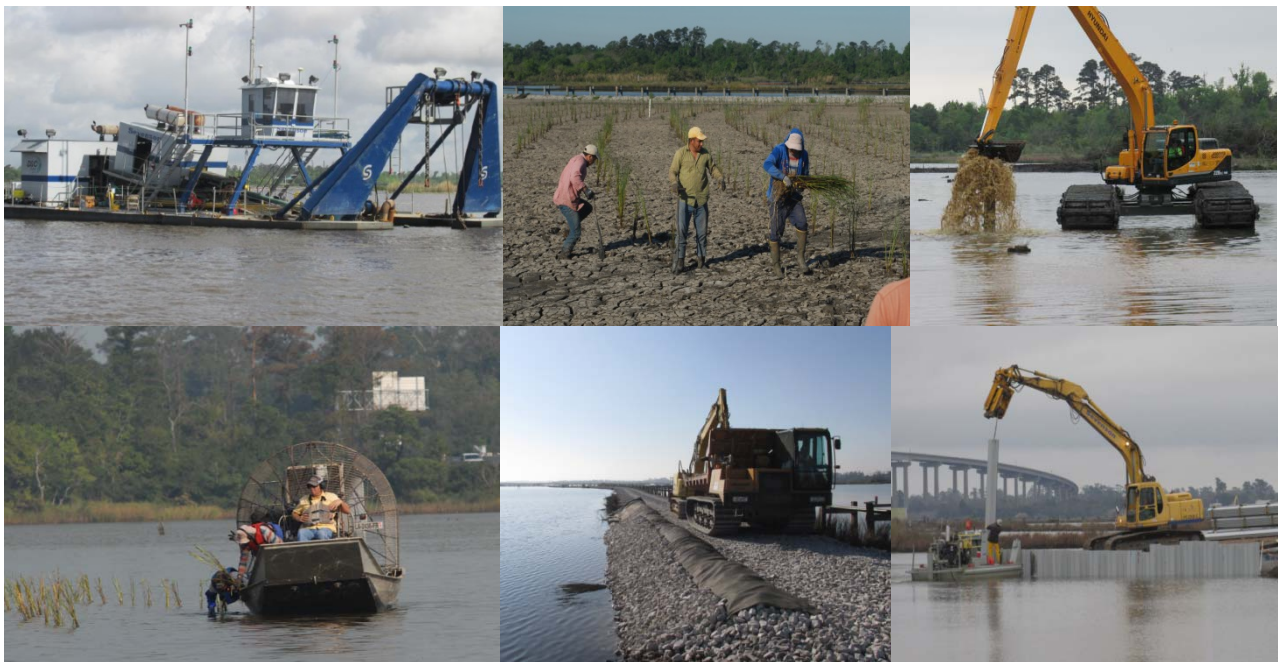


**2016 World Organization of Dredging Associations
Environmental Excellence Award – Environmental Dredging**

**Bayou D’Inde (Area B)/Lower Canal Sediment
Remediation Project
Lake Charles, Louisiana**



Sevenson Environmental Services, Inc.
2749 Lockport Road
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SUMMARY

Eagle US 2 LLC (Eagle) operates an industrial facility located approximately 2.5 miles west of Lake Charles in Calcasieu Parish in southwestern Louisiana. The plant is located on the west bank of the Coon Island Reach of the Calcasieu River Ship Channel and north of Bayou d'Inde. The facility has operated since 1947 and currently manufactures a variety of chemical products including chlorine, chlorinated hydrocarbons, and caustic soda. The plant used a canal to convey noncontact cooling water, treated process wastewater, and stormwater from the plant site to Bayou d'Inde. Historical plant operations, as well as operations from neighboring facilities, impacted the sediments of Bayou d'Inde, the canal, and adjacent former marshlands. The former marshlands, which have subsided due to historical channelization of the Calcasieu River and regional oil and gas production, have been areas of shallow open water for several decades.



