

Herbaceous Wetlands Reclamation

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About Mosaic Reclamation

> In carrying out its mission to help the world grow the food it needs, Mosaic couples recovery of phosphate resources with stewardship of the land that ultimately fuels thriving communities as well as American and global food production. While mining is a temporary use of the land, reclamation offers tremendous benefits for generations to come. In respecting this important balance, Mosaic continuously improves its reclamation practices to create sustainable habitats and other land use across the reclaimed landscapes.

Mosaic's dedicated team of reclamation scientists, engineers, ecologists and biologists develop detailed reclamation plans for the productive use of mined lands years before any phosphate is extracted from the ground. With Mosaic reclaiming every acre that it mines, the reclamation plans focus on connecting preserved and reclaimed habitats to create a diverse and sustainable habitat network that is integrated into the larger regional ecosystem.

All Things Considered

Reclaimed habitats include streams and their associated floodplains as well as connected and isolated wetland and upland natural habitats. These include unique



Some herbaceous wetlands are associated with littoral zones of lakes, providing water and cover for wildlife.

natural systems that are vital to the ecosystems of West Central Florida such as bay swamps and palmetto prairies. Reclamation also offers an opportunity to enhance lands that were drained or otherwise affected by development, agriculture, or other land uses years before mining ever began. Mosaic designs its reclamation plans from a holistic perspective. The plans are centered upon creating a diversity of habitats that provide wildlife a place to call home, and increase the sustainability of the broader regional ecosystem. <



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Supportive Function

➤ Wetlands support ecosystem diversity and sustainability by serving as valuable habitats for wildlife and providing for critical storage and purification of rainfall. Wetlands benefit the regional ecosystem by reducing flooding, keeping rivers flowing after the summer rains end and providing water for fish, other aquatic species, and wildlife.

Herbaceous wetlands are characterized by a large percentage of nonwoody plants, such as grasses, ferns and shrubs. A wide variety of herbaceous wetlands exists naturally, holding standing water between two and 12 months out of the year. Herbaceous wetlands can be isolated, meaning they have no surface drainage to streams or connection to the region's major rivers. These features provide water for wildlife that depend on the aquatic habitat, including endangered species such as wood storks.



A diversity of native herbaceous species may be found in reclaimed herbaceous wetlands. Isolated herbaceous wetlands provide breeding grounds for amphibians, such as gopher frogs, as it prevents fish from swimming upstream and eating the tadpoles.

Two examples of Mosaic's reclaimed herbaceous wetlands are North Fork Manatee-1 (NFM1), located in Manatee County, and Parker Branch, located in Polk County, Florida.

NFM1 is a mature stage reclaimed herbaceous wetland, which Mosaic established between 2001 and 2002. NFM1 consists of 517 acres of herbaceous marsh with three embedded lakes. In addition, an upland forest buffer was planted around the wetland. NFM1 was deemed self-sustaining by regulatory agencies less than 10 years after it was developed. Prior to mining, NFM1 was predominately agricultural lands, including row crop fields and cattle pastures. Small areas of wetlands existed on the site prior to mining.

The 2,000-acre Parker Branch reclamation site was constructed by Mosaic in 2010 and includes two large herbaceous wetlands totaling roughly 500 acres with mixed forested wetlands integrated into the overall system. The system is connected to land not mined near Parker Branch stream, which flows into Little Charlie Creek and into the Peace River. Before mining, the land consisted of a large forested wetland connected to other forested and herbaceous wetlands, isolated herbaceous wetlands, pine flatwoods and pasture. Currently, Mosaic is conducting vegetative and hydrological monitoring required to ultimately demonstrate the project meets permit success criteria and has become a fully functional wetland system. <

Advanced Design

> Mosaic’s firsthand knowledge of successful herbaceous wetland reclamation provides guidance about proper wetland depth, soil permeability, initial planting density, and early succession maintenance; all key components of the conceptual design process.

Over the past 30 years, the techniques used to develop conceptual designs for reclaimed wetlands have advanced significantly. Hydrologic modeling is one of the most advanced techniques. Once limited to two-dimensional surface water flow, wetland modeling now accounts for three-dimensional groundwater and surface water storage, flow and balance. This provides assurance the wetland will function as designed. In addition to hydrological modeling, improved methods of handling overburden and sand tailings, together with topsoil/ muck placement, help to sustain wetlands by providing the proper substrate soils to assure proper function. <



The placement of muck helps expedite the establishment of proper wetland functions.

Herbaceous Wetland Design At-a-Glance

Key Design Aspects	NFM1 (2001-02)	Parker Branch (2010)
Hydrology	• Two-dimensional surface water hydrology models applied to design. • Wetland size and embedded lakes provide unique and productive avian habitat.	• Reclaimed wetlands were designed based on existing wetland elevations. • Design for the 10 wetlands in the project was supported by hydrologic modeling, which verified the project will provide target wetland function.
Soils	• Sand tailings were placed over available overburden with muck on top.	• Designed overburden and sand upland elevations to provide needed seepage for proper wetland hydration. • Wetland topsoil (muck) was placed in the wetland to accelerate the succession process.

