ENGINEERING FLOODPLAIN MANAGEMENT

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ABSTRACT

The consequences of urbanization and reduction of floodplain capacity are growing concerns to communities throughout Florida and the nation. In the early 90's Sarasota County embarked on a three stage approach to addressing these problems that included watershed master planning, project feasibility analysis and construction and operation of multi-use regional stormwater facilities. This paper is the story of one such facility - the Celery Fields Regional Stormwater Facility (CFRSF). The County first initiated the creation of a hydrologic and hydraulic computer model that was able to simulate runoff, conveyance and flooding conditions for the Phillippi Creek basin. The model was utilized to identify numerous projects that could reduce the frequent flooding of specific areas within the basin. Borrowing a few notions from history the CFRSF, conceived as a floodplain creation/restoration project, was placed in an agricultural area that was once a large sawgrass marsh. A preliminary design report confirmed the feasibility of the CFRSF to reduce flooding in a large residential subdivision located downstream from the project. Planning and design of this project required the integration of otherwise unrelated goals including flood reduction, water quality enhancement, creation of a wetland mitigation bank, development of recreational facilities and local road improvements.

INTRODUCTION

Sarasota County Stormwater Environmental Utility (SEU) initiated a countywide basin master planning project in the early 1990's. The overall intent was to develop hydrologic and hydraulic models for all 31 major watersheds within the County. These models would be used to identify and quantify existing flooding problems in the County and investigate potential improvements. Phillippi Creek, totaling 57 square miles (see Figure 1), is the largest of these watersheds. Phillippi Creek is comprised of one main channel, Main A, and five major tributaries. Among the problem areas identified in this basin is Colonial Gables, a medium density residential subdivision constructed in the early 1970's. Main A flows through this subdivision. Modeling revealed 140 homes subject to flooding from the 100 year storm event.

The Celery Fields Regional Stormwater Facility was conceived as one of many potential solutions to reduce flooding in the Colonial Gables subdivision.

Located in the 6000 acre Main C tributary basin, the Celery Fields Regional Stormwater Facility (CFRSF) was conceptualized as a project with the potential to store 1000 acre feet of runoff in 500 acres of agricultural fields. The project was to sever the Main C canal and capture the runoff generated by 3400 acres of semi-urban, residential and open lands for up a 100 year storm event. Boyle's tasks included development of the Preliminary Design Report, permitting, plans and specifications for construction, Operation and Maintenance Manual, FEMA mapping revisions
DISCUSSION

The CFRSF Preliminary Design Report (PDR) was developed to investigate the feasibility of the project concept. Specific design criteria were established which addressed project goals such as downstream flood reduction levels, water quality improvements, creation of a wetland mitigation bank, and creation of recreational facilities. The design criteria was used to develop three alternative designs. Each of the designs was based on the concept of a three stage water treatment approach. This included a sedimentation cell, a central aeration cell, and a wetland polishing cell. These designs were evaluated for ability to meet project goals, constructability, cost and potential impacts on surrounding properties. With the assistance of County staff a single alternative was selected for in-depth study.

The project area chosen comprised approximately 500 acres of celery fields adjacent to the Main C Canal. The fields are bounded on the north by Fruitville Road, on the east by Center Road, on the west by the Main C Canal and on the south by Lateral CA, a tributary to Main C. The fields are also divided approximately in half east to west by Raymond Road and north to south by Palmer Boulevard and Sawgrass Road (see Figure 2). Main C flows due south in the project area and is controlled by two weirs: one north of Fruitville Road and one south of Lateral CA just upstream of the confluence with Main A. Surface drainage from the project area drains west to Main C through agricultural and roadside ditches. Farmers constructed Main C and operated the weirs for agricultural purposes since the 1940's. Prior to that the area was a sawgrass marsh which experienced seasonal flooding. During the years of agricultural use the farmers artificially controlled the groundwater levels in the celery fields by pumping for crop propagation. Complete, above ground, flooding of the fields was used at the beginning of each planting season for weed control.

