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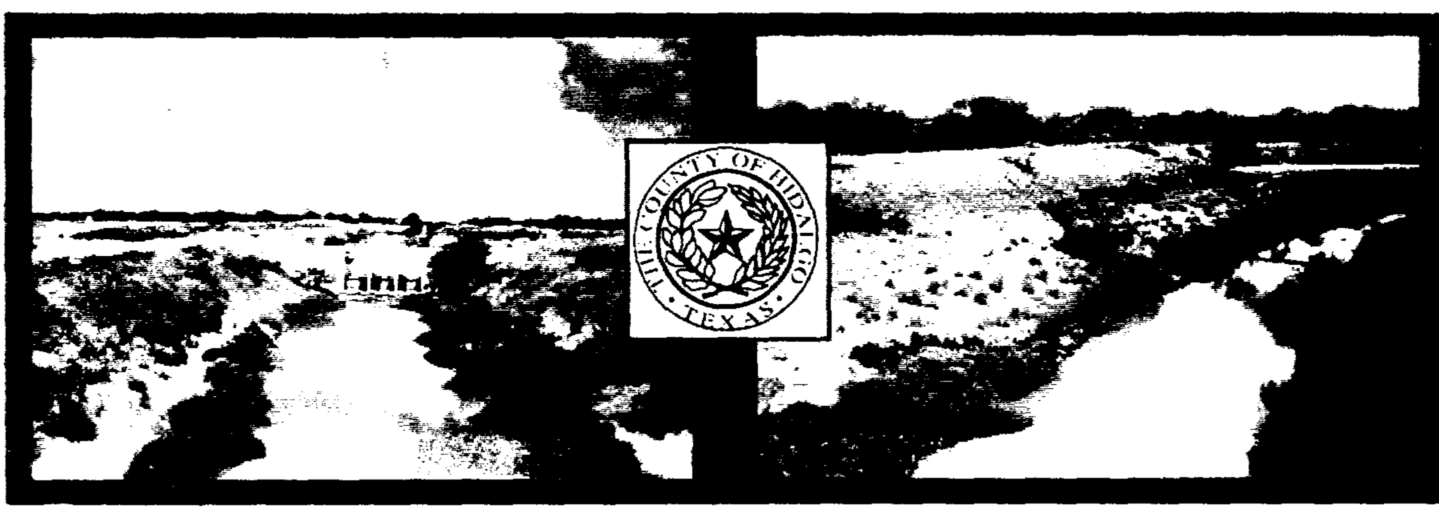
Engineering Report to Hidalgo County Drainage District No. 1 Texas Water Development Board

Flood Protection Plan for Hidalgo County, Texas

September 1997



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Turner Collie & Braden Inc.

ENGINEERING REPORT TO
HIDALGO COUNTY DRAINAGE DISTRICT NO. 1
TEXAS WATER DEVELOPMENT BOARD

Turner Collie & Braden Inc.
Job No. 31-00300-001

FLOOD PROTECTION PLAN FOR HIDALGO COUNTY, TEXAS

STATE OF TEXAS
ALAN J. POTOK
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REGISTERED PROFESSIONAL ENGINEER

Alan J. Potok, P.E.
Vice President

DECEMBER 1997

TABLE OF CONTENTS

During the late 1970s and through the mid-1980s, Hidalgo County Drainage District No. 1 constructed a series of drainage channels intended to provide relief from local flooding problems that occur within the County. These ditches, referred to as the Hidalgo County Master Drainage System (HCMDS), were financed and constructed using County resources after an unsuccessful attempt to gain federal authorization for a similar project. These early channels were designed to convey agricultural runoff from a 10-year storm event; they were not designed to accommodate the urban runoff presently associated with the population explosion Hidalgo County has been experiencing over the past 15 years. As this population expansion has occurred, two principal deficiencies have been identified with the HCMDS. These include the overall drainage capacity, and the lack of an adequate lateral drainage system to access the HCMDS. Both of these issues had been previously addressed in the original federal study effort; however, no action to their implementation has been taken to date.

The purpose of this study is to determine the drainage requirements necessary to convey runoff into the HCMDS. To achieve this purpose, the study has the following objectives: (1) to evaluate current drainage criteria and recommend modifications to drainage policies in developing areas; (2) to identify the watersheds associated with the lateral drainage systems that drain into the primary HCMDS; (3) to develop a basic mapping system for the lateral drain system; and (4) to define a Capital Improvement Plan for future construction of the lateral channels.

Hidalgo County, Texas is located in the Lower Rio Grande Valley (LRGV) and is one of the nation's richest agricultural areas. Agricultural land surrounds most urban communities in the County, and provides the primary industry. However, the accessibility to the Mexican border, combined with the region's moderate climate, has contributed to a rapidly developing economic community. The population of Hidalgo County is also growing rapidly, and the Lower Rio Grande Valley Development Council projects the population to increase to more than 500,000 by the year 2000. Commercial development has occurred, principally along major highways, railroads, and some drainage channels. Residential growth continues to expand the limits of the cities, resulting in the gradual conversion of some of the peripheral agricultural lands.

The Rio Grande forms the southern boundary of Hidalgo County, and is also the international boundary between the United States and Mexico. The Rio Grande provides the drainage outlet for the westernmost portions of Hidalgo County. A series of floods that inundated large portions of the LRGV, resulting in extensive damage, caused the International Boundary and Water Commission (IBWC) to construct a system of floodways to convey the flows that exceeded the Rio Grande's capacity.

Even with the federal floodway project in place, Hidalgo County suffered from a lack of adequate local drainage channels. In 1969, the US Soil Conservation Service (now the Natural Resource Conservation Service, NRCS) conducted a study concerning the flooding problems in the LRGV, and recommended that a comprehensive drainage plan be developed. The plan was to be accomplished in three phases. Phase One would address the major outlet channels within the study area, with phases Two and Three dealing with the lateral and on-farm drainage systems.

The U.S. Army Corps of Engineers undertook the first phase, and published the "Lower Rio Grande Basin, Texas Flood Control and Major Drainage Project" in October of 1980. The results of the first phase study showed that the proposed project would afford benefits from: the prevention of flood damages to existing and future urban and agricultural development; a reduction in public health and relief costs; enhancement of land values; an increase in net financial returns to farm and ranch operators; and the overall enhancement of the economy of the area. Phases Two and Three of the NRCS plan were never executed.

As part of the study, meetings were held between participants in the development community and local drainage authorities. One of the principal concerns of these stakeholders is the lack of an adequate outfall. In many cases, the development does not have access to an outfall ditch. There was a general consensus that all parties were willing to solve the drainage problem, providing that the costs were reasonable and criteria were consistent.

In review of the drainage criteria, the following recommendations are made to enhance overall drainage management:

1) Obtain recent aerial mapping in digital form and enhance the HCDD No. 1 GIS system, using this data to assist in determining channel alignments and land use.
2) Municipalities and the HCDD No. 1 should agree on a performance standard for the drainage system that encourages participation by the development community, as well as the public interests.
3) Pursue the lateral drainage channel plan defined in this report.
4) Develop a drainage criteria manual for the County.
5) Define a consistent methodology, such as the one presented in this report, for calculating channels, detention basins, and storm sewers.
6) Pursue a cooperative program with the IBWC that allowed for a major expansion of the flow from the HCMDS into the IBWC floodway system.

One of the primary objectives of this study was to plan for a series of lateral channels that would provide drainage to all local areas allowing access to the HCMDS. To perform this task, all previous and ongoing drainage studies were examined. To the extent practical, the results of these studies are incorporated into the lateral channel plan. The irrigation districts in Hidalgo County currently operate and maintain a significant number of channels. In most cases, the alignments of these channels was used to guide development of the lateral drains that would be operated by HCDD No. 1. An extensive array of channels and their corresponding drainage areas are shown on *Exhibit 5*. *Table 3* summarizes the physical characteristics of each channel, and *Table 4* shows the approximate cost for each. The total cost of the lateral channel system is approximated as $141,983,000. Maintenance costs associated with the channels are anticipated to be $2,330,000 annually.

Purpose

Outfall drainage in Hidalgo County, Texas, is provided by a series of large ditches that were constructed during the late 1970s through the mid-1980s. These ditches, referred to as the Hidalgo County Master Drainage System (HCMDS), were financed and constructed using county resources after an unsuccessful attempt to gain federal authorization for a similar project. The channels were designed at that time to convey agricultural runoff from a 10-year storm event, and subsequently do not accommodate the urban runoff associated with the population explosion Hidalgo County has experienced over the past 15 years. As this population expansion has occurred, two principal deficiencies have been identified with the HCMDS. These include the overall drainage capacity and the lack of an adequate lateral drainage system to access the HCMDS. Both of these questions had been previously addressed in the original federal study effort; however, no action has been taken to date to implement them.

The purpose of this study is to determine the drainage requirements necessary to convey runoff into the HCMDS. To achieve this purpose, the study has the following objectives: (1) to evaluate current drainage criteria and recommend modifications to drainage policies in developing areas; (2) to identify the watersheds associated with the lateral drainage systems that drain into the primary HCMDS; (3) to develop a basic mapping system for the lateral drain system; and (4) to define a Capital Improvement Plan for future construction of the lateral channels.

Study Participants

Hidalgo County Drainage District No. 1 (HCDD No. 1) is responsible for the maintenance of the HCMDS, and provides this service over the majority of Hidalgo County, as depicted on *Exhibit 1*. In support of its activities, HCDD No. 1 has implemented a permitting program that requires land development activities to gain HCDD No. 1 approval before accessing the HCMDS as an outfall. Recognizing the difficulty being experienced by the developing properties in the region, and also in response to numerous concerns by the municipalities in the County, HCDD No.1 developed the scope of services for this project. In August 1996, HCDD No. 1 completed an application for a regional Flood Protection Planning Grant for the Texas Water Development Board (TWDB). Other communities participating in the planning grant application were the cities of Pharr, McAllen, and Edinburg. The planning grant was issued on December 17, 1996. Selection of a consultant was completed, and work began on the study in January 1997.

Hidalgo County Drainage District No. 1 Service Area

HCDD No. 1 is a Conservation and Reclamation District created under Article 16, Chapter 59 of the Texas Constitution. It is responsible for the operation and maintenance of the major drainage channels constructed as part of the HCMDS. The service area encompasses most of, but not all of, Hidalgo County, as depicted on *Exhibit 1*. The service area extends from east of La Joya on the west, to the Willacy and Cameron County lines on the east, and from the Rio Grande on the south, to an area south of Hargill on the north. The total service area encompasses approximately 790 square miles within Hidalgo County.

Description of the Area

Hidalgo County, Texas is located in the Lower Rio Grande Valley, and is one of the nation's richest agricultural areas. The soils are fertile and produce high yields of citrus, vegetables, cotton, and other crops through the use of irrigation with adequate drainage. These favorable natural conditions in the Lower Rio Grande Valley, together with the development of water sources for irrigation, have resulted in an increase in the Lower Rio Grande Valley's irrigated area from a few thousand acres to more than 679,000 acres over the past 50 years. Hidalgo County represents about half of the total amount.

Hidalgo County comprises approximately 1,583 square miles in south Texas along the Texas Mexico border. Its proximity to Mexico has contributed to its high rate of population growth over the past 20 years. In 1970, the U.S. Census Bureau estimated the population of the County to be 181,525 persons. In 1990, the U.S. Census Bureau estimated the population to be 383,545. The majority of this growth has occurred along the route of U.S. 83, and between U.S. 83 and the Rio Grande.

The overall population of Hidalgo County is growing rapidly, and the Lower Rio Grande Valley Development Council projects the County's population to increase to more than 500,000 by the year 2000. The largest city in Hidalgo County is the City of McAllen, with an estimated population of 83,000. The second largest city is Edinburg, with a population of 32,700. Other major cities include Pharr, Mission, Weslaco, Donna, San Juan, and Mercedes.

Agricultural land surrounds most urban communities in the County, and serves as the primary industry. Commercial development has occurred principally along major highways, railroads, and some drainage channels. Residential growth continues to expand the limits of the cities, resulting in the gradual conversion of some of the peripheral agricultural lands.

Physical Features

The Lower Rio Grande Valley is a smooth, nearly flat plain that includes two physiographic features, the Rio Grande Delta and the Gulf Coastal Plain. The Rio Grande Delta covers all of Cameron County, the southern portion of Willacy County, and an eight mile-wide strip along the southern and eastern portions of Hidalgo County. The remainder of Hidalgo County is underlain by marine sedimentary formations of the Coastal Plain.

The minor surface slopes that do exist are related primarily to the Mission Ridge and to a natural levee which extends along the north bank of the Rio Grande from a point southwest of the City of Mission to the mouth of the Rio Grande. Mission Ridge is a minor rise that forms a drainage divide extending generally along U.S. 83, from just west of Mission to a point midway between Weslaco and Mercedes. The southern portion of Mission Ridge is part of the Coastal Plain and it slopes from the highway southeastward to the Main Floodway. The delta lands between the Main Floodway and the Rio Grande have a general northeastern slope towards the Floodway and away from the natural levee bordering the river. The coastal plain north of U.S. 83 and east of Mission slopes generally northeastward, towards the North Floodway and the Laguna Madre. The westernmost portions of the County slope towards the Rio Grande.

The Rio Grande provides a drainage outlet only for the westernmost portions of Hidalgo County, with the International Boundary and Water Commission (IBWC) Main Floodway, the IBWC North Floodway, and the Arroyo Colorado constituting the outlet for the remainder of Hidalgo County (*Exhibit 3*). The ultimate outfall of the floodway system is through Willacy and Cameron counties into the Laguna Madre. The Main Floodway was developed by constructing levees along each side of a series of resacas and excavating a pilot channel midway between the levees. The Main Floodway merges with the Arroyo Colorado southwest of Mercedes, creating a distributary of the Rio Grande that extends to the Laguna Madre. That is the only natural outlet channel in the Lower Rio Grande Valley, other than the Rio Grande.

The primary function of the IBWC Main Floodway, IBWC North Floodway, and Arroyo Colorado is to divert excess flows from the Rio Grande. During periods when the floodways are being used for diversions from the Rio Grande, floodgates are closed and local storm runoff is prevented from entering the system until the flood flows have receded. Since 1958, the floodway has been used five times to divert flows ranging from 3,000 cfs to 55,000 cfs.

The North Floodway branches from the Main Floodway at a point southwest of Mercedes. It was developed in the same manner as the Main Floodway, along other distributaries of the Rio Grande and extends across northwestern Cameron County and southeastern Willacy County to the Laguna Madre. The North Floodway serves as the outlet for most of the area between Mission and north of U.S. Highway 83, through a network of man-made drainage channels developed as part of the HCMDS.

Climate and Soils

Hidalgo County has a subtropical, semi-arid climate, characterized by long, hot summers and short, mild winters. The climate has an annual precipitation ranging from 20 to 24 inches. The climate is generally conducive to the growing of crops year-round, and the average length of the growing season is 330 days. Temperatures range from an average July maximum of 97° F to an average January minimum of 49° F. The highest average monthly rainfall occurs in September, and the lowest occurs in March. Hidalgo County historically experiences 69 percent of its annual rainfall during the period of May through October; this frequently occurs as intense tropical storms.

The land within Hidalgo County generally features gentle sloping to flat slopes with moderately permeable, loam and clay soil. Most of the soil is level, high in natural fertility, easily cultivated, and suitable for irrigation. The well-drained soils have a seasonal water table depth of four to eight feet. Hidalgo County attributes include depression areas with no drainage outlet; these areas have soils with fine-grained materials.

Flat terrain and soils having low infiltration rates severely limit the drainage capabilities within Hidalgo County. As the soils rapidly become saturated, ponding waters converge and begin to sheet flow. With a typical land slope of one foot per 2,500 feet, sheet flow advances very slowly towards the drainage channels. Obstructions such as elevated canals, roadways, dikes, and railroad embankments crisscross Hidalgo County, acting as barriers and preventing the flow to the drainage channels. Because of the flat topography, it may take several days for the storm water to travel overland into the drainage channels. Once the runoff reaches the channels, it continues to flow slowly because of the almost-flat drainage channel bottom slopes of one-foot-per-mile. The flows in the channels also experience excessive backwater because of restrictive culverts crossing under roadways. Overall, the water remains in the channels for prolonged periods of time due to the extremely low velocity of the flow.

Land Use

Hidalgo County remains predominantly agricultural in land use. However, the increasing population and industrial growth has induced conversion of much of the area along US 83 to urban land use. Annual growth rates exceeding 5 percent have been occurring for the past 10 years within the County. Digital land use and land cover were obtained from the US Geological Survey. This information is dated in the mid 1970s. Current mapping efforts by the State of Texas are underway, but were not available at the time of this study. The digital land use map is referenced as a background to *Exhibit 3* and depicts the primary outfall systems.

Localized Flooding Problems

The proximity to the coastal area results in tropical rainfalls and intense storms that often cover only portions of Hidalgo County during a single event. Frequent flooding of streets, homes, and agricultural fields have often been reported as evidenced by the representative news articles contained in *Appendix D*. Repetitive flood claim information was obtained from the Federal Emergency Management Agency (FEMA). These flood claims, shown on *Exhibit 3*, reflect only those houses that have applied for disaster assistance under the Flood Insurance Program more than one time. It does not reflect homes that have flooded and requested assistance only a single time. More importantly, it reflects only those persons who have flood insurance and are able to make a claim. It is believed that a significant number of residents experience flooding and are unable to make an insurance claim.

As part of the study effort, questionnaires were sent to every community within the study area. The questionnaire, a copy of which is also in *Appendix D*, attempted to identify locations of repetitive flooding occurrences and frequent flooding locations. However, no responses to the inquiries were received.

History of Major Flooding in Hidalgo County

There were 23 floods on the Rio Grande having discharges exceeding 60,000 cfs, occurring at Rio Grande City, Starr County, between 1900 and 1939. The floods of 1919, 1922, and 1932 inundated large portions of the Lower Rio Grande Valley and caused extensive damage. The IBWC, a joint agency formed in 1932 by the governments of the United States and Mexico, has constructed a system of floodways to dispose of the flows in excess of the river's capacity. These include the Main and the North floodways, previously described. The Anzalduas Dam diverts water from the Rio

Grande into the Main Floodway, which then crosses southern Hidalgo County in the vicinity of Mercedes, where it splits into the Arroyo Colorado and the North Floodway.

The frequency of large flows entering the Lower Rio Grande Valley has been substantially reduced by the completion of Falcon Reservoir, constructed by the IBWC in 1953. This reservoir has a flood storage pool of 1,685,000 acre-feet, and is used primarily for power generation and water supply. Since development of the reservoir, there have been only five floods requiring the diversion of flows from the Rio Grande. All of these floods, ranging between 3,000 cfs and 55,000 cfs, have been contained in the floodway.

Hidalgo County and the National Flood Insurance Program

Hidalgo County entered the National Flood Insurance Program (NFIP) in 1980, when a study of flood-prone areas was published. The majority of the floodplain designations for the County were based on historical data collected from Hurricane Beulah in 1967, rather than on standard numerical models. As a result, Hidalgo County is not able to benefit from development of numerical rainfall runoff models which could be used to help regulate and manage its floodplain areas. The National Flood Insurance Rate Maps currently in effect are based on the study performed in 1980.

The Federal Emergency Management Agency (FEMA) initiated a Flood Insurance Study (FIS) update for Hidalgo County in 1996. The objective of this study was to determine the limits of regulatory floodplain on approximately 20 miles of channels operated by HCDD No. 1, including portions of West Main III, from Abram Road on the upstream side to Taylor Road at the downstream end; North Main, from the junction with West Main I near McColl Road to the confluence with the South Main; and the East Lateral Drain, from Mile 11-N Road to Mile 2-W Road on the downstream side.

The Rio Grande Floodway System

The Hidalgo County watershed drains naturally north and east away from the Rio Grande. Major flooding and overflows along the Rio Grande result in major flooding of communities in the Lower Rio Grande Valley, most notably the cities of McAllen and Brownsville. The channel of the Rio Grande has never been capable of carrying more than a small portions of its floodwaters through the delta and to the Gulf of Mexico. Before flood control works were undertaken, the river regularly overflowed its banks, spread out over the lands, and collected in natural overflow channels to discharge to the Gulf.

The early efforts of individual farmers to protect their lands by building levees were not effective. Hidalgo County, in cooperation with Cameron County, began construction in 1925 of the first flood control project in the Lower Rio Grande Valleyin response to major flooding in the early 1900s. The project consisted of constructing levees along natural overflow channels to form the Mission and Hackney Inlets and the Main Floodway.

In 1933, a hurricane decimated the Lower Rio Grande Valley, crippling its economy and preventing the counties from continuing the flood protection plan. Under authority of the Emergency Act of 1933, the federal government assumed responsibility for the operation and maintenance of the Floodway System on a temporary basis. In 1934, a coordinated plan was developed between the United States and Mexico. The system included river levees and levees along natural overflow channels to form interior floodway systems. Further work on the project was authorized in 1935 by the Secretary of State acting through the IBWC. The United States interior floodway consisted of:

1. Mission Floodway, beginning near the river about three miles south of Mission and extending 10.6 miles to the Main Floodway;

2. Hackney Floodway, which had its inlet about four miles east from Anzalduas Dam, and extended four miles to connect to the Mission Floodway to form the Main Floodway;

3. The Main Floodway, extending from southeast of McAllen some 19.9 miles to Mercedes, and dividing there into the North Floodway and the Arroyo Colorado;

4. The North Floodway, constructed by adding levees along a natural overflow channel;

5. Arroyo Colorado, a natural channel that had levees added along its upper portion; and

6. A separate Rancho Viejo Floodway, diverting floodwaters from the Rio Grande, about 20 miles upstream of Brownsville to Resaca del Rancho Viejo.

