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BUFFALO BAYOU AND TRIBUTARIES, TEXAS

COMMUNICATION

FROM

THE ASSISTANT SECRETARY OF THE ARMY  
(CIVIL WORKS)

TRANSMITTING

A CORPS OF ENGINEERS REPORT ON BUFFALO BAYOU AND TRIBU-  
TARIES, TEXAS, IN PARTIAL RESPONSE TO A RESOLUTION OF THE  
HOUSE COMMITTEE ON PUBLIC WORKS ADOPTED APRIL 20, 1948



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LETTER OF TRANSMITTAL



DEPARTMENT OF THE ARMY  
OFFICE OF THE ASSISTANT SECRETARY  
WASHINGTON, D.C. 20310

3 AUG 1979

Honorable Thomas P. O'Neill, Jr.  
Speaker of the House of Representatives  
Washington, D. C. 20515

Dear Mr. Speaker:

I am transmitting herewith a favorable report dated 13 June 1978 from the Chief of Engineers, Department of the Army, on Buffalo Bayou and Tributaries, Texas, together with other pertinent reports. The report has been prepared in partial response to a resolution of the Committee on Public Works of the United States House of Representatives, adopted 20 April 1948.

The views of the Governor of Texas; the Departments of the Interior; Agriculture; Commerce; Health, Education and Welfare; and the Environmental Protection Agency are set forth in the enclosed communications. The Environmental Statement required by the Environmental Policy Act of 1969 has been submitted to the Environmental Protection Agency.

The President, in his June 6, 1978 water policy message to Congress, proposed several changes in cost sharing for water resources projects to allow states to participate more actively in project implementation decisions and to equalize cost sharing between structural and non-structural flood control projects. The changes include a cash contribution from benefiting states of 5% of construction (first) costs associated with non-vendible outputs and 10% of costs associated with vendible outputs. The President also proposed that the present cost-sharing requirements for flood control projects be modified to require a cash or in-kind contribution equal to 20% of the project first costs associated with flood control benefits.

At November 1977 price levels, the total estimated first cost of the local protection project for the Upper White Oak Bayou area recommended in the Buffalo Bayou and Tributaries report is \$61,328,000 including \$920,000 for recreational developments. Application of the President's proposed policies to the project would require the State of Texas to contribute an estimated \$3,066,000 in cash (5% of \$61,328,000 for flood control and recreation). In addition to the state contribution, non-Federal interests would be required to make a cash or in-kind contribution of an estimated \$12,082,000 (20% of \$60,408,000) toward flood control costs. The requirement for non-Federal interests to make a cash or in-kind contribution of

\$460,000 (50% of \$920,000) toward recreation facility costs would not be changed. In total, the non-Federal share of first costs reflected by the report of the Chief of Engineers would change from \$7,494,000 to \$15,608,000.

I recommend construction authorization for the White Oak Bayou project in accordance with the President's proposed cost-sharing policies.

The Office of Management and Budget advises that there is no objection to submission of the Chief of Engineers report to the Congress nor to authorization of the proposed project as amended to conform with the President's water policy. However, it states that no commitment can be made at this time as to when appropriations would be requested for the project, if authorized by the Congress, since this would be subject to review in the President's annual budget process. A copy of the letter from the Office of Management and Budget is enclosed as part of the report.

Sincerely,



Michael Blumenfeld  
Assistant Secretary of the Army  
(Civil Works)

1 Enclosure  
As stated

COMMENTS OF THE OFFICE OF MANAGEMENT AND BUDGET



EXECUTIVE OFFICE OF THE PRESIDENT

OFFICE OF MANAGEMENT AND BUDGET

WASHINGTON, D.C. 20503

July 26, 1979

Honorable Clifford Alexander  
Secretary of the Army  
Washington, D.C. 20310

Dear Mr. Secretary:

Assistant Secretary Michael Blumenfeld's letter of December 15, 1978, submitted the report of the Chief of Engineers on Buffalo Bayou and Tributaries, Texas, in accordance with Section 4 of Executive Order No. 9384, and requested information as to the relationship of the report to the program of the President.

We have reviewed the report of the Chief of Engineers in light of the President's water policy message to the Congress of June 6, 1978. We conclude that Buffalo Bayou, if modified, meets the project selection criteria specified by the President. However, the following modifications are required to meet provisions of the water policy.

- In order to insure that this project is in conformity with Executive Order 11988 on Flood Plain Management, the Department of the Army should provide a certification of compliance with Executive Order 11988 prior to any request for construction appropriations.
- The Department of the Army should modify the project in presenting it to the Congress to conform to the cost-sharing policies adopted by the President.

There is no objection to the transmission of the report to the Congress with the above identified amendments or to the authorization of the amended project from the standpoint of the President's water policy. No commitment, however, can be made at this time as to when appropriations would be requested for the project, if authorized by the Congress, since this would be subject to review in the President's annual budget process.

Sincerely,

A handwritten signature in black ink, appearing to read "W. Bowman Cutter".

W. Bowman Cutter  
Executive Associate  
Director for Budget

COMMENTS OF THE GOVERNOR OF TEXAS



OFFICE OF THE GOVERNOR  
STATE CAPITOL  
AUSTIN, TEXAS 78711

DOLPH BRISCOE  
GOVERNOR

September 23, 1977

J. W. Morris  
Lieutenant General, USA  
Chief of Engineers  
Department of the Army  
Office of the Chief of Engineers  
Washington, D. C. 20314

Dear General Morris:

Under the provisions of Section 6.073(b), Texas Water Code, I directed that the Texas Water Rights Commission evaluate the report, "Buffalo Bayou and Tributaries, Texas--Upper White Oak Bayou," and related papers which were transmitted by you on June 23, 1977.

The Texas Water Rights Commission recommends that the Corps of Engineers project be considered feasible, and that the project be given early consideration and approval by the United States Congress. Attached is a copy of the Commission Order of August 15, 1977.

In accordance with the recommendation of the Texas Water Rights Commission, I concur in your forwarding this report to the Secretary of the Army for its transmission to the Congress.

I will appreciate your sending to me a copy of the Secretary of the Army's report transmittal letter to the United States Congress, as indicated in your office's letter of June 23, 1977.

Sincerely,

A handwritten signature in black ink, appearing to read "Dolph Briscoe".

Dolph Briscoe  
Governor of Texas

# TEXAS WATER RIGHTS COMMISSION



AN ORDER approving the feasibility of a proposed federal project of the United States Army Corps of Engineers as presented in a report entitled "Buffalo Bayou and Tributaries, Texas--Upper White Oak Bayou"

On August 15, 1977, the Texas Water Rights Commission held a public hearing to consider the feasibility of a proposed federal project of the United States Army Corps of Engineers concerning flood control improvements and recreational development in the upper White Oak Bayou area and to receive the views of persons and groups who might be affected by the proposed federal project.

After hearing and considering the evidence submitted relevant to the feasibility of the project, the Commission makes the following findings and recommendations:

## FINDINGS

1. The Governor of Texas, the Honorable Dolph Briscoe, received an engineering report concerning the upper White Oak Bayou project submitted by the United States Army Corps of Engineers, and forwarded it to the Commission on July 6, 1977, for its study concerning the feasibility of the proposed project.
2. On July 29, 1977 and August 8, 1977, the Commission published notice of the public hearing in the Houston Chronicle, a newspaper having general circulation in the section of the state where the federal project is to be located or the work done.
3. The Commission mailed additional notices to an extensive list of persons, agencies and groups who were likely to be interested in the proposed project.
4. Due notice was given to the Secretary of State.
5. White Oak Bayou is a tributary of Buffalo Bayou, tributary of San Jacinto River, San Jacinto River Basin. Vogel and Cole Creeks are tributaries of White Oak Bayou. The affected project area encompasses residential and commercial developments within the City of Houston in northwest Harris County, Texas.

6. The Army Corps of Engineers selected plan of improvement includes the following:

- a. Channel enlargement, rectification and partial paving of 9.2 miles of the upper White Oak Bayou channel, 4.9 miles of Cole Creek and 4.5 miles of Vogel Creek;
- b. Nonstructural flood plain management of future suburban developments along the remaining headwater reaches of the streams involved -- 5.6 miles of White Oak Bayou, 2.0 miles of Cole Creek and 2.0 miles of Vogel Creek -- to prevent future damageable developments within the 100-year flood plain;
- c. Aesthetic and beautification features such as tree and shrub plantings and architectural treatment of channel linings, in areas frequently viewed by the public; and
- d. Construction of recreational facilities, including 8.1 miles of hike and bike trails along a 3.8-mile reach of White Oak Bayou in conjunction with a neighborhood park equipped with playground and picnic facilities.

7. The total first cost of the project will be \$56,786,000 of which \$6,939,000 will be supplied by local funding and \$49,847,000 will be federally funded. The non-federal local share of cost includes lands and damages, relocations and a contribution to the recreational development plan.

8. The proposed project, if well constructed, will not detrimentally affect superior and senior water users.

9. The project will be in the public interest for the following reasons:

- a. It will eliminate flood damages in flood plain areas affected by structural improvements;
- b. It will eliminate flood damages to future development in areas affected by nonstructural flood plain management measures;

c. It will substitute orderly, well maintained floodways, enhanced by appropriate beautification measures, for the irregular, unkempt and sporadically maintained channels now existing; and

d. It will provide recreational and fish and wildlife benefits.

10. The average annual benefits of the selected plan are estimated at \$7,011,000, and the average annual costs are estimated at \$4,169,000, yielding a benefit to cost ratio of 1.68.

11. The following alternatives were rejected for the following reasons:

a. Flood water detention dam and reservoir on upper White Oak Bayou -- The flat terrain would make construction of a reservoir with sufficient storage capacity to contain the standard project flood from the upstream drainage area virtually impossible, and the land values and acquisition expenses would be prohibitive in proportion to average annual costs;

b. Diversion of floodwaters from White Oak Bayou to adjacent watersheds -- The usefulness of this approach would be limited by the relatively flat terrain and by existing flooding problems in adjacent watersheds; and

c. Permanent evacuation and relocation of residents from the flood plains of White Oak Bayou -- Acquisition of all privately owned lands, dwellings and related improvements subject to flooding would involve huge economic and social costs unacceptable to the affected community, particularly in light of the availability of obvious structural improvements.

12. The proposed project will be an integral part of existing and proposed works on Buffalo Bayou and tributaries of Buffalo Bayou, and would not conflict with any other water conservation activities.

13. The proposed project would preserve and enhance the State's water resources, thereby protecting the State's interests therein.

14. The Commission has assessed the social, economic and environmental effects of the proposed project, including the impacts, upon the bays and estuaries of Texas and finds it to be minimal.

15. The federal project, including cost of construction, operation and maintenance, is engineeringly practical.

RECOMMENDATIONS

1. Having complied with Section 6.073(b) through (e) and Commission Rule 129.06.40.001, et seq, the Commission recommends the selected plan of the United States Army Corps of Engineers for upper White Oak Bayou as the most feasible and most justifiable of the alternatives by reason of its engineering and economic practicality. The Commission recommends early consideration and approval of the project by the United States Congress.

NOW, THEREFORE, BE IT ORDERED BY THE TEXAS WATER RIGHTS COMMISSION that the selected plan of the United States Army Corps of Engineers for the upper White Oak Bayou phase of the Buffalo Bayou project is approved and recommended to the Governor of Texas as feasible and in the public interest.

The Secretary of the Commission is directed to forward a copy of this order to the Governor of Texas.

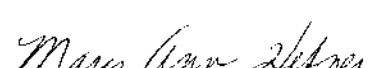
Executed and entered of record, this the 15th day of August, 1977.


TEXAS WATER RIGHTS COMMISSION

  
\_\_\_\_\_  
Joe D. Carter, Chairman

  
\_\_\_\_\_  
Joe R. Carroll, Commissioner

ATTEST:

  
\_\_\_\_\_  
Mary Ann Hefner, Secretary

  
\_\_\_\_\_  
Dorsey B. Hardeman, Commissioner



STATE OF TEXAS       X  
                          X  
COUNTY OF TRAVIS    X

I, Mary Ann Hefner, Secretary of the Texas Water Rights Commission, do hereby certify that the foregoing and attached is a true and correct copy of an order of said Commission, the original of which is filed in the permanent records of said Commission.

Given under my hand and the seal of the Texas Water Rights Commission, this the 15th day of August, A.D. 1977.

  
Mary Ann Hefner, Secretary

COMMENTS OF THE DEPARTMENT OF THE INTERIOR



United States Department of the Interior

OFFICE OF THE SECRETARY  
WASHINGTON, D.C. 20240

PEP ER-77/626

October 12, 1977

Lieutenant General J. W. Morris  
Chief of Engineers  
Department of the Army  
Washington, D. C. 20314

Dear General Morris:

Thank you for the letter of June 23, 1977, requesting our views and comments on the Chief of Engineers' Report and revised draft environmental statement for Buffalo Bayou and Tributaries, Harris County, Texas. We have reviewed the documents and conclude that they adequately consider those areas within our jurisdiction and expertise. Several brief comments follow.

Page 12, Paragraph 2.17. The active surface fault mentioned in this paragraph should be evaluated in greater detail. One sentence states that land shifting along the fault has been "gradual and not associated with earthquakes." Another sentence suggests that this fault is associated with "sudden land movement." Regardless of which statement is the most accurate, once the problem is exposed its effect upon the proposed project should be fully discussed in the Impact Section of the EIS.

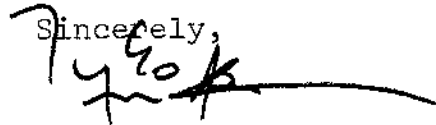
Page 21. The Probable Impact of the Proposed Action on the Environment. The proposed action will affect the hydrology of White Oak Bayou and move flows into Buffalo Bayou more rapidly. The effect, if any, on flooding along Buffalo Bayou should be discussed in this section.

Page 22, Paragraph 4.08. It seems unreasonable to conclude that environmental damages from the disposal of 1,227,000 cubic yards of earth would be "minimal" when the specific disposal site remains unknown. The reviewer has been told that this material may be used for construction purposes, placed in selected disposal areas, dumped in open pastures, and the acquisition of disposal areas would be the responsibility of the project sponsor. The final EIS should clarify the disposal plans and discuss the impacts.

Page 28, Paragraph 6.07. The alternative of diverting water to Addicks Reservoir would compound flooding problems on Buffalo Bayou. This paragraph does not explain why water flowing down White Oak Bayou to Buffalo Bayou would not be a problem, but water diverted to a flood-control reservoir (Addicks) would be a problem. A summary of the explanation on page 42 of the Interim Report on Upper White Oak Bayou should be used.

We hope these comments will be of assistance to you.

Sincerely,

A handwritten signature in black ink, appearing to read "L. Meierotto", with a long horizontal flourish extending to the right.

Larry E. Meierotto  
Deputy Assistant Secretary

COMMENTS OF THE DEPARTMENT OF AGRICULTURE



DEPARTMENT OF AGRICULTURE  
OFFICE OF THE SECRETARY  
WASHINGTON, D. C. 20250

September 19, 1977

Lieutenant General J. W. Morris  
Chief of Engineers  
Office of the Chief of Engineers  
Army Corps of Engineers  
U.S. Department of the Army  
Washington, D.C.

Dear General Morris:

This is in reply to Colonel Alfred F. Lawrence, Jr.'s letter of June 23, 1977, transmitting for our review and comment your proposed report, together with other pertinent reports, on Buffalo Bayou and Tributaries, Texas - Upper White Oak Bayou.

White Oak Bayou is a tributary of Buffalo Creek and drains approximately 108 square miles in the northwest part of the city of Houston. The proposed flood damage reduction plan consists of channel enlargement and rectification in the urbanized reaches of upper White Oak Bayou and Cole and Vogel Creeks, combined with nonstructural measures in the headwater areas. Recreational facilities are provided on flood control rights-of-way. At 1976 prices, first costs are estimated at \$56,786,000 of which \$49,847,000 are Federal costs. At 6-3/8 percent interest, the benefit-cost ratio is calculated at 1.7.

Responses to comments made by the Texas State Conservationist, Soil Conservation Service, and the Area Environmental Coordinator, Forest Service, on the first draft environmental impact statement (EIS) appear to be adequately addressed.

Specific comments are enclosed for your consideration.

Sincerely,

A handwritten signature in cursive script, reading "M. Rupert Cutler".

M. RUPERT CUTLER  
ASSISTANT SECRETARY FOR:  
CONSERVATION, RESEARCH, & EDUCATION

Enclosure

U.S. DEPARTMENT OF AGRICULTURE

Comments on Buffalo Bayou and Tributaries, Texas -  
Upper White Oak Bayou

1. Section B, Appendix 1, Plate B-2 - It appears that the nonstructural management area along the upper reaches of White Oak Bayou will impact on large tracts of ricelands. The environmental impact statement (EIS) does not identify any of these ricelands as prime farmland. Since it is probable that some prime farmlands will be impacted by this proposed project, the EIS should identify such lands and describe any impacts that might occur. It would appear that protection of prime farmland should be a part of the nonstructural management plan.
2. Section B, Appendix 1 - The population projections given in table B-1, page B-9, and table B-13, page B-19, are based on series C population projections. The series E OBERS population projections should also be considered.
3. Section D, Appendix 1 - In the summary comparison of Alternative Plans (page 2 of 6, plate D-4) the effects of the environmental quality (EQ) plan on agricultural activities is given as: "Same as NED plan except that 2,800 acres of rural and agricultural land will be removed from production." This does not appear consistent with the description of the EQ plan on page D-48.
4. Section F, Appendix 1 - Land enhancement benefits are claimed for approximately 4,000 acres (page F-37b). Enhancement benefits were calculated as reduction in flood proofing costs, except for 257 acres not amenable to flood proofing. For these 257 acres, enhancement benefits were taken as the estimated increase in market value between unprotected and protected land. The upper limit of the period of analysis is normally taken at 100 years (Principles and Standards, Federal Register, September 10, 1973, page 87). Therefore, enhancement benefits should be claimed for only that portion of the land use for which actual occupancy and use is expected during the 100-year period of analysis.

From the social viewpoint, land enhancement benefits are limited by the principle of net locational advantage. The Principles and Standards state, "Net income change to the landowner will be measured as the difference in net income from an enterprise at an alternative location that would be utilized without the plan compared with the net income received from the enterprise at a new location which is improved or enhanced as a result of the plan", pages 45 and 46.

Therefore, land enhancement benefits are limited by the difference in values between land in the flood plain and land in the most likely alternative location. This limitation is applicable to the Houston area since the plan is not expected to affect regional growth in the Houston area, and the "no action" plan is expected to divert regional growth to other areas of the region (main report, page 66).

COMMENTS OF THE DEPARTMENT OF COMMERCE



**UNITED STATES DEPARTMENT OF COMMERCE**  
**The Assistant Secretary for Policy**  
Washington, D.C. 20230

September 23, 1977

Lieutenant General J. W. Morris  
Chief of Engineers  
Department of the Army  
Washington, D.C. 20314

Dear General Morris:

Secretary Kreps has asked me to send you the Department of Commerce's comments on your proposed report and other pertinent papers for Buffalo Bayou and Tributaries, Texas - Upper White Oak Bayou.

The National Ocean Survey of the National Oceanic and Atmospheric Administration made one comment which I pass along for your consideration.

Geodetic control survey monuments are located in the proposed project area. If there is any planned activity which will disturb or destroy these monuments, the National Ocean Survey (NOS) requires not less than 90 days' notification in advance of such activity in order to plan for their relocation. NOS recommends that funding for this project includes the cost of any relocation required for NOS monuments.

Thank you for the opportunity you gave this Department to review the report.

Sincerely,

A handwritten signature in cursive script that reads "Lucy Falcone".

Lucy Falcone  
Deputy Assistant Secretary  
for Policy Development  
and Coordination

COMMENTS OF THE DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE



DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

OFFICE OF THE SECRETARY

WASHINGTON, D.C. 20201

September 19, 1977

Lieutenant General J.W. Morris  
Chief of Engineers  
Department of the Army  
Washington, D.C. 20314

Dear Sir:

Thank you for the opportunity to review the draft Environmental Impact Statement on Buffalo Bayou and Tributaries, Texas, Upper White Oak Bayou Flood Damage Prevention. We have the following comments:

1. It is difficult to understand the extensive channel lining recommended for this project in view of the groundwater and ground level subsidence due to the extraction of municipal water supplies. Groundwater recharge either for the immediate area or the downstream areas should be analyzed to properly assess future effects on groundwater recharge potential with implementation of the preferred alternative.
2. Since all the alternatives have a Benefit-Cost (B/C) ratio greater than one, they appear to be viable. The repeated reference to the higher ratio infers that this ratio was used as the basis for the decision. However, we feel it is inappropriate to place this much emphasis on the B/C ratio because of the uncertainty involved in classifying items appropriately either as costs or negative benefits.

Sincerely,

A handwritten signature in black ink that reads "Charles Custard". The signature is written in a cursive, slightly slanted style.

Charles Custard  
Director  
Office of Environmental Affairs



COMMENTS OF THE ENVIRONMENTAL PROTECTION AGENCY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

FIRST INTERNATIONAL BUILDING  
1201 ELM STREET  
DALLAS, TEXAS 75270

July 27, 1977

Lieutenant General J. W. Morris  
Chief of Engineers  
Department of the Army  
Washington, D. C. 20314

Dear General Morris:

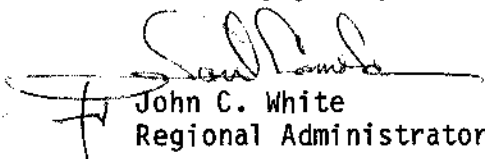
We have reviewed the Revised Draft Environmental Impact Statement and the Report on Upper White Oak Bayou. The action consists of constructing flood control improvements in upper White Oak Bayou and its tributaries, Cole and Vogel Creeks, in Harris County, Texas, to protect urban areas now subject to stream flooding. Channel improvements considered for upper White Oak Bayou would extend from the terminus of the existing Federal flood control project at mile 10.7 to mile 19.9. For the tributary streams, Cole and Vogel Creeks, improvements would extend from their mouths at White Oak Bayou upstream 1.9 and 4.5 miles, respectively. Extension of the existing Federal channel improvements upstream in White Oak Bayou and tributaries would consist of rectification, enlargement, and partial lining with concrete.

We classify your Draft Environmental Impact Statement as LO-1. Specifically, we have no objections to the project as it relates to Environmental Protection Agency's (EPA's) legislative mandates. The statement contained sufficient information to evaluate adequately the possible environmental impacts which could result from project implementation. The classification and the date of our comments will be published in the Federal Register in accordance with our responsibility to inform the public of our views on proposed Federal actions, under Section 309 of the Clean Air Act.

Definitions of the categories are provided on the attachment. Our procedure is to categorize our comments on both the environmental consequences of the proposed action and on the adequacy of the impact statement at the draft stage, whenever possible.

We appreciate the opportunity to review the Draft Environmental Impact Statement. Please send us two copies of the Final Environmental Impact Statement at the same time it is sent to the Council on Environmental Quality.

Sincerely yours,

  
John C. White  
Regional Administrator

Enclosure

xx



## ENVIRONMENTAL IMPACT OF THE ACTION

### LO - Lack of Objections

EPA has no objections to the proposed action as described in the draft impact statement; or suggests only minor changes in the proposed action.

### ER - Environmental Reservations

EPA has reservations concerning the environmental effects of certain aspects of the proposed action. EPA believes that further study of suggested alternatives or modifications is required and has asked the originating Federal agency to re-assess these aspects.

### EU - Environmentally Unsatisfactory

EPA believes that the proposed action is unsatisfactory because of its potentially harmful effect on the environment. Furthermore, the Agency believes that the potential safeguards which might be utilized may not adequately protect the environment from hazards arising from this action. The Agency recommends that alternatives to the action be analyzed further (including the possibility of no action at all).

## ADEQUACY OF THE IMPACT STATEMENT

### Category 1 - Adequate

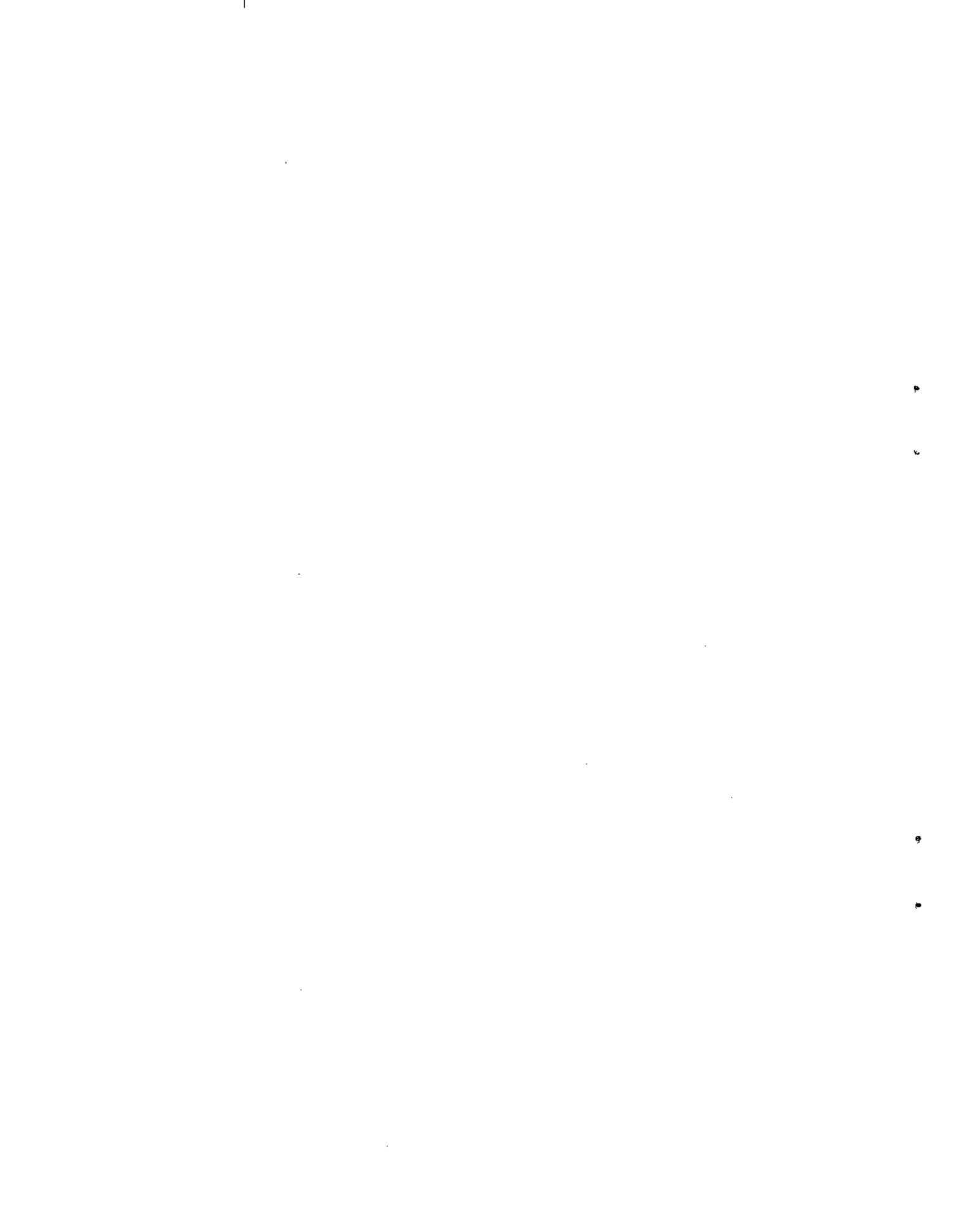
The draft impact statement adequately sets forth the environmental impact of the proposed project or action as well as alternatives reasonably available to the project or action.

### Category 2 - Insufficient Information

EPA believes the draft impact statement does not contain sufficient information to assess fully the environmental impact of the proposed project or action. However; from the information submitted, the Agency is able to make a preliminary determination of the impact on the environment. EPA has requested that the originator provide the information that was not included in the draft statement.

### Category 3 - Inadequate

EPA believes that the draft impact statement does not adequately assess the environmental impact of the proposed project or action, or that the statement inadequately analyzes reasonably available alternatives. The Agency has requested more information and analysis concerning the potential environmental hazards and has asked that substantial revision be made to the impact statement. If a draft statement is assigned a Category 3, no rating will be made of the project or action, since a basis does not generally exist on which to make such a determination.



# BUFFALO BAYOU AND TRIBUTARIES, TEXAS

## REPORT OF THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY



DAEN-CWP-A

REPLY TO  
ATTENTION OF:

DEPARTMENT OF THE ARMY  
OFFICE OF THE CHIEF OF ENGINEERS  
WASHINGTON, D.C. 20314

13 June 1978

SUBJECT: Buffalo Bayou and Tributaries, Texas

THE SECRETARY OF THE ARMY

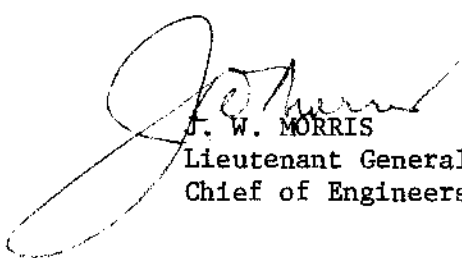
1. I submit for transmission to Congress the report of the Board of Engineers for Rivers and Harbors, accompanied by the reports of the District and Division Engineers. The reports are in partial response to a resolution of the Committee on Public Works of the United States House of Representatives adopted 20 April 1948 which requested a review of the reports on Houston Ship Channel and Buffalo Bayou, Texas. The purpose of the review was to determine a comprehensive plan for the betterment of navigation and for the control of floods throughout the Buffalo Bayou watershed to meet the materially changed conditions resulting from the rapid industrial expansion and growth of the city of Houston, Texas, and contiguous areas.
2. The District and Division Engineers recommend channel enlargement, rectification, and partial paving of the urbanized reaches of the upper White Oak Bayou and its tributaries, Cole and Vogel Creeks; nonstructural flood plain management of future suburban development in the headwater reaches of the three streams; and hiking and bike trails along White Oak Bayou. They estimate the total first cost of the project at \$56,786,000, of which \$49,847,000 would be Federal and \$6,939,000 would be non-Federal. Annual charges, based on an interest rate of 6-3/8 percent and a 100-year period for economic analysis, are estimated at \$4,169,000, including \$249,000 for non-Federal maintenance, operation, and major replacements. Average annual benefits are estimated at \$7,011,000, and the benefit-cost ratio is 1.7.
3. The Board of Engineers for Rivers and Harbors concurs generally in the findings of the reporting officers and recommends construction of improvements for flood control and recreation in the upper White Oak Bayou area, Texas, subject to certain items of local cooperation. The Board believes that a high level of flood protection, including protection from the standard project flood, should be provided for urban areas where it is environmentally acceptable and the benefits exceed costs. The Board notes that although the reporting officers' recommended plan provides for a partially lined channel improvement,

an unlined earth channel providing the same degree of protection could be constructed at comparable cost. It also recognizes that there are certain environmental considerations which favor an unlined earth channel and which should be evaluated along with the requirements for additional land for rights-of-way, displacement of people, and relocation of structures. The Board believes that during postauthorization planning consideration should be given to a plan which makes maximum use of an earth channel in areas where development has not proceeded to a point that makes such a plan impractical.

4. I note that local interests and affected property owners requested relief from frequent and damaging floods. Additional needs are recreational opportunities in the rapidly developing residential area. As the population continues to increase, municipal water supply problems are expected to emerge. However, there are no opportunities for surface storage within the basin. Mining of subsurface water supplies, although a reliable resource, is causing severe land subsidence problems in the eastern portion of metropolitan Houston. Additional surface water sources are being developed outside the basin to meet the existing and future needs for municipal and industrial water. I also note that all apparent structural and non-structural alternatives were investigated to develop the most practical solution to the water resources problems and needs in the basin.

5. Subsequent to the Board's consideration an interest rate of 6-5/8 percent was prescribed for water resources planning. I note that the November 1977 estimated first cost of construction is \$61,328,000. Applying the 6-5/8 percent interest rate the annual charges are estimated to be \$4,661,000, including \$249,300 for operations, maintenance and major replacements, and the average annual benefits are estimated to be \$7,428,000. The benefit-cost ratio is 1.6.

6. After due consideration of the reports of the District and Division Engineers, the Board of Engineers of Rivers and Harbors, and the foregoing discussion, I concur in the views and recommendations of the Board. Therefore, I recommend construction of the channel rectification and enlargement of White Oak Bayou, Cole Creek and Vogel Creek, flood plain management including the upper reaches of each stream to prevent future damageable developments within the 100-year flood plain, and implementation of a recreational development plan. The estimated cost to the United States is \$53,834,000, subject to the requirements of local cooperation recommended by the Board of Engineers for Rivers and Harbors.



J. W. MORRIS

Lieutenant General, USA  
Chief of Engineers

# REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS



REPLY TO  
ATTENTION OF:

**DEPARTMENT OF THE ARMY**  
**BOARD OF ENGINEERS FOR RIVERS AND HARBORS**  
**KINGMAN BUILDING**  
**FORT BELVOIR, VIRGINIA 22060**

DAEN-BR

4 May 1977

SUBJECT: Buffalo Bayou and Tributaries, Texas

Chief of Engineers  
Department of the Army  
Washington, D. C.

1. Authority. -- This report is in partial response to the following resolution adopted 20 April 1948:

Resolved by the Committee on Public Works of the House of Representatives, United States, That the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review the reports on Houston Ship Channel and Buffalo Bayou, Texas, contained in House Document No. 456, 75th Congress, 2nd Session, with a view to determining a comprehensive plan for the betterment of navigation and for the control of floods throughout the Buffalo Bayou watershed including modifications, if any, of the presently approved plan of improvement and of the requirements for local cooperation in order to meet the materially changed conditions resulting from the rapid industrial expansion and growth of the City of Houston, Texas, and contiguous areas.

A final report in response to this authority will be submitted at a later date.

2. Description. -- White Oak Bayou, a tributary of Buffalo Bayou, provides drainage for about 108 square miles in the central and northwestern portion of the city of Houston in Harris County, Texas. The upper White Oak Bayou study area, which includes White Oak Bayou and Cole and Vogel Creeks, is an integral part of the rapidly growing Houston metropolitan complex. The area is generally level, and varies from an elevation of 135 feet above mean sea level in the upper reaches to about 70 feet above mean sea level in the downstream reach.

3. Economic development. -- In 1970, the upper White Oak Bayou area had a population of 28,100, but it is expected to increase to about 82,000 by the year 2000. The study area primarily consists of residential developments and supporting commercial service facilities. Growth

is directly associated with development and employment opportunities in the city of Houston and Harris County. Because of the abundance of petroleum and natural gas in the area, Harris County has become the center of one of the greatest complexes of petrochemical industries in the world. Harris County also has the third largest United States seaport, via the Houston Ship Channel. Projected growth for shipping and manufacturing in Harris County indicates that additional residential and commercial development will continue for the foreseeable future.

4. Existing or authorized improvements. -- There are several Federally authorized navigation and flood control improvements in the study area. The Flood Control Acts of 1954 and 1965 authorized the construction of flood control improvements for White Oak Bayou between its confluence with Buffalo Bayou and mile 10.7. These improvements have been completed and consist of channel realignment, enlargement, rectification, and partial paving to contain floodwaters up to the standard project flood. The improvements provide flood protection to the lower reach of the bayou and extend upstream to the lower limits of the present study area. Between 1958 and 1962, the Harris County Flood Control District cleared and rectified the upper White Oak Bayou Channel upstream from the existing Federal project to about mile 25. In conjunction with the channel improvements, the Flood Control District also acquired rights-of-way and drainage easements throughout the improved reach.

5. Problems and needs. -- The study area is subject to intense local thunderstorms of short duration, general storms extending over a period of several days, and torrential rainfalls associated with hurricanes and other tropical storms. Major flood-producing storms in the Houston area can occur during any month of the year. During the last 10 years, residential and commercial development has proceeded rapidly to meet the population growth in Houston. Damaging floods occurred in 1968, 1969, 1970, and 1972. Flood damages resulting from the last two floods were estimated at \$1,100,000 and \$2,650,000, respectively. The present value of residential and commercial property within the standard project flood plain is estimated at approximately \$241,000,000. There is a need for improvements to reduce or eliminate flood damage to existing and future development.

6. The primary sources of municipal water supply are deep wells operated by various utility districts and surface water transported to the area by pipeline from Lake Houston, located in the northeast part of Harris County. The great demand placed on groundwater has caused a substantial lowering of the water table. Projected population increases for Harris County indicate a need for additional water supply sources.

7. Recreation development has not kept up with the rapid urban growth of this part of Harris County. Additional public recreational development is needed to meet present and future demands.

8. Improvements desired. --Two public meetings were held and several workshops were conducted to encourage local participation in solving water resource problems. In addition, a citizen's advisory group was formed to ensure that local interests' views were included. Local interests and property owners have requested that flood control improvements be provided for White Oak Bayou and Cole and Vogel Creeks to relieve the area from frequent and damaging floods. They have further requested that recreational development be included in conjunction with the requested flood control improvements.

9. Alternatives considered. --Several solutions to flood problems in the upper White Oak Bayou watershed were considered. The solutions included structural and nonstructural measures, as well as combinations of the two measures. Structural alternatives consisted of detention structures, diversion, levees, and channel rectification. Nonstructural measures included flood plain zoning, floodproofing, and evacuation of the flood plain.

10. Plan of improvement. --The District Engineer finds that the most practicable plan of improvement to provide flood protection for the upper White Oak Bayou area is channel enlargement and rectification of the urbanized reaches of White Oak Bayou and Cole and Vogel Creeks, combined with nonstructural measures in the headwater areas of the three streams. The proposed improvements are designed to provide standard project flood protection, and are upstream extensions of the existing Federal channel constructed in the lower 10.7 miles of White Oak Bayou. The existing improvements were also designed to provide standard project flood protection based on anticipated future urban development in the upstream areas. The selected plan of improvement includes the following features:

a. Channel enlargement, rectification, and partial paving of 9.2 miles of White Oak Bayou, 4.9 miles of Cole Creek, and 4.5 miles of Vogel Creek;

b. Nonstructural flood plain management of future damageable suburban developments along the remaining headwater reaches of the streams, including about 5.6 miles of White Oak Bayou, 2.0 miles of Cole Creek, and 2.0 miles of Vogel Creek;

c. Installation and construction of esthetic and beautification features; and

d. Construction of a recreational development plan on existing flood control rights-of-way along White Oak Bayou to include 3.8 miles of hiking and bike trails and a neighborhood park.

11. Economic evaluation. --Based on November 1976 price levels, the District Engineer estimates the total first cost of the proposed improvements to be \$56,786,000, of which \$49,847,000 would be Federal and \$6,939,000 would be non-Federal. Annual charges, based on an interest rate of 6-3/8 percent and a 100-year period for economic analysis, would be \$4,169,000, including \$249,000 for non-Federal operation, maintenance, and replacement. Average annual benefits are estimated at \$7,011,000, and the benefit-cost ratio is 1.7.

12. Recommendations of the reporting officers. --The District Engineer recommends authorization of flood control and recreational improvements on upper White Oak Bayou and Cole and Vogel Creeks, generally in accordance with the plans described in his report and subject to certain conditions of local cooperation. The Division Engineer concurs.

13. Public notice. --The Division Engineer issued a public notice stating the findings of the reporting officers and affording interested parties an opportunity to present additional information to the Board. No communications have been received.

#### Views and Recommendations of the Board of Engineers for Rivers and Harbors.

14. Views. --The Board of Engineers for Rivers and Harbors concurs in general in the views and recommendations of the reporting officers. The improvements are economically justified and the requirements of local cooperation are generally appropriate. Non-Federal first costs associated with the improvements are presently estimated at \$6,939,000, and local annual costs for operation, maintenance, and major replacements are estimated at \$249,000.

15. The Board notes that the partially lined channel improvement recommended in the report does not maximize net benefits. Supplemental information provided by the reporting officers indicates that an earthen channel with a 50-year level of protection would more nearly maximize net benefits. The Board believes that a higher level of protection, including standard project flood protection, should be provided for urban areas where it is environmentally acceptable and the benefits exceed the costs. Recent development in the flood plain requiring more extensive relocations and design changes to maintain the project's integrity has significantly increased the estimated costs of the earthen channel for greater levels of protection. Reevaluation of the



earthen channel improvement and the partially lined channel improvement with current data provided in the supplemental information indicates that economic costs are similar for standard project flood protection, although slightly lower for the partially lined channel. The Board recognizes that certain environmental considerations would favor an earthen channel. It also recognizes that there are trade-offs between those considerations and the requirement for additional land for rights-of-way, displacement of people, and relocation of structures. Therefore, the Board believes that during postauthorization planning, consideration should be given to a plan which makes maximum use of an earthen channel in areas where development has not proceeded to a point that makes such a plan impractical.

16. The Board notes that benefits for reduction of flood damages to future new development in the flood plain have been based on an increased value of structures over time. The Board finds that the report does not contain adequate information to substantiate that increase. Although the Board believes that the increase in value of structures should not be used in this report, it notes that exclusion of that portion of the benefits would not have a significant effect on project justification.

17. The Board notes that implementation of a plan to provide flood protection for upper White Oak Bayou would result in location benefits to property owners in the project area. However, it also notes that land holdings to individuals are limited to small parcels of land, and such benefits would be widespread.

18. The Board believes that the proposed improvement would provide a significant contribution to the regional economy and improvement of social well-being. It has carefully considered the environmental effects of the proposed project, including those discussed in the Revised Draft Environmental Impact Statement dated December 1976, and concludes that the beneficial effects will outweigh the potential adverse impacts.

19. Recommendations. --Accordingly, the Board recommends that improvements for flood control and recreation be authorized for construction in the upper White Oak Bayou area, Texas, generally in accordance with the plan of the District Engineer, and with such modifications thereof as is in the discretion of the Chief of Engineers may be advisable. The first cost to the United States for construction is presently estimated at \$49,847,000. This recommendation is made with the provision that, prior to commencement of construction, non-Federal interests will agree to:

- a. Provide without cost to the United States all lands, easements, and rights-of-way, including borrow and disposal areas for excavated material determined suitable by the Chief of Engineers and necessary for construction of the project;
- b. Hold and save the United States free from damages due to the construction and subsequent maintenance of the project, not including damages due to the fault or negligence of the United States or its contractors;
- c. Operate and maintain all works after completion, including the recreational facilities constructed as part of the project, in accordance with regulations prescribed by the Secretary of the Army;
- d. Accomplish without cost to the United States all alterations and relocations of utilities, transportation facilities (except railroad bridges), pipelines, and other existing structures and improvements made necessary by construction of the project;
- e. Prescribe and enforce regulations to prevent obstruction or encroachment on channels that would reduce their flood-carrying capacity, or hinder maintenance and operation;
- f. Assume responsibility for coordination of actions of all responsible local agencies to the end that adequate lateral channels and drains will be provided and maintained without cost to the United States;
- g. Prescribe and enforce flood plain regulations appropriate to the nonstructural measures of the plan of improvement which, combined with the structural measures, will minimize damages to future development in the project area that would be inundated from a flood with an annual exceedance frequency of one percent, such regulations to be consistent with those presently established;
- h. Provide a cash contribution for jointly funded recreation elements equal to 50 percent of the final separable cost for this function, less a credit for the value of lands, easements, rights-of-way, alterations, and relocations provided therefor;
- i. Administer and assure access to the recreational facilities and lands to all on an equal basis; and

j. At least annually inform affected interests regarding the limitations of the protection afforded by the nonstructural elements of the project.

FOR THE BOARD:

A handwritten signature in black ink, appearing to read "R. C. Marshall". The signature is fluid and cursive, with a large initial "M" and a long, sweeping tail.

R. C. MARSHALL  
Major General, USA  
Chairman

# *SYLLABUS*

The purpose of this interim study has been to investigate the flooding problems in the upper White Oak Bayou watershed in the vicinity of Houston, Texas and to determine the feasibility of a plan for mitigating these recurring problems. Overbank stream flooding of White Oak Bayou and its primary tributaries Cole Creek and Vogel Creek have caused substantial flood damages to the suburban developments located adjacent to the streams.

The study area comprises the upstream 61 square miles of the White Oak Bayou drainage basin in northwest Harris County. The area is a part of the Buffalo Bayou watershed, which drains much of the urbanized area of Houston and surrounding suburban communities. The study area has experienced extensive urbanization in the past decade in the form of residential subdivisions situated in the wooded areas adjacent to the bayou and tributary creeks. The flooding problems of the area are caused primarily by inadequate channel capacities of the streams. More than 4,500 single-family residences are located in flood prone areas near the streams. Damaging floods have been occurring almost annually for the past several years.

Various structural and nonstructural measures and combinations of both have been investigated to solve the problems of urban flooding. Of the alternatives investigated, the most practicable solution is found to be channel enlargement and rectification of the urbanized lower reaches of the streams of White Oak Bayou, Cole Creek, and Vogel Creek, combined with nonstructural measures in the headwater areas of the three streams. Various degrees of protection have been evaluated. A structural plan providing 50-year flood protection for the urbanized areas has been found to produce the maximum net benefits. However, a more conservative and long-term plan, providing protection from the standard project flood, has been selected. This selection has been influenced by the extent of existing urbanization and by the expected future growth to meet the residential needs of the Houston metropolitan area.

The planning studies have also considered other related water resource needs in the study area including environmental quality and recreation. Beautification measures, such as selective plantings and architectural treatment of channel linings, have been included in the plan. An outdoor recreational development plan is also included as an element of the proposed project.

The selected plan of improvement includes the following features:

- Channel enlargement, rectification, and partial paving of 9.2 miles of White Oak Bayou, 4.9 miles of Cole Creek, and 4.5 miles of Vogel Creek;

- Nonstructural flood plain management of future suburban developments along the remaining headwater reaches of the streams including about 5.6 miles of White Oak Bayou, 2.0 miles of Cole Creek, and 2.0 miles of Vogel Creek.

- Installation and construction of aesthetic and beautification improvements in areas frequently viewed by the public; and

- Construction of a recreational development plan on existing flood control rights-of-way along White Oak Bayou to include 8.1 miles of hike and bike trails together with a neighborhood park, including recreation equipment and picnic facilities.

Flood control improvements in White Oak Bayou itself constitute the basic element of the plan. Flood control improvements in each of the tributary creeks and the recreational development plan constitute separable increments which are independently justified.

The total first cost of the combined plan of improvement is estimated to be \$56,786,000. The non-Federal local share of cost for the plan is \$6,939,000 and includes lands and damages, relocations, and a cash contribution for a portion of the recreational development plan. The average annual benefits for the total plan are estimated at \$7,011,000 and the average annual costs are estimated at \$4,169,000. The total combined project plan would yield a benefits to cost ratio of 1.68. The individual elements of the selected plan are incrementally justified as follows:

Plan Elements	Project First Cost	Average Annual Costs	Average Annual Benefits	Benefits to Costs Ratio
White Oak Bayou Plan	\$ 31,927,000	\$2,355,000	\$3,255,000	1.38
Cole Creek Plan	11,499,000	826,000	907,000	1.10
Vogel Creek Plan	12,506,000	890,000	2,740,000	3.08
Recreational Development Plan	854,000	98,000	109,000	1.11

Implementation of the plan will eliminate stream flooding from 10,360 acres of urban land adjacent to the bayou and tributary creeks. The structural flood control plans are complemented by nonstructural measures to control future development in about 3,030 acres of flood plain along the upper reaches of the streams. The recreational development plan will partially satisfy existing needs for additional open space outdoor facilities for leisure activities. An expanded master development plan to complement the proposed facilities is displayed in the report for optional implementation by local interests.

No significant adverse environmental effects are foreseen as a result of the proposed action. Conversely, beneficial human environmental effects will accrue from the elimination of the flood threat to the community and its residents and the prevention of the economic losses and social stresses which are now occurring.

It is recommended that, subject to certain conditions of non-Federal cooperation as outlined in this report, the proposed plan of improvement be authorized for detailed planning and design. The total estimated first cost to the United States for subsequent design and construction of the project is currently estimated at \$49,847,000.

**BUFFALO BAYOU AND TRIBUTARIES, TEXAS  
(FLOOD DAMAGE PREVENTION)**

**INTERIM REPORT ON UPPER WHITE OAK BAYOU**

***THE STUDY AND REPORT***

This report is presented in two volumes, the main report and two appendices. The main report provides an overall view of the study, its results, and recommendations, with the degree of technical detail limited to that required for general understanding. Appendix 1 is a technical report that presents detailed information for technical review. Its general format is similar to the main report for convenience of cross-referencing. Appendix 2 contains related correspondence.

***Purpose and Authority***

This report presents the results of an interim investigation of flood control needs and opportunities in the watershed of upper White Oak Bayou, a major tributary in the Buffalo Bayou system, in the Houston, Texas, metropolitan area. The primary objective of the investigation has been to determine the advisability of providing flood control and related water resources improvements in the upper White Oak Bayou drainage basin. Additional objectives of the investigation have been to evaluate the environmental, social, and economic effects of the existing situation and all remedial measures considered to solve the problems and, secondarily, to evaluate the need for and advisability of providing project related recreational features.

This report and the study it presents are submitted in partial response to a Congressional authorization contained in a resolution of the House Public Works Committee, adopted 20 April 1948. This resolution authorized

a comprehensive flood control survey of Buffalo Bayou and Tributaries, Texas. The House Resolution reads as follows:

"Resolved by the Committee on Public Works of the House of Representatives, United States, That the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review the reports on Houston Ship Channel and Buffalo Bayou, Texas, contained in House Document No. 456, 75th Congress, 2nd session, with a view to determining a comprehensive plan for the betterment of navigation and for the control of floods throughout the Buffalo Bayou watershed including modification, if any, of the presently approved plan of improvement and of the requirements for local cooperation in order to meet the materially changed conditions resulting from the rapid industrial expansion of the City of Houston, and contiguous areas."

White Oak Bayou is a major tributary of Buffalo Bayou and drains about ten percent of the basin in northwest Houston and Harris County. A Federal flood control project, consisting of channel improvement and straightening, has been completed in the lower 10.7 miles of White Oak Bayou. Because of severe urban flooding conditions in the remaining upstream portions of the watershed, the Chief of Engineers on 23 July 1971 authorized an interim study of Buffalo Bayou and Tributaries, Texas - Upper White Oak Bayou at Houston, Texas, to determine the feasibility of extending the existing project in the interest of flood control and allied purposes.

### ***The Area and the Problem***

The upper White Oak Bayou study area is located within and near the northwest city limits of Houston in Harris County, Texas. The area is a part of the rapidly expanding Houston metropolitan area and includes residential communities of the city. Approximately twenty percent of the upper White Oak Bayou watershed is located within the present city limits of Houston, and it is likely that much of the remaining study area will be annexed within the next few years. The incorporated town of Jersey Village, located along White Oak Bayou in the central portion of the study area, is a residential community which has experienced considerable urban growth in recent years. Residential developments are attracted to this



general area of Harris County by the aesthetically appealing wooded areas and the absence of air pollution related to industrial and commercial developments. A map of the study area is included as Plate 1.

The primary water resources problem of the study area is the lack of adequate stream capacity to carry excessive rainfall runoff away from the area without causing flooding. Runoff from rainstorms frequently overflows the channel banks, causing significant damages to many residences in the flood plains of White Oak Bayou and its tributaries. Most recently, damaging floods occurred in May 1968, February 1969, October 1970, March 1972, and June 1973. The flooding problems are compounded by continuing urbanization which increases and accelerates the runoff from rainfall. Additional residential development is expected to occur with or without an adequate plan for controlling the floods. Although current local regulations require that new structures be built above the level of the 100-year flood, damages will increase substantially in the future with increased rainfall runoff rates. The residential areas suffer also from severe localized flooding caused by inadequate storm sewers and street drainage. Any system of main stream flood control improvements which might be adopted would need to be accompanied by commensurate local drainage improvements in order for virtually complete relief from flood damages to be realized.

### ***Scope of the Study***

This study has examined past flooding and the damages incurred and has related these to the probabilities and severity of future flooding and damages expected to result. It has investigated the engineering and economic feasibility of alternate measures for eliminating or reducing flood damage potential, including both structural and non-structural measures and combinations of both. Investigations have been carried to a degree of detail sufficient to attach reasonable estimates of benefits and costs to all alternatives and to determine their relative feasibility and comparative worth. Assessments of

social, economic, and environmental effects have been made, and participation of local government and affected citizens has been encouraged in order that the selected plan may accommodate the public desires.

### *Coordination and Public Contacts*

In the course of the study coordination has been maintained with officials of the local sponsoring agency and with the general public in the study area. Two public meetings were held in the study area, one on 14 May 1971 and the other on 18 April 1974, to consider public views on problems and needs and to determine public preferences regarding alternate plans of improvement. A Citizens' Advisory Committee was organized in September 1971 with membership consisting of four civic leaders of the project area, a prominent environmental leader in the Houston area, and the Harris County Flood Control Engineer. Three workshop meetings with the full committee were held in the course of the study. In addition, a number of informal discussions were held with individual members of the committee to assure that planning activities were understood and reflected current public desires. A draft of this report has been coordinated with appropriate Federal, State, and local agencies including: U. S. Fish and Wildlife Service, Bureau of Reclamation, National Marine Fisheries Service, Soil Conservation Service, Environmental Protection Agency, Bureau of Outdoor Recreation, Bureau of Mines, National Park Service, agencies of the State of Texas through the Office of Budget and Planning, Harris County Commissioners Court, Harris County Flood Control District, the City of Houston, and the City of Jersey Village. In addition, the draft environmental statement has been coordinated with local civic organizations and local and national environmental groups. The views and comments of these agencies, organizations and groups are presented and discussed later in the report.

### ***Other Related Studies and Reports***

Federal studies and reports for navigation improvements for Buffalo Bayou date back to 1871 when the first survey report was transmitted to Congress recommending dredging across natural bars in Galveston Bay to provide an unobstructed channel six feet in depth from the Gulf of Mexico inland by way of Buffalo Bayou to Houston. The recommended improvements were authorized by the Rivers and Harbors Act of June 1872. Several subsequent navigation studies and survey reports have resulted in Federal projects for enlargement of the channels from the Gulf across Galveston Bay and the lower 16 miles of Buffalo Bayou to provide for deep draft commercial navigation. The lower reach of Buffalo Bayou is now the inland upper reach of the Houston Ship Channel. An additional survey report on Buffalo Bayou was submitted to Congress in June 1921 recommending shallow draft navigation improvements from the Houston Ship Channel turning basin 5.6 miles upstream in Buffalo Bayou to the mouth of White Oak Bayou near the downtown area of Houston. This project was authorized for construction by the Rivers and Harbors Act of March 1925. Although no flood control benefits were ascribed to these navigation projects in Buffalo Bayou, the improvements have doubtless improved the flood carrying capacity of the lower reach of the bayou.

A survey report titled "Houston Ship Channel and Buffalo Bayou, Texas," transmitted to Congress in December 1937 and authorized by the Rivers and Harbors Act of June 1938, established the first Federal interest in flood control measures for Buffalo Bayou and its tributaries. The report recommended the prosecution of works for the control of floods in Buffalo Bayou and its tributaries upstream from the Houston Ship Channel turning basin, and for the prevention of shoaling in the turning basin of the ship channel. Generally, the specific

features of the plan, approved by the Chief of Engineers in July 1940, included channel rectification of Buffalo Bayou upstream from the ship channel turning basin to the western city limits of Houston with control works to minimize silt deposition; channel improvement in the lower reach of White Oak Bayou within the city limits; and construction of reservoirs on White Oak Bayou and Buffalo Bayou upstream from the city. The Flood Control Act of August 1939 modified the requirements of local cooperation for the authorized plan. Addicks and Barker Reservoirs located on the headwaters of Buffalo Bayou and its tributary creeks and seven miles of outlet channels below the dams were completed in 1948, as part of this plan of improvement.

In response to a study resolution of the House Committee on Flood Control, adopted 16 July 1945 and to the present study resolution of the House Committee on Public Works, adopted 20 April 1948, a survey report was prepared and transmitted to Congress in September 1953 recommending modification of the previously authorized plan of improvement to meet the materially changed conditions caused by rapid industrialization and urban growth of Houston. The revised plan, authorized by the Flood Control Act of September 1954, provided for Addicks and Barker Reservoirs on Buffalo Bayou, already completed, and for clearing, straightening, enlarging, and lining where necessary the channels of Buffalo, Brays, and White Oak Bayous.

A review of reports on Houston Ship Channel and Buffalo Bayou (Vince and Little Vince Bayous), Texas, recommended enlargement and rectification of the tributaries of Vince and Little Vince Bayous to afford flood protection to Pasadena and vicinity, Texas. The recommended improvements were authorized by the Flood Control Act of October 1962.

An interim review of reports on Buffalo Bayou and Tributaries, Texas, White Oak Bayou, prepared in January 1964 and conducted under the present

study authority, recommended a 2.1-mile extension of the previously authorized 8.6 miles of channel improvements in White Oak Bayou. These additional improvements were necessitated by the increased urbanization in the vicinity of the bayou. These improvements were authorized for construction by the Flood Control Act of October 1965. The existing improvements extend upstream in White Oak Bayou to the mouth of Cole Creek. The present study area extends from that point to the headwaters of White Oak Bayou and its tributaries, Cole and Vogel Creeks.

As discussed previously, Addicks and Barker Dams and Reservoirs and outlet channels were completed and in operation by 1948. Channel rectification of 25.4 miles of Brays Bayou was completed in 1971. The authorized 10.7 miles of improvement in White Oak Bayou were completed in 1975. Approximately four miles of the authorized 7.2 miles of improvements in Vince Bayou have been constructed. The remaining improvements and the 3.9 miles of authorized work in Little Vince Bayou are awaiting satisfaction of rights-of-way and other obligations of local interests. Approximately 21.9 miles of authorized channel improvements in Buffalo Bayou, upstream from the ship channel turning basin, have not been constructed. The completion of these improvements has been deferred indefinitely until local conflicts concerning the environmental issues of the project have been resolved. These authorized projects, when completed, will control the flood waters from less than 50 percent of the total watershed of Buffalo Bayou.

The existing study to consider a comprehensive plan for the control of floods in the remaining areas of the Buffalo Bayou watershed is being conducted on a tributary by tributary basis because of the changing needs and priorities caused by rapid urbanization of the Houston metropolitan area. The urgent flood control needs of the upper White Oak Bayou watershed have led to this interim study and report.

Substantial urbanization has also occurred in the Sims Bayou watershed in recent years. Similar flood problems are now occurring in that sub-drainage basin. These and other flooding problems will be considered in future studies leading to the completion of the comprehensive investigation.

## ***RESOURCES AND ECONOMY OF THE STUDY AREA***

The following general discussion of the resources, development, and economy of the area provides a basis for identifying the water resources problems and needs of the watershed and for evaluating alternate solutions to the problem.

The upper White Oak Bayou study area, comprising more than 39,000 acres in the headwaters of the drainage basin, is an integral part of the rapidly growing Houston metropolitan complex. The basin area is relatively flat and slopes generally southeastward at about four to five feet per mile. The area consists principally of open prairie and pastureland with strips of woodlands bordering the stream. Housing developments have been generally located within the scenically attractive wooded areas adjacent to the bayou and tributary creeks.

The large and dynamic industrial and commercial economy of the Houston metropolitan area produces a continuing high demand for quality residential areas such as those which are the subject of this study. Although property values in flood prone areas have been somewhat depressed by the frequent past flooding, the established suburban development trends of the study area are expected to continue. Harris County adopted flood plain regulations in September 1973 and the unincorporated areas of the county became eligible for Federally subsidized flood

insurance. The City of Houston took similar action in the fall of 1974. The entire study area is now regulated by the insurance program. The flood plain regulations, necessary for participation in the Federal insurance program, require that all new structures be elevated above the level of the 100-year flood. This requirement has temporarily slowed development to some extent; however, residential housing developments are continuing at a rapid rate in consonance with the regulations.

### ***Environmental Setting and Natural Resources***

Buffalo Bayou is a tributary of the San Jacinto River. With its several major tributaries it drains an area of 1,034 square miles, including essentially all of metropolitan Houston and surrounding communities in Harris County. White Oak Bayou, a major tributary of Buffalo Bayou, drains 108 square miles of the central and northwestern portions of the county. The bayou rises in the northwest part of Harris County, and flows generally southeast for about 25 miles into the City of Houston and joins Buffalo Bayou near the central business section of the city. The study area of upper White Oak Bayou comprises 61.4 square miles and represents approximately 57 percent of the total White Oak Bayou drainage basin. Downstream of the study area the White Oak Bayou channel has been enlarged, straightened and lined as part of a Federal flood control project.

Residential subdivisions are extensively developed along White Oak Bayou between stream mile 10.7 and mile 15.5. The bayou currently forms the city limits of Houston between stream mile 10.7 and mile 12.4. Portions of this developed reach have recently been incorporated by the City of Houston. Only scattered urban developments presently exist between mile 15.5 and mile 18.2; however, several large scale developments are being planned for this area. The incorporated town of Jersey Village is

located along both banks of White Oak Bayou between stream mile 18.2 and mile 19.9. Upstream from Jersey Village the flood plain areas are presently undeveloped and are used for agricultural purposes. This upstream reach of the bayou has previously been cleared of most natural woodlands for agricultural usage and is not particularly attractive for future urban development.

The flood plain areas of the tributary Cole Creek are developed along its lower 2.7 miles with residential subdivisions, apartment complexes, and commercial service facilities. Most of the flood plain areas of Cole Creek are within the city limits of Houston. In addition considerable scattered residential and commercial properties are located along the creek upstream from Guhn Street near stream mile 3.7. The Northwest Freeway, under construction in 1976, is located parallel and adjacent to the creek between mile 3.0 and mile 5.5. Improved freeway access to the area is certain to attract additional urban development.

The tributary Vogel Creek is about six miles long and drains 9.5 square miles of the upper White Oak Bayou watershed. Most of the flood plain areas of Vogel Creek are presently urbanized, with the remaining areas also committed to future residential development. The flood plains in the lower two miles of the streams are saturated with relatively new residential subdivisions, and older subdivisions are located along the creek from mile 2.9 to mile 4.5. A recently completed residential development is located along both sides of the creek upstream from North Houston-Rosslyn Road near stream mile 5.0.

