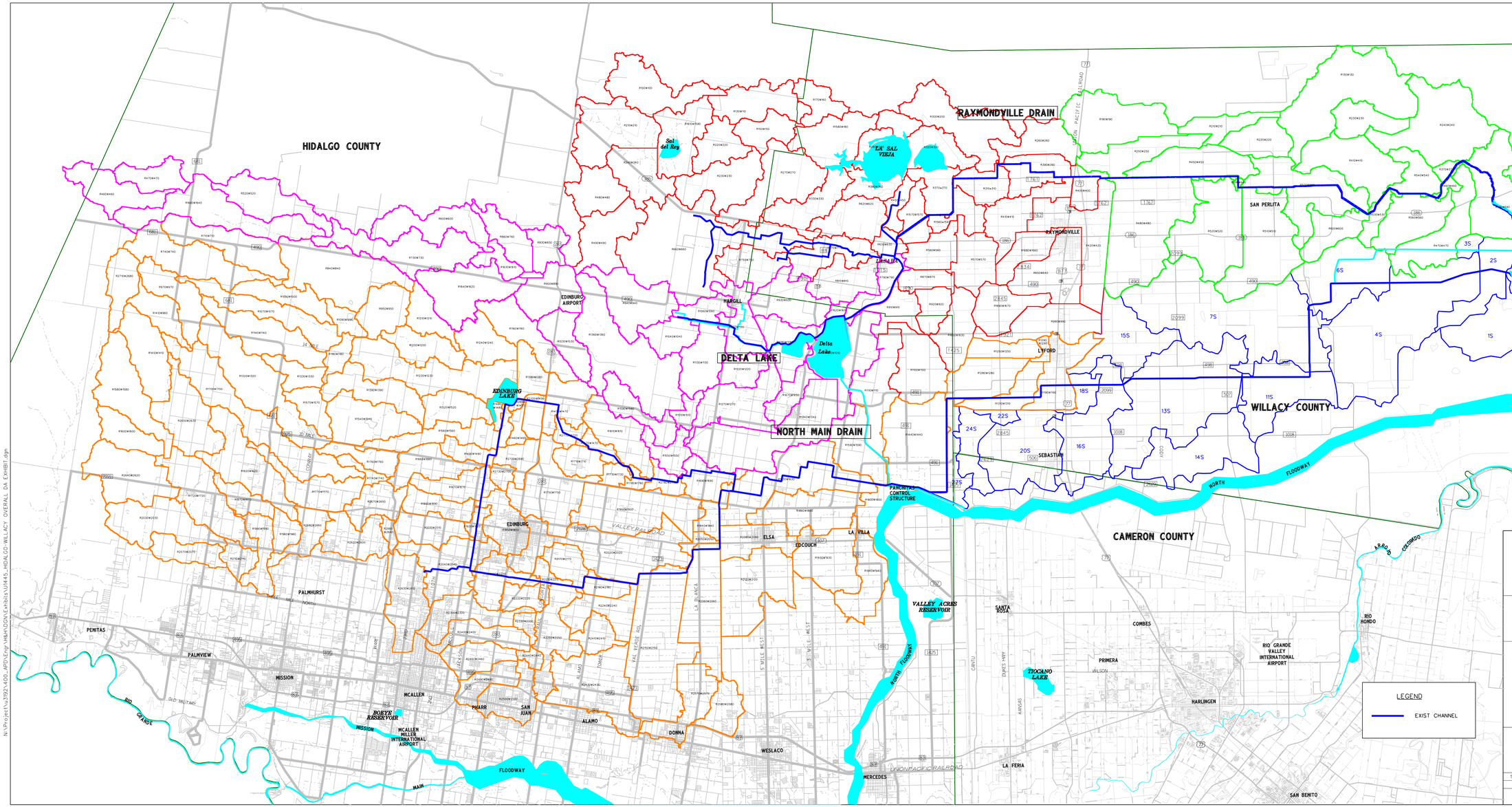
RAYMONDVILLE DRAIN PROJECT
ENGINEERING APPENDIX A1