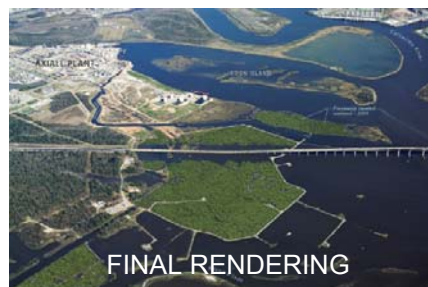
Eagle entered into a cooperative agreement with the State of Louisiana Department of Environmental Quality (LDEQ), as well as the owners of two neighboring facilities, to address the impacts to Bayou d'Inde and the former marshlands. The cooperative agreement has the following requirements:

1. Remove approximately 95,000 cubic yards of impacted sediment from Bayou d'Inde.
2. Provide an in situ cover of a minimum of 6 inches of clean sediment over the impacted sediments in fringe marshes adjacent to Bayou d'Inde and over portions of Lockport Marsh to the east of Bayou d'Inde.



Under the terms of a permit issued by LDEQ, Eagle was also required to place an in situ cap of a minimum of 12 inches of clean sediment over the impacted sediment in the canal.

The selected remedy for Bayou d'Inde dovetailed the removal of the impacted sediments from the bayou with the placement of clean cover in a contained area of Lockport Marsh. The design included hydraulic dredging and placement of unimpacted sediments from essential plant maintenance of berthing and other facilities as well as other nearby areas to provide the required sediment cap and cover fill. The design far exceeded the requirements of the cooperative agreement by providing enough sediment that these areas could be restored to an elevation that would sustain a wetland/marsh environment. Under an agreement between Eagle and the Lake Charles Harbor and Terminal District (Port of Lake Charles, POLC), sediment dredged for the development of a bulk terminal expansion were also beneficially used to provide the cap and cover fill as well as the additional sediment needed for wetland restoration.



Critical to the sequencing of activities was the preparation of 200 Acres to accept dredged sediments. To contain the dredged material, Severson constructed temporary berms with a pontoon excavator (side-casted sediment), installed over 700 linear feet of permanent steel and vinyl sheet piling, and increased the elevation of existing roads.

This work removed impacted sediment from local waterways and consolidated the material in an impacted area of Lockport Marsh before the final clean sediment cover remedy was implemented in Lockport Marsh. The clean fill, berms and sheeting were used to restore a tidal marsh that had degraded over time due to subsidence, sea level rise, and storm impacts. Planting wetland vegetation is underway, and additional wetland restoration is beginning in Lockport Marsh, beneficially using unimpacted sediment from another development project.

PROJECT TEAM MEMBERS

Owner – Eagle US 2

Bill Goulet
David Buford

Engineer of Record - CH2M Hill

George Hicks (WEDA Member)
Allen DuPont, P.E. (WEDA Member)
Dan Plomb, P.E.

Contractor – Severson Environmental Services, Inc.

Severson is a Corporate Sustaining Member
Mike Crystal (WEDA Member)
Tim Donegan, P.E. (WEDA Member)

Design Support and Construction Management – Anchor QEA

Anchor is a Corporate Sustaining Member
Wendell Mears (WEDA Member)
Rick Schwarz

Wetland Development Oversight – Stream Wetland Services

Dean Roberts

ENVIRONMENTAL BENEFITS

Approximately 40 percent of the coastal wetlands of the lower forty-eight states are located in Louisiana. Unfortunately, this fragile environment is disappearing at an alarming rate. Louisiana has lost up to 40 square miles of marsh per year for several decades, accounting for 80 percent of the nation's annual coastal wetland loss. To date, Louisiana has already lost coastal land area equal to the size of the state of Delaware. This loss is at an average rate of a football field every hour. If the current rate of loss is not slowed the Louisiana shoreline is expected to retreat inland as much as 33 miles in some areas by the year 2040 (Source <http://lacoast.gov/new/About/Default.aspx>).

