About Rockefeller Wildlife Refuge (RWR)

History and Origin of the Property

Only a year after purchasing and donating Marsh Island and State Wildlife refuges to the Conservation Commission of Louisiana, E.A. McIlhenny became interested in creating another wildlife refuge on a large tract of land located in western Vermilion and eastern Cameron Parishes totaling 86,000 acres (McIlhenny 1930). On July 12, 1913, he purchased the property for $212,500 using $27,500 cash and $185,000 of donated monies. On May 20, 1914 he sold the property to the Rockefeller Foundation for preservation and protection of migratory birds. Through the encouragement of McIlhenny, the Rockefeller Foundation agreed to allow the Conservation Commission of Louisiana to control the lands for a period of five years, and on September 25, 1914, the State formally accepted the care of the property. The property was donated to the State on December 18, 1919 and the State of Louisiana officially accepted the lands in 1920 thus creating the Rockefeller Wildlife Refuge.

During the early years, management practices at RWR consisted primarily of patrolling the area against poaching and trespassing, burning the marsh to encourage production of preferred goose and muskrat foods, and a trapping program aimed particularly at muskrats. RWR at this time was held to be self-supporting: that is, any funds needed for management or patrolling on the refuge had to be generated from within the refuge (Lynch 1942, cited in Wicker et al. 1983.) Thus, the sale of fur hides, especially those of the abundant muskrat, was an important source of revenue in the refuge's early history.

In addition to being "one of the most important wildlife areas in the United States", the refuge functions as a natural laboratory for research on "marsh management, plant ecology, pond culture and life history studies of the many forms of fish and wildlife found on the refuge" (Joanen 1969). The information gained in these research efforts "demonstrates what man can do to improve on nature to benefit wildlife" (Joanen 1969) and can serve as management guidelines for other state and Federal management areas, as well as private property owners.

Purpose/Need

The original purpose of RWR was to provide a sanctuary/preserve for wildlife and fisheries and there has been little deviation since then to this original vision. The refuge also serves as a research site for marsh management strategies (i.e., limiting saline encroachment, reversing marsh deterioration, and providing productive wildlife habitat), while also serving as a research site for wildlife/fisheries research by RWR staff and other governmental/academic agencies. RWR staff provides professional expertise for the implementation of international, federal, and state legislation and regulations governing wise use of alligators, coastal wetlands, and other important wildlife/fisheries resources. Further, management expertise and guidance is provided by RWR staff to local landowners of marshland. Lastly, RWR serves as a recreational outlet for local residents, as well as a destination for regional tourists.

Goals

Primary Goals

1. Based upon the original deed of donation, the primary goal of the RWR is to provide a refuge and preserve for all wildlife and fisheries species.

a. When possible, multiple use marsh management should be considered in order to provide habitat for waterfowl, shorebirds, wading birds, and estuarine organisms (i.e., fish, shrimp, and crabs).

b. Additional considerations should be given to establish and maintain the historical flora/fauna of RWR.

c. RWR should also contribute the maintenance of the Mermentau River Basin hydrology.

2. The deed also states that the refuge should study and improve wildlife foods, as well as study/remove the enemies to valuable wildlife species.

a. Research activity on RWR addresses pertinent biological questions related to marsh management, wildlife, or fisheries resources.

b. Research findings should also be disseminated (in publications or presentations) to local, state, national, and international audiences. Since 1955, RWR staff has contributed over 500 professional publications, reports, and professional conference abstracts to a wide range of audiences.

Secondary Goals (these goals should not supersede Goals 1 or 2)

3. The goal of public outreach with local landowners and/or state, federal, and international groups on legislation/regulation is to encourage best conservation/management practices for fish and wildlife species, as well as their habitats.

4. The goal of recreation is to provide a destination for recreational activities, primarily through the abundance of the fisheries resource (i.e., fishing, shrimping, crabbing; permitted by subsequent Deed Memorandum of Agreements) and the diversity of watchable wildlife (i.e., birdwatchers).

5. The goal of education is to actively engage in educational programs with local, regional, and statewide groups. This includes providing educational programs to local school groups, as well as continuing to host 4H Marsh Maneuvers at RWR.