ATTACHMENT A

HYDROLOGY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WILLACY COUNTY
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NORTH MAIN DRAIN
LAGUNA MADRE
LA SAL VIEJA
Sal del Rey
Delta Lake
EDINBURG LAKE
EDINBURG AIRPORT
HARGILL
LASARA
RAYMONDVILLE
SAN PERLITA
L'FORD
SEBASTIAN
PANCHITAS CONTROL STRUCTURE
EDINBURG
ELSA
EDCOUCH
LA VILLA
PALMHURST
PENITAS
PALMVIEW
MISSION
MCALLEN
PHARR
SAN JUAN
ALAMO
DONNA
WESLACO
MERCEDES
LA FERIA
SAN BENITO
HARLINGEN
PRIMERA
COMBES
SANTA ROSA
VALLEY ACRES RESERVOIR
THOCANO LAKE
RIO GRANDE VALLEY INTERNATIONAL AIRPORT
RIO HONDO
ARROYO CITY
ARROYO CREMADO
BORTE RESERVOIR
MCALLEN MILLER INTERNATIONAL AIRPORT
RIO GRANDE
FLOODWAY
NORTH MAIN FLOODWAY
UP/MP PACIFIC RAILROAD
VALLEY RAILROAD
LEGEND
EXIST CHANNEL
PROJECT DRAINAGE
AREA MAP
(PRE-PROJECT CONDITIONS)
RAYMONDVILLE DRAIN
AND
NORTH MAIN DRAIN
(HIDALGO & WILLACY COUNTIES)
SHEET 1 OF 1
STATE
COUNTY
DRAWN BY:
CHECKED BY:
TX
HIDALGO
PROJECT NO.
U1445
SHEET NO.
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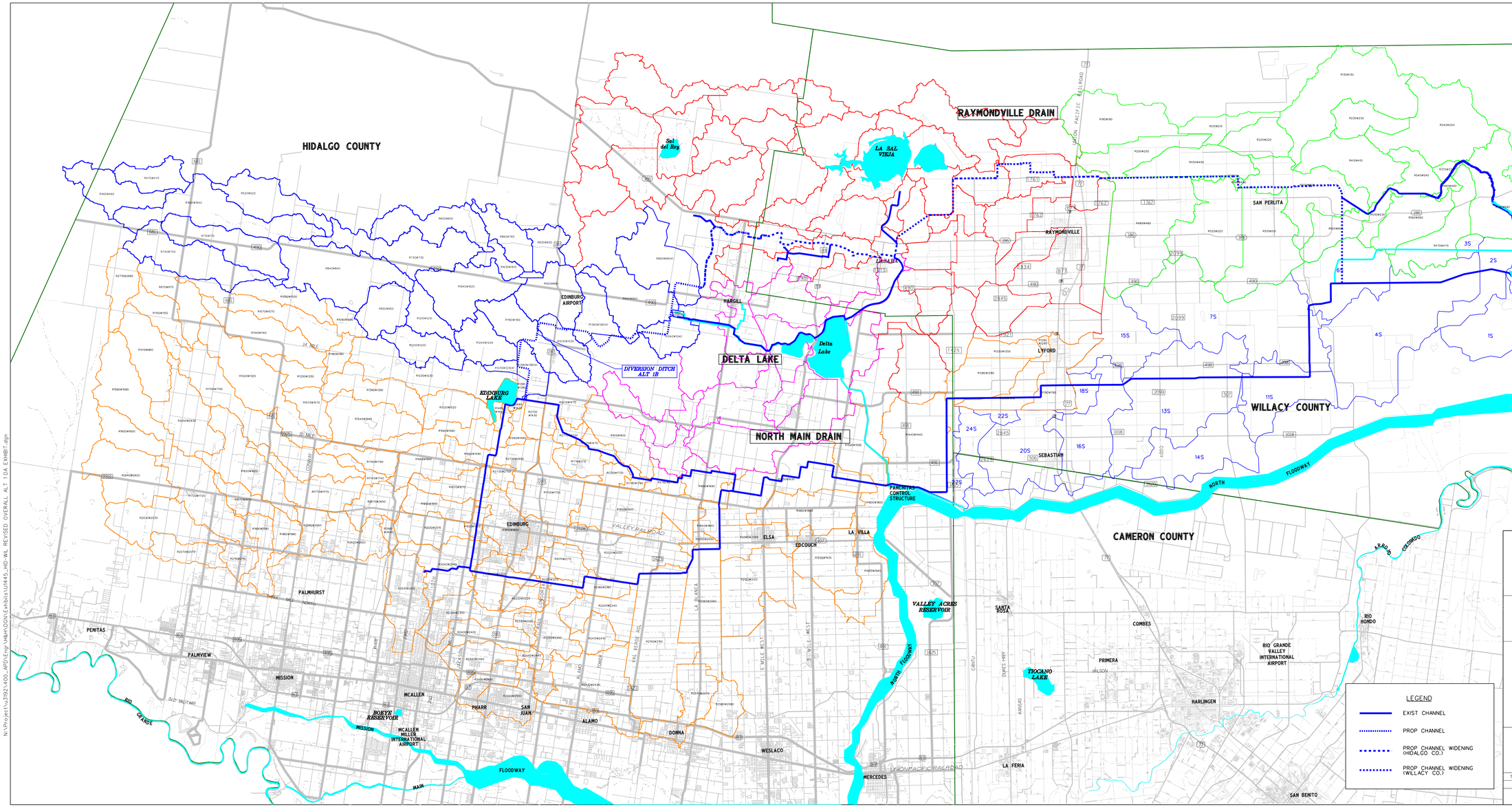
HIDALGO COUNTY
CAMERON COUNTY
WILLACY COUNTY
RAYMONDVILLE DRAIN
DELTA LAKE
NORTH MAIN DRAIN
DIVERSION DITCH ALT 1B
EDINBURG LAKE
Sal del Rey
LA SAL VIEJA
Delta Lake
LAGUNA MADRE
RAYMONDVILLE
SAN PERLITA
LASARA
HARGILL
EDINBURG AIRPORT
L'FORD
SEBASTIAN
PANCHITAS CONTROL STRUCTURE
EDINBURG
ELSA
EDCOUCH
LA VILLA
VALLEY ACRES RESERVOIR
SANTA ROSA
COMBES
PRIMERA
TIOCANO LAKE
HARLINGEN
RIO GRANDE VALLEY INTERNATIONAL AIRPORT
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ARROYO CITY
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SAN BENITO
RIO GRANDE
FLOODWAY
NORTH FLOODWAY
MAIN
UNION PACIFIC RAILROAD
VALLEY RAILROAD
LEGEND
EXIST CHANNEL
PROP CHANNEL
PROP CHANNEL WIDENING (HIDALGO CO.)
PROP CHANNEL WIDENING (WILLACY CO.)
HIDALGO COUNTY DRAINAGE DISTRICT NO. 1
INFRASTRUCTURE
TEXAS BOARD OF PROFESSIONAL ENGINEERS # F-15582
PROJECT DRAINAGE AREA MAP
ALTERNATIVE 1
REVISED
(HIDALGO & WILLACY COUNTIES)
SHEET 1 OF 1
STATE TX
COUNTY HIDALGO
DRAWN BY:
CHECKED BY:
PROJECT NO. U1445
SHEET NO.
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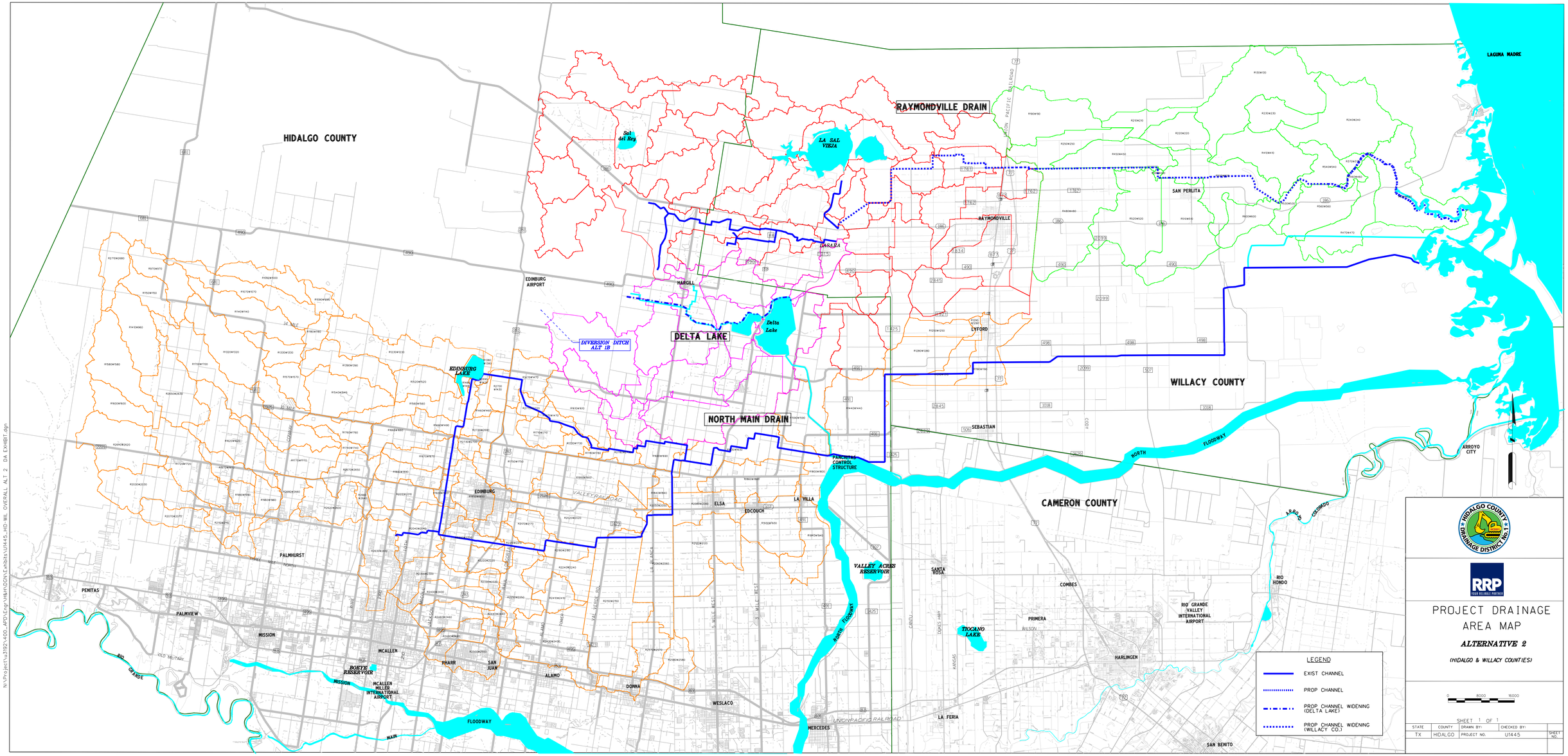


