



# COASTWIDE REFERENCE MONITORING SYSTEM (CRMS)

## OVERVIEW

In 1990, the U.S. Congress enacted the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) in response to Louisiana's land loss crisis. CWPPRA is a joint federal/state effort that has provided a stable and recurring funding stream to restore Louisiana's wetlands. From 1990 to 2025, the CWPPRA program has authorized over 240 restoration and protection projects. The restoration techniques used include: placement of dredge material for marsh creation or marsh nourishment, shoreline protection, freshwater and sediment diversions, terracing, ridge restoration, hydrologic restoration, barrier island restoration, and vegetative plantings.

The Coastwide Reference Monitoring System (CRMS) was designed to monitor the effectiveness of restoration actions at multiple spatial scales, including watersheds, subbasins, and basins, from individual projects to the influence of projects on the entire coastal landscape. CRMS is funded by CWPPRA and restoration programs created following the Deepwater Horizon Oil Spill of 2010.

### ESSENTIAL MONITORING OF LOUISIANA'S VANISHING COASTAL WETLANDS

- CRMS monitors the effectiveness of restoration actions throughout the Louisiana coastal zone.
- As the world's largest coastal monitoring program with publicly available data, CRMS is a model for reference monitoring networks and was commended by the National Academy of Sciences.
- CRMS data feed into interpretable tools that can be used by natural resource managers for project planning and evaluation.
- Scientists and engineers use CRMS data for all stages of CWPPRA project planning and implementation.