Physical Description

Location.— Rockefeller Wildlife Refuge (RWR) lies within the southeastern portion of the Chenier Plain Region of southwestern Louisiana in Cameron/Vermilion Parishes (between approximately 92º54' E and 92º30' E longitude). RWR borders the Gulf of Mexico for 26.5 miles and extends inland toward the Grand Chenier ridge, a stranded beach ridge six miles from the Gulf. RWR is owned by the Louisiana Department of Wildlife and Fisheries (LDWF) and managed by the Coastal and Non-Game Resources Division. When it was deeded to the state in 1914, RWR encompassed approximately 86,000 acres. However, since then the property has lost approximately 14,000 acres (16.6% acreage loss) and currently stands near 72,650 acres; the loss of acreage is primarily due to shoreline/beach erosion. The refuge boundaries are very linear because the land was purchased by sections or portions thereof and some section boundaries serve as the refuge boundaries.

Regional Hydrology.— The Mermentau River Basin is divided into three sub-basins: the Upland Sub-basin (primarily agricultural lands), the Lakes Sub-basin (land between the Gulf

Intracoastal Waterway and LA Hwy 82, including Grand/White lakes), and the Chenier Sub-basin (south of Highway 82 to the Gulf of Mexico; Figure 1). RWR is located at the lower end of the Mermentau River Basin, within the Chenier Sub-Basin. The Lakes and Chenier Sub-basins encompass 722,367 acres of fresh, intermediate, brackish, and salt marsh, non-marsh/other, and water (Table 1).

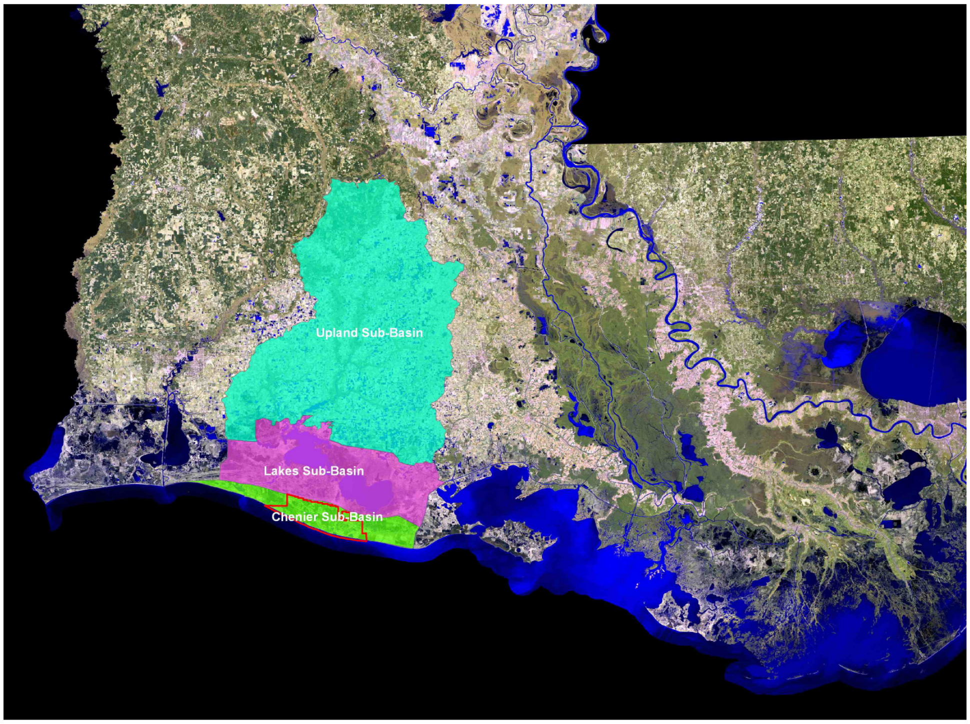

Figure 1: Mermentau River Sub-Basins.

Historically, drainage in the Mermentau River basin was achieved through two primary methods. The first was direct drainage of the basin uplands into the Lakes Sub-basin, and finally into the Chenier Sub-basin via the Mermentau River. The second method consisted primarily of water moving as sheet flow across the marsh in the lower sub-basins. This sheet flow would eventually find its way into the Gulf of Mexico via small tidal bayous and streams scattered through the Chenier Sub-basin. Prior to 1951, Gunter and Shell (1958) reported that Grand and White Lakes were low salinity estuaries.

