SECTION VI – STORM SEWERS

This section discusses the findings of GIS assisted EPA-SWMM storm sewer system modeling analysis. The existing storm sewer systems were modeled and analyzed for the 5-year design storm using EPA-SWMM 5 dynamic program. The model analyses were used to identify drainage problem areas and system inadequacies, and determine storm improvement requirements.

Storm sewer improvements were proposed for systems that are shown to have drainage problems and insufficient capacity. Typical storm sewer improvements include replacement of the existing systems or partial systems with larger pipes. For storm sewers located within areas with high tailwater effects, downstream channel improvements and detention alternatives were also investigated.

Downstream channel improvements would lower the tailwater condition of the storm sewer system. The lower tailwater would reduce the backwater inundation experienced by the storm sewer system, allowing a more positive conveyance from the storm sewer system into its receiving channel.

Detention basins can provide a tailwater independent outfall for a storm sewer system to prevent backwater inundation from the receiving stream. The basins would be sized and behave mostly as a retention facility during the design storm event. The detention basin system requires a backflow preventer as an outfall structure, such as a flap gate. The basin backflow preventer would isolate the storm sewer system from the receiving stream during the storm event.

OVERALL SYSTEM NETWORK

The existing storm sewer system networks for the entire study area were first digitized using ArcGIS, including storm pipe alignment and manhole locations. Manhole rim elevations (assumed same as natural ground) were extracted from the 5-foot LiDAR DEM dataset. **Figure 18** displays the overall storm sewer system network. The developed GIS data layers, as presented in ***Section III – GIS Layers***, provided the base information for EPA-SWMM dynamic modeling analysis.

