Vegetated Natural	WRNRuuv	Riverine Natural Vegetated	Riverine Vegetated	Riverine Vegetated
CVU	Channel Vegetated Unnatural	WRURuuv	Riverine Unnatural Vegetated	Riverine Vegetated	Riverine Vegetated
DOWN	Depressional Open Water Natural	ODNDuuN	Depressional Natural Non-vegetated	Pond and associated vegetation	Depressional
DOWU	Depressional Open Water Unnatural	ODUDuuN	Depressional Unnatural Non-vegetated	Pond and associated vegetation	Depressional
DUf	Farmed Depression Unnatural	WDUDuuf	Depressional Unnatural Forested	Pond and associated vegetation	Depressional
DVN	Depressional Vegetated Natural	WDNDuuv	Depressional Natural Vegetated	Pond and associated vegetation	Depressional
DVU	Depressional Vegetated Unnatural	WDUDuuv	Depressional Unnatural Vegetated	Pond and associated vegetation	Depressional
FS	Forested Slope	WSNSFuF	Slope Natural Forested	Slope and Seep Wetlands	Forested Slopes, Wet Meadows, and Seeps
FSr	Riparian - Forested Slope	WSNSFuF	Slope Natural Forested	Slope and Seep Wetlands	Forested Slopes, Wet Meadows, and Seeps
LOWU	Lacustrine Open Water Unnatural	OLULnuN	Lacustrine Unnatural Non-vegetated	Lake, Reservoir and associated vegetation	Lacustrine
LVU	Lacustrine Vegetated Unnatural	WLULnuv	Lacustrine Unnatural	Lake, Reservoir and	Lacustrine

			Vegetated	associated vegetation	
SN	Natural Slope	WSNSuuu	Slope Natural	Slope and Seep Wetlands	Forested Slopes, Wet Meadows, and Seeps
SNf	Farmed Slope Wetland Natural	WSNSuuf	Slope Natural Farmed	Irrigated	Farmed Irrigated
SU	Unnatural Slope	WSUSuuu	Slope Unnatural	Slope and Seep Wetlands	Forested Slopes, Wet Meadows, and Seeps
VP	Individual Vernal Pool	WDUVIuu	Individual Vernal Pool	Vernal Pool	Vernal Pool
VPC	Vernal Pool Complex	WDUVVuu	Vernal Pool System	Vernal Pool	Vernal Pool
WM	Wet Meadow	WSNSWuH	Slope Natural Wet Meadow Herbaceous	Slope and Seep Wetlands	Forested Slopes, Wet Meadows, and Seeps

Table 11. Crosswalk from NCARI line classes to CARI classes as of the compilation of CARIv1.0.

WType	*WetlandType*	*CARI clickcode*	*CARI Clicklabel*	*CARI LegLabel*
AP	*Artificial Path*	*WRU*	*Fluvial Unnatural*	*Fluvial*
C	*Channel*	*WRN*	*Fluvial Natural*	*Fluvial*
CM	*Channel Modified*	*WRU*	*Fluvial Unnatural*	*Fluvial*
CU	*Channel Unnatural*	*WRU*	*Fluvial Unnatural*	*Fluvial*
SD	*Subsurface Drain (Storm Drain)*	*WRU*	*Fluvial Unnatural*	*Fluvial*

Appendix G: Bar-built Estuaries & Lagoons Crosswalk

Table 12. Crosswalk from Bar-built Estuaries and Lagoons polygon classes to CARI classes as of the compilation of CARIv1.0.

Lagoon_Class	Lagoons Level 1	Lagoons Level 2	Lagoons Level 3	Lagoons Level 4	CARI clickcode	CARI ClickLabel	CARI LegCode	CARI LegLabel Level 1	CARI LegLabel Level 2
NWUDDuHC	Non-Wetland	Undeveloped	Dune	Hydrologically Connected	WMNdnnu	Marine Natural Dune	DU	Dune	Dune
NWUDDuNA	Non-Wetland	Undeveloped	Dune	Not Applicable	WMNdnnu	Marine Natural Dune	DU	Dune	Dune
WBBeHC	Wetland	Beach/Berm/Inlet	Beach	Hydrologically Connected	WMNBnIN	Marine Beach Natural Intertidal Non-vegetated	B	Beach	Beach
WBBeHI	Wetland	Beach/Berm/Inlet	Beach	Hydrologically Isolated	WMNBnIN	Marine Beach Natural Intertidal Non-vegetated	B	Beach	Beach
WBInHC	Wetland	Beach/Berm/Inlet	Beach Channel/Inlet	Hydrologically Connected	OMNBnIN	Marine Beach Natural Intertidal Non-vegetated	B	Beach	Beach
WBInNA	Wetland	Beach/Berm/Inlet	Beach Channel/Inlet	Not Applicable	OMNBnIN	Marine Beach Natural Intertidal Non-vegetated	B	Beach	Beach
WOBaHC	Wetland	Open Water	Bars	Hydrologically Connected	OENEBIN	Estuarine Bar-built Intertidal Non-vegetated	ES	Subtidal Water	Estuarine Subtidal
WOCHC	Wetland	Open Water	Channel	Hydrologically Connected	OENEBSN	Estuarine Bar-built Subtidal Non-vegetated	ES	Subtidal Water	Estuarine Subtidal
WOCHI	Wetland	Open Water	Channel	Hydrologically Isolated	OENEBuN	Estuarine Bar-built Non-vegetated	ES	Subtidal Water	Estuarine Subtidal
WOPHC	Wetland	Open Water	Pond	Hydrologically Connected	OENEBuN	Estuarine Bar-built Non-vegetated	ES	Subtidal Water	Estuarine Subtidal
WOPHI	Wetland	Open Water	Pond	Hydrologically Isolated	OENEBMN	Estuarine Bar-built Non-vegetated	EMT	Managed and Muted Tidal Habitats	Estuarine Muted Tidal
WVWoVWoHC	Wetland	Vegetated Woody	Vegetated Woody	Hydrologically Connected	WENEBIF	Estuarine Bar-built Intertidal Forested	EIF	Forested Tidal Wetland	Estuarine Intertidal Vegetated
WVWoVWoHI	Wetland	Vegetated Woody	Vegetated Woody	Hydrologically Isolated	WENEBnF	Estuarine Bar-built Forested	EIF	Forested Tidal Wetland	Estuarine Intertidal Vegetated
WWLFHC	Wetland	Wettable Lowland	Flats	Hydrologically	WENEBIN	Estuarine Bar-built	EI	Tidal Flat and Marsh	Estuarine Intertidal

				Connected		Intertidal Non-vegetated		Panne	
WWLMHC	Wetland	Wettable Lowland	Marsh Plain	Hydrologically Connected	WENEBIE	Estuarine Bar-built Intertidal Emergent	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
WWLMHI	Wetland	Wettable Lowland	Marsh Plain	Hydrologically Isolated	WENEBnE	Estuarine Bar-built Emergent	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
WWLPIHC	Wetland	Wettable Lowland	Periodically Inundated	Hydrologically Connected	WENEBIS	Estuarine Bar-built Intertidal Shrub-Scrub	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
WWLPIHI	Wetland	Wettable Lowland	Periodically Inundated	Hydrologically Isolated	WENEBnS	Estuarine Bar-built Shrub-Scrub	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
WWLPINA	Wetland	Wettable Lowland	Periodically Inundated	Not Applicable	WENEBnS	Estuarine Bar-built Shrub-Scrub	EIV	Tidal Marsh	Estuarine Intertidal Vegetated

Appendix H: NERR HRLC Crosswalk

Table 13. Crosswalk from NERR HRLC polygon classes to CARI classes as of the compilation of CARIv1.0.