HIDALGO COUNTY DRAINAGE DISTRICT NO. 1

RRP

PROJECT DRAINAGE AREA MAP

ALTERNATIVE 2

(HIDALGO & WILLACY COUNTIES)

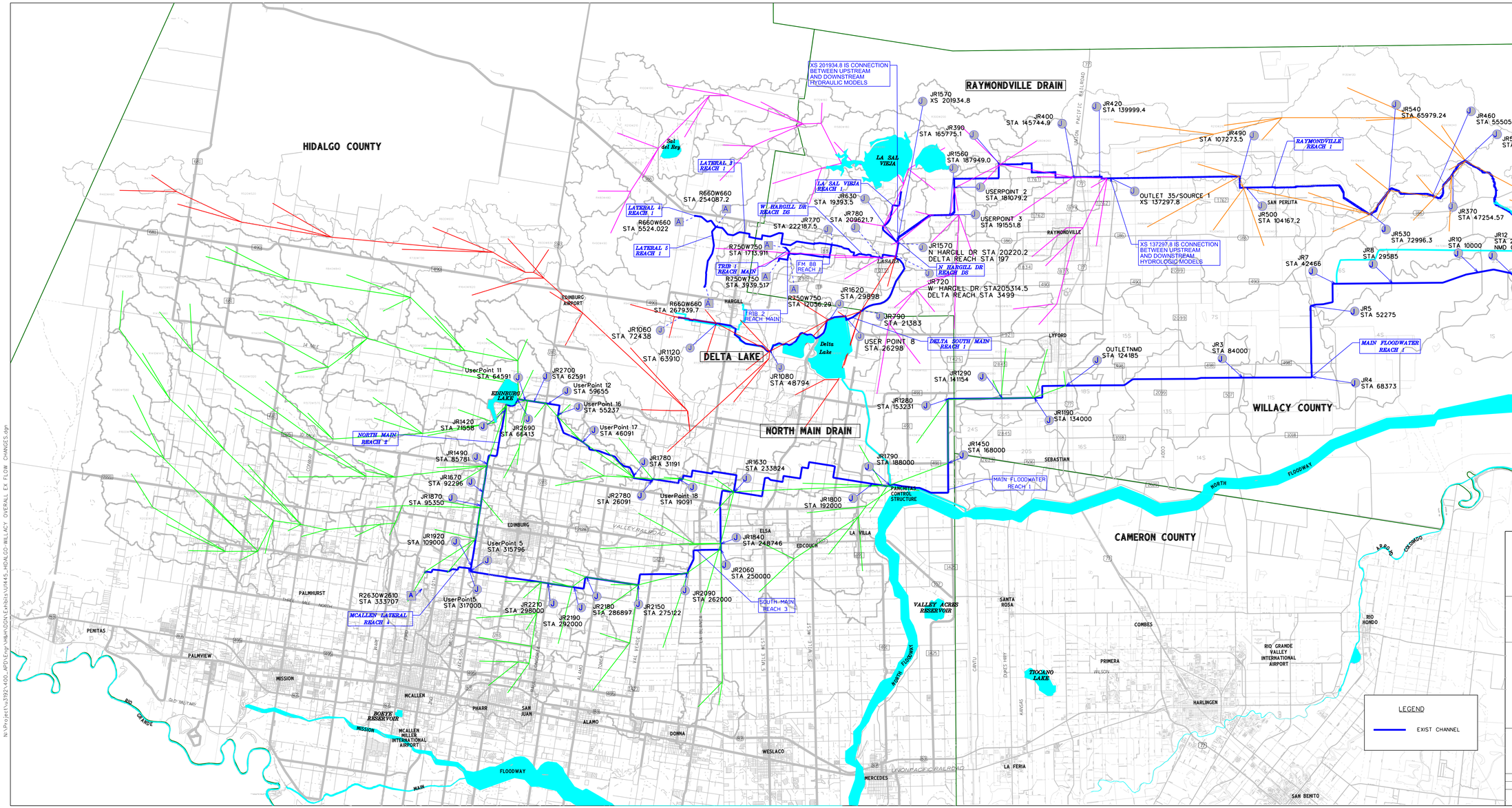
LEGEND

- EXIST CHANNEL
- PROP CHANNEL
- PROP CHANNEL WIDENING (DELTA LAKE)
- PROP CHANNEL WIDENING (WILLACY CO.)