Photographs of typical urban conditions in the study area are shown on the following pages. The natural ground in the upper White Oak Bayou watershed varies in elevation from about 135 feet above mean sea level near its headwaters to about 70 feet at the downstream limits of the study area. The flowline of the existing improved channel in

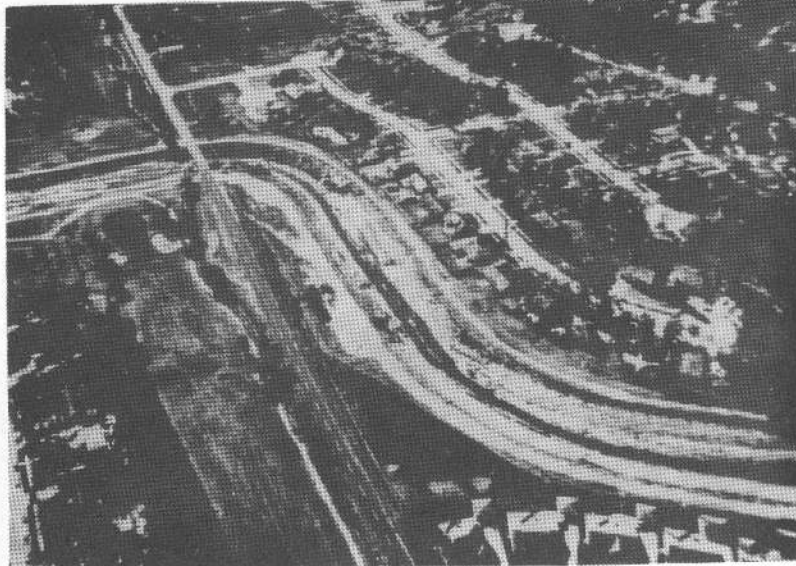


# TYPICAL URBANIZATION



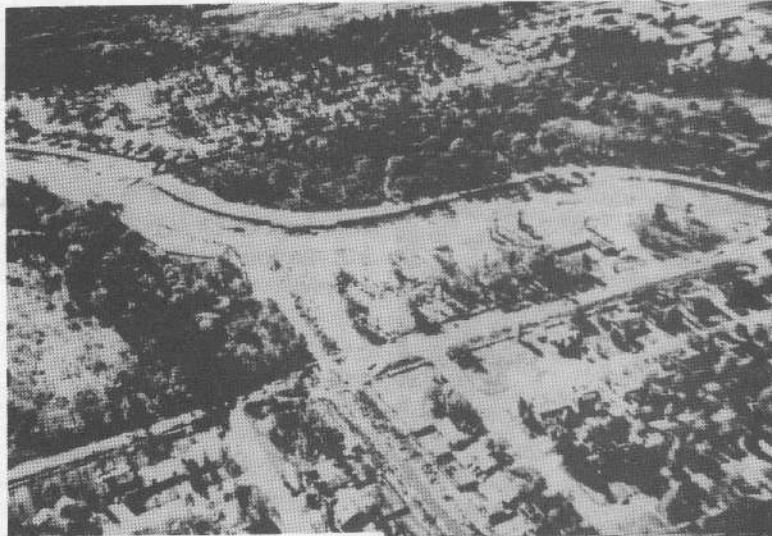
Residential and commercial developments along White Oak Bayou near Antoine Street

Residential development surrounding Inwood Forest golf course along White Oak Bayou



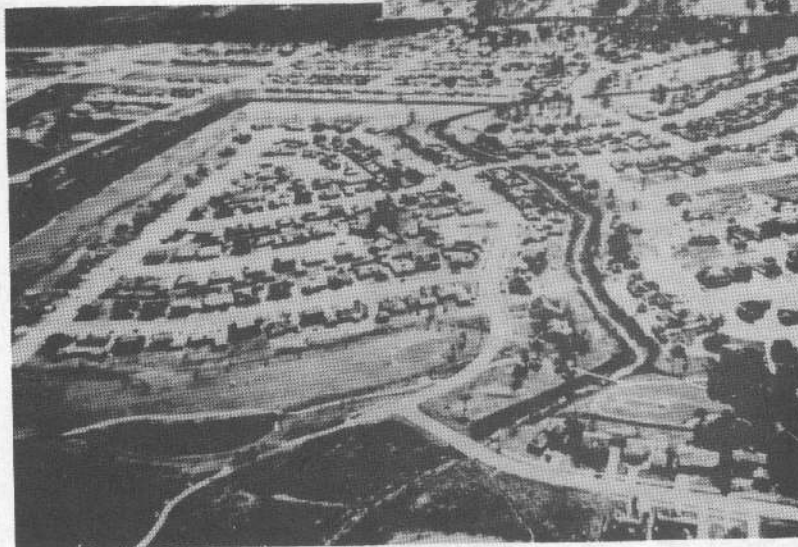
Residential development along White Oak Bayou near Alabonson Road

# TYPICAL URBANIZATION



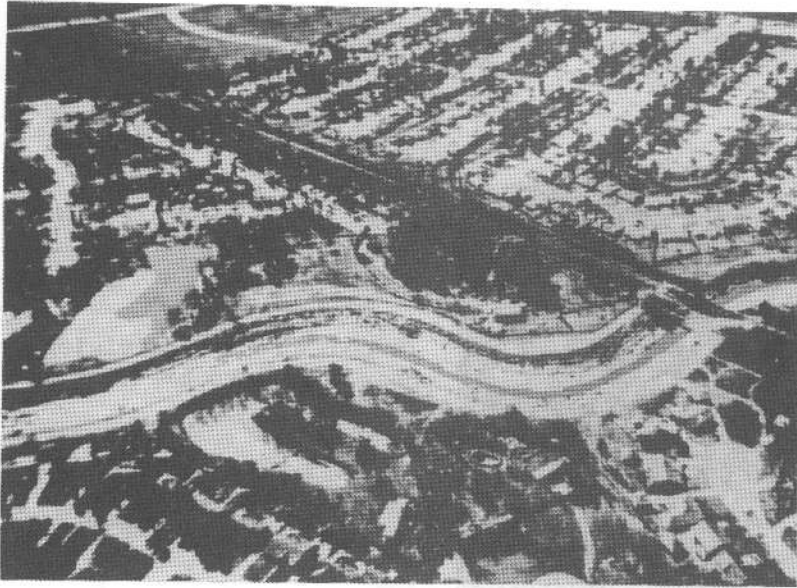
Urbanization along  
White Oak Bayou  
near the mouth of  
Vogel Creek

Residential congestion  
along Vogel Creek  
near its mouth



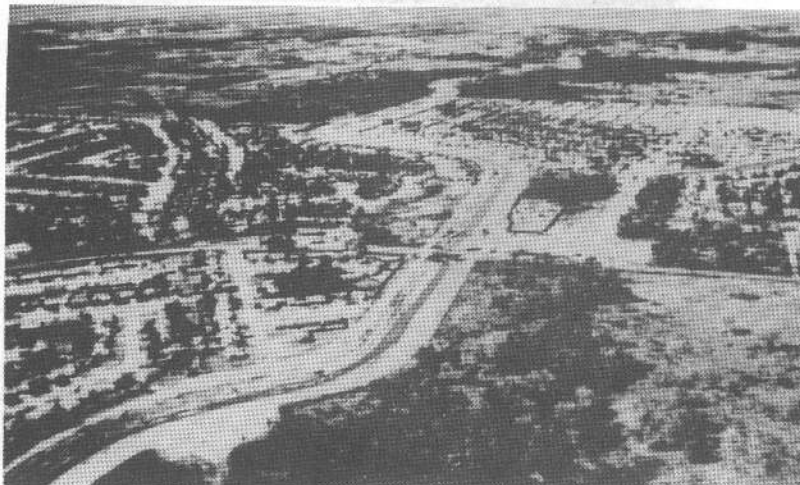
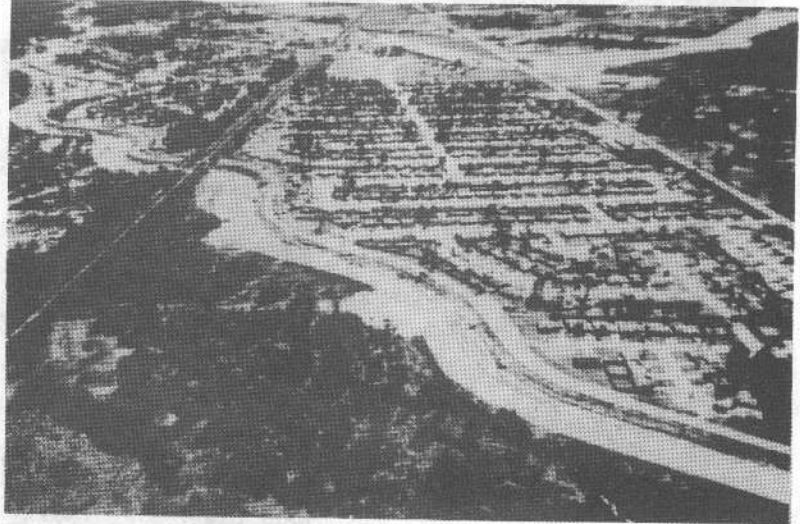
Residential development  
and golf course along  
Vogel Creek

# TYPICAL URBANIZATION



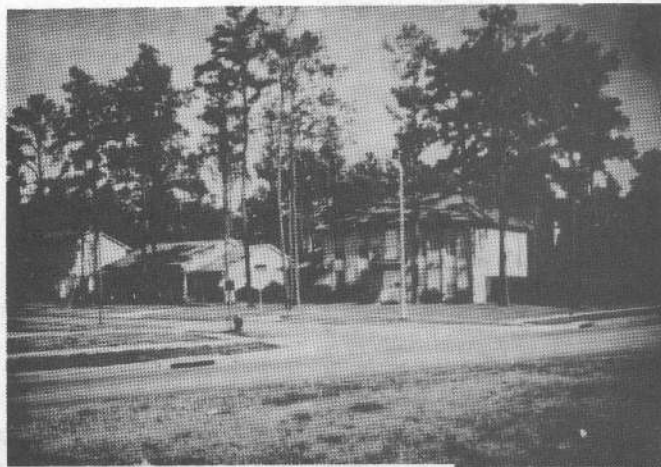
Residential development  
along White Oak Bayou  
near B. & R.I. Railroad

Residential development  
along White Oak Bayou



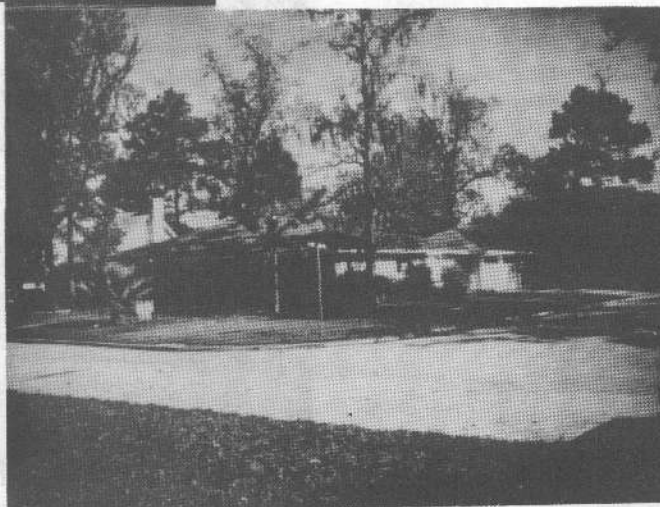
Urbanization surround-  
ing White Oak Bayou  
near North-Houston-  
Rosslyn Road

# TYPICAL URBAN DEVELOPMENT



Inwood Forest Subdivision  
near Vogel Creek

Arbor Oaks Subdivision  
near confluence of White Oak  
Bayou and Vogel Creek



Woodland Trails Subdivision  
near White Oak Bayou

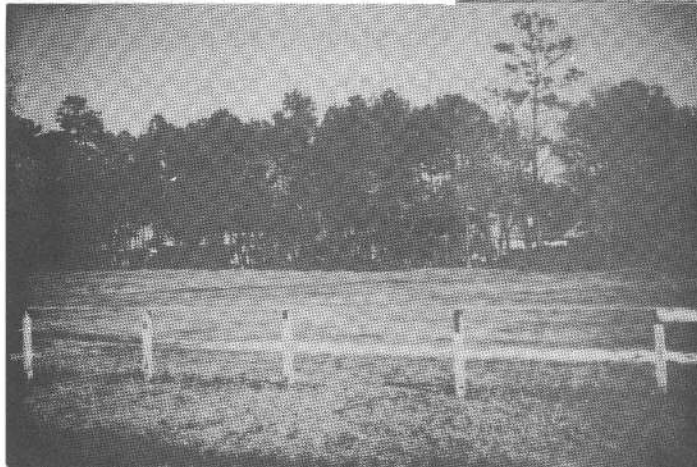
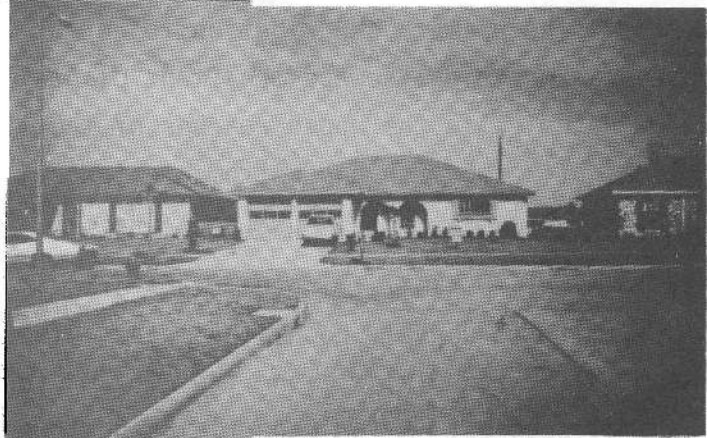


# TYPICAL URBAN DEVELOPMENT



Jersey Village near  
White Oak Bayou

Chateau Forest Subdivision  
near White Oak Bayou



Inwood Forest Subdivision  
and golf course near  
White Oak Bayou

White Oak Bayou at the downstream limits of the study area is 46.5 feet above mean sea level on the downstream side of a 4-foot drop structure. The slope of the stream in the study area averages about 4 to 5 feet per mile. Stream depths in the watershed vary from about 19 feet in the lower reaches to about 6 feet near the headwaters.

The climate is characterized by warm summers and mild winters. Temperatures range from a mean summer average of about 90 degrees to a winter average of about 45 degrees. Prevailing winds are from the south and southeast, causing high humidity and a uniform climate. Mean annual precipitation is about 45 inches. The region is subject to intense local thunderstorms of short duration, general storms which extend over a period of several days, and torrential rainfall associated with hurricanes and other tropical disturbances which periodically cause flooding of local streams.

Water quality in White Oak Bayou and its tributaries is generally poor. The primary contribution to normal low flow is effluent from the several municipal sewage treatment plants located along the streams. A few potholes in the upper reaches of the streams support small populations of scrub fish and bottom creatures. There is little sport fishing in the streams.

Wildlife habitat in the study area is limited because of the proximity to densely populated areas. The prairie grasses, woods, brush, and cultivated fields along the streams furnish some habitat for small animal species. A few rice fields northwest of Jersey Village and Addicks and Barker Reservoirs southwest of the study area provide habitat for migrating ducks and geese; however, populations of these species are generally small within the White Oak Bayou watershed. Rare and endangered

species have not been reported in the area, probably because of the extensive residential development.

An archeological survey conducted along the streams in the study area indicated that the entire area has been altered to varying degrees by previous channel work and by urbanization. Two archeological sites of significance were located along the banks of White Oak Bayou. One of the sites has been bisected by previous channel realignment, and the other is located along the bank line of the bayou.

### ***Human Resources***

The rapid population growth which has occurred in Houston and Harris County in recent years has had a significant influence on developments in the upper White Oak Bayou area. New residential housing to accommodate this growth has attracted developers to the west northwest region of Harris County because of its rural atmosphere, the relatively attractive wooded surroundings, and the remoteness from the adverse industrial atmosphere of the ship channel area. The population of the study area increased from 14,400 in 1960 to 28,100 in 1970, an increase of about 96 percent. The population is projected to be 55,000 by 1980. Additional development pressures on the study area are produced by its proximity to downtown Houston and its accessibility by U. S. Highway 290, the new Northwest Freeway and other major thoroughfares.

The following table shows the 1970 distribution of employment of the residents living in the study area. The largest occupation group is the service workers followed by operations workers; however, professional, technical and clerical workers make up more than 27 percent of the labor force.

## EMPLOYMENT DISTRIBUTION OF STUDY AREA RESIDENTS - 1970

Occupation	Number Employed	Percent Distribution
Professional & technical workers	1,356	13.5
Managers & administrators, except farm	780	7.7
Sales workers	690	6.8
Clerical workers	1,377	13.7
Craftsmen	1,486	14.8
Operations workers	1,713	17.0
Laborers, except farm	668	6.6
Farm workers	70	0.7
Service workers	1,932	19.2
Total	10,072	100.0

### ***Development and Economy***

The development trends and the economic characteristics of the upper White Oak Bayou study area are dominated by the economic influences of metropolitan Houston, a dynamic fast growing, modern city with a promising future. Houston is the largest city in Texas and in the South and ranks sixth in the nation in population, estimated to be about 1,370,000 in 1975.

Although Houston is located about 50 miles from the Gulf of Mexico and the Gulf Intracoastal Waterway, it is the third busiest seaport in the United States in terms of tonnage. Ocean going vessels reach the Port of Houston through the Houston Ship Channel, which provides a depth of forty feet from the Gulf through Galveston Bay almost to the heart of the city. The many major highways, railroads, and pipelines serving the city form an excellent transportation network. Thousands of tons of oil and chemical products, agricultural and manufactured products, and raw materials move through the city daily.

Houston is the center of the giant oil and petro-chemical industries of the Southwest with many refineries located in the



metropolitan area or in adjacent cities. The farmland around Houston is highly productive. Rice, cotton and cattle are the major farming and ranching industries of the area. The economy of the city, founded on shipping, commerce, banking, and industries, is versatile and highly capitalized. Tens of thousands of people are employed in manufacturing oil field equipment, electronic products, machinery and tools, chemical products, iron and steel, synthetic rubber, paper pulp, building materials, cement, bags and bagging, paint, containers, plastic products and clothing. Houston's industries process petroleum, natural gas, cotton seed and livestock, and mill rice and flour.

The developed portions of the Houston metropolitan area now occupy more than 27 percent of the land area of Harris County and extend into adjacent counties. Urban development is expected to occupy about 38 percent of the county area by 1990. Because of its proximity to the central business district of Houston and the accessibility of good transportation facilities to the commercial and industrial centers, the study area is expected to continue to develop to meet the residential and commercial needs of the metropolitan area. Studies made by the City of Houston and the Houston-Galveston Area Council between 1969 and 1971 indicate that existing and future land use of the study area will be primarily residential and related light commercial developments. Subsequent urbanization has been consistent with that projection, and the trend is expected to continue. Existing agricultural and vacant lands will yield gradually to residential development and to other more intense land uses.

### ***Existing Improvements***

A Federal flood control project has been constructed in the lower 10.7-mile reach of White Oak Bayou. The project consisting of channel enlargement, rectification, and partial paving of the bayou between its

mouth at Buffalo Bayou and its confluence with Cole Creek, provides a high degree of flood protection for the area immediately downstream from the present study area. Between 1958 and 1962 the Harris County Flood Control District cleared, straightened, and enlarged the White Oak Bayou channel in the study area upstream from the existing Federal project to Huffmeister Road, near stream mile 25.0. Many of the natural meanders of the stream were cut off and filled with excavated material. In conjunction with these improvements, the Harris County Flood Control District acquired drainage rights-of-way throughout the entire affected reach. These rights-of-way average about 200 feet in width in the reach between the existing project at mile 10.7 and Jersey Village at mile 18.2. From this point to the upstream end of the local improvements, the rights-of-way average about 150 feet in width. The rights-of-way areas were cleared of all trees and vegetation in connection with the construction and have since been recleared at infrequent intervals. These local improvements were designed to improve the drainage in the undeveloped rural areas of upper White Oak Bayou but not for the extensive urban developments which have since occurred. Although the rights-of-way obtained for the improvements are sufficient for a larger channel, no further improvement of the channel has been made by the Flood Control District, presumably because of limited financial resources and other demands throughout the county. Maintenance of the completed work has been insufficient to prevent erosion of the banks at some locations, and growths of weeds, brush and willow trees in some reaches of the stream impair the capacity of the channel.

Similar channel clearing and enlargement work has been accomplished by the Harris County Flood Control District in the lower reaches of Cole Creek and Vogel Creek. The lower 2.7-mile reach of Cole Creek has been cleared, straightened, and enlarged at various times in the past ten years. Similar work has been done in the lower reach of Vogel Creek.

The Texas Highway Department began construction of a portion of the Northwest Freeway (U.S. 290) across the southern portion of the study area in 1972. The highway route is generally located southwest of and adjacent to Cole Creek. To provide interim flood relief for the area the highway work included the utilization of Cole Creek and White Oak Bayou upstream of the mouth of Cole Creek as sources of needed fill material.

Arrangements between the Texas Highway Department and the Harris County Flood Control District provided that the excavation would be accomplished in a manner which would effectively increase hydraulic capacities of the streams. The improvements resulting from removal of about 500,000 cubic yards of material from White Oak Bayou and about 40,000 cubic yards from Cole Creek have been duly considered in the hydrologic and economic studies presented in this report.

## ***PROBLEMS AND NEEDS***

The primary water resources problem of the study area stems from frequent flooding of residential properties along White Oak Bayou and its tributaries. The basic need of the watershed, therefore, is a sound plan to eliminate the flooding or to minimize its adverse effects. Additional recreational facilities in the rapidly developing residential area are also needed. As the population continues to expand, municipal water supply problems are expected to emerge. The problems, needs, and local preferences concerning the upper White Oak Bayou watershed are summarized in the following paragraphs and presented in more detail in Appendix 1.

### ***Flooding Problems***

The principal cause of the flooding problems of the upper White Oak Bayou watershed is the lack of adequate capacity in the streams

draining the area. The problems are being compounded by the continuing increases in suburban development which reduces the infiltration of rainfall and increases and accelerates runoff to the streams. Large portions of the study area are subject to frequent flooding. The problems are further compounded by inadequate storm sewers and lateral drainage facilities which retard runoff to the primary streams. In recent years several rainstorms have caused severe property damage and large economic losses. Fortunately, no lives have been lost as a direct result of these floods. Although nearly all of the flood damage has been sustained by residential properties located along the streams, a few commercial establishments and public facilities have also been damaged. The following photographs illustrate the type and character of the homes which have been flooded. The depth of flooding is also indicated on the photos. Most residential properties subject to repeated flooding are less than ten years old. Many of these have suffered inundation damages four times between 1968 and 1976. Damage surveys made by the Corps of Engineers following the floods of October 1970 and March 1972 found that the flooding of more than 200 homes in 1970 had caused estimated property damages of \$1,100,000 and that the 1972 flood had damaged 292 homes with estimated property damages of \$2,650,000. Comparable estimates are not available for other floods.

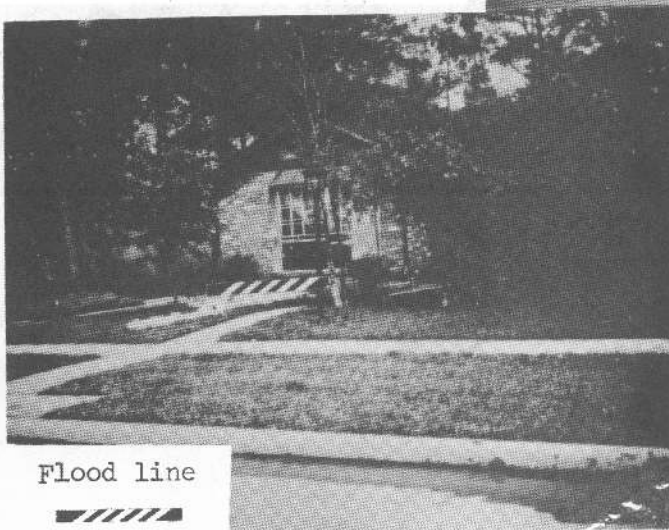
One of the basic standards for evaluating the flood potential of an area is the standard project flood (SPF). As used in this report, the SPF is defined as an estimated or hypothetical flood that would be produced by the most severe combination of rainfall and runoff conditions that are reasonably characteristic of the region. The SPF represents a reasonable upper limit of the flood potential. Although no specific recurrence frequency is assigned to such a flood, its probability of occurrence is generally much less than one percent in any particular year. An SPF in the upper White Oak Bayou watershed would inundate nearly 13,400 acres of land with a total property value,

# URBAN FLOODING-MARCH 1972



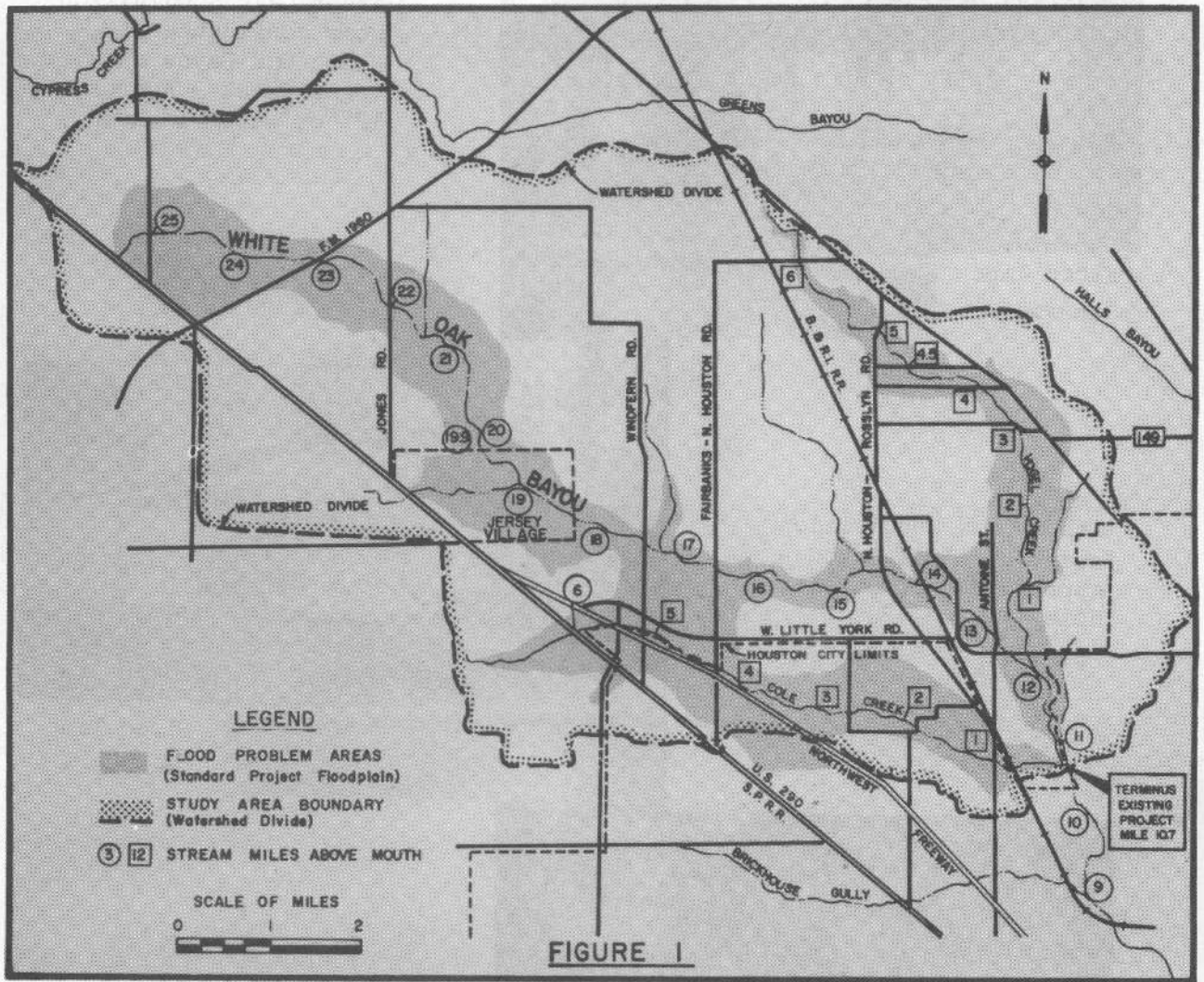
Arbor Oaks Subdivision  
near confluence of  
White Oak Bayou and  
Vogel Creek - Approx.  
12" of water in home

Arbor Oaks Subdivision  
near White Oak Bayou -  
Approx. 24" of water in  
home



Inwood Forest Subdivision  
near Vogel Creek - Approx.  
8" of water in home

public and private, currently estimated at more than \$241 million. More than 4,500 homes would be inundated and would sustain damages estimated to exceed \$33 million. The area subject to flooding by an SPF is shown in Figure 1. An Intermediate Regional Flood (IRF), having a recurrence frequency of 100 years or a one percent chance of occurrence in any year, would inundate nearly 10,300 acres and cause damage to 3,800 homes.



## FLOOD PROBLEM AREAS

Under present conditions of suburban development in the upper White Oak Bayou watershed, floods resulting from the occurrence of rainstorms of various magnitudes could cause potential property damages averaging \$4,356,000 each year. Continued development in the watershed will increase the damage potential with acceleration of runoff. Local ordinances regulating new construction will curtail new developments of a flood prone nature and minimize potential damages to future development.

A Special Flood Hazard Information Report was completed in June 1972 and presented to local officials for their use prior to completion of this report. The flood hazard information is being used by Harris County and the City of Houston as interim guidance for compliance with the Federal flood insurance program. Because of this prior report, a flood plain information appendix is not included with this interim report.

### ***Recreational Needs***

Existing recreational opportunities related to fish and wildlife are limited. The upper seven or eight miles of White Oak Bayou and adjacent lands provide some opportunities for sports fishing and hunting. Hunting is restricted to land outside of the city limits of Houston and the communities in the area. Sports fishing is limited to a few potholes along the upper reaches of White Oak Bayou where water quality is generally poor. Addicks and Barker Reservoirs and the upper reaches of Buffalo Bayou southwest of the study area provide significant opportunities for bird watching activities. Recreational development in the study area has not kept pace with the rapid urban growth of this portion of Harris County, and the existing recreational facilities are insufficient for current needs. Existing facilities are limited to two private country clubs, a few neighborhood parks, and public school playground areas. The banks of the streams are used as

bike trails in a few locations; however, urban development and limited access inhibit widespread use of the streams.

Plans for recreational development in the study area by local agencies generally consist of neighborhood-type park facilities to serve adjacent subdivisions. The residents of Harris County Water Control and Improvement District No. 93 passed a \$600,000 bond issue in June 1973 for neighborhood recreational development. The 880-acre utility district included four subdivisions located in the vicinity of White Oak Bayou between stream mile 12.4 and mile 15.0. Five park sites were considered for development and cost estimates were prepared by its architects. However, controversy arose concerning the legality of the utility district's involvement in recreational development, and construction of the improvements was delayed. The City of Houston has recently annexed the District and opposes such development at the present time. It is unlikely that the planned development will be constructed in the foreseeable future.

The City of Jersey Village owns a 5.8-acre park site along White Oak Bayou near stream mile 18.3. The City has recently constructed a swimming pool, and other compatible facilities are planned at this site in the near future. However, the full extent of this development has not been established.

The City of Houston, Planning Department, in its 1969 report, Open Space for Living, recommended the preservation of open greenbelt areas for recreational usage along most of the streams in the Houston area, including White Oak Bayou within the study area. The Houston-Galveston Area Council recommended similar action in its 1971 publication, Parks, Recreation and Open Space. However, no action has been taken by any local governmental agency to reserve the greenbelt areas along White Oak Bayou, and urban development has now precluded such future considerations in most areas.



The residential population in the study area was 28,000 in 1970 and is expected to increase to 55,000 by 1980 and to 117,000 by 2020. The demand for recreational opportunities is expected to increase comparably. Additional public recreational development will be needed to satisfy the expanding demands of this rapid growth. Public officials, residents of the area, and conservation organizations have expressed interest in and support for incorporating recreational facilities, such as hike and bike trails, into flood control plans.

### ***Water Supply Needs***

The primary sources of municipal water supply for the upper White Oak Bayou area are a few deep wells operated by various utility districts and surface water transported to the area by pipeline from Lake Houston in the northeast portion of Harris County. The great demands placed on the subsurface water supplies in the Houston area have caused substantial lowering of the groundwater table resulting in consolidation of subsurface soils and general land subsidence. The subsurface soils in the study area are composed of sediments of the Lissie and Beaumont formations of the Pleistocene Age which contain deposits of sand and silt interlaced with thick beds of clay. These subsurface formations provide a reliable source for municipal water supply. However, because of the severe land subsidence problems in the eastern portion of metropolitan Houston, some 20 miles from the study area, additional surface water sources are being developed to meet the existing and future needs for municipal and industrial water for the Houston and Harris County area. Existing ground water withdrawals in the immediate study area are insignificant in contributing to the land subsidence problems in adjacent areas. The streams in the upper White Oak Bayou study area are intermittent and offer no opportunity to develop as sources of surface water supply.

### ***Other Needs***

Other water resource problems and needs have been considered. Water quality of the streams is generally poor. Because of their intermittent nature, normal flows are frequently comprised primarily of effluent from several municipal sewage treatment plants. The quality of the effluent from these plants is generally improving as more stringent water quality standards are imposed. While most alternate flood control plans would have little effect on water quality of the streams, the channel improvement alternatives would remove potholes of stagnant water and eliminate associated health hazards.

In recent years considerable interest in preserving ecological and aesthetically pleasing spaces has emerged in the Houston area. Most of those spaces are concentrated in the wooded, greenbelt areas adjacent to the bayous, creeks and water courses. The woodlands along the streams have provided an aesthetic quality for homebuilders, and consequently many wooded areas have been substantially altered by subdivisions and other developments. The environmental setting along the streams in the upper White Oak Bayou watershed has been altered from a natural condition by previous channel work and by urbanization. Little natural environmental beauty remains. The stream areas at many locations are characterized by eroding banks and unsightly growths of weeds, brush, and other vegetation. All structural measures considered will incorporate special architectural and revegetation features to enhance the appearance.

### ***Improvements Desired***

The public views on the water resource problems and needs of the upper White Oak Bayou watershed are reflected in the input provided during the investigation. The public involvement activities have

included two public meetings, on 14 May 1971 and 18 April 1974, several informal workshop sessions with a local citizens' advisory committee for the study, and informal discussions with civic groups, individuals and the local sponsoring agency. In general local interests and the affected property owners have requested that channel improvements be constructed in White Oak Bayou, Cole Creek, and Vogel Creek to relieve the area from frequent and damaging floods. Elements of the public have requested that recreational facilities be incorporated in the plans. Environmental organizations have expressed an interest in preserving the remaining natural environment wherever possible.

### ***FORMULATING A PLAN***

To provide a long-term solution to the flood problems of the upper White Oak Bayou watershed, alternate solutions have been developed. Technical, economic, environmental, and social criteria have been applied to each alternative in order to evaluate its relative effectiveness, to select the most appropriate project plan, and to identify the degree of Federal interest and responsibility in its implementation.

In selecting a plan for flood control or flood damage prevention, a full range of alternatives is considered, including both structural and nonstructural measures and combinations thereof. Structural measures consist of structures designed to control, divert, or exclude the flow of water from flood prone areas to the extent necessary to preclude serious damages to property, hazard to life or public health, and general economic losses. Nonstructural measures, on the other hand, basically contemplate avoidance of flood damages by exclusion or removal of damageable properties from the flood plain areas, thus allowing the water to flow uncontrolled without damaging consequences. Flood proofing

of existing structures and implementation of effective warning and temporary evacuation procedures are alternate nonstructural measures for developed areas. Flood plain zoning and management measures are effective in preventing future damages in undeveloped or partially developed areas. Structural and nonstructural concepts may often be combined in developing a total plan for a flooding situation of broad scope.

### ***Formulation and Evaluation Criteria***

Technical, economic, environmental, and social criteria applicable to the plan selection process in this particular situation are summarized as follows:

#### **TECHNICAL CRITERIA**

● Structural measures should be designed to provide a relatively high degree of flood protection to minimize future residual flooding and eliminate threats to human life. In heavily urbanized reaches of the streams, protection against the standard project flood is considered desirable, and protection against a 50-year frequency flood is considered a minimum level. The potentially disastrous consequences of a reduced degree of protection, coupled with a false sense of security on the part of residents in flood prone areas, must be avoided. Some sacrifice of degree of protection could be tolerable if dictated by environmental or other compelling considerations and if supported by an adequate warning system.

● Nonstructural measures are adaptable to lesser degrees of protection provided that public awareness of the remaining hazard is maintained, an adequate flood forecasting and warning system is adopted, and appropriate evacuation procedures developed. By their nature nonstructural measures are most effective in undeveloped or partially developed flood plain areas. The nonstructural measures must reflect the building restrictions imposed by regulations adopted by local interests to qualify for participation in the National Flood Insurance Program. Flood plains in the study area are regulated by existing ordinances.

## ECONOMIC CRITERIA

● To meet the National Economic Development (NED) objective for planning water resources projects, estimated benefits must exceed estimated costs, including both initial cost and allowances for operation and maintenance. These are reduced to average annual equivalent values and related in a ratio of benefits to costs. This ratio must exceed unity or one to meet the NED objective. The NED plan should produce the maximum excess of benefits over costs. Annual benefits and annual costs do not vary proportionally with variations in the degree of flood protection provided.

● The selected plan, whether structural, nonstructural, or a combination of both, should ordinarily provide a maximum of excess benefits over costs; however, unquantifiable considerations or intangible benefits could influence the selection of a plan which would forgo a portion or all the excess benefits.

● The effectiveness of structural and nonstructural measures should be evaluated on the basis that all future development within the 100-year frequency flood plain will be built with the floor elevation at or above the 100-year frequency flood level.

● All structural measures and some nonstructural measures should be evaluated using a 100-year period of analysis. A lesser period of analysis may be warranted in the evaluation of certain nonstructural measures where the expected life of developed properties is less than 100 years. The benefits and costs derived from the alternate plans should be reduced to average annual equivalent values for comparative purposes and total annual costs should include amounts for operation, maintenance, and major replacements, as well as amortization and interest on the investment.

## ENVIRONMENTAL AND SOCIAL CRITERIA

● Structural and nonstructural measures must be evaluated in accordance with guidelines established by the National Environmental

Policy Act of 1969 (Public Law 91-190) and the "Principles and Standards for Planning Water and Related Land Resources," as developed by the United States Water Resources Council.

- Beautification and recreational aspects, consistent with Federal guidelines and public desires, should be considered as measures supplementary to the project alternatives.

- Structural and nonstructural alternatives must reflect close coordination with interested Federal and State agencies, the Harris County Commissioners Court, the Harris County Flood Control District, and the affected public. The effects of these measures on the environment must be carefully identified, compared with technical, economic, environmental, and social considerations on an equal basis, and evaluated in light of public preferences. Plans developed to enhance or preserve environmental quality of the area need not be economically justified.

### ***Alternate Solutions to the Flood Problems***

Several solutions to the flooding problems in the upper White Oak Bayou watershed are possible, including structural measures, nonstructural measures and combinations of the two. Certain alternate solutions have been subjected to only preliminary investigations because of the evident lack of technical and economic feasibility or social acceptability. The more favorable alternate solutions have been subjected to more detailed studies to define these aspects, as well as the environmental impacts.

#### NONSTRUCTURAL MEASURES

Nonstructural measures are designed to manage flood plain land and development in such a manner as to minimize the damaging effects of floods. These measures do not affect the frequency or level of flooding. Such nonstructural measures include:

- Flood proofing is employed primarily for the reduction or elimination of flood damages to existing structures. Possible methods of flood proofing residential and commercial areas include providing

water-tight coverings for door and window openings, raising of floor elevations, raising access roads and escape routes, constructing earthen levees or floodwalls around individual buildings or groups of buildings, and waterproofing of walls of structures. Although more easily applied to new construction, flood proofing is also applicable to existing facilities. This alternative has merit where flooding is of short duration, low velocity, infrequent, and of shallow depths. Flood proofing is also appropriate in locations where traditional flood protection is not feasible or where collective action is not possible. Almost all buildings in the extensively developed flood plains of the study area are constructed on concrete slabs. Raising of concrete floor slabs is not practicable, and flood proofing techniques would require major modifications to the existing structures.

- Zoning regulations or land use restrictions are legal measures adopted by local governments to control future development in flood-prone areas. Zoning insures the safekeeping of property for the public health and welfare and the best use of available land. The regulations adopted by Harris County and the cities of Houston and Jersey Village restrict development in the flood plain by requiring that the first floor elevations equal or exceed the 100-year flood level. Such regulations avoid compounding of flood damage problems but offer no relief to existing developments. A zoning alternative therefore is of limited effectiveness where a high damage potential already exists.

- Permanent evacuation of developed flood plain areas could be adopted to eliminate the flood damage potential to whatever frequency of flooding as might be decided upon; i.e., 50-year, 100-year, SPF. This would require the acquisition of all privately owned lands, dwellings, and related improvements by purchase and, if necessary, through the exercise of the powers of eminent domain. The dwellings

and structures would be removed, the population relocated to flood-free housing, and the land converted to nature areas or other uses consistent with periodic flooding. The high property values and density of developments in the study area would render this alternative prohibitively costly in relation to positive structural measures and would have undesirable social and cultural effects on the affected communities.

#### STRUCTURAL MEASURES

Three basic structural methods are available for providing flood damage prevention measures to the study area. These methods are summarized as follows:

- Channel enlargement and rectification of the existing streams is a viable structural means of improving drainage. This solution involves excavation of the existing channels to provide additional flood-carrying capacity and relieve adjacent lands of periodic overbank flooding. Important design considerations influencing this solution are the availability of channel rights-of-way for necessary enlargement, the inclusion of appropriate erosion control measures to assure that the improvements remain stable and can be easily maintained, and the selection of appropriate channel cross-section shape considering such factors as hydraulic efficiency and rights-of-way limitations.

- Detention reservoirs are another means of controlling stream flooding. A flood detention dam and reservoir serves to temporarily impound upstream flood waters during rainstorms for later release when downstream conditions in the flood prone areas permit. The dam would include a gated outlet structure for controlled flood releases from the reservoir. Full-time operation and maintenance personnel would be required for proper functioning of the facility. A reservoir area must have sufficient topographic relief to contain large volumes of floodwaters behind the dam structure. The effects of downstream



tributary inflows into the stream must be considered when evaluating this alternative. If downstream inflows are sufficient to cause over-bank flooding, supplementary channel enlargement may be required to provide adequate flood protection.

- Diversion of floodwaters by new channels to other areas is effective in relieving the flood problem area of excessive rainfall runoff provided the diverted flows do not substantially increase flood problems in the areas receiving the additional flows. This alternative presents advantages when the problems created in the areas receiving the additional flows can be solved with relative ease in comparison to those of the primary problem area.

The three basic structural alternatives appear technically feasible and have been evaluated in sufficient detail to determine economic justification. These alternatives are discussed in more depth later in this report and in Appendix 1.

### ***Plans Considered***

The various plans considered are summarized in the following paragraphs. Each alternative includes beautification and aesthetic measures to enhance the appearance of the completed work. Complementary non-structural measures in the form of flood plain regulations in undeveloped reaches have been incorporated in the alternate plan where appropriate. The plans for White Oak Bayou, Cole Creek, and Vogel Creek have been developed independently and analyzed separately. The tributaries are separable, and each warrants independent evaluation of its economic worth. Structural flood damage prevention measures in White Oak Bayou would reduce the area of lands subject to flooding along the lower reach of Vogel Creek and would avert overland flows from White Oak

Bayou to Cole Creek, a situation which can occur under present conditions. These benefits to the tributary areas are attributable to the main stream improvements and will be realized whether or not the tributaries themselves are improved. The benefits attributed to the various plans are derived from the prevention of flood damages, primarily to existing suburban developments, reduction in public health, relief, and emergency costs, and enhancement of land values. The benefits for each plan have been reduced to average annual equivalent values and compared to the costs for the corresponding plan, also reduced to average annual equivalent values. The annual costs include interest and amortization of the project first cost, amortized cost for items requiring replacement during the project life of 100 years and the estimated annual operation and maintenance costs.

The physical features, flat topography, and extent of urban development in the upper White Oak Bayou watershed limit the number of technically feasible structural alternatives. A detention reservoir plan and a diversion plan have been developed and evaluated for White Oak Bayou. A lack of suitable reservoir sites precludes this alternative for Cole Creek and Vogel Creek. Diversion is also impractical for the tributary creeks. Prior channelization and the availability of existing drainage rights-of-way along the streams provide a substantial initial cost advantage to the enlargement and rectification alternatives. Moreover the established patterns of development and storm drainage are oriented to the streams and their availability as main stem drains. In the absence of extremely attractive and effective alternatives, these patterns are for all practical purposes irreversible.

## WHITE OAK BAYOU ALTERNATIVES

Damage studies indicate that structural flood protection is needed for the 9.2-mile reach of White Oak Bayou extending from the head of the existing Federal project, stream mile 10.7, to the upstream limits of the town of Jersey Village at stream mile 19.9. The flood plain beyond that point is undeveloped and offers little potential for future urbanization in the foreseeable future. Nonstructural flood plain land use management measures, consistent with the requirements of the Federal flood insurance program, are proposed to preclude future flood prone developments in this head-waters reach, approximately 5.6 miles in length.

● Channel improvement alternatives for White Oak Bayou include enlargement and rectification of 9.2 miles of the bayou channel with various forms of erosion protection incorporated to provide hydraulic efficiency and reduce maintenance requirements. For a given capacity, channel size requirements vary inversely with the hydraulic efficiency; thus, a smoothly lined, relatively straight channel requires the smallest cross-sectional area. The extent of the considered improvements to White Oak Bayou is shown in Figure 2. The existing Federal project in White Oak Bayou terminates at its confluence with Cole Creek. It consists of a rectified and enlarged channel, partially lined with concrete to the level of the 10-year frequency flood flow. Above the lining, an enlarged trapezoidal earthen section provides the additional capacity required to convey the standard project flood flow. This channel design is a balance between the high cost of concrete lining, hydraulic efficiency and erosion prevention capability for high frequency floods and limiting of rights-of-way requirements. The greater rights-of-way needed for an unlined channel and the increased mowing, erosion repairs, and other operational requirements, all responsibilities of the non-Federal

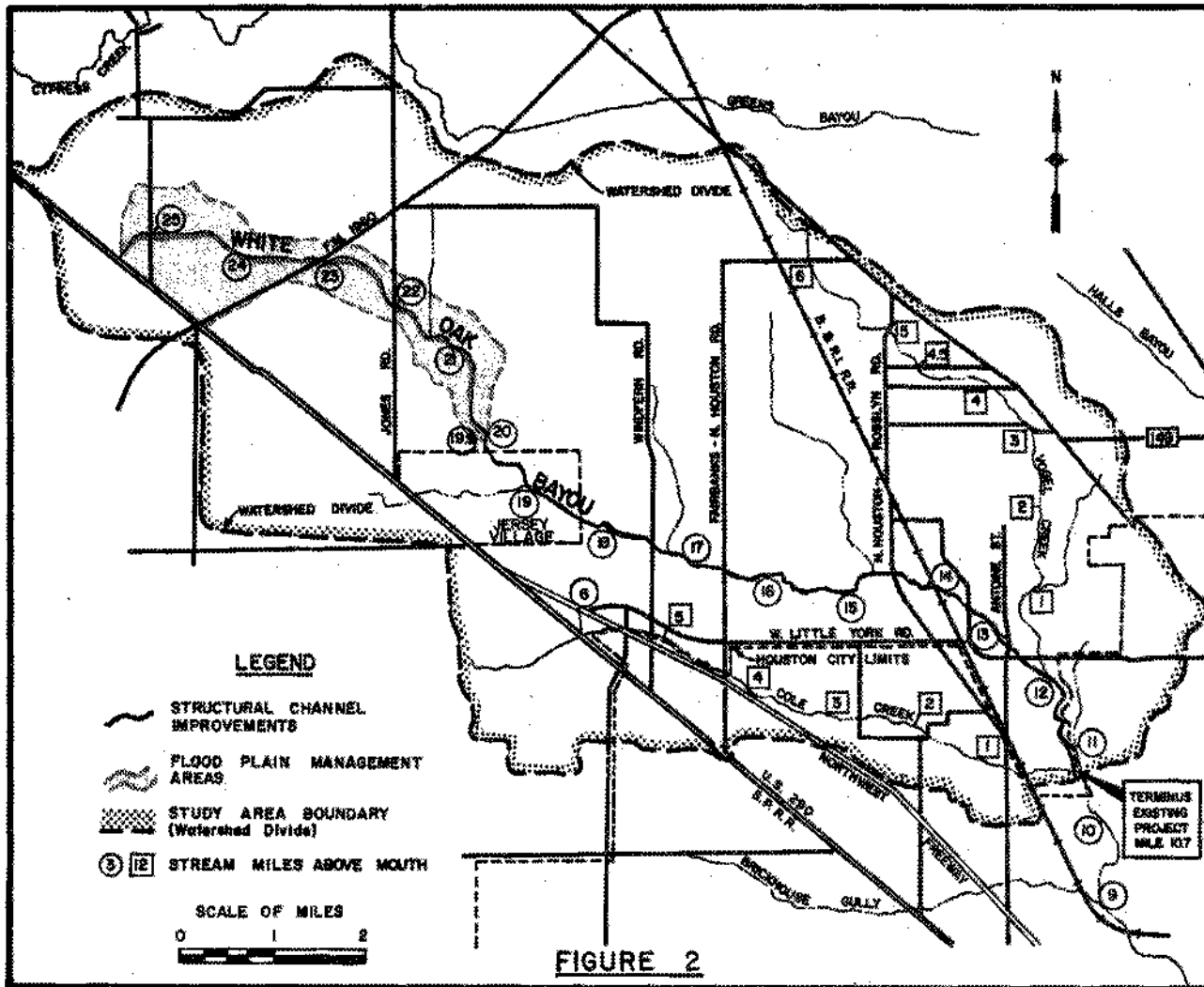


FIGURE 2

# CHANNEL IMPROVEMENT PLAN WHITE OAK BAYOU

sponsor, would involve prohibitive local costs. Extension of the existing project, using this channel design, has been developed as an alternative for the upper reach of White Oak Bayou, and its effectiveness has been evaluated at the standard project, the 100-year, and the 50-year flood levels of design.

An unlined earthen channel, using native grass for erosion control, has also been evaluated as an alternate solution for upper White Oak Bayou. Such a channel would require approximately 100 feet of additional right-of-way width throughout the length of the urbanized lower reach. The taking of these additional lands would impinge on the existing developed properties, including residences, increase adverse environmental impacts, and cause social disruption and inconveniences disproportionate to any advantages. The prospect of acceptance of such a plan by the affected residents, including the proportionately increased unsightliness of the much larger channel in a residential area, is slight.

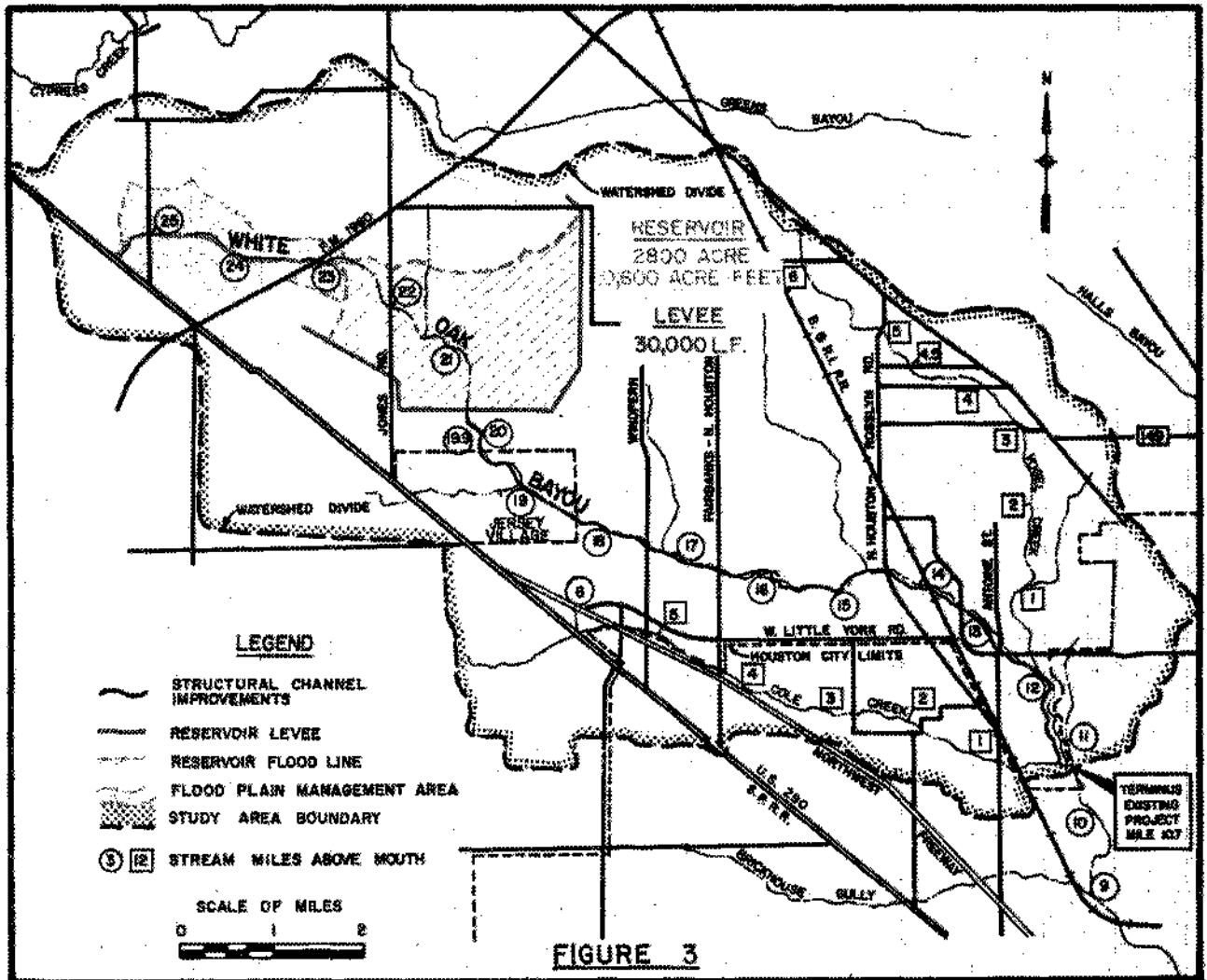
As an alternative to concrete for channel lining, construction devices known as "gabions" have been investigated. Gabions are wire baskets, rectangular in shape and variable in size, filled with stone, and placed and wired together in whatever configurations may be desired. Gabion linings usually collect silt which in turn develops vegetal growth. The vegetation tends to stabilize the gabion assembly. Channels lined with gabions, because of the inherent roughness and tendency to develop vegetal growth, provide poor hydraulic efficiency and entail high maintenance costs. A cost advantage associated with gabions stemming from a supply of native stone on the site for hand placement in the baskets is absent here, since the general area is devoid of native stone. Gabions do offer, however, opportunities for aesthetic design variations, and a gabion-lined channel has been evaluated accordingly.

Several other alternate forms of channel construction have also been considered. These alternatives include a concrete retaining-wall channel; a completely lined trapezoidal concrete channel; a steel sheet-pile wall channel; a flexible-mattress or gobimat lined channel; and a bin-type retaining-wall channel. All of these alternatives would entail considerably higher construction costs without apparent offsetting technical or aesthetic advantages. Several of the alternatives listed represent vertical wall construction which could involve reduced rights-of-way requirements, an advantage more than offset by higher construction costs and hazards to children and pets who, having fallen into the floodway, would find escape virtually impossible. An economic comparison of the more favorable channel improvement alternatives for upper White Oak Bayou follows:

CHANNEL IMPROVEMENT PLANS FOR WHITE OAK BAYOU

Alternate Plan	Total First Cost (\$Millions)	Annual Costs (\$Millions)	Annual Benefits (\$Millions)	Benefit: -Cost Ratio	Net Benefits (\$Millions)
Partially Lined Concrete Channel (SPF Protection)	31.93	2.36	3.26	1.38	0.90
Partially Lined Concrete Channel (100-Year Protection)	28.22	2.08	3.19	1.53	1.11
Partially Lined Concrete Channel (50-Year Protection)	26.02	1.93	3.16	1.64	1.23
Trapezoidal Earth Channel (SPF Protection)	25.96	2.03	3.26	1.60	1.23
Gabion-Lined Channel (SPF Protection)	34.90	2.74	3.26	1.19	0.51

● A flood water detention dam and reservoir could be built on upper White Oak Bayou at a site upstream from Jersey Village at stream mile 20.3. This site, shown on Figure 3, is the only site available. Because of the flat terrain, development of a reservoir at this location with sufficient storage capacity to contain the standard project flood from the upstream drainage area would be virtually impossible. A retarding reservoir would require releases during major floods, and tributary inflows below the reservoir combined with those releases would need substantial channel

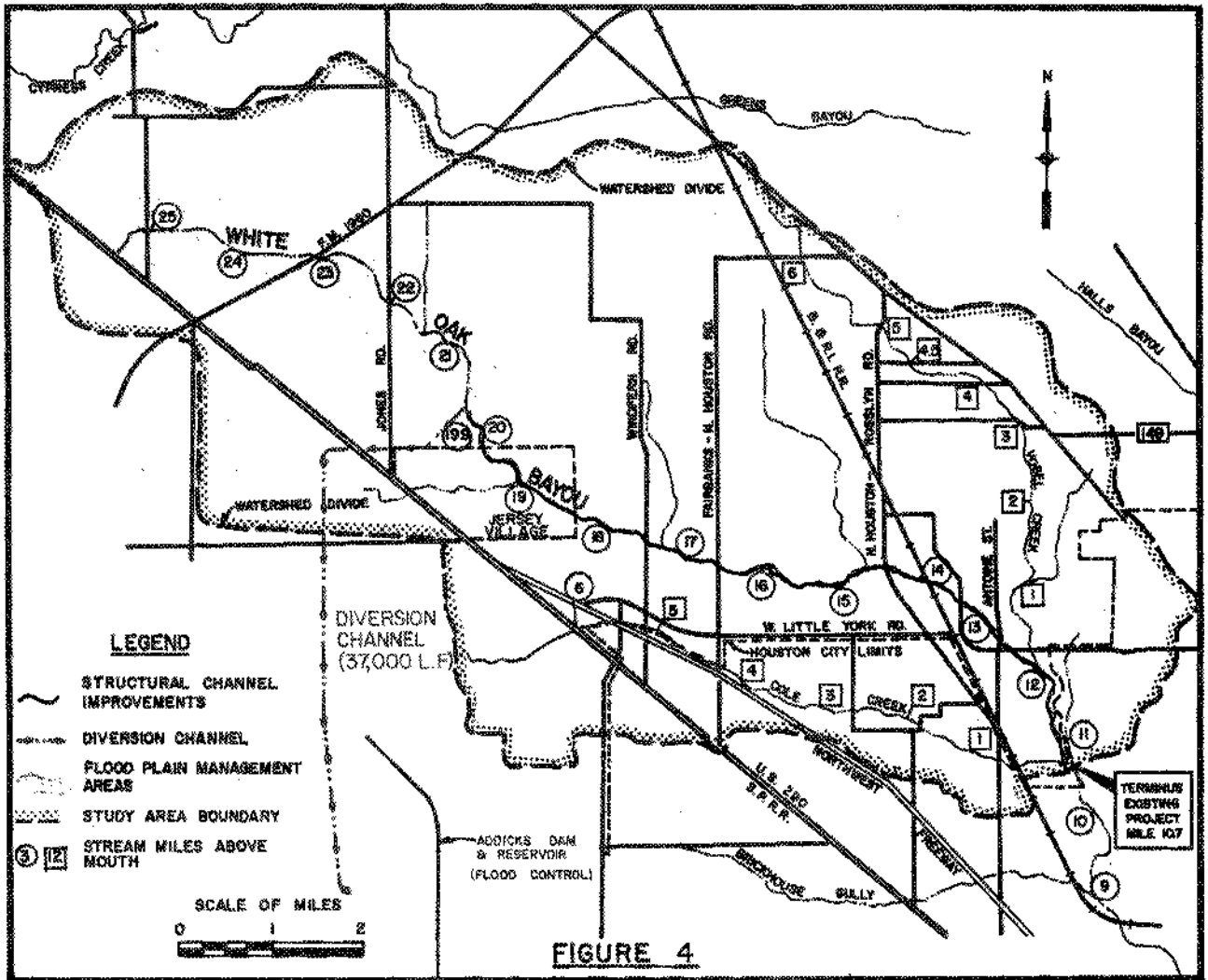


## RESERVOIR AND CHANNEL IMPROVEMENT PLAN WHITE OAK BAYOU

capacity. Thus the reservoir would reduce but not eliminate the improvements required. The total first cost of providing 50-year flood protection by means of the dam and reservoir combined with downstream channel enlargement is estimated to be \$54,699,000. Land values and acquisition expense for the reservoir site, a local cost, represent \$22,850,000 of this amount. Average annual costs of \$4,303,000 related to average annual benefits of \$3,157,000 represent a ratio of benefits to costs of 0.73.

● Diversion of floodwaters from White Oak Bayou to adjacent watersheds is theoretically a technically possible alternative, considered in isolation from adverse effects in the receiving watersheds. The reasonableness of this alternative is limited by the relatively flat terrain and by existing flooding problems in adjacent watersheds. One possible plan would divert the upper White Oak Bayou flows at mile 20.5 south through a channel 7 miles long to Turkey Creek and Addicks Reservoir, as shown on Figure 4. Addicks Reservoir, one of two detention structures in the upper Buffalo Bayou basin, controls 133 square miles of drainage area. The diversion channel would control the floodwaters from about 20 square miles or about one third of the upper White Oak Bayou watershed. This diversion, if it could reasonably be done, would only partially relieve the problem in White Oak Bayou. Channel enlargement and rectification would be necessitated by inflows originating below the diversion point. The same non-structural measures would be required in the reach upstream from the diversion point as are proposed with the basic channel improvement plan. The provisions for standard project flood protection to White Oak Bayou by means of the diversion channel and downstream channel enlargement would involve an estimated first cost of \$35,666,000 with a ratio of benefits to costs of 1.23. This diversion, while affording relief to the flooding problems of White Oak Bayou, would be totally unacceptable from the standpoint of acceptance of diverted waters in Addicks Reservoir, the operation of which, along with its companion, Barker Reservoir, is already drastically compromised by inadequate channel capacity in Buffalo Bayou. The increased hazard on Buffalo Bayou resulting from the diversion of White Oak Bayou has





## DIVERSION AND CHANNEL IMPROVEMENT PLAN WHITE OAK BAYOU

- not been evaluated; however, if all of the adverse economic effects in the receiving watershed were quantifiable, this plan of diversion would
- not be economically justified.

Another unacceptable alternative would divert White Oak Bayou flows to Cole Creek from a point of diversion near stream mile 17. The diversion

channel would be about 1 mile long. The lower 4.8 miles of Cole Creek, already inadequate to handle its own flows, would have to be further enlarged to accommodate the diverted waters. While this plan would eliminate the need for enlarging White Oak Bayou between Vogel Creek and the point of diversion, the increased channelization requirement in the lower reach of Cole Creek would substantially increase rights-of-way needs, necessitating removal of more than 50 homes and apartment complexes. This plan would cost approximately \$3,200,000 more than the combined channel improvement plans for the two streams. The adverse social impacts of transferring a problem from one place to another in this way appear to preclude a need for more detailed economic analyses.

● Permanent evacuation and relocation of residents from the flood plains of White Oak Bayou has been considered and found to be a technically feasible alternative for reducing flood damage potential. This would involve acquisition of all privately owned lands, dwellings, and related improvements subject to flooding. Relocation assistance would be provided all displaced residents in accordance with the Uniform Relocations Assistance Act. All structures would be razed or removed. The plan could be adapted to various levels of flooding; i.e., SPF, 100-year, etc. The lesser would require some companion structural measures or acceptance of residual flood risks to the remaining structures. An evacuation plan for the SPF flood plain would involve 1,949 homes, apartment units, and commercial buildings valued at about \$129,000,000. The social disruption involved in such a plan would make it completely unacceptable to the affected communities and citizens, particularly in the light of the availability of obvious structural improvements. Because of this and the huge costs, evacuation plans have not been subjected to detailed economic analyses.

#### COLE CREEK ALTERNATIVES

Damage studies in Cole Creek indicate that structural flood protection is needed in the creek from its confluence with White Oak Bayou upstream 4.9 miles to near Windfern Road. The wooded areas adjacent to the creek

have attracted the development of numerous residential subdivisions, apartment complexes, and supporting commercial facilities. Upstream of Windfern Road the flood plain is only sparsely developed. Nonstructural flood plain management and land use measures, to regulate future damageable development for this reach, are practicable for integration into an overall plan.

● Channel improvement possibilities for the lower reach of Cole Creek include enlargement and rectification of the stream with various forms of lining, similar to those discussed for White Oak Bayou. The location of the considered channel improvements is shown on Figure 5. Alternatives considered in detail are the partially lined concrete channel and the unlined turfed earthen channel concepts. Other forms of channel modifications such as those discussed for White Oak Bayou would be less advantageous. Rights-of-way constrictions and the adjacent suburban developments along the lower reach preclude the consideration of a full range of alternatives. The economic factors for the more favorable and acceptable channel improvement plans considered for Cole Creek are shown in the following tabulation.

CHANNEL IMPROVEMENT PLANS FOR COLE CREEK

Plan Description	First Cost (\$1,000)	Annual Costs (\$1,000)	Annual Benefits (\$1,000)	Benefit -Cost Ratio	Net Benefits (\$1,000)
Partially-Lined Concrete Channel (SPF Protection)	11,499	826	907	1.10	81
Partially-Lined Concrete Channel (100-Year Protection)	11,172	804	900	1.12	96
Partially-Lined Concrete Channel (50-Year Protection)	10,981	791	892	1.13	101
Trapezoidal Earth Channel (SPF Protection)	10,980	841	907	1.08	66

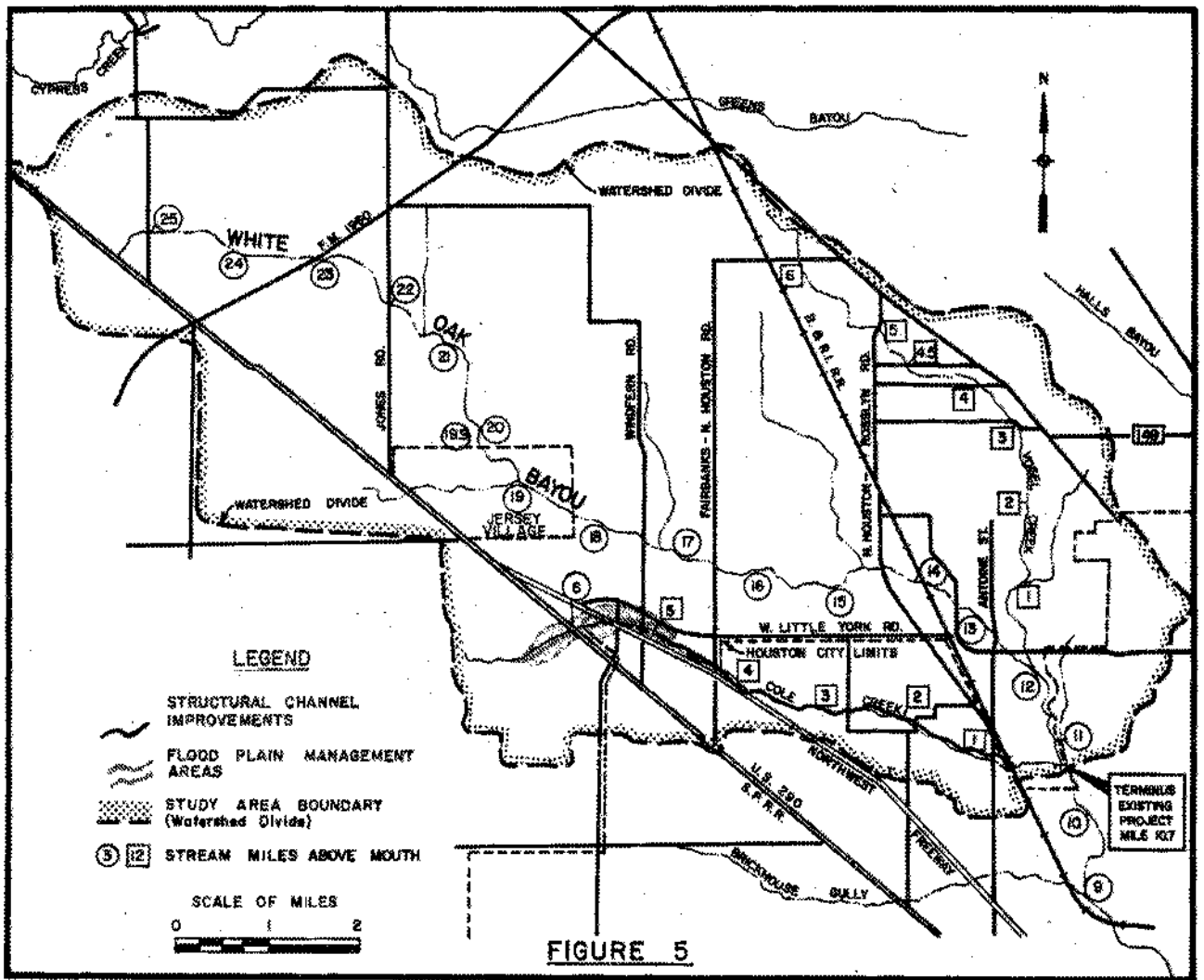


FIGURE 5

## CHANNEL IMPROVEMENT PLAN COLE CREEK

● Other alternatives to channel enlargement of Cole Creek are limited by the extensive urbanization in the vicinity of the creek. Existing development and lack of topographic relief preclude the consideration of detention structures. Under existing conditions, flood flows on Cole Creek overflow the watershed boundary to Brickhouse Gully, the adjacent tributary on the south. Brickhouse Gully has been rectified and lined with concrete by local interests to handle its own tributary inflows. Diversion of additional floodwaters from Cole Creek into the

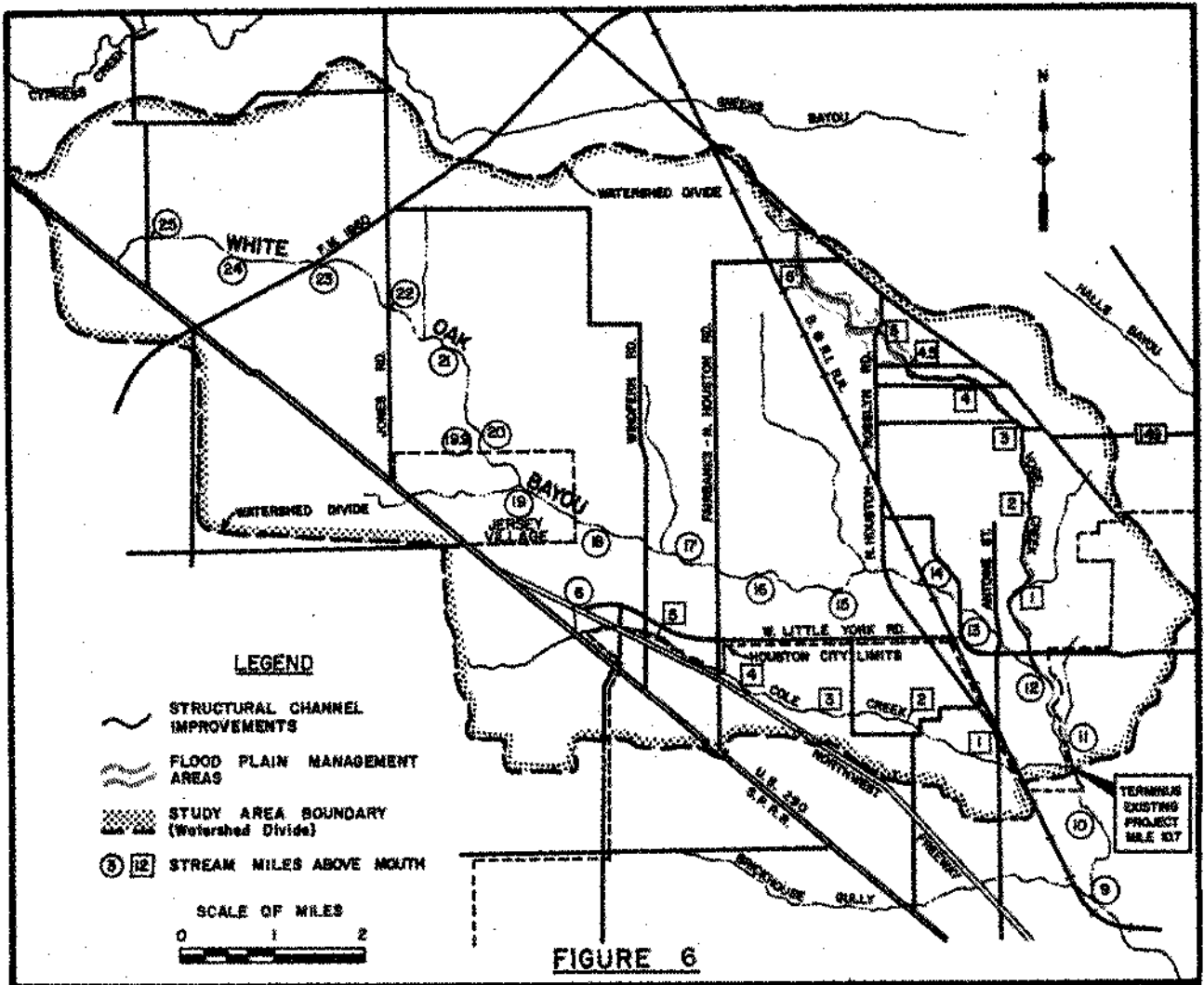
gully would overtax the improved gully channel and require major modifications and enlargement at high cost. No other diversion possibilities are apparent.