Beginning early in the twentieth century, large scale human-induced hydrologic alterations began to alter hydrology of the entire region (Louisiana Coastal Wetlands Conservation and Restoration Task Force 2002). The first major alteration to this area's hydrology began in 1912 with the dredging of the Old Intracoastal Waterway, a navigational channel from Franklin, LA to the Mermentau River. Completed in 1924, the channel was dredged through both Grand and White Lakes thus connecting the two large lakes together. This event was the beginning of change for wetlands south of Grand/White Lakes to the Gulf of Mexico. Water began to flow east/west through the new canal rather than sheet flowing across the marsh in a southerly direction toward RWR. The dredging of a larger second navigational canal, the Gulf Intracoastal Waterway (GIWW), occurred between 1925-1944 and stretched from Brownsville, TX to Apalachicola, FL. Wicker et al. (1983) reported that the natural hydrologic regime was altered significantly with construction of the GIWW.

North/south water flow patterns continued to change with the dredging of the upper Mermentau River and its four major tributaries between 1915 and 1935. Dredging, channelization, and desnagging continued through the 1970's facilitating rapid transport of storm-water and agricultural runoff into the Lakes and Chenier sub-basins (Louisiana Coastal Wetlands Conservation and Restoration Task Force, 2002).

Table 1. Wetland and aquatic habitat acreage in the Mermentau Lakes and Chenier sub-basins (after Chabreck and Linscombe 1997).

Habitat type	Acres	Percent of total cover (%)
Fresh marsh	319,098	44
Intermediate marsh	141,656	20
Brackish marsh	60,359	8
Salt marsh	25,090	3
Non-marsh/other	55,627	8
Water	120,537	17
Total	722,367	100

The alterations to the Mermentau Basin have resulted in the necessity to implement marsh management strategies which involve levees and water control structures to maintain healthy marsh ecosystems. Three major water control structures were constructed beginning in the 1950's to complete the Mermentau Basin Project (Figure 2), with the objectives of: conserving fresh water by maintaining normal to above normal lake stages in Grand and White Lakes for agricultural purposes, preventing uncontrolled tidal inflow during the agriculture irrigation season (April through August), and maintaining minimum water levels for navigation (Bodin 1983). Periodically the gates are operated to benefit fish and wildlife (when not detrimental to other interests) and flood water evacuation. The three structures serving these purposes include Calcasieu Locks (1950), Catfish Point Control Structure (1951), and Schooner Bayou Control Structure (1951). Calcasieu Locks was constructed to prevent salt water intrusion from the west via the newly constructed ship channel dredged in the Calcasieu River. Catfish Point Lock was built to prevent uncontrolled tidal inflow from the south via the Mermentau River. The value of this particular structure was further realized following the dredging of the Mermentau River Ship Channel in 1971, which caused significant saltwater intrusion and interior marsh loss throughout this region. Schooner Bayou Lock was designed to prevent uncontrolled tidal inflow from the east via the Old Intracoastal Waterway by way of Vermilion Bay. Two additional control structures were added in later years (Figure 2), including the Freshwater Bayou Canal Lock (1968) and Leland Bowman Lock (1985). The former was built after construction of the Freshwater Bayou Navigation Channel and the latter was a replacement of the 1933 Old Vermilion Lock (Louisiana Coastal Wetlands Conservation and Restoration Task Force 2002). Presently all five control structures are operated in unison to maintain the Lakes Sub-basin as a freshwater reservoir to accommodate primarily agricultural (rice/crawfish farming) and navigation interests.

