SECTION III - GEOGRAPHIC INFORMATION SYSTEM

This section discusses the applications of ArcGIS tools in the project development and the GIS layers developed for the Master Drainage Plan.

GIS APPLICATIONS

As discussed earlier, ESRI ArcGIS 9.2 was extensively used throughout this project. Specific tasks using GIS tools included: base mapping, topographic data development, drainage system inventory (primarily storm sewer systems), drainage system delineations, drainage and hydrologic parameter extraction, and hydrologic and hydraulic model development and analyses. The suite of ArcGIS tools utilized for this project include Spatial Analyst, 3D Analyst, ArcHydro, HEC-GeoHMS, HEC-GeoRAS, and other extensions. Base maps were compiled or developed and integrated in a consistent GIS environment, including street maps, aerial photographs, political boundaries (cities, counties, districts), and stream and drainage ditch centerlines.

The most pertinent task utilizing ArcGIS and its tools was the development of the digital elevation model (DEM) from LiDAR data, drainage and stream delineations, and citywide storm sewer inventory. A continuous Arc GRID DEM dataset with 5-foot pixel size was developed from tiled LiDAR data obtained from Texas Natural Resources System (TNRIS). The original datasets obtained from TNRIS are in LAS format and was converted to an Arc GRID format for this project. A 5-foot GRID dataset was developed based a series geospatial data processing procedures using a suit of 3D Analyst tools. The resulting 5-foot DEM dataset was further reconditioned by removing hydraulic structures contained within the LiDAR dataset. The reconditioned 5-foot DEM was used as the base grid dataset for this study.

The ArcHydro and HEC-GeoHMS tools were used to automate drainage area delineations using the 5-foot grid dataset. The resulting drainage area delineations were verified against the project aerials and consultation with city engineering staff. The HEC-GeoRAS tools were used to extract drainage ditch geometric input data for HEC-RAS modeling analyses. Field surveyed channel and hydraulic structure data along with available construction plans were used in the HEC-RAS model development.

GIS layers for City storm sewer systems were developed by digitizing the available paper storm sewer maps (1983 Storm Water Management Plan and as-built plans) and converting available CAD drawings to GIS format. The pertinent data for the storm sewer descriptions collected from the available data were used to populate the GIS layers attribute database. Typical data inputted included sizes, lengths, shapes, materials, elevations, and etc.

The storm sewer GIS layers include the storm sewer pipe and storm sewer manholes. These storm sewer GIS layers were used to facilitate EPA SWMM models development and modeling analyses. The proposed improvement data were also included in the storm sewer GIS layers.

GIS LAYERS

A set of GIS layers were developed for the City of Harlingen's Master Drainage Plan project and are provided on the attached CD. The following is a list of the GIS layers:

- Storm Sewer Pipe
- Storm Sewer Manhole
- Drainage Catchment
- Drainage Basin
- Drainage Ditch
- Drainage Ditch Improvement
- Drainage Ditch Structure
- Flooding Complaint
- Floodplain Boundary
- Street Map
- Soil Map
- Land Use Map
- District Boundary
- City Boundary
- County Boundary
- Digital Aerial Photos

Storm Sewer Pipe

Storm sewer pipe layer is a line feature class representing the existing and proposed storm sewer pipes. A pipe segment is defined as a storm sewer pipe having a manhole (node) located at each end of the pipe, one pipe diameter, and a flowline slope that does not change. Each storm sewer pipe system was assigned a unique system identification (ID) number. The storm sewer pipe attributes include the following:

- Pipe ID
- System ID
- Existing Pipe Shape
- Existing Pipe Size – Width
- Existing Pipe Size – Height (Diameter)
- Existing Upstream Flowline Elevation
- Existing Downstream Flowline Elevation
- Existing Pipe Length
- Existing Pipe Slope
- Proposed Pipe Shape
- Proposed Pipe Size – Width
- Proposed Pipe Size – Height (Diameter)
- Proposed Upstream Flowline Elevation
- Proposed Downstream Flowline Elevation
- Proposed Pipe Length
- Proposed Pipe Slope