In September 1967, Hurricane Beulah struck the Valley, dropping up to 35 inches of rain below Falcon Reservoir. The resulting flood had a peak discharge of 220,000 cfs at Rio Grande City, which was considerably higher than the capacity of the floodway systems. As a result, modifications to the flood protection system were developed, including enlargement of the Hackney Floodway through the Anzalduas Dam dike to allow diversion of the river upstream of the dam, and closure of the Mission Floodway;

raising levees along the Main and North Main Floodways. The system was designed to convey approximately 105,000 cfs in the Main Floodway. Of this amount, the Arroyo Colorado is capable of conveying an estimated 21,000 cfs, and the North Floodway can convey 84,000 cfs. The IBWC floodways are depicted on *Exhibit 2*.

The flood protection plan is managed and operated by the IBWC. The IBWC allows for localized drainage improvements to connect to the floodway system, providing that the connection does not interfere with the operation of the floodway. To accommodate this, all confluences are gated, and must be closed during times when the floodways are in use for diversions from the Rio Grande. It should also be noted that the probability of a 100-year frequency diversion on the Rio Grande occurring simultaneously with a 100-year storm event in Hidalgo County is a probability that exceeds the levels of protection considered as normal or economical.

Although the floodways serve a defined purpose in stormwater management, they also provide some of the most fertile agricultural property when they are not inundated by diversions from the Rio Grande. The pilot channels within the floodway system have capacities ranging from a mere 3,000 to 5,000 cfs. This fact, combined with the economic constraints of the HCDD No. 1 when it constructed the HCMDS, limits the actual drainage capacity of the drainage system in Hidalgo County.

The Hidalgo County Master Drainage System

Even with the federal Floodway project in place, Hidalgo County suffered from a lack of adequate local drainage channels. In 1969, the US Soil Conservation Service (now the Natural Resource Conservation Service, NRCS) conducted a study concerning the flooding problems in the Lower Rio Grande Valley, and recommended that a comprehensive drainage plan be developed. The plan was to be accomplished in three phases. Phase One would address the major outlet channels within the study area, and phases Two and Three would deal with the lateral and on-farm drainage systems.

The Corps of Engineers undertook the first phase, and published the "Lower Rio Grande Basin, Texas Flood Control and Major Drainage Project" in October of 1980. The results of the first phase showed that the proposed project would afford benefits from: the prevention of flood damages to existing and future urban and agricultural development; the reduction in public health and relief costs; enhancement of land values; an increase in net returns to farm and ranch operators; and the overall enhancement of the economy of the area. Phases Two and Three of the NRCS plan were never executed.

The Corps of Engineers' plan did not receive authorization for construction as a federal project. Officials in Hidalgo and Willacy counties realized a need for immediate drainage improvements. The counties planned to initiate a local project to alleviate the yearly flooding problems. On November 15, 1975, the voters in Hidalgo County approved a $26 million dollar bond issue to finance the local project. The project represented the beginning of the HCMDS, with construction initiated in the summer of 1981. The original bond issue financed the construction of a drainage ditch from the Laguna Madre to Panchita, a distance of 36 miles. Additional bond issues financed the construction of the following drainage channels: South Main Drain, North Main Drain, East Lateral, Southwest Lateral, Pharr-McAllen Lateral, Mission Lateral, Edinburg Lateral, Mission Inlet and Rado Drain, Weslaco Drain, Mercedes Lateral, and the East Donna Drain.

Prior to the completion of the HCMDS, Hidalgo County's drainage system consisted only of small drainage ditches constructed adjacent to the irrigation delivery system. The drains constructed as part of the HCMDS form the basic outfall system in use today. Capacity in the system is limited to an agricultural runoff rate, assuming approximately a 10-year frequency storm event. *Table 2* depicts the design capacity of the drainage system for each channel in the HCMDS. *Exhibit 3* depicts the HCMDS channel configuration.

All channels in the HCMDS outfall into either the IWBC- U.S. Section floodway channels within the County, or into the HCMDS Main Floodway channel that outfalls into the Laguna Madre. The primary drainage ditches in the southern portions of Hidalgo County outfall into the IBWC Main Floodway. The Arroyo Colorado carries the normal flow from the Main Floodway, but the Arroyo Inlet control structure restricts flows to a maximum of 3,000 cfs, with additional flows being diverted into the IBWC North Floodway. The primary HCMDS drainage ditches in the northern portions of Hidalgo County outfall into the Main Floodwater Channel. The Main Floodwater Channel carries flow through Willacy County to the Laguna Madre. However, the Panchita Structure restricts the flow in the Main Floodwater Channel to 3,750 cfs east of Panchita, with additional flows being diverted over the right bank into the IBWC North Floodway. This restriction prevents flooding downstream in Willacy County.

As part of the background investigation for this study, all available studies performed on drainage and flood control during the past decade were reviewed. Many of these reports were prepared by individual municipalities and address solutions of flooding problems on a localized basis. In many cases, the studies recommend different drainage criteria. The following section summarizes the objectives and overall content of each study.

REGIONAL DRAINAGE STUDIES

Master Drainage Plan Design Information
Hidalgo County Drainage District No. 1
Sigler, Winston, Greenwood and Associates, Inc.
1974

This report describes the basic design criteria for the main drainage channels constructed and operated by HCDD No. 1. It establishes a design level of protection for a 9.5-year storm, using "Runoff Rate of Point Excess" with 0.25 inches per hour infiltration rate, from curves developed by the U.S. Bureau of Reclamation. The report defines drainage areas associated with each main drain, and determines design capacities at key points along each drain. The design capacities are summarized in *Table 2*.

The report also establishes a design for subdivision drainage systems. It recommends a 10-year frequency, using the rational method (Q=CiA), with i equal to a rainfall intensity of 3.2 inches per hour and a runoff coefficient of C = 0.3. The factor Ci is therefore equal to 1.0, resulting in a design capacity of approximately 1.0 cfs per acre. The design was considered valid for areas up to 2,000 acres. It is likely that this method was applied for many of the urban drainage systems installed since the criteria was established. As part of the planning report, recommendations were also included for channel rights-of-way and the basic design criteria for the Main Floodway Channel and all major laterals.

Surface Water Hydrology for Hidalgo and Willacy County Drainage Districts
U.S. Army Corps of Engineers, Galveston District
1977

The purpose of this report was to evaluate the impact on water quality in the Laguna Madre resulting from runoff from the North Floodway Channel, Arroyo Colorado, Raymondville Drain, and Banker Drain. Since the focus of the report was water quality, it involved predominantly low flows (2-year frequency storms), as opposed to larger storms that contribute to widespread flooding. The report did not address any aspects of the localize drainage systems.

Flood Control and Major Drainage Project, Lower Rio Grande Basin, Texas
Phase I Design Memorandum
U.S. Army Engineer Corps of Engineers, Galveston District
1980

The purpose of this report was to determine the advisability of federal participation in flood control and agricultural drainage improvements in Willacy and Hidalgo counties in the Lower Rio Grande Basin of Texas. The plan proposed a high degree of flood protection and drainage for the urban areas within Hidalgo and Willacy Counties. The results of the study demonstrated the beneficial effects to the area of prevention of future flood damages.

The report recommended that the plan be approved, subject to certain conditions of non-federal cooperation, as a basis for future Phase II advanced engineering and design and construction. The funding for the project never transpired, and eventually Hidalgo County proceeded with its own plan.

Master Plan for Storm Water Disposal for Hidalgo County, Texas
Hidalgo County Drainage District No. 1
Melden and Hunt, Inc. and Sigler, Winston, Greenwood and Associates
1982

This report, and the subsequent construction activities that followed, were spurred by a lack of funding from the federal government for needed drainage improvements. This report follows the report by Sigler, Winston, Greenwood and Associates prepared in 1974. The report addresses the Main Floodway Channel, North Main Drain, South Main Drain, East Lateral, Southwest Lateral, South Floodwater Channel, and interceptor ditches. It includes all of the primary drainage channels that exist today, with the exception of the Rado Drain.

The design criteria established for the primary drainage channels is significant as it relates to the drainage problems being experienced in the County today. The channels were designed on the basis of crop tolerance to inundation. It was considered that full protection against crop damage due to flooding could be provided if the flooding did not persist for more than 48 hours. Previous cost/benefit studies had indicated that one flood every 10 years could be tolerated. At the same time, the design was anticipated to provide sufficient capacity to convey runoff from urban areas resulting from rainfall having an intensity of one inch per hour.

At the time this study was completed, the relative impact of urban runoff was considered to be insignificant when compared to the runoff from agricultural areas. Since that time, population in the County has doubled, and urban runoff impacts are now realized as being significant.

Because the drainage system relies on the capacity of the receiving floodway system operated by the IBWC, provisions had to be made for pumping water from the drainage channels into the floodways when the floodways were full because the drainage system relies on the capacity of the receiving floodway system operated by the IBWC. Eighteen pumping plants were proposed for construction in order to accommodate this scenario.

Master Drainage Plan for Mission Inlet and South Rado Drain
Hidalgo County Drainage District No. 1
Melden and Hunt, Inc. and Sigler, Winston, Greenwood and Associates
1985

Mission Inlet and South Rado Drain provide drainage for portions of the cities of Mission and McAllen, including the International Trade Zone, and an upstream portion of western Hidalgo County. Mission Inlet drains into the Banker Floodway, which in turn drains into the Arroyo Colorado or the North Floodway. The study was initiated because of a concern that modifications to the operation of Mission Inlet could cause downstream flooding.

The pilot channel of the floodway was designed to convey from 3,000 to 5,000 cfs of local runoff when the floodway was not being used for diversions from the Rio Grande. The pilot channel of Mission Inlet was designed for the same purpose. After Hurricane Beulah in 1967, the IBWC elected to construct the Banker Floodway and close the diversion of the Rio Grande to Mission Inlet.

The report proposes several changes to the operation of Mission Inlet including:

- Lowering of the levees to elevation 103,
- Expanding the capacity of the Arroyo Colorado from an existing 3,000 cfs to 5,000 cfs,
- Increasing the size of six gated openings between Mission Inlet and Banker Floodway from 225 sf to 600 sf, and

- Redesigning the overflow weir on South Rado Drain at Mission Inlet to accommodate increased runoff in the upstream watershed.

The design criteria used in this report reflected the results of the previous study completed in 1974.

Rado Drain Alternative
Hidalgo County Drainage District No. 1
Melden & Hunt Inc.
1988

The purpose of this report was to evaluate an alternative route to Rado Drain. This rerouting was proposed for several reasons, including:

- Diverting flow away from the proposed McAllen Civic Center site,
- Making the ditch more accessible to eastern sections of the City of Mission, and
- Avoiding environmentally sensitive areas that would be disrupted by expanding the existing ditch.

Drainage Policies and Permit Procedures
Hidalgo County Drainage District No. 1
Melden & Hunt Inc.
1990

The objective of this report was to establish guidelines that limit discharges into the HCMDS. The master drainage system is comprised of the primary channels described in the 1982 report. The report describes the basis for design of the HCMDS and its limitations on conveying flow, and it recommends a permit system to insure compliance with the capacity of the system.

The permit system requires the submittal and approval of a drainage report for all developing properties. The drainage report submitted must demonstrate that the developing property meets specified limitations on water quantity and water quality that may enter the HCMDS. This permit system, which is broadly defined, offers HCDD No. 1 a significant authority over drainage.

Summary of Regional Drainage Study Reports

The following conclusions are derived from the review of the previous studies and reports:

1) The HCMDS was designed predominantly for agricultural purposes. Neither the storm intensity or the time for runoff are applicable to continued urban development.

2) The floodway systems have significant capacity for conveying runoff when they are not being used for diversions from the Rio Grande. However, these floodways are widely used for agricultural purposes. Frequent, prolonged flooding would not be acceptable because of potential damages to crops. The allowable capacity of these floodways for local drainage is, therefore, limited to the range between 3,000 and 5,000 cfs.

3) Runoff from urbanizing areas is largely restricted through the use of detention.

4) It is impractical at this time to increase the capacity of the HCMDS. Although drainage agreements with IBWC would apparently allow an increase, economics would likely prevent it.

LOCAL DRAINAGE STUDIES

In response to localized drainage problems, and as part of periodic updating of master infrastructure planning, most municipalities in Hidalgo County have prepared master drainage plans. The following summarize the plans reviewed as part of this report.

Report of the Study Phase for Southeast Original Townsite Infrastructure
City of Edinburg
Quintanilla, Headley and Associates, Inc.
1994

This study was a comprehensive evaluation of a portion of the City of Edinburg's storm sewer system. The rational method was used to analyze system capacities. Although the Southeast study was prepared during the same time as the Northeast study, it used different watershed coefficients. The study also recommended a different cross-section for streets that would increase the collection of runoff and enlargement of all storm sewer inlets. The study recommends that regulation of peak flows be achieved by onsite or offsite detention storage, without specifying details of detention volumes or outlet sizes.

Northeast Original Townsite Drainage Study
City of Edinburg
R.E. Garcia & Associates
1994

This study was a comprehensive evaluation of the storm sewer facilities servicing the original townsite of the City of Edinburg. Thirty-two drainage areas were defined. City of Edinburg staff determined that the drainage facilities should be sized for a 25-year storm event. Facilities were sized using the rational method and runoff coefficients of 0.45 for residential areas and 0.95 for commercial areas. Drainage from the study area drains into one of two stormwater detention basins, known as the Northeast pond and the San Juan pond. Runoff in the detention basins is then pumped into the main drainage ditch operated by theHCDD No. 1.

The study concluded that the storm sewer systems were severely undersized for the criteria specified, that the detention basins were operated in an arbitrary manner, and that the receiving streams required maintenance.

Flood Protection Plan
City of Donna
Rust Lichliter/Jameson
1995

The objective of this report was to recommend solutions to localized flooding problems. Localized flooding that hinders mobility and threatens residential and commercial structures has been a frequent problem in downtown Donna and several adjacent neighborhoods. A total of 445 homes is believed to be affected by the local flooding problems. Outfall drainage is provided by a series of five ditches originally designed to convey runoff from agricultural fields. Channels on the eastern side of the City are reported to have historic flooding problems. Local drainage is provided by a series of valley swales and roadside ditches, with limited storm sewers.

Analysis of the flooding problem was performed, using HEC-1 and HEC-2 models for the outfall channels, and the rational method for storm drains. Most of the local drainage system was identified as needing improvements and inadequate culverts and storm sewers were identified as the major problem.

Southwest Edinburg Drainage Study
City of Edinburg
Melden & Hunt, Inc.
1995

This study addressed the infrastructure necessary to accommodate existing and future drainage needs of 1,780 acres in southwest Edinburg. The project area was divided into four drainage basins. The study revealed several alternative methods of drainage, and recommended a system of channels to serve as linear detention storage basins, as well as conveyance. Storm drain systems were proposed to be designed to convey the 25-year flow to provide conveyance in accordance with the rules for discharge from existing development, as determined by HCMDS. The channels were also proposed to provide detention storage for runoff from all new development.

The proposed drainage criteria for this study was:

• Storm sewers (internal to subdivision)	2-year
• Storm sewers (outfall to HCMDS)	25-year
• Channels and ditches	25-year
• Culverts and small bridges	25-year
• Large bridges	100-year
• Floodway between building lines	100-year

The report identifies alternative methods for implementing the drainage program, rather than making specific recommendations. However, the report does recommend that drainage criteria and policies be implemented in order to comply with the HCMDS requirements, achieve consistent design considerations, and arrange for orderly implementation.

Flood Protection Planning Study for Southern McAllen and Mission, Texas
Halff Associates, Inc.
1996

This study examined the potential flooding impact for an area bounded between Mission Inlet and Banker Floodway, assuming continued development of the Mission Inlet watershed. The Mission Inlet watershed includes approximately 76 square miles located west and north of the cities of Mission and McAllen. The watershed is currently considered about 53 percent developed. Concern was raised about the potential integrity of the levees and about isolating the Inlet from surrounding properties, assuming that development continues.

The study identifies frequent flooding in the study area that results from an insufficient drainage system, inadequate topographic relief, and low permeability soils. Using a rainfall-runoff model to generate flood hydrographs, the report approximates that 1,236 structures could potentially be flooded by overtopping of the Mission Inlet levee at several points.

Recommended improvements from the study include:

- Modification of the Mission Inlet levee at Cimarron Country Club,
- Construction of a 1,470 acre-ft storage basin to alleviate flooding,
- Raising the Mission inlet levee at other points to deter overtopping, and
- Requiring all new developments to provide a minimum of 0.8 acre-ft of storage per acre of development.

Summary of Local Drainage Study Reports

From review of the reports on localized drainage, the following conclusions were derived.

1) Frequent flooding in the urban areas has resulted in an increased emphasis on improving drainage infrastructure. Although the original intent of the HCMDS assumed minimal impact from urban runoff, the limited capacity of the outfall system has become a major constraint on the communities.

2) Most communities are proposing an infrastructure design that exceeds the capacity of the HCMDS. Design frequencies, ranging from 2 to 25 years for storm sewers, are being proposed as methods for conveying runoff from urban areas.

3) Stormwater detention is proposed as a method of controlling runoff into the HCMDS. However, only limited information has been developed for determining guidelines on calculating detention.

4) Access to some conveyance system (such as the HCMDS) is an extremely important component of the solution for the urban areas. The 1995 Southwest

Edinburg Drainage Study attempts to address this issue in its implementation plans.

Meetings with Stakeholders in Flood Control Management

Separate meetings were conducted with representatives of public agencies and land developers as part of the study process. The objective of these meetings was to identify issues that these stakeholders considered to be important.

The municipalities within Hidalgo County have expressed two major concerns with the drainage criteria. First is the lack of uniformity among the incorporated cities relative to the HCDD No. 1 drainage criteria. Second is the need to have a standard set of drainage calculations for all submittals within the County. The desired criteria should state minimum requirements strict enough to achieve the desired outcome, but no more severe than the most restrictive drainage criteria of the incorporated cities. The criteria should establish methods of meeting mutual goals between HCDD No. 1 and the incorporated cities.

The municipalities mutually desire a policy for the HCMDS to protect all structures from the 100-year flood. While the municipalities have varying opinions concerning street flooding, most expect some street flooding to occur under storms greater than the 10-year frequency. The majority of the municipalities desire protection from the 10-year storm event so that at least one lane of a roadway remains passable on major and local collector streets for major thoroughfares. At least one lane should remain passable for emergency vehicles during the 25-year storm event. According to the municipalities, linear detention facilities have been the best solution, but mechanisms to enforce detention requirements upon developers are lacking.

Presently, the engineer who designs a drainage system is responsible for compliance with the drainage requirements. The municipalities also want the contractor held accountable for the construction of the facilities, to ensure that they are constructed as designed. The municipalities believe that many developments currently being designed in the County do not meet minimum requirements for detention due to the lack of restriction on the outfall. The municipalities also have concerns about the inadequacies of the existing FEMA FIRMS in delineating flood-prone areas, and question the validity of using the maps as the basis for limiting development in these areas.

Developers within Hidalgo County expressed the greatest concern regarding drainage issues and costs related to acquiring right-of-way and connecting into the HCMDS. Developments near the HCMDS are often physically prevented from connecting to it, and frequently encounter difficulties in obtaining right-of-way through private property.

Once a developer constructs a drainage ditch or a long segment of storm sewer, the developer receives no reimbursement from other developments located along the ditch or storm sewer. The lack of available outfalls into the HCMDS is the greatest concern with the developers, who noted that the developments cannot support the costs incurred in constructing drainage ditches or storm sewers to connect to the HCMDS (which in some cases may exceed three miles in length).

The developers also stated that they prefer using drainage ditches rather than swales or underground storm sewers. Individual lot owners tend to either fill in or build on the swales, or owners may leave the swales intact but then do not maintain them. Swales also often become a place to dump garbage and pose safety hazards to the community. The major drawback to storm sewers is that their cost is viewed as too expensive.

Introduction

Drainage management in Hidalgo County is unique in its relationship, not only between incorporated and unincorporated areas, but also in the relationship with the federal and international (IBWC) governing bodies that operate the largest flood control system in the Rio Grande Valley. Whereas the facilities operated by the County are inadequate to convey large amounts of runoff, the IBWC system has a comparatively limitless capability to handle local runoff. Unfortunately, the IBWC system is not designed to convey local runoff, it is designed to control flooding of the Rio Grande. However, a permitting process allows for local drainage into the IBWC system, providing the drainage facility does not interfere with the operation of the IBWC system. The following paragraphs describe briefly the methods of control that are used by the various public agencies for drainage management in Hidalgo County.

