RAYMONDVILLE DRAIN PROJECT
ECONOMICS APPENDIX A-5

ATTACHMENT A

FDA DESIGN TASK PROTOCOL

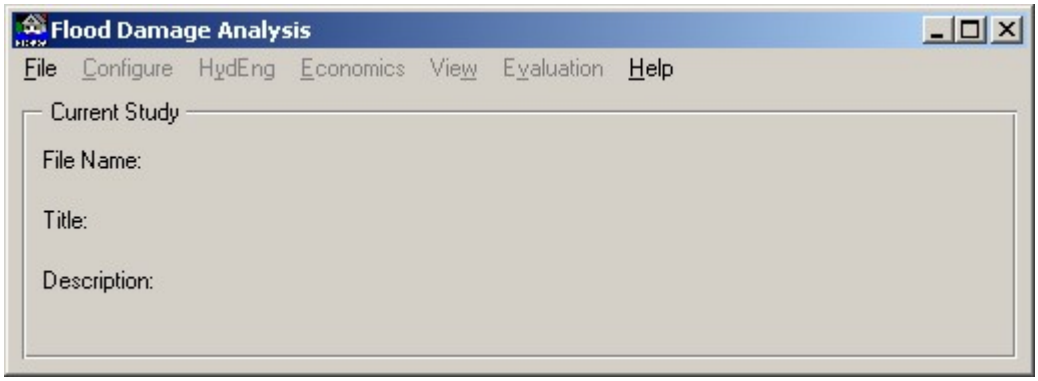
NOTES:

(1) The models described in this document were set-up for a previous submittal, where the PDT examined 4 alternatives. During the update to streamline this SMART Planning report, the PDT eliminated 2 of the alternatives (Alt 2 and 2B), and only carried forward Alt 1B and Alt 3. Alt 1B in this document is identified as Alt 1 in the updated Feasibility Study, and Alt 3 in this document is Alt 2 in the report.

(2) The runs of the models described in this document were based on an earlier assumption of a 2011-2061 period of analysis. In some cases the 2011-2061 dates remain in this background documentation. However, the updated analysis in the 2025 Feasibility Report and Appendix A5 properly reflect the updated 2034-2084 period. The real estate inventory and values used in the FDA runs for this Feasibility Study were updated to current values.

DESIGN TASK PROTOCOL
FLOOD DAMAGE ASSESSMENT

I. FLOOD DAMAGE ASSESSMENT (FDA) PROGRAM GUIDELINES:



This project contains four Flood Damage Study Areas: **Raymondville Drain, Delta South Main, Willacy, and North Main Drain**. The files will be named as follows:

FDA File Name	**Description of Study Area**
RVDFDA.STY	Raymondville Drain
DELTAFDA.STY	Delta South Main
WILLACYFDA.STY	Willacy
NMDFDA.STY	North Main Drain

Each of the above files will contain all the stream, damage reaches, and alternatives (plans) within the study area. ***(Note: The work has to be completed on the C drive and copied over to the project locations before you leave for the day and all files created have to follow the naming convention laid out in this document!)***

1. (CONFIGURE)

Under the CONFIGURE tab this is used to enter information about the study configuration and contains the following commands: **STUDY STREAMS, STUDY DAMAGE REACHES, STUDY ANALYSIS YEARS, AND STUDY PLAN DEFINITION**.

A. STUDY STREAMS and STUDY DAMAGE REACHES:

Under the "STUDY STREAMS" tab the stream name is entered with a short description.

Under the “STUDY DAMAGE REACHES” tab the “STREAM NAME” is entered associating it with the “DAMAGE REACH” name along with the beginning (downstream) and ending (upstream) cross section for the reach and an index cross section. For each of the damage reaches a beginning and ending cross section is identified along with an index cross section. The index cross section is located within the damage reach and is used to specify discharge-probability, stage-discharge, and stage-damage functions with uncertainty data for plan evaluations. In addition the index location station is where data is normally deemed more reliable and does not have to be a water surface profile cross section location. For these study areas the damage reaches include both the right and left overbank areas therefore in the BANK location “both” needs to be checked. The development of the damage reaches was based on the 500-year storm event for the project 2061 flood envelope. This was done to ensure the envelope was large enough to account for all potential damage areas. The streams were divided up into several damage reaches in order to evaluate portions of the stream upstream and downstream of the proposed improvements to document the reduction of damages to the study areas for each alternative.

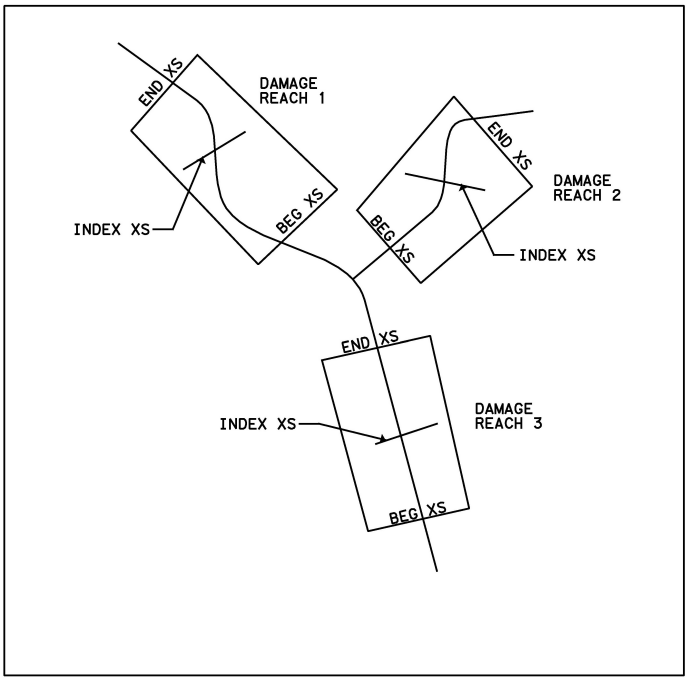


Figure 1 Example of Damage Reaches

The tables below were used to identify each study area (i.e. Willacy, Raymondville, Delta South Main, and North Main Drain), the “stream name”, “damage reach”, “index xs”, “begin xs”, and “end xs” associated within each area.

Table 1
Willacy Damage Reach Data

WILLACY				
STREAM NAME	**DAMAGE REACH**	**INDEX XS**	**BEGIN XS (DS)**	**END XS (US)**
RAYMONDVILLE	SAN PERLITA	98821.820	95954.780	100407.500
	RAY EAST	145390.800	142634.100	145587.500
	RAY WEST	148482.200	145744.900	153697.200

Table 2
Raymondville Damage Reach Data

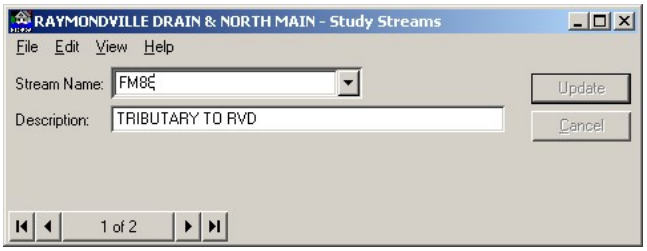
RAYMONDVILLE				
STREAM NAME	**DAMAGE REACH**	**INDEX XS**	**BEGIN XS (DS)**	**END XS (US)**
LATERAL 5	REACH 1A	263093.600	259880.800	267939.700
	REACH 1B	257357.700	254274.100	259880.800
LATERAL 4	REACH 1	2672.863	179.181	5524.022
LATERAL 3	REACH 1A	249591.400	245630.100	254087.200
	REACH 1B	238964.200	228911.400	245630.100
	REACH 1C	225117.500	222350.800	228911.400
TRIB 1	MAIN	1084.980	103.778	1713.911
TRIB 2	MAIN	2252.875	58.205	3939.517
FM 88	REACH 1	7835.994	1645.340	12056.290
W HARGILL DR	DS1	218290.300	214338.900	222187.500
	DS2	209155.800	202313.100	214338.900
LA SAL VIEJA	REACH 1	13607.380	4385.192	19393.500
N HARGILL DR	DS	202069.200	201934.800	202200.200

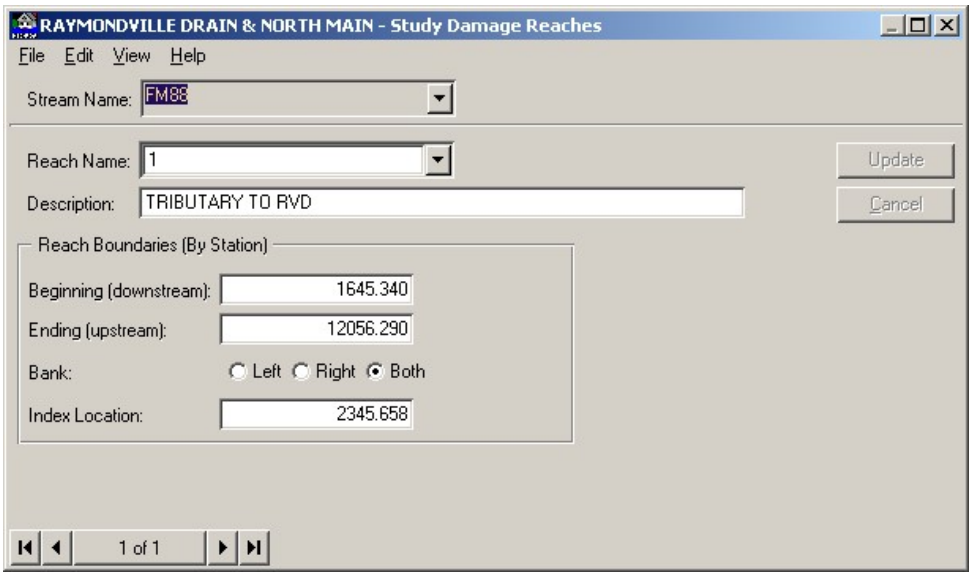
Table 3
Delta South Main Damage Reach Data

DELTA SOUTH MAIN				
STREAM NAME	**DAMAGE REACH**	**INDEX XS**	**BEGIN XS (DS)**	**END XS (US)**
DELTA SOUTH MAIN	REACH 1A	63910.000	56706.000	72438.000
	REACH 1B	40394.000	29898.000	56706.000
	REACH 1C	19526.210	196.869	29898.000

Table 4
North Main Drain Damage Reach Data

NORTH MAIN DRAIN				
STREAM NAME	**DAMAGE REACH**	**INDEX XS**	**BEGIN XS (DS)**	**END XS (US)**
MCALLEN LATERAL	REACH 4	324083.000	317000.000	333707.000
NORTH MAIN	REACH 2W1	94857.000	85628.000	109000.000
	REACH 2W2	75669.000	64591.000	85628.000
	REACH 2N1	46091.000	34191.000	64591.000
	REACH 2N2	22591.000	11971.000	34191.000
	REACH 2N3	5991.000	299.000	11971.000
SOUTH MAIN	REACH 3S1	300000.000	284201.000	315796.000
	REACH 3S2	264000.000	234280.000	284201.000
MAIN FLOODWATER	REACH 1A	219330.000	206000.000	233824.000
	REACH 1B	190000.000	182000.000	206000.000
	REACH 1C	164000.000	150000.000	182000.000
	REACH 1D	128000.000	102000.000	150000.000
	REACH 1E	80000.000	48000.000	102000.000
	REACH 1F	24000.000	0.000	48000.000





B. STUDY YEARS:

Identify the base year and the future years for analysis. A plan exists and is evaluated over an analysis period (project life), normally fifty years. The base year is the first year a plan is implemented and operational. In this case it will be 2035. In Figure 3.11 'Analysis Years', the Most Likely Future is the projection for a specific duration of time, usually 20 to 30 years, for complete development to occur in the study area, which is normally less than the analysis period (project life).

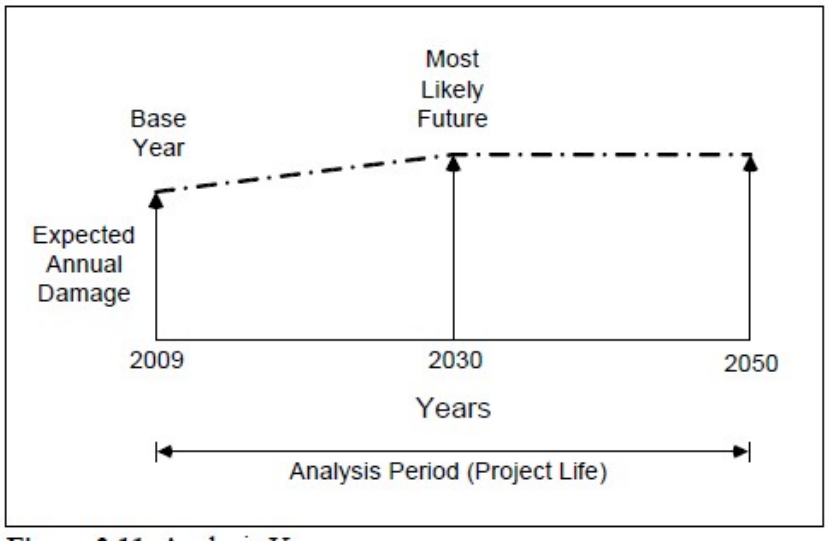
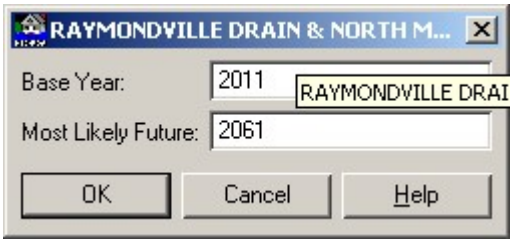


Figure 2 Example of Normal Analysis Years

However, our study area encompasses two counties, Hidalgo and Willacy, the "most likely future" build out will exceed the analysis period (project life). Therefore the "most likely future" will equal the project life which is 50 years or 2085.



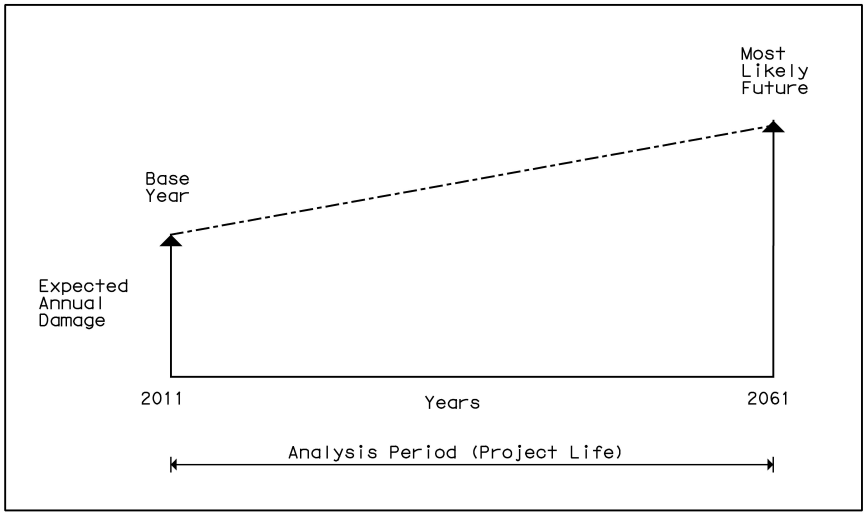
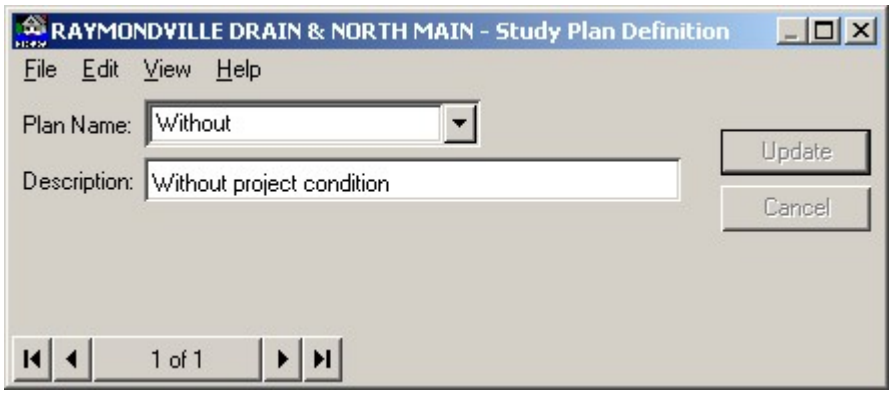


Figure 3 Example of Study's Analysis Years

C. PLAN DEFINITION:



Plans are defined to identify the base (without project) conditions and improvements (with project) conditions.

WITHOUT – without any channel improvements or hydrologic improvements

PLAN1ALT1B - diversion ditch from North Main Drain to Lateral 5 of Raymondville drain with channel improvements to Lateral 5, Lateral 3, and W Hargill Dr of Raymondville Drain and channel improvements to Raymondville of Willacy to the outfall at Laguna Madre. In addition, flow is intercepted from North Main Drain and Delta Lake to Lateral 5 in Raymondville Drain.

PLAN2ALT2B - diversion ditch from North Main Drain to Lateral 5 of Raymondville drain with channel improvements to Lateral 5, Lateral 3, and W Hargill Dr of Raymondville Drain and channel improvements to Raymondville of Willacy to the outfall at Laguna Madre and straightening a portion of the channel. In addition, flow is intercepted from North Main Drain and Delta Lake to Lateral 5 in Raymondville Drain.

PLAN3ALT2 - diversion ditch from North Main Drain to Lateral 5 of Raymondville drain with channel improvements to Lateral 5, Lateral 3, and W Hargill Dr of Raymondville Drain and channel improvements to Raymondville of Willacy up to the diversion ditch from Willacy to North Main Drain and channel improvements from here on North Main Drain to the outfall at Laguna Madre. In addition, flow is intercepted from North Main Drain and Delta Lake to Lateral 5 in Raymondville Drain and diverting flow from Willacy back to North Main Drain.

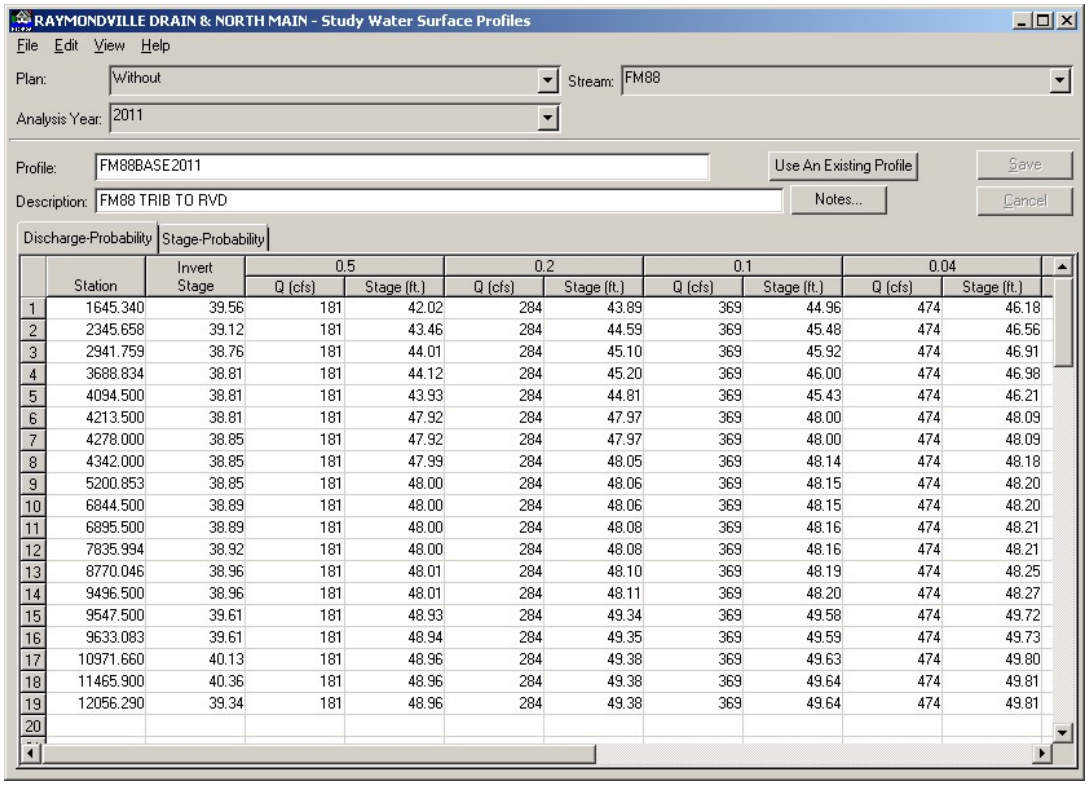
PLAN4ALT3 - diversion ditch from North Main Drain to Lateral 5 of Raymondville drain with channel improvements to Lateral 5, Lateral 3, and W Hargill Dr of Raymondville Drain and channel improvements to Raymondville of Willacy to the outfall at Laguna Madre. In addition, flow is intercepted from North Main Drain to Delta South Main then to W Hargill Dr in Raymondville.

2. (HYDENG)

This menu is used to enter data needed for hydrologic and hydraulic analyses. Available commands are: **STUDY WATER SURFACE PROFILES, EXCEEDANCE-PROBABILITY FUNCTION WITH UNCERTAINTY, STAGE-DISCHARGE FUNCTIONS WITH UNCERTAINTY, AND LEVEE FEATURES.** This project utilizes all except the LEVEE FEATURES.

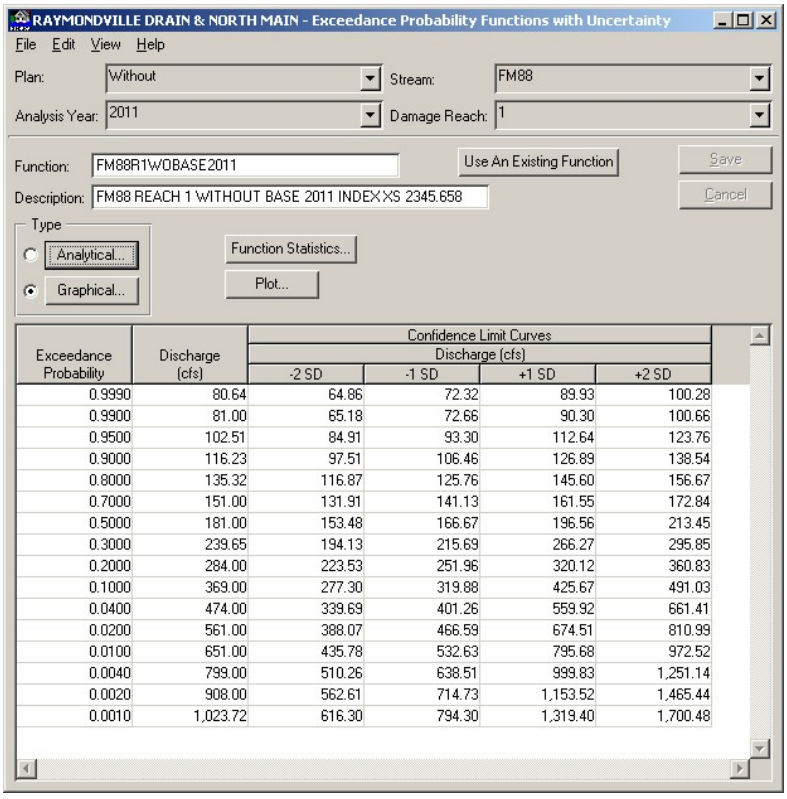
Sequence to follow in the hydrologic engineering section:

1) Import eight (8) water surface profiles. These are the discharge-probability profiles from HEC-RAS. Although the HEC-RAS output will have 9 water surface profiles, the 2, 5, 10, 25, 50 , 100, 250, 500, and Beulah year water surface profiles, the HEC-FDA program only reads eight (8). The default eight will be generated a table format like below and are for the 0.5, 0.2, 0.1, 0.04, 0.02, 0.01, 0.004, 0.002-exceedance probability flood events. The water surface profile stream station values must increase or be equal from downstream to upstream. At the index location, the discharge and stage for each profile must be greater that those from the previous profile.