0 8000 16000

SHEET 1 OF 1

STATE	COUNTY	DRAWN BY:	CHECKED BY:	
TX	HIDALGO	PROJECT NO.	U1445	SHEET NO.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WILLACY COUNTY
CAMERON COUNTY
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DELTA LAKE
NORTH MAIN DRAIN
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XS 137297.8 IS CONNECTION BETWEEN UPSTREAM AND DOWNSTREAM HYDROLOGIC MODELS
JR1570 XS 201934.8
JR390 STA 165775.1
JR1560 STA 187949.0
JR400 STA 145744.9
JR420 STA 139999.4
JR490 STA 107273.5
JR540 STA 65979.24
JR460 STA 55505.96
JR590 STA 43401.41
JR OUTLET STA 126.337
USERPOINT 2 STA 181079.2
USERPOINT 3 STA 191551.8
OUTLET 35/SOURCE 1 XS 137297.8
SAN PERLITA
JR500 STA 104167.2
JR370 STA 47254.57
JR530 STA 72996.3
JR10 STA 10000
JR12 STA 2000 NMD OUTLET
JR8 STA 29585
JR7 STA 42466
JR5 STA 52275
JR4 STA 68373
JR3 STA 84000
OUTLETNMD STA 124185
JR1190 STA 134000
JR1290 STA 141154
JR1280 STA 153231
JR1450 STA 168000
JR1790 STA 188000
JR1570 N HARGILL DR STA 20220.2 DELTA REACH STA 197
JR720 W HARGILL DR STA205314.5 DELTA REACH STA 3499
JR790 STA 21383
USER POINT 8 STA 26298
JR1620 STA 29898
JR1080 STA 48794
JR1120 STA 63910
JR1060 STA 72438
R660W660 STA 267939.7
R750W750 STA 12056.29
R750W750 STA 1939.517
R750W750 STA 1713.911
R660W660 STA 254087.2
R660W660 STA 5524.022
JR770 STA 222187.5
JR780 STA 209521.7
JR630 STA 19393.5
LA SAL VIEJA
Sal del Rey
LATERAL 3 REACH 1
LATERAL 4 REACH 1
LATERAL 5 REACH 1
TRIB 1 REACH MAIN
TRIB 2 REACH MAIN
W HARGILL DR REACH DS
LA SAL VIEJA REACH 1
FM 88 REACH 1
N HARGILL DR REACH DS
DELTA SOUTH MAIN REACH 1
RAYMONDVILLE REACH 1
MAIN FLOODWATER REACH 1
NORTH MAIN REACH 2
MCALLEN LATERAL REACH 1
SOUTH MAIN REACH 3
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JR1870 STA 95350
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UserPoint5 STA 317000
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JR2780 STA 26091
UserPoint 18 STA 19091
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EDINBURG LAKE
EDINBURG AIRPORT
HARGILL
LASALLE
RAYMONDVILLE
LYFORD
SEBASTIAN
PANCHITAS CONTROL STRUCTURE
EDINBURG
ELSA
EDCOUCH
LA VILLA
PALMHURST
PENITAS
PALMVIEW
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MCALLEN
PHARR
SAN JUAN
ALAMO
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MERCEDES
LA FERIA
SAN BENITO
HARLINGEN
PRIMERA
COMBES
SANTA ROSA
ARROYO CITY
RIO HONDO
RIO GRANDE VALLEY INTERNATIONAL AIRPORT
MCALLEN MILLER INTERNATIONAL AIRPORT
BORTA RESERVOIR
VALLEY ACRES RESERVOIR
THOCANO LAKE
NORTH FLOODWAY
MAIN FLOODWAY
