Table C3: 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
K12402#1	2073	2073	0	--
K12402#2	2445	2445	0	--
K124A	1784	1614	-170	-10
K124#1	2278	1901	-377	-16
K124#2US	2933	2456	-477	-16
K124#2DS	5234	4842	-392	-7
K124#3	5989	5569	-420	-7
K124#4	6448	5433	-1015	-16

Table C4: 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)
K12402#1	746	1124	1377	1625	1844	2073	2376	2599
K12402#2	937	1428	1729	1973	2199	2445	2788	3049
K124A	588	881	1076	1269	1436	1614	1845	2017
K124#1	694	1042	1270	1496	1692	1901	2162	2358
K124#2US	889	1339	1636	1934	2184	2456	2797	3048
K124#2DS	1813	2745	3355	3883	4346	4842	5510	6026
K124#3	2136	3182	3898	4507	4999	5569	6328	6912
K124#4A	2325	3466	4221	4878	5407	6027	6839	7462
K124#4	2325	3466	4145	4653	5022	5433	5953	6349

Table C5: Comparison of Water Surface Elevations (100-Year)
Seals Gully (K124-00-00)

Station	Location	Baseline Condition		Recommended Plan		Difference
		Flow	WSEL	Flow	WSEL	(ft)
1850		6448	93.34	5433	92.62	0.72
2850		6448	95.23	5433	94.52	0.71
2900		6203	95.47	6027	94.72	0.75
2950		6203	95.55	6027	94.82	0.73
3000		6203	95.60	6027	94.88	0.72
3051		6203	95.62	6027	94.90	0.72
3061		6203	95.60	6027	94.89	0.71
3101	Cypresswood Drive Bridge					
3141		6203	95.65	6027	94.94	0.71
3150		6203	95.66	6027	94.94	0.72
3200		6203	95.67	6027	94.95	0.72
3250		6203	95.65	6027	94.93	0.72
3300		6203	95.63	6027	94.90	0.73
3350		6203	95.64	6027	94.91	0.73
3400		6203	95.45	6027	94.64	0.81
5440		6203	100.36	6027	100.32	0.04
8410		5989	104.65	5569	104.48	0.17
8419		5490	104.74	5088	104.57	0.17
8435	Candle Creek Bridge					
8451		5490	104.93	5088	104.75	0.18
8460		5490	104.94	5088	104.76	0.18
8588		5490	104.83	5088	104.68	0.15
8640		5490	104.85	5088	104.70	0.15
8740		5490	105.16	5088	104.98	0.18
8790		5490	105.28	5088	105.08	0.20
8838		5490	105.25	5088	105.05	0.20
8844		5490	104.90	5088	104.75	0.15
8861	Mirror Lake Bridge					
8878		5490	105.93	5088	105.76	0.17
8891		5490	106.73	5088	106.47	0.26
8915		5413	106.71	5014	106.45	0.26
9055		5413	106.70	5014	106.45	0.25
9250		5413	106.75	5014	106.49	0.26
9570		5413	106.80	5014	106.53	0.27
9595		5413	106.82	5014	106.55	0.27
9600		5413	106.82	5014	106.55	0.27
9601	Transition Structure	5413	106.60	5014	106.34	0.26

Table C5: Comparison of Water Surface Elevations (100-Year)
Seals Gully (K124-00-00) *(continued)*

Station	Location	Baseline Condition		Recommended Plan		Difference
		Flow	WSEL	Flow	WSEL	(ft)
9606		5413	108.22	5014	107.88	0.34
9650		5413	108.23	5014	107.89	0.34
9900		5413	108.12	5014	107.74	0.38
10040		5413	108.42	5014	108.06	0.36
10670		5234	112.37	4842	112.07	0.30
11014		2933	113.95	2456	113.64	0.31
11365		2933	114.26	2456	113.88	0.38
11374		2765	114.29	2313	113.91	0.38
11390	Louetta Road Bridge					
11406		2765	114.45	2313	114.04	0.41
11415		2765	114.45	2313	114.05	0.40
13045		2765	115.62	2313	115.07	0.55
13735		2565	116.40	2144	115.75	0.65
14415		2565	118.22	2144	117.50	0.72
15105		2413	120.83	2015	120.10	0.73
15305		2413	121.51	2015	120.74	0.77
15705		2413	122.67	2015	121.87	0.80
15975		2278	123.53	1901	122.73	0.80
16024		2278	123.68	1901	122.87	0.81
16035	Wooden Bridge					
16046		2278	123.71	1901	122.90	0.81
16095		2278	123.84	1901	123.03	0.81
16105		2278	123.74	1901	122.95	0.79
16505		2278	124.81	1901	123.98	0.83
16870		2278	125.46	1901	124.61	0.85
16879		2163	125.51	1803	124.65	0.86
16895	Spring-Cypress Road Bridge					
16911		2163	125.86	1803	124.86	1.00
16920		2163	125.87	1803	124.87	1.00
17475		2163	126.40	1803	125.45	0.95
17524		2105	126.53	1755	125.58	0.95
17535	Wooden Bridge					
17546		2105	127.01	1755	125.95	1.06
17595		2105	127.08	1755	126.03	1.05
17650		2105	127.24	1755	125.90	1.34
17970		2105	127.60	1755	126.97	0.63
18019		2105	127.69	1755	127.04	0.65
18030	Wooden Bridge					
18041		2105	128.16	1755	127.35	0.81
18090		2105	128.22	1755	127.41	0.81
18880		2105	129.06	1755	128.27	0.79
19000		1977	129.20	1647	128.41	0.79
19120		1977	129.29	1647	128.52	0.77

Table C5: Comparison of Water Surface Elevations (100-Year)
Seals Gully (K124-00-00) *(continued)*

Station	Location	Baseline Condition		Recommended Plan		Difference
		Flow	WSEL	Flow	WSEL	(ft)
19230		1977	129.38	1647	128.61	0.77
19640		1977	129.66	1647	128.90	0.76
19649		1911	129.68	1591	128.93	0.75
19665	Bridgeview Bridge					
19681		1911	129.80	1591	128.98	0.82
19690		1911	129.81	1591	128.98	0.83
19845		1911	129.95	1591	129.12	0.83
19855		1911	129.95	1591	129.12	0.83
21265		1911	132.72	1591	131.87	0.85
21275		1911	132.63	1591	131.78	0.85
21390		1778	133.03	1478	132.19	0.84
21550		1778	133.15	1478	132.33	0.82
21700		1778	133.38	1478	132.59	0.79
21860		1778	133.61	1478	132.94	0.67
21869		1778	134.07	1478	133.46	0.61
21885	Rhodes Road Bridge					
21901		1778	137.62	1478	135.05	2.57
21910		1778	137.56	1478	135.10	2.46

Table C5: Comparison of Water Surface Elevations (100-Year)
Kothman Gully (K124-02-00)

Station	Location	Baseline Condition		Recommended Plan		Difference
		Flow	WSEL	Flow	WSEL	(ft)
105		2445	108.91	2445	108.91	0.00
521		2445	110.40	2445	110.40	0.00
562	Louetta Road					
604		2445	110.57	2445	110.57	0.00
654		2445	110.62	2445	110.62	0.00
2340		2412	117.76	2412	117.76	0.00
2399		2330	119.00	2330	119.00	0.00
2407	Wooden Bridge					
2415		2330	119.29	2330	119.29	0.00
2464		2330	119.39	2330	119.39	0.00
3619		2330	122.12	2330	122.12	0.00
4895		2330	126.14	2330	126.14	0.00
4995		2211	126.39	2211	126.39	0.00
5004		2211	127.36	2211	127.36	0.00

Table C5: Comparison of Water Surface Elevations (100-Year)
Kothman Gully (K124-02-00) *(continued)*

Station	Location	Baseline Condition		Recommended Plan		Difference
		Flow	WSEL	Flow	WSEL	(ft)
5017	Spring-Cypress Road					
5031		2211	127.58	2211	127.58	0.00
5070		2211	127.97	2211	127.97	0.00
6000		2211	129.13	2211	129.13	0.00
6888		2211	129.96	2211	129.96	0.00
6889		2122	129.98	2122	129.98	0.00
6902		2122	130.02	2122	130.02	0.00
6916		2122	130.04	2122	130.04	0.00
6917		2122	130.04	2122	130.04	0.00
6930		2122	130.06	2122	130.06	0.00
7833		2120	130.46	2120	130.46	0.00
7883		2120	130.46	2120	130.46	0.00
7894		2120	130.01	2120	130.01	0.00
7930	FM 2920					
7967		2120	130.36	2120	130.36	0.00
7980		2120	130.99	2120	130.99	0.00
8030		2120	131.01	2120	131.01	0.00
9000		2073	131.16	2073	131.16	0.00
9612		2073	131.80	2073	131.80	0.00
10000		2073	131.99	2073	131.99	0.00
11183		1454	132.58	1454	132.58	0.00
11194		1454	132.47	1454	132.47	0.00
11212		1454	132.50	1454	132.50	0.00
12000		1454	133.35	1454	133.35	0.00
12894		1014	134.52	1014	134.52	0.00
12900		1014	134.33	1014	134.33	0.00
12924	Green Lake					
12948		1014	134.37	1014	134.35	-0.02
13000		1014	134.66	1014	134.65	-0.01
13340		1014	134.83	1014	134.81	-0.02
13349		797	134.97	797	134.96	-0.01
13432	Spring-Stuebner					
13516		797	134.99	797	135.01	0.02
13535		797	135.13	797	135.14	0.01
13645		797	135.32	797	135.33	0.01
13845		797	136.13	797	136.13	0.00
14145		797	137.69	797	137.69	0.00
14935		689	139.06	689	139.06	0.00

3.0 PLAN IMPLEMENTATION AND MANAGEMENT STRATEGIES

Since the remaining undeveloped portions of the Seals Gully watershed is quickly developing, 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. Several of the elements identified within the recommended plan are to relieve existing flooding, while the channel extensions and new channel elements through these undeveloped areas have been identified 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 one area of medium-quality stream habitat that is to be managed without any structural flood reduction project. The area is from approximately 200 feet upstream of Louetta Road to downstream of Ella Boulevard. This is a total distance of 2600 feet. This channel area of Seals Gully has good natural stream habitat corridor that is beneficial to maintain in its existing condition. This section also has the capacity to contain less frequent storm events without inundating nearby structures.

The area contained within this corridor consists of varying existing right-of-way widths. The right-of-way width ranges from 100 feet up to 200 feet. Additional right-of-way will be required to encompass the floodplain within the preservation corridor. The corridor is proposed for a minimum width of 300 feet. 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. 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 alternative 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, easement, or setback. 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. Restrictions would have to be placed on the construction of these facilities so that they did not overly disturb the stream habitat that is to be preserved in the corridors.

3.2 New Lateral Channels/Channel Extensions

There are four channel corridor systems proposed for improvement and extension within the recommended plan. The channel systems include the proposed channel corridors along K124-04-00, K124-05-00, and the new lateral K124#C1. These channels will lie in a 300-foot wide waterway corridor. These corridors will provide conveyance, storage, and additional recreational possibilities to the existing facility. Also proposed is an extension and improvement of the Kothman Gully lateral, K124-02-03. This ditch improvement will serve as outfall to the proposed Ella Boulevard expansion as well as provide drainage for the Northwood subdivision. Several historical flooded structures are documented within this subdivision. Due to the limited amount of available right-of-way along the channel, a more constricted section was considered. A 200-foot wide channel corridor is proposed for this channel. This channel corridor incorporates a channel with a composite, terraced section and allows for multiple uses (see **Figure 1**).

The recommended implementation of the channel corridors 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 proposed right-of-way along the proposed channel corridor alignments. This portion of the right-of-way would be the minimum width (approximately 150 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

The detention facility identified within the recommended plan for the Seals Gully watershed is K124#B1. It should be noted that the recommended plan advocates the use of on-site detention as a requirement of development. The facility K124#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 facility. Implementation of the 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, several major thoroughfares cross the channels in the Seals Gully watershed. Several of these major thoroughfares have been identified for future expansion or extending within the Seals Gully watershed.

Spring-Cypress is a two-lane road that has been identified for future widening as part of the major thoroughfare plan. The roadway currently crosses Seals Gully and Kothman Gully as well as K124-05-00. The existing crossings over Seals and Kothman Gullies will require expansion due to the proposed roadway; however, they currently have capacity to pass the 100-year flows. The culvert crossing of K124-05-00 will need to be replaced as part of the proposed channel corridor along the stream. If the new structure is designed to pass the recommended plan 100-year flows in the tributary channel (approximately 542 cfs) with a minimal (less than 0.5') amount of head losses, an opening of approximately 128 square feet will be necessary. Consideration of the proposed roadway expansion should be given with the design of the proposed structure.

There are several other roadways proposed for expansion within the Seals Gully watershed; these include Kuykendahl Road and Ella Boulevard. However, these roadway expansions will not involve channel crossings, they will only require outfall into the existing channel infrastructure.

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 identified above was not included in the recommended plan cost because the crossings would not be implemented as part of the recommended plan, but as part of the county's transportation plan. However, the bridge replacements identified within the recommended plan have been included within the cost estimates. 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 $19.3 million, with the bulk of the cost in voluntary structural buyout, land acquisition, and excavation costs.

Table C6 – Estimated Recommended Plan Costs for Seals Gully

Description	Unit	Quantity	Unit Cost	Cost
1. Mobilization	Each	6	$10,000	$60,000
2. Clearing & Grubbing	Acre	159	$1,500	$238,350
3. Excavation & Haul	Ac-Ft	690	$5,000	$3,450,000
4a. Bridge Concrete Installation	S.F.	8700	$60	$522,000
4b. Weir Concrete Installation	S.F.	6300	$60	$378,000
5a. Culvert Boxes	L.F.	990	$600	$594,000
5b. Culvert Pipes	L.F.	180	$100	$18,000
5c. Flapgates	Each	2	$9,000	$18,000
6. Drop/Control Structures	L.S.	0	$100,000	$0
7. Backslope Drains	Each	6	$3,000	$18,000
8. Utilities Relocation	Each	0	$100,000	$0
9. Right-of-Way	Acre	159	$15,000	$2,383,500
10. Seeding & Mulching	Acre	159	$1,000	$158,900
11. Tree/Shrub Planting	Acre	18.4	$10,000	$184,000
SUB TOTAL				$8,004,750
Contingencies (15%)				$1,200,713
Engineering and Administration (10%)				$920,546
SUBTOTAL CONSTRUCTION COST				$10,126,009
VOLUNTARY STRUCTURAL BUYOUT				$9,130,000
STREAM HABITAT PRESERVATION CORRRIDOR				$180,000
TOTAL				**$19,436,009**

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 implementing projects that result in flood reduction benefits to existing flood-prone structures. In the Seals Gully watershed this would mean a priority for the K124-02-03 channel section between Kothman Gully and Falvel Road. This would also apply to the detention basin K124#B1. 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 corridors for K124-04-00, K124-05-00, and K124#C1 fit this category. Final priority should be placed on an on-going land acquisition program to purchase right-of-way for floodplain preservation corridor projects and for remaining recommended plan elements. The floodplain preservation corridor between Louetta Road and Ella Boulevard and the voluntary buyouts would fit this category.

The Seals Gully watershed does have current flooding problems near Cypresswood Drive and along K124-02-03. The first priority category of the recommended plan should be implemented

when possible to relieve some of the existing flooding problems. The second and final priority categories can be delayed until there is development pressure on areas slated for improvements. The recommended plan is estimated to take approximately two years to implement. The order of implementation would be to construct the K124-02-03 channel improvements and K124#B1 within the first year of implementation. The proposed detention facility K124#B1 would be constructed as soon as land is acquired. The channel corridors for K124-04-00, K124-05-00, and K124#C1 should be identified and right-of-way secured. These corridors can be constructed 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.

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.

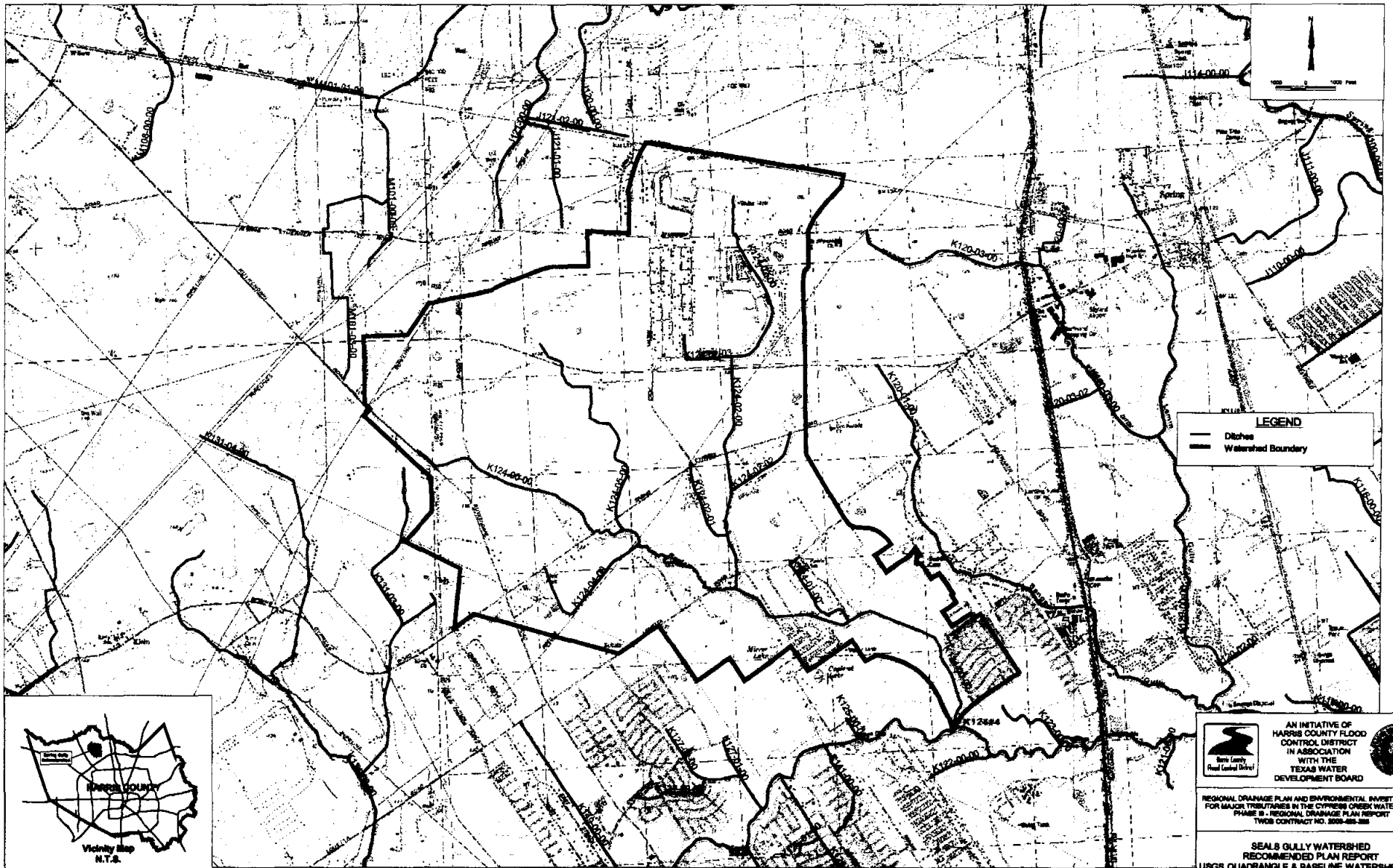
Harris County currently has a Parks & Recreation Masterplan that identifies corridors for proposed bikeway trails. There is a proposed corridor along Seals Gully within the watershed and it may be possible to extend the bikeways from Cypress Creek into desirable portions of the watershed using the funding identified for the bikeway program. The masterplan also identifies areas of desirable land acquisition for future park areas. Seals Gully watershed is located within this area of acquisition.

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, preservation and enhancement of stream habitat and water quality, opportunities for multi-use, 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 to the extent possible and, at a minimum, 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 Seals Gully watershed. It is estimated that, once begun, it would take approximately two years to implement the entire plan, with an average expenditure of $9.3 million per year.

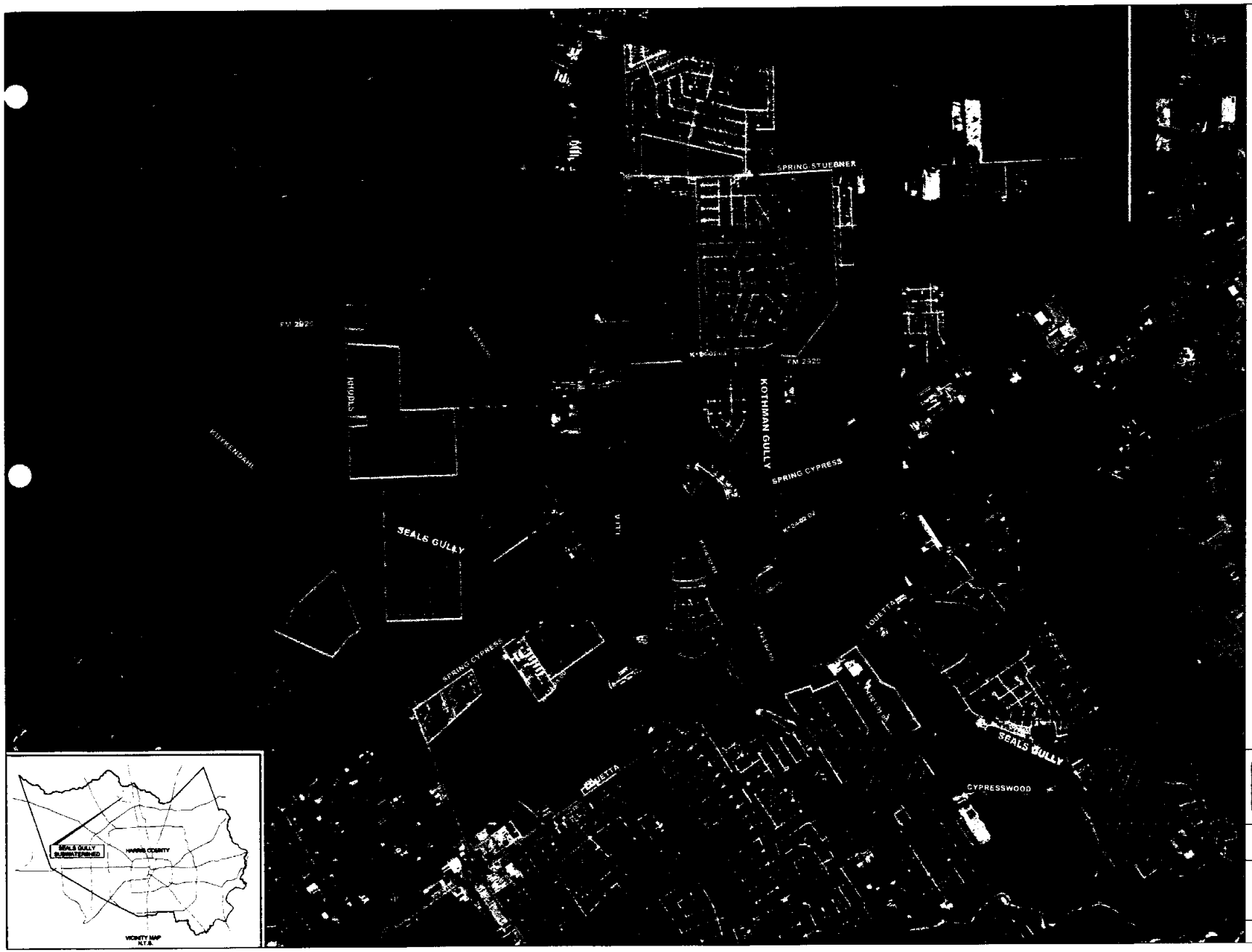


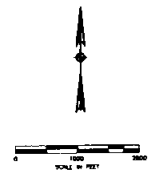
AN INITIATIVE OF
HARRIS COUNTY FLOOD
CONTROL DISTRICT
IN ASSOCIATION
WITH THE
TEXAS WATER
DEVELOPMENT BOARD

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

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

FEBRUARY 2003	K124-00-00	EXHIBIT C1





LEGEND

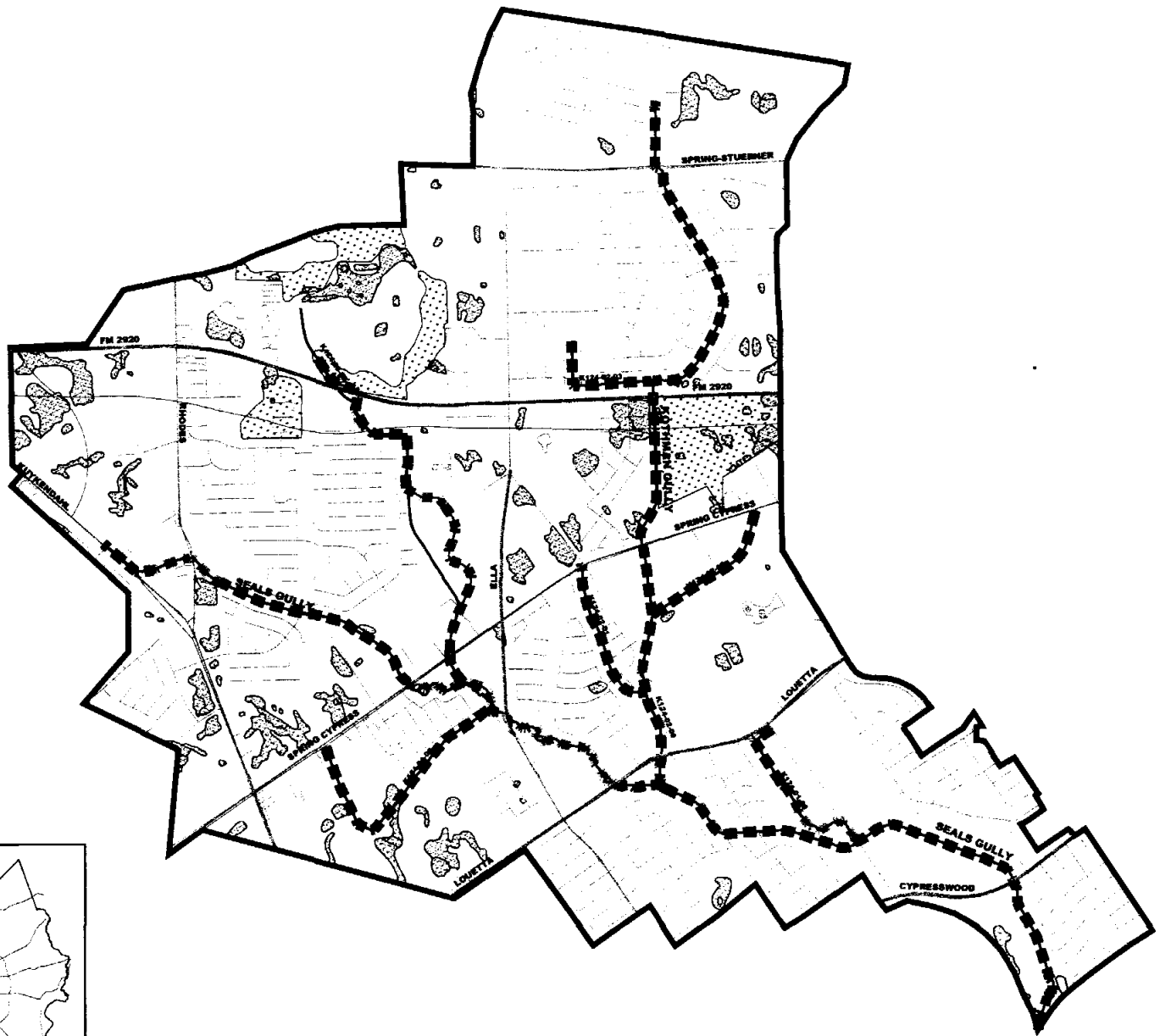
- Street
- Major Road
- Stream
- Watershed Boundary
- Recommended Plan Sub Watershed Boundary
- 1984 Developed Areas
- HCFCD Right-Of-Way
- Hydrologic Nodal Points

