Coastal Assessment and Restoration

Geosyntec has a wide range of expertise in coastal assessment and restoration. Our staff is experienced in taking coastal restoration sites from concept phase, with pre-restoration monitoring and feasibility studies, to development of final restoration designs, construction oversight and post-construction monitoring.

Geosyntec engineers and scientists have the broad range of technical training and practical experience required for assessment of coastal ecosystem health. Our expertise includes coastal ecology, water quantity and quality monitoring, collection of tidal hydrology data and development of hydraulic models to assess tidally restricted coastal environments and potential restoration alternatives. Geosyntec develops restoration plans and implements cost-effective engineering designs including geotechnical investigation, design for culverts and appurtenances, technical specifications and bid documents, construction oversight and post-construction monitoring and restoration assessment.

Geosyntec's coastal assessment and restoration services include:

- Restoration feasibility studies
- Restoration design, mitigation and alternatives analysis
- Coastal resource area delineation and mapping
- Coastal dredging and sediment remediation
- Tidal hydrology monitoring and site assessments
- Hydraulic modeling
- Climate change modeling and assessment
- Geotechnical evaluations
- Preparation of technical specifications, bid documents
- Construction oversight
Project Summaries

**Eagle Neck Creek Salt Marsh Restoration**

Tidal flows to Eagle Neck Creek have been restricted by an undersized road culvert, resulting in loss and degradation of salt marsh habitat. Geosyntec was selected by the Cape Cod Conservation District to conduct ecological investigations, tidal monitoring and modeling to determine optimal culvert sizing for restoration of tidal flows to the Eagle Neck Creek marsh. The primary goal of the feasibility study was to collect tidal data, including water level and salinity, and create a 2-dimensional hydrologic/hydraulic model to simulate water surface elevations for various culvert sizes.

Geosyntec installed water level transducers and salinity meters within the marsh and surrounding area. We also mapped natural community types and investigated the presence of rare/endangered species. Using LIDAR survey and a topographic survey, Geosyntec developed a baseline map of the marsh, used to build a model geometry of the marsh system. Geosyntec generated a 2-dimensional hydraulic/hydrologic model using RMA2/RMA4. The model was used to evaluate three proposed culvert sizes and their associated water surface elevations based on spring high tide, a 100-year storm-driven high tide and high tide associated with sea level rise due to climate change predictions. Geosyntec provided maps and videos depicting the salinity intrusion plume and water elevation for each high tide condition. For each restoration scenario, we assessed potential impacts to fish passage, low-lying properties, wells and septic systems. Geosyntec provided recommendations on restoration options for Eagle Neck Creek to (1) allow for the water elevation upstream and downstream of Old County Road to represent an unrestricted state and (2) provide maximum salt water intrusion.

**Gulf Oil Spill Response – Marsh Protection System Planning and Design**

In the weeks following the of the explosion of the Deepwater Horizon and catastrophic oil spill in the Gulf of Mexico in April of 2010, Geosyntec provided the Northwest Florida Water Management District with the assessment and design of an integrated March Protection System (MPS) to provide protection for highest priority (“first tier”) sensitive coastal wetlands owned by the District. These lands are located in the Perdido and Pensacola Bay ecosystems in Escambia and Santa Rosa Counties, Florida. The bayfront portions of NWFWM’s first tier coastal lands within these systems include 4,019 acres and 9.4 miles of shoreline.

As part of the emergency response to the oil spill, Geosyntec conducted an extensive shoreline reconnaissance and developed a comprehensive MPS Plan for the NWFWM in July 2010. The MSP Plan provided for a multi-line defense initiative at each of the four “priority one” marsh areas owned by the NWFWM. The Plan also included a detailed implementation strategy and cost evaluation for the various shoreline protection system designs. The overall objective of the MSP Plan was to: (i) develop shoreline and tidal creek/inlet protection strategies and recommend corresponding materials which can be readily obtained and deployed to defend these sensitive areas; and (ii) develop a plan for the timely procurement and rapid deployment of these protective strategies. The primary, secondary and tertiary diversion/deflection, barrier and collection defense systems were designed by Geosyntec to divert or otherwise capture oil sheen, oil slick, weathered oil (tar balls), emulsified oil (either floating on the surface or dispersed within the shallow water column) and oil-impacted flotsam that may pass through this first line boom defense. The multi-layered MPS utilized proven oil diversion/deflection principals combined with the innovative use of highly effective hydrophilic geosynthetic materials (i.e., material which collect or otherwise retain oil while allowing water to pass) to provide oil barrier protection.
Terry Creek Dredging and Sediment Remediation