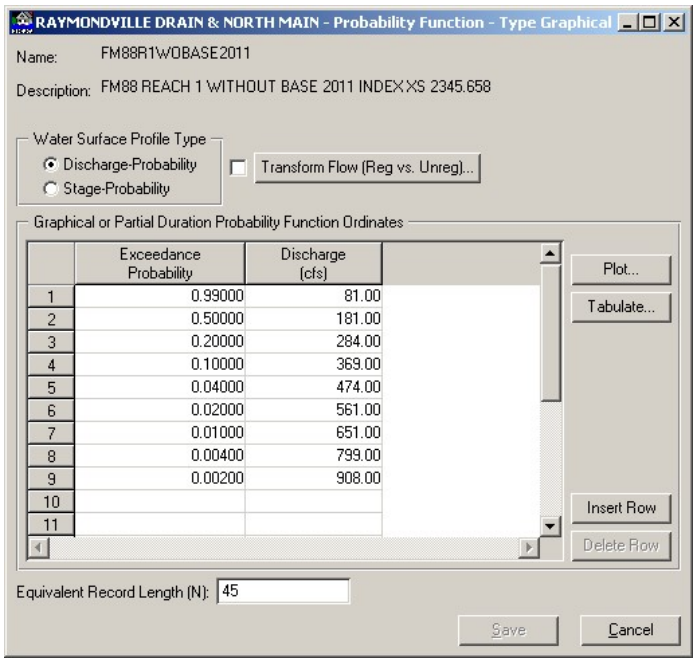


	Station	Invert Stage	0.5		0.2		0.1		0.04	
			Q (cfs)	Stage (ft.)	Q (cfs)	Stage (ft.)	Q (cfs)	Stage (ft.)	Q (cfs)	Stage (ft.)
1	1645.340	39.56	181	42.02	284	43.89	369	44.96	474	46.18
2	2345.658	39.12	181	43.46	284	44.59	369	45.48	474	46.56
3	2941.759	38.76	181	44.01	284	45.10	369	45.92	474	46.91
4	3688.834	38.81	181	44.12	284	45.20	369	46.00	474	46.98
5	4094.500	38.81	181	43.93	284	44.81	369	45.43	474	46.21
6	4213.500	38.81	181	47.92	284	47.97	369	48.00	474	48.09
7	4278.000	38.85	181	47.92	284	47.97	369	48.00	474	48.09
8	4342.000	38.85	181	47.99	284	48.05	369	48.14	474	48.18
9	5200.853	38.85	181	48.00	284	48.06	369	48.15	474	48.20
10	6844.500	38.89	181	48.00	284	48.06	369	48.15	474	48.20
11	6895.500	38.89	181	48.00	284	48.08	369	48.16	474	48.21
12	7835.994	38.92	181	48.00	284	48.08	369	48.16	474	48.21
13	8770.046	38.96	181	48.01	284	48.10	369	48.19	474	48.25
14	9496.500	38.96	181	48.01	284	48.11	369	48.20	474	48.27
15	9547.500	39.61	181	48.93	284	49.34	369	49.58	474	49.72
16	9633.083	39.61	181	48.94	284	49.35	369	49.59	474	49.73
17	10971.660	40.13	181	48.96	284	49.38	369	49.63	474	49.80
18	11465.900	40.36	181	48.96	284	49.38	369	49.64	474	49.81
19	12056.290	39.34	181	48.96	284	49.38	369	49.64	474	49.81
20										

2) For each damage reach retrieve the **graphical probability functions** from the water surface profiles. These are



Exceedance Probability	Discharge (cfs)	Confidence Limit Curves Discharge (cfs)			
		-2 SD	-1 SD	+1 SD	+2 SD
0.9990	80.64	64.86	72.32	89.93	100.28
0.9900	81.00	65.18	72.66	90.30	100.66
0.9500	102.51	84.91	93.30	112.64	123.76
0.9000	116.23	97.51	106.46	126.89	138.54
0.8000	135.32	116.87	125.76	145.60	156.67
0.7000	151.00	131.91	141.13	161.55	172.84
0.5000	181.00	153.48	166.67	196.56	213.45
0.3000	239.65	194.13	215.69	266.27	295.85
0.2000	284.00	223.53	251.96	320.12	360.83
0.1000	369.00	277.30	319.88	425.67	491.03
0.0400	474.00	339.69	401.26	559.92	661.41
0.0200	561.00	388.07	466.59	674.51	810.99
0.0100	651.00	435.78	532.63	795.68	972.52
0.0040	799.00	510.26	638.51	999.83	1,251.14
0.0020	908.00	562.61	714.73	1,153.52	1,465.44
0.0010	1,023.72	616.30	794.30	1,319.40	1,700.48



3. For each discharge-probability function the stage-discharge function needs to be entered from the water surface profiles.

4. no levee data needs to be entered for this project.

D. STUDY WATER SURFACE PROFILES:

Step 1:

Save the FDA Summary Table from HEC-RAS to a text file. First make sure in HEC-RAS the output table lists the cross sections from downstream to upstream (the HEC-2 way). Then open the FDA table format in HEC-RAS. This will have the flow, invert, and water surface elevation. Each Stream (river reach) and plan have separate data files. If more than one Stream or plan is in one data file a ERROR will occur and the data file needs to be re-generated from HEC-RAS. Each River Reach in HEC-RAS is saved as one text file. (Note: when the WSP file is imported into HEC-FDA each water surface file must match the stream name given) In Windows Explorer the extension needs to be changed from .TXT to .WSP so the file can be imported to the HEC-FDA program. Import the water surface profiles files for each of the streams. The tables below contain the files needed for the **pre-project, alt 1b, alt 2, alt 2b, and alt 3** scenarios. **The description for all water surface profiles shall contain the stream name, year, plan name (base, alt 1b, al 2b, alt 2, or alt 3) and WSP**. The proposed ditches in the alternatives are not included in this study since they are designed not to have any damage impacts. Only the existing ditches and their improvements are in the study. Once the water surface profiles have been imported and assigned to the correct streams and year, click on the view tab and water surface profile assignments. This screen will indicate which WSP is assigned to which PLAN, YEAR, and STREAM. If the water surface profile name has an "x" this means the WSE and or Flow does not increase by profile at one or more cross sections and needs to be addressed. If "xxxx" appears this indicates a water surface profile has not been assigned for that particular PLAN, YEAR, and STREAM.

WITHOUT – 2011YR & 2061YR

Table 5
Willacy Base Water Surface Profile Naming Convention

WILLACY			
STREAM NAME	**DAMAGE REACH**	**2011 WSP**	**2061 WSP**
RAYMONDVILLE	SAN PERLITA	RAYBASE2011.WSP	RAYBASE2061.WSP
	RAY EAST		
	RAY WEST		

Table 6
Raymondville Base Water Surface Profile Naming Convention

RAYMONDVILLE			
STREAM NAME	**DAMAGE REACH**	**2011 WSP**	**2061 WSP**
LATERAL 5	REACH 1A	LAT5BASE2011.WSP	LAT5PBASE061.WSP
	REACH 1B		
LATERAL 4	REACH 1	LAT4BASE2011.WSP	LAT4BASE2061.WSP
LATERAL 3	REACH 1A	LAT3BASE2011.WSP	LAT3BASE2061.WSP
	REACH 1B		
	REACH 1C		
TRIB 1	MAIN	TRIB1BASE2011.WSP	TRIB1BASE2061.WSP
TRIB 2	MAIN	TRIB2BASE2011.WSP	TRIB2BASE2061.WSP
FM 88	1	FM88BASE2011.WSP	FM88BASE2061.WSP
W HARGILL DR	DS1	WHARBASE2011.WSP	WHARBASE2061.WSP
	DS2		
LA SAL VIEJA	1	LASALBASE2011.WSP	LASALBASE2061.WSP
N HARGILL DR	DS	NHARBASE2011.WSP	NHARBASE2061.WSP

Table 7
Delta South Main Base Water Surface Profile Naming Convention

DELTA SOUTH MAIN			
STREAM NAME	**DAMAGE REACH**	**2011 WSP**	**2061 WSP**
DELTA SOUTH MAIN	REACH 1A	DELTABASE2011.WSP	DELTABASE2061.WSP
	REACH 1B		
	REACH 1C		

Table 8
North Main Drain Base Water Surface Profile Naming Convention

NORTH MAIN DRAIN			
STREAM NAME	**DAMAGE REACH**	**2011 WSP**	**2061 WSP**
MCALLEN LATERAL	REACH 4	MCALLENBASE2011.WSP	MCALLENBASE2061.WSP
NORTH MAIN	REACH 2W1	NORTHBASE2011.WSP	NORTHBASE2061.WSP
	REACH 2W2		
	REACH 2N1		
	REACH 2N2		
	REACH 2N3		
SOUTH MAIN	REACH 3S1	SOUTHBASE2011.WSP	SOUTHBASE2061.WSP
	REACH 3S2		
MAIN FLOODWATER	REACH 1A	MAINBASE2011.WSP	MAINBASE2061.WSP
	REACH 1B		
	REACH 1C		
	REACH 1D		
	REACH 1E		
	REACH 1F		

PLAN1ALT1B- 2011YR & 2061YR

Table 9
Willacy Alt 1B Water Surface Profile Naming Convention

WILLACY			
STREAM NAME	**DAMAGE REACH**	**2011 WSP**	**2061 WSP**
RAYMONDVILLE	SAN PERLITA	RAYALT1B2011.WSP	RAYALT1B2061.WSP
	RAY EAST		
	RAY WEST		

Table 10
Raymondville Alt 1B Water Surface Profile Naming Convention

RAYMONDVILLE			
STREAM NAME	**DAMAGE REACH**	**2011 WSP**	**2061 WSP**
LATERAL 5	REACH 1A	LAT5ALT1B2011.WSP	LAT5ALT1B2061.WSP
	REACH 1B		
LATERAL 4	REACH 1	LAT4ALT1B2011.WSP	LAT4ALT1B2061.WSP
LATERAL 3	REACH 1A	LAT3ALT1B2011.WSP	LAT3ALT1B2061.WSP
	REACH 1B		
	REACH 1C		
TRIB 1	MAIN	TRIB1ALT1B2011.WSP	TRIB1ALT1B2061.WSP
TRIB 2	MAIN	TRIB2ALT1B2011.WSP	TRIB2ALT1B2061.WSP
FM 88	1	FM88ALT1B2011.WSP	FM88ALT1B2061.WSP
W HARGILL DR	DS1	WHARALT1B2011.WSP	WHARALT1B2061.WSP
	DS2		
LA SAL VIEJA	1	LASALALT1B2011.WSP	LASALALT1B2061.WSP
N HARGILL DR	DS	NHARALT1B2011.WSP	NHARALT1B2061.WSP

Table 11
Delta South Main Alt 1B Water Surface Profile Naming Convention

DELTA SOUTH MAIN			
STREAM NAME	**DAMAGE REACH**	**2011 WSP**	**2061 WSP**
DELTA SOUTH MAIN	REACH 1A	DELTAALT1B2011.WSP	DELTAALT1B2061.WSP
	REACH 1B		
	REACH 1C		

Table 12
North Main Drain Alt 1B Water Surface Profile Naming Convention

NORTH MAIN DRAIN			
STREAM NAME	**DAMAGE REACH**	**2011 WSP**	**2061 WSP**
MCALLEN LATERAL	REACH 4	MCALLENALT1B2011.WSP	MCALLENALT1B2061.WSP
NORTH MAIN	REACH 2W1	NORTHALT1B2011.WSP	NORTHALT1B2061.WSP
	REACH 2W2		
	REACH 2N1		
	REACH 2N2		
	REACH 2N3		
SOUTH MAIN	REACH 3S1	SOUTHALT1B2011.WSP	SOUTHALT1B2061.WSP
	REACH 3S2		
MAIN FLOODWATER	REACH 1A	MAINALT1B2011.WSP	MAINALT1B2061.WSP
	REACH 1B		
	REACH 1C		
	REACH 1D		
	REACH 1E		
	REACH 1F		

PLAN2ALT2B- 2011YR & 2061YR

Table 13
Willacy Alt 2B Water Surface Profile Naming Convention

WILLACY			
STREAM NAME	**DAMAGE REACH**	**2011 WSP**	**2061 WSP**
RAYMONDVILLE	SAN PERLITA	RAYALT2B2011.WSP	RAYALT2B2061.WSP
	RAY EAST		
	RAY WEST		

Table 14
Raymondville Alt 2B Water Surface Profile Naming Convention

RAYMONDVILLE			
STREAM NAME	**DAMAGE REACH**	**2011 WSP**	**2061 WSP**
LATERAL 5	REACH 1A	LAT5ALT2B2011.WSP	LAT5ALT2B2061.WSP
	REACH 1B		
LATERAL 4	REACH 1	LAT4ALT2B2011.WSP	LAT4ALT2B2061.WSP
LATERAL 3	REACH 1A	LAT3ALT2B2011.WSP	LAT3ALT2B2061.WSP
	REACH 1B		
	REACH 1C		
TRIB 1	MAIN	TRIB1ALT2B2011.WSP	TRIB1ALT2B2061.WSP
TRIB 2	MAIN	TRIB2ALT2B2011.WSP	TRIB2ALT2B2061.WSP
FM 88	1	FM88ALT2B2011.WSP	FM88ALT2B2061.WSP
W HARGILL DR	DS1	WHARALT2B2011.WSP	WHARALT2B2061.WSP
	DS2		
LA SAL VIEJA	1	LASALALT2B2011.WSP	LASALALT2B2061.WSP
N HARGILL DR	DS	NHARALT2B2011.WSP	NHARALT2B2061.WSP

Table 15
Delta South Main Alt 2B Water Surface Profile Naming Convention

DELTA SOUTH MAIN			
STREAM NAME	**DAMAGE REACH**	**2011 WSP**	**2061 WSP**
DELTA SOUTH MAIN	REACH 1A	DELTAALT2B2011.WSP	DELTAALT2B2061.WSP
	REACH 1B		
	REACH 1C		

Table 16
North Main Drain Alt 2B Water Surface Profile Naming Convention

NORTH MAIN DRAIN			
STREAM NAME	**DAMAGE REACH**	**2011 WSP**	**2061 WSP**
MCALLEN LATERAL	REACH 4	MCALLENALT2B2011.WSP	MCALLENALT2B2061.WSP
NORTH MAIN	REACH 2W1	NORTHALT2B2011.WSP	NORTHALT2B2061.WSP
	REACH 2W2		
	REACH 2N1		
	REACH 2N2		
	REACH 2N3		
SOUTH MAIN	REACH 3S1	SOUTHALT2B2011.WSP	SOUTHALT2B2061.WSP
	REACH 3S2		
MAIN FLOODWATER	REACH 1A	MAINALT2B2011.WSP	MAINALT2B2061.WSP
	REACH 1B		
	REACH 1C		
	REACH 1D		
	REACH 1E		
	REACH 1F		

PLAN3ALT2- 2011YR & 2061YR

Table 17
Willacy Alt 2 Water Surface Profile Naming Convention

WILLACY			
STREAM NAME	**DAMAGE REACH**	**2011 WSP**	**2061 WSP**
RAYMONDVILLE	SAN PERLITA	RAYALT22011.WSP	RAYALT22061.WSP
	RAY EAST		
	RAY WEST		

Table 18
Raymondville Alt 2 Water Surface Profile Naming Convention

RAYMONDVILLE			
STREAM NAME	**DAMAGE REACH**	**2011 WSP**	**2061 WSP**
LATERAL 5	REACH 1A	LAT5ALT22011.WSP	LAT5ALT22061.WSP
	REACH 1B		
LATERAL 4	REACH 1	LAT4ALT22011.WSP	LAT4ALT22061.WSP
LATERAL 3	REACH 1A	LAT3ALT22011.WSP	LAT3ALT22061.WSP
	REACH 1B		
	REACH 1C		
TRIB 1	MAIN	TRIB1ALT22011.WSP	TRIB1ALT22061.WSP
TRIB 2	MAIN	TRIB2ALT22011.WSP	TRIB2ALT22061.WSP
FM 88	1	FM88ALT22011.WSP	FM88ALT22061.WSP
W HARGILL DR	DS1	WHARALT22011.WSP	WHARALT22061.WSP
	DS2		
LA SAL VIEJA	1	LASALALT22011.WSP	LASALALT22061.WSP
N HARGILL DR	DS	NHARALT22011.WSP	NHARALT22061.WSP

Table 19
Delta South Main Alt 2 Water Surface Profile Naming Convention

DELTA SOUTH MAIN			
STREAM NAME	**DAMAGE REACH**	**2011 WSP**	**2061 WSP**
DELTA SOUTH MAIN	REACH 1A	DELTAALT22011.WSP	DELTAALT22061.WSP
	REACH 1B		
	REACH 1C		

Table 20
North Main Drain Alt 2 Water Surface Profile Naming Convention

NORTH MAIN DRAIN			
STREAM NAME	**DAMAGE REACH**	**2011 WSP**	**2061 WSP**
MCALLEN LATERAL	REACH 4	MCALLENALT22011.WSP	MCALLENALT22061.WSP
NORTH MAIN	REACH 2W1	NORTHALT22011.WSP	NORTHALT22061.WSP
	REACH 2W2		
	REACH 2N1		
	REACH 2N2		
	REACH 2N3		
SOUTH MAIN	REACH 3S1	SOUTHALT22011.WSP	SOUTHALT22061.WSP
	REACH 3S2		
MAIN FLOODWATER	REACH 1A	MAINALT22011.WSP	MAINALT22061.WSP
	REACH 1B		
	REACH 1C		
	REACH 1D		
	REACH 1E		
	REACH 1F		

PLAN4ALT3- 2011YR & 2061YR

Table 21
Willacy Alt 3 Water Surface Profile Naming Convention

WILLACY			
STREAM NAME	**DAMAGE REACH**	**2011 WSP**	**2061 WSP**
RAYMONDVILLE	SAN PERLITA	RAYALT32011.WSP	RAYALT32061.WSP
	RAY EAST		
	RAY WEST		

Table 22
Raymondville Alt 3 Water Surface Profile Naming Convention

RAYMONDVILLE			
STREAM NAME	**DAMAGE REACH**	**2011 WSP**	**2061 WSP**
LATERAL 5	REACH 1A	LAT5ALT32011.WSP	LAT5ALT32061.WSP
	REACH 1B		
LATERAL 4	REACH 1	LAT4ALT32011.WSP	LAT4ALT32061.WSP
LATERAL 3	REACH 1A	LAT3ALT32011.WSP	LAT3ALT32061.WSP
	REACH 1B		
	REACH 1C		
TRIB 1	MAIN	TRIB1ALT32011.WSP	TRIB1ALT32061.WSP
TRIB 2	MAIN	TRIB2ALT32011.WSP	TRIB2ALT32061.WSP
FM 88	1	FM88ALT32011.WSP	FM88ALT32061.WSP
W HARGILL DR	DS1	WHARALT32011.WSP	WHARALT32061.WSP
	DS2		
LA SAL VIEJA	1	LASALALT32011.WSP	LASALALT32061.WSP
N HARGILL DR	DS	NHARALT32011.WSP	NHARALT32061.WSP

Table 23
Delta South Main Alt 3 Water Surface Profile Naming Convention

DELTA SOUTH MAIN			
STREAM NAME	**DAMAGE REACH**	**2011 WSP**	**2061 WSP**
DELTA SOUTH MAIN	REACH 1A	DELTAALT32011.WSP	DELTAALT32061.WSP
	REACH 1B		
	REACH 1C		

Table 24
North Main Drain Alt 3 Water Surface Profile Naming Convention

NORTH MAIN DRAIN			
STREAM NAME	**DAMAGE REACH**	**2011 WSP**	**2061 WSP**
MCALLEN LATERAL	REACH 4	MCALLENALT32011.WSP	MCALLENALT32061.WSP
NORTH MAIN	REACH 2W1	NORTHALT32011.WSP	NORTHALT32061.WSP
	REACH 2W2		
	REACH 2N1		
	REACH 2N2		
	REACH 2N3		
SOUTH MAIN	REACH 3S1	SOUTHALT32011.WSP	SOUTHALT32061.WSP
	REACH 3S2		
MAIN FLOODWATER	REACH 1A	MAINALT32011.WSP	MAINALT32061.WSP
	REACH 1B		
	REACH 1C		
	REACH 1D		
	REACH 1E		
	REACH 1F		

E. EXCEEDANCE PROBABILITY FUNCTIONS WITH UNCERTAINTY:

In order to perform a flood damage analysis that considers flood events of all sizes, a relationship between flood magnitude and the probability of exceeding that magnitude is needed. The exceedance probability functions or frequency curve is that relationship between the flood magnitude and the probability of exceeding that magnitude. The flood event magnitude is defined in terms of discharge (flow) or stage (elevation). An exceedance probability function can be either analytical (discharge-probability) or graphical (discharge- or stage-probability).

Analytical-exceedance probability function is a discharge-probability function that is fit with an analytical distribution. The distribution is defined by statistics which are the mean, standard deviation, and skew for the Log Pearson Type III distribution, and the equivalent record length and uses the procedures laid out in Bulletin 17B. The function is developed by site specific, hydrologic engineering analysis procedures. A "synthetic" approach defined by discharges associated with the 0.50, 0.1, and 0.01 probability events that fit the Log Pearson Type III distribution. Analytical methods often apply for unregulated discharge-probability functions derived from stream gage data or modeling. This method is not utilized here since the flows do not increase from upstream to downstream and would not "fit" the Log Pearson Type III distribution.

The graphical approach is commonly used for regulated and stage-probability functions whether or not they are based on stream gauge records or computed and stage-probability function whether or not they are based on stream gauge records or computed from simulation analysis. The exceedance probability functions will be generated graphically within the HEC-FDA program based on the water surface profiles for the different plans since the flow through the channels fluctuates and does not increase from upstream to downstream. This method will use plotting positions to define the relationship with the actual function fitted by "eye" through the plotting position points. The graphical method uses an approach termed 'order statistics'. (See ETL 1110-2-537 or 'Uncertainty, A Guide to Dealing wit

Uncertainty in Quantitative Risk and Policy Analysis' by Morgan and Henrion.) The uncertainty probability function distributions are assumed normal, thus requiring the use of the Wiebull's plotting positions, representing the expected value definition of the function.

A graphical probability function is defined by specifying the discharge- or stage-probability ordinates and the equivalent record length. The ordinates for this project were generated from the exceedance probability (storm event) and the discharge (flow). While only the 0.5, 0.2, 0.1, 0.04, 0.02, 0.01, 0.004, and 0.002 are calculated for the HEC-HMS and Storm Area Reduction calculations, the 0.999 (1-yr storm event) is entered into the FDA program by subtracting the delta of the 5 year and 2 year discharge from the 2 year discharge. The 0.001 (1000-yr storm event) and several others are extrapolated from the given ordinates. It is important to provide data to the 0.002 or greater event to ensure as much accuracy as possible. The equivalent record length will be 45 year for Willacy County and 60 years for Hidalgo County.

The tables below contain the files needed for the **pre-project, alt 1b, alt 2, alt 2b, and alt 3** scenarios. **The description for all exceedance probability functions shall contain the stream name, damage reach, year, plan name (base, alt 1b, al 2b, alt 2, or alt 3) and exceedance prob function**.

Once the functions are entered, the exceedance probability function assignments needs to be checked to assure all plans have a function assigned and that the function is not missing any information.