Historical plant operations, as well as operations from neighboring facilities, impacted the sediments of Bayou d'Inde Channel, the Lower Canal, and some adjacent marshlands (Lockport Marsh). The health and environmental risk associated with the sediment in the Bayou d'Inde channel was low, but maintenance dredging had been deferred for many years because the sediment did not meet standards for management at existing confined disposal facilities.

Eagle, its partners in the Bayou d'Inde Group, and their consultants developed a remedial approach that consolidated impacted sediment from the Bayou d'Inde channel in a contained, impacted area of Lockport Marsh prior to placing a layer of unimpacted sediment to reduce ecological risk in the sediment to acceptable levels. The recommended remedy was approved by state and federal agencies, and Eagle further proposed to place additional clean sediment in areas of Lockport Marsh and the former canal to achieve the final grade needed to restore the wetlands.

Critical to the sequencing of activities was the preparation of the areas to accept dredged sediments. The four main objectives of the activities required include:

1. Contain the dredged material,
2. Manage/control the discharge water (inflow was limited to 5,500 GPM because of the size of the placement area)
3. Protect ecological receptors in the construction area, and
4. Maintain access to oil producing wells located in the interior of the Marsh.

These four objectives were met with close on-site and corporate oversight, detailed planning, adaptive management during inflow, construction of sheetpile walls, water control elements (such as weir boxes), increasing road elevations with geotextile and stone, and temporary containment berms.

Specifically, the activities performed onsite were:

- ▶ Install more than 875 LF of steel and vinyl sheeting to contain the material.
- ▶ Improve and raise 7,500 LF of existing stone roadways to contain materials within Lockport Marsh.
- ▶ Build more than 7,200 LF of sidecast berms to contain dredge materials during inflow.
- ▶ Install water control structures (spillways) to allow controlled discharge of slurry decant water to the surrounding waters.
- ▶ Hydraulically dredge 107,000 CY of impacted sediment from the Bayou d'Inde channel and Eagle's existing barge slip.
- ▶ Hydraulically dredge 162,200 CY of unimpacted sediment from Bayou d'Inde and Eagle facilities for sediment cap and cover fill.
- ▶ Hydraulically dredge 350,000 CY of unimpacted sediment from the POLC bulk terminal expansion for additional sediment cap and cover fill and for wetland restoration.

Stakeholder coordination was integral to the success of this project, including collaboration of state and federal regulatory agencies, community organizations, Eagle, and

Sevenson Environmental Services, Inc.



the POLC. Ultimately, Eagle combined several projects into one solution to remediate the site. The Figure below shows the site configuration, dredge locations and the marsh development locations.



INNOVATION

The success of the remediation project required flexibility from the contractor, daily coordination with the owner, and a dredging approach that maximized production while minimizing inflow velocity to the site that could scour and resuspend impacted sediments. The site also required precision dredging and cap/cover material placement.

Inflow Management

The discharge slurry from the dredges included substantial quantities of water, which required management in each marsh area to control the effluent entering the surrounding water bodies. Management of water within the areas was also necessary for equipment access, manipulating the flow of slurry from dredge discharge locations, and to facilitate settlement of suspended solids. Severson constructed and managed weirs to control the water elevation within, transfer between, and discharge out of individual areas. Within the placement areas, Severson developed a placement and monitoring plan that positioned, sequenced, shifted, and detailed equipment used to control the volumes of sediment slurry to be placed at each individual discharge locations. The placement plan also incorporated the site's natural elevations to provide positive drainage to exterior water control points (weirs).

Cap and Cover

The cap and cover were critical components to the project requiring both a minimum thickness (12" cap and 6" cover) over underlying sediments and target elevations for the placed surface to promote wetland development and ensure 100% coverage of minimum cap/cover thicknesses. The final grade of 85% of the area had to be within the +/- 6-inches of the specified elevation. The dredged sediments (with the exception of impacted sediments from Bayou d'Inde and the Eagle barge slip) were used for both cap and cover over existing sediment and the base fill (impacted sediments dredged from Bayou d'Inde and the barge slip and placed in Lockport Marsh before the placement of cover fill). Severson utilized various manifolds and inflow points coupled with rigorous hydrographic surveying and marsh fill area topographic surveys to monitor, assess, and control the placement of dredged sediments.