● Passive solutions to the flooding problems, such as evacuation or flood proofing of damageable structures, would involve 1,897 structures located within the limits of the standard project flood plain with a total property value of about \$69,000,000. Because of the obvious high costs and the social disadvantages of these alternatives, economic details have not been developed.

#### VOGEL CREEK ALTERNATIVES

Damage studies in the flood plains of Vogel Creek indicate that structural flood protection is needed along its lower 4.5 miles. A degree of channel enlargement and realignment has been accomplished in the upper reach by developers to obtain fill for subdivision construction. Only minor overbank flooding occurs in the upper reach. Nonstructural measures to control future development in the flood plain of the upper reach are proposed as an adjunct to structural plans for the lower reach.

● Channel improvement alternatives considered for Vogel Creek, shown on Figure 6, are generally similar to those discussed for Cole Creek, except for certain cases where existing developments place a practical limitation on the availability of rights-of-way. In such cases, the necessary channel capacity must be achieved by designs less demanding of area, such as vertical-walled or steeply-sloped channels. For example, for a distance of about 2,200 feet upstream of West Little York Road, adjacent housing developments limit rights-of-way possibilities to 80 feet and design to a vertical-walled channel. Similarly, between the mouth of the creek and West Little York Road and between stream mile 0.5 (Victory Drive) and mile 1.6 (Arncliffe Drive), channel design must be accommodated to a right-of-way width



## CHANNEL IMPROVEMENT PLAN VOGEL CREEK

of 95 feet. A steeply-sloped paved channel could be provided in such a case. The above described channel design for this 1.6-mile restricted reach would allow for about 15 feet of construction and maintenance area on either side of the improved channel. The availability of additional lands upstream of Arncliffe Drive would remove restrictions on design and permit consideration of a full range of structural plans. The economics of the more favorable channel improvement plans evaluated for Vogel Creek are shown in the following tabulation. The "lined" portion of the plan description signifies the vertical-walled and steeply-sloped channel plan for the lower 1.6-mile reach where rights-of-way are severely restricted.

CHANNEL IMPROVEMENT PLANS FOR VOGEL CREEK

Plan Description	Total First Costs (\$1,000)	Annual Costs (\$1,000)	Annual Benefits (\$1,000)	Benefit -Cost Ratio	Net Benefits (\$1,000)
Lined & Partially Lined Concrete Channel (SPF Protection)	12,506	890	2,740	3.08	1,850
Lined & Partially Lined Concrete Channel (100-Year Protection)	11,119	796	2,716	3.41	1,920
Lined & Partially Lined Concrete Channel (50-Year Protection)	10,848	778	2,691	3.46	1,913
Lined & Earth Channel (SPF Protection)	11,067	838	2,740	3.27	1,902

● Alternatives to channel improvements are limited by the extensive urbanization in the vicinity of the creek. Existing development and a lack of suitable reservoir sites preclude serious consideration of detention structures. Flood flows from the upstream portion of the Vogel Creek basin could theoretically be diverted to Halls Bayou, compounding existing serious flooding problems in that stream. This alternative has not been evaluated in detail. Other diversion possibilities are not available.

● Flood proofing of structures would involve single-family residences located below the level of the 100-year flood plain. The types of residential structures involved do not lend themselves to structural modifications for effective flood proofing. It is unlikely that residents would accept the inconvenience and detraction from the appearance and utility of their dwellings involved in permanent or emergency flood proofing measures.

● Evacuation of flood-damageable properties would involve mostly single-family residences valued at nearly \$43,000,000. This represents the property values located below the level of the standard project flood plain. Project costs for an evacuation plan, including relocation and re-settlement costs, would be prohibitive. The social consequences of evacuation would be unacceptable to the community in light of an obvious structural solution to the problems.

#### THE "NO ACTION" PLAN

A fundamental alternative to any structural flood control plan is the "no action" plan. Adoption of this alternative implies acceptance of the existing situation, including the costs and the adverse effects of continued flooding. In cases where positive action fails the test of economic justification, the "no action" alternative is automatically adopted. In other cases, despite economic justification, environmental or social considerations may offset advantages provided by a plan of improvement and dictate that the plan not be adopted. In the upper White Oak Bayou watershed, several alternatives have been formulated which satisfy economic criteria, and no significant environmental, social, or other effects have been identified which would preclude adoption of an economically justified plan for White Oak Bayou itself and each of the two major tributaries under consideration, Cole and Vogel Creeks.



## OTHER CONSIDERATIONS

Studies show that current recreational needs of the local residents exceed the capabilities of existing facilities and that the demand will increase in proportion to the projected population increase. The nature of the study area and the character of the existing development limit potential project-related recreational development and facilities to a few alternatives. Local residents and public officials consider that the most desirable recreational potential lies in open-space and green-belt developments and associated neighborhood parks. These types of recreational developments are consistent with the planning efforts of Water Control and Improvement District No. 93, the cities of Houston and Jersey Village, and the Houston-Galveston Area Council. The land requirements for the more favorable channel improvement plans considered for White Oak Bayou can be adapted to inclusion of limited recreational facilities. Recreational development plans have therefore been formulated to provide facilities for nature study, walking, picnicking, bicycling, and similar activities. Facilities for more intensive usage, such as motorbike trails or equestrian trails, are considered unsuitable for the predominantly residential areas. Plans have been devised to utilize the available project lands associated with structural flood control plans. The recreational facilities are proposed for incorporation with a reach of White Oak Bayou because of its central location in the study area and its accessibility to the largest concentration of area residents. The site location is consistent with expressed local desires and is one of the few remaining areas in the basin where attractive woodlands still exist on lands adjacent to the bayou for optional local expansion of the parkway. The scale of the proposed development is limited by the availability of flood control lands adjacent to the bayou. Officials of Harris County, the local governmental sponsor of both the proposed flood control and recreational improvements, have agreed to provide the necessary local support for the

proposed facilities and have also expressed interest in expanding facilities into adjacent attractive woodland areas to enhance the project.

#### ECONOMIC COMPARISON OF PLANS

Economic comparisons of the more favorable structural plans considered for the three streams are displayed below. The economic factors for the recreational development plan are also shown. The excess benefits over costs result from comparing annual benefits to annual costs and are measures of economic efficiency. The intangible social and environmental effects of these alternate plans will be discussed in the following section of this report.

COMPARISON OF PLANS

<u>Alternate Plan of Improvement</u>	<u>Project First Cost</u>	<u>Excess Benefits over Costs</u>	<u>Benefits to Costs Ratio</u>
<u>WHITE OAK BAYOU PLANS:</u>			
Partially Lined Concrete Channel Improvements (SPF Protection)	\$31,927,000	\$ 900,000	1.38
Partially Lined Concrete Channel Improvements (100-Yr. Protection)	28,220,000	1,106,000	1.53
Partially Lined Concrete Channel Improvements (50-Yr. Protection)	26,020,000	1,228,000	1.64
Gabion Lined Channel Improvements (SPF Protection)	34,900,000	512,000	1.19
Earth Channel Improvements (SPF Protection)	25,956,000	1,226,000	1.60
Reservoir & Channel Improvements (50-Yr. Protection)	54,699,000	(-)1,146,000	0.73
Diversion & Channel Improvements (SPF Protection)	35,666,000	608,000	1.23
<u>COLE CREEK PLANS:</u>			
Partially Lined Concrete Channel Improvements (SPF Protection)	11,499,000	81,000	1.10
Partially Lined Concrete Channel Improvements (100-Yr. Protection)	11,172,000	96,000	1.12
Partially Lined Concrete Channel Improvements (50-Yr. Protection)	10,981,000	101,000	1.13
Earth Channel Improvements (SPF Protection)	10,980,000	66,000	1.08
<u>VOGEL CREEK PLANS</u>			
Partially Lined Concrete Channel Improvements (SPF Protection)	12,506,000	1,850,000	3.08
Partially Lined Concrete Channel Improvements (100-Yr. Protection)	11,119,000	1,920,000	3.41
Partially Lined Concrete Channel Improvements (50-Yr. Protection)	10,848,000	1,913,000	3.46
Earth Channel Improvements (SPF Protection)	11,067,000	1,902,000	3.27
<u>RECREATIONAL DEVELOPMENT PLAN</u>	854,000	11,000	1.11

## *Selection of a Plan*

As a basis for selection of a plan to solve the flooding problems of the upper White Oak Bayou watershed, several alternatives have been developed and evaluated. The alternatives have been formulated to reflect the full range of choices available and the trade-offs involved in making the choice to insure that the selected plan will be the most effective and efficient way to meet the social, economic and environmental needs of the area. One alternative has been formulated by optimizing contributions to a national economic development objective (the NED plan). Another has been formulated by emphasizing contributions to an environmental quality objective (the EQ plan). Each is susceptible to consideration in total or with the White Oak Bayou plan as a basic plan and plans for each of the tributary creeks, Vogel and Cole, as separable increments.

The NED plan would increase the national income by maximizing the net tangible benefits. It would provide the largest reduction of flood damages for the least project investment resulting in the greatest excess project benefits over costs. The NED plan would consist of channel enlargement and rectification work along the urbanized reaches of each major stream. The plan would provide 50 year structural flood protection in the lower reaches of upper White Oak Bayou, Cole Creek and Vogel Creek. The two tributary creeks would be separable increments of the plan. The channels would be partially lined with concrete for hydraulic efficiency. The flood plains along the upper reaches would be managed to control future development and preclude future flood losses. The plan would be complemented by controls in the urbanized areas to assure that any additional structures are constructed above the level of the 100-year flood, based on improved channel conditions. The plan would not include

evacuation or flood proofing of existing structures. The first cost of the NED plan is estimated to be \$48,703,000, including \$854,000 for recreational development. Annual benefits, estimated at \$6,849,000, would accrue from reductions in flood damages and public health and relief costs, from enhancement of land values, and from recreational visitations. The annual costs are estimated at \$3,596,000. Thus the annual benefits would exceed the costs by \$3,253,000. The ratio of benefits to costs would be 1.90. The incremental economic justification of the four separable elements of the total NED plan are shown in the following tabulation.

ECONOMICS OF THE NATIONAL ECONOMIC DEVELOPMENT PLAN OF IMPROVEMENT

Plan Elements	Total First Cost	Average Annual Costs	Average Annual Benefits	Benefits to Costs Ratio
White Oak Bayou Flood Control Plan	\$26,020,000	\$1,929,000	\$3,157,000	1.64
Cole Creek Flood Control Plan	10,981,000	791,000	892,000	1.13
Vogel Creek Flood Control Plan	10,848,000	778,000	2,691,000	3.46
Recreational Development Plan	<u>854,000</u>	<u>98,000</u>	<u>109,000</u>	<u>1.11</u>
Total Combined Plan of Improvement	\$48,703,000	\$3,596,000	\$6,849,000	1.90

The plan involving the greatest preservation of undeveloped acreage and the least impingement on remaining woodlands along the streams would provide the best opportunity to enhance, conserve, and preserve the natural environmental resources of the area and therefore would comprise the Environmental Quality (EQ) plan. This would include a detention reservoir in the upper reach of White Oak Bayou combined with downstream

channel enlargement. Channel rectification of the tributary creeks to provide 50-year structural flood protection would be the same as in the NED plan. The plan would also improve the human environment by including recreational development along White Oak Bayou in the form of trails, nature study areas, and a neighborhood park. The EQ plan would dedicate 2,800 acres of open pasture land within the temporary detention reservoir to passive uses compatible with periodic inundation, such as agriculture, grazing, and possibly low intensity forms of public recreation. The first cost of this EQ plan is estimated at \$77,382,000. The total project plan would yield a benefits to costs ratio of 1.15. However, the White Oak Bayou increment of the plan, comprising nearly 70 percent of the project first cost, would have a benefits to costs ratio of 0.73. The incremental evaluations of the four separable elements of the EQ plan are shown in the following tabulation.

#### ECONOMICS OF THE ENVIRONMENTAL QUALITY PLAN OF IMPROVEMENT

Plan Elements	Total First Cost	Average Annual Costs	Average Annual Benefits	Benefits to Costs Ratio
White Oak Bayou				
Flood Control Plan	\$54,699,000	\$4,303,000	\$3,157,000	0.73
Cole Creek				
Flood Control Plan	10,981,000	791,000	892,000	1.13
Vogel Creek				
Flood Control Plan	10,848,000	778,000	2,691,000	3.46
Recreational				
Development Plan	854,000	98,000	109,000	1.11
Total Combined Plan of Improvement	\$77,382,000	\$5,970,000	\$6,849,000	1.15

To insure that a selected plan reflects the priorities and preferences expressed by all levels of the affected public, all beneficial and adverse social, economic, and environmental effects must be considered. Also, the effects of the more viable alternatives must be identified and

evaluated in terms of their relative contributions to the four basic accounts: national economic development, environmental quality, social well-being, and regional development.

The partial paving design concept for channel improvements, as described for the NED plan, represents a favorable design approach for the study area because of right-of-way constrictions and the need to improve hydraulic efficiency in the streams. This channel design, minimizing the use of concrete yet providing adequate erosion protection, has been evaluated to provide 100-year and standard project flood protection to the developed areas adjacent to the streams. The economic justification for these two alternate plans of improvement are tabulated below.

ECONOMICS OF CHANNEL IMPROVEMENT PLAN  
PARTIALLY LINED CONCRETE CHANNEL - 100-YEAR PROTECTION

Plan Elements	First Cost	Average Annual Costs	Average Annual Benefits	Benefits to Cost Ratio
White Oak Bayou Flood Control Plan	\$28,220,000	\$2,084,000	\$3,190,000	1.53
Cole Creek Flood Control Plan	11,172,000	804,000	900,000	1.12
Vogel Creek Flood Control Plan	11,119,000	796,000	2,716,000	3.41
Recreational Development Plan	854,000	98,000	109,000	1.11
Total Combined Plan of Improvement	\$51,365,000	\$3,782,000	\$6,915,000	1.83

ECONOMICS OF CHANNEL IMPROVEMENT PLAN  
PARTIALLY LINED CONCRETE CHANNEL - SPF PROTECTION

Plan Elements	Total First Cost	Average Annual Costs	Average Annual Benefits	Benefits to Cost Ratio
White Oak Bayou Flood Control Plan	\$31,927,000	\$2,355,000	\$3,255,000	1.38
Cole Creek Flood Control Plan	11,499,000	826,000	907,000	1.10
Vogel Creek Flood Control Plan	12,506,000	890,000	2,740,000	3.08
Recreational Development Plan	<u>854,000</u>	<u>98,000</u>	<u>109,000</u>	<u>1.11</u>
Total Combined Plan of Improvement	\$56,786,000	\$4,169,000	\$7,011,000	1.68

The first cost, both Federal and non-Federal, for construction of the more favorable improvement plans are displayed for comparison in the following tabulation. The NED plan represents the least total project investment while the EQ plan represents the greatest total investment.



COMPARISON OF PROJECT FIRST COST

	Federal First Cost	Non-Federal First Cost	Total First Cost
<u>NED PLAN:</u>			
White Oak Bayou Flood Control Plan	\$22,797,000	\$3,223,000	\$26,020,000
Cole Creek Flood Control Plan	9,581,000	1,400,000	10,981,000
Vogel Creek Flood Control Plan	9,505,000	1,343,000	10,848,000
Recreational Development Plan	427,000	427,000	854,000
Total Combined Plan	<u>\$42,310,000</u>	<u>\$6,393,000</u>	<u>\$48,703,000</u>
<u>EQ PLAN:</u>			
White Oak Bayou Flood Control Plan	28,514,000	26,185,000	54,699,000
Cole Creek Flood Control Plan	9,581,000	1,400,000	10,981,000
Vogel Creek Flood Control Plan	9,505,000	1,343,000	10,848,000
Recreational Development Plan	427,000	427,000	854,000
Total Combined Plan	<u>\$48,027,000</u>	<u>\$29,355,000</u>	<u>\$77,382,000</u>
<u>100-YEAR CHANNEL IMPROVEMENT PLAN:</u>			
White Oak Bayou Flood Control Plan	24,885,000	3,335,000	28,220,000
Cole Creek Flood Control Plan	9,697,000	1,475,000	11,172,000
Vogel Creek Flood Control Plan	9,755,000	1,364,000	11,119,000
Recreational Development Plan	427,000	427,000	854,000
Total Combined Plan	<u>\$44,764,000</u>	<u>\$6,601,000</u>	<u>\$51,365,000</u>
<u>SPF CHANNEL IMPROVEMENT PLAN:</u>			
White Oak Bayou Flood Control Plan	28,379,000	3,548,000	31,927,000
Cole Creek Flood Control Plan	10,003,000	1,496,000	11,499,000
Vogel Creek Flood Control Plan	11,038,000	1,468,000	12,506,000
Recreational Development Plan	427,000	427,000	854,000
Total Combined Plan	<u>\$49,847,000</u>	<u>\$6,939,000</u>	<u>\$56,786,000</u>

There are sound intangible reasons, not reflected by economic evaluation, to influence selection of a more conservative plan offering a greater degree of flood protection than the NED and the EQ plans. The 50-year protection offered by those plans would tend to provide a false sense of security to occupants of an area that is expected to attract continual urban growth. Although hydrologic studies of project requirements allow for projected growth, some margin of safety is considered prudent for an area the population of which is expected to double within the next decade. The additional project costs, both Federal and non-Federal, entailed by more conservative plans are proportionately modest in relation to the higher degrees of flood protection to be afforded. The intangible benefits associated with the social well being of present and future residents in this urban area are considered to warrant investment in a higher degree of protection than afforded by the NED and EQ plans.

The conclusion is that a channel improvement plan to provide protection from a standard project flood in the urbanized reaches of the streams is the most advantageous flood control plan for the study area. This plan to provide structural improvements to the developed reaches of White Oak Bayou, Cole Creek, and Vogel Creek, combined with nonstructural flood plain management measures to prevent future encroachment within the 100-year flood plain in the remaining upstream areas, would satisfy all existing and most future flood control needs of the basin, provided that adequate lateral drainage facilities are installed for existing and future developments by developers or local governments. The selected project plan also includes beautification improvements in the form of revegetation and architectural treatment of channel linings. The location and features of the selected flood control portion of the plan are shown on Plate 2. The recreational plan is shown on Plate 3.

## ***THE SELECTED PLAN***

The following paragraphs describe the details of the selected plan, its features, accomplishments, effects, benefits, costs, and the division of responsibility between Federal and local interests.

### ***Features***

- Channel enlargement, rectification, and partial paving of 9.2 miles of the upper White Oak Bayou channel.

- Nonstructural flood plain management of future suburban developments along the upstream 5.6-mile reach of upper White Oak Bayou to prevent future damageable developments within the 100-year flood plain.

- Channel enlargement, rectification, and partial paving of 4.9 miles of the Cole Creek channel.

- Nonstructural flood plain management of suburban developments along the remaining headwater reach of Cole Creek to prevent future damageable developments within the 100-year flood plain.

- Channel enlargement, rectification, and partial paving of 4.5 miles of the Vogel Creek channel.

- Nonstructural flood plain management of suburban developments along the remaining headwater reach of Vogel Creek to prevent future damageable developments within the 100-year flood plain.

- Aesthetic and beautification features, such as tree and shrub plantings and architectural treatment of channel linings, in areas exposed to public view.

- Hike and bike trails along a 3.8-mile reach of White Oak Bayou together with a neighborhood park equipped with playground and picnic facilities.

## ***Accomplishments***

- Elimination of flood damages in flood plain areas affected by structural improvements.
- Elimination of flood damages to future development in areas affected by nonstructural flood plain management measures.
- Reduction of public health and relief costs, and the costs and inconvenience of temporary evacuation and cleanup associated with periodic flooding.
- Elimination of the economic hardships of depressed property values and loss of investments by property owners.
- Elimination of social stresses associated with constant threats of flooding.
- Substitution of orderly, well maintained floodways, enhanced by appropriate beautification measures, for the irregular, unkempt, and sporadically maintained channels now existing.
- Provision of open space outdoor recreational facilities to meet existing needs.

## ***Effects Assessment***

The following paragraphs summarize an assessment of the effects of the selected plan and the other basic alternatives with respect to the project objectives. A more detailed display of these effects has been included in Section D, Formulation of a Plan, Appendix I.

### NATIONAL ECONOMIC DEVELOPMENT

For the purposes of this assessment, beneficial and adverse effects have been compared on an annual basis to determine the overall net economic effects of each plan. Beneficial effects include prevention of flood damages, reductions in public health and relief costs, and enhancement of land values. Offsetting effects are represented by the

necessity for public investment in the project first costs, and the costs of operation, maintenance and major replacement during the project life. Both the NED plan and the selected plan display quantifiable beneficial effects in excess of the offsetting effects, indicating economic justification. The NED plan, displaying the greatest excess of benefits over costs of all plans considered, has been identified as a channel improvement plan which would provide 50-year structural protection to the urbanized areas. The selected plan to provide protection from the standard project flood results in a decrease of net excess benefits over costs of \$411,000 per year, a sacrifice of about 12 percent in the economic efficiency represented by the NED plan. The NED plan would develop more net tangible benefits at the expense of some of the intangible benefits offered by the selected plan.

The selected plan will eliminate the economic losses associated with periodic overbank flooding of the streams. It will eliminate the threat of stream flooding of 4,546 homes, apartments, and small businesses located within the standard project flood plain. Areas now committed to residential development will be permitted unrestricted development. The expansion of the Houston metropolitan complex will be allowed to continue in the study area in an orderly manner.

Implementation of the selected plan will eliminate flood damages associated with stream flooding and related disruption of public facilities and services such as transportation systems and utilities. The NED plan, while affording substantial flood protection, would not eliminate periodic inundation of public facilities.

The effect of the selected plan on employment and the local labor force will be of a temporary nature relating primarily to construction activities. Business activity within the affected area is limited to service facilities for the surrounding residential communities and a

few small commercial establishments. The area is essentially residential in nature, a bedroom community for persons employed elsewhere in the metropolitan area. Agricultural activities are being displaced by the encroachment of urbanization. This displacement may be slightly accelerated by the proposed action.

Implementation of the selected plan will minimize the requirement for Federally subsidized flood insurance. Flood insurance premiums paid by area residents, will be substantially reduced and insurance claims will be confined to areas where inadequate storm sewers and lateral drainage ditches cause delays in conveying rainfall runoff to the major streams. The NED plan and the EQ plan would have similar beneficial effects in reducing insurance requirements to a lesser degree.

#### ENVIRONMENTAL QUALITY

Lands previously dedicated for channel rights-of-way comprise 330 acres along the reaches of the streams where improvements are proposed. The appearance of the streams and the natural environmental setting have been substantially altered by previous channel work and maintenance. An additional 61 acres will be required for construction of the selected plan. The additional land required for channel enlargement will be cleared of vegetative growth for project construction. Permanent changes in the existing environmental setting will result from construction of the selected plan.

The EQ plan would preserve 2,800 acres of brushy pastureland within the reservoir as wildlife habitat or for agricultural or recreational purposes compatible with its flood control function and occasional inundation. The reservoir area would remain dry except during flood periods and could be utilized for other purposes most of the time. The EQ plan would have environmental effects similar to those of the selected plan along the downstream reaches of the streams where channel improvements would be required.

Temporary increases in noise and air pollution will result from the activity of construction equipment. Dust movement will accompany earth moving and other construction activities. Temporary increases in turbidity in the streams will occur during construction. With improvements in place water quality should improve slightly because of increased flow velocity and elimination of stagnant pools.

Beautification improvements are included in all structural plans. These improvements include turfing, selective planting of trees and shrubs, and architectural treatment of channel linings near road and street crossings. Treatments of this type will create an attractive appearance in areas frequently viewed by the public, relieve the starkness of a geometric channel design, and blend the completed project into its surroundings.

#### SOCIAL WELL-BEING

The risk of damage to existing development from stream flooding associated with the standard project flood will be eliminated by the selected plan. The project will provide capacity and opportunity for improvement of interior storm drainage systems by local governments, thus offering relief from localized flooding related to inadequate storm sewers and street drainage. The plan will also prevent flood damages to future development from floods up to the magnitude of the 100-year storm in areas where nonstructural regulation of the flood plains is effected. The NED plan would provide flood protection to the level of the 50-year storm by a combination of structural and non-structural means. The EQ plan would provide the same degree of flood protection as the NED plan. The social well-being of the inhabitants of the study area would be beneficially affected by the high degree of protection afforded by any of these three plans.

A "no-action" plan would have serious adverse effects on the existing housing developments. Damage potential for houses already in the flood plains would increase with acceleration of rainfall runoff accompanying continued conversion of adjacent upland areas to suburban use. The flood damage potential for existing developed properties is estimated at \$4,356,000 per year.

Adoption of the selected plan will allow continued orderly and unrestricted urban growth in the study area to accommodate its share of the expected residential housing demands of the Houston area. Removal of the flood threat will permit planned housing construction to continue in areas of high aesthetic appeal. As urbanization continues, population density will increase in undeveloped areas now susceptible to flooding.

The selected plan will eliminate the hazards and social anxiety related to stream flooding, and, if local drainage improvements commensurate with the project are installed, the health hazards and the repeated cleanup associated with residential inundation will be removed. The financial burden of flood insurance premiums on area residents will be substantially reduced. The peace of mind of residents free of flood threat is an important intangible benefit credited to the selected plan.

#### REGIONAL DEVELOPMENT

The selected plan is expected to have no significant effect on the regional growth of the Houston area. The general region will experience development and growth irrespective of the proposed project. The selected plan will make available additional unrestricted land for urban usage to meet the expected demands of the Houston metropolitan area. A no-action plan would divert urban growth to other areas of the region.



## SOCIO-ECONOMIC EFFECTS

It is estimated that more than 4,500 families will be benefited by the selected plan of improvement. These families are located within the standard project flood plains of the streams where structural flood protection is proposed. Most of these residents have lived in the study area less than ten years and many less than five years. In this relatively short period of time, considerable community interest and cohesion have developed within the several large subdivisions. Community concern has been actively demonstrated in the course of this study. The selected plan of improvement will satisfy the collective desires and concerns of the vast majority of the affected citizens.

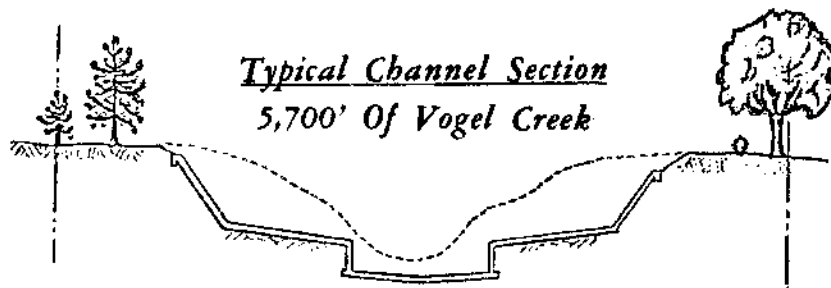
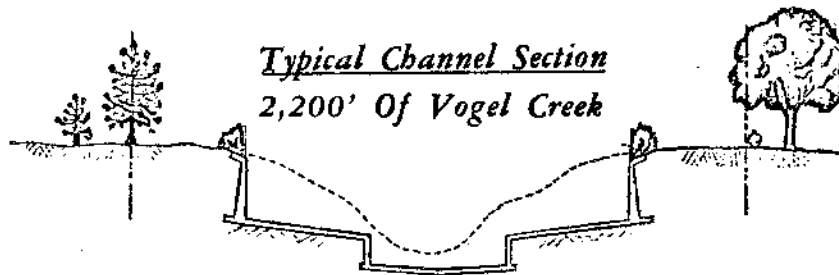
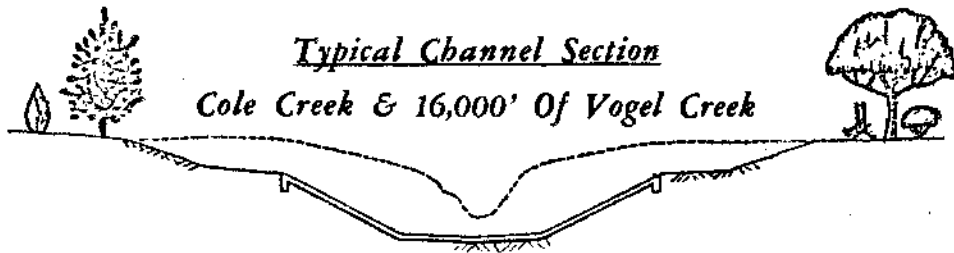
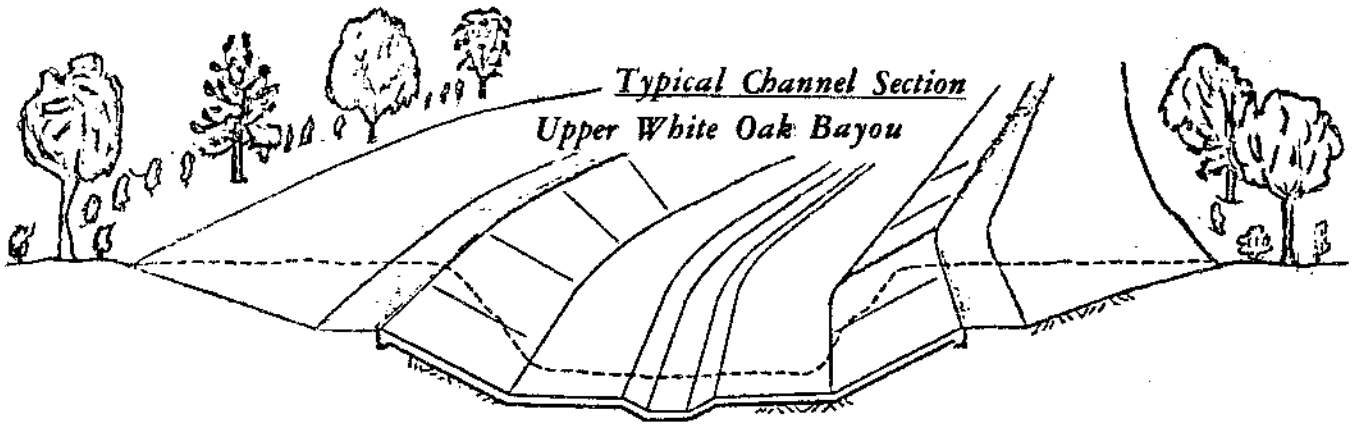
The most important socio-economic effect of the selected plan will be relief from the constant anxiety associated with existing flood hazards, depressed property values, public health hazards, and the inconvenience and frustrations of recurring cleanups of and damages to real property and personal possessions.

No effects on the industrial and major commercial economy of the City of Houston are anticipated. Some beneficial effects will be felt by service businesses located in the affected study area.

### ***Selected Project Design Features***

The proposed improved flood control channels will provide capacities for the standard project flood over the drainage basin. The peak flow from such a storm on upper White Oak Bayou would be 26,000 cubic feet per second at the downstream limits of the proposed channel. The peak discharges at the mouth of Cole Creek and Vogel Creek would be 8,760 and 7,650 cubic feet per second, respectively. Design will provide for containment of flows within the banks of the improved channels. Typical channel cross sections, showing the general configuration of the proposed improvements for upper White Oak Bayou, Cole Creek, and Vogel Creek, are shown on the following page.

PROPOSED CHANNEL IMPROVEMENTS



Channel improvements will require relocation or alteration of various facilities. These modifications include the construction of thirteen new road and street bridges, two new railroad bridges, six new foot bridges, and the alteration or extension of four existing street crossings. Six relatively new road and street bridges have adequate channel clearance and are structurally compatible with proposed channel improvements without major modifications. Fifty-six pipeline crossings will require alterations. Many of these are small collection pipelines from surrounding oil and gas production wells. Pipelines will be lowered to at least three feet below channel bottom. Three gravity sanitary sewer mains will require lowering and supplementation with lift stations.

Much of the rights-of-way required for channel work is already available to the local sponsor, amounting to about 330 acres. About 61 acres more are needed for construction and subsequent operation and maintenance of the flood control project. The proposed recreational development plan for White Oak Bayou will be constructed on existing flood control lands adjacent to the proposed improved channel.

Channel construction will involve excavation of about 1,227,000 cubic yards of earth, most of which will be excess to project needs. Productive uses for this material will be explored in detailed pre-construction planning, if the project should be authorized, and may represent a financial advantage to the project.

Aesthetic and beautification improvements have been included as an integral part of the plan of improvement. Specialized architectural treatment, alignment of channels, and selective planting with native trees and shrubs are proposed. These measures will generally be applied in areas open to public view. Architectural treatment will provide exposed aggregate finish on the channel linings within 300 to 400 feet

of road and street crossings to relieve the starkness of appearance of the concrete. Selected plantings will include live oak, pine, and other native trees along the project rights-of-way intermingled with native shrubs. Ivy and shrubs will be used along fences inclosing the vertical wall channel section proposed for Vogel Creek.

The recreational development plan along White Oak Bayou will extend from the residential subdivisions near North Houston-Rosslyn Road upstream to the town of Jersey Village. The plan, which is described in more detail in Appendix I, will include about eight miles of hike and bike trails and a neighborhood park. The trail system will extend from a park site proposed for optional development by Harris County in the Woodland Trails Subdivision, upstream to an existing city park site at Jersey Village. Seven foot bridges will be provided across the bayou at selected locations. A neighborhood park is proposed about midway along the trail on existing flood control rights-of-way and will include picnic areas, playground equipment, and public restroom facilities. Three heavily wooded areas along the trail route, totalling about 12 acres of additional land, are displayed for optional local expansion of the proposed facilities. Harris County has indicated an interest in preserving these attractive areas for park expansion at its convenience.

### ***Construction***

It is estimated that a five-year construction period will be required for completion of all elements of the project. These elements include land acquisition, relocation and alteration of facilities, excavation of channels, placement of channel linings and subdrainage systems, installation of recreational facilities, and completion of beautification measures.

Construction of the flood control channels for the three streams can be accomplished separately and simultaneously. It is anticipated that the White Oak Bayou portion of the improvement plan will be completed in the first three years of the five-year construction period. Vogel Creek improvements, with an estimated two-year construction schedule, will be initiated in the third year. Cole Creek improvements, also with a two-year completion schedule, will be initiated in the fourth year of the construction period. The recreational development plan will be initiated when channel improvements in the affected reach of White Oak are essentially complete. The revegetation portion of the beautification plan will be accomplished after completion of channel work on each stream.

The project will require the excavation and removal of 1,227,000 cubic yards of earthen material from the streams. The proposed construction materials required will include: approximately 150,000 cubic yards of concrete, about 6,300 tons of reinforcing steel, 141,000 cubic yards of sand and gravel filter material, and about 232,000 lineal feet of 6-inch subdrain pipe. These items are readily available in the Houston area.

Soil borings and laboratory analyses have been made to determine the foundation conditions along the streams. The quality and stability of the material in the channel base and slopes meet project requirements. Major construction or subsequent maintenance problems are not anticipated. Additional foundation testing will be done during the design phase of the project.

### ***Operation and Maintenance***

The principal items involved in operation and maintenance of the completed project will include: mowing and fertilizing of the turfed

slopes, periodic cleanout of silt from the channels and subdrainage systems, and repair of erosion damage to the slopes and channel lining. The recreational facilities will require routine maintenance and cleanup, repair and replacement of equipment, and law enforcement patrolling of the area.

The Harris County Flood Control District is the local agency responsible for operation and maintenance of some 3,000 miles of bayous and creeks in Harris County, including those located within corporate boundaries. The District is governed by the Harris County Commissioners Court and is financed by tax revenues for normal operation and maintenance of the major drainage outlets in the county. The Commissioners Court has agreed to provide the necessary items of local cooperation for the proposed project, including operation and maintenance of the completed works. A formal agreement will be executed in accordance with Section 221, P. L. 81-611, prior to construction. An operation and maintenance manual will be prepared and furnished to the local sponsoring agency following completion of construction, and periodic inspections will be made thereafter to assure compliance.

## ***ECONOMICS OF THE SELECTED PLAN***

### ***Methodology***

The economic feasibility of the selected plan is determined by comparing the average annual costs (including interest, amortization, operation and maintenance, and major replacements) with an estimate of the equivalent average annual benefits which would be realized from the plan over a 100-year period of analysis. This period of analysis is applicable because the project will provide a high degree of protection for an urban area and should receive adequate maintenance indefinitely.

Major replacement costs include an annual amount set aside for future replacement of sanitary sewer lift stations and recreational equipment not expected to last for the duration of the project life. Both benefits and costs have been reduced to average annual equivalent values for direct comparison. The applicable interest rate is 6-3/8 percent.

### **Costs**

The following summary of costs for the four separate elements of selected plan are supported in detail in Appendix 1. The costs for the project plan elements are based on November 1976 price levels.

#### SUMMARY OF FIRST COSTS

Project Requirements	White Oak Bayou Plan	Cole Creek Plan	Vogel Creek Plan	Recreational Plan
Channels	\$24,008,000	\$8,305,000	\$9,323,000	\$
Aesthetic Improvements	730,000	336,000	359,000	
Recreational Improvements	-	-	-	718,000
Relocations & Alterations	1,272,009	566,000	706,000	
Flood Control Lands	2,456,000	1,072,000	772,000	
Recreation Lands	-	-	-	28,000
Engineering & Design	1,917,000	676,000	746,000	58,000
Supervision & Administration	1,544,000	544,000	600,000	50,000
<b>Total Project First Costs</b>	<b>\$31,927,000</b>	<b>\$11,499,000</b>	<b>\$12,506,000</b>	<b>\$854,000</b>

The total construction period for completion of all elements of the combined plan of improvement is estimated to be five years. However, the four separate elements of the plan have estimated construction schedules as follows: White Oak Bayou improvements - 3 years; Cole Creek improvements - 2 years; Vogel Creek improvements - 2 years; and recreational improvements - 1-1/2 years. The project investment includes interest accrual during the construction phase of each project plan. By established evaluation procedures no interest accrual has been assigned for the recreational development construction phase since the construction period is less than two years. The project investment, shown in the following tabulation, serves as the basis for computing the average annual costs.

PROJECT INVESTMENT

	White Oak Bayou Plan	: Cole Creek Plan	: Vogel Creek Plan	: Recreational Plan	: Total Combined Plan
Project First Costs	\$31,927,000	\$11,499,000	\$12,506,000	\$854,000	\$56,786,000
Interest During Construction (6-3/8% x 1/2 const. period)	<u>3,053,000</u>	<u>733,000</u>	<u>797,000</u>	<u>0</u>	<u>4,583,000</u>
Total Project Investment	\$34,980,000	\$12,232,000	\$13,303,000	\$854,000	\$61,369,000

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SUMMARY OF ANNUAL COSTS

	White Oak Bayou Plan	: Cole Creek Plan	: Vogel Creek Plan	: Recreational Plan	: Total Combined Plan
Interest (0.06375 x Investment)	\$2,230,000	\$779,600	\$848,000	\$54,400	\$3,912,000
Amortization (0.000132 x Investment)	4,500	1,400	1,700	100	7,700
Operation & Maintenance	120,000	45,000	40,000	42,000	247,000
Major Advance Replacement	<u>500</u>	<u>0</u>	<u>300</u>	<u>1,500</u>	<u>2,300</u>
Total Annual Costs	\$2,355,000	\$826,000	\$890,000	\$98,000	\$4,169,000



## ***Benefits***

The primary benefit to be derived from the plan of improvement is the reduction in flood damages. The plan will also provide reductions in future flood proofing costs, location or land enhancement benefits, reduction in public health and relief costs, and recreational benefits. Social, environmental, and other intangible benefits are neither quantified in monetary terms nor entered into the economic evaluation. Estimated tangible average annual flood control benefits are tabulated below and are based on November 1976 price levels. Additional average annual benefits resulting from recreational facility visitations are \$109,000 per year.

### SUMMARY OF ANNUAL FLOOD CONTROL BENEFITS

	White Oak : Bayou Plan:	Cole Creek: Plan :	Vogel Creek Plan
Prevention of Damages for Existing Development	\$1,279,000	\$532,000	\$1,936,000
Prevention of Damages for Future Development	142,000	29,000	28,000
Prevention of Damages for Future Contents in Existing Developed Areas	398,000	143,000	441,000
Reduction in Future Flood Proofing Cost	274,000	44,000	38,000
Location (Enhancement)	680,000	123,000	169,000
Prevention of Damages on Cole & Vogel Creeks Credited to White Oak Improvements	367,000	-	-
Reduction in Public Health Relief, & Scare Costs	<u>115,000</u>	<u>36,000</u>	<u>128,000</u>
Total Average Annual Equivalent Benefits	\$3,255,000	\$907,000	\$2,740,000

### ***Ratio of Benefits to Costs***

The usual measure of economic feasibility is a ratio of average annual benefits to average annual costs of at least one or unity. The incremental elements of the plan of improvement, including the flood control features for White Oak Bayou, Cole Creek, and Vogel Creek, and

the recreational development plan, have been evaluated independently. Each incremental feature of the plan has met the test of economic feasibility. Details are discussed in Appendix 1. The economics of the features of the plan and the total combined plan are tabulated below.

ECONOMICS OF THE SELECTED PLAN OF IMPROVEMENT

Plan Elements	Total First Cost	Average Annual Costs	Average Annual Benefits	Ratio of Benefits to Costs
White Oak Bayou Flood Control Plan	\$31,927,000	\$2,355,000	\$3,255,000	1.38
Cole Creek Flood Control Plan	11,499,000	826,000	907,000	1.10
Vogel Creek Flood Control Plan	12,506,000	890,000	2,740,000	3.08
Recreational Development Plan	<u>854,000</u>	<u>98,000</u>	<u>109,000</u>	<u>1.11</u>
Total Combined Plan of Improvement	\$56,786,000	\$4,169,000	\$7,011,000	1.68

***DIVISION OF PLAN RESPONSIBILITIES***

Legislative and administrative policies have established the basis for Federal and non-Federal responsibilities in the construction, operation, and maintenance of Federal water resources projects. These responsibilities for local flood protection projects include in general the division of work elements for construction including the sharing of costs for recreational features and the non-Federal obligation for subsequent operation and maintenance of the completed project. Other non-Federal responsibilities are discussed later.

### *Cost Apportionment*

The following tabulation shows the apportionment of the first cost and annual operation, maintenance, and replacement costs between Federal and non-Federal interests, in accordance with current Federal policies. In general, the Federal government would be responsible for all flood control construction costs, and all recreational construction costs not in excess of 50 percent of the total recreational costs. The local sponsoring agency would generally be required to bear the costs for lands and relocations or alterations required for construction, provide a cash contribution for the recreational portion of the plan, and to operate, maintain, and provide replacements for equipment or facilities during the project life. The total project costs including flood control and recreation are currently estimated at \$56,786,000.

#### COST APPORTIONMENT

Plan Element	Estimated First Costs		Annual Operation, Maintenance and Major Replacement Costs	
	Federal	Non-Federal	Federal	Non-Federal
White Oak Bayou Flood Control Plan	\$28,379,000	\$3,548,000	0	\$120,500
Cole Creek Flood Control Plan	10,003,000	1,496,000	0	45,000
Vogel Creek Flood Control Plan	11,038,000	1,468,000	0	40,300
Recreational Plan	<u>427,000</u>	<u>427,000(1)</u>	<u>0</u>	<u>43,500</u>
Total Project Plan	\$49,847,000	\$6,939,000	0	\$249,300

(1) Includes \$28,000 for recreation lands and a \$399,000 cash contribution to make the non-Federal share equal to 50 percent of the total recreational costs.

### ***Federal Responsibilities***

The Federal Government will design the project after Congressional authorization of the plans included in this report. The Federal Government will also prepare detailed plans and construct the project after Congressional construction authorization and funding and after local interests have secured the necessary lands and accomplished the necessary relocations and alterations required for construction. The relocation of two railroad bridges will be accomplished at Federal expense.

### ***Non - Federal Responsibilities***

The local sponsoring agency will be required to provide all lands, rights-of-way, and disposal areas and to perform all relocations and alterations of structures such as bridges (except railroad bridges), pipelines, utilities, and similar obstructions prior to construction of the proposed improvements. Local interests will be required to operate and maintain the project after completion, including any replacements which become necessary during the project life. These and other items of local cooperation are listed in the "Recommendations" paragraph later in this report.

The local sponsoring agency will be required to provide the land necessary for construction of the recreational development plan, currently estimated at \$28,000, and to provide a sufficient contribution in cash or in kind to bring the total non-Federal share of cost to not less than 50 percent of the total. Local interests will be required to operate, maintain, and provide replacement items for the recreational portion of the project plan after completion, and to maintain order for the protection of the facilities and safety of the public.

## **PLAN IMPLEMENTATION**

The plan of improvement recommended in this report will be subject to a series of reviews and legislative processes before it can be completed as a Federal project. The following steps are involved in the review and implementation process:

- Review and approval by the Division Engineer, Southwestern Division, Corps of Engineers
- Review and approval by the Board of Engineers for Rivers and Harbors, Washington, D. C.
- Review and approval by the Chief of Engineers, Washington, D.C.
- At the request of the Chief of Engineers, review and acceptance by the Governor of Texas and the various Federal agencies at the departmental level
- Review and approval by the Secretary of the Army and submission to the Office of Management and Budget for review from the standpoint of administration policy and fiscal objectives
  - Submission to the Congress via the Public Works Committees
  - Congressional authorization for detailed planning and design
  - Budgetary request by the Corps of Engineers for advance engineering and design funds and inclusion in the President's budget as submitted to Congress
    - Congressional appropriation of funds for detailed planning
    - Detailed planning and reaffirmation of the project details and justification, including public meetings by the Corps of Engineers
  - Submission through appropriate channels to Congress for construction authorization
  - Congressional authorization for construction
  - Formal assurances of local cooperation from the non-Federal sponsor

- Budgetary request for construction funds by the President
- Appropriation of construction funds by the Congress
- Preparation of final plans and specifications and award of construction contracts, subject to satisfaction of the obligations of local interests, including any required cash contribution
- Construction of the project

Because of the many variables involved in the review, authorization, and funding processes, a time schedule for implementation is not accurately predictable in the early stages of planning.

### ***VIEWS OF NON-FEDERAL INTERESTS***

Information and recommendations contained in the draft of this report have been coordinated with the State of Texas, Office of the Governor; Houston-Galveston Area Council; Harris County Commissioners Court; Harris County Flood Control District; Harris County Flood Control Task Force; Harris County Parks Planning Department; City of Houston; and City of Jersey Village. The complete views and recommendations of these interests that responded are contained in Appendix 2 and are summarized on the following page.

The recreational development portion of the recommended plan, as displayed in the draft of this report and coordinated with Federal and non-Federal interests, included facilities on flood control lands, as well as 36 acres of additional lands adjacent to the channel rights-of-way. Recent interpretation of policy, effective June 1976, limits Federal participation in recreational development to the lands acquired for the basic flood control purposes. The Harris County Commissioners Court has expressed its support for the revised cooperative recreation plan and has expressed interest in developing the additional 36 acres at its convenience and entirely at local expense. Although the cooperative portion of the plan has been reduced, the overall recreational development plan remains essentially the same as proposed in the draft report and coordinated with all interests.

● State of Texas - The Director, Budget and Planning, Office of the Governor, coordinated the draft report with appropriate agencies of the State of Texas. The comments of these agencies are summarized in the following paragraphs.

a. The Texas Parks and Wildlife Department noted that the Houston Toad (Bufo houstonensis), which is on the endangered species list, has been found in localities bordering the study area. The Department stated that the proposed project will not adversely affect the species. The Parks and Wildlife Department also found minor discrepancies in base data extracted from the Texas Outdoor Recreation Plan and used in evaluating day-usage at the proposed recreational facilities. These minor discrepancies do not significantly affect the benefit evaluation for the proposed facilities. Further refinement of the project evaluation data will be made after the project is authorized.

b. The Texas Water Quality Board concurred with the findings and recommendations of the draft report. The Board requested that responsible local jurisdictional entities coordinate and assure that any proposed changes or modifications to existing sewer systems be in accordance with approved areawide or regional sewerage plans.

c. The Texas Water Rights Commission will have further opportunity for review when the report is transmitted from the Chief of Engineers to the Governor of Texas for review and acceptance. The Commission offered preliminary comments concerning a desire for further elaboration on the effects of land subsidence on the proposed project and questioned the procedures used in evaluating flood damage prevention benefits in view of further urbanization in the project area. The discussion of the effects of land subsidence, in Section C, Appendix 1, has been expanded to clarify questions of the Commission. The procedures used in developing flood

damage prevention benefits follow current Corps of Engineers policy. The economic evaluation of the proposed project will be re-evaluated following authorization by the Congress.

d. The Texas Air Control Board concurred with the findings and recommendations of the draft report. The Board requested that measures be taken during construction to minimize the effects of air pollution.

e. The Texas Department of Agriculture supplied crop production statistics for Harris County for 1974. The portion of the study area affected by the proposed structural flood protection project is primarily suburban land or committed to future urbanization with insignificant amounts of agricultural areas.

f. The State Department of Highways and Public Transportation confirmed the proposed project will not conflict with existing highway bridges owned by the State.

● Houston-Galveston Area Council - The Houston-Galveston Area Council is the official regional planning agency and A-95 clearinghouse for the study area. The Executive Director reported that the draft report had been reviewed favorably by the Council. Three staff comments and recommendations were included for consideration in the preparation of the final feasibility report. These comments are addressed in the following paragraphs.

a. The Council suggested the consideration of an additional alternative to include several small reservoirs strategically located along the streams. As stated in the report, lands are not available in the downstream areas for such reservoirs. If land were available, the detention reservoirs would have to be located adjacent to subdivided suburban areas and would further impair the already inadequate drainage capacities of the streams. For these reasons, no additional consideration is included in the feasibility report.



b. The Council also suggested that concreting the streams would destroy the natural biological treatment processes that now exist in stagnant pools of inadequately treated sewage effluent and would increase the wasteload downstream in Buffalo Bayou. The establishment of uniform flowlines and the aeration effects of free flowing effluent are considered beneficial as a treatment process. Additionally, the removal of existing stagnant potholes and insect-breeding habitat from the residential areas is also considered a beneficial effect of the proposed project.

c. The Council considered that the subject of lateral drainage requirements was inadequately covered in the draft report. The discussion of this subject has been expanded in Section D of Appendix 1.

● Harris County - The Harris County Flood Control District and its governing body, the Harris County Commissioners Court, have expressed favorable comments concerning the proposed project and have agreed to provide the necessary items of local cooperation. The Commissioners Court has further agreed to provide the necessary local cooperation for the recreational development plan.

● City of Jersey Village - The City of Jersey Village supports implementation of the proposed plan of improvement. The City has requested that hike and bike trail development be limited within the existing city park site. Recent Federal policy changes related to recreational development at local flood protection projects have required the deletion of trail development within the city park, except for public access. The trail development plan now complies with the desires of the City.

● Harris County Flood Control Task Force - The Task Force, an advisory body of the Commissioners' Court, concurs in the findings and recommendations of the draft report.

- Harris County Parks Planning Department - The Parks Planning Department was pleased that the bayou rights-of-way would be used for recreational development and suggested that future project proposals consider similar developments.

- Two members of the Citizens Advisory Committee for the study commented favorably on the project proposal.

### ***REVIEW BY OTHER FEDERAL AGENCIES***

The complete views and comments of other Federal agencies have been included in Appendix 2. The following paragraphs summarize those views.

- U.S. Department of Interior, Bureau of Mines - The Chief, Inter-mountain Field Operations Center stated that the selected plan would have no adverse effects on mineral resources or industry in the affected area. He expressed concern that flood plain zoning and regulation of the head-water reaches of the streams might preclude the future recovery of mineral resources in the future.

- U.S. Department of Interior, Fish and Wildlife Service - The Assistant Regional Director stated that the proposed plan was generally acceptable from an environmental viewpoint. He regards the 1,200,000 cubic yards of earthen material to be excavated from the streams as a natural resource and requested the local sponsors to judiciously use this material to the fullest extent possible for other constructive purposes. This would minimize the need for disposal on other open lands.

- U.S. Department of Interior, Bureau of Reclamation - The South-west Regional Director stated that the proposed project appears to be well justified and well planned. He expressed concern that ground water

infiltration would be cut off by the proposed partial paving of channels. In view of this and the continued ground water pumping in the area, he preferred that greater consideration be given to the detention reservoir alternative for ground water recharge.

● U.S. Department of Interior, Bureau of Outdoor Recreation - The South Central Regional Director stated that the proposed plan was comprehensive in scope and satisfactory with respect to outdoor recreation.

● Department of Housing and Urban Development - The Environmental Clearance Officer found the draft report satisfactory and transmitted it to the Housing Insuring Office for further review and comments. No additional comments have been received.

● U.S. Department of Transportation - The Division Administrator of the Federal Highway Administration offered no comments on the draft report.

● U.S. Department of Agriculture, Soil Conservation Service - The State Conservationist suggested that additional information on the existing vegetation and soils resource would add to the report.

● Environmental Protection Agency - The Regional Administrator, Region 6, expressed no objection to the project as proposed. He requested that additional information be included in the Environmental Statement on air and noise quality and spill prevention during construction. This additional information is contained in the Statement.

● U.S. Department of Commerce, National Marine Fisheries Service - The Regional Director stated that the proposed project would have no significant effects on resources for which his agency is responsible and offered no comments.

## **SUMMARY**

The upper White Oak Bayou watershed drains 61.4 square miles of northwest Harris County, Texas. The study area is part of the Buffalo Bayou watershed which drains much of the urbanized area of Houston and surrounding suburban communities. The study area has experienced extensive urbanization in the past decade. Most of this development has been in the form of residential subdivisions situated in the wooded areas adjacent to the bayou and tributary creeks. The flooding problems of the area are caused by inadequate channel capacities of the streams and are compounded by increased rainfall runoff caused by progressive urbanization. More than 4,500 single-family residences are located within the standard project flood plain. Damaging floods have been occurring almost annually for the past several years.

Various structural and nonstructural measures and combinations of both have been investigated to solve the problems of urban flooding. Of the alternatives investigated, the most practicable solution is found to be channel enlargement and rectification of the urbanized lower reaches of the streams of White Oak Bayou, Cole Creek, and Vogel Creek, combined with nonstructural measures in the undeveloped areas, generally in the upper reaches. Various degrees of protection have been evaluated. A structural plan providing 50-year flood protection for the urbanized areas has been found to produce the maximum net benefits. However, a more conservative and long-term plan, providing protection from the standard project flood, has been selected. This selection has been influenced by the extent of existing urbanization and by the expected future growth to meet the residential needs of the Houston metropolitan area.

The planning studies have also considered other related water resource needs in the study area including environmental quality, recreation, and water quality. Beautification measures, such as selective plantings and architectural treatment of channel linings, have been included in the plan. A recreational development plan is also included. The recreational plan includes a hike and bike trail system along the bayou rights-of-way and a neighborhood park with picnic areas and playground equipment. Specific water quality improvements have not been included; however, the establishment of uniform channel gradients and the resultant removal of pools of stagnant water will provide incidental water quality improvement.

The selected plan includes the following features:

- Channel enlargement, rectification, and partial paving of 9.2 miles of White Oak Bayou, 4.9 miles of Cole Creek, and 4.5 miles of Vogel Creek;
- Nonstructural flood plain management measures in the remaining headwater reaches of the streams consistent with requirements of the Federal flood insurance program and including about 5.6 miles of White Oak Bayou, 2.0 miles of Cole Creek, and 2.0 miles of Vogel Creek;
- Installation and construction of aesthetic and beautification improvements in areas frequently viewed by the public; and
- Construction of a recreational development plan along White Oak Bayou to include 43,000 lineal feet of hike and bike trails together with a neighborhood park including recreation equipment and picnic facilities.

Flood control improvements in White Oak Bayou itself constitute the basic element of the plan. Flood control improvements in each of the tributary creeks and the recreational development plan constitute separable increments which are independently justified.

The total first cost of the recommended plan of improvement is estimated to be \$56,786,000 of which local interests would provide \$6,939,000 for lands and damages, relocations, and a cash contribution for a portion of the recreational development plan. The average annual benefits for the total plan are estimated at \$7,011,000 and the average annual costs are estimated at \$4,169,000. The total project plan would yield a benefits to costs ratio of 1.68. The individual elements of the selected plan are incrementally justified as follows:

Plan Elements	Project First Costs	Average Annual Costs	Average Annual Benefits	Ratio of Benefits to Costs
White Oak Bayou Plan	\$31,927,000	\$2,355,000	\$3,255,000	1.38
Cole Creek Plan	11,499,000	826,000	907,000	1.10
Vogel Creek Plan	12,506,000	890,000	2,740,000	3.08
Recreational Development Plan	854,000	98,000	109,000	1.11

Implementation of the plan will eliminate stream flooding from 10,360 acres of urban land adjacent to the bayou and tributary creeks. The structural measures are complemented by nonstructural measures to control future development in about 3,030 acres of flood plain along the upper reaches of the streams. A recreational development plan is also included.

No significant adverse environmental effects are foreseen as a result of the proposed action. Conversely, beneficial human environmental effects will accrue from the elimination of the flood threat to the community and its residents and the prevention of the economic losses and social stresses which are now occurring. The overall environmental quality will benefit from substituting of orderly, well maintained flood-ways for the unsightly unkempt drainage ditches which the streams have become through fragmentary rectification over the years.

## **STATEMENT OF FINDINGS**

As District Engineer, U. S. Army Engineer District, Galveston, Texas, it is my duty as the responsible Federal official to review and evaluate in the overall public interest all documents, data, and information, as well as the stated views of other interested agencies and the concerned public, in regard to the problems of overbank stream flooding of the urbanized lands in the upper White Oak Bayou watershed. I have made this review and evaluation with detailed consideration of engineering feasibility, environmental impacts, direct social effects, and economic factors of local, regional, and national resource development and social well-being. I have determined that my interim investigation of the upper White Oak Bayou watershed is responsive, in part, to the Congressional authorization directing the development of a comprehensive plan for the control of floods on Buffalo Bayou and its tributaries.

In my investigations I have utilized a professional staff well versed and experienced in the applicable fields of engineering, economics, and environmental sciences. Field and office studies have been conducted in the depth necessary to determine feasibility and social and environmental impacts of the alternate proposals discussed in this report. Established procedures have been utilized in determining stream flooding conditions and the expected severities of flood damages. Historical flooding of the areas and experienced flood damages have been evaluated and correlated with predictions of future flood damages to be expected with continued urbanization and resultant increases in the severity of damages caused by increases in rainfall runoff.

I am convinced that the study has benefited from an adequate program of public communications and interagency relations and that the recommended plan has public understanding and acceptance. Public meetings

were held on 14 May 1971 and 18 April 1974 and several workshop meetings have been held with a local Citizens' Advisory Committee and with other civic groups. The report has been made available to all interested Federal and state agencies and their comments and recommendations have been duly considered. Support of the recommended action has been officially expressed by the Harris County Commissioners Court, the cognizant local governmental entity. Three orders passed by the Court have expressed its intent to fulfill the requirements of local cooperation.

All apparent alternate methods of relieving the study area of flood damages have been investigated in sufficient detail to determine their feasibility. Structural alternatives considered consist primarily of various forms of channel improvements combined with a flood detention reservoir or diversion of floodwaters to other areas. Nonstructural alternatives considered include flood plain zoning and management requirements, flood-proofing of existing structures, and evacuation of flood-prone areas. Combinations of structural and nonstructural alternatives also have been considered. The investigation has indicated that the most practical solution is channel enlargement and rectification of the urbanized reaches of White Oak Bayou, Cole Creek and Vogel Creek combined with nonstructural flood plain management of the remaining undeveloped reaches of the streams.

The investigation indicates that various degrees of protection corresponding to various frequencies of flooding are economically justified. A plan of improvement to provide structural protection from the passage of a 50-year frequency flood, according to my estimates, produces the maximum excess benefits over costs. However, I have concluded that a plan to provide a higher degree of flood protection, to the level of the standard project flood, would better serve the public interest. This conclusion is based primarily on the extent of existing urbanization and the expected future urban growth in the study area.



The investigation also has disclosed that the proposed plan of improvement offers opportunity for a public-use recreational plan for which there is growing demand and evident economic justification.

In considering the environmental effects of the proposed action, I find that there will be no significant adverse effects on the natural environment of the area. Most of the natural woodlands have previously been altered by channel clearing and by existing urban developments. The plan of improvement includes selective plantings along the channel rights-of-way in areas exposed to public view. The recreational portion of the plan will provide outdoor leisure opportunity for public enjoyment.

I find that social impacts of the action will be largely beneficial, relieving the residents of the economic losses and inconveniences related to repetitive flooding, depression of property values, and the social stresses of a continual threat of flooding. Temporary disruptions will occur to transportation facilities during construction. Local economic impacts will be beneficial, primarily through restoration of property values. Economic impacts of the proposed action on surrounding areas of the Houston metropolitan area will not be significant.

I am satisfied that there is a valid Federal interest in solving the flooding problems in the study area in terms of the historic involvement of the Federal Government in flood control activities. It is my judgment that the precedents for substantial local participation in the cost of flood control works are clear and well established. I am convinced that the items of local cooperation, as outlined in the following recommendations paragraph, are reasonable and consistent with present Federal policy.

I find that the proposal outlined in this report, consisting of enlargement and rectification of the lower reaches of the channels in the study area, nonstructural management of flood plains in the upper reaches, and construction of a recreational development plan is based on

thorough analyses and evaluations of various alternate courses of action for achieving the desired objectives. I also find that no significant adverse environmental effects are discernible; that the social and economic benefits to be derived outweigh any adverse effects; that the action is consonant with national policy, statutes, and administrative directives; and that on balance the total public interest should best be served by implementation of the proposal.

### **RECOMMENDATIONS**

It is recommended that the selected channel improvement plans for flood control on upper White Oak Bayou, Cole Creek, and Vogel Creek, as described in this report and shown on Plate 2, and the recreational development plan, as shown on Plate 3, be authorized as a Federal project, with such modifications as in the discretion of the Chief of Engineers may be advisable, at a first cost to the United States presently estimated at \$49,847,000 for construction. This recommendation is made with the provision that, prior to commencement of construction, non-Federal interests agree to:

- a. Provide without cost to the United States all lands, easements, and rights-of-way, including disposal areas for excavated material determined suitable by the Chief of Engineers and necessary for construction of the project;
- b. Hold and save the United States free from damages due to the construction works, not including damages due to the fault or negligence of the United States or its contractors;
- c. Operate and maintain all works after completion, including the recreational facilities constructed as part of the project, in accordance with regulations prescribed by the Secretary of the Army;
- d. Accomplish without cost to the United States all alterations and relocations of utilities, transportation facilities (except railroad

bridges), pipelines, and other existing structures and improvements made necessary by construction of the project;

e. Prevent any obstructions or encroachment that would reduce the flood carrying capacity of the project;

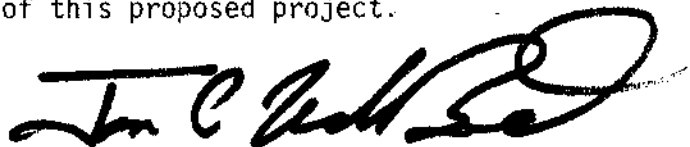
f. Assume responsibility for coordination of actions of all responsible local agencies to the end that adequate lateral channels and drains will be provided and maintained without cost to the United States;

g. Adopt and enforce flood plain regulations appropriate to the non-structural measures of the plan of improvement which, combined with the structural measures, will minimize damages to future development in the project area that would be inundated from a flood that could be expected to occur once in 100 years, such regulations to be consistent with those presently established;

h. Provide a cash contribution for recreation equal to 50 percent of the final first cost allocated to this function, less a credit for the value of lands, easements, rights-of-way, alterations, and relocations allocated therefor;

i. Administer and assure access to the recreational facilities and lands to all on an equal basis; and

j. Make available to all interested parties the Special Flood Hazard Information Report on White Oak Bayou, dated 1972, for use as interim guidance prior to completion of this proposed project.



JON C. VANDEN BOSCH  
Colonel, Corps of Engineers  
District Engineer

[First endorsement]

SWDPL-F

1st Ind

SUBJECT: Buffalo Bayou and Tributaries, Texas, Interim Report on Upper  
White Oak Bayou

DA, Southwestern Division, Corps of Engineers, Main Tower Building,  
1200 Main Street, Dallas, TX 75202 28 Jan 77

TO: HQDA (DAEN-ZA) WASH DC 20314

I concur in the findings of the District Engineer that the proposed  
improvements are needed, economically justified, and consistent with  
national water resource planning objectives.



CHARLES I. MCGINNIS  
Major General, USA  
Division Engineer

**BUFFALO BAYOU AND TRIBUTARIES, TEXAS  
FLOOD CONTROL**

**INTERM REPORT  
ON  
UPPER WHITE OAK BAYOU**

*Pertinent Correspondence*

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X**

**PREPARED BY  
GALVESTON DISTRICT, CORPS OF ENGINEERS  
DEPARTMENT OF THE ARMY**

**2**

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# United States Department of the Interior

## BUREAU OF MINES

BUILDING 20, DENVER FEDERAL CENTER

DENVER, COLORADO 80225

Intermountain Field Operations Center

Office of  
Chief

May 26, 1976

Your reference:  
SWCED-PS

District Engineer, Galveston District  
U.S. Army Corps of Engineers  
P.O. Box 1229  
Galveston, Texas 77553

Dear Sir:

We have reviewed the draft feasibility report on upper White Oak Bayou, Harris County, Texas, as you requested on April 23.

According to the report, channel improvements on lower reaches and flood plain zoning on headwater reaches of upper White Oak Bayou, Cole Creek, and Vogel Creek, and recreation development constitute the selected plan for flood control in the watershed that lies at the northwest edge of Houston. Rights-of-way required for the project total 430 acres.

The Bureau of Mines is interested in the effect of the proposed project on the mineral resources and mineral-production facilities that are present in the watershed. The report indicates that local sponsors would be responsible for relocation of the numerous oil and gas pipelines that cross the channels. However, the report fails to specify whether zoning and regulation along headwater reaches of the three streams, to prevent future development within the 100-year flood plain, would preclude the possible recovery of mineral resources from these areas in the future. Otherwise, our office review indicates that the selected plan would have no adverse effect on mineral resources or industry.

Our field-level comments are informal and are offered as a service; they do not constitute a formal project review by the Bureau of Mines.

Sincerely yours,

Raymond L. Lowrie, Chief  
Intermountain Field Operations Center





UNITED STATES  
DEPARTMENT OF THE INTERIOR  
FISH AND WILDLIFE SERVICE

IN REPLY REFER TO:

(ES)

POST OFFICE BOX 1306  
ALBUQUERQUE, NEW MEXICO 87103

May 19, 1976

District Engineer  
Corps of Engineers, U. S. Army  
P. O. Box 1229  
Galveston, Texas 77550

Dear Sir:

The U. S. Fish and Wildlife Service has reviewed the two-volume draft feasibility report covering flood damage prevention measures and recreational development on Upper White Oak Bayou in the vicinity of Houston, Texas, as requested in Lieutenant Colonel Kenneth P. Bretsch's letter of April 23, 1976.

We believe the selected plan of improvement, which provides for (1) channel enlargement, rectification, and partial paving of White Oak Bayou, Cole Creek, and Vogel Creek, (2) non-structural flood plain zoning and regulation of development along the remaining headwater reaches of the streams, (3) installation and construction of aesthetic and beautification improvements in areas frequently viewed by the public, and (4) construction of recreational facilities along White Oak Bayou, generally is acceptable from an environmental viewpoint.

However, the Service regards the 1,200,000 cubic yards of earth material that would be excavated from the bayou and tributary creeks during construction as a natural resource, and every effort should be made by the local sponsors to judiciously use this material to the fullest extent possible for other construction purposes. This would avoid impacting 139 acres of wildlife habitat, in the form of pastureland, and would negate the need to acquire similar material for construction purposes from a perhaps more environmentally sensitive area.

We appreciate the opportunity to comment on this draft feasibility report.

Sincerely yours,

*Jack P. Woolstenhulme*  
Assistant Regional Director

cc: Executive Director, Texas Parks and Wildlife Dept., Austin, Texas  
Field Supervisor, FWS, ES, Galveston, Texas



United States Department of the Interior  
BUREAU OF RECLAMATION

SOUTHWEST REGION  
HERRING PLAZA BOX H-4877  
AMARILLO, TEXAS 79101

MAY 17 1976

IN REPLY  
REFER TO: 730  
125.