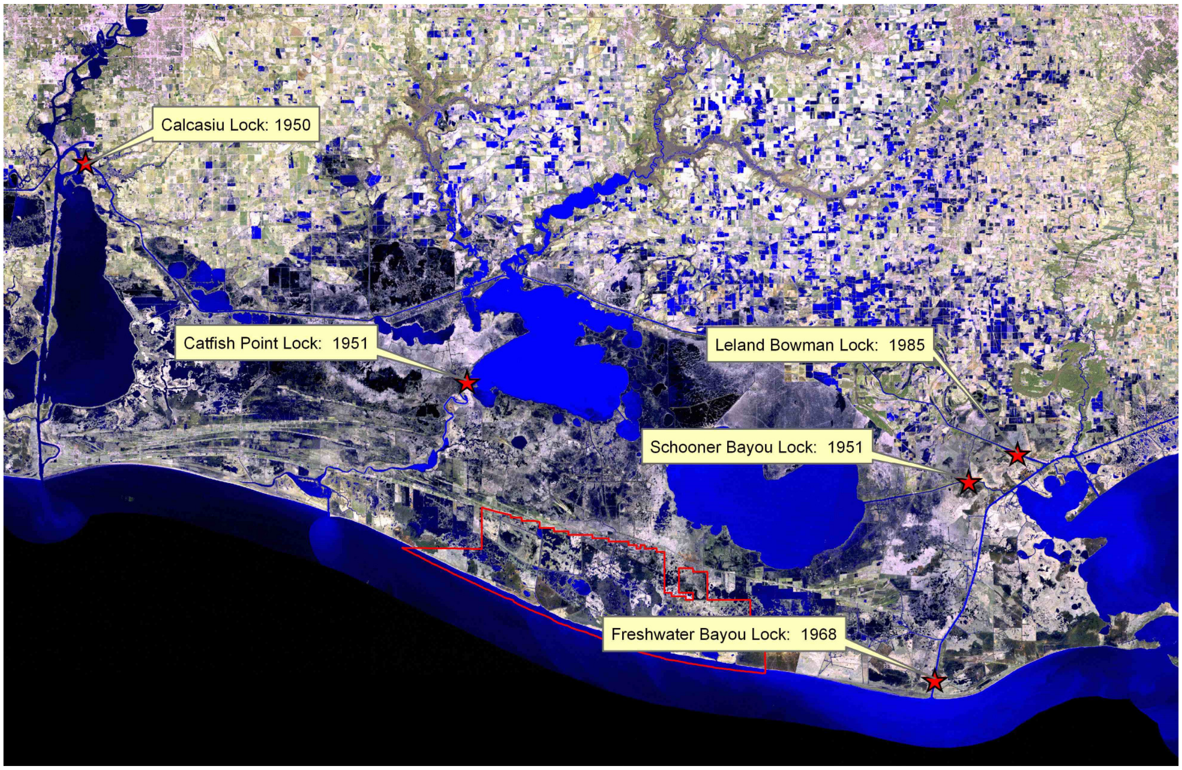

Figure 2: U.S. Army Corps of Engineers lock locations in the Mermentau River Basin.

Subsequent projects gradually segmented the wetlands and disrupted the natural flow of water, such as the construction of Highway 82 (which connected the Grand Chenier and Pecan Island ridges); the dredging of oil, gas, drainage and navigation canals; and the impounding of wetland areas through the deposition of spoil. In some areas, elevated water levels drowned existing vegetation and prohibited the reestablishment of vegetation that had been destroyed by other means such as eat-outs or fires. Canals that permitted rapid flooding of interior freshwater marshes with saltwater and rapid drainage of the natural freshwater that historically had remained in the marshes destroyed the freshwater environments. Brackish-to-saline marsh species have been slow to colonize the bare peat exposed in these former fresh-to-intermediate vegetation zones. The result has been a net loss in vegetation coverage.

Regional Geography, Chenier Formation, and Marsh Loss.—During the period of Mississippi River Delta progradation in the western portion of the Deltaic Plain, fine-grained sediments were transported west to the Chenier Plain by nearshore currents, and the shoreline prograded through the development of mud flats and coastal marsh deposits. When the Mississippi River shifted eastward, sediment supplies decreased and the gulfward progradation of the Chenier Plain slowed. In some instances, marine processes eroded the shoreline, creating beach ridges. This alternating progradation and erosion of the Chenier Plain was cyclic and resulted in a series of abandoned beach ridges, which mark ancient shorelines and stretch in an east-west direction roughly parallel to the coast (Gould and Morgan 1962).

One of the longest ridges is Grand Chenier, which extends eastward from the Mermentau River for approximately 45 miles and marks the northern boundary of the refuge. Like most ridges, this one is narrow (~ 400 yards wide) and seldom exceeds 10 ft in elevation (Russell and Howe 1935, cited in Wicker et al. 1983). Chenier "ridges" are very distinctive features on the landscape since they are interspersed among low-lying coastal marshlands. These ridges were historically dominated by coastal live oak-hackberry forests (*Quercus virginiana*, *Celtis laevigata*), but only small fragments of these forests remain (~2-10%, Lester et al. 2005) due to agricultural practices, including cattle grazing. The region is labeled Chenier Plain because of the prominence of the live oak (Gould and Morgan 1962), with "chene" being the French word for oak.

The geomorphology and meteorology of the Chenier Plain region influence the distribution of vegetative zones and distinguish it from the Deltaic Plain Region of coastal Louisiana (Wicker et al. 1983). Regional rainfall averaged approximately 52 inches per year. Historically, chenier ridges played a strategic role in the regional hydrology by restricting the movement of water to and from the Gulf of Mexico and the interior marshes (Chabreck 1972, Palmisano 1972). The well-defined beach rim, approximately 5 ft in elevation (Nichols 1959) and extending along the southern border of the RWR, restricts regular tidal inundation to the six tidal channels and one canal connecting interior marshes and the Gulf. Over the past 30 years, the number of channel openings to the Gulf has increased to a maximum of nine (due to canal dredging or shoreline erosion), but recent encroachment of vegetative growth in Big Constance Bayou/East Royalite Canal and a "sand plug" on Pigeon Bayou have closed these three tidal channels and one canal.