Hidalgo County Drainage District Number 1

HCDD No. 1 was established in 1908 under Article 13, Section 52 of the State Constitution. The Authority was later converted to a Conservation and Reclamation District under Article 16, Section 59 of the State Constitution. Under this authority, HCDD No. 1 can manage the conservation and development of the natural resources of the State including the storage, preservation, and distribution of its stormwaters. HCDD No. 1 constructed the HCMDS and is responsible for its continued development and maintenance. The District Director controls the HCDD No. 1 and reports to the Board of Commissioners for the HCDD No. 1. The District Director manages two departments: Operations and Maintenance, and System Development. Operations and Maintenance manages the daily maintenance of all channels, laterals, ditches, structures, pumping systems, and right-of-ways within the HCMDS. System Development is responsible for the planning, engineering, right-of-way acquisition, and new construction for the development of the HCMDS.

The HCDD No. 1 obtains income for operational costs through a drainage tax. HCDD No. 1 has the authority to issue bond certificates to finance new construction, upon approval of Hidalgo County voters.

The Hidalgo County Master Drainage System (HCMDS) design, as it currently exists, provides drainage for all watersheds within the HCDD No. 1 boundaries. The current criteria define the system to be "balanced," based upon the assumption that all watersheds will contribute similarly to the total runoff from the HCDD No. 1. Diversity in development of the watersheds would then cause the watersheds to become "unbalanced" as the existing runoff increases and contributes in excess of design values. In an effort to maintain this "balance," as urbanization occurs and land uses change, HCDD No. 1's policy on drainage restricts outfall discharge into the HCMDS to the unimproved state. Currently, either detention on-site or an approved off-site detention basin is used to limit flows. HCDD No. 1 uses this policy through a drainage permit process to regulate flows into the system.

The drainage permit requires all developments to submit a Proof of Ownership, a Drainage Engineering Report, and an Indemnification of the District. The Drainage Engineering Report is the mechanism that HCDD No. 1 uses to determine compliance with the drainage criteria. The report, signed and sealed by an engineer holding a current registration in the State of Texas, must present evaluations of the site runoff and detention calculations. The permit process is designed to control all connections to the HCMDS to: (1) prevent system unbalancing; (2) to provide added protection from pollutants and contamination to the citizens of Hidalgo County; and (3) to establish a set of standards for channel connection structures.

Agency standards, such as the Texas Department of Transportation Hydraulic Manual to determine the amount of rainfall, and drainage area versus discharge curves based on the NRCS 9.5-year storm event to determine runoff for the existing state, are used when developing the Drainage Engineering Report. The curves are based upon agricultural land use and do not reflect urban development. The criteria also require the rational method for hydraulic computations for storm sewer design.

Municipalities

The municipalities within Hidalgo County are responsible for drainage issues within their incorporated boundaries. Most municipalities distinguish between floodplain criteria and drainage criteria. Each of the principal cities within the County has adopted its own drainage criteria and, in some cases, has developed a master drainage plan. HCDD No. 1 requires the outfall from each municipality's drainage system to meet HCDD No. 1 criteria.

Much of the drainage criteria for the different municipalities is established through either subdivision regulations or Code of Ordinances. For the most part, these criteria attempt to address mobility issues, and ensure that runoff is accommodated through a combination of storm sewer, ditch, or stormwater detention facility. The design standard for storm sewers varies from a 10-year to a 25-year design event, and is typically calculated through use of the rational method. In some cases, however, the 10-year event is a reflection of the agricultural runoff curve used to design the HCMDS. Most cities adopted more conservative standards when they recognized flooding problems using the HCMDS criteria. The major issues surround the inability to gain access to one of the HCMDS channels, because of the relative remoteness of its location to that of the infrastructure being improved. In such cases, runoff frequently is allowed to drain into roadside ditches or is required to pond on the site of the development. No consistent criteria for sizing of stormwater detention basins or outfalls exists. When possible, the municipality or the land developer may negotiate with one of the irrigation districts for use of one of their drains. However, these drains are designed for agricultural runoff and, in most cases, are not capable of handling urbanized runoff without improvements. These practices have contributed to local flooding complaints by residents because of flooding streets, yards, and, in some cases, structures during even moderate rainfall events.

Hidalgo County

Hidalgo County has authority over developing properties that are located in the unincorporated areas of Hidalgo County. Management of the development is achieved through Subdivision Regulations. Hidalgo County requires a drainage plan report be submitted for approval. These reports are reviewed and approved by HCDD No. 1 staff. The content of these reports parallels the requirements of those in the incorporated areas and include a topographic map, delineation of regulatory floodplain areas, and engineering calculations.

Irrigation Districts

Some 18 irrigation districts operate within Hidalgo County. The irrigation district's primary purpose is to operate a series of raw water supply canals for use by municipalities and agricultural users. These canals extend from the Rio Grande and, in most cases, provide an intense network of either elevated or excavated conveyance structures. Since many of the canals are elevated, they form an obstruction to natural drainage. Because of the potential degradation of water quality, the canals cannot serve a dual purpose of drainage and convey raw water for potable and irrigation use. As a result, many miles of drainage ditches have been constructed parallel to or perpendicular to the canals. These ditches are operated and maintained by the irrigation districts. They vary in size and are intended for drainage of agricultural areas. In some cases, arrangements have been made for HCDD No. 1 to acquire an irrigation district drainage ditch and then expand it for additional capacity and other uses. Since the primary mission of the irrigation districts is water supply, and not drainage, many of the districts would prefer HCDD No. 1 to operate these ditches. However, to do so would require a significant increase to the operating budget of the HCDD No. 1.

International Boundary and Water Commission

The IBWC operates the major floodway systems diverting water from the Rio Grande into the Laguna Madre. The IBWC allows for drainage channels constructed by HCDD No. 1 to tie into the floodway system. However, all of the channels are regulated by floodgates in order to protect the County. In the event that a major diversion occurs, it is expected that local drainage authorities will close the gates. IBWC does regulate this activity and will also close the gates should the need arise. Each outfall proposed for connecting to the IBWC system requires approval of the IBWC through a formal permitting process.

Recommendations to Drainage Criteria

The following recommendations are offered based on the review of information in this study.

1. During the attempt to map proposed lateral channels, and from review of the local drainage planning studies, it became apparent that adequate mapping on a regional basis is not readily available. The State of Texas has entered into a high altitude mapping program which will be very useful to HCDD No. 1; however, the results of this mapping are not yet available. We suggest that the HCDD No. 1 obtain satellite imagery from either SPOT or the IDS. This photographic background image will be useful in examining the routing of lateral channels and in determining land use characteristics. The imagery should be able to be updated on an annual basis at a relatively low cost, on the order of $20,000.

2. The municipalities and HCDD No. 1 should jointly agree on the performance standard of the drainage system. Consensus on this standard should be mutually agreed between City staff, HCDD No. 1 staff, developers, and engineers. Adoption of the standard should be conducted by the various City councils and the HCDD No. 1 board. The following guidelines are offered as a basis:

    a. New construction should be protected from flooding resulting from a 100-year storm event.

    b. Major thoroughfares should remain passable during a 25-year storm event. "Passable" is defined as water being no deeper than curb height.

    c. Local streets should be passable during a 10-year event. "Passable" is defined again as water being no deeper than curb height.

d. Storm sewers should be sized for a 3-year storm event, using the rational method and urban watershed coefficients.

e. Lateral channels should be sized to convey the runoff from the agreed-upon level of protection for local streets, assuming that the lateral channels are constructed as linear detention systems feeding into the HCMDS.

It is important that a consensus be reached that is a fair compromise between the cost of development and the integrity of the municipal system. A cost/benefit analysis of the adopted performance standard should be conducted so that all parties can agree to the fairness of the plan.

3. Site development standards should be modified to complement the required size of the drainage system components so that the performance objectives are attained. This could include street grades and cross sections, spacing and size of inlets, lot grades relative to the street grades, and extent of impervious cover.

4. A Drainage Criteria Manual should be developed for HCDD No. 1. Since the integrity of the HCMDS is dependent upon the implementation by the various municipalities, a common Drainage Criteria Manual should be used by all parties.

5. As part of the Drainage Criteria Manual, a consistent method for calculating storm runoff should be applied. Various reports indicated that not all engineers are applying the criteria uniformly. It is suggested that, since FEMA will soon adopt its new FIS for Hidalgo County, the modeling technique used in that study should be adopted as the method for rainfall-runoff modeling on areas in excess of 640 acres, or one square mile. When the rational method is applied for sizing storm sewers and small ditches, standard rainfall patterns, watershed coefficients and time of concentration calculations should be used.

6. Standards for sizing of stormwater detention facilities should be established as part of the Drainage Criteria Manual. There have been many reported failures of on-site detention systems because of a lack of defined criteria for sizing the basins. Other sections of this report address the method by which the lateral drainage channels should be sized for linear detention. A similar approach should be adopted uniformly for all areas.

7. The practice of allowing drainage of developed properties into roadside ditches needs to be abandoned unless modifications to the practice are done to improve the ditch conveyance capacity. Frequently, the project site is limited by grade to drain to an existing outfall or no other outfall exists. Extension of the lateral

drainage system will resolve this problem, provided a method of implementation can be established.

8. HCDD No. 1 should begin a long-range plan to address the expansion of its primary drainage channel system. This system currently is, and will remain, a constraint to the overall drainage program if it not expanded. It is proposed that a channel system that anticipates a 25-year runoff from the watershed, according to the level of development anticipated by the end of the planning period, be used. Negotiations with the IBWC and other federal agencies should begin which examine the issues related to expansion and how these issues can be overcome.

Delineation of Drainage Areas

One of the primary objectives of this study was to plan for a series of lateral channels that would provide drainage to all local areas requiring access to the HCMDS. To facilitate identification of these channels and their sizes, it was necessary to develop background mapping and define drainage areas to be associated with each subwatershed. Background maps were obtained from each of the 18 irrigation districts to define the extent of drainage ditches and water canals operated by these entities. Additional mapping of the existing HCMDS channels was obtained from the HCDD No. 1. The data compiled is graphically depicted on *Exhibit 6*.

In order to determine the system of lateral channels, criteria were established for the depths of the channel and the maximum distance any property located within the district could be, and still have a gravity outfall, assuming construction of a storm sewer. In general, this meant that all locations within the service area of HCDD No. 1 should be within 1,500 feet of some point of a lateral channel. This number can vary depending on the depth of the lateral channel and the surface ground slope. Lateral ditches were then selected to meet this criteria. In many cases, the ditches were located to coincide with those of the existing irrigation district ditches, with the intent that an agreeable conveyance of title could be obtained.

With the lateral drainage ditches located, it was then necessary to delineate the drainage subareas. These subareas were developed on the basis of existing topographic information, and are presented in *Exhibit 5*. In some cases, more detailed information was available, as a result of detailed drainage reports by other entities. In such cases—for example, the area surrounding Weslaco—the drainage subareas appear more defined on *Exhibit 5* than in other areas.

Calculation of Runoff

The objective of the lateral channel planning is to identify the location and size of the channels necessary to accommodate full development of the watershed. Consequently, in planning for these channels, it is assumed that the area will be 100 percent developed. Although the actual phasing of construction will be timed with development, identifying the ultimate size allows for the immediate preservation or acquisition of right-of-way.

As previously indicated, local municipalities rely on Manning's equation for the design of local drainage facilities. The existing HCMDS has a limited capacity, approximating a 10-year agricultural runoff. This limited capacity means that the outfall channels do not have the capacity to convey all of the runoff from the local storm drains, and detention basins are necessary.

In sizing the lateral channels, however, as the future path to convey from the local storm drains to the HCMDS, some consideration of the design frequency had to be considered. Recognizing that the Corps of Engineers is examining the potential to expand the HCMDS to as much as a 25-year capacity, it is prudent to examine an alternative to the lateral channels that is not limited to the existing capacity of the lateral drains. Although the process was somewhat intuitive at this point, the design of the lateral drains assumed that conveyance would be sized for a 25-year storm event. Because of the existing restriction at the HCMDS, however, the flow into the HCMDS would be limited to an existing 10-year agricultural runoff, and the remaining channel capacity would be used for storm water detention.

Storm discharge curves have been developed for the 3, 10, 25, and 100-year recurrence interval design storms under fully developed conditions, and are presented in *Exhibit 4*, along with the 9.5-year agricultural discharge curve. The 9.5-year curve is taken from the HCDD No. 1 Drainage Policies and Permit Procedures manual. The equations for the curves are as follows:

<u>3-Year Developed</u>

$$Q = 4.015A^{0.6215}$$

<u>10-Year Developed</u>

$$Q = 6.105A^{0.6271}$$

<u>25-Year Developed</u>

$$Q = 7.603A^{0.6275}$$

<u>100-Year Developed</u>

$$Q = 9.624A^{0.6387}$$

<u>9.5-Year Agricultural</u>

$$Q = 2.911A^{0.5721}$$

The 3, 10, 25, and 100-year curves were developed using NRCS runoff curve number methodology and the U.S. Army Corps of Engineers HEC-1 computer program. A series of single-basin models was developed for each design storm, with varying drainage areas, runoff curve numbers (CN), and lag times. The peak flows from the HEC-1 models were then fit to determine the power curve shown in the above equations.

The design storms developed in HEC-1 require the input of a series of point rainfall depths, as shown in *Table 1*. Point rainfall depths for durations up to and including one hour are taken from the National Weather Service (NWS) document Hydro-35. Depths for durations longer than one hour are from NWS Technical Paper No. 40 (TP-40). Depths were read from the center of Hidalgo County on the isopluvial maps.

The SCS runoff curve number (CN) is a function of soil type and antecedent moisture condition. The composite curve number used is for the watershed under fully developed conditions. The following assumptions were used:

- Antecedent moisture condition II
- Developed watershed is 35 percent impervious
- Pervious surface CN = 74 (open space in good condition)
- Impervious surface CN = 95
- Composite CN = (.65)(74) + (.35)(95) = 81

The lag time is given by the following relationship (ref. SCS Technical Release No. 55):

$$L = \frac{l^{0.8}(S+1)^{0.7}}{1{,}900Y^{0.5}}$$

where:
L = lag time in hours
l = hydraulic length of watershed in feet
S = (1000/CN) - 10
Y = average watershed slope in percent (0.05 percent assumed)

This equation tends to overestimate the lag time for urban watersheds (TR-55). The lag time is adjusted by a lag factor for the presence of impervious area (0.8) and a lag factor for the hydraulic improvement of the main channel (0.72). The hydraulic length, l, is given by the following relationship (ref. SCS Technical Release No. 55):

$$l = 209a^{0.6}$$

where:
l = hydraulic length of watershed in feet
a = drainage area in acres

Lateral Channel Section Design

The lateral channels for the HCMDS were sized based upon Manning's equation, using the flows resulting from the previously discussed equations. Each channel includes one foot of free board for determination of the required right-of-way width, and at least one foot of drop is provided above the depth of the outfalling channel bottom. Topography and physical constraints, such as elevated irrigation channels, railroad embankments, roadways, and limited outfall depths, dictate the depth and placement of the proposed channels. The lateral channels were designed to have a 3:1 (H:V) side slope with a 20-foot maintenance easement on either side of the channel.

Development of the right-of-way for the proposed lateral channels includes a spoil bank berm on either side of the channel. The required excavations for the construction of the drainage channels establish the spoil bank size with a 2:1 (H:V) side slope and a 15-foot top width. The right-of-way widths for the proposed lateral drainage channels are presented in *Table 3*.

Drainage areas for Hidalgo County were determined through the Master Drainage Plans for the incorporated cities previously released and topographic features within the County (*Exhibit 5*).

Storm Water Detention

Increased peak flow due to development must be mitigated to the 9.5-year agricultural peak runoff rate. The total detention rate is 0.29 acre-ft/acre and represents the difference in runoff volumes between the 10-year developed conditions hydrograph and the 9.5-year agricultural hydrograph. The method used is as follows: Peak flows were determined from the 10-year developed discharge curve for a broad range of drainage areas. A hydrograph was developed in each case using the Malcom method. The Malcom method utilizes a pattern hydrograph to obtain a curvalinear design hydrograph that peaks at the design flow rate, and which contains a runoff volume consistent with the design rainfall. The Malcom method consists of the following equations:

$$T_p = \frac{V}{1.39Q_p}$$

$$q_i = \frac{Q_p}{2}\left[1-\cos\left(\frac{\pi t_i}{T_p}\right)\right] \quad \text{for } t_i \le 1.25T_p$$

$$q_i = 4.34Q_p e^{-1.3\frac{t_i}{T_p}} \quad \text{for } t_i > 1.25T_p$$

Where:

T_p = the time to Q_p
Q_p = the peak design flow rate
V = total volume of runoff for the design storm
t_i = time
q_i = flow rate

Detention volume was calculated as the volume between the 10-year hydrograph and a straight line intersecting the receding limb of the hydrograph, at a point equaling the 9.5-year peak discharge rate. The volumes were plotted against drainage area; the points fell on a straight line with a slope equal to 0.29 acre-ft/acre.

The following guidelines are offered for detention requirements for developments outfalling into the HCMDS.

1. Application of Detention

   a. The HCMDS design is based upon conveying a 9.5-year agricultural peak runoff rate. To maintain this standard, areas within HCDD No. 1 boundaries are restricted to limiting runoff from developed land at this rate at the unimproved condition.
   b. Increases in peak flow due to development are required to be mitigated to the 9.5-year agricultural peak runoff rate before outfalling into the HCMDS.

c. The HCMDS proposed lateral channels are designed to accommodate a 25-year developed condition flows, and, upon construction, will provide some detention for developing areas that outfall directly into the lateral channel.
d. Developments increasing the peak flow from the existing conditions must detain on-site or in an approved off-site detention area.
e. Tracts which previously have met these guidelines are not required to provide additional detention, if redevelopment occurs without increasing the overall impervious character of the site.

2. Calculation of Detention Volume

   a. Detention volume for developed areas are calculated based upon the point of connection to the outfall.
   b. Developments attaching to the HCMDS directly will be required to detain at a rate of 0.29 acre-ft/acre.
   c. Developments attaching to the proposed lateral system will be required to detain at a rate of 0.24 acre-ft/acre, as the difference will be provided in the oversized lateral channel.
   d. Detention volumes for a redeveloped area are calculated on the basis of the amount of area of increased impervious cover.

3. Calculation of Outlet Size

   a. Detention pond discharge pipe into existing HCDD No. 1 channel:
      1. Maximum pool elevation at or below the design hydraulic grade at the outfall: the discharge line shall be sized for the Design Storm with the outfall pipe flowing full. The detention pond will be above the drainage system to provide maximum benefit.
      2. Maximum pool elevation at or above the hydraulic grade at the outfall: provide a reducer or restrictor pipe to be constructed inside the discharge line. The discharge line shall be sized for the Design Storm with the outfall pipe flowing full.
      3. The outfall pipe should connect to the HCMDS or proposed lateral channel at a 30-degree angle to the direction of flow, to provide maximum conveyance within the channel.
   b. Reducer or Restrictor Pipes shall be sized as follows:
      1. Use the following equations to calculate the required outflow orifice:

$$Q = CA\sqrt{2gh}$$
$$D = \frac{Q^{1/2}}{2.25 * h^{1/4}}$$

where

$Q =$ outflow discharge in cfs
$C = 0.8$
$h =$ water surface differential in feet = head
$D =$ orifice diameter

3. Restrictor shall be either of the required diameter or of the equivalent cross-sectional area. The orifice diameter shall be a minimum of 6 inches.

c. In addition to a pipe outlet, the detention basin should be provided with a gravity spillway that will protect structures from flooding, should the detention basin be overtopped.

Calculation of Runoff Coefficient in the Rational Method

The runoff coefficient "C" used in the rational method accounts for many complex phenomena of the runoff process. The "C" value serves the function of converting the average rainfall rate of a particular recurrence interval to the peak runoff intensity of the same frequency. Its magnitude is dependent on several factors, such as antecedent moisture condition, ground slope, natural ground cover, depression storage, soil moisture, shape of drainage area, over-land flow velocity, rainfall intensity, percentage of impervious area, proximity of ground water table, and so on.

Analysis of typical watersheds within Hidalgo County, using the rational method, Urban Hydrology for Small Watersheds (Technical Release 55), and HEC-1, demonstrated an association between the very flat slopes (0.02 to 0.1percent), and a decrease in the magnitude of the value of "C." Through the analysis, it was shown that the very flat slopes could equate to a 20 to 30 percent reduction in the magnitude of "C." However, a straight across-the-board reduction in "C" values will not accurately reflect other phenomena within the diverse watersheds of Hidalgo County.

HCDD No. 1 currently uses TxDOT runoff coefficients. Due to factors within Hidalgo County that are not typical to the rest of the state, the "C" factor should be adjusted to reflect these unique features. The most influential factor in calculating the "C" value in Hidalgo County is the very flat slopes (0.02 to 0.1percent). To more accurately reflect the conditions in Hidalgo County, we recommend the use of the values with magnitudes near the lower end of the ranges currently being used by HCDD No. 1 with the rational method, as shown in *Table 4*.

As previously stated in this report, standards for sizing stormwater detention facilities and a consistent method for calculating storm runoff should be established through the adoption of a Drainage Criteria Manual. The following examples demonstrate the recommendations in this report, and are provided to aid in instituting a uniformity for calculations submitted to HCDD No. 1.