## COASTWIDE REFERENCE MONITORING SYSTEM STATIONS

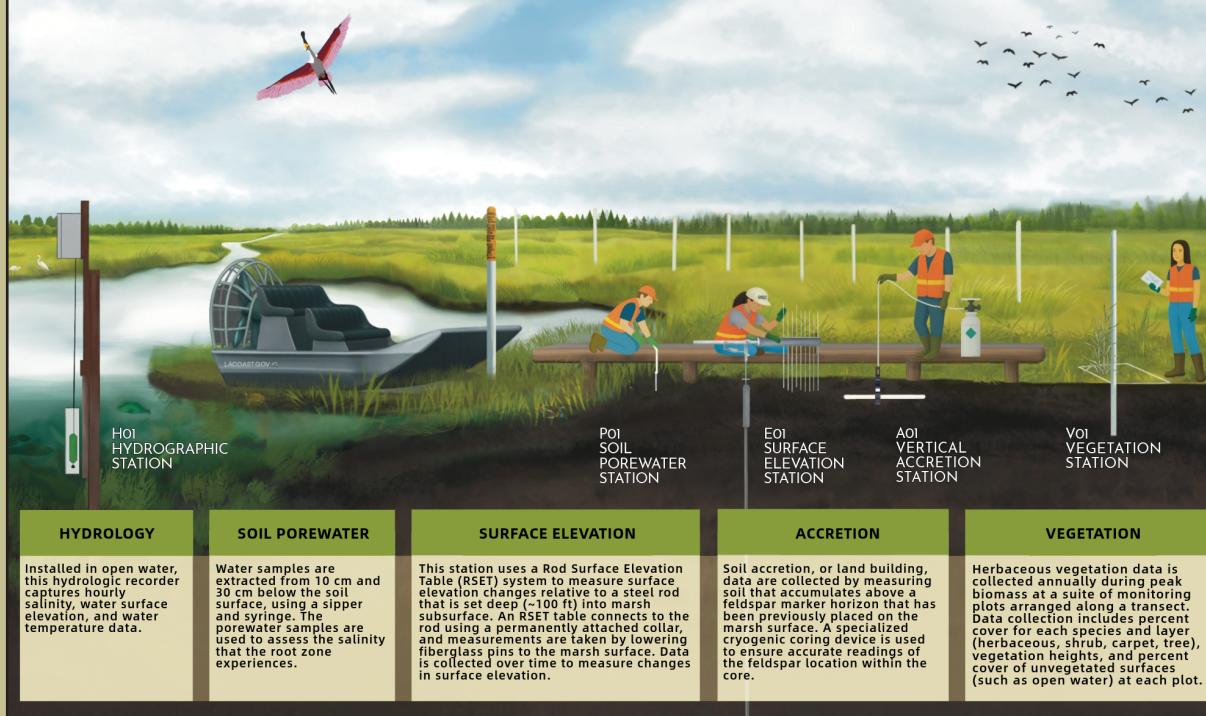
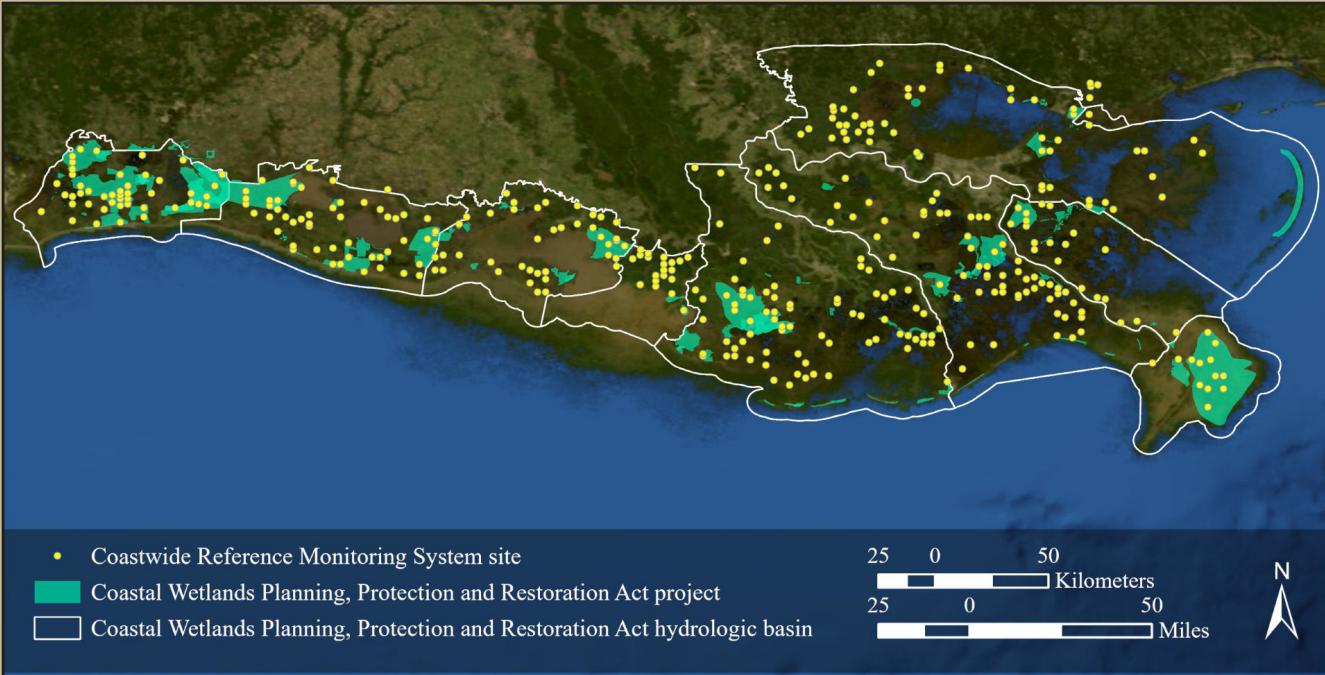


FIGURE 1.

Many data collection techniques are used at individual sampling stations within each CRMS site. Multiple methods are used to record hydrologic, soils, and vegetation data in the field.

**FIGURE 2.**

Approximately 390 sites across south Louisiana are part of the CRMS network.



## CRMS DESIGN & DATA COLLECTION

The CRMS network design includes a suite of sites distributed across all nine Louisiana coastal basins and all wetland types, including forested swamps and fresh, intermediate, brackish, and salt marshes. Approximately 390 sites are monitored using standardized data collection techniques (Figure 1) and fixed sampling schedules. CRMS sites are located throughout the nine CWPPRA hydrologic basins along the entire Louisiana coast, and sites can be found within and outside of CWPPRA coastal restoration and protection project boundaries (Figure 2). Comparisons of changing conditions are not limited to direct project influences, but can be made throughout the coastal zone. Coastwide comparisons are possible because CRMS is a reference network that enables assessment of ecological conditions at multiple spatial scales, thereby capturing ecological variability outside of project effects, such as hurricanes, drought, and floods.