Sys_Nom	SubSys_Nom	Cls_Nom	SubCls_Nom	Dsc_Nom	CARI clickcode	CARI ClickLabel	CARI LegCode	CARI LegLabel Level 1	CARI LegLabel Level 2
Estuarine Habitats	Intertidal Fresh	Emergent Wetland	Persistent	Tidal Fresh Marsh	WENENIE	Estuarine Non-saline Natural Intertidal Emergent	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
Estuarine Habitats	Intertidal Haline	Emergent Wetland	Persistent	Salt Marsh	WENESIE	Estuarine Saline Natural Intertidal Emergent	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
Estuarine Habitats	Intertidal Haline	Scrub-Shrub Wetland	NLE	Salt Shrub Thicket	WENESIS	Estuarine Saline Natural Intertidal Shrub-Scrub	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
Estuarine Habitats	Intertidal Haline	Streambed		Tidal slough	WENESIN	Estuarine Saline Natural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
Estuarine Habitats	Intertidal Haline	Streambed	Mud	Open Water/River Channel	WENESIN	Estuarine Saline Natural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
Estuarine Habitats	Intertidal Haline	Unconsolidated Shore		Marsh Panne, Mudflat	WENESIN	Estuarine Saline Natural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
Estuarine Habitats	Intertidal Haline	Unconsolidated Shore	Mud	Mud Flats	WENESIN	Estuarine Saline Natural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
Estuarine Habitats	Subtidal Haline	Unconsolidated Bottom		Subtidal habitat	OENESSN	Estuarine Saline Natural Subtidal Non-vegetated	ES	Subtidal Water	Estuarine Subtidal
Estuarine Habitats	Subtidal Haline	Unconsolidated Bottom	Mud	Creek Bottom, Impounded Wetlands	OENESSN	Estuarine Saline Natural Subtidal Non-vegetated	ES	Subtidal Water	Estuarine Subtidal
Estuarine Habitats	Supratidal Haline	Emergent Wetland	Persistent	Supratidal Brackish Marsh	WENESuE	Estuarine Saline Natural Emergent	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
Estuarine Habitats	Supratidal Haline	Scrub-Shrub Wetland	BLE	Supratidal Salt Thicket	WENESuS	Estuarine Saline Natural Shrub-Scrub	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
Estuarine Habitats	Supratidal Haline	Scrub-Shrub Wetland	NLD	Supratidal Salt Thicket	WENESuS	Estuarine Saline Natural Shrub-Scrub	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
Estuarine Habitats	Supratidal Haline	Unconsolidated Bottom	Mud	Supratidal Pool	WENESuN	Estuarine Saline Natural Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
Estuarine Habitats	Supratidal Haline	Unconsolidated Bottom	Sand	Maritime Dunes	WMNdnnV	Marine Natural Dune Vegetated	DU	Dune	Dune

Marine Habitats	Intertidal	Unconsolidated Shore	Sand	Coastal Beach	OMNBnIN	Marine Beach Natural Intertidal Non-vegetated	B	Beach	Beach
Palustrine Habitats	Intermittent	Emergent Wetland	Persistent	Inland Freshwater Marsh	WDNDSuE	Depressional Seasonal Natural Emergent	D	Pond and associated vegetation	Depressional
Palustrine Habitats	Perennial	Unconsolidated Bottom	Mud	Inland Freshwater Marsh	ODNDPnN	Depressional Perennial Natural Non-vegetated	D	Pond and associated vegetation	Depressional

Appendix I: ESI Crosswalk

Table 14. Crosswalk from Environmental Sensitivity Index (ESI) classes to CARI classes used to attribute elevation modeled coastal habitat polygons as of the compilation of CARIv1.0.

ESI	Landward_Shoretype	Seaward Shoretype	Seaward Shoretype1	Beach CARI Clickcode	Rocky Intertidal CARI Clickcode
4	Coarse Grained Sand Beaches			OMNBnIN	
5	Mixed Sand and Gravel Beaches			OMNBnIN	
4/7	Coarse Grained Sand Beaches	Exposed Tidal Flats		OMNBnIN	
5/7	Mixed Sand and Gravel Beaches	Exposed Tidal Flats		OMNBnIN	
10A/4	Salt and Brackish Water Marshes	Coarse Grained Sand Beaches		OMNBnIN	
10A/4/9A	Salt and Brackish Water Marshes	Coarse Grained Sand Beaches	Sheltered Tidal Flats	OMNBnIN	
10A/6B	Salt and Brackish Water Marshes	Riprap			WMUrnIN
10B/6B	Freshwater Marshes	Riprap			WMUrnIN
1A	Exposed, Rocky Banks				WMNrnIN
1A/2A	Exposed, Rocky Banks	Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay)			WMNrnIN
1A/3A	Exposed, Rocky Banks	Fine to Medium Grained Sand Beaches		OMNBnIN	
1A/4	Exposed, Rocky Banks	Coarse Grained Sand Beaches		OMNBnIN	
1A/5	Exposed, Rocky Banks	Mixed Sand and Gravel Beaches		OMNBnIN	
1A/6D	Exposed, Rocky Banks	Boulder Rubble			WMNrnIN
1B	Exposed, Solid Man-Made Structures				WMUrnIN
1B/2A	Exposed, Solid Man-Made Structures	Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay)			WMNrnIN
1B/3A	Exposed, Solid Man-Made Structures	Fine to Medium Grained Sand Beaches		OMNBnIN	
1B/3A/2A	Exposed, Solid Man-Made Structures	Fine to Medium Grained Sand Beaches	Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay)	OMNBnIN	WMNrnIN
1B/4	Exposed, Solid Man-Made Structures	Coarse Grained Sand Beaches		OMNBnIN	
1B/4/2A	Exposed, Solid Man-Made Structures	Coarse Grained Sand Beaches	Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay)	OMNBnIN	WMNrnIN
1B/5	Exposed, Solid Man-Made Structures	Mixed Sand and Gravel Beaches		OMNBnIN	
1B/5/2A	Exposed, Solid Man-Made Structures	Mixed Sand and Gravel Beaches	Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay)	OMNBnIN	WMNrnIN

1B/6A	Exposed, Solid Man-Made Structures	Gravel Beaches		OMNBnIN	
1B/6A/3A	Exposed, Solid Man-Made Structures	Gravel Beaches	Fine to Medium Grained Sand Beaches	OMNBnIN	
1B/6B	Exposed, Solid Man-Made Structures	Riprap			WMNrnIN
1B/6B/3A	Exposed, Solid Man-Made Structures	Riprap	Fine to Medium Grained Sand Beaches	OMNBnIN	
1B/6B/4	Exposed, Solid Man-Made Structures	Riprap	Coarse Grained Sand Beaches	OMNBnIN	
2A	Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay)				WMNrnIN
2A/3A	Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay)	Fine to Medium Grained Sand Beaches		OMNBnIN	
2A/5	Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay)	Mixed Sand and Gravel Beaches		OMNBnIN	
3A	Fine to Medium Grained Sand Beaches			OMNBnIN	
3A/2A	Fine to Medium Grained Sand Beaches	Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay)		OMNBnIN	WMNrnIN
3A/6A	Fine to Medium Grained Sand Beaches	Gravel Beaches		OMNBnIN	
3A/7	Fine to Medium Grained Sand Beaches	Exposed Tidal Flats		OMNBnIN	
3A/9A	Fine to Medium Grained Sand Beaches	Sheltered Tidal Flats		OMNBnIN	
4/2A	Coarse Grained Sand Beaches	Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay)		OMNBnIN	WMNrnIN
4/9A	Coarse Grained Sand Beaches	Sheltered Tidal Flats		OMNBnIN	
5/1A	Mixed Sand and Gravel Beaches	Exposed, Rocky Banks		OMNBnIN	WMNrnIN
5/2A	Mixed Sand and Gravel Beaches	Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay)		OMNBnIN	WMNrnIN
5/3A	Mixed Sand and Gravel Beaches	Fine to Medium Grained Sand Beaches		OMNBnIN	
5/3A/2A	Mixed Sand and Gravel Beaches	Fine to Medium Grained Sand Beaches	Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay)	OMNBnIN	WMNrnIN
6A	Gravel Beaches			OMNBnIN	
6A/1A	Gravel Beaches	Exposed, Rocky Banks		OMNBnIN	WMNrnIN
6A/2A	Gravel Beaches	Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay)		OMNBnIN	WMNrnIN
6A/3A	Gravel Beaches	Fine to Medium Grained Sand Beaches		OMNBnIN	
6A/3A/2A	Gravel Beaches	Fine to Medium Grained Sand Beaches	Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay)	OMNBnIN	WMNrnIN
6A/4	Gravel Beaches	Coarse Grained Sand Beaches		OMNBnIN	
6A/5	Gravel Beaches	Mixed Sand and Gravel Beaches		OMNBnIN	