WITHOUT – 2011YR & 2061YR

Table 25
Willacy Base Exceedance Probability Function Naming Convention

WILLACY			
STREAM NAME	**DAMAGE REACH**	**2011 EXCEEDANCE PROB. FUNCTION**	**2061 EXCEEDANCE PROB. FUNCTION**
RAYMONDVILLE	SAN PERLITA	RAYSPBASE2011	RAYSPBASE2061
	RAY EAST	RAYREBASE2011	RAYREBASE2061
	RAY WEST	RAYRWBASE2011	RAYRWBASE2061

Table 26
Raymondville Base Exceedance Probability Function Naming Convention

RAYMONDVILLE			
STREAM NAME	**DAMAGE REACH**	**2011 EXCEEDANCE PROB. FUNCTION**	**2061 EXCEEDANCE PROB. FUNCTION**
LATERAL 5	REACH 1A	LAT5R1ABASE2011	LAT5R1ABASE2061
	REACH 1B	LAT5R1BBASE2011	LAT5R1BBASE2061
LATERAL 4	REACH 1	LAT4R1BASE2011	LAT4R1BASE2061
LATERAL 3	REACH 1A	LAT3R1ABASE2011	LAT3R1ABASE2061
	REACH 1B	LAT3R1BBASE2011	LAT3R1BBASE2061
	REACH 1C	LAT3R1CBASE2011	LAT3R1CBASE2061
TRIB 1	MAIN	TRI1MAINBASE2011	TRI1MAINBASE2061
TRIB 2	MAIN	TRI2MAINBASE2011	TRI2MAINBASE2061
FM 88	REACH 1	FM88R1BASE2011	FM88R1BASE2061
W HARGILL DR	DS1	WHARDS1BASE2011	WHARDS1BASE2061
	DS2	WHARDS2BASE2011	WHARDS2BASE2061
LA SAL VIEJA	REACH 1	LASALR1BASE2011	LASALR1BASE2061
N HARGILL DR	DS	NHARDSBASE2011	NHARDSBASE2061

Table 27
Delta South Main Base Exceedance Probability Function Naming Convention

DELTA SOUTH MAIN			
STREAM NAME	**DAMAGE REACH**	**2011 EXCEEDANCE PROB. FUNCTION**	**2061 EXCEEDANCE PROB. FUNCTION**
DELTA SOUTH MAIN	REACH 1A	DELTA1ABASE2011	DELTA1ABASE2061
	REACH 1B	DELTA1BBASE2011	DELTA1BBASE2061
	REACH 1C	DELTA1CBASE2011	DELTA1CBASE2061

Table 28
North Main Drain Base Exceedance Probability Function Naming Convention

NORTH MAIN DRAIN			
STREAM NAME	**DAMAGE REACH**	**2011 EXCEEDANCE PROB. FUNCTION**	**2061 EXCEEDANCE PROB. FUNCTION**
MCALLEN LATERAL	REACH 4	MCALEN4BASE2011	MCALEN4BASE2061
NORTH MAIN	REACH 2W1	NR2W1BASE2011	NR2W1BASE2061
	REACH 2W2	NR2W2BASE2011	NR2W2BASE2061
	REACH 2N1	NR2N1BASE2011	NR2N1BASE2061
	REACH 2N2	NR2N2BASE2011	NR2N2BASE2061
	REACH 2N3	NR2N3BASE2011	NR2N3BASE2061
SOUTH MAIN	REACH 3S1	SR3S1BASE2011	SR3S1BASE2061
	REACH 3S2	SR3S2BASE2011	SR3S2BASE2061
MAIN FLOODWATER	REACH 1A	MAINR1ABASE2011	MAINR1ABASE2061
	REACH 1B	MAINR1BBASE2011	MAINR1BBASE2061
	REACH 1C	MAINR1CBASE2011	MAINR1CBASE2061
	REACH 1D	MAINR1DBASE2011	MAINR1DBASE2061
	REACH 1E	MAINR1EBASE2011	MAINR1EBASE2061
	REACH 1F	MAINR1FBASE2011	MAINR1FBASE2061

PLAN1ALT1B- 2011YR & 2061YR

Table 29
Willacy Alt 1B Exceedance Probability Function Naming Convention

WILLACY			
STREAM NAME	**DAMAGE REACH**	**2011 EXCEEDANCE PROB. FUNCTION**	**2061 EXCEEDANCE PROB. FUNCTION**
RAYMONDVILLE	SAN PERLITA	RAYSPALT1B2011	RAYSPALT1B2061
	RAY EAST	RAYREALT1B2011	RAYREALT1B2061
	RAY WEST	RAYRWALT1B2011	RAYRWALT1B2061

Table 30
Raymondville Alt 1B Exceedance Probability Function Naming Convention

RAYMONDVILLE			
STREAM NAME	**DAMAGE REACH**	**2011 EXCEEDANCE PROB. FUNCTION**	**2061 EXCEEDANCE PROB. FUNCTION**
LATERAL 5	REACH 1A	LAT5R1AALT1B2011	LAT5R1AALT1B2061
	REACH 1B	LAT5R1BALT1B2011	LAT5R1BALT1B2061
LATERAL 4	REACH 1	LAT4R1ALT1B2011	LAT4R1ALT1B2061
LATERAL 3	REACH 1A	LAT3R1AALT1B2011	LAT3R1AALT1B2061
	REACH 1B	LAT3R1BALT1B2011	LAT3R1BALT1B2061
	REACH 1C	LAT3R1CALT1B2011	LAT3R1CALT1B2061
TRIB 1	MAIN	TR1MAINALT1B2011	TR1MAINALT1B2061
TRIB 2	MAIN	TR2MAINALT1B2011	TR2MAINALT1B2061
FM 88	REACH 1	FM88R1ALT1B2011	FM88R1ALT1B2061
W HARGILL DR	DS1	WHARDS1ALT1B2011	WHARDS1ALT1B2061
	DS2	WHARDS2ALT1B2011	WHARDS2ALT1B2061
LA SAL VIEJA	REACH 1	LASALR1ALT1B2011	LASALR1ALT1B2061
N HARGILL DR	DS	NHARDSALT1B2011	NHARDSALT1B2061

Table 31
Delta South Main Alt 1B Exceedance Probability Function Naming Convention

DELTA SOUTH MAIN			
STREAM NAME	**DAMAGE REACH**	**2011 EXCEEDANCE PROB. FUNCTION**	**2061 EXCEEDANCE PROB. FUNCTION**
DELTA SOUTH MAIN	REACH 1A	DELTA1AALT1B2011	DELTA1AALT1B2061
	REACH 1B	DELTA1BALT1B2011	DELTA1BALT1B2061
	REACH 1C	DELTA1CALT1B2011	DELTA1CALT1B2061

Table 32
North Main Drain Alt 1B Exceedance Probability Function Naming Convention

NORTH MAIN DRAIN			
STREAM NAME	**DAMAGE REACH**	**2011 EXCEEDANCE PROB. FUNCTION**	**2061 EXCEEDANCE PROB. FUNCTION**
MCALLEN LATERAL	REACH 4	MCALEN4ALT1B2011	MCALEN4ALT1B2061
NORTH MAIN	REACH 2W1	NR2W1ALT1B2011	NR2W1ALT1B2061
	REACH 2W2	NR2W2ALT1B2011	NR2W2ALT1B2061
	REACH 2N1	NR2N1ALT1B2011	NR2N1ALT1B2061
	REACH 2N2	NR2N2ALT1B2011	NR2N2ALT1B2061
	REACH 2N3	NR2N3ALT1B2011	NR2N3ALT1B2061
SOUTH MAIN	REACH 3S1	SR3S1ALT1B2011	SR3S1ALT1B2061
	REACH 3S2	SR3S2ALT1B2011	SR3S2ALT1B2061
MAIN FLOODWATER	REACH 1A	MAINR1AALT1B2011	MAINR1AALT1B2061
	REACH 1B	MAINR1BALT1B2011	MAINR1BALT1B2061
	REACH 1C	MAINR1CALT1B2011	MAINR1CALT1B2061
	REACH 1D	MAINR1DALT1B2011	MAINR1DALT1B2061
	REACH 1E	MAINR1EALT1B2011	MAINR1EALT1B2061
	REACH 1F	MAINR1FALT1B2011	MAINR1FALT1B2061

PLAN2ALT2B- 2011YR & 2061YR

Table 33
Willacy Alt 2B Exceedance Probability Function Naming Convention

WILLACY			
STREAM NAME	**DAMAGE REACH**	**2011 EXCEEDANCE PROB. FUNCTION**	**2061 EXCEEDANCE PROB. FUNCTION**
RAYMONDVILLE	SAN PERLITA	RAYSPALT2B2011	RAYSPALT2B2061
	RAY EAST	RAYREALT2B2011	RAYREALT2B2061
	RAY WEST	RAYRWALT2B2011	RAYRWALT2B2061

Table 34
Raymondville Alt 2B Exceedance Probability Function Naming Convention

RAYMONDVILLE			
STREAM NAME	**DAMAGE REACH**	**2011 EXCEEDANCE PROB. FUNCTION**	**2061 EXCEEDANCE PROB. FUNCTION**
LATERAL 5	REACH 1A	LAT5R1AALT2B2011	LAT5R1AALT2B2061
	REACH 1B	LAT5R1BALT2B2011	LAT5R1BALT2B2061
LATERAL 4	REACH 1	LAT4R1ALT2B2011	LAT4R1ALT2B2061
LATERAL 3	REACH 1A	LAT3R1AALT2B2011	LAT3R1AALT2B2061
	REACH 1B	LAT3R1BALT2B2011	LAT3R1BALT2B2061
	REACH 1C	LAT3R1CALT2B2011	LAT3R1CALT2B2061
TRIB 1	MAIN	TR1MAINALT2B2011	TR1MAINALT2B2061
TRIB 2	MAIN	TR2MAINALT2B2011	TR2MAINALT2B2061
FM 88	REACH 1	FM88R1ALT2B2011	FM88R1ALT2B2061
W HARGILL DR	DS1	WHARDS1ALT2B2011	WHARDS1ALT2B2061
	DS2	WHARDS2ALT2B2011	WHARDS2ALT2B2061
LA SAL VIEJA	REACH 1	LASALR1ALT2B2011	LASALR1ALT2B2061
N HARGILL DR	DS	NHARDSALT2B2011	NHARDSALT2B2061

Table 35
Delta South Main Alt 2B Exceedance Probability Function Naming Convention

DELTA SOUTH MAIN			
STREAM NAME	**DAMAGE REACH**	**2011 EXCEEDANCE PROB. FUNCTION**	**2061 EXCEEDANCE PROB. FUNCTION**
DELTA SOUTH MAIN	REACH 1A	DELTA1AALT2B2011	DELTA1AALT2B2061
	REACH 1B	DELTA1BALT2B2011	DELTA1BALT2B2061
	REACH 1C	DELTA1CALT2B2011	DELTA1CALT2B2061

Table 36
North Main Drain Alt 2B Exceedance Probability Function Naming Convention

NORTH MAIN DRAIN			
STREAM NAME	**DAMAGE REACH**	**2011 EXCEEDANCE PROB. FUNCTION**	**2061 EXCEEDANCE PROB. FUNCTION**
MCALLEN LATERAL	REACH 4	MCALEN4ALT2B2011	MCALEN4ALT2B2061
NORTH MAIN	REACH 2W1	NR2W1ALT2B2011	NR2W1ALT2B2061
	REACH 2W2	NR2W2ALT2B2011	NR2W2ALT2B2061
	REACH 2N1	NR2N1ALT2B2011	NR2N1ALT2B2061
	REACH 2N2	NR2N2ALT2B2011	NR2N2ALT2B2061
	REACH 2N3	NR2N3ALT2B2011	NR2N3ALT2B2061
SOUTH MAIN	REACH 3S1	SR3S1ALT2B2011	SR3S1ALT2B2061
	REACH 3S2	SR3S2ALT2B2011	SR3S2ALT2B2061
MAIN FLOODWATER	REACH 1A	MAINR1AALT2B2011	MAINR1AALT2B2061
	REACH 1B	MAINR1BALT2B2011	MAINR1BALT2B2061
	REACH 1C	MAINR1CALT2B2011	MAINR1CALT2B2061
	REACH 1D	MAINR1DALT2B2011	MAINR1DALT2B2061
	REACH 1E	MAINR1EALT2B2011	MAINR1EALT2B2061
	REACH 1F	MAINR1FALT2B2011	MAINR1FALT2B2061

PLAN3ALT2- 2011YR & 2061YR

Table 37
Willacy Alt 2 Exceedance Probability Function Naming Convention

WILLACY			
STREAM NAME	**DAMAGE REACH**	**2011 EXCEEDANCE PROB. FUNCTION**	**2061 EXCEEDANCE PROB. FUNCTION**
RAYMONDVILLE	SAN PERLITA	RAYSPALT22011	RAYSPALT22061
	RAY EAST	RAYREALT22011	RAYREALT22061
	RAY WEST	RAYRWALT22011	RAYRWALT22061

Table 38
Raymondville Alt 2 Exceedance Probability Function Naming Convention

RAYMONDVILLE			
STREAM NAME	**DAMAGE REACH**	**2011 EXCEEDANCE PROB. FUNCTION**	**2061 EXCEEDANCE PROB. FUNCTION**
LATERAL 5	REACH 1A	LAT5R1AALT22011	LAT5R1AALT22061
	REACH 1B	LAT5R1BALT22011	LAT5R1BALT22061
LATERAL 4	REACH 1	LAT4R1ALT22011	LAT4R1ALT22061
LATERAL 3	REACH 1A	LAT3R1AALT22011	LAT3R1AALT22061
	REACH 1B	LAT3R1BALT22011	LAT3R1BALT22061
	REACH 1C	LAT3R1CALT22011	LAT3R1CALT22061
TRIB 1	MAIN	TR1MAINALT22011	TR1MAINALT22061
TRIB 2	MAIN	TR2MAINALT22011	TR2MAINALT22061
FM 88	REACH 1	FM88R1ALT22011	FM88R1ALT22061
W HARGILL DR	DS1	WHARDS1ALT22011	WHARDS1ALT22061
	DS2	WHARDS2ALT22011	WHARDS2ALT22061
LA SAL VIEJA	REACH 1	LASALR1ALT22011	LASALR1ALT22061
N HARGILL DR	DS	NHARDSALT22011	NHARDSALT22061

Table 39
Delta South Main Alt 2 Exceedance Probability Function Naming Convention

DELTA SOUTH MAIN			
STREAM NAME	**DAMAGE REACH**	**2011 EXCEEDANCE PROB. FUNCTION**	**2061 EXCEEDANCE PROB. FUNCTION**
DELTA SOUTH MAIN	REACH 1A	DELTA1AALT22011	DELTA1AALT22061
	REACH 1B	DELTA1BALT22011	DELTA1BALT22061
	REACH 1C	DELTA1CALT22011	DELTA1CALT22061

Table 40
North Main Drain Alt 2 Exceedance Probability Function Naming Convention

NORTH MAIN DRAIN			
STREAM NAME	**DAMAGE REACH**	**2011 EXCEEDANCE PROB. FUNCTION**	**2061 EXCEEDANCE PROB. FUNCTION**
MCALLEN LATERAL	REACH 4	MCALEN4ALT22011	MCALEN4ALT22061
NORTH MAIN	REACH 2W1	NR2W1ALT22011	NR2W1ALT22061
	REACH 2W2	NR2W2ALT22011	NR2W2ALT22061
	REACH 2N1	NR2N1ALT22011	NR2N1ALT22061
	REACH 2N2	NR2N2ALT22011	NR2N2ALT22061
	REACH 2N3	NR2N3ALT22011	NR2N3ALT22061
SOUTH MAIN	REACH 3S1	SR3S1ALT22011	SR3S1ALT22061
	REACH 3S2	SR3S2ALT22011	SR3S2ALT22061
MAIN FLOODWATER	REACH 1A	MAINR1AALT22011	MAINR1AALT22061
	REACH 1B	MAINR1BALT22011	MAINR1BALT22061
	REACH 1C	MAINR1CALT22011	MAINR1CALT22061
	REACH 1D	MAINR1DALT22011	MAINR1DALT22061
	REACH 1E	MAINR1EALT22011	MAINR1EALT22061
	REACH 1F	MAINR1FALT22011	MAINR1FALT22061

PLAN4ALT3- 2011YR & 2061YR

Table 41
Willacy Alt 3 Exceedance Probability Function Naming Convention

WILLACY			
STREAM NAME	**DAMAGE REACH**	**2011 EXCEEDANCE PROB. FUNCTION**	**2061 EXCEEDANCE PROB. FUNCTION**
RAYMONDVILLE	SAN PERLITA	RAYSPALT32011	RAYSPALT32061
	RAY EAST	RAYREALT32011	RAYREALT32061
	RAY WEST	RAYRWALT32011	RAYRWALT32061

Table 42
Raymondville Alt 3 Exceedance Probability Function Naming Convention

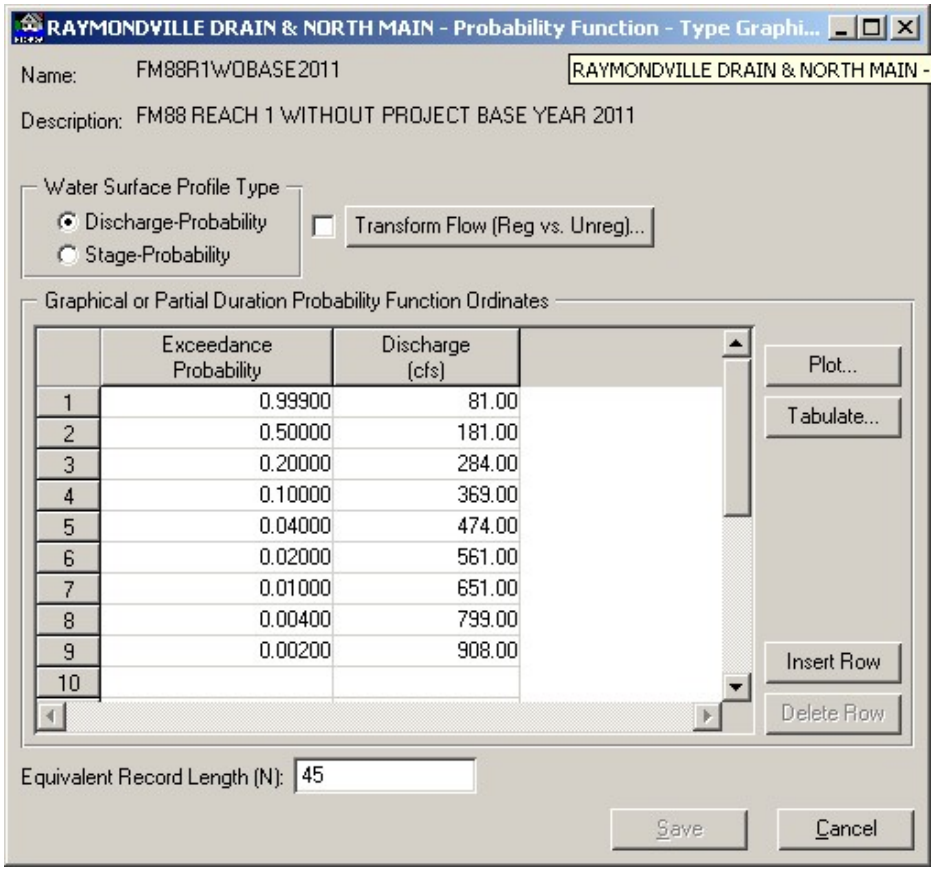
RAYMONDVILLE			
STREAM NAME	**DAMAGE REACH**	**2011 EXCEEDANCE PROB. FUNCTION**	**2061 EXCEEDANCE PROB. FUNCTION**
LATERAL 5	REACH 1A	LAT5R1AALT32011	LAT5R1AALT32061
	REACH 1B	LAT5R1BALT32011	LAT5R1BALT32061
LATERAL 4	REACH 1	LAT4R1ALT32011	LAT4R1ALT32061
LATERAL 3	REACH 1A	LAT3R1AALT32011	LAT3R1AALT32061
	REACH 1B	LAT3R1BALT32011	LAT3R1BALT32061
	REACH 1C	LAT3R1CALT32011	LAT3R1CALT32061
TRIB 1	MAIN	TR1MAINALT32011	TR1MAINALT32061
TRIB 2	MAIN	TR2MAINALT32011	TR2MAINALT32061
FM 88	REACH 1	FM88R1ALT32011	FM88R1ALT32061
W HARGILL DR	DS1	WHARDS1ALT32011	WHARDS1ALT32061
	DS2	WHARDS2ALT32011	WHARDS2ALT32061
LA SAL VIEJA	REACH 1	LASALR1ALT32011	LASALR1ALT32061
N HARGILL DR	DS	NHARDSALT32011	NHARDSALT32061

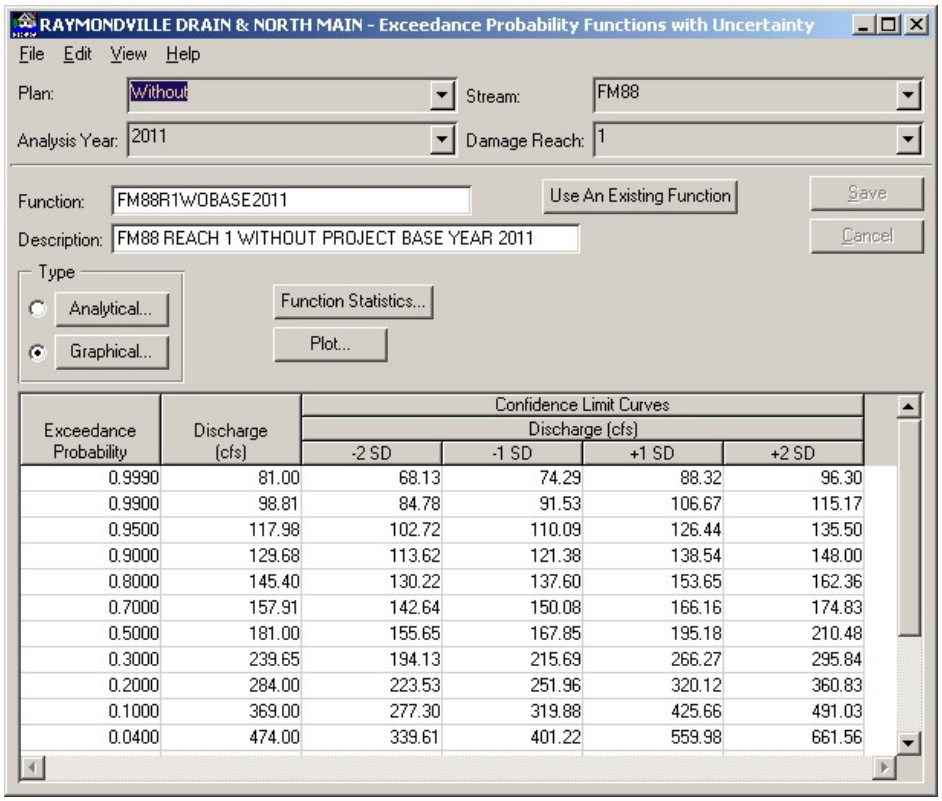
Table 43
Delta South Main Alt 3 Exceedance Probability Function Naming Convention

DELTA SOUTH MAIN			
STREAM NAME	**DAMAGE REACH**	**2011 EXCEEDANCE PROB. FUNCTION**	**2061 EXCEEDANCE PROB. FUNCTION**
DELTA SOUTH MAIN	REACH 1A	DELTA1AALT32011	DELTA1AALT32061
	REACH 1B	DELTA1BALT32011	DELTA1BALT32061
	REACH 1C	DELTA1CALT32011	DELTA1CALT32061

Table 44
North Main Drain Alt 3 Exceedance Probability Function Naming Convention

NORTH MAIN DRAIN			
STREAM NAME	**DAMAGE REACH**	**2011 EXCEEDANCE PROB. FUNCTION**	**2061 EXCEEDANCE PROB. FUNCTION**
MCALLEN LATERAL	REACH 4	MCALEN4ALT32011	MCALEN4ALT32061
NORTH MAIN	REACH 2W1	NR2W1ALT32011	NR2W1ALT32061
	REACH 2W2	NR2W2ALT32011	NR2W2ALT32061
	REACH 2N1	NR2N1ALT32011	NR2N1ALT32061
	REACH 2N2	NR2N2ALT32011	NR2N2ALT32061
	REACH 2N3	NR2N3ALT32011	NR2N3ALT32061
SOUTH MAIN	REACH 3S1	SR3S1ALT32011	SR3S1ALT32061
	REACH 3S2	SR3S2ALT32011	SR3S2ALT32061
MAIN FLOODWATER	REACH 1A	MAINR1AALT32011	MAINR1AALT32061
	REACH 1B	MAINR1BALT32011	MAINR1BALT32061
	REACH 1C	MAINR1CALT32011	MAINR1CALT32061
	REACH 1D	MAINR1DALT32011	MAINR1DALT32061
	REACH 1E	MAINR1EALT32011	MAINR1EALT32061
	REACH 1F	MAINR1FALT32011	MAINR1FALT32061





Exceedance Probability	Discharge (cfs)	Confidence Limit Curves Discharge (cfs) -2 SD	-1 SD	+1 SD	+2 SD
0.9990	81.00	68.13	74.29	88.32	96.30
0.9900	98.81	84.78	91.53	106.67	115.17
0.9500	117.98	102.72	110.09	126.44	135.50
0.9000	129.68	113.62	121.38	138.54	148.00
0.8000	145.40	130.22	137.60	153.65	162.36
0.7000	157.91	142.64	150.08	166.16	174.83
0.5000	181.00	155.65	167.85	195.18	210.48
0.3000	239.65	194.13	215.69	266.27	295.84
0.2000	284.00	223.53	251.96	320.12	360.83
0.1000	369.00	277.30	319.88	425.66	491.03
0.0400	474.00	339.61	401.22	559.98	661.56

F. STAGE DISCHARGE FUNCTION WITH UNCERTAINTY:

A stage-discharge function (rating curve) is the relations ship between the discharge (flow) at a particular river cross section and the stage (elevation) produced by that discharge. This function is used to determine the uncertainty when the exceedance probability function is defined as discharge and stage. Either NONE, NORMAL, TRIANGULAR, or LOG NORMAL is selected to compute or not compute the uncertainty.