Each CRMS site has a suite of data types collected, at multiple scales. Spatial analyses are conducted at the 1 km<sup>2</sup> scale, while on-the-ground ecological data are collected within a smaller 200 meter by 200 meter data collection area. At the 1 km<sup>2</sup> scale, high resolution aerial photography is used to calculate periodic land/water ratios to investigate land change trends through time. Within the 200 meter by 200 meter data collection area, data are collected in the field using standardized protocols at a series of stations including hydrologic, vegetation, accretion, and surface elevation (Table 1). The hydrologic station is generally in a bayou or water body near the boardwalk. The vegetation stations are located randomly on a transect line diagonally across the data collection area. The rod surface elevation table (RSET) and accretion stations are nested around a boardwalk.

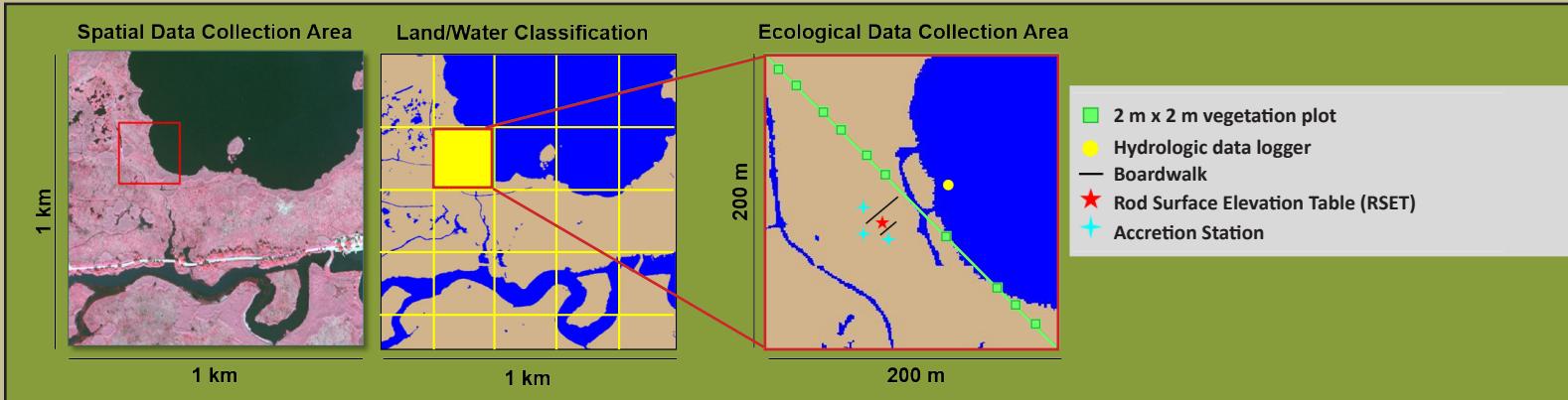
## DATA ACCESS

After the data undergo quality assurance and control procedures, data are approved and accepted into the Louisiana Coastal Protection and Restoration Authority's (CPRA) Coastal Information Management System (CIMS) database. Full data sets can be downloaded from CIMS at <https://cims.coastal.louisiana.gov/>.

Calculated or derived data (e.g., averages, marsh classification, elevations, elevation change rates, and CRMS indices) are hosted on the CRMS website at <https://lacoast.gov/crms/>. Information is analyzed and summarized in maps, charts, tables, graphs, and indices, and also incorporated into interactive report cards that are available for free online.

## KEY QUESTIONS ANSWERED BY CRMS

- Did the restoration project reduce coastal wetland loss?
- Did the restoration project sustain a diversity of vegetation types within the basin?
- Is the restoration project effective in reducing major stressors (e.g., flooding regime, salinity, elevation change)?



**FIGURE 3.**

Spatial data, including remotely sensed imagery, are analyzed in a 1 km x 1 km area at each CRMS site. Ecological data collection occurs within a 200m x 200m area, including accretion, RSET, vegetation, and hydrologic data collection stations.

## CRMS REPORT CARD

CRMS data feed into interpretation tools that can be used to assess the condition of individual CRMS sites, coastal restoration projects, hydrologic basins, and the entire Louisiana coast. Analytical teams, made up of agency and academic personnel, use CRMS data to develop indices for ecological assessments. These data are summarized for each year (2006 to present) in a “Report Card,” which creates charts and graphs for these indices as the data become available.