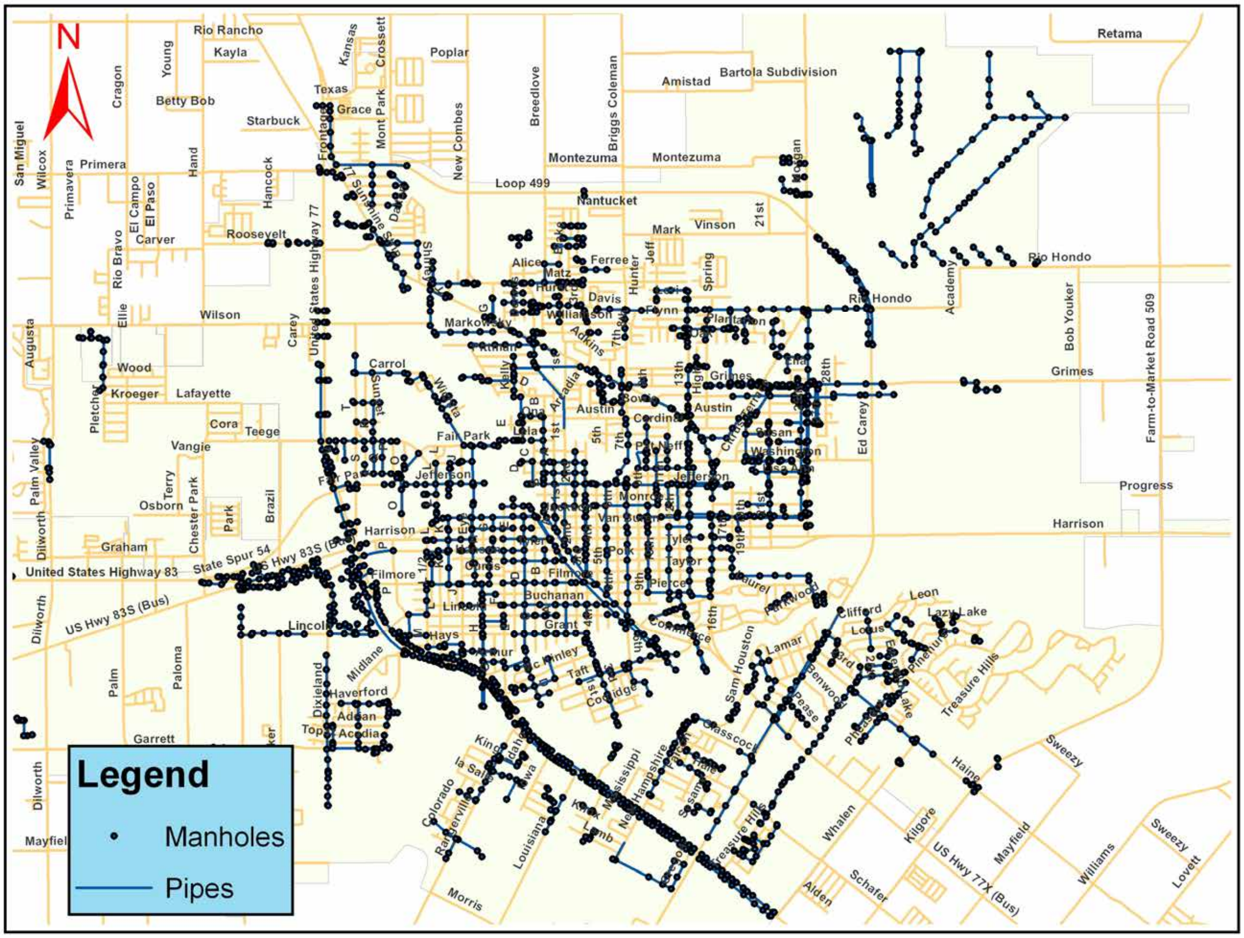

FIGURE 18. OVERALL STORM SEWER NETWORK

DRAINAGE CATCHMENT DELINEATIONS

Storm sewer drainage catchments were delineated to manholes using ArcHydro tools based on the 5-foot LiDAR DEM dataset, and drainage areas were also calculated using GIS tools. The resulting catchments were verified and revised based on aerials, street maps, as-builts. **Figure 19** shows the overall drainage catchment delineations. A total of 128 storm drainage systems were delineated. These systems include a total of 720 drainage catchments with a total drainage area of 12,152 acres. Individual storm system layouts along with storm catchment delineations are graphically shown in detail in ***Storm Sewer Maps***.