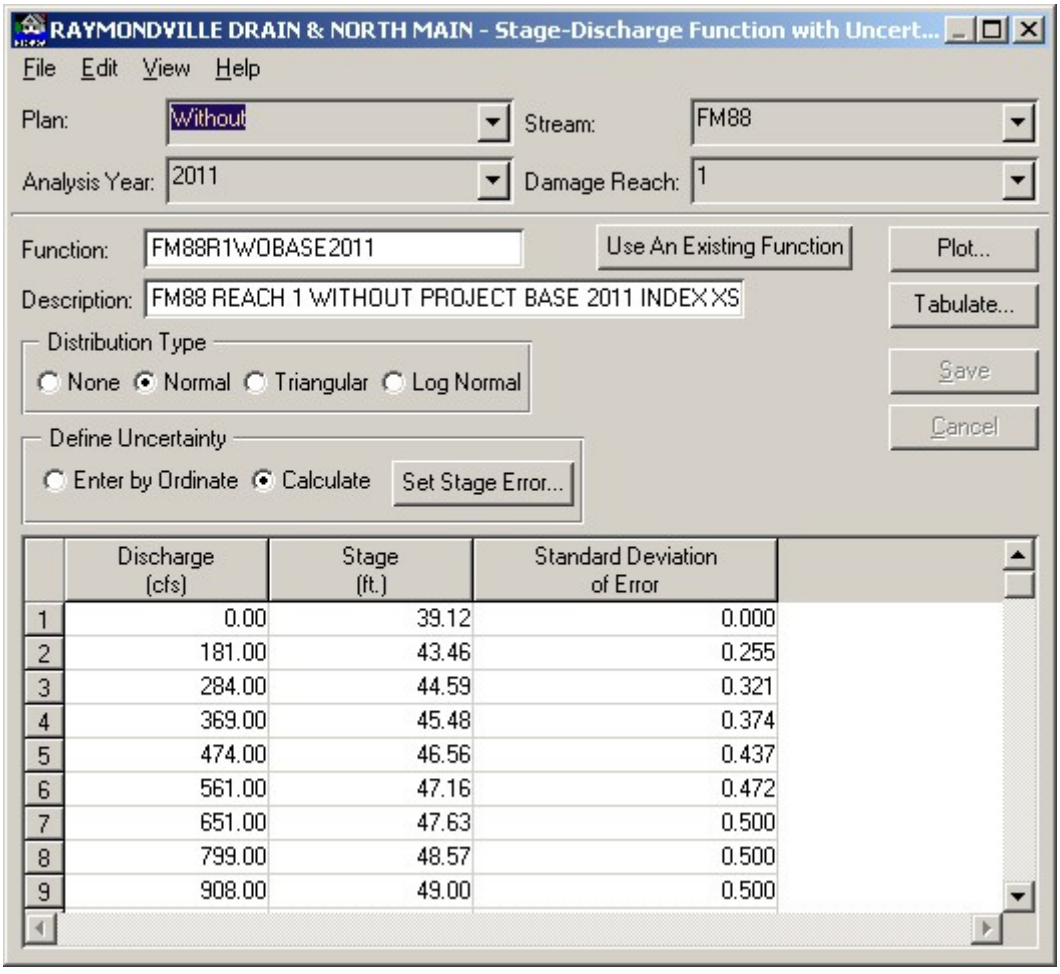
- NONE is not uncertainty is assumed (this will not be used)
- NORMAL – a two parameter probability distribution defined by the mean and standard deviation. A symmetrical "bell shaped" curve applicable to many kinds of data sets where values are equally likely to be greater than or less than the mean. Also called a Gaussian distribution. The distribution is truncated at three standard deviations.
- TRIANGULAR DISTRIBUTION – A three-parameter bounded probability distribution defined by the minimum, most likely (mode), and maximum. (this will not be used)
- LOG NORMAL DISTRIBUTION – a two-parameter probability distribution defined by the mean and standard deviation. A no-symmetrical distribution applicable to many kinds of data sets where the majority (more than half) of values are less than the mean but values greater tan the mean can be extreme, such as with stream flow data. The distribution is truncated at three standard deviations. (this will not be used)

"Log Normal" distribution is not utilized for this project since the discharges for this study area do not increase going downstream. "None" is not used since the discharges and stages are not gage data or

documented. “Triangular distribution”, although the simplest, only requiring the use of three points the mode and the range is not utilized for this project. The range is the minimum and maximum values and the mode is the most frequently occurring value or the peak value.

The uncertainty can be enter either manually by each ordinate or specify “calculate” to define the uncertainty for a specific stage. The uncertainty parameter will be calculated for the purpose of this study. In order for the calculations to be performed, the “stage error” needs to be set for the normal distribution. This is the 100 year water surface elevation at the index cross section for the damage reach with a standard deviation of 0.5 foot.

To enter the data into the FDA program, select the PLAN, STREAM, ANALYSIS YEAR, and DAMAGE REACH. Next Click on “EDIT” then “RETRIEVE FROM WSP” this will bring in the 9 coordinate points needed for the function. The program automatically sets 0 cfs with the invert elevation of the ‘INDEX CROSS SECTION’ of the ‘DAMAGE REACH’. Then the next eight (8) will be generated from the WSP file. For the Distribution Type select ‘NORMAL’ then select ‘CALCULATE’. On the ‘SET STAGE ERROR FOR DISTRIBUTION TYPE’ GUI, the ‘Stage Where Error Becomes Constant’ will be the 100 year water surface elevation at the INDEX CROSS SECTION and the ‘Standard Deviation of Error for the Entered Stage’ will by 0.5 ft.



	Discharge (cfs)	Stage (ft.)	Standard Deviation of Error
1	0.00	39.12	0.000
2	181.00	43.46	0.255
3	284.00	44.59	0.321
4	369.00	45.48	0.374
5	474.00	46.56	0.437
6	561.00	47.16	0.472
7	651.00	47.63	0.500
8	799.00	48.57	0.500
9	908.00	49.00	0.500

Below is the names for the exceedance probability functions for the without project and all of the alternatives. **The description for all stage discharge functions shall contain the stream name, damage reach, year, plan name (base, alt 1b, al 2b, alt 2, or alt 3) and stage discharge function.**

Once the functions are entered, the stage discharge function assignments needs to be checked to assure all plans have a function assigned and that the function is not missing any information.

WITHOUT – 2011YR & 2061YR

Table 45
Willacy Base Stage Discharge Function Naming Convention

WILLACY			
STREAM NAME	**DAMAGE REACH**	**2011 STAGE DISCHARGE FUNCTION**	**2061 STAGE DISCHARGE FUNCTION**
RAYMONDVILLE	SAN PERLITA	RAYSPBASE2011	RAYSPBASE2061
	RAY EAST	RAYREBASE2011	RAYREBASE2061
	RAY WEST	RAYRWBASE2011	RAYRWBASE2061

Table 46
Raymondville Base Stage Discharge Function Naming Convention

RAYMONDVILLE			
STREAM NAME	**DAMAGE REACH**	**2011 STAGE DISCHARGE FUNCTION**	**2061 STAGE DISCHARGE FUNCTION**
LATERAL 5	REACH 1A	LAT5R1ABASE2011	LAT5R1ABASE2061
	REACH 1B	LAT5R1BBASE2011	LAT5R1BBASE2061
LATERAL 4	REACH 1	LAT4R1BASE2011	LAT4R1BASE2061
LATERAL 3	REACH 1A	LAT3R1ABASE2011	LAT3R1ABASE2061
	REACH 1B	LAT3R1BBASE2011	LAT3R1BBASE2061
	REACH 1C	LAT3R1CBASE2011	LAT3R1CBASE2061
TRIB 1	MAIN	TRI1MAINBASE2011	TRI1MAINBASE2061
TRIB 2	MAIN	TRI2MAINBASE2011	TRI2MAINBASE2061
FM 88	REACH 1	FM88R1BASE2011	FM88R1BASE2061
W HARGILL DR	DS1	WHARDS1BASE2011	WHARDS1BASE2061
	DS2	WHARDS2BASE2011	WHARDS2BASE2061
LA SAL VIEJA	REACH 1	LASALR1BASE2011	LASALR1BASE2061
N HARGILL DR	DS	NHARDSBASE2011	NHARDSBASE2061

Table 47
Delta South Main Base Stage Discharge Function Naming Convention

DELTA SOUTH MAIN			
STREAM NAME	**DAMAGE REACH**	**2011 STAGE DISCHARGE FUNCTION**	**2061 STAGE DISCHARGE FUNCTION**
DELTA SOUTH MAIN	REACH 1A	DELTA1ABASE2011	DELTA1ABASE2061
	REACH 1B	DELTA1BBASE2011	DELTA1BBASE2061
	REACH 1C	DELTA1CBASE2011	DELTA1CBASE2061

Table 48
North Main Drain Base Stage Discharge Function Naming Convention

NORTH MAIN DRAIN			
STREAM NAME	**DAMAGE REACH**	**2011 STAGE DISCHARGE FUNCTION**	**2061 STAGE DISCHARGE FUNCTION**
MCALLEN LATERAL	REACH 4	MCALEN4BASE2011	MCALEN4BASE2061
NORTH MAIN	REACH 2W1	NR2W1BASE2011	NR2W1BASE2061
	REACH 2W2	NR2W2BASE2011	NR2W2BASE2061
	REACH 2N1	NR2N1BASE2011	NR2N1BASE2061
	REACH 2N2	NR2N2BASE2011	NR2N2BASE2061
	REACH 2N3	NR2N3BASE2011	NR2N3BASE2061
SOUTH MAIN	REACH 3S1	SR3S1BASE2011	SR3S1BASE2061
	REACH 3S2	SR3S2BASE2011	SR3S2BASE2061
MAIN FLOODWATER	REACH 1A	MAINR1ABASE2011	MAINR1ABASE2061
	REACH 1B	MAINR1BBASE2011	MAINR1BBASE2061
	REACH 1C	MAINR1CBASE2011	MAINR1CBASE2061
	REACH 1D	MAINR1DBASE2011	MAINR1DBASE2061
	REACH 1E	MAINR1EBASE2011	MAINR1EBASE2061
	REACH 1F	MAINR1FBASE2011	MAINR1FBASE2061

PLAN1ALT1B- 2011YR & 2061YR

Table 49
Willacy Alt 1B Stage Discharge Function Naming Convention

WILLACY			
STREAM NAME	**DAMAGE REACH**	**2011 STAGE DISCHARGE FUNCTION**	**2061 STAGE DISCHARGE FUNCTION**
RAYMONDVILLE	SAN PERLITA	RAYSPALT1B2011	RAYSPALT1B2061
	RAY EAST	RAYREALT1B2011	RAYREALT1B2061
	RAY WEST	RAYRWALT1B2011	RAYRWALT1B2061

Table 50
Raymondville Alt 1B Stage Discharge Function Naming Convention

RAYMONDVILLE			
STREAM NAME	**DAMAGE REACH**	**2011 STAGE DISCHARGE FUNCTION**	**2061 STAGE DISCHARGE FUNCTION**
LATERAL 5	REACH 1A	LAT5R1AALT1B2011	LAT5R1AALT1B2061
	REACH 1B	LAT5R1BALT1B2011	LAT5R1BALT1B2061
LATERAL 4	REACH 1	LAT4R1ALT1B2011	LAT4R1ALT1B2061
LATERAL 3	REACH 1A	LAT3R1AALT1B2011	LAT3R1AALT1B2061
	REACH 1B	LAT3R1BALT1B2011	LAT3R1BALT1B2061
	REACH 1C	LAT3R1CALT1B2011	LAT3R1CALT1B2061
TRIB 1	MAIN	TR1MAINALT1B2011	TR1MAINALT1B2061
TRIB 2	MAIN	TR2MAINALT1B2011	TR2MAINALT1B2061
FM 88	REACH 1	FM88R1ALT1B2011	FM88R1ALT1B2061
W HARGILL DR	DS1	WHARDS1ALT1B2011	WHARDS1ALT1B2061
	DS2	WHARDS2ALT1B2011	WHARDS2ALT1B2061
LA SAL VIEJA	REACH 1	LASALR1ALT1B2011	LASALR1ALT1B2061
N HARGILL DR	DS	NHARDSALT1B2011	NHARDSALT1B2061

Table 51
Delta South Main Alt 1B Stage Discharge Function Naming Convention

DELTA SOUTH MAIN			
STREAM NAME	**DAMAGE REACH**	**2011 STAGE DISCHARGE FUNCTION**	**2061 STAGE DISCHARGE FUNCTION**
DELTA SOUTH MAIN	REACH 1A	DELTA1AALT1B2011	DELTA1AALT1B2061
	REACH 1B	DELTA1BALT1B2011	DELTA1BALT1B2061
	REACH 1C	DELTA1CALT1B2011	DELTA1CALT1B2061

Table 52
North Main Drain Alt 1B Stage Discharge Function Naming Convention

NORTH MAIN DRAIN			
STREAM NAME	**DAMAGE REACH**	**2011 STAGE DISCHARGE FUNCTION**	**2061 STAGE DISCHARGE FUNCTION**
MCALLEN LATERAL	REACH 4	MCALEN4ALT1B2011	MCALEN4ALT1B2061
NORTH MAIN	REACH 2W1	NR2W1ALT1B2011	NR2W1ALT1B2061
	REACH 2W2	NR2W2ALT1B2011	NR2W2ALT1B2061
	REACH 2N1	NR2N1ALT1B2011	NR2N1ALT1B2061
	REACH 2N2	NR2N2ALT1B2011	NR2N2ALT1B2061
	REACH 2N3	NR2N3ALT1B2011	NR2N3ALT1B2061
SOUTH MAIN	REACH 3S1	SR3S1ALT1B2011	SR3S1ALT1B2061
	REACH 3S2	SR3S2ALT1B2011	SR3S2ALT1B2061
MAIN FLOODWATER	REACH 1A	MAINR1AALT1B2011	MAINR1AALT1B2061
	REACH 1B	MAINR1BALT1B2011	MAINR1BALT1B2061
	REACH 1C	MAINR1CALT1B2011	MAINR1CALT1B2061
	REACH 1D	MAINR1DALT1B2011	MAINR1DALT1B2061
	REACH 1E	MAINR1EALT1B2011	MAINR1EALT1B2061
	REACH 1F	MAINR1FALT1B2011	MAINR1FALT1B2061

PLAN2ALT2B- 2011YR & 2061YR

Table 53
Willacy Alt 2B Stage Discharge Function Naming Convention

WILLACY			
STREAM NAME	**DAMAGE REACH**	**2011 STAGE DISCHARGE FUNCTION**	**2061 STAGE DISCHARGE FUNCTION**
RAYMONDVILLE	SAN PERLITA	RAYSPALT2B2011	RAYSPALT2B2061
	RAY EAST	RAYREALT2B2011	RAYREALT2B2061
	RAY WEST	RAYRWALT2B2011	RAYRWALT2B2061

Table 54
Raymondville Alt 2B Stage Discharge Function Naming Convention

RAYMONDVILLE			
STREAM NAME	**DAMAGE REACH**	**2011 STAGE DISCHARGE FUNCTION**	**2061 STAGE DISCHARGE FUNCTION**
LATERAL 5	REACH 1A	LAT5R1AALT2B2011	LAT5R1AALT2B2061
	REACH 1B	LAT5R1BALT2B2011	LAT5R1BALT2B2061
LATERAL 4	REACH 1	LAT4R1ALT2B2011	LAT4R1ALT2B2061
LATERAL 3	REACH 1A	LAT3R1AALT2B2011	LAT3R1AALT2B2061
	REACH 1B	LAT3R1BALT2B2011	LAT3R1BALT2B2061
	REACH 1C	LAT3R1CALT2B2011	LAT3R1CALT2B2061
TRIB 1	MAIN	TR1MAINALT2B2011	TR1MAINALT2B2061
TRIB 2	MAIN	TR2MAINALT2B2011	TR2MAINALT2B2061
FM 88	REACH 1	FM88R1ALT2B2011	FM88R1ALT2B2061
W HARGILL DR	DS1	WHARDS1ALT2B2011	WHARDS1ALT2B2061
	DS2	WHARDS2ALT2B2011	WHARDS2ALT2B2061
LA SAL VIEJA	REACH 1	LASALR1ALT2B2011	LASALR1ALT2B2061
N HARGILL DR	DS	NHARDSALT2B2011	NHARDSALT2B2061

Table 55
Delta South Main Alt 2B Stage Discharge Function Naming Convention

DELTA SOUTH MAIN			
STREAM NAME	**DAMAGE REACH**	**2011 STAGE DISCHARGE FUNCTION**	**2061 STAGE DISCHARGE FUNCTION**
DELTA SOUTH MAIN	REACH 1A	DELTA1AALT2B2011	DELTA1AALT2B2061
	REACH 1B	DELTA1BALT2B2011	DELTA1BALT2B2061
	REACH 1C	DELTA1CALT2B2011	DELTA1CALT2B2061

Table 56
North Main Drain Alt 2B Stage Discharge Function Naming Convention

NORTH MAIN DRAIN			
STREAM NAME	**DAMAGE REACH**	**2011 STAGE DISCHARGE FUNCTION**	**2061 STAGE DISCHARGE FUNCTION**
MCALLEN LATERAL	REACH 4	MCALEN4ALT2B2011	MCALEN4ALT2B2061
NORTH MAIN	REACH 2W1	NR2W1ALT2B2011	NR2W1ALT2B2061
	REACH 2W2	NR2W2ALT2B2011	NR2W2ALT2B2061
	REACH 2N1	NR2N1ALT2B2011	NR2N1ALT2B2061
	REACH 2N2	NR2N2ALT2B2011	NR2N2ALT2B2061
	REACH 2N3	NR2N3ALT2B2011	NR2N3ALT2B2061
SOUTH MAIN	REACH 3S1	SR3S1ALT2B2011	SR3S1ALT2B2061
	REACH 3S2	SR3S2ALT2B2011	SR3S2ALT2B2061
MAIN FLOODWATER	REACH 1A	MAINR1AALT2B2011	MAINR1AALT2B2061
	REACH 1B	MAINR1BALT2B2011	MAINR1BALT2B2061
	REACH 1C	MAINR1CALT2B2011	MAINR1CALT2B2061
	REACH 1D	MAINR1DALT2B2011	MAINR1DALT2B2061
	REACH 1E	MAINR1EALT2B2011	MAINR1EALT2B2061
	REACH 1F	MAINR1FALT2B2011	MAINR1FALT2B2061

PLAN3ALT2- 2011YR & 2061YR

Table 57
Willacy Alt 2 Stage Discharge Function Naming Convention

WILLACY			
STREAM NAME	**DAMAGE REACH**	**2011 STAGE DISCHARGE FUNCTION**	**2061 STAGE DISCHARGE FUNCTION**
RAYMONDVILLE	SAN PERLITA	RAYSPALT22011	RAYSPALT22061
	RAY EAST	RAYREALT22011	RAYREALT22061
	RAY WEST	RAYRWALT22011	RAYRWALT22061

Table 58
Raymondville Alt 2 Stage Discharge Function Naming Convention

RAYMONDVILLE			
STREAM NAME	**DAMAGE REACH**	**2011 STAGE DISCHARGE FUNCTION**	**2061 STAGE DISCHARGE FUNCTION**
LATERAL 5	REACH 1A	LAT5R1AALT22011	LAT5R1AALT22061
	REACH 1B	LAT5R1BALT22011	LAT5R1BALT22061
LATERAL 4	REACH 1	LAT4R1ALT22011	LAT4R1ALT22061
LATERAL 3	REACH 1A	LAT3R1AALT22011	LAT3R1AALT22061
	REACH 1B	LAT3R1BALT22011	LAT3R1BALT22061
	REACH 1C	LAT3R1CALT22011	LAT3R1CALT22061
TRIB 1	MAIN	TR1MAINALT22011	TR1MAINALT22061
TRIB 2	MAIN	TR2MAINALT22011	TR2MAINALT22061
FM 88	REACH 1	FM88R1ALT22011	FM88R1ALT22061
W HARGILL DR	DS1	WHARDS1ALT22011	WHARDS1ALT22061
	DS2	WHARDS2ALT22011	WHARDS2ALT22061
LA SAL VIEJA	REACH 1	LASALR1ALT22011	LASALR1ALT22061
N HARGILL DR	DS	NHARDSALT22011	NHARDSALT22061

Table 59
Delta South Main Alt 2 Stage Discharge Function Naming Convention

DELTA SOUTH MAIN			
STREAM NAME	**DAMAGE REACH**	**2011 STAGE DISCHARGE FUNCTION**	**2061 STAGE DISCHARGE FUNCTION**
DELTA SOUTH MAIN	REACH 1A	DELTA1AALT22011	DELTA1AALT22061
	REACH 1B	DELTA1BALT22011	DELTA1BALT22061
	REACH 1C	DELTA1CALT22011	DELTA1CALT22061

Table 60
North Main Drain Alt 2 Stage Discharge Function Naming Convention

NORTH MAIN DRAIN			
STREAM NAME	**DAMAGE REACH**	**2011 STAGE DISCHARGE FUNCTION**	**2061 STAGE DISCHARGE FUNCTION**
MCALLEN LATERAL	REACH 4	MCALEN4ALT22011	MCALEN4ALT22061
NORTH MAIN	REACH 2W1	NR2W1ALT22011	NR2W1ALT22061
	REACH 2W2	NR2W2ALT22011	NR2W2ALT22061
	REACH 2N1	NR2N1ALT22011	NR2N1ALT22061
	REACH 2N2	NR2N2ALT22011	NR2N2ALT22061
	REACH 2N3	NR2N3ALT22011	NR2N3ALT22061
SOUTH MAIN	REACH 3S1	SR3S1ALT22011	SR3S1ALT22061
	REACH 3S2	SR3S2ALT22011	SR3S2ALT22061
MAIN FLOODWATER	REACH 1A	MAINR1AALT22011	MAINR1AALT22061
	REACH 1B	MAINR1BALT22011	MAINR1BALT22061
	REACH 1C	MAINR1CALT22011	MAINR1CALT22061
	REACH 1D	MAINR1DALT22011	MAINR1DALT22061
	REACH 1E	MAINR1EALT22011	MAINR1EALT22061
	REACH 1F	MAINR1FALT22011	MAINR1FALT22061

PLAN4ALT3- 2011YR & 2061YR

Table 61
Willacy Alt 3 Stage Discharge Function Naming Convention

WILLACY			
STREAM NAME	**DAMAGE REACH**	**2011 STAGE DISCHARGE FUNCTION**	**2061 STAGE DISCHARGE FUNCTION**
RAYMONDVILLE	SAN PERLITA	RAYSPALT32011	RAYSPALT32061
	RAY EAST	RAYREALT32011	RAYREALT32061
	RAY WEST	RAYRWALT32011	RAYRWALT32061