The Terry Creek Dredge site is located in coastal Georgia and consists of three disposal areas and an outfall ditch. The U.S. Army Corps of Engineers (USACE) has been involved in dredging Terry and Dupree Creeks since 1938, and the dredged sediments were determined to be contaminated with toxaphene. The largest disposal area used by the USACE is 72 acres. The impoundment construction was such that sediment and water were disposed directly into the spoil area, and as the solids settled out of the dredge slurry, water was allowed to drain out of three weirs and back into Terry and Dupree Creeks.

Geosyntec prepared and implemented work plans for creek sediment, marsh and outfall ditch sampling. Geosyntec evaluated dredging options and prepared a work plan, design, and bid packages for the removal of impacted sediment in Terry Creek, Dupree Creek and an outfall ditch. Our design included steel sheetpile, sediment excavation/dredging, and sediment dewatering/stabilization for off-site disposal. Remedial construction using wet dredging, monitoring, and the use of floating turbidity curtains to address sediment was completed in several months. Geosyntec provided construction management/quality assurance and GIS data management services to support the remedial construction activities.

Massachusetts Estuary Assessment and Delineation Project

Geosyntec was selected by the Massachusetts Bays Program (MBP) to evaluate the condition of 43 estuaries watersheds on the Massachusetts coast. The project consists of watershed delineation, data collection, and classification of each watershed based on MBP management priorities. The delineation process includes standard delineation methods and adjustment of boundaries based on the seaward extent of estuarine resources and the landward head-of-tide. Statistics for each watershed will be calculated for factors such as population, impervious cover, land use, wastewater discharge, stream continuity, estuarine habitat for shellfish and shorebirds, seagrass beds, tidal flats, etc. The watersheds will be ranked based on estuarine resources and environmental stressors to allow for a comparative analysis which will aid in determining management priorities for each watershed. The results of this analysis will be used to update the MBP Comprehensive Conservation and Management Plan.

Bucks Creek Salt Marsh Restoration

Bucks Creek (Chatham, MA) previously flowed under Cranberry Lane through a degraded, 24” culvert. The culvert restricted tidal inundation of the upstream 5-acre salt marsh, leading to loss of salt marsh habitat and restricting passage of anadromous fish species. To restore the salt marsh, the Massachusetts Division of Ecological Restoration retained Geosyntec to develop a construction package and provide environmental permitting support for the culvert’s replacement with a 3 foot by 4 foot concrete box culvert. Permitting included a Massachusetts Wetlands Protection Act Notice of Intent, U.S. Army Corps of Engineers Section 404, MEPA Environmental Notification Form, Section 401 Water Quality Certification and Chapter 91 Waterways License. We developed construction plans for the culvert replacement which allowed DER to put the project out for public bid. Geosyntec produced a construction phase Erosion and Sediment Control Plan and “water handling plan” to specify flow management in the creek during construction. Geosyntec also provided construction management services to ensure proper project implementation and installed water level transducers to assess post-construction restoration results.
Laguna Creek Bacteria Source Tracking Study

The City of Santa Barbara selected Geosyntec to conduct a bacteria source tracking study for the Laguna Creek. This project is part of the City’s efforts to address dry weather sources of Fecal Indicator Bacteria (FIB) and human fecal contamination at its beaches. The City had previously identified ozone disinfection at the Laguna Channel outlet as an option for reducing pathogen concentrations in dry weather runoff that discharges to the Pacific Ocean at East Beach, which is a 303(d)-listed impaired water body for bacteria. Geosyntec’s tasks project included (1) reconnaissance of the channel and storm drain network to identify sources of dry weather flow and human fecal contamination, followed by installation of automated gauges to measure flow; (2) monitoring of FIB and human bacteroides marker (HBM), followed by estimation of FIB/HBM loads from the watershed; and (3) a cost/feasibility evaluation of dry weather flow treatment alternatives, including diversion to sewer and UV/ozone disinfection and source control recommendations.