RIO GRANDE
ARROYO COLORADO
UNION PACIFIC RAILROAD
VALLEY RAILROAD
LEGEND
EXIST CHANNEL
HIDALGO COUNTY DRAINAGE DISTRICT NO. 1
RRP
PROJECT INFLOW LOCATIONS
(PRE-PROJECT CONDITIONS)
RAYMONDVILLE DRAIN AND NORTH MAIN DRAIN
(HIDLAGO & WILLACY COUNTIES)
0 8000 16000
SHEET 1 OF 1
STATE TX
COUNTY HIDALGO
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CHECKED BY:
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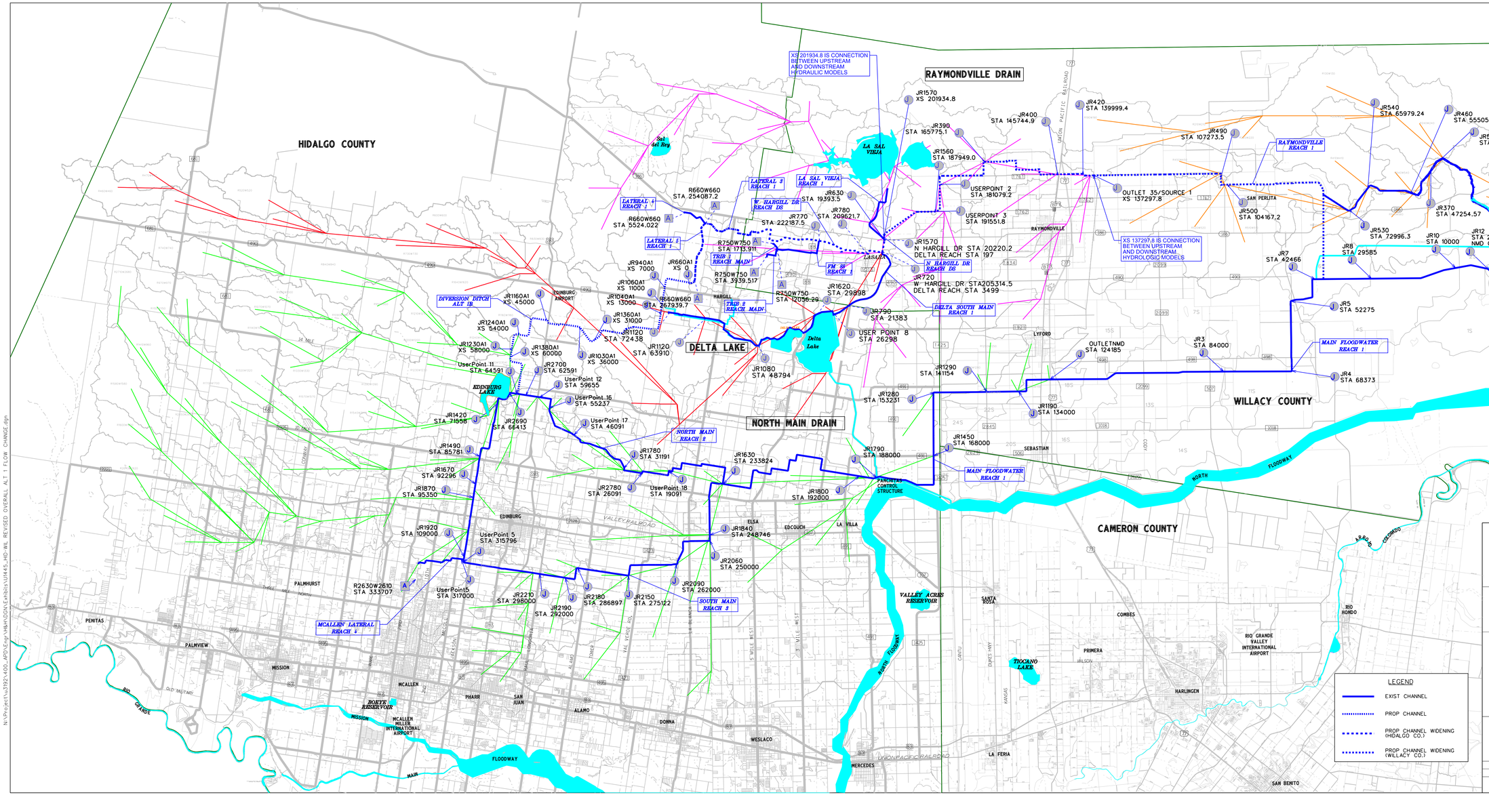
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WILLACY COUNTY
CAMERON COUNTY
RAYMONDVILLE DRAIN
DELTA LAKE
NORTH MAIN DRAIN
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Delta Lake
EDINBURG LAKE
VALLEY ACRES RESERVOIR
THICANO LAKE
BORTE RESERVOIR
PANCHITAS CONTROL STRUCTURE
LATERAL 4 REACH 1
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RAYMONDVILLE REACH 1
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RIO GRANDE FLOODWAY
ARROYO CEGINDO
ARROYO CITY
RIO HONDO
RIO GRANDE
RAYMONDVILLE
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PRIMERA
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EDCOUCH
ELSA
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RIO GRANDE VALLEY INTERNATIONAL AIRPORT
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UNION PACIFIC RAILROAD
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ALTERNATIVE 1
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COUNTY HIDALGO
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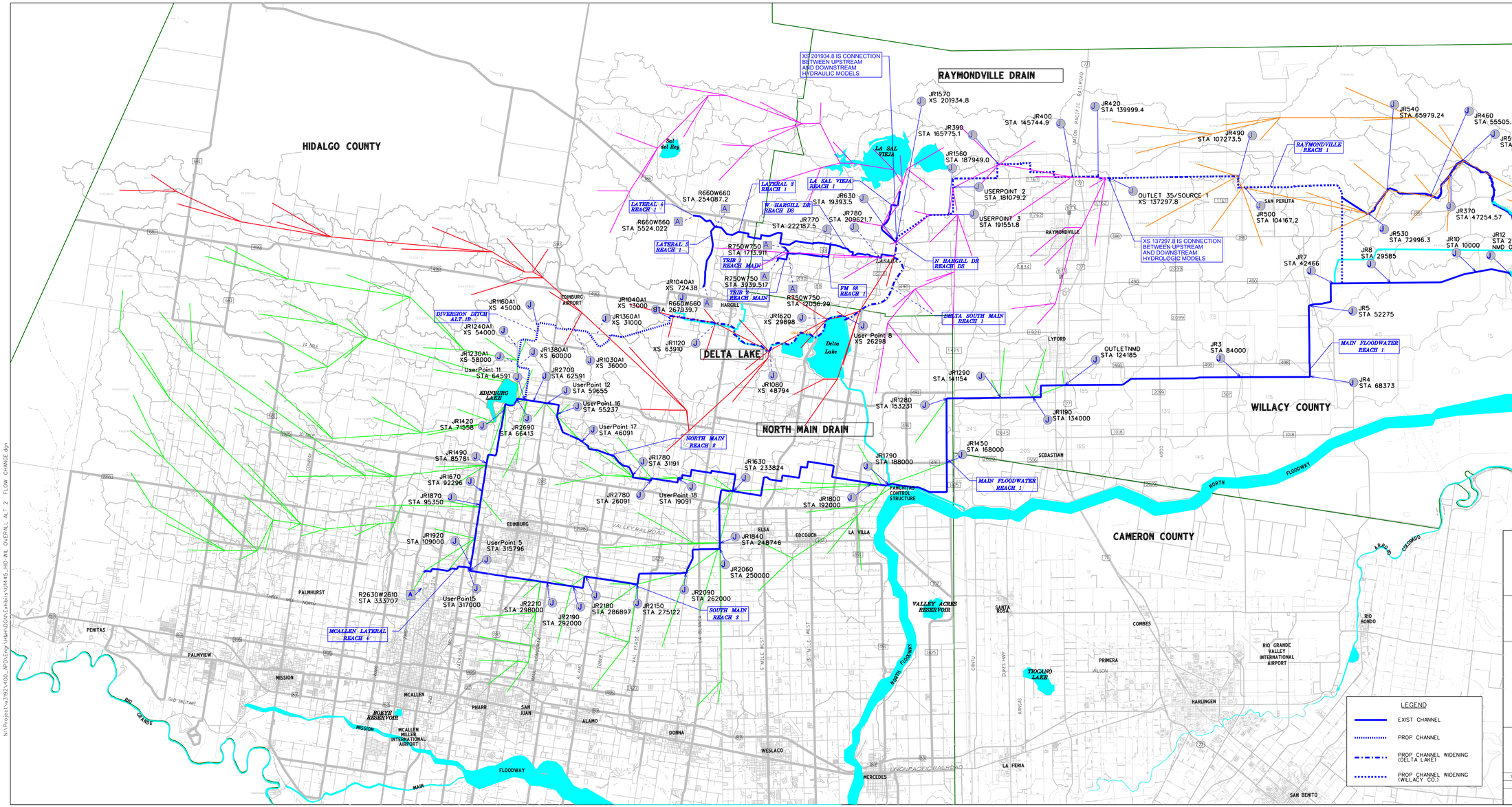
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LA SAL VIEJA
Sal del Rey
LATERAL 4 REACH 1
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TRIB 1 REACH MAIN
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FM 88 REACH 1
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DELTA SOUTH MAIN REACH 1
DIVERSION DITCH ALT. JB
EDINBURG LAKE
NORTH MAIN REACH 2
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MCALLEN LATERAL REACH 4
MAIN FLOODWATER REACH 1
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PANCHITAS CONTROL STRUCTURE
VALLEY ACRES RESERVOIR
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PROP CHANNEL WIDENING (DELTA LAKE)
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HIDALGO COUNTY DRAINAGE DISTRICT NO. 1
RRP
PROJECT INFLOW LOCATIONS
ALTERNATIVE 2
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SHEET 1 OF 1
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COUNTY HIDALGO
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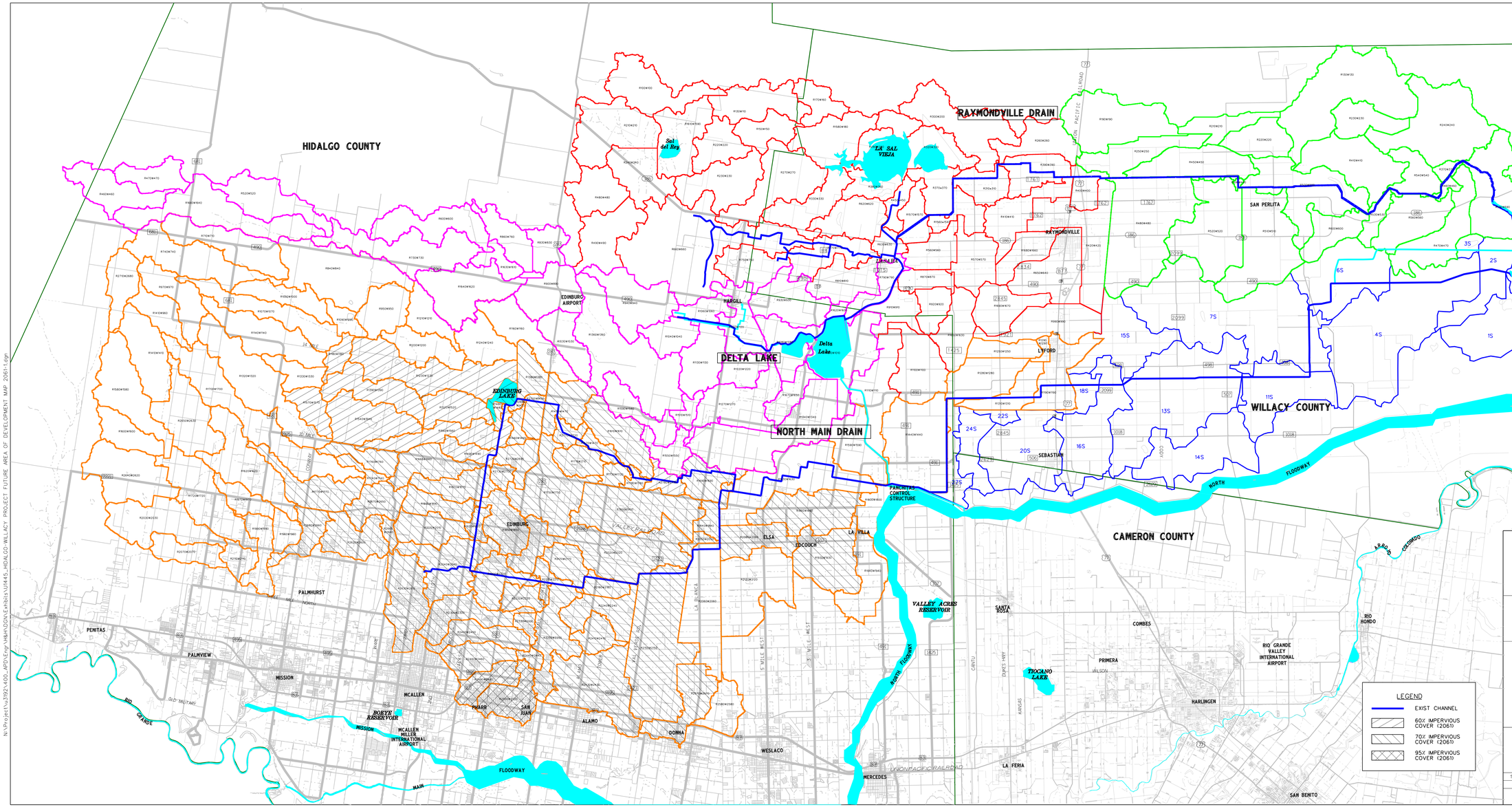