Example of Detention Pond Design

<u>Given:</u> A 30-acre subdivision is proposed adjacent to a HCMDS channel. The tract proposed for development has a 2-foot drop from a high elevation of 80 feet to a low of 78 feet. Outfall channel is 10 feet deep.

<u>Required:</u> Size a gravity flow detention pond and outflow structure to store the increase in runoff due to development of the subject tract.

<u>Design Procedures:</u>

1) The outlet flowline of the outfall structure from the pond should be one foot above the outfall channel flowline. A preliminary storm sewer analysis should be made to assure there is adequate outfall depth in the pond to facilitate storm sewer outfalls.

2) Determine the required amount of detention storage (S) required from the detention equation. The selection between the detention equations is based upon the point of outfall into the HCMDS.

   $S = 0.29A$ for connection directly to HCMDS

   $S = 0.24A$ for connection to an oversized lateral of the HCMDS

   $S = 0.29(30\text{acres}) = 8.7\ acre\text{-}ft$

3) Using HCDD No. 1 discharge curves (*Exhibit 4*) or the discharge equations provided in this section, determine existing condition 9.5-year agricultural

runoff. The outfall from a developed site is limited to the 9.5-year agricultural runoff.

$$Q = 2.911A^{0.5721} = 20\ cfs$$

4) Size the outfall structure from equations provided in *Section V*. The outfall pipe will act as a restrictor and, as such, will be required to have a diameter of equal to or less than the determined value.

$$D = Q^{1/2}\ / 2.25 * h^{1/4}$$

Where:

$$Q = 20\ cfs$$
$$h = 0.3\,feet$$

Then:

$$D = 2.7\,feet = 32.5\ inches$$

5) The detention pond is now sized to accommodate 8.7 acre-ft of storage and one foot of freeboard with a 30-inch outfall pipe.
6)

Example of Storm Sewer Design

Given: A 3,700-foot storm sewer system is required to provide stormwater drainage to a residential subdivision consisting of single family lots, ¼ acre in size. The layout of the storm sewer alignment is provided in *Figure 1*. The overland slope is 0.1percent. For TR-55 calculations, CN = 83. The channel is 14 feet deep, with one foot of freeboard at the storm sewer outfall. The outfall pipe should be a minimum of one foot above the flowline of the channel.

Required: Size the storm sewer to accommodate the 3-year storm event.

Design Procedures:

1) A drainage area map should be prepared indicating drainage limits for the site, external tributary areas, location of minor systems, and direction of surface flow. The extreme event flow should be shown on a separate exhibit. For this example, the drainage areas have been assumed and the contributing areas shown at each inlet location.

2) Runoff coefficients should be determined for each subarea in the watershed. The values of "C" can be obtained using *Table 4* in this report. This example has been simplified, and a "C" value of 0.35 will be used for the entire drainage area based on the ¼-acre residential lot land use.

3) The required capacity of each inlet should be calculated using the rational method, with initial time of concentration and intensity. The initial time of concentration will be calculated for overland flow from the Kirpich formula. The Kirpich formula is used due to its general acceptance and use in rural drainage basins. At each successive segment downstream, add the required travel time in the conduit. The intensity will be calculated using the 3-year intensity equation developed for this report, as shown below.

From TR-55: Time of Concentration for overland flow:

$$t_c = 0.0078 * L^{0.77} * S^{-0.385} \text{ (Kirpich Formula)}$$

$$L = 209 * A^{0.6}$$

Where:

$t_c =$ Time of Concentration for Overland Flow(min)
$S =$ Watershed Slope (ft/ft)
$L =$ Length of the principal watercourse
$A =$ Area of Sub Watershed Draining to first inlet(acres)

$$T_c = t_i + T_s$$

Where: $T_c =$ Total Time of Concentration
$T_s =$ Travel Time in Storm Sewer

$$i = \frac{83}{(T_c + 9.4)^{0.822}} \quad \text{3-Year Storm Event Intensity Equation}$$

Where: $i =$ Intensity for a specific T_c

For this example, the initial time of concentration and intensity is:

$$L = 209 * (3.1 acres)^{0.6} = 412$$

$$t_c = 0.0078 * (412)^{0.77} * (0.001)^{-0.385} = 11.5 \min$$

$$i = \frac{83}{(11.5 + 9.4)^{0.822}} = 6.8 in / hr$$

The time of concentration and intensity at each manhole is calculated on the spreadsheet provided as *Figure 3*. At a confluence of two or more conduits, the longest time of concentration is selected.

4) Commencing at the upstream end of the system, the discharge to be carried by each successive segment in the downstream direction is calculated on the spreadsheet using the rational method.

$$Q = CiA$$

Where:

$Q =$ Flow (cfs)
$C =$ Runoff Coefficient
$i =$ Intensity (in/hr)
$A =$ Area (acres)

For initial peak flow:

$$Q = (0.35)(6.8)(3.1) = 7.4 cfs$$

5) Once discharges at the upstream end of each pipe segment are computed, a tentative pipe size is selected. The corresponding velocities for the expected flow are determined to calculate the pipe flow time. This time is added to the upstream time of concentration to establish the new time of concentration for that pipe segment. Design velocities in storm sewers should be a minimum of 3 ft/s for self cleaning. The pipe sizes are adjusted to accommodate the flows and the hydraulic grade line remains below the top of curb. To calculate the hydraulic grade line, begin with the starting water surface elevation (which can be obtained from HCDD No. 1), and then use the following equations to work upstream.

$$S_f = \frac{V^2 n^2}{2.22 R^{\frac{4}{3}}}$$

$$h_f = S_f L$$

Where:

S_f = Friction Slope (feet)
h_f = Friction Loss (feet)
V = Actual Velocity (ft/s)
n = Manning's Coefficient
R = Hydraulic Radius
L = Length of Storm Sewer Segment

Probable Costs Associated with the Lateral Channels

The probable costs associated with the construction of the proposed lateral channels summarized in *Table 5* were calculated based on the following information. For excavation, it was assumed that no channel or ditch currently exists where the proposed lateral channels will be located. Many of the proposed lateral channels are designated where current irrigation drainage ditches exist. However, these ditches tend to be comparatively shallow, and it is unlikely that the proposed laterals will have the same flow line as the existing ditch. Excavation costs are calculated using current cost information for Hidalgo County of $1.25 per cubic yard. Excavation spoil was assumed to be placed on adjacent berms in the maintenance easement, with no cost for transportation and disposal.

Flow Control structures will be required along the channels to attain in-line detention within the channel. For planning purposes, control structures were anticipated at ¼-mile intervals along all lateral channels. Many of these control structures could be constructed as part of a roadway crossing. However, we have conservatively assumed the cost of these to be part of the drainage costs. Probable costs for the control structures were determined assuming that the structure consists of a 9' x 9' reinforced concrete box with bedding and back fill material, and concrete slope paving extended 20' on either side to protect against erosion. All channel costs included hydro-mulch seeding after construction to aid in the prevention of bank erosion and siltation of the channel. All construction costs include an engineering and contingency fee of 25 percent.

It is assumed that the level of maintenance of the lateral channels will be the same as the current maintenance level of the HCMDS. The current budget of $2.8 million includes the current work force of 47 employees, and the annual cost of maintenance equipment and supplies. Currently, each channel is being maintained twice a year. The annual maintenance cost for the proposed lateral system was calculated by dividing the current annual maintenance budget of Hidalgo County by the total number of miles of ditch currently being maintained. The annual maintenance cost of the lateral channel system is then determined by multiplying that rate by the total number of miles in each lateral channel. These costs are shown in *Table 5*.

The expected right-of-way costs were established using the current property cost information for Hidalgo County of $8,710 per acre. This unit cost was provided through inquiries with the local municipalities within the County. The right-of-way is inclusive of spoil bank berms and maintenance easements, as shown in *Table 3*. It is assumed that there is no prior existing right-of-way. Many of the lateral channels are designated where a current irrigation drainage ditch exists with some existing right-of-way.

However, in most cases that right-of-way is owned by other entities. The expected right-of-way costs are shown in *Table 5.*

Alternative methods of funding

The potential capital costs associated with the proposed lateral drainage ditch construction are $141,983,000, including right-of-way purchase. An additional $2,330,000 in annual maintenance costs is projected.

Funding for the current HCDD No. 1 maintenance activities is derived from a current tax rate of 0.0409/$100.00 AV. This funding level is not sufficient to accomplish the proposed improvements, and since it is intended for maintenance purposes, it would not be allowed for use in major capital construction. Three potential alternative methods of financing the proposed improvements are discussed: (1) issuance of new bonds, repaid by general tax revenues; (2) a pay-as-you-go approach to financing; and (3) debt recovery using a development impact fee. It is assumed that the construction of the lateral channels would take place within a time frame that the local industry could absorb the construction activity. We have assumed that the construction industry could develop the project at a pace of approximately $ 14,000,000 per year. This would mean a 10-year timeframe for development of the entire project.

Issuance of New Bonds

A new bond issue for channel construction was assumed to have a life of 25 years at an interest rate of 7 percent. In order to obtain the necessary capital funding, bonds in an amount of $175,000,000 would have to be issued to cover all expenses. Under these assumptions, annual payments of $15,017,000 would be required to retire the debt. Based on the current assessed valuation, with an overall appreciation and growth of 3 percent per year, this would result in a tax rate increase of approximately $0.121 per $100 AV. Given the 10-year time over which the activity would be completed, it may be preferable to divide the cost into two separate bond issues.

The increased maintenance costs of $2,330,000 will require an additional tax increase of $0.0272 per $100 AV.

The advantage to this approach is that construction can take place at a pace dictated by the HCDD No. 1, and funds are available to offset increasing costs of inflation associated with the construction.

Pay-As-You-Go

Under the pay-as-you-go approach, projects would be constructed as funds are made available through tax revenues. Under this approach, a cost inflation of 3 percent is assumed as an offset to additional tax income achieved through the growth in assessed valuation. Since projects would not be constructed until the year in which funds were available, the project costs increase every year, and funds are not available for investment to offset this cost, as is the case with bond funds. Alternatively, there is no interest cost on debt associated with the pay-as-you-go approach.

It is assumed that the project would be constructed over a 10-year period, with an annual cost of $14,189,000 (annually increasing according to a 3 percent increase in cost). The tax increase necessary to achieve this rate of construction under the pay-as-you-go approach is approximately $0.1658 per $100 AV.

The alternative answer to this approach would be to stagger construction at a level equal to the tax rate necessary to retire bonds (i.e. $0.121). Under this approach, construction could occur at a rate of $ 10,400,000 annually, and would take approximately 13.7 years to complete.

The advantage to this approach is that it actually costs the County less money overall. However, the pace of construction is dictated by the amount of money available through tax revenues.

Assessment Through Impact Fees

The concept of the impact fee is to require land that benefits from the improvements to pay for the improvements. Special assessment districts can be established so that properties benefiting from the channel construction in one part of the County are assessed differently than other properties receiving benefits from channels in another part of the County. The principal legislative act used to establish these impact fees is Senate Bill 336.

Under this bill, it is necessary to distinguish between those aspects of a project that are benefiting newly developing properties and those aspects necessary to correct existing deficiencies. It is beyond the scope of this current effort to make that distinction accurately. We have assumed that one-half of the channel improvements and all of the in-line control structures would be associated with developing properties. The remaining cost of channels is associated with existing problems. This assumption does somewhat unfairly place a cost on developing properties, since many road crossings may need improvement, and these structures could be used as control structures.

Under these broad assumptions, the cost of the channels associated with developing properties is $68,200,000, excluding right-of-way. Using the parameters of a 7 percent interest rate and a 25-year bond, plus 30 percent bond costs, the annual payments would average $7,585,000. The next part of the solution is to estimate the amount of acreage that will be developed, and the respective timeframe over which this development will occur. Although the lateral channel system assumes full development of the watershed, this will likely not occur in any reasonable timeframe associated with the life of the constructed improvement. The assumption is necessary, however, because it is not known where the development will occur. We have selected a 50-year period for growth as being coincident with the likely life of the channel system.

Studies performed by the Texas Water Development Board indicate a population growth in Hidalgo County of some 1.4 million persons beyond its current population of 700,000, by the year 2050. Using a population density of 8 persons per gross acre (to include all roads, open spaces, etc.), this would indicate development of approximately 175,000 acres of land in the next 50 years. An average of 3,500 acres of land will develop annually. On this basis, an impact fee of approximately $2,200 per acre would be necessary.

The cost associated with solving the existing problems is approximated at $73,693,000 including the right-of-way. This cost, under the assumption of a 7 percent interest, a 25-year bond, and 30 percent bond issuance costs would require an annual payment of $8,220,000, and result in a tax increase of $0.066. It should not be assumed that this capital cost would accomplish all of the drainage improvements necessary to solve existing problems. The figure benefits from the contribution of funds from developing properties, as the figure for developing properties benefits from the figure stated here.

There are several difficulties associated with the implementation of this type of solution. First, debt recovery is dependent on the rate of growth, and where that growth occurs within the County. It is possible that the HCDD No. 1 would end up financing the improvements either because growth did not occur, or because growth was dispersed to a point that the HCDD No. 1 ended up constructing a large portion of the improvements, with no hope that development would ever allow full recovery of the cost. If growth is slowed, it is possible to increase the cost of the impact fee to recover lost investment. However, the fee must remain reasonable so as not to become punitive as development responds to changes in economic growth. Controlling a dispersion of growth could be accomplished by providing incentives for construction along a drainage way that has already been improved.

An alternative approach is for the developing property to pay for the offsite drainage improvements associated with the lateral channels. If such an approach is taken, the developing property should be able to achieve some cost recovery from the HCDD No. 1 for costs beyond those expected for the development to remain on parity with other properties of its type.

It is unlikely that the impact fee approach can be accomplished without support of a bond issue in some fashion.

Assigning Priority for Ditch Construction

The priority levels for construction for the lateral channels, as shown in *Table 5*, were determined through a weighted point system based on the following information:

- Lateral Channel Designation — 1 (major channel) to 4 (minor channel)
- Flood-Prone Area — 1 (flood prone) to 4 (no reported flooding)
- Level of Development in Area — 1 (highly developing) to 4 (low development)

Determination of the flood-prone areas was based upon reported flooding to HCDD No. 1, the municipalities within the County, and reports of repetitive flood losses to FEMA. The scores were tabulated, and averaged to give a priority level of 1 to 4 for each proposed lateral channel, with 1 being the highest priority channel.

FIGURES

Figure 1. Example of Storm Sewer Design

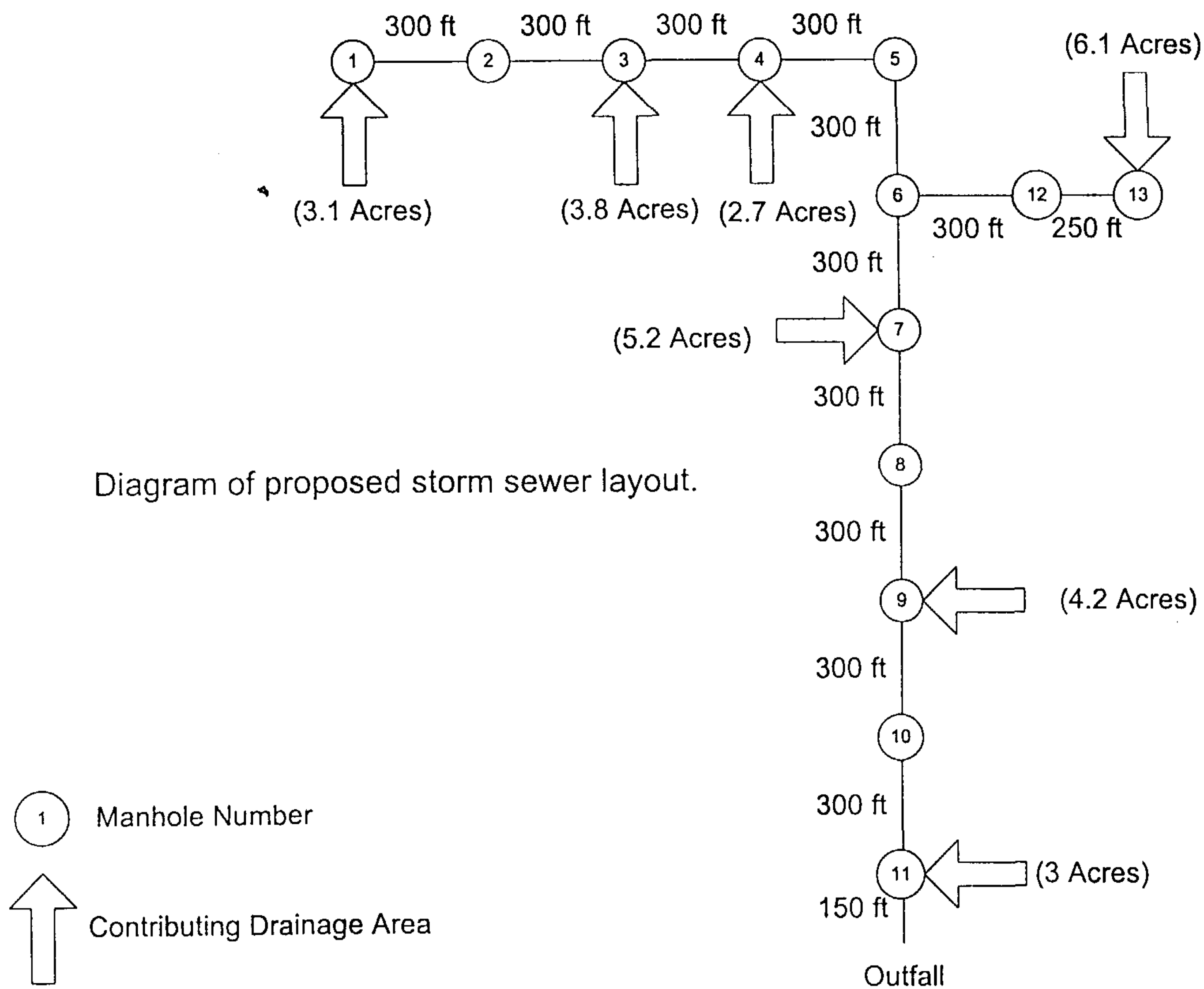


Figure 2 - HCDD#1 Storm Sewer Calculation Form

Project: ____________________
Job No.: ____________________
System: ____________________
By: ____________________ Date: ____________________
Checked By: ____________________ Date: ____________________

M.H. From	M.H. To	Area (acres)	Runoff Coefficien C	Sum of C*A	Intensity I (in/hr)	Sum of Flows (cfs)	Time of Conc. (Minutes)	Reach Length (feet)	Diameter or Rise (inches)	Span (inches)	Slope %	Manning's "n"	Design Capacity (cfs)	Design Velocity (ft/s)	Fall (feet)	Manhole Drop (feet)	Flowline Elevation Upstream (feet)	Flowline Elevation Downstream (feet)	Actual Velocity (ft/s)	Hydraulic Gradient %	Change in Head (feet)	Elevation of Hyd. Grad. Upstream (feet)	Elevation of Hyd. Grad. Downstream (feet)	Natural Ground Upstream (feet)	Natural Ground Downstream (feet)

Figure 3 - HCDD#1 Storm Sewer Calculation Form - Example of Storm Sewer Design

Project: __________
Job No.: __________
System: __________
By: __________ Date: __________
Checked By: __________ Date: __________

M.H. From	M.H. To	Area (acres)	Runoff Coefficient C	Sum of C*A	Intensity I (in/hr)	Sum of Flows (cfs)	Time of Conc. (Minutes)	Reach Length (feet)	Diameter or Rise (inches)	Span (inches)	Slope %	Manning's "n"	Design Capacity (cfs)	Design Velocity (ft/s)	Fall (feet)	Manhole Drop (feet)	Flowline Elevation Upstream (feet)	Flowline Elevation Downstream (feet)	Actual Velocity (ft/s)	R	Hydraulic Gradient %	Change in Head (feet)	Elevation of Hyd. Grad. Upstream (feet)	Elevation of Hyd. Grad. Downstream (feet)	Natural Ground Upstream (feet)	Natural Ground Downstream (feet)
1	2	3.1	0.35	1.085	6.82	7.40	11.5	300	24	NA	0.33	0.013	13.10	3.31	1	0	60.00	59	2.36	0.5	0.0011	0.3196	66.87	66.55	67.00	66.88
2	3	0	0.35	1.085	6.41	14.35	13.2	300	24	NA	0.40	0.013	14.35	3.61	1.2	0	59.00	57.80	4.57	0.5	0.0040	1.2010	66.55	65.35	66.88	66.76
3	4	3.8	0.35	2.415	6.04	28.94	14.8	300	30	NA	0.50	0.013	29.08	5.05	1.5	0	57.80	56.30	5.90	0.625	0.0050	1.4856	65.35	63.86	66.76	66.64
4	5	0	0.35	2.415	5.72	42.75	16.5	300	42	NA	0.20	0.013	45.11	4.47	0.6	0	56.30	55.70	4.44	0.875	0.0018	0.5388	63.86	63.32	66.64	66.52
5	6	0	0.35	2.415	5.43	55.87	18.2	300	42	NA	0.33	0.013	58.24	5.77	1	0	55.70	54.70	5.81	0.875	0.0031	0.9204	63.32	62.40	66.52	66.4
13	12	6.1	0.35	2.135	6.47	13.81	12.9	250	24	NA	0.36	0.013	13.61	3.43	0.9	0	57.50	56.60	4.40	0.5	0.0037	0.9274	64.61	63.68	64.8	64.7
12	5	0	0.35	2.135	6.10	26.83	14.6	300	30	NA	0.53	0.013	30.03	5.22	1.6	0	56.60	55.00	5.47	0.625	0.0043	1.2773	63.68	62.40	64.7	64.58
6	7	0	0.35	4.55	5.18	106.27	19.8	300	60	NA	0.17	0.013	106.61	5.83	0.5	0	54.70	54.20	5.41	1.25	0.0017	0.4968	62.40	61.90	64.58	64.46
7	8	5.2	0.35	6.37	4.95	137.78	21.5	300	72	NA	0.13	0.013	155.06	6.26	0.4	0	54.20	53.80	4.87	1.5	0.0011	0.3158	61.90	61.59	64.46	64.34
8	9	0	0.35	6.37	4.74	167.96	23.2	300	78	NA	0.13	0.013	191.95	6.78	0.4	0	53.80	53.40	5.06	1.625	0.0010	0.3063	61.59	61.28	64.34	64.22
9	10	4.2	0.35	7.84	4.55	203.61	24.6	300	84	NA	0.13	0.013	233.89	7.30	0.4	0	53.40	53.00	5.29	1.75	0.0010	0.3031	61.28	60.98	64.22	64.1
10	11	3	0.35	8.89	4.37	242.49	26.5	300	90	NA	0.10	0.013	243.47	6.78	0.3	0	53.00	52.70	5.49	1.875	0.0010	0.2976	60.98	60.68	64.1	63.98
11	Out	0	0.35	8.89	4.29	280.64	27.3	150	96	NA	0.33	0.024	285.99	7.15	0.5	0	52.70	52.20	5.58	2	0.0032	0.4815	60.68	60.2	63.98	63.92

TABLES

Table 1. Hidalgo County Point Rainfall Depths

Return Period	Rainfall Depth (inches)							
	5-min	15-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
10-Year	0.64	1.42	2.97	3.95	4.30	5.20	6.10	7.10
25-Year	0.74	1.63	3.53	4.60	5.00	6.20	7.20	8.50
100-Year	0.88	1.95	4.40	5.70	6.30	7.80	9.50	11.00

Table 2 - Design Capacity of the Hidalgo County Master Drainage System

All existing Mains and Branches are designed on a 9.5-Year agricultural storm.

