plan. Because of the rectification of the entire reach of Dry Gully and its laterals, the watershed streams are labeled as low-quality habitat.

2.3.2 Land Uses in the Watershed

A land use inventory of the watershed was performed using the Harris County Appraisal District (HCAD) real property database. Aerial mapping and field investigations were used to confirm land uses in the area. The watershed is primarily residential with some commercial/industrial, and public (schools, churches, open spaces) land uses. Existing development in the watershed is approximately 37 percent.

Approximately 2000 acres of the undeveloped acreage within the Dry Gully watershed is located within the Gleannloch Subdivision. This subdivision is a masterplan community that is in continual development. This subdivision occupies 55 percent of the watershed. The undeveloped tracts of the watershed outside of Gleannloch Farms subdivision, only occupy nine percent of the Dry Gully watershed. As measured, there is less than 400 acres of undeveloped land downstream of Spring-Cypress Road. Upon the completion of the Gleannloch Farms Subdivision, the Dry Gully watershed will be approximately 91 percent developed.

Approximately 37 percent of the land use in the watershed is residential. This is largely single family. Commercial land use is mostly business with little or no industrial use. Commercial land use in the watershed is currently limited to approximately three percent. Public land uses include schools, churches, fire and police, stations, utilities, golf courses, and recreational open space. This constitutes approximately four percent of the land use in the watershed. A map of land uses in the watershed can be seen in **Exhibit E3**.

2.3.3 Structure Inventory

An inventory of structures that might be affected by flooding along the main stem was performed. The purpose of the inventory was to identify and estimate the economic value or benefit if the structures were either removed or protected from flooding by the regional plans. In the Dry Gully watershed, approximately 346 structures were identified that might be affected by flooding from the main stem and tributaries. The general location of these structures is shown on **Exhibit E4**. In order to estimate the value of these structures, a search of the Harris County Appraisal District (HCAD) records was performed using a GIS file supplied by HCFCD. Using HCAD data, it is estimated that the total value of the 346 structures is approximately $63,400,000.

2.3.4 Economic Factors for the Watershed

The Dry Gully watershed is typical of many of the Cypress Creek tributary watersheds in that it is in a state of development. A portion of the upper watershed has been planned for development as noted above. Land values in the watershed are rising due to this development pressure, especially in areas where outfall for drainage is present, along the main stem and the tributary ditches. As noted above, there are few structures currently located in flood-prone areas and current development regulations are written to ensure that new structures are not placed in areas without adequate flood protection.

2.4 Problems and Opportunities Identification

The flood hazard information identified in the Phase I study efforts was used to determine the areas within the watershed most susceptible to out-of-bank flooding. Additionally, opportunities for enhancement of the watershed through the reduction of existing flooding and preservation of environmental features in the design of the regional plans were identified.

2.4.1 Economic Flood Damage Analysis

In the Dry Gully watershed, 346 structures were identified as structures likely to suffer economic damage to structure and content during a 100-year event at a cost of approximately $16 million. The general location of these structures is shown on **Exhibit E4**. The specified dollar amount will be the likely benefit of any plan implemented that eliminates the out-of-bank 100-year floodplain.

An economic analysis was carried out for a 50-year period with a probable start date of 2010. Using the federal interest rate for fiscal year 2001 of 6.375 percent, it is expected that average annual equivalent damages to structure and content in the watershed will be approximately $4.3 million if the current (baseline) drainage conditions remain unchanged. Less than $25,000 of the annual damages is attributed to commercial and public structures.

2.4.2 Identification of Flood-Prone Areas

As shown on **Exhibit E4**, flood prone areas as determined from the LIDAR-based HEC-FDA analysis of baseline conditions, can be seen to occur mostly in the mid-reaches of the watershed, between Spring-Cypress Road and Louetta Road, east of the channel. Although most of these areas have channel capacity, the subdivisions within these reaches are lower than the channel banks.

2.4.3 Summary of Public Comments Received

Three public meetings have been held to discuss this project, and public comment on existing drainage problems, plan alternates, and the recommended plan have been solicited. A summary of public comments received regarding the Dry Gully watershed is shown below.

First Public Meeting (August 2001)
No comments were received for Dry Gully watershed during this first public meeting.

Second Public Meeting (October 2002)
Four attendees in Dry Gully watershed that did not attend the first public meeting were present in the second. These residents were from the Memorial Northwest subdivision, which lies on the watershed divided of Dry Gully and Theiss Gully. The comments presented correlated to the historical flooding data. The attendees believed that the houses along Memorial Oaks Lane and within the subdivision have experienced flooding due to the internal drainage of the subdivision, the incapacity of the outfall structure of the subdivision into Dry Gully, and flows entering the subdivision from Theiss Mail Route. General comments regarding the public's views on flood control measures are mentioned in **Section 2.5.5** of this report.

Third Public Meeting (April 2003)
No comments were received.

2.4.4 Summary of Repetitive Flood Loss Data

Databases containing records of flooded structures and flood insurance claims were obtained from FEMA. They contained records obtained for events up to and including Tropical Storm Allison in 2001. Historically flooded properties on record were geocoded and their approximate locations are shown in **Exhibit E4**. Several structures were identified within the Memorial Northwest subdivision within the mid-reaches of the watershed.

2.4.5 Opportunities for Watershed Enhancement

This drainage study presents an opportunity to provide for future multiple-use facilities such as parks and sports fields that also serve as detention facilities and preserve any areas for environmental conservation. Hike and bike trails along the existing channels have been identified within the Harris County Parks Masterplan. These trails are potential multiple-use aspects for the watershed.

2.4.6 Identification of Major Thoroughfare Outfalls

The major roads through the watershed are shown in **Exhibit E5**. A future project, the proposed Northpointe Road, will provide an additional east-west corridor in the upper section

of the watershed between Spring-Cypress Road and Boudreaux Road. Northpointe Road will divide the Gleannloch Farms Subdivision. Spring-Cypress Road is also proposed for lane expansion through the watershed. The roadway is proposed to be expanded from the existing two-lanes to a proposed four and five-lane road.

2.4.7 Storm Water Quality Issues

As part of new regulations enacted by Harris County in October 2001, all new development that outfalls into Dry Gully will be required to provide storm water quality protection for the outfall drainage. This includes roadway projects, subdivisions and other development of five acres or more. The regional plans evaluated as part of this project are planned to provide general water quality benefits, as will be discussed later, but do not specifically address individual developments or roadway projects. Additional storm water quality features will have to be designed for these projects, in order to comply with the new effective regulations.

2.5 Alternate Drainage Plan Formulation

A series of alternative drainage plans were formulated for the Dry Gully watershed. The formulation of the alternative plans was performed towards the achievement of stated goals and objectives identified for the study effort. The general objectives include the alleviation of existing drainage problems and to construct a plan to provide the necessary drainage infrastructure for future roadways and development that the watershed may incur. Also within the objectives is applied a consideration of the environmental concerns as well as provisions for multiple-use facilities that could, in addition to flood control, provide other benefits such as recreation and aesthetics.

Generally, plan formulation alternatives for the watershed were developed by considering elements that include channel modification alternatives, detention alternatives, and non-structural and "no-action" alternatives. The principal components of each alternative scenario included a single opportunity for each reach or a combination of these opportunities, especially in the consideration of multiple-use facilities. The following section presents a description of each alternative investigated and its benefits to the Dry Gully watershed.

As mentioned in Section 2.2, the baseline subbasins were further subdivided in order to more accurately model particular plan elements. The additional subdivision created a model slightly different than the one included in the Phase I report. The addition of subareas to the model caused peak flows to increase slightly in the baseline models used in this study. **Table E1** of this report presents the updated watershed parameters resulting from this modification of subareas. The peak flows resulting from this subdivision are identified in the following sections describing the plan alternates.

The models used to simulate the plan alternatives are based on the revised modeling efforts that define an updated baseline condition. For the simulation of the Dry Gully watershed, the watershed parameters did not change and are the same as that identified in **Table E1**. Additional storage volume resulting from alternative plan features were incorporated into the models, and the peak flow values along appropriate reaches were determined.

Each of the alternate plans presented below are combinations of these elements. Although the alternates differ somewhat in their features, there are common elements to all the plans presented in this study.

2.5.1 Common Features to Alternate Plans

As mentioned many of the plan elements may provide a multiple-use. Emphasis was placed on preserving areas of high-quality stream habitat as well as to provide a flood control facility. Where new channels (or channel extensions) have been recommended, the channel design is based on a more aesthetic, multiple-use section. This section has flat side slopes and large benches for vegetation and recreational usages. This section tends to ensure less maintenance and is less susceptible to erosion. A typical cross-section of this channel is shown in **Figure 1** of the main report. Where a detention basin has been recommended, the basin will be based on a multiple-use design. A typical layout of a detention basin is shown in **Figure 2** of the main text report.

The current regulations requiring storm water detention to serve new development are assumed to remain in place for this analysis. The plans described below provide benefits in addition to the on-site requirements. The plans considered that the Gleannloch Farms Masterplan Subdivision will mitigate its on-going construction with on-site detention, as indicated by its construction plans. Each alternative plan elements are shown on **Exhibit E6**.

The Dry Gully watershed is almost completely developed, and most of the portions of the watershed not currently developed have been included within a Masterplan subdivision. The flooding problems within the watershed are scattered and few and mostly are not related to the capacity of the channel. Therefore a different strategy of plan formulation was used for Dry Gully. The Memorial Northwest subdivision has had several historical floodings. For the engineering investigations of the watershed, the channel, and its capacity and discussions with residents, it was determined that these floodings were mainly caused by internal drainage problems. Therefore, improvements to the drainage infrastructure and outfall of these areas are proposed for all alternatives. This element has been considered for each alternative. Coordination of implementation and funding with the respective regulatory agency will be required for this element.

2.5.2 Alternate 1 Features and Benefits

Alternative 1 consists of a non-structural element and a no-action element. This alternative includes a proposal to coordinate stormwater drainage improvements that have been designated for the two areas within the Memorial Northwest subdivision. Alternative 1 features are shown on **Exhibit E6**.

Also, as indicated by the major thoroughfare plan, Spring-Cypress Road is designated to be expanded. Because of the limited availability of land within the Dry Gully watershed, it is recommended that the HCPID reserve a tract of land along Dry Gully for impact mitigation and water quality.

This plan maintains baseline conditions and does not offer any reduction to peak flows. The following table shows the peak flows at each hydrologic computational node in the baseline and alternate condition.

Alternative 1 Benefits (100-Year Flows)				
Node	**Location**	**Baseline Flow (cfs)**	**Alt Flow (cfs)**	**Benefit (cfs)**
K133A	Dry Gully at Spring-Cypress Road	1402	1402	0
K133#2	Dry Gully at Louetta Road	3379	3379	0
K133#3	Dry Gully at its Confluence with Cypress Creek	3923	3923	0

* The flow from the baseline model with subbasins revised as noted in Part 2.2 of this report.

Because the alternative does not have physical elements, it does not reduce flows along Dry Gully or Cypress Creek. This alternative will offset the effects of full development with onsite detention in the watershed. The estimated cost for implementing Alternative 1 is speculative because the items presented will require other regulatory agencies involvement and funding.

2.5.3 Alternate 2 Features and Benefits

Alternative 2 consists of a non-structural element and a detention element to fulfill the analysis goals. A sideweir detention basin is proposed along Dry Gully to reduce the flows entering Cypress Creek. The basin is proposed within a 9.8-acre tract south of Louetta Road along the west bank. The basin weir is set to provide flow reduction for 25-year and less frequent events. Alternative 2 features are shown on **Exhibit E6**.

Also, as indicated by the major thoroughfare plan, Spring-Cypress Road is designated to be expanded. Because of the limited availability of land within the Dry Gully watershed, it is recommended that the HCPID reserve a tract of land along Dry Gully for impact mitigation and water quality.

This plan provides benefits in reducing peak flows at each node in the watershed. The table below shows the peak flows at each hydrologic computational node in the baseline and alternate condition.

Alternative 2 Benefits (100-Year Flows)				
Node	**Location**	**Baseline Flow (cfs)**	**Alt Flow (cfs)**	**Benefit (cfs)**
K133A	Dry Gully at Spring-Cypress Road	1402	1402	0
K133#2	Dry Gully at Louetta Road	3379	3379	0
B#1B	Dry Gully Downstream of Basin #1	--	2978	--
K133#3	Dry Gully at its Confluence with Cypress Creek	3923	3532	-391

* The flow from the baseline model with subbasins revised as noted in Part 2.2 of this report.

The alternative as noted has the effect of lowering flows at the mouth by approximately 10 percent. This alternative will offset the effects of full development with onsite detention in the watershed and reduces peak flows into Cypress Creek. The estimated cost for implementing Alternative 1 is $1,030,000. This cost does not include the cost of the basin for the Spring-Cypress Road improvements, nor does it include the cost of drainage investigation for the Memorial Northwest subdivision. These costs will need to be coordinated with the respective governing agencies.

2.5.4 Alternate 3 Features and Benefit

Alternative 3 consists of a non-structural element and a detention element to fulfill the analysis goals similar to the elements presented in Alternative 2. A sideweir detention basin is proposed along Dry Gully to reduce the flows entering Cypress Creek. The basin is proposed within a 9.8-acre tract south of Louetta Road along the west bank. However, the weir for this alternative basin is located to provide flow reduction starting at the 10-year frequency. Alternative 3 features are shown on **Exhibit E6**.

Also, as indicated by the major thoroughfare plan, Spring-Cypress Road is designated to be expanded. Because of the limited availability of land within the Dry Gully watershed, it is recommended that the HCPID reserve a tract of land along Dry Gully for impact mitigation and water quality.

This plan provides benefits in reducing peak flows at each node in the watershed. The table below shows the peak flows at each hydrologic computational node in the baseline and alternate condition.

Alternative 3 Benefits (100-Year Flows)				
Node	**Location**	**Baseline Flow (cfs)**	**Alt Flow (cfs)**	**Benefit (cfs)**
K133A	Dry Gully at Spring-Cypress Road	1402	1402	0
K133#2	Dry Gully at Louetta Road	3379	3379	0
B#1B	Dry Gully Downstream of Basin #1	--	2962	--
K133#3	Dry Gully at its Confluence with Cypress Creek	3923	3514	-409

* The flow from the baseline model with subbasins revised as noted in Part 2.2 of this report.

The alternative as noted has the effect of lowering flows at the mouth by approximately 10 percent. This alternative will offset the effects of full development with onsite detention in the watershed and reduces peak flows into Cypress Creek. The estimated cost for implementing Alternative 1 is $1,030,000. This cost does not include the cost of the basin for the Spring-Cypress Road improvements, nor does it include the cost of drainage investigation for the Memorial Northwest subdivision. These costs will need to be coordinated with the respective governing agencies.

2.5.5 Public Input on Alternate Plans

On October 8, 2002, a public meeting was held to describe the progress of the project and to inform the public regarding the alternative plans being proposed for the watershed. Only a few attendees addressed the alternative elements presented for Dry Gully. These attendees were residents of Memorial Northwest subdivision, which has experienced previous flooding. They concurred with the assumption that the drainage problems within their subdivision could be alleviated with improvements to the subdivisions drainage system and outfall structure.

2.5.6 Screening of Alternates

In order to determine the recommended plan for the Dry Gully watershed, a number of criteria were screened to determine which of the alternatives best met the goals of the watershed and the HCFCD. This screening was performed on a relative basis. The following criteria matrix was used when evaluating the alternative plans identified for this watershed. The ability of the plan alternative to meet each criteria was ranked from 0 to 10, with 0 indicating that the criteria is not met, and 10 indicating that the criteria is met to the best of its ability. Relative weights were then set for each of the criteria as shown below based on the stated goals of the study.

Table E1 – Screening Matrix for Dry Gully Watershed				
		Plan		
Criteria	Weight	ALT 1	ALT 2	ALT 3
Minimal Construction Cost	0.2	8	6	6
Provides Aesthetics	0.5	2	4	4
Ease of Implementation	0.8	7	7	7
Flood Protection within Tributary Watershed	1	5	7	7
Ability to Accommodate Multiple Uses	0.5	5	7	7
Preserves/Enhances Water Quality	0.8	5	7	7
Preserves/Enhances Stream Habitat Quality	0.5	5	5	5
Ease of Maintenance	0.8	6	4	4
Reduction of Peak Flows into Cypress Creek	1	2	6	7
Outfalls for Future Roadways/Development	0.8	10	10	10
Acceptable to the Public	0.8	7	8	8
TOTAL	-----	**62**	**71**	**72**
WEIGHTED TOTAL	**77(max)**	**43**	**51**	**52**

2.6 Recommended Plan and Identification of Elements

Based on the criteria noted above, a plan was recommended that met the needs of the watershed as noted in this report. The recommended plan is described in detail in the following sub-sections.

2.6.1 Determination of Recommended Plan

Alternative 3 was chosen as the recommended plan, primarily due to the fact that it met most of the criteria of the study and provided a reduction of flows to Cypress Creek. It also provides a flow reduction during a more frequent event than Alternative 2. The downstream Dry Gully detention basin K133#B1 site may prove highly useful in reducing Cypress Creek flooding. This plan also calls for the detail investigation of the internal drainage problems of Memorial Northwest subdivision. This drainage problem has been reported by residents and is indicated by historic flooding of homes within the subdivision. A tract, K133#B2 is identified for the impact mitigation and water quality requirements for the future expansion of Spring-Cypress Road. Another provision of this plan is that the undeveloped land within the Gleannloch Farms Subdivision be developed according to the approved construction plans for the subdivision.

2.6.2 Recommended Plan Features

The recommended plan consists of features that provide outfall drainage for future roadways, address existing flooding in the watershed, and provide flow reduction to Cypress Creek. The features of the plan, beginning at the mouth, consist of the elements outlined in Section 2.5.3 (Alternative 3 Features and Benefits) and further described below.

A 9.8-acre tract sideweir detention basin is proposed downstream of Louetta Road. The detention basin is proposed with a 7.7-acre top area with 30-foot wide maintenance berms. The average usable depth of the basin is 10 feet. The basin weir is a side weir is 55-foot in length set to an elevation of 122.5 feet. At weir elevation, the basin provides 52 acre-feet of storage with a maximum storage of approximately 66.6 acre-feet at the 100-year water surface elevation of 104.6 feet. The implementation of the basin is expected to reduce peak flows to Cypress Creek by as much as 400 cfs. This basin can be utilized as a multiple-use facility. A typical basin layout is shown as **Figure 2** of the main report.

A 2.5-acre tract was been identified downstream of Spring-Cypress Road along the right bank of Dry Gully to serve as a potential area to fulfill the impact mitigation and water quality requirements. The average depth of the basin is 10 feet with a storage volume of 12.7 acre-feet. Spring-Cypress Road is to outfall into the basin, which then will provide the required mitigation storage and water quality volume. This basin can be utilized as a multi-use facility. A typical basin layout is shown as **Figure 2** of the main report.

2.6.3 Recommended Plan Benefits

Taken together, these elements make up the recommended plan for the Dry Gully watershed and satisfy the criteria for this study while providing quantifiable benefits to the watershed. Some recreational elements will be necessary to add to the plan features to fully meet the desired goal for multiple-use facilities. The area of the detention basin in the southwest corner of Louetta Road and Dry Gully will be encouraged for use as a park or for soccer fields.

Hydrologic benefits due to the plan elements were summarized earlier in the alternate plan formulation section of this report. In order to maintain consistency with the Phase I report, the flows calculated as a result of the more detailed modeling were compared with the revised baseline flows, then the prorated decrease (or increase) resulting from the modeling of the recommended plan was applied to the original baseline flows to create an adjusted plan flow. The adjusted plan flows were used as the basis for the HEC-RAS modeling and floodplain mapping for the recommended plan. The revised Tc and R parameters for the recommended plan compared to the baseline are shown in **Table E2**. The resulting 100-year flows comparing the baseline conditions to the recommended plan conditions are presented in **Table E3** of this report. **Table E4** of this report presents the HEC-1 peak flows resulting from the

recommended plan for various storm frequencies. The 100-year recommended plan and baseline condition floodplains are shown on **Exhibit E8**. A comparison between the recommended plan and baseline condition 100-year storm event flood profiles for Dry Gully are presented in **Exhibits E9-1** through **E9-2**. The Dry Gully eight frequencies storm event profiles for the recommended plan are presented in **Exhibits E11-1** through **E11-2**.

The plan reduces peak flows along Dry Gully downstream of Louetta Road and reduces flows entering into Cypress Creek. Additionally, water surface elevations are lowered in conjunction with the lower flows. As shown in **Table E5**, the 100-yearwater surface elevations decrease along Dry Gully by as much as 0.6 feet. As noted earlier, the goal of this plan was not to bring all areas of out-of-bank flooding to within the banks. The goal was to preserve some areas of out-of-bank flooding that occurs in areas that are beneficial to the watershed and to address out-of-bank flooding in areas where it causes existing or projected flooding problems outside of the stream corridor areas.

Table E2: Watershed Physical Characteristics (Baseline & Recommended Plan Conditions)

Subarea Name	Drainage Area		Watershed Length	Length to Centroid	Channel Slope	Overland Slope	Urban Dev. *	Watershed Dev. *	Channel Imp.	Channel Conv.	Ponding
	(Acre)	(Sq.Mi)	(mi)	(mi)	(ft/mi)	(ft/mi)	(%)	(%)	(%)	(%)	(%)
Baseline Condition											
K133A	1535	2.40	2.49	0.88	6.3	10	0	28.0	40	100	0
K133B	1394	2.18	2.61	0.98	8.0	10	50.4	85.1	100	100	0
K133C	489	0.76	2.83	0.78	6.3	10	37.5	81.3	100	100	0
Recommended Plan Condition											
K133A	2254	3.52	2.49	0.88	6.3	10	0	28.0	40	100	0
K133B	1394	2.18	2.61	0.98	8.0	10	50.4	85.1	100	100	0
K133C	489	0.76	2.83	0.78	6.3	10	37.5	81.3	100	100	0

* % based on development in place prior to implementation of HCFCD on-site detention policy (1984)

Baseline & Recommended Plan Conditions

Subarea Name	TC	R	RTIMP
	(hrs)	(hrs)	(%)
K133A	7.20	0.72	35.0
K133B	3.30	0.40	35.0
K133C	4.64	0.38	35.0

Table E3: 100-Year Flow Comparison Table (Baseline vs. Recommended Plan)

HEC-1 Analysis Point	Baseline Condition (cfs)	Recommended Condition (cfs)*	Baseline vs. Recommended Plan	
			Difference (cfs)	% Change
	(cfs)	(cfs)	(cfs)	(%)
K133#1	1402	1402	0	0
K133#2	3379	3379	0	0
K133#3	3923	3514	-409	-10

Table E4: HEC-1 Peak Flow Rates for Recommended Plan Conditions*

HEC-1 Analysis Point	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	250-Year	500-Year
	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
K133A	456	716	888	1076	1228	1402	1619	1784
K133B	766	1170	1440	1714	1948	2199	2527	2770
K133#2	1089	1724	2141	2583	2971	3379	3893	4280
K133#2A	1089	1724	2122	2467	2723	2962	3248	3468
K133C	203	315	389	466	531	603	694	763
K133#3	1245	2000	2473	2892	3206	3514	3886	4170

Table E5: Comparison of Water Surface Elevations (100-Year)
Dry Gully (K133-00-00)

Station	Location	Baseline Condition		Recommended Plan		Difference
		Flow	WSEL	Flow	WSEL	WSEL
104		3923	103.64	3514	103.06	-0.58
154		3923	103.57	3514	103.00	-0.57
155	Transition Structure	3923	103.73	3514	103.36	-0.37
184		3923	105.89	3514	105.39	-0.50
185		3923	105.93	3514	105.44	-0.49
500		3923	106.15	3514	105.64	-0.51
1000		3923	107.01	3514	106.55	-0.46
1250		3923	107.69	3514	107.23	-0.46
1299		3923	107.77	3514	107.30	-0.47
1346	Cypresswood Drive					
1393		3923	108.35	3514	107.71	-0.64
1442		3923	108.42	3514	107.77	-0.65
1500		3791	108.44	3338	107.80	-0.64
2000		3791	109.01	3338	108.38	-0.63
2508		3791	109.47	3338	108.83	-0.64
2547		3791	109.50	3338	108.87	-0.63
2564	Champions Forest Drive					
2581		3791	109.58	3338	108.93	-0.65
2630		3791	109.63	3338	108.97	-0.66
2840		3676	109.73	3189	109.08	-0.65
2890		3676	109.60	3189	108.97	-0.63
2892	Transition Structure	3676	112.58	3189	112.06	-0.52
2921		3676	114.39	3189	113.85	-0.54
2999		3676	114.47	3189	113.89	-0.58
3499		3676	115.38	3189	114.84	-0.54
3999		3580	116.05	3065	115.48	-0.57
4487		3580	117.01	3065	116.35	-0.66
4507	Herts Road					
4525		3580	117.15	3065	116.49	-0.66
4655		3580	116.97	3065	116.35	-0.62
4706		3580	117.76	3065	117.03	-0.73
4708	Transition Structure	3580	121.29	3065	120.78	-0.51
4735		3580	123.17	3065	122.50	-0.67
5000	Sideweir Basin	3499	123.54	2962	122.90	-0.64
5500		3499	124.64	2962	123.97	-0.67
6000		3499	125.72	3379	125.06	-0.66
6456		3499	126.66	3379	126.22	-0.44
6505		3379	126.77	3379	126.30	-0.47
6520	Louetta Road					
6536		3379	126.88	3379	126.44	-0.44
6585		3379	126.94	3379	126.52	-0.42

Table E5: Comparison of Water Surface Elevations (100-Year)
Dry Gully (K133-00-00) *(continued)*

Station	Location	Baseline Condition		Recommended Plan		Difference
		Flow	WSEL	Flow	WSEL	WSEL
6793		3379	126.48	3379	125.90	-0.58
7000		3379	128.68	3379	128.76	0.08
7500		3062	130.40	3062	130.43	0.03
8000		3062	131.20	3062	131.22	0.02
8500		3062	132.07	3062	132.08	0.01
9000		2632	132.79	2632	132.80	0.01
9500		2632	133.49	2632	133.49	0.00
10000		2632	134.17	2632	134.16	-0.01
10500		2263	134.99	2263	134.98	-0.01
11000		2263	135.41	2263	135.41	0.00
11150		2263	135.49	2263	135.48	-0.01
11199		2263	135.63	2263	135.63	0.00
11219	Kilrenny Drive					
11239		2263	135.65	2263	135.64	-0.01
11288		2263	135.65	2263	135.64	-0.01
11500		2047	135.87	2047	135.87	0.00
12000		2047	136.30	2047	136.29	-0.01
12500		2047	136.65	2047	136.65	0.00
13000		1760	137.10	1760	137.10	0.00
13260		1760	137.24	1760	137.24	0.00
13500		1760	137.44	1760	137.44	0.00
13660		1760	137.57	1760	137.57	0.00
14000		1591	137.85	1591	137.85	0.00
14500		1591	138.15	1591	138.15	0.00
14705		1591	138.27	1591	138.28	0.01
14743		1591	138.29	1591	138.30	0.01
14950		1591	138.42	1591	138.42	0.00
15127		1402	138.54	1402	138.55	0.01
15257	Spring-Cypress Road					
15387		1402	141.90	1402	141.91	0.01
15421		1402	141.93	1402	141.94	0.01
16263		1402	142.02	1402	142.03	0.01
16343	50' United Gas Pipeline Esmt					
16424		1247	142.59	1247	142.59	0.00
16928		1247	142.61	1247	142.61	0.00
17041	130' Tennaco Gas Pipeline Esmt					
17155		1247	144.25	1247	144.25	0.00
17223		1247	144.25	1247	144.25	0.00
17273		1247	144.25	1247	144.25	0.00
17696		1097	144.31	1097	144.31	0.00

3.0 PLAN IMPLEMENTATION AND MANAGEMENT STRATEGIES

Since little remains of undeveloped lands within the Dry Gully watershed, the right-of-way for the features identified, as part of the recommended plan, should be obtained ahead of the development, while the acreage is available.