Storm Sewer Manhole

Storm sewer manhole layer is a point feature class that includes data for manholes (nodes) located along the storm sewer system. The storm sewer manhole attributes include:

- Manhole ID
- System ID
- Manhole Type
- Rim Elevation
- Critical Elevation
- Invert Elevation

Drainage Catchment

The drainage catchment layer is a polygon feature class reflecting the drainage catchment contributing to a manhole. Drainage catchments were delineated using ArcHydro tools along with storm systems and existing street patterns based on the project DEM dataset. The drainage catchment layer attributes include:

- Catchment ID
- System ID
- Receiving Manhole ID
- Catchment Area (acre)
- C-value
- T_c (min)
- Q_5 (cfs)

Drainage Basin

The drainage basin layer is a polygon feature class that includes the drainage areas delineations for the hydrologic modeling analysis. The drainage basins represent the contributing drainage area for the drainage ditches. The layer attributes include:

- Drainage System ID
- Basin ID
- Basin Area (ac)

Drainage Ditch

The drainage ditch layer is a line feature class that includes the alignment of drainage channels and ditches within the study area. This layer was developed using information obtained from the City of Harlingen Public Works Department. The layer attributes include:

- Drainage System ID
- Ditch ID
- Ditch Name

Drainage Ditch Improvement

The drainage ditch improvement layer is a line feature class that includes the reaches of drainage ditches that are recommended for improvements. The layer attributes include:

- Drainage System ID
- Ditch ID
- Ditch Name
- Proposed Improvement Description

Drainage Ditch Structure

The drainage ditch structure layer is a point feature class that includes the location of the hydraulic structures within the studied channels. The layer attributes include:

- Drainage System ID
- Ditch ID
- Ditch Name
- Structure ID
- Structure (Street) Name
- Existing Structure Description
- Proposed Structure Description

Flooding Complaint

The flood complaint layer is a polygon feature class that presents the historical flooding records obtained from the City's Public Works Department and from FEMA's files for repetitive insurance claims. The flooding complaint areas were approximately located.

Floodplain Boundary

The floodplain boundary layer is a polygon feature class that includes floodplain and floodway boundaries as defined by FEMA. The layer includes the boundaries as shown on the Flood Insurance Rate Maps (FIRMs) for the floodway, 500-year floodplain, and 100-year floodplain.

Street Map

The street map layer is a line feature class that includes streets, major highways, and railroads located in the study area. The street map layer was acquired from the City of Harlingen.

Soil Map

The soil map layer is a polygon feature class that contains the hydrologic soil group types. The soil map was obtained from the NRCS Soil Data Mart. The datasets included both spatial and tabular data were spatially referenced to the UTM NAD83. **Figure 3** shows the hydrologic soil types within the City of Harlingen and surrounding areas.