Colonel Don S. McCoy  
District Engineer  
Corps of Engineers  
Post Office Box 1229  
Galveston, Texas 77553

Dear Colonel McCoy:

This is in reply to your letter of April 23 requesting our field level comments on your draft feasibility report on Upper White Oak Bayou near Houston, Texas.

The report appears to be well written and the project well justified and well planned.

At the present time, we do not have any existing or planned studies for the Upper White Oak Bayou area; therefore, the selected plan will not interfere with our activities.

It is not clear to us from the report whether ground water infiltration that would be cut off by the proposed lined channels would be significant in light of possible continued pumping in the study area. In light of such pumping, perhaps the benefits of recharge from the detention basin in the environmental quality plan would be worthy of consideration.

Thank you for the opportunity to comment on the report.

Sincerely yours,

FOR

J. A. Bradley  
Regional Director



United States Department of the Interior  
BUREAU OF OUTDOOR RECREATION

SOUTH CENTRAL REGIONAL OFFICE  
PATIO PLAZA, 5000 MARBLE N.E., ROOM 211  
ALBUQUERQUE, NEW MEXICO 87110

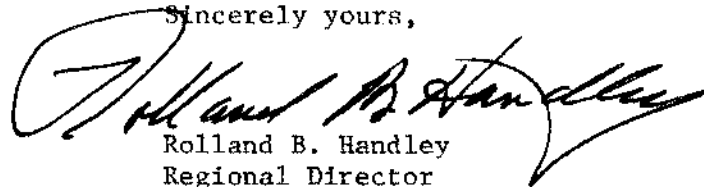
IN REPLY REFER TO:

Lt. Col. Kenneth P. Bretsch  
Deputy District Engineer  
Corps of Engineers  
Galveston District  
P.O. Box 1229  
Galveston, Texas 77553

Dear Colonel Bretsch:

We have reviewed the draft feasibility report on the Upper White Oak Bayou, in the vicinity of Houston, Texas. We find the documents to be comprehensive in scope and satisfactory with respect to outdoor recreation.

Sincerely yours,



Rolland B. Handley  
Regional Director



DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT  
REGIONAL OFFICE  
1100 COMMERCE STREET  
DALLAS, TEXAS 75202 NL., ZIP CODE 75242

April 27, 1976

REGION VI

IN REPLY REFER TO:

6C

Your Reference:

SWGED-PS


Colonel Kenneth P. Bretsch  
Deputy District Engineer  
Galveston District  
Corps of Engineers  
P. O. Box 1229  
Galveston, Texas 77553

Dear Colonel Bretsch:

This will acknowledge and thank you for the draft feasibility report on Upper White Oak Bayou in the vicinity of Houston, which was transmitted by your letter of April 23.

By copy of this letter, we are transmitting the subject report to our Houston Insuring Office and asking that Office to furnish you directly any comments it might have, with a copy to this Office.

Sincerely,

  
Travis Wm. Miller  
Environmental Clearance Officer



U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL HIGHWAY ADMINISTRATION  
826 FEDERAL OFFICE BUILDING  
AUSTIN, TEXAS 78701

May 13, 1976

IN REPLY REFER TO

06-48.10B

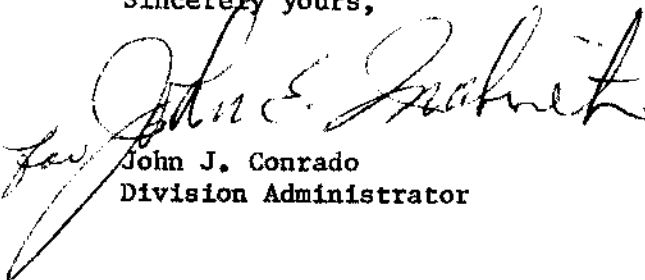
Feasibility Report for Flood Damage Prevention  
Upper White Oak Bayou

Lieutenant Colonel Kenneth P. Bretsch  
Deputy District Engineer  
Galveston District, Corps of Engineers  
P. O. Box 1229  
Galveston, Texas 77553

Dear Colonel Bretsch:

We have no comments concerning the subject feasibility  
report.

Sincerely yours,

A handwritten signature in black ink, appearing to read 'John J. Conrado'. The signature is written in a cursive style with a large, sweeping flourish at the end.

John J. Conrado  
Division Administrator

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

---

P. O. Box 648  
Temple, Texas 76501

May 25, 1976

Mr. Kenneth P. Bretsch  
LTC, CE  
Deputy District Engineer  
Department of the Army  
Galveston District, Corps of Engineers  
P. O. Box 1229  
Galveston, Texas 77553

Dear Mr. Bretsch:

We have reviewed the draft feasibility report on Upper White Oak Bayou, Buffalo Bayou and Tributaries, Texas.

It is noted that the selected plan will provide flood protection to land that has been committed to urban use and that nonstructural measures are to be implemented in upstream reaches which remain primarily in agricultural use.

We feel that additional information on the existing vegetation and soils resource would add to the report. Information on the pattern and composition of the present vegetation would be helpful in identifying the nature of past disturbances of the landscape and would also indicate value for wildlife resources. It would also be useful for identifying the nature study areas to be included in the selected plan. Information on the soil resource would be helpful in identifying soil problems that may be associated with planning of parks, playgrounds, trails, etc.

We appreciate the opportunity to comment on this report.

Sincerely,



George C. Marks  
State Conservationist

**ENVIRONMENTAL PROTECTION AGENCY**

**REGION VI**

**1600 PATTERSON, SUITE 1100**

**DALLAS, TEXAS 75201**

May 18, 1976

OFFICE OF THE  
REGIONAL ADMINISTRATOR

Colonel Don S. McCoy  
District Engineer  
Department of the Army  
Galveston District, Corps of Engineers  
P. O. Box 1229  
Galveston, Texas 77553

Dear Colonel McCoy:

We have reviewed the Draft Environmental Statement and the Draft Feasibility Report on Upper White Oak Bayou. The proposed plan is to prevent flood damages to urban development on upper White Oak Bayou and its tributaries Cole and Vogel Creeks in the vicinity of Houston, Texas. The structural project under consideration is for the section of White Oak Bayou from mile 10.7 to mile 19.9, Cole Creek from White Oak Bayou to mile 4.5.

In general, the statement discusses several environmental impacts of the proposed project. However, we are including the following comments for your consideration in preparing the final statement.

1. The statement should include a discussion of construction impacts on air quality including increased vehicular emissions from construction equipment.

2. The final statement should identify sensitive receptors such as schools, churches, hospitals in the project area. The effects of construction noise and the specific precautions for noise abatement and protection of the area residents from construction-related noise impacts should be discussed.

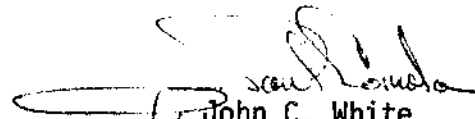
3. The statement should more fully describe the modifications to be made on the ten pipelines as a result of the project. Changes to pipelines carrying oil or wastewater could become significant from a public health standpoint if adequate pollution abatement controls are not implemented.

These comments classify your Draft Environmental Impact Statement as LO-2. Generally, we have no objection to the project as proposed. However, we are requesting additional information be provided concerning air and noise quality plus information on spill prevention. The classification and the date of our comments will be published in the Federal Register in accordance with our responsibility to inform the public of our views on proposed Federal actions, under Section 309 of the Clean Air Act.

Definitions of the categories are provided on the attachment. Our procedure is to categorize our comments on both the environmental consequences of the proposed action and on the adequacy of the impact statement at the draft stage, whenever possible.

We appreciate the opportunity to review the Draft Environmental Impact Statement and the Draft Feasibility Report and we will be happy to discuss our comments with you. Please send us two copies of the Final Environmental Impact Statement at the same time it is sent to the Council on Environmental Quality.

Sincerely yours,

  
John C. White  
Regional Administrator

Enclosure



## ENVIRONMENTAL IMPACT OF THE ACTION

### IO - Lack of Objections

EPA has no objections to the proposed action as described in the draft impact statement; or suggests only minor changes in the proposed action.

### ER - Environmental Reservations

EPA has reservations concerning the environmental effects of certain aspects of the proposed action. EPA believes that further study of suggested alternatives or modifications is required and has asked the originating Federal agency to re-assess these aspects.

### EU - Environmentally Unsatisfactory

EPA believes that the proposed action is unsatisfactory because of its potentially harmful effect on the environment. Furthermore, the Agency believes that the potential safeguards which might be utilized may not adequately protect the environment from hazards arising from this action. The Agency recommends that alternatives to the action be analyzed further (including the possibility of no action at all).

## ADEQUACY OF THE IMPACT STATEMENT

### Category 1 - Adequate

The draft impact statement adequately sets forth the environmental impact of the proposed project or action as well as alternatives reasonably available to the project or action.

### Category 2 - Insufficient Information

EPA believes the draft impact statement does not contain sufficient information to assess fully the environmental impact of the proposed project or action. However, from the information submitted, the Agency is able to make a preliminary determination of the impact on the environment. EPA has requested that the originator provide the information that was not included in the draft statement.

### Category 3 - Inadequate

EPA believes that the draft impact statement does not adequately assess the environmental impact of the proposed project or action, or that the statement inadequately analyzes reasonably available alternatives. The Agency has requested more information and analysis concerning the potential environmental hazards and has asked that substantial revision be made to the impact statement. If a draft statement is assigned a Category 3, no rating will be made of the project or action, since a basis does not generally exist on which to make such a determination.



**U.S. DEPARTMENT OF COMMERCE**  
**National Oceanic and Atmospheric Administration**  
NATIONAL MARINE FISHERIES SERVICE  
Duval Building  
9450 Gandy Boulevard  
St. Petersburg, FL 33702

June 10, 1976

FSE21/RKO

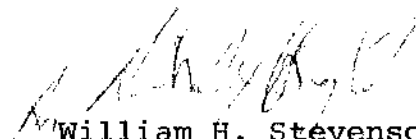
Colonel Jon C. Vanden Bosch  
District Engineer, Galveston District  
Department of the Army, Corps of Engineers  
P.O. Box 1229  
Galveston, TX 77553

Dear Colonel Vanden Bosch:

Please reference Lt. Colonel Kenneth B. Bretsch's April 23, 1976, letter which requested our views and comments on the Draft Interim Report (DIR) on Upper White Oak Bayou, Feasibility Report for Flood Damage Prevention, Buffalo Bayou and Tributaries, Texas.

We have reviewed the DIR and do not believe that the proposed work would significantly affect resources for which the National Marine Fisheries Service is responsible. We, therefore, have no comments.

Sincerely,

  
William H. Stevenson  
Regional Director



OFFICE OF THE GOVERNOR

DOLPH BRISCOE  
GOVERNOR

June 7, 1976

Colonel Don S. McCoy  
District Engineer  
Galveston District  
Corps of Engineers  
P.O. Box 1229  
Galveston, Texas 77553

Dear Colonel McCoy:

The draft feasibility report on "Upper White Oak Bayou in the Vicinity of Houston, Texas" has been reviewed by the Budget and Planning Office and interested State agencies in accordance with the Office of Management and Budget Circular A-95.

The enclosed comments of the review participants should be considered in their entirety. The following is a brief summary of these comments:

1. The Texas Water Rights Commission, retaining the right to future formal action under Section 6.073, Texas Water Code, stated that a more rigorous assessment on land subsidence impacts should be included. They commented on the impacts of existing and proposed impervious channel work regarding ground-water recharge and suggested that a statement be included to acknowledge limitations involved in determining flood control damages and benefits.
2. The Houston-Galveston Area Council stated that additional consideration should be given to the alternatives, particularly concerning the detention reservoir and downstream channel improvements and expressed concern for the lack of consideration of the unfavorable effects of channel concreting and increased waste loads to Buffalo Bayou resulting from the elimination of the existing tertiary treatment provided by the organisms and vegetation. It was suggested that earthen embankments or gabions could alleviate this problem. They stated that the report should address the ability of the Harris County Flood Control District to provide other improvements to realize the full benefits of the final plan.

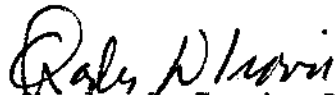
3. The Texas Air Control Board stated that the assessment of the effects of air pollution from construction would be more effective if more detail on these effects were provided in the discussion. They suggested that increased exhaust emissions from the use of recreational areas be discussed and they provided guidance for any outdoor burning that may be required.

It has been noted that the concerns about groundwater recharge as well as those related to aesthetics and bio-degradation of wastes could both be addressed through the substitution of PVC-coated gabions for the concrete channel lining. An added advantage of terraced gabions would be safety, in that it would be easier for a person or an animal to get out of high-velocity, turbulent floodwaters if they fell into the channel. Since native stone rubble for the gabions is in short supply in the project area, demolition and construction rubble from buildings and obsolete roadways could be used for gabion fill.

Other agencies commented favorably on the report or provided comments for consideration. The Texas Department of Agriculture provided information on agricultural production and urged that agricultural data be included in future reports of environmental and economic impacts. The State Department of Highways and Public Transportation confirmed that the new U.S. 290 bridges are accommodated to the future improvements on Cole Creek.

The comments of all of the review participants are provided to assist your planning effort. If this Office can be of further assistance, please contact us.

Sincerely,



Charles D. Travis, Director  
Budget and Planning Office

Enclosures

TEXAS  
PARKS AND WILDLIFE DEPARTMENT



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June 21, 1976

Mr. H. Anthony Breard, Coordinator  
Natural Resources Section  
Governor's Budget and Planning Office  
Executive Office Building  
411 West 13th Street  
Austin, Texas 78701

Dear Mr. Breard:

The Texas Parks and Wildlife Department has reviewed the Interim Report on Upper White Oak Bayou and the Draft Environmental Statement; Upper White Oak Bayou Flood Damage Prevention. Our comments on the contents of both documents are contained in this letter.

At one time, the project area was undoubtedly good to excellent wildlife habitat, however, urban development has greatly diminished wildlife habitat values in the area of the proposed channel enlargement. Fisheries in this portion of White Oak Bayou are thought to be insignificant.

The Houston toad (Bufo houstonensis), which is on the Department of the Interior's and this State's endangered species lists, has been found in several localities bordering the watershed boundary (see attached map) and might be expected to occur in the White Oak Bayou watershed. Since this species seems to prefer temporary breeding pools formed in relatively loose, easily drained soils, it is not likely to be adversely affected by channelization of lower White Oak Bayou. Any modification of the wooded, sandy soil ridges could have a deleterious effect on this species.

Wildlife would be least affected by the preferred alternative of channelization of the lower portion of the bayou and non-structural flood plain management on the upper reaches of White Oak Bayou. The alternative plan for detention reservoirs would further reduce wildlife habitat in the project area.

The Department found the objectives as proposed in the feasibility report to be in accord with the Texas Outdoor Recreation Plan (TORP). The Department suggests that the Corps of Engineers and local sponsors give due consideration to providing a balanced distribution of recreation opportunities to meet existing and projected recreation needs.

The proposed action would not affect any waterways having local, regional, or statewide waterway potentials, or existing trails having statewide system potentials. The proposed action does include 8.7 miles of hike and bike trails which is in keeping with the findings and recommendations of the "Texas Trailways" report where it points out that floodplains have excellent potential for trail development. The Corps of Engineers should be commended for realizing this potential and proposing the incorporation of hike and bike trails in the project.

The Department notes the technical report in Appendix 1, Section F, "Economics of the Selected Plan," specifically as it relates to the use of TORP empirical and statistical data and methodologies for evaluating recreation benefits.

The Department appreciates and encourages continual reference to and implementation of the TORP. A review of the TORP-based data and findings as compared to the document prompts the following comments:

1. A minor discrepancy was found between the data presented for the subject market area in Table B-24, Annual Days Participation Per Household by Activity (page F-31, Appendix 1). Household participation rates cited from the TORP for Analytical Planning Region 25 Metropolitan Area are slightly lower than indicated in the Corps of Engineers' report. An attempt was made to ascertain more specifically the source of the information cited by contacting Galveston District, Corps of Engineers staff members who prepared the information. They were unavailable for comment due to job transfers and vacations. It is recommended that household rates in the document be changed to accurately cite the TORP.

2. Annual participation (visitor) days projected to occur at the proposed project site for picnicking and trail activities are also presented on page F-31, Appendix 1. A more detailed presentation and explanation of the procedures and sources of information used in obtaining these estimates is recommended, and the estimates will change slightly if TORP days/household are corrected as noted.

3. The assumption made by the Corps of Engineers concerning picnicking participation in footnote 2/ on page F-32 of Appendix 1 is incorrect. The footnote reads as follows:

"2/ No percentages were given for participation at public facilities by the Texas Outdoor Recreation Plan; therefore, it is assumed that picnic outings generally take place at some public facility."

The Corps of Engineers should be advised that TORP Urban Volume participation data for all activities except trails represents total projected participation on all trips to all public and private destinations. For picnicking, approximately 97% of all urban participation in 1968 occurred at public facilities.

The draft environmental impact statement recognizes the demand for fill material in the Houston area and states that material from channel excavation might be made available for this purpose by the project sponsor (page 4). This Department has previously suggested such use of spoil material to the Corps of Engineers with the interest of reducing spoiling on valuable wildlife habitat and wetlands. We are pleased to note that they are recognizing the wisdom of using spoil material for constructive purposes rather than covering natural areas.

Thank you for the opportunity to comment on these documents.

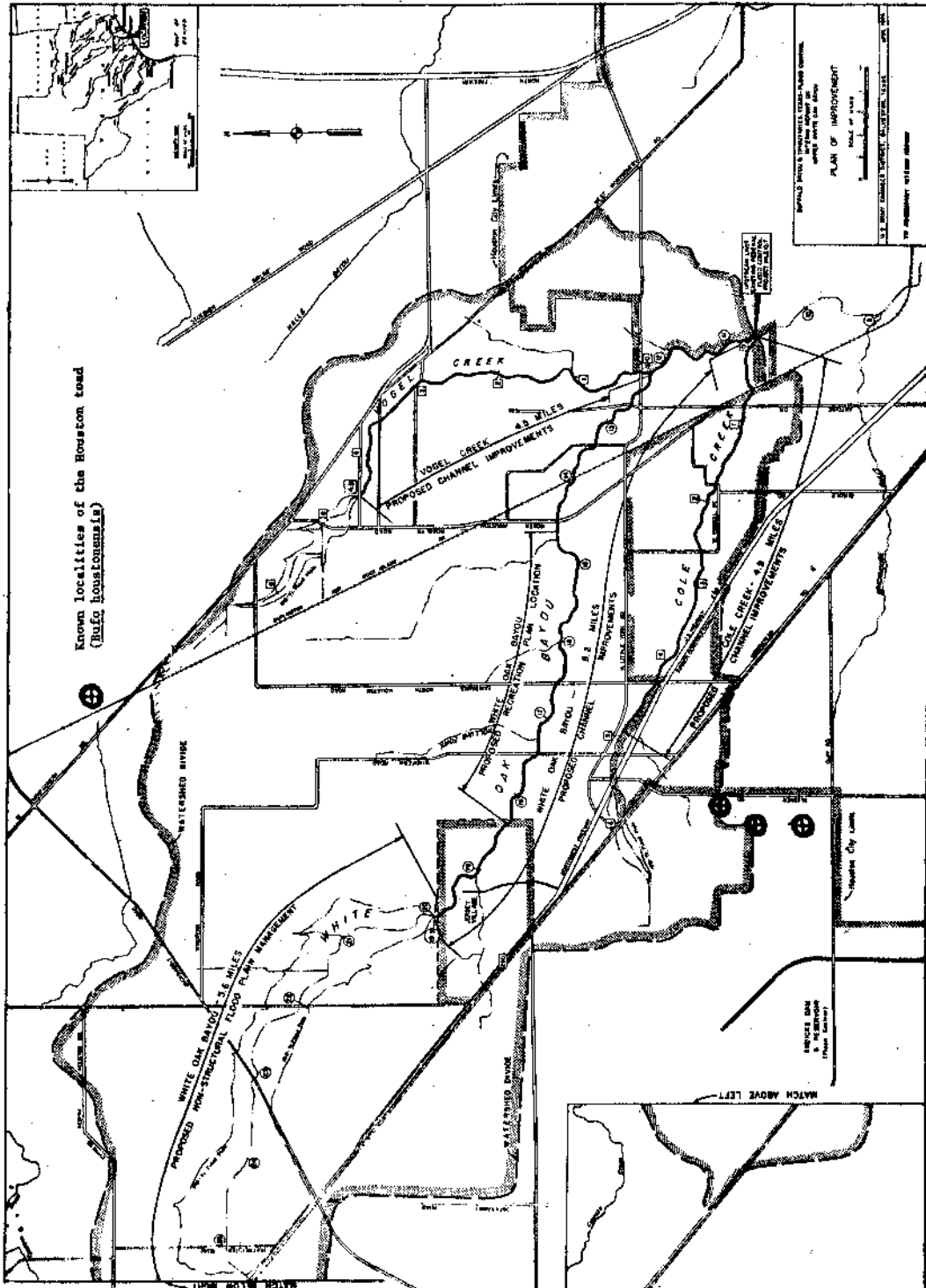
Sincerely,



CLAYTON T. GARRISON  
Executive Director

CTG:MW:pm

Attachment



Known localities of the Houston toad  
(*Bufo houstonensis*)

IMPROVED CHANNEL  
PROPOSED CHANNEL IMPROVEMENTS  
WATERED DIVIDE  
WATERED DIVIDE  
WATERED DIVIDE

PLAN OF IMPROVEMENT  
SCALE OF 1:50,000  
U.S. GEOLOGICAL SURVEY, WASHINGTON, D.C.



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BEN RAMSEY  
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HUGH C. YANTIS, JR.  
EXECUTIVE DIRECTOR  
PH. (512) 475-2651

1700 NORTH CONGRESS AVE.  
P.O. BOX 13246 CAPITOL STATION 78711  
AUSTIN, TEXAS

May 26, 1976

Re: Feasibility Report on Upper  
White Oak Bayou in Harris  
County by Corps of Engineers

Mr. Charles D. Travis, Director  
Governor's Budget and Planning Office  
Executive Office Building  
411 West 13th Street  
Austin, Texas 78701

Dear Mr. Travis:

The staff of the Texas Water Quality Board has reviewed the feasibility report for flood damage prevention in the Upper White Oak Bayou watershed in Harris County as prepared by the U. S. Army Corps of Engineers and concurs with the findings of the study that there should be no significant adverse affects as a result of the proposed action. We have noted that the report found the most practicable solution to be channel enlargement and rectification of the urbanized lower reaches of White Oak Bayou, Cole Creek, and Vogel Creek combined with non-structural measures in the headwater areas of the three streams, which would require some regulation of development in the affected area.

It is requested that close coordination be maintained with the local jurisdictional entities regarding any proposed modification of existing sewer system in order for any proposed changes to be in accord with approved areawide or regional sewerage plans.

We appreciate the opportunity to review this proposed project. If we can be of further assistance, please let us know.

Very truly yours,

*Emory G. Long*  
Emory G. Long, Director  
Administrative Operations

cc: Col. Don S. McCoy, Corps of Engineers

STEPHEN F. AUSTIN STATE OFFICE BUILDING

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475-2461

May 20, 1976

R. E. (BOB) SCHNEIDER  
EXECUTIVE DIRECTOR

475-2462

MARY ANN HEFNER

SECRETARY

475-4614

Mr. Charles D. Travis, Director  
Governor's Budget and Planning Office  
Executive Office Building  
411 West 13th Street  
Austin, Texas 78701

Attention: Mr. Albert D. Schutz

Re: U.S. Corps of Engineers, Galveston  
District Project Documents:

- (A) Feasibility Report for Flood  
Damage Prevention: "Interim  
Report on Upper White Oak  
Bayou, Buffalo Bayou and  
Tributaries, Texas." (Main  
Report and Appendices, April  
1976).
- (B) Draft Environmental Statement:  
"Upper White Oak Bayou Flood  
Damage Prevention, Buffalo Bayou  
and Tributaries, Texas." (April  
1976).

Dear Mr. Travis:

In response to the request in letter of April 28, 1976 (File Reference: SWGED-E) from Colonel Don S. McCoy, Galveston District Engineer, and letters of April 28th and May 5th from Mr. H. Anthony Breard, of your Office, the staff of the Texas Water Rights Commission has reviewed concurrently the referenced documents relative to a proposed incremental Federal flood prevention project on White Oak Bayou and tributaries, in the vicinity of Houston, Texas, at an estimated, initial construction cost of \$54,626,000 (1975 price level).

The following comments are furnished regarding the Feasibility Report:

1. Final, formal action by the Texas Water Rights Commission on the referenced Report, pursuant to Section 6.073, Texas Water

Code, will be undertaken after the Report is received from the Chief of Engineers, through the Office of the Governor of Texas. (See Main Report, page 73: "The following steps are involved in the review and implementation process: . . . At the request of the Chief of Engineers, review and acceptance by the Governor of Texas and the various Federal agencies at the departmental level. "). Therefore, our staff review comments at this advanced stage in project formulation should not be construed in any manner as obviating the imminent, formal action by the Commission under Section 6.073, Texas Water Code. Nor should the staff comments made hereinafter be misconstrued as an advance expression of the Commissioners' views relative to referenced project and the proposed reports thereon.

2. The Commission staff believes that the findings and recommendations in the proposed Report have been logically developed. However, the staff believes that a more rigorous assessment should be included on the dynamic land subsidence impacts. This should be an integral part of all reports on major water resources and public works development projects planned in the Texas Gulf coast subsidence zones of influence. In U.S. Geological Survey Professional Paper 813-F (Summary Appraisals of the Nation's Ground-Water Resources ---- Texas-Gulf Region, 1976), page F22, statement is made that:

"The areas of major subsidence in the Texas-Gulf Region are centered in and around Houston, . . . In Houston, the increasing draft of ground water which causes the progressive lowering of artesian pressures in enlarging the subsidence bowl in depth and lateral extent. Between 1943 and 1973, the land surface subsided a maximum amount of about 7.5 ft (2.3 m) near the Houston Ship Channel, . . . Subsidence prior to 1943. . . was about 2 ft (0.6 m), which added to the 7.5 ft (2.3 m) that occurred between 1943 and 1973 makes a total of 9.5 ft (2.9 m) of subsidence in that area. . . Subsidence will continue if the decline in artesian pressures continues, and even if the pressure could be maintained at its present level, the land surface would nevertheless subside a few additional feet near the

center of the cone of depression. . . . Efforts to minimize the subsidence problem will necessitate a decrease in the rate of artesian-pressure decline, which can be accomplished only by reducing the ground-water draft or by recharging the aquifers. "

In view of the above-described dynamic conditions, a major question arises as to the relative stability (i. e., vulnerability of slabs to settlement, and hydrostatic uplift, etc.) of the extensive concrete channel paving (existing and planned) of both upper and lower White Oak Bayou, Cole Creek, and Vogel Creek. Also, major questions arise as to the effects of the extensive channel paving on aquifer recharge, aquifer-pressure gradient, and salt water intrusion into aquifers. Finally, in view of the substantial population concentration increase expected to occur in the flood-protected region, additional analysis is warranted on the expected effects of the greatly increased urban storm runoff in channels of higher hydrodynamic and hydraulic efficiency. The effects of expected increased velocities, erosive forces around bridge piers, and sediment transport should be examined closer.

3. A statement should be made regarding the realistic limitations involved in the determination of flood control damages and benefits. In the 1975 Annual Report of Institute for Water Resources, Department of the Army, Corps of Engineers, page 4, statement is made that:

"Flood control evaluations remain among the most persistent problems addressed by the Institute. Some of the earliest investigations undertaken by IWR (Institute for Water Resources) centered on ways to improve the estimates of national income from flood control projects. Later efforts were directed toward the concept of optimal use of the nation's flood plains. This led to the land use models undertaken in 1974 and 1975 as major steps in IWR efforts toward a more efficient means of flood control benefit evaluation. Since the measurement of flood damages is very time consuming and expensive, the Institute is seeking proxy measures which would be easier to obtain while accurately reflecting the economic impact of flooding. Rents and land values

have been proposed, and the Institute has investigated these approaches. . . . Work in FY 76 is concentrating on developing computational capability to assist District planners to estimate damage reduction, intensification, and location benefits; development of flood damage functions from Flood Insurance Payment data; analysis of projection of flood damages to commercial and industrial property and contents; . . . " (Parenthetical expression and underlining added for clarity and emphasis. )

In view of the foregoing statement, it is believed that a more realistic qualifying statement should be made regarding the 1.8 benefit-to-cost ratio of the referenced project. Over the estimated five-year project period, additional factors will enter into the making of realistic calculations. On page 73 of the Main Report statement is made that:

"Because of many variables involved in the review, authorization, and funding processes, a time schedule for implementation is not accurately predictable in the early stages of planning. " (Emphasis added. )

The following comments are furnished in the Draft Environmental Statement:

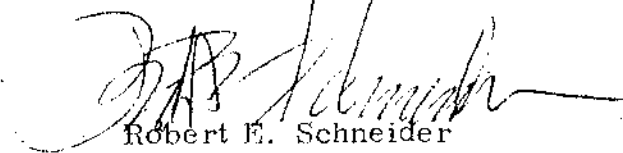
1. The Commission staff believes that the Draft Environmental Statement fulfills adequately the administrative, coordinative, and analytical requirements of the National Environmental Policy Act of 1969, and the U.S. Office of Management and Budget Circular No. A-95.
2. The Statement should be regarded as an integral element of the project report.

We appreciated the opportunity to participate in the project formulation reviews. The foregoing comments are furnished with the constructive

intent of assisting the planners concerned. If you have any questions, or desire further assistance, please notify Dr. Alfred J. D'Arezzo, Analyst for Environmental Sciences and Interagency Coordination, (Phone: 512-475-2678).

Very truly yours,

TEXAS WATER RIGHTS COMMISSION

A handwritten signature in black ink, appearing to read "R. E. Schneider", with a long horizontal flourish extending to the right.

Robert E. Schneider  
Executive Director

RES-AJD:ll



# TEXAS AIR CONTROL BOARD

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8520 SHOAL CREEK BOULEVARD

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WILLIAM D. PARISH  
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WILLIE L. ULICH, Ph.D., P.E.

May 19, 1976

Mr. H. Anthony Breard, Coordinator  
Natural Resources Section  
Budget and Planning Office  
Governor's Office  
Executive Office Building  
411 West 13th Street  
Austin, Texas 78701

Re: Draft Feasibility Report: Flood Control on Upper White Oak  
Bayou. (In the vicinity of Houston, Texas, Buffalo Bayou,  
and Tributaries.)

Dear Mr. Breard:

We have reviewed the above cited document from the standpoint of  
potential adverse air quality effects.

We concur that the excavation and removal of over one million cubic  
yards of earthen material over a five-year construction period will  
have some adverse air quality effects. Wind erosion may also be a  
factor. Even though most of the effects will probably be localized  
and transitory, the urban nature of the project area may cause these  
effects to be very noticeable. The magnitude and duration of this  
pollution could be discussed in more detail.

In addition to the exhaust emissions from equipment during construc-  
tion, there may be increased exhaust emissions associated with motor  
vehicles traveling to the recreation areas. The anticipated magni-  
tude of the use of these recreational areas could be discussed.

Any outdoor burning must be done in accordance with Regulation I of  
the Texas Air Control Board. Thank you for the review opportunity.  
If we can assist further, please contact me.

Sincerely yours,

A handwritten signature in cursive script, appearing to read "Bill Stewart".

Bill Stewart, P.E.  
Deputy Director  
Control and Prevention

cc: Mr. Lloyd Stewart, Regional Supervisor, Bellaire



MEMO

DATE: May 7, 1976

RE: Comments, Draft Feasability Report: Flood Control  
on Upper White Bayou

In 1974 Harris County produced more than \$25,000,000 worth of agricultural products. This report makes no mention of agriculture or its relationship to the proposed project. A copy of the 1974 Texas Department of Agriculture agricultural statistics report for Harris County is attached. We urge that such agricultural data be considered in any future reports of environmental or economic impact.

Ed Nichols, Assistant Commissioner



# HARRIS

## 1974 AGRICULTURAL STATISTICS

### 1. CROPS

CROP	PLANTED ACRES	HARVESTED ACRES	YIELD PER HARVESTED ACRE	UNIT	PRODUCTION
UPLAND COTTON	850	850	169	Lb./Bale	300
AMERICAN PIMA COTTON	--	--	--	Lb./Bale	--
WHEAT	1,100	700	13.4	Bushel	9,400
OATS	1,300	--	--	Bushel	--
BARLEY	--	--	--	Bushel	--
RYE	--	--	--	Bushel	--
FLAXSEED	--	--	--	Bushel	--
SORGHUMS	3,600	1,600	58.6	Bushel	93,800
GRAIN	✓	--	--	Ton	--
SILAGE	--	1,400	3.6	Ton	5,000
HAY	--	2,000	60.5	Bushel	121,000
CORN	2,100	2,000	27.4	Ton	477,000
GRAIN	✓	--	--	Bushel	--
SILAGE	--	17,400	1,914	Pound	2,555,000
SOYBEANS	1,375	1,335	4,596	Lb./Acr.	1,418,000
PEANUTS	30,900	30,850	--	Ton	--
RICE	--	--	--	Pound	--
SUGARCANE	--	--	--	Ton	--
CASTORBEANS	--	--	--	Ton	--
SUGARBEETS	--	--	--	Pound	--
GUAR	--	--	--	Ton	--
ALFALFA HAY	--	12,900	2.23	Ton	28,800
DIVER HAY EXCLUDING SORGHUM	--	--	--	Ton	--
VELCH SEED	--	--	--	Pound	--
CONPEAS	✓	--	--	Pound	--
GREEN	--	--	--	Pound	--
YELLOW	--	--	--	Pound	--

### 2. IRRIGATED CROPS

SELECTED CROP	ACRES PLANTED		ACRES HARVESTED		UNIT	YIELD PER HARVESTED ACRE	
	IRRIGATED	NOT IRRIGATED	IRRIGATED	NOT IRRIGATED		IRRIGATED	NOT IRRIGATED
UPLAND COTTON	--	850	850	700	Pound	169	13.4
WHEAT	--	1,100	700	1,600	Bushel	58.6	13.4
SORGHUMS FOR GRAIN	✓	3,600	1,600	1,335	Bushel	1,914	58.6
PEANUTS	--	1,375	1,335	--	Pound	--	4,596

### 3. VEGETABLES FOR FRESH MARKET AND PROCESSING

CROP	ACRES HARVESTED	CROP	ACRES HARVESTED	CROP	ACRES HARVESTED
BROCCOLI	--	SWISS CHARD	--	TOMATOES	500
CABBAGE	200	HORNED MELONS	--	WATERMELONS	100
PANFLOWS	--	LETTUCE	--	IRISH POTATOES	--
CARROTS	--	ONIONS	--	SWEET POTATOES	--
CANTIFLOWER	--	GREEN PEPPERS	--	ALL VEGETABLES	500
CUCUMBERS	--	SPINACH	--		

### 4. FRUITS AND PECANS

CROP	PRODUCTION
PEACHES (80)	2,700
GRAPEFRUIT (100 Lb./Acr.)	--
ORANGES (85 Lb./Acr.)	--
PECANS 1973	126
PECANS 1974	✓

### 5. 1974 LIVESTOCK PRODUCTION OR MARKETING

EGGS PRODUCED (100)	6,780
CHICKENS PRODUCED (100)	71
DUCKS PRODUCED (100)	7
TRUCKS PRODUCED (100)	63,500
MILK PRODUCED (100)	2,000
WOL PRODUCED (100)	2,000
WHAIR PRODUCED (100)	2,000
CATTLE MARKETED (FROM FEEDLOTS) (Quarter)	0

### 6. JANUARY 1 LIVESTOCK ON FARMS

ITEM	1975
ALL CATTLE	80,000
MILK COWS THAT HAVE CALVED	7,000
BEEF COWS THAT HAVE CALVED	36,000
CATTLE ON FEED	2,000
ALL HOGS	2,000
ALL SHEEP	20
ALL SWINE	20
ALL YEAR AND OVER	20
ALL ANGORA GOATS	20
HENS AND PULLETS OF LAYING AGE (1000)	✓

### 7. GOVERNMENT PAYMENTS IN 1974

ITEM	DOLLARS
FEED GRAIN PROGRAM	--
WHEAT PROGRAM	--
PLANT AND P. COTTON PROGRAM	--
SUGARBEET PROGRAM	--
WOL AND WHEAT PROGRAM	--
WHEAT PLAINS RECOVERY PROGRAM	1,227
INDIANS ADJUSTMENT PROGRAM	39,233
FEDERAL ENVIRONMENTAL ASSISTANCE PROGRAM	1,575
WHEAT AND MILK PROGRAM	--

### 8. CASH RECEIPTS FROM FARM MARKETINGS

ITEM	1973	1974
ALL CROPS	22,899	26,393
LIVESTOCK AND LIVESTOCK PRODUCTS	15,887	13,698
TOTAL CROPS AND LIVESTOCK	38,786	40,091
GOVERNMENT PAYMENTS	102	4
TOTAL FARM MARKETINGS AND GOVERNMENT PAYMENTS	38,888	40,133

\* Items reported but not published on a county basis because of either limited production or to avoid disclosure of individual operations. ✓/Planted for all purposes. 2/For fresh market only but processing included in all vegetables. 3/Revised. 4/On hand preceding December 1. 5/Does not include value of standing timber sold from industry, public, and other non-farm underlands. For values see cash receipts bulletin.



**TEXAS STATE SOIL AND WATER CONSERVATION BOARD**

1018 First National Building  
Temple, Texas 76501  
AREA CODE 817, 773-2250

May 14, 1976

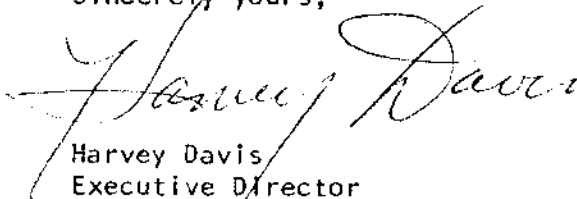
Mr. H. Anthony Breard, Coordinator  
Natural Resources Section  
Budget and Planning Office  
411 West 13th Street  
Austin, Texas 78701

Dear Mr. Breard:

We have received a copy of the draft feasibility report for flood control on Upper White Oak Bayou, Buffalo Bayou, and tributaries in the vicinity of Houston, Texas.

We offer no comment on this draft report.

Sincerely yours,

A handwritten signature in cursive script that reads "Harvey Davis".

Harvey Davis  
Executive Director

HD/lc



COMMISSION  
HEAGAN HOUSTON, CHAIRMAN  
DEWITT C. GREER  
CHARLES E. SIMONS

STATE DEPARTMENT OF HIGHWAYS  
AND PUBLIC TRANSPORTATION  
AUSTIN, TEXAS 78701

ENGINEER-DIRECTOR  
B. L. DEBERRY

May 19, 1976

IN REPLY REFER TO  
FILE NO.

D8-E 454

U.S. Army Corps of Engineers  
Harris County

Draft Feasibility Report: Flood Control on Upper White Oak Bayou

Draft Environmental Impact Statement: Flood Damage Prevention - Upper  
White Oak Bayou, Buffalo Bayou,  
and Tributaries

Mr. Charles D. Travis  
Governor's Office of Budget and Planning  
Executive Office Building  
411 West 13th Street  
Austin, Texas 78701

Attention: Mr. H. Anthony Breard

Dear Mr. Travis:

Reference is made to your letters of April 28, 1976, transmitting the subject draft feasibility report, and May 5, 1976, transmitting the subject draft environmental impact statement.

The Department has reviewed the subject documents and notes that the Corps' proposed improvements of White Oak Bayou, Cole Creek, and Vogel Creek are located downstream from F.M. Highway 1960, new U.S. Highway 290 (Northwest Freeway) and F.M. Highway 149 respectively. The new U.S. 290 bridges on Cole Creek, constructed in 1972, are accommodated to the future improvements of Cole Creek.

Thank you for the opportunity to review these documents.

Sincerely yours

B. L. DeBerry  
Engineer-Director

By:

*R. L. Lewis*  
R. L. Lewis, Chief Engineer  
of Highway Design



COMMISSION  
REAGAN HOUSTON, CHAIRMAN  
DEWITT C. GREER  
CHARLES E. SIMONS

STATE DEPARTMENT OF HIGHWAYS  
AND PUBLIC TRANSPORTATION

P. O. Box 1386  
Houston, Texas 77001

May 13, 1976

ENGINEER-DIRECTOR  
B. L. DEBERRY

IN REPLY REFER TO  
FILE NO.

Harris County  
U.S. Corps of Engineers  
Feasibility Report for Flood Control on  
Upper White Oak Bayou

Lt. Col. Kenneth P. Bretsch  
Galveston District, Corps of Engineers  
P. O. Box 1229  
Galveston, Texas 77553

Dear Sir:

Reference is made to your letter dated April 23, 1976, transmitting the draft feasibility report on Upper White Oak Bayou in the vicinity of Houston, Texas.

We note that the proposed improvements of White Oak Bayou, Cole Creek and Vogel Creek are located downstream from FM 1960, new US 290 (Northwest Freeway) and FM 149 respectively. The proposed improvements would not require adjustment of several highway stream crossings. We have no comments to offer.

Thank you for the opportunity to review the draft report.

Very truly yours,

A handwritten signature in cursive script, reading "Omer F. Poorman".

Omer F. Poorman  
District Engineer  
District No. 12

MKH:vh

# HOUSTON-GALVESTON AREA COUNCIL

1 June 1976

Col. Don S. McCoy  
Department of the Army  
Galveston District, Corps of Engineers  
P. O. Box 1229  
Galveston, Texas 77553

RE: 605-17039  
Draft Feasibility Report  
for Flood Damage Prevention,  
Upper White Oak Bayou

Dear Sir:

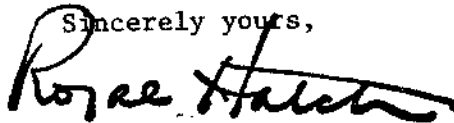
I am happy to advise you that your recent application has been reviewed favorably by this Council.

A copy of Form CG-99 has been attached so that you may complete your application and forward it to the agency to whom your application is addressed.

The form contains the comments and recommendations of the Council regarding the relationship of your application to regional planning and environmental impact.

My best wishes on this worthwhile project. Please contact us if we may assist you in any way.

Sincerely yours,



ROYAL HATCH  
Executive Director

RH/CW/jw

Enclosures

COMMENTS AND RECOMMENDATIONS

Date 1 June 1976

Name of Clearinghouse: HOUSTON-GALVESTON AREA COUNCIL

Address: 3701 West Alabama, Houston, Texas 77027 (P.O. Box 22777,  
Houston, Texas 77027)

A. COMPREHENSIVE PLANNING CERTIFICATION

The project described DOES   X\*   DOES NOT            conform with the comprehensive plan developed or in process of development for the area in which it is located.

U.S. ARMY CORPS OF ENGINEERS, GALVESTON DISTRICT: Draft Feasibility Report for Flood Damage Prevention, Upper White Oak Bayou

\* page 2, staff comments

B. ENVIRONMENTAL ASSESSMENT

\_\_\_\_\_ We have reviewed this assessment and agree that no adverse environmental impact is probable.

\_\_\_\_\_ Our comments upon the environmental impact are as follows:



ROYAL HATCH  
Executive Director  
(Signature of Authorized Representative of Clearinghouse)

APPLICANT: U.S. Army Corps of Engineers, Galveston District

TITLE: Draft Feasibility Report for Flood Damage Prevention  
Upper White Oak Bayou

PROJECT SPONSOR: Col. Don S. McCoy  
Department of the Army  
Galveston District, Corps of Engineers  
P.O. Box 1229  
Galveston, Texas 77553  
713/763-1211

H-GAC STAFF: Robert J. Silver, Environmental Analyst

DESCRIPTION: The U.S. Army Corps of Engineers is proposing to modify  
Upper White Oak Bayou in order to prevent flood  
damage along the bayou. These modifications will  
take the form of channelization and rectification  
of the existing bayou.

Location: Houston Area

Area Affected : Vogel Creek, Cole Creek, White Oak Bayou, and  
Buffalo Bayou (Segment 1007)

RJS:dg  
5/14/76

**SYNOPSIS:** The U.S. Army Corps of Engineers has prepared a draft Environmental Statement and a draft Feasibility Report for Upper White Oak Bayou Flood Drainage Prevention Plan. This draft statement addresses a proposed plan to prevent flood damages to urban development on Upper White Oak Bayou and its tributaries, Vogel and Cole Creeks. The study area is located in and extends beyond the northwestern portion of the Houston City limits.

The proposed structural improvements to White Oak Bayou and its tributaries call for channel enlargement and partial pavement of the channel with concrete. These improvements have been designed on the basis of the U.S. Army Corps of Engineers Standard Project Flood. The proposed non-structural techniques include a regulation for future development in the flood plain. This would limit future development to elevations at or above the 100 year flood plain.

In addition, the stark appearance of the Bayou and its tributaries will be partially improved by architectural treatment and selective plantings of vegetation in areas frequently viewed by the public.

Recreational facilities considered for the project area include three small parks, nine (9) miles of hike and bike trails, and three (3) wooded nature study areas.

**STAFF COMMENTS AND RECOMMENDATIONS:**

Staff recommends approval of the basic project but requests that consideration be given to the following remarks in the preparation of the final Environmental Statement and Feasibility Report:

1. Staff is of the opinion that additional consideration should be given to the project alternatives identified. The "Flood Detention Reservoir on White Oak Bayou and Downstream Channel Improvement" alternative is particularly deserving of further consideration. Rather than one large detention reservoir, the possibility of several smaller reservoirs strategically located to partially detain stormwater runoff should also be considered. Such a system, built in conjunction with earthen or gabion lined drainage channels, maybe a practicable alternative. Several small reservoirs would provide open green spaces for recreation when not detaining runoff water and the earthen or gabion lined channels would provide a more aesthetically pleasing view for the public than the proposed concrete channels.



2. The effect of the proposed project upon the water quality does not consider possible impact on Buffalo Bayou. Organisms and vegetation normally existing in stream channels provide a form of tertiary treatment to effluent from wastewater treatment facilities and nonpoint source runoff. This action should be considered as a benefit in the cost/benefit analysis. Concreting the stream channels of White Oak Bayou Vogel and Cole Creeks, will destroy the natural treatment processes in these waterways. Consequently effluent from wastewater treatment facilities and urban runoff will drain to Buffalo Bayou without receiving the existing treatment from natural biological processes. The net effect will be to increase the wasteloads to Buffalo Bayou.
  
3. The Feasibility Report states that channel improvements need to be accompanied by local drainage improvements. However, the draft report does not address what those improvements should be nor does it consider the benefit of the flood prevention plan without the local drainage improvements. The benefit of the proposed flood prevention plan could be substantially reduced if not coordinated with local improvements. Staff therefore believes that the Feasibility Report should address the ability of the Harris County Flood Control District to provide other necessary drainage improvements to realize the full benefit of the final plan.

MINUTES

PROJECT REVIEW COMMITTEE

June 1, 1976

605-17039 --- U.S. ARMY CORPS OF ENGINEERS, GALVESTON DISTRICT: Draft  
Feasibility Report for Flood Damage Prevention, Upper White  
Oak Bayou.

Proponents: Jerry M. Pool  
Mike McClenan

Discussion:

Joe Bryan summarized the project and gave staff recommendations.

ACTION

MOTION: Councilman Payne  
SECOND: Councilwoman Wilbanks

THAT, this project be approved and state that it is not inconsistent  
with other planning in the area; and, FURTHER, that the recommendation  
of the staff as set forth above\* concerning this proposal be adopted  
as the recommendation of this Committee.

Motion carried by unanimous vote of members present.

\* page 2 and 3, staff comments



DEPARTMENT OF THE ARMY  
GALVESTON DISTRICT, CORPS OF ENGINEERS  
P. O. BOX 1229  
GALVESTON, TEXAS 77553

REPLY TO  
ATTENTION OF:

SWGED-PR

18 March 1971

Honorable Bill Elliott  
County Judge, Harris County  
Harris County Courthouse  
Houston, Texas 77002

Dear Judge Elliott:

The Corps of Engineers for several years has been studying the flood control needs of the secondary streams and bayous tributary to Buffalo Bayou. White Oak Bayou upstream of Cole Creek, the present terminus of the Federal project, has thus far been excluded from further study because of language contained in the project authorization for the extension to Cole Creek (House Document No. 169, 89th Congress, 1st Session). The document in essence noted that the flood plain above Cole Creek was then largely undeveloped, that flood plain management principles should be applied, and that, in the event of further developments in the flood plain, protection thereof should be the responsibility of the developer or other local interests.

As you know, a damaging flood situation now exists with respect to substantial residential developments above Cole Creek. Congressman Bill Archer has requested that our current study be extended to White Oak Bayou above Cole Creek, and I have been instructed by the Chief of Engineers that existing study authority is sufficient to provide for this.

In view of the obvious urgency of the situation based on our observation of flooding resulting from rains which occurred last fall and in response to the vigorous Congressional support for the study, we propose to pursue it on an expedited basis and have already begun field surveys. It is proposed to include Cole Creek and Vogel Creek in the study.

I have scheduled a public meeting to be held in the Cafetorium of the Inwood Elementary School on Little York Road at 7:30 p.m., 14 May 1971. I trust you will be present or appropriately represented.

**SNCHD-FR**

**18 March 1971**

**Honorable Bill Elliott**

Constructive furtherance of the study will, of course, depend on the support of Harris County and a statement of intent to provide local cooperation. Typical requirements of local cooperation are set forth in the inclosure.

A reply at your early convenience will be appreciated. Please call on us if further information is needed for your consideration of the matter.

**Sincerely yours,**

**ORIGINAL SIGNED BY:**

**NOLAN C. RHODES  
COLONEL, CE  
DISTRICT ENGINEER**

**1 Incl  
Requirement of Local  
Cooperation (dupe)**

**Copy furnished: w/incl  
Mr. T. R. Langford  
Harris County Flood Control Engineer**

CURRENT FEDERAL POLICIES ON  
LOCAL COOPERATION REQUIREMENTS  
FOR FEDERAL FLOOD CONTROL PROJECTS

March 1971

Local interests will:

- a. Provide without cost to the United States all lands, easements, right-of-way, and spoil disposal areas necessary for construction of the project;
- b. Provide without cost to the United States, all relocations and alterations of bridges, except railroad bridges, and of all buildings, structures, pipelines, sewers, and utilities made necessary by construction of the project;
- c. Hold and save the United States free from damages due to the construction works;
- d. Maintain and operate all works after completion in accordance with regulations prescribed by the Secretary of the Army;
- e. Prevent any obstruction or encroachment that would reduce the flood carrying capacities of the channel improvements;
- f. Notify all interested parties at least annually that the project will not provide protection from the occurrence of storms greater than a storm which could be expected to occur once in (number of years for frequency of design storm inserted here) years;
- g. Adopt and enforce flood plain regulations appropriate to the non-structural measures of the plan of improvement which, combined with the structural measures, would minimize damages to future development in the project area that would be inundated from a flood that could be expected to occur once in 100 years; and
- h. Publicize the flood plain management information contained in the report and make it readily available to all interested persons.

April 29, 1971

Upon motion of Commissioner Chapman, seconded by Commissioner Elliott, duly put and carried, it is ordered that T. R. Langford, Flood Control Engineer, be authorized to prepare a brief for the Commissioners Courts approval, stating that Harris County will sponsor a public hearing on the development of White Oak Bayou, Vogee and Cole Creeks in Harris County.

-----

THE STATE OF TEXAS |  
COUNTY OF HARRIS |

I, R. E. Turrentine, Jr., County Clerk and Ex-Officio Clerk of Commissioners' Court of Harris County, Texas, do hereby certify that the above and foregoing is a true and correct copy of an Order made and entered April 29, 1971, as same appears of record in Volume 75, Page 600, Minutes of the Commissioners' Court of Harris County, Texas.

GIVEN UNDER MY HAND AND SEAL OF OFFICE this the 6<sup>th</sup> day of January, 1977.

R. E. TURRENTINE, JR., County Clerk  
and Ex-Officio Clerk of Commissioners'  
Court of Harris County, Texas.

By

Camela E. Woods  
Deputy.



DEPARTMENT OF THE ARMY  
DALVESTON DISTRICT CORPS OF ENGINEERS  
P. O. BOX 1229  
BALVESTON, TEXAS 77553

REPLY TO  
ATTENTION OF:

**SWCEB-PR**

**2 April 1974**

Honorable Bill Elliott  
County Judge, Harris County  
Harris County Court House  
Houston, Texas 77002

Dear Judge Elliott:

This letter is in reference to the public meeting I have scheduled for 18 April 1974 to consider flood control improvements for upper White Oak Bayou in Houston. A copy of the announcement of the meeting and a list of persons to whom it was addressed are inclosed.

You will recall our letter to you in March 1971 advising of a scheduled public meeting to obtain the views of interested persons, and to start our studies on the proposed upper White Oak Bayou project. A copy of this letter also is inclosed for ready reference. With that letter you were furnished a list of the items of local cooperation usually required for Federal flood control projects.

It is Corps of Engineers' policy to require flood plain regulation in a problem area as an item of required local participation in projects proposed for authorization as Federal projects. Accordingly, in addition to local cooperation requirements a through f stated on pages 5 and 6 of the inclosed announcement, any project for structural improvements in the upper White Oak Bayou watershed will be subject to a requirement that the local interests agree to provide appropriate nonstructural measures. The wording proposed for this additional requirement follows:

"g. Adopt and enforce flood plain regulations appropriate to the nonstructural measures of the plan of improvement which, combined with the structural measures, would minimize damages to future development in the project area that would be inundated from a flood that could be expected to occur once in 100 years, such regulations to be consistent with those presently established."

The Water Resources Development Act of 1974 has revised Federal policy with respect to the "hold and save the United States free from damages" item of local cooperation, shown as requirement c on page 6 of the announcement. The wording of this requirement is now modified to read as follows:

"c. Hold and save the United States free from damages due to the construction works, except damages due to the fault of the United States and its contractors;"

As mentioned in the inclosed March 1971 letter, constructive furtherance of our studies and report will depend on the continued support of Harris County. I hope you will be present or represented at the public meeting, and that an appropriate statement of intent to provide the necessary items of local cooperation will be made.

Please call on us if further information for your consideration of the matter is desired. A copy of this letter has been furnished to the Harris County Flood Control Engineer for his information.

Sincerely yours,

ORIGINAL SIGNED BY:

DON S. McCOY  
COLONEL, CE  
DISTRICT ENGINEER



3 Incl

1. Cy GD ltr to Co.  
Judge, Harris Co.,  
dtd 18 Mar 71
2. Announcement of  
public meeting  
dtd 20 Mar 74
3. List of persons  
furnished cy of  
incl 2

Copy furnished: w/incl 1

Mr. T. R. Langford

Harris County Flood Control Engineer

8615 North Main Street

Houston, Texas 77022

April 18, 1974

HARRIS COUNTY FLOOD CONTROL DISTRICT

STATEMENT:

In response to a Notice of Public Hearing dated 20 March 1974, issued by the Corps of Engineers, U. S. Army, office of the District Engineer, Galveston District to consider modification of existing Federal Flood Control Project for White Oak Bayou in Houston, Texas.

The Harris County Flood Control District, governed by the Commissioners Court of Harris County, Texas, was created and established in 1937 by the 45th Legislature of the State of Texas and is vested with the authority to act for and in the name of all interested parties, other than the Federal Government, in all matters pertaining to formation, planning, financing, construction and maintenance of flood control projects within the boundaries of Harris County.

Tonight I represent Judge Bill Elliott and other members of Commissioners Court of Harris County and have been authorized by the Court to reiterate the position of the District.

In May 1971, at a Public Hearing held to consider the same subject, Commissioners Court went on record that the Harris County Flood Control District would be the local sponsoring agency for any project that may develop on White Oak Bayou.

On April 4, 1974, Commissioners Court passed an additional Order reaffirming its original position that should a project be authorized by Congress for White Oak Bayou and its tributaries, the Flood Control District will act as the local sponsoring agency. A copy of this Court Order is attached hereto.

As the local sponsoring agency, the Flood Control District will provide all items of local cooperation required by law, including a program of land use management, to minimize the recurrence of new flood problems in the upper watershed.

Upon motion of Commissioner Eckels, seconded by Commissioner Bass, duly put and carried, it is ordered that the Harris County Flood Control District hereby reiterates and affirms its original position to act as the local sponsor of the modification of existing Federal Flood Control Project for White Oak Bayou should determinations be made that the project is feasible and authorized by Congress.

It is further ordered that Tom Langford, Flood Control Engineer, be authorized to attend the public meeting to be held on April 18, 1974 regarding this project and present a copy of this Order to the U. S. Corps of Engineers.

-----

THE STATE OF TEXAS    §  
COUNTY OF HARRIS    §

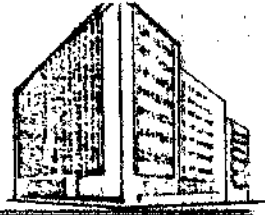
I, R. E. Turrentine, Jr., County Clerk and Ex-Officio Clerk of Commissioners' Court of Harris County, Texas, do hereby certify that the above and foregoing is a true and correct copy of an Order made and entered April 4, 1974, as same appears of record in Volume 84 of the Minutes of the Commissioners' Court.

GIVEN UNDER MY HAND AND SEAL OF OFFICE this the 4th day  
of April, 1974.

R. E. TURRENTINE, JR., County Clerk  
and Ex-Officio Clerk of Commissioners'  
Court of Harris County, Texas.

By Patricia G. Woods  
Deputy.

# BILL ELLIOTT, COUNTY JUDGE



COUNTY OF HARRIS  
STATE OF TEXAS  
HOUSTON, TEXAS 77002

September 23, 1974

Don S. McCoy  
Colonel, District Engineer  
Department of the Army  
P.O. Box 1229  
Galveston, Texas 77550

Dear Colonel:

Harris County will participate in the recreational development program in connection with the proposed upper White Oak Bayou flood control project. Commissioners Court adopted an order at its meeting of September 19 approving the county's participation.

We look forward to working with the Corps of Engineers on this important project. Please let me know if you have any questions or if I can be of assistance.

Very truly yours,

BILL ELLIOTT  
COUNTY JUDGE

BE:dr:pjg

Moved by Commissioner Eckels, seconded by Commissioner Lyons, duly put and carried, it is ordered that the Commissioners' Court hereby agrees to participate with the Department of the Army, Galveston District, Corps of Engineers, and sponsor the recreational development of the Upper White Oak Bayou Flood Control Project, which will consist of hike and bike trail, wooded nature study areas, neighborhood parks, and picnic and parking areas.

It is further ordered that Harris County accepts the responsibility for acquiring the additional lands plus contributing the necessary funds to bring the non-Federal share of cost up to 50 percent of the actual cost of the recreational development.

-----

THE STATE OF TEXAS |  
COUNTY OF HARRIS |

I, R. E. Turrentine, Jr., County Clerk and Ex-Officio Clerk of Commissioners' Court of Harris County, Texas, do hereby certify that the above and foregoing is a true and correct copy of an Order made and entered September 19, 1974, as same appears of record in Volume 85, Minutes of the Commissioners' Court of Harris County, Texas.

GIVEN UNDER MY HAND AND SEAL OF OFFICE this the 6th day  
of January, 1974. 1974



R. E. TURRENTINE, JR., County Clerk  
and Ex-Officio Clerk of Commissioners'  
Court of Harris County, Texas.

By Samela B. Woods  
Deputy.



DEPARTMENT OF THE ARMY  
GALVESTON DISTRICT CORPS OF ENGINEERS  
P. O. BOX 1229  
GALVESTON, TEXAS 77559

REPLY TO  
ATTENTION OF:

SWGED-PS

6 AUG 1976

Honorable Jon Lindsay  
County Judge, Harris County  
Family Law Center  
1115 Congress Avenue  
Houston, Texas 77002

Dear Judge Lindsay:

A draft feasibility report on Upper White Oak Bayou was transmitted for your review and comment on 23 April 1976. The report recommends flood damage prevention measures and recreational development in the upstream watershed area of the bayou. A copy of the letter of transmittal is inclosed for ready reference (inclosure 1).

A recent Federal policy change involving participation in recreational development at local flood protection projects now requires a reevaluation of this feature of the project proposal. The local share of the cost presented in the draft report is based on previous policy which allowed the Federal Government to share equally with the local sponsor the cost of land acquisition and development of facilities on all lands proposed for recreation. New Federal policy now specifies that recreational developments will be provided within the lands owned or acquired by local interests for the basic flood control project, except as may be required for public access, parking, health, and safety. The recreation plan, as presented in the draft report and shown in general on inclosure 2, includes 36 acres of additional land specifically proposed for recreational development. To comply with new policy guidance, the cost sharing arrangements of the present plan or the scope of the plan must be altered.

The recreational development plan, as described in the draft feasibility report, includes 8.7 miles of hike and bike trails along White Oak Bayou extending from North-Houston Rosslyn Road upstream to the town of Jersey Village and complemented by attractive wooded nature study areas on adjacent lands and neighborhood-type park developments on existing and proposed additional rights-of-way. The total cost of the plan, including the additional 36 acres of land, is \$1,252,000. The Harris County Commissioners Court adopted an order on September 19, 1974 approving the county's participation in the plan implementation on a 50-50 cost sharing arrangement.

Three basic options are available to comply with new Federal policy and retain the desirable features associated with an outdoor recreational development plan to complement the flood control project for Upper White Oak Bayou. These options are: (1) recommend congressional authorization of the plan as presented in the draft report with revised local-Federal cost sharing arrangements; (2) reduce the scope of the plan and recommend development only on existing rights-of-way; and (3) recommend authorization of the reduced recreation plan with optional local expansion.

The plan as presented in the draft report and shown on inclosure 2 would retain the desirable features of nature study areas, neighborhood park developments, and buffer zones adjacent to future urban developments. The Federal government could participate to the extent of 50 percent in all development on existing flood control rights-of-way and in land acquisition and development for public access to the facilities. Table 1 (inclosure 3) shows the revised cost sharing arrangement for implementation of the plan. Harris County's share of cost would be about \$841,000 or about two-thirds of the total, instead of the 50 percent for which the Commissioners Court has previously agreed to provide.

A reduced recreation plan to comply with the restrictions of revised Federal policy would limit facilities development to existing flood control rights-of-way, except as required for public access. The more desirable features of nature areas, neighborhood parks, and buffer zones would be eliminated from the plan. Table 2 (inclosure 4) shows the cost sharing distribution for this optional plan.

A reduced recreational development plan, as described above, could be recommended as a cooperative local-Federal project with optional local park expansion at the county's convenience. This plan would allow Harris County the flexibility of park expansion consistent with available local funds. Table 3 (inclosure 5) shows the cost distribution for a plan with an optional local park expansion cost of \$430,000. The optional portion of the plan could, however, be easily modified and reduced to conform to the \$626,000 total local participation which the county has already agreed to provide. The extent of optional park expansion could vary with Harris County's preferences. Only the cooperative portion of the plan would be recommended for congressional authorization.

A fourth available option would be to delete recreational development entirely from the recommended plan of action. Should this option be adopted, the congressional authorizing document would contain no appropriate wording to allow flexibility for the addition of recreational development during the design phase of the project.

The recommended flood control project for the Upper White Oak Bayou area is a worthy and much needed improvement plan for the suburban areas of north-west Harris County. A recreational development plan was added to the project

proposal because of expressed public desires of area residents and local organizations. Harris County has indicated its support for such development to the extent of the plan presented in the draft report.

The addition of recreational development has caused approximately a one-year delay in the completion of the draft feasibility report. Additional delays are now imminent because of the recent change in Federal policy. The Commissioners Court's expression of preference of the available options discussed and the Court's intent to support that preference is requested as soon as practicable to avoid further delays in submittal of the final feasibility report to higher authority and to Congress for authorization. At the same time, your favorable comments concerning the flood control features of the project would serve to strengthen the report.

If additional information is needed for your necessary action, please call on me.

5 Incl  
As stated

JON C. VANDEH BOSCH  
Colonel, Corps of Engineers  
District Engineer

Copies furnished:

Mr. Tom East, Harris County Commissioner, Precinct No. 1  
Mr. James Fortson, Harris County Commissioner, Precinct No. 2  
Mr. Bob Eckels, Harris County Commissioner, Precinct No. 3  
Mr. E. A. Lyons, Harris County Commissioner, Precinct No. 4  
Mr. Gordon H. Smith, Director, Harris County Flood Control District





DEPARTMENT OF THE ARMY  
GALVESTON DISTRICT, CORPS OF ENGINEERS  
P. O. BOX 1229  
GALVESTON, TEXAS 77553

REPLY TO  
ATTENTION OF,

SMGED-PS

Honorable Jon Lindsay  
County Judge, Harris County  
Family Law Center  
1115 Congress Avenue  
Houston, Texas 77002

Dear Judge Lindsay:

A draft feasibility report on Upper White Oak Bayou in the vicinity of Houston, Texas, is inclosed for your review. The report, recommending flood damage prevention measures and recreational development, consists of two volumes. Volume 1 is the main report summarizing the problems and needs, the studies and findings, and the recommended action. Volume 2 is a technical report with appropriate details for the technical reviewer and copies of pertinent correspondence.

The Commissioners Court and the Flood Control District previously stated intent to provide the local cooperation required for the proposed project. Although further official action is not essential at this time, a reaffirmation would strengthen the report. A formal agreement with Harris County will be required if the project should be authorized for construction. Any comments the Commissioners Court may have at this time will be appreciated by 28 May. To facilitate your review, copies of the report are being furnished to each of the Commissioners and the Director, Harris County Flood Control District.

A list of agencies, organizations, and individuals concurrently reviewing the draft report is inclosed. The comments of all will be considered in finalizing the report.

The same distribution is being made of a draft environmental statement, which, though a companion document, requires separate processing.