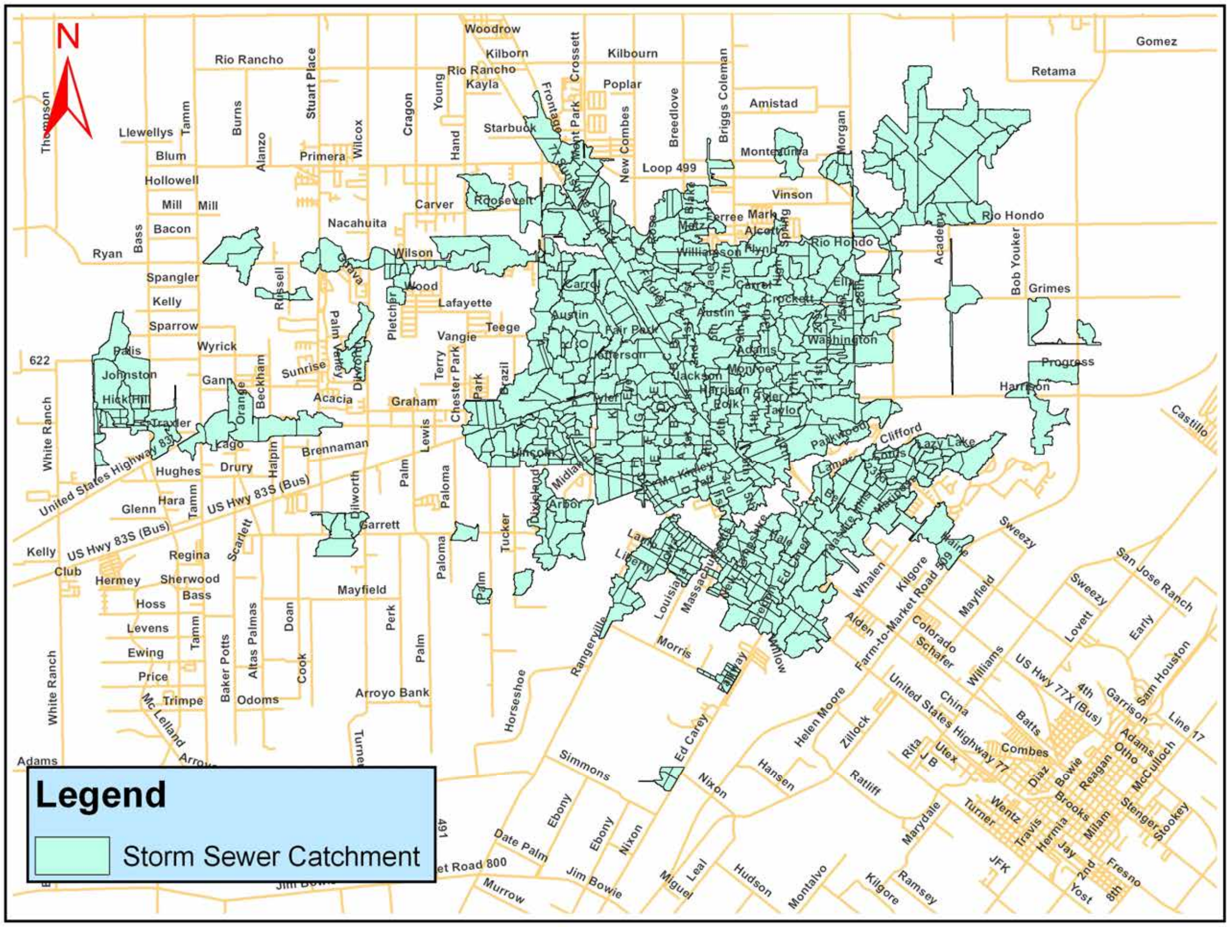

FIGURE 19. OVERALL STORM CATCHMENT DELINEATIONS

EPA-SWMM MODELING

EPA-SWMM 5 was developed for each of the 128 storm systems and used to analyze the existing and proposed storm sewer systems. As discussed earlier, this program is a dynamic model which has the capability to evaluate backwater effect in flat terrain area like City of Harlingen.

<u>Existing Conditions Storm Sewer</u>

SWMM models were first created for the existing storm sewer systems. The preliminary storm sewer layouts with storm pipe alignments and manhole locations were exported from GIS to an import file to create the basic system networks for EPA-SWMM models. Within SWMM models, the storm system attribute data (storm pipe shape, sizes, lengths, material, flowline elevations, manhole invert elevations, and manhole rim elevation) were inputted and verified. Each storm sewer system was assigned with an unique system identification (ID) number.

SWMM model requires hydrographs at nodes (manhole locations). As discussed earlier, a triangular hydrograph was assumed for this study with peak flow calculated from Rational Method with a hydrograph base of 2 times Tc. Composite runoff coefficient C values were computed using Spatial Analyst Zonal Statistics tool based on drainage catchments and the land use data layer.

Time of concentration Tc for each drainage catchment was computed using the equation recommended by City of Houston Drainage Criteria. The equation relates Tc only to the drainage area size with a minimum of time of concentration of 15 minutes. The Tc formula is shown as *Equation 9*. Peak flows were calculated based on the Rational Method, shown as *Equation 7*.

The resulting existing EPA-SWMM model for each storm drainage system was run to evaluate the existing systems to identify flooding problem areas and inadequate storm sewer sections based on the 5-year drainage design criteria. There were 59 systems identified to be inadequate, either partially or as a complete system. All storm catchment drainage parameters and peak flows are provided in ***Appendix B***. All the128 existing conditions and 59 proposed conditions EPA-SWMM models are contained in the attached **CD-ROM**.

Proposed Conditions Storm Sewer

There are 59 systems identified with inadequate pipe capacities. Proposed improvements were evaluated and optimized to meet the 5-year storm event design criteria for these systems. The computed hydraulic grade line control was set to below the gutter line. As discussed earlier, it was assumed that gutter line is 6 inches below the rim elevation (natural ground elevation). The proposed storm sewer improvements are contained the Storm Sewer Pipe GIS layer and are graphically shown in ***Storm Sewer Maps***.