6A/9A	Gravel Beaches	Sheltered Tidal Flats		OMNBnIN	
6B	Riprap				WMUrnIN
6B/2A	Riprap	Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay)			WMNrnIN
6B/3A	Riprap	Fine to Medium Grained Sand Beaches		OMNBnIN	
6B/3A/2A	Riprap	Fine to Medium Grained Sand Beaches	Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay)	OMNBnIN	WMNrnIN
6B/3A/7	Riprap	Fine to Medium Grained Sand Beaches	Exposed Tidal Flats	OMNBnIN	
6B/4	Riprap	Coarse Grained Sand Beaches		OMNBnIN	
6B/4/2A	Riprap	Coarse Grained Sand Beaches	Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay)	OMNBnIN	WMNrnIN
6B/5	Riprap	Mixed Sand and Gravel Beaches		OMNBnIN	
6B/5/2A	Riprap	Mixed Sand and Gravel Beaches	Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay)	OMNBnIN	WMNrnIN
6B/6A	Riprap	Gravel Beaches		OMNBnIN	
6B/6A/3A	Riprap	Gravel Beaches		OMNBnIN	
6B/7	Riprap	Exposed Tidal Flats			WMUrnIN
6B/9A	Riprap	Sheltered Tidal Flats			WMUrnIN
6D	Boulder Rubble				WMUrnIN
6D/5	Boulder Rubble	Mixed Sand and Gravel Beaches		OMNBnIN	
8A	Sheltered, Impermeable, Rocky Shores				WMNrnIN
8A/7	Sheltered, Impermeable, Rocky Shores	Exposed Tidal Flats			WMNrnIN
8B	Sheltered, Solid Man-Made Structures				WMUrnIN
8B/9A	Sheltered, Solid Man-Made Structures	Sheltered Tidal Flats			WMUrnIN
8C	Sheltered Riprap				WMUrnIN
8C/3A	Sheltered Riprap	Fine to Medium Grained Sand Beaches		OMNBnIN	
8C/4	Sheltered Riprap	Coarse Grained Sand Beaches		OMNBnIN	
8C/7	Sheltered Riprap	Exposed Tidal Flats			WMUrnIN
8C/9A	Sheltered Riprap	Sheltered Tidal Flats			WMUrnIN

Appendix J: NHD Crosswalks

Note that converting National Hydrography Dataset (NHD) features to CARI classification was not a simple crosswalk (see NWI & NHD Integration section above).

Table 15. Crosswalk from NHD line classes to CARI classes as of the compilation of CARIv1.0.

FCode	FCode_Description	CARI Clickcode	CARI Clickcode	CARI LegLabel Level	Planarize
46007	Stream/River: Hydrographic Category = Ephemeral	WRN	Fluvial Natural	Fluvial	Yes
46003	Stream/River: Hydrographic Category = Intermittent	WRN	Fluvial Natural	Fluvial	Yes
46006	Stream/River: Hydrographic Category = Perennial	WRN	Fluvial Natural	Fluvial	Yes
33600	Canal/Ditch	WRU	Fluvial Unnatural	Fluvial	Yes
55800	Artificial Path	AP	not shown	n/a	Yes
42823	Pipeline: Pipeline Type = Stormwater; Relationship to Surface = Underground	WRS	Fluvial Subsurface	Fluvial	No
56600	Coastline	n/a	#N/A	#N/A	Yes
33400	Connector	AP	not shown	n/a	Yes
42803	Pipeline: Pipeline Type = Aqueduct; Relationship to Surface = Underground	WRS	Fluvial Subsurface	Fluvial	No
42807	Pipeline: Pipeline Type = General Case; Relationship to Surface = Underground	WRS	Fluvial Subsurface	Fluvial	No
42801	Pipeline: Pipeline Type = Aqueduct; Relationship to Surface = At or Near	WRS	Fluvial Subsurface	Fluvial	No
33601	Canal/Ditch: Canal/Ditch Type = Aqueduct	WRU	Fluvial Unnatural	Fluvial	Yes
33603	Canal Ditch: Canal Ditch Type = Stormwater	WRU	Fluvial Unnatural	Fluvial	Yes
42000	Underground Conduit	WRS	Fluvial Subsurface	Fluvial	No
42813	Pipeline: Pipeline Type = Siphon	WRS	Fluvial Subsurface	Fluvial	No
46000	Stream/River	WRN	Fluvial Natural	Fluvial	Yes
42800	Pipeline	WRS	Fluvial Subsurface	Fluvial	No
42809	Pipeline: Pipeline Type = Penstock; Relationship to Surface = At or Near	WRS	Fluvial Subsurface	Fluvial	No
42805	Pipeline: Pipeline Type = General Case; Relationship to Surface = At or Near	WRS	Fluvial Subsurface	Fluvial	No
42821	Pipeline: Pipeline Type = Stormwater; Relationship to Surface = At or Near	WRS	Fluvial Subsurface	Fluvial	No
46800	Drainageway	WRU	Fluvial Unnatural	Fluvial	Yes

42802	Pipeline: Pipeline Type = Aqueduct; Relationship to Surface = Elevated	WRS	Fluvial Subsurface	Fluvial	No
42816	Pipeline: Pipeline Type = Aqueduct	WRS	Fluvial Subsurface	Fluvial	No
42820	Pipeline: Pipeline Type = Stormwater	WRS	Fluvial Subsurface	Fluvial	No
42814	Pipeline: Pipeline Type = General Case	WRS	Fluvial Subsurface	Fluvial	No
42811	Pipeline: Pipeline Type = Penstock; Relationship to Surface = Underground	WRS	Fluvial Subsurface	Fluvial	No
42808	Pipeline: Pipeline Type = General Case; Relationship to Surface = Underwater	WRS	Fluvial Subsurface	Fluvial	No
42806	Pipeline: Pipeline Type = General Case; Relationship to Surface = Elevated	WRS	Fluvial Subsurface	Fluvial	No
42810	Pipeline: Pipeline Type = Penstock; Relationship to Surface = Elevated	WRS	Fluvial Subsurface	Fluvial	No
42822	Pipeline: Pipeline Type = Stormwater; Relationship to Surface = Elevated	WRS	Fluvial Subsurface	Fluvial	No
42812	Pipeline: Pipeline Type = Penstock; Relationship to Surface = Underwater	WRS	Fluvial Subsurface	Fluvial	No
42804	Pipeline: Pipeline Type = Aqueduct; Relationship to Surface = Underwater	WRS	Fluvial Subsurface	Fluvial	No
42003	Underground Conduit: Positional Accuracy = Approximate	WRS	Fluvial Subsurface	Fluvial	No
42815	Pipeline: Pipeline Type = Penstock	WRS	Fluvial Subsurface	Fluvial	No

Table 16. Crosswalk from NHD polygon classes to CARI classes as of the compilation of CARIv1.0.

FCode	FCode_Description	CARI_Clickcode	Where_Clause
39009	Lake/Pond: Hydrographic Category = Perennial; Stage = Average Water Elevation	OLNLnnN / OLULnnN (lakes), or ODNDPnN (Natural pond)/ ODUDPnN	Area and Dam Distance
36100	Playa	WDNPnnN	All
39004	Lake/Pond: Hydrographic Category = Perennial	OLNLnnN / OLULnnN (lakes), or ODNDPnN (Natural pond)/ ODUDPnN	Area and Dam Distance
46600	Swamp/Marsh	n/a	n/a
39001	Lake/Pond: Hydrographic Category = Intermittent	OLNLnnN / OLULnnN (lakes), or ODNDSnN (Natural Seasonal pond)/ ODUDSnN	Area and Dam Distance
43600	Reservoir	OLULnnN or ODUDPnN	Area
39010	Lake/Pond: Hydrographic Category = Perennial; Stage = Normal Pool	OLNLnnN / OLULnnN (lakes), or ODNDPnN (Natural pond)/ ODUDPnN	Area and Dam Distance
46601	Swamp/Marsh: Hydrographic Category = Intermittent	n/a	n/a
46602	Swamp/Marsh: Hydrographic Category = Perennial	n/a	n/a
43607	Reservoir: Reservoir Type = Evaporator	WDUDSnu	Bay Area