This information identifies the tracts of right-of-way needed to implement the recommended plan features. Further, the plan element identification provides the local agencies with areas of concern that will require further detail investigation. The following sections outline a suggested approach for implementing the recommended plan and identify recommended management strategies for the watershed.

3.1 Preservation of Stream Habitat Corridors

The Dry Gully channel has been identified as having poor natural stream habitat. This is because the channel has been rectified for its entire length. Therefore no corridors of stream habitat preservation were identified as part of this plan.

3.2 New Lateral Channels/Channel Extensions

The Dry Gully watershed is mostly developed with residential subdivisions. Because lateral extensions have already been constructed to provide outfall for the existing developments, new channels and/or channel extensions are not required. Therefore no new lateral channels or channel extensions were identified as part of this plan.

3.3 Detention Facilities

Two detention facilities were identified within the recommended plan for the Dry Gully watershed. It should be noted that the recommended plan advocates the use of on-site detention as a requirement of development. The facility K133#B1 proposed as part of the recommended plan are for flow reduction within the watershed. Therefore, it will likely not be feasible to allow developers to mitigate individual developments by excavating in the facilities. The facility K133#B2 was proposed as a potential area of mitigation and water quality to be acquired by the HCPID for the expansion of Spring-Cypress Road. Implementation of the detention facility elements of the recommended plan will consist of the actual purchase of the land and construction of the facility by public agencies such as the HCFCD.

3.4 Channel Crossings

As noted earlier, several major thoroughfares cross Dry Gully. Although Spring-Cypress Road has been identified for expansion, its existing structure has adequate length for the proposed roadway; therefore it will not require replacement. Also the other major thoroughfares have adequate capacity to convey the 100-year event; therefore they were not recommended for replacement as part of this plan.

3.5 Cost Analysis

Costs were identified for implementation of the recommended plan. These costs consider acquisition of right-of-way, engineering, and construction of the plan elements. The table below shows the plan elements, the identified right-of-way, the unit costs, and total costs for the project. The total cost when fully implemented is approximately $1.0 million, with the bulk of the cost in land acquisition, concrete paving, and excavation costs.

Table E6 – Estimated Recommended Plan Costs for Dry Gully

Description	Unit	Quantity	Unit Cost	Cost
1. Mobilization	Each	1	$10,000	$10,000
2. Clearing & Grubbing	Acre	9.8	$1,500	$14,625
3. Excavation & Haul	Ac-Ft	78.7	$5,000	$393,500
4. Concrete Weir Installation	S.F.	3668	$60	$220,072
5. Culvert Outlet Pipes (48" CMP)	L.F.	90	$100	$9,000
5a. Flapgates	Each	1	$9,000	$9,000
6. Drop/Control Structures	L.S.	0	$100,000	$0
7. Backslope Drains (every 600')	Each	4	$3,000	$12,000
8. Utilities Relocation	Each	0	$100,000	$0
9. Right-of-Way	Acre	9.8	$15,000	$146,250
10. Seeding & Mulching	Acre	9.8	$1,000	$9,750
11. Tree/Shrub Planting	Acre	0	$10,000	$0
1. Mobilization	Each	1	$10,000	$10,000
SUB TOTAL				$824,197
Contingencies (15%)				$123,629
Engineering and Administration (10%)				$82,420
SUBTOTAL CONSTRUCTION COST				$1,030,246
VOLUNTARY STRUCTURAL BUYOUT				$0
STREAM HABITAT PRESERVATION CORRRIDOR				$0
TOTAL				**$1,030,246**

3.6 Implementation Phasing

Implementation of the recommended plan features is suggested to occur in phases so that appropriate funding can be identified for each fiscal year. First priority should be given to the acquisition of the right-of-way identified within the plan. This includes the tracts of land for the detention basins K133#B1 and K133#B2. Second priority should be given to the detail internal

drainage investigation of the Memorial Northwest subdivision. Final priority should be placed on the construction of the detention facilities. The sideweir facility, K133#B1, should be implemented once the right-of-way is acquired and the funds provided. Since the K133#B2 facility is to be implemented as a mitigation and water quality facility for the proposed expansion of Spring-Cypress Road, it should only be constructed as part of the proposed roadway project.

3.7 Identification of Possible Funding Sources

Implementation of the plan is dependent upon the cooperation of other stakeholders in addition to the Harris County Flood Control District. The District's primary role is to implement flood reduction projects. The construction of parks and the creation of mitigation for new roadways cannot be implemented with District funds. Also the detail investigation of the Memorial Northwest subdivision internal drainage will also required funding cooperation with HCPID.

It is anticipated the implementation of parks or trails within the drainage corridor right-of-way could proceed through agreements between the District and the appropriate stakeholders. Such stakeholders could include the Texas Parks and Wildlife, Legacy Land Trust, Harris County, and the various civic associations located throughout the watershed. Management of these uses and respective maintenance of the facilities would also be performed by the stakeholders. The District could enter into an agreement to construct the necessary detention or flood-reduction drainage element with consideration for multiple uses such that the stakeholder will take over maintenance of the facility.

Harris County currently has a Parks & Recreation Master Plan that identifies corridors for proposed bikeway trails. A proposed corridor lies within the Dry Creek watershed and it may be possible to extend the bikeways from Cypress Creek into desirable portions of the watershed using the funding identified for the bikeway program.

The construction of the necessary roadway crossing of the channels will be funded through the appropriate stakeholder responsible for the project, such as Harris County Public Infrastructure Department for county roads, Texas Department of Transportation for state roads, and developers for their respective developments that include roadway channel crossings.

4.0 CONCLUSIONS

The recommended plan identified in this report represents a feasible solution to provide flood reduction benefits, guidance for drainage planning of new development projects and the major thoroughfare plan, enhancement of water quality, opportunities for multiple uses, reduction of peak flows to Cypress Creek, and acceptance by the public. Existing environmental conditions of the watershed are considered in the plan so they are preserved as much as possible and, at a minimum, that they are not further degraded. Further, when implemented, the plan should have the ability to accommodate multiple recreational uses and result in reduced stormwater peak flows into Cypress Creek, suggesting that the plan will also result in flood reduction benefits for existing developments along Cypress Creek.

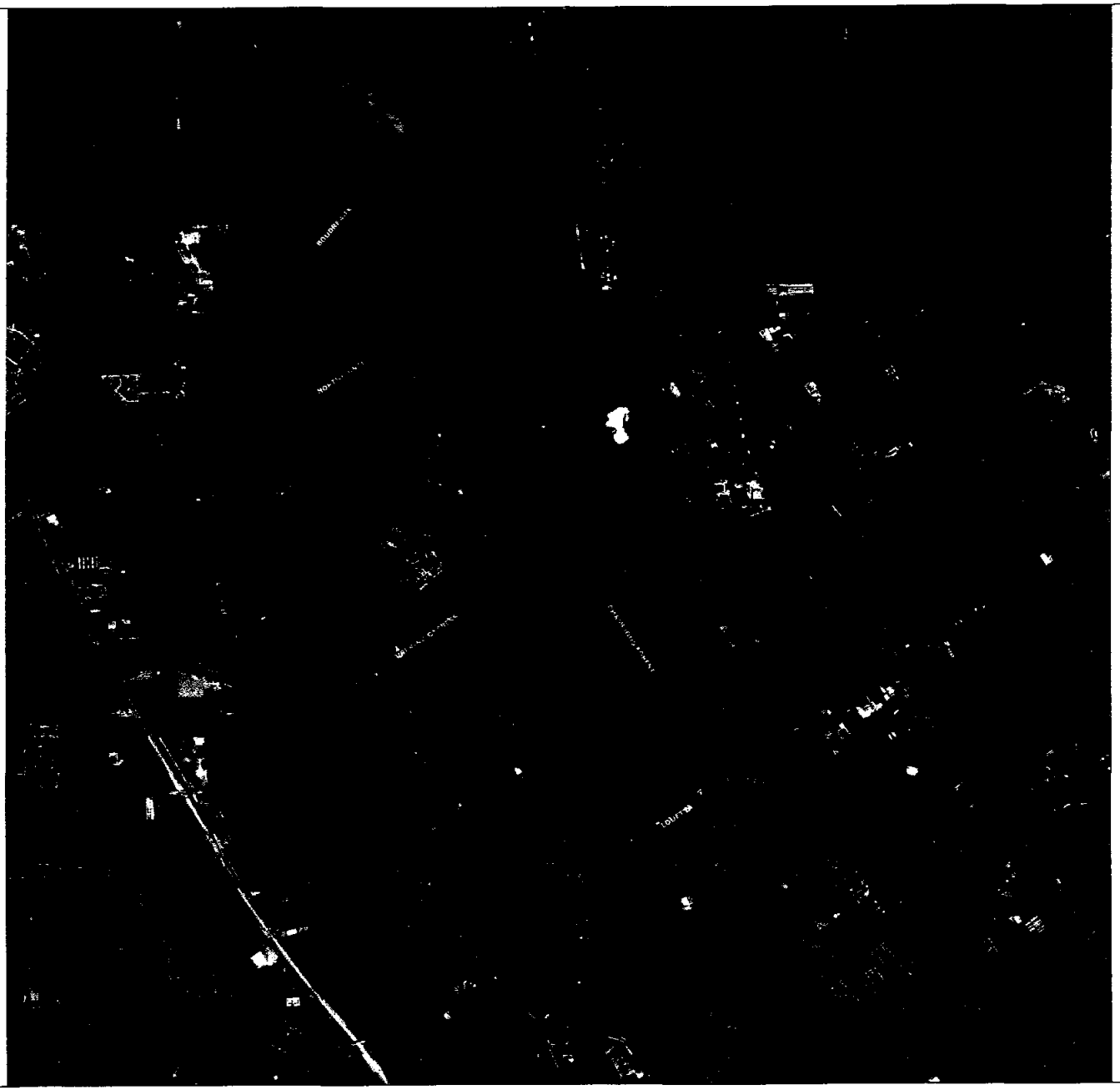
Implementation of the plan will have to occur over many years and will require the cooperation of additional stakeholders. Prioritization of the plan elements has been performed, and land acquisition or reservation should be initiated immediately for the recommended plan features within Dry Gully watershed. It is estimated, once begun, it would take approximately one year to implement the entire plan.

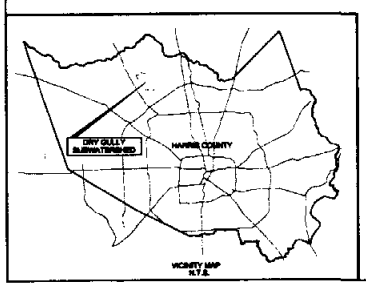
AN INITIATIVE OF
HARRIS COUNTY FLOOD
CONTROL DISTRICT
IN ASSOCIATION
WITH THE
TEXAS WATER
DEVELOPMENT BOARD

REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION
FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO. 2000-483-359

DRY GULLY WATERSHED
RECOMMENDED PLAN REPORT
USGS QUADRANGLE & BASELINE WATERSHED MAP

FEBRUARY 2003	K133-00-00	EXHIBIT E1





LEGEND

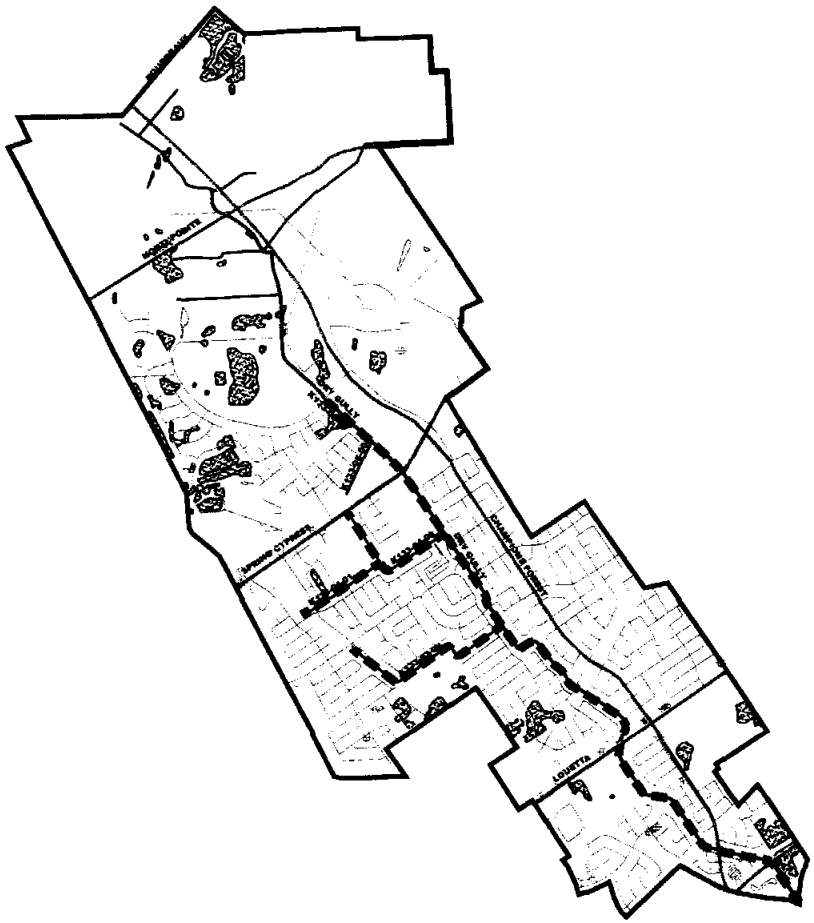
- Street
- Major Road
- Stream
- Watershed Boundary
- Recommended Plan Sub Watershed Boundary
- 1984 Developed Areas
- HCFCD Right-Of-Way
- Hydrologic Nodal Points

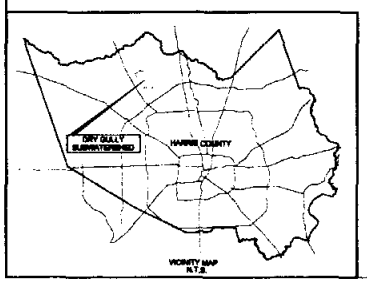
AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

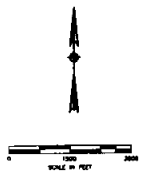
REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO. 2000-483-386

DRY GULLY WATERSHED REGIONAL DRAINAGE PLAN REPORT 1999 AERIAL WATERSHED MAP

FEBRUARY 2003	K132-00-00	EXHIBIT E2







LEGEND

- Street
- Major Road
- Stream
- Watershed Boundary
- Potential Wetlands
- Natural Prairies
- Wetlands
- Known Historical Sites
- Hazardous Material Sites

STREAM HABITAT QUALITY

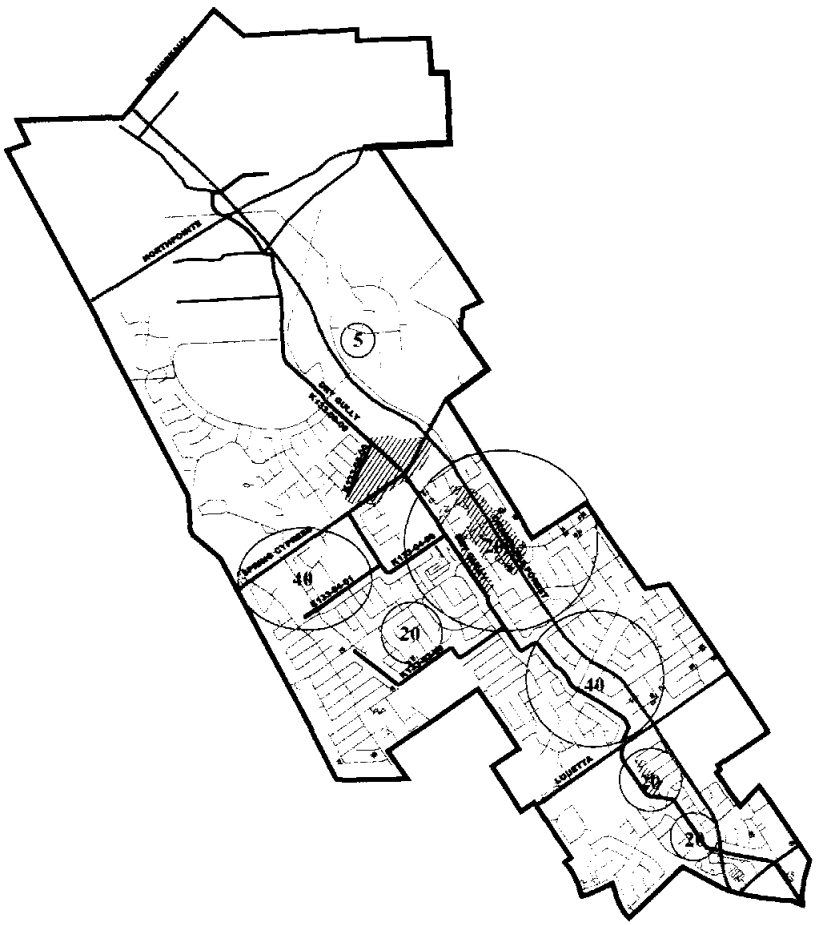
- Low
- Medium
- High

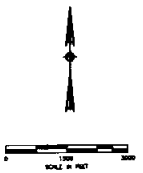
AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO. 2000-483-366

DRY GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
ENVIRONMENTAL CONSIDERATIONS

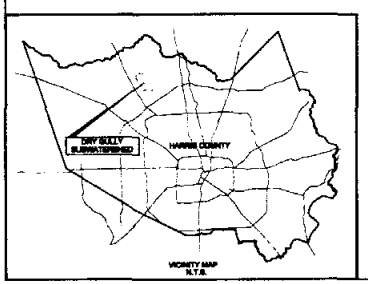
FEBRUARY 2003	K133-00-00	EXHIBIT: E3





LEGEND

- AREAS OF DOCUMENTED FLOOD DAMAGE
- COMMENTS FROM PUBLIC MEETINGS
- (10) AREAS OF POTENTIAL STRUCTURAL FLOODING
- STREAMS ALIGNMENTS
- MAJOR ROADWAYS
- STREETS
- BASELINE FLOODPLAIN
- WATERSHED BOUNDARY

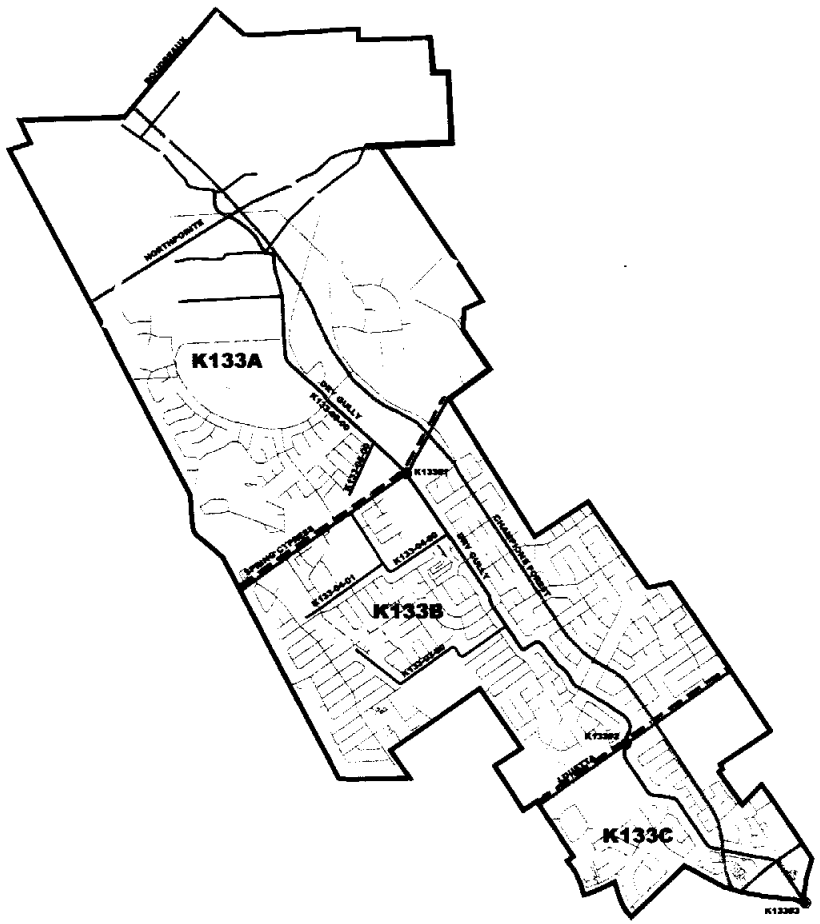


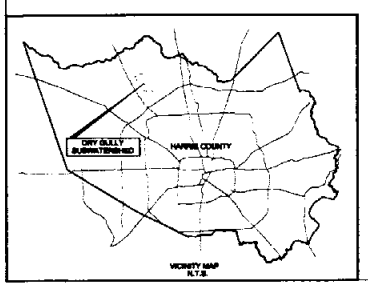
AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

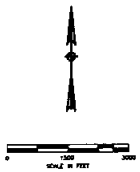
REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO. 2000-483-386

DRY GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
STRUCTURAL FLOODING CONCERNS

FEBRUARY 2003	K133-00-00	EXHIBIT E4







LEGEND

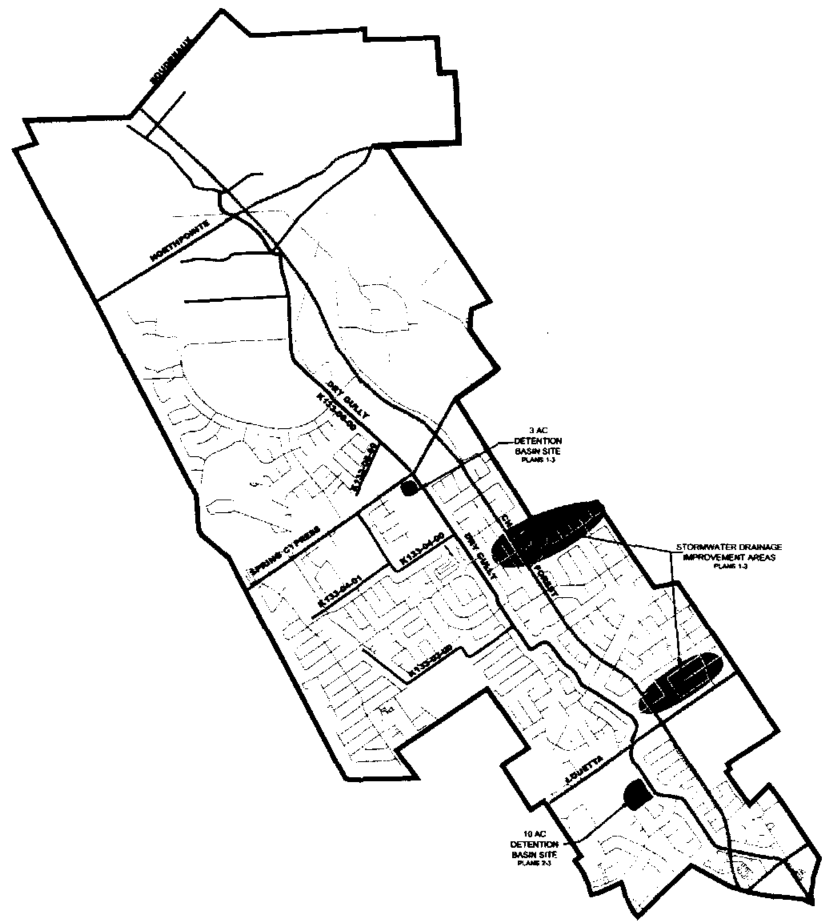
- Street
- Major Road
- Stream
- Watershed Boundary
- Recommended Plan Sub Watershed Boundary
- Baseline Report Sub Watershed Boundary
- Hydrologic Nodal Points

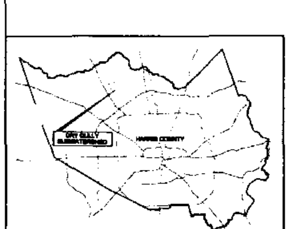
AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO. 2000-483-356

DRY GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
WATERSHED DELINEATION COMPARISON

FEBRUARY 2003	K133-00-00	EXHIBIT E5





LEGEND

- Street
- Major Road
- Stream
- Watershed Boundary

PLAN COMPONENTS

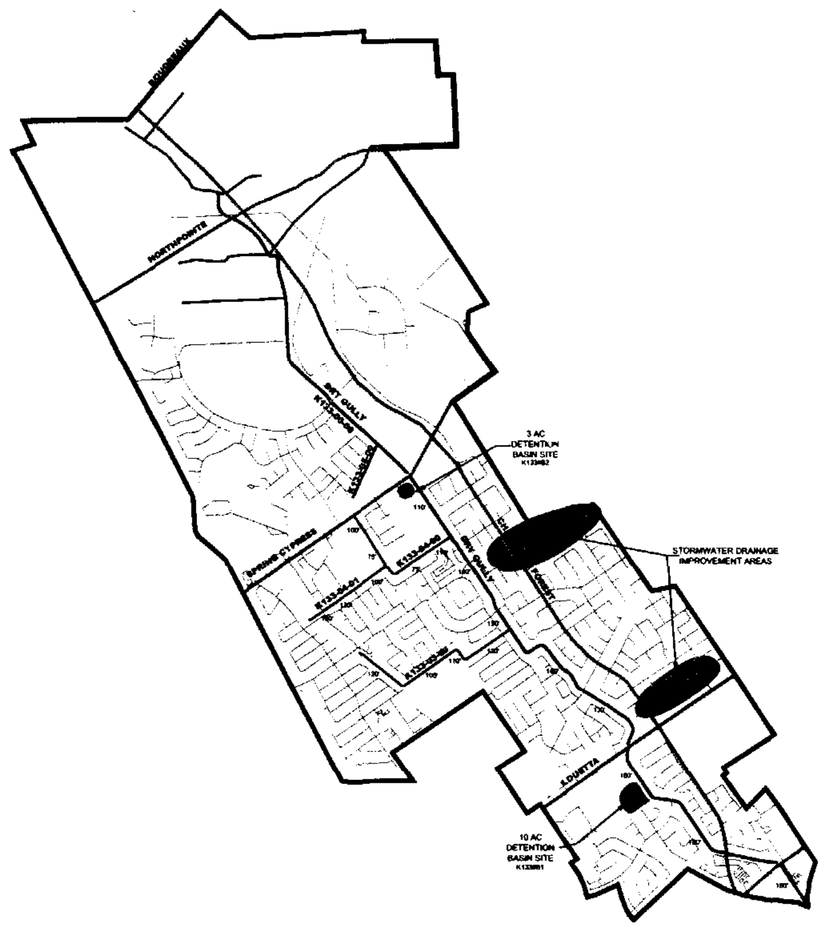
- Proposed Detention Basin
- Proposed Channel Corridor
- Proposed Floodplain/Stream Habitat Preservation
- Proposed Stormwater Drainage Improvement Investigation Areas
- Proposed Bridge Modification

AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATESRHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO 2000-483-356

DRY GULLY WATERSHED REGIONAL DRAINAGE PLAN REPORT COMBINED ALTERNATIVES FEATURES

FEBRUARY 2003	K133-00-00	EXHIBIT: E6

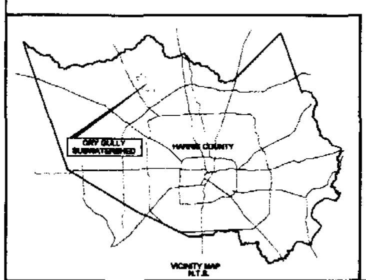


LEGEND

- Street
- Major Road
- Stream
- Watershed Boundary

PLAN COMPONENTS

- Proposed Detention Basin
- Proposed Channel Corridor
- Proposed Floodplain/Stream Habitat Preservation
- Proposed Stormwater Drainage Improvement Investigation Areas
- Proposed Bridge Modification