Wicker et al. (1983) extrapolated aerial measurements made for selected transects and reported a rate of marsh loss of approximately 192 ac per year between 1930 and 1974. During this period, the approximate rate of shoreline erosion along the entire refuge was 97 ac per year. This extreme loss was supported in a recent study in which the rate of shoreline loss averaged 28.5 ft. per year in the area of Rockefeller Wildlife Refuge (Byrnes et al. 1995). Natural processes contributing to land loss are marine and estuarine (i.e., wave) erosion, subsidence, waterfowl and muskrat eat-outs, and deep burns during droughts. The major man-made process contributing to land loss in the region is the alteration of the natural hydrologic regime in the absence of active wetland management.

Rockefeller Wildlife Refuge Geomorphology and Hydrology.—The marshes on the RWR occupy an elongated basin confined by the high Grand Chenier Ridge to the north and the lower sea rim beach to the south. Prior to major man-made landscape changes, freshwater reached this basin through precipitation and drainage from surrounding ridges, thus creating deep freshwater rush marshes near the chenier ridge. The rush marsh zone was vegetated primarily by bulrush (*Scirpus californicus*), giant cutgrass (*Zizaniopsis miliacea*), sawgrass (*Cladium mariscus*), and cattail (*Typha* sp.; Lynch 1942 cited in Wicker et al. 1983). Freshwater ponds in this zone contained various species of algae, frogsbit (*Limnobium spongia*), bladderwort (*Utricularia macrorhiza*), water pennywort (*Hydrocotyle sp.*), duckweeds (*Lemna* spp. and *Spirodela* spp.) and exotic water hyacinth (*Eichhornia crassipes*; Lynch 1942 cited in Wicker et al. 1983). Originally brackish (interior marsh zone) to saline (sea rim marsh zone) marshes occupied the lower two-thirds of the area which was drained by dendritic tidal channels. A series of low salinity marsh ponds were situated at the inland extremities of the tidal marsh and supported widgeongrass (*Ruppia maritima*; Lynch 1942 cited in Wicker et al. 1983). The brackish interior marshes were densely vegetated with leafy-three square (*Scirpus robustus*) and wiregrass (*Spartina patens*), while the sea rim marshes contained saltgrass (*Distichlis spicata*), hogcane (*Spartina cynosuroides*), iva (*Iva frutescens*), and oystergrass (*Spartina alterniflora*; Lynch 1942 cited in Wicker et al. 1983). The distribution of vegetation zones that constitute major wildlife habitat types on the refuge has been altered considerably over the past 40 years due to the management of areas via water control structures/levees (see Appendix 1 for more listing of plants).

The average elevation of the RWR marshes is approximately 0.8-1.0 ft. NAVD 88. Normal tides are contained within the channels and canals, and the amount of water covering the marsh is governed by weather conditions, primarily precipitation and wind direction (Nichols 1959). While the average tidal fluctuation in the area is 1 ft, extremely high tides associated with southerly winds from storms flood the interior marshes at least once or twice a year, bringing in marine mud and saltwater (Chabreck 1960, Lynch 1942 cited in Wicker et al. 1983). The introduction of saline mud creates a firmer marsh than is present in the Deltaic Plain because it prevents the formation of highly organic marsh peats (Lynch 1942 cited in Wicker et al. 1983). Creation of leveed impoundments on the refuge (beginning in 1954) has restricted, to some degree, the input of saline water and mud to only the unimpounded areas nearest the gulf (Chabreck 1960). However, extreme high water can overtop or even break the levees, and cause the impounded areas to be subjected to higher salinities than are desirable under the management program. During periods of drought or prolonged northerly winds, which cause low winter tides, the marsh is subject to extreme low water. Extended low-water periods expose the marsh to the threat of fire, with the possibility of intense peat fires that create new lakes at the cost of loss of vegetated marshlands.