39012	Lake/Pond: Hydrographic Category = Perennial; Stage = Spillway Elevation	OLNLnnN / OLULnnN (lakes), or ODNDPnN (Natural pond)/ ODUDPnN	Area and Dam Distance
43614	Reservoir: Reservoir Type = Water Storage; Construction Material = Earthen; Hydrographic Category = Intermittent	OLULnnN or ODUDPnN	Area
39005	Lake/Pond: Hydrographic Category = Intermittent; Stage = High Water Elevation	OLNLnnN / OLULnnN (lakes), or ODNDSnN (Natural Seasonal pond)/ ODUDSnN	Area and Dam Distance
37800	Ice Mass	n/a	n/a
43618	Reservoir: Construction Material = Earthen	OLULnnN or ODUDPnN	Area
39000	Lake/Pond	OLNLnnN / OLULnnN (lakes), or ODNDPnN (Natural pond)/ ODUDPnN	Area and Dam Distance
43623	Reservoir: Reservoir Type = Evaporator; Construction Material = Earthen	WDUDSnu	Bay Area
43613	Reservoir: Reservoir Type = Water Storage; Construction Material = Nonearthen	OLULnnN or ODUDPnN	Area
43612	Reservoir: Reservoir Type = Sewage Treatment Pond	ODUDPnu	All
39006	Lake/Pond: Hydrographic Category = Intermittent; Stage = Date of Photography	OLNLnnN / OLULnnN (lakes), or ODNDSnN (Natural Seasonal pond)/ ODUDSnN	Area and Dam Distance
43624	Reservoir; Reservoir Type = Treatment	OLULnnN or ODUDPnN	Area
43615	Reservoir: Reservoir Type = Water Storage; Construction Material = Earthen; Hydrographic Category = Perennial	OLULnnN or ODUDPnN	Area
43617	Reservoir: Reservoir Type = Water Storage	OLULnnN or ODUDPnN	Area
49300	Estuary	n/a	All
39011	Lake/Pond: Hydrographic Category = Perennial; Stage = Date of Photography	OLULnnN or ODUDPnN	Area
43604	Reservoir: Reservoir Type = Tailings Pond; Construction Material = Earthen	OLULnnN or ODUDPnu	Area
43619	Reservoir: Construction Material = Nonearthen	OLULnnN or ODUDPnu	Area
43625	Reservoir: Reservoir Type = Disposal; Construction Material = Earthen	OLULnnN or ODUDSnu	Area
43601	Reservoir: Reservoir Type = Aquaculture	OLMLnnN or ODMDPnu	Area
43609	Reservoir: Reservoir Type = Cooling Pond	ODUDPnu	All
43621	Reservoir: Reservoir Type = Water Storage; Hydrographic Category = Perennial	OLULnnN or ODUDPnu	Area

43606	Reservoir: Reservoir Type = Disposal	ODUDSnu	All
43611	Reservoir: Reservoir Type = Settling Pond	ODUDPnu	All
43605	Reservoir: Reservoir Type = Tailings Pond	ODUDPnu	All
43603	Reservoir: Reservoir Type = Decorative Pool	n/a	n/a
43608	Reservoir: Reservoir Type = Swimming Pool	n/a	n/a
43610	Reservoir: Reservoir Type = Filtration Pond	ODUDPnu	All
43626	Reservoir: Reservoir Type = Disposal; Construction Material = Nonearthen	ODUDPnu	All

Appendix K: NWI Crosswalks

Note that converting National Wetlands Inventory (NWI) features to CARI classification was not a simple crosswalk (see NWI & NHD Integration section above).

Table 17. Crosswalk from NWI polygon classes to CARI classes as of the compilation of CARIv1.0.

NWI ATTRIBUTE	CARI Clickcode	Where Clause	CARI Clicklabel	CARI LegCode	CARI LegLabel Level 1	CARI LegLabel Level 2
E1AB3L	OENESSv	All	Estuarine Saline Natural Subtidal Vegetated	SV	Subtidal Vegetation	Subtidal Vegetation
E1ABL	OENESSv	All	Estuarine Saline Natural Subtidal Vegetated	SV	Subtidal Vegetation	Subtidal Vegetation
E1ABLh	OEUESSu	All	Estuarine Saline Subtidal	ES	Subtidal Water	Estuarine Subtidal
E1UB2L	OENESSN	All	Estuarine Saline Natural Subtidal Non-vegetated	ES	Subtidal Water	Estuarine Subtidal
E1UB3L	OENESSN	All	Estuarine Saline Natural Subtidal Non-vegetated	ES	Subtidal Water	Estuarine Subtidal
E1UBL	OENESSN	All	Estuarine Saline Natural Subtidal Non-vegetated	ES	Subtidal Water	Estuarine Subtidal
E1UBLh	OEUESSN	All	Estuarine Saline Subtidal Non-vegetated	ES	Subtidal Water	Estuarine Subtidal
E1UBLx	OEUESSN	All	Estuarine Saline Subtidal Non-vegetated	ES	Subtidal Water	Estuarine Subtidal
E2AB/USN	WENESIv	All	Estuarine Saline Unnatural Intertidal Vegetated	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
E2AB3M	WENESIv	All	Estuarine Saline Unnatural Intertidal Vegetated	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
E2ABM	WENESIv	All	Estuarine Saline Unnatural Intertidal Vegetated	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
E2ABN	WENESIv	All	Estuarine Saline Unnatural Intertidal Vegetated	EIV	Tidal Marsh	Estuarine Intertidal Vegetated

E2EM1/SSP	WENESIE	All	Estuarine Saline Natural Intertidal Emergent	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
E2EM1/USN	WENESIE	All	Estuarine Saline Natural Intertidal Emergent	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
E2EM1N	WENESIE	All	Estuarine Saline Natural Intertidal Emergent	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
E2EM1Nh	WEUESIE	All	Estuarine Saline Unnatural Intertidal Emergent	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
E2EM1Ns	WEUESIE	All	Estuarine Saline Unnatural Intertidal Emergent	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
E2EM1Nx	WEUESIE	All	Estuarine Saline Unnatural Intertidal Emergent	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
E2EM1P	WENESIE	All	Estuarine Saline Natural Intertidal Emergent	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
E2EM1Pd	WEUESIE	All	Estuarine Saline Unnatural Intertidal Emergent	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
E2EM1Ph	WEUESIE	All	Estuarine Saline Unnatural Intertidal Emergent	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
E2EM1Px	WEUESIE	All	Estuarine Saline Unnatural Intertidal Emergent	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
E2FO1P	WENESIF	All	Estuarine Saline Natural Intertidal Forested	EIF	Forested Tidal Wetland	Estuarine Intertidal Vegetated
E2FOPx	WEUESIF	All	Estuarine Saline Unnatural Intertidal Forested	EIF	Forested Tidal Wetland	Estuarine Intertidal Vegetated
E2RF2M	WENESIu	All	Estuarine Saline Natural Intertidal	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
E2RSN	WENESIN	All	Estuarine Saline Natural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
E2RSNr	WEUESIN	All	Estuarine Saline Unnatural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal

E2RSPr	WEUESIN	All	Estuarine Saline Unnatural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
E2SB3N	WENESIN	All	Estuarine Saline Natural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
E2SBM	WENESIN	All	Estuarine Saline Natural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
E2SBMh	WEUESMN	All	Estuarine Saline Unnatural Muted Tidal Non-vegetated	EMT	Managed and Muted Tidal Habitats	Estuarine Muted Tidal
E2SBMx	WEUESIN	All	Estuarine Saline Unnatural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
E2SBN	WENESIN	All	Estuarine Saline Natural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
E2SBNh	WEUESIN	All	Estuarine Saline Unnatural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
E2SBNx	WEUESIN	All	Estuarine Saline Unnatural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
E2SBP	WENESIN	All	Estuarine Saline Natural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
E2SS/EM1P	WENESIE	All	Estuarine Saline Natural Intertidal Emergent	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
E2SS1P	WENESIS	All	Estuarine Saline Natural Intertidal Shrub-Scrub	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
E2SS3P	WENESIS	All	Estuarine Saline Natural Intertidal Shrub-Scrub	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
E2SSP	WENESIS	All	Estuarine Saline Natural Intertidal Shrub-Scrub	EIV	Tidal Marsh	Estuarine Intertidal Vegetated

E2SSPh	WEUESMS	All	Estuarine Saline Unnatural Muted Tidal Shrub-Scrub	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
E2US/ABM	WENESIN	All	Estuarine Saline Natural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
E2US/ABN	WENESIN	All	Estuarine Saline Natural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
E2US/ABNh	WEUESIN	All	Estuarine Saline Unnatural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
E2US/EM1N	WENESIE	All	Estuarine Saline Natural Intertidal Emergent	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
E2US/EM1Nh	WEUESIE	All	Estuarine Saline Unnatural Intertidal Emergent	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
E2US/EM1P	WENESIE	All	Estuarine Saline Natural Intertidal Emergent	EIV	Tidal Marsh	Estuarine Intertidal Vegetated
E2US1P	WENESIN	All	Estuarine Saline Natural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
E2US2M	WENESIN	All	Estuarine Saline Natural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
E2US2N	WENESIN	All	Estuarine Saline Natural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
E2US2P	WENESIN	All	Estuarine Saline Natural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
E2US3N	WENESIN	All	Estuarine Saline Natural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
E2US3P	WENESIN	All	Estuarine Saline Natural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
E2USM	WENESIN	All	Estuarine Saline Natural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal

E2USMh	WEUESMN	All	Estuarine Saline Unnatural Muted Tidal Non-vegetated	EMT	Managed and Muted Tidal Habitats	Estuarine Muted Tidal
E2USMs	WEUESIN	All	Estuarine Saline Unnatural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
E2USMx	WEUESIN	All	Estuarine Saline Unnatural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
E2USN	WENESIN	All	Estuarine Saline Natural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
E2USNh	WEUESMN	All	Estuarine Saline Unnatural Muted Tidal Non-vegetated	EMT	Managed and Muted Tidal Habitats	Estuarine Muted Tidal
E2USNx	WEUESIN	All	Estuarine Saline Unnatural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
E2USP	WENESIN	All	Estuarine Saline Natural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
E2USPh	WEUESMN	All	Estuarine Saline Unnatural Muted Tidal Non-vegetated	EMT	Managed and Muted Tidal Habitats	Estuarine Muted Tidal
E2USPx	WEUESIN	All	Estuarine Saline Unnatural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
L1AB/UBH	OLNLnnN	All	Lacustrine Natural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L1ABGh	OLULnnv	All	Lacustrine Unnatural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L1ABGx	OLULnnv	All	Lacustrine Unnatural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L1ABH	OLNLnnv	All	Lacustrine Natural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L1ABHh	OLULnnv	All	Lacustrine Unnatural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L1ABHx	OLULnnv	All	Lacustrine Unnatural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine

L1ABK	OLULnnv	All	Lacustrine Unnatural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L1ABKx	OLULnnv	All	Lacustrine Unnatural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L1UBG	OLNLnnN	All	Lacustrine Natural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L1UBGh	OLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L1UBH	OLNLnnN	All	Lacustrine Natural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L1UBH1	OLNLnnN	All	Lacustrine Natural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L1UBHh	OLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L1UBHx	OLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L1UBK	OLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L1UBKr	OLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L1UBKx	OLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L1UBV	OLNLnuN	All	Lacustrine Natural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L1UBVh	OLULnuN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2AB3Fh	OLULnnv	All	Lacustrine Unnatural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2AB3H	OLNLnnv	All	Lacustrine Natural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2AB3Hh	OLULnnv	All	Lacustrine Unnatural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2AB3Hx	OLULnnv	All	Lacustrine Unnatural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2AB3K	OLULnnv	All	Lacustrine Unnatural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2AB4H	OLNLnnv	All	Lacustrine Natural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine

L2AB4K	OLULnnv	All	Lacustrine Unnatural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2ABCh	OLULnnv	All	Lacustrine Unnatural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2ABF	OLNLnnv	All	Lacustrine Natural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2ABFh	OLULnnv	All	Lacustrine Unnatural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2ABFx	OLULnnv	All	Lacustrine Unnatural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2ABG	OLNLnnv	All	Lacustrine Natural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2ABGh	OLULnnv	All	Lacustrine Unnatural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2ABGx	OLULnnv	All	Lacustrine Unnatural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2ABH	OLNLnnv	All	Lacustrine Natural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2ABHh	OLULnnv	All	Lacustrine Unnatural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2ABHx	OLULnnv	All	Lacustrine Unnatural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2ABK	OLULnnv	All	Lacustrine Unnatural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2ABKx	OLULnnv	All	Lacustrine Unnatural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2EM2F	OLNLnnE	All	Lacustrine Natural Emergent	L	Lake, Reservoir and associated vegetation	Lacustrine
L2EM2Fh	OLULnnE	All	Lacustrine Unnatural Emergent	L	Lake, Reservoir and associated vegetation	Lacustrine
L2EM2Fx	OLULnnu	All	Lacustrine Unnatural	L	Lake, Reservoir and associated vegetation	Lacustrine
L2EM2H	OLNLnnu	All	Lacustrine Natural	L	Lake, Reservoir and associated vegetation	Lacustrine
L2EM2Hh	OLULnnu	All	Lacustrine Unnatural	L	Lake, Reservoir and associated vegetation	Lacustrine
L2RSAr	WLULnnu	All	Lacustrine Unnatural	L	Lake, Reservoir and associated vegetation	Lacustrine

L2RSCh	WLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2UB3H	OLNLnnN	All	Lacustrine Natural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2UBF	OLNLnnN	All	Lacustrine Natural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2UBFh	OLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2UBFx	OLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2UBG	OLNLnnN	All	Lacustrine Natural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2UBGh	OLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2UBH	OLNLnnN	All	Lacustrine Natural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2UBHh	OLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2UBHh3	OLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2UBHx	OLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2UBK	OLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2UBK1	OLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2UBK3	OLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2UBKx	OLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2UBV	OLULnuN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2US	WLNLnuN	All	Lacustrine Natural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2US2C	WLNLnnN	All	Lacustrine Natural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2US5A	WLNLnnv	All	Lacustrine Natural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine

L2US5C	WLNLnnv	All	Lacustrine Natural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2US5J	WLNLnnv	All	Lacustrine Natural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2USA	WLNLnnN	All	Lacustrine Natural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2USAh	WLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2USAr	WLULnnu	All	Lacustrine Unnatural	L	Lake, Reservoir and associated vegetation	Lacustrine
L2USAx	WLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2USC	WLNLnnN	All	Lacustrine Natural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2USCh	WLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2USCh3	WLULnnu	All	Lacustrine Unnatural	L	Lake, Reservoir and associated vegetation	Lacustrine
L2USCx	WLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2USJ	WLNLnnN	All	Lacustrine Natural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2USJh	WLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2USJx	WLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2USK	WLNLnnN	All	Lacustrine Natural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2USK1	WLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2USK3	WLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2USKx	WLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2USKx1	WLULnnN	All	Lacustrine Unnatural Non-vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
Lh	OLULnuu	All	Lacustrine Unnatural	L	Lake, Reservoir and associated vegetation	Lacustrine

M1ABL	OMNnnSv	All	Marine Natural Subtidal Vegetated	SV	Subtidal Vegetation	Subtidal Vegetation
M1UBL	OMNnnSN	All	Marine Natural Subtidal Non-vegetated	MI	Marine Intertidal	Marine Intertidal
M1UBLx	OMUnnSN	All	Marine Unnatural Subtidal Non-vegetated	MI	Marine Intertidal	Marine Intertidal
M2AB/USN	WMNrnIv or WMNBnIv	Adjacent Marine	#N/A	#N/A	#N/A	#N/A
M2AB1N	WMNrnIv or WMNBnIv	Adjacent Marine	#N/A	#N/A	#N/A	#N/A
M2ABM	WMNrnIv or WMNBnIv	Adjacent Marine	#N/A	#N/A	#N/A	#N/A
M2ABN	WMNrnIv or WMNBnIv	Adjacent Marine	#N/A	#N/A	#N/A	#N/A
M2RS/ABN	WMNrnIN	All	Marine Rocky Shore Natural Intertidal	RS	Rocky Shore	Rocky Shore
M2RS/ABNr	WMNrnIN	All	Marine Rocky Shore Natural Intertidal	RS	Rocky Shore	Rocky Shore
M2RS1N	WMNrnIN	All	Marine Rocky Shore Natural Intertidal	RS	Rocky Shore	Rocky Shore
M2RS2N	WMNrnIN	All	Marine Rocky Shore Natural Intertidal	RS	Rocky Shore	Rocky Shore
M2RS2Nr	WMNrnIN	All	Marine Rocky Shore Natural Intertidal	RS	Rocky Shore	Rocky Shore
M2RSM	WMNrnIN	All	Marine Rocky Shore Natural Intertidal	RS	Rocky Shore	Rocky Shore
M2RSN	WMNrnIN	All	Marine Rocky Shore Natural Intertidal	RS	Rocky Shore	Rocky Shore
M2RSNr	WMNrnIN	All	Marine Rocky Shore Natural Intertidal	RS	Rocky Shore	Rocky Shore
M2RSP	WMNrnIN	All	Marine Rocky Shore Natural Intertidal	RS	Rocky Shore	Rocky Shore
M2RSPr	WMNrnIN	All	Marine Rocky Shore Natural Intertidal	RS	Rocky Shore	Rocky Shore