Each index helps assess a particular aspect of the coastal wetland ecosystem:

- Floristic Quality Index (FQI):** Used to determine wetland quality based on plant species composition.
- Vegetation Volume Index (VVI):** Quantifies the three-dimensional vegetative structure regardless of vegetation species.
- Hydrologic Index (HI):** Assesses the suitability of average salinity and percent time flooded in maximizing vegetation primary productivity.
- Landscape Aggregation Index (LAI):** Quantifies the configuration and aggregation of wetland habitats within the defined area, which is used to determine spatial integrity.

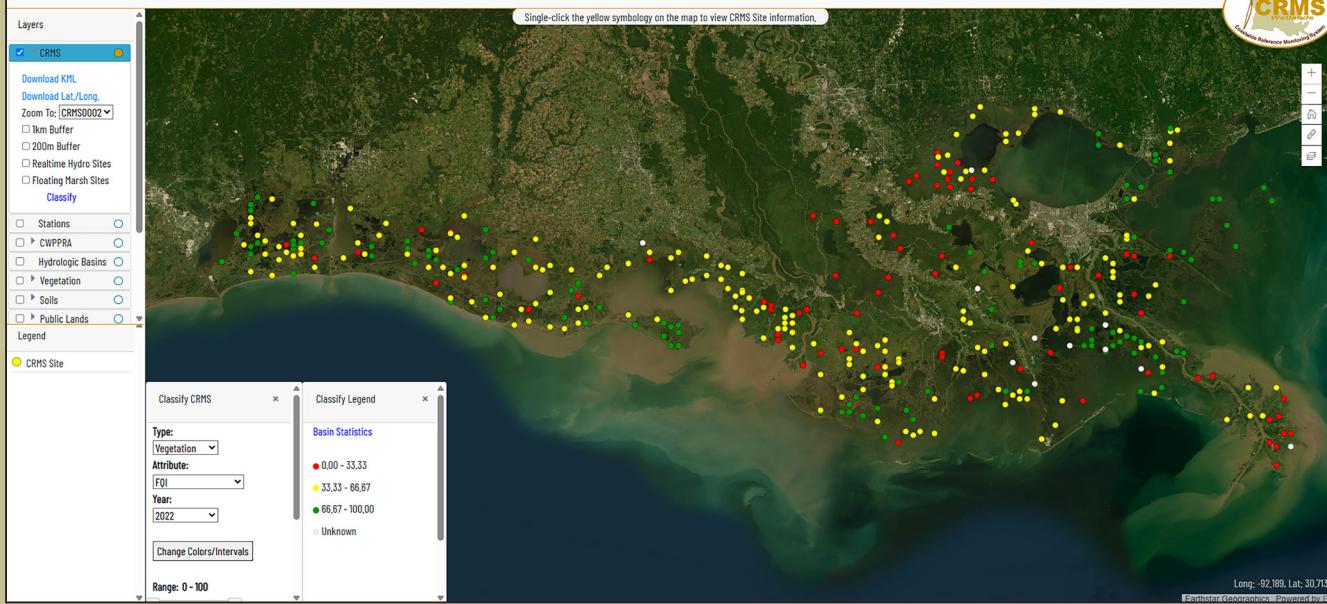
## AVAILABLE DATA TYPES

**Table 1.** Description of the data types collected at each CRMS site.

Data Type	Parameter	Method	Scale	Frequency
<b>Land Change</b>	Land: Water Ratio	Satellite Imagery	Hydrologic Basin	4 years
	Land: Water Ratio	Digital Aerial Photography	CRMS Site (1 km <sup>2</sup> )	3 years
<b>Vegetation</b>	Emergent Vegetation	Braun Blanquet: % Cover, Species Richness, Height of Dominant Species	Ten 2 m x 2 m plots per marsh site or nine plots per swamp site	Annually during peak biomass
	Forested Vegetation	DBH, Canopy Cover, Understory Vegetation	Three 20 m x 20 m forested plots	3 years during peak biomass
<b>Soils</b>	Aboveground Biomass	Live and dead biomass, stem counts, stem height, stem diameter, and total C, N & P of leaf material	Three 0.25 m <sup>2</sup> clip plot	Every 5 years at select CRMS sites
	Soil Characteristics	Soil profile of bulk density, OM%, soil salinity, pH, and moisture	Three cores, 18 archived samples per site	6 to 10 years
<b>Hydrology</b>	Soil Nutrients	Soil profile of total C, N, & P of sediment	Three cores, 4cm increments to 24cm	Every 5 years at select CRMS sites
	Belowground Biomass	Profile of live and dead biomass	Three cores, 8cm increments to 24cm	Every 5 years at select CRMS sites
	Vertical Accretion	Feldspar Plots/Cryogenic Cores	Three plots per plot set, multiple plot sets per site	Twice/yr 2006-2020, Once/yr after 2020
	Marsh Elevation Change	Rod Surface Elevation Table (RSET)	Four directions per site	Twice/yr 2006-2020, Once/yr after 2020
	Soil Porewater	10 and 30 cm syringe sippers	Three samples per depth per site and at vegetation plots	Variable at boardwalk, and annually at veg plots
	Surface Water Salinity, Temperature, and Water Level	Submersible Data Logger	In available water within 200 m of CRMS site or in a well	Hourly