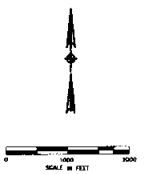
AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

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

SEALS GULLY WATERSHED REGIONAL DRAINAGE PLAN REPORT 1999 AERIAL WATERSHED MAP

FEBRUARY 2003	K124-00-00	EXHIBIT C2



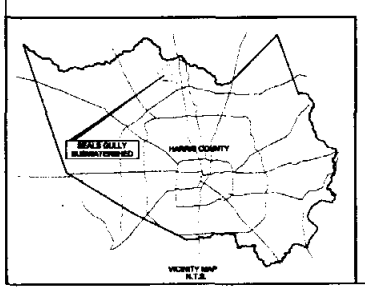


LEGEND

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

STREAM HABITAT QUALITY

- Low
- Medium
- High

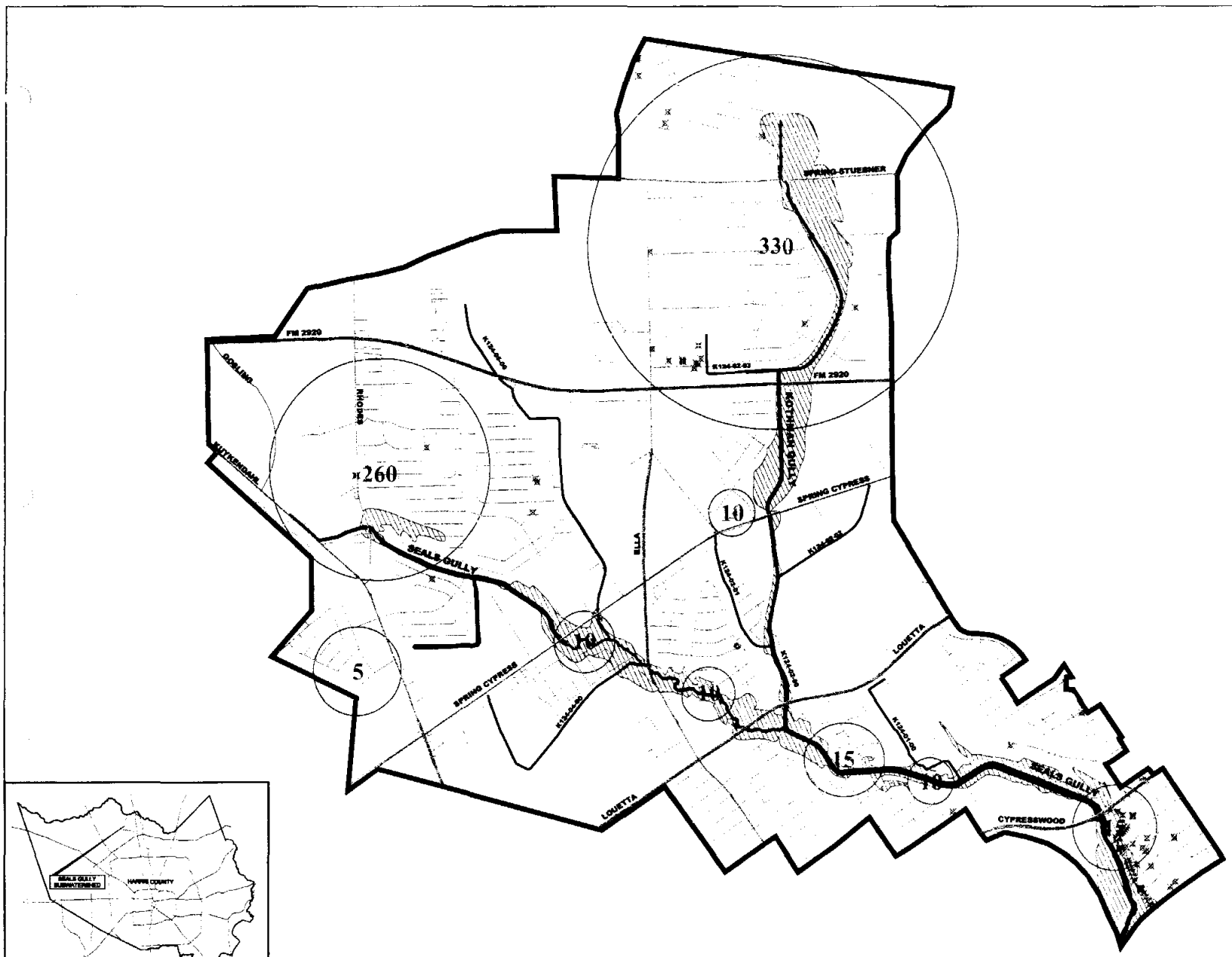


AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

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

SEALS GULLY WATERSHED REGIONAL DRAINAGE PLAN REPORT ENVIRONMENTAL CONSIDERATIONS

FEBRUARY 2003	K124-00-00	EXHIBIT C3



LEGEND

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

Harris County Flood Control District

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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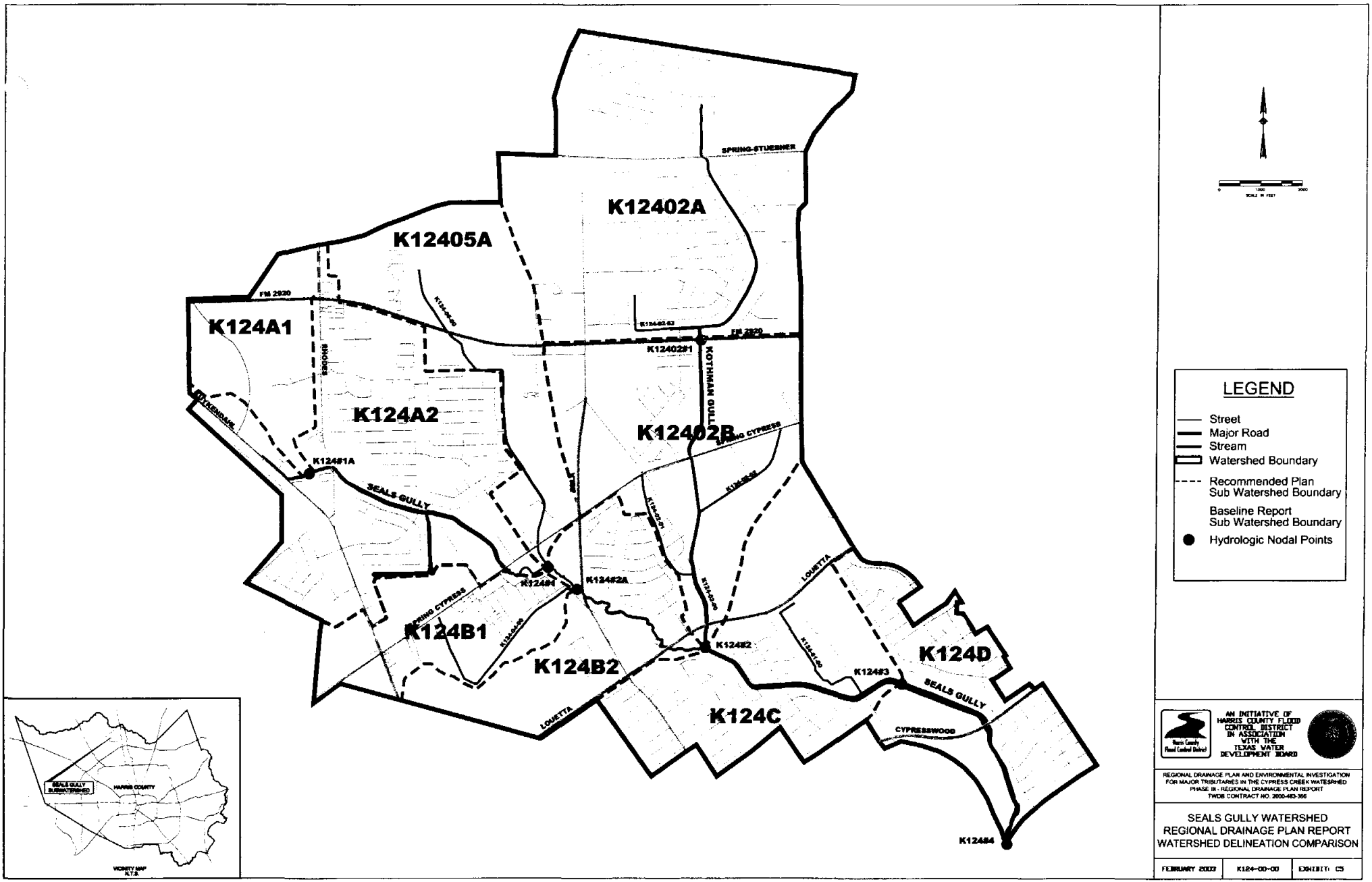
SEALS GULLY WATERSHED REGIONAL DRAINAGE PLAN REPORT STRUCTURAL FLOODING CONCERNS

FEBRUARY 2003	K124-00-00	EXHIBIT C4


K12402A
K12405A
K124A1
K124A2
K12402B
K124B1
K124B2
K124C
K124D
SPRING-STUEBNER
FM 2920
K12402#1
KOTHMAN GULLY
SCHOOL
K124#1A
SEALS GULLY
SPRING CYPRESS
K124#1
K124#2A
K124#2
K124#3
K124#4
LOUETTA
CYPRESSWOOD
SEALS GULLY SUBWATERSHED
HARRIS COUNTY
VICINITY MAP
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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
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SEALS GULLY WATERSHED
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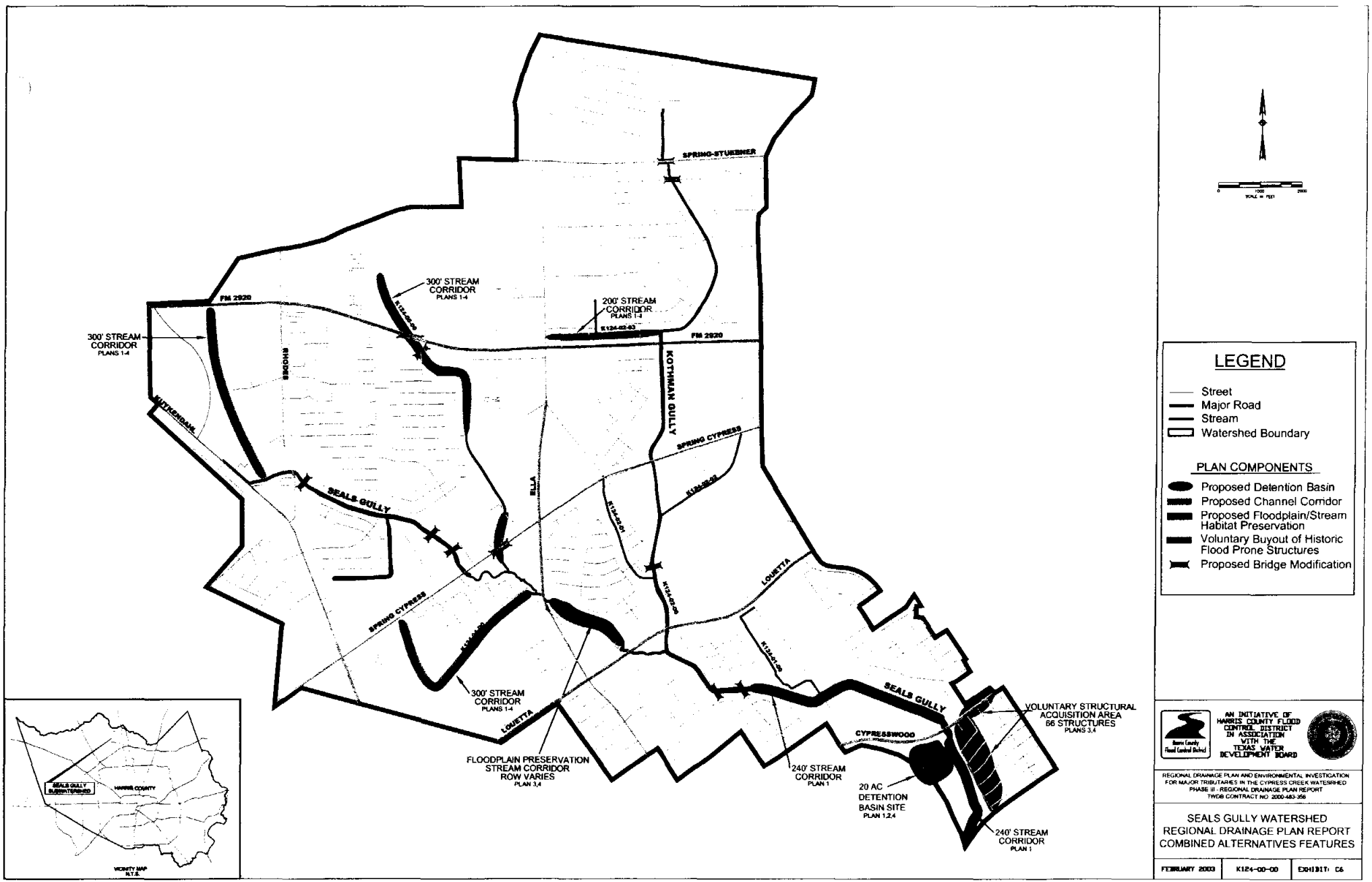
WATERSHED DELINEATION COMPARISON
FEBRUARY 2003
K124-00-00
EXHIBIT C5



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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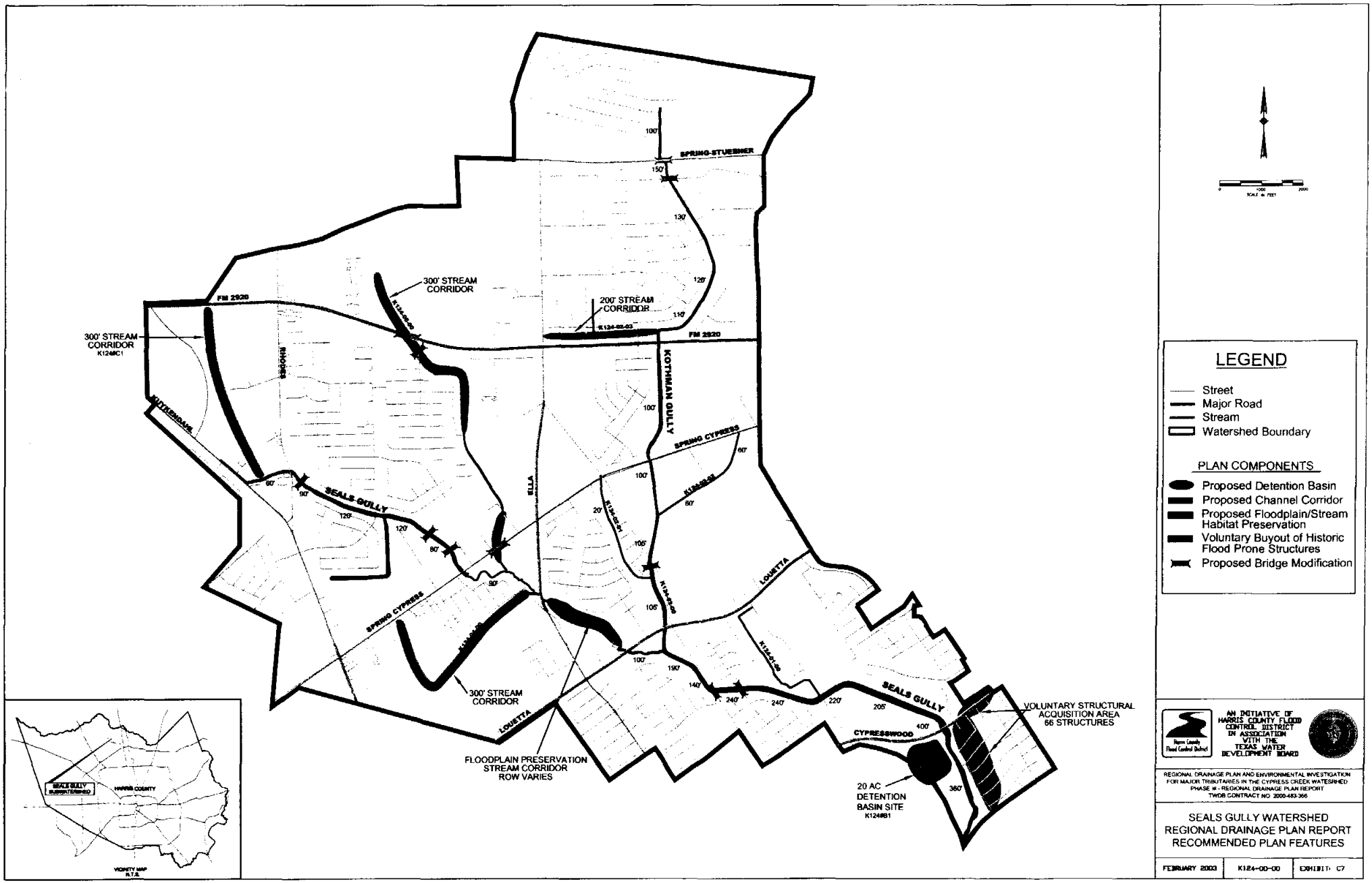
SEALS GULLY WATERSHED REGIONAL DRAINAGE PLAN REPORT COMBINED ALTERNATIVES FEATURES

FEBRUARY 2003	K124-00-00	EXHIBIT C6


SPRING-STUEBNER
FM 2920
300' STREAM CORRIDOR
K1248C1
300' STREAM CORRIDOR
200' STREAM CORRIDOR
K124-00-03
KOTHMAN GULLY
SPRING CYPRESS
K124-00-01
K124-00-02
SEALS GULLY
ELLA
LOUETTA
K124-00-04
CYPRESSWOOD
300' STREAM CORRIDOR
FLOODPLAIN PRESERVATION
STREAM CORRIDOR
ROW VARIES
VOLUNTARY STRUCTURAL
ACQUISITION AREA
66 STRUCTURES
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Proposed Detention Basin
Proposed Channel Corridor
Proposed Floodplain/Stream
Habitat Preservation
Voluntary Buyout of Historic
Flood Prone Structures
Proposed Bridge Modification
AN INITIATIVE OF
HARRIS COUNTY FLOOD
CONTROL DISTRICT
IN ASSOCIATION
WITH THE
TEXAS WATER
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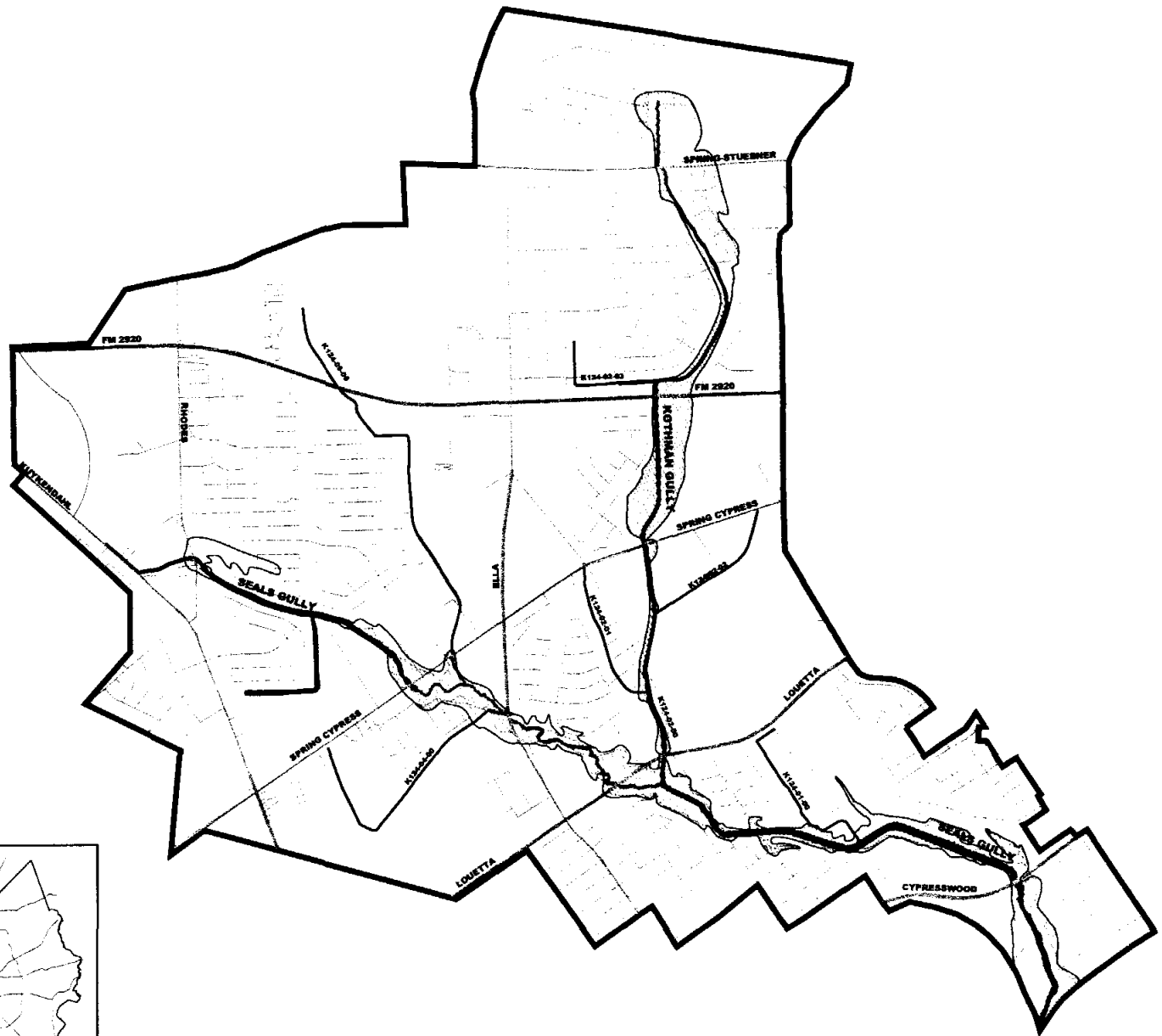
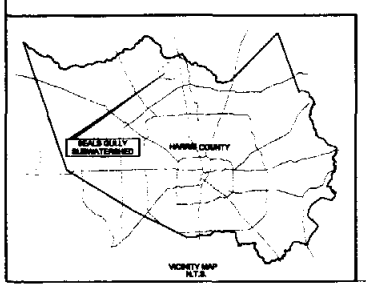
SEALS GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
RECOMMENDED PLAN FEATURES
FEBRUARY 2003
K124-00-00
EXHIBIT C7





LEGEND

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

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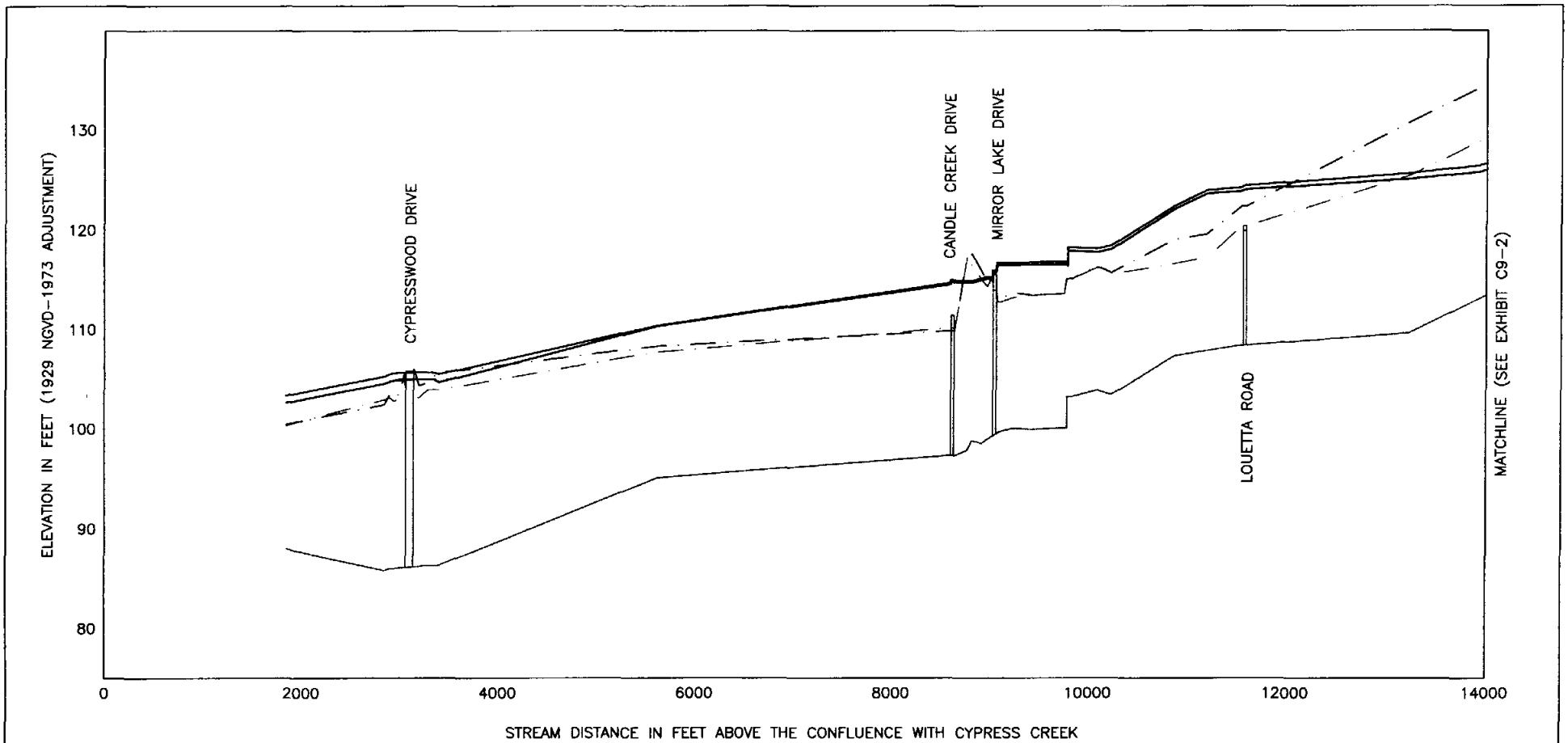
SEALS GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
BASELINE AND RECOMMENDED PLAN FLOODPLAIN MAP