Mill Pond Tidal Assessment Project

Geosyntec was selected by the Massachusetts Division of Ecological Restoration to assess tidal hydrology at locations upstream and downstream of Mill Pond Road in Truro, MA. Mill Pond Road crosses a tidal channel that connects flow from the Pamet Harbor to Mill Pond. The channel flows under the road via a 3-foot corrugated plastic culvert. There is evidence that tidal flow into Mill Pond is restricted by the culvert, including impacts to vegetation and major scouring basins/erosion on both sides of the culvert. This project involved the deployment of continuous data-logging water level transducers, to assess restoration or restoration potential at site. The gauges were deployed to collect continuous tide data at 6-minute intervals with time and date stamps for 14 days. Geosyntec prepared an assessment of the tide data for the site, including tidal hydrographs, and presented the findings at a public meeting to discuss potential future restoration along Mill Pond Road including increasing the culvert size.

Elba Island - Design of Dredged Ship Turning Basin

The Southern Liquid Natural Gas Company (SLNG) needed to reopen its liquefied natural gas terminal and ship off-loading facility at Elba Island in Savannah Harbor. To improve navigation safety and maneuverability in the harbor, a 1500-ft by 2300-ft ship turning basin was constructed opposite the mooring and off-loading pier. The new turning basin also required the relocation of approximately 2,500 ft of a dredged material containment area (DMCA) dike on the South Carolina side of the river.

For the ship turning basin, Geosyntec prepared construction plans and technical specifications for the dredging of approximately 1 million cubic yards of maintenance sediments and approximately 3 million cubic yards of new work materials. The design included over 4,500 ft of shore protection to control erosion for extreme tidal fluctuations and 15-knot container ship traffic. The shore protection consisted of a graded filter capped by armor stone. The location of the turning basin required relocation of a containment area dike more than 200 ft into an adjacent DMCA. Geosyntec performed a geotechnical investigation and select material sampling. Stability analyses indicated ground improvement was necessary in the soft marsh and dredged soils to assure continued performance of the relocated shoreline. During dredging and construction, Geosyntec provided construction management and quality assurance activities for SLNG. The services included construction monitoring, materials testing, dredged quantity verification, and permit compliance monitoring.
Boat Meadow Creek Salt Marsh Restoration
Geosyntec conducted an engineering design and permitting project for the Massachusetts Office of Coastal Zone Management, to evaluate options for restoration of the Boat Meadow Creek Salt Marsh in Eastham. Boat Meadow Creek is a tidal stream extending from Cape Cod Bay into the extensive salt marshes of the Cape's North Shore. Tidal flow and drainage in the creek is affected by two crossings in Eastham, the Cape Cod Rail Trail and Smith Lane. Geosyntec conducted an existing conditions/wetlands survey, a feasibility study including hydrologic modeling, developed a draft restoration plan, and provided permitting services and related technical assistance.

Ballard Street Salt Marsh Restoration
Geosyntec was selected by the Massachusetts Division of Ecological Restoration to provide engineering, ecological and permitting services for the Ballard Street Salt Marsh Restoration Project. Geosyntec has been advancing this restoration project in phases since 2004, including wetland regulatory support, sediment sampling for development of specifications for dredging and dewatering, and development of construction cost estimates. The most recent phase includes (1) wetland delineation, (2) development of permit-level design plans for a culvert enlargement and tide gate to restore tidal flushing to a historic salt marsh that has become dominated by Phragmites, (3) development of permit-level designs for restoration dredging of an approximate 18-acre area upstream of the culvert enlargement, and (4) preparation of permit applications for the proposed dredging and tide gate/culvert installation.

Santa Ana River Marsh - Sediment Sampling and Remediation
Geosyntec performed a remedial investigation and design at the Santa Ana River Marsh for the U.S. Army Corps of Engineers in preparation of dredging to widen the Santa Ana River and restoration of the marsh. The work included soil/sediment sampling for hydrocarbons, chlorinated compounds, pesticides, metals, and PCBs. Samples were generally collected using a specially designed and constructed piston sampler. Many samples were collected below the water by wading or from a boat in tidally-influenced channels in the wetlands. Geosyntec then compiled and analyzed the sampling and chemical data to define areas of concern at the site. Geosyntec defined action levels for petroleum hydrocarbon based on potential ecological impacts. Geosyntec also developed a remedial plan which included excavation of impacted material, on-site soil and sediment consolidation, and capping of impacted materials. The remediation plan was integrated with the wetland restoration project to reduce overall project cost and disturbance of the environment due to remediation activities. Geosyntec also designed habitat features for the California Least Tern. The remediation and restoration of 91 acres of the Santa Ana River Marsh is now complete and the area provides a vibrant wetland habitat for many types of wildlife.