Table 62
Raymondville Alt 3 Stage Discharge Function Naming Convention

RAYMONDVILLE			
STREAM NAME	**DAMAGE REACH**	**2011 STAGE DISCHARGE FUNCTION**	**2061 STAGE DISCHARGE FUNCTION**
LATERAL 5	REACH 1A	LAT5R1AALT32011	LAT5R1AALT32061
	REACH 1B	LAT5R1BALT32011	LAT5R1BALT32061
LATERAL 4	REACH 1	LAT4R1ALT32011	LAT4R1ALT32061
LATERAL 3	REACH 1A	LAT3R1AALT32011	LAT3R1AALT32061
	REACH 1B	LAT3R1BALT32011	LAT3R1BALT32061
	REACH 1C	LAT3R1CALT32011	LAT3R1CALT32061
TRIB 1	MAIN	TR1MAINALT32011	TR1MAINALT32061
TRIB 2	MAIN	TR2MAINALT32011	TR2MAINALT32061
FM 88	REACH 1	FM88R1ALT32011	FM88R1ALT32061
W HARGILL DR	DS1	WHARDS1ALT32011	WHARDS1ALT32061
	DS2	WHARDS2ALT32011	WHARDS2ALT32061
LA SAL VIEJA	REACH 1	LASALR1ALT32011	LASALR1ALT32061
N HARGILL DR	DS	NHARDSALT32011	NHARDSALT32061

Table 63
Delta South Main Alt 3 Stage Discharge Function Naming Convention

DELTA SOUTH MAIN			
STREAM NAME	**DAMAGE REACH**	**2011 STAGE DISCHARGE FUNCTION**	**2061 STAGE DISCHARGE FUNCTION**
DELTA SOUTH MAIN	REACH 1A	DELTA1AALT32011	DELTA1AALT32061
	REACH 1B	DELTA1BALT32011	DELTA1BALT32061
	REACH 1C	DELTA1CALT32011	DELTA1CALT32061

Table 64
North Main Drain Alt 3 Stage Discharge Function Naming Convention

NORTH MAIN DRAIN			
STREAM NAME	**DAMAGE REACH**	**2011 STAGE DISCHARGE FUNCTION**	**2061 STAGE DISCHARGE FUNCTION**
MCALLEN LATERAL	REACH 4	MCALEN4ALT32011	MCALEN4ALT32061
NORTH MAIN	REACH 2W1	NR2W1ALT32011	NR2W1ALT32061
	REACH 2W2	NR2W2ALT32011	NR2W2ALT32061
	REACH 2N1	NR2N1ALT32011	NR2N1ALT32061
	REACH 2N2	NR2N2ALT32011	NR2N2ALT32061
	REACH 2N3	NR2N3ALT32011	NR2N3ALT32061
SOUTH MAIN	REACH 3S1	SR3S1ALT32011	SR3S1ALT32061
	REACH 3S2	SR3S2ALT32011	SR3S2ALT32061
MAIN FLOODWATER	REACH 1A	MAINR1AALT32011	MAINR1AALT32061
	REACH 1B	MAINR1BALT32011	MAINR1BALT32061
	REACH 1C	MAINR1CALT32011	MAINR1CALT32061
	REACH 1D	MAINR1DALT32011	MAINR1DALT32061
	REACH 1E	MAINR1EALT32011	MAINR1EALT32061
	REACH 1F	MAINR1FALT32011	MAINR1FALT32061

3. (ECONOMICS)

Summary:

This section is where the stage-damage functions with uncertainty are produced for flood damage reduction. Using the without project flooding limits for the 500-year storm event were utilized to develop a flood envelope to determine the possible effected area. This envelope is shows the area of interest and the tax records are then used to identify the parcels within the limits. The Hidalgo and Willacy County Tax Appraisals were used to determine type of structure and value. The existing parcels will have year in service of 1950 and 2060 will be assigned for the year of service for the future structures.

The economics is the breakdown of structures found within the study area. Theses were broken down into STUDY DAMAGE CATEGORIES then further by STRUCTURE OCCUPANCY TYPES. The main damage categories are COMMERICAL, PUBLIC, RESIDENTIAL, AGRICULTURE, LIVESTOCK, AND POST DISASTER. These were further divided into subcategories depending on structure type and contents.

For RESIDENTIAL the structures were broken out between single family homes one story, single family multiple stories, mobile homes, and multi-family dwellings. (Note: basements are not considered) The structure and contents depth to damage and standard deviation of damage tables are from the Corps of Engineers 'Economic Guidance Memorandum (EGM) 01-03' with the exception of the mobile home which is from the 'FIA Depth-Damage Data'. Each resident is assumed to have one vehicle on site during the flooding event and the SUV's depth to damage and standard deviation was chosen with a

value of 15% of the structure value. The content's depth to damage tables were developed using 100% of the value of the structure.

For COMMERCIAL AND PUBLIC structures the 'Depth-Damage Functions for Commercial and Public Structures Galveston, Texas' (Galveston Spreadsheet) was used. The inventory and equipment depth to damage tables were manipulated in order to get one contents depth to damage table. The two methods are:

- **average of the two tables** – if both the inventory and equipment tables have values then the two were averaged.
- **use either the inventory or equipment table** – if one had zeros for the depth to damage table the one with values was used.

In order to determine the percent of the structure value the 'Standard Deviation of Pearl River Flood Damage to Contents by Category and Flood Stage' was utilized. These content to structure ratio (C/S) were assigned to the corresponding Galveston Spreadsheet, but when the description of the two did not match the average C/S ratio is applied, which is 92.00.

The DEFINED UNCERTAINTY – FIRST FLOOR STAGE will be set to normal and have an uncertainty of 0.1 feet since lidar is used for ground elevation based table 9.1 from the FDA User manual.

Table 9.1
Uncertainty Based on Measurement Methods

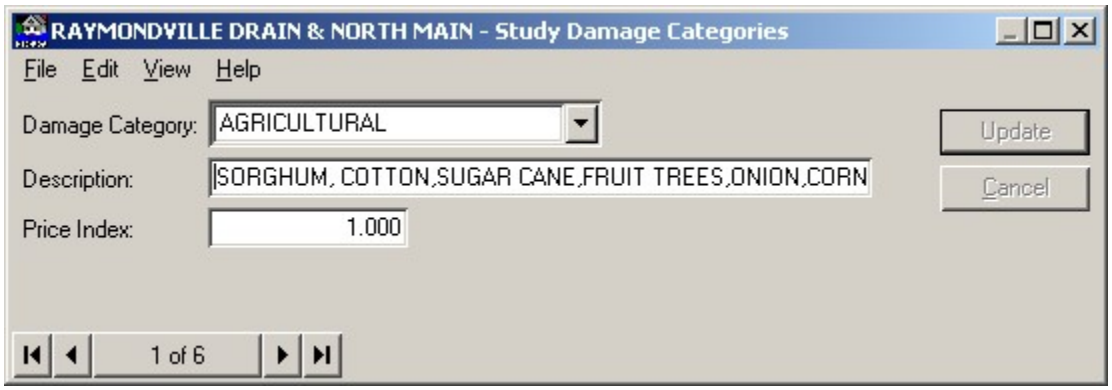
Method	Contour Interval (ft)	Error (ft)	Standard Deviation (ft)
Field survey			
Hand level	NA	± 0.2 @ 50'	0.1
Stadia	NA	± 0.4 @ 500'	0.2
Conventional level	NA	± 0.05 @ 800'	0.03
Automatic level	NA	± 0.03 @ 800'	0.02
Aerial survey			
	2'	± 0.59	0.3
	5'	± 1.18	0.6
	10'	± 2.94	1.5
Topographic map			
	2'	± 1.18	0.6
	5'	± 2.94	1.5
	10'	± 5.88	3

Procedure:

This menu is used to enter the information needed for economic analyses. Available commands are: **STUDY DAMAGE CATEGORIES, STUDY STRUCTURE OCCUPANCY TYPES, STRUCTURE MODEULES, STRUCTURE MODULE ASSIGNMENTS, STRUCTURE INVENTORY DATA, ENTER/EDIT/VIEW REACH STAGE-DISCHARGE FUNCTION WITH UNCERTAINTY, COMPUTE REACH STAGE-DAMAGE, IMPORT, AND EXPORT.**

G. STUDY DAMAGE CATEGORIES:

Under the **Economics** heading the first option is STUDY DAMAGE CATEGORIES. This is where the categories are entered with a DESCRIPTION and a PRICE INDEX. The PRICE INDEX is to be set to 1.00 unless otherwise noted.

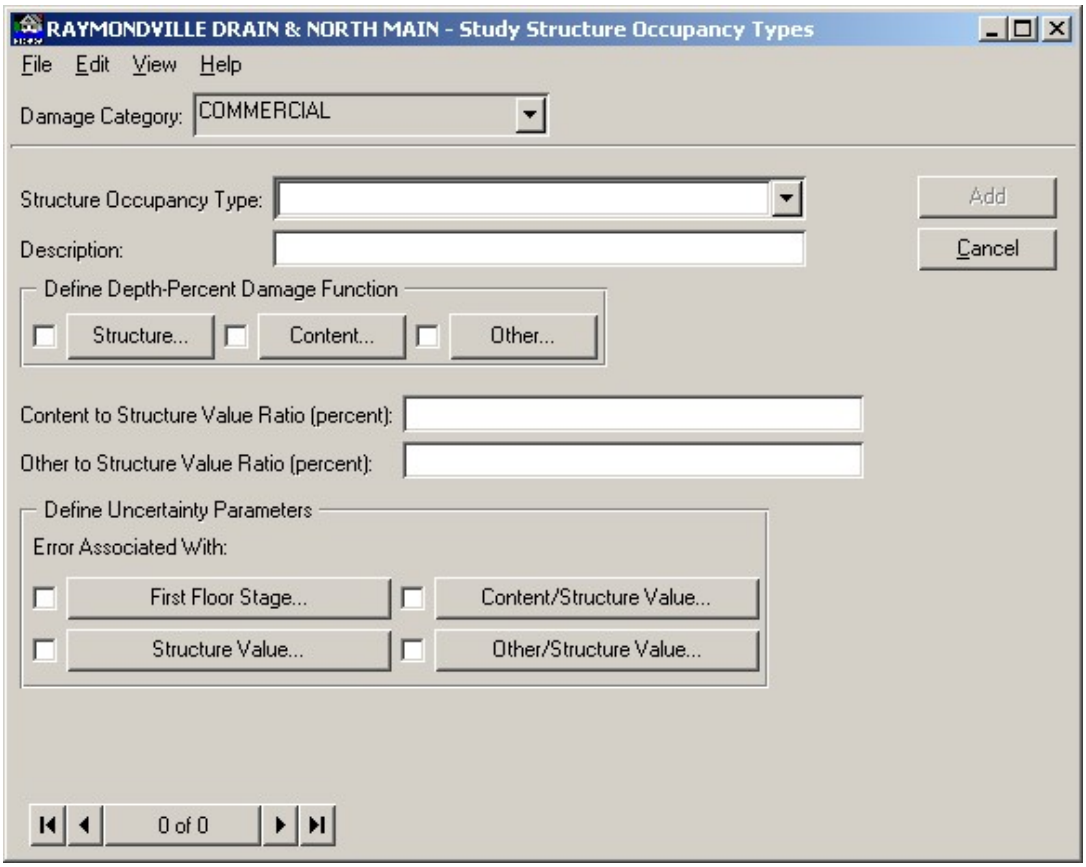


The damage categories used:

COMMERCIAL – any property privately owner and operated either industrial or commercial
PUBLIC – any property owned by the government/public such as City Hall, Fire Station, etc.
RESIDENTIAL – any type of housing
AGRICULTURE – farmlands
LIVESTOCK – ranch lands
POST DISASTER – Taken as an additional cost percentage of the total damage as per Appendix C Economic analysis, 'Dredged Material Management Plan and Environmental Impact Statement', July 2002, USACE and the 'Kentucky Report'.

EMERGENCY COSTS- 13.4%
TRANSPORTATION COSTS-5%
UTILITY COSTS-0.6%
NON-PHYSICAL DAMAGES-20%
TOTAL OF OTHER COSTS-39%

H. STRUCTURE OCCUPANCY TYPES

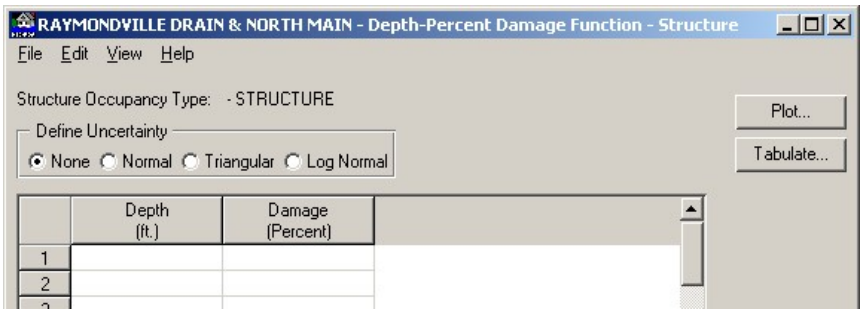


This is where the depth to damage tables are entered into the FDA program. There will be a structure and content depth to damage table for each type of category and structure occupancy listed for the study areas.

COMMERCIAL- (DAMAGE CATEGORY, ASSOCIATED TO OCCUPANCY TYPE OR CODE, STD DEV NONE OR NORMAL AND DEFINE DEPTH TO DAMAGE TABLE, STRUCTURE VALUE OR RATIO, ERROR ASSOCIATIONS WITH FIRST FLOOR STAGE, AND STRUCTURE/CONTENT/OTHER VALUES.)

The structure occupancy type is defined on the spreadsheet attach. A maximum of 16 character names identifies what type of business, the structure and content depth to damage tables, and the content to structure ratio for the contents. No standard deviation is used for commercial properties.

STRUCTURE – The Define Uncertainty is set to NONE and only the depths and percent damages are entered.

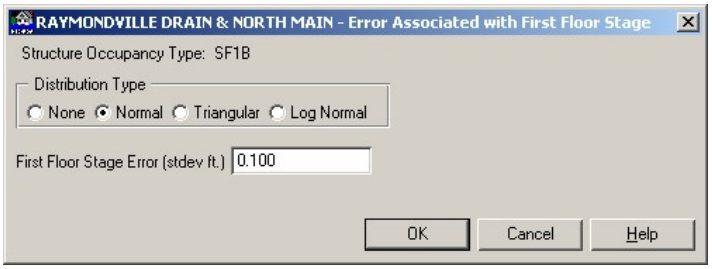


CONTENT – the content ratio and depth to damage data is found on spreadsheet attached.

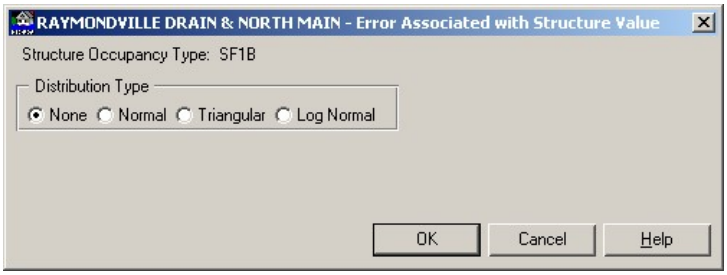
OTHER - not used

DEFINED UNCERTAINTY –

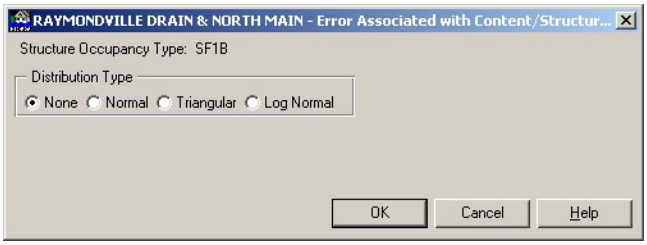
FIRST FLOOR STAGE will be set to normal and have an uncertainty of 0.1 feet since lidar is used for ground elevation.



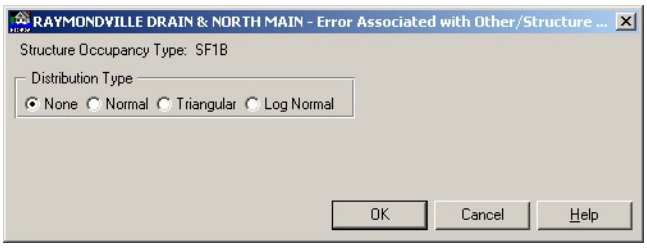
STRUCTURE will be set to NONE since the values will be taken from the tax record and are deemed accurate.



CONTENT will be set to NONE since the C/S ratio for all is deemed accurate



OTHER will be set to NONE since the 15% used for the O/S ratio for Residential is deemed accurate and OTHER is not applied to any other CATEGORY



PUBLIC-

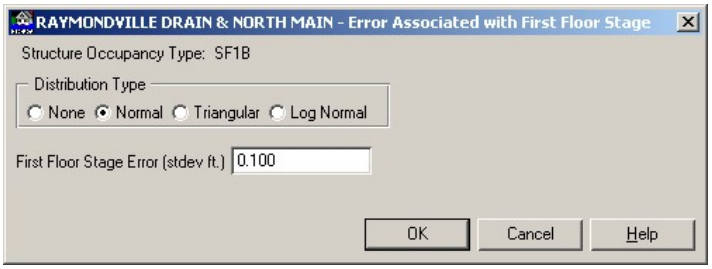
STRUCTURE - The structure occupancy type is defined on the spreadsheet attach. A maximum of 16 character names identifies what type of business, the structure and content depth to damage tables, and the content to structure ratio for the contents. No standard deviation is used for public properties.

CONTENT - the content ratio and depth to damage data is found on spreadsheet attached

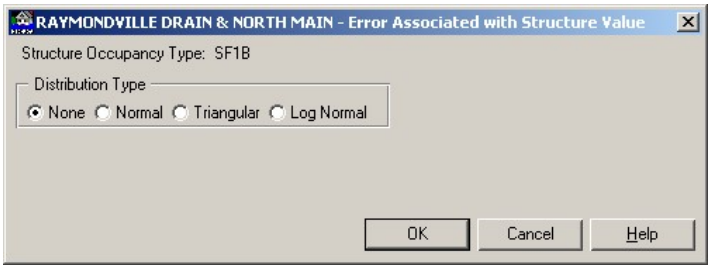
OTHER - not used

DEFINED UNCERTAINTY –

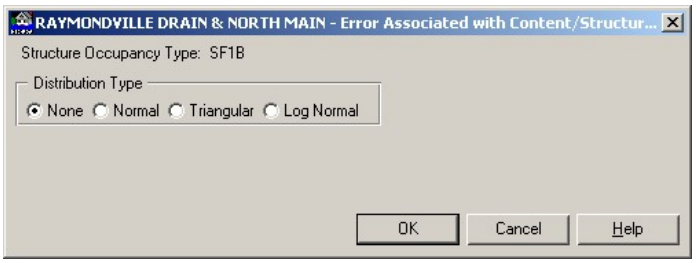
FIRST FLOOR STAGE will be set to normal and have an uncertainty of 0.1 feet since lidar is used for ground elevation.



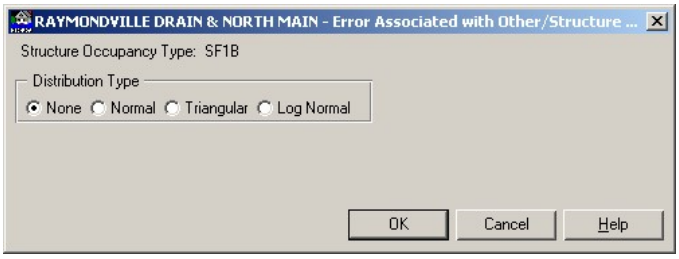
STRUCTURE will be set to NONE since the values will be taken from the tax record and are deemed accurate.



CONTENT will be set to NONE since the C/S ratio for all is deemed accurate



OTHER will be set to NONE since the 15% used for the O/S ratio for Residential is deemed accurate and OTHER is not applied to any other CATEGORY



RESIDENTIAL-

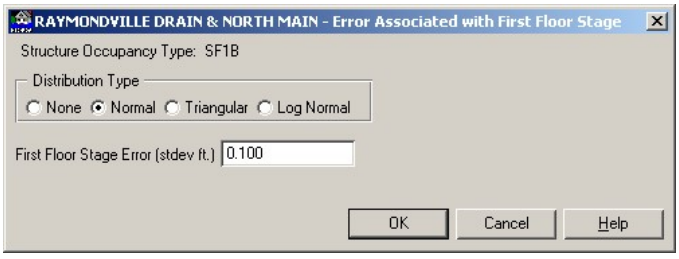
STRUCTURE – The structure occupancy type is assigned on the spreadsheet attach. The maximum 16 character name identifies what type of business, the structure and content depth to damage tables, and the content to structure ratio for the contents. The standard deviation is used for residential properties and is provided in the spreadsheet attached.

CONTENT - the content ratio is based on 100% of the structure value and depth to damage data is found on spreadsheet attached

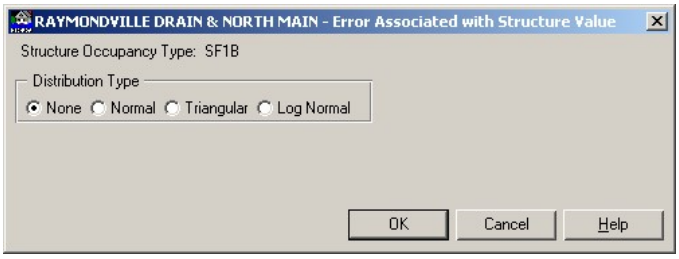
OTHER – the SUV vehicle depth to damage and standard deviation tables are found on the spreadsheet attached and the other to structure ratio is set to 15%

DEFINED UNCERTAINTY –

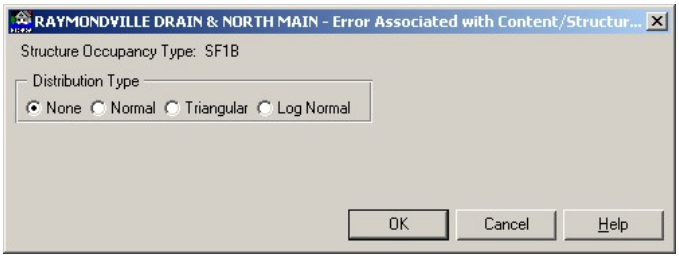
FIRST FLOOR STAGE will be set to normal and have an uncertainty of 0.1 feet since lidar is used for ground elevation.



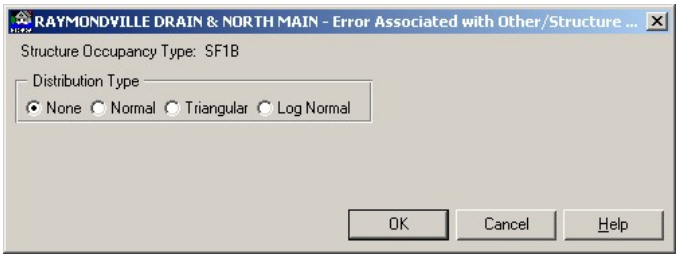
STRUCTURE will be set to NONE since the values will be taken from the tax record and are deemed accurate.



CONTENT will be set to NONE since the C/S ratio for all is deemed accurate



OTHER will be set to NONE since the 15% used for the O/S ratio for Residential is deemed accurate and OTHER is not applied to any other CATEGORY



AGRICULTURE-

OTHER -

LIVESTOCK-

OTHER

I. STRUCTURE MODULES

BASE –Includes existing inventory and future inventory with future year structure is built included in OPTIONAL in the structure inventory module.