FEBRUARY 2003	K124-00-00	EXHIBIT C8



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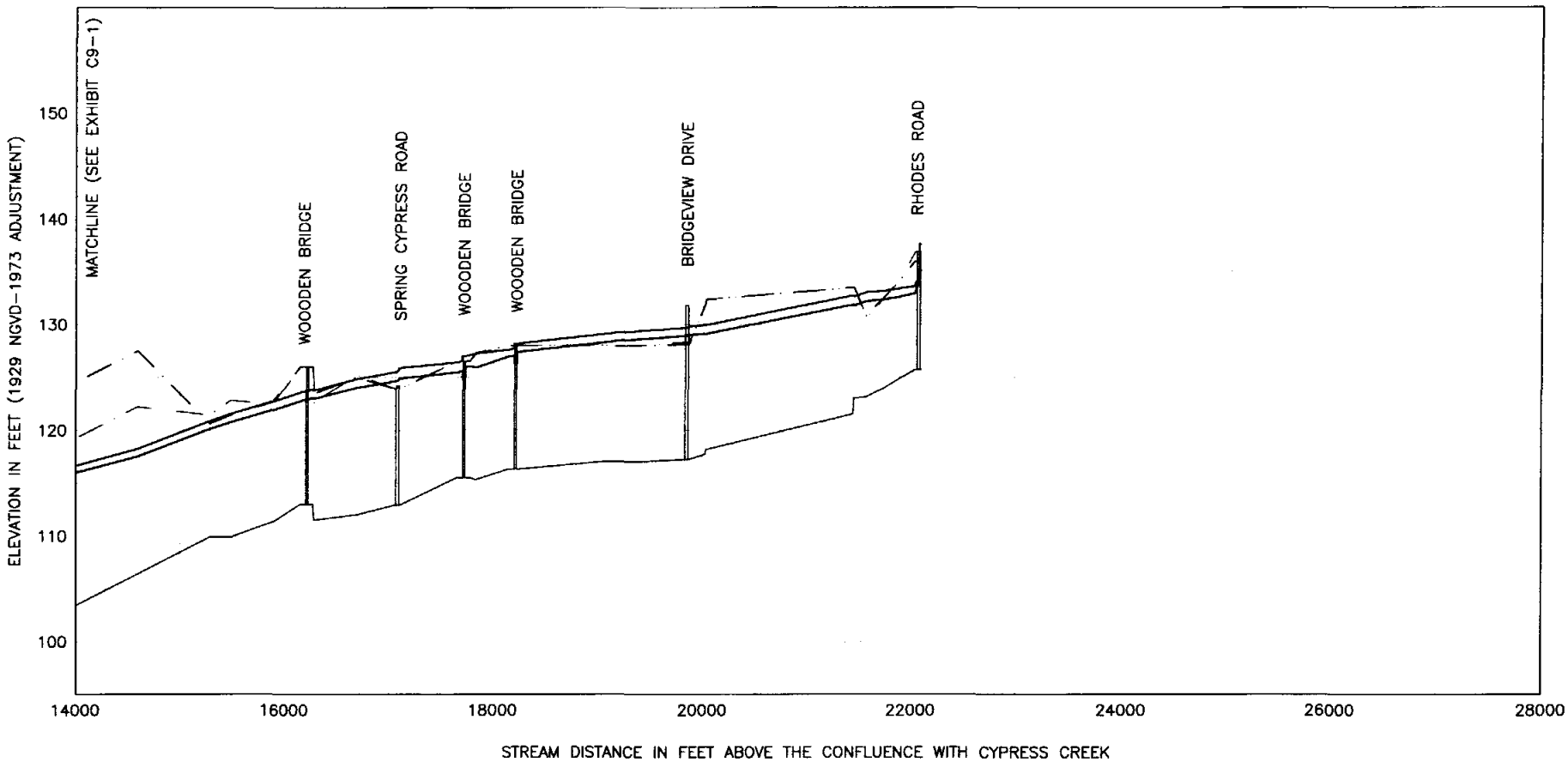
SEALS GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
SEALS GULLY WATER SURFACE PROFILES
BASELINE AND RECOMMENDED PLAN

FEBRUARY 2003	K124-00-00	EXHIBIT: C9-1



LEGEND

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

WATER SURFACE PROFILES

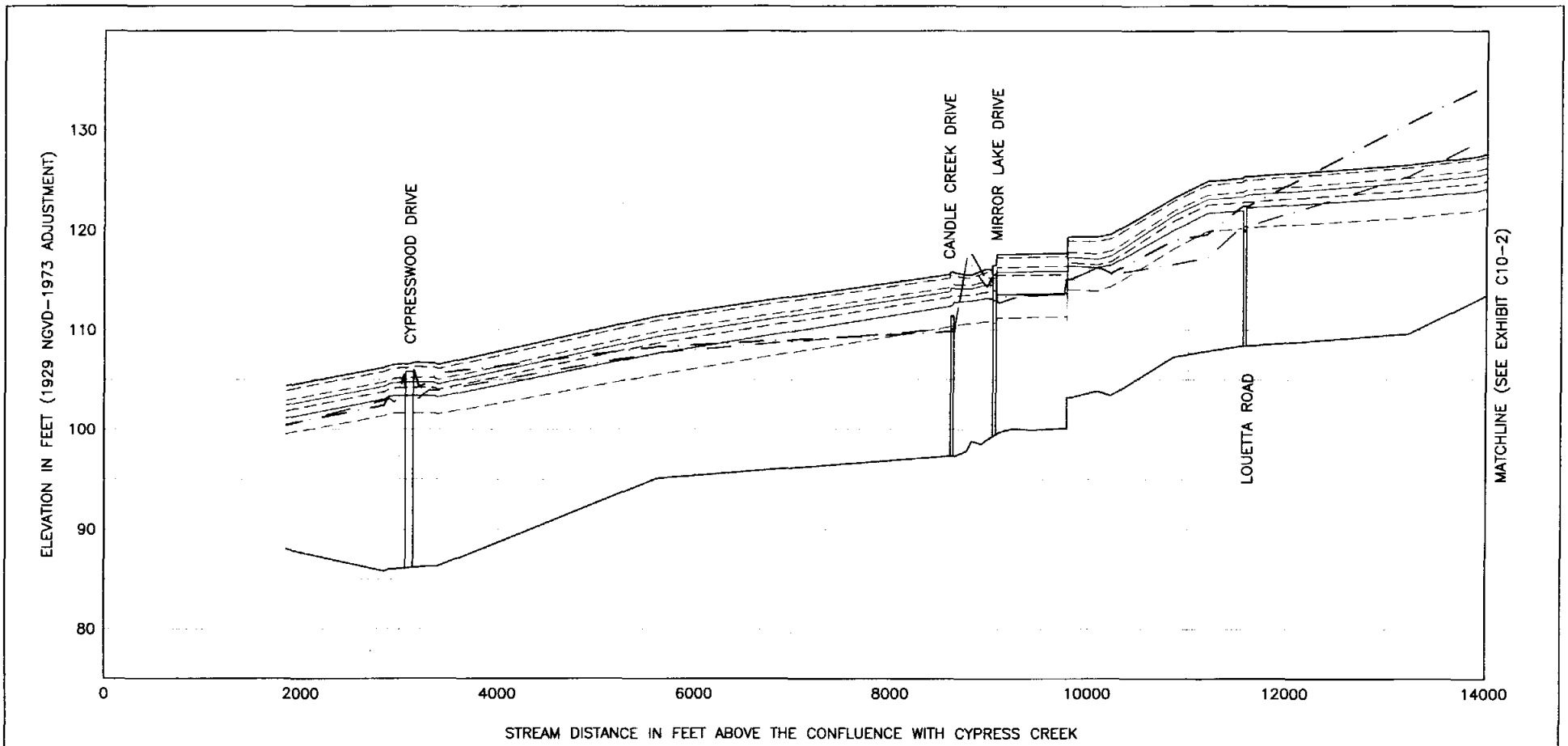
- 100-YEAR BASELINE
- 100-YEAR RECOMMENDED PLAN

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. 2000-483-336

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

FEBRUARY 2003	K124-00-00	EXHIBIT: C9-2



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

Harris County Flood Control District

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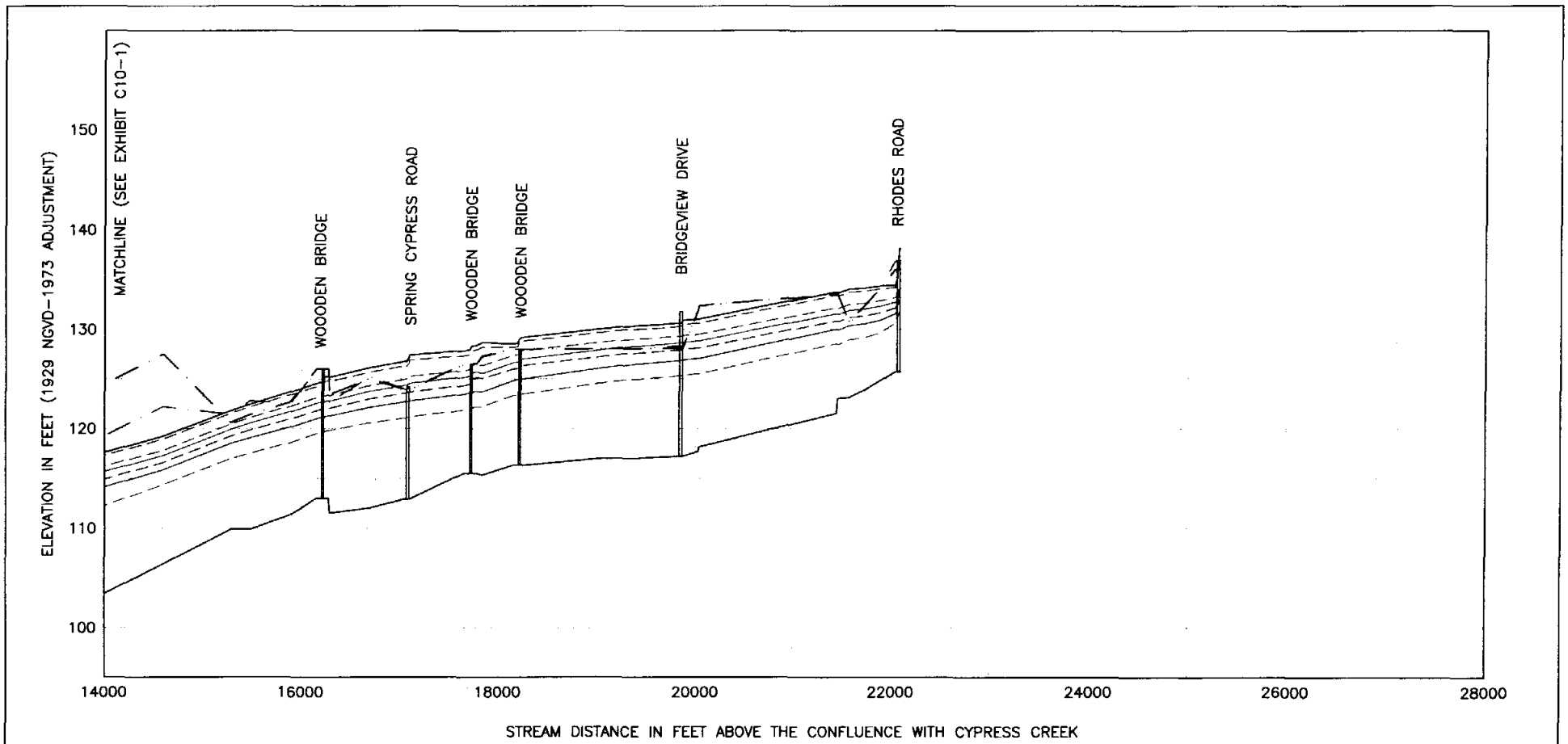
SEALS GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
SEALS GULLY WATER SURFACE PROFILES
BASELINE CONDITION MULTIPLE FREQUENCIES

FEBRUARY 2003	K124-00-00	EXHIBIT: C10-1



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

Harris County Flood Control District

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

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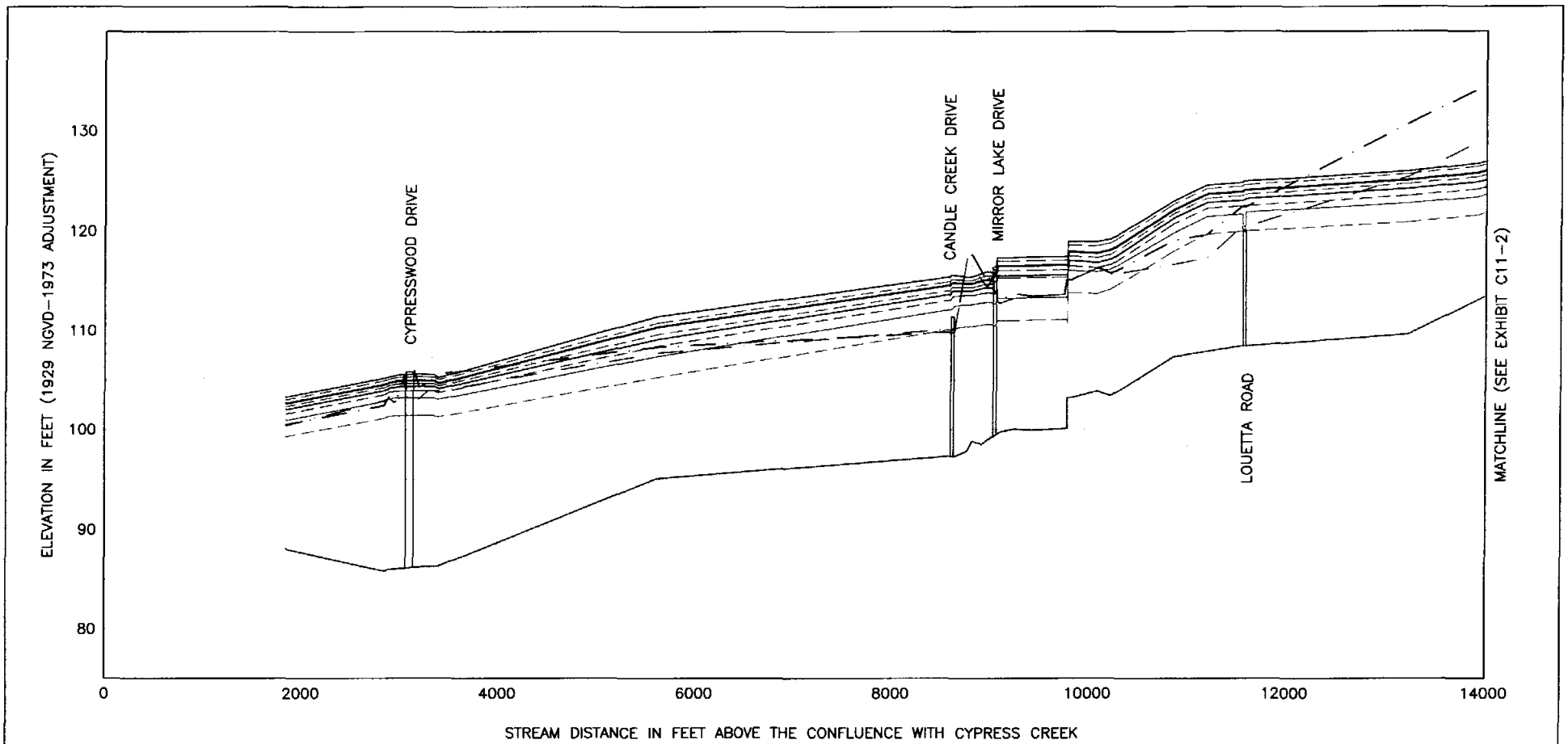
SEALS GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
SEALS GULLY WATER SURFACE PROFILES
BASELINE CONDITION MULTIPLE FREQUENCIES

FEBRUARY 2003	K124-00-00	EXHIBIT: C10-2



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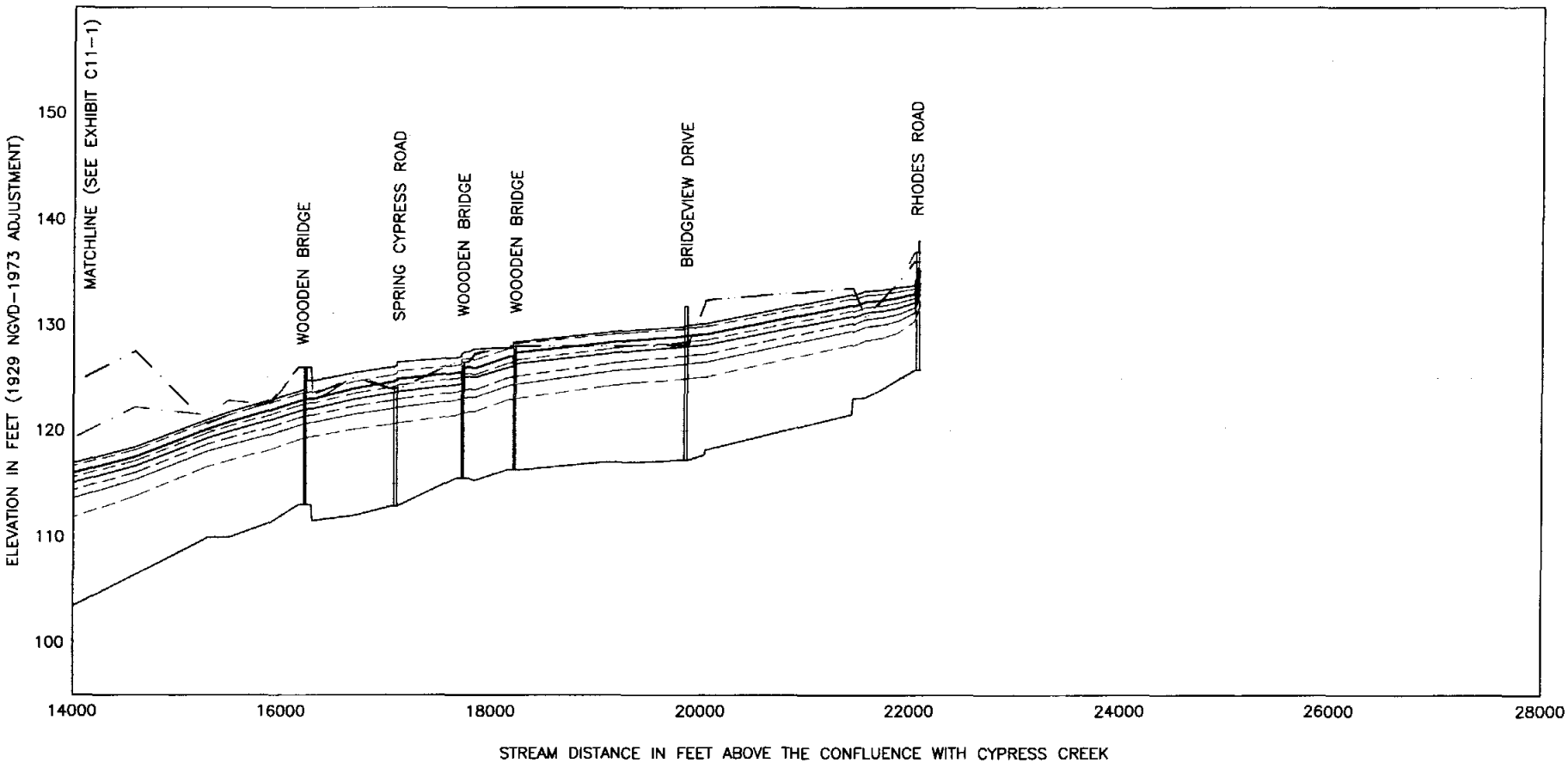
SEALS GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
SEALS GULLY WATER SURFACE PROFILES
RECOMMENDED PLAN MULTIPLE FREQUENCIES

FEBRUARY 2003	K124-00-00	EXHIBIT: C11-1



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

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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:	
K131B02.ih1	Baseline Conditions 2-year Flows
K131B05.ih1	Baseline Conditions 5-year Flows
K131B10.ih1	Baseline Conditions 10-year Flows
K131B25.ih1	Baseline Conditions 25-year Flows
K131B50.ih1	Baseline Conditions 50-year Flows
K131B100.ih1	Baseline Conditions 100-year Flows
K131B250.ih1	Baseline Conditions 250-year Flows
K131B500.ih1	Baseline Conditions 500-year Flows
K131R-2.ih1	Recommended Plan 2-year (50%) Flows
K131R-5.ih1	Recommended Plan 5-year (20%) Flows

ELECTRONIC FILES *(continued)*

File Name:	Description
HEC-1 Models:	
K131R-10.ih1	Recommended Plan 10-year (10%) Flows
K131R-25.ih1	Recommended Plan 25-year (4%) Flows
K131R-50.ih1	Recommended Plan 50-year (2%) Flows
K131R100.ih1	Recommended Plan 100-year (1%) Flows
K131R250.ih1	Recommended Plan 250-year (0.4%) Flows
K131R500.ih1	Recommended Plan 500-year (0.2%) Flows
HEC-RAS Models:	
K13100.prj	Project File – Spring Gully
K13100.p01	Baseline Multiprofile Plan – Spring Gully
K13100.p05	Recommended Multiprofile Plan – Spring Gully
K13102.prj	Project File – Theiss Gully
K13102.p10	Baseline Multiprofile – Theiss Gully
K13102.p04	Recommended Multiprofile – Theiss Gully

1.0 INTRODUCTION

The information presented in this appendix report intends to document the process of developing the recommended regional drainage plan for the Spring 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 Spring Gully watershed is included in this report.

1.1 Project Location

The Spring 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 in **Exhibit 1** of the main text report. The 12.3 square mile watershed drains in a southerly direction from Boudreaux Road to Cypress Creek. As seen in **Exhibit D1** and **Exhibit D2**, the watershed is bounded by Boudreaux Road, FM 2920, and Kuykendahl Road on the north; Theiss Mail Road on the west; Klein Church Road and TC Jester Blvd. on the east; and Cypress Creek on the south.

The Spring Gully watershed includes one main stem (Spring Gully) and a main tributary (Theiss Gully). The main stem of Spring Gully has two unit designations: K131-00-00 and K131-04-00. Similarly, the main tributary of Theiss Gully has two unit designations K131-02-00 and K131-02-04. The other tributary is designated as K131-03-00 (Trib. 2.1 to Spring Gully). The two unit designations referenced above for Spring Gully and Theiss Gully are identified as contiguous streams on the effective FEMA floodplain mapping. These streams represent the studied stream network included as part of the Flood Insurance Study (FIS) for the Spring Gully watershed. These streams are also included within this baseline report.

Theiss Gully drains the western portion of the watershed. It crosses Spring-Cypress Road, Stuebner-Airline Drive, and Louetta Road before its confluence with Spring Gully just north of Cypresswood Drive. The main stem, Spring Gully, crosses Spring-Cypress Road, Louetta Road, and Cypresswood Drive before its confluence with Cypress Creek downstream of Stuebner-Airline Road.

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 Spring Gully watershed is one of the nine watersheds. Several studies have been conducted within the Spring Gully watershed at varying levels and are identified in Appendix D 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 D1,** with the existing development conditions shown on **Exhibit D2**. 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 Spring Gully watershed.

An assessment of the environmental baseline conditions of the Spring 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 Spring 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 Spring Gully watershed are shown on **Exhibit D3**.

1.3 Flood Hazard

Flood hazards along Spring 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-percent 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 D8**.

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 Spring 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 study area of Spring Gully is part of the Cypress Creek drainage basin. The Spring Gully watershed drains an area of approximately 12.3 square miles in northwest Harris County in a southerly direction from Boudreaux Road to Cypress Creek. The watershed is bounded by Boudreaux Road, FM 2920, and Kuykendahl Road on the north; Theiss Mail Road on the west; Klein Church Road and TC Jester Blvd. on the east; and Cypress Creek on the south. The entire watershed is in the unincorporated areas of Harris County.

The watershed generally has a southeasterly overland slope averaging 10 feet per mile. The natural ground in the watershed is highest in the vicinity of Boudreaux Road and Theiss Gully by the Hooks Memorial Airport in the northwestern corner of the watershed at approximately 156 feet above mean sea level. The lowest point in the watershed can be found at the area by the confluence of Spring Gully and Cypress Creek with an elevation of approximately 90 feet above mean sea level. Existing development is concentrated primarily in the lower half of the watershed. The masterplanned community of WindRose constitutes most of the ongoing development activity in the upper half of the watershed.