Sincerely yours,

DOE S. MCCOY  
Colonel, Corps of Engineers  
District Engineer

- 2 Incl  
1. Draft Report  
2. List of names & addresses

Copies furnished:

- Mr. Tom Bass, Harris County Commissioner, Precinct No. 1  
Mr. James Fonteno, Harris County Commissioner, Precinct No. 2  
Mr. Bob Echels, Harris County Commissioner, Precinct No. 3  
Mr. E. A. Lyons, Harris County Commissioner, Precinct No. 4  
Mr. Gordon H. Smith, Director, Harris County Flood Control District

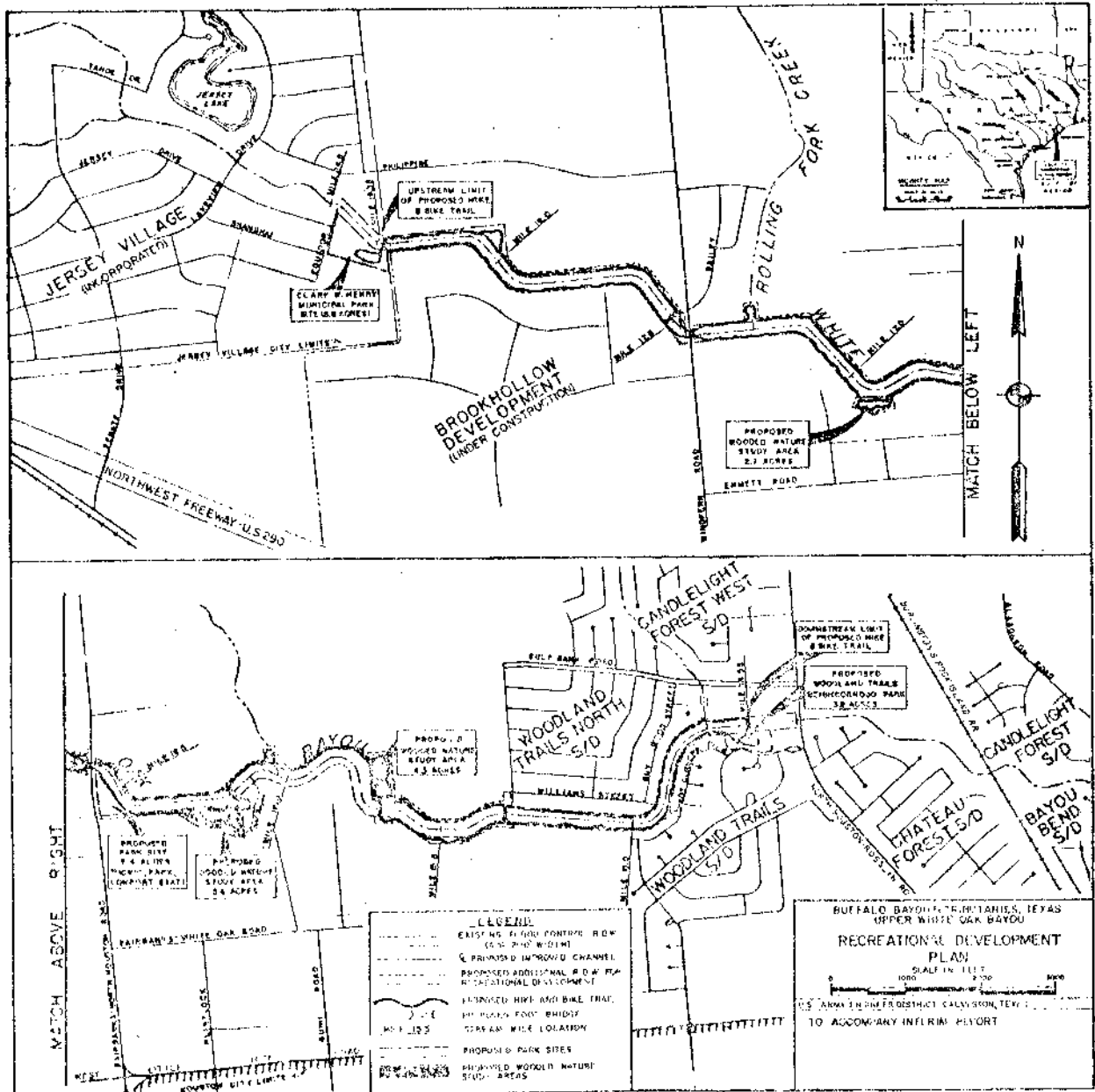


PLATE 3

TABLE 1  
PRESENT RECREATIONAL DEVELOPMENT PLAN  
REVISED LOCAL/FEDERAL COST SHARING ARRANGEMENT

A. LOCAL COST:

1. Development on Existing Flood Control Rights-of-Way (50% of total)		
a. Trails	\$314,000	
b. Fairbanks-North Houston Road Park Site Development	31,000	
c. Engineering, Design, Supervision & Administration	52,000	
d. Subtotal		<u>\$397,000</u>
2. Development on Additional Recreational Lands (100% of total)		
a. Trails	18,000	
b. Woodland Trails Neighborhood Park Development	82,000	
c. Jersey Village Neighborhood Park Development	26,000	
d. Engineering, Design, Supervision & Administration	18,000	
e. Subtotal		<u>144,000</u>
3. Lands		
a. Additional Recreational Lands for Parking & access (50% of total)	14,000	
b. Additional Recreational Land for Park Development, Wooded Nature Study Areas, and Buffer Zones (100% of total)	286,000	
c. Subtotal		<u>300,000</u>
4. TOTAL LOCAL COST		<u>\$841,000</u>

B. FEDERAL COST:

1. Development on Existing Flood Control Rights-of-Way (50% of total)		
a. Trails	314,000	
b. Fairbanks-North Houston Road Park site Development	31,000	
c. Engineering, Design, Supervision & Administration	52,000	
d. Subtotal		<u>397,000</u>
2. Additional Recreational Lands for Parking and Access (50% of total)		<u>14,000</u>
3. TOTAL FEDERAL COST		<u>\$411,000</u>

C. TOTAL PLAN DEVELOPMENT COST \$1,252,000

TABLE 2  
REDUCED RECREATIONAL DEVELOPMENT PLAN  
LOCAL/FEDERAL COST SHARING ARRANGEMENT

A. LOCAL COST:

1. Development on Existing Flood Control Rights-of-Way (50% of total)		
a. Trails		\$314,000
b. Fairbanks-North Houston Road Park Site Development		31,000
c. Engineering, Design, Supervision & Administration		52,000
d. Subtotal		\$397,000
2. Additional Recreational Lands for Parking & Access (50% of total)		14,000
3. TOTAL LOCAL COST		\$411,000

B. FEDERAL COST:

1. Development on Existing Flood Control Rights-of-Way (50% of total)		
a. Trails		\$314,000
b. Fairbanks-North Houston Road Park Site Development		31,000
c. Engineering, Design, Supervision, & Administration		52,000
d. Subtotal		\$397,000
2. Additional Recreational Lands for Parking and Access (50% of total)		14,000
3. TOTAL FEDERAL COST		\$411,000

C. TOTAL PLAN DEVELOPMENT COST \$822,000

TABLE 3  
REDUCED RECREATIONAL DEVELOPMENT PLAN  
WITH OPTIONAL LOCAL EXPANSION  
LOCAL/FEDERAL COST SHARING ARRANGEMENT

A. LOCAL COST:

1. Cooperative Project Development		
a. Development on Existing Project Rights-of-Way (50% of total)	\$397,000	
b. Additional Project Lands for Parking and Access (50% of total)	14,000	
c. Subtotal, Cooperative Project Development	\$411,000	
2. Optional Local Project Expansion		
a. Development on Additional Recreational Lands (100% of total)	144,000	
b. Additional Recreational Lands for Park Development Nature Study, and Buffer Zones (100% of total)	286,000	
c. Subtotal, Optional Local Project Expansion	430,000	

B. FEDERAL COST:

1. Development on Existing Project Rights-of-Way (50% of total)	397,000	
2. Additional Project lands for Parking and Access (50% of total)	14,000	
3. TOTAL FEDERAL COST	411,000	

C. TOTAL PROJECT COST WITHOUT LOCAL OPTIONAL PROJECT EXPANSION 822,000

D. TOTAL PROJECT COST WITH LOCAL OPTIONAL PROJECT EXPANSION \$1,252,000



OFFICE OF  
**R. E. TURRENTINE, JR.**  
COUNTY CLERK  
HARRIS COUNTY  
HOUSTON, TEXAS

ADDRESS ALL CORRESPONDENCE TO  
P. O. BOX 1525  
HOUSTON, TEXAS 77001

September 17, 1976

Colonel Jon C. Vanden Bosch  
U. S. Army Corps of Engineers  
Galveston District  
P. O. Box 1229  
Galveston, Texas 77550

Dear Colonel Vanden Bosch:

Enclosed is a certified copy of the Order of Commissioners' Court regarding modification of the existing Federal Flood Control Project in connection with White Oak Bayou.

The Court reaffirms its original position that the project for Upper White Oak Bayou and its tributaries is a very vital project, and recommends Option Number 3.

If we may be of further assistance, do not hesitate to contact us.

Yours very truly,

R. E. Turrentine, Jr., County Clerk  
and Ex-Officio Clerk of Commissioners'  
Court of Harris County, Texas.

By Pamela E. Woods  
Pamela E. Woods  
Deputy.

RET, JR:pw  
Enclosure

cc: Hon. Jon Lindsay  
County Judge

Mr. G. H. Smith  
Flood Control District

September 13, 1976

WHEREAS, the Corps of Engineers, Galveston, Texas, has advised the Harris County Flood Control District of a recent Federal Policy change that affects the proposed recreational development, as originally reflected in the project feasibility report dated April 23, 1976, and, as a result of this change in Federal Policy, the proposed Federal Flood Control Project on Upper White Oak Bayou must be re-evaluated; and,

WHEREAS, under the new Federal Policy, recreational developments must be provided within lands owned or acquired by local interests for the basic flood control project; and, in order to comply with this new policy guidance, either the cost-sharing arrangement of the present plan or the scope of the plan must be altered; and,

WHEREAS, Colonel Jon C. Vanden Bosch of the Corps of Engineers has advised that there are three options that are available; and,

WHEREAS, the Commissioners' Court favors Option Number 3 for a reduced recreation plan with optional local expansion;

NOW, THEREFORE, upon motion of Commissioner Bass, seconded by Commissioner Fonteno, duly put and unanimously carried,

IT IS ORDERED, that Harris County Commissioners' Court, sitting as the governing body of the Harris County Flood Control District, hereby reaffirms its original position that the project for Upper White Oak Bayou and its tributaries is a very vital and much needed project, in light of the flood problems in the Upper Watershed of White Oak Bayou, and recommends authorization of the reduced recreation plan with optional local expansion (Option 3).

IT IS FURTHER ORDERED that County Judge Jon Lindsay be, and he is hereby, authorized to execute the necessary documents on behalf of Harris County Commissioners' Court in regards to this matter.

-----

THE STATE OF TEXAS )  
COUNTY OF HARRIS )

I, R. E. Turrentine, Jr., County Clerk and Ex-Officio Clerk of Commissioners' Court of Harris County, Texas, do hereby certify that the above and foregoing is a true and correct copy of Order made and entered on the 13<sup>th</sup> day of September, 1976, as same appears of record in Volume 97 of the Minutes of the Commissioners' Court.

GIVEN UNDER MY HAND AND SEAL OF OFFICE this the 13<sup>th</sup> day of September, 1976.

R. E. TURRENTINE, JR., County Clerk  
and Ex-Officio Clerk of Commissioners'  
Court of Harris County, Texas.

By Theresa E. Woods  
Deputy..



# CITY of JERSEY VILLAGE, TEXAS

16501 JERSEY DRIVE / 466-6159

HOUSTON, TEXAS 77040

May 25, 1976

Mr. Kenneth P. Bretsch  
Deputy District Engineer  
Department of the Army  
Galveston District, Corps of Engineers  
P. O. Box 1229  
Galveston, Texas 77553

Gentlemen:

We have reviewed the Interim Report on Upper White Oak Bayou, Feasibility Report for Flood Damage Prevention. The City of Jersey Village supports implementation of this plan with its considerable benefits to residents and businesses in this area. We do, however, have suggestions on a few aspects of the proposed project as follows:

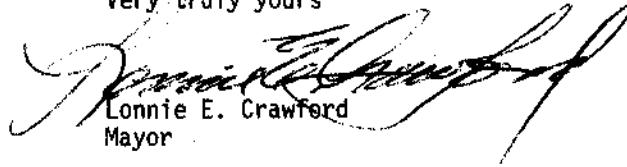
1. Our overall plan for Senate Avenue (referred to as the proposed West Outer Belt Freeway in Appendix 1, page D-7, paragraph 22), and Equador Street have included bridges over White Oak Bayou. Please include these bridges in this project as perhaps part of the contingent costs in Table F-1, Appendix 1, page F-5. The City of Jersey Village has gone on record as officially opposing the routing of the West Outer Belt Freeway in favor of other proposed routings around Jersey Village which would give fewer environmental and economic problems to the public.

2. The extent of hike and bike trails within the Jersey Village city park as depicted on plat E-9 is no longer practical considering recent and planned construction in the area. The new swimming pool, parking lot, and existing ball field have already greatly reduced the available area in this small park. This park is also the primary area for location of a future civic center building. We, therefore, feel that the hike and bike trail should end at mile 18.2.

3. From the junction of the South Fork of White Oak Bayou and Upper White Oak Bayou to mile 19.9 we request that the right of way be restricted to the 150 feet already acquired. This would prevent the reduction of lot sizes on already platted land to the extent that many lots would not be used.

On behalf of the City of Jersey Village I would like to compliment the U.S. Army Corps of Engineers on the excellent study you have performed and thank you for a job well done. We believe that the plan you have selected will provide the flood damage protection we need and we sincerely hope that the selected plan will be approved and implemented expeditiously.

Very truly yours

  
Lonnie E. Crawford  
Mayor



## HARRIS COUNTY FLOOD CONTROL TASK FORCE

Office of the County Engineer  
ROOM 650 FAMILY LAW CENTER BLDG.  
1115 CONGRESS STREET  
HOUSTON, TEXAS 77002

May 25, 1976

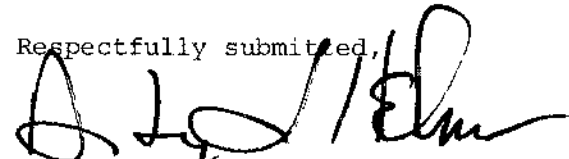
SWGED-PS  
DEPARTMENT OF THE ARMY  
GALVESTON DISTRICT, CORPS OF ENGINEERS  
P. O. BOX 1229  
GALVESTON, TEXAS 77553

Gentlemen:

Please be advised that the Harris County Flood Control Task Force has reviewed the interim report on Upper White Oak Bayou.

Although several members of the Task Force noted several discrepancies in the report, it was generally agreed that the project as proposed by the Corps would alleviate flooding conditions in the watershed. Accordingly, the Task Force in regular meeting on Monday, May 24 adopted a motion recommending that the Corps of Engineers proceed with the White Oak Bayou project as proposed in the above referenced interim report.

Respectfully submitted,

*for* 

Clinton Morse, Chairman  
Harris County Flood Control Task Force

CM/ALH/dkj



## HARRIS COUNTY PARKS PLANNING DEPARTMENT

7TH FLOOR, FAMILY LAW CENTER BLDG

1115 CONGRESS

HOUSTON, TEXAS 77002

May 24, 1976

SWGED-PS

Department of the Army  
Galveston District, Corps of Engineers  
P. O. Box 1229  
Galveston, Texas 77553

Attention: Kenneth P. Bretsch, LTC, CE

Gentlemen:

The Harris County Parks Planning Department has reviewed the Interim Report on Upper White Oak Bayou solely with regard to the recreation facilities proposed to be constructed in conjunction with the project.

The statements made in the report relative to a severe shortage of recreational facilities and the need for additional public recreational facilities are entirely correct. The proposed recreational facilities plan which includes hike and bike trails, nature study areas, bridges, rest stops and points of access is entirely satisfactory to this Department and should constitute an important adjunct to Harris County's existing recreational open space system. It is recommended that points of access to the trail system should be designed so as to discourage motorcycle access and trust that this will be incorporated in the final design stage.

We believe that the provision of public recreational open space adjacent to bayous is an integral part of the future parks system in Harris County and would hope the Corps of Engineers would continue this dual use concept in all future projects.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Andy L. Helms". The signature is stylized and cursive.

Andy L. Helms  
Harris County Parks Planner

ALH/dkj



**INWOOD FOREST**

COUNTRY CLUB

26301 BARKER BLVD. HOUSTON, TEXAS 77055

June 3, 1976

Dept. of the Army  
Galveston Dist. Corp of Engineers  
P. O. Box 1229  
Galveston, Texas 77553

Subject: Draft Feasibility Report on Upper White Oak Bayou  
in the Vicinity of Houston, Texas

Gentlemen:

This is to advise that our evaluation, analysis, surveys, costs, etc. have not been finalized at this time. This re the recommended flood prevention measures on White Oak Bayou and Vogel Creek.

We know that several greens, tees, fairways, etc. will have to be relocated in areas where both White Oak Bayou and Vogel Creek pass thru our property.

Yours very truly,

INWOOD FOREST COUNTRY CLUB

Bob Duke  
General Manager

BD:fl

7215 Brushwood  
Houston, Texas 77088  
May 17, 1976

Department of the Army  
Galveston District - Corps of Engineers  
P. O. Box 1229  
Galveston, Texas 77553

Reference Reply: SWGED-PS

Gentlemen:

Thank you for the opportunity to review and comment on the draft interim report on Upper White Oak Bayou and associated tributaries, Cole Creek and Vogel Creek.

The plan of improvements selected for flood control purposes as outlined in your report requires no further modification.

Incorporation of environmental considerations into the plan of improvement meets the desires of affected communities for additional recreation utilization bordering these streams.

I urge that this proposed plan of improvements be implemented at the earliest possible time to relieve this urbanized area from further flooding potentialities.

It has been a pleasure to work with your department throughout the development of this project and will continue to offer my assistance until this needed project is completed.

Sincerely yours,



B. E. Woodall  
Citizens Advisory Group

cd









# FINAL ENVIRONMENTAL STATEMENT

## SUMMARY

### BUFFALO BAYOU AND TRIBUTARIES, TEXAS UPPER WHITE OAK BAYOU FLOOD DAMAGE PREVENTION

( ) Revised Draft (X) Final Environmental Statement

Responsible Office: U.S. Army Engineer District, Galveston  
Jon C. Vanden Bosch, Colonel, CE  
District Engineer  
P.O. Box 1229  
Galveston, Texas 77550  
Telephone: 713-763-1211 EXT 301

1. Name of Action. ( ) Administrative (X) Legislative

2. Description of Action:

a. The action proposed for Congressional consideration consists of constructing flood control improvements in upper White Oak Bayou and its tributaries, Cole and Vogel Creeks, in Harris County, Texas, to protect urban areas now subject to stream flooding. Channel improvements considered for upper White Oak Bayou would extend from the terminus of the existing Federal flood control project at mile 10.7 to mile 19.9. For the tributary streams, Cole and Vogel Creeks, improvements would extend from their mouths at White Oak Bayou upstream 4.9 and 4.5 miles, respectively. Extension of the existing Federal channel improvements upstream in White Oak Bayou and tributaries would consist of rectification, enlargement, and partial lining with concrete. The lined portion of the channels would consist of a trapezoidal concrete section containing a two-foot deep pilot channel at the centerline. The concrete lining would extend to the level of the 10-year frequency flood line. Above that level an earthen section with turf cover for erosion protection would provide flow capacity for the standard project flood. The earthen section would include a 10-foot berm on each side of the channel extending outward from the top of the concrete section and earthen side slopes of 1 vertical to 3 horizontal beyond the berms. Flood plain regulations would be applicable to portions of the watershed upstream of the structural modifications.

b. Beautification improvements, including tree and shrub plantings and architectural treatment of channels in areas frequently viewed by the public, have been incorporated into the plans of improvement. Recreational facilities such as hike and bike trails and a neighborhood park are included in the proposed plans.

c. Sponsoring agency for the White Oak Bayou project is the Commissioners Court of Harris County. However, items of local cooperation for the project will be furnished through the Harris County Flood Control District which is empowered by State legislation to act in this capacity subject to the approval of the Commissioners Court.

3. a. Environmental Impact: The project would eliminate the hazard of severe stream flooding from all floods up to the magnitude of the standard project storm in the urbanized residential communities adjacent to White Oak Bayou and tributaries. The improvements would facilitate companion improvements to storm drainage by the local communities. Elimination of the flood hazard would result in continued safe urbanization of the flood plains. The resulting impact on the social and economic well-being of the inhabitants of the area would be an environmental improvement.

b. Adverse Environmental Effects: Adverse environmental effects of the project would consist of removal of about 30 acres of trees and about 31 acres of shrubs and brush along the stream banks which now serve as habitat for birds and small populations of other wildlife. Construction of the channels would disturb or remove small populations of aquatic organisms. Turbidity increases caused by construction would further degrade the existing poor water quality. There would be temporary damage to lawns and ornamental shrubs on residential properties abutting the bayous. Channel excavation and enlargement would affect the remains of archeological sites along White Oak Bayou that have been partially destroyed by previous channel work. However, during preconstruction planning, if the project should be authorized, further investigation will be made into the value of these sites and possible salvage or mitigation measures.

4. Alternatives: Alternatives investigated include (1) purchase and removal of developments located in the flood plain subject to flood damages; (2) construction of a detention reservoir on White Oak Bayou combined with partially lined channel improvements downstream in White Oak Bayou and Cole and Vogel Creeks; (3) construction of a diversion channel from White Oak Bayou to Addicks Reservoir and partially lined channel improvements downstream and in Cole and Vogel Creeks; (4) trapezoidal earthen channel improvements in White Oak Bayou and Cole and Vogel Creeks; (5) flood proofing, and (6) "no action."

5. a. Comments Received: (District Review):

Forest Service, Department of Agriculture  
Soil Conservation Service, Department of Agriculture  
Geological Survey, Department of the Interior  
Fish and Wildlife Service, Department of the Interior  
National Park Service, Department of the Interior  
Bureau of Outdoor Recreation, Department of the Interior  
Bureau of Reclamation, Department of the Interior  
Region VI, Department of Health, Education, and Welfare  
Federal Highway Administration, Department of Transportation  
Region VI, Environmental Protection Agency  
Advisory Council on Historic Places  
Budget and Planning Office, Office of the Governor of Texas  
Texas Air Control Board  
Texas Department of Agriculture  
Texas Water Development Board  
Texas Water Quality Board  
Texas Water Rights Commission  
Texas State Soil and Water Conservation Board  
Texas Parks and Wildlife Department  
Texas Department of Community Affairs  
General Land Office of Texas  
The Bureau of Economic Geology, The University of Texas  
at Austin  
Texas Forest Service  
Texas Historical Commission  
Houston-Galveston Area Council  
City of Houston, Department of Parks and Recreation  
City of Jersey Village  
Mr. B. E. Woodall, Civilian Advisory Group

b. Comments Received (Departmental Review):

Department of Agriculture  
Department of Commerce  
Department of Health, Education and Welfare  
Department of the Interior  
Environmental Protection Agency  
Advisory Council on Historic Preservation  
State of Texas

6. Draft Statement to CEQ 26 April 1976  
Revised Draft Statement to CEQ 27 June 1977.  
Final Statement to EPA 3 AUG 1979.



DEPARTMENT OF THE ARMY  
BOARD OF ENGINEERS FOR RIVERS AND HARBORS  
KINGMAN BUILDING  
FORT BELVOIR, VIRGINIA 22060

REPLY TO  
ATTENTION OF:

Addendum  
to the  
Revised Draft Environmental Statement  
for  
Buffalo Bayou and Tributaries, Texas  
Upper White Oak Bayou Flood Damage Prevention

The BERH recommended in its report of 4 May 1977 that the Buffalo Bayou, Texas project be authorized for construction. The Board recognized that certain environmental considerations would favor an earthen channel, but that involved with this are requirements for additional land, displacement of people, and relocation of structures. The Board believed that during postauthorization planning, consideration should be given to a plan which makes maximum use of an earthen channel where development has not proceeded to a point that such a plan is impractical.

FOR THE BOARD:

A handwritten signature in cursive script, reading "Robert L. Bangert".

ROBERT L. BANGERT  
Colonel, Corps of Engineers  
Resident Member

FINAL ENVIRONMENTAL STATEMENT  
 BUFFALO BAYOU AND TRIBUTARIES, TEXAS  
 UPPER WHITE OAK BAYOU  
 FLOOD DAMAGE PREVENTION

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4.	Economics of the Selected Plan of Improvement
5.	Cost Apportionment - Selected Plan of Improvement
6.	Water Quality Data for White Oak Bayou, 1971-72
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8.	Pertinent Data for Selected Plan and Alternatives

APPENDIX "A"

Letters Received by the District Engineer on the Draft Statement

APPENDIX "B"

News Release

APPENDIX "C"

Letters Received by the District Engineer on the Revised Draft Statement

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FINAL  
ENVIRONMENTAL STATEMENT

BUFFALO BAYOU AND TRIBUTARIES, TEXAS  
UPPER WHITE OAK BAYOU  
FLOOD DAMAGE PREVENTION

1. PROJECT DESCRIPTION.

1.01 Introduction. A resolution of the House Public Works Committee, adopted 20 April 1948, authorized a comprehensive flood control survey of Buffalo Bayou and Tributaries, Harris County, Texas. Additional approval to conduct an interim study of the upper White Oak Bayou watershed under this authorization was received in August 1971. An authorized Federal channel improvement project in the lower 10.7 mile reach of White Oak Bayou has been completed. The structural project under consideration is for the section of White Oak Bayou from mile 10.7 to mile 19.9, Cole Creek from White Oak Bayou to mile 4.9, and Vogel Creek from White Oak Bayou to mile 4.5 (Figure 1). Sponsoring agency for the White Oak Bayou project is the Commissioners Court of Harris County. However, items of local cooperation for the project will be furnished through the Harris County Flood Control District (HCPCD) which is empowered by State legislation to act in this capacity subject to the approval of the Commissioners Court.

1.02 The flood problems along upper White Oak Bayou and Cole and Vogel Creeks are caused by inadequate stream channel capacity, the increased runoff rates resulting from the extensive urbanization in the general areas in recent years, and inadequate street drainage to the bayou and creeks. Hydrologic studies indicate the flow capacity of the upper White Oak Bayou Channel, under existing urban conditions, is adequate to contain only floods that statistically can be expected about once every two to five years. Flows related to runoff from larger rainstorms overflow the banks and cause heavy damage to the many residences in the flood plain. Damage presently occurs on about 10,300 acres of suburban lands or lands committed to future urbanization within White Oak Bayou and Vogel and Cole Creeks. The average annual potential flood damage to existing properties along upper White Oak Bayou is currently estimated at about \$1,421,000 for White Oak Bayou, \$753,000 for Cole Creek, and \$2,182,000 for Vogel Creek. The total average annual damage cost is estimated at about \$4,356,000.

1.03 White Oak Bayou Improvements. Existing Federal channel improvements in White Oak Bayou have provided an acceptable means of controlling floods in the lower reaches of the bayou. A similar plan of improvement has been considered for the upper reaches from the present terminus at stream mile 10.7 to mile 19.9 and includes a rectified and enlarged channel partially lined with concrete. Table 1 includes data pertinent to these channel modifications. The lined portion of the channel (Figure 2A) would have a trapezoidal concrete section containing a two-foot deep pilot channel at its center to confine low flows and have side slopes of 1 vertical on 2 horizontal extending to the level of the 10-year frequency flood. Concentration of low flows in a pilot channel provides a degree of flushing action under conditions of minimum flow. Above the lined portion, an enlarged trapezoidal earthen section would provide the flow capacity required for the standard project flood. The Standard Project Flood is defined as the flood that may be expected from the most severe combination of meteorological and hydrological conditions considered reasonably characteristic of the geographical area in which the drainage basin is located, excluding extremely rare combinations. This earthen section would contain a 10-foot berm area on each side of the channel extending outward from the top of the concrete section, with earthen side slopes of 1 vertical on 3 horizontal.

1.04 The flood plain of White Oak Bayou from mile 19.9 to the headwaters, at about mile 25.5, is presently undeveloped. Therefore, flood plain regulation is the primary plan being considered along this reach. This would limit future development along this section of the bayou to elevations at or above the 100-year flood plain and would be consistent with regulations established by the Federal Insurance Administration (FIA) and implemented by local governments to qualify for federally subsidized flood insurance.

1.05 Right-of-way width requirements for the project range from 260 feet at stream mile 10.7 to 180 feet at stream mile 19.9. The Harris County Flood Control District presently owns right-of-way about 200 feet wide from mile 10.7 to mile 18.2 and 150 feet wide from mile 18.2 to mile 19.9.

1.06 Cole Creek Improvements. Channel improvements considered for Cole Creek (Table 2) would extend from the mouth at White Oak Bayou upstream to mile 4.9 near Windfern Road and would include a partially lined trapezoidal channel similar to that proposed for White Oak Bayou (Figure 2B).

1.07 Such a channel improvement would be constructed to fit the natural gradient of the existing stream bed. The partial channel lining to the 10-year flood elevation would provide a durable surface to withstand the excessive channel velocities that occur during flooding. A channel bottom width of 20 feet would be required to provide standard project flood protection, and, because of this small size, a pilot channel to confine normal low flow and provide flushing action to remove silt from the channel would be unnecessary. The channel bottom would be sloped to the centerline to channelize low flows and maintain a flow velocity to prevent sedimentation. Flood plain regulation is a supplementary requirement to the Cole Creek Channel improvements and would require that all future building elevations in the flood plain upstream from the terminus of the proposed improvements be constructed at or above the level of the residual 100-year flood plain which is consistent with FIA's regulations.

1.08 Harris County Flood Control District has secured a portion of the right-of-way needed for channel enlargement along Cole Creek. The Flood Control District owns right-of-way varying in width from 150 feet to 130 feet between the mouth of the creek and mile 2.6. Upstream from this point the right-of-way varies in width from 100 feet to about 60 feet near Windfern Road (mile 4.9). Additional right-of-way widths required for channel enlargement range from 40 feet at mile 1.9 to 75 feet at mile 4.9.

1.09 Vogel Creek Improvements. Channel improvements considered for Vogel Creek (Table 3) would extend from the mouth at White Oak Bayou upstream to mile 4.5 near Ramona Street. Since right-of-way widths are restricted by development along the lower reach of Vogel Creek from stream mile 0.1 to 1.6, the types of channel improvements suitable for construction are limited to those which require the least area for construction. Acquisition of temporary work easements for construction along Vogel Creek would be necessary.

1.10 For the portion of the creek from mile 0.1 to mile 0.5, where available right-of-way is only 80 feet wide, a vertical concrete wall channel (Figure 2C) would be constructed. From mile 0.5 to mile 1.6, where available right-of-way is 95 feet wide, a similar type structure with layback slopes (Figure 2D) is considered feasible. This sloped section would be more economical to construct than the vertical wall channel because lateral support requirements are eliminated. Above stream mile 1.6, a right-of-way width of 140 feet

would be needed to construct a partially lined channel similar to that described for Cole Creek (Figure 2B).

1.11 Construction of the proposed improvements in Vogel Creek would require the relocation or alteration of six road and street bridges and four timber foot bridges at the Inwood golf course. Two of these street bridges are relatively new structures with sufficient flow capacity to be utilized with the proposed project without major modifications. Ten pipelines would require modifications, including one sanitary sewer line which will require the installation of a sewage lift station. No permanent relocations of developed properties will be required, although temporary work easements will be necessary during construction in the lower reach of the creek.

1.12 Flood plain regulation is also a supplementary requirement of the Vogel Creek Channel improvement plan and would require that first floor elevations of all future buildings in the flood plain upstream from the terminus of the proposed improvements be constructed above the residual 100-year flood plain as presently required by FIA's regulations.

1.13 Pipeline Modifications. A total of fifty-six pipelines on the three streams will require alterations. Pipelines crossing the streams will be lowered to a minimum of 3 feet below the bottom of the proposed channels. The Harris County Flood Control District will be responsible for the alterations, although the pipeline owners or qualified pipeline contractors will probably perform the work on a reimbursible basis. New sections of pipelines will be laid in place before the existing lines are tapped, valved, and connected on either side of the channel. Personnel trained in health and safety aspects of pipeline work will modify the lines.

1.14 Disposal of Excavated Material. Channel construction will involve excavation of about 1,227,000 cubic yards of earth, most of which will be in excess of project needs. There is a continuing demand for fill and construction material of this type in the Houston area, and it is possible that the material would be made available by the local sponsor for such use. However, for project purposes, it is proposed to haul the material away from the construction area for disposal in open pastureland. Disposal areas would be carefully

selected to minimize any detrimental environmental effects to the natural vegetation and wildlife. Approximately 139 acres of disposal easements that would be used one time have been included in the project plan. Acquisition of the disposal easements is the responsibility of the Harris County Flood Control District. Selection will occur during detailed preconstruction planning, if the project should be authorized. Methods to minimize effects of erosion of the disposal sites on the surrounding area will be coordinated with the Harris County Flood Control District during the design phase of the project.

1.15 Aesthetic Improvements. Proposed aesthetic improvements (Figure 2E) for the project area of White Oak Bayou and tributaries include architectural treatment and planting of vegetation in areas frequently viewed by the public. Special architectural treatment provides for the use of exposed aggregate concrete finish on the channel lining within 300 to 400 feet of all road and street crossings to relieve the stark appearance of the concrete. Selected plantings of oak and pine intermingled with other native vegetation are contemplated along the rectified streams. Ivy and shrubs would be used along fences inclosing vertical wall channel sections proposed along Vogel Creek.

1.16 Recreational Facilities. A master recreational development plan has been considered for the project area to include three small parks, over eight miles of hike and bike trails, and three attractive wooded nature study areas along the reach of White Oak Bayou from North Houston-Rossllyn Road (mile 14.5) upstream to the city limits of Jersey Village (mile 18.3). Most of the trail system and one of the small parks would be constructed on existing bayou rights-of-way. The remaining parks and the three nature study areas would require the acquisition of about 36 acres of additional land. Current Federal policy concerning recreational development at local flood protection projects precludes the development of facilities on lands other than those acquired for the basic flood control purpose, except as may be required for access, parking, and public health and safety. The cooperative Federal/local development plan recommended in the feasibility report has been limited by current Federal policy. The Harris County Commissioners Court has agreed to participate in the plan and has also agreed in principle to development of the remaining facilities on additional lands when practicable and at local expense.

1.17 Operation and Maintenance. Responsibility for the maintenance and operation of the selected project would be assumed by the local sponsor. This would require mowing of the side slopes and berms of the channel, fertilizing and maintaining the grasses and plants, controlling erosion along the slopes and lateral drains, repairing pavement damages caused by erosion, and periodic removal of silt deposits from the drainage channels. Harris County would also be responsible for operation, maintenance, and policing of the associated recreational facilities.

1.18 Benefits-to-Costs. The usual measure of economic feasibility of a project is a ratio of average annual benefits to average annual cost of at least one or unity. The incremental elements of the plan of improvement, including the flood control features for White Oak Bayou, Cole Creek, and Vogel Creek, and the recreational development plan, have been evaluated independently. Flood control benefits for the proposed project would be derived from the reduction of flood damages to existing and future properties, both public and private, from the reductions in public health and relief costs during flood periods, and from the enhancement of land values by the elimination of the flood hazard. Recreational benefits would be derived from the expected visitations to the proposed recreational facilities for purposes of picnicking, bicycling, walking, and nature study. Flood control and recreational benefits have been reduced to average annual equivalent values for appropriate comparison to average annual costs. Annual costs are comprised of the amortized initial investment for construction of the project, the amortized costs for expected future replacement items, and for the estimated annual operation and maintenance of the completed project. Each incremental feature of the proposed plan has met the test of economic feasibility.

1.19 The cost of constructing the improvements considered for White Oak Bayou and its tributaries Cole and Vogel Creeks is estimated at \$56,786,000 and the benefits-to-cost ratio is 1.68 based on November 1976 price data (Table 4). Improvements on White Oak Bayou would cost \$31,927,000 with a benefits-to-cost ratio of 1.38; improvements on Cole Creek would cost \$11,499,000 with a benefits-to-cost ratio of 1.10; improvements on Vogel Creek would cost \$12,506,000 with a benefits-to-cost ratio of 3.08; and the recreational development plan would cost \$854,000 with a benefits-to-cost ratio of 1.11.

1.20 Cost Apportionment. The apportionment of the first cost and annual operation, maintenance, and replacement costs between Federal and non-Federal interests, in accordance with current Federal policies, is presented in Table 5. In general, the Federal government would be responsible for all flood control construction costs and all recreational construction costs not in excess of 50 percent of the total recreational costs. The local sponsoring agency would generally be required to bear the costs for lands and relocations or alterations required for construction, provide a cash contribution for the recreational portion of the plan, and to operate, maintain, and provide replacements for equipment or facilities during the project life.

## 2. ENVIRONMENTAL SETTING WITHOUT THE PROJECT.

2.01 General Description of the Area. Buffalo Bayou, a tributary of the San Jacinto River in southeast Texas, and its tributaries comprise a watershed area of approximately 1,034 square miles and provide drainage for essentially all of the metropolitan area of Houston and surrounding communities in Harris County. White Oak Bayou, Cole Creek, and Vogel Creek are located in the northwestern portion of Harris County. White Oak Bayou flows generally southeastward for about 25 miles to join Buffalo Bayou in the downtown area of Houston at a point 21.7 miles upstream from its confluence with the San Jacinto River and about five and one-half miles upstream from the Houston Ship Channel Turning Basin. Cole and Vogel Creeks join White Oak Bayou at points 10.5 and 12.2 miles, respectively, above its confluence with Buffalo Bayou. The watershed area of White Oak Bayou and its tributaries (Figure 3) totals about 108 square miles. The study area comprises the upstream 61 square miles of the White Oak Bayou watershed.

2.02 Upper White Oak Bayou and Cole and Vogel Creeks are shallow freshwater streams that flow through wooded and pastureland areas and residential developments. The wooded areas are limited generally to the flood plain closely adjacent to the streams and are attractive for residential development. Although some wooded areas remain undeveloped, they appear to be committed to residential development. Numerous developed residential subdivisions abut the Harris County Flood Control District right-of-way along both sides of White Oak Bayou below mile 15.5 and on the lower reaches of Cole and Vogel Creeks. The incorporated town of Jersey Village is located in the flood plain of White Oak Bayou between stream mile 18.2 and mile 19.9. Between mile 15.5 and Jersey Village, the area adjacent to White Oak Bayou is only partially developed with residential and commercial facilities. However, numerous additional residential subdivisions are planned in this area and are expected to develop in the next few years. Upstream of mile 19.9, the area adjacent to White Oak Bayou is rural, with land use limited generally to oil exploration, ranching, dairying, poultry raising, and truck farming.

2.03 Between 1958 and 1962, the Harris County Flood Control District cleared, straightened, and enlarged White Oak Bayou from mile 10.7 upstream to Huffmeister Road at mile 25.1. Numerous natural stream meanders



were cut off and filled with excavated material. Bottom widths of the rectified channel vary from 40 feet near West Little York Road (mile 12.5) to 20 feet in the upper reaches of the bayou. The height of the banks above the stream bed varies from about 15 feet just upstream of the existing Federal project (at mile 10.7) to about 8 feet near the upper end of the county's rectification work.

2.04 The right-of-way secured by the Harris County Flood Control District for the rectification work averages about 200 feet in width from mile 10.7 to mile 18.2 near Jersey Village and about 150 feet in width from mile 18.2 upstream to mile 25.1. The right-of-way areas were cleared of all trees and other vegetation in constructing the flood control improvements. Maintenance of the locally constructed improvements has not been performed regularly, and the banks have eroded at many locations. Weeds, brush, and small willow trees which have grown along many reaches of White Oak Bayou since the original clearing seriously impair its flood carrying capacity.

2.05 Cole Creek, a major tributary of White Oak Bayou, has a watershed area of about 10.4 square miles. The stream rises just east of the Fairbanks community near the northwest city limits of Houston and flows east-southeast about 6.5 miles to join White Oak Bayou at the upper terminus of the existing Federal flood control project (mile 10.7). The stream area from mile 0.6 to mile 4.2 is entirely within the city limits of Houston. From mile 4.2 to mile 6.0, the centerline of the creek forms the Houston city limits. The wooded areas adjacent to Cole Creek have in recent years attracted the development of numerous residential subdivisions and apartment complexes. Cole Creek, because of its proximity to the new Northwest Freeway, is certain to attract continuing and rapid residential and commercial development.

2.06 Under intense flood conditions, water in White Oak Bayou overtops the banks and flows overland south into Cole Creek. These overflows occur along White Oak Bayou for approximately 1.5 miles from stream mile 15.7 to mile 17.2. Because of the relatively flat topography in this general area, overflows also occur in a similar manner from Cole Creek south to Brickhouse Gully.

2.07 The Cole Creek channel has been enlarged from its mouth to about stream mile 1.9 by private developers.

The excavated material was used as a source of borrow material for land fill along the stream. This reach has been reshaped to a reasonably uniform trapezoidal cross section. The profile slope of the stream is about 4 to 5 feet per mile, which is sufficient to produce erosive stream velocities in the earthen channel during floods.

2.08 Vogel Creek, the other principal tributary of White Oak Bayou, has a watershed area of about 9.5 square miles. The stream originates northwest of North Houston-Rosslyn Road near the community of North Houston. The creek flows southeast then south for about 6.5 miles to join White Oak Bayou at stream mile 12.2. The watershed lies just north and outside of the city limits of Houston. The flood plain is heavily urbanized with relatively new residential developments from the mouth to about stream mile 1.6. Older subdivisions are located within the flood plain in the area from about mile 2.9 to mile 4.6. New subdivisions have been either completed or are in progress along the creek west of North Houston-Rosslyn Road at mile 5.1. Approximately one-half mile of the creek has been relocated and enlarged in this area to obtain borrow material for this development.

2.09 Residential areas are being developed in the attractive wooded areas adjacent to the creek between stream miles 1.6 and 2.9. Future development will be controlled to some degree by the Federal flood insurance program. As a condition of future Federal financial assistance, the local governing body must adopt flood plain restrictions that require residential structures to have first floor elevations at or above the 100-year flood level.

2.10 The lower reach of Vogel Creek has been straightened and enlarged to some degree by local interests. The channel was constructed to a reasonably uniform trapezoidal cross section; however, high flows in the rather steep profile slope of the stream have caused some bank erosion and channel shoaling.

2.11 Socioeconomic Development. The rapid population growth which has occurred in Houston and Harris County in recent years has had a significant impact on the urban growth along upper White Oak Bayou. The need for new residential housing has attracted developers to the west and northwest areas of Harris County because of its rural atmosphere, the attractive wooded surroundings, and the remoteness from the industrial atmosphere of the

Houston Ship Channel area. The population of the study area increased from 14,400 in 1960 to 28,100 in 1970, an increase of about 96 percent in the ten year period. The population is estimated to be about 55,000 by 1980 and 117,000 by 2020 based on OBERS Projections (U.S. Department of Commerce and U.S. Department of Agriculture, 1972). Development of the study area is further encouraged by its proximity to downtown Houston and the accessibility afforded by the new Northwest Freeway and other thoroughfares in the area.

2.12 The development trends and economic characteristics of the study area are dominated by the Houston metropolitan area. This area is the center of a major petrochemical industrial complex and, according to the 1974-75 Texas Almanac, is third largest seaport in the United States. The inland port has excellent railroad and highway connections. This network of transportation facilities combined with pipelines provide for efficient movement of industrial goods. The economy of the Houston area is one that is highly capitalized compared to many areas of the United States. Its type of economic development provides high paying jobs with rather stable to expanding job opportunities.

2.13 Houston is the largest metropolitan area in the State of Texas and the sixth largest city in the nation (Texas Almanac, 1974-75). Urban development in 1975 occupied over 27 percent of the land area of Harris County, with some development extending into adjacent counties. It is expected that urban development will comprise about 38 percent of the county by 1990. The study area is expected to continue to develop to meet the residential and commercial needs of the metropolitan area.

2.14 Studies made by the City of Houston (1970 and 1972) and the Houston-Galveston Area Council (1971) indicate existing and future land use in the study area to be committed primarily to residential and related light commercial developments. Urbanization since that time has been consistent with that prediction and is expected to continue. Existing agricultural and vacant lands will be converted gradually to residential and other higher orders of land use.

2.15 Existing outdoor recreational facilities within the White Oak Bayou watershed are very limited. Recreational development has not kept pace with the rapid urban growth of the area. Existing facilities within the study area

on upper White Oak Bayou consist of two private country clubs, a few neighborhood parks, and a public school playground. With the rapidly growing population within the area, recreational development is needed.

2.16 Geology. White Oak Bayou and its tributaries flow over sediments of the Lissie formation from the headwaters of the streams to within about seven miles of the mouth of White Oak Bayou and then over outcroppings of the Alta Loma sand of the Beaumont formation. Both are thick bed formations of the Pleistocene Age. The Lissie formation is composed of sand containing lentils of gravel interbedded with clay and silt and some thick beds of marine clays. The Alta Loma portion of the Beaumont formation is composed of a fine silty sand. The outcrop is rather indefinite as it is covered with topsoil and recent alluvial deposits. The subsurface soils along White Oak Bayou and its tributaries consist mostly of stiff to hard clay with some sand, silt, and various mixtures of these soils. Excavation along the streams should not present any problems since the foundation soils are very strong and dense. A map of the surface soils for the White Oak Bayou watershed is shown in Figure 6.

2.17 An active surface fault, verified by surface evidence of movement, cracked roads and structures, and land surface subsidence, occurs in upper White Oak Bayou watershed (St. Clari et. al., 1975). The major problem associated with this fault is land movement. Shifting of land along the fault has been gradual and not associated with earthquakes. Structural damages related to surface faulting has been confined to the immediate area of surface movement. Early incorporation of this information into land planning activities in the area can help prevent unnecessary damage and expense.

2.18 Ground Water and Land Subsidence. The major urban freshwater sources in the project area are deep wells operated by various utility districts and surface water transported to the area by pipelines from Lake Houston in the northeast portion of Harris County. Because of excessive groundwater withdrawals for municipal and industrial uses and the subsequent lowering of groundwater tables and consolidation of subsurface soils, varying degrees of land subsidence have occurred in Harris County in recent years. The most severe subsidence has occurred in the southeastern portion of Houston about 20 miles from the White Oak Bayou watershed. Land surface in that area has subsided about 7.5 feet in the past 30 years. The White

Oak Bayou watershed is located on the fringe of the cone of subsidence. Within the watershed, subsidence has averaged about 1.4 feet over the past 30 years. Additional surface water sources are being developed to meet existing and future water needs for the Harris County area and to decrease groundwater pumping and its associated effects on land subsidence.

2.19 Climate. The project area lies in a humid region having warm summers and mild winters. The proximity of this watershed to the Gulf of Mexico, the prevalence of southerly winds, and the absence of marked topographic relief result in relatively high humidity and uniformity in climate. Freezing temperatures are infrequent and of short duration. Data from the National Weather Service, Houston, Texas, indicate that the mean annual temperature is about 70 degrees Fahrenheit. Temperatures in the Houston area have ranged from a summer maximum of 108 degrees to a winter minimum of 5 degrees. January, the coldest month, has a mean temperature of about 45 degrees, and July, the warmest month, has a mean temperature of about 90 degrees.

2.20 Prevailing winds are from the south or southeast during all but the winter months when high pressure air masses approaching from the north cause winds to shift and come from that direction for short periods of time.

2.21 Mean annual precipitation at Houston is about 45 inches. Annual precipitation has ranged from a maximum of 73 inches in 1900 to a minimum of 18 inches in 1917. The maximum 24 hour rainfall recorded was 16 inches at the William P. Hobby Airport in 1945. The Houston area is subject to intense local thunderstorms of short duration, general storms which extend over a period of several days, and torrential rainfall associated with hurricanes and other tropical disturbances which occasionally cause flooding of local streams.

2.22 Air Quality. Air quality is influenced in the Houston area by construction activities, industry, and vehicular traffic. Weather conditions appear to be a major factor controlling the quality of air to which persons within the study area are exposed and account for varying levels of pollutants from day to day. Because most heavy industry in the Houston metropolitan area is located along the ship channel, wind direction appears to be the major controlling factor on industrial

pollution in various sections of the city. Trend surface maps prepared by the City of Houston Department of Public Health (1973) for suspended particulate matter, sulfur dioxide, nitrogen dioxide, and total oxidant levels show that the study area is under the influence of air pollution from the previously mentioned sources, but the concentrations are lower than in the downtown area and the highly industrialized east side of the city. Houston has an active air pollution control program and has filed civil suits to enjoin polluters from emitting contaminants. These controls which have helped mitigate and abate pollution in Houston are expected to become more stringent in the future and should further improve air quality throughout the metropolitan area.

2.23 Water Quality. Streams in the White Oak Bayou watershed are intermittent in flow, and, during dry periods, flow is limited primarily to effluent from municipal sewage plants and local land drainage. The streams do not furnish a dependable source of fresh water. During low flow periods the shallow streams become stagnant, and dense growths of algae frequently occur on the stream beds.

2.24 Water quality data collected weekly from the lower ten miles of White Oak Bayou in 1971 and 1972 by the City of Houston's Department of Public Health were used to evaluate the quality of the streams. The station selected to evaluate water quality is located immediately below the confluence of White Oak Bayou and Cole Creek. This station was chosen because it is near the proposed flood control project in upper White Oak Bayou and is assumed to represent the quality of water flowing from the area.

2.25 Water samples were analyzed for chemical composition and bacterial count. The data are presented in Table 6. These values were compared to general water quality criteria since the Texas Water Quality Board has developed no standards specifically for White Oak Bayou. These data show that some of the parameters are outside the normal limits for a free flowing stream. Dissolved oxygen values were occasionally lower than the general criteria recommended by Texas Water Quality Board for a natural stream. Biochemical oxygen demand, chemical oxygen demand, and ammonia values were high, and coliform counts were generally higher than acceptable limits for water contact recreation.

2.26 Additional water quality data for 1973 and 1974 were furnished by the City of Houston's Health Department

and were used in further assessing the water quality of White Oak Bayou (Table 7). These data indicate that dissolved oxygen levels were adequate to sustain aquatic organisms; but coliform counts, biochemical oxygen demand, and oil and grease values were high.

2.27 Vegetation. A published report on vegetation native to Houston and vicinity lists over 1,500 plants (Vines and Thurow, 1964). Extensive land development has removed large areas of natural vegetation, and new species are continuously being introduced. Neither officially recognized endangered plants nor champion trees listed in the national and state registry have been documented in the project area.

2.28 Trees found within the watershed of White Oak Bayou include water oak, loblolly pine, water elm, and willow. Dominant type woodlands appear to be hardwood mixed with pine. Figure 3 shows the present location of woodlands in the watershed. A variety of wild flowers, shrubs, and small trees, including willows, have revegetated on previously cleared stream banks. At several locations in upper White Oak Bayou near Jersey Village, cattails (*Typha* sp.) grow in the stream bed and impede stream flow. In some areas along the streams, the banks are bare and eroded. On White Oak Bayou, where the Federal flood control project has been completed, bermuda-grass turf has been established on the banks. This presents a neat, well-kept appearance but is poor wildlife habitat.

2.29 Fish and Wildlife. Previous modifications of the streams and poor water quality have nearly eliminated fish habitat that may have existed in the watershed (U.S. Fish and Wildlife Service, 1960 and 1962). In the upper seven to eight miles of White Oak Bayou, a number of potholes support small populations of catfish, sunfish, and bass which offer limited opportunities for sport fishing. The population densities appear to be low, probably because of limited habitat and poor water quality, especially during the summer when water flow is minimal. Other freshwater aquatic animals caught or observed in the stream include a variety of killifish, minnows, shad, carp, gar, grass shrimp, crayfish, turtles, frogs, and snakes. The lower two miles of White Oak Bayou are tidal, and the water quality is very poor. This portion of the bayou supports only sparse populations of turtles and rough fish. Because of their extremely shallow

depths and intermittent flows, Cole and Vogel Creeks support primarily minnow populations.

2.30 Benthic fauna are almost nonexistent in the streams. A few annelids (segmented worms) and some insect larva were collected at several locations in the stream bed of White Oak Bayou. These animals are less sensitive to poor water quality than most benthic animals, and the absence of other common types reflects the poor environmental condition of the stream bed.

2.31 Only a limited amount of natural wildlife habitat remains in the watershed because of heavy development in the area. Prairie grasses, woods, brush, and cultivated fields in undeveloped areas along the streams furnish habitat for fox squirrel, raccoon, opossum, eastern cottontail, armadillo, striped skunk, gray fox, and various rodents. Miscellaneous birds of prey and song-birds typical of prairies and sparse woodlands also occur in the area. Rice fields northwest of Jersey Village and Barker and Addicks Reservoirs southwest of the watershed are high usage areas for ducks and geese, but populations of these species appear to be generally low within the upper White Oak Bayou watershed. Numerous song and garden birds including the blue jay, mockingbird, several species of woodpeckers, cardinal, and eastern meadowlark are also common along the streams. Attwater's greater prairie chicken, red wolf, red-cockaded woodpecker, and the Houston toad, listed as endangered species by the U.S. Fish and Wildlife Service (1974), may range into the general area. Because of the extensive residential development, the prairie chicken and the red wolf probably do not reside in the project area; however, it is possible that the Houston toad and red-cockaded woodpecker might be found in adjacent woodland reaches along reaches of the bayou and creeks. The red-cockaded woodpecker, however, prefers native pine forests and could only be considered accidental in the area.

2.32 Recreational Aesthetics. Recreational use of the watershed is limited to the upper seven or eight miles of White Oak Bayou and adjacent lands which offer limited opportunities for sport fishing and hunting. Hunting is restricted to land outside of the city limits of Houston and the various communities in the area. The woodlands along the streams are limited in value for nature study because much of the area is being extensively cleared and developed for residential subdivisions. The closest major bird watching areas are Addicks and Barker Reservoirs and upper Buffalo Bayou (unpublished data, TPWD).



2.33 The woodlands along the streams provide a desirable aesthetic quality for home builders. Many people prefer to build along the stream banks because of the presence of attractive woodlands and the rural atmosphere within reach of a large city. Such areas within a short driving distance of downtown Houston have a high aesthetic as well as monetary value. Thus, people have been attracted to build within the flood plains of the streams.

2.34 Archeological and Historical Resources. The Texas Archeological Survey, under contract with the Galveston District, Corps of Engineers, conducted an intensive study of upper White Oak Bayou and Cole and Vogel Creeks (Payne, 1973). It found that the entire area has been altered to varying degrees by previous flood control measures and urbanization. Nevertheless, five middens of the early Prehistoric Period or the early Archaic Period were confirmed to be present along the banks of White Oak Bayou. Of the five confirmed sites, only two have potential archeological significance. These two sites are located between stream miles 15 and 17 along the channel bank 1 to 2 feet below the present land surface and have been damaged by previous modifications to the channel. Thirty-two additional sites have been reported in the project area by amateur archeologists, but none has been confirmed. Subsequent to the Texas Archeological Survey reconnaissance survey in the project area, an archeological site was discovered along the banks of White Oak Bayou at stream mile 11.2. This site has been determined to be eligible for inclusion to the National Register of Historic Places, and procedures for nominating the site to the National Register have been initiated by the Texas Historical Commission. A search of the National Register of Historic Places revealed no registered historical sites in the area that would be affected by the proposed project. By letter dated 5 November 1976, a copy of which is inclosed in Appendix A as page A-45, the State Historic Preservation Officer advised that some of the archeological sites located during the survey are potentially eligible for nomination to The National Register of Historic Places.

### 3. RELATIONSHIP OF THE PROPOSED ACTION TO LAND USE PLANS.

3.01 Two other Federal projects located in the general area are the flood control project on lower White Oak Bayou and the Northwest Freeway. Other projects or surveys either proposed, planned, or under construction that may have some relation to the selected project for upper White Oak Bayou watershed include City of Houston's "Open Space for Living," Cypress Creek flood control survey, and Texas Highway Department's Outer Belt Freeway. Texas Parks and Wildlife Department stated that the proposed action would not affect any waterways having local, regional, or statewide waterway potential, or existing trails having statewide system potentials.

3.02 Flood Insurance Program. A flood hazard information study of White Oak Bayou and Cole and Vogel Creeks in Harris County was made by the Corps of Engineers at the request of the Harris Soil and Water Conservation District in June 1972. The anticipated flood levels expected to occur from the 100-year storm were determined from the study, and this information is now used by the Federal Insurance Administration (FIA) to establish the base flood levels for new construction or substantial improvement to existing structures. As a condition of future Federal financial assistance, the local governing body must adopt flood plain restrictions that require residential structures to have first floor elevations at or above the 100-year flood level. This regulation provides no relief to existing development.

3.03 Relation to Other Federal Projects. As part of the Federal flood control project for Buffalo Bayou and tributaries, Texas, flood control improvements are authorized for the White Oak Bayou reach extending from the mouth at Buffalo Bayou to stream mile 10.7 where Cole Creek enters from the west. The improvements consist principally of channel enlargement, rectification, and partial paving. The Federal flood control improvements for lower White Oak Bayou were completed in 1975. The improved reach of the channel is designed to contain rainfall runoff from a standard project flood. The design capacity of this improvement provides for increased runoff resulting from anticipated additional urban development in the upstream areas of the watershed which comprises the present study area. Although further improvements to the stream would increase the flow rate in the bayou, the capacity of the existing improved channel would be adequate because of the time lag between peak flow conditions in the upstream and downstream areas.

3.04 Highway Department. In September 1972, the Texas Highway Department awarded a contract for construction of a portion of the Northwest Freeway (U.S. Highway 290) near the upper White Oak Bayou project area. This reach of highway construction is located generally southwest of and adjacent to Cole Creek. A requirement of the highway construction contract was that the borrow material of approximately 560,000 cubic yards needed for overpass construction be excavated from Cole Creek and a reach of upper White Oak Bayou upstream from its junction with Cole Creek. An additional requirement was that the channels be excavated to a uniform trapezoidal cross section established by the Harris County Flood Control District, and any structural alterations or relocations required by excavation for the freeway would be performed by the Flood Control District. Approximately 40,000 cubic yards of material were excavated from the Cole Creek Channel. The remaining 520,000 cubic yards were removed from White Oak Bayou from stream mile 10.7 upstream to about mile 16.0.

3.05 Open Space Plan. The Parks and Recreation Department and the City Planning Department of the City of Houston have prepared a guide for decisions on public land preservation and the use of open space within the city. This plan prepared in 1969, called "Open Space for Living," divided the city into several Open Space Districts. Most of the White Oak Bayou watershed falls into Open Space District No. 1. Proposals for this area contemplate development of parks and parkways along White Oak Bayou. Approximately 1,500 acres were proposed for development of large and small recreation sites along the bayou. A full range of athletic complexes, an Olympic pool, and a major recreation building were planned along the bayou, downstream from the present study area between the Interstate Highway Loop 610 and downtown Houston. Similar facilities were proposed on land along and adjacent to the bayou outside the Interstate Highway Loop 610. By 1990, a third complex, north of the junction of Cole Creek and White Oak Bayou and within the present study area, was anticipated. The features of the open space plan have not been implemented and, for the most part, are now precluded by the extensive suburban development which has occurred along the bayou

3.06 Beltway 8. The Texas Highway Department has plans for a second belt freeway similar to the Interstate Highway Loop 610 which now circles the City of Houston. The western portion of this planned freeway, tentatively

named the Beltway 8 Freeway, will cross the project area in the vicinity of Jersey Village. Various routes for the freeway through and around Jersey Village are still being considered, but the only effect the freeway will have on the proposed project will be the inducement of increased urban development that usually accompanies freeway construction. The development of Beltway 8 as a controlled access state highway facility to provide an outer loop around Houston, however, is very uncertain at the time.

3.07 Cypress Creek Flood Control. A flood control study of the Cypress Creek watershed, which is adjacent to and north of the White Oak Bayou watershed, is being conducted by U.S. Army Corps of Engineers, Galveston District, as part of the basin study of the San Jacinto River and tributaries. The results of this study will not change the proposed plan for the White Oak Bayou project.

3.08 Project Compatibility to Present Land Use. Existing land use in the upper White Oak Bayou watershed is comprised primarily of residential housing developments, related light commercial facilities, and vacant land committed to future residential development. Existing suburban developments presently occupy about 17 percent of the land area within the watershed. This urban land use is expected to nearly double within the next 10 years. With or without the proposed plan of action, most of the projected future urbanization will occur to fill the projected needs for residential housing in the Houston area. The proposed action to improve the flood carrying capacity of the streams and to provide recreational open-space facilities is compatible with existing and projected future land uses of the study area.

#### 4. THE PROBABLE IMPACT OF THE PROPOSED ACTION ON THE ENVIRONMENT.

4.01 The proposed project would eliminate the hazard of severe flooding from all floods up to the magnitude of a standard project flood that now occurs in the communities adjacent to White Oak Bayou and tributaries. Improved stream drainage and lower water surfaces in the channels would provide additional hydraulic head, thus improving lateral drainage from residential areas adjacent to the rectified streams. Benefits to be derived from this project include the elimination of damages caused by floods to 4,546 homes, apartments, and small businesses located within the standard project flood plain; prevention of diseases; and loss of lives. Full derivation of these benefits would require concomitant local drainage improvements. The resulting impact on the social and economic well-being of the inhabitants of the area represents an environmental improvement. Elimination of the flood hazard would result in continued urbanization of the aesthetically pleasing flood plain. This urbanization could eventually reduce or eliminate the value of the land for agriculture and woodlands and would require added public recreational development to fulfill the needs of the rapidly expanding population.

4.02 Although continued urbanization would occur with the improvements, this development trend is presently well established and is not expected to be significantly stimulated by the proposed flood control improvements. Associated air, noise, water, and solid waste pollution that may accompany this urbanization is also not expected to be significantly different with or without the improvements and would be under stringent control of State and Federal regulations.

4.03 In addition to providing the fundamental benefits to the human environment, the project would change the general appearance of the streams. Shrubs, brush, and small willow trees have grown along many reaches of the streams since the original clearing by the Harris County Flood Control District. These growths of shrubs and brush would be replaced by landscaped and regularly maintained floodways. The realigned channels would have banks turfed with bermudagrass to prevent erosion and trees to improve their scenic quality. Adjacent residents would be able to improve their properties without fear of future damage by periodic overbank flooding and erosion.

4.04 White Oak Bayou outfalls into Buffalo Bayou near the downtown area of Houston at the head of a federally authorized shallow draft navigation channel (10' x 60') which connects to the deep-draft Houston Ship Channel about 6.5 miles downstream. Upstream flows in Buffalo Bayou are restrained by Addicks and Barker Reservoirs, two federally constructed flood detention structures, and by flow constrictions in the unimproved 15.5 miles of Buffalo Bayou upstream from the mouth of White Oak Bayou. Under existing conditions, some flooding problems are experienced in the downstream reach of Buffalo Bayou. A Federal channel improvement project is authorized for Buffalo Bayou, extending from the Houston Ship Channel Turning Basin upstream to Addicks and Barker Reservoirs. Future design studies for this authorized project will consider the additional downstreams channel requirements from improved flow conditions in Buffalo Bayou.

4.05 Paving of about 50 percent of the proposed channels will eliminate some normal infiltration which now occurs. Openings in the concrete lining to allow for equalization of subsurface water pressures will allow for some small amounts of infiltration to still occur. The loss of infiltration from the proposed action is considered insignificant and unmeasurable in comparison to the groundwater withdrawals in the Houston area.

4.06 Construction of the proposed project would require the removal of trees and shrubs along the banks of the bayous. Much of the vegetation in and along the bayou has appeared since the last clearing operations. Along White Oak Bayou the channel would be constructed entirely within the previously cleared channel right-of-way between mile 13.3 to mile 18.2. However, from stream mile 10.7 to mile 13.3 and from mile 18.2 to 19.9, additional right-of-way from 20 to 60 feet wide would be needed. This would require the clearing of approximately 20 acres of trees and brush along and adjacent to the existing right-of-way.

4.07 Stream rectification along Cole Creek would be within the existing cleared right-of-way in the lower 1.9 mile reach. Above this reach, from mile 1.9 to mile 4.9, additional right-of-way from 40 to 75 feet wide would be required. Clearing of the additional right-of-way would remove approximately 19 acres of trees and undergrowth.

4.08 Along Vogel Creek from mile 0.1 to mile 1.6, construction would be confined to the existing cleared

right-of-way, but an additional 50 to 70 feet of right-of-way width would be needed from mile 1.6 to mile 4.5. Clearing for the additional right-of-way would require the removal of about 22 acres of trees and brush.

4.09 Removal of trees and undergrowth along the stream banks would eliminate desirable habitat for birds and small populations of other wildlife. The endangered Houston toad prefers prairie pothole regions and temporary breeding ponds in sandy woodlands and will probably not be affected by channelization of upper White Oak Bayou. Construction within the channels would disturb or remove bottom habitat for aquatic organisms and would suspend sediments and associated pollutants. Populations of desirable fish in the streams are small because of past channelization work and the poor water quality, and only a very limited amount of recreational fishing occurs along the streams. The additional stress on these populations caused by channelization would further reduce the standing crop of aquatic organisms.

4.10 Excavated material would be either used for constructive purposes or placed in carefully selected disposal areas where environmental damages would be minimal; approximately 139 acres would be required for disposal operations. Disposal areas, the acquisition which would be the responsibility of the Harris County Flood Control District, will be selected during preconstruction planning if the project should be authorized.

4.11 Although a major portion of the project would be constructed within the right-of-way limits presently owned by the Harris County Flood Control District, there would be some damage to lawns and ornamental shrubs of residential properties abutting the bayous.

4.12 During construction, a temporary disruption of roads, bridges, utilities, and other local services would occur. Fifty-six pipeline crossings would require alterations. The added movement of trucks and heavy equipment associated with the rectification of the streams would temporarily increase noise, exhaust emission, and dust levels in the area and may cause some damage to street and roads. Sedimentation and turbidity increases caused by construction would temporarily add to the present water quality problems of the streams. With the improvements completed, water quality should improve slightly because of increased flow velocity and elimination of stagnant pools. Dust and other particulate matter that may be suspended or carried into the streams during construction of the channel would be a

localized problem. Although the contractors for the construction of the project would be responsible for control of environmental pollution such as air, water, and noise, the Corps of Engineers will specify sprinkling and other methods to control these problems.

4.13 Channel excavation and enlargement would affect the remains of Prehistoric or Archaic middens along White Oak Bayou damaged by previous channel work. A report by the Texas Archeological Survey in July 1973 recommended that these sites be further tested and excavated before additional channel improvements are made. The State Historic Preservation Officer has advised that these sites may be considered potentially eligible for inclusion in the National Register of Historic Places. Should the proposed project be authorized, these sites will be tested, and an opinion as to their eligibility for nomination to the National Register will be sought from the National Park Service during post authorization planning for the project. Should these sites prove eligible for nomination to the National Register, measures will be taken to preserve or salvage the sites prior to construction. Should any additional archeological resources be encountered during construction of the project, the State Historic Preservation Officer and the Advisory Council on Historic Preservation would be notified immediately so that appraisals of their significance could be made and mitigation measures suggested prior to further construction.



5. ANY PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED.

5.01 Construction of the proposed project would require removal of about 30 acres of trees and almost 31 acres of shrubs and brush along the banks which serve as habitat for birds and small populations of other wildlife. In addition, construction of the channels would disturb or remove nektonic and benthic organisms causing additional stress on their populations. Loss of organisms and vegetation normally existing in the stream channels will result in a reduction in the limited amount of tertiary treatment which they exert on effluent from wastewater treatment facilities and nonpoint source runoff. The net effect of this action be to increase, by an unknown quantity, the wasteload reaching Buffalo Bayou. Turbidity increases caused by construction would temporarily degrade the already poor water quality.

5.02 There would be damage to lawns and ornamental shrubs on residential properties abutting the streams. Construction would require rerouting of traffic at bridge crossings and disruption of utilities and other local services which would cause inconvenience to local residents. The added movement of trucks and heavy equipment associated with construction of the channels would temporarily add to noise levels in the area. Dust and other particulate matter that might be suspended during construction would be a localized problem.

5.03 Channel excavation and enlargement would affect the remains of Prehistoric or Archaic middens along White Oak Bayou that have partially been destroyed by previous channel work. Steps will be taken to either mitigate the disturbance of these archeological sites or to protect them.

## 6. ALTERNATIVES TO THE PROPOSED ACTION.

6.01 General. The formulation of a plan to resolve the flooding problems in upper White Oak Bayou watershed required the investigations of both structural and non-structural alternatives and combinations of these methods. Structural solutions for flood prevention included measures to control the rising waters in the bayou and tributary creeks to prevent property damage, whereas non-structural measures included removal or exclusion of development susceptible to flood damage. Five such alternative plans were investigated along with a "no action" alternative.

6.02 No Action. This alternative would forgo the flood protection benefits that would result from the completed project. The results of "no action" would be continued damaging floods, losses to property owners, and potential loss of lives. Families and small businesses would be displaced as their financial capacity to cope with repeated flood losses declined. Temporary disruption to automobile traffic in the area during flooding would continue to occur. This plan would require the acceptance of nearly \$4,400,000 in potential average annual flood damages to existing properties in the future. Such a plan would subject the local residents to continued social and economic stresses and, therefore, is not considered an acceptable alternative.

6.03 Evacuation from the Flood Plain. Existing developments subject to flood damages could be purchased and removed and the flood plain restored to as nearly a natural state as possible or developed for recreational and open space uses. This alternative would involve about 3,800 single family residences located within the 100 year flood plain and valued at about \$207,000,000. Only limited fish and wildlife resources would be expected to exist in the area should this alternative be adopted because of the poor stream quality, past disturbances within the watershed, and surrounding urban development. Because of the high cost and the social disruption that would result from the forced relocation of nearly 13,000 persons, this is not considered a reasonable alternative.

6.04 Flood Detention Reservoir on White Oak Bayou and Improvements Downstream (Figure 4). A detention reservoir could be built on White Oak Bayou at stream mile 20.3 to temporarily detain floodwaters from the upper watershed for later releases when downstream conditions permit.

This location is the nearest downstream site to the flood problem area where sufficient undeveloped land is presently available. The dam would consist of an earthen levee about 30,000 feet in length containing about 300,000 cubic yards of compacted material and would have a spillway system. Because of the flat topography only a shallow water storage reservoir, with a maximum depth of about 15 feet, could be provided. The 2,800 acre reservoir would have a storage capacity of about 10,600 acre feet. The ratio of area inundated by the impoundment to the volume of water temporarily stored would be inordinately large.