J. STRUCTURE MODULE ASSIGNMENT

These will automatically generate since BASE is the only STRUCTURE MODULE used. Theses will be labeled as follows:

WITHOUT – 2011 - BASE
WITHOUT – 2061 - BASE

PLAN1ALT1B - 2011 - BASE
PLAN1ALT1B - 2061 - BASE

PLAN2ALT2B - 2011 - BASE
PLAN2ALT2B - 2061 - BASE

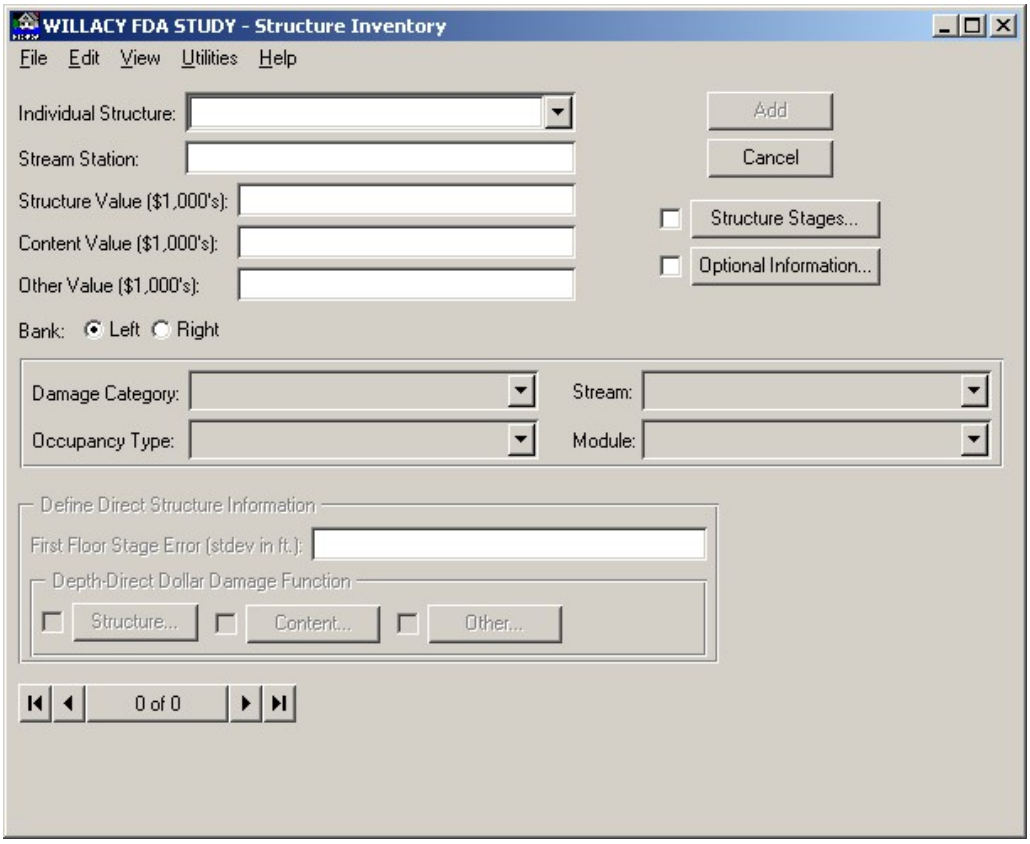
PLAN3ALT2 – 2011 - BASE
PLAN3ALT2 – 2061 - BASE

PLAN4ALT3 – 2011 - BASE
PLAN4ALT3 – 2061 - BASE

K. STRUCTURE INVENTORY

This is where the individual parcels are entered for the study area. In addition, the structure value in $1,000 increments is taken from the tax records while leaving the "content" and "other" blank on COMMERCIAL, PUBLIC AND RESIDENTIAL STRUCTURES since the C/S and O/S ratios are assigned in the Structure Occupancy. The AGICULTURAL AND LIVESTOCK will have the structure and content blank and the other will be filled in based on type of use. The individual structure naming convention will be as follows:

CATEGORY	INDIVIDUAL STRUCTURE ID
Commercial	C1, C2, C3, ……, C200
Public	P1, P2, P3, ……..., P200
Residential	R1, R2, R3, …….., R200
Agriculture	A1, A2, A3, ……., A200
Livestock	L1, L2, L3, …….., L200



(INDIVIDUAL STRUCTURE, STREAM STATION, STRUCTURE VALUE (in $1000), CONTENT & OTHER VALUE (left blank due to prior ratio), BANK STATION toggled LEFT or RIGHT,

Assign to DAMAGE CATEGORY, STREAM, OCCUPANCY TYPE and BASE MODULE;

STRUCTURE STAGES based on ground elevation and foundation height and BEGINNING DEPTH ELEVATION left blank,

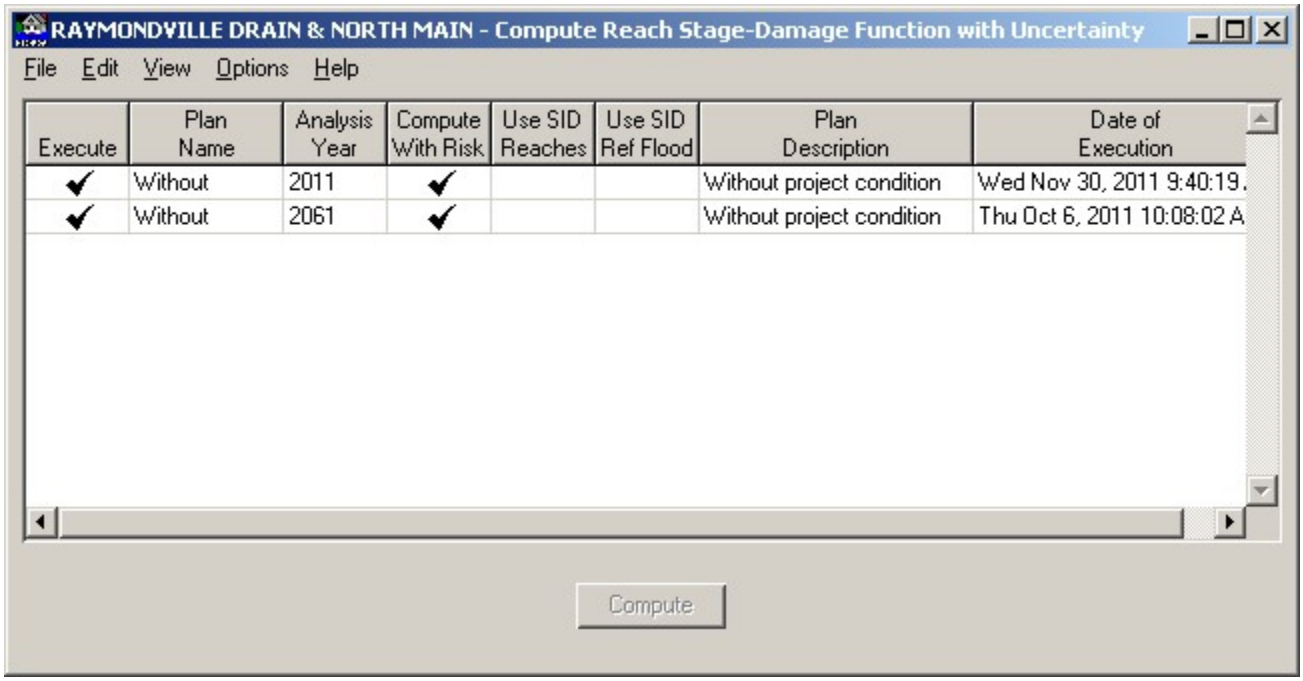
OPTIONAL INFORMATION WITH ADDRESS, YEAR IN SERVICE 1950 OR FUTURE YEAR (which will be 2060), NOTES DESCRIBES STRUCTURE, NORTHING EASTING left blank, NUMBER OF STRUCTURES INPUT as 1, SID DATA left blank.

L. COMPUTE REACH STAGE DAMAGE FUNCTION WITH UNCERTAINTY

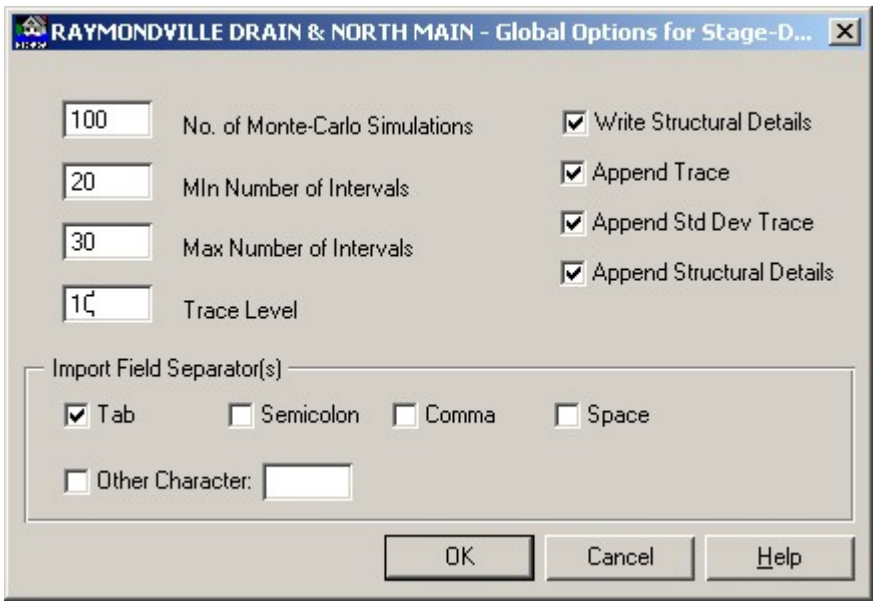
A stage-damage function is the relationship of the direct economic costs caused by flood inundation to a range of flood stages for a given river or damage reach. The FDA will create this function automatically. This module computes reach stage damage function with normal deviation of uncertainty based on input water surface profile, stage-discharge with uncertainty functions, and depth to damage functions.

A general overview of what is done when a plan/analysis year combination and then calculate stage-damage function:

1) For each damage reach, FDA calculates the range of stages at the index location. The stage represents the range from very frequent to very infrequent events based on the input functions and the uncertainty related.
2) For the selected plan/analysis year, FDA filters the structures using the structure module assignments so that it will process only those structures which are assigned to the selected modules(s). It also filters the structures based on the "Year in Service"
3) FDA processes each of the filtered structures. It transforms the tabulation stages that were determined in Step 1 from the index location to the structure. The transformation uses the water surface profiles.
4) FDA checks each structure to see if it has invalid data and to see if the structure is "out of the floodplain". FDA will immediately proceed to the next structure if either case exists
5) FDA determines the damage category, structure occupancy type, and damage reach, and then computes stage-damage at each of the tabulation stages for a structure. Damages computed for the structure, contents, other and total. The damage of each tabulations stage is then aggregated to the index locations. During calculations, the stage-aggregated damage functions are stored in memory. After all of the filtered structures are processed, the stage-aggregated damage functions are stored in the FDA study files.



Before the computations are completed the GLOBAL OPTIONS need to be set. This is done under the options tab. A box like the one below will pop up.



4. (EVALUATION)

Compute and evaluate economic and engineering performance under this menu. Evaluation is where the study status is reviewed, three types of analysis are performed, and view results. The three computations are:

- Computation of expected annual damage and
- Project performance (Evaluation of Plans by Analysis Year)
- Computation of equivalent annual damage over the specified analysis period (project life) for the plan

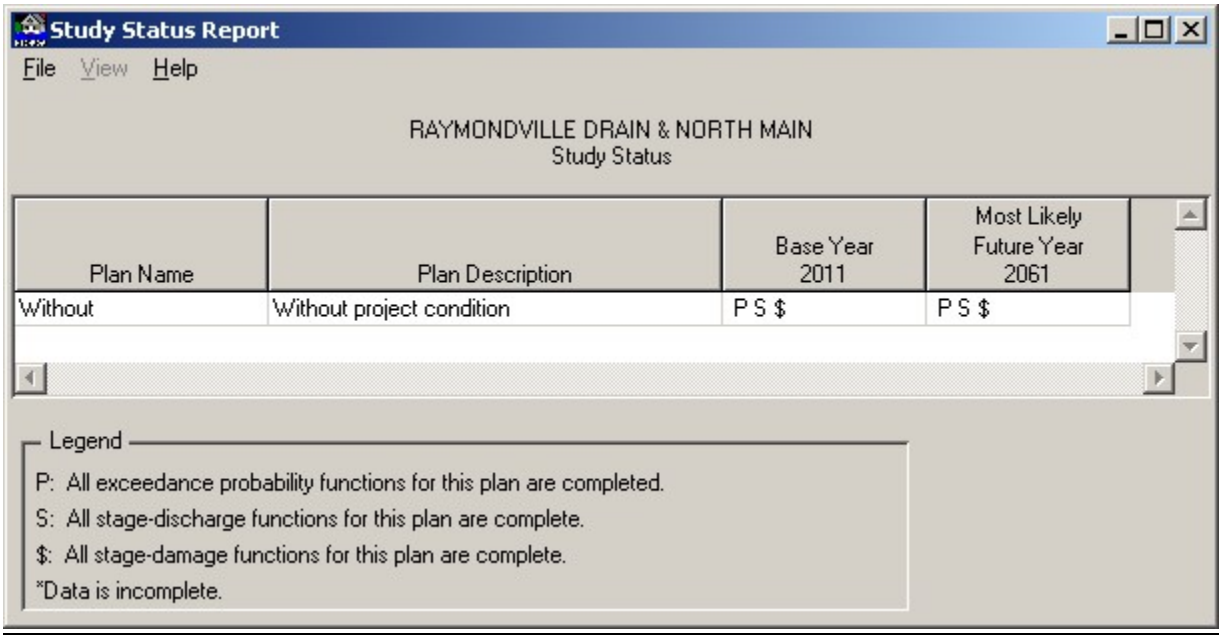
Data developed under **HydEng** and **Economics** represents the best estimates of the median values of the exceedance probability, stage, and damage functions for without- and with-project conditions. Uncertainty parameters of the functions were also developed. The analyses and results use the median valued functions and associated uncertainties as input to produce expected values. The computations are performed by plans and analysis year or by plan equivalent annual damage.

This tab contains four items:

- **Study Status Report** which displays the completeness of the study data by plans and analysis years
- **Evaluation of Plans by Analysis Year** which computes the expected annual damages.
- **Equivalent Annual Damage Analysis** computes the equivalent annual damage.
- **Results**

Study Status Report

The Study Status Report informs the user the data is complete and all of the functions have been calculated. Each plan must have a "P", "S", and "$" next to it in order to proceed to Evaluation of Plans by Analysis Year and Equivalent Annual Damage Analysis. If there is an "*" anywhere the user must go back and fix the incomplete functions before proceeding.



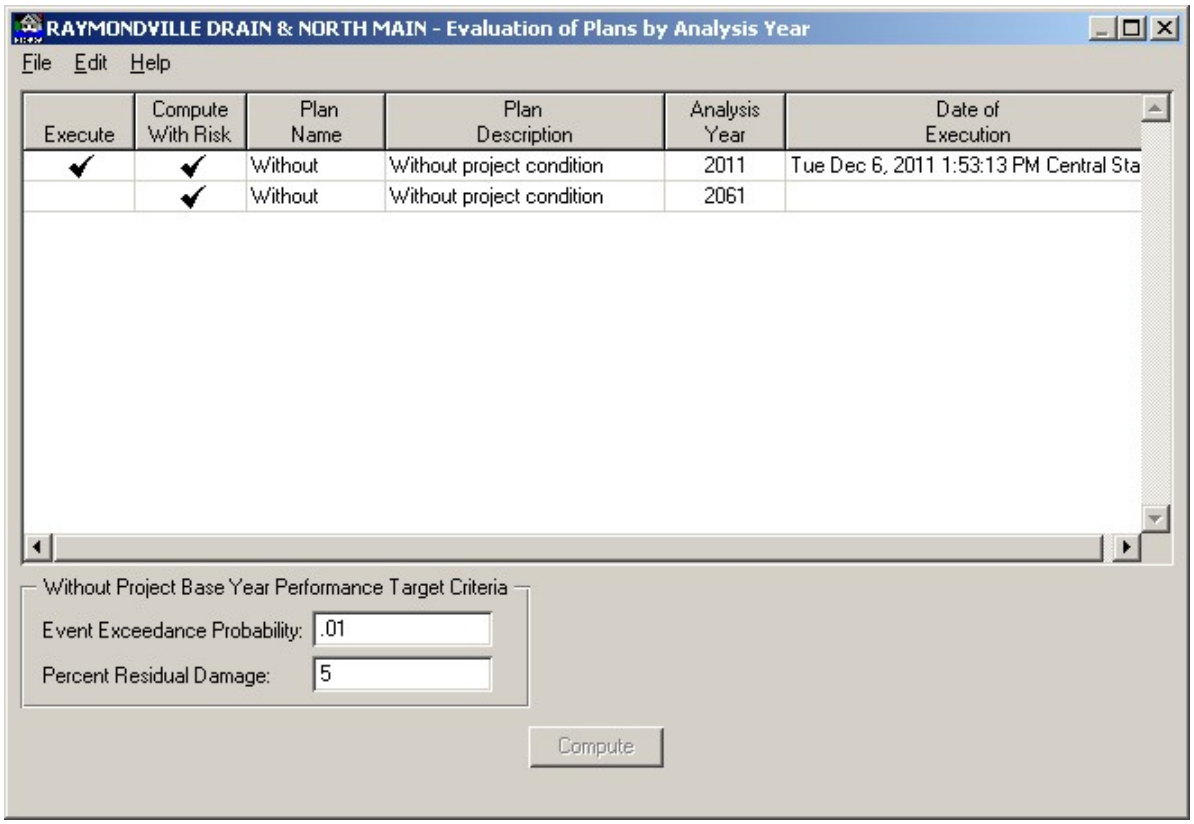
M. Evaluation of Plans By Analysis Year

The FDA program uses the Monte Carlo simulation to derive the expected annual damage corresponding to a particular plan/analysis year for a damage reach. The Expected Annual Damage (EAD) is computed during the Evaluation of Plans by Analysis Year. The EAD is the mean damage obtained by integrating the damage exceedance probability curve for the damage reach. The damage-exceedance probability function is obtained from the discharge-exceedance probability, stage-discharge, and damage-stage functions derived at a damage reach index location.

The inclusion of uncertainty for these variables requires a numerical integration approach be applied. By including the uncertainty associated with each computation, it is possible to obtain both a best estimate of expected annual damage and a distribution of possible values about this best estimate. Additionally, an expected set of exceedance probability functions and event conditional stages can be computed as a consequence of providing these estimated of uncertainty.

This is where all of the previous data entered or generated is used. EAD is the probability weighted average of all possible peak annual damages. It is also termed the mean or expected annual damage. For reaches without levees, the standards used by the GDA program are based on the residual damage associated with a specific exceedance probability event. Performance targets are essentially the zero damage stage but normally consider minor damage to the infrastructure as acceptable and significant damage to structures as not acceptable. Consistent criteria for comparing the impacts of different measures and plans are also a goal. Experience at HEC has shown that a 5% residual damage associated

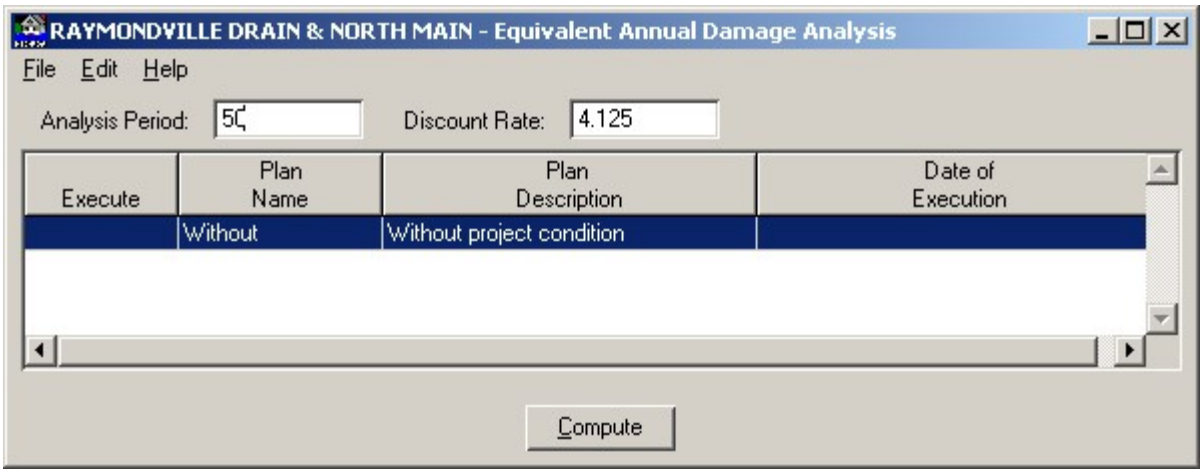
with the 0.01 exceedance probability event is normally a good target stage and was adopted as the FDA default.



N. Equivalent Annual Damage Analysis

This next step computes the equivalent annual damages. The Equivalent annual damage is computed by discounting future EAD values given the appropriate interest rate and time for discounting. The expected annual damage computation for the base and most likely future conditions must be completed before this computation can happen.

In order to equate future damages back to base year conditions the discount rate needs to be applied. According to 'Economic Guidance Memorandum, 11-01, Federal Interest Rates for Corps of Engineers Projects for Fiscal Year 2011' dated Nov 5, 2010 the project evaluation and formulation rate (discount rate) is 4.128% for the fiscal year 2011. The Analysis period will be the project life which is 50 years.