N:\Project\u1392\400_APD\Engr\H&H\DGN\Exhibits\U1445_HIDALGO-WILLACY PROJECT FUTURE AREA OF DEVELOPMENT MAP 2061-1.dgn

Raymondville Drain
Design Task Protocol – 1
Hydrology

The Raymondville Drain is located in the Rio Grande Valley of South Texas including four towns; Raymondville, San Perlita, La Sara, and Hargill. The watershed flows in a west to east direction and the total area is approximately 355 square miles. The model performed by RRP began just downstream of the town of Raymondville and proceeded upstream through Willacy and Hidalgo Counties. In response to RRP's submittal on January 2005, the USACE wrote a draft white paper titled "Raymondville Drain Pre-Project Conditions Report," April 2006. (USACE RDPR) RRP's model is referred to as the 'Upstream HMS Model' since USACE developed the Downstream HMS Model. Outlet 35 is the HMS junction point between the RRP upstream and USACE downstream model. "Preliminary model tests indicated that the models provided by RRP for the upstream portion of the basin under estimate flood frequency at Raymondville" (USACE, April 2006, p. 8).

Required Changes to Upstream HMS Model

RRP performed the hydrologic model in HEC-HMS Version 3.1. The following revisions are needed to correct the model.

1. The original model used a 24-hr Storm Duration; however, the time of concentration for the basin is around 5 days. To be in accordance with the HEC-HMS Technical Reference Manual, "The selected storm must be sufficiently long so that the entire watershed is contributing to runoff at the [basin outlet] concentration point. Thus, the duration must exceed the [travel] time … of the watershed" (Feldman, 2000, p. 35). The adjusted data will be based on a 10-day Storm Duration, as recommended by the USACE.
2. The Control Specification in the RRP HMS model was 24 hours. This time frame is not long enough to describe the entire storm due to the subarea T_cs exceeding 10 hours. The short control time resulted in the subarea hydrograph being truncated or open ended when viewed in the results. In other words, the HMS control and storm duration were not long enough with respect to the time of concentration of the individual subareas to allow total runoff to complete or zero out. The HMS Control will be revised to 30-days.
3. The TR55 program SCS curve number method will only accept a maximum time of concentration of 10 hours and many subareas yield T_cs in excess of this limitation. The program generally defaults to a 10-hour time of concentration when this value is exceeded and yields false results. Since the method is only applicable to a 24-hour storm duration and T_cs less than 10 hours, the Time of Concentration will be calculated manually using Sheet Flow, Shallow Concentrated Flow, and Channel Flow assuming bank full conditions.
4. The SCS Curve Number method assumes $I_a = 0.2S$. The basic fault with the SCS Curve Number Method is that it assumes initial infiltration, losses go to zero. For a 10 day duration, this is not appropriate. It was also noted that the values found in the RRP model could not be equated to this condition and it is unknown how they were derived. The revised method for accounting for infiltration losses will be the Initial / Constant Loss as recommended by the USACE. Since a constant loss is applied to the 10 day

duration, this will duplicate calculating an adjusted Curve Number for a 10-day storm duration, as tabulated in SCS Technical Report 60.

It was found that the SWG draft report recommended this method; however, we found that the I_a values (initial loss) were not calculated with a standard SCS AMC II (average antecedent moisture condition) or $I_a = 0.2S$. This may be an error in the SWG February 2005 model.

5. The point rainfall in the original model was based on the USGS report 98-4044. The data does not provide depth-area adjustments for the various storm durations. The National Weather Bureau Technical Paper No. 40 (TP-40) and Technical Paper No. 49 (TP-49) rainfall has area adjustment factors up to a 10 day storm event and is consistent for the revised model. NOAA Technical Memorandum National Weather Service HYDRO-35 is used for 5-minute and 15-minute rainfall depths; and TP-40 and TP-49 is used for 30-minute to 10-day duration. The point rainfalls for the 2, 5, and 10 year were adjusted, respectively, by 0.88, 0.95, and 0.99. This adjustment is because TP 40 and TP 49 rainfall depths are partial duration data series which also accounts for the second highest value exceeding the highest value of another year. The annual data series accounts for only the highest value. For lower storm frequencies, i.e., 25, 50, 100, 250, and 500, the partial duration and annual series converge. Adjusting the 2, 5, and 10 year values to annual data series allows the HMS frequency storm meteorological models to all be run as annual series rainfall series. Since the HEC HMS program requires input data as partial duration series which is representative of the TP 40 and TP 49 point rainfall depths the annual switch should be used and the HMS program will automatically adjust, internally the partial duration series data to annual.

   The storm area was also changed to 355 square miles for the Raymondville Drain. The depth-area relationship "reduces the point values of precipitation shown on the [TP 49] maps to areal values" (Miller, p. 4). The peak rainfall hyetograph was left at the default storm center of 50%. The other options such as 25% would offset the peak rainfall in the hyetograph, however, trial computations revealed that flow changes were relatively insignificant. The original model used an SCS unit hydrograph with a peaking factor of 484 which is not applicable for flat terrain areas. A more logical peaking factor for the Raymondville Drain, as recommended by USACE, is 150. This peak factor yields results that approximate those documented during Hurricane Beulah.
6. Routing in HEC-HMS used a Muskingum-Cunge 8-point method. The original model used a Manning's Roughness coefficient of 0.06. The adjusted model will use a Manning's n of 0.1 as recommended by USACE "to account for the relatively flat terrain, as well as the numerous roads and elevated irrigation ditches that criss cross the watershed" (USACE, 2006, p. 11).