This analysis uses the baseline conditions model and modifies accordingly, the hydrologic parameters of each subarea to reflect alternative plan conditions. Where necessary, a baseline

condition subarea was further subdivided in order to more accurately model particular plan elements. The Spring Gully watershed subareas can be described as follows:

- K13103A – HCFCD Unit K131-03-00 drainage area (664 acres), which includes the entire drainage area for the stream.
- K13102A – Upstream western subarea (1130 acres) of the Theiss Gully subwatershed, which includes areas upstream of Spring-Cypress Road and west of Stuebner-Airline Drive. It basically encompasses K131-02-04 drainage area. Approximately 370 acres of this subarea as delineated in the baseline report has been added to the Dry Gully watershed to account for the changing drainage patterns due to the construction of the Glenloch Farms masterplanned community.
- K13102B – Upstream eastern subarea of the subwatershed (705 acres), which includes areas upstream of Spring-Cypress Road and east of Stuebner-Airline Drive along Theiss Gully.
- K13102C – Midreach subarea of the subwatershed (873 acres), which includes areas between Spring-Cypress Road and Stuebner-Airline Drive along Theiss Gully.
- K13102D – Downstream subarea of the subwatershed (1050 acres), which includes areas between Stuebner-Airline Drive and the confluence with Spring Gully.
- K13104A – Upstream subarea of the Spring Gully subwatershed (1558 acres), which includes the northern portions of the subwatershed along HCFCD Unit K131-04-00; this represents the HCFCD Unit K131-04-00 drainage area.
- K13100A – Upstream subarea of the Spring Gully subwatershed (941 acres), which includes areas within the northern part of the subwatershed along Spring Gully.
- K13100B – Midreach subarea of the Spring Gully subwatershed (778 acres), which includes areas at the confluence of Theiss Gully and Spring Gully.
- K13100C – Lower subarea of the Spring Gully subwatershed (245 acres), which includes areas between the confluence of Theiss Gully and the confluence with Cypress Creek.

Spring Gully discharges into Cypress Creek (HCFCD Unit K100-00-00) between Stuebner Airline Road and Kuykendahl Road. **Exhibit D2** shows Spring Gully Watershed subareas with location and station of each routing node along with sub-basin names.

2.2.1 Stream Identification

The main stem of Spring Gully watershed is Spring Gully with HCFCD unit number K131-00-00. The three main tributaries to Spring Gully are Theiss Gully (K131-02-00), Spring Gully Tributary 2.1 (K131-03-00), and Ditch K131-04-00. A main tributary to Theiss Gully is Ditch K131-02-04. The streams in the watershed can be described as follows:

- The main stem, Spring Gully (K131-00-00) has been rectified up to its confluence with K131-04-00 except for an 1800-foot stretch downstream near the confluence with Cypress Creek. Upstream of the confluence to its head north of Spring Cypress Road,

Spring Gully is currently unstudied and exists as a swale with no existing HCFCD R.O.W. The upstream section of K131-00-00 will be part of this study to allow for future development.

- K131-04-00 serves the northeast section of the watershed where the Windrose masterplanned community exists. It is also a studied stream modeled with K131-00-00.
- Spring Gully Tributary 2.1 (K131-03-00) is a studied stream and fully rectified channel serving the eastern portion of the watershed that includes the Bridgestone and Spring Creek Oaks subdivisions.
- Theiss Gully (K131-02-00) is rectified in its lower and middle reaches. It is also a studied stream up to its confluence with K131-02-04. Upstream of the confluence K131-02-00 exists as a swale and has previously not been studied. This section of K131-02-00 will be considered in this study to allow for future development in the area.
- K131-02-04 is a studied stream but can best be described as part swale part shallow ditch. This stream receives flow from the Hooks Memorial Airport and also serves as a drainage ditch for the western portion of the watershed that includes the Homestead Oaks, and Cedar Oaks subdivisions.

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 D3**. 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 Spring Gully watershed, in the downstream reach of Spring Gully south of Louetta Road near the confluence with Cypress Creek. Medium quality habitat areas were identified in the upper middle reaches of Theiss Gully and in the upstream areas of Spring Gully. The watershed streams are mostly low habitat stream quality due to previous rectifications.

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. Approximately 27 percent of the land use in the watershed is residential. This is largely single family. Less than 8 acres of land is used for multi-family residences. Commercial land use includes businesses and industries. Industries tend to be located at the upper sections of the watershed. Commercial land use in the watershed is currently limited to approximately 9 percent. Public land uses include schools, churches, fire and police, stations, utilities, golf courses, and recreational open space. This constitutes approximately 9 percent of the land use in the watershed. A map of land uses in the watershed can be seen in **Exhibit D3**.

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 Spring Gully watershed, approximately 128 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 D4**. 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 128 structures is approximately $34,700,000.

2.3.4 Economic Factors for the Watershed

The Spring Gully watershed is typical of many of the Cypress Creek tributary watersheds in that it is in a state of development. Much of the upper third of the 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 Spring Gully watershed, 128 structures were identified as structures likely to suffer economic damage to structure and content during a 100-year event at a cost of approximately $6 million. The general location of these structures is shown on **Exhibit D4.** 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 2002 of 6.125-percent, it is expected that average annual equivalent damages to structure and content in the watershed will be approximately $0.9 million if the current (baseline) drainage conditions remain unchanged. $334,000 of the annual damages is attributed to Spring Gully flooding while Theiss Gully flooding is expected to produce $584,000 annual economic damage. Flooding from Spring Gully Tributary 2.1 is expected to result in less than $10,000 in economic damage.

2.4.2 Identification of Flood-Prone Areas

As shown on **Exhibit D4**, flood prone areas as determined from the LIDAR-based HEC-FDA analysis of baseline conditions, can be seen to occur mostly in the lower downstream reaches of Theiss Gully and Spring Gully, near the confluence between Spring Gully and K131-03-00, and upstream of Theiss Gully near its confluence with K131-02-04. All these areas have low to medium capacity reaches (below the 100-year).

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 Spring Gully watershed is shown below.

First Public Meeting (August 2001)
Sixteen comments were received for Spring Gully watershed from two distinct areas of the watershed. Three were from the upper section of the watershed at Stuebner Airline Drive. These comments suggest that flooding problems here were caused by localized activity such as landscaping and driveway improvements. The other 13 were from attendees who reside in the Wimbledon Champions subdivision at the downstream end of the watershed near Cypress Creek. Their comments included a lack of stream maintenance, inadequate subdivision drainage, and lack of conveyance in Spring Gully and Cypress Creek.

Second Public Meeting (October 2002)
Five attendees in Spring Gully watershed that did not attend the first public meeting were present in the second. However, none of the attendees volunteered any comments in the meeting, which concentrated on proposed plans. General comments regarding the public's views on flood control measures are mentioned in **Section 2.5.8** of this report.

Third Public Meeting (April 2003)
Several comments were received generally supporting the plans as recommended. A few comments requested that the recommended channel alignment across Stuebner-Airline Road between F.M. 2920 and Spring-Cypress Road would greatly help to reduce some of the existing flooding conditions in the area.

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 D4**.

2.4.5 Opportunities for Watershed Enhancement

This drainage study presents an opportunity to provide for future dual-use facilities such as parks and sports fields that also serve as detention facilities and preserve any areas for environmental conservation. The downstream end of Spring Gully near the confluence with Cypress Creek is a prime example of environmental preservation to maintain the high quality stream habitat. The location of outfall channels and detention ponds to serve future development provide opportunities for dual use as parks. The Spring Gully subarea K13100A, which is presently undeveloped and has an unimproved channel, is a potential park/detention basin dual-use location. Hike and bike trails are potential multi-use aspects of new or improved channels. Locations to be considered for such opportunities can be found in new channels in subareas K1300A and K13102B.

2.4.6 Identification of Major Thoroughfare Outfalls

Exhibit D5 shows the major roads through the watershed. 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 FM 2920. Northpointe Road will follow the existing Pine Lakes Boulevard's alignment and bear northwards in the Windrose Masterplanned community to Gosling Road and eventually link the proposed Grand Parkway north of the watershed boundaries. Spring Cypress Road is also proposed for lane expansion. The section of Stuebner Airline Drive north of Spring Cypress Road is proposed for lane

expansion all the way to FM 2920. TC Jester Boulevard has several proposed sections to finalize its corridor as a continuous thoroughfare from Cypresswood Drive all the way to FM 2920.

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 Spring Gully will be required to provide storm water quality protection for their 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, including the roadway projects mentioned above, in order to comply with the effective regulations.

2.5 Alternate Drainage Plan Formulation

A series of alternative drainage plans were formulated for the Spring 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 modifications 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 Spring 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 D2** 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 Spring Gully watershed, the watershed parameters did not change and are the same as that identified in **Table D2**. 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 D6** shows the locations of all features for the watershed, including those common to the alternate plans.

2.5.2 Alternate 1 Features and Benefits

Alternative 1 consists of channel improvements and channel extensions to fulfill the analysis goals. In the upper reaches of Theiss Gully, channel improvements with downstream mitigating detention are proposed, and within subareas K13100A and K13102B, new channel systems within waterway corridors are proposed.

Within subarea K13100A, the channel will lie in a 300-foot waterway corridor and run from the proposed Northpointe Road to its confluence with K131-04-00. A proposed lateral approximately 600 feet south of Spring Cypress Road of equal design is also included for the subarea. This component is designed to provide outfall depth for potential new development and roadways in the subarea. The channel will also provide storage to mitigate any impacts due to the channelization of the subarea. It will require the construction and replacement of two bridges - Spring Cypress Road and Klein Cemetery Road.

In subarea K13102B, the waterway corridor will run from the airport, at the proposed Northpointe Road, to FM2920, extending K131-02-04 upstream from Stuebner Airline Road. This component is designed to provide outfall depth for potential new development and roadways in the subarea. The channel will also provide storage to mitigate any impacts due to the channelization of the subarea. A bridge replacement at Stuebner Airline Road will be required.

Due to the limited amount of available right-of-way near the channel, a more conventional section was considered for upper Theiss Gully. A proposed earthen trapezoidal channel section is proposed. The channel considered has a 6-foot bottom width, 4:1 side slopes, and a 10-foot channel depth. This section will run from the existing improved reach at Sta. 14+555 upstream to the proposed Northpointe Road. At Sta. 145+55, a flowline drop structure is proposed is connect the proposed channel with the existing improved channel. Because of the potential increase in flows due to the channel improvements, a mitigation detention basin is proposed downstream of Spring Cypress Road. This facility will be an on-line basin constructed within a large channel section. The outfall for this structure will be near Sta. 150+55, just upstream of the proposed drop structure. The basin will run along the channel upstream pass the K124-02-04 confluence to 200 feet of Spring Cypress Road. The proposed enhancements to the channel will enable a 100-year or greater capacity and relieve existing flooding in the area. The channel will also provide the necessary infrastructure due to the proposed widening of Spring Cypress Road. Crossings at Shimmering Pines, Valka Road, and Azalea Way will require bridge replacements.

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 1 Benefits (100-Year Flows)

Node	Location	Baseline Flow (cfs)	Alt Flow (cfs)	Benefit (cfs)
TG#1	Theiss Gully at Stuebner-Airline Road	2440	2415	-25
SG#1	Theiss Gully Confluence with Spring Gully	3701	3622	-79
SG#3	Spring Gully and K131-04-00	2361	2195	-166
SG#2	Spring Gully and K131-03-00	3241	2939	-302
SG#1US	Spring Gully Upstream of Theiss Gully	4356	4029	-330
SG#1DS	Spring Gully Downstream of Theiss Gully	7973	7592	-381
K10016	Spring Gully Confluence with Cypress Creek	8175	7789	-386

* 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 5 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 $9,600,000.

2.5.3 Alternate 2 Features and Benefits

Alternative 2 features are shown on **Exhibit D6**. Alternative 2 replaces the two channel corridors described in Alternative 1 with trapezoidal channels and regional detention ponds for subareas K13100A and K13102B. The upper Theiss Gully channel improvements and mitigation basin will remain as described in Alternative 1. The proposed channels for subareas K13100A and K13102B are proposed as earthen, trapezoidal sections 10 feet deep with 6-foot bottom widths and 4:1 side slopes. In subarea K13100A, the alignment follows the existing swale of K131-02-00 upstream of Spring Cypress Road and runs up to FM 2920. The regional detention basin in K13100A is a 40-acre pond providing 312 acre-ft of storage. The outlet structure is comprised of two - 8' X 8' box culverts. The basin also serves to mitigate the channel improvements in this subarea. In subarea K13102B, a 35-acre detention pond providing 243 acre-ft of storage at a depth of 8 feet is used as a regional detention basin and mitigates the channel improvements. The outlet structure used is one – 8' X 9' box. The detention basin south of the confluence of Spring Gully and Theiss Gully is excluded from this alternative.

The following table 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)
TG#1	Theiss Gully at Stuebner-Airline Road	2440	2217	-223
SG#1	Theiss Gully Confluence with Spring Gully	3701	3546	-155
SG#3	Spring Gully and K131-04-00	2361	2328	-33
SG#2	Spring Gully and K131-03-00	3241	3111	-130
SG#1US	Spring Gully Upstream of Theiss Gully	4356	4166	-193
SG#1DS	Spring Gully Downstream of Theiss Gully	7973	7639	-334
K10016	Spring Gully Confluence with Cypress Creek	8175	7850	-325

* 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 4 percent. This alternative will offset the effects of full development with onsite detention in the watershed and reduce peak flows entering Cypress Creek. The estimated cost for implementing Alternative 2 is $12,170,000.

2.5.4 Alternate 3 Features and Benefit

Alternative 3 includes the elements described in Alternative 1 as well as a 21-acre detention pond along Spring Gully. Non-structural measures are also added in the form of a voluntary buyout and floodplain preservation. The floodplain preservation area is a 16-acre dedicated

right-of-way for floodplain and stream habitat preservation downstream of Cypresswood Drive on the left bank of Spring Gully. The voluntary buyout program in Alternative 3 is proposed for the 25 repetitive loss homes in Wimbledon Champions Subdivision.

The 21-acre detention pond is proposed as an aid to downstream flood reduction along Spring Gully as well as reducing peak flows to Cypress Creek. The basin is located within a 24-acre tract along the left bank of Spring Gully upstream of Cypresswood Drive and downstream of Theiss Gully. Inflow to the detention basin is by side channel weir. The basin has an average, usable depth of 17 feet and provides a maximum of 300 acre-ft of storage. Implementation of the basin significantly reduces peak flow from Spring Gully watershed into Cypress Creek.

The following table shows the peak flows at each hydrologic computational node in the baseline and alternate condition. The combination of channel improvements and downstream detention has the effect of lowering flows at the mouth by approximately 17 percent. The extensive reduction in flow at the mouth of Spring Gully is attributed to the side-weir basin along Spring Gully. In addition to providing environmental conservation benefits to Spring Gully watershed, the plan lowers flows throughout the watershed and also provides a significant reduction in peak flows entering Cypress Creek. The estimated cost for implementing Alternative 3 is $12,860,000 plus $6,800,000 for voluntary structural buyout and $240,000 for a floodplain preservation area. The total estimated cost for implementing Alternative 3 is $19,800,000.

Alternative 3 Benefits (100-Year Flows)

Node	Location	Baseline Flow (cfs)	Alt Flow (cfs)	Benefit (cfs)
TG#1	Theiss Gully at Stuebner-Airline Road	2440	2415	-25
SG#1	Theiss Gully Confluence with Spring Gully	3701	3622	-79
SG#3	Spring Gully and K131-04-00	2361	2195	-166
SG#2	Spring Gully and K131-03-00	3241	3939	-302
SG#1US	Spring Gully Upstream of Theiss Gully	4356	4029	-330
SG#1DS	Spring Gully Downstream of Theiss Gully	7973	7416	-557
K10016	Spring Gully Confluence with Cypress Creek	8175	6715	-1460

* 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

Alternative 4 features are shown on **Exhibit D6**. Alternative 4 duplicates the elements of Alternative 1 and adds the non-structural measures of a voluntary buyout and floodplain preservation area. The voluntary buyout program is as described in Alternative 3, consisting of the 25 repetitive loss homes in Wimbledon Champions Subdivision. The floodplain preservation area proposed includes the 16 acres described in Alternative 3, and adds an additional 24 acres upstream of Cypresswood Drive along the left bank of Spring Gully. This 24-acre tract was mentioned as a proposed detention basin site in Alternative 3. This plan provides similar benefits to Alternative 1 upstream. However the non-structural measures

provide a solution to existing flooding downstream and contributes significantly to environmental preservation.

The following table shows the peak flows at each hydrologic computational node in the baseline and alternative condition. Alternative 4 has the effect of lowering flows at the mouth by 5 percent. In addition to providing Spring Gully watershed with environmental conservation benefits, the plan lowers flows in the watershed and also reduces peak flows entering Cypress Creek. The estimated cost for implementing Alternative 4 is $9,600,000 plus $6,800,000 for voluntary structural buyout and $705,000 for a floodplain preservation area. The total estimated cost for implementing Alternative 4 is $17,100,000.

Alternative 4 Benefits (100-Year Flows)				
Node	**Location**	**Baseline Flow (cfs)**	**Alt Flow (cfs)**	**Benefit (cfs)**
TG#1	Theiss Gully at Stuebner-Airline Road	2440	2415	-25
SG#1	Theiss Gully Confluence with Spring Gully	3701	3622	-79
SG#3	Spring Gully and K131-04-00	2361	2195	-166
SG#2	Spring Gully and K131-03-00	3241	2939	-302
SG#1US	Spring Gully Upstream of Theiss Gully	4356	4029	-330
SG#1DS	Spring Gully Downstream of Theiss Gully	7973	7592	-381
K10016	Spring Gully Confluence with Cypress Creek	8175	7789	-386

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

2.5.6 Alternative 5 Features and Benefits

Alternative 5 features are shown on **Exhibit D6.** Alternative 5 is an entirely non-structural alternative for Spring Gully watershed. It includes the following nonstructural measures:

- A 16-acre dedicated R.O.W for floodplain and stream habitat preservation downstream of Cypresswood Drive on the left bank of Spring Gully.
- A 31-acre dedicated R.O.W for floodplain preservation between Glenmere Drive and Cypresswood Drive on the left bank of Spring Gully.
- A 12-acre dedicated R.O.W for floodplain preservation between Wimbledon Trails and confluence of Spring Gully and Theiss Gully.
- A voluntary buyout of all 70 repetitive loss homes in the watershed.

Alternative 5 has no effect on baseline flows in the watershed. It however contributes to solving existing flooding problems in the watershed and provides environmental preservation. The estimated cost for implementing Alternative 5 is $12,400,000 for voluntary structural buyout and $885,000 for a floodplain preservation area. The total estimated cost for implementing Alternative 5 is $13,290,000.

Alternative 5 Benefits (100-Year Flows)				
Node	**Location**	**Baseline Flow (cfs)**	**Alt Flow (cfs)**	**Benefit (cfs)**
TG#1	Theiss Gully at Stuebner-Airline Road	2440	2440	0
SG#1	Theiss Gully Confluence with Spring Gully	3701	3701	0
SG#3	Spring Gully and K131-04-00	2361	2361	0
SG#2	Spring Gully and K131-03-00	3241	3241	0
SG#1US	Spring Gully Upstream of Theiss Gully	4356	4356	0
SG#1DS	Spring Gully Downstream of Theiss Gully	7973	7973	0
K10016	Spring Gully Confluence with Cypress Creek	8175	8175	0

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

2.5.7 Alternative 6 Features and Benefits

Alternative 6 includes the elements described in Alternative 1 as well as a 21-acre detention pond along Spring Gully. Non-structural measures are also added in the form of floodplain preservation. The floodplain preservation area is a 16-acre dedicated right-of-way for floodplain and stream habitat preservation downstream of Cypresswood Drive on the left bank of Spring Gully.

The 21-acre detention pond is proposed as an aid to downstream flood reduction along Spring Gully as well as reducing peak flows to Cypress Creek. The basin is located within a 24-acre tract along the left bank of Spring Gully upstream of Cypresswood Drive and downstream of Theiss Gully. Inflow to the detention basin is by side channel weir. The basin has an average, usable depth of 17 feet and provides a maximum of 300 acre-feet of storage. Implementation of the basin significantly reduces peak flow from Spring Gully watershed into Cypress Creek. The table below shows the peak flows at each hydrologic computational node in the baseline and alternate condition.

Alternative 6 Benefits (100-Year Flows)				
Node	**Location**	**Baseline Flow (cfs)**	**Alt3 Flow (cfs)**	**Benefit (cfs)**
TG#1	Theiss Gully at Stuebner-Airline Road	2440	2415	-25
SG#1	Theiss Gully Confluence with Spring Gully	3701	3622	-79
SG#3	Spring Gully and K131-04-00	2361	2195	-166
SG#2	Spring Gully and K131-03-00	3241	3939	-302
SG#1US	Spring Gully Upstream of Theiss Gully	4356	4029	-330
SG#1DS	Spring Gully Downstream of Theiss Gully	7973	7416	-557
K10016	Spring Gully Confluence with Cypress Creek	8175	6715	-1460

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

The combination of channel improvements and downstream detention has the effect of lowering flows at the mouth by approximately 17 percent. The extensive reduction in flow at the mouth of Spring Gully is attributed to the side-weir basin along Spring Gully. In addition to providing environmental conservation benefits to Spring Gully watershed, the plan lowers flows throughout the watershed and also provides a significant reduction in peak flows

entering Cypress Creek. The estimated cost for implementing Alternative 6 is $12,909,330 plus $240,000 for a floodplain preservation area. The total estimated cost for implementing Alternative 3 is $13,149,330.

2.5.8 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. No comments regarding alternatives for Spring Gully watershed were received. Generally the public in response to questionnaires showed they were not averse to channel improvement projects. Multi-use facilities incorporating recreation was popular with the respondents. Respondents were evenly split on whether they favored the use of voluntary buyouts as a flood-control measure.

2.5.9 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 D1 – Screening Matrix for Spring Gully Watershed

Criteria	Weight	Plan					
		ALT 1	ALT 2	ALT 3	ALT 4	ALT 5	ALT 6
Minimal Construction Cost	0.2	7	6	3	4	6	6
Provides Aesthetics	0.5	4	5	8	7	3	8
Ease of Implementation	0.8	8	2	6	7	3	6
Flood Protection within Tributary Watershed	1	4	4	7	6	8	7
Ability to Accommodate Multiple Uses	0.5	5	8	8	7	3	8
Preserves/Enhances Water Quality	0.8	5	6	7	7	3	7
Preserves/Enhances Stream Habitat Quality	0.5	7	3	9	10	5	9
Ease of Maintenance	0.8	7	2	4	6	9	4
Reduction of Peak Flows into Cypress Creek	1	6	6	9	6	0	9
Outfalls for Future Roadways/Development	0.8	10	10	10	10	0	10
Acceptable to the Public	0.8	6	7	6	8	5	9
TOTAL	-----	**69**	**59**	**77**	**78**	**45**	**83**
WEIGHTED TOTAL	**77(max)**	**48.2**	**40.8**	**55.5**	**55.2**	**30.7**	**58.5**

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 6 was chosen as the recommended plan, primarily due to the fact that it met all the criteria of the study and provided a more significant reduction of flows to Cypress Creek than the other alternatives. The downstream Spring Gully detention basin site may prove highly useful in reducing Cypress Creek flooding. Also, the floodplain preservation area at the confluence of Spring Gully and Cypress Creek will provide environmental benefit and protect the floodplain areas of Spring Gully and Cypress Creek.

Alternative 4 provides a similar level of protection with the same types of non-structural elements downstream, however without the downstream detention basin, the flow reduction of Spring Gully is not as significant.

The regional plan reflected in Alternative 2 scored lower because of the difficulty in implementing an impact fee system for the contributing area, constructing the regional facility in advance of the development, and possible public acceptance problems associated with the larger facilities.

The non-structural alternative presented as Alternative 5 scored lower because of the lack of developing the infrastructure for future development as well as the lack of reduction of existing flows as well as the difficulty of buyouts of all the historic flooded structures.

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, addresses 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.

Approximately 3,000 feet of Spring Gully, from its confluence with Cypress Creek upstream, will be preserved in a corridor that extends eastwards up to 800 feet along the left banks of the channel. This corridor will preserve the existing high quality stream habitat in the downstream 2000 feet of channel and will also contain most of the Spring Gully and Cypress Creek floodplain area downstream of Cypresswood Drive. The existing vegetated waterway

in the downstream end of the channel will require occasional maintenance to ensure an enhanced habitat value and aesthetics of the area.

A 24-acre tract sideweir detention basin is proposed upstream of Cypresswood Drive. The detention basin is proposed with a 21-acre top area with 30-foot wide maintenance berms. The average usable depth of the basin is 17-18 feet. The basin weir is a side weir is 185-foot in length set to an elevation of 105.7 feet with natural ground averaging 108 feet. At weir elevation, the basin provides 270 acre-feet of storage with a maximum storage of approximately 300 acre-feet at the 100-year water surface elevation of 107.6 feet. The implementation of the basin on its own is expected to reduce peak flows to Cypress Creek by as much as 1100 cfs. This basin can be utilized as a multi-use facility. A typical basin layout is shown as **Figure 2** of the main report. Upstream of Cypresswood Drive along Spring Gully, no action is proposed in the reaches up to the confluence of K131-00-00 and K131-04-00. The channel through this reache has previously been rectified and has sufficient capacity in most sections. The low availability of contiguous land also does not allow for any significant flood control measures in this reach.

To provide outfall for future development, channel improvements upstream of the K131-00-00/K131-04-00 confluence are proposed within the K13100A subarea. The existing K131-00-00 alignment will be improved and extended upstream to the proposed Northpointe Road. A new channel extension will run from K131-00-00 westward for 3300 feet. This 300-foot channel corridor will be located 600 feet south of Spring-Cypress Road. These improvements will combine conveyance and linear storage in a large channel section incorporating more aesthetics and providing opportunities for multiple uses. This section is a 300-foot wide channel corridor, providing 10 feet of outfall depth. A typical channel section is shown as **Figure 1** on the main report. These channels were analyzed using a typical composite section consisting of conveyance and storage element sections. The conveyance element will consist of a meandering vegetated channel section. The channel will be approximately four feet deep with 6-foot bottom width. The storage element will consist of a 100-foot wide bench section, within which the channel shall meander. The bench section will be approximately 6 feet deep and have a minimum of 8:1 side slopes. The bench section will also have a multiple usage emphasis. An additional 30 feet on each side of the banks is reserved as maintenance berm.

The downstream section of the proposed K131-00-00 channel is comprised of two 8' X 8' box culverts to provide a regulated discharge into Spring Gully at the confluence. These channels, as outlined in the alternatives, provide outfall depth for a potential 800-acres of new development in the K13100A subarea. The reduction of flow in Spring Gully due to the proposed K131-00-00 improvement at full development of the K13100A subarea, assumes the development occurs with implementation of the District's current on-site detention policy.

Upstream of the confluence along K131-04-00, no action is necessary. K131-04-00 has recently been improved to serve the WindRose masterplanned communities and currently handles design flows.