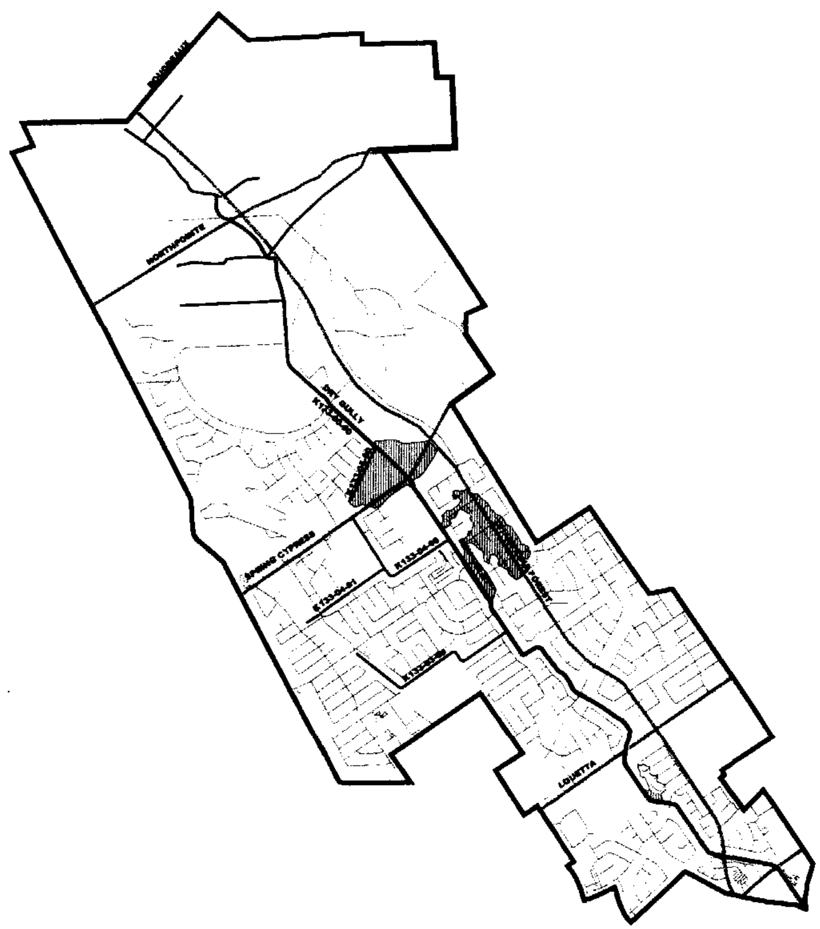


AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO. 2000-483-356

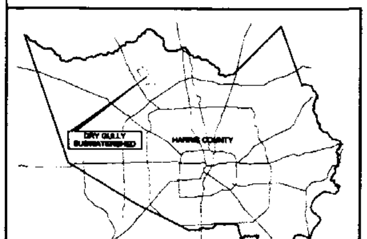
DRY GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
RECOMMENDED PLAN FEATURES

FEBRUARY 2003	K133-00-00	EXHIBIT: E7



LEGEND

- Street
- Major Road
- Stream
- Watershed Boundary
- Baseline Floodplain
- Recommended Plan Floodplain



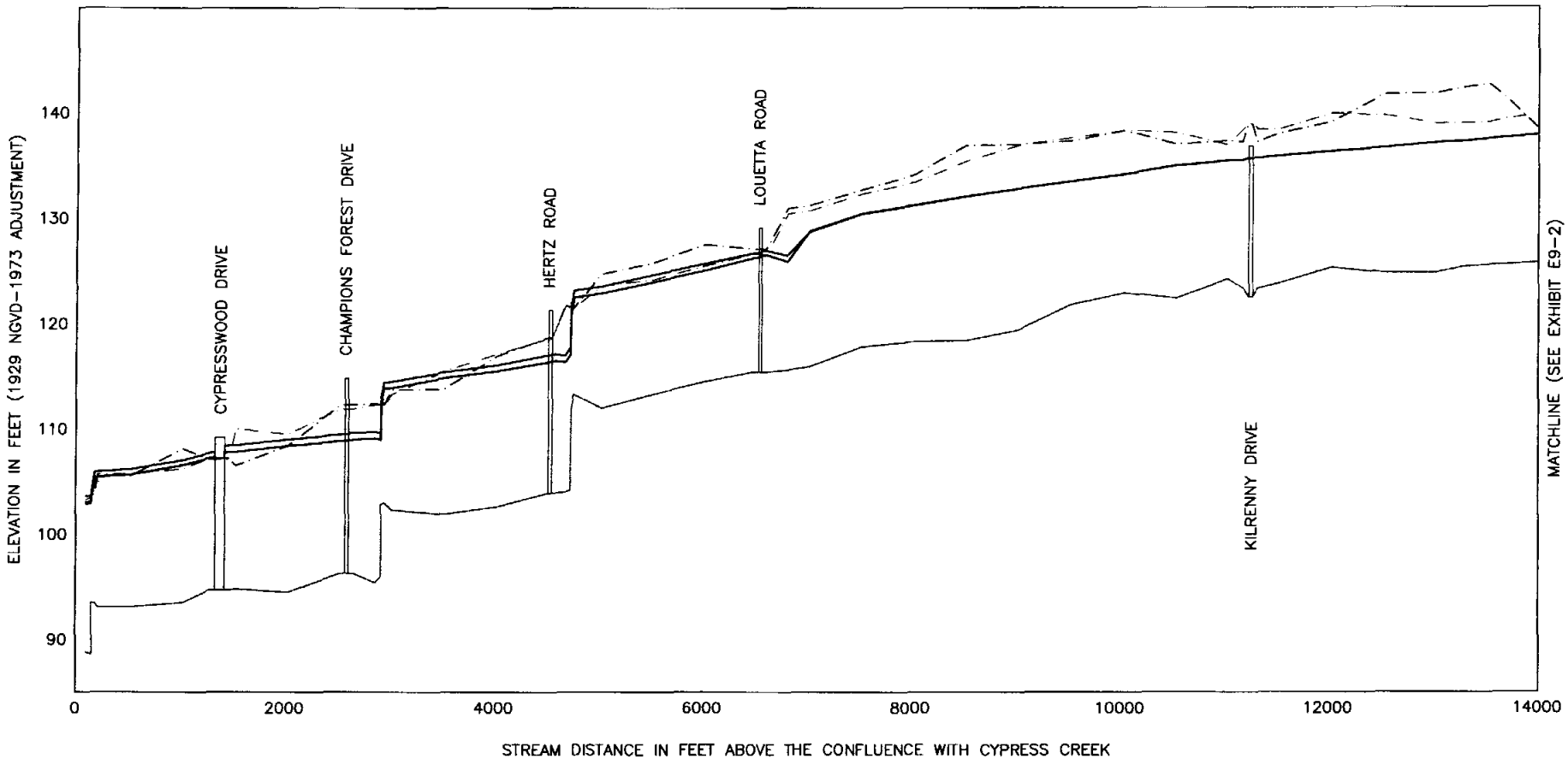
VICINITY MAP
N.T.S.

AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATESRHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO 2000-483-366

DRY GULLY WATERSHED REGIONAL DRAINAGE PLAN REPORT BASELINE AND RECOMMENDED PLAN FLOODPLAIN MAP

FEBRUARY 2003	K133-00-00	EXHIBIT: E8



LEGEND

- BRIDGES
- LEFT BANK
- RIGHT BANK
- BASELINE FLOWLINE
- RECOMMENED PLAN FLOWLINE

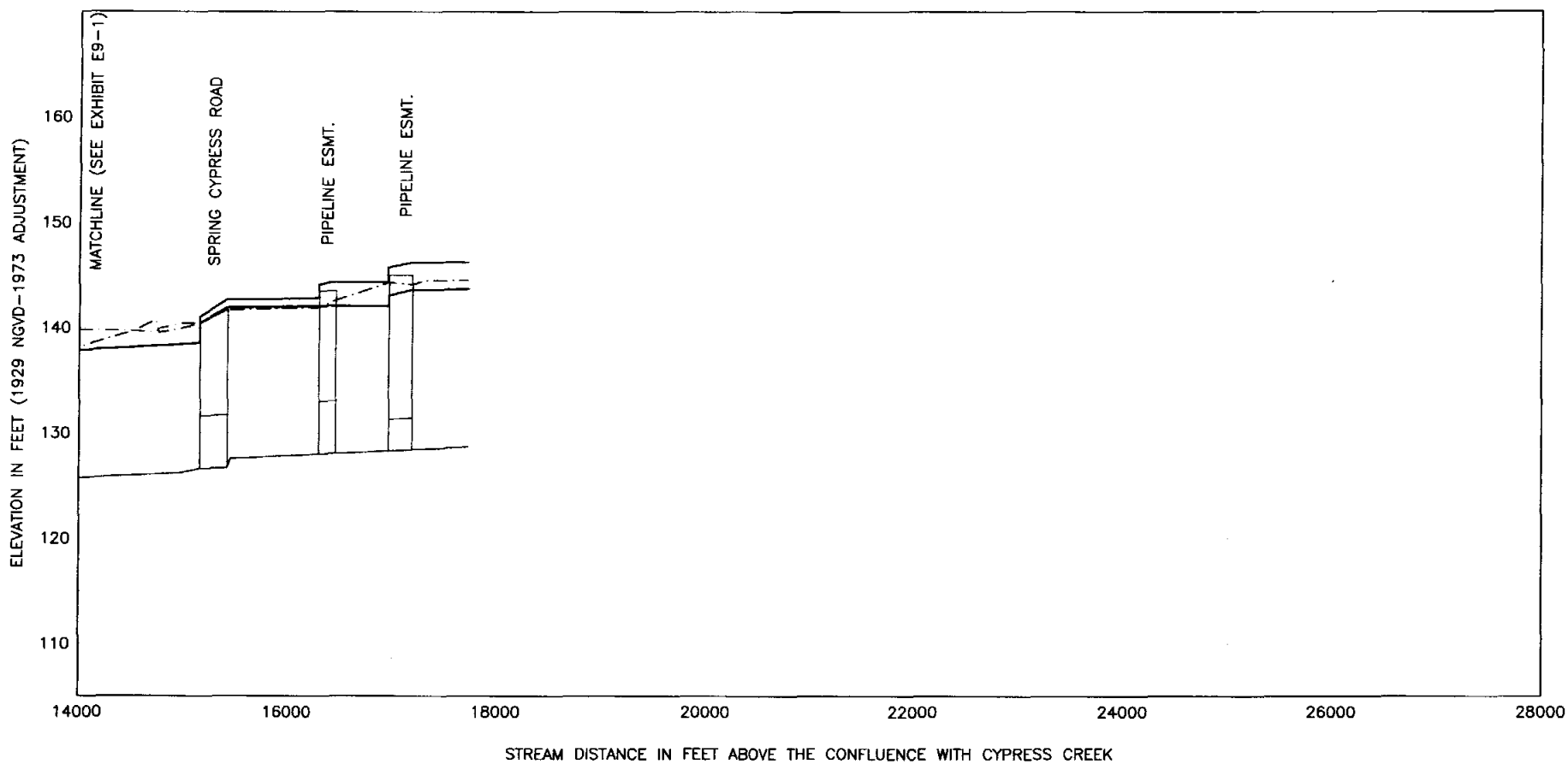
WATER SURFACE PROFILES
- 100-YEAR BASELINE
- 100-YEAR RECOMMENDED PLAN

AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO. 7000-483-356

DRY GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
DRY GULLY WATER SURFACE PROFILES
BASELINE AND RECOMMENDED PLAN

FEBRUARY 2003	K133-00-00	EXHIBIT: E9-1



LEGEND

- BRIDGES
- LEFT BANK
- RIGHT BANK
- BASELINE FLOWLINE
- RECOMMENED PLAN FLOWLINE

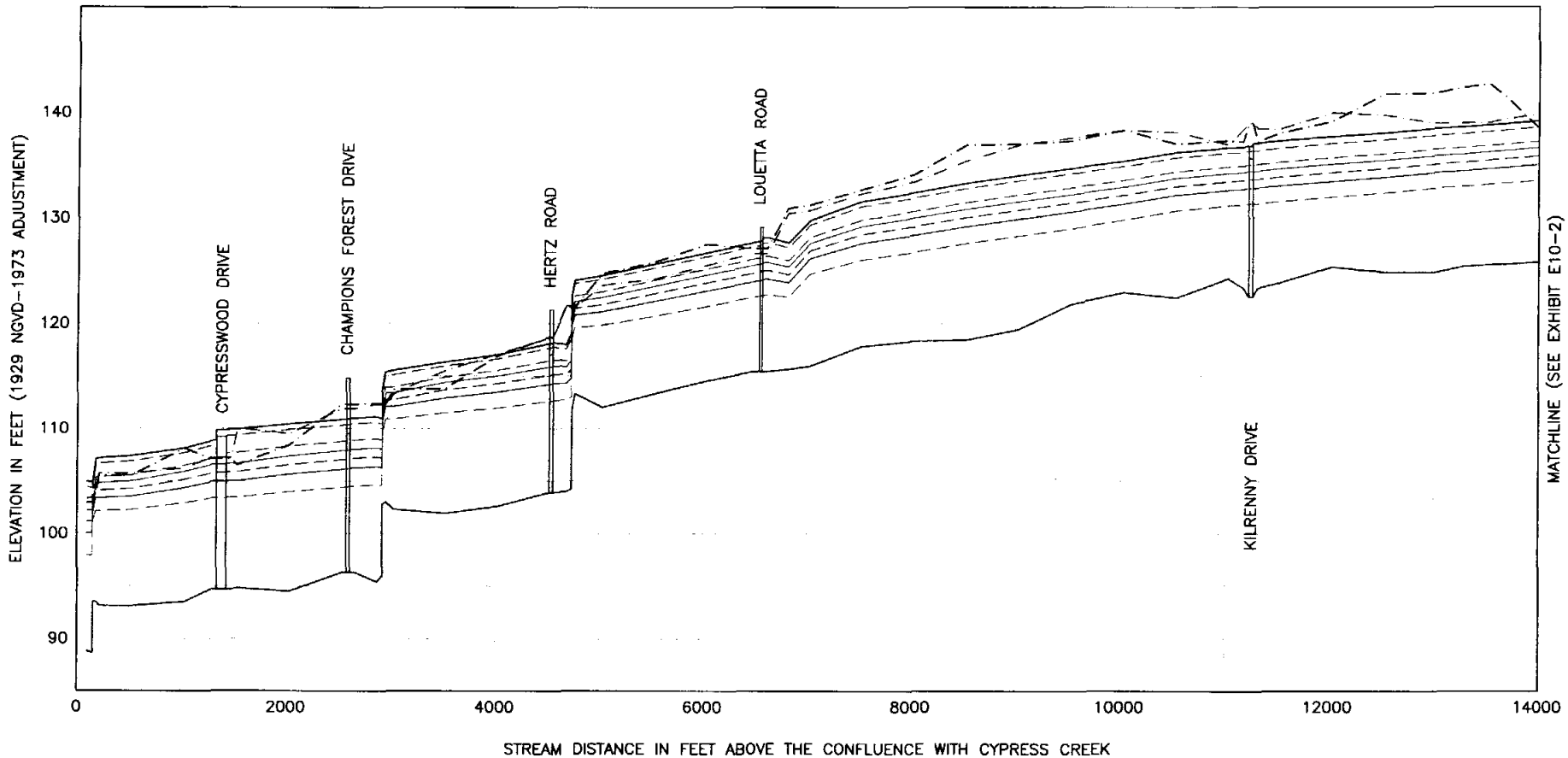
WATER SURFACE PROFILES
- 100-YEAR BASELINE
- 100-YEAR RECOMMENDED PLAN

AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO. 2000-483-356

DRY GULLY WATERSHED
REIGIONAL DRIANAGE PLAN REPORT
DRY GULLY WATER SURFACE PROFILES
BASELINE AND RECOMMENDED PLAN

FEBRUARY 2003	K133-00-00	EXHIBIT: E9-2



LEGEND

WATER SURFACE PROFILES

- 500-YEAR
- 250-YEAR
- 100-YEAR
- 50-YEAR
- 25-YEAR
- 10-YEAR
- 5-YEAR
- 2-YEAR

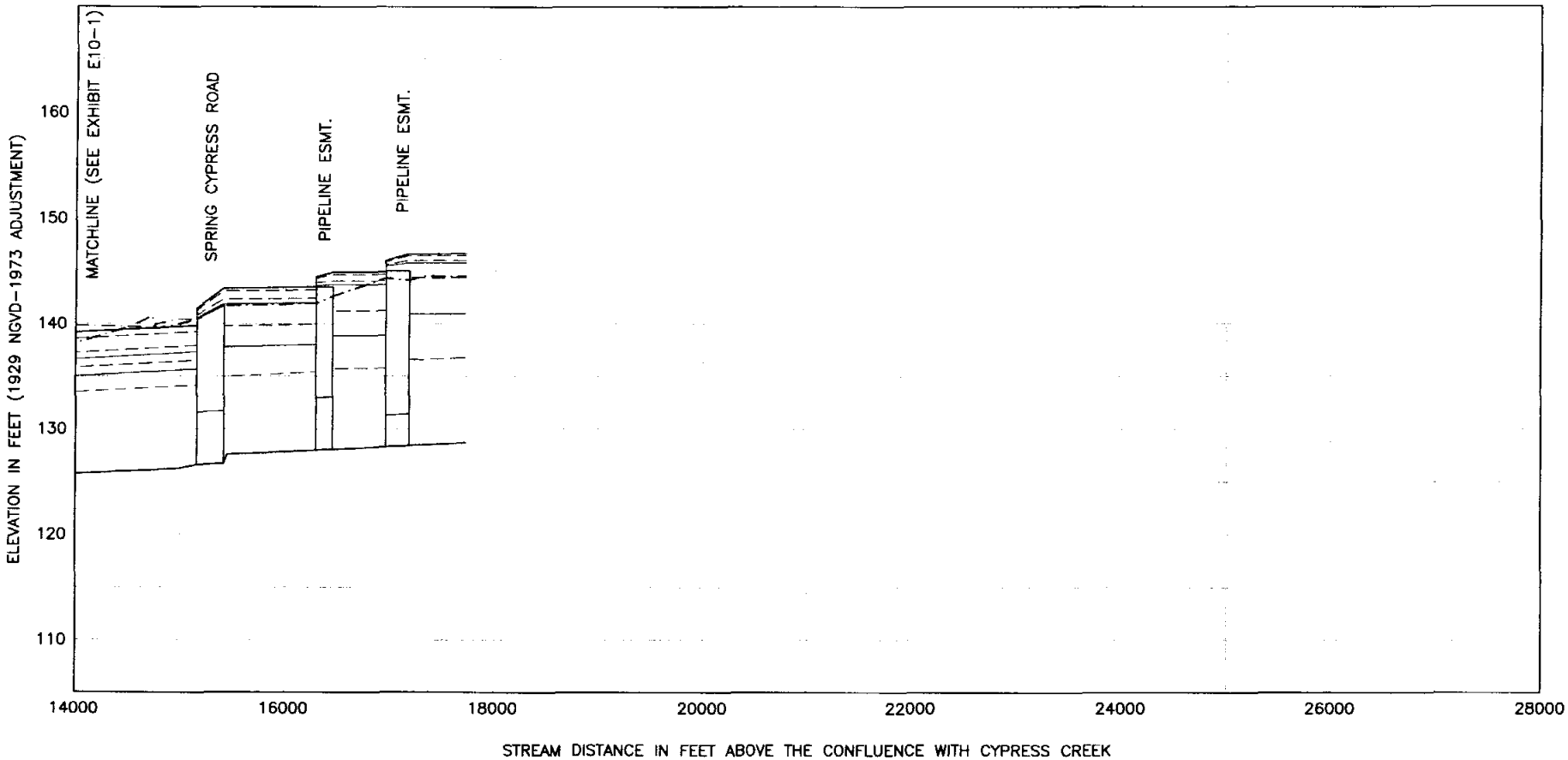
- BRIDGES
- LEFT BANK
- RIGHT BANK
- BASELINE FLOWLINE

AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO. 2000-483-356

DRY GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
DRY GULLY WATER SURFACE PROFILES
BASELINE CONDITION MULTIPLE FREQUENCIES

FEBRUARY 2003	K133-00-00	EXHIBIT: E10-1



LEGEND

WATER SURFACE PROFILES

- 500-YEAR
- 250-YEAR
- 100-YEAR
- 50-YEAR
- 25-YEAR
- 10-YEAR
- 5-YEAR
- 2-YEAR

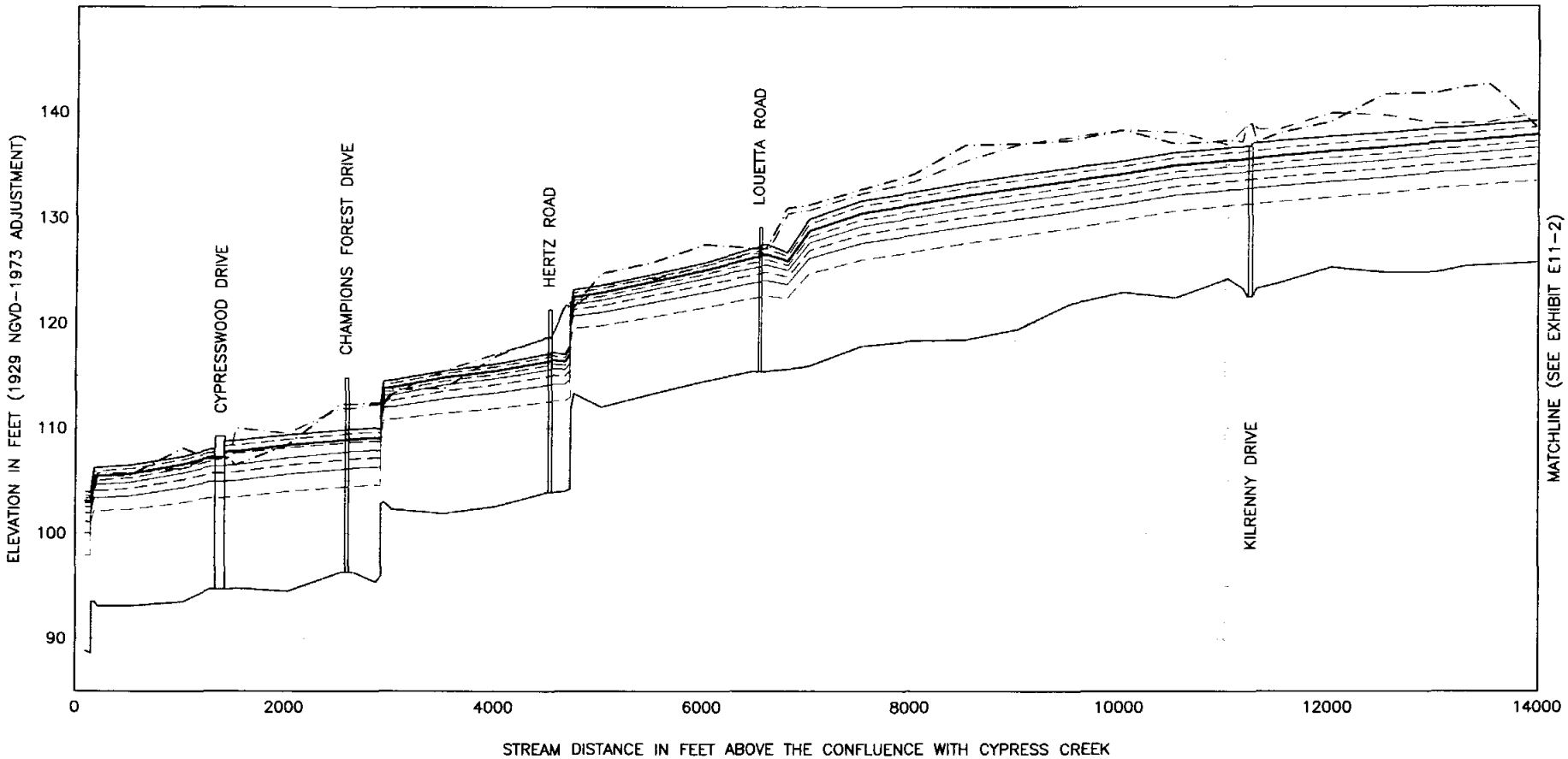
- BRIDGES
- LEFT BANK
- RIGHT BANK
- BASELINE FLOWLINE

AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO. 2000-483-356

DRY GULLY WATERSHED
REIGIONAL DRIANAGE PLAN REPORT
DRY GULLY WATER SURFACE PROFILES
BASELINE CONDITION MULTIPLE FREQUENCIES

FEBRUARY 2003	K133-00-00	EXHIBIT E10-2



LEGEND

WATER SURFACE PROFILES

- 500-YEAR
- 250-YEAR
- 100-YEAR
- 50-YEAR
- 25-YEAR
- 10-YEAR
- 5-YEAR
- 2-YEAR

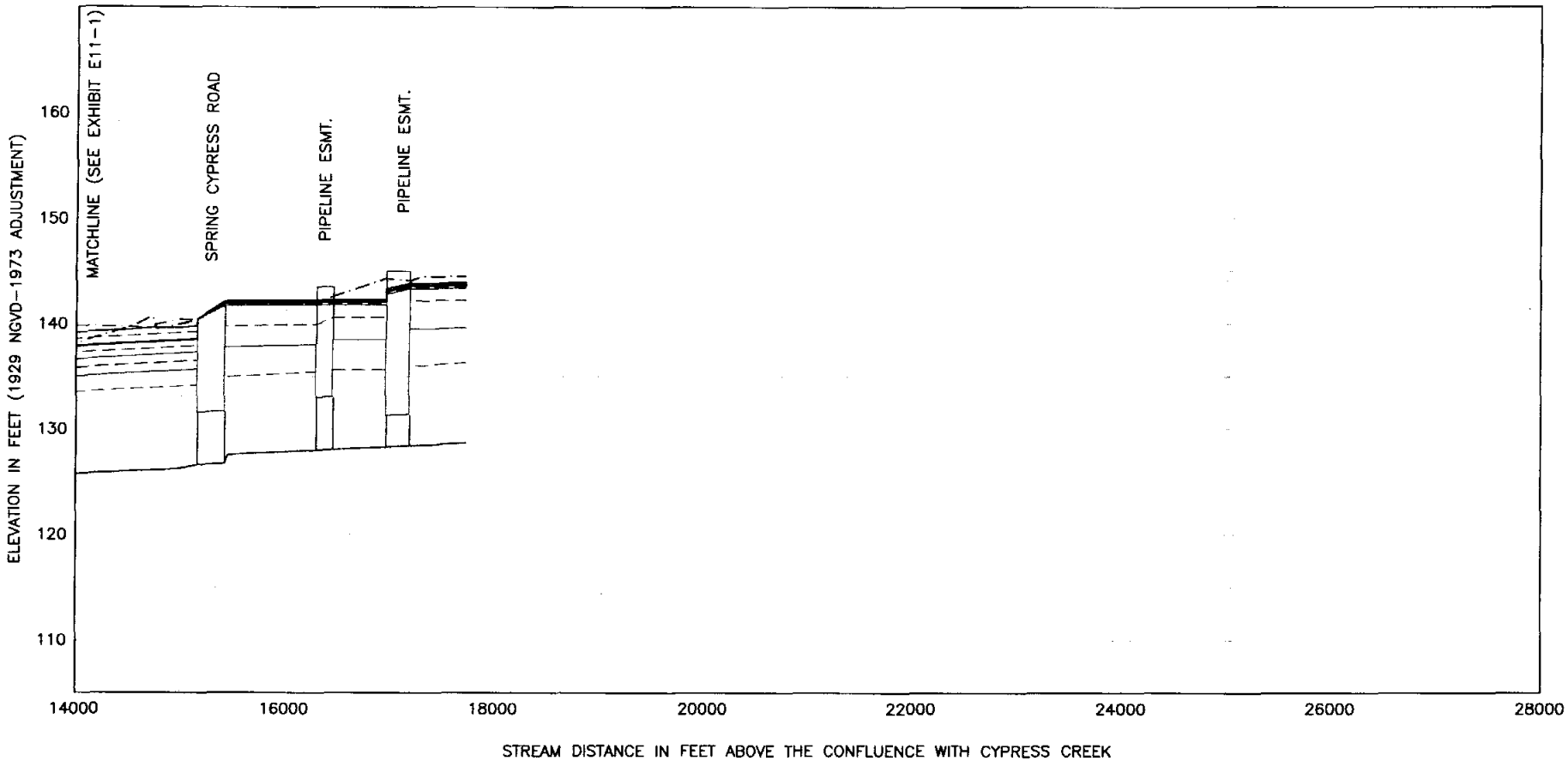
- BRIDGES
- LEFT BANK
- RIGHT BANK
- BASELINE FLOWLINE
- RECOMMENED PLAN FLOWLINE

AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO 2000-483-356

DRY GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
DRY GULLY WATER SURFACE PROFILES
RECOMMENDED PLAN MULTIPLE FREQUENCIES

FEBRUARY 2003	K133-00-00	EXHIBIT: E11-1



LEGEND

WATER SURFACE PROFILES

- 500-YEAR
- 250-YEAR
- 100-YEAR
- 50-YEAR
- 25-YEAR
- 10-YEAR
- 5-YEAR
- 2-YEAR

- BRIDGES
- LEFT BANK
- RIGHT BANK
- BASELINE FLOWLINE
- RECOMMENED PLAN FLOWLINE

AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO. 2000-483-356

DRY GULLY WATERSHED
REIGIONAL DRIANAGE PLAN REPORT
DRY GULLY WATER SURFACE PROFILES
RECOMMENDED PLAN MULTIPLE FREQUENCIES

FEBRUARY 2003 | K133-00-00 | EXHIBIT: E11-2

TABLE OF CONTENTS

EXHIBITS

TABLES

DEFINITIONS

Baseline Conditions or Baseline Model - Conditions identified for the watershed from which future planning efforts and the recommended plan will be compared to determine if the study goals and objectives will be met. This condition considers the watershed 100% developed, with new development after 1984 consistent with current HCFCD criteria for on-site storm water detention in the determination of the appropriate baseline hydrologic processes. Further, this condition considers the information identified in the environmental baseline report.