Procedure

I. Drainage Areas
   a. The watersheds were previously delineated based on surface topography using HEC-GeoHMS Version 1.1. GeoHMS enabled the user to delineate a watershed using digital terrain. Lidar survey data was used in combination with Digital

Elevation Models (DEMs) representing USGS quad maps to develop a 60 ft by 60 ft grid. The subareas are summarized in file RVD_TOCnew.xls.

b. The relatively flat topography required the watershed to be reconditioned which ensures that HEC-GeoHMS identifies the main drain. A line file was created of the drain. This file was burned into the grid to create a more deeply incised feature along the main drain alignment. The longest travel path was determined from this model using GeoHMS, Version 1.1Beta.

II. Time of Concentration (T_c) – USACE provided the following recommendation in the USACE RDPR.

> New … [subarea time of concentrations] were computed using a method for estimating time of concentration. Travel time along the longest flow path in each subbasin is computed based on flow velocity. The method assumes the first 500-ft length is sheet flow, the next length is represented as shallow concentrated flow and is equal to 15% of the total length, and the remaining length is assumed to be channel flow (USACE, p. 10).

USACE assumed velocities in their downstream models as 0.05 fps for sheet flow, 0.1 fps for shallow concentrated flow, and 0.6 fps for open channel flow. The velocity assumptions were decided to be too broad based assumption for all subbasins. In lieu of the assumed velocities, this design task protocol will calculate average velocity as follows:

a. Calculate T_c by adding sheet flow, shallow concentrated flow, and channel flow. Document Time of Concentration calculations in the excel spreadsheet named RVD_TOCnew.xls. The travel path through each subarea was created in GeoHMS and exported as a line file to a Microstation file and will be utilized for total travel distance through each subarea of the watershed.

   i. For Sheet Flow, use the following equation:

$$T_{t1} = \frac{0.007(nL_1)^{0.8}}{(P_2)^{0.5}s^{0.4}}$$

where:

T_{t1}	=	travel time (hr),
n	=	Manning's roughness coefficient (n = 0.10 as per USACE, p. 13)
L_1	=	flow length (500 ft)[1]
P_2	=	2-year, 24-hour rainfall (4.375 in)
s	=	slope of hydraulic grade line (land slope, ft/ft)

[1] Note: The SCS TR55 generally only allows 100 ft and prior 300 ft maximum lengths; however, due to the flat terrain and recommendation by the USACE, 500 ft seems plausible.

ii. Shallow Concentrated Flow – Use fifteen percent of the longest flow path to determine shallow concentrated flow. Calculate travel time as follows:

$$T_{t2} = \frac{0.15L_T}{3600V_1}$$

where:
L_T = longest flow path
V_1 = Velocity (fps)

1. For slopes greater than 0.005 ft/ft, delineate the flow path as either paved or unpaved and use Figure 3-1, "Average Velocities for Estimating Travel Time for Shallow Concentrated Flow", from Urban Hydrology for Small Watersheds, Technical Release 55, June 1986 to obtain the velocity for use in the above equation. the figure is included at the end of this report.
2. Due to the flat terrain within the Raymondville Drain, slopes are predominantly less than 0.005 ft/ft. For this condition, calculate velocity from the following equations:

   For Unpaved $V_1 = 16.1345\ (s)^{0.5}$, or
   For Paved $V_1 = 20.3282\ (s)^{0.5}$

iii. Channel Flow – Determine channel flow using the remaining length of the longest flow path and an existing cross within each drainage area. Obtain cross section from the digital terrain model along the channel section within the subbasin. Use equation:

$$T_{t3} = \frac{L_2}{3600V_2}$$

Determine average flow velocity for bank full elevation using the following equation:

$$V_2 = \frac{1.49r^{2/3}s^{1/2}}{n}$$

where:
V_2 = average velocity (ft/s)
r = hydraulic radius (ft) and is equal to a/p_w
a = cross sectional flow area (ft^2)
p_w = wetted perimeter (ft)
s = slope of the hydraulic grade line (channel slope, ft/ft)
n = Manning's roughness coefficient for open channel flow (n = 0.10)

User Specified Hydrograph

a. Calculate the SCS Unit Hydrograph (UHG) using a standard excel spreadsheet. A sample copy is included at the end of this report. The spreadsheet requires Time of Concentration as determined in Section II of this Design Task Protocol, a time interval within an allowable range based on the T_c, and a Peak Rate Factor (PRF). The standard SCS PRF is 484, but this number does not correctly reflect the flat terrain within the project. All hydrographs are calculated using a PRF of 150.
b. Develop a SCS Unit Hydrograph for each drainage area, or subbasin. In HEC-HMS, edit subbasin and change Transform to User-Specified UH. This selection requires a specific table for each subbasin. Enter the table into HMS via the HMS Project Definition Menu ➔Data➔User Specified Unit Hydrographs. Set time interval to that developed for the UHG in the USACE unit hydrograph spreadsheet. Copy and paste UHG for Selected PRF from excel spreadsheet using Control C (copy) and Control V (paste). One unit hydrograph record is entered for each subbasin.

III. Point Rainfall Data HYDRO-35, TP 40, & TP 49

a. Create an HMS Meteorologic Model for each storm frequency. The Exceedance Probability is the chance that a storm will occur in a single year. The relationship between Storm Frequency and Exceedance Probability is described in Table 1.

Table 1: Storm Frequency and Probability

Storm Frequency	Exceedance Probability
2-year	50%
5-year	20%
10-year	10%
25-year	4%
50-year	2%
100-year	1%
250-year	0.4%
500-year	0.2%

b. For each frequency, obtain the rainfall depths in Hidalgo/Willacy counties as shown in the sample HMS Meterologic Model shown on the following page for 10-Days. Use HYDRO-35 to determine 5-minute and 15-minute durations. Use TP 40 and TP 49, National Weather Bureau dated 1964, to determine durations from 1-hour to 10-days as shown in sample Model.