No action is proposed along Theiss Gully from its confluence with Spring Gully to Station 150+55 where the existing improved channel ends. Upstream of this station, proposed measures are required to reduce flows and the 100-year water surface elevation along the upper portions of Theiss Gully. At 150+55, a proposed drop-structure provides the flowline transition between the existing improved channel and the proposed improved channel. The proposed channel is a 10-foot deep minimum earthen trapezoidal channel with 4:1 side slopes and a 6-foot bottom width. The proposed channel will require 140 to 150 feet of right-of-way width. The proposed channel will run from the drop structure at station 150+55 to the proposed Northpointe Road, near the airport, where the section changes to a much larger section as described for K13100A subarea incorporating more aesthetic properties.

Upstream of the proposed drop structure and downstream of Spring Cypress Road, an in-line detention basin is proposed to mitigate the channel improvements. A 20-acre tract is required for the flow through basin. The basin will provide a total volume of 114 acre-feet. The limit the flows, the outlet structure comprises two 8' X 7' box culverts. This channel section with the basin is proposed to form a composite section similar to the larger channel section described earlier except that the conveyance component will have a two foot depth.

The culverts at Shimmering Pines, Valka Road, and Azalea Way are to be replaced with bridges. At Northpointe Road, two 8' X 8' box culverts will provide the transition from a standard earthen trapezoidal channel to the wider, multiple-use channel section which extends K131-02-04 past Stuebner-Airline Road to FM 2920. The proposed channel sections will provide 100-year capacity and provide a solution to existing flooding in the area up to this event. The channel upstream of Northpointe Road provides drainage infrastructure for new development in the K13102B subarea. This reach will also eliminate the existing ponding within the subarea and the inundation of the Stuebner-Airline storm sewers with the subarea's runoff. The Theiss Gully channel improvements with the mitigation basin will reduce downstream flows along Theiss Gully.

2.6.3 Recommended Plan Benefits

Taken together, these elements make up the recommended plan for the Spring 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 somewhat fragmented nature of the plan elements will make a recreational feature such as a continuous trail system infeasible. However, trails in the upper reaches of Spring Gully and Theiss Gully are feasible in

combination with the proposed channel improvements. Developments served by the proposed channel improvements would be encouraged to incorporate trails along the bayous as a recreational amenity for the development. Also the area of the detention basin in the southeast corner of Spring Cypress Road and Theiss 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 D2**. The resulting 100-year flows comparing the baseline conditions to the recommended plan conditions are presented in **Table D3** of this report. **Table D4** 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 D8**. A comparison between the recommended plan and baseline condition 100-year storm event flood profiles for Spring Gully and Theiss Gully are presented in **Exhibits D9-1** through **D9-4**. The Spring Gully and Theiss Gully eight frequencies storm event profiles for the recommended plan are presented in **Exhibits D11-1** through **D11-4**.

The plan reduces peak flows downstream at all nodes of Spring Gully and Theiss Gully, and reduces flows entering into Cypress Creek. Additionally, water surface elevations are lowered in conjunction with the lower flows. As shown in **Table D5**, the 100-year flood water surface elevations decrease along Spring Gully by as much as 4 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. Finally, the plan provides environmental benefits by preserving identified areas of good stream habitat as well as preserving some naturally flood-prone areas, as noted above.

Table D2: 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											
K13102A	1502	2.35	3.07	1.42	5	5	7.9	2	0	90	27
K13102B	705	1.1	2.2	1.16	4.8	4.1	10	73	100	90	19
K13102C	873	1.36	2.27	0.81	9.2	15.8	59.1	74	80	90	0
K13102D	1050	1.64	2.98	1.59	7.7	17.6	62.1	89	100	90	0
K13104A	1558	2.43	2.77	1.48	6.1	8.8	10	73	100	100	0
K13100A	941	1.47	1.8	0.87	6.1	7.5	10	3	0	100	0
K13103A	664	1.04	2.14	0.89	8.1	15.8	47.3	84	100	100	0
K13100B	778	1.21	2.21	1.34	7.8	18.9	59	88	100	100	0
K13100C	245	0.39	1.08	0.74	5.1	30	10	45	60	100	0
Recommended Plan Condition											
K13102A1	749	1.78	2.2	0.55	5	5	15.7	5	0	90	27
K13102A2	438	0.68	0.87	0.5	5	5	26.6	8	0	90	0
K13102B	592	0.93	1.1	0.6	4.8	4.1	7.3	73	100	90	19
K13102C	873	1.36	2.27	0.81	9.2	15.8	59.1	74	80	90	0
K13102D	1050	1.64	2.98	1.59	7.7	17.6	62.1	89	100	90	0
K13104A	1558	2.43	2.77	1.48	6.1	8.8	10	73	100	100	0
K13100A	941	1.47	1.8	0.87	6.1	7.5	10	3	0	100	0
K13103A	664	1.04	2.14	0.89	8.1	15.8	47.3	84	100	100	0
K13100B	778	1.21	2.21	1.34	7.8	18.9	59	88	100	100	0
K13100C	245	0.39	1.08	0.74	5.1	30	10	45	60	100	0

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

Table D2 (continued) Baseline & Recommended Plan Conditions

Subarea Name	Tc	R	Ponding Adjusted Storage Coefficients								RTIMP
			R'	R'	R'	R'	R'	R'	R'	R'	
	(hrs)	(hrs)	(2-yr)	(5-yr)	(10-yr)	(25-yr)	(50-yr)	(100-yr)	(250-yr)	(500-yr)	(%)
Baseline Condition											
K13102A	1.50	7.57	22.71	20.08	18.66	16.63	15.41	14.14	13.16	11.76	35.0
K13102B	0.68	6.58	6.58	6.58	6.58	6.58	6.58	6.58	6.58	6.58	35.0
K13102C	0.33	2.51	2.51	2.51	2.51	2.51	2.51	2.51	2.51	2.51	35.0
K13102D	0.62	2.93	2.93	2.93	2.93	2.93	2.93	2.93	2.93	2.93	35.0
K13104A	0.79	7.07	7.07	7.07	7.07	7.07	7.07	7.07	7.07	7.07	35.0
K13100A	0.80	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	35.0
K13103A	0.34	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	35.0
K13100B	0.51	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	35.0
K13100C	0.84	3.47	3.47	3.47	3.47	3.47	3.47	3.47	3.47	3.47	35.0
Recommended Plan Condition											
K13102A1	0.54	6.63	19.89	17.58	16.35	14.56	13.50	12.40	11.53	10.30	35.0
K13102A2	0.48	2.59	2.59	2.59	2.59	2.59	2.59	2.59	2.59	2.59	35.0
K13102B	0.61	3.85	3.85	3.85	3.85	3.85	3.85	3.85	3.85	3.85	35.0
K13102C	0.33	2.51	2.51	2.51	2.51	2.51	2.51	2.51	2.51	2.51	35.0
K13102D	0.62	2.93	2.93	2.93	2.93	2.93	2.93	2.93	2.93	2.93	35.0
K13104A	0.79	7.07	7.07	7.07	7.07	7.07	7.07	7.07	7.07	7.07	35.0
K13100A	0.80	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	35.0
K13103A	0.34	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	35.0
K13100B	0.51	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	35.0
K13100C	0.84	3.47	3.47	3.47	3.47	3.47	3.47	3.47	3.47	3.47	35.0

Table D3: 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
TG#3	--	966	--	--
TG#2	--	1442	--	--
TG#1	2440	2415	-25	1
SG#1	3701	3622	-79	2
SG#3	2361	2195	-166	7
SG#2	3241	2939	-302	9
SG#1US	4356	4029	-330	8
SG#1DS	7973	7416	-557	7
K10016	8175	6715	-1460	18

Table D4: 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)
TG#3	277	446	567	711	830	966	1123	1269
TG#2	422	681	867	1083	1248	1442	1669	1855
TG#1	659	1110	1431	1793	2086	2415	2815	3137
SG#1 (Theiss)	1078	1768	2210	2710	3134	3622	4171	4616
SG#3	712	1116	1384	1678	1920	2195	2523	2781
SG#2	980	1537	1905	2293	2615	2939	3367	3701
SG#1US	1347	2115	2633	3165	3604	4029	4567	4960
SG#1DS	2397	3833	4784	5824	6683	7416	8669	9505
K10016	2454	3682	4907	5841	6386	6715	7235	7618

Table D5: Comparison of Water Surface Elevations (100-Year)
Spring Gully (K131-00-00)

Station	Location	Baseline Condition		Recommended Plan		Difference
		Flow	WSEL	Flow	WSEL	(ft)
510		8175	102.79	6770	101.98	-0.81
1800		8175	106.05	6770	105.26	-0.79
1920		8175	106.43	6770	105.69	-0.74
2710		8175	106.76	6770	105.96	-0.80
2760	CYPRESSWOOD DRIVE					
2810		8081	106.98	7137	106.10	-0.88
3100		8081	107.02	7137	106.17	-0.85
4710		8081	107.57	7137	106.77	-0.80
4780		8081	107.62	7137	106.81	-0.81
5380		8081	107.93	7137	107.11	-0.82
5420		8081	107.94	7137	107.13	-0.81
5500		7973	107.83	7592	106.98	-0.85
5700		4359	108.23	4029	107.41	-0.82
5701		4359	108.13	4029	107.30	-0.83
5702		4359	108.58	4029	107.85	-0.73
5722		4359	108.58	4029	107.85	-0.73
5742		4359	108.57	4029	107.82	-0.75
5762		4359	108.54	4029	107.79	-0.75
5782		4359	108.51	4029	107.74	-0.77
5802		4359	108.45	4029	107.65	-0.80
5822		4359	108.49	4029	107.71	-0.78
5842		4359	108.55	4029	107.81	-0.74
6010		4359	108.87	4029	108.23	-0.64
7510		3919	110.98	3598	110.67	-0.31
8910		3919	112.66	3598	112.35	-0.31
9042		3582	113.17	3269	112.86	-0.31
9102	LOUETTA ROAD					
9162		3582	113.30	3269	112.97	-0.33
9210		3582	113.17	3269	112.83	-0.34
9610		3582	114.04	3269	113.72	-0.32
10010		3582	114.72	3269	114.39	-0.33
10182		3350	114.98	3044	114.65	-0.33
10201.5	SPRING CREEK OAKS DRIVE					
10221		3350	115.44	3044	115.00	-0.44
10310		3350	115.77	3044	115.25	-0.52
10487		3350	115.95	3044	115.47	-0.48
10620		3350	116.05	3044	115.60	-0.45
10744		3241	116.16	2939	115.72	-0.44

Table D5: Comparison of Water Surface Elevations (100-Year)
Spring Gully (K131-00-00) *(continued)*

Station	Location	Baseline Condition		Baseline Condition		Difference
		Flow	WSEL	Flow	WSEL	(ft)
11033		2361	116.45	2195	116.02	-0.43
11331		2361	116.74	2195	116.34	-0.40
11423		2361	116.76	2195	116.37	-0.39
11652		2361	117.00	2195	116.62	-0.38
11993		2361	117.40	2195	117.02	-0.38
12062		2361	117.40	2195	117.02	-0.38
12320		2361	117.94	2195	117.55	-0.39
12576		2361	118.24	2195	117.86	-0.38
12929		2361	118.70	2195	118.32	-0.38
13046		2361	118.93	2195	118.55	-0.38
13555		2361	119.69	2195	119.31	-0.38
13949		2361	120.56	2195	120.20	-0.36
14277		2361	121.02	2195	120.66	-0.36
14623		2361	121.15	2195	120.79	-0.36
14880		2361	121.25	2195	120.89	-0.36
15269		2361	121.46	2195	121.10	-0.36
15543		2361	121.65	2195	121.29	-0.36
15929		1338	122.52	1338	122.17	-0.35
16291		1338	122.64	1338	122.31	-0.33
16292		1338	122.64	1338	122.31	-0.33
16399		1338	122.65	1338	122.33	-0.32
16400		1338	122.53	1338	122.17	-0.36
16401		1338	123.05	1338	122.88	-0.17
16451		1338	123.03	1338	122.86	-0.17
16452		1338	123.03	1338	122.86	-0.17
16819		1338	123.85	1338	123.77	-0.08
17174		1238	124.51	1238	124.46	-0.05
17383		1238	124.78	1238	124.75	-0.03
17518		1238	124.98	1238	124.95	-0.03
17675		1238	125.19	1238	125.15	-0.04
17711		1238	125.08	1238	125.05	-0.03
17764	SPRING-CYPRESS ROAD					
17817		1238	126.23	1238	126.19	-0.04
17852		1238	126.92	1238	126.88	-0.04
17853		1238	126.82	1238	126.78	-0.04
17854		1238	127.21	1238	127.19	-0.02
17904		1238	127.28	1238	127.25	-0.03
17905		1182	127.35	1182	127.33	-0.02
18312		1182	128.86	1182	128.86	0.00
18754		1182	130.14	1182	130.14	0.00
19012		1182	130.71	1182	130.72	0.01
19617		1062	131.79	1062	131.79	0.00

Table D5: Comparison of Water Surface Elevations (100-Year)
Spring Gully (K131-00-00) *(continued)*

Station	Location	Baseline Condition		Baseline Condition		Difference
		Flow	WSEL	Flow	WSEL	(ft)
20017		1062	132.22	1062	132.23	0.01
20299		1017	132.55	1017	132.55	0.00
20767		1017	132.99	1017	133.00	0.01
20802		1017	132.99	1017	132.99	0.00
20850	PIPELINE CROSSING					
20898		1017	134.08	1017	134.09	0.01
20932		1017	134.36	1017	134.36	0.00
20952		1017	134.37	1017	134.37	0.00
21369		1017	134.54	1017	134.54	0.00
21401		949	134.55	949	134.56	0.01
21458	PIPELINE CROSSING					
21515		949	135.73	949	135.74	0.01
21550		949	135.75	949	135.75	0.00
21570		949	135.76	949	135.75	-0.01
21668		949	135.77	949	135.76	-0.01
21694		949	135.78	949	135.78	0.00
21731		930	135.74	930	135.74	0.00
21837	PINE LAKES BLVD					
21943		930	136.79	930	136.79	0.00
21968		930	137.12	930	137.12	0.00
21990		930	137.12	930	137.12	0.00
22010		930	137.13	930	137.12	-0.01
22301		930	137.17	930	137.17	0.00
22418		930	137.20	930	137.18	-0.02
22803		846	137.26	846	137.25	-0.01
23160		846	137.33	846	137.32	-0.01
23540		846	137.42	846	137.41	-0.01
23921		766	137.51	766	137.51	0.00
24162		766	137.56	766	137.56	0.00
24442		766	137.63	766	137.62	-0.01
24479		766	137.61	766	137.61	0.00
24546	TC JESTER					
24613		720	138.18	720	138.18	0.00
24650		720	138.35	720	138.35	0.00
24670		720	138.36	720	138.36	0.00
25026		720	138.41	720	138.41	0.00
25590		720	138.51	720	138.51	0.00
25591		720	138.51	720	138.51	0.00
25665		720	138.51	720	138.51	0.00
25766	PIPELINE CROSSING					
25867		720	139.08	720	139.08	0.00
25920		720	139.08	720	139.08	0.00

Table D5: Comparison of Water Surface Elevations (100-Year)
Theiss Gully (K131-02-00)

Station	Location	Baseline Condition		Recommended Plan		Difference
		Flow	WSEL	Flow	WSEL	(ft)
1		3701	106.33	3622	106.18	-0.15
200		3701	106.41	3622	106.26	-0.15
500		3701	106.54	3622	106.38	-0.16
1000		3701	106.59	3622	106.43	-0.16
1100		3701	106.52	3622	106.36	-0.16
1101		3701	106.15	3622	106.06	-0.09
1133		3701	111.08	3622	110.90	-0.18
1588		3701	111.17	3622	111.00	-0.17
2026		3375	111.34	3312	111.17	-0.17
2234		3375	111.42	3312	111.26	-0.16
2365		3375	111.49	3312	111.33	-0.16
2369.5	WOODEN BRIDGE					
2373		3375	111.52	3312	111.36	-0.16
2636		3375	111.66	3312	111.51	-0.15
2827		3375	111.76	3312	111.62	-0.14
2929		3375	111.82	3312	111.68	-0.14
2946	SIR WILLIAM ROAD					
2963		3375	112.28	3312	112.13	-0.15
3127		3375	112.42	3312	112.27	-0.15
3341		3375	112.53	3312	112.39	-0.14
3562		3375	112.64	3312	112.51	-0.13
3744		3375	112.76	3312	112.62	-0.14
4128		3067	113.03	3017	112.90	-0.13
4768		3067	113.52	3017	113.40	-0.12
5169		3067	113.92	3017	113.81	-0.11
5346		3067	114.08	3017	113.97	-0.11
5381	LOUETTA ROAD					
5416		3067	114.4	3017	114.27	-0.13
5604		3067	114.68	3017	114.55	-0.13
6004		3067	115.04	3017	114.92	-0.12
6204		2791	115.51	2753	115.39	-0.12
6448		2791	115.88	2753	115.77	-0.11
6473.5	OAKWOOD GLEN DRIVE					
6499		2791	116.59	2753	116.46	-0.13
6698		2791	116.93	2753	116.81	-0.12
6963		2791	117.15	2753	117.03	-0.12
6973		2791	117.06	2753	116.95	-0.11
7000		2791	117.25	2753	117.13	-0.12

Table D5: Comparison of Water Surface Elevations (100-Year)
Theiss Gully (K131-02-00) *(continued)*

Station	Location	Baseline Condition		Recommended Plan		Difference
		Flow	WSEL	Flow	WSEL	(ft)
7070		2791	117.25	2753	117.13	-0.12
7135		2791	116.99	2753	116.88	-0.11
7145		2791	117.27	2753	117.16	-0.11
7281		2791	117.63	2753	117.52	-0.11
7489		2791	117.91	2753	117.80	-0.11
7891		2791	118.41	2753	118.31	-0.10
8303		2537	118.93	2508	118.84	-0.09
8690		2537	119.3	2508	119.21	-0.09
8878		2537	119.5	2508	119.42	-0.08
9032		2537	119.61	2508	119.53	-0.08
9159		2440	119.81	2415	119.73	-0.08
9177.5	STUEBNER-AIRLINE DRIVE					
9196		2440	119.82	2415	119.73	-0.09
9241		2440	119.84	2415	119.75	-0.09
9549		2440	120.4	2415	120.32	-0.08
9856		2172	120.63	2152	120.56	-0.07
9944		2172	120.6	2152	120.52	-0.08
9945		2172	120.58	2152	120.50	-0.08
9946		2172	120.88	2152	120.82	-0.06
9976		2172	120.89	2152	120.83	-0.06
9977		2172	120.82	2152	120.76	-0.06
10058		2172	120.87	2152	120.81	-0.06
10076.5	THEISSWOOD DRIVE					
10095		2172	120.92	2152	120.86	-0.06
10309		2172	121.81	2152	121.75	-0.06
10705		1885	123.73	1870	123.69	-0.04
10894		1885	124.03	1870	123.99	-0.04
11112		1885	124.33	1870	124.30	-0.03
11311		1885	124.8	1870	124.77	-0.03
11713		1593	125.35	1583	125.31	-0.04
12130		1593	126.03	1583	126.00	-0.03
12738		1342	126.63	1336	126.60	-0.03
13134		1342	126.91	1336	126.88	-0.03
13542		1173	127.28	1169	127.25	-0.03
13741		1173	127.41	1169	127.39	-0.02
13895		1173	127.53	1169	127.50	-0.03
13896		1173	127.53	1169	127.50	-0.03
13936		1173	127.52	1169	127.49	-0.03
13980		1173	127.28	1169	127.25	-0.03
14180		1173	129.18	1169	129.15	-0.03
14555		991	131.95	989	131.94	-0.01
15055		991	133.81	989	133.13	-0.68

Table D5: Comparison of Water Surface Elevations (100-Year)
Theiss Gully (K131-02-00) *(continued)*

Station	Location	Baseline Condition		Recommended Plan		Difference
		Flow	WSEL	Flow	WSEL	(ft)
15555		838	134.76	838	133.67	-1.09
16055		838	135.52	838	134.15	-1.37
16555		709	136.37	1027	134.73	-1.64
16760		709	136.81	1027	135.05	-1.76
16965		662	137.62	1117	135.36	-2.26
17170		640	138.69	1164	135.70	-2.99
17185	SPRING CYPRESS ROAD					
17200		640	140.05	1164	135.76	-4.29
17400		640	140.29	1164	136.09	-4.20
17760		640	140.38	1164	136.63	-3.75
17815		640	140.39	1164	136.70	-3.69
17840	SHIMMERING PINES					
17865		640	140.42	1164	136.77	-3.65
17885		640	140.36	1164	136.80	-3.56
18768		640	142.42	1164	137.91	-4.51
18815		640	142.53	1164	137.96	-4.57
18839	VALKA ROAD					
18863		640	142.54	1164	138.02	-4.52
18896		640	142.57	1164	138.06	-4.51
19482		640	143.02	1164	138.72	-4.30
19515		640	143.15	1164	138.75	-4.40
19538	AZALEA ROAD					
19561		640	143.13	1164	138.81	-4.32
19581		640	143.21	1164	138.83	-4.38
20190		687	144.03	633	139.37	-4.66
21395		535	144.29	519	139.79	-4.50
22105		462	144.34	462	140.05	-4.29

3.0 PLAN IMPLEMENTATION AND MANAGEMENT STRATEGIES

Since the remaining undeveloped portions of the Spring Gully watershed is quickly developing, 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. Several of the elements identified within the recommended plan are to relieve existing flooding, while the channel extensions and new channel elements through these undeveloped areas have been identified 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 one area of high quality stream habitat that is to be managed without any structural flood reduction project. The area is from the mouth at the confluence of Cypress Creek to downstream of Cypresswood Road. This channel area of Spring Gully has good natural stream habitat corridor that is beneficial to maintain in its existing condition.

The area contained within this corridor consists of a varying right-of-way width up to 600 feet on the right bank. An additional right-of-way width varying up to 800 feet is required on the left bank for habitat and floodplain preservation. 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. Since 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 alternative 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, easement, or setback. 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. Restrictions would have to be placed on the construction of these facilities so that they did not overly disturb the stream habitat that is to be preserved in the corridors.

3.2 New Lateral Channels/Channel Extensions

There are two channel corridor systems proposed for improvement and extension within the recommended plan. One system consists of the improvement to and extension of K131-00-00 from its confluence with K131-04-00 to the proposed Northpointe Road. This system includes a new lateral (K131#C1) 600 feet south of and parallel to Spring Cypress Road. The other system consists of the K131-02-04 improvements and extension from Northpointe Road upstream to FM2920. The recommended plan proposes a 300-foot right-of–way width along these alignments. This channel corridor width incorporates a channel with a composite, terraced section and allows for multiple uses (see **Figure 1**). Another system proposed is the K131-02-00/K131-02-04. This system runs from the upstream end of the existing improved reach of Theiss Gully, upstream to Northpointe Road. The required right-of-way width for these improvements is 150 feet.

The recommended implementation of the channel corridors 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 proposed right-of-way along the proposed channel corridor alignments. This portion of the right-of-way would be the minimum (approximately 150 feet wide) 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

Two detention facilities were identified within the recommended plan for the Spring Gully watershed. It should be noted that the recommended plan advocates the use of on-site detention as a requirement of development. The facilities K13102#B1 and K131#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. 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 the channels in the Spring Gully watershed. Several of these major thoroughfares have been identified for future expansion or extending within the Spring Gully watershed.

Spring Cypress is a two-lane road that has been identified for future widening as part of the major thoroughfare plan. The existing crossing over K131-02-04 is a single span bridge that was constructed within the past five years. The crossing would be improved with an additional two lanes. If the new structure is designed to pass the recommended plan 100-year flows in the tributary channel (approximately 1881 cfs) with a minimal (less than 0.5') amount of head losses, an opening of approximately 460 square feet will be necessary.

Spring Cypress Road also crosses K131-00-00. At the crossing of K131-00-00, If the new structure is designed to pass the recommended plan 100-year flows in the tributary channel (approximately 1760 cfs) with a minimal (less than 0.5') amount of head losses, an opening of approximately 420 square feet will be necessary.

Stuebner-Airline Road is a two-lane road that has been identified for future widening as part of the major thoroughfare plan. The crossing would be improved with an additional two lanes. The channel has been identified within the recommended plan as a proposed channel corridor. If the new structure is designed to pass the recommended plan 100-year flows in the tributary channel (approximately 780 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 TC Jester is proposed as part of the major thoroughfare plan. This new alignment crosses tributary channel K131-04-00. 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. Using the baseline condition flow, 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 1340 cfs) with a minimal (less than 0.5') amount of head losses, a minimum opening of approximately 320 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. However, the bridge replacements identified within the recommended plan have been included within the cost estimates. 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 $20 million, with the bulk of the cost in voluntary structural buyout, land acquisition, and excavation costs.

Table D6 – Estimated Recommended Plan Costs for Spring Gully

Description	Unit	Quantity	Unit Cost	Cost
1. Mobilization	Each	6	$10,000	$60,000
2. Clearing & Grubbing	Acre	186	$1,500	$278,400
3. Excavation & Haul	Ac-Ft	977	$5,000	$4,884,000
4a. Bridge Concrete Installation	S.F.	10800	$60	$648,000
4b. Weir Concrete Installation	S.F.	9000	$60	$540,000
5a. Culvert Boxes	L.F.	720	$600	$432,000
5b. Culvert Pipes	L.F.	200	$100	$20,000
6. Drop/Control Structures	L.S.	2	$100,000	$200,000
7. Backslope Drains	Each	37	$3,000	$111,000
8. Utilities Relocation	Each	0	$100,000	$0
9. Right-of-Way	Acre	178	$15,000	$2,673,000
10. Seeding & Mulching	Acre	186	$1,000	$185,600
11. Tree/Shrub Planting	Acre	17.3	$10,000	$173,000
SUB TOTAL				$10,205,000
Contingencies (15%)				$1,530,750
Engineering and Administration (10%)				$1,173,580
SUBTOTAL CONSTRUCTION COST				$12,909,330
VOLUNTARY STRUCTURAL BUYOUT				$0
STREAM HABITAT PRESERVATION CORRRIDOR				$240,000
TOTAL				**$13,149,330**

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 implementing projects that result in flood reduction benefits to existing flood-prone structures. In the Spring Gully watershed this would mean a priority for the Theiss Gully channel section between Station 150+55 and Northpointe Road and K13102#B1. This would also apply to the

detention basin K131#B1 within along the lower portions of Spring Gully. 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 upstream extension of K131-02-04, upstream extension of K131-00-00, and K131#C1 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 floodplain preservation area south of Cypresswood Drive and the voluntary buyouts would fit this category.