Main Floodwater Channel

1. Outfall to West Ranch Boundary	4,300 cfs
2. West Ranch to Junction of W.C.D.D. North Main	4,000 cfs
3. Junction to Panchita	3,750 cfs
4. Panchita to Junction North & South Mains	3,750 cfs

North Main

1. Junction to F.M. 493	1,475 cfs
2. F.M. 493 to Delta Lake Ditch Junction	1,400 cfs
3. Delta Lake Ditch Junction to Junction Old Ditch	1,350 cfs
4. Begin relocation to U.S. 281	1,250 cfs
5. U.S. 281 to Edinburg Lake	1,250 cfs
6. Edinburg Lake to S.W. Lateral	1,200 cfs
7. S.W. Lateral to S.H. 107	300 cfs
8. S.H. 107 to Main Canal	550 cfs
9. Main Canal to Junction South Main	300 cfs

South Main

1. Junction of North Main to Old North Main	2,375 cfs
2. Old N. Main - E. Donna-West Ditch	2,275 cfs
3. Ditch to F.M. 493	2,200 cfs
4. F.M. 493 to Donna Drain	2,000 cfs
5. Donna Drain to Alamo Road F.M. 907	1,950 cfs
6. F.M. 907 to Pharr-McAllen Lateral	1,850 cfs
7. Pharr-McAllen Lateral to Sugar Road	1,350 cfs
8. Sugar Road to Junction	1,300 cfs

Table 2 - Design Capacity of the Hidalgo County Master Drainage System

North Main to McAllen

1.	Junction to New McAllen Ditch west of McColl	1,300 cfs
2.	Ditch to turn west on new route at Junction 18th St. Ditch	1,300 cfs
3.	Junction to Mile 4	900 cfs
4.	Mile 4 to End	500 cfs

Southwest Lateral

1.	Junction to Old Ditch	1,000 cfs
2.	Ditch Junction to Highway 107	925 cfs
3.	Highway 107 to Edinburg Main Canal	900 cfs
4.	Main Canal to E. Mission Branch	800 cfs
5.	Branch to F.M. 494	750 cfs
6.	F.M. 494 to S.H. 107	600 cfs
7.	S.H. 107 to Inspiration	500 cfs
8.	Inspiration to Mile 5	400 cfs
9.	Mile 5 to F.M. 492	300 cfs
10.	F.M. 492 to End	220 cfs

Mission Branch

1.	Junction to Mile 1½	300 cfs
2.	Mile 1½ to Bryan	250 cfs

Rado Drain

1.	Outfall to U.S. 83	800 cfs
2.	U.S. 83 to M.P.R.R.	720 cfs
3.	M.P.R.R. to Edinburg Main	520 cfs
4.	Under Edinburg Main	300 cfs

South Donna Drain

1.	Nominal Capacity	345 cfs

South Weslaco Drain

1.	Nominal Capacity	340 cfs

McAllen Drain

1. Nominal Capacity 1300 cfs

Pharr/McAllen Drain

1. Nominal capacity 600-1500 cfs

Capacity of IWBC Operated Channel System

Banker Floodway (abandoned)	105,000 cfs
Main Floodway	105,000 cfs
North Floodway	84,000 cfs
Arroyo Colorado	21,000 cfs

Table 3 - Hidalgo County Master Drainage System - Lateral R.O.W. Widths

HCDD#1 MDS Proposed Lateral Channel I.D. Number	Station Number for Lateral	Inflow 25 Year Storm Discharge cfs	Outflow 9.5 Year Agr. Discharge cfs	Cross Section Depth ft	Btm Width ft	Top Width ft	Right-of-Way With Berm ft	Right-of-Way W/O Berm ft	Detention Volume acre-ft
A-01	0	1760	420	10.0	18.0	84	220	124	29
	2640	1680	400	10.0	16.0	82	220	122	28
	5280	1580	380	10.0	13.0	79	210	119	26
	7920	1410	340	10.0	13.0	79	210	119	26
	10560	1230	300	9.0	13.0	73	200	113	22
	13200	1020	250	9.0	8.0	68	190	108	19
	15840	800	200	8.0	8.0	62	180	102	16
								Total Detention	166
E-01	0	820	210	8.0	21.0	75	200	115	22
	2640	800	200	8.0	20.0	74	200	114	21
	5280	550	140	7.0	17.0	65	180	105	16
	7920	410	110	7.0	8.0	56	170	96	12
								Total Detention	72
E-02	0	960	240	9.0	17.0	77	210	117	24
	2640	840	210	9.0	12.0	72	200	112	21
	5280	790	200	9.0	10.0	70	200	110	20
	7920	690	180	9.0	7.0	67	190	107	19
	10560	540	140	8.0	7.0	61	180	101	15
								Total Detention	99
F-01	0	1870	440	10.0	20.0	86	230	126	30
	2640	1860	440	10.0	20.0	86	230	126	30
	5280	1820	430	10.0	19.0	85	230	125	30
	7920	1670	400	10.0	16.0	82	220	122	28
	10560	1600	380	10.0	14.0	80	220	120	27
	13200	1220	300	9.0	13.0	73	200	113	22
	15840	1050	260	8.5	12.0	69	190	109	19
	18480	750	190	8.0	7.0	61	180	101	15
								Total Detention	201

Table 3 - Hidalgo County Master Drainage System - Lateral R.O.W. Widths

HCDD#1 MDS Proposed Lateral Channel I.D. Number	Station Number for Lateral	Inflow 25 Year Storm Discharge cfs	Outflow 9.5 Year Agr. Discharge cfs	Cross Section					
				Depth ft	Btm Width ft	Top Width ft	Right-of-Way With Berm ft	Right-of-Way W/O Berm ft	Detention Volume acre-ft
F-01-01	0	830	210	10.0	18.0	84	220	124	29
	2640	790	200	9.0	18.0	78	210	118	25
	5280	680	180	8.0	18.0	72	200	112	20
	7920	570	150	7.0	18.0	66	190	106	17
								Total Detention	91
F-03	0	1440	350	9.0	19.0	79	210	119	25
	2640	1380	330	9.0	18.0	78	210	118	25
	5280	1160	280	9.0	11.0	71	200	111	21
	7920	950	240	8.5	9.0	66	190	106	18
	10560	780	200	8.0	8.0	62	180	102	16
	13200	720	180	8.0	8.0	62	180	102	16
	15840	650	170	7.5	7.0	58	170	98	13
								Total Detention	133
F-04	0	930	230	8.0	13.0	67	190	107	18
	2640	930	230	8.0	13.0	67	190	107	18
	5280	900	230	8.0	12.0	66	190	106	17
	7920	750	190	7.5	11.0	62	180	102	15
	10560	490	130	6.5	9.0	54	160	94	11
								Total Detention	80
F-05-01	0	1410	340	9.5	13.0	76	210	116	24
	2640	1380	330	9.5	12.5	76	210	116	24
	5280	1350	330	9.5	11.0	74	200	114	23
	7920	1300	320	9.5	10.5	74	200	114	22
	10560	1240	300	9.5	9.0	72	200	112	22
	13200	1180	290	9.5	8.0	71	200	111	21
	15840	1110	270	9.5	7.0	70	200	110	20
	18480	990	250	9.0	7.0	67	190	107	19
	21120	880	220	8.5	7.0	64	180	104	17
	23760	560	150	7.0	7.0	55	160	95	12
								Total Detention	203

Table 3 - Hidalgo County Master Drainage System - Lateral R.O.W. Widths

HCDD#1 MDS Proposed Lateral Channel I.D. Number	Station Number for Lateral	Inflow 25 Year Storm Discharge cfs	Outflow 9.5 Year Agr. Discharge cfs	Cross Section Depth ft	Btm Width ft	Top Width ft	Right-of-Way With Berm ft	Right-of-Way W/O Berm ft	Detention Volume acre-ft
F-06	0	1740	410	12.0	14.0	92	240	132	36
	2640	1670	400	12.0	12.0	90	240	130	35
	5280	1490	360	11.5	12.0	87	230	127	32
	7920	1340	330	11.0	12.0	84	220	124	30
	10560	1160	280	10.5	10.0	79	210	119	26
	13200	1030	260	10.0	10.0	76	210	116	24
	15840	950	240	10.0	9.0	75	210	115	24
	18480	870	220	9.5	9.0	72	200	112	22
	21120	640	170	8.5	8.0	65	190	105	17
	23760	640	170	8.5	8.0	65	190	105	17
								Total Detention	264
F-07-00	0	900	230	8.0	12.0	66	190	106	17
	2640	700	180	7.5	9.0	60	170	100	14
	5280	460	120	6.5	8.0	53	160	93	11
								Total Detention	43
F-08	0	1000	250	8.0	15.0	69	190	109	19
	2640	980	240	8.0	15.0	69	190	109	19
	5280	870	220	7.5	15.0	66	190	106	17
	7920	810	210	7.5	13.0	64	180	104	16
	10560	680	180	7.0	13.0	61	180	101	14
	13200	460	120	6.5	7.0	52	160	92	10
	15840	370	100	6.0	6.0	48	150	88	9
								Total Detention	105
F-09-00	0	840	210	7.5	14.0	65	180	105	17
	2640	840	210	7.5	14.0	65	180	105	17
	5280	820	210	7.5	13.0	64	180	104	16
	7920	760	190	7.5	11.0	62	180	102	15
	10560	720	190	7.5	10.0	61	180	101	15
	13200	620	160	7.0	10.0	58	170	98	13
								Total Detention	92

Table 3 - Hidalgo County Master Drainage System - Lateral R.O.W. Widths

HCDD#1 MDS Proposed Lateral Channel I.D. Number	Station Number for Lateral	Inflow 25 Year Storm Discharge cfs	Outflow 9.5 Year Agr. Discharge cfs	Cross Section					
				Depth ft	Btm Width ft	Top Width ft	Right-of-Way With Berm ft	Right-of-Way W/O Berm ft	Detention Volume acre-ft
F-10-00	0	1200	290	9.0	12.0	72	200	112	21
	2640	1160	280	9.0	11.0	71	200	111	21
	5280	900	230	8.5	9.0	66	190	106	18
	7920	670	170	7.5	8.0	59	170	99	14
								Total Detention	74
F-11-00	0	2040	480	12.0	33.0	111	280	151	50
	2640	1970	460	12.0	33.0	111	280	151	50
	5280	1860	440	12.0	33.0	111	280	151	50
	7920	1820	430	11.5	32.0	107	270	147	46
								Total Detention	197
F-12-00	0	2830	640	15.0	22.5	118	300	158	61
	2640	1610	380	12.0	20.0	98	250	138	41
	5280	1580	380	12.0	19.0	97	250	137	40
	7920	1520	360	12.0	17.0	95	250	135	39
	10560	1450	350	12.0	15.0	93	240	133	37
	13200	1330	320	11.5	15.0	90	240	130	35
	15840	1230	300	11.5	12.0	87	230	127	32
	18480	1180	290	11.5	11.0	86	230	126	32
								Total Detention	316
F-12-01	0	1260	310	11.0	20.0	92	240	132	35
	2640	1190	290	11.0	20.0	92	240	132	35
	5280	1160	290	10.5	19.0	88	230	128	32
	7920	1100	270	10.5	17.0	86	230	126	31
	10560	960	240	10.0	17.0	83	220	123	28
	13200	890	220	9.5	17.0	80	220	120	26
								Total Detention	188

Table 3 - Hidalgo County Master Drainage System - Lateral R.O.W. Widths

HCDD#1 MDS Proposed Lateral Channel I.D. Number	Station Number for Lateral	Inflow 25 Year Storm Discharge cfs	Outflow 9.5 Year Agr. Discharge cfs	Cross Section					
				Depth ft	Btm Width ft	Top Width ft	Right-of-Way With Berm ft	Right-of-Way W/O Berm ft	Detention Volume acre-ft
F-14-01	0	1490	470	11.5	12.0	87	230	127	32
	2640	1310	400	11.5	10.0	85	230	125	31
	5280	1270	380	11.5	10.0	85	230	125	31
	7920	1230	370	11.0	10.0	82	220	122	29
	10560	1170	340	11.0	9.0	81	220	121	28
	13200	1110	320	10.5	9.0	78	210	118	26
	15840	1030	290	10.5	9.0	78	210	118	26
									203
F-15-00	0	1200	360	9.0	12.0	72	200	112	21
	2640	1130	330	9.0	11.0	71	200	111	21
	5280	1030	290	9.0	10.5	71	200	111	20
	7920	990	280	9.0	10.5	71	200	111	20
	10560	950	260	9.0	10.0	70	200	110	20
									103
J-01-00	0	2960	670	14.0	25.0	115	290	155	57
	2640	2930	660	14.0	22.0	112	280	152	54
	5280	2810	640	14.0	20.0	110	280	150	53
	7920	2670	610	14.0	17.0	107	270	147	50
	10560	2530	580	14.0	16.0	106	270	146	49
	13200	2390	550	13.5	16.0	103	260	143	46
	15840	2220	520	13.0	16.0	100	260	140	43
	18480	2090	490	13.0	14.0	98	250	138	42
	21120	1830	430	12.5	12.0	93	240	133	38
	23760	1490	360	11.5	12.0	87	230	127	32
	26400	1420	340	11.5	10.0	85	230	125	31
	29040	1340	330	11.5	10.0	85	230	125	31
	31680	1260	310	11.0	10.0	82	220	122	29
	34320	1180	290	11.0	9.0	81	220	121	28
	36960	1110	270	10.5	9.0	78	210	118	26
	39600	1090	270	10.5	9.0	78	210	118	26
								Total Detention	635

Table 3 - Hidalgo County Master Drainage System - Lateral R.O.W. Widths

HCDD#1 MDS Proposed Lateral Channel I.D. Number	Station Number for Lateral	Inflow 25 Year Storm Discharge cfs	Outflow 9.5 Year Agr. Discharge cfs	Cross Section					
				Depth ft	Btm Width ft	Top Width ft	Right-of-Way With Berm ft	Right-of-Way W/O Berm ft	Detention Volume acre-ft
J-02-00	0	3150	710	14.0	40.0	170	320	186	70
	2640	3150	710	14.0	40.0	170	320	186	70
	5280	3150	710	14.0	40.0	170	320	186	70
	7920	2900	660	13.5	40.0	167	310	183	66
	10560	2690	610	13.0	40.0	164	300	180	62
	13200	2460	570	12.5	40.0	161	300	172	59
	15840	2270	530	12.0	40.0	158	290	172	55
								Total Detention	451
J-02-01	0	1030	260	10.0	18.0	84	220	124	29
	2640	1030	260	10.0	18.0	84	220	124	29
	5280	680	180	9.0	12.0	72	200	112	21
	7920	680	180	9.0	12.0	72	200	112	21
								Total Detention	101
J-02-02	0	1430	340	10.0	35.0	101	250	141	39
	2640	1380	330	10.0	33.0	99	250	139	38
	5280	1200	290	10.0	26.0	92	240	132	34
	7920	1080	270	10.0	21.0	87	230	127	31
								Total Detention	142
J-03-00	0	1550	370	11.0	18.0	90	240	130	34
	2640	1490	360	11.0	16.0	88	230	128	33
	5280	1430	340	11.0	14.0	86	230	126	31
	7920	1270	310	11.0	10.0	82	220	122	29
								Total Detention	127
J-04-00	0	1470	350	10.0	11.0	77	210	117	25
	2640	1470	350	10.0	11.0	77	210	117	25
	5280	1140	280	9.5	7.0	70	200	110	20
	7920	1140	280	9.5	7.0	70	200	110	20
	10560	1140	280	9.5	7.0	70	200	110	20
								Total Detention	111

Table 3 - Hidalgo County Master Drainage System - Lateral R.O.W. Widths

HCDD#1 MDS Proposed Lateral Channel I.D. Number	Station Number for Lateral	Inflow 25 Year Storm Discharge cfs	Outflow 9.5 Year Agr. Discharge cfs	Cross Section					
				Depth ft	Btm Width ft	Top Width ft	Right-of-Way With Berm ft	Right-of-Way W/O Berm ft	Detention Volume acre-ft
J-05-00	0	2920	660	14.0	22.0	112	280	152	54
	2640	2900	660	14.0	22.0	112	280	152	54
	5280	2870	650	14.0	21.0	111	280	151	53
	7920	2820	640	14.0	20.0	110	280	150	53
	10560	2820	640	14.0	20.0	110	280	150	53
	13200	2260	520	13.0	18.0	102	260	142	45
	15840	1920	450	12.5	14.0	95	250	135	39
	18480	1740	410	12.0	14.0	92	240	132	36
	21120	1380	330	11.0	13.0	85	230	125	31
								Total Detention	418
J-05-01	0	1310	320	10.0	20.0	86	230	126	30
	2640	1310	320	10.0	20.0	86	230	126	30
								Total Detention	60
J-06-00	0	2940	670	14.0	23.0	113	280	153	55
	2640	2940	670	14.0	23.0	113	280	153	55
	5280	2900	660	14.0	22.0	112	280	152	54
	7920	2850	650	14.0	21.0	111	280	151	53
	10560	2610	600	13.5	21.0	108	270	148	50
	13200	2470	570	12.0	14.0	92	240	132	36
	15840	2270	530	12.0	14.0	92	240	132	36
	18480	2170	500	9.0	10.0	70	200	110	20
	21120	2170	500	9.0	9.0	69	190	109	20
	23760	1990	470	9.0	9.0	69	190	109	20
	26400	1900	450	9.0	8.0	68	190	108	19
	29040	1790	420	8.5	8.0	65	190	105	17
	31680	1600	380	8.0	8.0	62	180	102	16
	34320	1600	380	8.0	8.0	62	180	102	16
								Total Detention	468

Table 3 - Hidalgo County Master Drainage System - Lateral R.O.W. Widths

HCDD#1 MDS Proposed Lateral Channel I.D. Number	Station Number for Lateral	Inflow 25 Year Storm Discharge cfs	Outflow 9.5 Year Agr. Discharge cfs	Cross Section					
				Depth ft	Btm Width ft	Top Width ft	Right-of-Way With Berm ft	Right-of-Way W/O Berm ft	Detention Volume acre-ft
J-07-00	0	2710	620	14.0	18.0	108	270	148	51
	2640	2710	620	14.0	18.0	108	270	148	51
	5280	2710	620	14.0	18.0	108	270	148	51
	7920	2540	580	14.0	17.0	107	270	147	50
	10560	2450	560	13.5	17.0	104	270	144	47
	13200	2350	540	11.5	17.0	92	240	132	36
	15840	2160	500	11.0	17.0	89	230	129	33
	18480	1960	460	9.0	9.0	69	190	109	20
	21120	2030	470	9.0	9.0	69	190	109	20
	23760	1810	430	8.5	9.0	66	190	106	18
	26400	1660	400	8.0	9.0	63	180	103	16
	29040	1500	360	8.0	8.0	62	180	102	16
	31680	1470	350	8.0	8.0	62	180	102	16
	34320	1380	330	7.5	8.0	59	170	99	14
	36960	1270	310	7.5	7.0	58	170	98	13
								Total Detention	450
J-07-01	0	590	150	8.0	10.0	64	180	104	16
	2640	590	150	8.0	10.0	64	180	104	16
								Total Detention	33