Proposed Condition Detention Basin

In addition to storm sewer enlargement within the inadequate systems, detention basins were considered for systems that have high tailwaters such as the tributaries of North Main Drain. The tributaries to North Main Drain and adjacent overbank areas are inundated during frequent events by North Main Drain. The backwater from North Main Drain does not allow for properly-sized storm sewer systems to have a positive conveyance condition during the design events.

There are potential detention basins along 3rd Street and 13th Street Ditches, as discussed in ***Section V – Drainage Ditch***. However, these detention basin sites are not adjacent to the subdivisions that are served by storm sewers. In addition, once the North Main Drain channel improvement project is completed, each receiving ditch would provide a tailwater condition that would allow storm system have a positive conveyance condition.

Along the T-Street Ditch, backwater from North Main Drain inundates the overbank areas during the 5- and 10-year events. Considering that the proposed improvements along North Main Drain will not provide significant reduction in the water surface elevation at the T-Street Ditch location, the storm sewer systems need a tailwater independent outfall. Routing the existing storm sewer systems through a detention basin prior to outfalling into the T-Street Ditch will provide the system a positive conveyance condition.

An undeveloped location adjacent to the ditch and residential area was considered for detention, as shown in **Figure 20**. The tract is approximately 42 acres. Based on the depth of T-Street ditch, storm sewer, adjacent existing topography, and basin configuration, a storage volume of 260 acre-feet was estimated, assuming a 20-foot maintenance berm, 3:1 side slopes, and an 8-foot depth. The basin should be designed with an extreme event overflow weir and outfall system to allow for controlled passage of runoff from the basin to the T-Street Ditch during large storm events. The available storage volume approximates the total runoff excess of 260 acre-feet for a 5-year design storm event from the storm sewer system's contributing drainage area of 715 acres.

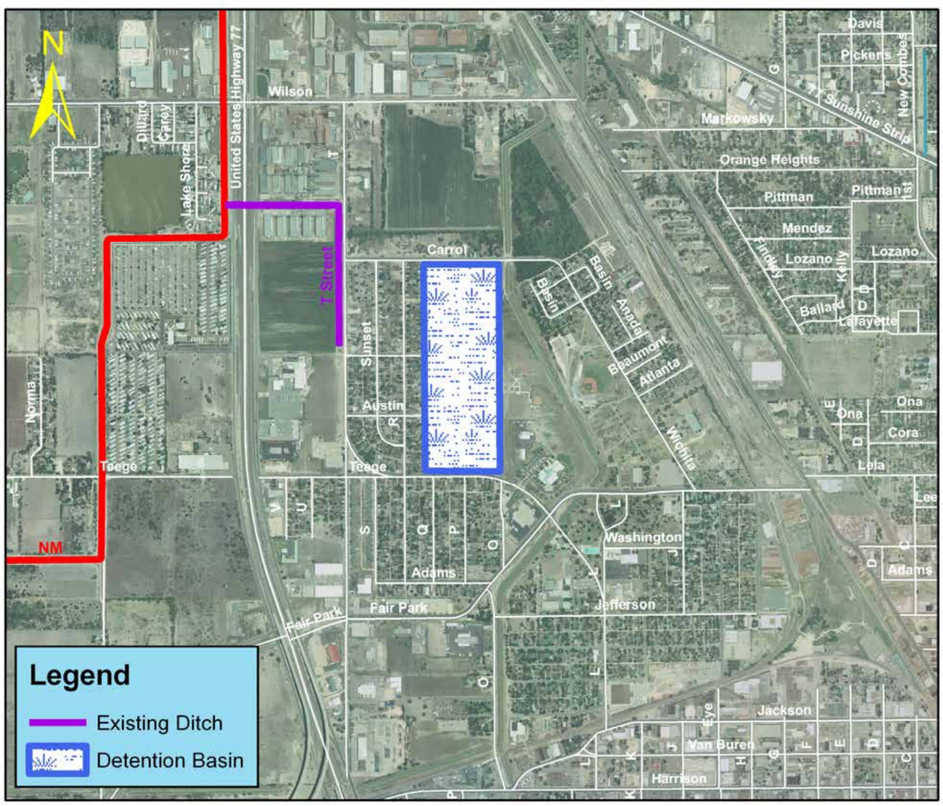

FIGURE 20. T-STREET DETENTION BASIN