The Spring Gully watershed does have current flooding problems near it confluence with Cypress Creek and along Theiss Gully. The first priority category of the recommended plan should be implemented when possible to relieve some of the existing flooding problems. The second and final priority categories can be delayed until there is development pressure on areas slated for improvements. The recommended plan is estimated to take approximately two years to implement. The order of implementation would be to construct the upper Theiss Gully channel improvements and K13102#B1 within the first year of implementation. The proposed detention facility K131#B1 would be constructed as soon as land is acquired. The channel corridors for K131-02-04, K131-00-00, and K131#C1 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.

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.

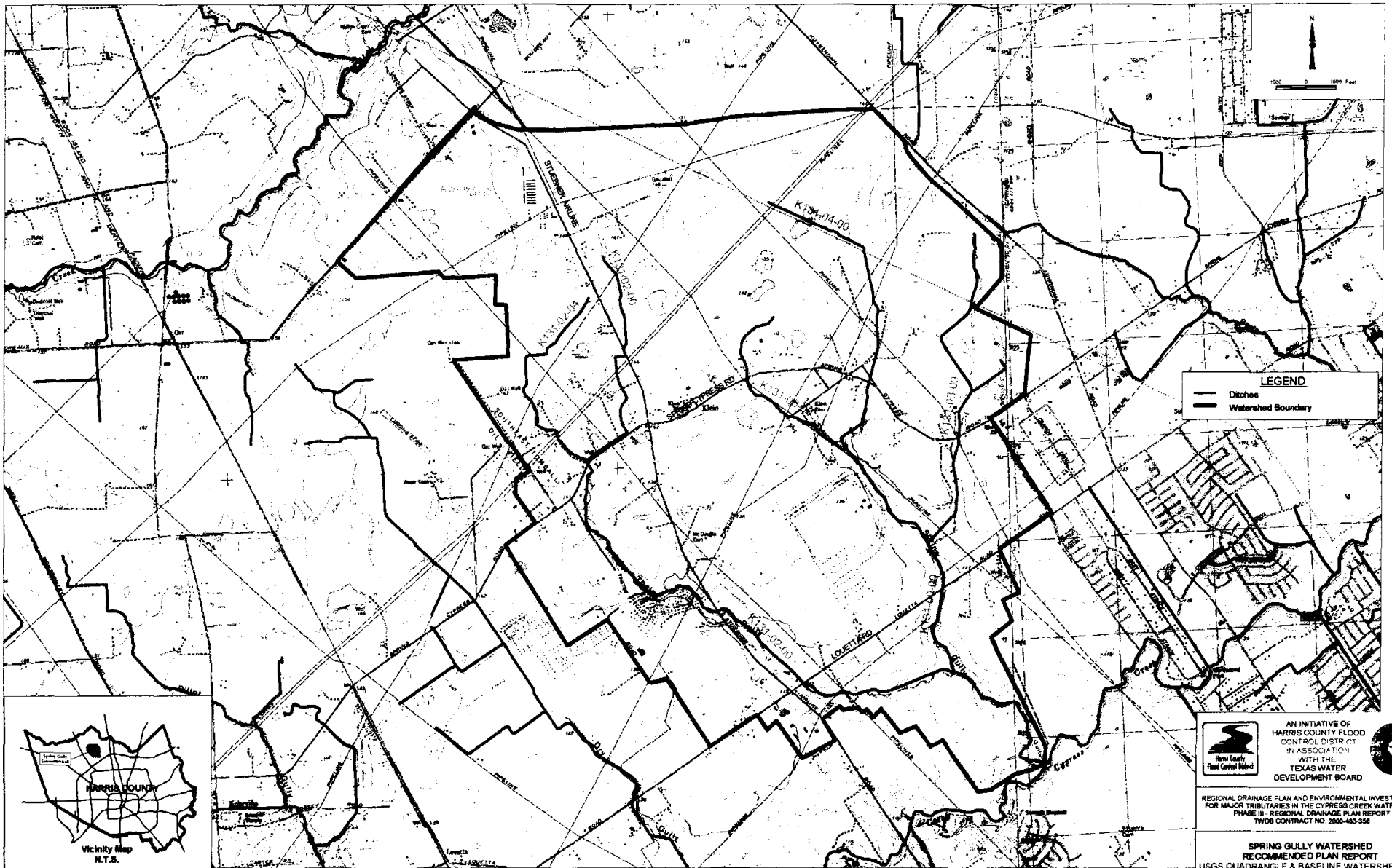
Harris County currently has a Parks & Recreation Master Plan that identifies corridors for proposed bikeway trails. Several of these proposed corridors are within the Spring Creek watershed and it may be possible to extend the bikeways from Cypress Creek into desirable portions of the watershed using 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 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, preservation and enhancement of stream habitat and water quality, opportunities for multiple-use, 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 to the extent 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 Spring Gully watershed. It is estimated, once begun, it would take approximately two years to implement the entire plan, with an average expenditure of $9.9 million per year.

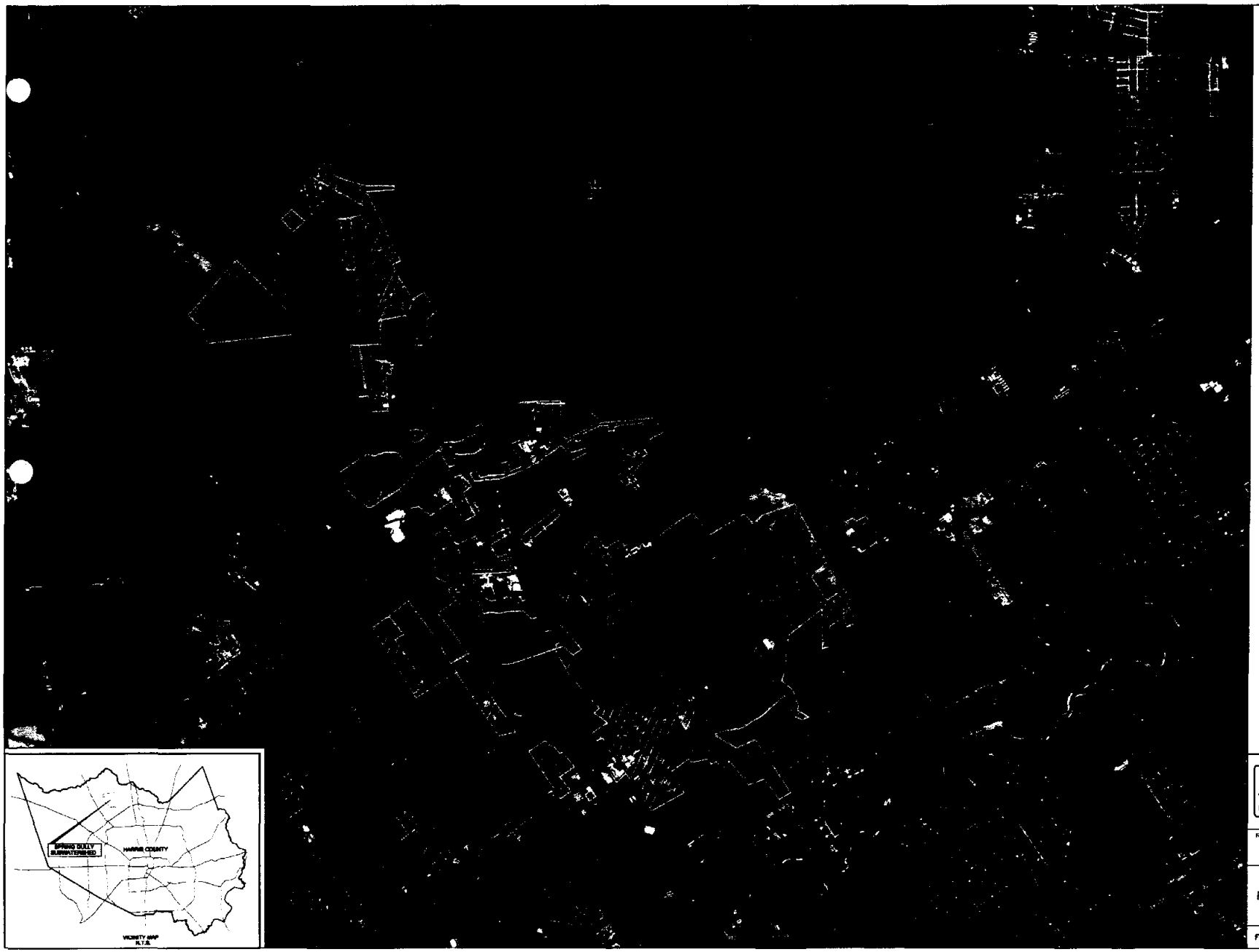


AN INITIATIVE OF
HARRIS COUNTY FLOOD
CONTROL DISTRICT
IN ASSOCIATION
WITH THE
TEXAS WATER
DEVELOPMENT BOARD

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

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

FEBRUARY 2003	K131-00-00	EXHIBIT D1



0 1500 3000
SCALE IN FEET

LEGEND

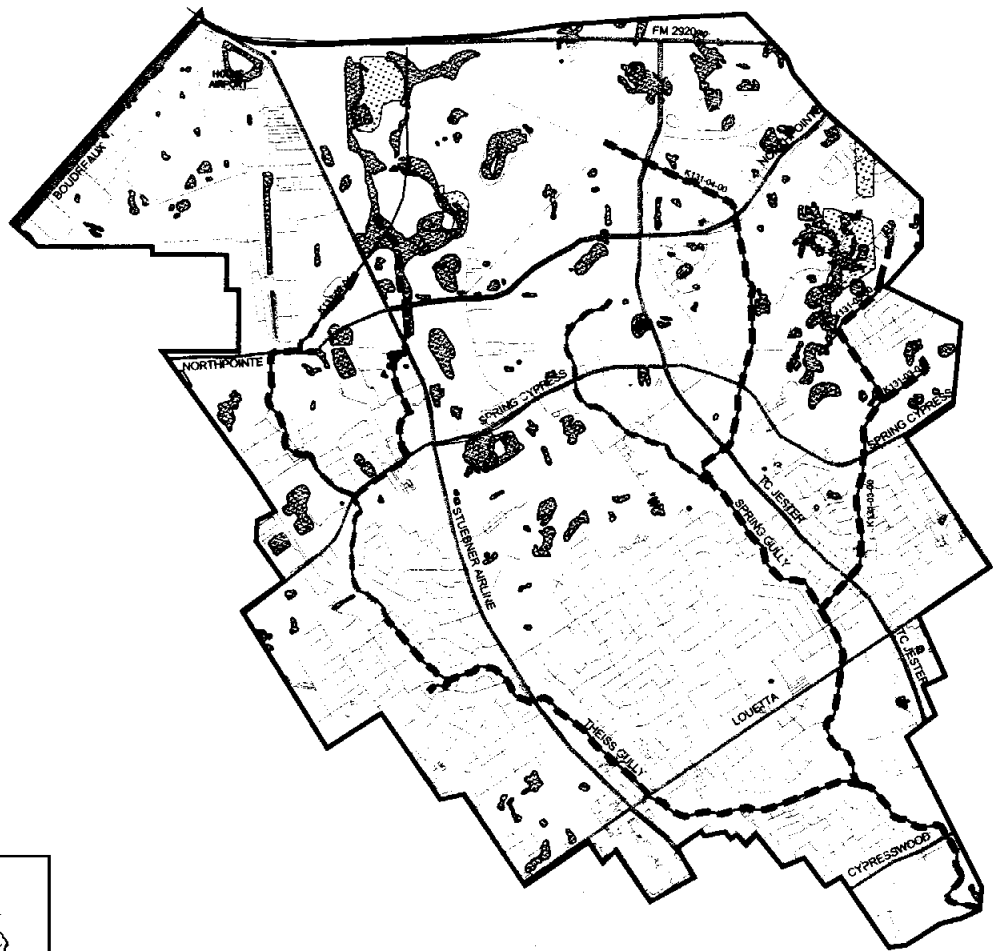
- Street
- Major Road
- Stream
- Watershed Boundary
- Recommended Plan Sub Watershed Boundary
- 1984 Developed Areas
- HCFCD Right-Of-Way
- Hydrologic Nodal Points

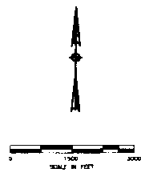
AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

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

SPRING GULLY WATERSHED REGIONAL DRAINAGE PLAN REPORT 1999 AERIAL WATERSHED MAP

FEBRUARY 2003	K131-00-00	EXHIBIT 32



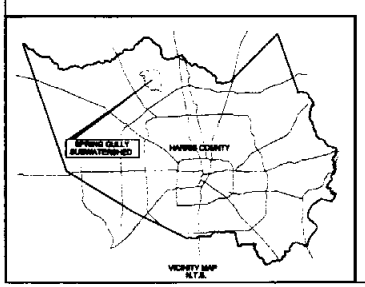


LEGEND

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

STREAM HABITAT QUALITY

- Low
- Medium
- High

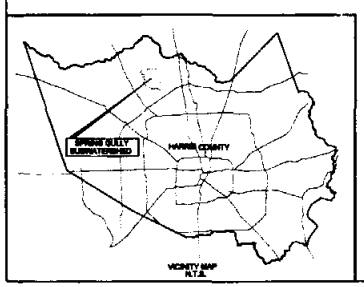


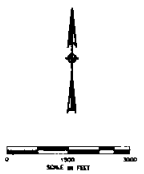
AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

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

SPRING GULLY WATERSHED REGIONAL DRAINAGE PLAN REPORT ENVIRONMENTAL CONSIDERATIONS

FEBRUARY 2003	K131-00-00	EXHIBIT B3





LEGEND

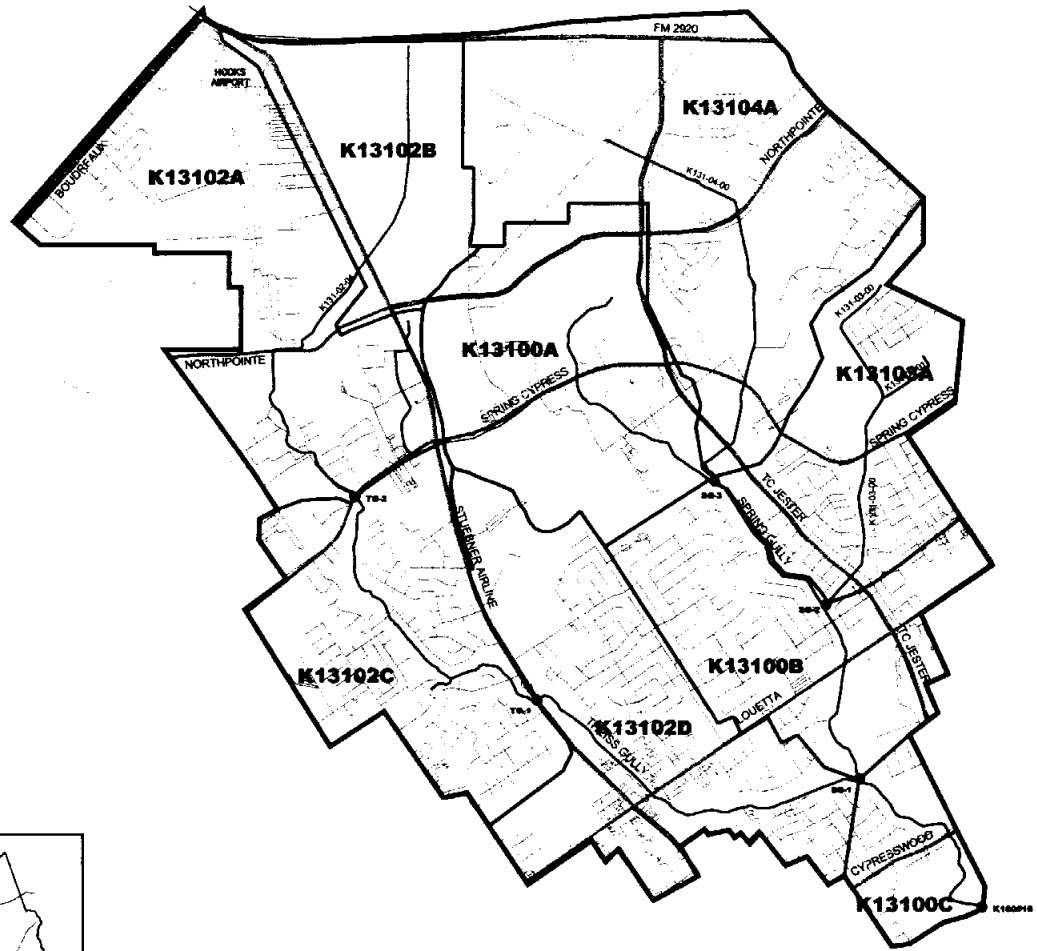
- AREAS OF DOCUMENTED FLOOD DAMAGE
- COMMENTS FROM PUBLIC MEETINGS
- (10) AREAS OF POTENTIAL STRUCTURAL FLOODING
- STREAMS ALIGNMENTS
- MAJOR ROADWAYS
- STREETS
- BASELINE FLOODPLAIN
- WATERSHED BOUNDARY

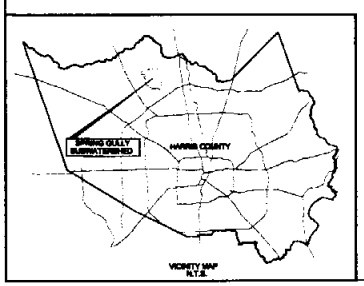
AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

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

SPRING GULLY WATERSHED REGIONAL DRAINAGE PLAN REPORT STRUCTURAL FLOODING CONCERNS

FEBRUARY 2003	K131-00-00	EXHIBIT: D4





LEGEND

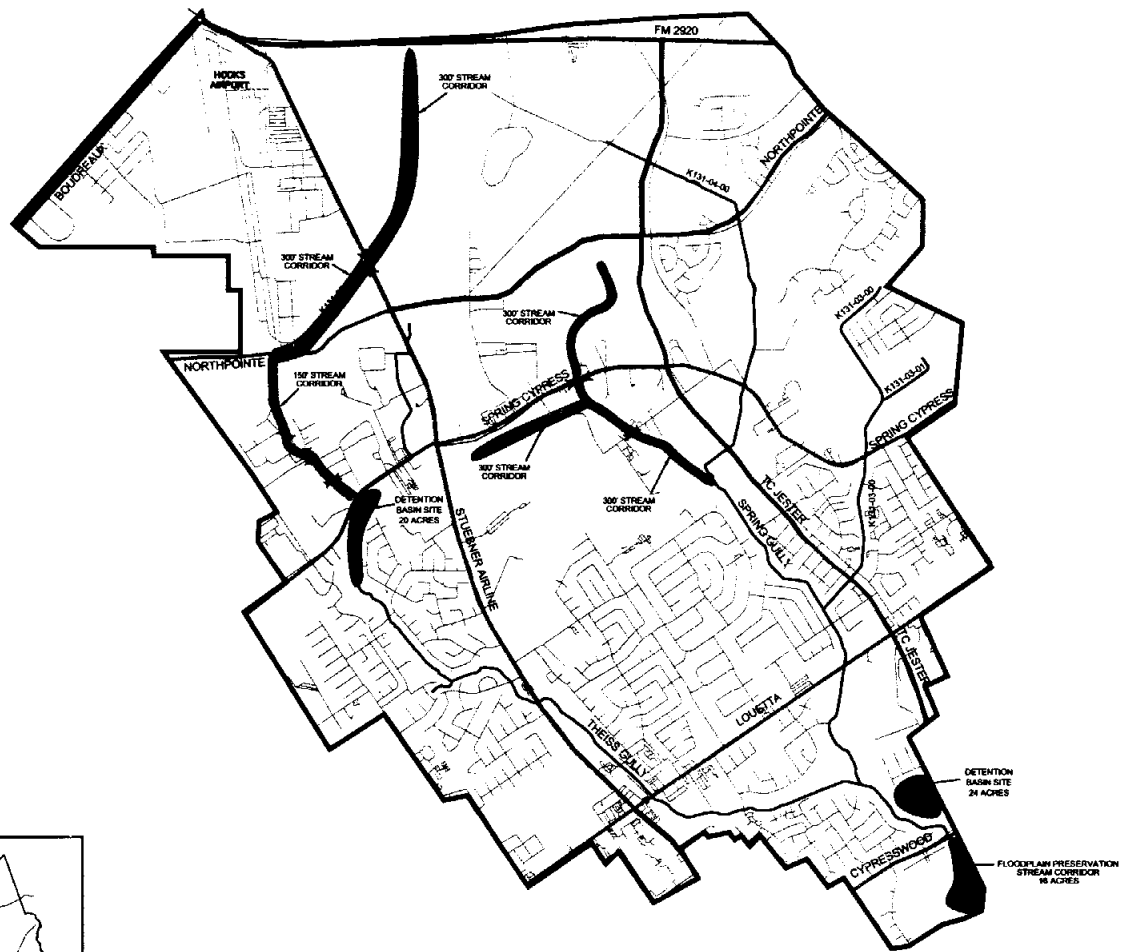
- Street
- Major Road
- Stream
- Watershed Boundary
- Recommended Plan Sub Watershed Boundary
- Baseline Report Sub Watershed Boundary
- Hydrologic Nodal Points

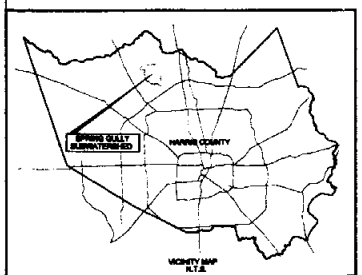
AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

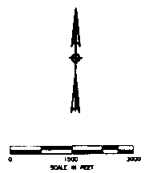
REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO. 2000-483-358

SPRING GULLY WATERSHED REGIONAL DRAINAGE PLAN REPORT WATERSHED DELINEATION COMPARISON

FEBRUARY 2003	K131-00-00	EXHIBIT 35







LEGEND

- Street
- Major Road
- Stream
- Watershed Boundary

PLAN COMPONENTS

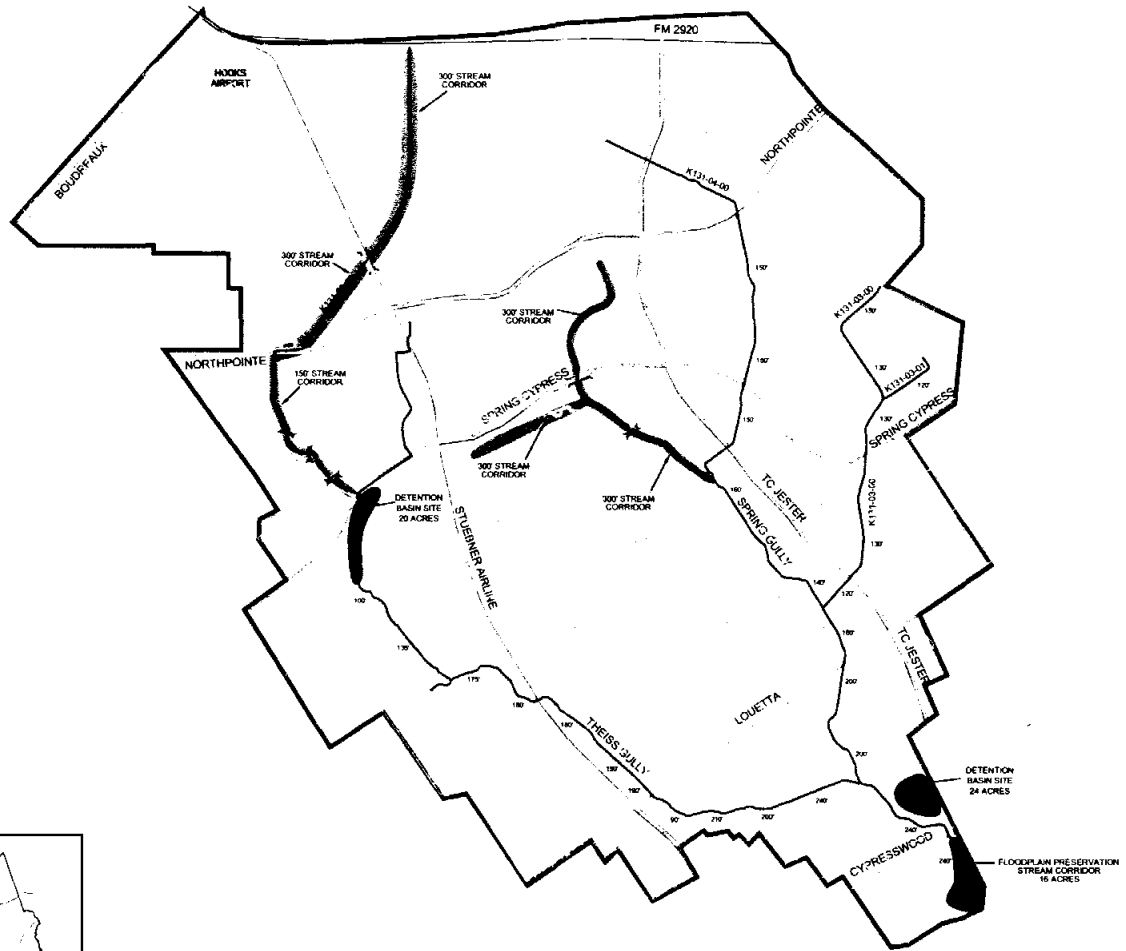
- Proposed Detention Basin
- Proposed Channel Corridor
- Proposed Floodplain/Stream Habitat Preservation
- Voluntary Buyout of Historic Flood Prone Structures
- Proposed Bridge Modification

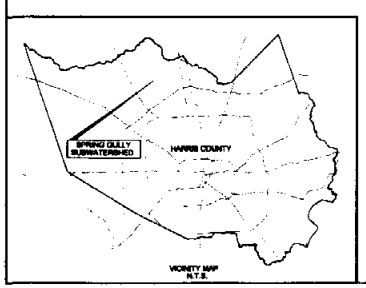
AN INITIATIVE OF HARRIS COUNTY FLOOD CONTROL DISTRICT IN ASSOCIATION WITH THE TEXAS WATER DEVELOPMENT BOARD

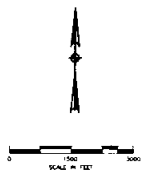
REGIONAL DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
PHASE III - REGIONAL DRAINAGE PLAN REPORT
TWDB CONTRACT NO. 2000-483-358