Table 3 - Hidalgo County Master Drainage System - Lateral R.O.W. Widths

HCDD#1 MDS Proposed Lateral Channel I.D. Number	Station Number for Lateral	Inflow 25 Year Storm Discharge cfs	Outflow 9.5 Year Agr. Discharge cfs	Cross Section					
				Depth ft	Btm Width ft	Top Width ft	Right-of-Way With Berm ft	Right-of-Way W/O Berm ft	Detention Volume acre-ft
J-08-00	0	5400	1160	18.0	24.0	138	340	178	85
	2640	5400	1160	18.0	24.0	138	340	178	85
	5280	5400	1160	18.0	24.0	138	340	178	85
	7920	5400	1160	18.0	24.0	138	340	178	85
	10560	5400	1160	18.0	24.0	138	340	178	85
	13200	5280	1140	16.0	18.0	120	300	160	64
	15840	5280	1140	16.0	18.0	120	300	160	64
	18480	5280	1140	12.0	18.0	96	250	136	39
	21120	5280	1140	12.0	18.0	96	250	136	39
	23760	5170	1110	12.0	16.0	94	250	134	38
	26400	5170	1110	12.0	16.0	94	250	134	38
	29040	5170	1110	12.0	16.0	94	250	134	38
	31680	5090	1100	12.0	16.0	94	250	134	38
	34320	5090	1100	12.0	16.0	94	250	134	38
	36960	5010	1080	12.0	16.0	94	250	134	38
	39600	5010	1080	12.0	16.0	94	250	134	38
	42240	4930	1070	12.0	16.0	94	250	134	38
	44880	4930	1070	12.0	16.0	94	250	134	38
	47520	2460	570	9.0	13.0	73	200	113	22
	50160	2460	570	9.0	13.0	73	200	113	22
	52800	2390	550	9.0	12.0	72	200	112	21
	55440	2390	550	9.0	12.0	72	200	112	21
	58080	2170	500	9.0	12.0	72	200	112	21
	60720	1940	460	8.5	12.0	69	190	109	19
	63360	1940	460	8.5	12.0	69	190	109	19
	66000	1700	400	8.0	12.0	66	190	106	17
	68640	1480	350	7.5	12.0	63	180	103	16
	71280	1230	300	7.0	10.0	58	170	98	13
	73920	960	240	6.5	10.0	55	160	95	12
	76560	620	160	6.0	6.0	48	150	88	9
								Total Detention	1185

Table 3 - Hidalgo County Master Drainage System - Lateral R.O.W. Widths

HCDD#1 MDS Proposed Lateral Channel I.D. Number	Station Number for Lateral	Inflow 25 Year Storm Discharge cfs	Outflow 9.5 Year Agr. Discharge cfs	Cross Section					
				Depth ft	Btm Width ft	Top Width ft	Right-of-Way With Berm ft	Right-of-Way W/O Berm ft	Detention Volume acre-ft
J-08-01	0	920	230	8.5	10.0	67	190	107	18
	2640	920	230	8.5	10.0	67	190	107	18
	5280	920	230	8.5	10.0	67	190	107	18
								Total Detention	55
J-08-02	0	2610	600	9.0	15.0	75	210	115	23
	2640	2610	600	9.0	15.0	75	210	115	23
	5280	2610	600	9.0	15.0	75	210	115	23
	7920	2610	600	9.0	15.0	75	210	115	23
	10560	2610	600	9.0	15.0	75	210	115	23
	13200	2380	550	9.0	13.0	73	200	113	22
	15840	2120	490	8.5	13.0	70	190	110	20
	18480	1860	440	8.0	13.0	67	190	107	18
	21120	1860	440	8.0	13.0	67	190	107	18
	23760	1860	440	8.0	13.0	67	190	107	18
								Total Detention	210
J-08-03	0	2310	530	9.0	11.0	71	200	111	21
	2640	2310	530	9.0	11.0	71	200	111	21
	5280	2220	510	9.0	10.0	70	200	110	20
	7920	2070	480	9.0	10.0	70	200	110	20
	10560	1910	450	8.5	9.0	66	190	106	18
	13200	1750	410	8.5	7.0	64	180	104	17
	15840	1540	370	8.0	7.0	61	180	101	15
	18480	1300	320	7.5	7.0	58	170	98	13
	21120	730	190	6.0	6.0	48	150	88	9
								Total Detention	154
J-09-00	0	1130	280	9.0	10.0	70	200	110	20
	2640	1120	270	9.0	10.0	70	200	110	20
	5280	980	240	8.5	10.0	67	190	107	18
	7920	850	210	8.0	10.0	64	180	104	16
	10560	710	180	7.5	10.0	61	180	101	15
	13200	540	140	7.0	6.0	54	160	94	11
								Total Detention	101

Table 3 - Hidalgo County Master Drainage System - Lateral R.O.W. Widths

HCDD#1 MDS Proposed Lateral Channel I.D. Number	Station Number for Lateral	Inflow 25 Year Storm Discharge cfs	Outflow 9.5 Year Agr. Discharge cfs	Cross Section					
				Depth ft	Btm Width ft	Top Width ft	Right-of-Way With Berm ft	Right-of-Way W/O Berm ft	Detention Volume acre-ft
K-01-00	0	2190	510	13.5	16.5	104	270	144	47
	2640	2190	510	13.5	16.5	104	270	144	47
	5280	2160	500	13.5	16.0	103	260	143	46
	7920	2150	500	13.5	16.0	103	260	143	46
	10560	1810	430	13.0	12.0	96	250	136	40
	13200	1790	420	13.0	12.0	96	250	136	40
	15840	1760	420	13.0	11.0	95	250	135	39
	18480	1750	410	13.0	11.0	95	250	135	39
	21120	1730	410	13.0	11.0	95	250	135	39
	23760	1280	310	11.5	10.0	85	230	125	31
	26400	1250	310	11.5	10.0	85	230	125	31
	29040	1230	300	11.5	10.0	85	230	125	31
	31680	1160	280	11.0	10.0	82	220	122	29
	34320	620	160	9.0	8.0	68	190	108	19
	36960	590	150	8.5	8.0	65	190	105	17
	39600	540	140	8.5	6.0	63	180	103	16
	42240	500	130	8.5	6.0	63	180	103	16
								Total Detention	575
K-01-01	0	880	220	8.5	13.0	70	190	110	20
	2640	810	210	8.5	10.0	67	190	107	18
	5280	720	180	8.5	7.0	64	180	104	17
		0						Total Detention	55
K-01-02	0	940	240	9.0	11.0	71	200	111	21
	2640	840	210	9.0	10.0	70	200	110	20
	5280	810	210	8.5	10.0	67	190	107	18
	7920	750	190	8.5	8.0	65	190	105	17
								Total Detention	76
K-01-03	0	950	240	10.0	11.0	77	210	117	25
	2640	870	220	10.0	10.0	76	210	116	24
	5280	820	210	9.5	10.0	73	200	113	22
	7920	650	170	9.0	8.0	68	190	108	19
	10560	580	150	8.5	8.0	65	190	105	17
	13200	500	130	8.0	8.0	62	180	102	16
								Total Detention	123

Table 3 - Hidalgo County Master Drainage System - Lateral R.O.W. Widths

HCDD#1 MDS Proposed Lateral Channel I.D. Number	Station Number for Lateral	Inflow 25 Year Storm Discharge cfs	Outflow 9.5 Year Agr. Discharge cfs	Cross Section					
				Depth ft	Btm Width ft	Top Width ft	Right-of-Way With Berm ft	Right-of-Way W/O Berm ft	Detention Volume acre-ft
K-02-00	0	1190	290	10.0	10.0	76	210	116	24
	2640	1180	290	10.0	10.0	76	210	116	24
	5280	1110	270	10.0	8.0	74	200	114	23
	7920	1110	270	10.0	8.0	74	200	114	23
	10560	900	230	9.5	6.0	69	190	109	20
	13200	900	230	9.5	6.0	69	190	109	20
	15840	650	170	8.5	6.0	63	180	103	16
	18480	650	170	8.5	6.0	63	180	103	16
	21120	500	130	7.5	6.0	57	170	97	13
	23760	500	130	7.5	6.0	57	170	97	13
								Total Detention	193
K-03-00	0	2720	620	13.0	20.0	104	270	144	46
	2640	2720	620	13.0	20.0	104	270	144	46
	5280	2720	620	13.0	20.0	104	270	144	46
	7920	2720	620	13.0	20.0	104	270	144	46
	10560	2380	550	12.5	18.0	99	260	139	42
	13200	2380	550	12.5	18.0	99	260	139	42
	15840	2380	550	12.5	18.0	99	260	139	42
	18480	2050	480	12.0	15.0	93	240	133	37
	21120	2050	480	12.0	15.0	93	240	133	37
	23760	1550	370	11.0	12.0	84	220	124	30
	26400	990	250	9.5	8.0	71	200	111	21
	29040	990	250	9.5	8.0	71	200	111	21
	31680	990	250	9.5	8.0	71	200	111	21
	34320	990	250	9.5	8.0	71	200	111	21
								Total Detention	500
K-03-01	0	950	240	9.0	11.0	71	200	111	21
	2640	820	210	8.5	11.0	68	190	108	19
	5280	750	190	8.5	8.0	65	190	105	17
	7920	580	150	8.0	6.0	60	180	100	15
								Total Detention	71

Table 3 - Hidalgo County Master Drainage System - Lateral R.O.W. Widths

HCDD#1 MDS Proposed Lateral Channel I.D. Number	Station Number for Lateral	Inflow 25 Year Storm Discharge cfs	Outflow 9.5 Year Agr. Discharge cfs	Cross Section					
				Depth ft	Btm Width ft	Top Width ft	Right-of-Way With Berm ft	Right-of-Way W/O Berm ft	Detention Volume acre-ft
K-03-02	0	900	230	8.5	14.0	71	200	111	20
	2640	820	210	8.5	11.0	68	190	108	19
	5280	700	180	8.0	10.0	64	180	104	16
	7920	540	140	7.5	8.0	59	170	99	14
								Total Detention	70
K-03-03	0	1080	270	8.5	21.0	78	210	118	24
	2640	1000	250	8.5	18.0	75	200	115	22
	5280	910	230	8.5	14.0	71	200	111	20
	7920	720	180	8.0	11.0	65	180	105	17
	10560	620	160	7.5	11.0	62	180	102	15
	13200	480	130	7.0	9.0	57	170	97	13
	15840	380	100	6.5	7.0	52	160	92	10
								Total Detention	122
K-03-04	0	1020	250	8.0	24.0	78	210	118	23
	2640	900	230	7.5	24.0	75	200	115	21
	5280	810	210	7.5	20.0	71	200	111	19
	7920	500	130	6.0	20.0	62	180	102	14
								Total Detention	78
K-03-05	0	990	250	8.0	23.0	77	210	117	23
	2640	990	250	8.0	23.0	77	210	117	23
	5280	900	230	8.0	19.0	73	200	113	21
	7920	900	230	8.0	19.0	73	200	113	21
	10560	580	150	7.0	14.0	62	180	102	15
								Total Detention	102
K-04-00	0	1200	290	9.0	20.0	80	210	120	26
	2640	1110	270	9.0	17.0	77	210	117	24
	5280	840	210	8.0	16.0	70	190	110	19
								Total Detention	69

Table 3 - Hidalgo County Master Drainage System - Lateral R.O.W. Widths

HCDD#1 MDS Proposed Lateral Channel I.D. Number	Station Number for Lateral	Inflow 25 Year Storm Discharge cfs	Outflow 9.5 Year Agr. Discharge cfs	Cross Section Depth ft	Btm Width ft	Top Width ft	Right-of-Way With Berm ft	Right-of-Way W/O Berm ft	Detention Volume acre-ft
K-05-00	0	1840	430	11.0	19.0	91	240	131	35
	2640	1750	410	11.0	19.0	91	240	131	35
	5280	1660	390	10.5	19.0	88	230	128	32
	7920	1560	370	10.5	15.0	84	220	124	30
	10560	1450	350	10.5	14.0	83	220	123	29
	13200	1230	300	10.0	12.0	78	210	118	25
	15840	980	250	9.0	12.0	72	200	112	21
								Total Detention	207
K-05-01	0	900	230	8.5	14.0	71	200	111	20
	2640	840	210	8.5	12.0	69	190	109	19
	5280	750	190	8.0	12.0	66	190	106	17
	7920	580	150	7.5	10.0	61	180	101	15
	10560	500	130	7.0	10.0	58	170	98	13
								Total Detention	85
K-05-02	0	980	250	8.0	22.0	76	210	116	22
	2640	920	230	8.0	20.0	74	200	114	21
	5280	840	210	8.0	17.0	71	200	111	20
	7920	750	190	7.5	17.0	68	190	108	18
	10560	650	170	7.0	17.0	65	180	105	16
								Total Detention	98
K-07-01	0	920	230	10.0	10.0	76	210	116	24
	2640	810	210	9.5	10.0	73	200	113	22
	5280	720	180	9.0	10.0	70	200	110	20
									67
K-07-02	0	750	190	9.0	11.0	71	200	111	21
	2640	670	170	9.0	8.0	68	190	108	19
	5280	580	150	8.5	8.0	65	190	105	17
									57

Table 3 - Hidalgo County Master Drainage System - Lateral R.O.W. Widths

HCDD#1 MDS Proposed Lateral Channel I.D. Number	Station Number for Lateral	Inflow 25 Year Storm Discharge cfs	Outflow 9.5 Year Agr. Discharge cfs	Cross Section Depth ft	Btm Width ft	Top Width ft	Right-of-Way With Berm ft	Right-of-Way W/O Berm ft	Detention Volume acre-ft
K-08-00	0	750	190	9.0	11.0	71	200	111	21
	2640	670	170	9.0	8.0	68	190	108	19
	5280	580	150	8.5	8.0	65	190	105	17
								Total Detention	57
L-02-01	0	900	230	8.0	19.0	73	200	113	21
	2640	780	200	7.5	19.0	70	190	110	19
	5280	580	150	7.0	14.0	62	180	102	15
								Total Detention	55
L-03-00	0	1680	400	11.0	15.0	87	230	127	32
	2640	1670	400	11.0	15.0	87	230	127	32
	5280	1650	390	11.0	15.0	87	230	127	32
	7920	1630	390	11.0	15.0	87	230	127	32
	10560	1550	370	11.0	15.0	87	230	127	32
	13200	1490	360	10.5	15.0	84	220	124	30
	15840	1440	350	10.5	13.0	82	220	122	28
	18480	1250	310	10.0	12.0	78	210	118	25
	21120	960	240	9.0	12.0	72	200	112	21
	23760	750	190	8.0	12.0	66	190	106	17
								Total Detention	282
L-04-00	0	1060	260	9.0	15.0	75	210	115	23
	2640	1060	260	9.0	15.0	75	210	115	23
	5280	1060	260	9.0	15.0	75	210	115	23
	7920	750	190	8.0	12.0	66	190	106	17
								Total Detention	86
M-01-00	0	950	240	9.0	11.0	71	200	111	21
	2640	950	240	9.0	11.0	71	200	111	21
	5280	950	240	9.0	11.0	71	200	111	21
								Total Detention	62

Table 3 - Hidalgo County Master Drainage System - Lateral R.O.W. Widths

HCDD#1 MDS Proposed Lateral Channel I.D. Number	Station Number for Lateral	Inflow 25 Year Storm Discharge cfs	Outflow 9.5 Year Agr. Discharge cfs	Cross Section					
				Depth ft	Btm Width ft	Top Width ft	Right-of-Way With Berm ft	Right-of-Way W/O Berm ft	Detention Volume acre-ft
M-02-00	0	1260	310	10.0	12.0	78	210	118	25
	2640	1200	290	10.0	12.0	78	210	118	25
	5280	1110	270	9.5	12.0	75	210	115	23
	7920	1000	250	9.5	9.0	72	200	112	22
	10560	840	210	9.0	8.0	68	190	108	19
	13200	650	170	8.0	8.0	62	180	102	16
								Total Detention	130
M-03-00	0	1990	470	12.0	14.0	92	240	132	36
	2640	1990	470	12.0	14.0	92	240	132	36
	5280	1900	450	12.0	14.0	92	240	132	36
	7920	1800	430	11.5	14.0	89	230	129	34
	10560	1700	400	11.5	11.0	86	230	126	32
	13200	1700	400	11.5	11.0	86	230	126	32
								Total Detention	206
M-04-00	0	1160	280	10.0	10.0	76	210	116	24
	2640	1160	280	10.0	10.0	76	210	116	24
	5280	1160	280	10.0	10.0	76	210	116	24
								Total Detention	73
M-05-00	0	1840	430	11.0	19.0	91	240	131	35
	2640	1840	430	11.0	19.0	91	240	131	35
	5280	1610	380	10.5	18.0	87	230	127	32
	7920	1510	360	10.5	15.0	84	220	124	30
	10560	1000	250	9.0	13.0	73	200	113	22
	13200	900	230	9.0	10.0	70	200	110	20
	15840	750	190	8.5	8.0	65	190	105	17
	18480	640	170	8.0	8.0	62	180	102	16
	21120	500	130	7.5	6.0	57	170	97	13
								Total Detention	218

Table 3 - Hidalgo County Master Drainage System - Lateral R.O.W. Widths

HCDD#1 MDS Proposed Lateral Channel I.D. Number	Station Number for Lateral	Inflow 25 Year Storm Discharge cfs	Outflow 9.5 Year Agr. Discharge cfs	Cross Section					
				Depth ft	Btm Width ft	Top Width ft	Right-of-Way With Berm ft	Right-of-Way W/O Berm ft	Detention Volume acre-ft
M-05-01	0	960	240	8.0	21.0	75	200	115	22
	2640	810	210	7.5	20.0	71	200	111	19
	5280	650	170	7.0	18.0	66	190	106	17
	7920	580	150	7.0	15.0	63	180	103	15
	10560	500	130	6.5	15.0	60	170	100	14
								Total Detention	87
S-01-00	0	1160	280	11.0	16.0	88	230	128	33
	2640	1120	280	11.0	16.0	88	230	128	33
	5280	1090	270	10.5	16.0	85	230	125	30
	7920	1020	250	10.5	15.0	84	220	124	30
	10560	940	240	10.0	15.0	81	220	121	27
	13200	850	220	9.5	15.0	78	210	118	25
	15840	790	200	9.5	15.0	78	210	118	25
	18480	700	180	9.0	13.0	73	200	113	22
	21120	610	160	8.5	12.0	69	190	109	19
	23760	500	130	8.0	11.0	65	180	105	17
								Total Detention	261
S-02-00	0	1450	350	11.0	24.0	96	250	136	38
	2640	1340	330	11.0	24.0	96	250	136	38
	5280	1230	300	10.5	22.0	91	240	131	34
	7920	1110	270	10.0	22.0	88	230	128	32
	10560	980	240	9.5	21.0	84	220	124	29
								Total Detention	170

Table 3 - Hidalgo County Master Drainage System - Lateral R.O.W. Widths

HCDD#1 MDS Proposed Lateral Channel I.D. Number	Station Number for Lateral	Inflow 25 Year Storm Discharge cfs	Outflow 9.5 Year Agr. Discharge cfs	Cross Section					
				Depth ft	Btm Width ft	Top Width ft	Right-of-Way With Berm ft	Right-of-Way W/O Berm ft	Detention Volume acre-ft
W-01-00	0	4360	950	16.0	30.0	132	320	172	76
	2640	4290	940	16.0	30.0	132	320	172	76
	5280	4190	920	15.5	30.0	129	320	169	72
	7920	4040	890	15.5	30.0	129	320	169	72
	10560	3930	870	15.5	27.0	126	310	166	69
	13200	3690	820	15.0	27.0	123	300	163	65
	15840	3300	740	14.5	25.0	118	290	158	60
	18480	3300	740	14.5	25.0	118	290	158	60
	21120	3300	740	14.5	25.0	118	290	158	60
	23760	3000	680	14.0	24.0	114	290	154	56
	26400	3000	680	14.0	24.0	114	290	154	56
	29040	3000	680	14.0	24.0	114	290	154	56
	31680	3000	680	14.0	24.0	114	290	154	56
	34320	3000	680	14.0	24.0	114	290	154	56
	36960	2630	600	13.5	21.0	108	270	148	50
	39600	2190	510	13.0	16.0	100	260	140	43
	42240	2190	510	13.0	16.0	100	260	140	43
	44880	2190	510	13.0	16.0	100	260	140	43
	47520	2190	510	13.0	16.0	100	260	140	43
	50160	2000	470	12.5	16.0	97	250	137	41
	52800	1480	350	11.5	11.0	86	230	126	32
	55440	1480	350	11.5	11.0	86	230	126	32
	58080	1250	310	11.0	9.0	81	220	121	28
	60720	910	230	10.0	7.0	73	200	113	22
	63360	910	230	10.0	7.0	73	200	113	22
	66000	910	230	10.0	7.0	73	200	113	22
	68640	910	230	10.0	7.0	73	200	113	22
								Total Detention	1335