Consistency Counts

➤ Every detail matters when creating a reclaimed herbaceous wetland. To create a sustainable site, land forms and elevations, hydrology restoration, and plant species and density must be carefully achieved.

Newer methods also include the use of Global Positioning System (GPS) technology, allowing construction teams to create very precise elevations that support the wetland design. During the initial grading of the project, the overburden is graded to specific elevations. Frequently, sand tailings are placed on top of the overburden to generate the required seepage. These methods provide precise placement of soils, which results in proper hydrology function and sustainable wetland plant communities.

On Parker Branch, Mosaic worked with the orientation of the overburden left behind by mining to optimize groundwater flow and the elevation needed for the reclaimed site’s success. Following contouring of the land, plantings were installed and monitoring was put in place to ensure the vegetation was well established and unwanted vegetation, also known as nuisance species or weeds, were controlled. Initial planting and weed control during the early years of the project helps increase the wetland’s success rate. ➤

Herbaceous Wetland Execution At-a-Glance

Key Execution Aspects	LPC7 Wetland No. 3 (2000)	PR7 (2007)
Grading Elevations	• Because of the lack of overburden, elevations were established primarily through sand backfill.	• Used GPS technology to meet strict tolerances (+/- three inches) of design elevations. • Utilized overburden row orientation to create proper surface water flow through soils.
Re-vegetation	• Initial vegetation was established by using organic muck which was stockpiled prior to mining. • Proper hydrology resulted in quickly establishing ground cover.	• Initial vegetation was established by using organic muck which was stockpiled prior to mining. • Additional species diversity achieved by hand planting roughly 10,000 plants per acre on two-foot centers.
Site monitoring and maintenance	• Very little maintenance required from an early point in the site’s development. • Planted some supplemental species that weren’t present in the muck seed bank to assist with diversity.	• Storm water management system used to maintain proper water levels until project was sufficiently established to meet Florida water quality standards. • Nuisance management and monitoring is supporting the site’s success.

A Model Habitat

> Performance metrics offer a project team valuable insight into the potential success of a wetland.

In an early stage project like Parker Branch, regular monitoring of the site's hydrology and vegetation are key indicators of success. These measurements, based on the permit criteria, document how the site is maturing into a self-sustaining and productive wetland habitat. It also provides Mosaic information needed to determine

if the site requires additional maintenance in order to improve performance.

For established sites like NFM1, meeting the criteria needed to achieve a "release" status by the regulatory agencies is a key indicator. If a reclaimed wetland is "released" by the regulatory agency it demonstrates that the wetland is functioning equally as well as or better than the natural system which it replaces. <



Wetland modeling provides assurance that the wetland will function properly.



Spanning 500 acres, this vast wetland serves as a haven for migratory birds as well as vital nesting grounds for several protected species.

Herbaceous Wetland Execution At-a-Glance

Key Success Aspects	LPC7 Wetland No. 3 (2000)	PR7 (2007)
Connectivity	• Its location adjacent to the North Fork Manatee River results in connectivity between unmined and reclaimed habitat.	• Project connected to un-mined Parker Branch stream, into Little Charlie Creek and to the Peace River.
Vegetation	• Site is progressing toward success in meeting permit requirements.	• Site is progressing toward success in meeting permit requirements. • The 500 acres Parker Branch wetland attained 50 percent desirable vegetation coverage after two years.
Wildlife utilization	• Heavily used by wildlife species such as roseate spoonbills, eagles, herons and many other species. • Located to tie into wildlife corridors.	• A total of 27 wildlife species have been observed since the baseline monitoring event, including 22 avian species, three amphibian species, one fish species and one mammal species. • Four species observed, the little blue heron, the snowy egret, the tricolored heron and the white ibis, are listed by the Florida Fish and Wildlife Conservation Commission (FWC) as Species of Special Concern. • One species, the wood stork, is listed as Federally Endangered by the FWC and Endangered by the United States Fish and Wildlife Service.



A site’s hydrology and vegetation are two key indicators of success and are used to measure how well the site is maturing into a self-sustaining habitat.

Maximizing Best Practices

> NFM1 and Parker Branch demonstrate Mosaic's leadership in re-establishing important habitats across the regional ecosystem.

With public funding unable to fully support expensive conservation land acquisition programs, mining and reclamation may also provide permanent protection through conservation easements to help ensure the availability of high-quality habitat for generations to come.



Reclaimed herbaceous wetlands such as freshwater marshes and wet prairies become habitat sanctuaries for a variety of plants and other wildlife species.



Grasses, such as those shown here, as well as ferns and shrubs are characteristic of herbaceous wetlands.