Plan Conditions or Plan Model - The baseline conditions model modified to reflect the land-use conditions and recommended plan elements identified for the recommended regional drainage plan for the watershed.

ELECTRONIC FILES

File Name:	Description
HEC-1 Models:	
K140B-2.ih1	Baseline Conditions 2-year Flows
K140B-5.ih1	Baseline Conditions 5-year Flows
K140B-10.ih1	Baseline Conditions 10-year Flows
K140B-25.ih1	Baseline Conditions 25-year Flows
K140B-50.ih1	Baseline Conditions 50-year Flows
K140B100.ih1	Baseline Conditions 100-year Flows
K140B250.ih1	Baseline Conditions 250-year Flows
K140B500.ih1	Baseline Conditions 500-year Flows
K140R-2.ih1	Recommended Plan 2-year Flows
K140R-5.ih1	Recommended Plan 5-year Flows

ELECTRONIC FILES *(continued)*

File Name:	**Description**
HEC-1 Models:	
K140R-10.ih1	Recommended Plan 10-year Flows
K140R-25.ih1	Recommended Plan 25-year Flows
K140R-50.ih1	Recommended Plan 50-year Flows
K140R100.ih1	Recommended Plan 100-year Flows
K140R250.ih1	Recommended Plan 250-year Flows
K140R500.ih1	Recommended Plan 500-year Flows
HEC-RAS Models:	
K140.prj	Project File
K140.p03	Baseline Multiprofile Plan
K140.p01	Recommended Multiprofile Plan

1.0 INTRODUCTION

The information presented in this appendix report intends to document the process of developing the recommended regional drainage plan for the Pillot Gully watershed. The plan elements identified for the recommended plan are presented, along with the recommended funding and implementation strategies identified for the plan. All supporting regional-plan modeling information for the Pillot Gully watershed is included in this report.

1.1 Project Location

The Pillot Gully Watershed is located in northwest Harris County and is a subwatershed of the Cypress Creek Watershed. A vicinity map of the watershed is provided on **Exhibit 1** in the main text report.

The Pillot Gully Watershed includes one main stem (K140-00-00) and minor tributary ditches K140-02-00 and K140-04-00 as well as a tributary ditch (K140-05-00) shown on HCFCD maps but without a defined right-of-way (R-O-W). However, only the main stem of Pillot Gully was studied as part of the Flood Insurance Study for Harris County and is the primary subject of this report. The 5.2-square mile watershed is drained into Cypress Creek through the main stem. As seen in **Exhibit F1** and **Exhibit F2**, the upper reaches of the watershed lie just east of SH 249 (with a small portion located just west) and the watershed drains in a southerly direction under Huffsmith-Kohrville Road, Spring-Cypress Road, Cossey Road, Rodgers Road, Louetta Road, Compaq Center Drive and then to the mouth at Cypress Creek just upstream of the Cutten Road Bridge.

1.2 Background Information

HCFCD intends to prepare a storm water management and flood protection plan for nine tributary watersheds located within the Cypress Creek watershed. The Pillot Gully watershed is one of the nine watersheds. Several studies have been conducted within the Pillot Gully watershed at varying levels and are identified in Appendix F of the February 2002 *Regional Drainage Plan and Environmental Investigation for Major Tributaries in the Cypress Creek Watershed, Phase I – Hydrologic and Hydraulic Baseline Report.*

The baseline watershed boundary is shown on **Exhibit F1,** with the existing development conditions shown on **Exhibit F2**. The information identified on these exhibits was generated as part of the Phase I study efforts, and was used to assist in identification of the appropriate regional drainage plan for the Pillot Gully watershed.

An assessment of the environmental baseline conditions of the Pillot Gully watershed was prepared as part of the Phase II – Environmental Baseline Report study efforts. The information presented in this report was used to help identify the recommended regional drainage plan and appropriate plan elements for the watershed. The lower portions of the main stem of Pillot Gully

are identified as having good stream corridor habitat beneficial for wildlife and water quality. Further, scattered wetlands have been identified in the upper portions of the watershed. However, some of the wetlands and areas of high quality stream habitat have been replaced or impacted by development since the Environmental Baseline Report was completed. Environmental considerations for the Pillot Gully watershed are shown on **Exhibit F3**.

1.3 Flood Hazard

Flood hazards along Pillot Gully for which existing model information was available were identified for the baseline conditions. These flood hazards were identified by modifying the current effective hydrologic models for the watershed to reflect appropriate baseline land-use conditions, with the resulting storm flows incorporated into the appropriate hydraulic model reflecting the current conditions of the channel system. The 1% storm flood profile information resulting from the hydraulic model was used in conjunction with existing digital terrain model produced from LIDAR-obtained ground elevation information to produce a flood-hazard boundary map. The result of this mapping is shown on **Exhibit F7**.

1.4 Summary of Baseline Conditions

The results of the study efforts for identifying the baseline conditions indicate that the 1% storm flood boundary is different from the current effective Federal Emergency Management Agency regulatory flood boundary. This is predictable since updated information about the watershed and its studied streams has been used in the identification of the baseline conditions. The information prepared in the identification of the baseline conditions flood hazards and environmental baseline conditions is suitable for use in identifying the appropriate regional drainage plans.

2.0 REGIONAL DRAINAGE PLAN FORMULATION

The objectives of this Phase III study are to develop Regional Drainage Plans to guide future development of the watershed and to address existing flooding issues. The sections below detail the methodology of the plan formulation steps, the watershed resources and alternate plans developed for the Pillot Gully watershed.

2.1 Methodology

The formulation of the recommended regional drainage plan used an approach that considered the information prepared as part of the Phase I and Phase II study efforts. Further, information concerning the proposed major roadway thoroughfare alignments was also used to help in the identification of recommended alignments for lateral channels that could serve as outfall drainage for these roadways. A series of public meetings and coordination through advisory committee meetings helped in providing direction for identifying a recommended plan.

Hydrologic and hydraulic models prepared as part of the baseline study effort were modified appropriately to reflect alternate plans for the watershed. Alternate plans were identified and the results measured against each other to determine which alternate represented the best plan for the watershed.

2.2 Watershed Description

The Pillot Gully watershed as delineated in this study contains 5.2 square miles and has mild southerly overland slopes. Development is concentrated primarily in the middle portion of the watershed. There is one main stem (K140-00-00) and two tributary streams (K140-02-00 and K140-04-00) as well as another tributary ditch (K140-05-00) shown on HCFCD maps, but without a defined R-O-W within the watershed. As noted earlier however, only the main stem was the subject of the previous studies and is subject to these analyses.

This analysis uses the baseline conditions model subbasins and modifies the hydrologic parameters of each accordingly to reflect alternate plan scenarios. In some instances, the baseline subbasins were further subdivided in order to more accurately model particular plan elements. The subbasins can be described as follows:

- The area upstream and generally west of Huffsmith-Kohrville Road, (1128 acres – K140A);
- The area upstream and generally east of Huffsmith-Kohrville Road, (349 acres – K140B1);
- The area between Huffsmith-Kohrville Road and Spring-Cypress Road not drained by K140-04-00 (286 acres – K140B2);
- The area primarily drained by K140-04-00 (366 acres – K140D);

- The area south of Spring-Cypress Road primarily drained by K140-02-00 (264 acres – K140C); and,
- The area from the confluence of K140-02-00 to the mouth (934 acres – K140E).

Pillot Gully discharges into Cypress Creek (HCFCD Unit K100-00-00) between S.H. 249 and Cutten Road. **Exhibit F2** shows Pillot Gully Watershed subareas with location and station of each routing node along with sub-basin names. **Exhibit F5** shows the difference in watershed delineation between the baseline and recommended-plan conditions.

The topography of the basin is very flat, especially in the upper half of the watershed. The lower half of the watershed has some limited slope, especially near the mouth where Pillot Gully empties into Cypress Creek. The main stem has been rectified through the middle of the watershed and upstream of Spring-Cypress Road as part of development projects and drainage improvements.

2.3 Basin Resource Inventory

Information was obtained for the watershed concerning existing and planned land use, structure values, environmental resources, etc. This information was used to help identify the value of the resources within the watershed and how best they should be considered in the overall planning efforts.

2.3.1 Stream Habitat Quality

The Environmental Baseline Report (EBR) qualitatively established stream habitat quality rankings based upon characteristics of the stream channel such as channelization, vegetation, and urban density. The ranking system is shown in the EBR and was based solely on color infrared aerial photos and local knowledge of the streams. The stream quality designations are shown on **Exhibit F3**. The goal of the regional drainage planning effort was to attempt to preserve areas of high quality stream habitat in order to enhance the environmental benefits of the plan.

Areas of high quality stream habitat were identified within the Pillot Gully watershed, especially in the lower and upper reaches of the main stem. Approximately 30 percent of the Pillot Gully main stem was identified as having high quality stream habitat. However, much of the upper reach of the main stem has already been rectified, as part of an ongoing development project and would no longer be considered as high quality. The lower reach, south of Louetta Road remains in a mostly natural condition.

2.3.2 Land Uses in the Watershed

Exhibit F2 illustrates land uses within the watershed. Approximately 30 percent of the total watershed is developed with the development along the main channel and tributary ditches. Major high-density residential developments include Charterwood in the lower reaches of the watershed, Champion Lakes and Memorial Springs in the middle of the watershed and Three Lakes in the upper portions of the watershed. There is scattered low-density development in the upper portions of the watershed. Limited commercial development exists along the western boundary of the watershed, bordering State Highway 249. Livestock production and local agriculture remains in isolated portions of the upper reaches of the watershed.

2.3.3 Structure Inventory

An inventory of structures that might be affected by flooding along the main stem was performed. The purpose of the inventory was to identify and estimate the economic value or benefit if the structures were either removed or protected from flooding by the regional plans. In the Pillot Gully watershed, very few structures were identified that might be affected by flooding from the main stem and tributaries. The general location of these structures is shown on **Exhibit F4**. In order to estimate the value of these structures, a search of the Harris County Appraisal District (HCAD) records was performed using a Geographic Information System (GIS) file supplied by HCFCD. Three parcels with structures were identified as having a possible risk of flooding in baseline conditions. The total structure (improvements) value of these three parcels was estimated by HCAD to be approximately $227,500.

In order to determine whether these structures were at risk, an examination of available Lambert Maps (2-foot contour maps with finish floor elevations identified for some structures near the floodplain) was performed. The maps were provided by HCFCD. None of the structures noted above were shown on the Lambert Maps, meaning that they had likely been constructed after the maps were created. Visual field surveys showed that the structures identified appeared to be constructed at or near natural ground level. Therefore, they should be assumed to be in some risk of flooding in the baseline condition.

2.3.4 Economic Factors for the Watershed

The Pillot Gully watershed is typical of many of the Cypress Creek tributary watersheds in that it is in a state of development. Much of the middle third of the watershed has been planned for development. Much of the development that is planned will be built along the main stem of Pillot Gully or along tributary ditches. Land values in the watershed are rising due to this development pressure, especially in areas where outfall for drainage is present, along the main stem and the tributary ditches. As noted above, there are few structures currently located in flood-prone areas and current development regulations are written to

ensure that new structures are not placed in areas without adequate flood protection. Therefore, significant structural damage prevention is not an economic factor within the Pillot Gully watershed.

2.4 Problems and Opportunities Identification

The flood hazard information identified in the Phase I study efforts was used to determine the areas within the watershed most susceptible to out-of-bank flooding. Additionally, opportunities for enhancement of the watershed through the reduction of existing flooding and preservation of environmental features in the design of the regional plans were identified.

2.4.1 Economic Flood Damage Analysis

Since only a few structures were identified in areas that may be subject to flooding, no formal economic analysis of flood damage was performed. The structures noted above total approximately $227,500. If approximately 50% of the value of the structure is added for the contents, the total economic benefit from any flood reduction planning in the area would be approximately $340,000, assuming the structures and their contents would be completely lost in flooding.

2.4.2 Identification of Flood-Prone Areas

As shown on the floodplain map, **Exhibit F8**, the baseline condition modeling identified areas along the upper reach of the main stem of Pillot Gully upstream of Spring-Cypress Road as subject to out-of-bank flooding. A portion of this area, between Spring-Cypress Road and Huffsmith-Kohrville Road has been recently improved and is no longer subject to out-of-bank flooding. The remainder of the main stem of Pillot Gully upstream of Huffsmith-Kohrville Road is still subject to flooding and includes the structures noted earlier. The lower reach of Pillot Gully, downstream of Louetta Road has also been identified as subject to flooding. The majority of this area is owned by the Hewlett-Packard Corporation and is undeveloped and heavily forested. There are no structures in this area.

There are additional areas that are subject to flooding due to poor surface drainage. Areas within the Indian Trails subdivision in the upper reaches of the watershed have experienced flooding due to the flat terrain and open-ditch drainage systems. Although this type of flooding is not specifically addressed in the watershed study since it is not directly related to out-of-bank channel flooding, it should be noted as an area for future improvements.

2.4.3 Summary of Public Comments Received

Three public meetings have been held to discuss this project, and public comment on existing drainage problems, plan alternates, and the recommended plan have been solicited. A summary of public comments received regarding the Pillot Gully watershed is shown below.

First Public Meeting (August 2001)
No comments received for Pillot Gully watershed.

Second Public Meeting (October 2002)
One comment received for Pillot Gully watershed. The comment related to the possible location of a regional detention facility near Spring-Cypress Road. The commenter relayed a desire for a proposed detention basin to be deleted, and individual on-site detention basins for new developments used instead.

Third Public Meeting (April 2003)
One comment received indicated that the plan should include additional channel conveyance improvements downstream of Spring-Cypress Road.

2.4.4 Summary of Repetitive Flood Loss Data

Data on structures that have experienced repetitive flood losses was collected for Harris County and the HCFCD. This data includes FEMA-related flood damage claims and does not include minor flooding that may have occurred throughout the watershed. Approximately 3000 properties are listed in the database of information obtained. None of the listed properties are within the Pillot Gully watershed.

2.4.5 Opportunities for Watershed Enhancement

There are several areas available within the watershed that may be beneficial to preserve and to enhance in order to benefit the community. As noted above, there are areas of high stream habitat quality, especially in the lower reach of Pillot Gully, that are not under development pressure and can be preserved to enhance the environmental quality of the watershed. There are also large open areas near the main channel that may be available for dual-use facilities such as parks and sports fields that also serve as detention facilities. The upper reach of Pillot Gully contains a sand pit that appears to no longer be in use. This area may also be available for use as a storm water detention facility.

2.4.6 Identification of Major Thoroughfare Outfalls

Exhibit F1 and **Exhibit F3** show the major roads through the watershed. Of major roads shown, Louetta Road, Spring-Cypress Road and Huffsmith-Kohrville Road cross Pillot Gully. Spring-Cypress Road is currently undergoing an improvement project, with outfall provided at Pillot Gully and K140-04-00. Louetta Road is currently a four-lane crossing and has no plans to be improved beyond its current condition in the foreseeable future. Huffsmith-Kohrville Road may be improved in the future since it is currently only a two-lane section. The bridge over the main channel of Pillot Gully would be expanded to include capacity for additional lanes. The major thoroughfare plan includes a new alignment for Cutten Road, which crosses tributary K140-02-00, and will require outfall depth on this tributary.

2.4.7 Storm Water Quality Issues

As part of new regulations enacted by Harris County in October 2001, all new development that outfalls into Pillot Gully will be required to provide storm water quality protection for the outfall drainage. This includes roadway projects, subdivisions and other development of 5 acres or more. The regional plans evaluated as part of this project are planned to provide general water quality benefits, as will be discussed later, but do not specifically address individual developments or roadway projects. Additional storm water quality features will have to be designed for these projects, in order to comply with the new effective regulations.

2.5 Alternate Drainage Plan Formulation

A series of alternate drainage plans were identified for the watershed. Each plan was prepared in consideration of the goals and objectives identified early on for the study effort. As mentioned above, the alternate plans were developed by considering channelization alternates, detention alternates, and non-structural and "no-action" alternates.

As mentioned in Section 2.2, the baseline subbasins were further subdivided in order to more accurately model particular plan elements. The additional subdivision created a model slightly different than the one included in the Phase I report. The addition of subareas to the model caused peak flows to increase slightly in the baseline models used in this study. **Table F2** of this report presents the updated watershed parameters resulting from this modification of subareas. The peak flows resulting from this subdivision are identified in the following sections describing the plan alternates.

The models used to simulate the plan alternatives are based on the revised modeling efforts that define an updated baseline condition. For the simulation of the Pillot Gully watershed, the watershed parameters did not change and are the same as that identified in **Table F2**. Additional

storage volume resulting from alternative plan features were incorporated into the models, and the peak flow values along appropriate reaches were determined.

Each of the alternate plans presented below are combinations of these elements. Although the alternates differ somewhat in their features, there are common elements to all the plans presented in this study.

2.5.1 Common Features to Alternate Plans

In keeping with the goals of the program, outfall depth and flood reduction were emphasized in each of the plans. Emphasis was also placed on preserving areas of high-quality stream habitat where possible. Where new channels (or channel extensions) have been recommended, the channel design is based on a wide section that has flat side slopes and benches for vegetation. This type of section (illustrated in **Figure 1**) provides more opportunities for multiple uses and is less susceptible to erosion. The locations and number of channels provided for future outfalls were also not changed between alternates, unless otherwise noted. The current regulations requiring storm water detention to serve new development are assumed to remain in place for this analysis, unless otherwise noted. The plans described below provide benefits in addition to the on-site requirements. Additionally, a water quality basin is shown as common to all alternate plans. The location of this basin was chosen primarily to offset any water quality impacts from the watershed prior to the flows entering Cypress Creek. **Exhibit F6** shows the locations of all features for the watershed, including those common to the alternate plans.

2.5.2 Alternate 1 Features and Benefits

Alternate 1 features are shown on **Exhibit F6**. Alternate 1 includes two areas of high-quality stream habitat protection in the lower and middle reaches of the stream, one area of channel modification, and two channel extensions to serve the upper portion of the watershed. The channel modification and channel extensions provide additional volume as well as outfall depth.

The table below shows the peak flows at each hydrologic computational node in the baseline and alternate condition.

Alternate 1 Benefits (100-Year Flows)				
Node	**Location**	**Baseline Flow (cfs)***	**Alt Flow (cfs)**	**Benefit (cfs)**
PG-1	At Huffsmith-Kohrville Road	1320	1204	-116
PG-2	At Spring-Cypress Road	1995	1745	-250
PG-3	At Confluence with K140-02-00	2775	2408	-367
K100#14	At Mouth	3752	3374	-378

* The flow from the baseline model with subbasins revised as noted in Part 2.2 of this report.

The alternate as noted has the effect of reducing baseline peak flows at the mouth by approximately 10 percent but without providing sufficient benefit to the upper portion of the watershed where out-of-bank flooding occurs.

2.5.3 Alternate 2 Features and Benefits

Alternate 2 features are shown on **Exhibit F6**. Alternate 2 includes the same two areas of high-quality stream habitat protection in the lower and middle reaches of the stream, one area of channel modification and two channel extensions to serve the upper portion of the watershed. A detention basin is included in this alternate just upstream of Huffsmith-Kohrville Road, in an abandoned sand pit. The difference between Alternates 1 and 2 is the addition of this detention basin.

The table below shows the peak flows at each hydrologic computational node in the baseline and alternate condition.

Alternate 2 Benefits (100-Year Flows)				
Node	**Location**	**Baseline Flow (cfs)***	**Alt Flow (cfs)**	**Benefit (cfs)**
PG-1	At Huffsmith-Kohrville Road	1320	858	-462
PG-2	At Spring-Cypress Road	1995	1439	-556
PG-3	At Confluence with K140-02-00	2775	2262	-513
K100#14	At Mouth	3752	3296	-456

* The flow from the baseline model with subbasins revised as noted in Part 2.2 of this report.

The combination of detention in the upper reaches and the additional volume provided by the channel extensions has the effect of lowering baseline flows at the mouth by approximately 12 percent while mitigating the baseline peak flows in the upper watershed more significantly. In addition to benefiting the Pillot Gully watershed, the plan will also reduce baseline flows entering Cypress Creek.

2.5.4 Alternate 3 Features and Benefit

Alternate 3 features are shown on **Exhibit F6**. Alternate 3 includes the same two areas of high-quality stream habitat protection at the lower and middle reaches of the stream, one area of channel modification and two channel extensions to serve the upper portion of the watershed. A much larger detention basin is included in this alternate just upstream of Spring-Cypress Road. The difference between Alternates 2 and 3 is in the location and size of the proposed detention basin. The larger detention basin could be configured in a number of ways to provide space for recreation and open space, in addition to storm water detention. A typical general layout of this detention facility is shown on **Figure 2**.

The table below shows the peak flows at each hydrologic computational node in the baseline and alternate condition.

Alternate 3 Benefits (100-Year Flows)				
Node	**Location**	**Baseline Flow (cfs)***	**Alt Flow (cfs)**	**Benefit (cfs)**
PG-1	At Huffsmith-Kohrville Road	1320	1204	-116
PG-2	At Spring-Cypress Road	1995	1294	-701
PG-3	At Confluence with K140-02-00	2775	2052	-723
K100#14	At Mouth	3752	3125	-627

* The flow from the baseline model with subbasins revised as noted in Part 2.2 of this report.

The combination of detention in the upper reaches and the additional volume provided by the channel extensions has the effect of lowering baseline peak flows at the mouth by as much as 17 percent, while lowering baseline flows in the upper portion of the watershed much more significantly, depending on the configuration of the basin. In addition to benefiting the Pillot Gully watershed, the plan will also reduce baseline flows entering Cypress Creek.

2.5.5 Public Input on Alternate Plans

On October 8, 2002, a public meeting was held to describe the progress of the project and to inform the public regarding the alternate plans being proposed for the watershed. As noted above, one public comment regarding the Pillot Gully alternates was received as a result of the meeting. The comment regarded Alternate 3 and the large detention basin. The commenter, a landowner of one of the properties in the general location where the basin was proposed, was opposed to the recommended basin-site location. The low number of comments on Pillot Gully likely relates to the fact that there are not significant flooding concerns within the watershed.

2.5.6 Screening of Alternates

The following criteria matrix was used when evaluating the alternative plans identified for each watershed. The ability of the plan alternative to meet each criteria was ranked from 0 to 10, with 0 indicating that the criteria is not met, and 10 indicating that the criteria is met to the best of its ability. Relative weights were then set for each of the criteria as shown below based on the stated goals of the study.

As shown, the three alternates meet the criteria, with the only difference being the addition of more multiple-use possibilities and more benefits to Cypress Creek in Alternates 2 & 3. However, the cost, maintenance issues, and possible public acceptance problems associated with the larger basin in Alternate 3 are likely to be higher than the other alternates.

Table F1 – Screening Matrix for Pillot Gully				
Criteria	**Weight**	**Plan**		
		ALT 1	**ALT 2**	**ALT 3**
Minimal Construction Cost	0.2	7	5	3
Provides Aesthetics	0.5	8	8	8
Ease of Implementation	0.8	10	7	5
Flood Protection within Tributary Watershed	1	2	10	10
Ability to Accommodate Multiple Uses	0.5	7	9	10
Preserves/Enhances Water Quality	0.8	6	7	8
Preserves/Enhances Stream Habitat Quality	0.5	10	10	10
Ease of Maintenance	0.8	9	6	3
Reduction of Peak Flows into Cypress Creek	1	2	5	8
Outfalls for Future Roadways/Development	0.8	10	10	10
Acceptable to the Public	0.8	9	8	5
TOTAL	**-----**	**80**	**85**	**80**
WEIGHTED TOTAL	**77 (max)**	**53.1**	**59.9**	**57.4**

2.6 Recommended Plan and Identification of Elements

Based on the criteria noted above, a plan was recommended that met the needs of the watershed as noted in this report. The recommended plan is described in detail below.

2.6.1 Determination of Recommended Plan

Alternate 2 was chosen as the recommended plan, primarily due to the fact that it addressed all the criteria of the study and was deemed to be relatively less costly than Alternate 3. The large regional detention basin site, the primary feature of Alternate 3, may be useful in the future as a site for a regional facility to further reduce the flows from the watershed. However, since the watershed is not subject to extensive flood damages in the baseline condition, it was determined that the use of such a large detention facility was not feasible for the purposes of this study. Alternate 2 features a smaller detention basin that reduces peak flows in the main channel of the watershed. Further, the plan reduces peak flows entering Cypress Creek and meets the other criteria noted above.

2.6.2 Recommended Plan Features

The recommended plan consists of features that preserve areas of good quality stream habitat, provide outfall drainage for future development and address out-of-bank flooding in the upstream portion of the watershed. The features of the plan, beginning at the mouth, consist of the following elements. The first approximately 6000 feet of the main channel is recommended to be preserved in a corridor with an average width of approximately 1000 feet. This corridor will preserve the good quality stream habitat and will also contain most of the

floodplain area within this reach. A water quality basin (K140#B1) is proposed as part of this element at the upstream end of the reach to enhance the quality of runoff prior to entering the high-quality area. This basin consists of an area of about 13 acres and should be designed as a "wet basin" in order to address the common pollutants found in Cypress Creek and tributary streams. The basin will accommodate approximately 0.5 inch of runoff per acre of upstream developed drainage area between Louetta Road and Spring-Cypress Road. The water quality basin will not be used to detain storm water during extreme events although it will likely provide some limited detention capability. This reach ends upstream of Louetta Road, where the majority of the high-quality stream habitat ends and the channel has been rectified.

Upstream of Louetta Road and through the Charterwood subdivision, the channel has been rectified and has sufficient capacity to handle the design storms. No additional work is planned in this reach. Upstream of Charterwood and the confluence of K140-04-00, another shorter reach of good quality stream habitat was identified. Since this area is relatively undeveloped and under little pressure to develop, preservation of the high quality areas is recommended. A section of channel approximately 3000 feet long and 600 feet wide is recommended to preserve the areas of high quality habitat and also encompass the majority of any floodplain in the reach. This reach passes under Cossey Road, which is not currently slated for any improvements.