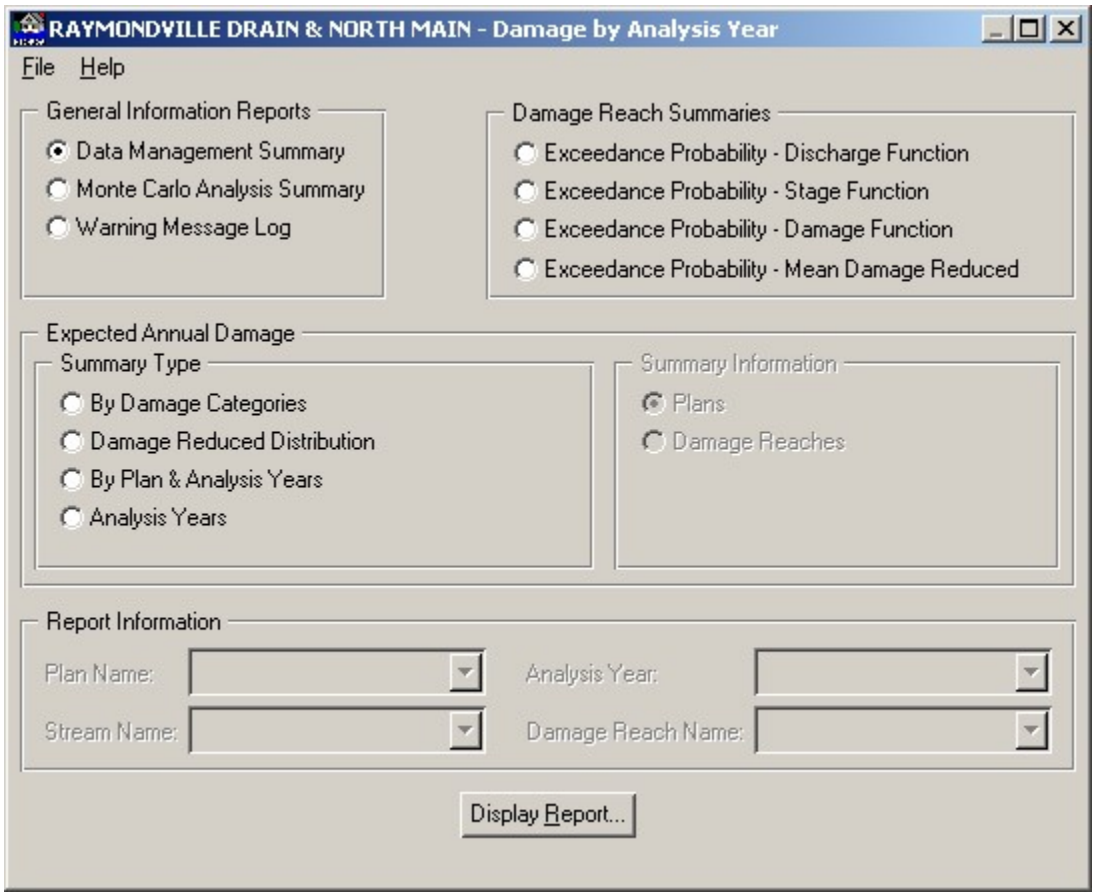


O. Results.

Damage Analysis by Year

The damage by analysis year reports shows the results of the expected annual damage (EAD). The reports are grouped into three areas:

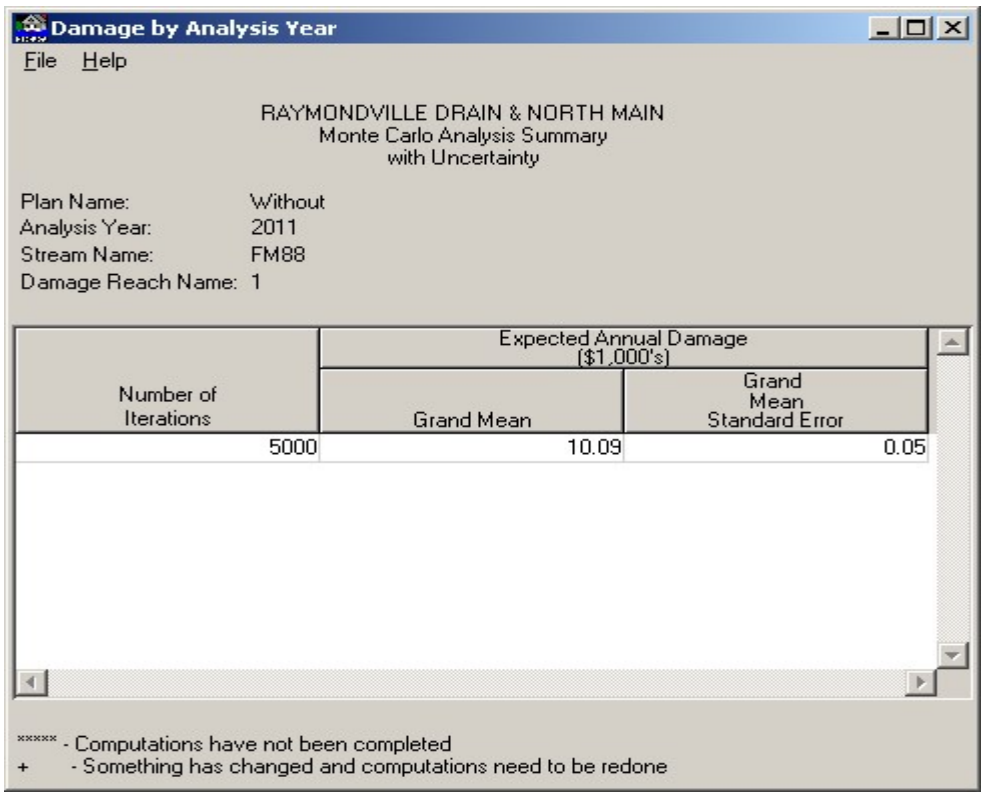
- General information
- Damage reach summaries
- Expected annual damage



General Information

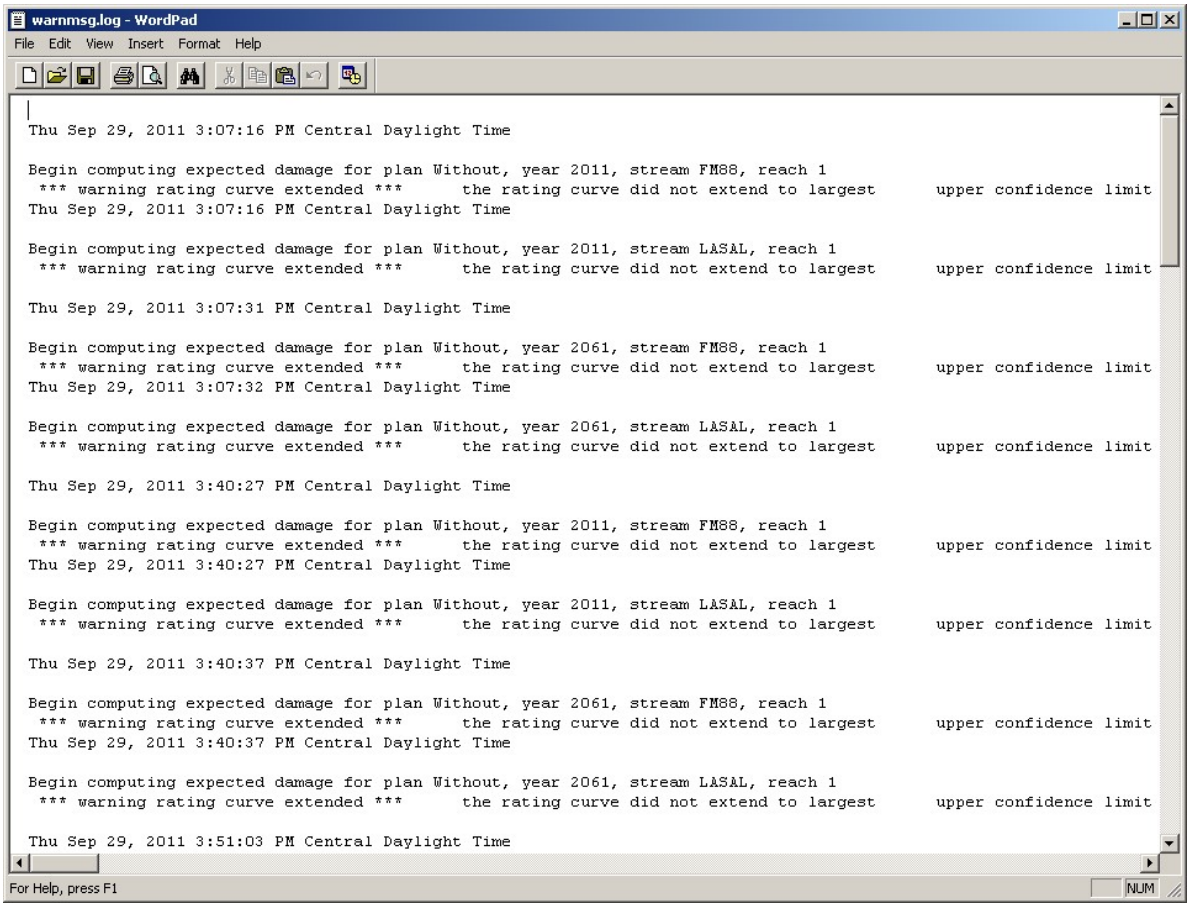
General information reports provide the following information:

- Data Management Summary (What plans and analysis years were computed for the evaluation of plans by analysis years)
- The Monte Carlo computation by plan, analysis year stream, and damage reach
- And warning information for each computation



Above is an example of the Monte Carlo Analysis Summary report. This report is viewed by PLAN NAME, ANALYSIS YEAR, STREAM NAME, and DAMAGE REACH NAME. This shows the number of Monte Carlo iterations preformed, variation in EAD (Grand Mean) and the Grand Mean Standard Error. The computations are terminated when the grand mean is within the allowable tolerance. If (*****) occurs this means the computations were not able to be completed and if (+) is shown something has been changed in the data and the computations need to be re-computed.

Below is an example of the WARNING MESSAGE LOG. These files need to be reviewed after each run. **It should be noted that the messages do not disappear after each run. The new warnings are added to the end so this file causing it to become very large if the older warning messages are not deleted by the user.**



Damage Reach Summaries

This section shows the four types of probability functions used within this report:

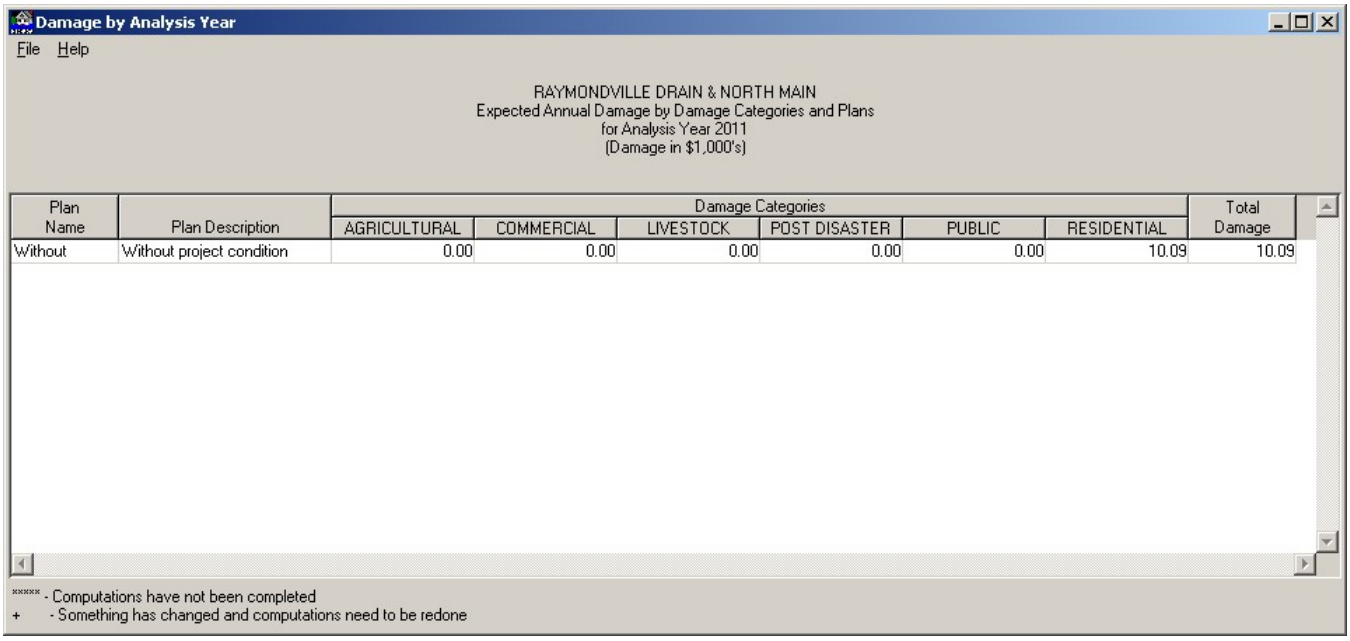
- Discharge probability function
- Stage probability function
- Damage probability function
- Mean damage probability function.

These four functions are “average” curves that are calculated from the ones generated during the Monte Carlo iterations, and cannot be used for analytical purposes such as to compute expected annual damage. Therefore the DAMAGE REACH SUMMARIES are not active when not computing uncertainty during the computation of EAD.

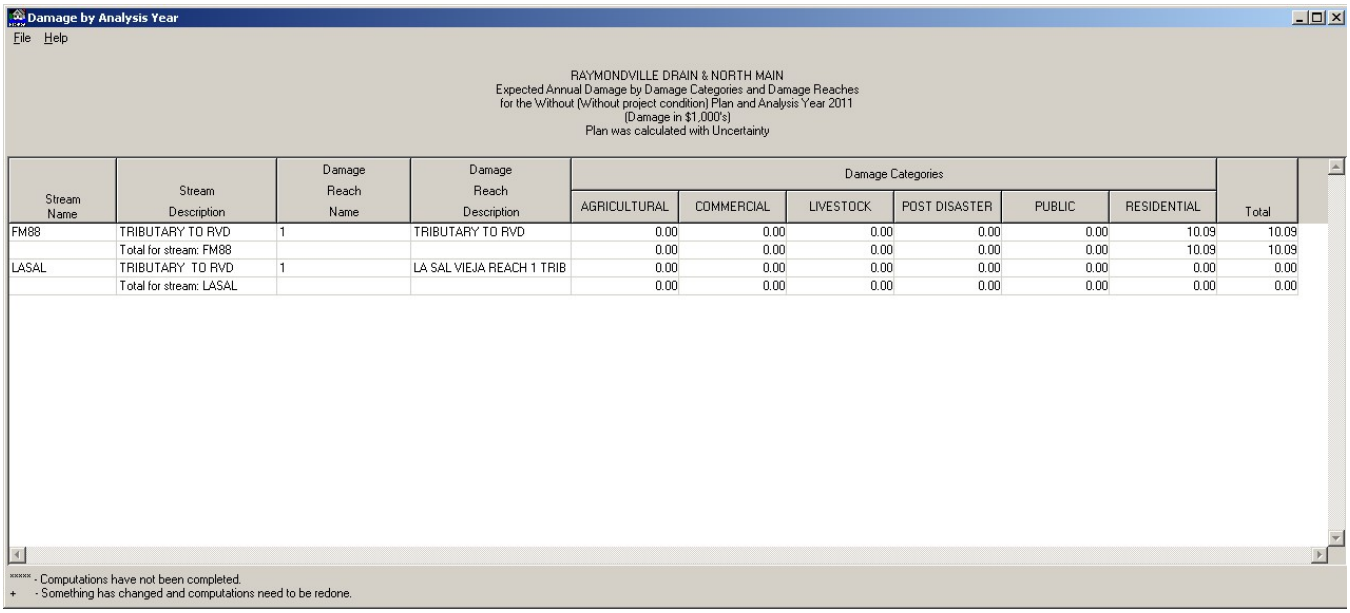
Expected Annual Damage

These reports consist of four types:

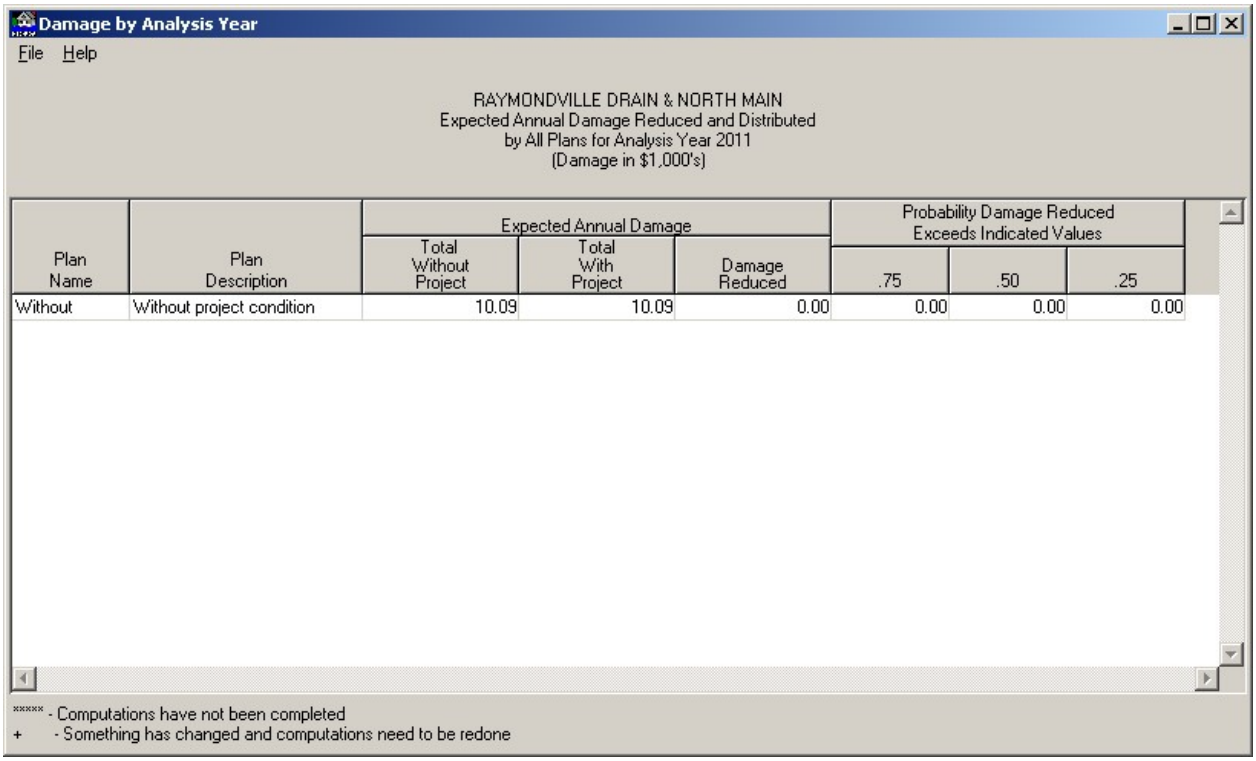
- By damage category
    - **By Damage Categories – Plans -** This is where the total damages are shown by Plan and are broken down by category by analysis year.



- **By Damage Categories – Damage Reaches** – This shows the total damage by damage reach for all the damage reaches within Plan for a certain Analysis Year by Category



- Damage reduced and distributed
  - Damage Reduced Distribution – Plans – shows the expected annual damage for the without- and with-project conditions for all plans for a selected analysis year. It also shows the distribution of expected annual damage reduced by plan in terms of the probability that the damage reduced exceeds a value for the probabilities of 0.75, 0.50, and 0.25.



Damage by Analysis Year

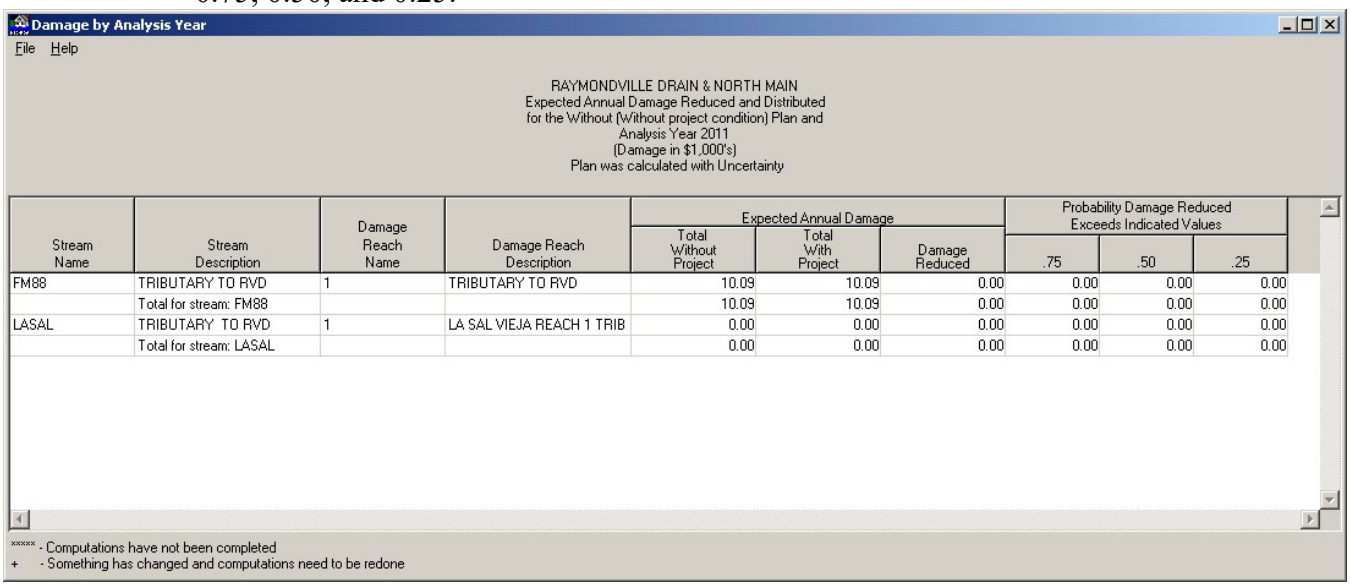
File Help

RAYMONDVILLE DRAIN & NORTH MAIN
Expected Annual Damage Reduced and Distributed
by All Plans for Analysis Year 2011
(Damage in $1,000's)

Plan Name	Plan Description	Expected Annual Damage			Probability Damage Reduced Exceeds Indicated Values		
		Total Without Project	Total With Project	Damage Reduced	.75	.50	.25
Without	Without project condition	10.09	10.09	0.00	0.00	0.00	0.00

***** - Computations have not been completed
\+ - Something has changed and computations need to be redone

- Damage Reduced Distribution – Damage Reaches - shows the expected annual damage for the without- and with-project conditions for all plans for a selected analysis year. It also shows the distribution of expected annual damage reduced by damage reaches in terms of the probability that the damage reduced exceeds a value for the probabilities of 0.75, 0.50, and 0.25.



Damage by Analysis Year

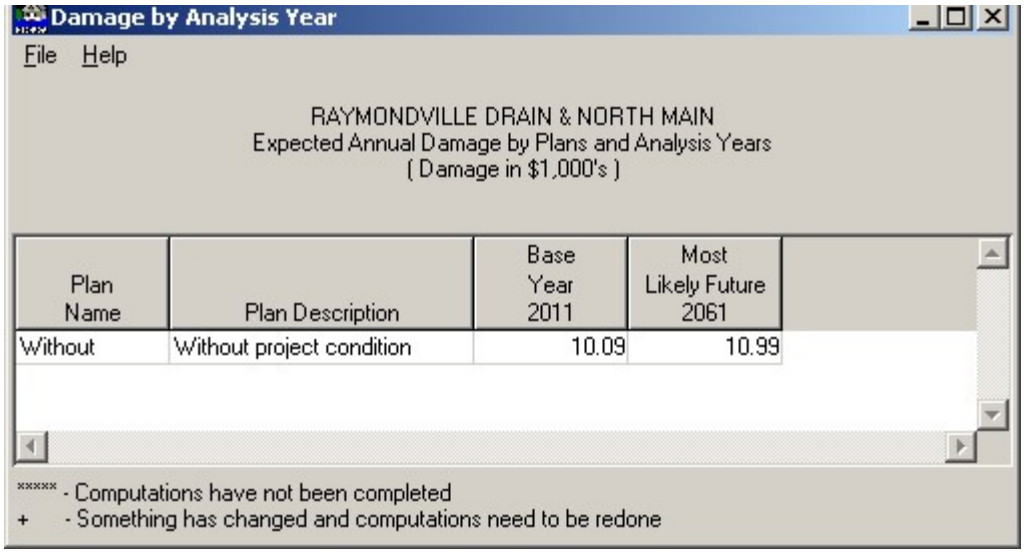
File Help

RAYMONDVILLE DRAIN & NORTH MAIN
Expected Annual Damage Reduced and Distributed
for the Without (Without project condition) Plan and
Analysis Year 2011
(Damage in $1,000's)
Plan was calculated with Uncertainty

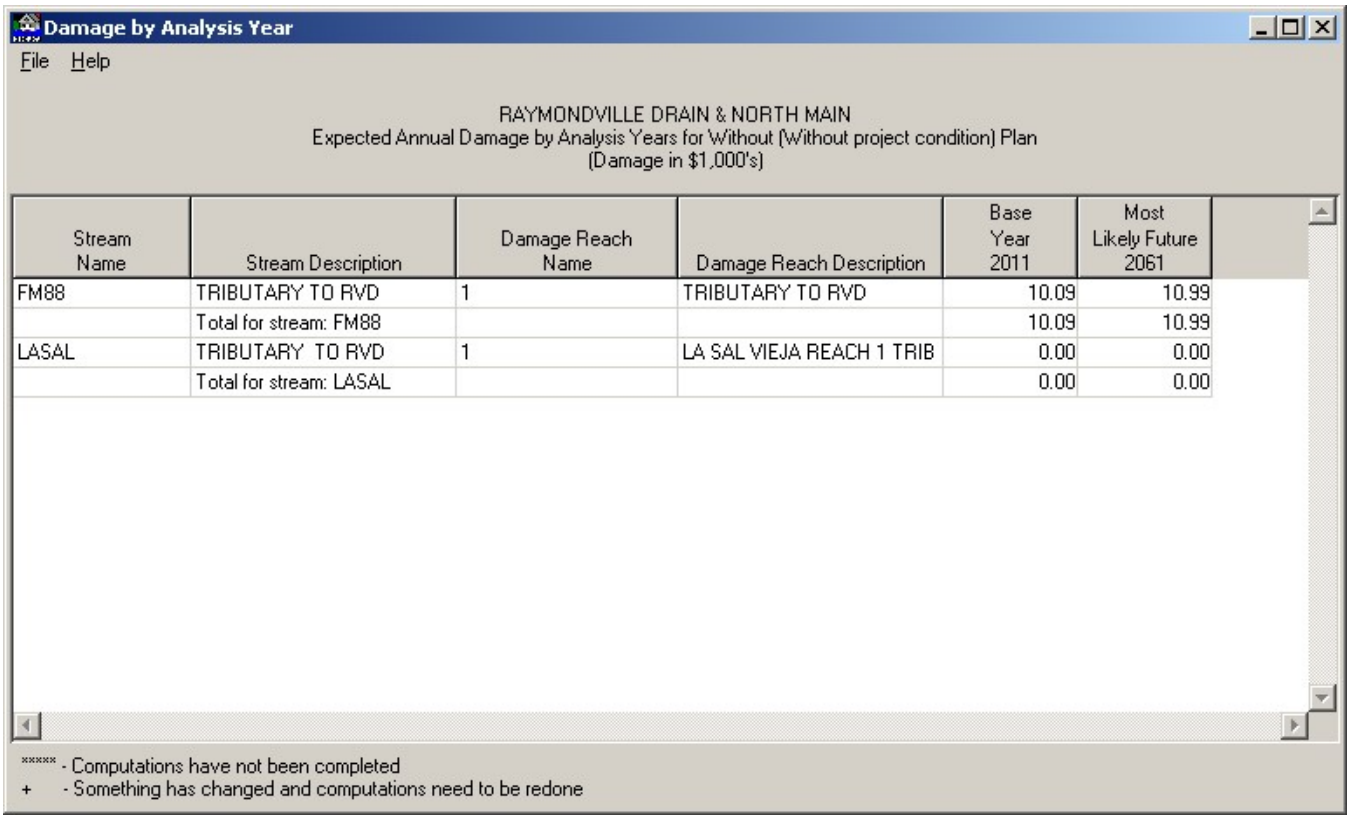
Stream Name	Stream Description	Damage Reach Name	Damage Reach Description	Expected Annual Damage			Probability Damage Reduced Exceeds Indicated Values		
				Total Without Project	Total With Project	Damage Reduced	.75	.50	.25
FM88	TRIBUTARY TO RVD	1	TRIBUTARY TO RVD	10.09	10.09	0.00	0.00	0.00	0.00
	Total for stream: FM88			10.09	10.09	0.00	0.00	0.00	0.00
LASAL	TRIBUTARY TO RVD	1	LA SAL VIEJA REACH 1 TRIB	0.00	0.00	0.00	0.00	0.00	0.00
	Total for stream: LASAL			0.00	0.00	0.00	0.00	0.00	0.00

***** - Computations have not been completed
\+ - Something has changed and computations need to be redone

- By Plans and Analysis Years – This report show the total expected annual damages for each Plan for the base year and most likely future year.