Table 3 - Hidalgo County Master Drainage System - Lateral R.O.W. Widths

HCDD#1 MDS Proposed Lateral Channel I.D. Number	Station Number for Lateral	Inflow 25 Year Storm Discharge cfs	Outflow 9.5 Year Agr. Discharge cfs	Cross Section					
				Depth ft	Btm Width ft	Top Width ft	Right-of-Way With Berm ft	Right-of-Way W/O Berm ft	Detention Volume acre-ft
W-01-01	0	1330	320	10.0	21.0	87	230	127	31
	2640	1200	290	9.5	21.0	84	220	124	29
	5280	1070	260	9.0	21.0	81	220	121	26
	7920	750	190	8.5	13.0	70	190	110	20
	10560	330	90	6.0	12.0	54	160	94	11
								Total Detention	116
W-01-02	0	1180	290	9.5	20.0	83	220	123	28
	2640	1180	290	9.5	20.0	83	220	123	28
								Total Detention	56
W-01-03	0	500	130	7.5	9.0	60	170	100	14
	2640	500	130	7.5	9.0	60	170	100	14
	5280	500	130	7.5	9.0	60	170	100	14
								Total Detention	43
W-01-04	0	910	230	8.5	20.0	77	210	117	23
	2640	910	230	8.5	20.0	77	210	117	23
	5280	910	230	8.5	20.0	77	210	117	23
	7920	910	230	8.5	20.0	77	210	117	23
								Total Detention	94
W-01-05	0	1130	280	8.5	30.0	87	230	127	29
	2640	1130	280	8.5	30.0	87	230	127	29
	5280	1130	280	8.5	30.0	87	230	127	29
	7920	1130	280	8.5	30.0	87	230	127	29
								Total Detention	114
W-02-00	0	1710	410	11.0	24.0	96	250	136	38
	2640	1590	380	10.5	24.0	93	240	133	35
	5280	1510	360	10.5	22.0	91	240	131	34
	7920	1300	320	10.0	20.0	86	230	126	30
	10560	1030	260	9.5	15.0	78	210	118	25
	13200	840	210	9.0	12.0	72	200	112	21
	15840	650	170	8.5	10.0	67	190	107	18
								Total Detention	202

Table 3 - Hidalgo County Master Drainage System - Lateral R.O.W. Widths

HCDD#1 MDS Proposed Lateral Channel I.D. Number	Station Number for Lateral	Inflow 25 Year Storm Discharge cfs	Outflow 9.5 Year Agr. Discharge cfs	Cross Section					
				Depth ft	Btm Width ft	Top Width ft	Right-of-Way With Berm ft	Right-of-Way W/O Berm ft	Detention Volume acre-ft
W-03-00	0	660	170	8.5	9.0	66	190	106	18
	2640	660	170	8.5	9.0	66	190	106	18
	5280	660	170	8.5	9.0	66	190	106	18
								Total Detention	53
W-04-00	0	1490	360	11.0	16.0	88	230	128	33
	2640	1490	360	11.0	16.0	88	230	128	33
	5280	1490	360	11.0	16.0	88	230	128	33
	7920	1490	360	11.0	16.0	88	230	128	33
								Total Detention	131
W-05-00	0	1490	360	11.0	16.0	88	230	128	33
	2640	1490	360	11.0	16.0	88	230	128	33
	5280	1490	360	11.0	16.0	88	230	128	33
	7920	1490	360	11.0	16.0	88	230	128	33
	10560	1490	360	11.0	16.0	88	230	128	33
								Total Detention	163
W-06-00	0	1390	340	11.0	13.0	85	230	125	31
	2640	1340	330	11.0	13.0	85	230	125	31
	5280	1130	280	10.5	10.0	79	210	119	26
	7920	870	220	9.5	9.0	72	200	112	22
	10560	870	220	9.5	9.0	72	200	112	22
								Total Detention	131
W-07-00	0	810	210	10.0	9.0	75	210	115	24
	2640	780	200	9.0	9.0	69	190	109	20
	5280	750	190	9.0	9.0	69	190	109	20
	7920	670	170	8.5	9.0	66	190	106	18
	10560	580	150	8.0	9.0	63	180	103	16
	13200	500	130	7.5	9.0	60	170	100	14
								Total Detention	111

Table 3 - Hidalgo County Master Drainage System - Lateral R.O.W. Widths

HCDD#1 MDS Proposed Lateral Channel I.D. Number	Station Number for Lateral	Inflow 25 Year Storm Discharge cfs	Outflow 9.5 Year Agr. Discharge cfs	Cross Section					
				Depth ft	Btm Width ft	Top Width ft	Right-of-Way With Berm ft	Right-of-Way W/O Berm ft	Detention Volume acre-ft
Z-01-00	0	3040	690	10.0	20.0	86	230	126	30
	2640	3040	690	10.0	20.0	86	230	126	30
	5280	3040	690	10.0	20.0	86	230	126	30
	7920	2970	670	10.0	20.0	86	230	126	30
	10560	2960	670	9.5	20.0	83	220	123	28
	13200	2910	660	9.5	20.0	83	220	123	28
	15840	2910	660	9.5	20.0	83	220	123	28
	18480	2810	640	9.5	18.0	81	220	121	27
	21120	2810	640	9.5	18.0	81	220	121	27
	23760	2670	610	9.0	18.0	78	210	118	25
	26400	2540	580	9.0	18.0	78	210	118	25
	29040	2390	550	9.0	17.0	77	210	117	24
	31680	2240	520	9.0	16.0	76	210	116	23
	34320	2090	490	8.5	16.0	73	200	113	21
	36960	1880	440	8.5	13.0	70	190	110	20
	39600	1680	400	8.0	13.0	67	190	107	18
	42240	1450	350	7.5	13.0	64	180	104	16
	44880	1200	290	7.0	12.0	60	170	100	14
	47520	910	230	6.5	10.0	55	160	95	12
	50160	540	140	6.0	6.0	48	150	88	9
	52800	540	140	6.0	6.0	48	150	88	9
								Total Detention	473

** Right-of-way is determined with one foot of freeboard included in all channels.

TABLE 4. RUNOFF COEFFICIENTS FOR RATIONAL METHOD

Type of Drainage Area	Runoff Coefficient
Residential Districts:	
Single Family (Lots less than 1/4 acre)	0.35
Single Family (Lots 1/4 to 1/2 acre)	0.30
Single Family (Lots greater than 1/2 acre)	0.25
Multi-Family (Less than 20 DU/AC)	0.45
Multi-Family (Greater than 20 DU/AC)	0.55
Business District:	0.70
Industrial Districts:	
Light Areas	0.50
Heavy Areas	0.60
Railroad Yard Areas	0.20
Parks	0.10
Unimproved Areas:	
Bare Surface	0.30
Grassland	0.25
Cultivated Land	0.20
Woodlands	0.15
Streets:	
Asphalt	0.70
Concrete	0.75
Drives and Walks:	
Concrete	0.75

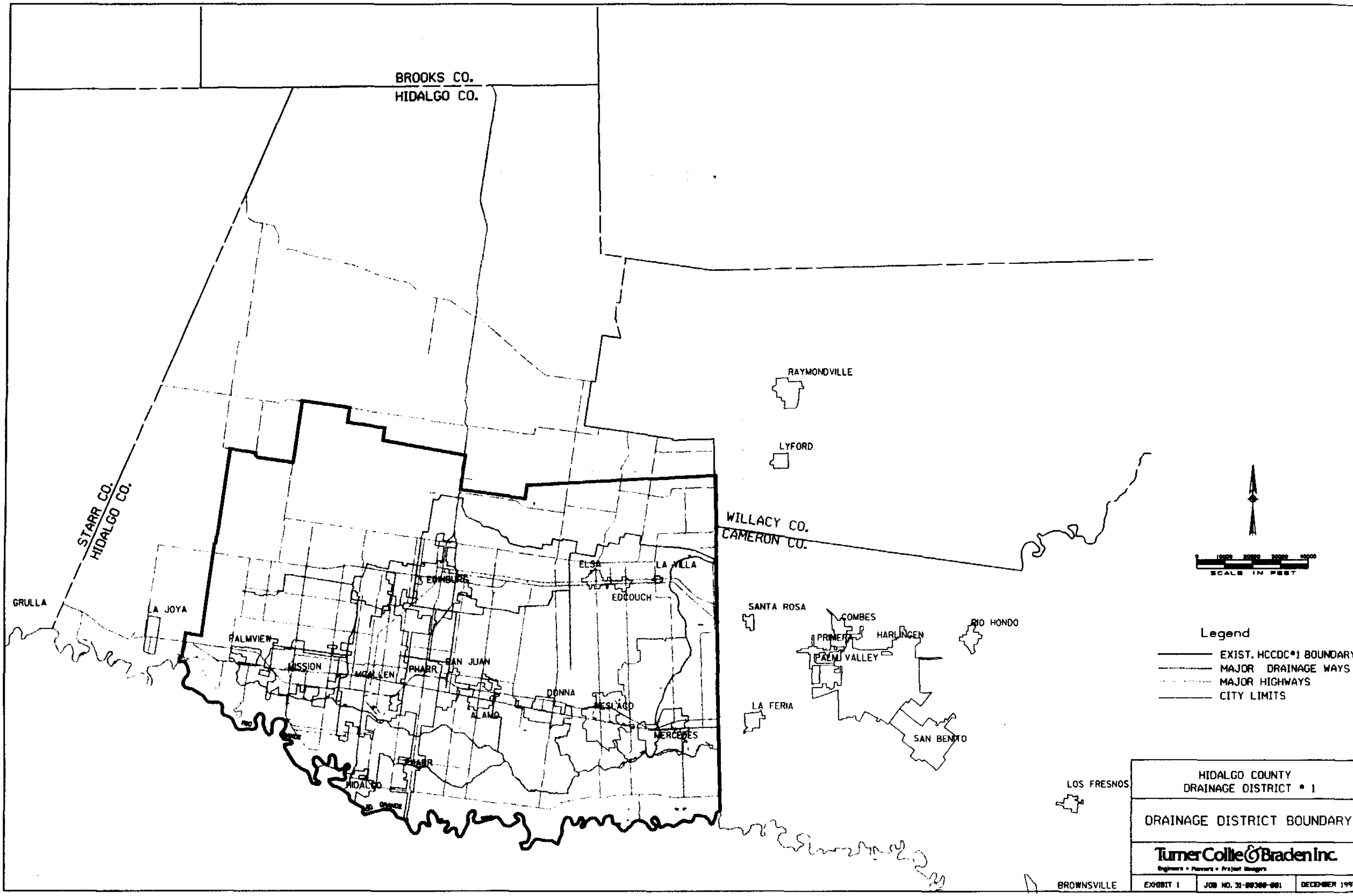
Table 5 - Capital Improvement Costs

HCDD#1 MDS Proposed Lateral Channel I.D. Number	Priority Level for Construction	Proposed Lateral Channel			
		Excavation & Seeding Cost	Control Structure Cost	Right-of-way Cost	Annual Maintenance Cost
A-01	4	$444,500	$700,000	$755,300	$32,900
E-01	3	$196,000	$400,000	$396,100	$18,800
E-02	3	$269,100	$500,000	$517,600	$23,500
F-01	3	$538,000	$800,000	$898,000	$37,600
F-01-01	4	$243,800	$400,000	$433,100	$18,800
F-03	3	$361,400	$700,000	$707,800	$32,900
F-04	4	$220,600	$500,000	$480,800	$23,500
F-05-01	3	$550,300	$1,000,000	$1,029,800	$47,000
F-06	3	$704,700	$1,000,000	$1,130,400	$47,000
F-07-00	3	$119,100	$300,000	$274,700	$14,100
F-08	4	$291,100	$700,000	$655,100	$32,900
F-09-00	4	$256,500	$600,000	$565,300	$28,200
F-10-00	2	$201,100	$400,000	$401,400	$18,800
F-11-00	3	$974,000	$900,000	$1,225,300	$42,300
F-12-00	2	$828,700	$800,000	$1,051,000	$37,600
F-12-01	2	$498,200	$600,000	$729,000	$28,200
F-14-01	1	$538,300	$700,000	$818,700	$32,900
F-15-00	4	$279,400	$500,000	$528,000	$23,500
J-01-00	3	$1,662,000	$1,600,000	$2,086,300	$75,200
J-02-00	2	$1,163,700	$700,000	$1,140,700	$32,900
J-02-01	3	$269,400	$400,000	$443,600	$18,800
J-02-02	2	$374,600	$400,000	$512,300	$18,800
J-03-00	4	$334,900	$400,000	$486,000	$18,800
J-04-00	2	$299,200	$500,000	$538,600	$23,500
J-05-00	4	$1,089,400	$900,000	$1,257,100	$42,300
J-05-01	4	$160,600	$200,000	$243,000	$9,400
J-06-00	2	$1,234,100	$1,400,000	$1,685,200	$65,800
J-07-00	2	$1,193,700	$1,500,000	$1,727,400	$70,500
J-07-01	3	$91,000	$200,000	$190,200	$9,400
J-08-00	1	$3,103,900	$3,000,000	$3,844,600	$141,000
J-08-01	3	$150,000	$300,000	$301,200	$14,100
J-08-02	3	$568,100	$1,000,000	$1,061,700	$47,000
J-08-03	3	$422,000	$900,000	$882,000	$42,300
J-09-00	1	$279,000	$600,000	$586,300	$28,200
K-01-01	3	$150,000	$300,000	$295,900	$14,100
K-01-02	3	$208,300	$400,000	$412,000	$18,800
K-02-00	3	$524,700	$1,000,000	$1,003,600	$47,000
K-03-00	2	$1,145,300	$1,100,000	$1,457,700	$51,700
K-03-01	3	$195,400	$400,000	$401,500	$18,800
K-03-02	3	$190,800	$400,000	$390,900	$18,800
K-03-03	2	$335,100	$700,000	$686,600	$32,900
K-03-04	2	$211,100	$400,000	$417,200	$18,800
K-03-05	2	$276,900	$500,000	$528,100	$23,500
K-04-00	2	$185,700	$300,000	$322,200	$14,100
K-05-00	2	$548,600	$700,000	$824,000	$32,900
K-05-01	2	$233,900	$500,000	$491,300	$23,500

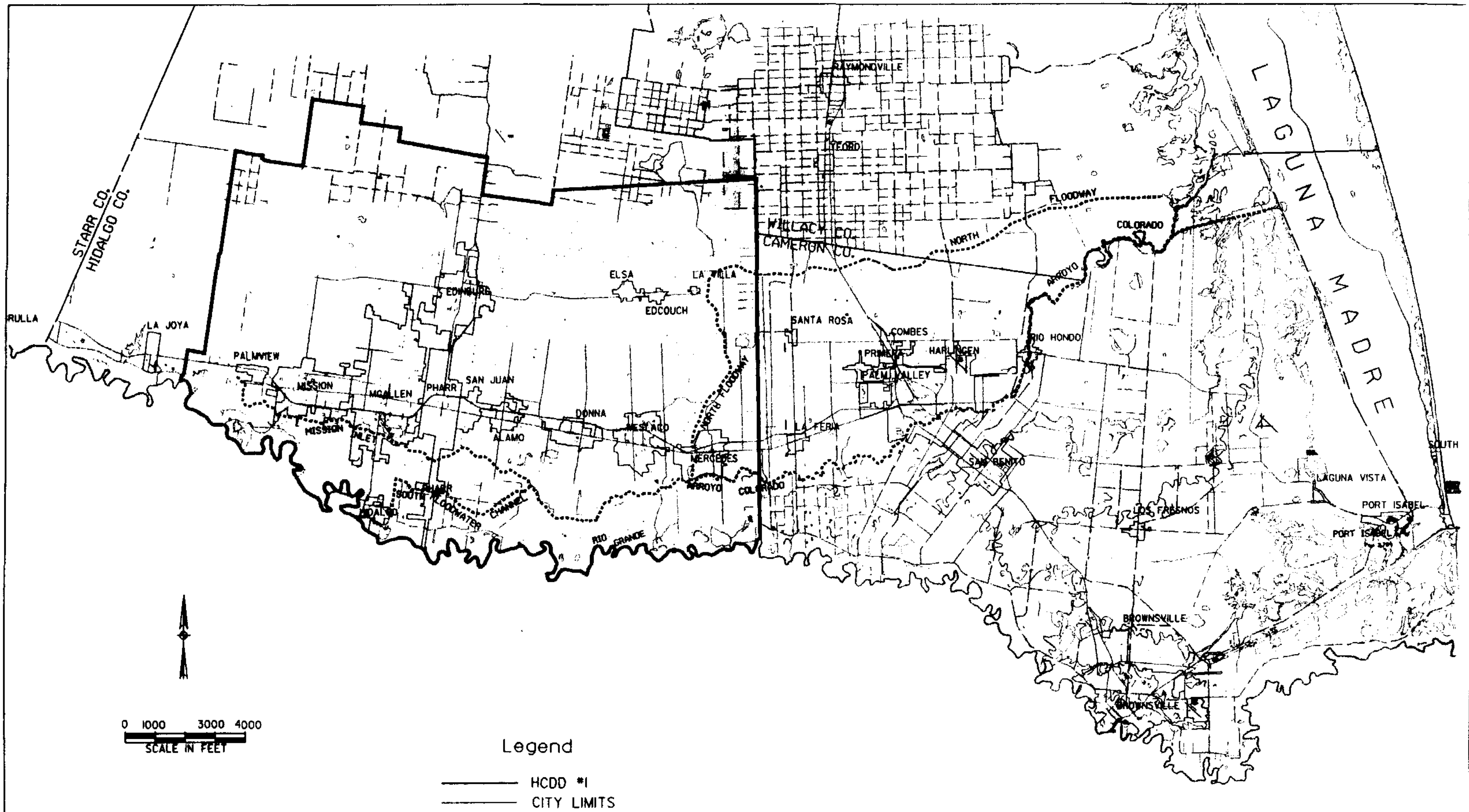
Table 5 - Capital Improvement Costs

HCDD#1 MDS Proposed Lateral Channel I.D. Number	Priority Level for Construction	Proposed Lateral Channel			
		Excavation & Seeding Cost	Control Structure Cost	Right-of-way Cost	Annual Maintenance Cost
K-05-02	2	$265,500	$500,000	$517,600	$23,500
K-07-01	1	$179,600	$300,000	$322,100	$14,100
K-07-02	1	$155,500	$300,000	$306,400	$14,100
K-08-00	1	$155,500	$300,000	$306,400	$14,100
L-02-01	2	$149,300	$300,000	$301,100	$14,100
L-03-00	2	$750,300	$1,000,000	$1,156,800	$47,000
L-04-00	2	$232,700	$400,000	$433,100	$18,800
M-01-00	3	$168,300	$300,000	$316,800	$14,100
M-02-00	3	$352,200	$600,000	$633,800	$28,200
M-03-00	3	$543,500	$600,000	$744,900	$28,200
M-04-00	3	$195,000	$300,000	$332,700	$14,100
M-05-00	3	$585,100	$900,000	$987,800	$42,300
M-05-01	3	$237,700	$500,000	$496,500	$23,500
S-01-00	4	$695,800	$1,000,000	$1,119,800	$47,000
S-02-00	3	$448,100	$500,000	$628,500	$23,500
W-01-00	2	$3,471,500	$2,700,000	$3,829,100	$126,900
W-01-01	3	$312,700	$500,000	$538,800	$23,500
W-01-02	2	$148,600	$200,000	$232,400	$9,400
W-01-03	3	$120,000	$300,000	$269,400	$14,100
W-01-04	3	$252,000	$400,000	$443,600	$18,800
W-01-05	3	$304,000	$400,000	$486,000	$18,800
W-02-00	3	$537,100	$700,000	$824,000	$32,900
W-03-00	3	$146,100	$300,000	$301,200	$14,100
W-04-00	3	$344,800	$400,000	$486,000	$18,800
W-05-00	3	$431,000	$500,000	$607,500	$23,500
W-06-00	2	$349,500	$500,000	$565,100	$23,500
W-07-00	2	$303,200	$600,000	$597,000	$28,200
Z-01-00	1	$1,275,500	$2,100,000	$2,244,800	$98,700
Totals:		$37,226,300	$49,600,000	$56,844,000	$2,332,000

EXHIBITS



BROOKS CO.
HIDALGO CO.
STARR CO.
HIDALGO CO.
WILLACY CO.
CAMERON CO.
RAYMONDVILLE
LYFORD
GRULLA
LA JOYA
PALMVIEW
MISSION
MCALLEN
PHARR
SAN JUAN
EDINBURG
ELSA
LA VILLA
EDCOUCH
DONNA
WESLACO
ALAMO
MERCEDES
HIDALGO
SANTA ROSA
COMBES
PRIMERA
HARLINGEN
PALM VALLEY
RIO HONDO
LA FERIA
SAN BENITO
LOS FRESNOS
BROWNSVILLE
SCALE IN FEET
Legend
EXIST. HCCDC#1 BOUNDARY
MAJOR DRAINAGE WAYS
MAJOR HIGHWAYS
CITY LIMITS
HIDALGO COUNTY
DRAINAGE DISTRICT • 1
DRAINAGE DISTRICT BOUNDARY
Turner Collie & Braden Inc.
EXHIBIT 1
DECEMBER 1997