SPRING GULLY WATERSHED REGIONAL DRAINAGE PLAN REPORT COMBINED ALTERNATIVES FEATURES

FEBRUARY 2003	K131-00-00	EXHIBIT: D6







LEGEND

- Street
- Major Road
- Stream
- Watershed Boundary

PLAN COMPONENTS

- Proposed Detention Basin
- Proposed Channel Corridor
- Proposed Floodplain/Stream Habitat Preservation
- Voluntary Buyout of Historic Flood Prone Structures
- Proposed Bridge Modification

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

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SPRING GULLY WATERSHED REGIONAL DRAINAGE PLAN REPORT RECOMMENDED PLAN FEATURES

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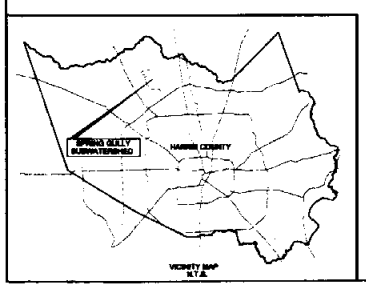
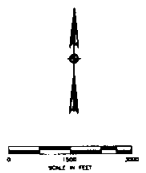




LEGEND

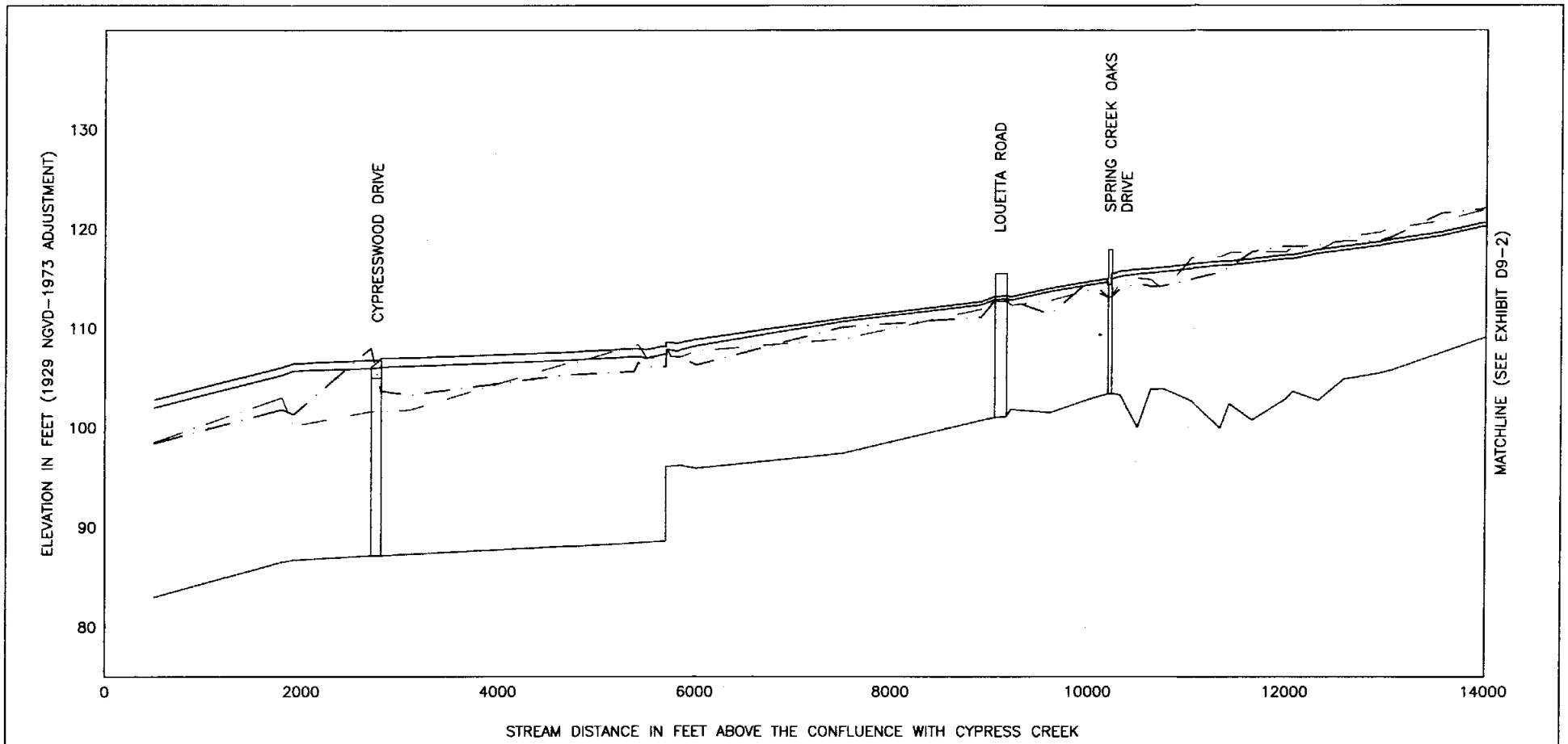
- Street
- Major Road
- Stream
- Watershed Boundary
- Baseline Floodplain
- Recommended Plan Floodplain

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

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

FEBRUARY 2003	K131-00-00	EXHIBIT 28



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

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PHASE III - REGIONAL DRAINAGE PLAN REPORT
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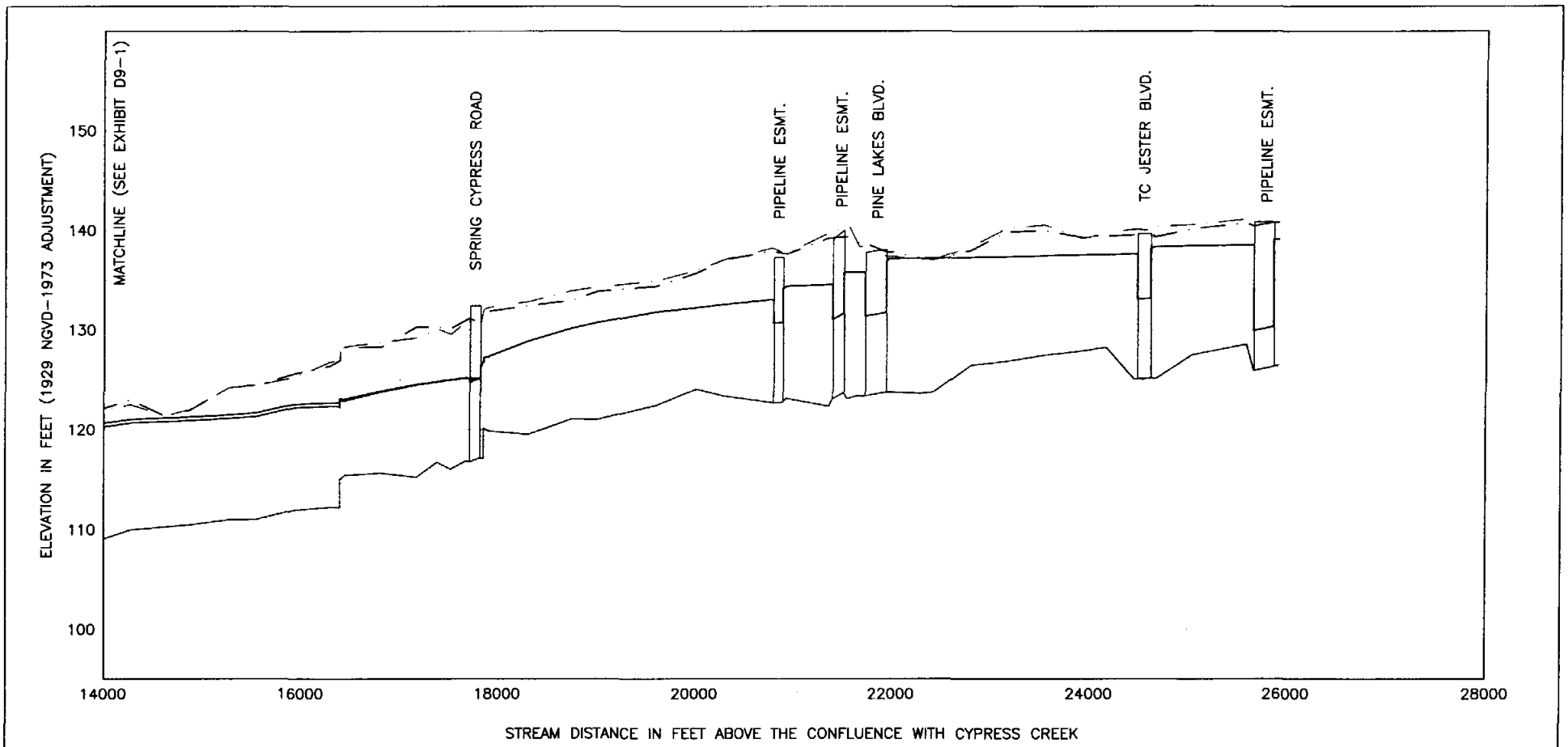
SPRING GULLY WATERSHED
REGIONAL DRAINAGE PLAN REPORT
SPRING GULLY WATER SURFACE PROFILES
BASELINE AND RECOMMENDED PLAN

FEBRUARY 2003	K131–00–00	EXHIBIT: D9–1



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

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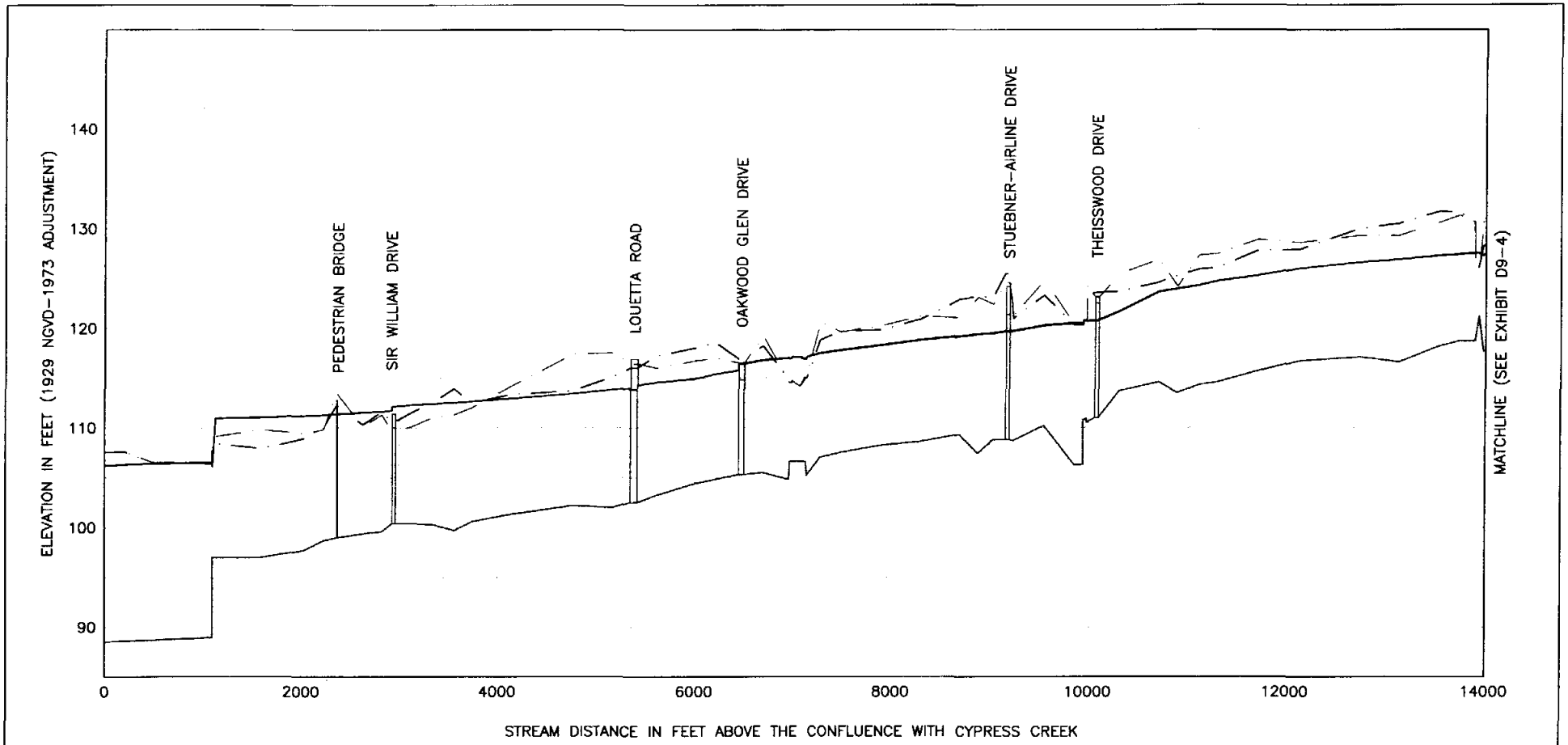
BASELINE AND RECOMMENDED PLAN

FEBRUARY 2003	K131-00-00	EXHIBIT: D9-2



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

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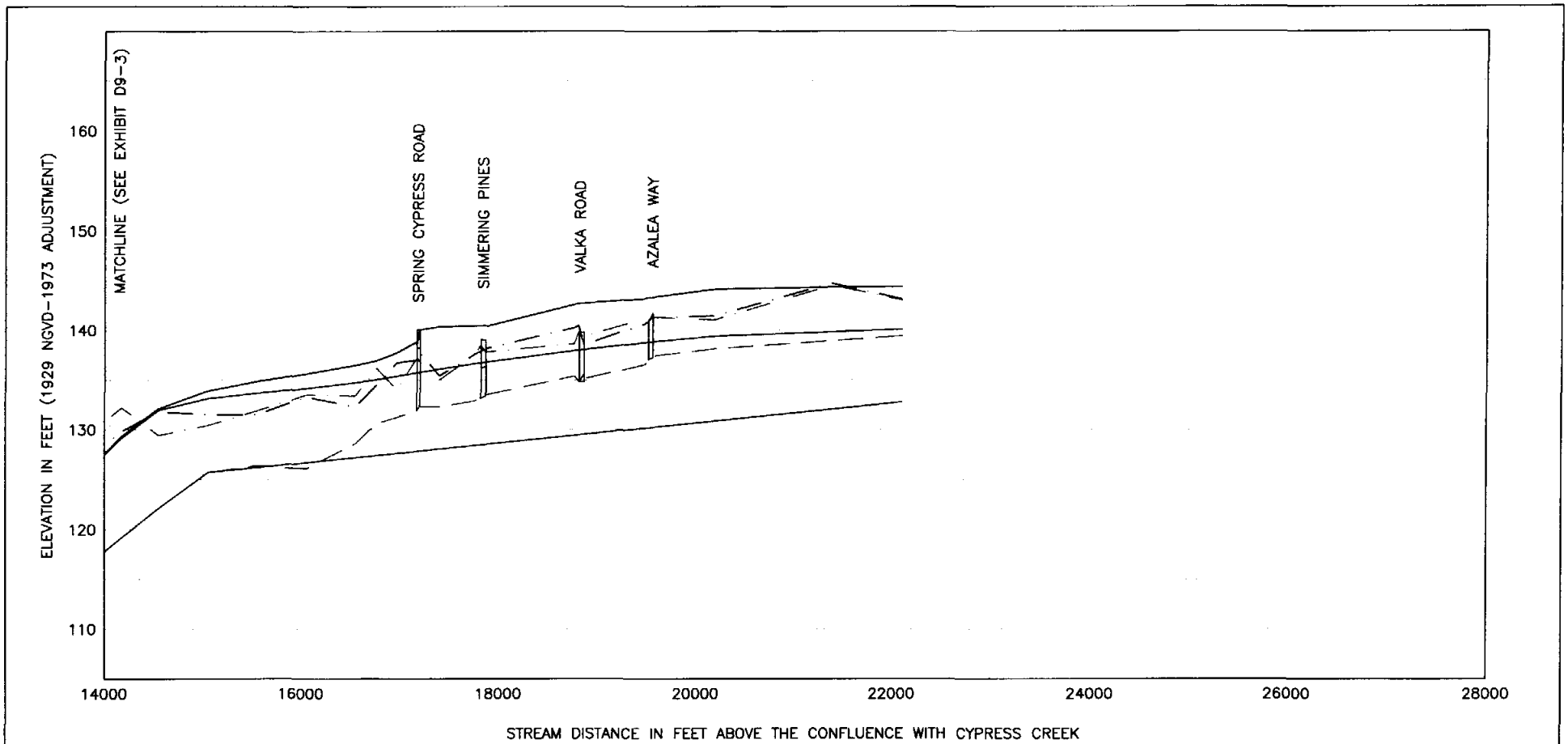
THEISS GULLY WATER SURFACE PROFILES
BASELINE AND RECOMMENDED PLAN

FEBRUARY 2003	K131-02-00	EXHIBIT: D9-3



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

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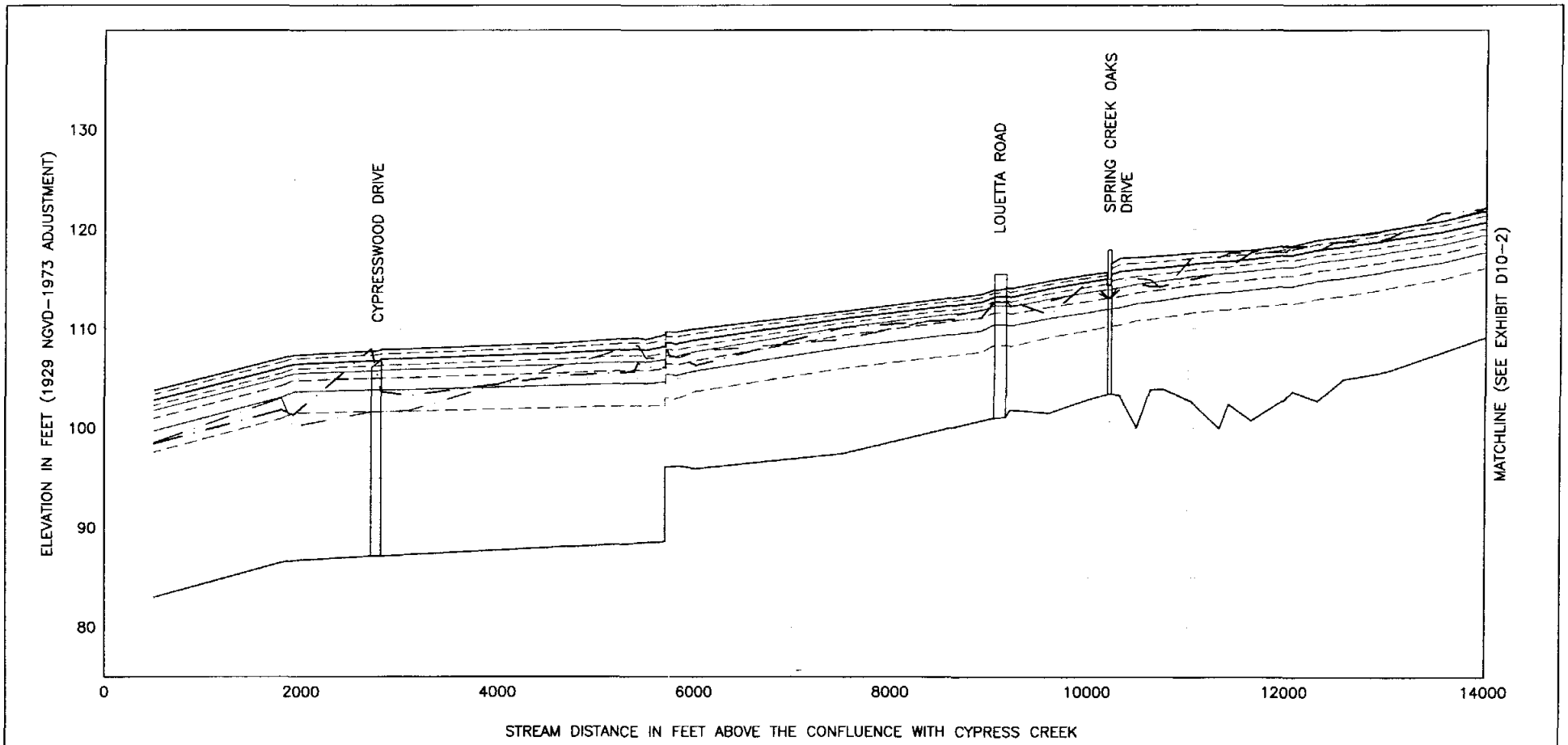
THEISS GULLY WATER SURFACE PROFILES
BASELINE AND RECOMMENDED PLAN

FEBRUARY 2003	K131-02-00	EXHIBIT: D9-4



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

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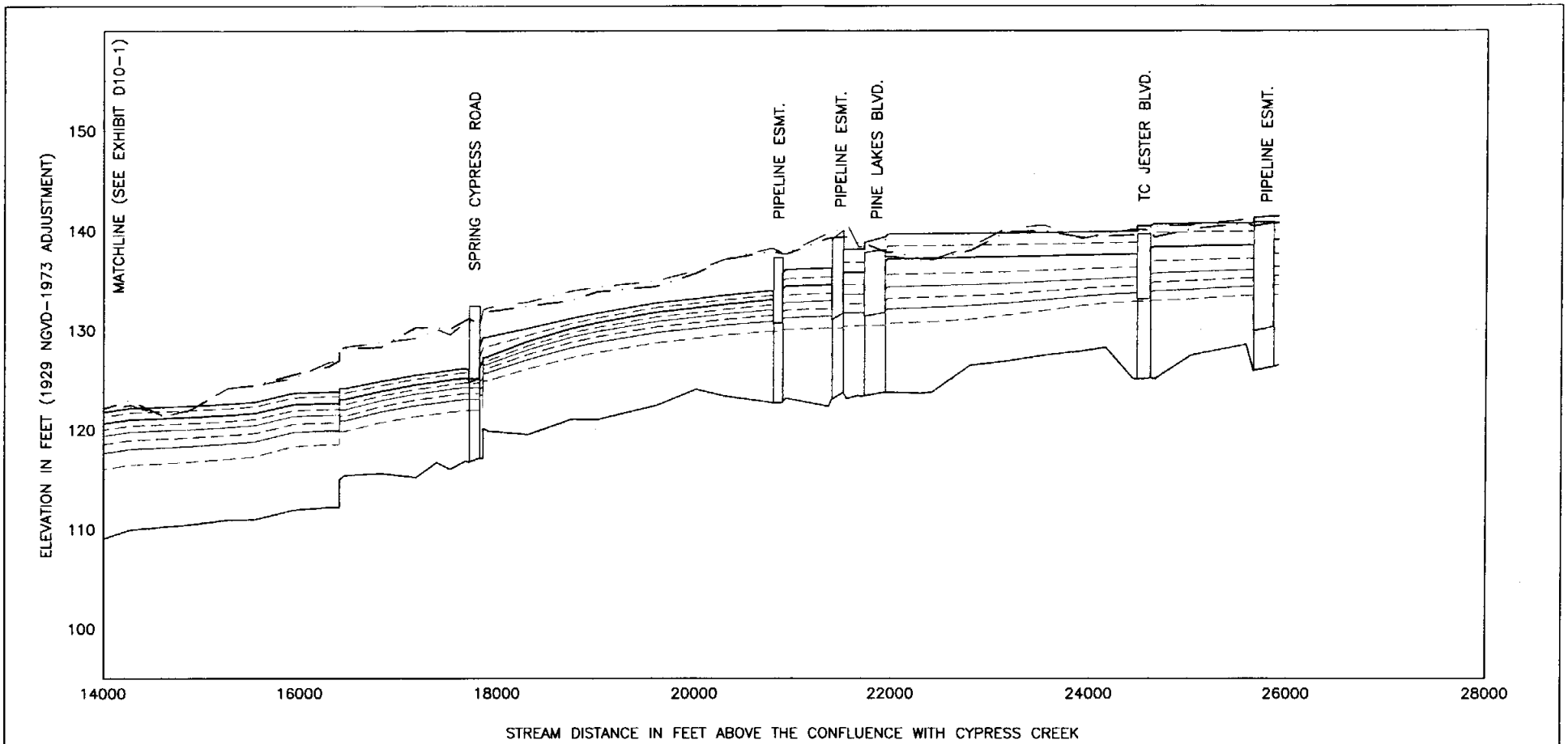
BASELINE CONDITION MULTIPLE FREQUENCIES

FEBRUARY 2003	K131–00–00	EXHIBIT: D10–1



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

Harris County Flood Control District

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

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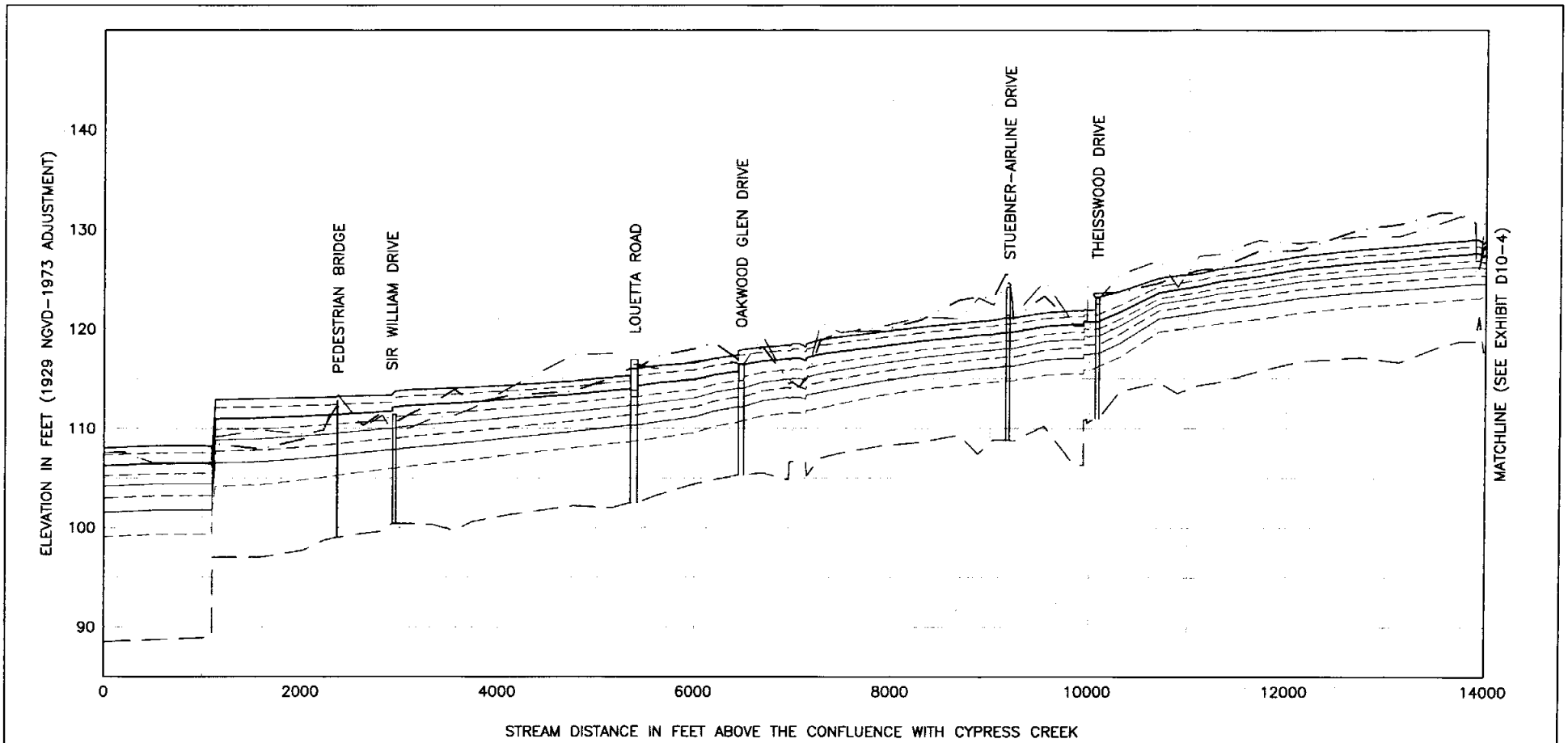
SPRING GULLY WATER SURFACE PROFILES
BASELINE CONDITION MULTIPLE FREQUENCIES