M2US/ABN	WMNBnIN	All	Marine Beach Natural Intertidal Non-vegetated	B	Beach	Beach
M2US2N	WMNBnIN	All	Marine Beach Natural Intertidal Non-vegetated	B	Beach	Beach
M2US2P	WMNBnIN	All	Marine Beach Natural Intertidal Non-vegetated	B	Beach	Beach
M2USN	WMNBnIN	All	Marine Beach Natural Intertidal Non-vegetated	B	Beach	Beach
M2USP	WMNBnIN	All	Marine Beach Natural Intertidal Non-vegetated	B	Beach	Beach
PAB/EM1Ch	WDUDSnE	All	Depressional Seasonal Unnatural Emergent	D	Pond and associated vegetation	Depressional
PAB/EM1Cx	WDUDSnE	All	Depressional Seasonal Unnatural Emergent	D	Pond and associated vegetation	Depressional
PAB/EM1F	WDNDPnE	All	Depressional Perennial Natural Emergent	D	Pond and associated vegetation	Depressional
PAB/EM1Fh	WDUDPnE	All	Depressional Perennial Unnatural Emergent	D	Pond and associated vegetation	Depressional
PAB/EM1Fx	WDUDPnE	All	Depressional Perennial Unnatural Emergent	D	Pond and associated vegetation	Depressional
PAB/UBH	ODNDPnN	All	Depressional Perennial Natural Non-vegetated	D	Pond and associated vegetation	Depressional
PAB/UBHh	ODUDPnN	All	Depressional Perennial Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
PAB/UBK	ODUDPnN	All	Depressional Perennial Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
PAB1F	ODNDPnv	All	Depressional Perennial Natural Vegetated	D	Pond and associated vegetation	Depressional
PAB1Fx	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional

PAB1H	ODNDPnv	All	Depressional Perennial Natural Vegetated	D	Pond and associated vegetation	Depressional
PAB1Hh	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PAB1Hx	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PAB3/UBHx	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PAB3F	ODNDPnv	All	Depressional Perennial Natural Vegetated	D	Pond and associated vegetation	Depressional
PAB3Fh	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PAB3Fx	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PAB3G	ODNDPnv	All	Depressional Perennial Natural Vegetated	D	Pond and associated vegetation	Depressional
PAB3H	ODNDPnv	All	Depressional Perennial Natural Vegetated	D	Pond and associated vegetation	Depressional
PAB3Hh	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PAB3Hx	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PAB3K	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PAB3Kx	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PAB4F	ODNDPnv	All	Depressional Perennial Natural Vegetated	D	Pond and associated vegetation	Depressional
PAB4Fh	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PAB4Fx	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PAB4G	ODNDPnv	All	Depressional Perennial Natural Vegetated	D	Pond and associated vegetation	Depressional
PAB4Gx	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PAB4H	ODNDPnv	All	Depressional Perennial Natural Vegetated	D	Pond and associated vegetation	Depressional

PAB4Hh	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PAB4Hx	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PAB4K	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PAB4Kx	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PABC	ODNDSnv	All	Depressional Natural Seasonal Vegetated	D	Pond and associated vegetation	Depressional
PABCh	ODUDSnv	All	Depressional Unnatural Seasonal Vegetated	D	Pond and associated vegetation	Depressional
PABCx	ODUDSnv	All	Depressional Unnatural Seasonal Vegetated	D	Pond and associated vegetation	Depressional
PABF	ODNDPnv	All	Depressional Perennial Natural Vegetated	D	Pond and associated vegetation	Depressional
PABFb	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PABFh	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PABFr	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PABFx	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PABG	ODNDPnv	All	Depressional Perennial Natural Vegetated	D	Pond and associated vegetation	Depressional
PABGh	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PABGx	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PABH	ODNDPnv	All	Depressional Perennial Natural Vegetated	D	Pond and associated vegetation	Depressional
PABHb	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PABHh	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PABHr	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional

PABHx	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PABK	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PABKr	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PABKx	ODUDPnv	All	Depressional Perennial Unnatural Vegetated	D	Pond and associated vegetation	Depressional
PABV	ODNDPuv	All	Depressional Perennial Natural Vegetated	D	Pond and associated vegetation	Depressional
PEM	WDNDuuE or WRNRuuE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/ABF	WDNDPnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/ABFh	WDUDPnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/ABFx	WDUDPnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/FO1A	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/FO1C	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/FO4B	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/FO4C	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/FOA	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/FOAh	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A

PEM1/FOB	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/FOC	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/FOCh	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/FOCx	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/FOF	WDNDPnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/SS1A	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/SS1Ad	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/SS1B	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/SS1C	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/SS1Ch	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/SS1E	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/SS1F	WDNDPnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/SS2A	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A

PEM1/SS2C	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/SS2Ch	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/SS2F	WDNDPnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/SS4A	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/SS4C	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/SSA	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/SSAh	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/SSAx	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/SSB	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/SSC	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/SSCh	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/SSCx	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/SSF	WDNDPnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A

PEM1/SSFh	WDUDPnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/SSJ	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/SSR	WDNDSuE or WRNRTuE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/SSS	WDNDSuE or WRNRTuE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/SSTx	WDUDPuE or WRURTuE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/USA	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/USAh	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/USAx	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/USC	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/USCh	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/USCx	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/USJ	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/USK	WDUDunE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A

PEM1/USKx	WDUDunE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1/USR	WDNDSuE or WRNRTuE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1A	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Ab	WDNDnnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Ad	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Af	WDUDSnf	All	Depressional Seasonal Unnatural Farmed	FI	Irrigated	Farmed Irrigated
PEM1Ah	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Ai	WDNVInu or WDNVVnu	Area	#N/A	#N/A	#N/A	#N/A
PEM1Am	WDMDSnE	All	Depressional Managed Seasonal Emergent	D	Pond and associated vegetation	Depressional
PEM1As	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Ax	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1B	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Bd	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Bf	WDUDSnf	All	Depressional Seasonal Unnatural Farmed	FI	Irrigated	Farmed Irrigated

PEM1Bh	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Bm	WDMDSnE	All	Depressional Managed Seasonal Emergent	D	Pond and associated vegetation	Depressional
PEM1Bx	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1C	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Cb	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Cd	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Cf	WDUDSnf	All	Depressional Seasonal Unnatural Farmed	FI	Irrigated	Farmed Irrigated
PEM1Ch	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Ci	WDNVInu or WDNVVnu	Area	#N/A	#N/A	#N/A	#N/A
PEM1Cm	WDMDSnE	All	Depressional Managed Seasonal Emergent	D	Pond and associated vegetation	Depressional
PEM1Cr	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Cs	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Cx	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1D	WDNDPnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A

PEM1E	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Eh	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Ei	WDNVInu or WDNVVnu	Area	#N/A	#N/A	#N/A	#N/A
PEM1F	WDNDPnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Fb	WDNDPnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Fd	WDUDPnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Fh	WDUDPnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Fm	WDMDPnE	All	Depressional Managed Perennial Emergent	D	Pond and associated vegetation	Depressional
PEM1Fx	WDUDPnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1J	WDNDSnE or WRNRnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Jh	WDUDSnE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1K	WDUDunE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Kx	WDUDunE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A

PEM1R	WDNDSuE or WRNRTuE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Rh	WDUDSuE or WRURTuE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Rx	WDUDSuE or WRURTuE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1S	WDNDSuE or WRNRTuE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Sh	WDUDSuE or WRURTuE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1T	WDNDSuE or WRNRTuE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Tx	WDUDPuE or WRURTuE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
Pf	WDNDSuf	All	Depressional Seasonal Natural Forested	D	Pond and associated vegetation	Depressional
PFO	WDNDuuF or WRNRuuF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO/ABFh	WDUDPnF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO/EM1A	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO/EM1Ah	WDUDSnF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO/EM1Ax	WDUDSnF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A

PFO/EM1B	WDNDPnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO/EM1C	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO/EM1Ch	WDUDSnF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO/EM1Cx	WDUDSnF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO/EM1R	WDNDSuF or WRNRTuF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO/SS1B	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO/SS4B	WDNDPnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO/SSA	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO/SSAh	WDUDSnF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO/SSAx	WDUDSnF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO/SSB	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO/SSC	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO/SSCh	WDUDSnF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A

PFO/SSCx	WDUDSnF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO/SSF	WDNDPnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO/SSR	WDNDSuF or WRNRTuF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO/SSS	WDNDSuF or WRNRTuF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO/USA	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO/USC	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO1/4A	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO1/4C	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO1/EM1A	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO1/EM1F	WDNDPnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO1/SS1A	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO1/SS1C	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO1A	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A

PFO1Ah	WDUDSnF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO1Ax	WDUDSnF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO1B	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO1C	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO1Ch	WDUDSnF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO1Cx	WDUDSnF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO1F	WDNDPnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO1Fh	WDUDPnF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO1K	WDUDunF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO1R	WDNDSuF or WRNRTuF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO1S	WDNDSuF or WRNRTuF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO2A	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO2Ah	WDUDSnF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A