6.05 Such a plan would not provide complete flood protection because the reservoir would not provide storage capacity to contain the entire volume of floodwater from a standard project flood. Releases from the reservoir during flood periods combined with downstream tributary inflow would require substantial channel improvements downstream to contain these flood waters. Such a reservoir would require the displacement of prairie land by the construction of a levee and periodic flooding of about 3,800 acres of agricultural and prairie land that are moderate quality wildlife habitat. A stable freshwater fishery would not establish in the reservoir because it would not contain flood waters for an appreciable length of time, but would generally be dry. During the periods that the reservoir was full, nesting, feeding, and nursery habitat for some birds, small land mammals, and reptiles would be flooded, requiring the animals to temporarily migrate from the area and causing pernicious effects on their population. Vegetation changes may also occur, converting some areas of the reservoir to a wetland type habitat with an associated change in wildlife species. The reservoir would preserve the 2,800 acres for future open space plans and recreational development. However, because the reservoir and associated improvements did not prove to be economically feasible, no recreational plan was developed for this area. Channel improvements in the lower streams would also disrupt or displace low quality fish and wildlife habitat. During construction of channel improvements, a temporary disruption of roads, utilities, and other local services would result.

6.06 The cost of this plan would be great because of the large real estate requirements for the reservoir. It is estimated that to provide 50 year flood protection to the urbanized reaches of the bayou and the tributary creeks by means of a reservoir combined with channel

enlargements would cost about \$77,382,000, and the project would have a benefit-to-cost ratio of 1.15.

6.07 Diversion of Floodwaters (Figure 5). Floodwater could be diverted at stream mile 20.3 south through a channel 7 miles long to Turkey Creek within Addicks Reservoir to relieve channel flooding on White Oak Bayou. Such a diversion system would consist of about 37,000 feet of channel and require about 1,900,000 cubic yards of excavation. The diversion channel would also require new structures on seven highway and road crossings and one railroad crossing. The channel would cross the Stasuma oilfield, requiring numerous pipeline alterations. This is not considered to be a practicable alternative since it would only partially solve the White Oak Bayou flooding problem while increasing flooding problems on Buffalo Bayou downstream from Addicks Reservoir. Diversion alone would not completely solve the flooding problems of White Oak Bayou since tributary inflow downstream from the point of diversion would be sufficient to require substantial enlargement of the bayou through the primary flood problem areas to provide adequate protection. This diversion, while affording relief to the flooding problems of White Oak Bayou, would be totally unacceptable from the standpoint of acceptance of diverted waters in Addicks Reservoir, the operation of which, along with its companion, Barker Reservoir, is already drastically compromised by inadequate channel capacity in the upper reaches of Buffalo Bayou above the mouth of White Oak Bayou. The increased hazard on Buffalo Bayou resulting from the diversion of White Oak Bayou has not been evaluated. The diversion would require construction of 7.0 miles of channel across prairie and agricultural land and disrupt roads, utilities, and other local services. Moderate quality wildlife habitat within the area of construction would also be permanently disturbed, adversely affecting resident wildlife populations. This alternative for White Oak Bayou combined with rectification of the tributary creeks would cost about \$60,525,000 and would have a benefit-to-cost ratio of 1.57.

6.08 Another unacceptable alternative would be to divert White Oak Bayou flows to Cole Creek from a point near stream mile 17 on White Oak Bayou. The channel would be about one mile long. The lower 4.8 miles of Cole Creek would have to be enlarged to accommodate the diverted water. The increased channelization requirement in the lower reach of Cole Creek would substantially increase

right-of-way needs, necessitating removal of more than 50 homes and apartments. The adverse social impacts indicate detailed economic analysis is not warranted.

6.09 Trapezoidal Earthen Channel. The existing earthen channels in White Oak Bayou from mile 10.7 to mile 19.9 could be enlarged to adequately handle the floodwaters. Such an improvement would require a channel bottom width of about 150 feet, a top width of about 250 feet, and a depth of about 17 feet through the heavily developed area of White Oak Bayou. This channel size would be required to contain floodwaters and reduce the velocities to acceptable levels to prevent future erosion of the channel banks. Earthen channels in Cole and Vogel Creeks would be similarly enlarged. Twenty existing homes and about sixty subdivided lots dedicated to future development would have to be acquired to provide sufficient right-of-way. The real estate cost for this alternative would be large, and extensive social disruption would result from the forced relocation of the persons now occupying the homes. Enlargement of channels would require about 100 feet of additional right-of-way on White Oak Bayou, removing existing woodlands and associated wildlife habitat. Excavation in the streams would disturb aquatic habitat, increase turbidities adding to the present water quality problems, and require the relocation of numerous pipelines, sewers, and other utilities. This alternative would cost about \$48,851,000 and would have a benefit-to-cost ratio of 1.84. The earthen channel would require a higher maintenance cost than the other alternatives. Although this plan presents economic advantages over the proposed plan, the social disadvantages of relocating residents, the disruption of orderly planned future development, the removal of 197 acres of attractive woodlands, and the unsightliness of such a large channel within heavily urbanized areas make it less acceptable to the local community than the proposed plan of action.

6.10 Flood Proofing. Flood proofing of structures has merit when flooding is of short duration, infrequent, and is of minor consequence. However, along upper White Oak Bayou the adverse aesthetic and social impacts of floodwalls, levees, and similar water proofing techniques on individual high valued single family residences is considered to make flood proofing an unacceptable flood damage prevention solution.

6.11 Summary. The selection of the most acceptable plan has been based on technical, economic, environmental and

social criteria. The evacuation plan is considered unacceptable because of economic and social problems; the detention reservoir alternative, although preserving the greatest amount of land for future environmental usage, is considered unacceptable; the diversion channel plan is considered unacceptable because of economics and the operational and environmental problems created in Addicks Reservoir; the earthen channel plan is considered unacceptable because of environmental and social problems; and flood proofing is considered unacceptable because of aesthetic and social impacts. Therefore, the proposed plan of protection to the standard project flood elevation is considered the best solution to flooding on upper White Oak Bayou watershed. Table 8 presents pertinent data for evaluating the various alternative plans.

6.12 Within the proposed plan, three levels of flood protection were considered. These included protection to the standard project flood elevation, the 100-year flood elevation, and the 50-year flood elevation. From an economic standpoint, considering a project to create the maximum project benefits for the least costs, the partially lined channel plan to provide 50-year structural flood protection is the most efficient. However, other considerations were made in selecting the plan that would meet projected future flood protection needs of the watershed. It was determined that a 50-year protection plan could provide a false sense of security to present and future residents in the watershed. This plan would not offer protection to some low lying areas adjacent to the streams. Because of the lack of adequate protection and the fact that urban growth is expected to double within the next decade within the watershed, protection to the standard project flood elevation is considered justified and is the plan recommended.

6.13 Environmentally there is little difference between the three plans of protection. The primary difference would be the amounts of woodland clearing required for construction. A 100-year protection plan would require about 10 feet more right-of-way than a 50-year protection plan. Similar differences would be required between a 100-year plan and a standard project flood protection plan. Much of the improvements to provide the standard project flood protection plan can be constructed within previously cleared rights-of-way. The amount of woodland clearing would be minor for either of the three degrees of protection. It is estimated for the standard project flood protection plan about 61 acres of woodland would be cleared.

7. THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY. Completion of the flood protection project will contribute to the safety and well-being of all inhabitants, as well as existing and future property developments within the flood plain area. The economic productivity of the area will be maintained and enhanced which will insure both the short and long-term economic and social well-being of the area and its inhabitants. Recreational facilities that may be associated with the project will help fulfill future recreational needs of the area. The long-term loss of the relatively low quality fish habitat and the removal of 61 acres of wildlife habitat as a result of channel construction will be the environmental cost for the long-term gains in the well-being of local residents.

8. ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED. The proposed action involves an irretrievable commitment of resources through the labor, capital, and material associated with the construction of the project. The removal of 61 acres of vegetative habitat in and along the channelized portion of the streams that supports limited populations of aquatic animals, birds, mammals, rodents, and reptiles is considered an irreversible loss. Prehistoric or archaic middens would be affected during channel rectification. Although salvage excavation may be undertaken prior to construction of the project, such resources would still be lost to the project, and any opportunities for future research using possibly improved techniques would be eliminated.

## 9. COORDINATION.

9.01 Coordination During Investigation. Approximately 500 persons attended the initial public meeting held in Houston, Texas on 14 May 1971 to consider modification of the existing Federal project. Local interests, represented by the Harris County Flood Control District, requested an extension of the existing authorized flood control project on White Oak Bayou from the point of terminus at Cole Creek upstream to its crossing of U.S. Highway 290. It was also requested that the major tributaries, Cole Creek and Vogel Creek, be investigated for possible flood control and drainage improvements. Petitions were received from approximately 1,700 residents along upper White Oak Bayou supporting these desired improvements. The Harris County Flood Control District agreed to act as the local sponsoring agency and agreed to furnish all items of local cooperation for any projects which might develop from the studies.

9.02 As a means of insuring that public ideas and opinions were fully recognized in project planning, a citizens' advisory committee was organized in September 1971. The committee was composed of local residents, a member of a local conservation organization, and representatives of the local sponsoring agency. The first meeting of the committee was held in Houston on 21 September 1971. The committee members, most of whom are civic leaders in the community, expressed their interest and willingness to represent the locally affected citizens, to solicit their views and opinions on alternate plans for structural and non-structural measures, and to participate in periodic informal workshop meetings throughout the duration of the interim studies. Other meetings with the committee were held periodically.

9.03 On 18 April 1974, a second public meeting was held in Houston, Texas. This meeting was held to inform the public of the alternative plans of improvement considered to correct the flood problems in the upper watershed, to solicit public views on these alternatives as well as on tentatively selected plan of improvement, and to receive tentative assurances from the local sponsoring agency that it will provide the necessary items of local cooperation for the proposed project. The meeting was attended by over 1,000 persons representing various state and local organizations and residents from the area. In general, those in attendance were in favor of the tentatively



selected plan of improvement. Some elements of the community expressed a desire for the incorporation of recreational facilities in the project plans. These facilities are described in the project description.

9.04 Representatives of the U.S. Fish and Wildlife Service and a Corps of Engineers biologist made a field survey of the project area in July 1974. Various aspects of the proposed project were discussed including construction methods, right-of-way limits, and impacts on fish and wildlife.

9.05 Coordination of the Draft Environmental Statement.

a. Governmental Agencies. Draft copies of the environmental statement were circulated to interested local, State, and Federal agencies on 26 April 1976 for field review and comments. The draft statement was filed with the Council on Environmental Quality, and notice of its filing appeared in the Federal Register on 7 May 1976. Comments received on the draft statement are summarized and responded to below, and copies of the replies are included in Appendix "A" (Attachments A-1 through A-57).

(1) U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE. (Attachment A-1)

Comment: "The statement reveals that flood plain regulation is a supplementary requirement for proposed improvement of Vogel and Cole Creek Channels. We recommend similar protection for the proposed improvement of the White Oak Bayou Channel."

Response: As discussed in paragraph 1.04 of the draft statement, flood plain regulation is the primary plan for flood damage prevention on White Oak Bayou from the upstream terminus of the proposed structural improvements at mile 19.9 to the headwaters at about mile 25.5.

Comment: "Urbanization will be greatly accelerated by the project. Consequently, any serious considerations for open space, recreation areas, etc., should be incorporated in approved local land use plans prior to project construction."

Response: The recommended recreational plan has been developed in accordance with published land planning reports prepared by the Houston-Galveston Area Council and the City of Houston Planning Department. The plan

complies with the desires of local residents and has been approved by the Harris County Commissioners Court, the local sponsoring agency for the proposed plan.

Comment: "We recommend early contact with the Texas Forest Service relative to possible State or National champion trees within the project area, protection of leave trees during construction, and for advice and council on trees and shrubs to be used in landscaping the improved channel."

Response: Comments of the Texas Forest Service on the draft statement are included in Appendix "A" (Attachment A-44) and are summarized and responded to elsewhere in this section.

(2) U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE. (Attachments A-2 and A-3)

Comment: "Page ii, Adverse Environmental Effects - It is suggested that the acres of woody vegetation to be destroyed be added."

Response: The summary has been revised as suggested.

Comment: "Page 1, paragraph 1.02 - Information on the acreage and kinds of land damaged would be helpful to the reviewer."

Response: Information on acreages and types of land damages related to flooding has been added to paragraph 1.02.

Comment: "Section 2, Environmental Setting Without The Project - A section on soils of the area would provide some basic information on type of material to be excavated, problems that may be encountered in park and natural area development, productivity, etc."

Response: Additional information has been added to paragraph 2.16 to further define the soil types along White Oak Bayou and its tributaries along with a surface soil map (Figure 6). Our studies indicate that excavations along the streams should present no problems since soils are dense and strong enough for stable channel side slopes.

Comment: "Page 14, paragraph 2.25, Vegetation - This section contains a good list of plants that may occur

in the area. It is suggested that a description of the existing vegetation also be included to reflect present conditions in the project area."

Response: Existing vegetation along White Oak Bayou and its tributaries is described in paragraph 2.28. Figure 3 shows the present location of woodlands within the watershed. Extensive land development is resulting in continuous removal of natural vegetation; therefore, distribution of vegetation in the watershed is subject to continuous change.

Comment: "Page 15, paragraph 2.29 - A description of wildlife habitat based on present vegetation would help clarify kinds of habitat to be affected."

Response: Present vegetation types and their value as habitat for key wildlife species are discussed in paragraph 2.31.

Comment: "Page 24, paragraph 5.01 - It would be helpful to include the acreage of trees and shrubs to be removed."

Response: Acreages of trees and shrubs to be removed have been included in paragraph 5.01.

Comment: "Page 31, sections 7 and 8 - It is suggested that acreages of wildlife habitat destroyed or changed be added."

Response: A discussion of acreages of wildlife habitat to be removed has been added to Sections 7 and 8 as recommended.

Comment: "There is no indication as to what effects these improved channels may have downstream on Buffalo Bayou on possible increase in flooding or other associated problems."

Response: The downstream improved channel was designed to accommodate increased stream runoff resulting from future anticipated urban development in the upstream areas of the watershed. Although the proposed flood control work in the watershed would increase the flow rate in the streams, the capacity of the existing flood control work downstream on White Oak Bayou would be generally adequate to handle the increase in stream flow. White Oak Bayou flows into Buffalo Bayou near downtown

Houston. This is downstream of presently critical areas of flooding and erosion along Buffalo Bayou. Shallow draft navigation improvements are authorized for Buffalo Bayou from the Houston Ship Channel turning basin upstream to the mouth of White Oak Bayou. A portion of the proposed improvements from the turning basin to Jensen Drive has been completed and is periodically maintained. These navigation improvements provide incidental flood relief for the White Oak and upper Buffalo Bayou watersheds.

(3) U.S. DEPARTMENT OF THE INTERIOR, GEOLOGICAL SURVEY. (Attachment A-4)

Comment: "Measures for protecting the disposal site for excavated material (p. 4, Par. 1.13; p. 22, par. 408) should be considered in order to minimize any adverse effects of erosion that may result from stormwater runoff."

Response: The selection of disposal sites and the methods of minimizing the effects of erosion of the sites will be coordinated with the Harris County Flood Control District during the design phase of the project.

Comment: "We find no treatment of ground water or impacts of the project on groundwater resources in the statement. The effects of lining, rectification, and enlargement of channels on ground-water resources should be considered."

Response: A discussion of ground water withdrawal and its effect on land subsidence in the White Oak Bayou watershed has been added to the statement (Paragraph 2.18). The proposed lining of the lower sections of the upper White Oak Bayou watershed with concrete would reduce absorption of surface water into the ground over an area of about 135 acres. This represents about 0.3 percent of the land area in the watershed. Although it is recognized that ground water absorption would be greater in the bottom of the streams, the effect on ground water absorption as a result of lining the channels with concrete is considered insignificant for the total watershed area.

Comment: ". . . . ., we suggest that the statement evaluate effects of revised storm drainage as well as those of the adjunct recreational use development."

Response: The statement has been amended to discuss the effects of the project on storm drainage

(Paragraph 4.01) and on the proposed recreational development plan (Paragraph 1.16).

(4) U.S. DEPARTMENT OF THE INTERIOR, FISH AND WILDLIFE SERVICE. (Attachment A-5)

Comment: "We generally find the statement to be an adequate assessment of impact expected from the proposed project."

Comment: "Page 21, paragraph 4.03. We question the inclusion of this paragraph. While the orderly appearance of maintained floodways with bermudagrass turf and neatly spaced trees might constitute an improvement of esthetic quality to some, to others the natural setting with a large diversity of weeds and brush would be less monotonous and preferable. Hence, because Paragraph 4.03 in its entirety is highly debatable, we recommend that it be deleted."

Response: We do not concur that the paragraph should be deleted. However, it was revised to present a more objective discussion.

Comment: "Page 31, paragraph 8. While we agree that removal of habitat in the channelized portion of the streams is an irreversible loss, we disagree that removal of habitat along the channelized portion should be considered an irreversible loss."

Response: The removal of existing vegetation along the channelized streams would effect an irreversible loss of the vegetation removed; however, vegetation could be planted or allowed to naturally reestablish eventually creating a similar type habitat.

(5) U.S. DEPARTMENT OF THE INTERIOR, NATIONAL PARK SERVICE. (Attachment A-6)

Comment: "We have reviewed the draft environmental statement for flood damage prevention, Upper White Oak Bayou, Buffalo Bayou and Tributaries, Harris County, Texas, and have no comments."

Comment: "The final environmental statement should include the comments of the State Historic Preservation Officer following his review of the proposed project. He is Mr. Truett Latimer, Executive Director, Texas Historical Commission, P.O. Box 12276, Capitol Station, Austin, Texas 78711."

Response: Comments of the State Historic Preservation Officer on the draft statement are included in Appendix "A" (Attachments A-45) and are summarized and responded to elsewhere in this section.

(6) U.S. DEPARTMENT OF THE INTERIOR, BUREAU OF OUTDOOR RECREATION. (Attachment A-7)

Comment: "We find the document to be comprehensive in scope and satisfactory with respect to outdoor recreation."

Response: None required

(7) U.S. DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION. (Attachments A-8 and A-9)

Comment: "Coverage of environmental, economic, and social aspects within the expertise of the Bureau of Reclamation is generally adequate. Tables used in the statement are appropriate in number and content, and the tables are clear."

Response: None required.

Comment: "Page 1, paragraph 1.02--Does the total average annual damage (\$4,146,000 for White Oak, Cole, and Vogel Creeks) include a wider range of damage than the average annual potential flood damage to existing properties (\$1,639,000 for White Oak Bayou alone)?"

Response: The statement has been revised to clarify flood damage costs (Paragraph 1.02).

Comment: "Page 9, paragraph 2.04 and page 21, paragraph 4.03--Are there assurance that maintenance of the proposed features will be at a higher level than for features implemented in the past?"

Response: A contractual agreement will be made with the local sponsoring agency as a prerequisite to construction of the project. This agreement will provide for maintenance and operation of the project in accordance with Federal policy. The completed project will be inspected periodically by the Corps of Engineers to assure that maintenance is performed.

Comment: "Page 23, paragraph 4.11--The positive statement made in paragraph 5.03 that steps will be taken seems appropriate as a part of paragraph 4.11"

Response: The statement has been revised to recognize this comment (Paragraph 4.11).

(8) U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE. (Attachment A-11)

Comment: ". . . our review of the Draft Environmental Statement for the project discerns no adverse effects that might be of significance where our program responsibilities and standards pertain, provided that appropriate guides are followed in concert with State, County, and local environmental health laws and regulations.

We therefore have no objection to the authorization of this project insofar as our interests and responsibilities are concerned."

Response: None required.

(9) U.S. DEPARTMENT OF TRANSPORTATION, FEDERAL HIGHWAY ADMINISTRATION. (Attachment A-12)

Comment: "We have no comments to offer concerning the subject draft environmental statement."

Response: None required.

(10) ENVIRONMENTAL PROTECTION AGENCY, REGION VI. (Attachment A-13 through A-15)

Comment: "The statement should include a discussion of construction impacts on air quality including increased vehicular emissions from construction equipment."

Response: Construction will unavoidably cause an increase in dust level and vehicular exhaust emission within the construction area. A discussion of the effects of construction activities on air quality is included in Paragraph 4.10.

Comment: "The final statement should identify sensitive receptors such as schools, churches, hospitals in the project area. The effects of construction noise and the specific precautions for noise abatement and protection of the area residents from construction-related noise impacts should be discussed."

Response: Three schools and a church are located within 500 feet of the streams to be rectified. No hospitals

are located adjacent to the streams. Construction activities are expected to affect the schools and church and local residents only while construction is within their immediate vicinity. This could occur for a period of from 6 to 8 months. The contractors for construction will be responsible for controlling environmental pollution based on methods specified by the Corps of Engineers (Paragraph 4.12).

Comment: "The statement should more fully describe the modifications to be made on the ten pipelines as a result of the project. Changes to pipelines carrying oil or wastewater could become significant from a public health standpoint if adequate pollution abatement controls are not implemented."

Response: The statement has been amended to further describe the proposed pipeline modifications and safety measures to be taken (Paragraph 1.13).

Comment: "These comments classify your Draft Environmental Impact Statement as LO-2. Generally, we have no objection to the project as proposed. However, we are requesting additional information be provided concerning air and noise quality plus information on spill prevention."

Response: The statement has been revised to include information on health and safety aspects of pipeline modifications (Paragraph 1.13). A discussion of air and noise quality effects is included in Paragraph 4.12.

(11) ADVISORY COUNCIL ON HISTORIC PLACES.  
(Attachments A-16 and A-17)

Comment: "Pursuant to its responsibilities under Section 102(2)(C) of the National Environmental Policy Act of 1969, the Advisory Council has determined that the DES appears adequate concerning compliance with Section 106 of the National Historic Preservation Act of 1966. However, with respect to compliance with Executive Order 11593, 'Protection and Enhancement of the Cultural Environment' issued May 13, 1971, we note that the undertaking as proposed may effect (sic) two sites which appear to possess archeological significance and thus may be eligible for inclusion in the National Register of Historic Places."



Therefore, pursuant to Section 2(b) of the Executive Order 11593 and Section 800.4(a)(2) of the 'Procedures for the Protection of Historic and Cultural Properties' (36 C.F.R. Part 800), which sets forth the steps for compliance with the Order, the Council requests the Corps of Engineers to request in writing an opinion from the Secretary of the Interior respecting these properties' eligibility for inclusion in the National Register of Historic Places and inform us of the findings. Furthermore, the Corps is reminded that should the Secretary of the Interior determine the properties are eligible for inclusion in the National Register, it should follow the remaining steps in Section 800.4 of the procedures to evaluate the effect and obtain the Council's comments as appropriate.

Until the requirements of the Executive Order 11593 and the procedures are met, the Council considers the DES to be incomplete in its treatment of the cultural resources. To remedy this deficiency, the Council will provide substantive comments on the undertaking's effect on the above cited properties through the process set forth in the procedures."

Response: The State Historic Preservation Officer has been fully apprised of the existing archeological sites in the area and the proposed action. He has been furnished a copy of "Upper White Oak Bayou and Cole and Vogel Creeks, Harris County, Texas: An Archeological and Historical Inventory and Evaluation" conducted by the Texas Archeological Survey, The University of Texas at Austin and has been furnished copies of the draft statement. His comments on the value of archeological and historical resources in the area and possible effects of the proposed action have been received and responded to in this section.

Should the proposed project be authorized, the sites on White Oak Bayou which possess potential archeological significance and which may be affected by project activities will be systematically tested during preconstruction planning. Prior to taking any action which could affect these sites, the necessary determinations of eligibility for inclusion in the National Register will be requested from the National Park Service. If the properties are considered eligible for inclusion in the National Register, other procedures in 36 CFR 800 relating to determination of effects will be followed.

(12) BUDGET AND PLANNING OFFICE, OFFICE OF THE GOVERNOR OF TEXAS. (Attachments A-18 through A-20)

Comments: The Budget and Planning Office, Office of the Governor of Texas, is the designated clearing house for coordination of Federal plans and projects with the various state agencies. The Director furnished copies of comments of various state agencies and briefly summarized the comments of the Texas Water Rights Commission, the Texas Water Quality Board, the Texas Department of Agriculture, and the Texas Water Development Board. Comments of these and other responding state agencies are summarized and responded to below.

(a) TEXAS AIR CONTROL BOARD. (Attachments A-21 and A-22)

Comment: "We have reviewed the above cited document. Any outdoor burning of brush must be done in accordance with Regulation I, Rule 101.26 of the Texas Air Control."

Response: Construction specifications will prohibit burning of brush; however, should it be necessary to modify the specifications, burning will be in accordance with Texas Air Control Board's regulations.

Comment: "This agency concurs with the implementation of this project."

(b) TEXAS DEPARTMENT OF AGRICULTURE.  
(Attachment A-23 through A-26)

Furnished 1974 Agricultural Statistics for Harris and Houston Counties, Texas and offered the following:

Comment: "This DEIS fails to mention agriculture or its relationship to the proposed flood damage prevention program. This oversight should be corrected."

Response: Streams to be affected by the structural features of the flood protection project are generally located in suburban lands or lands committed to future urbanization. Most of the agricultural land is located outside of the areas of structural modification. However, flood plain regulation is being considered on the upper reach of White Oak Bayou within existing agriculture lands. This should have little influence on its present land use.

(c) TEXAS WATER DEVELOPMENT BOARD. (Attachments A-27 and A-28)

Comment: "The rapidly developing suburban areas of Texas, and in this particular case the northwest Houston area, will cause increased runoff and alter flood flow regimes from heavy rains. As a result, flood protection projects such as this are essential for urban areas. It is indeed unfortunate that this project could not have been completed prior to extensive development in the White Oak Bayou watershed."

Comment: "We suggest that the section on Geology be revised and expanded to address, in general, the effects of land subsidence and related active faulting in the project area insofar as these phenomena relate to flooding of low-lying areas."

Response: A discussion has been added to include information on land subsidence related to ground water withdrawal (Paragraph 2.18) and on active surface faulting within the White Oak Bayou watershed (Paragraph 2.17). More detailed studies in the design phase of this project will be made to determine the effects of subsidence and faulting on the structural plans. Modifications necessary to the design will then be considered.

Comment: "On page 16 of the draft EIS, the last sentence of Section 2.31 which reads 'Thus, people are encouraged to build within the flood plains of the streams' is somewhat confusing. As it reads, it appears that someone or some entity is encouraging people to build homes in flood plains. We do not believe that this connotation was intended in the Draft EIS. Perhaps, the sentence should be reworded to convey the idea that even though these areas have desirable qualities, the areas are flood plains."

Response: Concur. The sentence has been revised as recommended (Paragraph 2.33).

Comment: "We reiterate our support for this urgently needed project in this rapidly-developing urban area."

(d) TEXAS WATER QUALITY BOARD. (Attachments A-29 and A-30)

Comment: "The staff of the Texas Water Quality Board has reviewed the draft environmental impact statement for the proposed flood damage prevention improvements in Upper White Oak Bayou and its tributaries, Cole and Vogel Creeks in Harris County, Texas as prepared by the

Corps of Engineers and has determined that there should be no lasting harmful effects on water quality if the precautionary measures outlined in the statement are taken during and after construction."

Comment: "The proposed modification of the sanitary sewer line as well as the installation of a sewage lift station should be coordinated closely with the local jurisdictional entity in order for such proposed changes to be in accord with approved areawide or regional sewerage plans."

Response: The proposed modifications will only affect existing sewer lines serving present developments. The use of lift stations is a common practice in the coastal region and should not conflict with requirements of any area or regional entity.

Comment: "This agency concurs with implementation of this project."

(e) TEXAS WATER RIGHTS COMMISSION. (Attachments A-31 through A-35)

Comment: "The Commission staff believes that the Draft Environmental Statement fulfills adequately the administrative, coordinative, and analytical requirements of the National Environmental Policy Act of 1969, and the U.S. Office of Management and Budget Circular No. A-95."

Response: None required.

Comment: "The Statement should be regarded as an integral element of the project report."

Response: Concur

(f) TEXAS STATE SOIL AND WATER CONSERVATION BOARD. (Attachment A-36)

Comment: "We offer no comment on this draft statement."

Response: None required.

(g) TEXAS PARKS AND WILDLIFE DEPARTMENT. (Attachments A-37 through A-40)

Comment: "At one time, the project area was undoubtedly good to excellent wildlife habitat; however, urban development has greatly diminished wildlife habitat values in the area of the proposed channel enlargement. Fisheries in this portion of White Oak Bayou are thought to be insignificant."

Response: Concur

Comment: "The Houston toad (*Bufo houstonensis*), which is on the Department of the Interior's and this State's endangered species lists, has been found in several localities bordering the watershed boundary (see attached map) and might be expected to occur in the White Oak Bayou watershed. Since this species seems to prefer temporary breeding pools formed in relatively loose, easily drained soils, it is not likely to be adversely affected by channelization of lower White Oak Bayou. Any modification of the wooded, sandy soil ridges could have a deleterious effect on this species."

Response: It is recognized that potential Houston toad habitat occurs along the periphery of the project area. Impacts of this project on endangered species including the Houston toad, are discussed in Paragraphs 2.31 and 4.07 of this statement.

Comment: "Wildlife would be least affected by the preferred alternative of channelization of the lower portion of the bayou and non-structural flood plain management on the upper reaches of White Oak Bayou. The alternative plan for detention reservoirs would further reduce wildlife habitat in the project area."

Response: Concur that physical impacts of the reservoir plan would be greater than the preferred alternative.

Comment: "The proposed action would not affect any waterways having local, regional, or state-wide waterway potentials, or existing trails having statewide system potentials."

Response: The statement has been amended to include this information (Paragraph 3.01).

Comment: "The proposed action does include 8.7 miles of hike and bike trails which is in keeping with

the findings and recommendations of the 'Texas Trailways' report where it points out that floodplains have excellent potential for trail development. The Corps of Engineers should be commended for realizing this potential and proposing the incorporation of hike and bike trails in the project."

Response: None required.

Comment: "The draft environmental impact statement recognizes the demand for fill material in the Houston area and states that material from channel excavation might be made available for this purpose by the project sponsor (page 4). This Department has previously suggested such use of spoil material to the Corps of Engineers with the interest of reducing spoiling on valuable wildlife habitat and wetlands. We are pleased to note that they are recognizing the wisdom of using spoil material for constructive purposes rather than covering natural areas."

Response: None required.

(h) The following state agencies indicated concurrence with implementation of this project but offered no further comments:

TEXAS DEPARTMENT OF COMMUNITY AFFAIRS (Attachment A-41)  
GENERAL LAND OFFICE OF TEXAS (Attachment A-42)  
THE BUREAU OF ECONOMIC GEOLOGY, THE UNIVERSITY OF TEXAS  
AT AUSTIN (Attachment A-43)

(13) TEXAS FOREST SERVICE. (Attachment A-44)

Comment: "There are no Champion Trees from the National and State Registry located in the proposed project area."

Response: This information has been added to the statement (Paragraph 2.27).

Comment: "I could find no statement concerning the presence or absence of endangered or threatened floral taxa within the project area. Such a statement should be made a part of the Environmental Impact Statement for the subject project to be in compliance with the provisions of the Endangered Species Act of 1973 (87 stat. 884; 16 U.S.C.)."

Response: The statement has been revised to reflect that no officially recognized endangered plants have been documented in the project area (Paragraph 2.27).

(14) TEXAS HISTORICAL COMMISSION. (Attachments A-45 through A-47)

Comment: "We have checked our master file and find, that as described, the proposal will effect (sic) known cultural (prehistoric, historic and architectural) resources which are potentially eligible for inclusion within the National Register of Historic Places. Because we believe that other sites of significance lie within the area generally affected and to comply with federal legislation concerning the protection of cultural resources, the area must be surveyed."

Response: The Texas Archeological Survey has conducted a cultural resource reconnaissance survey of upper White Oak Bayou and Cole and Vogel Creeks. Sites on White Oak Bayou with potential archeological significance will be tested during post authorization planning, should the project be authorized. Also, further surveys will be conducted to determine if other cultural resources in the area would be eligible for inclusion to the National Register of Historic Places.

(15) HOUSTON-GALVESTON AREA COUNCIL. (Attachments A-48 through A-53)

Comment: "Staff is of the opinion that additional consideration should be given to the project alternatives identified. The 'Flood Detention Reservoir on White Oak Bayou and Downstream Channel Improvement' alternative is particularly deserving of further consideration. Rather than one large detention reservoir, the possibility of several smaller reservoirs strategically located to partially detain stormwater runoff should also be considered. Such a system, built in conjunction with earthen or gabion lined drainage channels, maybe (sic) a practicable alternative. Several small reservoirs would provide open green spaces for recreation when not detaining runoff water and the earthen or gabion lined channels would provide a more aesthetically pleasing view for the public than the proposed concrete channels."

Response: Lands are not available in the downstream areas for small flood detention reservoirs. For this reason, the small reservoirs as proposed are not considered to be a practical alternative. Earthen and gabion lined channels have been investigated and are not considered feasible because of the inefficiency of such channels and their high maintenance costs.

Comment: "The effect of the proposed project upon the water quality does not consider possible impact on Buffalo Bayou. Organisms and vegetation normally existing in stream channel provide a from (sic) of tertiary treatment to effluent from wastewater treatment facilities and nonpoint source runoff. This action should be considered as a benefit in the cost-benefit analysis. Concreting the stream channels of White Oak Bayou Vogel and Cole Creeks, will destroy the natural treatment processes in these waterways. Consequently effluent from wastewater treatment facilities and urban runoff will drain to Buffalo Bayou without receiving the existing treatment from natural biological processes. The net effect will be to increase the wasteloads to Buffalo Bayou."

Response: A discussion of this impact has been added to the statement (Paragraph 5.01).

(16) CITY OF HOUSTON, DEPARTMENT OF PARKS AND RECREATION. Attachments A-54 and A-55)

Comment: "This Department has reviewed the statement and is in basic agreement with the Corps' proposed action."

Comment: "In paragraph number 1.15 Recreational Facilities, the Parks and Recreation Department endorses the concept of recreational use of flood plain lands. A cooperative Federal-County venture, such as proposed for this project is most commendable. Similarly, this Department supports the plan as outlined in paragraph number 1.14 Aesthetic Improvements. Of particular interest is the planned replenishment of vegetation in rectified areas."

Response: None required.

Comment: "In paragraph number 3.05 Open Space Plan, the 'Open Space for Living' plan referenced in the statement has never received sufficient funding to justify its implementation as a cohesive plan of action. Secondly, since the plan was prepared in 1969 it is subject to a reordering of priorities. Thus, the 'Open Space for Living' plan and its recommendations should not be considered as the final course of action without verification from the Parks and Recreation Department. We will continue to investigate and encourage new funding sources to enable fulfillment of this concept."

Response: The statement has been revised in recognition of this comment (Paragraph 3.05).



Comment: "In paragraph number 6.03 Evacuation from the Flood Plain, this Department believes that whenever possible this action has the greatest potential benefits for the citizens of the area. However, we do recognize that in this particular instance, 'the high cost and the social disruption that would result from the forced relocation of nearly 10,000 persons,' make this an unreasonable alternative."

Response: Concur

(17) CITY OF JERSEY VILLAGE, TEXAS. (Attachments A-56 and A-57)

Comment: "We agree that a vast majority of the people in our City wholeheartedly indorse the selected plan and hope that the plan will quickly be approved and implemented."

Comment: "The primary benefits that we foresee from this project are:

Greatly increased protection from the possibility of flood damage. This is the most important of all factors and should be the predominant consideration in evaluating the plan or its environmental impact. Safety from floods will greatly improve the attractiveness of this area.

Cleaning of the present Upper White Oak Bayou. The portion of White Oak Bayou in and near the City of Jersey Village has not been properly maintained. It is now grown up in weeds, brush, and small trees so that it catches all kinds of trash and debris. This makes it a harbor for snakes and rodents, thus it has become a hazard to the health and safety of nearby residents. The planned rectification and concrete lining with pilot channel would eliminate this hazard.

Improved appearance of the Harris County Flood Control District Right-of-way. In addition to the physical hazard mentioned in the preceding comment, the neglected state of Upper White Oak Bayou creates an eye-sore in our City. Construction of the planned improvements would greatly simplify the maintenance needed to make this bayou an attractive part of the area."

Response: None required.

Comment: "The possible adverse effects we foresee from this project are:

If the present 150' right-of-way through Jersey Village must be expanded to 180', some lots already platted would be reduced in size so that it would be illegal to build residences on these lots under our zoning laws. If the planned improvements could be limited to the existing 150' right-of-way with only a temporary easement for construction access on the additional 15' on each side, then no serious adverse effects would be contemplated.

The hike and bike trails within the Jersey Village City Park which are a part of the recreational facilities in the selected plan are no longer practical. This area contains the new City swimming pool and parking lot as well as ball fields and playground equipment. Also part of this area will be used for our future Civic Center Building. We therefore feel that the hike and bike trail should end at mile 18.2."

Response: Detailed planning and design studies following congressional authorization will determine more accurately the right-of-way requirements for the project. Based on present studies, the 180 feet appears to be the amount of right-of-way required.

Recent Federal policy related to recreational development in conjunction with flood protection projects have required the deletion of trail development within city parks, except for public access. The present trail development plan thus complies with the desires of the city.

b. Citizen Groups. Draft copies of this environmental statement were also furnished to citizen and conservation groups. The only reply received is summarized and responded to below, and a copy of the reply is included in Appendix "A" (Attachment A-58)

MR. B. E. WOODALL, CIVILIAN ADVISORY GROUP. (Attachment A-58)

Comment: "The draft environmental statement as submitted does not require any further modification. I find that all aspects concerning the affected urbanized communities within the watershed have been adequately addressed in this statement."

Comment: "I urge that this environmental statement be submitted as a complement to the Interim Engineering Report on Upper White Oak Bayou at the earliest possible time to bring this flood control project to completion."

Response: The environmental statement will be submitted as a companion document to the Interim Feasibility Report on upper White Oak Bayou.

9.06. Comments Not Received. Comments on the draft statement were requested from the following agencies, organizations, and individuals, but no reply was received.

Region VI, Department of Housing and Urban Development  
Office of Environmental Programs, Federal Energy Administration

Dallas Regional Office, Federal Insurance Administration  
Coordinator for Water Resources, U.S. Department of Transportation

Deputy Assistant Director for Environmental Affairs,  
Department of Commerce

County Judge, Harris County

Harris County Commissioner, Precinct 1

Harris County Commissioner, Precinct 2

Harris County Commissioner, Precinct 3

Harris County Commissioner, Precinct 4

Harris County Flood Control District

County Engineer, Harris County

Harris County Flood Control Task Force

Harris County Parks Planning Department

Water Control and Improvement District 93, Harris County  
Mayor, City of Houston

Houston Chamber of Commerce

Water Resources Congress

Water Resources Council

Houston Sierra Club

Sportsmen's Clubs of Texas, Inc.

National Audubon Society

League of Women Voters

Bayou Preservation Association

Citizens Environmental Coalition

Citizens for Hike and Bike

Mr. Richard Higgenbotham, Citizens Advisory Group

Mr. Richard Crosser, Citizens Advisory Group

Mr. Robert E. Duke, Citizens Advisory Group

Mrs. Charles G. Hooks, Jr., Citizens Advisory Group

Mr. Joe L. Mitchell, Citizens Advisory Group

9.07. Other Coordination. A news release describing the proposed plan and stating that copies of the draft statement were available to the public on request was issued on 7 May 1976. A copy of this news release is attached as Appendix "B". Notice of the filing of the draft statement also appeared in the Federal Register on

7 May 1976. As a result of these notices, copies of the draft statement were requested by and sent to the following individuals, firms, and institutions listed below, but no comments were received from those listed.

Mr. Keith Ozmore, Office of U.S. Congressman, Bob Eckhardt,  
Houston, Texas

Mr. Harold Scarlett, Houston Post, Houston, Texas  
Vinson, Elkins, Searls, Connally, and Smith, Attorneys  
at Law, Houston, Texas

National Parks and Conservation Association, Washington, D.C.  
Northwestern University, Evanston, Illinois  
Colorado State University, Ft. Collins, Colorado  
Mitchell Carlison and Associates, Houston, Texas  
Mischer Corporation, Houston,

9.08 Coordination of the Revised Draft Environmental Statement.

The draft environmental statement was revised to reflect comments received during field level review. The revised draft environmental statement was furnished to the Department of Transportation; Department of Health, Education, and Welfare; Department of Commerce; Department of Agriculture; Department of the Interior; Department of Housing and Urban Development; Environmental Protection Agency; Advisory Council on Historic Preservation; and the Governor of Texas for review and was filed with the Council on Environmental Quality on 27 June 1977. With exception of the Department of Transportation and The Department of Housing and Urban Development, all of the above cited recipients of the revised draft statement replied with comments. All comments received are summarized and responded to below, and copies of the replies are attached to this statement as Appendix "C".

a. REGION VI, UNITED STATES ENVIRONMENTAL PROTECTION AGENCY. (Attachments C-1 and C-2)

Comment: "We classify your Draft Environmental Impact Statement as LO-1. Specifically, we have no objections to the project as it relates to Environmental Protection Agency's (EPA's) legislative mandates. The statement contained sufficient information to evaluate adequately the possible environmental impacts which could result from project implementation."

Response: No response required.

b. UNITED STATES DEPARTMENT OF THE INTERIOR. (Attachments C-3 and C-4)

Comment: "Page 12, Paragraph 2.17. The active surface fault mentioned in this paragraph should be evaluated in greater detail. One sentence states that land shifting along the fault has been 'gradual and not associated with earthquakes.' Another sentence suggests that this fault is associated with 'sudden land movement.' Regardless of which statement is the most accurate, once the problem is exposed its effect upon the proposed project should be fully discussed in the Impact Section of the EIS."

Response: The referenced paragraph has been revised. A known fault line traverses the project area and crosses White Oak Bayou and Vogel Creek where structural improvements are proposed. No physical evidence of land shifting is detectable in the area resulting from this fault line. Should the project be authorized, post authorization studies will more accurately evaluate the effects on the proposed action, and measures will be incorporated into the project design to minimize future maintenance and operation problems. No adverse effects on the proposed project are anticipated. A similar fault in the lower portion of the existing completed project has not resulted in any identifiable damage or related maintenance work.

Comment: "Page 21. The Probable Impact of the Proposed Action on the Environment. The proposed action will affect the hydrology of White Oak Bayou and move flows into Buffalo Bayou more rapidly. The effect, if any, on flooding along Buffalo Bayou should be discussed in this section."

Response: This information has been added to the statement (Paragraph 4.04).

Comment: "Page 22, Paragraph 4.08. It seems unreasonable to conclude that environmental damages from the disposal of 1,227,000 cubic yards of earth would be 'minimal' when the specific disposal sites remain unknown. The reviewer has been told that this material may be used for construction purposes, placed in selected disposal areas, dumped in open pastures, and the acquisition of disposal areas would be the responsibility of the project sponsor. The final EIS should clarify the disposal plans and discuss the impacts."

Response: With project construction at least 5 years away and with the rapid development currently under way in

the Houston area, selection of disposal areas at this time is impractical. Disposal areas will be selected to avoid or minimize environmental degradation.

Comment: "Page 28, Paragraph 6.07. The alternative of diverting water to Addicks Reservoir would compound flooding problems on Buffalo Bayou. This paragraph does not explain why water flowing down White Oak Bayou to Buffalo Bayou would not be a problem, but water diverted to a flood-control reservoir (Addicks) would be a problem. A summary of the explanation on page 42 of the Interim Report on Upper White Oak Bayou should be used.

Response: The referenced paragraph has been revised.

c. UNITED STATES DEPARTMENT OF COMMERCE. (Attachment C-5)

Comment: "Geodetic control survey monuments are located in the proposed project area. If there is any planned activity which will disturb or destroy these monuments, the National Ocean Survey (NOS) requires not less than 90 days' notification in advance of such activity in order to plan for their relocation. NOS recommends that funding for this project includes the cost of any relocation required for NOS monuments."

Response: Prior to initiation of the proposed plan, the National Ocean Survey will be advised so that bench marks, triangulation stations, and traverse stations that might be affected by the proposed action can be preserved or relocated. In the event that such monuments are damaged during evacuation operations, they will be replaced at project cost. Such costs are not expected to be appreciable therefore, the contingency item of the estimated project cost is considered adequate to cover this eventuality.

d. ADVISORY COUNCIL ON HISTORIC PRESERVATION. (Attachment C-6)

Comment: "We note from our review of the RDES that the Corps of Engineers recognizes its responsibility pursuant to Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. 470f, as amended, 90 Stat. 1320), should the proposed project be authorized. Accordingly, we look forward to working with the Corps in accordance with the 'Procedures for the Protection of Historic and Cultural Properties' (36 C.F.R. Part 800) at that time.

Response: No response required.

e. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE.  
(Attachment C-7)

Comment: "It is difficult to understand the extensive channel lining recommended for this project in view of the groundwater and ground level subsidence due to the extraction of municipal water supplies. Groundwater recharge either for the immediate area or the downstream areas should be analyzed to properly assess future effects on groundwater recharge potential with implementation of the preferred alternative."

Response: During detailed design of the proposed improvements, consideration of ground level subsidence and faulting will be incorporated into the final plan of improvement. Information related to ground water recharge has been added to the statement (Paragraph 4.05).

Comment: "2. Since all the alternatives have a Benefit-Cost (B/C) ratio greater than one, they appear to be viable. The repeated reference to the higher ratio infers that this ratio was used as the basis for the decision. However, we feel it is inappropriate to place this much emphasis on the B/C ratio because of the uncertainty involved in classifying items appropriately either as costs or negative benefits."

Response: The selected plan was not chosen simply based on the B/C ratio but considered equally environmental and social impacts such as relocation of homes, loss of wooded areas, and the well-being of area residents. Because of these factors, the most cost-effective plan was not selected.

f. DEPARTMENT OF AGRICULTURE. (Attachments C-8 and C-9)

Comment: "Section B, Appendix 1, Plate B-2 - It appears that the nonstructural management area along the upper reaches of White Oak Bayou will impact on large tracts of ricelands. The environmental impact statement (EIS) does not identify any of these ricelands as prime farmland. Since it is probable that some prime farmlands will be impacted by this proposed project, the EIS should identify such lands and describe any impacts that might occur. It would appear that protection of prime farmland should be a part of the nonstructural management plan."

Response: During preparation of the Phase I Design Memorandum, a request to the Department of Agriculture will be made for a determination of prime and unique farmlands in the project area. This information will be used in evaluating the impacts of the proposed and alternative plans of improvement.

g. BUDGET AND PLANNING OFFICE, STATE OF TEXAS. (Attachment C-10)

Forwarded comments of various state agencies and summarized significant comments. Comments of the agencies are given and responded to below:

(1) TEXAS PARKS AND WILDLIFE DEPARTMENT. (Attachment C-11 and C-12)

Comment: "The Texas Parks and Wildlife Department has reviewed the above-captioned report. Previous departmental comments, submitted June 21, 1976, have been satisfactorily addressed and incorporated within the subject document revisions."

Response: No response required.

(2) TEXAS WATER RIGHTS COMMISSION. (Attachments C-13 and C-14)

Comment: "The Commission staff reaffirms the review comments expressed in its May 20, 1977 letter (see pp. A-31, thru A-33, RDES) relative to both the April 1976 Draft Feasibility Report and the April 1976 Draft Environmental Statement for the proposed Upper White Oak Bayou Project. Since both documents are considered to be virtually inseparable project documents, we believe that all comments in our May 20, 1977, letter should be responded on on page 44 of the referenced RDES."

Response: Since the RDES is an integral part of the Feasibility Report and all comments from the Commission are included in the report, the need to duplicate this effort in the RDES is not considered necessary.

Comment: "In addition to earlier comments, the Commission staff now recommends that further special analysis be included in the RDES regarding the cumulative effects of the proposed segment of the Buffalo Bayou and Tributaries, Texas project, pursuant to policy contained in Section 3-3d of Corps of Engineers Pamphlet EP 1165-2-1, 10 January 1975. The policy states:



'The cumulative effects of the plan and other similar activities should be analyzed. Each proposed water resource development activity is but a piece of a large-scale program. The combined beneficial and adverse economic, environmental and social impacts of individual projects, each of which may be relatively minor, can have a significant regional or national impact. At each level of the evaluation and review process it is necessary to assess the cumulative beneficial and adverse effects of individual project impacts. Significant effects should guide the decisions.'

In short, the cumulative impacts of the fully-developed Buffalo Bayou and tributaries watershed should be assessed.

Response: Cumulative effects of the fully developed Buffalo Bayou and tributaries watershed on continued urban expansion in the Houston area cannot be identified. However, a trend toward development either with or without the project is expected. Expansion throughout the watershed has been much faster than originally estimated and there are no reasons why this should not continue. Cumulative effects of this urban expansion is beyond the scope of this statement.

(3) TEXAS DEPARTMENT OF HEALTH RESOURCES. (Attachments C-15 and C-16)

Comment: "The elimination of health hazards resulting from the creation of breeding areas for vectors in ponding water during and upon completion of the work should be included as a consideration of this flood damage prevention project."

Response: This health hazard was not originally considered in planning the project, yet benefits from eliminating this situation will be realized by construction of the proposed improvements and elimination of ponding areas.

Comment: "Brush and construction-demolition waste should be disposed of in a state-permitted or county-licensed sanitary landfill."

Response: Post-authorization planning and design of the proposed improvements will present detailed information concerning disposal of brush, excess material, and debris.

(4) BUUREAU OF ECONOMIC GEOLOGY. (Attachment C-17)

Comment: "The staff of the Bureau of Economic Geology have received the above cited report. We have no adverse comments on this project."

Response: No response required.

(5) TEXAS DEPARTMENT OF COMMUNITY AFFAIRS. (Attachment C-18)

Comment: "The Department of Community Affairs concurs in the plan and its recommended alternatives and will assist local governments in the area with whatever related problems or needs may arise from this project."

Response: No response required.

(6) GENERAL LAND OFFICE. (Attachment C-19)

No comment

(7) STATE DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION. (Attachment C-20)

Comment: "The Department does not have any comments to offer other than an explanation of the status of Beltway 8. Beltway 8 has been in the planning stage for many years. The County has constructed several short road segments which may serve as part of any ultimate facility. The development of Beltway 8 as a controlled access State highway facility to provide an outer loop around Houston is very uncertain at this time.

Response: This information has been added to the statement in Paragraph 3.06.

(8) TEXAS WATER DEVELOPMENT BOARD. (Attachment C-21)

Comment: "The proposed flood control improvements in Upper White Oak Bayou and its tributaries, Cole and Vogel Creeks, will, no doubt prove to be a vital asset to the area. As noted in our May 27, 1976, letter on the previous draft EIS, we are encouraged by the beneficial effects of flood protection afforded by this project and urge its early implementation.

Response: No response required.

(9) TEXAS WATER QUALITY BOARD. (Attachments C-22 and C-23)

Comment: "As per our letter of May 18, 1976 on this proposed action, any modification of sanitary sewer lines and construction of sewage pumping stations should be closely coordinated with the proper local jurisdictional entity, whether an incorporated city or municipal utility district, to insure that construction activity does not create a situation where degradation of water quality may occur. Examples of this potential degradation would result from: raw sewage bypasses due to construction; additional loadings to existing treatment facilities due to the incremental flow advantages of a pumping station; poor operation and maintenance of facilities due to uncertain ownership of proposed transportation facilities' modifications; and the deterioration of treatment efficiencies because of increased infiltration and/or inflow due to construction activities. The staff feels that these concerns have yet to be addressed in the draft environmental impact statement."

Response: Relocation and modification of sewer lines or pumping stations will be made so as to avoid such problems. During detailed design of the proposed plans and construction of the improvements, coordination with the proper local entity will be accomplished in order that a situation does not occur that will significantly degrade water quality.

Comment: "In addition, all controls and practices which prevent the erosion of soil associated with construction activities should be implemented in order to minimize any increase of pollutants in the State's waters."

Response: Post authorization planning and design will propose methods of control and prevention of soil erosion associated with construction activities to minimize any potential problems.

6

7

8

9

## GLOSSARY

1. Alta Loma Sand - Sediments of the Beaumont formation.
2. Annelid - Elongated segmented worms.
3. Beaumont clay - The most recent depositional surface of the Pleistocene epoch.
4. Benthic or benthic - Plants or animals living on, in, or near the bottom, often attached.
5. Berm - A narrow shelf or ledge.
6. Biochemical Oxygen Demand (BOD) - The amount of oxygen required to decompose (oxidize) a given amount of organic compounds to simple, stable substances - an index to the degree of organic pollution in the water. Although the time required for complete biological oxidation is considered to be about 20 days, it is common practice to use 5-day BOD values (BOD<sub>5</sub>) to represent pollutional loading.
7. Chemical Oxygen Demand (COD) - The amount of oxygen required to oxidize completely the organic and inorganic oxidizable compounds present - an index to the degree of pollution in water.
8. Conductivity - The capacity of a given water sample to conduct or transmit an electric current.
9. Dissolved Oxygen - The oxygen freely available in water. Adequate dissolved oxygen is necessary for the survival of fish and other aquatic organisms. About 3 - 5 mg/l is considered the lowest limit for support of fish life over a long period of time.
10. Ekman Dredge - A standard spring loaded device used for sampling soft substrates.
11. Coliform - Any of a number of organisms common to the intestinal tract of man and animals. Presence of coliform in waste water is an indication of pollution.
12. Fauna - Animal life of a region.
13. Flood Plain Management - A non-structural method of reducing flood losses by altering or controlling existing and future developments in flood prone areas.
14. Flora - The entire plant life of a region.
15. Lissie Formation - Sediments of the older portion of the Beaumont formation.
16. mg/l - Milligrams per liter.

17. MPN/100ml - Most probable number per 100 milliliters.
18. Nektonic - Free swimming organisms large and strong enough to be independent of turbulent water movement.
19. pH - The negative logarithm of the effective hydrogen ion concentration or hydrogen ion activity used in expressing both acidity and alkalinity on a scale of values from 0 to 14 with 7 representing neutrality.
20. Pleistocene Age - The earlier of the two epochs of the Quaternary Period comprised of five ice stages separated by four interglacial stages, or intervals when the ice retreated and vegetation returned.
21. ppm - Parts per million. In water analysis, ppm implies a weight/weight (not volume/volume) ratio.
22. Standard Project Flood - For the White Oak Bayou watershed is a severe flood which could be expected from the runoff from about 22 inches of rainfall in a 24 hour period.
23. Watershed - An entire drainage basin including living and non-living components of the system.

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Vines, Robert A. and Frederick W. Thurow. 1964. A checklist of the Native and Naturalized Plants of Houston and Vicinity. Copyright by Robert A. Vines, Houston, Texas, 133 p.



TABLE 1

PERTINENT DATA  
 SELECTED PLAN OF IMPROVEMENT  
 UPPER WHITE OAK BAYOU

S.P.F. - PARTIALLY LINED CHANNEL - MILE 10.69 to 19.90

NON-STRUCTURAL FLOOD PLAIN MANAGEMENT - MILE 19.90 to 25.50

Drainage area	51 sq. mi.
Stream miles above existing improvements	15 miles
Stream miles considered for structural improvements	9.21 miles
Stream miles considered for non-structural flood plain management	5.6 miles
Design standard project flood discharge	26,200 c.f.s.
Design channel slope	0.093%
Design channel bottom width (concrete):	
Mile 10.69 to mile 13.00	50 feet
Mile 13.00 to mile 19.90	40 feet
Depth of concrete	12 to 14 feet
Total channel depth	18 to 23 feet
Channel top width	150 to 190 feet
Bridges requiring alteration or relocation	9
Pipeline alterations required	40
Lateral storm sewer alterations required	118

TABLE 2

PERTINENT DATA  
 SELECTED PLAN OF IMPROVEMENT  
 S.P.F. - PARTIALLY LINED CHANNEL - COLE CREEK  
 STREAM MILE 0.00 to 4.90

Drainage area	10.4 sq. mi.
Stream miles considered for structural improvements	4.90 miles
Design standard project flood discharge	8,800 c.f.s.
Design channel slope	0.10%
Channel bottom width (concrete)	20 feet
Depth of concrete	8 to 9 feet
Total channel depth	12 to 15 feet
Channel top width	100 to 115 feet
Bridges requiring alterations or relocation	4
Pipeline alterations required	6
Lateral storm sewer alterations required	54

TABLE 3  
 PERTINENT DATA  
 SELECTED PLAN OF IMPROVEMENT  
 S.P.F. - PARTIALLY LINED CHANNEL IMPROVEMENTS - VOGEL CREEK  
 STREAM MILE 0.00 to 4.50

Drainage area	9.5 sq. mi.
Stream miles considered for structural improvements	4.5 miles
Design standard project flood discharge	7,700 c.f.s.
Design channel slope:	
Mile 0.00 to 1.60	0.10%
Mile 1.60 to 3.10	0.17%
Mile 3.10 to 4.50	0.145%
Channel bottom width:	
Mile 0.00 to 0.52	50 feet
Mile 0.52 to 1.60	42 feet
Mile 1.60 to 2.30	20 feet
Mile 2.30 to 4.50	10 feet
Average channel depth	10 to 16 feet
Bridges requiring alterations or relocation	10
Pipeline alterations required	10
Lateral storm sewer alterations required	23

TABLE 4

ECONOMICS OF THE SELECTED PLAN OF IMPROVEMENT  
 (STANDARD PROJECT FLOOD PROTECTION)

Plan Elements	Total First Cost	Average Annual Costs	Average Annual Benefits	Ratio of Benefits to Costs
White Oak Bayou Flood Control Plan	\$31,927,000	\$2,355,000	\$3,255,000	1.38
Cole Creek Flood Control Plan	11,499,000	826,000	907,000	1.10
Vogel Creek Flood Control Plan	12,506,000	890,000	2,740,000	3.08
Recreational Development Plan	854,000	98,000	109,000	1.11
Total Combined Plan of Improvement	\$56,786,000	\$4,169,000	\$7,011,000	1.68

TABLE 5  
COST APPORTIONMENT  
SELECTED PLAN OF IMPROVEMENT

	: Estimated First Costs		: Annual Operation, Maintenance and Major Replacement Costs	
	: Federal	: Non Federal	: Federal	: Non Federal
	White Oak Bayou Flood Control Plan	\$28,379,000	\$3,548,000	0
Cole Creek Flood Control Plan	10,003,000	1,496,000	0	45,000
Vogel Creek Flood Control Plan	11,038,000	1,468,000	0	40,300
Recreational Plan	<u>427,000</u>	<u>427,000</u> 1/	<u>0</u>	<u>43,500</u>
Total Project Plan	\$49,847,000	\$6,939,000	0	\$249,300

1/ Includes \$28,000 for recreational lands and a \$399,000 cash contribution to make the non-Federal share equal to 50 percent of the total recreational costs.

TABLE 6

WATER QUALITY DATA FOR WHITE OAK BAYOU, 1971-72 1/

<u>PARAMETER</u>	<u>MIN</u>	<u>MAX</u>	<u>AVG</u>
Water Temperature (°C)	6	32	22
pH	6.8	8.9	7.3
Dissolved Oxygen (mg/l)	0.2	16.7	4.7
Biochemical Oxygen Demand (mg/l)	1	41	4.6
Chemical Oxygen Demand (mg/l)	19	160	28.9
Conductivity (Micromhos)	216	2,400	921
Nitrogen (mg/l)			
NH <sub>3</sub> -N	0.0	25.6	2.6
NO <sub>2</sub> -N	0.0	0.6	0.1
NO <sub>3</sub> -N	0.1	0.9	0.2
Total Coliform (MPN/100ml)	1,200	330,000	62,000

## GENERAL WATER QUALITY CRITERIA

Biochemical Oxygen Demand (BOD)	
A natural stream in good condition	0.5 - 4 mg/l
Should not exceed	5.0 mg/l
Raw domestic sewage	100 - 300 mg/l
Well treated domestic sewage	10 - 20 mg/l
Dissolved Oxygen (DO)	
A natural stream in good condition	4 to 10 mg/l
Should not fall below	3 mg/l
pH	
Range in a natural stream	6.5 - 8.3
Should not fall below	5.0
Should not exceed	9.0
Fecal Coliform (MPN/100 ml)	
Acceptable limit for water	
contact recreation	less than 1,000
Acceptable limit for drinking water	less than 1
Raw sewage	10 - 20 million
Complete treated sewage	
unchlorinated	1 - 10 million
chlorinated	100 - 10,000

1/ From City of Houston, Water Pollution Control Division, Station 10 near confluence of White Oak Bayou and Cole Creek.

TABLE 7

WATER QUALITY DATA FOR WHITE OAK BAYOU 1973-74 1/

	Average Annual Values	
	<u>1973</u>	<u>1974</u>
Coliform (MPN/100ml)		
Total	2,395,283	1,115,474
Fecal	931,593	690,581
Dissolved Oxygen (mg/l)	3.2	6.3
Biochemical Oxygen Demand	11	10.1
Oil and Grease (mg/l)	1.6	1.2

1/ Water Pollution Control 1974 Annual Report by the Division of the City of Houston Health Department. Average for the total watershed.

TABLE 8

PERTINENT DATA FOR SELECTED PLAN AND ALTERNATIVES  
(STANDARD PROJECT FLOOD PROTECTION)

Factor/Plan	Selected Plan	Evacuation	Detention Reservoir and Partially Lined Channel	Diversion Channel	Earthen Channel	Flood Proofing
Channel length to be rectified (miles)	18.6	0	18.9	24.7	18.6	0
Stream miles for Flood Plain Management	9.6	28.8	9.3	9.2	9.6	28.8
Additional Rights- of-Way (acres)	61	0	2939	236	197	0
People relocated	0	10,000	0	0	29	0
Bridge alterations	23	0	26	27	27	0
Pipeline alterations	56	0	55	59	57	0
Storm sewer alterations	195	0	198	198	198	0
Clearing of natural vegetation (acres)	61	0	139	236	197	0
Disposal areas (acres)	139	0	106	326	906	0
Dredged Material (Cy)	1,227,000	0	792,000	2,444,000	4,869,000	0
Estimated cost of plan \$	56,786,000	ND <u>1/</u>	77,382,000	60,525,000	48,857,000	ND <u>1/</u>
Average Annual Flood Control & Recreation Benefits	7,011,000	ND <u>1/</u>	6,849,000	7,011,000	7,011,000	ND <u>1/</u>
Annual Charges	4,169,000	ND <u>1/</u>	5,970,000	4,461,000	3,806,000	ND <u>1/</u>
Benefit-to-cost ratio	1.68	ND <u>1/</u>	1.15	1.57	1.84	ND <u>1/</u>

1/ ND - No data

APPENDIX "A"

LETTERS RECEIVED BY THE DISTRICT ENGINEER  
ON THE DRAFT STATEMENT

Attachment

- 255 Forest Service, Department of Agriculture  
letter dated 1 June 1976
- 256 Soil Conservation Service, Department of  
Agriculture letter dated 7 June 1976
- 258 Geological Survey, Department of the Interior  
letter dated 26 May 1976
- 259 Fish and Wildlife Service, Department of the  
Interior letter dated 19 May 1976
- 260 National Park Service, Department of the Interior  
letter dated 27 May 1976
- 261 Bureau of Outdoor Recreation, Department of the  
Interior letter dated 26 May 1976
- 262 Bureau of Reclamation, Department of the  
Interior letter dated 3 June 1976
- 264 Regional Office, Department of Health, Educa-  
tion and Welfare letter dated 28 May 1976
- 266 Federal Highway Administration, Department of  
Transportation letter dated 13 May 1976
- 267 Region VI, Environmental Protection Agency  
letter dated 18 May 1976
- 270 Advisory Council on Historic Preservation  
letter dated 7 May 1976
- 272 Budget and Planning Office, Office of the Gover-  
nor of Texas letter dated 4 June 1976
- 274 Budget and Planning Office, Office of the Gover-  
nor of Texas letter dated 23 June 1976
- 275 Texas Air Control Board letter dated 11 May 1976
- 277 Texas Department of Agriculture memorandum  
dated 7 May 1976

Attachment

- 281 Texas Water Development Board letter dated  
27 May 1976
- 283 Texas Water Quality Board letter dated  
18 May 1976
- 285 Texas Water Rights Commission letter dated  
20 May 1976
- 290 Texas State Soil and Water Conservation Board  
letter dated 14 May 1976
- 291 Texas Parks and Wildlife Department letter  
dated 21 June 1976
- 295 Texas Department of Community Affairs memo-  
randum dated 21 May 1976
- 296 General Land Office of Texas memorandum  
dated 17 May 1976
- 297 Bureau of Economic Geology, The University of  
Texas at Austin undated memorandum
- 298 Texas Forest Service letter dated 18 June 1976
- 299 Texas Historical Commission letter dated  
5 November 1976
- 302 Houston-Galveston Area Council letter dated  
1 June 1976
- 308 City of Houston, Department of Parks and  
Recreation letter dated 8 June 1976
- 310 City of Jersey Village, Texas letter dated  
7 June 1976
- 312 Mr. B. E. Woodall, Civilian Advisory Group  
letter dated 17 May 1976



UNITED STATES DEPARTMENT OF AGRICULTURE  
FOREST SERVICE

1720 Peachtree Road, N. W.  
Atlanta, Georgia 30309

8400  
June 1, 1976



Colonel Don S. McCoy  
District Engineer  
Galveston District, Corps of Engineers  
P. O. Box 1229  
Galveston, TX 77553

Dear Colonel McCoy:

Here are United States Forest Service, State and Private Forestry comments on the draft Environmental Statement covering the Buffalo Bayou and Tributaries, Texas, Upper White Oak Bayou Flood Damage Prevention Project.

The statement reveals that flood plain regulation is a supplementary requirement for proposed improvement of Vogel and Cole Creek Channels. We recommend similar protection for the proposed improvement of the White Oak Bayou Channel.

Urbanization will be greatly accelerated by the project. Consequently, any serious considerations for open space, recreation areas, etc., should be incorporated in approved local land use plans prior to project construction.

We recommend early contact with the Texas Forest Service relative to possible State or National champion trees within the project area, protection of leave trees during construction and for advice and council on trees and shrubs to be used in landscaping the improved channel.

Thank you for the opportunity to review and comment on this draft Environmental Impact Statement.

Sincerely,

  
ROBERT K. DODSON

Area Environmental Coordinator

Copy: State Forester, Texas

**UNITED STATES DEPARTMENT OF AGRICULTURE**

**SOIL CONSERVATION SERVICE**

---

P. O. Box 648  
Temple, Texas 76501

June 7, 1976

Colonel Don S. McCoy  
District Engineer  
Department of the Army  
Galveston District, Corps of Engineers  
P. O. Box 1229  
Galveston, Texas 77553

Dear Colonel McCoy:

We have reviewed the draft environmental statement for flood damage prevention on Upper White Oak Bayou, Buffalo Bayou and Tributaries, Texas. The following comments are provided for your consideration in preparation of the final draft:

1. Page ii, Adverse Environmental Effects - It is suggested that the acres of woody vegetation to be destroyed be added.
2. Page 1, paragraph 1.02 - Information on the acreage and kinds of land damaged would be helpful to the reviewer.
3. Section 2, Environmental Setting Without The Project - A section on soils of the area would provide some basic information on type of material to be excavated, problems that may be encountered in park and natural area development, productivity, etc.
4. Page 14, paragraph 2.25, Vegetation - This section contains a good list of plants that may occur in the area. It is suggested that a description of the existing vegetation also be included to reflect present conditions in the project area.
5. Page 15, paragraph 2.29 - A description of wildlife habitat based on present vegetation would help clarify kinds of habitat to be affected.
6. Page 24, paragraph 5.01 - It would be helpful to include the acreage of trees and shrubs to be removed.
7. Page 31, sections 7 and 8 - It is suggested that acreages of wildlife habitat destroyed or changed be added.

8. There is no indication as to what effects these improved channels may have downstream on Buffalo Bayou on possible increase in flooding or other associated problems.

We appreciate the opportunity to provide comments for this draft statement.