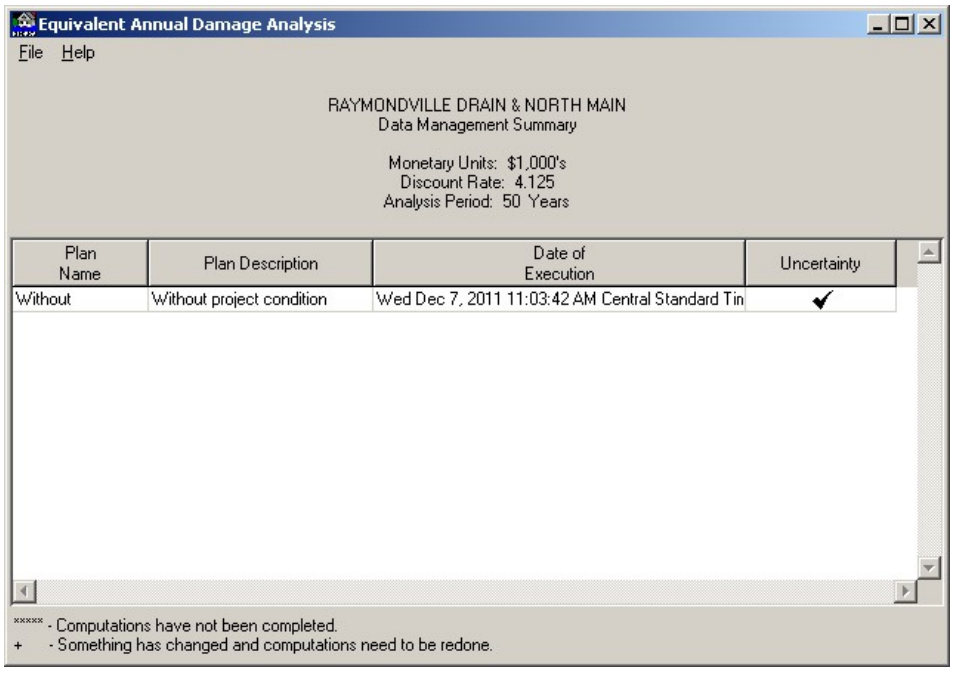
- By Analysis Years – summary of the expected annual damages by damage reach for the base and most likely future years.



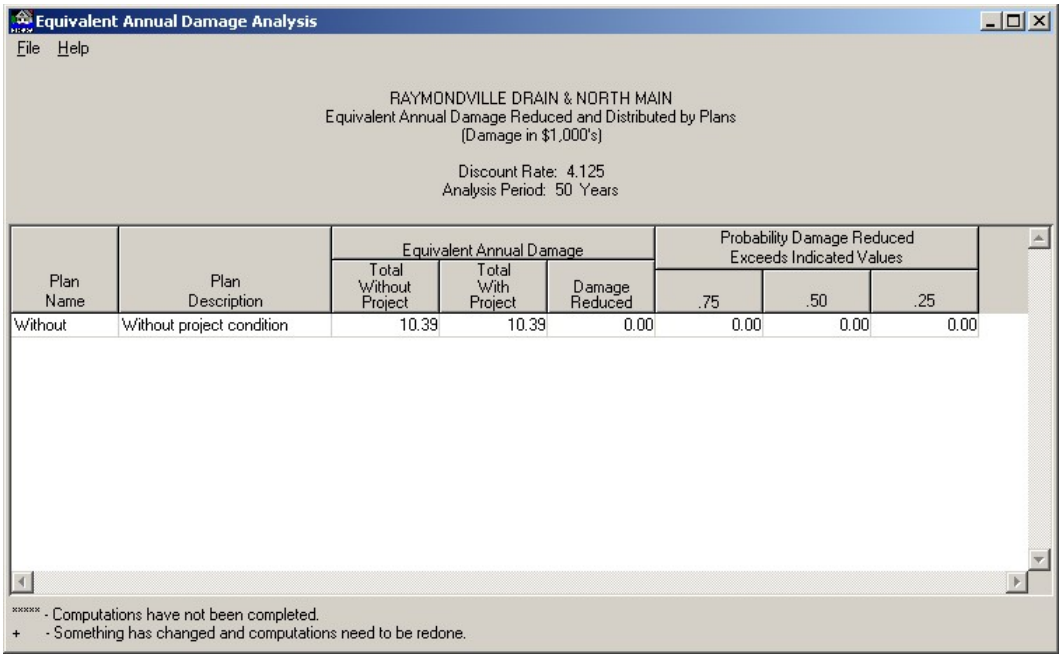
Equivalent Annual Damage Analysis Report

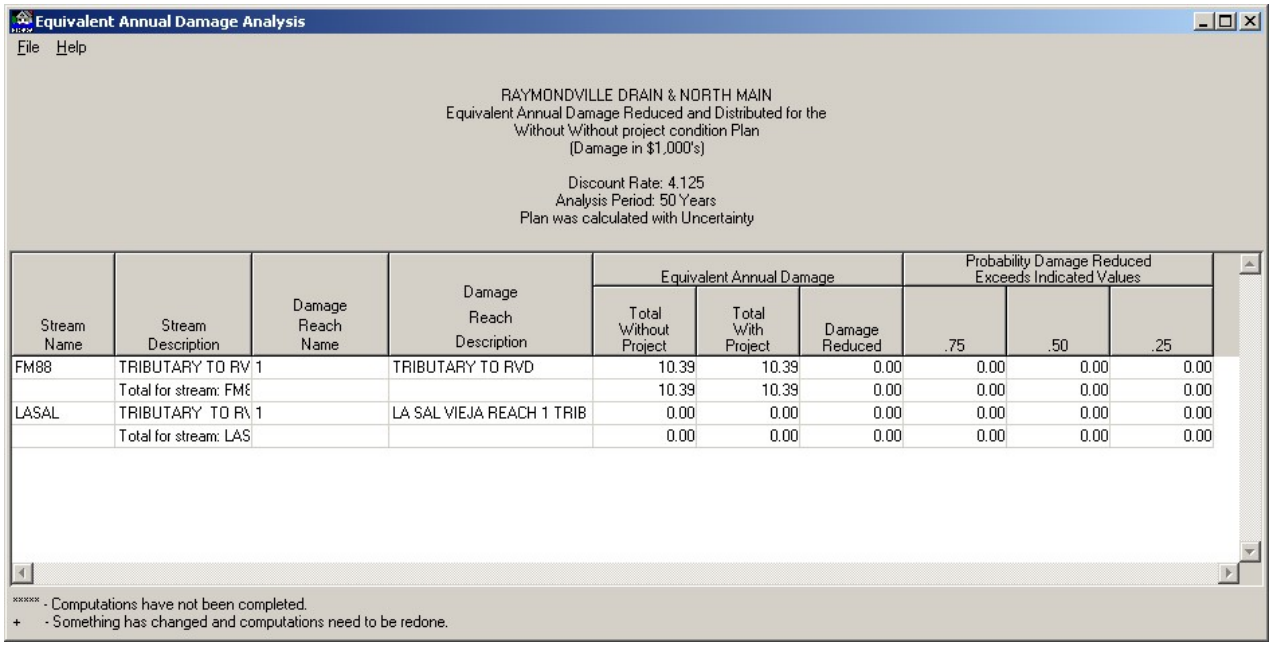
This section produces three types of reports:

- **Data management summary** – displays information about the equivalent annual damage analysis computations by plan and whether or not uncertainty was computed.

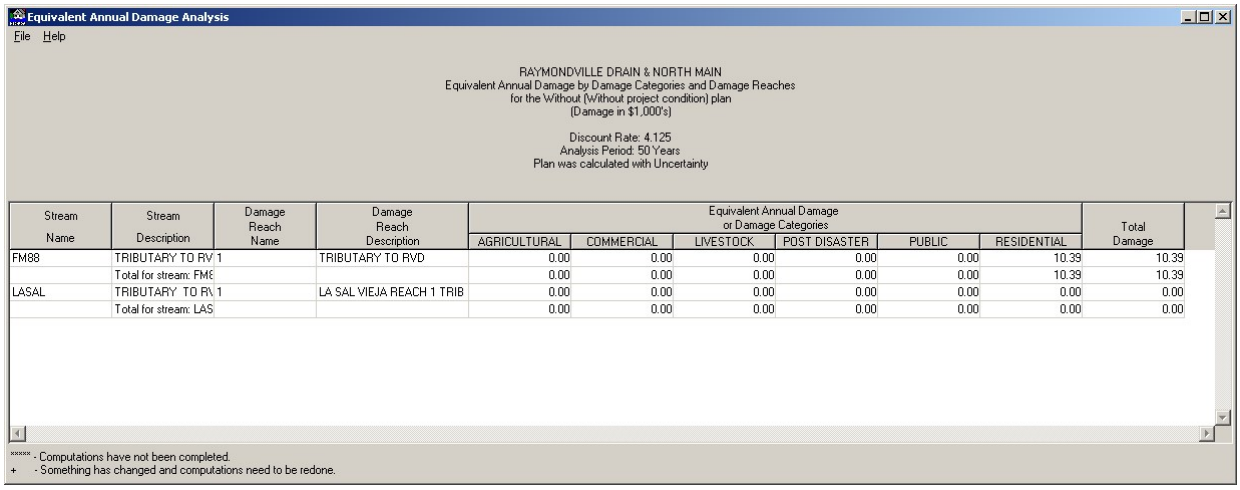


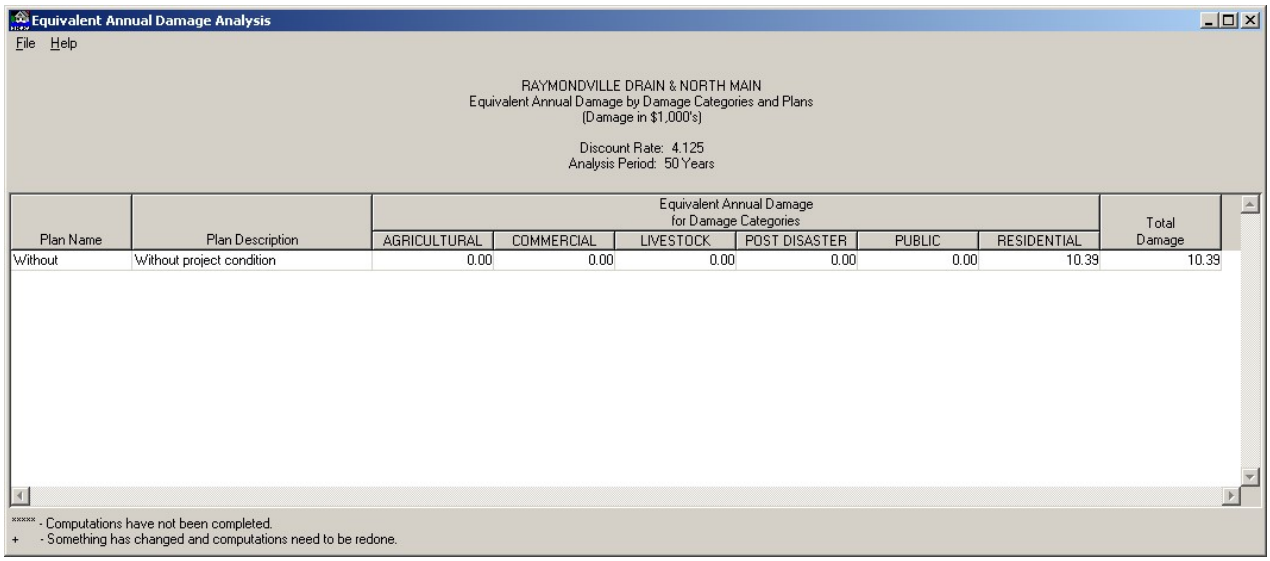
- **Equivalent annual damage reduced and distributed –** shows the equivalent annual damage for the without- and with-project conditions and associated damage reduced for all plans or damage reaches





- **Equivalent annual damage by damage category**
  - Shows the annual damage equivalent based on the discount rate and can be view either by damage reaches or plans





Equivalent Annual Damage Analysis

File Help

RAYMONDVILLE DRAIN & NORTH MAIN
Equivalent Annual Damage by Damage Categories and Plans
(Damage in $1,000's)

Discount Rate: 4.125
Analysis Period: 50 Years

Plan Name	Plan Description	Equivalent Annual Damage for Damage Categories						Total Damage
		AGRICULTURAL	COMMERCIAL	LIVESTOCK	POST DISASTER	PUBLIC	RESIDENTIAL	
Without	Without project condition	0.00	0.00	0.00	0.00	0.00	10.39	10.39

***** - Computations have not been completed.
+ - Something has changed and computations need to be redone.

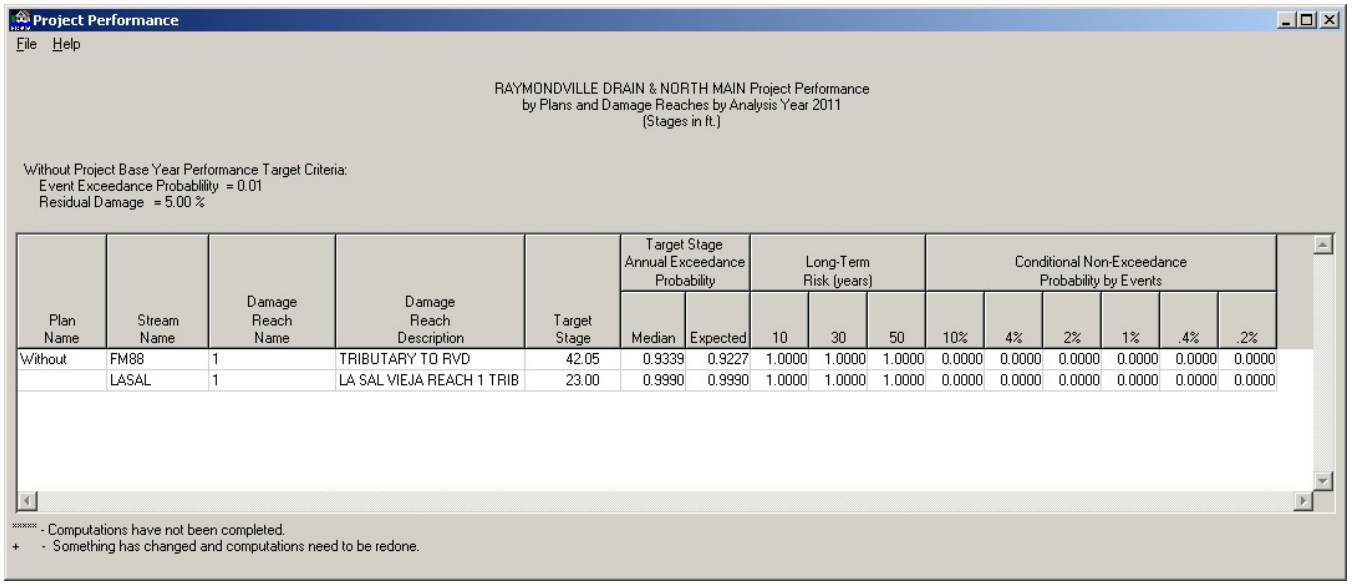
Project Performance Reports

These reports provide information about the hydrologic/hydraulic performance of the plans. The three types of reports:

- List of target stages by damage reach and analysis year for a selected plan
- Project performance by damage reach for a selected plan and year
- Project performance by plan and damage reach for a selected analysis year.

Target Stages by Damage Reach or Plan and Damage Reach (Shown is PLAN & DAMAGE REACH)

This table shows the water surface elevation (target stage) where significant damage for the base conditions begins.



Project Performance

File Help

RAYMONDVILLE DRAIN & NORTH MAIN Project Performance
by Plans and Damage Reaches by Analysis Year 2011
(Stages in ft.)

Without Project Base Year Performance Target Criteria:
Event Exceedance Probability = 0.01
Residual Damage = 5.00 %

Plan Name	Stream Name	Damage Reach Name	Damage Reach Description	Target Stage	Target Stage Annual Exceedance Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events					
					Median	Expected	10	30	50	10%	4%	2%	1%	.4%	.2%
Without	FM88	1	TRIBUTARY TO RVD	42.05	0.9339	0.9227	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	LASAL	1	LA SAL VIEJA REACH 1 TRIB	23.00	0.9990	0.9990	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

***** - Computations have not been completed.
+ - Something has changed and computations need to be redone.

P. Troubleshooting and errors

As mentioned earlier, the message warning log needs to be reviewed after every computation is complete. If errors or warnings are given they need to be addressed and deleted from the log. The log is continuous and will keep old warnings and errors.

If the program encounters problems during certain tasks a message window will pop up displaying an error number. Table 16.1 in Chapter 16 of the FDA manual lists the error numbers and an explanation of the problem.

If an error message titled "CODEBASE ERROR" appears immediately shut the program down. This indicates a major problem with the database. Some CODEBASE errors will have a display pop up saying the program has stopped some won't. The primary source of these errors is either missing or corrupt files.

Q. .OUT FILES

The FDA program generates several other useful output files which cannot be viewed using the FDA program. These files can be located under the subdirectory folder as are all the database files for the study. The following are the output files generated and a description:

- FDA_SDmg.out – contains stage-damage functions by damage reach, category, and optionally by structure.
- FDA_SdErrors.out – contains structure data validation information. This file indicated whether invalid data has been used. Such as unknown damage reach or category and if the structure is not included in the calculations due to being outside the floodplain or the service year is outside the calculation year.
- FDA_StrucDetail.out – contains detailed structure information including all of the structure's data as well as the damage computed for each of the water surface profile probabilities.
- FDA_SDev.out – contains detailed results by structure of the Monte-Carlo simulations for stage-damage.

FDA_SDmg.out

This file contains the computed stage-damage functions for the study. This breaks down the damage per depth per reach/category/structure. The first set of tables is the stage-aggregated damage functions without the standard deviation of error. There are four tables and are broken down by Structure, Content, Other and Total. The second set of tables is the stage-aggregated damage functions by stream, damage reach, and damage category. These functions include the standard deviation of error and are broken down the same as the first set. This file can contain more detailed output for the individual structures such as the structure name, address, water surface elevation at index location, water surface elevation at the structure, etc.

FDA_SdErrors.out

This file contains the structures not used in the calculations. These need to be verified to make sure they are truly out of the floodplain (first floor elevation is higher than the water surface elevation) or are future structures that have not been implemented at the time of the flood event. If all the structures in

this file have been evaluated and deemed to be outside the parameters of the flood area then these structures will not be included in the damage totals.

FDA_SDev.out

This file contains the detailed results from the Monte-Carlo simulation

FDA_StrucDetail.out

This file contains all the structure inventory data and water surface elevation based on the discharge probability.

II Procedure and/or Process for the Flood Damage Assessment (FDA) Analysis

1. Storm Exceedance Probabilities and Analysis

- The 100-year, 24 hour storm event, based on current conditions, is used by the Federal Emergency Management Agency (FEMA) for designating risk factors and floodplain insurance rates.

- Improvements or modifications within the existing floodplain are analyzed based on the 100-year, 24 hour, storm event and weighed against existing conditions prior to the proposed improvements.

- In some cases, the Flood Insurance Rate Maps (FIRM) will utilize other storm durations or exceedance probabilities such as the 25-year, 3-day, or the 500-year, 24 hour, etc., when the subject area is downstream of a dam or reservoir (ie, high risk areas), or the local authority has more conservative and stricter floodplain management requirements.

- Also, post build-out/future conditions in association with the 100-year, 24hour storm event may be used for flow generation and analyses of modifications within a designated floodplain by some communities warranting stricter requirements. Flood insurance rates, however, are always generated by FEMA using existing/current conditions. It should be noted, that good practice is for a proposed flood facility to be implemented with a project service life extended into a future year, say 20 to 50 years. This enables a system which will maintain the floodplain envelope through an extended period of development and time.

2. USACE Flood Damage Feasibility Study

- The USACE FDA feasibility study is used for developing stage-discharge-damage relationships and encompasses a series of annual exceedance events. The 100-year, 10-day storm event for existing (2011) and future conditions (2061) was used for flow generation. This exceedance storm event and duration relates the project area back to a known historical storm event (Beulah 1967).

- Although only the development years 2011 and 2061 in conjunction with their associated exceedance frequencies of 2-year through the 500-year are calculated from the HEC-HMS program, the FDA model further extrapolates the 1-year storm exceedance event and the 1,000-year storm event for each incremental year between 2011 to 2061. When warranted, these limits could be expanded to the 2,000-year…10,000-year etc. HEC-FDA performs multiple simulations to determine a stage-discharge-damage envelope that incorporates standard deviations for error accountability (survey accuracy, accuracy of rainfall data, housing costs, accuracy of forecast development trends etc.). These stage-discharge-damage relationships are used to calculate the expected annual damages per each year between 2011 and 2061. They are also used to forecast an equivalent annual damage which discounts future damage costs back to the base year and annualizes each year to an equivalent annual damage. This procedure is developed for the without-project and the project's proposed plan alternatives.

- For the proposed alternatives the 100-year, 10-day, 2061 projected peak flow rates were conservatively used to size the proposed flood improvements.

- Equivalent and expected annual damages are calculated for the without-project and the project alternative models and compared. A damage reduction is calculated and a benefit-cost (B/C) ratio is developed.

- A B/C ratio of 1.0 or higher is in general, necessary to obtain funding through the USACE. If the B/C ratio meets or slightly exceeds 1.0, then no further analysis is needed and the proposed improvements are sufficient. If it is too high downsizing may be necessary to maintain an efficient but cost effective design. If the ratio is below 1.0 then other alternative measures may need to be considered.