The manifolds were capable of splitting flow to reduce flow rates as required to reduce resuspension while also enabling even distribution of cap/cover materials. The discharge lines along the perimeter roads and within the placement areas were managed by a tracked excavator, operating on the stone roadway and a long front marsh excavator, respectively.

Hydraulic Sand Capping

Unlike other site areas, the easternmost fringe marsh required the placement of imported sand as the sediment cover fill. Severson's custom-built slurry system for hydraulic placement consisted of a feed hopper, oversized screening, and slurry system that pumped the sand hydraulically from land through a pipeline for placement through a diffuser affixed to a pontoon excavator. Sand was loaded into a hydraulic slurry bin where the sand is agitated and pumped to the placement area using a dredge booster pump.

The excavator swung the discharge pipe through the capping area at a fixed rate to place the capping material via the supplied slurry. Thickness was checked using hand coring techniques on the prescribed grid. The slurry rate was fixed to assist in even placement and at a rate not to resuspend existing sediment in the marsh.

ECONOMIC BENEFITS

Shoaling at the mouth of Bayou d'Inde Channel was an impediment to commercial navigation along the waterway that services approximately eight commercial terminals upriver of the project site requiring vessels to light load or wait for optimal tidal conditions. By taking advantage of the remedial action in Lockport Marsh and the option to securely contain sediment from Bayou d'Inde within the area subject to remedial action, Eagle was able to avoid the costs and obstacles to disposal, remove contaminated sediment from the bayou, restore the channel to its authorized depth increasing local commerce, and build up the marsh grade within the wetland restoration area.



The economic impact was also felt by the POLC. Axiall and the Lake Charles Harbor and Terminal District Board developed a cooperative agreement to share the costs of dredging the 350,000 CY of clean sediment from the bulk terminal expansion with beneficial use of the dredged sediment to

restore wetlands in Lockport Marsh. The POLC saved existing, limited CDF capacity, did not have to pay for a separate mobilization and demobilization of dredging equipment, and was part of a project that provided beneficial use of dredged material.

The economic impact will also be felt through the increased commerce at the POLC new terminal when it is complete and the additional staff needed for construction and operation of the facility.

TRANSFERABILITY

The success of this phase of the work has opened the door for future beneficial use projects in the area. The project has proven that impacted sediment can be dredged and spread over large acreages to tight elevation tolerances (\pm 6-inches).

Currently, Eagle is initiating a second phase of wetlands restoration, which will be performed using the same approach as the earlier project. The preparatory work includes raising roads and constructing sidecast levees, fabric/stone berms, and installation of water-control structures. The submerged areas will be filled with clean materials from another development project that will result in economic benefits to the Lake Charles area.



The equipment used for sand capping in Fringe Marsh 1 can be scaled to larger equipment and production rates. The sand capping placement approach can be used in shallow and deep water applications. The sand slurry system has been coupled with a sand spreader barge system on other projects with great success.

OUTREACH AND EDUCATION

Eagle, in cooperation with McNeese State University developed the *Naturelab* in 1995 as an idea generated by the Wildlife Habitat Committee at the Eagle Lake Charles Complex. This group of dedicated Eagle employees regularly volunteer their time and expertise to protect natural habitat areas and wildlife species at the Eagle Complex.

Eagle employees, on-site contractors, and dozens of volunteer educators and nature experts have helped to design and produce an outdoor classroom, nature trails and learning curricula for all age groups. The primary focus of *Naturelab* is to help the people of Southwest Louisiana, especially grade school students, learn more about the ecosystem and environment in which we all must live, work, and learn.

For the Marsh restoration project, Eagle developed a Community Action Panel (CAP) to keep the citizens informed of the project progress. The CAP team detailed the current conditions and routinely updated the citizens through progress meetings and mailings/flyers.