Sincerely,

 3/11/12

George C. Marks  
State Conservationist



# United States Department of the Interior

GEOLOGICAL SURVEY  
RESTON, VIRGINIA 22092

OFFICE OF THE DIRECTOR

ER-76/418

MAY 26 1976

Colonel Don S. McCoy  
District Engineer  
Galveston District, Corps of Engineers  
P. O. Box 1229  
Galveston, Texas 77553

Dear Colonel McCoy:

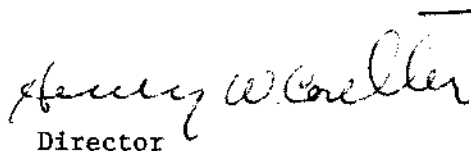
We have reviewed your draft environmental statement for Upper White Oak Bayou, covering flood damage prevention along Buffalo Bayou and tributaries, Harris County, Texas. The following suggestions are offered at this time, prior to the Department of the Interior's more formal review of the proposal by the Chief of Engineers at a later date.

Measures for protecting the disposal site for excavated material (p. 4, par. 1.03; p. 22, par. 4.08) should be considered in order to minimize any adverse effects of erosion that may result from stormwater runoff.

We find no treatment of ground water or impacts of the project on ground-water resources in the statement. The effects of lining, rectification, and enlargement of channels on ground-water resources should be considered. Similarly, we suggest that the statement evaluate effects of revised storm drainage as well as those of the adjunct recreational use development.

Thank you for the opportunity to comment on the draft environmental statement.

Sincerely yours,

  
Director



IN REPLY REFER TO:

UNITED STATES  
DEPARTMENT OF THE INTERIOR  
FISH AND WILDLIFE SERVICE

(ES)

POST OFFICE BOX 1306  
ALBUQUERQUE, NEW MEXICO 87103

May 19, 1976

District Engineer  
Corps of Engineers, U. S. Army  
Post Office Box 1229  
Galveston, Texas 77550

Dear Sir:

The U. S. Fish and Wildlife Service has reviewed the Draft Environmental Statement for "Buffalo Bayou and Tributaries, Texas-Upper White Oak Bayou-Flood Damage Prevention," as requested in your letter dated April 23, 1976.

We generally find the statement to be an adequate assessment of impacts expected from the proposed project. However, two items are discussed below which we believe should be rectified:

Page 21, paragraph 4.03. We question the inclusion of this paragraph. While the orderly appearance of maintained floodways with bermudagrass turf and neatly spaced trees might constitute an improvement of esthetic quality to some, to others the natural setting with a large diversity of weeds and brush would be less monotonous and preferable. Hence, because Paragraph 4.03 in its entirety is highly debatable, we recommend that it be deleted.

Page 31, paragraph 8. While we agree that removal of habitat in the channelized portion of the streams is an irreversible loss, we disagree that removal of habitat along the channelized portion should be considered an irreversible loss.

We appreciate the opportunity to comment on the statement.

Sincerely yours,

Assistant Regional Director

cc: Field Supervisor, FWS, Ecological Services, Galveston, Texas  
Director, FWS, Washington, D. C. (ES)



United States Department of the Interior  
NATIONAL PARK SERVICE  
SOUTHWEST REGION  
P.O. Box 728  
Santa Fe, New Mexico 87501

IN REPLY REFER TO:

L7619 (SWR) PSE  
ER 76/418

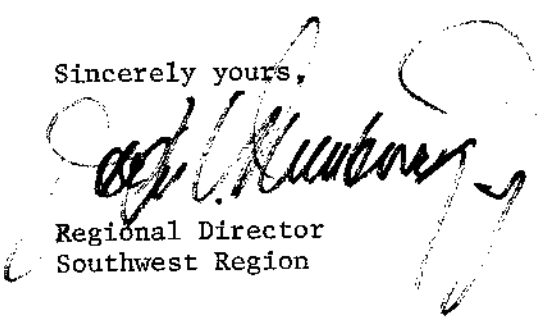
Colonel Don S. McCoy, District Engineer  
Galveston District, Corps of Engineers  
P. O. Box 1229  
Galveston, Texas 77553

Dear Colonel McCoy:

We have reviewed the draft environmental statement for flood damage prevention, Upper White Oak Bayou, Buffalo Bayou and Tributaries, Harris County, Texas, and have no comments.

The final environmental statement should include the comments of the State Historic Preservation Officer following his review of the proposed project. He is Mr. Truett Latimer, Executive Director, Texas Historical Commission, P. O. Box 12276, Capitol Station, Austin, Texas 78711.

Sincerely yours,



Regional Director  
Southwest Region



United States Department of the Interior  
BUREAU OF OUTDOOR RECREATION

SOUTH CENTRAL REGIONAL OFFICE  
PATIO PLAZA, 5000 MARBLE N.E., ROOM 211  
ALBUQUERQUE, NEW MEXICO 87110

IN REPLY REFER TO:

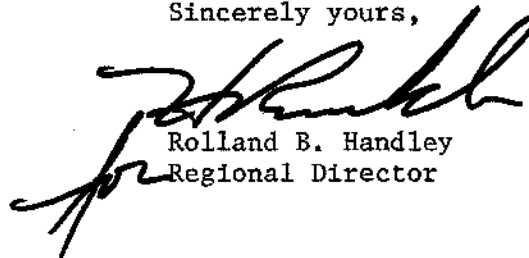
ER-76/418

Lt. Col. Kenneth P. Bretsch  
Deputy District Engineer  
Corps of Engineers  
Galveston District  
P.O. Box 1229  
Galveston, Texas 77553

Dear Colonel Bretsch:

As requested, we have reviewed the draft environmental statement for Upper White Oak Bayou; Flood Damage Prevention, Buffalo Bayou and Tributaries, Harris County, Texas. We find the document to be comprehensive in scope and satisfactory with respect to outdoor recreation.

Sincerely yours,



Rolland B. Handley  
Regional Director

cc: O.E.A., BOR, WASO



United States Department of the Interior  
BUREAU OF RECLAMATION

SOUTHWEST REGION  
HERRING PLAZA BOX H-4877  
AMARILLO, TEXAS 79101

IN REPLY  
REFER TO: 735

125.1

Colonel Don S. McCoy  
District Engineer  
Corps of Engineers  
Post Office Box 1229  
Galveston, Texas 77553

Dear Colonel McCoy:

In response to your letter of April 23, the Director, Office of Environmental Project Review has requested the Bureau of Reclamation to review the draft environmental statement for Upper White Oak Bayou; Flood Damage Prevention, Buffalo Bayou and Tributaries, Harris County, Texas. The Commissioner of Reclamation requested this office to review the statement and provide our comments directly to you.

Therefore, the following Bureau of Reclamation comments are provided to you for your consideration in revising the draft statement.

Coverage of environmental, economic, and social aspects within the expertise of the Bureau of Reclamation is generally adequate. Tables used in the statement are appropriate in number and content, and the tables are clear.

Clarification is needed in a few places.

Page 1, paragraph 1.02--Does the total average annual damage (\$4,146,000 for White Oak, Cole, and Vogel Creeks) include a wider range of damage than the average annual potential flood damage to existing properties (\$1,639,000 for White Oak Bayou alone)?


Page 9, paragraph 2.04 and page 21, paragraph 4.03--Are there assurances that maintenance of the proposed features will be at a higher level than for features implemented in the past?



Page 23, paragraph 4.11--The positive statement made in paragraph 5.03 that steps will be taken seems appropriate as a part of paragraph 4.11.

This office will be glad to give further assistance if it is requested.

Sincerely yours,

  
J. A. Bradley  
Regional Director

cc: Commissioner  
Attention: 150  
Director, Office of Environmental Project Review



DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

REGIONAL OFFICE  
1200 MAIN TOWER BUILDING  
DALLAS, TEXAS 75202

OFFICE OF  
THE REGIONAL DIRECTOR

May 28, 1976

Our Reference: EI# 0176-677  
Draft Environmental Statement  
Buffalo Bayou and Tributaries

Department of the Army  
Galveston District, Corps of Engineers  
ATTN: SWGED-E  
P.O. Box 1229  
Galveston, Texas 77553

Dear Sir:

Pursuant to your request, we have reviewed the Environmental Impact Statement for the above project proposal in accordance with Section 102(2)(C) of P.L. 91-190, and the Council on Environmental Quality Guidelines of April 23, 1971.

Environmental health program responsibilities and standards of the Department of Health, Education, and Welfare include those vested with the United States Public Health Service and the Facilities Engineering and Construction Agency. The U.S. Public Health Service has those programs of the Federal Food and Drug Administration, which include the National Institute of Occupational Safety and Health and the Bureau of Community Environmental Management (housing, injury control, recreational health and insect and rodent control).

Accordingly, our review of the Draft Environmental Statement for the project discerns no adverse effects that might be of significance where our program responsibilities and standards pertain, provided that appropriate guides are followed in concert with State, County, and local environmental health laws and regulations.

We therefore have no objection to the authorization of this project insofar as our interests and responsibilities are concerned.

Sincerely,

D. Dean Blue  
Regional Environmental Officer  
Facilities Engineering  
and Construction

DEPARTMENT OF HEALTH, EDUCATION AND WELFARE

Reaction Review and Comments on Environmental Impact Statement for Project Proposal:

Draft Environmental Impact Statement Reviewed with Objections

Draft Environmental Impact Statement Reviewed with No Objections

Date: May 27, 1976

EI#: 0176-677

Agency/Bureau: DHEW/PHS

Project Proposal: Buffalo Bayou and Tributaries, Texas  
Upper White Oak Bayou

Comments:



U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL HIGHWAY ADMINISTRATION  
826 FEDERAL OFFICE BUILDING  
AUSTIN, TEXAS 78701

May 13, 1976

IN REPLY REFER TO

06-48.10B

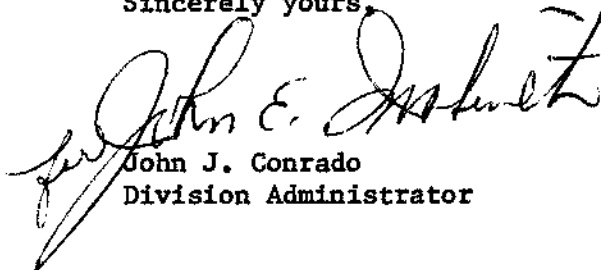
Draft Environmental Statement  
Upper White Oak Bayou

Colonel Don S. McCoy  
District Engineer  
Galveston District, Corps of Engineers  
P. O. Box 1229  
Galveston, Texas 77553

Dear Colonel McCoy:

We have no comments to offer concerning the subject draft  
environmental statement.

Sincerely yours,



John J. Conrado  
Division Administrator

**ENVIRONMENTAL PROTECTION AGENCY**

**REGION VI**

**1600 PATTERSON, SUITE 1100**

**DALLAS, TEXAS 75201**

**May 18, 1976**

**OFFICE OF THE  
REGIONAL ADMINISTRATOR**

Colonel Don S. McCoy  
District Engineer  
Department of the Army  
Galveston District, Corps of Engineers  
P. O. Box 1229  
Galveston, Texas 77553

Dear Colonel McCoy:

We have reviewed the Draft Environmental Statement and the Draft Feasibility Report on Upper White Oak Bayou. The proposed plan is to prevent flood damages to urban development on upper White Oak Bayou and its tributaries Cole and Vogel Creeks in the vicinity of Houston, Texas. The structural project under consideration is for the section of White Oak Bayou from mile 10.7 to mile 19.9, Cole Creek from White Oak Bayou to mile 4.5.

In general, the statement discusses several environmental impacts of the proposed project. However, we are including the following comments for your consideration in preparing the final statement.

1. The statement should include a discussion of construction impacts on air quality including increased vehicular emissions from construction equipment.

2. The final statement should identify sensitive receptors such as schools, churches, hospitals in the project area. The effects of construction noise and the specific precautions for noise abatement and protection of the area residents from construction-related noise impacts should be discussed.

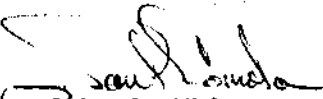
3. The statement should more fully describe the modifications to be made on the ten pipelines as a result of the project. Changes to pipelines carrying oil or wastewater could become significant from a public health standpoint if adequate pollution abatement controls are not implemented.

These comments classify your Draft Environmental Impact Statement as LO-2. Generally, we have no objection to the project as proposed. However, we are requesting additional information be provided concerning air and noise quality plus information on spill prevention. The classification and the date of our comments will be published in the Federal Register in accordance with our responsibility to inform the public of our views on proposed Federal actions, under Section 309 of the Clean Air Act.

Definitions of the categories are provided on the attachment. Our procedure is to categorize our comments on both the environmental consequences of the proposed action and on the adequacy of the impact statement at the draft stage, whenever possible.

We appreciate the opportunity to review the Draft Environmental Impact Statement and the Draft Feasibility Report and we will be happy to discuss our comments with you. Please send us two copies of the Final Environmental Impact Statement at the same time it is sent to the Council on Environmental Quality.

Sincerely yours,

  
John C. White  
Regional Administrator

Enclosure

## ENVIRONMENTAL IMPACT OF THE ACTION

### IO - Lack of Objections

EPA has no objections to the proposed action as described in the draft impact statement; or suggests only minor changes in the proposed action.

### ER - Environmental Reservations

EPA has reservations concerning the environmental effects of certain aspects of the proposed action. EPA believes that further study of suggested alternatives or modifications is required and has asked the originating Federal agency to re-assess these aspects.

### EU - Environmentally Unsatisfactory

EPA believes that the proposed action is unsatisfactory because of its potentially harmful effect on the environment. Furthermore, the Agency believes that the potential safeguards which might be utilized may not adequately protect the environment from hazards arising from this action. The Agency recommends that alternatives to the action be analyzed further (including the possibility of no action at all).

## ADEQUACY OF THE IMPACT STATEMENT

### Category 1 - Adequate

The draft impact statement adequately sets forth the environmental impact of the proposed project or action as well as alternatives reasonably available to the project or action.

### Category 2 - Insufficient Information

EPA believes the draft impact statement does not contain sufficient information to assess fully the environmental impact of the proposed project or action. However, from the information submitted, the Agency is able to make a preliminary determination of the impact on the environment. EPA has requested that the originator provide the information that was not included in the draft statement.

### Category 3 - Inadequate

EPA believes that the draft impact statement does not adequately assess the environmental impact of the proposed project or action, or that the statement inadequately analyzes reasonably available alternatives. The Agency has requested more information and analysis concerning the potential environmental hazards and has asked that substantial revision be made to the impact statement. If a draft statement is assigned a Category 3, no rating will be made of the project or action, since a basis does not generally exist on which to make such a determination.

Advisory Council  
On Historic Preservation

1522 K Street N.W.  
Washington, D.C. 20005

May 7, 1976

Colonel Don S. McCoy  
District Engineer  
Corps of Engineers, Galveston District  
U. S. Department of the Army  
P. O. Box 1229  
Galveston, Texas 77553

Dear Colonel McCoy:

This is in response to your request of April 28, 1976 for comments on the draft environmental statement (DES) for the Buffalo Bayou and Tributaries, Upper White Oak Bayou, Flood Damage Protection, Texas. Pursuant to its responsibilities under Section 102(2)(C) of the National Environmental Policy Act of 1969, the Advisory Council has determined that the DES appears adequate concerning compliance with Section 106 of the National Historic Preservation Act of 1966. However, with respect to compliance with Executive Order 11593, "Protection and Enhancement of the Cultural Environment" issued May 13, 1971, we note that the undertaking as proposed may effect two sites which appear to possess archeological significance and thus may be eligible for inclusion in the National Register of Historic Places.

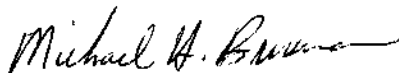
Therefore, pursuant to Section 2(b) of the Executive Order 11593 and Section 800.4(a)(2) of the "Procedures for the Protection of Historic and Cultural Properties" (36 C.F.R. Part 800), which sets forth the steps for compliance with the Order, the Council requests the Corps of Engineers to request in writing an opinion from the Secretary of the Interior respecting these properties' eligibility for inclusion in the National Register of Historic Places and inform us of the findings. Furthermore, the Corps is reminded that should the Secretary of the Interior determine the properties are eligible for inclusion in the National Register, it should follow the remaining steps in Section 800.4 of the procedures to evaluate the effect and obtain the Council's comments as appropriate.

Until the requirements of the Executive Order 11593 and the procedures are met, the Council considers the DES to be incomplete in its treatment



of the cultural resources. To remedy this deficiency, the Council will provide substantive comments on the undertaking's effect on the above cited properties through the process set forth in the procedures. Please contact Michael H. Bureman of the Advisory Council staff at P. O. Box 25085, Denver, Colorado 80225, telephone number (303) 234-4946, to assist you in completing this process as expeditiously as possible to avoid any unnecessary delays in the implementation of the project.

Sincerely yours,



Louis S. Wall

Assistant Director, Office  
of Review and Compliance



OFFICE OF THE GOVERNOR

DOLPH BRISCOE  
GOVERNOR

June 4, 1976

Colonel Don S. McCoy  
Galveston District  
Corps of Engineers  
P. O. Box 1229  
Galveston, Texas 77550

Dear Colonel McCoy:

The draft environmental impact statement prepared by the Corps of Engineers to accompany the draft Feasibility Report, "Buffalo Bayou and Tributaries, Texas--Upper White Oak Bayou--Flood Damage Prevention," has been reviewed by the Budget and Planning Office and interested State agencies in accordance with the National Environmental Policy Acts of 1969. Comments on the draft Feasibility Report are being forwarded by separate correspondence.

The enclosed comments submitted by the reviewing agencies should be considered in their entirety. The following is a brief summary of these comments:

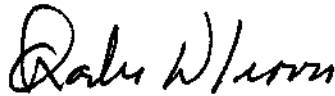
1. The Texas Water Rights Commission, retaining the right to future formal action under Section 6.073, Texas Water Code, commented on the effects of subsidence and stated that the report should include a more rigorous assessment of land subsidence impacts. They also suggested that a statement be included regarding the realistic limitations involved in determining flood control benefits and damages.
2. The Texas Water Quality Board noted the provisions, outlined in the statement, for controlling water pollution and, as an additional measure, they stated that modifications to the existing sewer system should be in accord with approved areawide or regional sewerage plans.
3. The Texas Department of Agriculture provided information on agricultural production and stated that the failure to mention agriculture or its relationship to the proposed flood damage prevention program should be corrected.

4. The Texas Water Development Board suggested that the effects of land subsidence and related active faulting in the project area, as they relate to flooding of low-lying areas, be discussed in the section on Geology. They also suggested a clarifying amendment to a statement in the draft concerning the building of homes in the flood plain.

Other reviewing agencies commented favorably on this draft environmental impact statement. In addition to their concurrence, the Texas Air Control Board provided guidance for any outdoor burning that may be required.

The enclosed comments of the reviewing agencies are provided to assist your planning efforts. If this Office can be of any further assistance, please contact us.

Sincerely,



Charles D. Travis, Director  
Budget and Planning Office

Enclosures



OFFICE OF THE GOVERNOR

DOLPH BRISCOE  
GOVERNOR

June 23, 1976

Colonel Jon C. Vanden Bosch  
District Engineer, Galveston District  
Corps of Engineers  
P. O. Box 1229  
Galveston, Texas 77553

Dear Colonel Vanden Bosch:

The Budget and Planning Office recently coordinated the review of the draft Feasibility Report and the draft environmental impact statement for "Buffalo Bayou and Tributaries, Texas--Upper White Oak Bayou--Flood Damage Prevention." Subsequent to this review, the enclosed comments were received from the Texas Parks and Wildlife Department. The comments of that agency are forwarded to assist your planning effort.

If this Office can be of further assistance, please contact us.

Sincerely,

A handwritten signature in cursive script, appearing to read "H. Anthony Breard".

H. Anthony Breard, Coordinator  
Natural Resources Section  
Budget and Planning Office

Enclosures



# TEXAS AIR CONTROL BOARD

PHONE 512/451-5711  
8520 SHOAL CREEK BOULEVARD

CHARLES R. BARDEN, P. E.  
EXECUTIVE DIRECTOR

JOHN L. BLAIR, Chairman  
WILLIAM N. ALLAN  
JOE C. BRIDGEFARMER, P.E.  
FRED HARTMAN

AUSTIN, TEXAS - 78758

CHARLES R. JAYNES  
D. JACK KILIAN, M.D.  
WILLIAM D. PARISH  
E. W. ROBINSON, P.E.  
WILLIE L. ULICH, Ph.D., P.E.

May 11, 1976

Mr. H. Anthony Breard, Coordinator  
Natural Resource Section  
Budget and Planning Office  
Governor's Office  
Executive Office Building  
411 West 13th Street  
Austin, Texas 78701

Re: Draft Environmental Impact Statement: Flood Damage  
Prevention - Upper White Oak Bayou, Buffalo Bayou,  
and Tributaries, Texas

Dear Mr. Breard:

We have reviewed the above cited document. Any outdoor  
burning of brush must be done in accordance with Regula-  
tion I, Rule 101.26 of the Texas Air Control Board.

Thank you for the review opportunity. If we can assist  
further, please contact me.

Sincerely yours,

A handwritten signature in cursive script, appearing to read "Bill Stewart".

Bill Stewart, P.E.  
Deputy Director  
Control and Prevention

cc: Mr. Lloyd Stewart, Regional Supervisor, Bellaire

TO: Charles D. Travis, Director  
Budget and Planning Office  
Office of the Governor  
(Attn: State Clearinghouse)

Date: Sent: May 6, 1976

Date: Due: May 26, 1976

Refer: EIS- EIS -6-05-002

FROM: *Charles R. Barden - TACB*

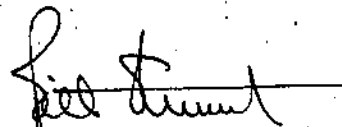
SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT: FLOOD DAMAGE PREVENTION UPPER WHITE OAK BAYOU, BUFFALO BAYOU AND TRIBUTARIES, TEXAS

We have reviewed the cited document and our comments as to the adequacy of treatment of environmental effects of concern are shown below:

	Check (✓) for each item	
	Done	Comment enclosed
1. Additional specific effects which should be assessed:	X	
2. Additional alternatives which should be considered:	X	
3. Better or more appropriate measures and standards which should be used to evaluate environmental effects:	X	
4. Additional control measures which should be applied to reduce adverse environmental effects or to avoid or minimize the irreversible or irretrievable commitment of resources.	X	
5. Our assessment of how serious the environmental damage from this project might be, using the best alternative and control measures:	X	
6. We identify issues which require further discussion or resolution:	X	

This agency concurs with the implementation of this project.

This agency does not wish to comment on the subject document because:



Name & title of Reviewing official  
Bill Stewart, P.E.  
Deputy Director  
Control and Prevention



MEMO

Budget/Planning

DATE: May 7, 1976

RE: Comments, DEIS: Flood Damage Prevention-Upper White  
Oak Bayou, Buffalo Bayou and Tributaries, Texas

Item 6: In 1974, Harris and Houston Counties produced more than \$30,000,000 worth of agricultural products. This DEIS fails to mention agriculture or its relationship to the proposed flood damage prevention program. This oversight should be corrected.

A handwritten signature in cursive script, appearing to read "Ed Nichols".

Ed Nichols, Assistant Commissioner

Budget and Planning Office  
 Office of the Governor  
 (Attn: State Clearinghouse)

Date: Sent: May 6, 1976

Date: Due: May 26, 1976

Refer: EIS- EIS -6-05-002

FROM:

*John C. White - T. D. A.*

SUBJECT:

DRAFT ENVIRONMENTAL IMPACT STATEMENT: FLOOD DAMAGE PREVENTION UPPER WHITE OAK BAYOU, BUFFALO BAYOU AND TRIBUTARIES, TEXAS

We have reviewed the cited document and our comments as to the adequacy of treatment of environmental effects of concern are shown below:

	Check (✓) for each item	
	Done	Comment enclosed
1. Additional specific effects which should be assessed:		
2. Additional alternatives which should be considered:		
3. Better or more appropriate measures and standards which should be used to evaluate environmental effects:		
4. Additional control measures which should be applied to reduce adverse environmental effects or to avoid or minimize the irreversible or irretrievable commitment of resources.		
5. Our assessment of how serious the environmental damage from this project might be, using the best alternative and control measures:		
6. We identify issues which require further discussion or resolution:		✓

This agency concurs with the implementation of this project.

This agency does not wish to comment on the subject document because:

*Samuel L. DeLoach*  
 Name & Title of Reviewing official



# HOUSTON

## 1. CROPS

CROP	PLANTED ACRES	HARVESTED ACRES	YIELD PER HARVESTED ACRE	UNIT	PRODUCTION
UPLAND COTTON	9,000	7,500	250	Lb./Bale	3,900
AMERICAN - PIMA COTTON	--	--	--	Lb./Bale	--
WHEAT	--	--	--	Bushel	--
OATS	4,200	200	26.0	Bushel	5,200
BARLEY	--	--	--	Bushel	--
RYE	2,700	700	5.1	Bushel	3,600
FLAXSEED	--	--	--	Bushel	--
SORGHUMS	1/ 5,200	2,700	68.5	Bushel	185,000
{ GRAM	--	--	--	Ton	--
{ ENLAGE	--	1,900	1.8	Ton	3,500
{ HAY	--	--	--	Bushel	--
CORN	1/ 2,800	2,700	37.4	Bushel	101,000
{ GRAM	--	--	--	Ton	--
{ ENLAGE	--	--	--	Bushel	--
SOYBEANS	--	--	--	Bushel	--
PEANUTS	6,350	6,300	1,022	Pound	6,436,000
RICE	--	--	--	Lb./cwt.	--
SUGARCANE	--	--	--	Ton	--
CASIOREANS	--	--	--	Pound	--
SUGARBETTS	--	--	--	Ton	--
CLAR	--	--	--	Pound	--
ALFAFA HAY	--	18,100	1.82	Ton	33,000
OTHER HAY EXCLUDING SORGHUM	--	--	--	Ton	--
VETCH SEED	--	--	--	Pound	--
COWPEAS	1/ --	--	--	Pound	--
{ GREEN	--	--	--	Pound	--
{ DRY	--	--	--	Pound	--

## 2. IRRIGATED CROPS

SELECTED CROP	ACRES PLANTED		ACRES HARVESTED		UNIT	YIELD PER HARVESTED ACRE	
	IRRIGATED	NOT IRRIGATED	IRRIGATED	NOT IRRIGATED		IRRIGATED	NOT IRRIGATED
UPLAND COTTON	--	9,000	--	7,500	Pound	--	250
WHEAT	--	--	--	--	Bushel	--	--
SORGHUMS FOR GRAIN	1/ --	1/ 5,000	--	2,500	Bushel	--	68.4
PEANUTS	1,000	5,350	1,000	5,300	Pound	1,507	930

## 3. VEGETABLES FOR FRESH MARKET AND PROCESSING

CROP	ACRES HARVESTED	CROP	ACRES HARVESTED	CROP	ACRES HARVESTED
BROCCOLI	--	SWEET CORN 2/	--	TOMATOES	--
CABBAGE	--	HONEYDEW MELONS	--	WATERMELONS	200
CANTALOUPES	--	LETTUCE	--	IRISH POTATOES	*
CARROTS	--	ONIONS	--	SWEET POTATOES	*
CAULIFLOWER	--	GREEN PEAS	--	ALL VEGETABLES	300
CUCUMBERS	--	SPINACH 2/	--		

## 4. FRUITS AND PECANS

CROP	PRODUCTION
PEACHES (Bu.)	1,100
GRAPEFRUIT (80 Lb. box)	--
ORANGES (85 Lb. box)	--
Pecans 1973	3/
(%) 1974	*

## 5. 1974 LIVESTOCK PRODUCTION OR MARKETING

EGGS PRODUCED (000)	2,400
BROILERS PRODUCED (000)	--
TURKEYS PRODUCED (000)	--
MILK PRODUCED (000)	12,000
WOOL PRODUCED (Pound)	--
MOHAIR PRODUCED (Pound)	--
CATTLE MARKETED FROM FEEDLOTS (Number)	*

## 6. JANUARY 1 LIVESTOCK ON FARMS

ITEM	1975
ALL CATTLE	145,000
MILK COWS THAT HAVE CALVED	1,300
BEEF COWS THAT HAVE CALVED	77,000
CATTLE ON FEED	*
ALL HOGS 4/	7,000
ALL SHEEP	--
EWES 1 YEAR AND OVER	--
ALL ANGORA GOATS	--
HENS AND FULLETS OF LAYING AGE (000) 5/	9

## 7. GOVERNMENT PAYMENTS IN 1974

ITEM	DOLLARS
FEED GRAIN PROGRAM	7,015
WHEAT PROGRAM	--
UPLAND AND AP COTTON PROGRAM	112,309
SUGARBEET PROGRAM	--
WOOL AND MOHAIR PROGRAM	--
GREAT PLAINS CONSERVATION PROGRAM	--
CROPLAND ADJUSTMENT PROGRAM	78,218
RURAL ENVIRONMENTAL ASSISTANCE PROGRAM	542,717
BEEES AND MILK PROGRAM	--

## 8. CASH RECEIPTS FROM FARM MARKETINGS

ITEM	1973 3/	1974
	1,000 DOLLARS	
ALL CROPS 5/	4,438	3,168
LIVESTOCK AND LIVESTOCK PRODUCTS	19,373	15,780
TOTAL CROPS AND LIVESTOCK	23,811	18,948
GOVERNMENT PAYMENTS	770	740
TOTAL FARM MARKETINGS AND GOVERNMENT PAYMENTS	24,581	19,688

Items reported but not published on a county basis because of either limited production or to avoid disclosure of individual operations. 1/Planted for all purposes. 2/Fresh market only but processing included in all vegetables. 3/Revised. 4/On hand preceding December 1. 5/Does not include value of standing timber sold from industry, public, and other non-farm timberlands. For values see cash receipts bulletin.

1974 AGRICULTURAL STATISTICS

1. CROPS

CROP	PLANTED ACRES	HARVESTED ACRES	YIELD PER HARVESTED ACRE	UNIT	PRODUCTION
UPLAND COTTON	850	850	169	Lb./Bale	300
AMERICAN - PIMA COTTON	--	--	--	Lb./Bale	--
WHEAT	1,100	700	13.4	Bushel	9,400
OATS	1,300	--	--	Bushel	--
BANLEY	--	--	--	Bushel	--
RYE	--	--	--	Bushel	--
FLAXSEED	--	--	--	Bushel	--
SORGHUMS	3,600	1,600	58.6	Bushel	93,600
GRAIN	1/	--	--	Bushel	--
SILAGE	--	--	--	Ton	--
HAY	--	1,400	3.6	Ton	5,000
CORN	2,100	2,000	60.5	Bushel	121,000
GRAIN	1/	--	--	Bushel	--
SILAGE	--	--	--	Ton	--
SOYBEANS	17,500	17,400	27.4	Bushel	477,000
PEANUTS	1,375	1,335	1,914	Pound	2,555,000
RICE	30,900	30,850	4,596	Lb./Cwt.	1,418,000
SUGARCANE	--	--	--	Ton	--
CASTORBEANS	--	--	--	Pound	--
SUGARBEETS	--	--	--	Ton	--
GUAR	--	--	--	Pound	--
ALFALFA HAY	--	--	--	Ton	--
OTHER HAY - EXCLUDING SORGHUM	--	12,900	2.23	Ton	28,800
VETCH SEED	--	--	--	Pound	--
COWPEAS	1/	--	--	Pound	--
GREEN	--	--	--	Pound	--
DRY	--	--	--	Pound	--

2. IRRIGATED CROPS

SELECTED CROP	ACRES PLANTED		ACRES HARVESTED		UNIT	YIELD PER HARVESTED ACRE	
	IRRIGATED	NOT IRRIGATED	IRRIGATED	NOT IRRIGATED		IRRIGATED	NOT IRRIGATED
UPLAND COTTON	--	850	--	850	Pound	--	169
WHEAT	--	1,100	--	700	Bushel	--	13.4
SORGHUMS FOR GRAIN	1/	3,600	--	1,600	Bushel	--	58.6
PEANUTS	--	1,375	--	1,335	Pound	--	1,914

3. VEGETABLES FOR FRESH MARKET AND PROCESSING

CROP	ACRES HARVESTED	CROP	ACRES HARVESTED	CROP	ACRES HARVESTED
BROCCOLI	--	SWEET CORN 2/	--	TOMATOES	--
CABBAGE	200	HONEYDEW MELONS	--	WATERMELONS	--
CAR/CAULIFLOWS	*	LETTUCE	--	IRISH POTATOES	100
CARROTS	*	ONIONS	--	SWEET POTATOES	--
CAULIFLOWER	--	GREEN PEPPERS	--	ALL VEGETABLES	500
CUCUMBERS	--	SPINACH 2/	--		

4. FRUITS AND PECANS

CROP	PRODUCTION
PEACHES (Do.)	2,700
GRAPEFRUIT (50 Lb. box)	--
ORANGES (65 Lb. box)	*
Pecans 1973 3/	126
1974	*

5. 1974 LIVESTOCK PRODUCTION OR MARKETING

EGGS PRODUCED (DOZ.)	6,780
CHICKENS PRODUCED (DOZ.)	71
TURKEYS PRODUCED (DOZ.)	7
PIGK PRODUCED (DOZ.)	63,500
WOLK PRODUCED (Pound)	2,000
WOOL PRODUCED (Pound)	2,000
CATTLE MARKETED FROM FEEDLOTS (Number)	*

6. JANUARY 1 LIVESTOCK ON FARMS

ITEM	1975
ALL CATTLE	80,000
MILK COWS THAT HAVE CALVED	7,000
BEEF COWS THAT HAVE CALVED	36,000
CATTLE ON FEED	*
ALL HORSES 1/	2,000
ALL SHEEP	*
EWES 1 YEAR AND OVER	*
ALL ANGORA GOATS	*
HENS AND PULLETS OF LAYING AGE (DOZ) 2/	20

7. GOVERNMENT PAYMENTS IN 1974

ITEM	DOLLARS
FD GRAIN PROGRAM	--
WAT PROGRAM	--
LAND AND AP COTTON PROGRAM	--
BARRETT PROGRAM	--
WOL AND MOHAIH PROGRAM	--
WAT PLAINS CONSERVATION PROGRAM	--
WLAND ADJUSTMENT PROGRAM	1,227
WAL ENVIRONMENTAL ASSISTANCE PROGRAM	39,213
WES AND MILK PROGRAM	1,115

8. CASH RECEIPTS FROM FARM MARKETINGS

ITEM	1973 3/	1974
1,000 DOLLARS		
ALL CROPS 5/	22,899	26,393
LIVESTOCK AND LIVESTOCK PRODUCTS	15,887	13,698
TOTAL CROPS AND LIVESTOCK	38,786	40,091
GOVERNMENT PAYMENTS	102	42
TOTAL FARM MARKETINGS AND GOVERNMENT PAYMENTS	38,888	40,133

\* Items reported but not published on a county basis because of low production or to avoid disclosure of individual operations. 1/Planted for all purposes. 2/Fresh market only but processing included in all vegetables. 3/Revised. 4/Industry, public, and other non-farm lands. For values see cash receipts.

5/Production or to avoid disclosure of individual operations. 6/Planted for all purposes. 7/Including December 1. 8/Does not include value of standing timber sold from farms.

# TEXAS WATER DEVELOPMENT BOARD



P.O. BOX 13087  
CAPITOL STATION  
AUSTIN, TEXAS 78711

May 27, 1976

Mr. Charles D. Travis, Director  
Governor's Budget & Planning Division  
Office of the Governor  
Executive Office Building  
411 West 13th Street  
Austin, Texas 78701

Attention: Mr. H. Anthony Breard

Re: Draft Environmental Impact  
Statement: Flood Damage  
Prevention - Upper White Oak  
Bayou, Buffalo Bayou, and  
Tributaries, Texas, prepared  
by U.S. Army Corps of  
Engineers, Galveston District.

Dear Mr. Travis:

Our staff has reviewed the above-cited Draft Environmental Impact Statement (EIS) and offer the following comments and suggestions for your consideration.

The rapidly developing suburban areas of Texas, and in this particular case the northwest Houston area, will cause increased runoff and alter flood flow regimes from heavy rains. As a result, flood protection projects such as this are essential for urban areas. It is indeed unfortunate that this project could not have been completed prior to extensive development in the White Oak Bayou watershed.

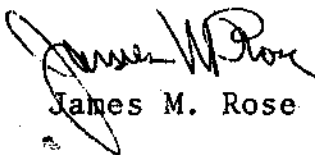
We suggest that the section on Geology be revised and expanded to address, in general, the effects of land subsidence and related active faulting in the project area insofar as these phenomena relate to flooding of low-lying areas.

On page 16 of the Draft EIS, the last sentence of Section 2.31 which reads "Thus, people are encouraged to build within the flood plains of the streams" is somewhat confusing. As it reads, it appears that someone or some entity is encouraging people to build homes in flood plains. We do not believe that this connotation was intended in the Draft EIS. Perhaps, the sentence should be reworded to convey the idea that even though these areas have desirable qualities, the areas are flood plains.

We reiterate our support for this urgently-needed project in this rapidly-developing urban area.

Thank you for the opportunity to comment on this document.

Sincerely,

A handwritten signature in black ink, appearing to read "James M. Rose", written in a cursive style. The signature is positioned above the printed name.

James M. Rose

TEXAS WATER QUALITY BOARD



1700 NORTH CONGRESS AVE.  
P.O. BOX 13246 CAPITOL STATION 78711  
AUSTIN, TEXAS

May 18, 1976

Re: Draft Environmental Impact  
Statement - Flood Damage  
Prevention for Upper White  
Oak Bayou, Buffalo Bayou  
and Tributaries

Mr. Charles D. Travis, Director  
Governor's Budget and Planning Office  
Executive Office Building  
411 West 13th Street  
Austin, Texas 78701

Dear Mr. Travis:

The staff of the Texas Water Quality Board has reviewed the draft environmental impact statement for the proposed flood damage prevention improvements in Upper White Oak Bayou and its tributaries, Cole and Vogel Creeks in Harris County, Texas as prepared by the Corps of Engineers and has determined that there should be no lasting harmful effects on water quality if the precautionary measures outlined in the statement are taken during and after construction. The proposed modification of the sanitary sewer line as well as the installation of a sewage lift station should be coordinated closely with the local jurisdictional entity in order for such proposed changes to be in accord with approved areawide or regional sewerage plans.

We appreciate the opportunity to review this proposed project. If we can be of further assistance, please let us know.

Very truly yours,

A handwritten signature in cursive script that reads "Emory G. Long".

Emory G. Long, Director  
Administrative Operations

cc: Col. Don S. McCoy, Corps of Engineers  
TWQB District 7

TO: Charles D. Travis, Director  
 Budget and Planning Office  
 Office of the Governor  
 (Attn: State Clearinghouse)

Date: Sent: May 6, 1976

Date: Due: May 26, 1976

FROM: *Mr. Hugh C. Gant, T.W. 2.B.*

Refer: EIS- EIS -6-05-006

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT: FLOOD DAMAGE PREVENTION UPPER WHITE OAK BAYOU, BUFFALO BAYOU AND TRIBUTARIES, TEXAS

We have reviewed the cited document and our comments as to the adequacy of treatment of environmental effects of concern are shown below:

	Check (✓) for each item	
	Done	Comment enclosed
1. Additional specific effects which should be assessed:	✓	
2. Additional alternatives which should be considered:	✓	
3. Better or more appropriate measures and standards which should be used to evaluate environmental effects:	✓	
4. Additional control measures which should be applied to reduce adverse environmental effects or to avoid or minimize the irreversible or irretrievable commitment of resources.	✓	
5. Our assessment of how serious the environmental damage from this project might be, using the best alternative and control measures:	✓	
6. We identify issues which require further discussion or resolution:		✓

This agency concurs with the implementation of this project.

This agency does not wish to comment on the subject document because:

*Emory S. Long*  
 Name & title of reviewing official

# TEXAS WATER RIGHTS COMMISSION

STEPHEN F. AUSTIN STATE OFFICE BUILDING

May 20, 1976

Mr. Charles D. Travis, Director  
Governor's Budget and Planning Office  
Executive Office Building  
411 West 13th Street  
Austin, Texas 78701

Attention: Mr. Albert D. Schutz

Re: U.S. Corps of Engineers, Galveston  
District Project Documents;

- (A) Feasibility Report for Flood  
Damage Prevention: "Interim  
Report on Upper White Oak  
Bayou, Buffalo Bayou and  
Tributaries, Texas." (Main  
Report and Appendices, April  
1976).
- (B) Draft Environmental Statement:  
"Upper White Oak Bayou Flood  
Damage Prevention, Buffalo Bayou  
and Tributaries, Texas." (April  
1976).

Dear Mr. Travis:

In response to the request in letter of April 28, 1976 (File Reference: SWGED-E) from Colonel Don S. McCoy, Galveston District Engineer, and letters of April 28th and May 5th from Mr. H. Anthony Breard, of your Office, the staff of the Texas Water Rights Commission has reviewed concurrently the referenced documents relative to a proposed incremental Federal flood prevention project on White Oak Bayou and tributaries, in the vicinity of Houston, Texas, at an estimated, initial construction cost of \$54,626,000 (1975 price level).

The following comments are furnished regarding the Feasibility Report:

1. Final, formal action by the Texas Water Rights Commission on the referenced Report, pursuant to Section 6.073, Texas Water

Code, will be undertaken after the Report is received from the Chief of Engineers, through the Office of the Governor of Texas. (See Main Report, page 73: "The following steps are involved in the review and implementation process: . . . At the request of the Chief of Engineers, review and acceptance by the Governor of Texas and the various Federal agencies at the departmental level. "). Therefore, our staff review comments at this advanced stage in project formulation should not be construed in any manner as obviating the imminent, formal action by the Commission under Section 6.073, Texas Water Code. Nor should the staff comments made hereinafter be misconstrued as an advance expression of the Commissioners' views relative to referenced project and the proposed reports thereon.

2. The Commission staff believes that the findings and recommendations in the proposed Report have been logically developed. However, the staff believes that a more rigorous assessment should be included on the dynamic land subsidence impacts. This should be an integral part of all reports on major water resources and public works development projects planned in the Texas Gulf coast subsidence zones of influence. In U.S. Geological Survey Professional Paper 813-F (Summary Appraisals of the Nation's Ground-Water Resources ---- Texas-Gulf Region, 1976), page F22, statement is made that:

"The areas of major subsidence in the Texas-Gulf Region are centered in and around Houston, . . . In Houston, the increasing draft of ground water which causes the progressive lowering of artesian pressures in enlarging the subsidence bowl in depth and lateral extent. Between 1943 and 1973, the land surface subsided a maximum amount of about 7.5 ft (2.3 m) near the Houston Ship Channel, . . . Subsidence prior to 1943, . . . was about 2 ft (0.6 m), which added to the 7.5 ft (2.3 m) that occurred between 1943 and 1973 makes a total of 9.5 ft (2.9 m) of subsidence in that area. . . Subsidence will continue if the decline in artesian pressures continues, and even if the pressure could be maintained at its present level, the land surface would nevertheless subside a few additional feet near the



center of the cone of depression. . . . Efforts to minimize the subsidence problem will necessitate a decrease in the rate of artesian-pressure decline, which can be accomplished only by reducing the ground-water draft or by recharging the aquifers. "

In view of the above-described dynamic conditions, a major question arises as to the relative stability (i. e., vulnerability of slabs to settlement, and hydrostatic uplift, etc.) of the extensive concrete channel paving (existing and planned) of both upper and lower White Oak Bayou, Cole Creek, and Vogel Creek. Also, major questions arise as to the effects of the extensive channel paving on aquifer recharge, aquifer-pressure gradient, and salt water intrusion into aquifers. Finally, in view of the substantial population concentration increase expected to occur in the flood-protected region, additional analysis is warranted on the expected effects of the greatly increased urban storm runoff in channels of higher hydrodynamic and hydraulic efficiency. The effects of expected increased velocities, erosive forces around bridge piers, and sediment transport should be examined closer.

3. A statement should be made regarding the realistic limitations involved in the determination of flood control damages and benefits. In the 1975 Annual Report of Institute for Water Resources, Department of the Army, Corps of Engineers, page 4, statement is made that:

"Flood control evaluations remain among the most persistent problems addressed by the Institute. Some of the earliest investigations undertaken by IWR (Institute for Water Resources) centered on ways to improve the estimates of national income from flood control projects. Later efforts were directed toward the concept of optimal use of the nation's flood plains. This led to the land use models undertaken in 1974 and 1975 as major steps in IWR efforts toward a more efficient means of flood control benefit evaluation. Since the measurement of flood damages is very time consuming and expensive, the Institute is seeking proxy measures which would be easier to obtain while accurately reflecting the economic impact of flooding. Rents and land values

have been proposed, and the Institute has investigated these approaches. . . . Work in FY 76 is concentrating on developing computational capability to assist District planners to estimate damage reduction, intensification, and location benefits; development of flood damage functions from Flood Insurance Payment data; analysis of projection of flood damages to commercial and industrial property and contents; . . ." (Parenthetical expression and underlining added for clarity and emphasis.)

In view of the foregoing statement, it is believed that a more realistic qualifying statement should be made regarding the 1.8 benefit-to-cost ratio of the referenced project. Over the estimated five-year project period, additional factors will enter into the making of realistic calculations. On page 73 of the Main Report statement is made that:

"Because of many variables involved in the review, authorization, and funding processes, a time schedule for implementation is not accurately predictable in the early stages of planning." (Emphasis added.)

The following comments are furnished in the Draft Environmental Statement:

1. The Commission staff believes that the Draft Environmental Statement fulfills adequately the administrative, coordinative, and analytical requirements of the National Environmental Policy Act of 1969, and the U.S. Office of Management and Budget Circular No. A-95.
2. The Statement should be regarded as an integral element of the project report.

We appreciated the opportunity to participate in the project formulation reviews. The foregoing comments are furnished with the constructive

intent of assisting the planners concerned. If you have any questions, or desire further assistance, please notify Dr. Alfred J. D'Arezzo, Analyst for Environmental Sciences and Interagency Coordination, (Phone: 512-475-2678.

Very truly yours,

TEXAS WATER RIGHTS COMMISSION

A handwritten signature in dark ink, appearing to read "R. E. Schneider", is written over the typed name. The signature is fluid and cursive, with a long horizontal stroke extending to the right.

Robert E. Schneider  
Executive Director

RES-AJD:11



**TEXAS STATE SOIL AND WATER CONSERVATION BOARD**

1018 First National Building  
Temple, Texas 76501  
AREA CODE 817. 773-2250

May 14, 1976

Mr. H. Anthony Breard, Coordinator  
Natural Resources Section  
Budget and Planning Office  
411 West 13th Street  
Austin, Texas 78701

Dear Mr. Breard:

We have received a copy of the draft environmental impact statement for flood damage prevention on Upper White Oak Bayou, Buffalo Bayou and tributaries in the vicinity of Houston, Texas.

We offer no comment on this draft statement.

Sincerely yours,

A handwritten signature in cursive script that reads "Harvey Davis".

Harvey Davis  
Executive Director

HD/lc

# PARKS AND WILDLIFE DEPARTMENT



CLAYTON T. GARRISON  
EXECUTIVE DIRECTOR

JOHN H. REAGAN BUILDING  
AUSTIN, TEXAS 78701

June 21, 1976

Mr. H. Anthony Breard, Coordinator  
Natural Resources Section  
Governor's Budget and Planning Office  
Executive Office Building  
411 West 13th Street  
Austin, Texas 78701

Dear Mr. Breard:

The Texas Parks and Wildlife Department has reviewed the Interim Report on Upper White Oak Bayou and the Draft Environmental Statement: Upper White Oak Bayou Flood Damage Prevention. Our comments on the contents of both documents are contained in this letter.

At one time, the project area was undoubtedly good to excellent wildlife habitat, however, urban development has greatly diminished wildlife habitat values in the area of the proposed channel enlargement. Fisheries in this portion of White Oak Bayou are thought to be insignificant.

The Houston toad (Bufo houstonensis), which is on the Department of the Interior's and this State's endangered species lists, has been found in several localities bordering the watershed boundary (see attached map) and might be expected to occur in the White Oak Bayou watershed. Since this species seems to prefer temporary breeding pools formed in relatively loose, easily drained soils, it is not likely to be adversely affected by channelization of lower White Oak Bayou. Any modification of the wooded, sandy soil ridges could have a deleterious effect on this species.

Wildlife would be least affected by the preferred alternative of channelization of the lower portion of the bayou and non-structural flood plain management on the upper reaches of White Oak Bayou. The alternative plan for detention reservoirs would further reduce wildlife habitat in the project area.

The Department found the objectives as proposed in the feasibility report to be in accord with the Texas Outdoor Recreation Plan (TORP). The Department suggests that the Corps of Engineers and local sponsors give due consideration to providing a balanced distribution of recreation opportunities to meet existing and projected recreation needs.

The proposed action would not affect any waterways having local, regional, or statewide waterway potentials, or existing trails having statewide system potentials. The proposed action does include 8.7 miles of hike and bike trails which is in keeping with the findings and recommendations of the "Texas Trailways" report where it points out that floodplains have excellent potential for trail development. The Corps of Engineers should be commended for realizing this potential and proposing the incorporation of hike and bike trails in the project.

The Department notes the technical report in Appendix 1, Section F, "Economics of the Selected Plan," specifically as it relates to the use of TORP empirical and statistical data and methodologies for evaluating recreation benefits.

The Department appreciates and encourages continual reference to and implementation of the TORP. A review of the TORP-based data and findings as compared to the document prompts the following comments:

1. A minor discrepancy was found between the data presented for the subject market area in Table B-24, Annual Days Participation Per Household by Activity (page F-31, Appendix 1). Household participation rates cited from the TORP for Analytical Planning Region 25 Metropolitan Area are slightly lower than indicated in the Corps of Engineers' report. An attempt was made to ascertain more specifically the source of the information cited by contacting Galveston District, Corps of Engineers staff members who prepared the information. They were unavailable for comment due to job transfers and vacations. It is recommended that household rates in the document be changed to accurately cite the TORP.

2. Annual participation (visitor) days projected to occur at the proposed project site for picnicking and trail activities are also presented on page F-31, Appendix 1. A more detailed presentation and explanation of the procedures and sources of information used in obtaining these estimates is recommended, and the estimates will change slightly if TORP days/household are corrected as noted.

3. The assumption made by the Corps of Engineers concerning picnicking participation in footnote 2/ on page F-32 of Appendix 1 is incorrect. The footnote reads as follows:

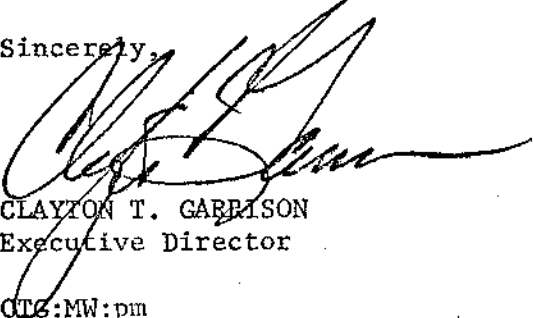
"2/ No percentages were given for participation at public facilities by the Texas Outdoor Recreation Plan; therefore, it is assumed that picnic outings generally take place at some public facility."

The Corps of Engineers should be advised that TORP Urban Volume participation data for all activities except trails represents total projected participation on all trips to all public and private destinations. For picnicking, approximately 97% of all urban participation in 1968 occurred at public facilities.

The draft environmental impact statement recognizes the demand for fill material in the Houston area and states that material from channel excavation might be made available for this purpose by the project sponsor (page 4). This Department has previously suggested such use of spoil material to the Corps of Engineers with the interest of reducing spoiling on valuable wildlife habitat and wetlands. We are pleased to note that they are recognizing the wisdom of using spoil material for constructive purposes rather than covering natural areas.

Thank you for the opportunity to comment on these documents.

Sincerely,



CLAYTON T. GARRISON  
Executive Director

CTG:MW:pm

Attachment





TO: Charles D. Travis, Director  
Budget and Planning Office  
Office of the Governor  
(Attn: State Clearinghouse)

Date: Sent: May 6, 1976

Date: Due: May 26, 1976

FROM: Gene Lopez - TDCA

Refer: EIS- EIS -6-05-002

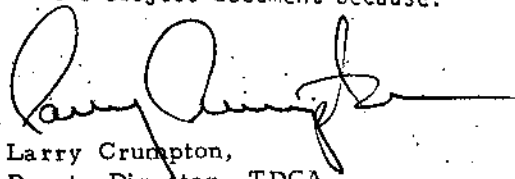
SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT: FLOOD DAMAGE PREVENTION UPPER WHITE OAK BAYOU, BUFFALO BAYOU AND TRIBUTARIES, TEXAS

We have reviewed the cited document and our comments as to the adequacy of treatment of environmental effects of concern are shown below:

	Check (✓) for each item	
	None	Comment enclosed
1. Additional specific effects which should be assessed:	X	
2. Additional alternatives which should be considered:	X	
3. Better or more appropriate measures and standards which should be used to evaluate environmental effects:	X	
4. Additional control measures which should be applied to reduce adverse environmental effects or to avoid or minimize the irreversible or irretrievable commitment of resources.	X	
5. Our assessment of how serious the environmental damage from this project might be, using the best alternative and control measures:	X	
6. We identify issues which require further discussion or resolution:	X	

This agency concurs with the implementation of this project.

This agency does not wish to comment on the subject document because:



Larry Crumpton,  
Deputy Director, TDCA

5/21/76

Name & title of Reviewing official

CHARLES W. TRAVIS, Director  
Budget and Planning Office  
Office of the Governor  
(Attn: State Clearinghouse)

Date: Sent: May 6, 1976

Date: Due: May 26, 1976

FROM: *The Honorable Bob Armstrong* Refer: EIS- EIS -6-05-002

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT: FLOOD DAMAGE PREVENTION UPPER WHITE OAK BAYOU, BUFFALO BAYOU AND TRIBUTARIES, TEXAS

MAY 17 1976

We have reviewed the cited document and our comments as to the adequacy of treatment of environmental effects of concern are shown below:

	Check (✓) for each item	
	Done	Comment enclosed
1. Additional specific effects which should be assessed:	✓	
2. Additional alternatives which should be considered:	✓	
3. Better or more appropriate measures and standards which should be used to evaluate environmental effects:	✓	
4. Additional control measures which should be applied to reduce adverse environmental effects or to avoid or minimize the irreversible or irretrievable commitment of resources.	✓	
5. Our assessment of how serious the environmental damage from this project might be, using the best alternative and control measures:	✓	
6. We identify issues which require further discussion or resolution:	✓	

This agency concurs with the implementation of this project.

This agency does not wish to comment on the subject document because:

*A. J. Bishop*  
Name & title of Reviewing official

TO: CHARLES W. TRAVIS, Director  
Budget and Planning Office  
Office of the Governor  
(Attn: State Clearinghouse)

Date: Sent: May 6, 1976

Date: Due: May 26, 1976

Refer: EIS- EIS -6-05-002

FROM: *Dr. Charles H. Groat BEM*

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT: FLOOD DAMAGE PREVENTION UPPER WHITE OAK BAYOU, BUFFALO BAYOU AND TRIBUTARIES, TEXAS

We have reviewed the cited document and our comments as to the adequacy of treatment of environmental effects of concern are shown below:

	Check (✓) for each item	
	Done	Comment enclosed
1. Additional specific effects which should be assessed:		
2. Additional alternatives which should be considered:		
3. Better or more appropriate measures and standards which should be used to evaluate environmental effects:		
4. Additional control measures which should be applied to reduce adverse environmental effects or to avoid or minimize the irreversible or irretrievable commitment of resources:		
5. Our assessment of how serious the environmental damage from this project might be, using the best alternative and control measures:		
6. We identify issues which require further discussion or resolution:		

This agency concurs with the implementation of this project.

This agency does not wish to comment on the subject document because:

*[Signature]*  
Name & title of reviewing official

*Acting Director*

# TEXAS FOREST SERVICE

File 5.7

College Station, Texas 77843  
June 18, 1976

Colonel Don S. McCoy  
District Engineer  
Galveston District  
Corps of Engineers  
P. O. Box 1229  
Galveston, Texas 77553

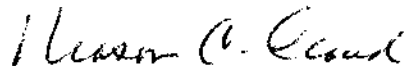
Dear Colonel McCoy:

This is in reference to the Environmental Impact Statement for Buffalo Bayou and Tributaries, Texas, Upper White Oak Bayou dated April 1976.

a. There are no Champion Trees from the National and State Registry located in the proposed project area.

b. I could find no statement concerning the presence or absence of endangered or threatened floral taxa within the project area. Such a statement should be made a part of the Environmental Impact Statement for the subject project to be in compliance with the provisions of the Endangered Species Act of 1973 (87 stat. 884; 16 U.S.C.).

Sincerely,



Mason C. Cloud  
Head, Forest Environment Dept.

MC/jc  
cc: Budget and Planning Office  
Bob Dodson, USFS



Texas Historical Commission  
Box 12276, Capitol Station  
Austin, Texas 78711  
Truett Latimer  
Executive Director

November 5, 1976

District Engineer  
Department of the Army  
Galveston District, Corps of Engineers  
P.O. Box 1229  
Galveston, Texas 77553

Re: Buffalo Bayou and Tributaries, Texas - Upper White Oak Bayou -  
Flood Damage Prevention

Dear Colonel McCoy:


Thank you for the maps forwarded to the Texas Historical Commission concerning the above-referenced undertaking. "We have checked our master file and find, that as described, the proposal will effect known cultural (prehistoric, historic and architectural) resources which are potentially eligible for inclusion within the National Register of Historic Places. Because we believe that other sites of significance lie within the area generally affected and to comply with federal legislation concerning the protection of cultural resources, the area must be surveyed. To accomodate your need in finding an appropriately trained specialist to locate, inventory and nominate sites to the National Register of Historic Places, we are sending along a list of professionals that are capable of performing this type of service. By selecting a person close to your area, the cost and time required to perform this work should prove minimal. Upon receipt of the evaluation of the project in relation to cultural resources, we will immediately respond.

Your attention to this matter is appreciated. If we may be of further service, please advise.

Sincerely,

Truett Latimer  
State Historic Preservation Officer

By

  
Alton K. Briggs  
Archeologist  
Cultural Resource Management

AKB/la  
Enclosure

Institutions, agencies, and individuals in Texas that have indicated they are qualified, equipped and interested in conducting archeological preservation projects (Surveys and Salvage). 2/76 Subject to revision.

Institutions and Agencies	Individuals	
University of Texas, El Paso	Dr. Rex Gerald Mr. Herbert C. Morrow, Jr. Mr. Thomas C. O'Laughlin	Centennial Museum El Paso, TX 79968
Texas Tech University	Dr. William Mayer-Oakes Dr. Robert Campbell	Dept. of Anthropology P.O. Box 4549 Lubbock, TX 79409
Texas Tech University Museum	Dr. Mary Elizabeth King Ms. Eileen Johnson	Texas Tech University Box 4499 Lubbock, TX 79409
West Texas State University	Dr. Jack Hughes	Dept. of Anthropology and Geology WT Station Canyon, TX 79015
Southern Methodist University	Dr. S. Alan Skinner	Archaeology Research Program Dallas, TX 75275
	Dr. Fred Wendorf Dr. Joel Shiner Dr. Garth Sampson Dr. Anthony Marks Dr. Ronald K. Wetherington Mr. Tom Ryan Mr. Frank Servello Mr. Mark Lynott Mr. Robb Floyd Mr. Jeff Richner Mr. Joseph Gallagher Mr. Peter Jescknig Mr. Jim Gallagher	Dept. of Anthropology Dallas, TX 75275
North Texas State University	Mr. Olin McCormick Dr. Kathleen Gilmore Dr. Barbara Butler Marx	Dept. of Anthropology and Sociology Denton, TX 76203
University of Texas, Arlington	Dr. T.R. Hayes	Dept. of Anthropology and Sociology Arlington, TX 76019
Richland College	Dr. J. Parker Nunley	Division of Social Sciences 12800 Abrams Road Dallas, TX 75231
Incarnate Word College	Ms. Suzanna Katz	4301 Broadway San Antonio, TX 78209

Texas A&M University

Dr. Harry Shafer  
Dr. Vaughn Bryant  
Ms. Glenna Williams Dean

Archeology Laboratory  
College Station, TX 77843

Rice University

Dr. Frank Hole  
Ms. Barbara Berger  
Ms. Margie Lohse

Dept. of Anthropology  
Houston, TX 77001

University of Texas,  
San Antonio

Dr. Tommy Hester  
Mr. Paul Katz

Center for Archaeological  
Research  
San Antonio, TX 78285

University of Texas,  
Austin

Dr. David S. Dibble  
Mr. Elton Prewitt

Texas Archeological Survey  
Balcones Research Center  
Rt. 4, Box 189  
Austin, Texas 78757

Dr. Dee Ann Story  
Mr. Don Hamilton

Texas Archeological  
Research Laboratory  
Balcones Research Center  
Rt. 4, Box 189  
Austin, Texas 78757

Dr. Jeremiah Epstein  
Dr. James A. Neely  
Dr. E. Mott Davis  
Dr. T.N. Campbell

Dept. of Anthropology  
Burdine Hall 336  
Austin, TX 78712

Stephen F. Austin  
State University

Dr. James Corbin

Dept. of Sociology  
Nacogdoches, TX 75961

State of Texas

Mr. Curtis Tunnell  
Mr. James M. Malone  
Mr. Alton K. Briggs  
Mr. Dan Scurlock  
Mr. Barto Arnold  
Mr. Warren Lynn  
Mr. Robert Mallouf

Texas Historical Commission  
P.O. Box 12276  
Capitol Station  
Austin, TX 78711

Mr. Frank Weir  
Dr. John E. Keller  
Mr. Clive Luke  
Mr. Bruce Fullen  
Mr. Glen Doran

Texas Highway Department  
11th and Brazos  
Box 307  
Austin, TX 78701

Mr. Wayne Roberson  
Mr. George Kegley  
Mr. David Ing

Texas Parks and Wildlife  
Historic Sites Branch  
John H. Reagan Building  
Austin, TX 78701

# HOUSTON-GALVESTON AREA COUNCIL

1 June 1976

Col. Don S. McCoy  
Department of the Army  
Galveston District, Corps of Engineers  
P. O. Box 1229  
Galveston, Texas 77553

RE: 605-17039  
Draft Feasibility Report  
for Flood Damage Prevention,  
Upper White Oak Bayou

Dear Sir:

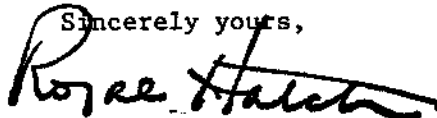
I am happy to advise you that your recent application has been reviewed favorably by this Council.

A copy of Form CG-99 has been attached so that you may complete your application and forward it to the agency to whom your application is addressed.

The form contains the comments and recommendations of the Council regarding the relationship of your application to regional planning and environmental impact.

My best wishes on this worthwhile project. Please contact us if we may assist you in any way.

Sincerely yours,



ROYAL HATCH  
Executive Director

RH/CW/jw

Enclosures



## COMMENTS AND RECOMMENDATIONS

Date 1 June 1976

Name of Clearinghouse: HOUSTON-GALVESTON AREA COUNCIL

Address: 3701 West Alabama, Houston, Texas 77027 (P.O. Box 22777,  
Houston, Texas 77027)A. COMPREHENSIVE PLANNING CERTIFICATION

The project described DOES X\* DOES NOT \_\_\_\_\_ conform  
with the comprehensive plan developed or in process of development for  
the area in which it is located.

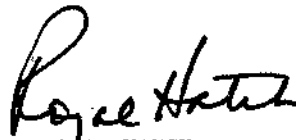
U.S. ARMY CORPS OF ENGINEERS, GALVESTON DISTRICT: Draft Feasibility  
Report for Flood Damage Prevention, Upper  
White Oak Bayou

\* page 2, staff comments

B. ENVIRONMENTAL ASSESSMENT

\_\_\_\_\_ We have reviewed this assessment and agree that no  
adverse environmental impact is probable.

\_\_\_\_\_ Our comments upon the environmental impact are as  
follows:



ROYAL HATCH  
Executive Director  
(Signature of Authorized Representative  
of Clearinghouse)

APPLICANT: U.S. Army Corps of Engineers, Galveston District

TITLE: Draft Feasibility Report for Flood Damage Prevention  
Upper White Oak Bayou

PROJECT SPONSOR: Col. Don S. McCoy  
Department of the Army  
Galveston District, Corps of Engineers  
P.O. Box 1229  
Galveston, Texas 77553  
713/763-1211

H-GAC STAFF: Robert J. Silver, Environmental Analyst

DESCRIPTION: The U.S. Army Corps of Engineers is proposing to modify  
Upper White Oak Bayou in order to prevent flood  
damage along the bayou. These modifications will  
take the form of channelization and rectification  
of the existing bayou.

Location: Houston Area

Area Affected : Vogel Creek, Cole Creek, White Oak Bayou, and  
Buffalo Bayou (Segment 1007)

RJS:dg  
5/14/76

**SYNOPSIS:** The U.S. Army Corps of Engineers has prepared a draft Environmental Statement and a draft Feasibility Report for Upper White Oak Bayou Flood Drainage Prevention Plan. This draft statement addresses a proposed plan to prevent flood damages to urban development on Upper White Oak Bayou and its tributaries, Vogel and Cole Creeks. The study area is located in and extends beyond the northwestern portion of the Houston City limits.

The proposed structural improvements to White Oak Bayou and its tributaries call for channel enlargement and partial pavement of the channel with concrete. These improvements have been designed on the basis of the U.S. Army Corps of Engineers Standard Project Flood. The proposed non-structural techniques include a regulation for future development in the flood plain. This would limit future development to elevations at or above the 100 year flood plain.

In addition, the stark appearance of the Bayou and its tributaries will be partially improved by architectural treatment and selective plantings of vegetation in areas frequently viewed by the public.

Recreational facilities considered for the project area include three small parks, nine (9) miles of hike and bike trails, and three (3) wooded nature study areas.

**STAFF COMMENTS AND RECOMMENDATIONS:**

Staff recommends approval of the basic project but requests that consideration be given to the following remarks in the preparation of the final Environmental Statement and Feasibility Report:

1. Staff is of the opinion that additional consideration should be given to the project alternatives identified. The "Flood Detention Reservoir on White Oak Bayou and Downstream Channel Improvement" alternative is particularly deserving of further consideration. Rather than one large detention reservoir, the possibility of several smaller reservoirs strategically located to partially detain stormwater runoff should also be considered. Such a system, built in conjunction with earthen or gabion lined drainage channels, maybe a practicable alternative. Several small reservoirs would provide open green spaces for recreation when not detaining runoff water and the earthen or gabion lined channels would provide a more aesthetically pleasing view for the public than the proposed concrete channels.

2. The effect of the proposed project upon the water quality does not consider possible impact on Buffalo Bayou. Organisms and vegetation normally existing in stream channels provide a form of tertiary treatment to effluent from wastewater treatment facilities and nonpoint source runoff. This action should be considered as a benefit in the cost/benefit analysis. Concreting the stream channels of White Oak Bayou Vogel and Cole Creeks, will destroy the natural treatment processes in these waterways. Consequently effluent from wastewater treatment facilities and urban runoff will drain to Buffalo Bayou without receiving the existing treatment from natural biological processes. The net effect will be to increase the wasteloads to Buffalo Bayou.
  
3. The Feasibility Report states that channel improvements need to be accompanied by local drainage improvements. However, the draft report does not address what those improvements should be nor does it consider the benefit of the flood prevention plan without the local drainage improvements. The benefit of the proposed flood prevention plan could be substantially reduced if not coordinated with local improvements. Staff therefore believes that the Feasibility Report should address the ability of the Harris County Flood Control District to provide other necessary drainage improvements to realize the full benefit of the final plan.

MINUTES

PROJECT REVIEW COMMITTEE

June 1, 1976

605-17039 --- U.S. ARMY CORPS OF ENGINEERS, GALVESTON DISTRICT: Draft  
Feasibility Report for Flood Damage Prevention, Upper White  
Oak Bayou

Proponents: Jerry M. Pool  
Mike McClenan

Discussion:

Joe Bryan summarized the project and gave staff recommendations.

ACTION

MOTION: Councilman Payne  
SECOND: Councilwoman Wilbanks

THAT, this project be approved and state that it is not inconsistent with other planning in the area; and, FURTHER, that the recommendation of the staff as set forth above\* concerning this proposal be adopted as the recommendation of this Committee.

Motion carried by unanimous vote of members present.