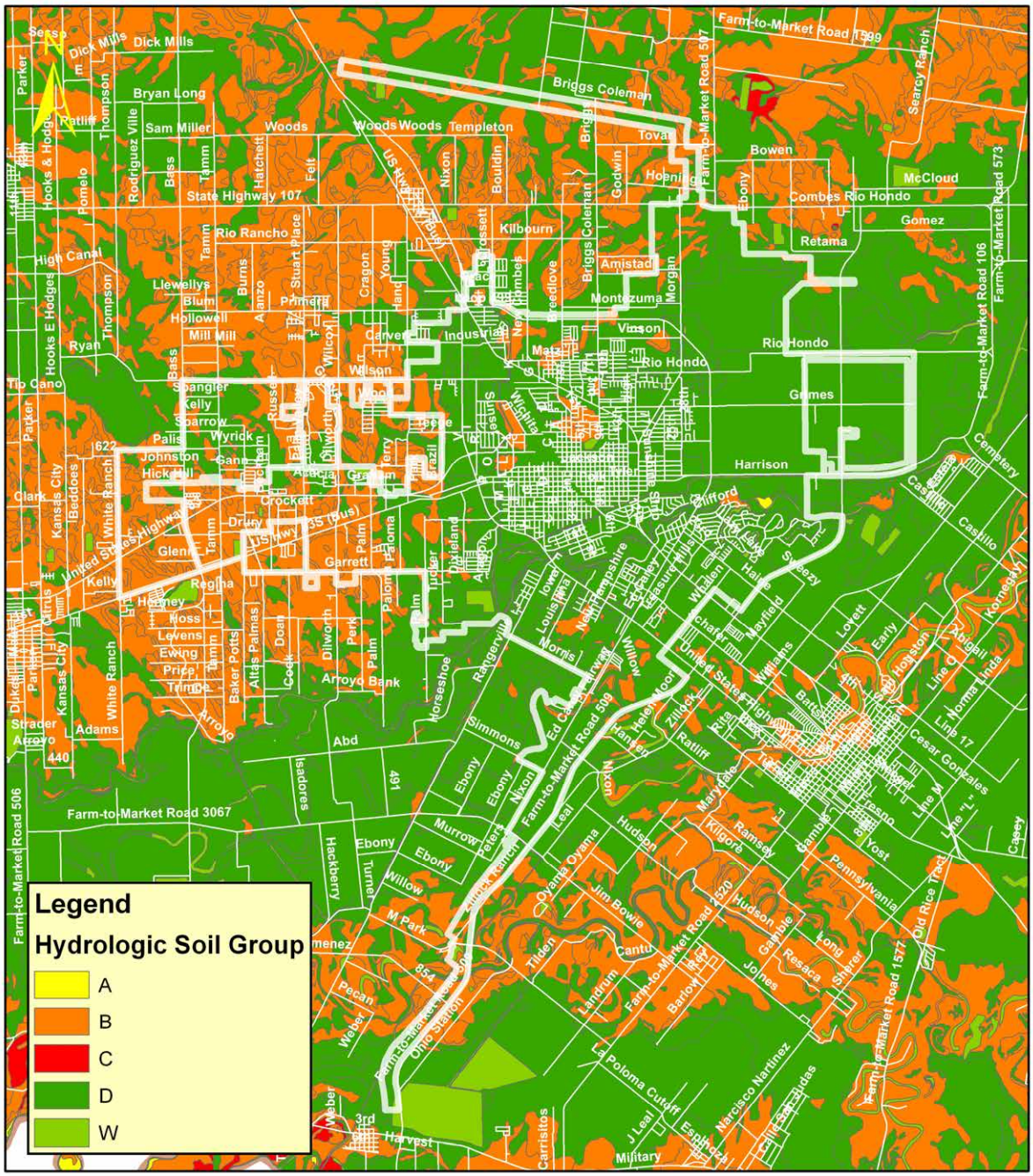

FIGURE 3. SOIL MAP

Land Use Map

The land use layer is a polygon feature class that contains land use type and cover and percent impervious cover information. The land use layer was developed based on the parcel maps from the Cameron County Appraisal District. **Figure 4** shows the land use classifications within the City of Harlingen and surrounding areas.