Upstream of Spring-Cypress Road, a number of improvements are recommended as part of this plan. The existing channel is in the process of being widened as part of a development project and will contain the 100-year flows within banks as part of the widening project. The tributary ditch K140-05-00 is also in the process of being improved as part of a development project. The recommended plan extends channel K140-05-00 northwestward in order to provide additional outfall for future development. The channel section in this extension is recommended to be a terraced section with a nominal 40-foot bottom width and side slopes that vary from 4:1 to 10:1 (H:V). A typical section of this channel is shown in **Figure 1**. The total right-of-way width estimated for the channel extension is approximately 220 feet, assuming a nominal channel depth of 8 feet.

The detention facility (K140#B2) is proposed just upstream of Huffsmith-Kohrville Road, in a portion of a sand mining operation that has been abandoned. This sand pit is assumed to provide approximately 120 acre-feet of storage for the watershed, siphoning off peak flows from the main stem of Pillot Gully. Upstream of the detention facility, a proposed tributary channel (K140#C1) is located to provide outfall for future development in the upper portions of the watershed. The channel section is recommended to be similar to the extension described above for channel K140-05-00. The right-of-way width necessary for this channel is approximately 220 feet, assuming a nominal 8-foot depth. Between the tributary channel and the bridge at Huffsmith-Kohrville Road, the existing channel is recommended to be improved with a deeper channel section similar to that shown in Figure 1. The channel

modification project will allow future development outfall depth in the main channel and contain the current areas of out-of-bank flooding. The proposed right-of-way width for this channel will be 240 feet, based on a nominal 9-foot depth.

The remaining area of the upper watershed has no element recommended, primarily because they are currently served by the S.H. 249 roadside ditches and can also be served by the proposed new channel K140#C1. Any future development in this area would be drained westward to roadside ditches along S.H. 249 or eastward toward the proposed lateral channel K140#C1.

2.6.3 Recommended Plan Benefits

Taken together, these elements make up the recommended plan for Pillot Gully and satisfy the criteria for this study while providing quantifiable benefits to the watershed. Some recreational elements will be necessary to add to the plan features to fully meet the desired goal for multiple-use facilities. The somewhat fragmented nature of the plan elements will make a recreational feature such as a continuous trail system infeasible. However, a trail in the lower reach of Pillot Gully is feasible, would offer benefits for recreation, and would be accessible. Additionally, developments served by the proposed channel extensions would be encouraged to construct trails along these extensions as a recreational amenity for the development.

Hydrologic benefits due to the plan elements were summarized earlier in the alternate plan formulation section of this report. In order to maintain consistency with the Phase I report, the flows calculated as a result of the more detailed modeling were compared with the revised baseline flows, then the prorated decrease (or increase) resulting from the modeling of the recommended plan was applied to the original baseline flows to create an adjusted plan flow. The adjusted plan flows were used as the basis for the HEC-RAS modeling and floodplain mapping for the recommended plan. The resulting 100-year flows comparing the revised base conditions to the recommended plan conditions are presented in **Table F3** of this report. **Table F4** of this report presents the HEC-1 peak flows resulting from the recommended plan for various storm frequencies. These flows, which have been prorated, are used to generate the stream profiles presented on **Exhibit F11-1** and **Exhibit F11-2**.

The plan reduces peak flows in the main channel of Pillot Gully and into Cypress Creek. Additionally, water surface elevations are lowered in conjunction with the lower flows. As shown in **Table F5**, the 100-year water surface elevations decrease along Pillot Gully by less than 1 foot downstream of Huffsmith-Kohrville Road, and from more than 1 foot to as much as 5 feet along the channel modification upstream of the road. Finally, the plan provides environmental benefits by preserving identified areas of good quality stream habitat as well as preserving some naturally flood-prone areas, as noted above.

Table F2: Watershed Physical Characteristics (Baseline & Recommended Plan Conditions)

Subarea Name	Drainage Area		Watershed Length	Length to Centroid	Channel Slope	Overland Slope	Urban Dev. *	Watershed Dev. *	Channel Imp.	Channel Conv.	Ponding
	(Acre)	(Sq.Mi)	(mi)	(mi)	(ft/mi)	(ft/mi)	(%)	(%)	(%)	(%)	(%)
K140A	1128	1.76	2.87	1.55	12.2	<20	23	6.9	0	100	0
K140B1	349	0.55	2.02	1.00	9.91	<20	7	2.1	0	100	0
K140B2	286	045	0.85	0.66	10.0	<20	2	0.6	0	100	0
K140C	264	0.41	1.19	0.65	14.2	<20	45	13.5	0	100	0
K140D	366	0.57	1.83	1.02	13.1	<20	27	8.1	0	100	0
K140E	934	1.46	2.61	1.25	12.3	<20	38	81.4	100	90	0

* % based on development in place prior to implementation of HCFCD on-site detention policy (1984)

Baseline & Recommended Plan Conditions

Subarea Name	TC	R	RTIMP
	(hrs)	(hrs)	(%)
K140A	1.00	4.20	35.0
K140B1	0.72	4.58	35.0
K140B2	0.47	2.40	35.0
K140C	0.35	1.33	35.0
K140D	0.61	2.70	35.0
K140E	0.41	3.41	35.0

Table F3: 100-Year Flow Comparison Table (Baseline vs. Recommended Plan)

HEC-1 Analysis Point	Baseline Condition (cfs)	Recommended Condition (cfs)*	Baseline vs. Recommended Plan	
			Difference (cfs)	% Change
PG-1	1171	761	-410	-35.0
PG-2	1532	1105	-427	-27.9
PG-3	2435	1985	-450	-18.5
K100#14 (Mouth)	3464	3043	-420	-12.2

* The flow from the recommended plan model prorated as identified in part 2.6.3 of this report.

Table F4: HEC-1 Peak Flow Rates for Recommended Plan Conditions*

HEC-1 Analysis Point	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	250-Year	500-Year
	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
K140A (PG-1)	331	499	572	624	665	761	918	1040
PG-2	416	636	751	858	948	1105	1276	1374
PG-3	659	1029	1268	1512	1735	1985	2272	2449
K100#14	977	1559	1936	2333	2667	3043	3469	3785

* The flows prorated as identified in part 2.6.3 of this report.

Table F5: Comparison of Water Surface Elevations (100-Year)

SECNO	Location	Baseline Condition		Recommended Plan		Delta
		Flow	WSEL	Flow	WSEL	(ft)
1900		3464	118.66	3043	118.51	-0.15
1910	Timber Bridge	3386	118.77	2960	118.65	-0.13
1940		3386	119.03	2960	118.90	-0.13
1950		3386	119.04	2960	118.91	-0.13
2711		3215	120.02	2780	119.82	-0.20
2761	Compaq Center Drive	3215	120.16	2780	119.93	-0.22
2805		3215	120.35	2780	120.09	-0.26
2855		3215	120.70	2780	120.33	-0.35
3320		3215	121.50	2780	121.12	-0.38
4605		2743	122.78	2293	122.43	-0.35
4655	Louetta Bridge	2743	122.80	2293	122.46	-0.34
4755		2743	123.26	2293	123.12	-0.14
4805		2743	123.29	2293	123.14	-0.14
5270		2743	123.51	2293	123.32	-0.19
7159		2743	125.09	2293	124.62	-0.47
7780		2435	125.90	1985	125.33	-0.57
7830	Rodgers Road	2435	125.96	1985	125.38	-0.58
7875		2435	126.05	1985	125.45	-0.60
7925		2435	126.10	1985	125.50	-0.59
8954		2435	126.94	1985	126.26	-0.67
9376		2405	127.46	1954	126.77	-0.68
9798		2405	128.32	1954	127.63	-0.68
10190		2405	129.01	1954	128.34	-0.67
10220		2405	130.51	1954	129.96	-0.54
10750	Cossey Road	1532	135.11	1105	134.39	-0.72
10790		1532	135.53	1105	134.60	-0.93
10800		1532	135.55	1105	134.62	-0.92
12200	Spring Cypress Road	1532	138.11	1105	137.12	-0.99
12240		1532	138.58	1105	137.85	-0.73
12250		1532	138.58	1105	137.86	-0.72
14060		1256	139.31	874	138.39	-0.92
15760	Huffsmith-Kohrville Rd.	1171	143.28	761	141.73	-1.55
15800		763	143.71	496	141.94	-1.77
16100		763	143.92	496	142.03	-1.89
16400		763	144.29	496	142.05	-2.24
16700		763	144.79	496	142.08	-2.71
17000		763	145.04	496	142.12	-2.92
17900		763	146.00	496	142.30	-3.71
18700		587	147.32	382	142.55	-4.77
19300		308	147.85	200	142.70	-5.15
20087		267	148.20	173	142.84	-5.36

3.0 PLAN IMPLEMENTATION AND MANAGEMENT STRATEGIES

Since a majority of the Pillot Gully watershed is still undeveloped, the features identified as part of the recommended plan can be constructed as the watershed develops. As new development continues, mitigation for anticipated increases in storm water runoff can be implemented. The channel extensions and new channel elements through these undeveloped areas have been identified to be used as a guide for new development.

This information identifies ultimate drainage corridor right-of-way needed to implement the recommended plan features. Further, this identification of right-of-way will help local agencies in their coordination with new development to ensure that the appropriate considerations for drainage are being implemented. The following sections outline a suggested approach for implementing the recommended plan and identify recommended management strategies for the watershed.

3.1 Preservation of Stream Habitat Corridors

The recommended plan identifies two areas of high quality stream habitat that are to be managed without any structural flood reduction project. The two areas are from the mouth at the confluence of Cypress Creek upstream to Louetta Road, and between the confluence of K140-04-00 to Spring-Cypress Road. In both of these areas the channel of Pillot Gully has good natural stream habitat corridor that is beneficial to maintain in its existing condition.

The area contained within these corridors consists of a varying right-of-way width. The right-of-way width was determined based on the extents of mature tree cover as well as the limits of areas of out-of-bank flooding. Because a majority of this right-of-way represents floodplain, it is anticipated that development consisting of homes and the placement of fill material will not occur as quickly within these areas. Any development in these corridors will require substantial mitigation and coordination with the appropriate regulatory/governmental agencies. In order to implement this plan element, it is necessary to reserve the right-of-way in some fashion in order to limit or restrict development within the extents of these corridors.

One alternative for implementing this plan element is to request the appropriate easements from the landowner as development occurs in the adjacent area. Another alternate would be to have the appropriate entity such as the Harris County Flood Control District acquire the appropriate right-of-way through the fee title or easement. However, this would severely tax the funding source of the district if implemented on a wide basis. Another alternative would be to allow adjacent developments to construct mitigation facilities such as detention basins and water quality basins (that are a requirement of the development process) within these corridors, and to have the use of the corridors for recreational features such as hiking trails. No other portions of the development would be allowed within the corridors. Requirements would have to be placed on

the construction of these facilities so that they did not overly disturb the stream habitat that is meant to be preserved in the corridors.

3.2 New Lateral Channels/Channel Extensions

There are two new channels proposed in the recommended plan and one area of channel modification. One new channel is an extension of an existing tributary channel (K140-05-00), one is a new lateral channel (K140#C1). The channel modification area is proposed between Huffsmith-Kohrville Road and the upstream end of the main stem as shown on the plan. The plan suggests a right-of-way width sufficient to incorporate a channel that has terraced sections and allows for multiple uses in each of these areas (see **Figure 1**). The recommended implementation of this channel corridor would consist of having the Harris County Flood Control District prioritize (as best as possible) the immediate need for these channels, and proceed with the acquisition of a portion of the right-of-way along the proposed lateral channel alignments. This portion of the right-of-way would be the minimum (approximately 100 feet) necessary to implement a typical trapezoidal channel with the appropriate depth for outfall. Additional right-of-way and construction of the channel would be provided by adjacent properties of new development as they occur. Alternative right-of-way acquisition strategies are similar to those already discussed in the previous section and consist of requiring dedication of larger easements, purchasing the land outright, or entering into an agreement with the proposed development to share the land.

3.3 Detention Facilities

One detention facility is identified for the Pillot Gully watershed recommended plan. It should be noted that the recommended plan includes the use of on-site detention as a requirement of development. The facility proposed as part of the recommended plan is for further reduction of flows in the watershed. Therefore, it will likely not be feasible to allow developers to mitigate individual developments by excavating in a regional facility, as has been occurring in other watersheds, unless the facility in the recommended plan is expanded and designed for that purpose. Implementation of the regional detention facility element of the recommended plan will consist of the actual purchase of the land and construction of the facility by public agencies such as the HCFCD.

3.4 Channel Crossings

As noted earlier, few major thoroughfares cross the channels in the Pillot Gully watershed. Of the major thoroughfares shown on the exhibits, only Spring-Cypress Road has plans for future improvements. The plan for future improvements to Spring-Cypress Road calls for the current culvert configuration (2-10' x 7' concrete box culverts) to remain and an additional structure constructed to accommodate the additional lanes. If the new structure is designed to pass the

recommended plan 100-year flows (approximately 1105 cfs) with a minimal (less than 0.5') amount of head losses, an opening of approximately 260 square feet will be necessary.

Huffsmith-Kohrville Road is a two lane road that may be improved in the future. The crossing of the main channel of Pillot Gully would be improved with an additional two lanes. Since the bridge experiences overtopping during extreme events in the recommended plan, it is likely that the bridge may be raised or expanded as part of the future improvements. If the new structure is designed to pass the recommended plan 100-year flows (approximately 761 cfs) with a minimal (less than 0.5') amount of head losses, an opening of approximately 180 square feet will be necessary.

A new alignment for Cutten Road is proposed as part of the major thoroughfare plan. This new alignment crosses tributary channel K140-02-00 outside of the study area. This crossing is planned as part of the major thoroughfare plan and will cross a rectified channel where no improvements are recommended in this plan. However, the flow in the baseline condition can be estimated in this channel and a preliminary size given for the opening area. If the new structure is designed to pass the 100-year flows in the tributary channel (approximately 510 cfs) with a minimal (less than 0.5') amount of head losses, an opening of approximately 120 square feet will be necessary.

The Louetta Road bridge crosses the main channel in the lower part of the watershed. This crossing is currently a four-lane crossing with no immediate plans for expansion or improvement. The Louetta bridge also experiences overtopping in during extreme events in the recommended plan, if the bridge is improved in the future, it is likely that the bridge may be raised or expanded. If the new structure is designed to pass the recommended plan flows (approximately 2293 cfs) with a minimal (less than 0.5') amount of head losses, a opening of approximately 500 square feet will be necessary.

There may be crossings that are constructed as part of developments or as revisions to the major thoroughfare plan. Channel crossings must be considered in light of the goals for the "frontier program" in each of these watersheds. For example, a new bridge spanning an area of high-quality habitat protection, such as the lower portion of the watershed, would need to be built to preserve the habitat quality of the area. This would include longer spans or additional spans to clear more of the conveyance area of the channel, limited clearing of trees along the right-of-way and storm water quality features at any outfalls proposed with the crossing. Proposed crossings of the channel extension or new tributary channel included in the recommended plan could be designed in a more conventional manner however, care must be taken to ensure that the storage of the channel is not impacted by the construction of a too-narrow structure.

3.5 Cost Analysis

Costs were identified for implementation of the recommended plan. These costs consider acquisition of right-of-way, engineering, and construction of the plan elements. It should be noted that the bridge crossing information included above was not included in the recommended plan cost because the crossings were not implemented as part of the recommended plan, but as part of the county's transportation plan. The table below shows each plan element, the identified right-of-way, the unit costs and total costs for the project. The total cost when fully implemented is approximately $7.3 million, with the bulk of the cost in land acquisition and excavation costs.

Table F6 – Estimate of Recommended Plan Construction Costs for Pillot Gully

Description	Unit	Quantity	Unit Cost	Cost
1. Mobilization	Each	3	$10,000	$30,000
2. Clearing & Grubbing	Acre	13.5	$1,500	$20,250
3. Excavation & Haul	Ac-Ft	424	$5,000	$2,120,000
4. Bridge Installation	S.F.	0	$60	$0
5. Culvert Installation	S.F.	0	$75	$0
6. Drop/Control Structures	L.S.	5	$100,000	$500,000
7. Backslope Drains	Each	43	$3,000	$129,000
8. Utilities Relocation	Each	0	$100,000	$0
9. Right-of-Way	Acre	174.4	$15,000	$2,616,000
10. Seeding & Mulching	Acre	81	$1,000	$81,000
11. Tree/Shrub Planting	Acre	26	$10,000	$260,000
SUB TOTAL				$5,756,250
Contingencies (15%)				$863,437
TOTAL CONSTRUCTION COST				$6,619,687
ENGINEERING AND ADMINISTRATION (10%)				$661,968
TOTAL				**$7,281,656**

3.6 Implementation Phasing

Implementation of the recommended plan features is suggested to occur in phases so that the appropriate funding can be identified for each fiscal year. First priority should be given to implementing projects that result in flood reduction benefits to existing flood-prone structures. In the Pillot Gully watershed, there are no plan elements that fit this category. Second priority should be given to acquiring right-of-way ahead of new development, to ensure that future drainage projects can be implemented accordingly. This acquisition will also coincide with future major roadway thoroughfare projects. The channel modification, proposed channel extension and new channel elements of the Pillot Gully recommended plan fit this category. Final priority should be placed on an ongoing land acquisition program to purchase right-of-way for stream corridor preservation projects and for remaining recommended plan elements. The stream corridor and detention elements of the Pillot Gully recommended plan would fit this category.

Since there are currently few flooding problems in the Pillot Gully watershed, implementation of the plan could be delayed until there is development pressure on areas slated for improvements.

The recommended plan is estimated to take approximately 3 years to implement. The order of implementation would then be to construct the channel extension and new lateral channel (K140#C1 and extension of K140-05-00) within the first year of implementation. Once channel K140#C1 was complete, the channel modification would be constructed next. The proposed detention facility (K140#B2) would be constructed as the channel projects were completed in the second and third years of implementation. The stream corridors and water quality basin should be identified and right-of-way secured as development begins to occur in the adjacent areas.

3.7 Identification of Possible Funding Sources

Implementation of the plan is dependent upon the cooperation of other stakeholders in addition to the Harris County Flood Control District. The District's primary role is to implement flood reduction projects. The construction of parks and the creation of mitigation for new development cannot be implemented with District funds.

Currently, there does not appear to be an expressed interest by any other organization to implement various park or trail amenities within the Pillot Gully watershed. In the event that such interest is expressed, it is anticipated the implementation of parks or trails within the drainage corridor right-of-way could proceed through agreements between the District and the appropriate stakeholders. Such stakeholders could include the Texas Parks and Wildlife, Legacy Land Trust, Harris County, and the various civic associations located throughout the watershed. Management of these uses and respective maintenance of the facilities would also be performed by the stakeholders. The District could enter into an agreement to construct the necessary detention or flood-reduction drainage element with consideration for multiple uses such that the stakeholder will take over maintenance of the facility.

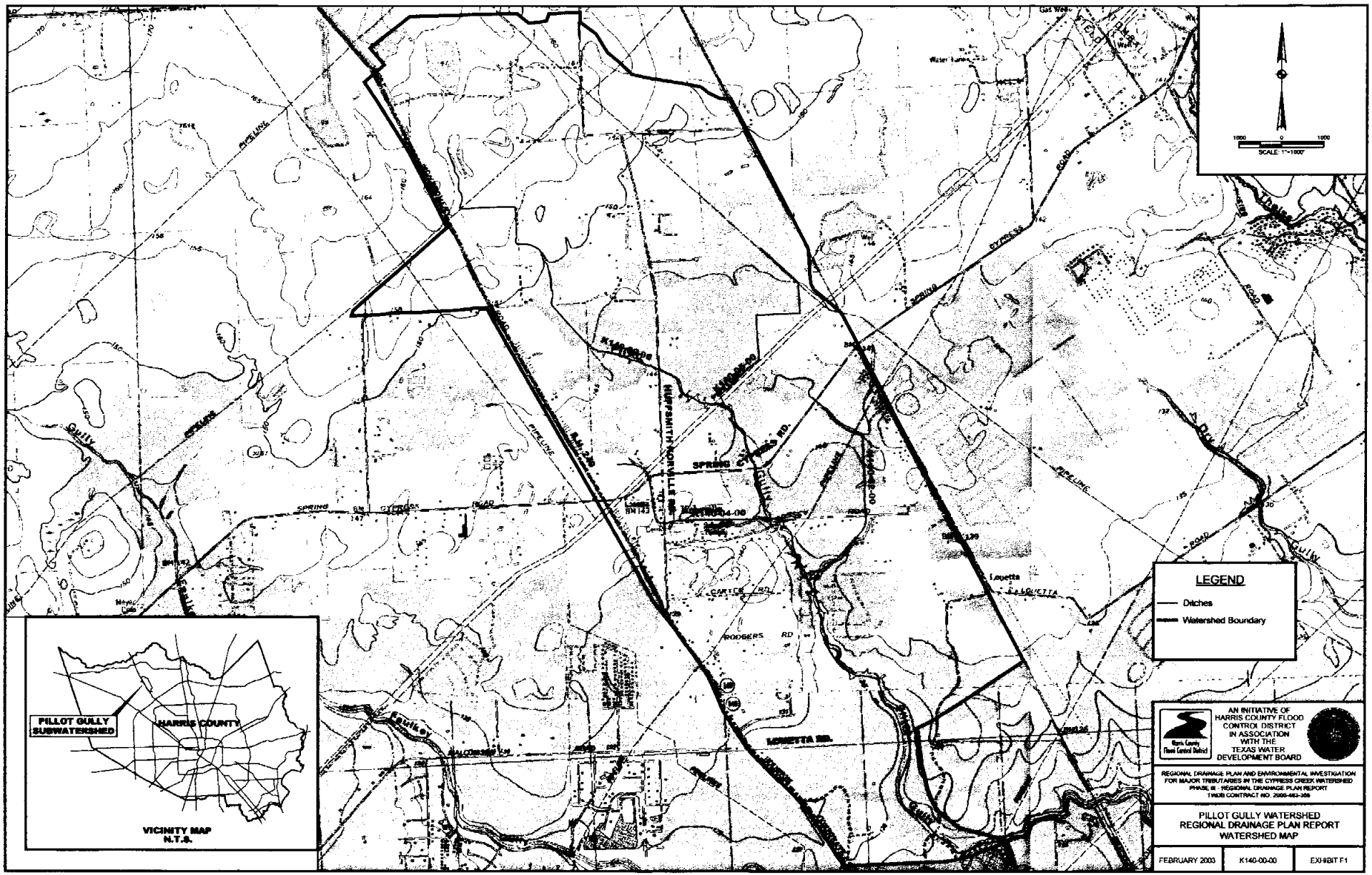
Harris County currently has a Parks & Recreation Master Plan that identifies corridors for proposed bikeway trails. Although none of these proposed corridors are within the Pillot Gully watershed, it may be possible to extend the bikeways from Cypress Creek into desirable portions of the watershed using the funding identified for the bikeway program.

The construction of the necessary roadway crossing of the channels will be funded through the appropriate stakeholder responsible for the project, such as Harris County Engineering for county roads, Texas Department of Transportation for U.S 249, and developers for their respective developments that include roadway channel crossings.

4.0 CONCLUSIONS

The recommended plan identified in this report represents a feasible solution to providing flood reduction benefits and guidance for drainage planning of new development projects. Existing environmental conditions of the watershed are considered in the plan so they are preserved to the extent possible and, at a minimum, that they are not further degraded. Further, the plan, when implemented, will result in slightly reduced stormwater peak flows into Cypress Creek, suggesting that the plan will also result in flood reduction benefits for existing developments along Cypress Creek.

Implementation of the plan will have to occur over many years and will require the cooperation of additional stakeholders. Prioritization of the plan elements has been performed, suggesting that there is not an immediate need to implement plan features along Pillot Gully. However, land acquisition or reservation should be planned for the watershed. It is estimated that, once begun, it would take approximately 3 years to implement the entire plan, with an average expenditure of $2.4 million per year.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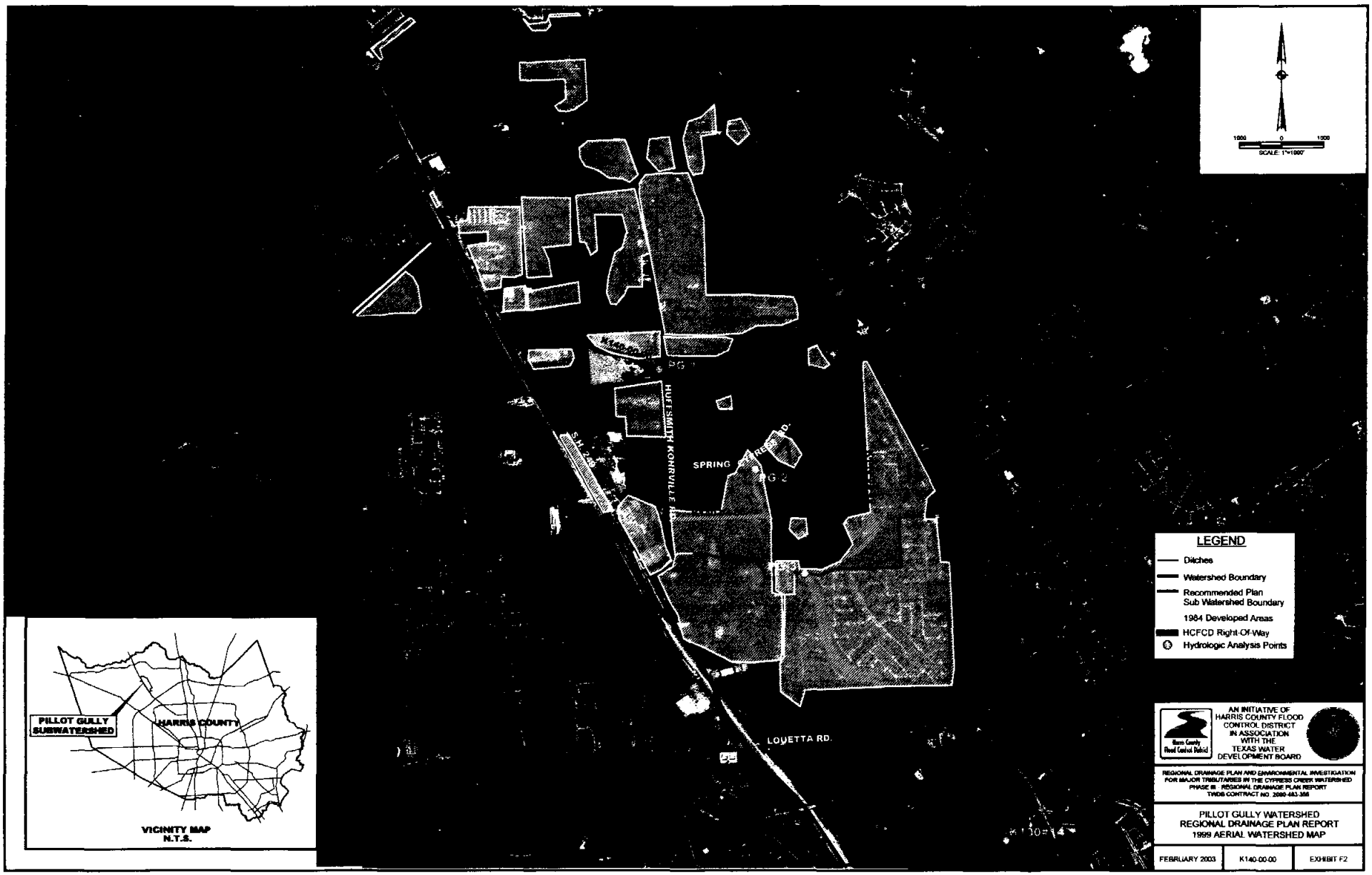
Ditches
Watershed Boundary
PILLOT GULLY SUBWATERSHED
HARRIS COUNTY
VICINITY MAP
N.T.S.
SPRING CYPRESS RD.
HUFFSMITH-CONROE RD.
CARTER RD.
RODGERS RD
LOMETTA RD.
Loquetta
LOQUETTA
PIPELINE
Gully
Bulkey
AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD
REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO. 2000-483-386
PILLOT GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
WATERSHED MAP
FEBRUARY 2003
K140-00-00
EXHIBIT F1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Ditches
Watershed Boundary
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1984 Developed Areas
HCFCD Right-Of-Way
Hydrologic Analysis Points
PG 1
PG 2
HUFF SMITH KOHRVILLE RD.
SPRING CYPRESS RD.
LOVETTA RD.
PILLOT GULLY SUBWATERSHED
HARRIS COUNTY
VICINITY MAP
N.T.S.
AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD
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PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO. 2000-483-358
PILLOT GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
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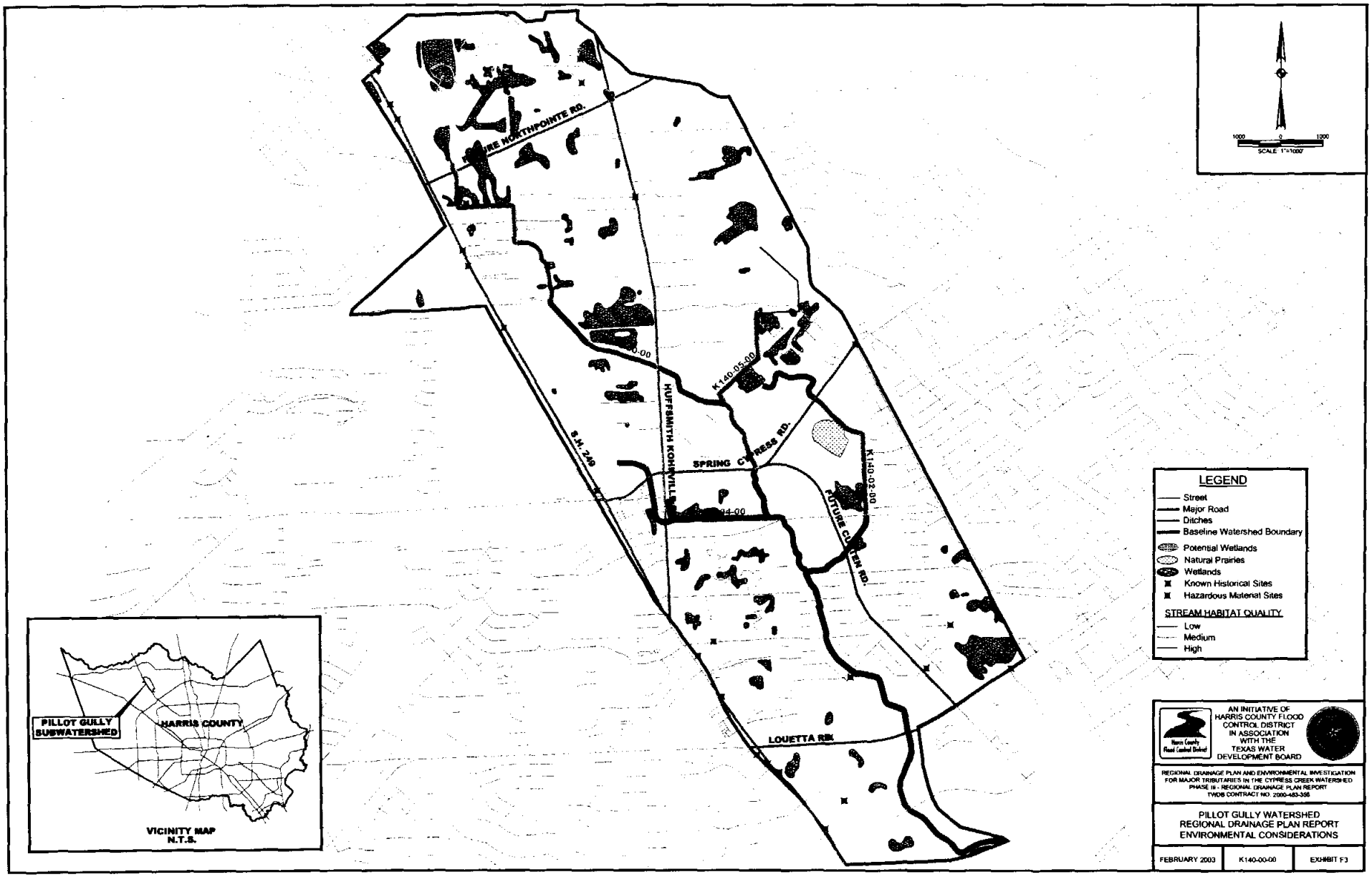
FEBRUARY 2003
K140-00-00
EXHIBIT F2