\* page 2 and 3, staff comments



DEPARTMENT OF PARKS & RECREATION  
GEORGE W. LANIER, JR.  
DIRECTOR

*City of*  
**HOUSTON**

FRED HOFHEINZ, MAYOR

HOUSTON, TEXAS 77001

**CITY COUNCIL**

LARRY MCKASKLE  
JUDSON ROBINSON, JR.  
LOUIS MACEY  
HOMER L. FORD  
FRANK O. MANCUSO  
JIM WESTMORELAND  
FRANK E. MANN  
JOHNNY GOVEN

**CONTROLLER**

LEONEL J. CASTILLO

June 8, 1976

Colonel Jon C. Vanden Bosch  
Department of the Army  
Galveston District, Corps  
of Engineers  
P. O. Box 1229  
Galveston, Texas 77553

Dear Colonel Bosch:

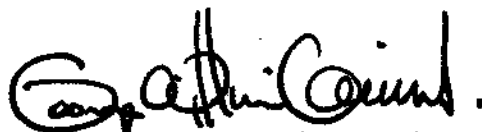
Reference is made to the Draft Environmental Statement for "Buffalo Bayou and Tributaries, Texas - Upper White Oak Bayou - Flood Damage Prevention." This Department has reviewed the statement and is in basic agreement with the Corps' proposed action. Specific comments are listed below.

In paragraph number 1.15 Recreational Facilities, the Parks and Recreation Department endorses the concept of recreational use of flood plain lands. A cooperative Federal-County venture, such as proposed for this project is most commendable. Similarly, this Department supports the plan as outlined in paragraph number 1.14 Aesthetic Improvements. Of particular interest is the planned replenishment of vegetation in rectified areas.

In paragraph number 3.05 Open Space Plan, the "Open Space for Living" plan referenced in the statement has never received sufficient funding to justify its implementation as a cohesive plan of action. Secondly, since the plan was prepared in 1969 it is subject to a reordering of priorities. Thus, the "Open Space for Living" plan and its recommendations should not be considered as the final course of action without verification from the Parks and Recreation Department. We will continue to investigate and encourage new funding sources to enable fulfillment of this concept.

In paragraph number 6.03 Evacuation from the Flood Plain, this Department believes that whenever possible this action has the greatest potential benefit for the citizens of the area. However, we do recognize that in this particular instance, "the high cost and the social disruption that would result from the forced relocation of nearly 10,000 persons," make this an unreasonable alternative.

This Department would be most willing to supply any further explanations or additional comments as may be requested.

A handwritten signature in black ink, appearing to read "George W. Lanier". The signature is stylized and cursive.

George W. Lanier, Director  
Parks and Recreation-Department

GWL/JS/jm

*City of Jersey Village, Texas*  
16501 Jersey Drive / 466 6159  
77040

*Lonnis E. Crawford*  
Mayor

June 7, 1976

Colonel Don S. McCoy  
District Engineer, Galveston District  
U.S. Army Corps of Engineers  
P.O. Box 1229  
Galveston, Texas 77553

Dear Colonel McCoy:

In accordance with the request contained in your letter of April 28, 1976, the City of Jersey Village is pleased to present its comments concerning your draft Environmental Statement on Upper White Oak Bayou Flood Damage Prevention.

We agree that a vast majority of the people in our City wholeheartedly indorse the selected plan and hope that the plan will quickly be approved and implemented.

The primary benefits that we foresee from this project are:

- 1) Greatly increased protection from the possibility of flood damage. This is the most important of all factors and should be the predominant consideration in evaluating the plan or its environmental impact. Safety from floods will greatly improve the attractiveness of this area.
- 2) Cleaning of the present Upper White Oak Bayou. The portion of White Oak Bayou in and near the City of Jersey Village has not been properly maintained. It is now grown up in weeds, brush, and small trees so that it catches all kinds of trash and debris. This makes it a harbor for snakes and rodents, thus it has become a hazard to the health and safety of nearby residents. The planned rectification and concrete lining with pilot channel would eliminate this hazard.
- 3) Improved appearance of the Harris County Flood Control District Right-of-way. In addition to the physical hazard mentioned in the preceding comment, the neglected state of Upper White Oak Bayou creates an eye-sore in our City. Construction of the planned improvements would greatly simplify the maintenance needed to make this bayou an attractive part of the area.

The possible adverse effects we foresee from this project are:

- 1) If the present 150' right-of-way through Jersey Village must be expanded to 180', some lots already platted would be reduced in size so that it would be illegal to build residences on these lots under our zoning laws. If the planned improvements could be limited to the existing 150' right-of-way with only a temporary easement for construction access on the additional 15' on each side, then no serious adverse effects would be contemplated.
- 2) The hike and bike trails within the Jersey Village City Park which are a part of the recreational facilities in the selected plan are no longer practical. This area contains the new City swimming pool and parking lot as well as ball fields and playground equipment. Also part of this area will be used for our future Civic



Center Building. We therefore feel that the hike and bike trail should end at mile 18.2.

On behalf of the City of Jersey Village, I wish to thank you for the opportunity of submitting these comments.

Very truly yours

CITY OF JERSEY VILLAGE

A large, stylized handwritten signature in black ink, which appears to read "Lonnie E. Crawford". The signature is written over the printed name and title.

Lonnie E. Crawford  
Mayor

LEC/snc

7215 Brushwood  
Houston, Texas 77088  
May 17, 1976

Department of the Army  
Galveston District, Corps of Engineers  
P. O. Box 1229  
Galveston, Texas 77553

Reference Reply: SWGED-E

Gentlemen:

Thank you for the opportunity to review the draft environmental statement for Upper White Oak Bayou.

The draft environmental statement as submitted does not require any further modification. I find that all aspects concerning the affected urbanized communities within the watershed have been adequately addressed in this statement.

I urge that this environmental statement be submitted as a complement to the Interim Engineering Report on Upper White Oak Bayou at the earliest possible time to bring this flood control project to completion.

Sincerely yours,



B. E. Woodall  
Civilian Advisory Group

cd

U. S. ARMY ENGINEER DISTRICT, GALVESTON  
CORPS OF ENGINEERS



JUNE 16, 1775

# NEWS RELEASE

PUBLIC AFFAIRS OFFICE  
606 A Santa Fe Building  
Galveston, Texas 77550  
Ph. 713-763-1211, Ext. 305



HURRICANE FLOOD  
PROTECTION



NAVIGATION



FLOOD CONTROL



BASIN PLANNING



THE ENVIRONMENT



RECREATION

Engineers Complete Draft Environmental Statement

119/May 7, 1976

KBB

On Flood Damage Prevention for Upper White Oak Bayou

SWGPA

GALVESTON, Texas -- The draft environmental statement on a proposed plan for flood damage prevention on upper White Oak Bayou and its tributaries in Houston and Harris County has been completed by the Corps of Engineers in Galveston and forwarded to the Council on Environmental Quality in Washington, D. C.

The statement is being circulated to federal, state and local governmental agencies, conservation and environmental groups and other interested parties for review and comments, according to Colonel Don S. McCoy, District Engineer.

The proposed project would extend the existing project nine miles up White Oak Bayou and include structural improvements to Cole and Vogel Creeks. The proposed work incorporates rectification, enlargement and partial lining with concrete. Land use regulations would be applicable to portions of the flood plain upstream of the structural modifications.

Beautification of the area with trees and shrubs, architectural treatment of channels, and construction of recreational facilities such as hike and bike trails, nature study areas, picnic areas and neighborhood parks are also proposed.

The statement says the project would eliminate the hazard of stream flooding up to the most severe storm that could reasonably be expected to occur in a given area. The improvements would facilitate companion improvements to storm drainage by the local communities.

Elimination of the flood hazard would result in continued safe urbanization of the flood plains, the statement said. The resulting impact on the social and economic well-being of the inhabitants of the area would be an environmental improvement.

Adverse environmental effects would include removal of trees and shrubs which now serve as habitat for birds and small populations of other wildlife. Channel construction also would disturb or remove small populations of aquatic organisms, cause temporary damage to lawns and ornamental shrubs abutting the bayous, and would affect the remains of two archeological sites along White Oak Bayou.

However, the statement pointed out, during preconstruction planning, if the project should be authorized, further investigation will be made into the value of the archeological sites and possible salvage or mitigation measures.

Alternatives investigated include:

- Purchase and removal of developments in the flood plain;
- Construction of a detention reservoir;
- Construction of a diversion channel from White Oak Bayou to Addicks Reservoir;
- Unlined channel improvements in White Oak Bayou and Cole and Vogel Creeks;
- Flood proofing, and
- No action.

The statement will be reviewed by federal, state and local agencies, private citizens, conservation and environmental groups and others, as required by the National Environmental Policy Act of 1969 and guidelines of the Council on Environmental Quality.

Single copies of the statement may be obtained by writing to the Environmental Resources Branch, U. S. Army Engineer District, Galveston, P. O. Box 1229, Galveston, Texas 77553.

--30--

Distr: 1, 2, 7, 8, 10-13

APPENDIX "C"

LETTERS RECEIVED BY THE DISTRICT ENGINEER  
ON THE REVISED DRAFT STATEMENT

Attachment

- C-1 Region VI, United States Environmental Protection Agency
- C- 3 United States Department of the Interior
- C- 5 United States Department of Commerce
- C- 6 Advisory Council on Historic Preservation
- C- 7 Department of Health, Education, and Welfare
- C- 8 Department of Agriculture
- C-10 Office of the Governor, State of Texas
- C-11 Texas Parks and Wildlife Department
- C-13 Texas Water Rights Commission
- C-15 Texas Department of Health Resources
- C-17 Bureau of Economic Geology
- C-18 Texas Department of Community Affairs
- C-19 General Land Office
- C-20 State Department of Highways and Public Transportation
- C-21 Texas Water Development Board
- C-22 Texas Water Quality Board



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

FIRST INTERNATIONAL BUILDING

1201 ELM STREET

DALLAS, TEXAS 75270

July 27, 1977

Lieutenant General J. W. Morris  
Chief of Engineers  
Department of the Army  
Washington, D. C. 20314

Dear General Morris:

We have reviewed the Revised Draft Environmental Impact Statement and the Report on Upper White Oak Bayou. The action consists of constructing flood control improvements in upper White Oak Bayou and its tributaries, Cole and Vogel Creeks, in Harris County, Texas, to protect urban areas now subject to stream flooding. Channel improvements considered for upper White Oak Bayou would extend from the terminus of the existing Federal flood control project at mile 10.7 to mile 19.9. For the tributary streams, Cole and Vogel Creeks, improvements would extend from their mouths at White Oak Bayou upstream 1.9 and 4.5 miles, respectively. Extension of the existing Federal channel improvements upstream in White Oak Bayou and tributaries would consist of rectification, enlargement, and partial lining with concrete.

We classify your Draft Environmental Impact Statement as LO-1. Specifically, we have no objections to the project as it relates to Environmental Protection Agency's (EPA's) legislative mandates. The statement contained sufficient information to evaluate adequately the possible environmental impacts which could result from project implementation. The classification and the date of our comments will be published in the Federal Register in accordance with our responsibility to inform the public of our views on proposed Federal actions, under Section 309 of the Clean Air Act.

Definitions of the categories are provided on the attachment. Our procedure is to categorize our comments on both the environmental consequences of the proposed action and on the adequacy of the impact statement at the draft stage, whenever possible.

We appreciate the opportunity to review the Draft Environmental Impact Statement. Please send us two copies of the Final Environmental Impact Statement at the same time it is sent to the Council on Environmental Quality.

Sincerely yours,

A handwritten signature in dark ink, appearing to read "John C. White".

John C. White  
Regional Administrator

Enclosure

## ENVIRONMENTAL IMPACT OF THE ACTION

### IO - Lack of Objections

EPA has no objections to the proposed action as described in the draft impact statement; or suggests only minor changes in the proposed action.

### ER - Environmental Reservations

EPA has reservations concerning the environmental effects of certain aspects of the proposed action. EPA believes that further study of suggested alternatives or modifications is required and has asked the originating Federal agency to re-assess these aspects.

### EU - Environmentally Unsatisfactory

EPA believes that the proposed action is unsatisfactory because of its potentially harmful effect on the environment. Furthermore, the Agency believes that the potential safeguards which might be utilized may not adequately protect the environment from hazards arising from this action. The Agency recommends that alternatives to the action be analyzed further (including the possibility of no action at all).

## ADEQUACY OF THE IMPACT STATEMENT

### Category 1 - Adequate

The draft impact statement adequately sets forth the environmental impact of the proposed project or action as well as alternatives reasonably available to the project or action.

### Category 2 - Insufficient Information

EPA believes the draft impact statement does not contain sufficient information to assess fully the environmental impact of the proposed project or action. However, from the information submitted, the Agency is able to make a preliminary determination of the impact on the environment. EPA has requested that the originator provide the information that was not included in the draft statement.

### Category 3 - Inadequate

EPA believes that the draft impact statement does not adequately assess the environmental impact of the proposed project or action, or that the statement inadequately analyzes reasonably available alternatives. The Agency has requested more information and analysis concerning the potential environmental hazards and has asked that substantial revision be made to the impact statement. If a draft statement is assigned a Category 3, no rating will be made of the project or action, since a basis does not generally exist on which to make such a determination.





# United States Department of the Interior

OFFICE OF THE SECRETARY  
WASHINGTON, D.C. 20240

PEP ER-77/626

Lieutenant General J. W. Morris  
Chief of Engineers  
Department of the Army  
Washington, D. C. 20314

Dear General Morris:

Thank you for the letter of June 23, 1977, requesting our views and comments on the Chief of Engineers' Report and revised draft environmental statement for Buffalo Bayou and Tributaries, Harris County, Texas. We have reviewed the documents and conclude that they adequately consider those areas within our jurisdiction and expertise. Several brief comments follow.

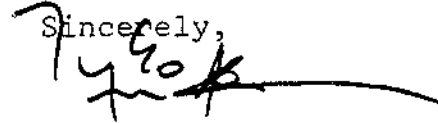
Page 12, Paragraph 2.17. The active surface fault mentioned in this paragraph should be evaluated in greater detail. One sentence states that land shifting along the fault has been "gradual and not associated with earthquakes." Another sentence suggests that this fault is associated with "sudden land movement." Regardless of which statement is the most accurate, once the problem is exposed its effect upon the proposed project should be fully discussed in the Impact Section of the EIS.

Page 21. The Probable Impact of the Proposed Action on the Environment. The proposed action will affect the hydrology of White Oak Bayou and move flows into Buffalo Bayou more rapidly. The effect, if any, on flooding along Buffalo Bayou should be discussed in this section.

Page 22, Paragraph 4.08. It seems unreasonable to conclude that environmental damages from the disposal of 1,227,000 cubic yards of earth would be "minimal" when the specific disposal site remains unknown. The reviewer has been told that this material may be used for construction purposes, placed in selected disposal areas, dumped in open pastures, and the acquisition of disposal areas would be the responsibility of the project sponsor. The final EIS should clarify the disposal plans and discuss the impacts.

Page 28, Paragraph 6.07. The alternative of diverting water to Addicks Reservoir would compound flooding problems on Buffalo Bayou. This paragraph does not explain why water flowing down White Oak Bayou to Buffalo Bayou would not be a problem, but water diverted to a flood-control reservoir (Addicks) would be a problem. A summary of the explanation on page 42 of the Interim Report on Upper White Oak Bayou should be used.

We hope these comments will be of assistance to you.

Sincerely,  


Larry E. Meierotto  
Deputy Assistant Secretary



**UNITED STATES DEPARTMENT OF COMMERCE**  
**The Assistant Secretary for Policy**  
Washington, D.C. 20230

Lieutenant General J. W. Morris  
Chief of Engineers  
Department of the Army  
Washington, D.C. 20314

Dear General Morris:

Secretary Kreps has asked me to send you the Department of Commerce's comments on your proposed report and other pertinent papers for Buffalo Bayou and Tributaries, Texas - Upper White Oak Bayou.

The National Ocean Survey of the National Oceanic and Atmospheric Administration made one comment which I pass along for your consideration.

Geodetic control survey monuments are located in the proposed project area. If there is any planned activity which will disturb or destroy these monuments, the National Ocean Survey (NOS) requires not less than 90 days' notification in advance of such activity in order to plan for their relocation. NOS recommends that funding for this project includes the cost of any relocation required for NOS monuments.

Thank you for the opportunity you gave this Department to review the report.

Sincerely,

Lucy Falcone  
Deputy Assistant Secretary  
for Policy Development  
and Coordination

Advisory Council on  
Historic Preservation  
1522 K Street N.W.  
Washington, D.C. 20005

August 29, 1977

Lieutenant Colonel Robert L. Oliver  
Deputy District Engineer  
Corps of Engineers, Galveston District  
Department of the Army  
P. O. Box 1229  
Galveston, Texas 77553

Dear Colonel Oliver:

We have reviewed the Revised Draft Environmental Statement (RDES) for the Buffalo Bayou and Tributaries, Upper White Oak Bayou, Flood Damage Protection, Texas, received on August 23, 1977. We note from our review of the RDES that the Corps of Engineers recognizes its responsibility pursuant to Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. 470f, as amended, 90 Stat. 1320), should the proposed project be authorized. Accordingly, we look forward to working with the Corps in accordance with the "Procedures for the Protection of Historic and Cultural Properties" (36 C.F.R. Part 800) at that time.

Should you have questions, please contact Michael H. Bureman of the Council staff at P. O. Box 25085, Denver, Colorado 80225, or at (303) 234-4946, an FTS number.

Your continued cooperation in this matter is appreciated.

Sincerely yours,



Louis S. Wall

Assistant Director, Office  
of Review and Compliance



DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE  
OFFICE OF THE SECRETARY  
WASHINGTON, D.C. 20201

Lieutenant General J.W. Morris  
Chief of Engineers  
Department of the Army  
Washington, D.C. 20314

Dear Sir:

Thank you for the opportunity to review the draft Environmental Impact Statement on Buffalo Bayou and Tributaries, Texas, Upper White Oak Bayou Flood Damage Prevention. We have the following comments:

1. It is difficult to understand the extensive channel lining recommended for this project in view of the groundwater and ground level subsidence due to the extraction of municipal water supplies. Groundwater recharge either for the immediate area or the downstream areas should be analyzed to properly assess future effects on groundwater recharge potential with implementation of the preferred alternative.
2. Since all the alternatives have a Benefit-Cost (B/C) ratio greater than one, they appear to be viable. The repeated reference to the higher ratio infers that this ratio was used as the basis for the decision. However, we feel it is inappropriate to place this much emphasis on the B/C ratio because of the uncertainty involved in classifying items appropriately either as costs or negative benefits.

Sincerely,

Charles Gustard  
Director  
Office of Environmental Affairs



DEPARTMENT OF AGRICULTURE  
OFFICE OF THE SECRETARY  
WASHINGTON, D. C. 20250

Lieutenant General J. W. Morris  
Chief of Engineers  
Office of the Chief of Engineers  
Army Corps of Engineers  
U.S. Department of the Army  
Washington, D.C.

Dear General Morris:

This is in reply to Colonel Alfred F. Lawrence, Jr.'s letter of June 23, 1977, transmitting for our review and comment your proposed report, together with other pertinent reports, on Buffalo Bayou and Tributaries, Texas - Upper White Oak Bayou.

White Oak Bayou is a tributary of Buffalo Creek and drains approximately 108 square miles in the northwest part of the city of Houston. The proposed flood damage reduction plan consists of channel enlargement and rectification in the urbanized reaches of upper White Oak Bayou and Cole and Vogel Creeks, combined with nonstructural measures in the headwater areas. Recreational facilities are provided on flood control rights-of-way. At 1976 prices, first costs are estimated at \$56,786,000 of which \$49,847,000 are Federal costs. At 6-3/8 percent interest, the benefit-cost ratio is calculated at 1.7.

Responses to comments made by the Texas State Conservationist, Soil Conservation Service, and the Area Environmental Coordinator, Forest Service, on the first draft environmental impact statement (EIS) appear to be adequately addressed.

Specific comments are enclosed for your consideration.

Sincerely,

A handwritten signature in cursive script, reading "M. Rupert Cutler".

M. RUPERT CUTLER  
ASSISTANT SECRETARY FOR:  
CONSERVATION, RESEARCH, & EDUCATION

Enclosure

U.S. DEPARTMENT OF AGRICULTURE

Comments on Buffalo Bayou and Tributaries, Texas -  
Upper White Oak Bayou

1. Section B, Appendix 1, Plate B-2 - It appears that the nonstructural management area along the upper reaches of White Oak Bayou will impact on large tracts of ricelands. The environmental impact statement (EIS) does not identify any of these ricelands as prime farmland. Since it is probable that some prime farmlands will be impacted by this proposed project, the EIS should identify such lands and describe any impacts that might occur. It would appear that protection of prime farmland should be a part of the nonstructural management plan.
2. Section B, Appendix 1 - The population projections given in table B-1, page B-9, and table B-13, page B-19, are based on series C population projections. The series E OBERS population projections should also be considered.
3. Section D, Appendix 1 - In the summary comparison of Alternative Plans (page 2 of 6, plate D-4) the effects of the environmental quality (EQ) plan on agricultural activities is given as: "Same as NED plan except that 2,800 acres of rural and agricultural land will be removed from production." This does not appear consistent with the description of the EQ plan on page D-48.
4. Section F, Appendix 1 - Land enhancement benefits are claimed for approximately 4,000 acres (page F-37b). Enhancement benefits were calculated as reduction in flood proofing costs, except for 257 acres not amenable to flood proofing. For these 257 acres, enhancement benefits were taken as the estimated increase in market value between unprotected and protected land. The upper limit of the period of analysis is normally taken at 100 years (Principles and Standards, Federal Register, September 10, 1973, page 87). Therefore, enhancement benefits should be claimed for only that portion of the land use for which actual occupancy and use is expected during the 100-year period of analysis.

From the social viewpoint, land enhancement benefits are limited by the principle of net locational advantage. The Principles and Standards state, "Net income change to the landowner will be measured as the difference in net income from an enterprise at an alternative location that would be utilized without the plan compared with the net income received from the enterprise at a new location which is improved or enhanced as a result of the plan", pages 45 and 46.

Therefore, land enhancement benefits are limited by the difference in values between land in the flood plain and land in the most likely alternative location. This limitation is applicable to the Houston area since the plan is not expected to affect regional growth in the Houston area, and the "no action" plan is expected to divert regional growth to other areas of the region (main report, page 66).



OFFICE OF THE GOVERNOR

DOLPH BRISCOE  
GOVERNOR

September 23, 1977

J.W. Morris  
Lieutenant General, USA  
Chief of Engineers  
Department of the Army  
Office of the Chief of Engineers  
Washington, D.C. 20314

Dear General Morris:

The Budget and Planning Office and interested State agencies, including the Texas Parks and Wildlife Department, have reviewed the Revised Draft Environmental Impact Statement for Buffalo Bayou and Tributaries, Texas - Upper White Oak Bayou Flood Damage Prevention.

The comments submitted by the reviewing agencies during the processing of the draft environmental impact statement are enclosed for your information and use in the preparation of the final environmental statement. If this Office can be of further assistance, please let us know.

Sincerely,

A handwritten signature in cursive script that reads "Roy Hogan".

Roy Hogan, Assistant Director  
Budget and Planning Office



TEXAS  
PARKS AND WILDLIFE DEPARTMENT



CLAYTON T. GARRISON  
EXECUTIVE DIRECTOR

4200 Smith School Road  
Austin, Texas 78744

August 23, 1977

Mr. Ward C. Goessling, Jr., Coordinator  
Natural Resources Section  
Governor's Budget and Planning Office  
Executive Office Building  
411 West 13th Street  
Austin, Texas 78701

Re: Proposed Report of the Chief of Engineers and Revised Draft  
Environmental Statement on Buffalo Bayou and Tributaries, Texas -  
Upper White Oak Bayou

Dear Mr. Goessling:

The Texas Parks and Wildlife Department has reviewed the above-captioned report. Previous departmental comments, submitted June 21, 1976, have been satisfactorily addressed and incorporated within the subject document revisions.

Thank you for the opportunity to review this report.

Sincerely,

A handwritten signature in black ink, appearing to read "Clayton T. Garrison".

CLAYTON T. GARRISON  
Executive Director

CTG:BDK:j19/20

# PARKS AND WILDLIFE DEPARTMENT



CLAYTON T. GARRISON  
EXECUTIVE DIRECTOR

4200 Smith School Road  
Austin, Texas 78744

July 20, 1977

Mr. Ward C. Goessling, Jr., Coordinator  
Natural Resources Section  
Governor's Budget and Planning Office  
Executive Office Building  
411 West 13th Street  
Austin, Texas 78701

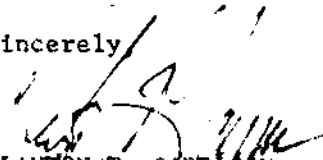
Re: Proposed Report of the Chief of Engineers on Buffalo Bayou  
and Tributaries, Texas - Upper White Oak Bayou

Dear Mr. Goessling:

The Texas Parks and Wildlife Department has reviewed the above-captioned report. Previous Departmental comments, submitted June 21, 1976, have been satisfactorily addressed and incorporated within the subject document revisions and the revised draft environmental statement.

Thank you for the opportunity to review this report and related documents.

Sincerely,

  
CLAYTON T. GARRISON  
Executive Director

CTG:BDK:lmw

# TEXAS WATER RIGHTS COMMISSION

STEPHEN F. AUSTIN STATE OFFICE BUILDING

August 17, 1977

Mr. Charles D. Travis, Director  
Governor's Budget & Planning Office  
Executive Office Building  
411 West 13th Street  
Austin, Texas 78701

Attention: Mr. Albert D. Schutz

Re: Office of the Chief of Engineers Department of the Army -- Revised Draft Environmental Statement -- Buffalo Bayou and Tributaries, Texas -- Upper White Oak Bayou (Flood Damage Prevention), December 1976.

Dear Mr. Travis:

In response to the request in your July 6 letter which transmitted to us the referenced Revised Draft Environmental Statement (RDES), and related papers, the Commission staff has reviewed the RDES and furnishes the following comments relative to the RDES:

1. The Commission staff reaffirms the review comments expressed in its May 20, 1977 letter (see pp. A-31, thru A-33, RDES) relative to both the April 1976 Draft Feasibility Report and the April 1976 Draft Environmental Statement for the proposed Upper White Oak Bayou Project. Since both documents are considered to be virtually inseparable project documents, we believe that all comments in our May 20, 1977, letter should be responded to on page 44 of the referenced RDES.
2. In addition to earlier comments, the Commission staff now recommends that further special analysis be included in the RDES regarding the cumulative effects of the proposed segment of the Buffalo Bayou and Tributaries, Texas project,

pursuant to policy contained in Section 3-3d of Corps of Engineers Pamphlet EP 1165-2-1, 10 January 1975. The policy states:

"The cumulative effects of the plan and other similar activities should be analyzed. Each proposed water resource development activity is but a piece of a large-scale program. The combined beneficial and adverse economic, environmental and social impacts of individual projects, each of which may be relatively minor, can have a significant regional or national impact. At each level of the evaluation and review process it is necessary to assess the cumulative beneficial and adverse effects of individual project impacts. Significant effects should guide the decisions."

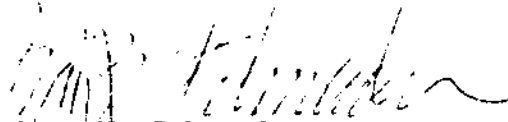
In short, the cumulative impacts of the fully-developed Buffalo Bayou and tributaries watershed should be assessed.

3. Nothing in foregoing comments should be construed or interpreted as modifying in any manner the basic project feasibility determination made by the Commission and noted in its Order of August 15, 1977.

We appreciated the opportunity to participate in the formulation of the referenced project. The comments are furnished with constructive intents. If you have any questions on our comments please notify Dr. Alfred J. D'Arezzo, Analyst for Environment and Interagency Coordination, phone: (512)475-2678.

Very truly yours,

TEXAS WATER RIGHTS COMMISSION



Robert E. Schneider  
Executive Director

RES-AJD:ll

ccs: Dr. Alfred J. D'Arezzo  
TWRC Reading File



# Texas Department of Health Resources

1100 West 49th Street  
Austin, Texas 78756  
458-7111

July 28, 1977

Mr. Charles D. Travis, Director  
Governor's Budget and Planning  
Office  
Executive Office Building  
411 West 13th Street  
Austin, Texas 78701

ATTENTION: Ward C. Goessling, Jr., Coordinator  
Natural Resources Section

SUBJECT: Harris County, Texas  
Buffalo Bayou and Tributaries  
Upper White Oak Bayou  
Flood Damage Prevention  
Revised Draft Environmental Statement

Dear Mr. Travis:

The Texas Department of Health Resources has reviewed the following reports concerning the Buffalo Bayou and Tributaries, Upper White Oak Bayou, Flood Damage Prevention Project:

"Main Report"  
"Appendices"  
"Revised Draft Environmental Statement"

The reports are dated December, 1976, and were prepared by the U. S. Army Corps of Engineers, Galveston District.

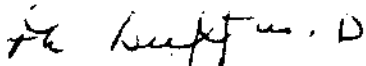
The proposed flood control and recreation improvements project is estimated to cost \$56,786,000, of which \$49,847,000 would be federally funded. The purpose of the project would be to alleviate flooding of the residential and commercial developments in the White Oak Bayou Drainage Basin within the City of Houston in northwest Harris County.

The elimination of health hazards resulting from the creation of breeding areas for vectors in ponding water during and upon completion of the work should be included as a consideration of this flood damage prevention project.

Brush and construction-demolition waste should be disposed of in a state-permitted or county-licensed sanitary landfill.

We appreciate the opportunity to review and comment on the proposed flood prevention project in Harris County.

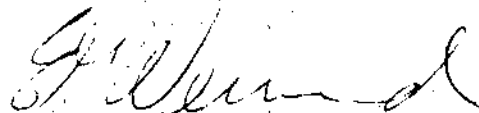
Sincerely,

  
Fratis L. Duff, M.D.  
Director

TO: Mr. Ward C. Goessling, Coordinator  
Natural Resources Section

SUBJECT: Proposed report of the Chief of Engineers on  
Buffalo Bayou and Tributaries, Texas -- Upper  
White Oak Bayou

The staff of the Bureau of Economic Geology have received  
the above cited report. We have no adverse comments on  
this project.



---

E. G. Wermund, Associate Director  
Bureau of Economic Geology  
The University of Texas at Austin  
Austin, Texas 78712



OFFICE OF THE GOVERNOR  
BUDGET AND PLANNING OFFICE  
STATE CLEARINGHOUSE  
Phone: 512/475-2427

## COMMENTS

The improvements proposed for White Oak Bayou are intended to provide primary flood protection to urbanizing areas in NW Houston. White Oak Bayou is a major tributary to Buffalo Bayou and has been subject to almost annual out-of-bank flooding for the last several years. Improvements consist mainly of channel enlargement and rectification to increase the run-off capabilities of the streams.

More than 4500 residences are located in flood prone areas in this watershed and urbanization of the area is progressing rapidly. The designed improvements will encompass a level of protection up to the Standard Project Flood (SPF) (maximum expected rainfall and run-off conditions).

Both structural (channel improvements) and non-structural (flood plain management) measures are combined in this area. A recreational development element is also covered.

Total first cost of the plan is estimated to be \$56,786,000 (non-federal local share is \$6,939,000). A total combined project plan would yield a very favorable benefit to cost ratio of 1.68.

The neighborhoods in NW Houston and Harris County to be protected by this project are badly in need of help and this project offers a reasonable solution to most of the areas flooding problems.

The Department of Community Affairs concurs in the plan and its recommended alternatives and will assist local governments in the area with whatever related problems or needs may arise from this project.

Person Conducting Review (Signature) \_\_\_\_\_

Agency Texas Department of Community Affairs

Date July 14, 1977



Legislative and Planning Office  
Office of the Governor  
(Attn: State Clearinghouse)

Date: Due: 7/27/77

Refer: EIS-

FROM: *The Honorable Bob Armstrong*  
*D.S.O.*

SUBJECT: INTERIM REPORT OF THE CHIEF OF ENGINEERS ON BUFFALO BAYOU  
AND TRIBUTARIES, TEXAS - UPPER WHITE OAD BAYOU

We have reviewed the cited document and our comments as to the adequacy of treatment of environmental effects of concern are shown below:

	Check (✓) for each item	
	None	Comment enclosed
1. Additional specific effects which should be assessed:	✓	
2. Additional alternatives which should be considered:	✓	
3. Better or more appropriate measures and standards which should be used to evaluate environmental effects:	✓	
4. Additional control measures which should be applied to reduce adverse environmental effects or to avoid or minimize the irreversible or irretrievable commitment of resources.	✓	
5. Our assessment of how serious the environmental damage from this project might be, using the best alternative and control measures:	✓	
6. We identify issues which require further discussion or resolution:	✓	

This agency concurs with the implementation of this project.

This agency does not wish to comment on the subject document because:

*A. H. McKam*, Review Coord.  
State of Reviewing official



COMMISSION

REAGAN HOUSTON, CHAIRMAN  
DEWITT C. GREER  
CHARLES E. SIMONS

STATE DEPARTMENT OF HIGHWAYS  
AND PUBLIC TRANSPORTATION

AUSTIN, TEXAS 78701

August 1, 1977

ENGINEER-DIRECTOR  
B. L. DEBERRY

IN REPLY REFER TO  
FILE NO.

Buffalo Bayou and Tributaries  
Interim Report and Revised Draft EIS  
Upper White Oak Bayou  
Harris County

Mr. Ward C. Goessling, Jr., Coordinator  
Natural Resources Section  
Governor's Budget and Planning Office  
411 West 13th Street  
Austin, Texas 78701

Dear Sir:

Reference is made to your memorandum dated July 8, 1977 transmitting the above captioned draft environmental statement for review and comments.

The Department does not have any comments to offer other than an explanation of the status of Beltway 8. Beltway 8 has been in the planning stage for many years. The County has constructed several short road segments which may serve as part of any ultimate facility. The development of Beltway 8 as a controlled access State highway facility to provide an outer loop around Houston is very uncertain at this time.

There are several post-1975 instances where this Department's current name should be used.

The opportunity to review this document is appreciated.

Sincerely yours,

B. L. DeBerry  
Engineer-Director

*Marcus L. Yancey, Jr.*  
Marcus L. Yancey, Jr.  
Engineer-Director

# TEXAS WATER DEVELOPMENT BOARD



P.O. BOX 13087  
CAPITOL STATION  
AUSTIN, TEXAS 78711

July 14, 1977

Lieutenant General J.W. Morris  
Chief of Engineers  
Department of the Army  
Washington, D.C. 20314

Re: Revised Draft Environmental State-  
ment: Upper White Oak Bayou Flood  
Damage Prevention.

The above-cited Revised Environmental Statement has been reviewed at staff-level. We note that the section on Geology has been revised and expanded as per our recommendation to address the effects of land subsidence and related active faulting in the project area insofar as these phenomena relate to flooding of low-lying areas. No conflict is foreseen between the proposed measures and any planned or potential future development of Texas water resources.

The proposed flood control improvements in Upper White Oak Bayou and its tributaries, Cole and Vogel Creeks, will, no doubt prove to be a vital asset to the area. As noted in our May 27, 1976, letter on the previous draft EIS, we are encouraged by the beneficial effects of flood protection afforded by this project and urge its early implementation.

Sincerely,

A handwritten signature in dark ink, appearing to read "James M. Rose".

James M. Rose

cc: Mr. Ward C. Goessling, Jr.  
Office of the Governor  
State of Texas



1700 North Congress  
Stephen F. Austin Building  
Box 13246 Capitol Station  
Austin, Texas 78711 Phone (512) 475-2651

J. Douglass Toole  
Chairman  
Frank H. Lewis  
Vice Chairman  
M. F. Frost  
Fratz L. Duff, MD  
Clayton T. Garrison  
James M. Rose  
Mark Wallace  
Hugh C. Yantis, Jr.  
Executive Director

July 26, 1977

Re: Interim Report and Draft  
EIS on Flood Damage Pre-  
vention Project, Upper  
White Oak Bayou

Mr. Charles D. Travis, Director  
Governor's Office of Budget  
and Planning  
411 West 13th Street  
Austin, Texas 78701

Dear Mr. Travis:

The staff of the Texas Water Quality Board has reviewed the draft environmental impact statement and interim report covering the proposed Flood Damage Prevention Project on the Upper White Oak Bayou drainage basin in northwest Harris County as prepared by the U.S. Army Corps of Engineers, Galveston District. The staff concurs with the conclusions of the draft environmental impact statement and interim report that, although this proposed activity will have some adverse environmental impacts, it should not cause any significant long-term water quality problems if the pollution control measures are employed as set forth in the draft environmental impact statement.

As per our letter of May 18, 1976 on this proposed action, any modification of sanitary sewer lines and construction of sewage pumping stations should be closely coordinated with the proper local jurisdictional entity, whether an incorporated city or municipal utility district, to insure that construction activity does not create a situation where degradation of water quality may occur. Examples of this potential degradation would result from: raw sewage bypasses due to construction; additional

loadings to existing treatment facilities due to the incremental flow advantages of a pumping station; poor operation and maintenance of facilities due to uncertain ownership of proposed transportation facilities' modifications; and the deterioration of treatment efficiencies because of increased infiltration and/or inflow due to construction activities. The staff feels that these concerns have yet to be addressed in the draft environmental impact statement.

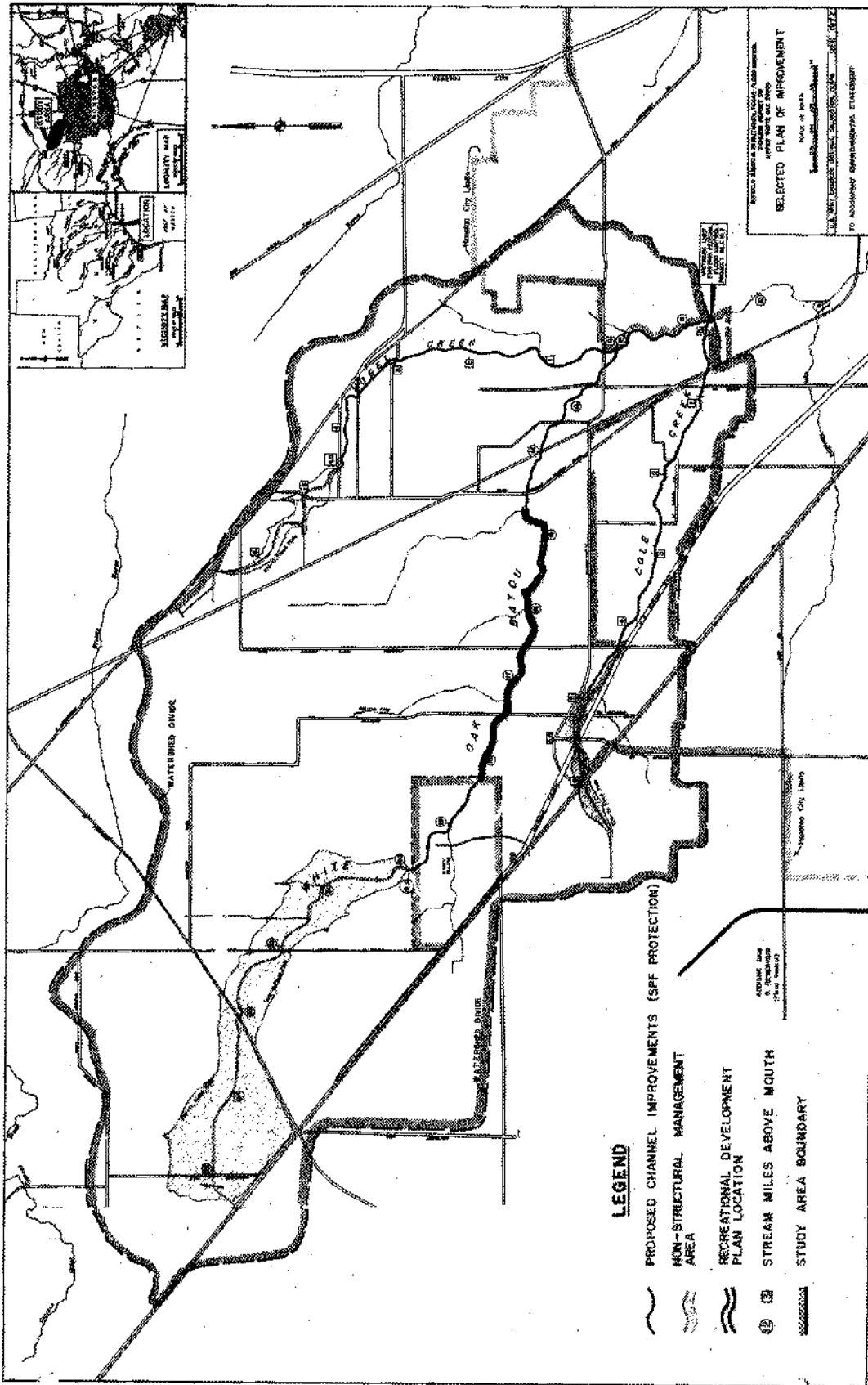
In addition, all controls and practices which prevent the erosion of soil associated with construction activities should be implemented in order to minimize any increase of pollutants in the State's waters.

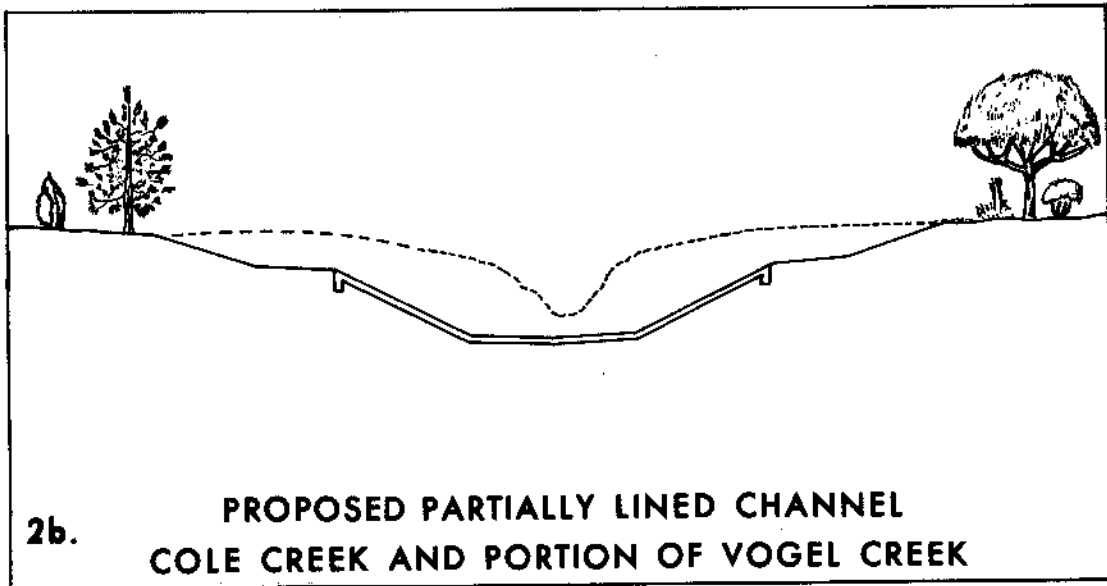
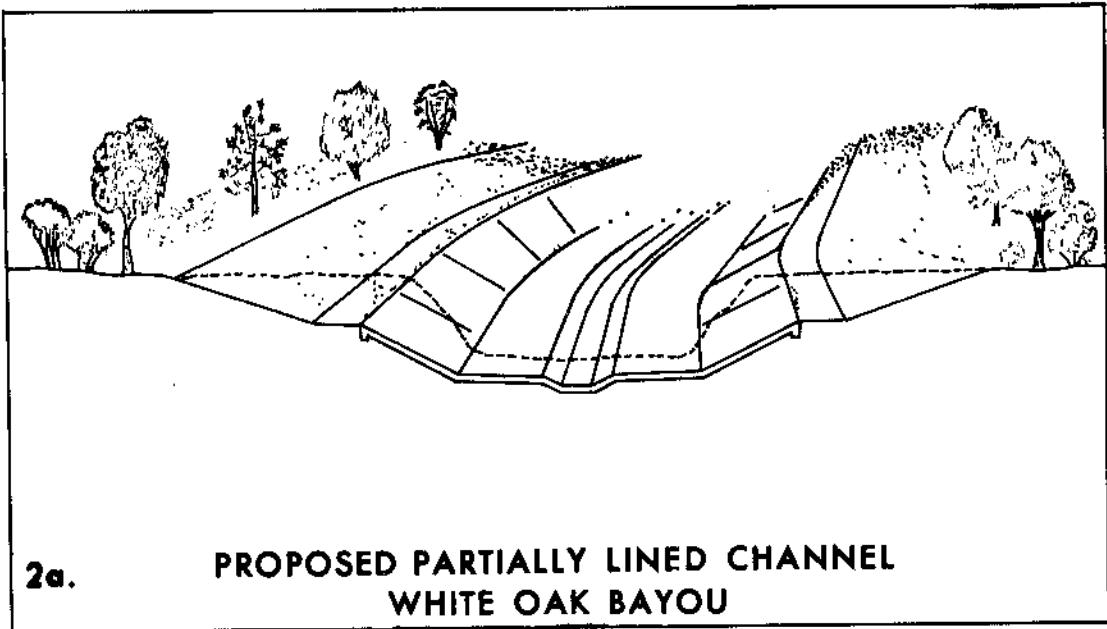
We appreciate the opportunity to review this proposed activity. If we can be of further assistance, please let me know.

Very truly yours,

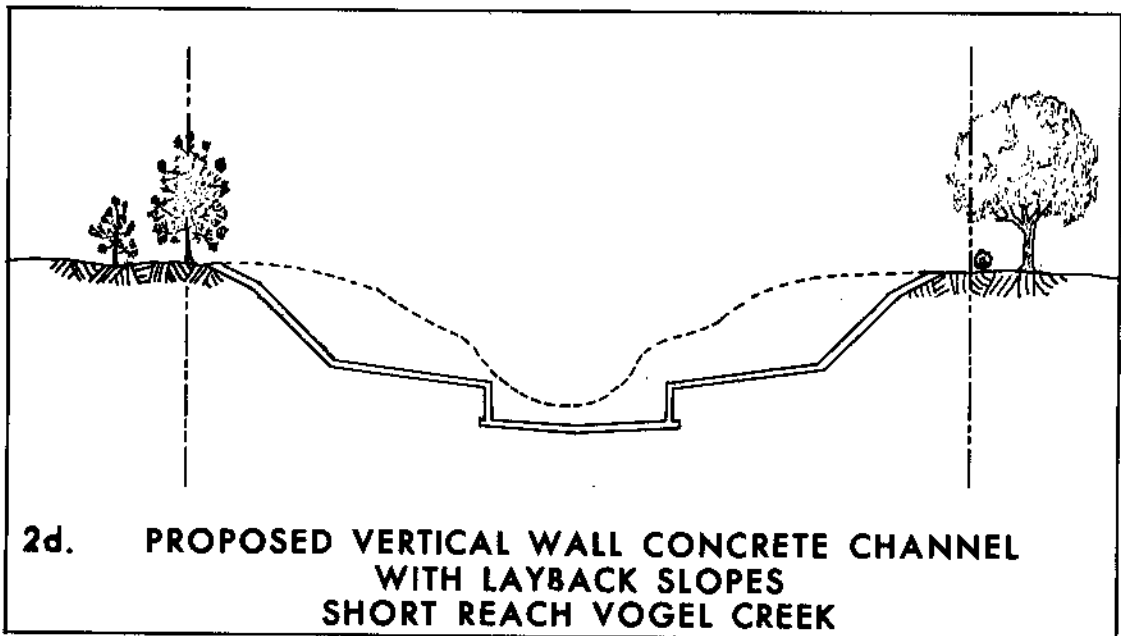
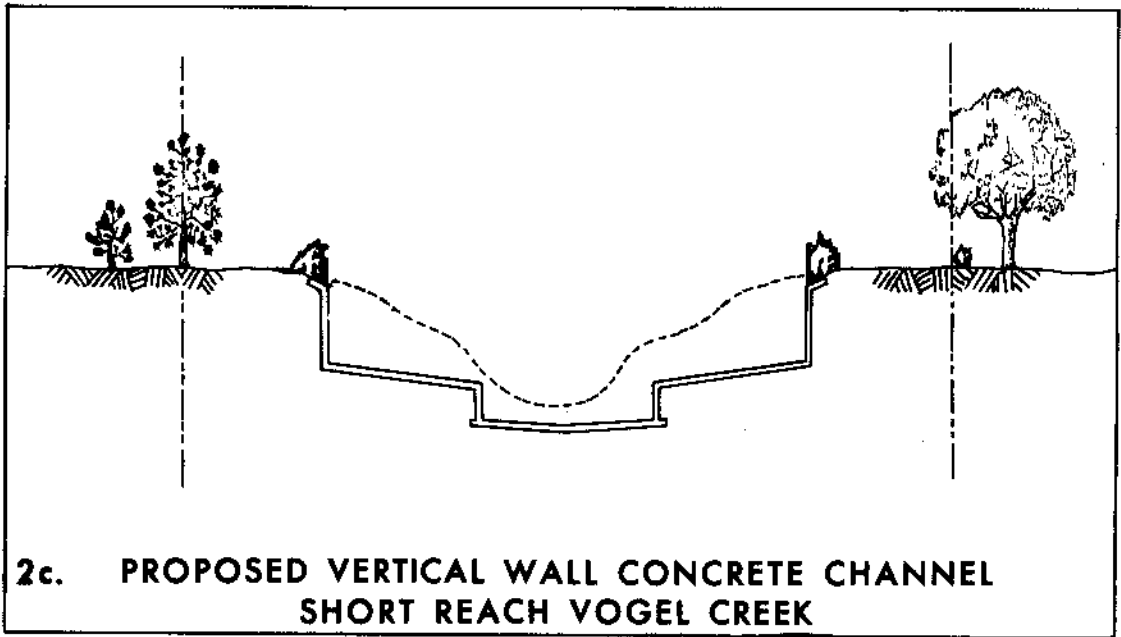


Emory G. Long, Director  
Administrative Operations Division





**FIGURE 2:**  
IMPROVEMENTS PROPOSED FOR UPPER WHITE OAK BAYOU AND TRIBUTARIES



**FIGURE 2: (cont.)**



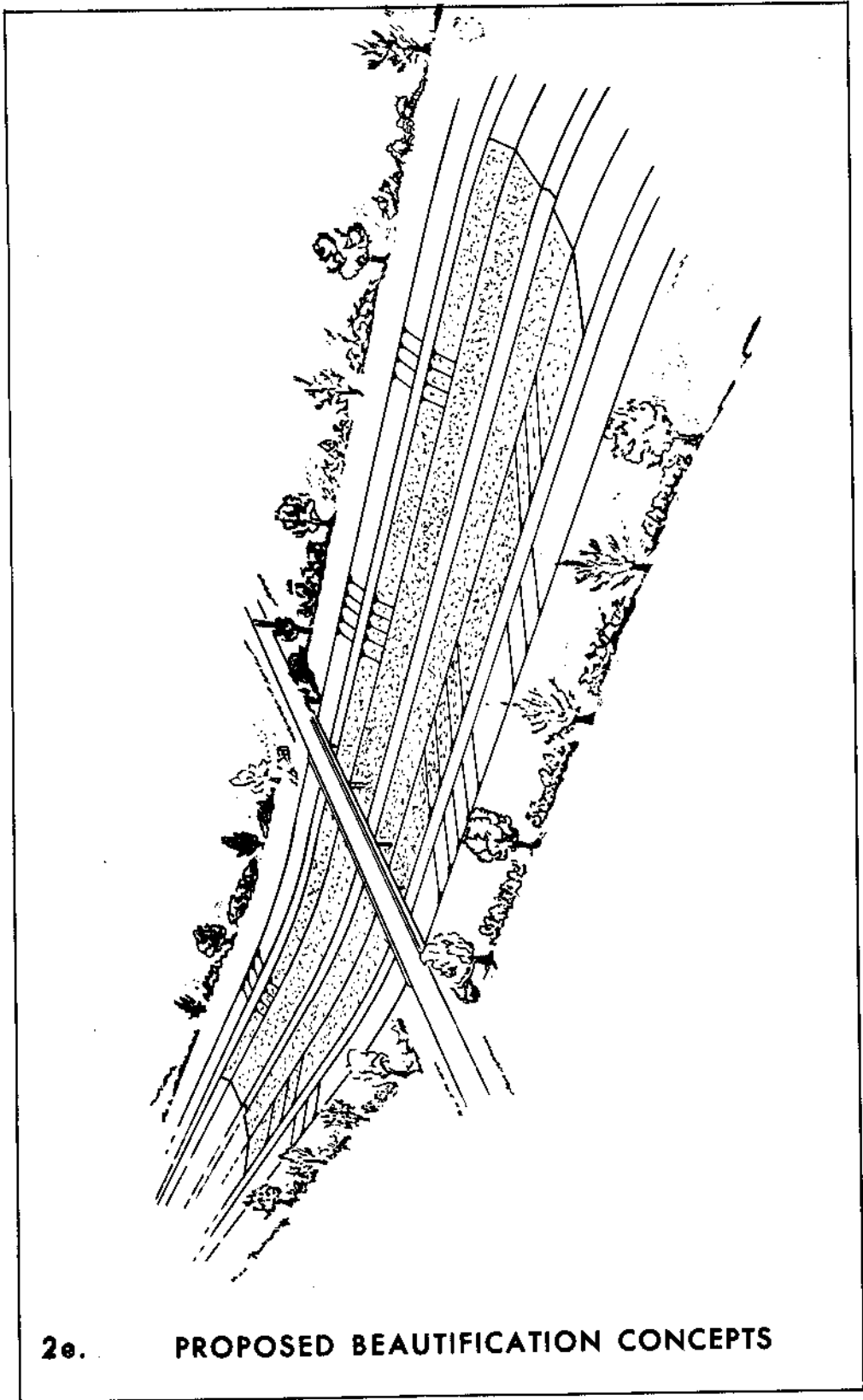


FIGURE 2: (cont.)



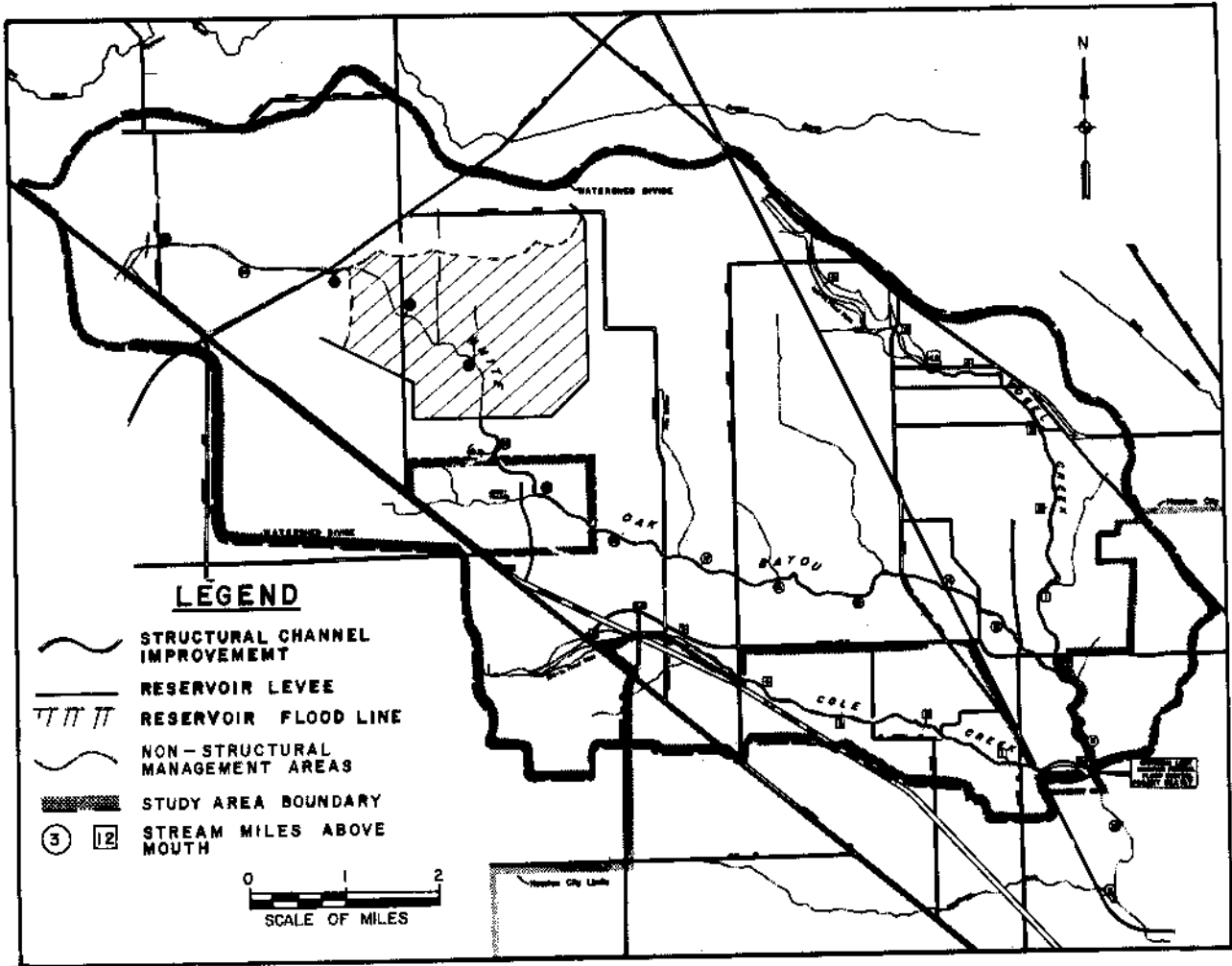


FIGURE 4  
 RESERVOIR AND CHANNEL IMPROVEMENT ALTERNATE PLAN

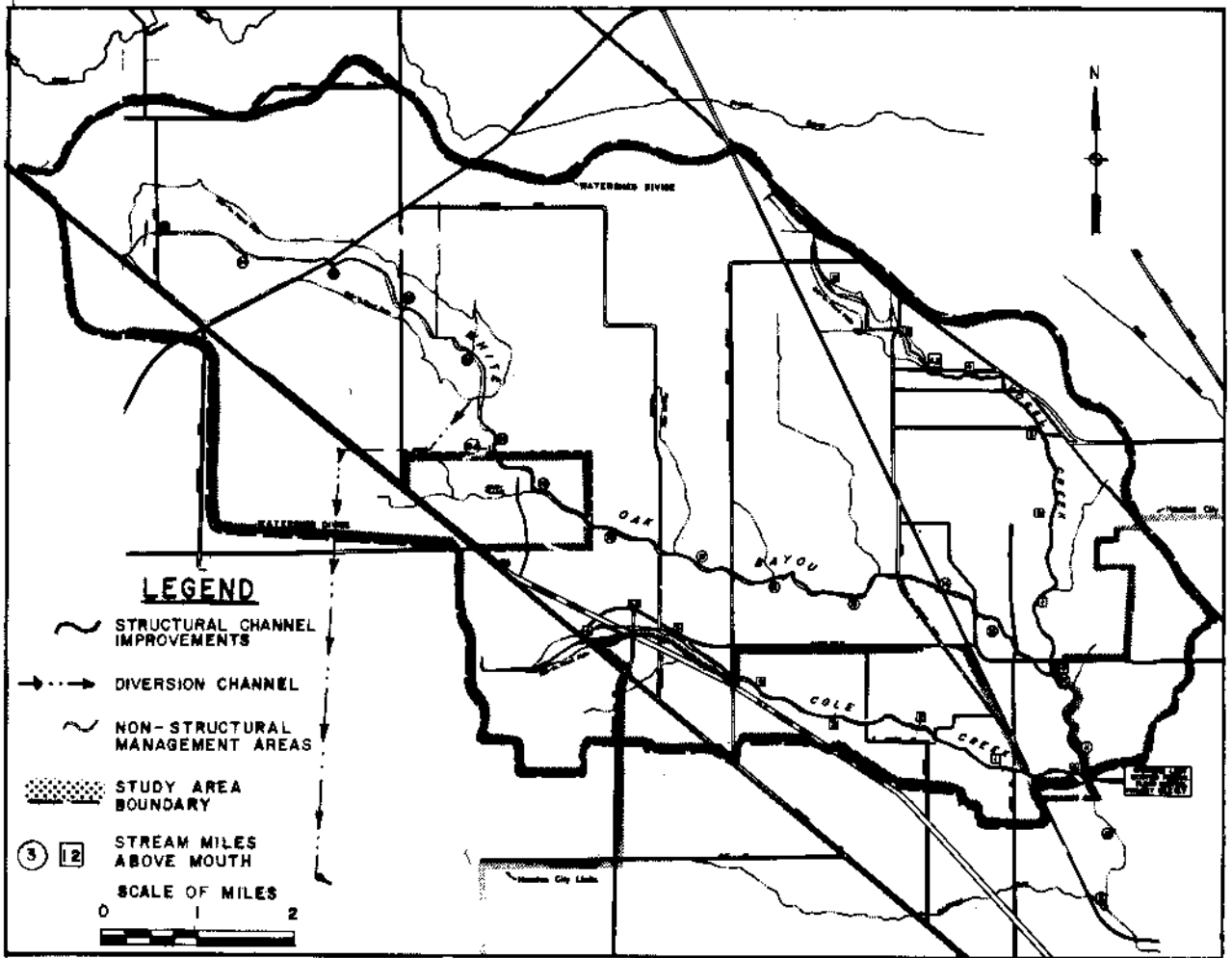


FIGURE 5  
DIVERSION AND CHANNEL IMPROVEMENT ALTERNATE PLAN



BUFFALO BAYOU AND TRIBUTARIES, TEXAS  
UPPER WHITE OAK BAYOU  
FLOOD DAMAGE PREVENTION

ECONOMIC DATA

EXTRACTED FROM U.S. ARMY CORPS OF ENGINEERS DRAFT FEASIBILITY REPORT, BUFFALO BAYOU AND TRIBUTARIES, TEXAS, INTERIM REPORT ON UPPER WHITE OAK BAYOU, NOVEMBER 1976 PRICE DATA. COMPLETE DOCUMENT IS AVAILABLE AT U.S. ARMY ENGINEER DISTRICT, GALVESTON, TEXAS

1. <u>Total Project Cost</u>	\$56,786,000
2. <u>Average Annual Benefits</u>	
a. Prevention of Flood Damages to Existing Development	4,114,000
b. Prevention of Flood Damages to Future Development	1,181,000
c. Reduction of Public Health and Relief Costs	279,000
d. Reduction in Future Flood Proofing Cost	356,000
e. Location (Enhancement) Benefits	972,000
f. Recreational Opportunity Benefits	<u>109,000</u>
TOTAL AVERAGE ANNUAL BENEFITS	\$7,011,000
3. Average Annual Charges	4,169,000
4. Benefits-to-Cost Ratio	1.7 <sup>1/</sup>

1/ Non-quantifiable environmental benefits and costs have not been reflected in benefit-to-cost determination.

## STATEMENT OF FINDINGS

U.S. ARMY ENGINEER DISTRICT, GALVESTON, TEXAS

STATEMENT OF FINDINGS  
BUFFALO BAYOU AND TRIBUTARIES, TEXAS  
INTERIM REPORT ON  
UPPER WHITE OAK BAYOU

1. As District Engineer, U. S. Army Engineer District, Galveston, Texas, it is my duty as the responsible Federal official to review and evaluate in the overall public interest all documents, data, and information, as well as the stated views of other interested agencies and the concerned public, in regard to the problems of overbank stream flooding of the urbanized lands in the upper White Oak Bayou watershed at Houston, Texas. I have made this review and evaluation with detailed consideration of engineering feasibility, environmental impacts, direct social effects, and economic factors of local, regional, and national resource development and social well-being. I have determined that my interim investigation of the upper White Oak Bayou watershed is responsive, in part, to the Congressional authorization directing the development of a comprehensive plan for the control of floods on Buffalo Bayou and its tributaries.
2. In my investigations I have utilized a professional staff well versed and experienced in the applicable fields of engineering, economics, and environmental sciences. Field and office studies have been conducted in the depth necessary to determine feasibility and social and environmental impacts of the alternate proposals discussed in this report. Established procedures have been utilized in determining stream flooding conditions and the expected severities of flood damages. Historical flooding of the areas and experienced flood damages have been evaluated and correlated with predictions of future flood damages to be expected with continued urbanization and resultant increases in the severity of damages caused by increases in rainfall runoff.
3. I am convinced that the study has benefited from an adequate program of public communications and interagency relations and that the recommended plan has public understanding and acceptance. Public meetings were held on 14 May 1971 and 18 April 1974 and several workshop meetings have been held with a local Citizens' Advisory Committee and with other civic groups. The report has been made available to all interested Federal and state agencies and their comments and recommendations have been duly considered. Support of the recommended action has been officially expressed by the Harris County Commissioners Court, the cognizant local governmental entity. Three orders passed by the Court have expressed its intent to fulfill the requirements of local cooperation.
4. All apparent alternate methods of relieving the study area of flood damages have been investigated in sufficient detail to determine their feasibility. Structural alternatives considered consist primarily of various forms of channel improvements combined with a flood detention

reservoir or diversion of floodwaters to other areas. Nonstructural alternatives considered include local regulations to prevent future damageable developments in flood-prone areas, flood-proofing of existing structures, and evacuation of flood-prone areas. Combinations of structural and nonstructural alternatives also have been considered. The investigation has indicated that the most practical solution is channel enlargement and rectification of the urbanized reaches of White Oak Bayou, Cole Creek and Vogel Creek combined with nonstructural flood plain management of the remaining undeveloped reaches of the streams.

5. The investigation indicates that various degrees of protection corresponding to various frequencies of flooding are economically justified. A plan of improvement to provide structural protection from the passage of a 50-year frequency flood, according to my estimates, produces the maximum excess benefits over costs. However, I have concluded that a plan to provide a higher degree of flood protection, to the level of the standard project flood, would better serve the public interest. This conclusion is based primarily on the extent of existing urbanization and the expected future urban growth in the study area.

6. The investigation also has disclosed that the proposed plan of improvement offers opportunity for a public-use recreational plan for which there is growing demand and evident economic justification.

7. In considering the environmental effects of the proposed action, I find that there will be no significant adverse effects on the natural environment of the area. Most of the natural woodlands have previously been altered by channel clearing and by existing urban developments. The plan of improvement includes selective plantings along the channel rights-of-way in areas exposed to public view. The recreational portion of the plan will provide outdoor leisure opportunity for public enjoyment.

8. I find that social impacts of the action will be largely beneficial, relieving the residents of the economic losses and inconveniences related to repetitive flooding, depression of property values, and the social stresses of a continual threat of flooding. Temporary disruptions will occur to transportation facilities during construction. Local economic impacts will be beneficial, primarily through restoration of property values. Economic impacts of the proposed action on surrounding areas of the Houston metropolitan area will not be significant.

9. I am satisfied that there is a valid Federal interest in solving the flooding problems in the study area in terms of the historic involvement of the Federal Government in flood control activities. It is my judgment that the precedents for substantial local participation in the cost of flood control works are clear and well established. I am convinced that the items of local cooperation are reasonable and consistent with present Federal policy.

10. I find that the proposal outlined in the feasibility report, consisting of enlargement and rectification of the lower reaches of the channels in the study area, nonstructural management of flood plains in the upper reaches,



and a recreational development plan, is based on thorough analyses and evaluations of various alternate courses of action for achieving the desired objectives. I also find that no significant, adverse environmental effects are discernible; that the social and economic benefits to be derived outweigh any adverse effects; that the action is consonant with national policy, statutes, and administrative directives; and that on balance the total public interest should best be served by implementation of the proposal.



JON C. VANDEN BOSCH  
Colonel, Corps of Engineers  
District Engineer


DATE 13 December 1976

SWDPL-F

SUBJECT: Buffalo Bayou and Tributaries, Texas, Interim Report on Upper  
White Oak Bayou


I concur in the preceding Statement of Findings.

28 January 1977  
Date

  
CHARLES I. MCGINNIS  
Major General, USA  
Division Engineer

I concur in the preceding Statement of Findings.

30 May 1978  
Date

  
DRAKE WILSON  
Brigadier General, USA  
Deputy Director of Civil Works