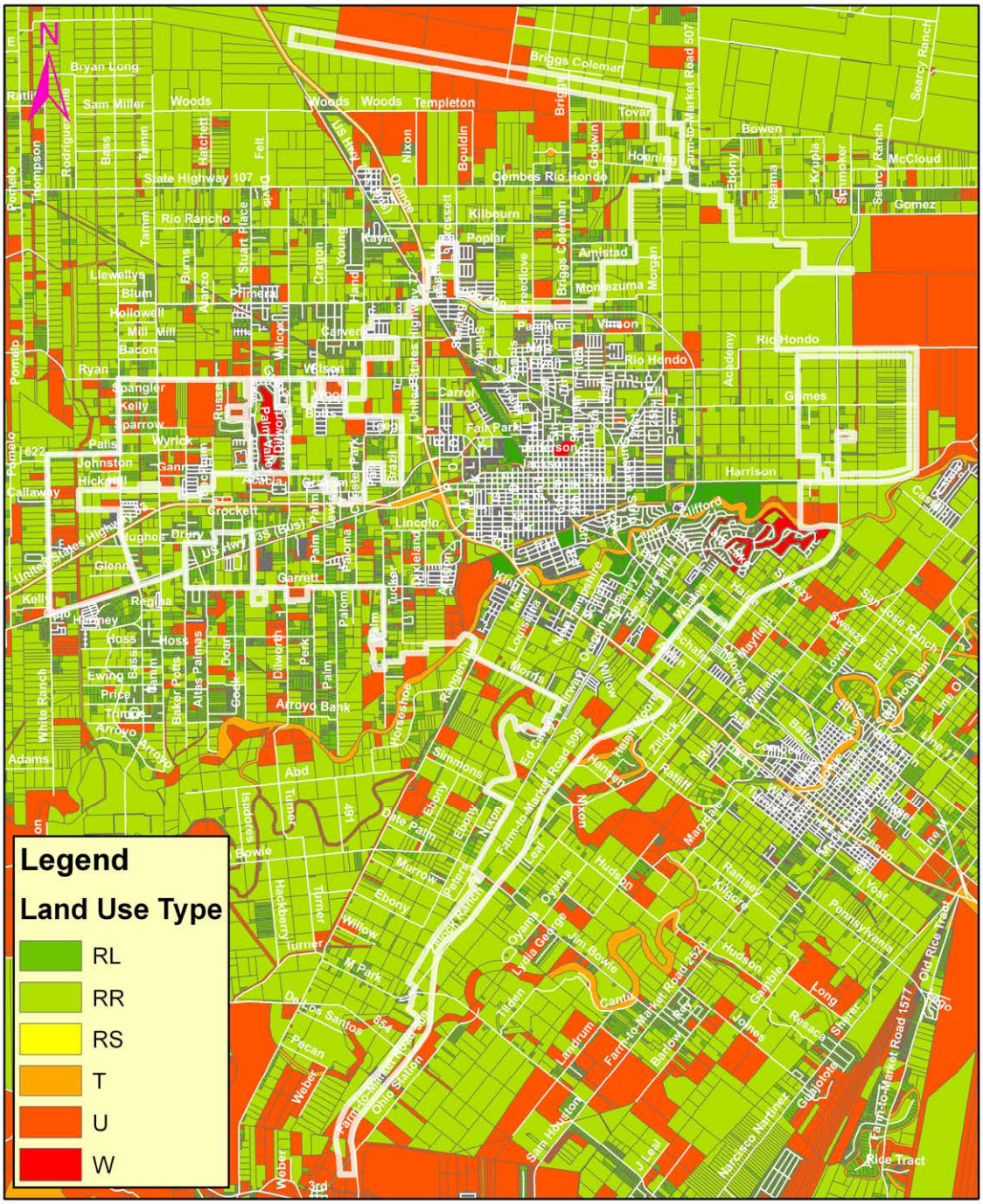

FIGURE 4. LAND USE MAP

District Boundary

The district boundary layer is a polygon feature class representing the drainage and irrigation district boundaries within the study area. The district boundary layer was acquired from the City of Harlingen.

City Boundary

The city boundary layer is a polygon feature class representing the city boundaries within the study area. The city boundary layer was acquired from the City of Harlingen.

County Boundary

The county boundary layer is a polygon feature class representing the county boundaries within the study area. The county boundary layer was acquired from the City of Harlingen.

Digital Aerial Photos

The digital aerial photos are raster images representing the digital aerials developed by Aerial Express in 2006.

All resulting GIS layers are contained on the attached **CD-ROM**.