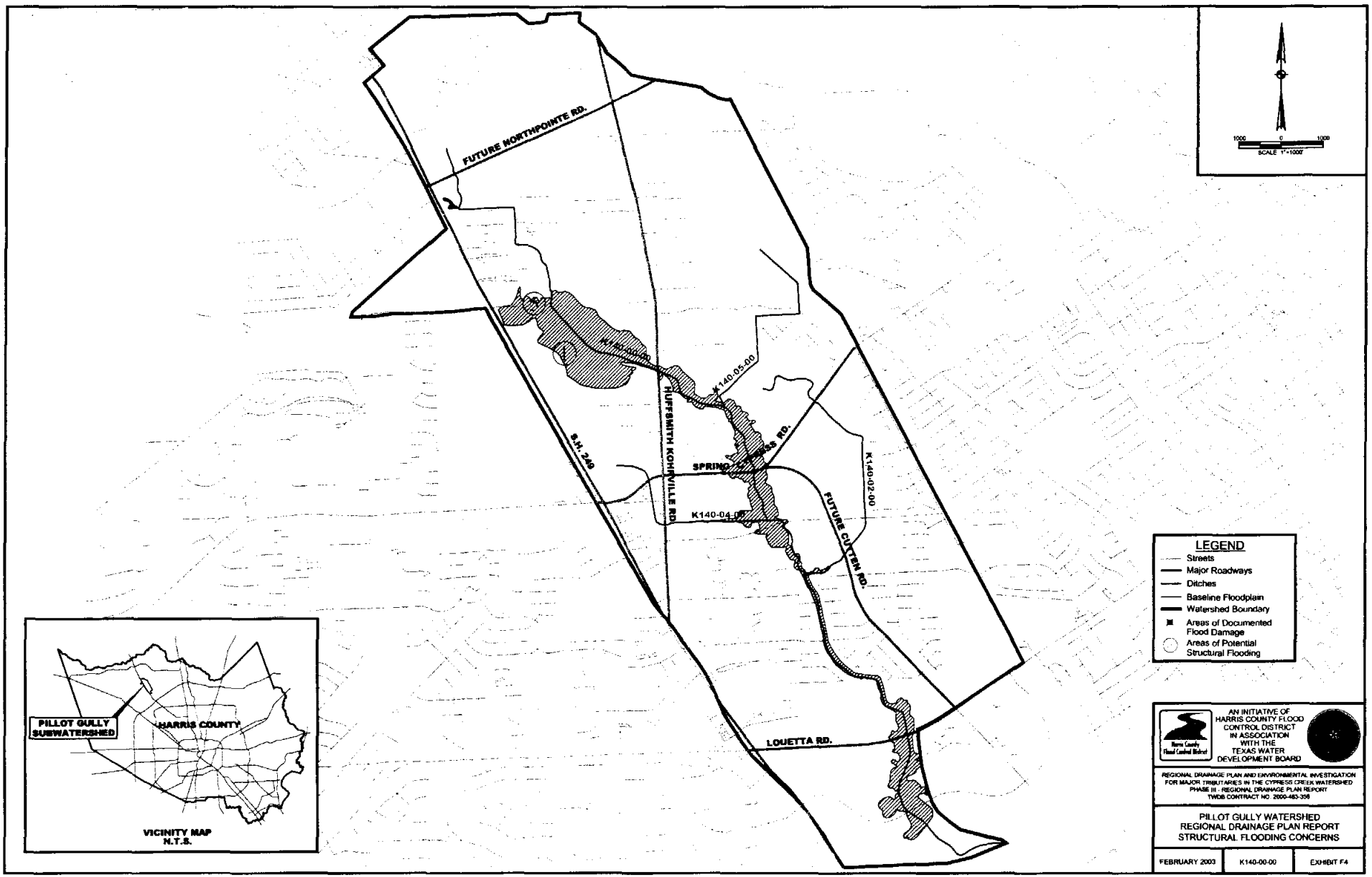


AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO. 2000-483-358

PILLOT GULLY WATERSHED REGIONAL DRAINAGE PLAN REPORT ENVIRONMENTAL CONSIDERATIONS

FEBRUARY 2003	K140-00-00	EXHIBIT F3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K140-04-00
K140-02-00
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S.H. 249
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FUTURE CUTTEN RD.
LOUETTA RD.
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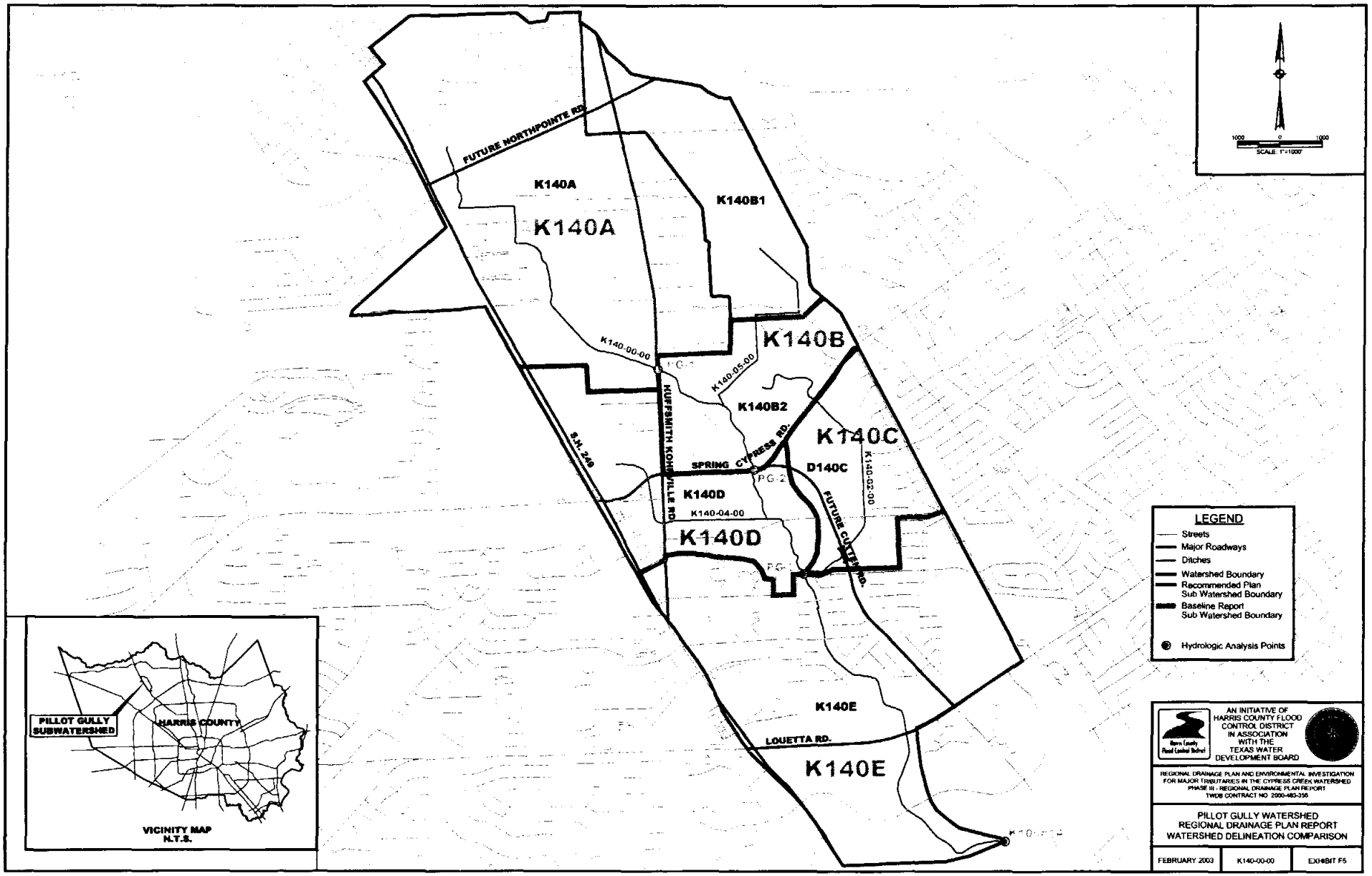
LEGEND
Streets
Major Roadways
Ditches
Baseline Floodplain
Watershed Boundary
Areas of Documented Flood Damage
Areas of Potential Structural Flooding
PILLOT GULLY SUBWATERSHED
HARRIS COUNTY
VICINITY MAP
N.T.S.
AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD
REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO. 2000-483-358
PILLOT GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
STRUCTURAL FLOODING CONCERNS
FEBRUARY 2003
K140-00-00
EXHIBIT F4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K140A
K140A
K140B1
K140B
K140-00-00
K140-05-00
K140B2
K140C
D140C
K140-02-00
SPRING CYPRESS RD.
S.H. 249
HUFFSMITH KOHRVILLE RD.
K140D
K140-04-00
K140D
FUTURE CLAY RD.
K140E
LOUETTA RD.
K140E
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LEGEND
Streets
Major Roadways
Ditches
Watershed Boundary
Recommended Plan Sub Watershed Boundary
Baseline Report Sub Watershed Boundary
Hydrologic Analysis Points
PILLOT GULLY SUBWATERSHED
HARRIS COUNTY
VICINITY MAP
N.T.S.
AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD
REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
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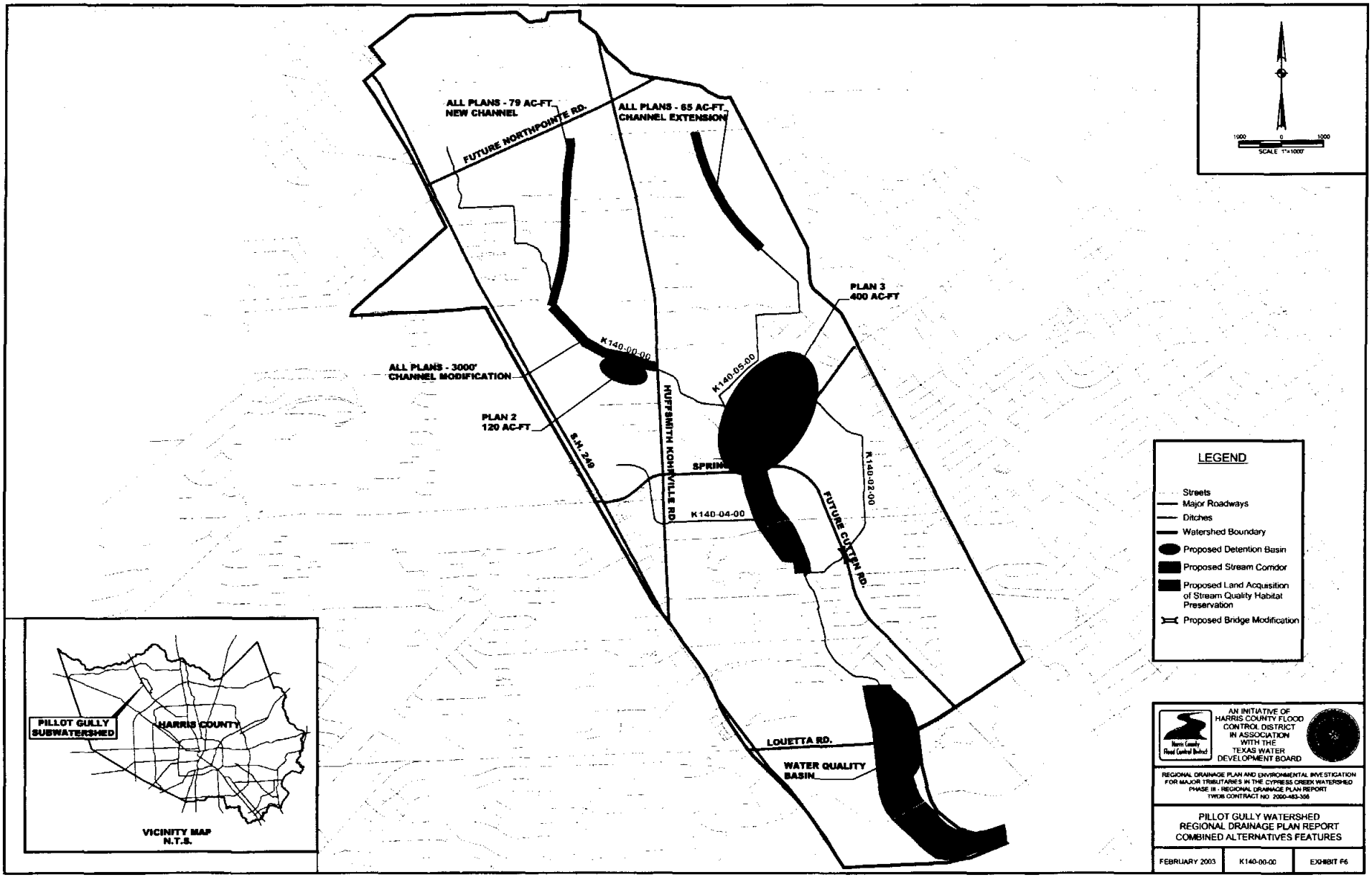
PILLOT GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
WATERSHED DELINEATION COMPARISON
FEBRUARY 2003
K140-00-00
EXHIBIT F5


ALL PLANS - 79 AC-FT
NEW CHANNEL
FUTURE NORTHPOINTE RD.
ALL PLANS - 65 AC-FT
CHANNEL EXTENSION
PLAN 3
400 AC-FT
K140-00-00
K140-05-00
ALL PLANS - 3000'
CHANNEL MODIFICATION
PLAN 2
120 AC-FT
S.H. 249
HUFFSMITH KOHRVILLE RD.
SPRING
K140-02-00
K140-04-00
FUTURE CLEVEN RD.
LOUETTA RD.
WATER QUALITY
BASIN
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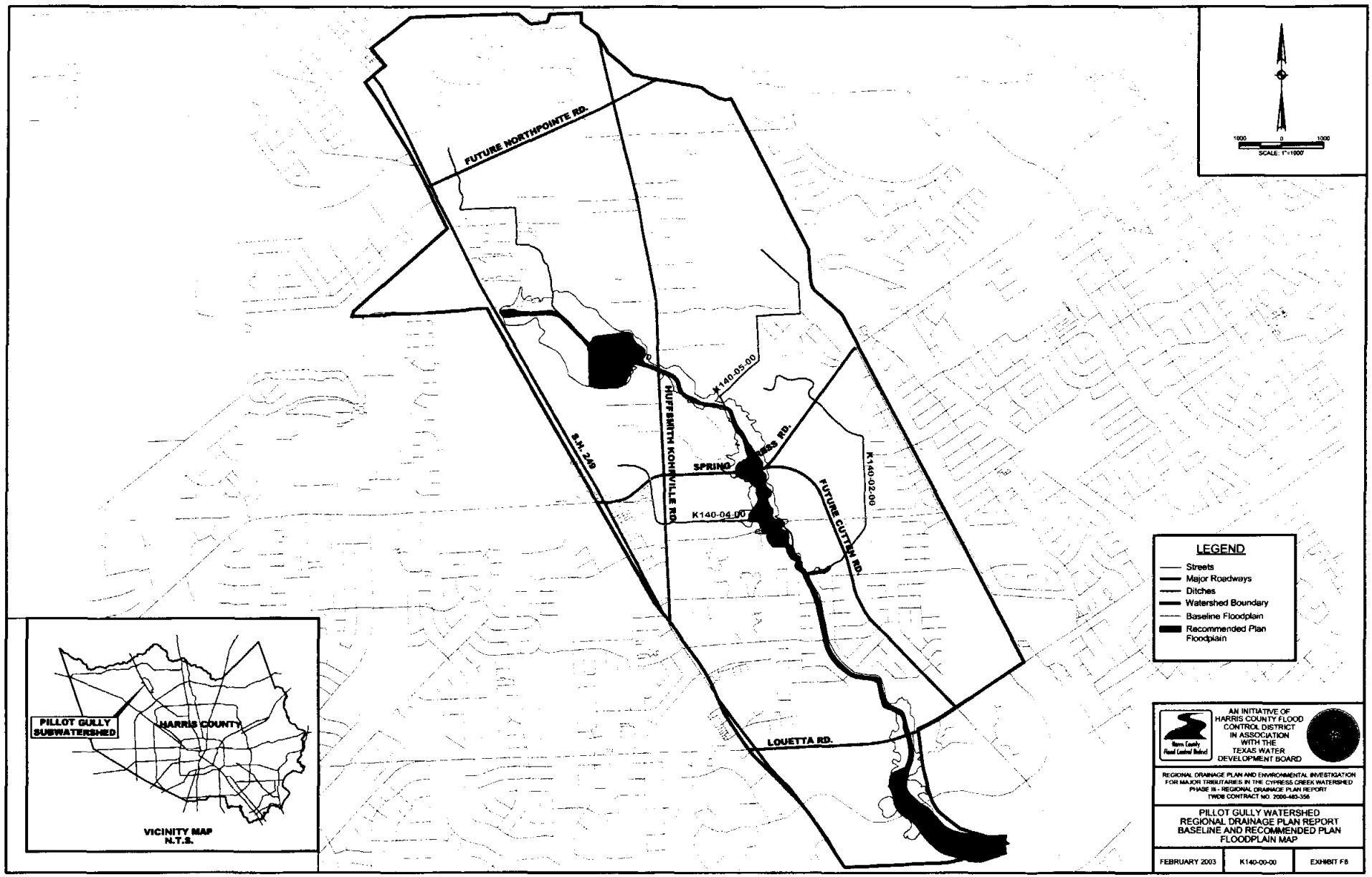
SCALE 1"=1000'
LEGEND
Streets
Major Roadways
Ditches
Watershed Boundary
Proposed Detention Basin
Proposed Stream Corridor
Proposed Land Acquisition of Stream Quality Habitat Preservation
Proposed Bridge Modification
PILLOT GULLY SUBWATERSHED
HARRIS COUNTY
VICINITY MAP
N.T.S.
AN INITIATIVE OF
HARRIS COUNTY FLOOD
CONTROL DISTRICT
IN ASSOCIATION
WITH THE
TEXAS WATER
DEVELOPMENT BOARD
REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION
FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO. 2000-483-356
PILLOT GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
COMBINED ALTERNATIVES FEATURES
FEBRUARY 2003
K140-00-00
EXHIBIT F6

TABLE OF CONTENTS

EXHIBITS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S.H. 249
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K140-02-00
FUTURE GUTTER RD.
LOUETTA RD.
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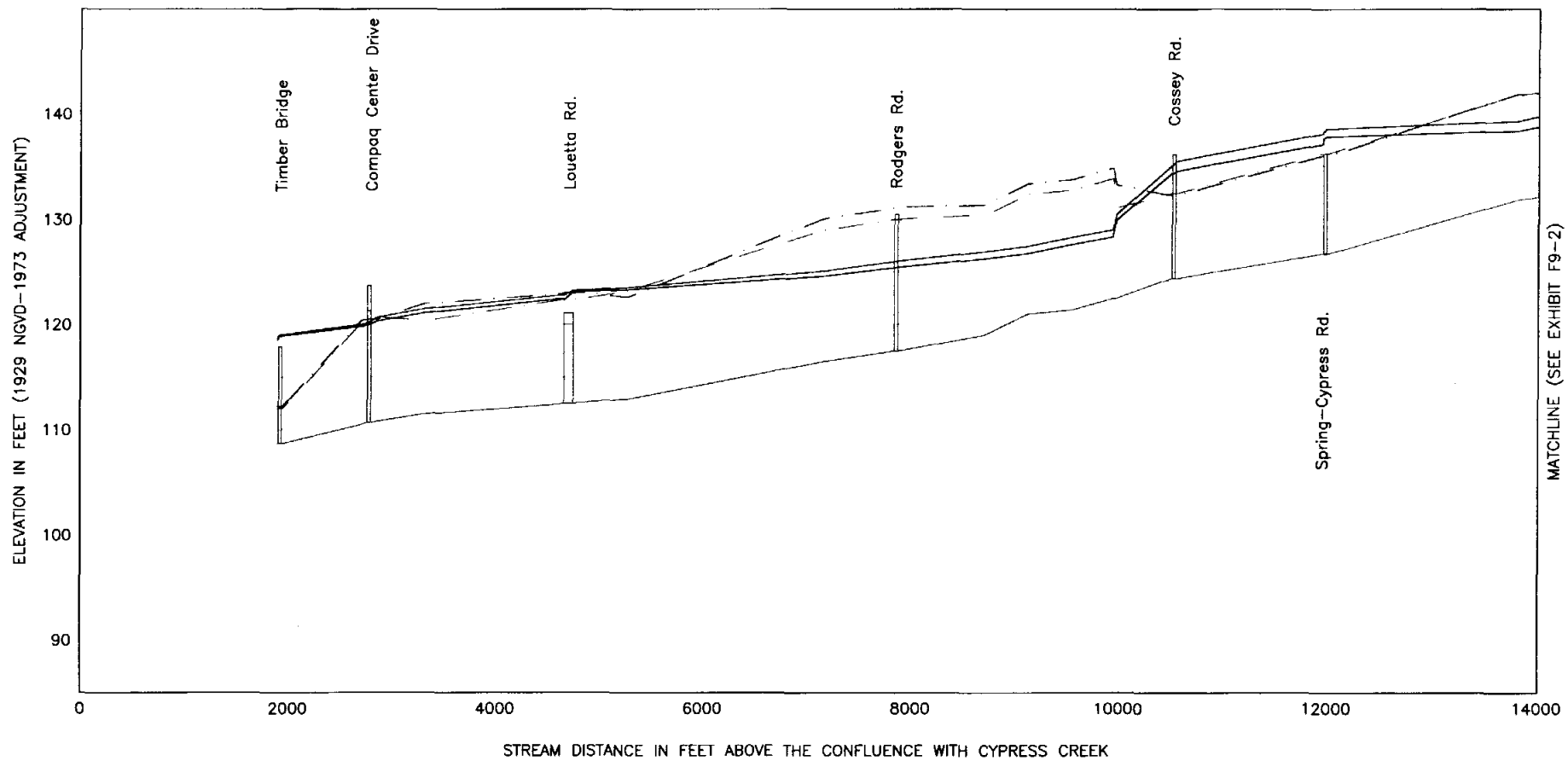
SCALE: 1"=1000'
LEGEND
Streets
Major Roadways
Ditches
Watershed Boundary
Baseline Floodplain
Recommended Plan Floodplain
PILLOT GULLY SUBWATERSHED
HARRIS COUNTY
VICINITY MAP
N.T.S.
AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD
REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO. 2000-483-356
PILLOT GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
BASELINE AND RECOMMENDED PLAN
FLOODPLAIN MAP
FEBRUARY 2003
K140-00-00
EXHIBIT F8