**FIGURE 4.**

The CRMS website contains useful data visualization tools, including the ability to map Floristic Quality Index (FQI) scores at CRMS sites across the coast.

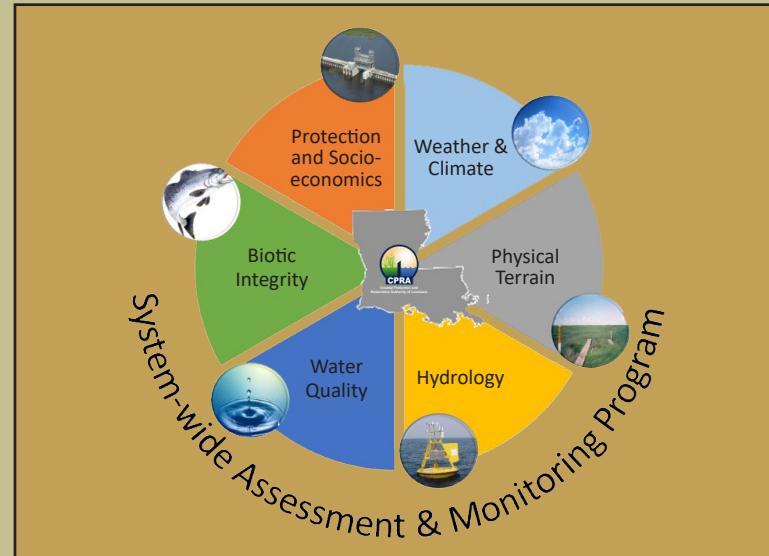


By comparing indices at various temporal and spatial scales, managers can understand the overall condition of coastal wetlands at an individual site or for the entire coastal zone (Figure 4). For detailed descriptions of each data type, indices, reports, and data descriptions, visit the CRMS website (<https://www.lacoast.gov/crms>).

## FUTURE OF CRMS

With over 18 years of long-term data collection, CRMS data are crucial for evaluation and assessment of CWPPRA's restoration and protection efforts. CRMS data are also used to determine the ecological conditions of coastal wetlands in support of [Louisiana's Coastal Master Plan](#), the overall guiding document for coastal restoration and protection efforts. CRMS is also a vital element of the System-Wide Assessment and Monitoring Program (SWAMP), a multi-part comprehensive network of coastal data collection activities integrated to support the development, implementation, and adaptive management of Louisiana's coastal protection and restoration programs (Figure 5.) SWAMP also supports Louisiana's Coastal Master Plan tools, informs adaptive management, and evaluates project effectiveness, socio-economics, and risk reduction. The Deepwater Horizon Natural Resources Damage Assessment ([DWH-NRDA](#)), [RESTORE](#) Act program, and projects funded through the [Gulf Environmental Benefit Fund](#) also use CRMS data for monitoring and adaptive management plans.

The CRMS program is as dynamic as the coastal habitats it monitors. The program continues to evolve by developing new products and analysis tools to improve project planning and implementation, and to support the evaluation of restoration actions. In addition to the integral role CRMS plays for CWPPRA project planning and evaluation, CRMS data are leveraged to support adaptive management, future scenario modeling, and a wide range of scientific research.

**FIGURE 5.**

The SWAMP data network leverages data from a variety of sources, including the CRMS program.

## FOR MORE INFORMATION, PLEASE CONTACT:



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