FEBRUARY 2003	K131-00-00	EXHIBIT: D10-2



LEGEND

WATER SURFACE PROFILES

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

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

DRAINAGE PLAN AND ENVIRONMENTAL INVESTIGATION FOR MAJOR TRIBUTARIES IN THE CYPRESS CREEK WATERSHED
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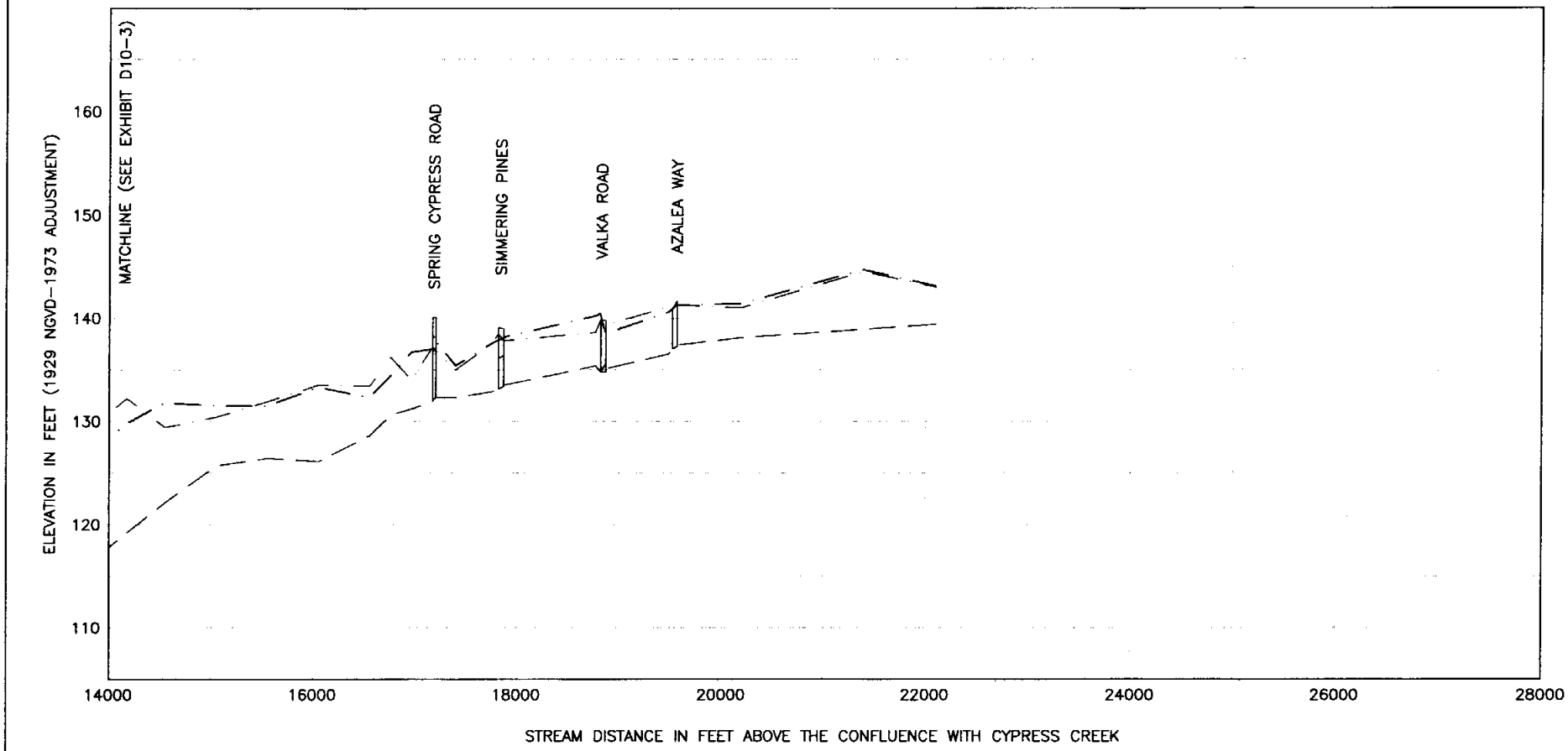
FEBRUARY 2003	K131-02-00	EXHIBIT: D10-3



LEGEND

WATER SURFACE PROFILES

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

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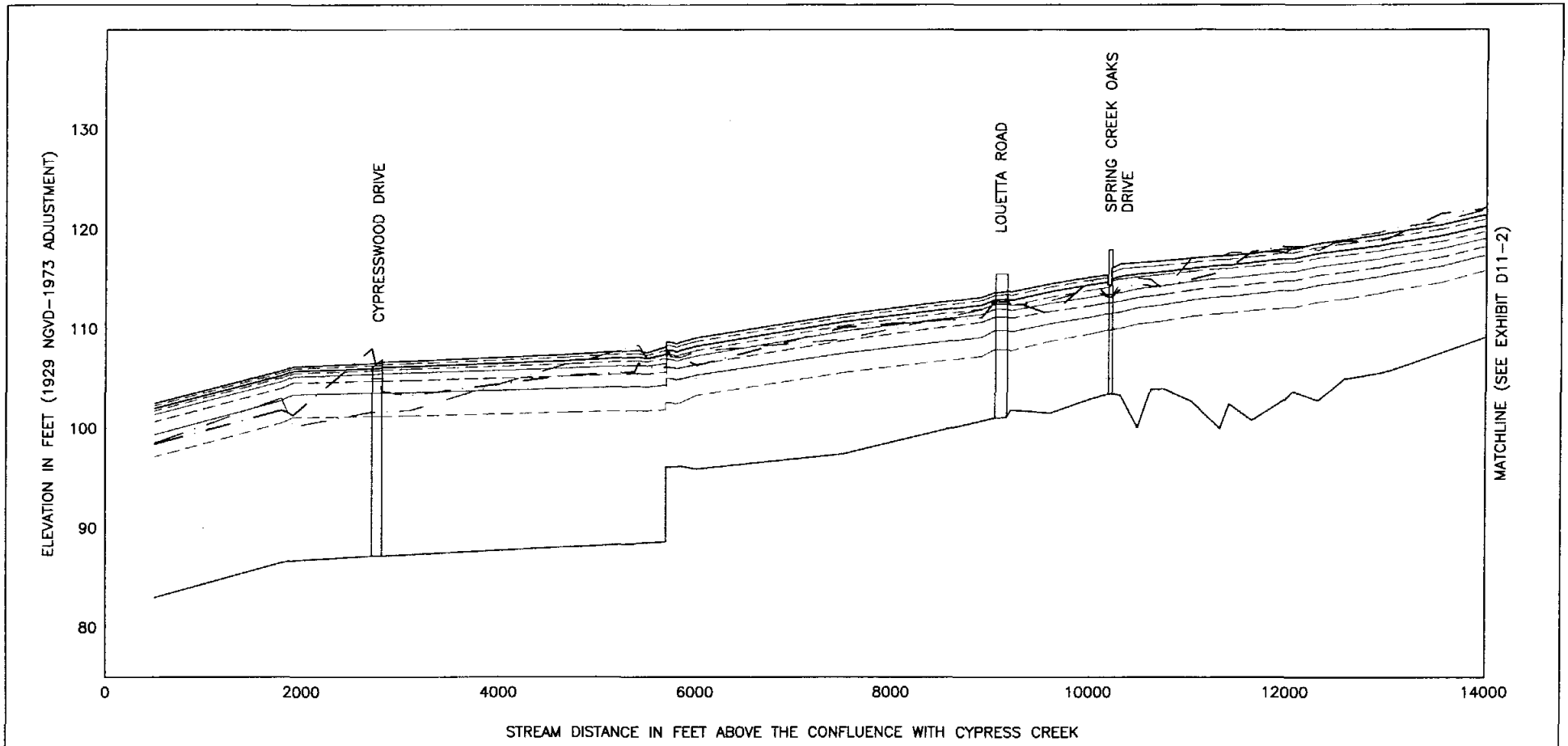
FEBRUARY 2003	K131-02-00	EXHIBIT: D10-4



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

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RECOMMENDED PLAN MULTIPLE FREQUENCIES

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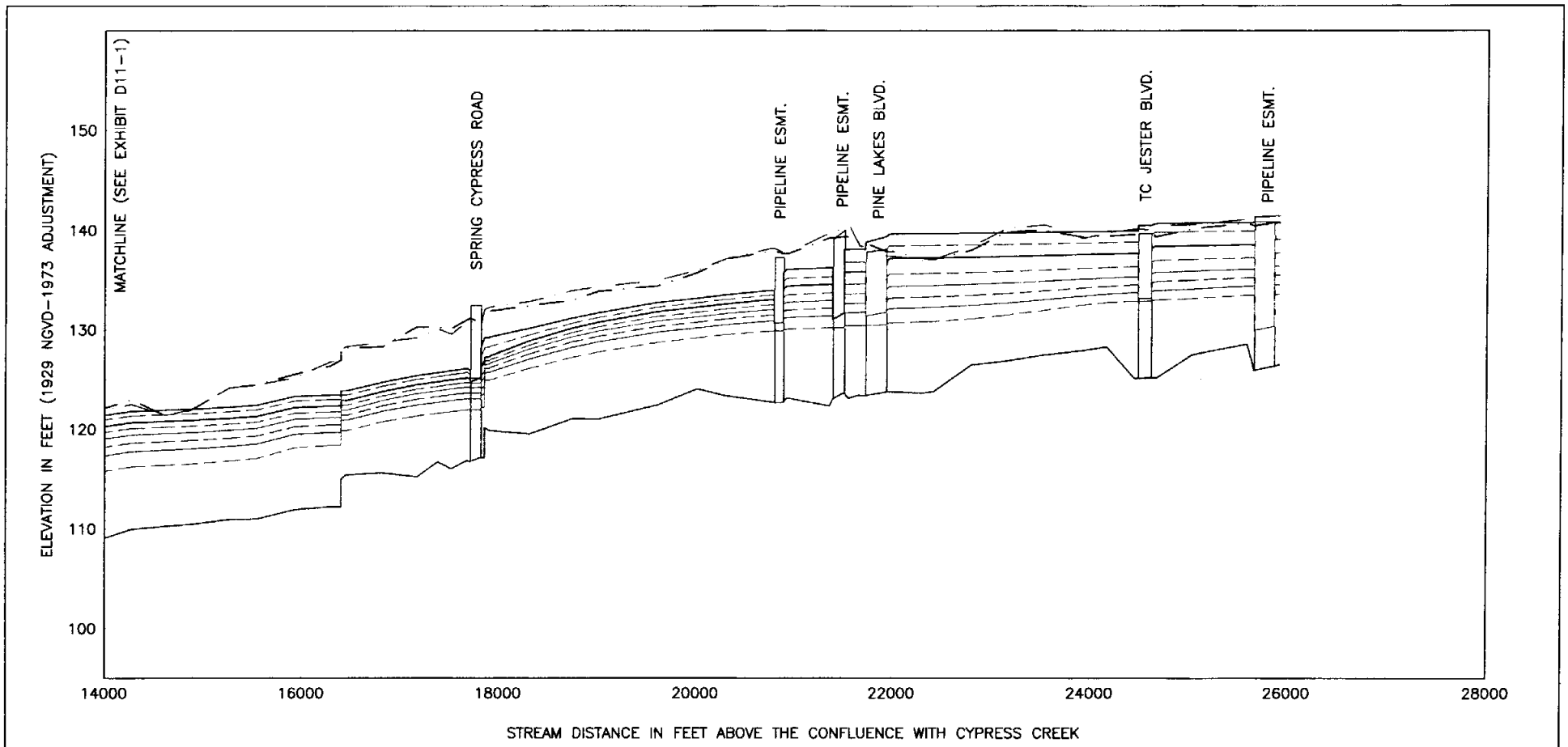

LEGEND

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

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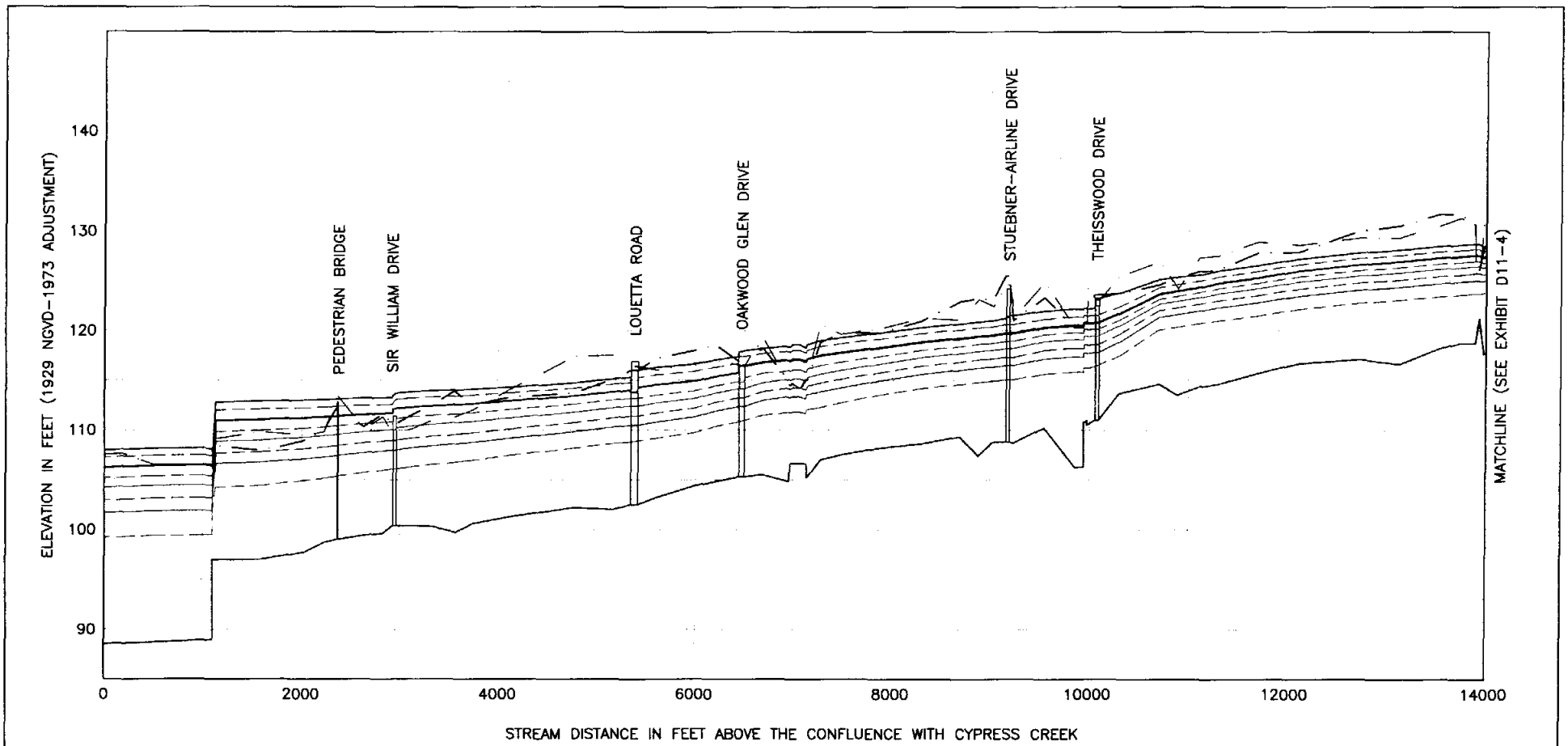

LEGEND

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

Harris County Flood Control District

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

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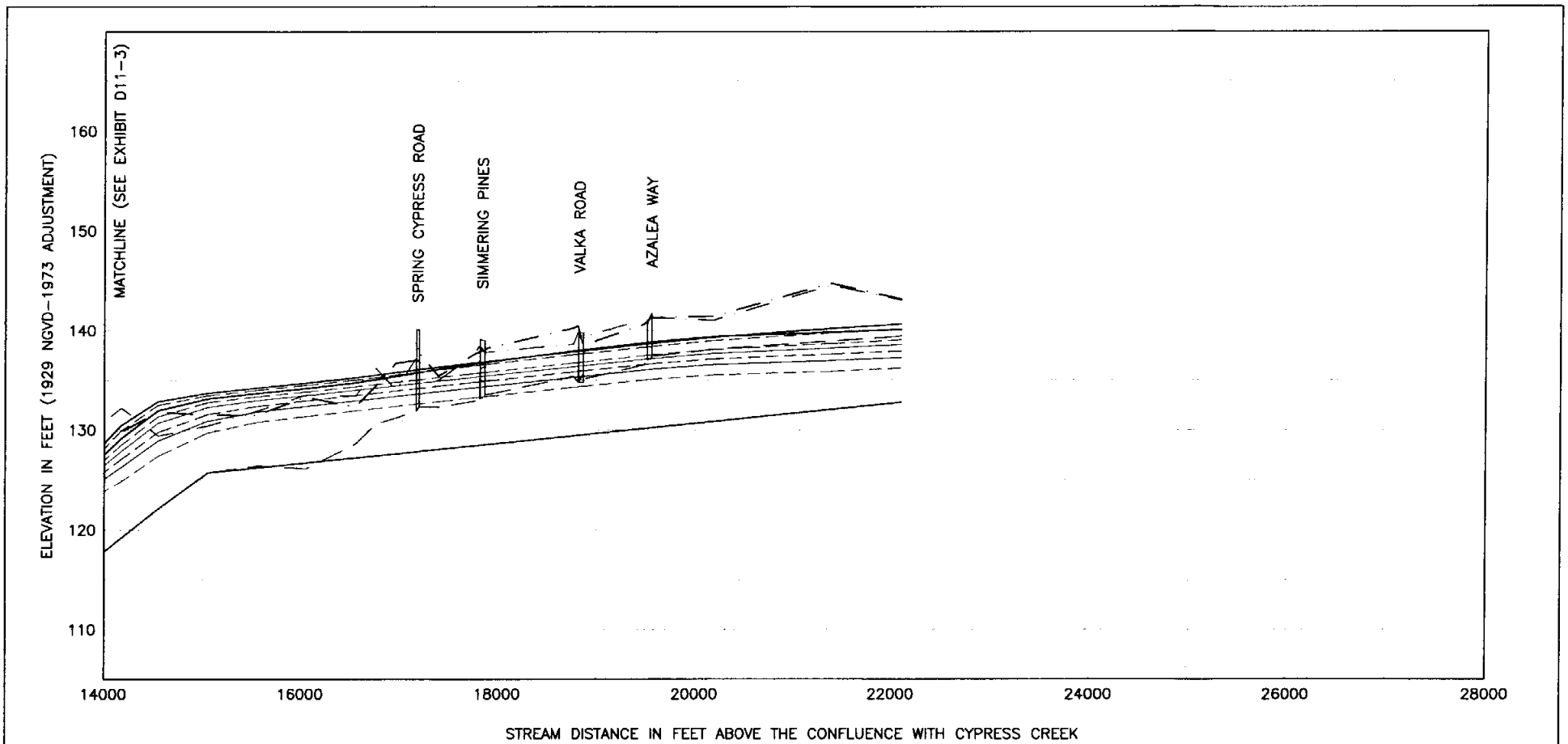

LEGEND

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

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FEBRUARY 2003	K131-02-00	EXHIBIT: D11-4

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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:	
K133B02.ih1	Baseline Conditions 2-year Flows
K133B05.ih1	Baseline Conditions 5-year Flows
K133B10.ih1	Baseline Conditions 10-year Flows
K133B25.ih1	Baseline Conditions 25-year Flows
K133B50.ih1	Baseline Conditions 50-year Flows
K133B100.ih1	Baseline Conditions 100-year Flows
K133B250.ih1	Baseline Conditions 250-year Flows
K133B500.ih1	Baseline Conditions 500-year Flows

ELECTRONIC FILES *(continued)*

File Name:	Description
HEC-1 Models:	
K133R2.ih1	Recommended Plan 2-year Flows
K133R5.ih1	Recommended Plan 5-year Flows
K133R10.ih1	Recommended Plan 10-year Flows
K133R25.ih1	Recommended Plan 25-year Flows
K133R50.ih1	Recommended Plan 50-year Flows
K133R100.ih1	Recommended Plan 100-year Flows
K133R250.ih1	Recommended Plan 250-year Flows
K133R500.ih1	Recommended Plan 500-year Flows
HEC-RAS Models:	
K133.prj	Project File – Dry Gully
K133.p05	Baseline Multiprofile Plan – Dry Gully
K133.p04	Recommended Multiprofile Plan – Dry Gully

1.0 INTRODUCTION

The information presented in this appendix report intends to document the process of developing the recommended regional drainage plan for the Dry 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 Dry Gully watershed is included in this report.

1.1 Project Location

The Dry 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 in **Exhibit 1** of the main text report. The 5.3-square mile watershed drains in a southerly direction from Boudreaux Road to Cypress Creek. As seen in **Exhibit E1** and **Exhibit E2**, the watershed is bounded by Boudreaux Road on the north, the BNRR Railroad on the west, Theiss Mail Road on the east, and Cypress Creek on the south.

The Dry Gully watershed includes one main stem (K133-00-00) and several tributary ditches constructed to serve development in the watershed. Only the main stem of Dry Gully was studied as part of the FEMA Flood Insurance Study (FIS) for Harris County and is the subject of this report. The main stem of Dry Gully bisects several transportation arterials including Spring-Cypress Road, Louetta Road, and Cypresswood Drive. The main stem has a studied length of approximately 2.8 miles and outfalls into Cypress Creek just downstream of Champion Forest Drive.

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 Dry Gully watershed is one of the nine watersheds. The studies conducted within the Dry Gully watershed at varying levels are identified in Appendix E 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 E1,** with the existing development conditions shown on **Exhibit E2**. 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 Dry Gully watershed.

An assessment of the environmental baseline conditions of the Dry 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. Environmental considerations for the Dry Gully watershed are shown on **Exhibit E3**.

1.3 Flood Hazard

Flood hazards along Dry 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 one-percent 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 E8**.

1.4 Summary of Baseline Conditions

The results of the Phase I study efforts show slight differences between the hydraulic baseline conditions and the current effective Federal Emergency Management Agency conditions. The information prepared in the identification of the hydrologic and hydraulic baseline conditions flood, and the 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 Dry 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 study area of Dry Gully is part of the Cypress Creek drainage basin. The Dry Gully watershed drains an area of approximately 5.3 square miles in northwest Harris County in a southerly direction from Boudreaux Road to Cypress Creek. The watershed is bounded by Boudreaux Road on the north, the BNRR Railroad on the west, Theiss Mail Road on the east, and Cypress Creek on the south. The entire watershed is in the unincorporated areas of Harris County.

The watershed has a southerly overland slope. The natural ground in the watershed is highest in the vicinity of Boudreaux Road by the Hooks Memorial Airport in the northeastern corner of the watershed with an elevation of approximately 157 feet above mean sea level. The lowest point in the watershed can be found at the area by the confluence of Dry Gully and Cypress Creek with an elevation of approximately 107 feet above mean sea level.

The southern two-thirds of the watershed, downstream of Spring-Cypress Road, is almost completely urbanized with single-family subdivisions. Upstream of Spring-Cypress Road, the watershed is not completely developed; however, this portion of the watershed has been designated as part of the master-planned community of Gleannloch Farms Subdivision and is under continual development.

This analysis used the baseline conditions model and modified, accordingly, the hydrologic parameters of each subarea to reflect alternative plan conditions. Where necessary, a baseline condition subarea was further subdivided in order to more accurately model particular plan elements. The Dry Gully watershed subareas can be described as follows:

- K133A – Upstream subarea of the watershed (2254 acres), includes areas upstream of Spring-Cypress Road;
- K133B – Midreach subarea of the watershed (1394 acres), includes areas between Spring-Cypress Road and Louetta Road; and,
- K133C – Downstream subarea of the watershed (489 acres), includes areas between Louetta Road and the confluence with Cypress Creek.

Subarea K133A was initially delineated as 1535 acres within the baseline condition report. However, because of the Gleannloch Farms Subdivision, this area has been delineated as 2254 acres. This additional acreage is taken from the Theiss Gully (HCFCD Unit K131-02-00) watershed. Dry Gully drains into Cypress Creek (HCFCD Unit K100-00-00) just downstream of Champions Forest Drive. **Exhibit E2** shows Spring Gully Watershed subareas with location and station of each routing node along with sub-basin names.

2.2.1 Stream Identification

The Dry Gully watershed includes one main stem Dry Gully (K133-00-00) and two laterals K133-03-00 and K133-04-00. Both of these laterals have been rectified to serve existing development within the watershed. As noted earlier, only Dry Gully was the subject of the previous baseline study. Dry Gully has a studied length of approximately 3.4 miles, which runs from the stream confluence with Cypress Creek to upstream of Spring-Cypress Road.

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 E3**. 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