LEGEND

FLOWLINE
LEFT BANK
RIGHT BANK
BRIDGES

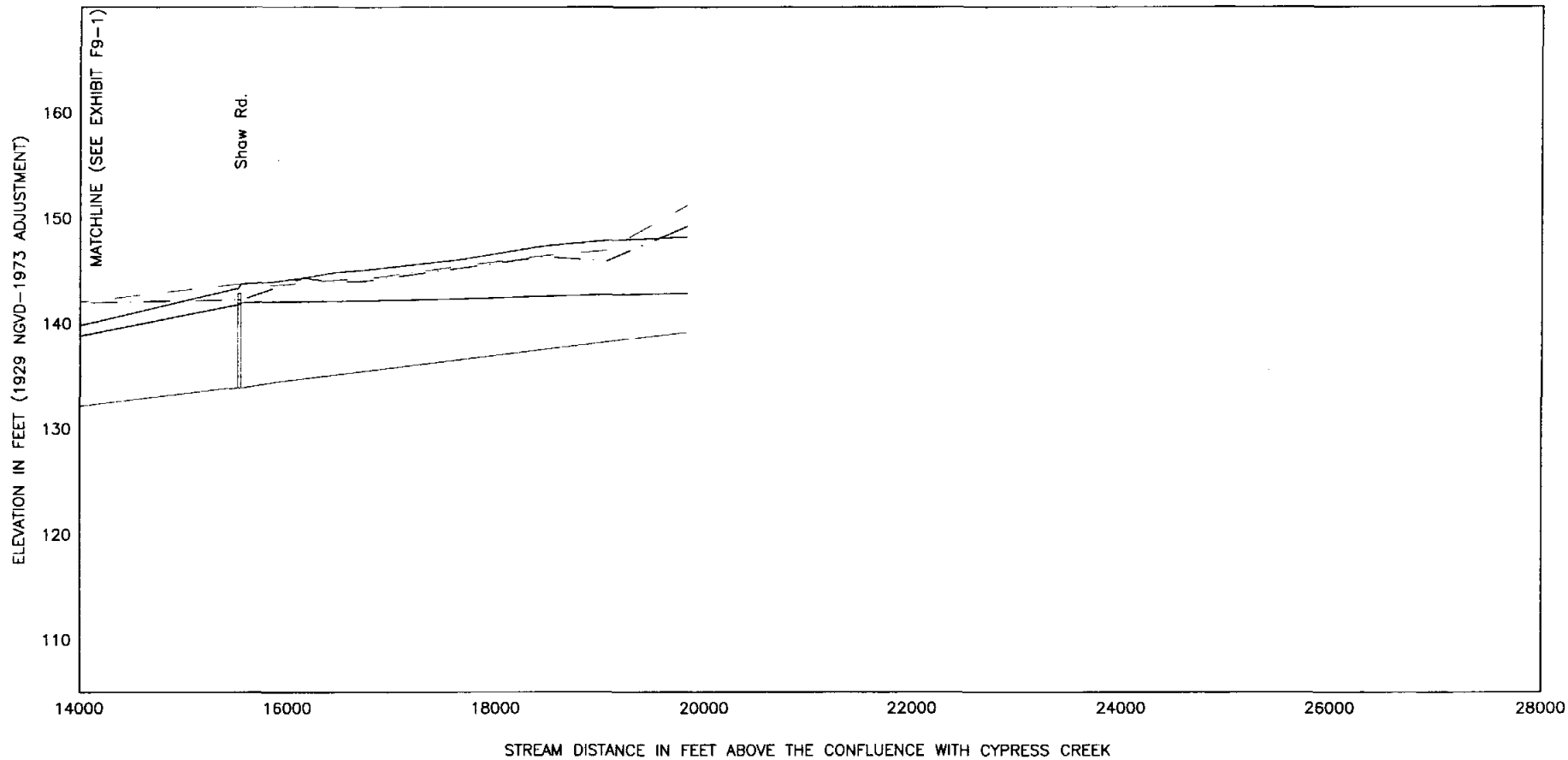
WATER SURFACE PROFILES
100-YEAR RECOMMENDED PLAN
100-YEAR BASELINE

AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO. 2000-483-336

PILLOT GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
100-YR WATER SURFACE PROFILE COMPARISON

FEBRUARY 2003 | K140-00-00 | EXHIBIT F9-1



LEGEND

FLOWLINE
LEFT BANK
RIGHT BANK
BRIDGES

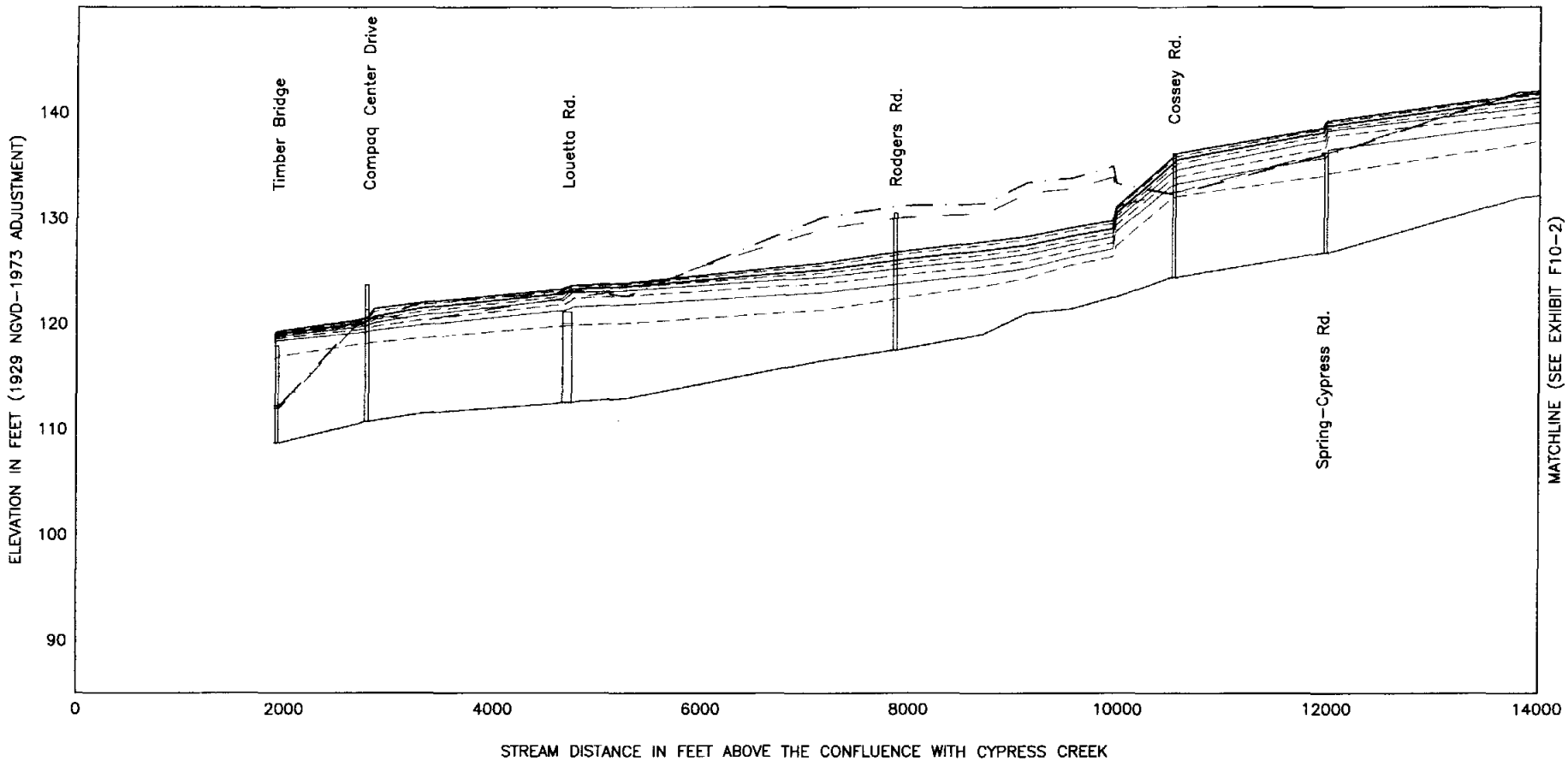
WATER SURFACE PROFILES
100-YEAR RECOMMENDED PLAN
100-YEAR BASELINE

AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO. 2000-483-356

PILLOT GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
100-YR WATER SURFACE PROFILE COMPARISON

FEBRUARY 2003	K140-00-00	EXHIBIT F9-2



LEGEND

- FLOWLINE
- LEFT BANK
- RIGHT BANK
- BRIDGES

WATER SURFACE PROFILES

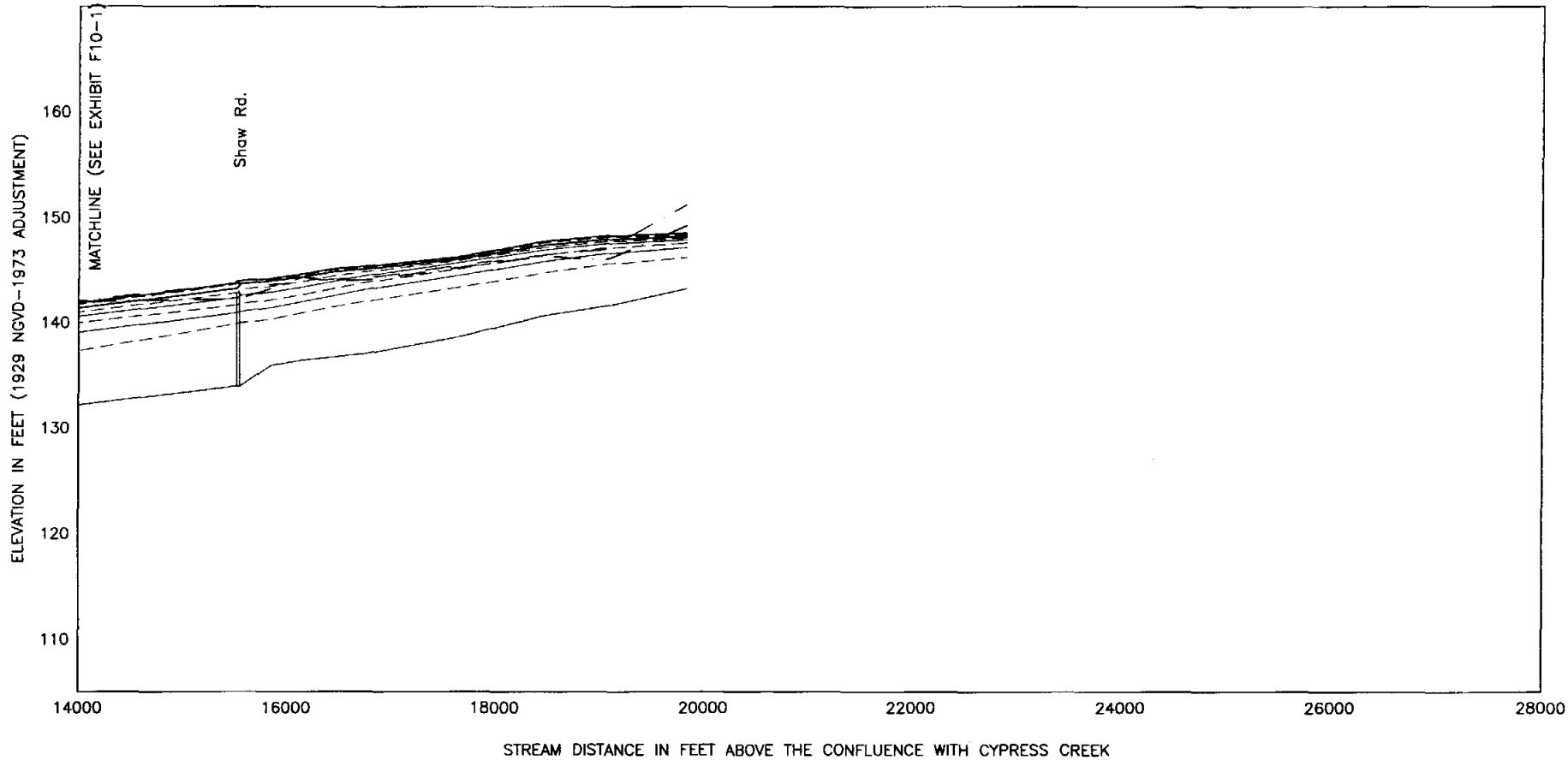
- 500-YEAR
- 250-YEAR
- 100-YEAR
- 50-YEAR
- 25-YEAR
- 10-YEAR
- 5-YEAR
- 2-YEAR

AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO. 2000-483-356

PILLOT GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
PILLOT GULLY WATER SURFACE PROFILES
BASELINE CONDITION

FEBRUARY 2003	K140-00-00	EXHIBIT F10-1



LEGEND

- FLOWLINE
- LEFT BANK
- RIGHT BANK
- BRIDGES

WATER SURFACE PROFILES

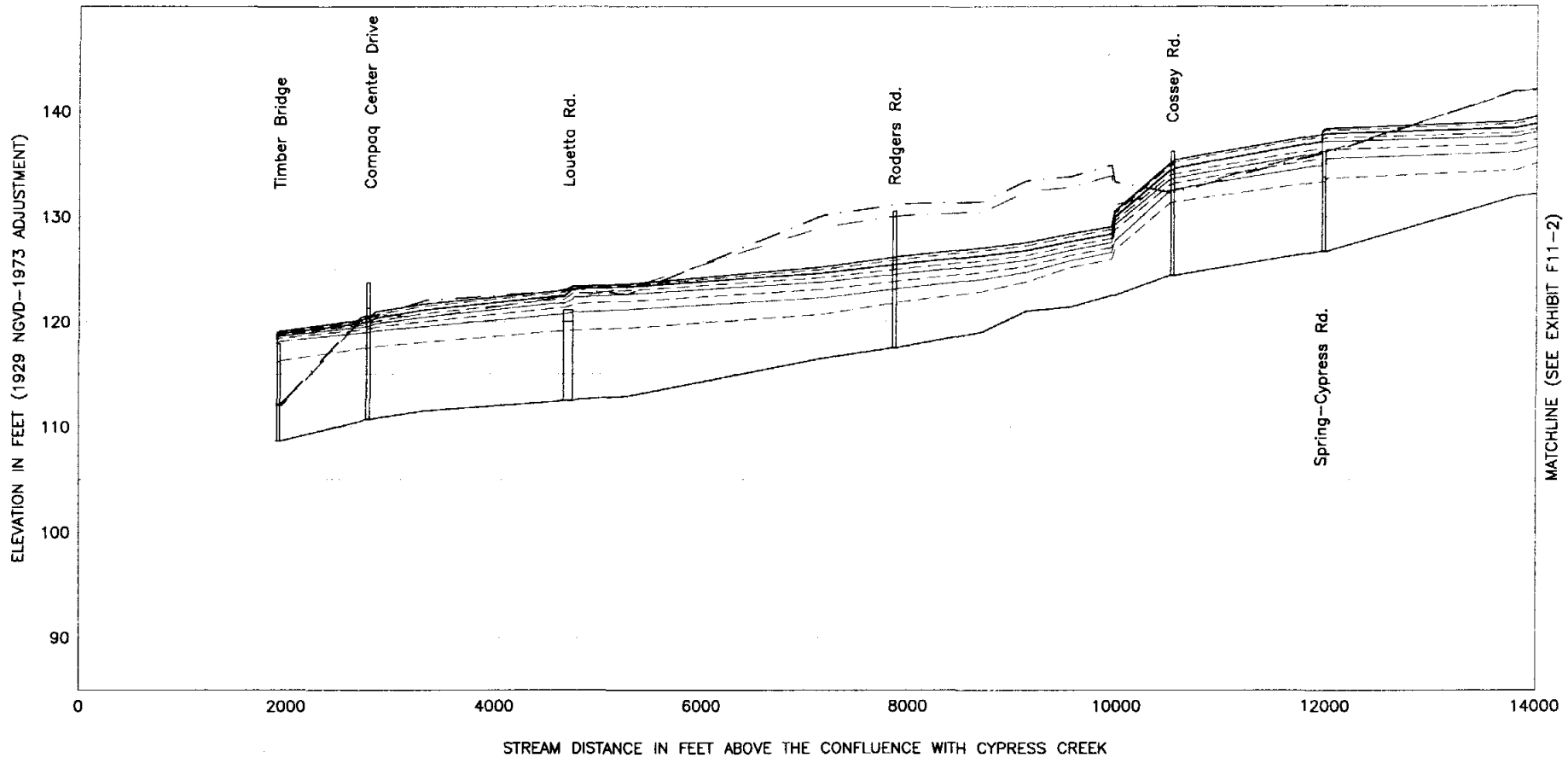
- 500-YEAR
- 250-YEAR
- 100-YEAR
- 50-YEAR
- 25-YEAR
- 10-YEAR
- 5-YEAR
- 2-YEAR

AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO. 2000-483-356

PILLOT GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
PILLOT GULLY WATER SURFACE PROFILES
BASELINE CONDITION

FEBRUARY 2003	K140-00-00	EXHIBIT F10-2



LEGEND

- FLOWLINE
- LEFT BANK
- RIGHT BANK
- BRIDGES

WATER SURFACE PROFILES

- 500-YEAR
- 250-YEAR
- 100-YEAR
- 50-YEAR
- 25-YEAR
- 10-YEAR
- 5-YEAR
- 2-YEAR

AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

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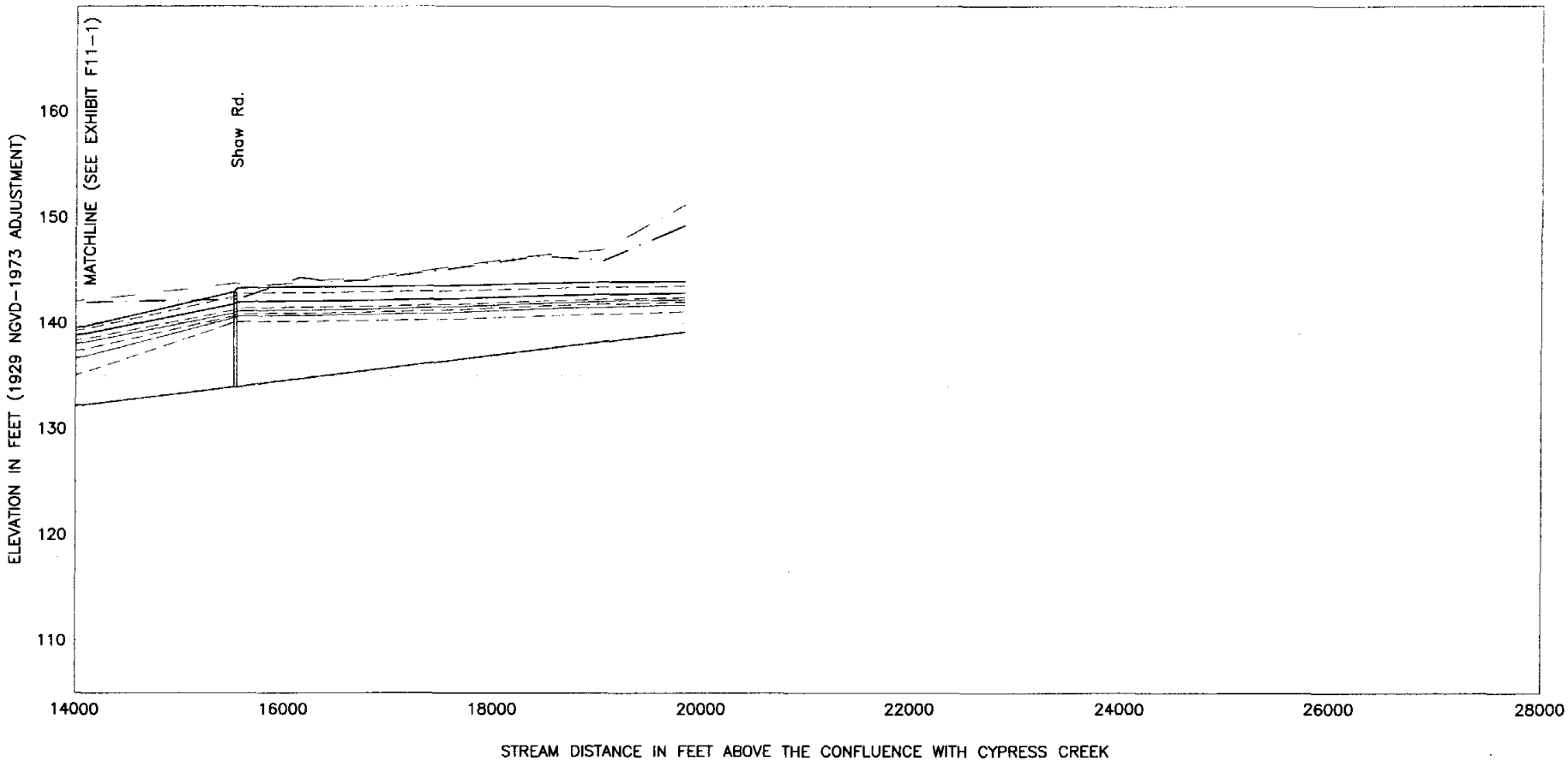
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO. 2000-483-356

PILLOT GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
PILLOT GULLY WATER SURFACE PROFILES
RECOMMENDED PLAN CONDITION

FEBRUARY 2003	K140-00-00	EXHIBIT: F11-1



LEGEND

- FLOWLINE
- LEFT BANK
- RIGHT BANK
- BRIDGES

WATER SURFACE PROFILES

- 500-YEAR
- 250-YEAR
- 100-YEAR
- 50-YEAR
- 25-YEAR
- 10-YEAR
- 5-YEAR
- 2-YEAR

AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO. 2000-483-356

PILLOT GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
PILLOT GULLY WATER SURFACE PROFILES
RECOMMENDED PLAN CONDITION

FEBRUARY 2003	K140-00-00	EXHIBIT: F11-2

TABLE OF CONTENTS

EXHIBITS

TABLES

DEFINITIONS

Baseline Conditions or Baseline Model - Conditions identified for the watershed from which future planning efforts and the recommended plan will be compared to determine if the study goals and objectives will be met. This condition considers the watershed 100% developed, with new development after 1984 consistent with current HCFCD criteria for on-site storm water detention in the determination of the appropriate baseline hydrologic processes. Further, this condition considers the information identified in the environmental baseline report.

Plan Conditions or Plan Model - The baseline conditions model modified to reflect the land-use conditions and recommended plan elements identified for the recommended regional drainage plan for the watershed.

ELECTRONIC FILES

File Name:	Description
HEC-1 Models:	
K142B-2.ih1	Baseline Conditions 2-year Flows
K142B-5.ih1	Baseline Conditions 5-year Flows
K142B-10.ih1	Baseline Conditions 10-year Flows
K142B-25.ih1	Baseline Conditions 25-year Flows
K142B-50.ih1	Baseline Conditions 50-year Flows
K142B100.ih1	Baseline Conditions 100-year Flows
K142B250.ih1	Baseline Conditions 250-year Flows
K142B500.ih1	Baseline Conditions 500-year Flows
K142R-2.ih1	Recommended Plan 2-year (50%) Flows
K142R-5.ih1	Recommended Plan 5-year (20%) Flows

ELECTRONIC FILES *(continued)*

File Name:	Description
HEC-1 Models:	
K142R-10.ih1	Recommended Plan 10-year (10%) Flows
K142R-25.ih1	Recommended Plan 25-year (4%) Flows
K142R-50.ih1	Recommended Plan 50-year (2%) Flows
K142R100.ih1	Recommended Plan 100-year (1%) Flows
K142R250.ih1	Recommended Plan 250-year (0.4%) Flows
K142R500.ih1	Recommended Plan 500-year (0.2%) Flows
HEC-RAS Models:	
K142.prj	Project File
K142.p07	Baseline Multiprofile Plan
K142.p03	Recommended Multiprofile Plan

1.0 INTRODUCTION

The information presented in this appendix report intends to document the process of developing the recommended regional drainage plan for the Faulkey Gully watershed. The plan elements identified for the recommended plan are presented, along with the recommended funding and implementation strategies identified for the plan. All supporting regional-plan modeling information for the Faulkey Gully watershed is included in this report.

1.1 Project Location

The Faulkey Gully Watershed is located in northwest Harris County and is a subwatershed of the Cypress Creek Watershed. A vicinity map of the watershed is provided on **Exhibit 1** in the main text report.

The Faulkey Gully Watershed includes one main stem (K142-00-00) and minor tributary ditches K142-03-00, K142-05-00, K142-06-00, K140-07-00 and K142-08-00 shown on HCFCD maps. However, only the main stem of Faulkey Gully was studied as part of the Flood Insurance Study for Harris County and is the primary subject of this report. The 12.9-square mile watershed is drained into Cypress Creek through the main stem. As seen in **Exhibit G1** and **Exhibit G2**, the watershed lies to the west of SH 249 and drains in a southeasterly direction under Shaw Road, Spring-Cypress Road, Eldridge Parkway, Louetta Road, Lakewood Forest Drive and Jones Road and then to the mouth at Cypress Creek just upstream of the SH 249 bridge.

1.2 Background Information

HCFCD intends to prepare a storm water management and flood protection plan for nine tributary watersheds located within the Cypress Creek watershed. The Faulkey Gully watershed is one of the nine watersheds. Several studies have been conducted within the Faulkey Gully watershed at varying levels and are identified in Appendix G of the February 2002 *Regional Drainage Plan and Environmental Investigation for Major Tributaries in the Cypress Creek Watershed, Phase I – Hydrologic and Hydraulic Baseline Report.*

The baseline watershed boundary is shown on **Exhibit G1,** with the existing development conditions shown on **Exhibit G2**. The information identified on these exhibits was generated as part of the Phase I study efforts, and was used to assist in identification of the appropriate regional drainage plan for the Faulkey Gully watershed.

An assessment of the environmental baseline conditions of the Faulkey Gully watershed was prepared as part of the Phase II – Environmental Baseline Report study efforts. The information presented in this report was used to help identify the recommended regional drainage plan and appropriate plan elements for the watershed. The upper half of the main stem of Faulkey Gully was identified as having good quality (or medium quality) stream corridor habitat beneficial for wildlife and water quality. Further, scattered wetlands and prairie mounds have been identified in

the upper portions of the watershed. However, some of the wetlands and areas of high quality stream habitat have been replaced or impacted by development since the Environmental Baseline Report was completed. Environmental considerations for the Faulkey Gully watershed are shown on **Exhibit G3**.

1.3 Flood Hazard

Flood hazards along Faulkey Gully for which existing model information was available were identified for the baseline conditions. These flood hazards were identified by modifying the current effective hydrologic models for the watershed to reflect appropriate baseline land-use conditions, with the resulting storm flows incorporated into the appropriate hydraulic model reflecting the current conditions of the channel system. The 1% storm flood profile information resulting from the hydraulic model was used in conjunction with existing digital terrain model produced from LIDAR-obtained ground elevation information to produce a flood-hazard boundary map. The result of this mapping is shown on **Exhibit G8**.

1.4 Summary of Baseline Conditions

The results of the study efforts for identifying the baseline conditions indicate that the 1% storm flood boundary is different from the current effective Federal Emergency Management Agency regulatory flood boundary. This is predictable since updated information about the watershed and its studied streams has been used in the identification of the baseline conditions. The information prepared in the identification of the baseline conditions flood hazards and environmental baseline conditions is suitable for use in identifying the appropriate regional drainage plans.

2.0 REGIONAL DRAINAGE PLAN FORMULATION

The objectives of this Phase III study are to develop Regional Drainage Plans to guide future development of the watershed and to address existing flooding issues. The sections below detail the methodology of the plan formulation steps, the watershed resources and alternate plans developed for the Faulkey Gully watershed.

2.1 Methodology

The formulation of the recommended regional drainage plan used an approach that considered the information prepared as part of the Phase I and Phase II study efforts. Further, information concerning the proposed major roadway thoroughfare alignments was also used to help in the identification of recommended alignments for lateral channels that could serve as outfall drainage for these roadways. A series of public meetings and coordination through advisory committee meetings helped in providing direction for identifying a recommended plan.

Hydrologic and hydraulic models prepared as part of the baseline study effort were modified appropriately to reflect alternate plans for the watershed. Alternate plans were identified and the results measured against each other to determine which alternate represented the best plan for the watershed.

2.2 Watershed Description

The Faulkey Gully watershed as delineated in this study contains 12.9 square miles and has mild southerly overland slopes. Development is concentrated primarily in the lower half of the watershed. A large planned development is being constructed in the middle third of the watershed. There is one main stem (K142-00-00) and one major tributary stream (K140-07-00) as well as other tributary ditches (K142-03-00, K142-05-00, K142-06-00 and K142-08-00) shown on HCFCD maps. As noted earlier however, only the main stem was the subject of the previous studies and is subject to these analyses.