Detailed photogrammetric aerial mapping and field survey was developed for the project area and surrounding lands. This information was used to create a three dimensional digital terrain model (DTM). Early evaluation of the selected alternative concentrated on the main project goal of providing at least 1000 acre feet of runoff storage for the 100 year event. The project design team utilized the DTM to modify the existing topography for simulation of ponds and berms used in the three cell approach. Use of the DTM provided quick and accurate estimates of storage capacities during design development. The design DTM was ultimately used to create the final construction plans. Existing physical features were used to segregated the three stages of the selected alternative design. The sediment cells were located north of Sawgrass Road. Sawgrass Road was closed to traffic and incorporated as a maintenance berm. The central pond cell was located between Sawgrass Road and Palmer Blvd. This area is the most visible aspect of the facility with future soccer fields and walking trails surrounding the perimeter of the pond. The wetland mitigation cell was located south of Palmer Blvd. Raymond Road was rerouted around the eastern perimeter of the wetland mitigation cell. An existing railroad grade and the remnants of Raymond Road were used as maintenance berms.

During master planning the County opted initially to model the basin using EPA SWMM RUNOFF and EXTRAN, a two-dimensional hydrologic and hydraulic model. Attempts were made to verify the model results using the 1992 storm which totaled more than 20 inches of rainfall in many areas of the County. A restriction of SWMM which allows only a limited number of structures to be represented resulted in an unsatisfactory verification. The County decided to amend the SWMM EXTRAN results with the COE HEC-2 model, a one-dimensional hydraulic model. The final verification for the basin model was performed using the SWMM results as input to the HEC-2 model.

The master plan modeling was revised based on the results of the DTM and additional field survey to more accurately depict actual existing conditions. The updated hydrologic and hydraulic modeling was used to develop hydraulic control elements (weirs, gates, etc.) of the project. Although the design storm was the 100 year-24 hour storm event using the Army Corps of Engineers (COE) rainfall distribution, a series of storms was utilized to evaluate various operation scenarios. These included the 2 year, 5 year, 10 year, and 25 year-24 hour events.
Ultimately, the freeboard and emergency discharge aspects of the design were also evaluated using the 100 year 48 hour, 72 hour and 96 hour events. Most hydraulic features of the design were initially sized based on flows from SWMM. Final water surface elevations were determined and flows verified using the HEC-2 model.

The existing weir at Fruitville Road was removed from service. The weir was replaced by a structure approximately 1/4 mile south of Fruitville Road which diverts 100% of Main C flows into the sedimentation cells of the CFRSF. Flows are passed under Sawgrass Road through a 9'x32’ concrete span culvert (CSC). Flows continue through the central pond into the wetland mitigation cell through another 9’x32’ CSC. Flows pass back into Main C through a 5’x12’ CSC which is controlled by four gates. These gates can be completely closed to contain upstream flows during storm events and can be used to regulate return flows to Main C once the storm has passed. Additional flexibility was provided in controlling water levels in the wetland mitigation cell. Flows can be diverted from the wetland cell by the placement of stop logs on the north side of the CSC under Palmer Blvd. An emergency structure located in the central pond can be used for controlled discharge of up to the 10 year-24 hour event while maintaining water levels in the wetland cell to pre-storm event levels. Unlike the littoral area plantings in the central and sediment pond areas, the mitigation bank plantings are comprised mostly of wooded wetland species which are less tolerant of long periods of inundation in their early years of development. This allows the facility to be operated to control moderate flooding events while preserving the costly mitigation bank plantings.

Permitting of this project was coordinated with a multitude of local, state and federal agencies. Early involvement in the design process was key to a smooth and timely issuance of permits. The COE claimed virtually 100% of the project area as low grade, impacted wetlands, while SWFWMD only claimed the ditch and canal areas. A Modified Wetland Rapid Assessment Procedure (WRAP) analysis was performed to establish the value of the impacted wetlands to the proposed mitigation. The wetland impacts for the project itself were mitigated by littoral shelf plantings in the sediment ponds and central pond. The wetland mitigation cell was designed and permitted to provided wetland mitigation banking credits for use by various future County projects.

CONCLUSIONS

The CFRSF provides for capture and controlled release of 100% of the runoff generated by the 100 year-24 hour storm event from approximately 3800 acres in the Main C basin. This resulted in the reduction of water elevations in the Colonial Gables subdivision of up to one foot. Combined with channel improvements in the subdivision, the resultant water surface reduction approached 2 feet which removed over 90% of the existing homes from the floodplain. This was accomplished with no negative impacts to areas surrounding the CFRSF. An overall reduction of 8% of the total suspended solids delivered to Sarasota Bay from the Phillippi Creek basin is estimated to be achieved by the project. Ultimate creation of 120 acres of wetland mitigation banking credits is also anticipated. The CFRSF will also provide opportunities for future recreational facilities as departmental budgets allow.

LITERATURE CITED