PFO2C	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO4/1A	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO4/1C	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO4/EM1C	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO4A	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO4B	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO4C	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO5F	WDNDPnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFOA	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFOAd	WDUDSnF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFOAh	WDUDSnF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFOAx	WDUDSnF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFOB	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A

PFOBh	WDUDPnF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFOC	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFOCb	WDUDSnF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFOCh	WDUDSnF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFOCx	WDUDSnF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFOF	WDNDPnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFOFh	WDUDPnF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFOFx	WDUDPnF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFOK	WDUDunF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFOKx	WDUDunF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFOR	WDNDSuF or WRNRTuF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFORh	WDUDSuF or WRURTuF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFOS	WDNDSuF or WRNRTuF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A

PFOSx	WDUDSuF or WRURTuF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PRBKx	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
PSS	WDNDuuS or WRNRuuS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/ABF	WDNDPnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/EM1A	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/EM1Ad	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/EM1Ah	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/EM1Ax	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/EM1B	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/EM1C	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/EM1Ch	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/EM1Cx	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/EM1F	WDNDPnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A

PSS/EM1Fh	WDUDPnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/EM1J	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/EM1K	WDUDPnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/EM1R	WDNDSuS or WRNRTuS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/EM1S	WDNDSuS or WRNRTuS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/FO1B	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/FOA	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/FOAh	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/FOB	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/FOC	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/FOCh	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/FOCx	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/FOF	WDNDPnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A

PSS/FOR	WDNDSuS or WRNRTuS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/UBF	WDNDPnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/USA	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/USAh	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/USC	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/USCh	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/USJ	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS/USR	WDNDSuS or WRNRTuS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1/2A	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1/2B	WDNDPnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1/2C	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1/2Ch	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1/2Cx	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A

PSS1/2J	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1/EM1A	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1/EM1Ah	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1/EM1B	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1/EM1C	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1/EM1D	WDNDPnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1/EM1E	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1/EM1F	WDNDPnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1/EM1J	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1/FO1A	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1/FO1C	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1/FO4B	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1/FO4C	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A

PSS1/UBF	WDNDPnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1/USA	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1/USAh	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1/USC	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1/USJ	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1A	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1Ah	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1Am	WDMDSnS	All	Depressional Managed Seasonal Shrub-Scrub	D	Pond and associated vegetation	Depressional
PSS1Ax	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1B	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1Bh	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1C	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1Cd	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A

PSS1Ch	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1Ci	WRNRnnS	All	Riverine Natural Shrub-Scrub	RV	Riverine Vegetated	Riverine Vegetated
PSS1Cm	WDMDSnS	All	Depressional Managed Seasonal Shrub-Scrub	D	Pond and associated vegetation	Depressional
PSS1Cx	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1D	WDNDPnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1Dx	WDUDPnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1E	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1F	WDNDPnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1Fh	WDUDPnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1Fx	WDUDPnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1J	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1Jh	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1Jx	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1K	WDUDunS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A

PSS1Kx	WDUDunS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1R	WDNDSuS or WRNRTuS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1S	WDNDSuS or WRNRTuS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS2/1A	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS2/1C	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS2/EM1A	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS2/EM1C	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS2/EM1Ch	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS2/USA	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS2A	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS2Ah	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS2Ax	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS2B	WDNDPnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A

PSS2C	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS2Ch	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS2Cx	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS2D	WDNDPnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS2F	WDNDPnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS2Fh	WDUDPnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS2J	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS2Jx	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS3A	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS4/FO4B	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS4B	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS4C	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS5F	WDNDPnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A

PSS5Fb	WDUDPnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS7B3	WDNDPnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSSA	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSSAd	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSSAh	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSSAx	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSSB	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSSBh	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSSBx	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSSC	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSSCb	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSSCd	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSSCh	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A

PSSCx	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSSE	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSSF	WDNDPnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSSFb	WDUDPnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSSFh	WDUDPnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSSFx	WDUDPnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSSHx	WDUDPnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSSJ	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSSJh	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSSK	WDNDunS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSSKh	WDUDunS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSSKx	WDUDunS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSSR	WDNDSuS or WRNRTuS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A

PSSRh	WDUDSuS or WRURTuS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSSRx	WDUDSuS or WRURTuS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSSS	WDNDSuS or WRNRTuS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSST	WDNDPuS or WRNRTuS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PUB	ODNDPuN	All	Depressional Perennial Natural Non-vegetated	D	Pond and associated vegetation	Depressional
PUB/ABFh	ODUDPnN	All	Depressional Perennial Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
PUB/ABFx	ODUDPnN	All	Depressional Perennial Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
PUB/ABH	ODUDPnN	All	Depressional Perennial Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
PUB/ABHh	ODUDPnN	All	Depressional Perennial Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
PUB/EM1F	ODNDPnN	All	Depressional Perennial Natural Non-vegetated	D	Pond and associated vegetation	Depressional
PUB/EM1K	ODNDPnN	All	Depressional Perennial Natural Non-vegetated	D	Pond and associated vegetation	Depressional
PUB/SSFb	ODUDPnN	All	Depressional Perennial Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
PUB3F	ODNDPnN	All	Depressional Perennial Natural Non-vegetated	D	Pond and associated vegetation	Depressional

PUB3G	ODNDPnN	All	Depressional Perennial Natural Non-vegetated	D	Pond and associated vegetation	Depressional
PUB3H	ODNDPnN	All	Depressional Perennial Natural Non-vegetated	D	Pond and associated vegetation	Depressional
PUBF	ODNDPnN	All	Depressional Perennial Natural Non-vegetated	D	Pond and associated vegetation	Depressional
PUBFb	ODUDPnN	All	Depressional Perennial Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
PUBFh	ODUDPnN	All	Depressional Perennial Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
PUBFm	ODMDPnN	All	Depressional Managed Perennial Non-vegetated	D	Pond and associated vegetation	Depressional
PUBFr	ODUDPnN	All	Depressional Perennial Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
PUBFx	ODUDPnN	All	Depressional Perennial Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
PUBG	ODNDPnN	All	Depressional Perennial Natural Non-vegetated	D	Pond and associated vegetation	Depressional
PUBGh	ODUDPnN	All	Depressional Perennial Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
PUBGx	ODUDPnN	All	Depressional Perennial Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
PUBH	ODNDPnN	All	Depressional Perennial Natural Non-vegetated	D	Pond and associated vegetation	Depressional
PUBHb	ODUDPnN	All	Depressional Perennial Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional

PUBHh	ODUDPnN	All	Depressional Perennial Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
PUBHh3	ODUDPnN	All	Depressional Perennial Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
PUBHr	ODUDPnN	All	Depressional Perennial Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
PUBHx	ODUDPnN	All	Depressional Perennial Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
PUBHx3	ODUDPnN	All	Depressional Perennial Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
PUBK	ODNDPnN	All	Depressional Perennial Natural Non-vegetated	D	Pond and associated vegetation	Depressional
PUBK1	ODNDPnN	All	Depressional Perennial Natural Non-vegetated	D	Pond and associated vegetation	Depressional
PUBKr	ODUDPnN	All	Depressional Perennial Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
PUBKx	ODUDPnN	All	Depressional Perennial Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
PUBKx1	ODUDPnN	All	Depressional Perennial Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
PUBT	ODNDPuN or WRNRTuu	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PUBV	WRNRTuu	All	Riverine Natural Tidal	ES	Subtidal Water	Estuarine Subtidal
PUBVx	WRURTSu	All	Riverine Unnatural Subtidal	R	Fluvial Channel	Fluvial Channel
PUS	WDNDuuN	All	Depressional Natural Non-vegetated	D	Pond and associated vegetation	Depressional

PUS/EM1A	WDNDSnN	All	Depressional Natural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUS/EM1Ah	WDUDSnN	All	Depressional Unnatural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUS/EM1Ax	WDUDSnN	All	Depressional Unnatural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUS/EM1C	WDNDSnN	All	Depressional Natural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUS/EM1Ch	WDUDSnN	All	Depressional Unnatural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUS/EM1Cx	WDUDSnN	All	Depressional Unnatural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUS/EM1J	WDNDSnN	All	Depressional Natural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUS/EM1K	WDNDSnN	All	Depressional Natural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUS/EM1S	WDNDSuN or WRNRTuu	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PUS/FOA	WDNDSnN	All	Depressional Natural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUS/SS1A	WDNDSnN	All	Depressional Natural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUS/SS1C	WDNDSnN	All	Depressional Natural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUS/SS1J	WDNDSnN	All	Depressional Natural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUS/SSA	WDNDSnN	All	Depressional Natural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUS/SSAh	WDUDSnN	All	Depressional Unnatural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUS/SSC	WDNDSnN	All	Depressional Natural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional

PUS/SSCh	WDUDSnN	All	Depressional Unnatural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUS5Ch	WDUDSnv	All	Depressional Unnatural Seasonal Vegetated	D	Pond and associated vegetation	Depressional
PUS5Cx	WDUDSnv	All	Depressional Unnatural Seasonal Vegetated	D	Pond and associated vegetation	Depressional
PUS5J	WDNDSnv	All	Depressional Natural Seasonal Vegetated	D	Pond and associated vegetation	Depressional
PUSA	WDNDSnN	All	Depressional Natural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUSAd	WDUDSnN	All	Depressional Unnatural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUSAh	WDUDSnN	All	Depressional Unnatural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUSAm	WDMDSnN	All	Depressional Managed Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUSAr	WDUDSnN	All	Depressional Unnatural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUSAx	WDUDSnN	All	Depressional Unnatural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUSC	WDNDSnN	All	Depressional Natural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUSCh	WDUDSnN	All	Depressional Unnatural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUSCh3	WDUDSnN	All	Depressional Unnatural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUSCr	WDUDSnN	All	Depressional Unnatural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUSCx	WDUDSnN	All	Depressional Unnatural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional

PUSCx1	WDUDSnN	All	Depressional Unnatural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUSEh	WDUDSnN	All	Depressional Unnatural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUSJ	WDNDSnN	All	Depressional Natural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUSJh	WDUDSnN	All	Depressional Unnatural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUSJx	WDUDSnN	All	Depressional Unnatural Seasonal Non-vegetated	D	Pond and associated vegetation	Depressional
PUSK	WDNDunN	All	Depressional Natural Non-vegetated	D	Pond and associated vegetation	Depressional
PUSK1	WDNDunN	All	Depressional Natural Non-vegetated	D	Pond and associated vegetation	Depressional
PUSKr	WDUDunN	All	Depressional Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
PUSKx	WDUDunN	All	Depressional Unnatural Non-vegetated	D	Pond and associated vegetation	Depressional
PUSR	WDNDSuN or WRNRTuu	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PUSS	WDNDSuN or WRNRTuu	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PUSSh	WDUDSuN or WRURTuu	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
R1ABV	WRNRTSv	All	Riverine Natural Subtidal Vegetated	SV	Subtidal Vegetation	Subtidal Vegetation
R1ABVx	WRURTSv	All	Riverine Unnatural Subtidal Vegetated	SV	Subtidal Vegetation	Subtidal Vegetation
R1UBT	WRNRTuN	All	Riverine Natural Tidal Non-vegetated	ES	Subtidal Water	Estuarine Subtidal
R1UBV	WRNRTSN	All	Riverine Natural Subtidal Non-vegetated	ES	Subtidal Water	Estuarine Subtidal

R1UBVr	WRURTSN	All	Riverine Unnatural Subtidal Non-vegetated	ES	Subtidal Water	Estuarine Subtidal
R1UBVx	WRURTSN	All	Riverine Unnatural Subtidal Non-vegetated	ES	Subtidal Water	Estuarine Subtidal
R1USQ	WRNRTIN	All	Riverine Natural Intertidal Non-vegetated	ES	Subtidal Water	Estuarine Subtidal
R1USQr	WRURTIN	All	Riverine Unnatural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
R1USQx	WRURTIN	All	Riverine Unnatural Intertidal Non-vegetated	EI	Tidal Flat and Marsh Panne	Estuarine Intertidal
R2AB3F	WRNRnnv	All	Riverine Natural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R2AB3Fx	WRURnnv	All	Riverine Unnatural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R2AB3H	WRURnnv	All	Riverine Unnatural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R2AB3Hx	WRURnnv	All	Riverine Unnatural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R2AB4F	WRNRnnv	All	Riverine Natural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R2AB4Fx	WRURnnv	All	Riverine Unnatural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R2AB4H	WRNRnnv	All	Riverine Natural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R2AB4Hx	WRURnnv	All	Riverine Unnatural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R2ABF	WRNRnnv	All	Riverine Natural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R2ABFr	WRURnnv	All	Riverine Unnatural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R2ABFx	WRURnnv	All	Riverine Unnatural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R2ABG	WRNRnnv	All	Riverine Natural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R2ABGx	WRURnnv	All	Riverine Unnatural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R2ABH	WRNRnnv	All	Riverine Natural Vegetated	RV	Riverine Vegetated	Riverine Vegetated

R2ABHr	WRURnnv	All	Riverine Unnatural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R2ABHx	WRURnnv	All	Riverine Unnatural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R2EM2F	WRNRnnv	All	Riverine Natural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R2EM2H	WRNRnnv	All	Riverine Natural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R2EM2Hx	WRURnnv	All	Riverine Unnatural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R2RSA	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
R2RSC	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
R2RSCr	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
R2RSCx	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
R2UBF	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
R2UBFr	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
R2UBFx	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
R2UBG	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
R2UBH	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
R2UBHh	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
R2UBHr	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
R2UBHx	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
R2USA	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
R2USAr	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel

R2USAx	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
R2USC	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
R2USCh	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
R2USCr	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
R2USCx	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
R2USJ	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
R3AB1H	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
R3ABF	WRNRnnv	All	Riverine Natural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R3ABFx	WRURnnv	All	Riverine Unnatural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R3ABH	WRNRnnv	All	Riverine Natural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R3RBF	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
R3RBG	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
R3RBH	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
R3RBHx	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
R3RSA	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
R3RSC	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
R3UBF	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
R3UBFr	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
R3UBFx	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel

R3UBG	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
R3UBH	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
R3UBHh	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
R3UBHr	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
R3UBHx	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
R3US1C	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
R3US5A	WRNRnnv	All	Riverine Natural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R3US5C	WRNRnnv	All	Riverine Natural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R3USA	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
R3USC	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
R3USCx	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
R3USJ	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
R4SB7A	WRNRnnv	All	Riverine Natural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R4SB7C	WRNRnnv	All	Riverine Natural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R4SB7J	WRNRnnv	All	Riverine Natural Vegetated	RV	Riverine Vegetated	Riverine Vegetated
R4SBA	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
R4SBAh	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
R4SBAr	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
R4SBAx	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel

R4SBC	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
R4SBCr	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
R4SBCx	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
R4SBJ	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
R4SBJr	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
R4SBJx	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
R5UBF	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
R5UBFx	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel
R5UBH	WRNRnnN	All	Riverine Natural Non-Vegetated	R	Fluvial Channel	Fluvial Channel
PEM1/UBF	WDNDSnE	All	Depressional Natural Seasonal Emergent	D	Pond and associated vegetation	Depressional
M1AB3L	OMNnnSv	All	Marine Natural Subtidal Vegetated	SV	Subtidal Vegetation	Subtidal Vegetation
L2AB4Fh	OLULnnv	All	Lacustrine Unnatural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2AB4Ch	OLULnnv	All	Lacustrine Unnatural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
L2AB4Hh	OLULnnv	All	Lacustrine Unnatural Vegetated	L	Lake, Reservoir and associated vegetation	Lacustrine
PEM2Kf	WDUDunf or WRURnnf	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1/EM1Ch	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1/EM1Cx	WDUDSnS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A

PFO5Gh	WDUDunF or WRURnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Dh	WDUDunE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PEM1Jx	WDUDunE or WRURnnE	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PFO1/EM1C	WDNDSnF or WRNRnnF	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1/EM1Fh	WDUDunS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1/EM1Jh	WDUDunS or WRURnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1Cb	WDNDSnS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PSS1Fb	WDNDunS or WRNRnnS	Adjacent Riverine and Area	#N/A	#N/A	#N/A	#N/A
PUS5A	WDNDunv	All	Depressional Natural Vegetated	D	Pond and associated vegetation	Depressional
R3RBFx	WRURnnN	All	Riverine Unnatural Non-vegetated	R	Fluvial Channel	Fluvial Channel

Appendix L: Salinity Modifier Methods

Adding Salinity Modifiers to CARI - Methods Brief

Appendix M: SFEI Internal Documents

Below are SFEI Internal Crosswalk Tables used and updated for CARI classification and data compilation:

- *CARI Wetlands Crosswalks*
- *CARI Streams Crosswalks*

SFEI Internal CARI Development Resources:

- *CARI Methods - Notes*: Google doc with detailed notes on CARI v1.0 methods used for the development of SOP.
- SFEI GitHub/Stash: CARI integration scripts for CARI.
- *CARI Script Improvements*: Google doc with details on possible improvements to consider for the CARI methods script. Many have been implemented in the update to CARI v2.2