This analysis uses the baseline conditions model subbasins and modifies the hydrologic parameters of each accordingly to reflect alternate plan scenarios. In some instances, the baseline subbasins were further subdivided in order to more accurately model particular plan elements. The subbasins can be described as follows:

- K142A1 – The uppermost subbasin of the watershed (972 acres);
- K142A2 – Downstream of K142A1 and upstream of Shaw Road (822 acres);
- K142B – The north-central portion of the watershed (834 acres);
- K142C – The northeastern portion of the watershed (683 acres);
- K142D – The eastern portion of the watershed drained by K142-07-00 (882 acres);

- K142E – The central portion of the watershed (355 acres);
- K142F – The area upstream of Spring-Cypress Road and the confluence of Tributary K142-07-00 (476 acres); and,
- K142G – The area between Spring-Cypress Road and the mouth (3216 acres).

Faulkey Gully discharges into Cypress Creek (HCFCD Unit K100-00-00) between Jones Road and F.M. 249. **Exhibit G2** shows Faulkey Gully Watershed subareas with location and station of each routing node along with sub-basin names. **Exhibit G5** shows the difference in watershed delineation between the baseline report and this report.

The topography of the basin is very flat, especially in the upper half of the watershed. The lower half of the watershed has some limited slope, especially near the mouth where Faulkey Gully empties into Cypress Creek. The main stem has been rectified from the mouth to approximately 3500 feet upstream of Spring-Cypress Road as part of development projects and drainage improvements.

2.3 Basin Resource Inventory

Information was obtained for the watershed concerning existing and planned land use, structure values, environmental resources, etc. This information was used to help identify the value of the resources within the watershed and how best they should be considered in the overall planning efforts.

2.3.1 Stream Habitat Quality

The Environmental Baseline Report (EBR) qualitatively established stream habitat quality rankings based upon characteristics of the stream channel such as channelization, vegetation, and urban density. The ranking system is shown in the EBR and was based solely on color infrared aerial photos and local knowledge of the streams. The stream quality designations are shown on **Exhibit G3**. The goal of the regional drainage planning effort was to attempt to preserve areas of high stream quality in order to enhance the environmental benefits of the plan.

Areas of high quality stream habitat were identified within the Faulkey Gully watershed, especially in the upper reaches of the main stem. Approximately 7 percent of the Faulkey Gully main stem was identified as having high stream quality and about 49 percent as having medium stream quality. These areas exist in the upper half of the watershed, above Spring-Cypress Road, where most of the channel exists in a more natural condition. The lower reach, south of Spring-Cypress Road has been completely rectified to the mouth and serves a nearly completely developed portion of the watershed.

2.3.2 Land Uses in the Watershed

Exhibit G2 illustrates land uses within the watershed. Approximately 40 percent of the total watershed is developed with the development almost exclusively in the lower half of the watershed along the main channel and tributary ditches. A planned development (NorthPointe) is being developed on approximately 1900 acres within the middle third of the watershed. There is scattered low-density development in the upper portions of the watershed. Limited commercial development exists along the eastern boundary of the watershed, bordering State Highway 249, and along the other major thoroughfares in the watershed. Livestock production and local agriculture remains in isolated portions of the very upper watershed, west of Telge Road.

2.3.3 Structure Inventory

An inventory of structures that might be affected by flooding along the main stem was performed. The purpose of the inventory was to identify and estimate the economic value or benefit if the structures were either removed or protected from flooding by the regional plans. In the Faulkey Gully watershed, few structures were identified that might be affected by flooding from the main stem and tributaries. These structures were all located in the upper reaches of the watershed. The general location of these structures is shown on **Exhibit G4**. In order to estimate the value of these structures, a search of the Harris County Appraisal District (HCAD) records was performed using a GIS file supplied by HCFCD. Twelve parcels with structures were identified as having a possible risk of flooding in baseline conditions. The total structure (improvements) value of these three parcels was estimated by HCAD to be approximately $1,637,000.

In order to determine whether these structures were at risk, an examination of available Lambert Maps (2-foot contour maps with finish floor elevations identified for some structures near the floodplain) was performed. The maps were provided by HCFCD. Several of the structures were shown on the maps with finish floor elevations noted. The majority of the structures were not shown on the Lambert Maps, meaning that they had likely been constructed after the maps were created. Visual field surveys were performed to see whether the structures appeared to be raised above natural ground level. All structures that could be identified were noted as newer structures and were constructed above natural ground elevations. By eliminating these structures that either were identified on the Lambert Maps as above the base flood elevation or showed by field visits to be above natural ground, the number of structures estimated to be at risk from flooding was five, with a total structure value of approximately $284,300. These structures should be assumed to be in some risk of flooding in the baseline condition.

2.3.4 Economic Factors for the Watershed

The Faulkey Gully watershed is typical of many of the Cypress Creek tributary watersheds in that it is in a state of development. Much of the middle third of the watershed has been planned for development as noted above. Much of the development that is planned will be built along the main stem of Faulkey Gully and along tributary ditches, especially K142-07-00. Land values in the watershed are rising due to this development pressure, especially in areas where outfall for drainage is present, along the main stem and the tributary ditches. As noted above, there are few structures currently located in flood-prone areas and current development regulations are written to ensure that new structures are not placed in areas without adequate flood protection. Therefore, significant structural damage prevention is not an economic factor within the Faulkey Gully watershed.

2.4 Problems and Opportunities Identification

The flood hazard information identified in the Phase I study efforts was used to determine the areas within the watershed most susceptible to out-of-bank flooding. Additionally, opportunities for enhancement of the watershed through the reduction of existing flooding and preservation of environmental features in the design of the regional plans were identified.

2.4.1 Economic Flood Damage Analysis

Since only a few structures were identified in areas that may be subject to flooding, no formal economic analysis of flood damage was performed. The structures noted above total approximately $284,300. If approximately 50% of the value of the structure is added for the contents, the total economic benefit from any flood reduction planning in the area would be approximately $426,500, assuming the structures and their contents would be completely lost in flooding.

2.4.2 Identification of Flood-Prone Areas

As shown on the floodplain map, **Exhibit G8**, the baseline condition modeling identified areas along the upper reach of the main stem of Faulkey Gully upstream of Spring-Cypress Road as subject to out-of-banks flooding. A portion of this area upstream of Spring-Cypress Road has been recently improved as part of the NorthPointe planned development and is no longer subject to out-of-bank flooding. The remainder of the main stem of Faulkey Gully upstream of this area is subject to flooding and includes the structures noted above. The lower reach of Faulkey Gully, downstream of Spring Cypress Road appears to have adequate protection against out-of-bank flooding.

There are additional areas that are subject to flooding due to poor surface drainage and/or blocked or poorly maintained outfall ditches. Some areas of the Lakewood Forest subdivision

served by a tributary ditch to Faulkey Gully have experienced flooding in the past due to these circumstances. Residents from these areas have been present at public meetings for this project and have informed study personnel regarding their problems. Although this type of flooding is not specifically addressed in the watershed study since it is not directly related to out-of-bank channel flooding along the studied portion of the gully, it should be noted as an area that should be monitored in the future.

2.4.3 Summary of Public Comments Received

Three public meetings have been held to discuss this project, and public comment on existing drainage problems, plan alternates, and the recommended plan have been solicited. A summary of public comments received regarding the Faulkey Gully watershed is shown below.

First Public Meeting (August 2001)
Two comments were received from residents of the Faulkey Gully watershed. One of the comments involved the resident's wish for more buyouts in the watershed. The second comment is noted above and dealt with a resident's concerns about poor maintenance on their outfall ditch and the opinion that their home had flooded during Tropical Storm Alison as a result of this problem.

Second Public Meeting (October 2002)
No comments received for Faulkey Gully watershed.

Third Public Meeting (April 2003)
One comment was received indicating that more details about the plan would be beneficial to the understanding of the plan benefits.

2.4.4 Summary of Repetitive Flood Loss Data

Data on structures that have experienced repetitive flood losses was collected for Harris County and the HCFCD. This data includes FEMA-related flood damage claims and does not include minor flooding that may have occurred throughout the watershed. Approximately 3000 properties are listed in the database of information obtained. Of the properties listed in the database, four were located in the Faulkey Gully watershed. The approximate locations of these structures are shown on **Exhibit G4**. Although information as to the cause of the repetitive damage is not included with the available information, the four properties are all located near an old lateral channel of the main stem that was apparently filled as part of the development and are likely still located in a lower area somewhat more prone to flooding.

2.4.5 Opportunities for Watershed Enhancement

There are several areas available within the watershed that may be beneficial to preserve and to enhance in order to benefit the community. As noted above, there are areas of high (and medium) stream habitat quality, especially in the upper reach of Faulkey Gully, that can be preserved to enhance the environmental quality of the watershed. There are also large open areas near the main channel along the upper reaches that may be available for dual-use facilities such as parks and sports fields that also serve as detention facilities. There also may be opportunities to work with the developer of the NorthPointe master planned community to preserve areas along proposed drainage rights-of-way. Areas of potential wetlands also exist in the upper watershed and could be preserved or enhanced. Finally, the Harris County Parks Master Plan includes a planned bikeway area in the lower reach of the watershed.

2.4.6 Identification of Major Thoroughfare Outfalls

Exhibit G1 and **Exhibit G3** show the major roads and proposed major roads through the watershed. Of major roads shown, the future Northpointe Road and Shaw Road cross Faulkey Gully in the upper reaches of the watershed. Spring-Cypress Road, Eldridge Parkway, Louetta Road, Lakewood Forest Drive and Jones Road all cross the main channel of Faulkey Gully in the lower reach. Eldridge and Louetta Roads (and Lakewood Forest Drive) are at desired service levels and have no current plans to be improved in the near future. Spring-Cypress Road will be expanded in the future and will likely require additional area at the outfall for a water quality basin. The proposed NorthPoint Road will require bridge structures over proposed lateral channels, as described later in this report, and over the main channel of Faulkey Gully, upstream of Shaw Road. Shaw Road is not currently slated for improvements but has a low clearance over the main channel and so may be improved in the future.

2.4.7 Storm Water Quality Issues

As part of new regulations enacted by Harris County in October 2001, all new developments that outfall into Faulkey Gully will be required to provide storm water quality protection for their outfall drainage. This includes roadway projects, subdivisions and other development of 5 acres or more. The regional plans evaluated as part of this project are planned to provide general water quality benefits, as will be discussed later, but do not specifically address individual developments or roadway projects. Additional storm water quality features will have to be designed for these projects, including the roadway projects mentioned above, in order to comply with the effective regulations.

2.5 Alternate Drainage Plan Formulation

A series of alternate drainage plans were identified for the watershed. Each plan was prepared in consideration of the goals and objectives identified early on for the study effort. As mentioned above, the alternate plans were developed by considering channelization alternates, detention alternates, and non-structural or "no-action" alternates.

As mentioned in Section 2.2, the baseline subbasins were further subdivided in order to more accurately model particular plan elements. The additional subdivision created a model slightly different than the one included in the Phase I report. The addition of subareas to the model caused peak flows to increase slightly in the baseline models used in this study. **Table G2** of this report presents the updated watershed parameters resulting from this modification of subareas. The peak flows resulting from this subdivision are identified in the following sections describing the plan alternates.

The models used to simulate the plan alternatives are based on the revised modeling efforts that define an updated baseline condition. For the simulation of the Faulkey Gully watershed, the watershed parameters did not change and are the same as that identified in **Table G2**. Additional storage volume resulting from alternative plan features were incorporated into the models, and the peak flow values along appropriate reaches were determined.

Each of the alternate plans presented below are combinations of these elements. Although the alternates differ somewhat in their features, there are common elements to all the plans presented in this study.

2.5.1 Common Features to Alternate Plans

In keeping with the goals of the program, outfall depth and existing flood protection were emphasized in each of the plans. Emphasis was also placed on preserving areas of high-quality stream habitat where possible. Where new channels (or channel extensions) have been recommended, the channel design is based on a wide section that has flat side slopes and benches for vegetation. This type of section (illustrated in **Figure 1**) provides more opportunities for multiple uses and is less susceptible to erosion. The channel modification locations and number of channels provided for future outfalls were not changed between alternates, since they were necessary to provide outfall depth. The current regulations requiring storm water detention to serve new development are assumed to remain in place for this analysis, unless otherwise noted. The plans described below provide benefits in addition to the on-site requirements. **Exhibit G6** shows the locations of all features for the watershed, including those common to the alternate plans.

2.5.2 Alternate 1 Features and Benefits

Alternate 1 features are shown on **Exhibit G6**. Alternate 1 includes two areas of high- and medium-quality stream habitat protection in the upper half of the watershed and four new lateral channels to serve the upper portion of the watershed. The new channels provide additional volume as well as outfall depth for developments that may be constructed further from the main channel. The channels designated K142#C1 and K142#C2 are currently planned as part of the NorthPointe development. This plan expands those channels from the typical 140-foot wide right-of-way to the wider section as noted above. Channels K142#C3 and K142#C4 are new lateral channels.

The table below shows the peak flows at each hydrologic computational node in the baseline and alternate condition.

Alternate 1 Benefits (100-Year Flows)				
Node	**Location**	**Baseline Flow (cfs)***	**Alt Flow (cfs)**	**Benefit (cfs)**
K142A1	Outlet of Subarea K142A1	1048	983	-65
FG-1	3000' Downstream of Shaw Rd.	2138	2026	-112
FG-2	At Confluence with K142-07-00	3751	3603	-148
FG-3	At Spring-Cypress Road	4086	3900	-186
K100#13	Mouth of Faulkey Gully	6964	6614	-350

* The flow from the baseline model with subbasins revised as noted in Part 2.2 of this report.

The alternate as noted has the effect of reducing baseline peak flows at the mouth by approximately 5 percent. In addition to having some benefit for the Faulkey Gully watershed, the plan will also reduce baseline flows entering Cypress Creek. However, the shallow depth of the channel upstream of Spring-Cypress Road and the resulting shallow depth of the proposed lateral channels (less than 6 feet in some cases) will not allow sufficient outfall depth from planned development without significant effort. Additionally, the existing areas of out-of-bank flooding are only marginally reduced in this alternate.

2.5.3 Alternate 2 Features and Benefits

Alternate 2 features are shown on **Exhibit G6**. Alternate 2 replaces the areas of stream habitat quality protection noted above with a modified channel section that is deepened to allow for outfall depth. This channel ranges in depth from approximately 15 feet to 9 feet. Since the channel will be modified to allow for vegetative and tree plantings, it will likely replace some of the good quality stream habitat that is disturbed by the project. The additional lateral channels remain per Alternate 1. The difference between the two alternates is the replacement of the stream corridor element with the channel modification element.

The table below shows the peak flows at each hydrologic computational node in the baseline and alternate condition.

Alternate 2 Benefits (100-Year Flows)				
Node	**Location**	**Baseline Flow (cfs)***	**Alt Flow (cfs)**	**Benefit (cfs)**
K142A1	Outlet of Subarea K142A1	1048	947	-101
FG-1	3000' Downstream of Shaw Rd.	2138	2253	+183
FG-2	At Confluence with K142-07-00	3751	3898	+147
FG-3	At Spring-Cypress Road	4086	4253	+167
K100#13	Mouth of Faulkey Gully	6964	6950	-14

* The flow from the baseline model with subbasins revised as noted in Part 2.2 of this report.

The combined effect of less volume due to the channel modification and the additional volume provided by the new lateral channels has the effect of offsetting the peak flows in the watershed. The peaks along the area of channel modification are higher, due to the shallower flow in the channel. However, the potential exists in the modified channel sections to accommodate flows from adjacent development as a trade-off for the possibility of requiring additional right-of-way or to construct control structures that take advantage of the deeper channel and provide additional volume. Although there are slight hydrologic benefits at the mouth, the main benefit to the Faulkey Gully watershed from this alternate is that flows upstream of Spring-Cypress Road remain within banks.

2.5.4 Alternate 3 Features and Benefit

Alternate 3 features are shown on **Exhibit G6**. Alternate 3 includes the same areas of channel modification and the proposed new lateral channels as described earlier. This plan provides additional storage in the upper watershed by adding a proposed detention basin to an area downstream of Shaw Road. The detention basin provides approximately 133 acre-feet of detention volume. The difference between Alternates 2 and 3 is the addition of the proposed detention basin. This basin is also located in an area where nearby environmental features can be preserved. There are areas of natural prairie and potential wetlands located nearby that could be incorporated the plan for the basin.

The table below shows the peak flows at each hydrologic computational node in the baseline and alternate condition. The combination of detention and the additional volume provided by the new channels has the effect of slightly lowering baseline flows at the mouth and decreasing baseline flows upstream of the mouth by a greater margin. Again, flows above Spring-Cypress Road are also kept within banks, with the potential of additional storage as mentioned earlier. In addition to benefiting the Faulkey Gully watershed, the plan will also reduce baseline flows entering Cypress Creek.

Alternate 3 Benefits (100-Year Flows)				
Node	**Location**	**Baseline Flow (cfs)***	**Alt Flow (cfs)**	**Benefit (cfs)**
K142A1	Outlet of Subarea K142A1	1048	947	-101
FG-1	3000' Downstream of Shaw Rd.	2138	1863	-275
FG-2	At Confluence with K142-07-00	3751	3526	-225
FG-3	At Spring-Cypress Road	4086	3906	-180
K100#13	Mouth of Faulkey Gully	6964	6842	-122

* The flow from the baseline model with subbasins revised as noted in Part 2.2 of this report.

2.5.5 Alternate 4 Features and Benefits

Alternate 4 features are shown on **Exhibit G6**. Alternate 4 includes the same areas of channel modification and the proposed new lateral channels as described earlier. Additionally, this plan provides additional storage through the use of a second detention basin upstream of Shaw Road. The combined facilities provide approximately 390 acre-feet of detention volume. The area of the second basin also provides the opportunity for environmental enhancement. A potentially large area of natural prairie and wetlands is located near the proposed basin and could be protected or enhanced with this project.

The table below shows the peak flows at each hydrologic computational node in the baseline and alternate condition.

Alternate 4 Benefits (100-Year Flows)				
Node	**Location**	**Baseline Flow (cfs)***	**Alt Flow (cfs)**	**Benefit (cfs)**
K142A1	Outlet of Subarea K142A1	1048	705	-343
FG-1	3000' Downstream of Shaw Rd.	2138	1676	-462
FG-2	At Confluence with K142-07-00	3751	3348	-403
FG-3	At Spring-Cypress Road	4086	3737	-349
K100#13	Mouth of Faulkey Gully	6964	6743	-221

* The flow from the baseline model with subbasins revised as noted in Part 2.2 of this report.

The combination of additional detention and the volume provided by the new channels has the effect of lowering baseline flows at the mouth, decreasing baseline flows upstream of the mouth by greater margin, keeping these flows within the banks of the modified channel and providing the potential for additional storage along the channel modification sections.

2.5.6 Public Input on Alternate Plans

On October 8, 2002, a public meeting was held to describe the progress of the project and to inform the public regarding the alternate plans being proposed for the watershed. As noted above, no public comments regarding the Faulkey Gully alternates were received as a result of the meeting. This lack of comments on Faulkey Gully likely relates to the fact that there are not significant flooding concerns within the watershed.

2.5.7 Screening of Alternates

The following criteria matrix was used when evaluating the alternative plans identified for each watershed. The ability of the plan alternative to meet each criteria was ranked from 0 to 10, with 0 indicating that the criteria is not met, and 10 indicating that the criteria is met to the best of its ability. Relative weights were then set for each of the criteria as shown below based on the stated goals of the study.

Table G1 - Screening Matrix for Faulkey Gully

Criteria	Weight	Plan			
		ALT 1	ALT 2	ALT 3	ALT 4
Minimal Construction Cost	0.2	8	6	4	3
Provides Aesthetics	0.5	8	6	8	8
Ease of Implementation	0.8	7	6	6	4
Flood Protection within Tributary Watershed	1	1	10	10	10
Ability to Accommodate Multiple Uses	0.5	5	5	6	7
Preserves/Enhances Water Quality	0.8	5	5	8	8
Preserves/Enhances Stream Habitat Quality	0.5	10	5	5	5
Ease of Maintenance	0.8	5	9	8	7
Reduction of Peak Flows into Cypress Creek	1	7	1	2	3
Outfalls for Future Roadways/Development	0.8	1	10	10	10
Acceptable to the Public	0.8	10	10	10	10
TOTAL	-----	**67**	**73**	**77**	**75**
WEIGHTED TOTAL	**77**	**43.5**	**52.2**	**55.9**	**54.8**

As shown, the alternates with the channel modification meet the minimum criteria with the only differences being the addition of more multiple-use possibilities, flood protection benefits, and more benefit to Cypress Creek as the amount of detention volume is increased. Of the alternates, Alternate 3 appears to be the best fit for the goals of this study.

2.6 Recommended Plan and Identification of Elements

Based on the criteria noted above, a plan was recommended that met the needs of the watershed as noted in this report. The recommended plan is described in detail below.

2.6.1 Determination of Recommended Plan

Alternate 3 was chosen as the recommended plan due to the fact that it addressed all the criteria of the study and was deemed to be effective at reducing flows throughout the watershed, provide sufficient outfall depth and opportunities for implementation and was less

costly and easier to implement than Alternate 4. The remaining alternates also provide benefits to portions of the watershed, but typically not throughout the entire watershed.

2.6.2 Recommended Plan Features

The recommended plan consists of features that preserve areas of good quality stream habitat, provide outfall drainage for future development and addresses out-of-bank flooding in the upstream portion of the watershed. The features of the plan, beginning at the mouth, consist of the following elements. The first approximately 17,000 feet of the main channel will not be addressed with an element of the plan. This reach of the channel has been rectified and does not experience any significant out-of-bank flooding in the baseline 100-year condition.

Upstream of Spring-Cypress Road and running to Shaw Road, a large portion of the channel runs through the proposed NorthPointe development and is planned for future improvements as part of the development. Some portions of the work have already been completed as a result of an earlier section of development. The plan element proposed for this section is to modify the channel upstream of Spring-Cypress Road. The channel modification will consist of an approximately 15-foot deep section similar to that shown in **Figure 1**. The section will require a right-of-way width of approximately 300 feet to construct, approximately 100 feet wider than that currently proposed in the development plan. The developers will need to coordinate this different channel design into their overall drainage plan. Although this section will replace an area of good quality stream habitat, it was previously planned to be developed. The use of a stream section as outlined in this report will provide a better quality habitat replacement than a standard trapezoidal section. The channel modification will also provide additional storage for the watershed and opportunities for the developer to take advantage of this additional storage as a trade-off for providing the additional right-of-way.

From the confluence of K142-07-00 to Shaw Road, the channel modification will consist of a section approximately 12 feet deep. This will require a right-of-way width of approximately 260 feet. Upstream of Shaw Road to the limit of the definable channel at Telge Road, the channel modification will continue with a section approximately 9 feet deep. This will require the replacement of the Shaw Road bridge as part of this project. The required right-of-way width for this section is approximately 240 feet.

At the upstream end of the NorthPointe development, two channels are proposed by the developer for internal (and a limited amount of external) drainage. These channels, designated K142#C1 and K142#C2 are currently identified as trapezoidal sections in the development plan. The recommended plan implements these channels as a terraced section with a nominal 40-foot bottom width and side slopes that vary from 4:1 to 10:1 (H:V). A typical section of this channel is shown in **Figure 1**. This somewhat wider section should serve the development as well as the offsite drainage in a way similar to what is currently proposed, but

will also provide additional volume and require less maintenance as noted earlier. The total right-of-way width estimated for the channels is approximately 240 feet, assuming a nominal channel depth of 9 feet. A slightly wider right-of-way section may be required, depending on the drainage outfall depth necessary for the development.

The proposed detention facility, K142#B1 is located just upstream of the two channels, between Shaw Road and the NorthPointe development, south of the main channel. The basin is assumed to provide approximately 130 acre-feet of storage for the watershed, siphoning off peak flows from the main stem of Faulkey Gully. As noted above, there are possibilities to enhance nearby natural resources with the basin plan.

Upstream of the detention facility, a proposed tributary channel, K142#C3 is located to provide outfall for future development in the upper portions of the watershed. The channel section will be similar to the channels described above. The right-of-way width necessary for this channel is approximately 220 feet, assuming a nominal 8-foot depth. Another tributary channel, K142#C4 lies the furthest upstream and will provide outfall depth for future development in the upper watershed. The right-of-way width for this channel is 220 feet, assuming a nominal 8-foot depth.

2.6.3 Recommended Plan Benefits

Taken together, these elements make up the recommended plan for Faulkey Gully and satisfy the criteria for this study while providing quantifiable benefits to the watershed. Some recreational elements will be necessary to add to the plan features to fully meet the desired goal for multiple-use facilities. The nature of the plan elements will make a recreational feature such as a continuous trail system along the entire watershed infeasible. However, a trail in the upper reach of Faulkey Gully is feasible, would offer benefits for recreation, and would be accessible. Additionally, developments served by the proposed channel extensions would be encouraged to construct trails along these extensions as a recreational amenity for the development. It may even be feasible to connect the trail system to the proposed Harris County Parks Master Plan bikeway trail that is currently shown in the lower portion of the watershed and noted on **Exhibit G6** and **Exhibit G7**.

Additionally, as noted earlier, areas of potential wetlands exists in the vicinity of both proposed detention facilities. If these basins are designed to preserve or enhance these features, additional environmental benefits will result from the recommended plan.

Hydrologic benefits due to the plan elements were summarized earlier in the alternate plan formulation section of this report and are highlighted in **Table G3** at the end of this report section.

The plan reduces baseline peak flows along the main stem and into Cypress Creek. Additionally, water surface elevations are lowered in conjunction with the lower flows. As shown in **Table G5**, the 100-year water surface elevations decrease along Faulkey Gully by as much as about 6 feet and reduces the majority of the out-of-bank flooding areas to the extents of the proposed wider channel sections. This reduction in elevation is somewhat misleading however, because the channel modification has been designed to offer additional volume or capacity, depending upon the decisions made during implementation of the project.

Finally, the plan provides environmental benefits by preserving some naturally flood-prone areas and wetlands, as noted above.

Table G2: Watershed Physical Characteristics (Baseline & Recommended Plan Conditions)

Subarea Name	Drainage Area		Watershed Length	Length to Centroid	Channel Slope	Overland Slope	Urban Dev. *	Watershed Dev. *	Channel Imp.	Channel Conv.	Ponding
	(Acre)	(Sq.Mi)	(mi)	(mi)	(ft/mi)	(ft/mi)	(%)	(%)	(%)	(%)	(%)
K142A1	972	1.52	1.90	1.30	6.38	<20	6.0	1.80	0	100	0
K142A2	822	1.28	2.07	0.92	7.59	<20	12.7	3.81	0	100	0
K142B	834	1.30	2.26	1.22	8.20	<20	11.0	3.30	0	100	0
K142C	683	1.07	1.61	0.64	6.10	<20	7.0	2.10	0	100	0
K142D	882	1.38	2.64	1.12	7.50	<20	12.0	73.60	100	100	0
K142E	355	0.55	1.02	0.53	8.30	<20	0.0	0	0	100	0
K142F	476	0.74	1.31	0.22	11.50	<20	5.0	1.50	0	100	0
K142G	3216	5.03	3.59	1.97	6.90	<20	53.0	85.90	100	100	0

* % based on development in place prior to implementation of HCFCD on-site detention policy (1984)

Baseline & Recommended Plan Conditions

Subarea Name	TC	R	RTIMP
	(hrs)	(hrs)	(%)
K142A1	1.20	4.73	35.0
K142A2	0.75	5.17	35.0
K142B	0.98	5.16	35.0
K142C	0.58	4.78	35.0
K142D	0.52	6.55	35.0
K142E	0.41	3.07	35.0
K142F	0.13	3.57	35.0
K142G	0.85	3.38	43.6

Table G3: 100-Year Flow Comparison Table (Baseline vs. Recommended Plan)

HEC-1 Analysis Point	Baseline Condition (cfs)	Recommended Condition (cfs)*	Baseline vs. Recommended Plan	
			Difference (cfs)	% Change
FG-1	2298	2002	-296	-12.9
FG-2	3900	3666	-234	-6.0
FG-3	4213	4027	-186	-4.4
K100#13	6989	6867	-122	-1.7

* The flow from the recommended plan model prorated as identified in part 2.6.3 of this report.