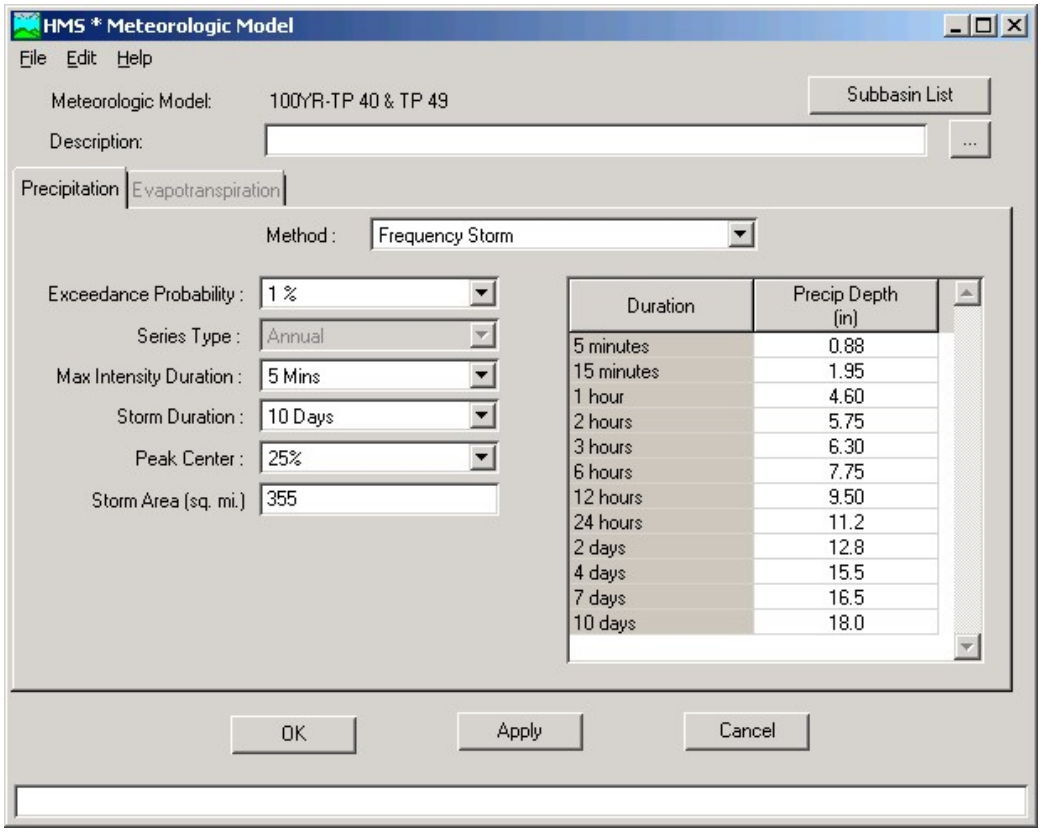
TP 49 states that in frequency analysis there are

> "Two types of series - Frequency analyses of precipitation data are based on one of two types of data series. The annual series consists only of the highest value for each year. The partial-duration series recognizes that the second highest of some year occasionally exceeds the highest of some other year, and utilizes all items above a base value which is selected to yield *n*-items for *n*-years. The highest value of record, of course, is the top value of either series, but the lower values in the partial-duration series tend to be higher than those of the annual series" (p. 2).

The Technical Paper No. 49 uses partial-duration series to determine rainfall depths. For the 2-yr, 5-yr, and 10-yr storms, the rainfall depths need to be converted to annual series as described in Table 2. For storm frequencies equal to or greater than 25-year, the annual and partial duration series data converge.

Table 2: Empirical factors for converting partial-duration series to annual series

Return period	Conversion factor
2-yr.	0.88
5-yr.	0.96
10-yr.	0.99



c. The peak center is set at 25% rather than the default value of 50%. This will cause the location of the peak rainfall amount to occur at 25% in the hyetograph rather than in the center at 50%. The peak flow will occur at day 7 at Outlet 35, or the HMS junction point between the upstream and downstream models as noted by historical records.

d. As stated in Technical Paper No. 49, "Any value read from an isopluvial map for a point is an average depth for the location, for a given return period and duration. The depth-area curve attempts to relate this average point value, for a given duration and frequency and within a given area, to the average depth over that area for the same duration used frequency" (p. 4). The storm area is 355 square miles for the Raymondville watershed. This value is required to be input in order to account for a depth-area relationship which "reduces the point values of

precipitation shown in the [TP 49] maps" and the depth-area curve relationships shown in Figure 10 (Miller, p. 4-5).

IV. Curve Number (CN)

a. Determine the Weighted Curve Number. Use TR-55 to compute Curve Numbers for a 1 Day Storm Duration. Obtain input values for both Land Use and Hydrologic Soil Group (HSG). Although the information for hydrologic soil group is within our current ARC-GIS files, they are not quantified by subbasin, and there is no aerial attachment for land use. The process will be expedited by using the Web Soil Survey 1.1 at http://websoilsurvey.nrcs.usda.gov/app/

   i. Enter the Web Soil Survey and draw an Area of Interest (AOI) that approximately represents a drainage subbasin.
   ii. Once the Area of Interest is selected, go to Soil Properties and Qualities ➔ Soil Qualities and Features ➔ Hydrologic Group and select View Ratings. The website generates a report for the AOI describing the soil names and slopes, HSG for each soil, Total Acres in AOI per soil, and Percent of AOI per Soil.
   iii. Click on the Create Printable Document icon and save PDF version of report to the Project Directory. The report includes an aerial view of the AOI and a theme showing Hydrologic Group.
   iv. The original HMS model obtained the drainage areas for each subbasin from GeoHMS. These values do not require any revisions. Use the percentage of HSG Group A, B, C, and D obtained from the web soil survey and land use observed in the aerial photo to develop a Weighted Curve Number in TR 55. Note the percentage of A, B, C, and D shall total 100%. The total area shall equal the number previously determined by GeoHMS. The maximum area per file in TR-55 is 25 square miles. Once this limit is reached, create a new TR-55 file and document a 1-day, 24 hour Curve Number for each subbasin accordingly.

V. Initial Loss

a. As recommended by USACE, derive the Initial Loss with the following soil conservation service (SCS) equations, which relate the initial loss to the soil curve number.

$$I = 0.2S$$

$$S = \frac{1000-CN}{CN}$$

where:
I = Initial loss (in)
S = Potential Maximum Retention
CN = Curve Number

b. Document the Initial Loss calculations in the Excel Spreadsheet named InitialLoss.xls.

VI. Constant Loss

a. The required constant loss parameter is based on the SCS recommendations for specific hydrologic soil groups. Assign the values shown in Table 3 to each soil group and calculate composite Constant Loss Rate based on proportion of Hydrologic Soil Group as determined using the Web Soil Survey, and the average of the following ranges:

Table 3: SCS Soil Groups and Infiltration (Loss) Rates

Soil Group	Description	Range of Loss Rates (in/hr)
A	Deep sand, deep loess, aggregated silts	0.30-0.45
B	Shallow loess, sandy loam	0.15-0.30
C	Clay loams, shallow sandy loam, soils low in organic content, and soils usually high in clay	0.05-0.15
D	Soils that swell significantly when wet, heavy plastic clays, and certain saline soils	0.00-0.05

These values are calculated on InitialLoss.xls spreadsheet and input into the HMS Model and will be applied to the unit hydrograph for the 10 day duration.

VII. Status of HEC-HMS Models

a. Revise the existing 'Without Project' Model to reflect the changes described in this Design Task Protocol, Hydrology. Copy the corrected HMS Project, as applicable, and revise to represent each proposed alternative. Clearly describe each project alternative and document the basins accordingly.

Documentation

All supporting documentation shall be maintained in a hardcopy format using Calculation Books. The Table of Contents shall be as shown as follows:

Hydrology

I. Design Task Protocol
II. Flow Summary
III. Initial Loss
  a. Initial Loss and Constant Loss Calculation Summary
  b. Hydrologic Soil Group Breakdown by Percentage Summary
  c. Sub-Area Land Use and Curve Number Details
  d. USDA Hydrologic Group Rating for Hidalgo County, Texas (by Subarea)
IV. Time of Concentration
  a. Time of Concentration Calculation Summary
  b. Sub-Watershed Cross Section Details
V. Unit Hydrograph
  a. User Specified Unit Hydrograph
VI. HEC-HMS prints of Input Data

References

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