Regional and local hydrology changes caused by navigation, drainage, and mineral development projects have necessitated and influenced marsh management strategies employed on RWR. In 1940 the Humble Canal was dredged from the East End Headquarters to the mouth of Joseph Harbor Bayou to facilitate oil and gas exploration. This event allowed the beginning of saltwater intrusion into the interior brackish and intermediate marshes of RWR. In 1953, the dredging of the Union Producing Canal permanently changed the hydrology in the western half of the refuge (Nichols 1961). These actions along with drought conditions in 1948, 1951, and 1954 caused marsh die-offs and wildlife habitat deterioration (Wicker 1983).

Construction of the Superior Canal connecting Grand Lake with RWR began in 1951 to facilitate oil and gas exploration in that area (Nichols 1961). This event caused additional changes in regional water flow patterns when the canal breached Highway 82 allowing water from Grand Lake to flow directly into the central portion of RWR. Additional oilfield canals were constructed off the Superior Canal to allow mineral development on the refuge. This action permanently altered normal sheet flow patterns and changed regional hydrology by creating a direct link between the Chenier Sub-basin and the Lakes Sub-basin via the Superior Canal. Several years later, in 1954, a property line canal was dredged from the Superior Canal to the Humble Canal (Nichols 1961). This action allowed saltwater intrusion from the Gulf of Mexico into the Mermentau River Lakes Sub-basin via the Property Line Canal and Superior Canal. Because of this, RWR was forced by agricultural interests in the Upland Sub-basin to construct the East End Locks in 1961 at the intersection of the Property Line Canal and Humble Canal; this effectively stopped saltwater intrusion into the Mermentau Basin. The structure, which is still in operation, also allows the rapid release of floodwater from the region to the Gulf of Mexico (Louisiana Wildlife and Fisheries Commission [LWFC] 1962).

Active management was initiated on Rockefeller Refuge in the mid-1950s at a time when royalties from oil/gas operations on the refuge increased and habitat degradation from eat-outs, fires, saltwater intrusion and vegetation die-offs was approaching major proportions. Management operations, while founded on the best management principles of the time, were (and still are to some extent) experimental. Refuge personnel were instituting management plans based primarily on a system of leveed impoundments and water control structures to enhance wildlife habitat. By 1954, over 40 gated culverts were placed in levees constructed in strategic locations on the refuge for salinity control, with each individual impoundment created identified as a management unit. On June 27, 1957, Hurricane Audrey significantly damaged levees and water control structures. These were later repaired and additional management units were constructed with major improvements over time.

In 1961, a six mile levee was constructed from Deep Lake to the Property Line Levee south of Unit 13 creating the 13,500 acre Management Unit 6. Additionally, two large, radial-arm, three-gate water control structures were constructed on Big Constance and Little Constance bayous on the south end of the unit to prevent saltwater from entering the unit. A sheet pile dam was constructed across Dyson Bayou in 1962 to completely eliminate uncontrolled tidal flow into Unit 6 which serves as the southern boundary of the Mermentau Basin. The water control structures associated with this unit along with the East End Locks are key elements in controlling saltwater intrusion and flooding in the region (LWFC 1964).

Hydrologic alterations occurred in eastern portions of RWR when Rollover Bayou Channel was dredged from the Gulf of Mexico to Highway 82 in the 1950s. A large radial arm three gate water control structure was constructed on the lower end of Rollover Bayou in 1957 to control salt water intrusion. The structure was damaged by Hurricane Audrey and repaired in 1959 (LWFC 1960). Structure operation was discontinued in the 1960s due to local concerns over flooding of private property east of RWR. In 1963 an additional radial arm three gate structure was constructed on Middle Bayou west of Rollover Bayou to gain water level control and stop saltwater intrusion on 9,000 acres west of Rollover Bayou (LWFC 1964). Structure operation was also discontinued in the 1960s due to flooding concerns by the local community. Numerous Wakefield type weirs were constructed in this particular area of RWR in the 1960s to allow access for fur trapping, control water levels, stabilize water salinities, reduce water turbidity, and promote the growth of aquatic vegetation.

Hurricane Rita struck RWR on September 24, 2005 and caused extensive damage to levees and water control structures. However, repairs have been made to all the pumps and all management units currently have water level or water salinity control at this time except for Unit 15. In the fall of 2007, a five million dollar Coastal Wetlands Planning and Protection Act (CWPPRA) project entitled "Fresh Water Introduction South of Highway 82" was completed to remove excess water from the Mermentau Basin and provide additional fresh water to the southeast RWR tidal marsh. Four aluminum stop-log flap-gate structures were installed and Little Constance structure was automated with large aluminum flap-gates.

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