Multi-site Tidal Assessment Project
Geosyntec was selected by the Massachusetts Division of Ecological Restoration to assess tidal hydrology at locations upstream and downstream of five restoration projects. This project involved deployment of continuous data-logging pressure-transducer tide-gauges. To assess restoration potential at the sites, the gauges were deployed to collect continuous tide data at 6-minute intervals with time and date stamps for 28 days spanning a monthly spring tide. Geosyntec prepared
an assessment of the tide data for each site, including tidal hydrographs, and a discussion of post-construction tidal hydrology, water quality and modeling information for the pre-construction condition. Geosyntec also provided recommendations for adaptive management/improvements that can be made at each site. For pre-construction sites, Geosyntec summarized the existing tidal hydrology and included information on the severity of the restriction.

Salt Marsh Assessment and Restoration Tool – SMART Project
Geosyntec, in partnership with the Wells National Estuary Research Reserve, Brown University and Massachusetts CZM, was awarded a research grant from the UNH/NOAA Cooperative program to evaluate several innovative technologies for salt marsh restoration. The SMART (Salt Marsh Assessment and Restoration Tool) project used remote sensing and modeling software for achieving restoration planning by coastal managers. The project approach included: 1) hyperspectral imagery analysis as an aerial-based source of spatial vegetation distribution, 2) light detection and ranging (LiDAR) data as a remote source of high-resolution elevation data, 3) storm water management modeling (SWMM) for hydrologic simulation of complex restoration designs, and 4) ESRI ArcGIS version 9 with a Visual Basic (VB) delivery platform for SMART predictive ecology and visualization. Remotely-sensed data sources and detailed hydrologic simulations were integrated with existing program logic of the Konisky restoration model to provide a state-of-the-art system for regional restoration managers.

Mayo Creek Salt Marsh Assessment
The Mayo Creek Salt Marsh, which is connected to Wellfleet Harbor by a single 2-foot diameter culvert under Commercial Street, is a degraded salt marsh system. The culvert is equipped with a duckbill valve that prevents incoming tides from entering the former tidal creek and restricts tidal exchange. The elevation of the culvert combined with the unidirectional influence of the duckbill valve has reduced the tidal range as well as the mean water level in the creek to such a degree that normal tidal inundation of the surrounding marsh area no longer occurs. Geosyntec assessed tidal hydrology at locations upstream and downstream of Commercial Street by deployment of continuous data-logging pressure-transducer tide-gauges. The gauges collected continuous tide data at 6-minute intervals with time and date stamps for 28 days. Geosyntec analyzed the tide data for the site, including tidal hydrographs, and developed an alternative tide gate to allow additional tidal flushing.

Oak Island Salt Marsh, Self-Regulating Tidegate Operation
Geosyntec was contracted by Massachusetts CZM/WRP to create an Operation and Maintenance Plan for a self-regulating tide gate (SRT) at the Oak Island Marsh. As part of this plan, we evaluated marsh inundation elevations to provide maximum flood protection for local homes while also maintaining the goal of salt marsh restoration. Geosyntec conducted an innovative modeling and visualization approach to provide the needed information for the tide gate’s operation required by the tide gate managers, as well as an important public information tool to educate local property owners.
Little Namskaket Salt Marsh Restoration

In support of the feasibility design and associated permitting of a salt marsh restoration project for the Massachusetts Office of Coastal Zone Management, Geosyntec performed field reconnaissance to conduct an existing conditions survey. This effort included detailed wetland resources boundary mapping, elevation verification of marsh and surrounding topography, location of nearby utilities, and other field efforts. Geosyntec also developed a continuous simulation hydrologic and hydraulic model based on the EPA Stormwater Management Model (SWMM) to provide time series data for parameters such as water surface elevations, flow rates, and velocities within modeled natural channel sections.

Town Creek Marsh Restoration

Geosyntec was contracted by the Massachusetts Office of Coastal Zone Management to perform the data collection and mapping necessary to support future modeling and design of restoration options for Town Creek Marsh. Geosyntec evaluated marsh inundation elevations and salinity to aid in the determination of the extents of the marsh capable of supporting a salt marsh ecosystem. We created base maps using high resolution aerial imagery and we assessed salinity concentrations in this tidal marsh.