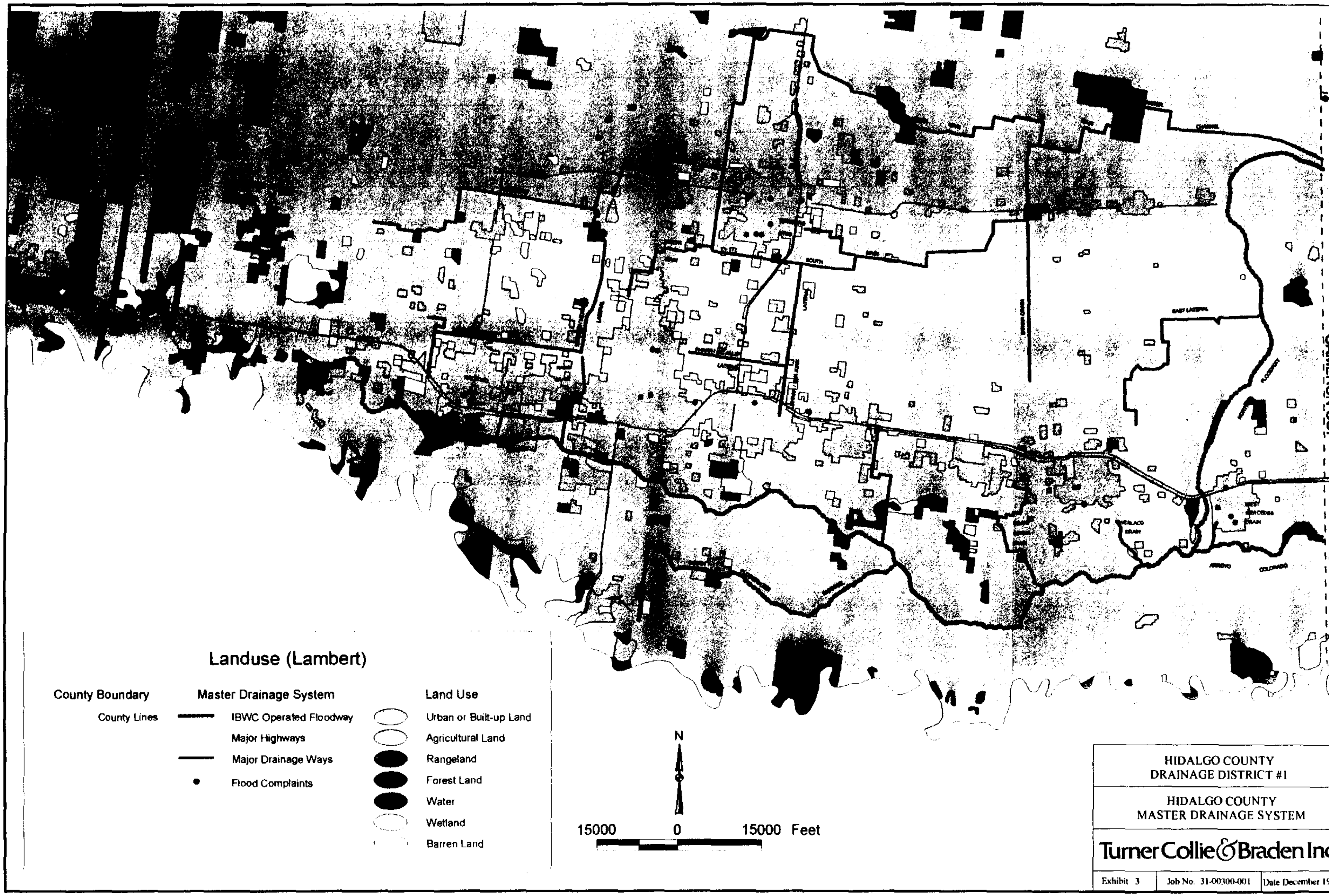


HIDALGO COUNTY
DRAINAGE DISTRICT # 1

IBWC FLOODWAY SYSTEM

Turner Collie & Braden Inc.
Engineers • Planners • Project Managers

EXHIBIT 2	JOB NO. 31-00300-001	DECEMBER 1997


CAMERON CO.
Landuse (Lambert)
County Boundary
County Lines
Master Drainage System
IBWC Operated Floodway
Major Highways
Major Drainage Ways
Flood Complaints
Land Use
Urban or Built-up Land
Agricultural Land
Rangeland
Forest Land
Water
Wetland
Barren Land
N
15000
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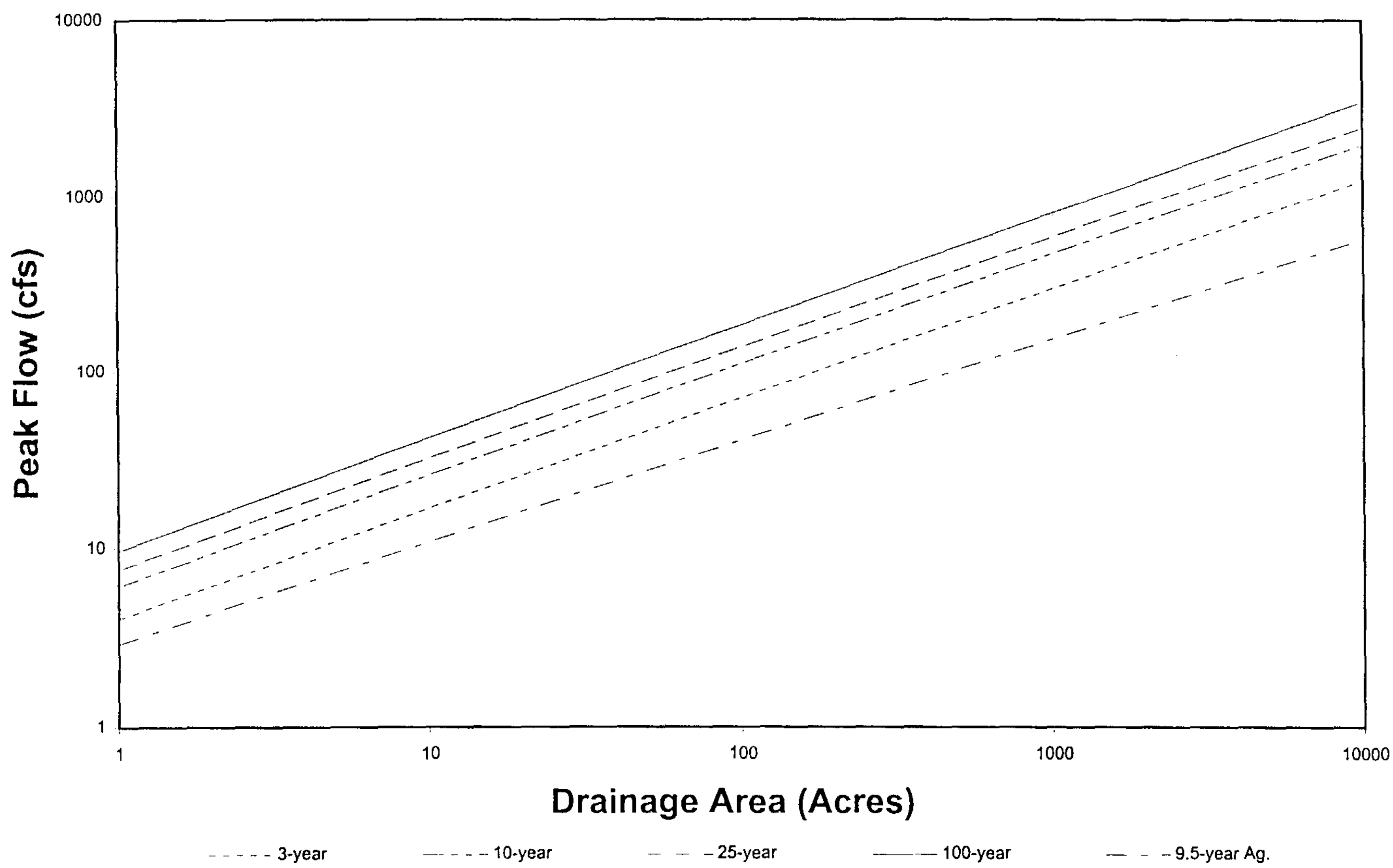
15000 Feet
HIDALGO COUNTY
DRAINAGE DISTRICT #1
HIDALGO COUNTY
MASTER DRAINAGE SYSTEM
Turner Collie & Braden Inc.
Exhibit 3
Job No. 31-00300-001
Date December 199

Exhibit 4 - Hidalgo County Discharge Curves



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«Date»

«ContactName»
«JobTitle»
«CityName»
«CityAddress»
«City», «State» «Zip»

Re: Hidalgo County Drainage District No. 1 Drainage Master Plan
«CityName» Drainage Criteria and Flooding Complaints
Turner Collie & Braden Inc. Job No. 31-00300-001

Dear «Salutation»:

Recently Turner Collie & Braden Inc. has undertaken the project of developing a Master Drainage Plan for Hidalgo County Drainage District No. 1. In part, this project will include: identifying whether or not current design standards for drainage facilities are adequate, creation of a base map of the County drainage network with subareas for design and management purposes, defining the basic channel cross section and right-of-way requirements to allow developments to gain access to the regional drainage system, and to approximate costs associated with the lateral drainage system including a method for implementing the construction program.

To successfully meet the ultimate goals of this project, information pertaining to all cities within Hidalgo County is necessary. Would you please provide to us the following:

Acceptable formats would include an ASCII text file, a database file in a DBF format, or an Excell, Lotus, or Quattro Pro spreadsheet. We can read PC floppy disks, zip disks, 4mm tapes, and 8mm tapes.

We would like to thank you in advance for your assistance in this matter. If you have any questions concerning the information requested please contact Mr. Keith Kindle at (210) 781-6991. Mr. Kindle will contact you within a couple of weeks to follow-up on this request.

Very truly yours,

Mark V. Lowry, P.E.
Sr. Project Manager

Flood victims in Pharr irate

By GILKA ROMERO
The Monitor

LAS MILPAS — Neighborhood residents expressed outrage Thursday about the way Pharr city officials handled the flooding on their street this week.

■ Valley Farmers Smiling — 5A

"We've called and called and the city authorities are not responding," said Maria Garcia, who lives on a cul-de-sac on Veracruz Street. "We haven't had running water for three days."

Gilbert Aguilar, a Pharr city official, said most of the areas in the city have dried up except for Vera-

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To Mark Dausky	From Kristin Kendle
Co./Dept.	Co.
Phone #	Phone #
Fax #	Fax #
Date	# of pages ▶ 3

Flood Continued from page one

cruz Street. He plans to drain the street today.

Some of the concerns that Maria Garcia and her husband, Jesus Garcia, had included the well-being of the children who splashed and played in the foul smelling, green-colored water that had traces of gasoline from cars stalling.

"Yuk. ... It stinks," 10-year-old Fernando Garcia said about the standing water that swept into his parents' driveway.

"I just checked outside to make sure none of my children drowned," said Maria Montoya, who lives at the end of the cul-de-sac, where the water accumulated the most.

Flood victims appeared to be most upset that garbage was not picked up and that their mail was not delivered to them for three days.

"It was a lot of water in a short time," Pharr Mayor Victor Garcia said. "We had to pound water out and at the same time work at other places."

Garcia said city crews were having success correcting rain-related problems.

He said Pharr city officials will be traveling to Austin next week to try to get a $22 million grant and a $9 million loan for road work in Las Milpas.

In Donna, American Red Cross officials have sheltered about 50 flood victims at Todd Middle School since Wednesday night. The Red Cross plans to keep the shelter open for a few more days if needed.

"Normally this area has not flooded in the past," said Bob Morton, who is general manager of the Rio Grande Valley chapter of the American Red Cross. "The major problem is that we have to wait for the drainage ditch to drain.

Other cities still fighting flooding Thursday included Weslaco, Elsa and Progreso, Morton said.

Morton said Valley residents can help flood-ravaged families by making contributions to the Red Cross at P.O. Box 250, McAllen, 78501.

National Weather Service forecasters are predicting only a slight chance of rain today.

The forecast calls for partly cloudy skies with highs in the upper 80s. The lows are expected to drop to the low- to mid-50s tonight with a 20 percent chance for rain, NWS meteorologists said.

Cooler temperatures are forecasted for Saturday, when the highs are expected to stay in the lower 60s with a 20 percent chance for rain, NWS meteorologist Greg Flatt said.

Rain causes problems for farmers, but they'll take them

By JEANNE RUSSELL
The Monitor

MONTE ALTO — In this little farm community, a bull's-eye for three recent rainstorms, farmers say too much water beats none.

"We go from one problem to another, don't we?" Aaron Shields said, referring to farmers' struggles against pests and drought during the last four years.

Farmers across the Rio Grande Valley called the week of water a net gain. Yet in the Monte Alto area north of Elsa, a cumulative 15 inches in the last week drowned some seeds.

"There's going to be replanting going on," Shields said.

Still, planting makes up just a tenth of the total cost of growing cotton, the crop most likely damaged by the heavy rains. And without rain, farmers can't make a crop. So few are complaining.

"It's probably going to do more good than harm, although if I had it in my house I probably wouldn't be saying that," Shields said.

On his farms, Shields had planted about half his cotton and 80 percent of his milo, or grain sorghum. He estimates he will replant about half the cotton he planted and about 20 percent of the grain.

Shields figures he may have been ahead of the average grower in already planting 50 percent of his cotton. Melinda Berg, manager of the Elsa Co-op, estimated cotton growers have planted about 20 percent of their cotton so far.

Baby corn and soy beans could have been damaged, but, like sorghum, they are hardier than cotton, Berg said.

"In certain areas, it rained so hard that it washed the seed right out of the dirt," Berg said.

It could take up to 10 days for the land to dry so farmers can get their equipment back in the fields, pushing them up against a March 31 cotton planting deadline.

"They're going to be very busy once the water dries out," Berg said.

But better busy than dry.

"Some of the crops that were already planted will have to be replanted, but the benefits of the rain far outweigh the costs of replanting," she said.

Clogged drainage system partly blamed for flooding

By KIMBERLY DURNAN
The Monitor

EDINBURG — Refrigerators, couches, bottles and diapers dumped into drainage ditches doubled this week's flooding problems, Hidalgo County officials said Thursday.

"First of all there's a lot of water," Hidalgo County Judge J. Edgar Ruiz said. "Then we have a problem with people throwing a lot of trash into our main drains. Then there are subdivisions that should never have been developed because they are in low areas."

County commissioners are responsible for maintaining the county drainage systems in their own districts, Ruiz said.

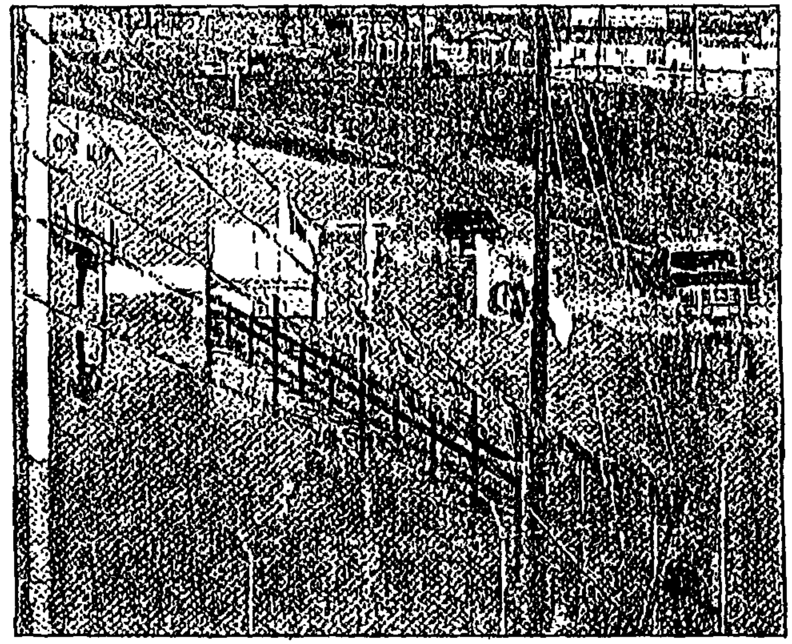
"It's been improperly maintained," Ruiz said. "There is no way out of that. They should have a crew on that constantly."

Precinct 1 Commissioner Sylvia Handy has seen firsthand what clogged drainage systems can do.

Since heavy rains fell earlier this week, precinct workers have cleared drains and relocated about 50 families to temporary shelters. Some areas near Donna, Progreso, Monte Alto and northern Weslaco received more than 7 inches of rain.

The commissioner blamed some of the flooding on the amount of rainfall and the need for an improved drainage system.

See DRAINS page 5A



Delcia Lopez / The Monitor

Still Standing: Vehicles crawl through floodwater still standing on the frontage road of Expressway 83 Thursday in Donna. Clogged drain pipes in several areas of Hidalgo County contributed to the flooding.

Drains

Continued from page one

"We need to replace some of the pipes where population has increased," Handy said. "(The pipes) need to be bigger so more water will flow through."

Meanwhile, ditches need better maintenance and county residents need to help keep their drains clean, Handy said.

"This has really opened their eyes," Handy said. "They know they are suffering because they didn't take preventative measures."

Commissioner Lupe Garces said he agreed county residents should take some responsibility and help maintain drainage ditches.

"It's improper dumping," he said. "We have a big trash bin for people to use. We are trying to make it convenient for them to dump."

Commissioners say they now plan to control subdivisions more strictly and make developers provide adequate drainage.

"We've got to stop approving subdivisions in flood-prone areas," Ruiz said. "Engineers (for developers) come to us and say they can install systems to drain the water, but then they just don't work."

Ruiz said he wants to make it mandatory for developers to use underground pipes to drain water, or a proper surface drain connected to a main county ditch.

Some older subdivisions or colonias were developed years ago and traditionally flood, Garces said.

And, of course, everyone blamed the rain.

"It's too much water in a short period time," Commissioner Lalo Arcaute said. "There is no drainage system that can get rid of that amount of water."

The Monitor
11-16-97

Larry W. Clubb/The Monitor

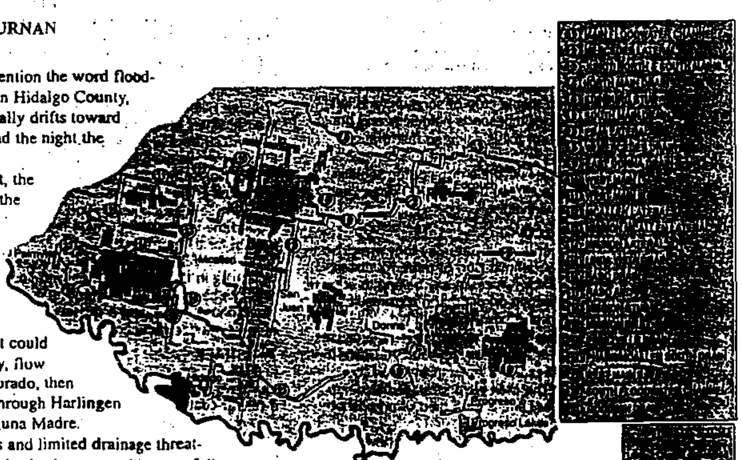
Drain Strain: A dragline operator cleans a county drainage ditch recently north of Donna. The cleaning is part of an ongoing operation by Hidalgo County to improve its drainage system, which is pressed to keep up with a booming population and inherent problems caused by the flatness of the region.

Growth swamping county's drainage system; problem is persistent, answer expensive

By KIMBERLY DURNAN
The Monitor

MERCEDES – Mention the word flooding to some people in Hidalgo County, and the topic eventually drifts toward Hurricane Beulah and the night the dam exploded.

As local lore has it, the time was 1967, and the weir dam in the floodway at Farm-to-Market Road 1015 in Weslaco did its job – at first. It monitored the amount of water that could leave the Mid-Valley, flow into the Arroyo Colorado, then move downstream through Harlingen and out into the Laguna Madre.



WALT BARTLICK/THE MONITOR

But as heavy rains and limited drainage threatened to flood Mercedes businesses and homes, folks there built a huge wall of sandbags. Still, their efforts proved futile against Beulah's bluster and brawn.

"All of a sudden, the weir dam exploded," recalled Anthony Covacevich, now Urban County director. "It benefited Mercedes, but flooded Harlingen's upscale Treasure Hills area."

Many only half-jokingly speculate Mercedes businessmen blasted the dam with dynamite.

"Some people have taken the secret to their graves," Covacevich said.

The tale underscores the value of drainage in an area increasingly burdened by audacious growth and forever cursed with low-lying land, some of it below sea level.

Farmland that once absorbed excess water into thirsty soil rapidly is giving way to new businesses, expanding neighborhoods and more concrete, and that means the county could be in over its head.

Although the current drainage system was completed in 1993, engineers designed the plan in the post-Beulah 1960s, without foresight of the Valley's future growing pains, said Godfrey Garza, director of Hidalgo County Drainage District No. 1.

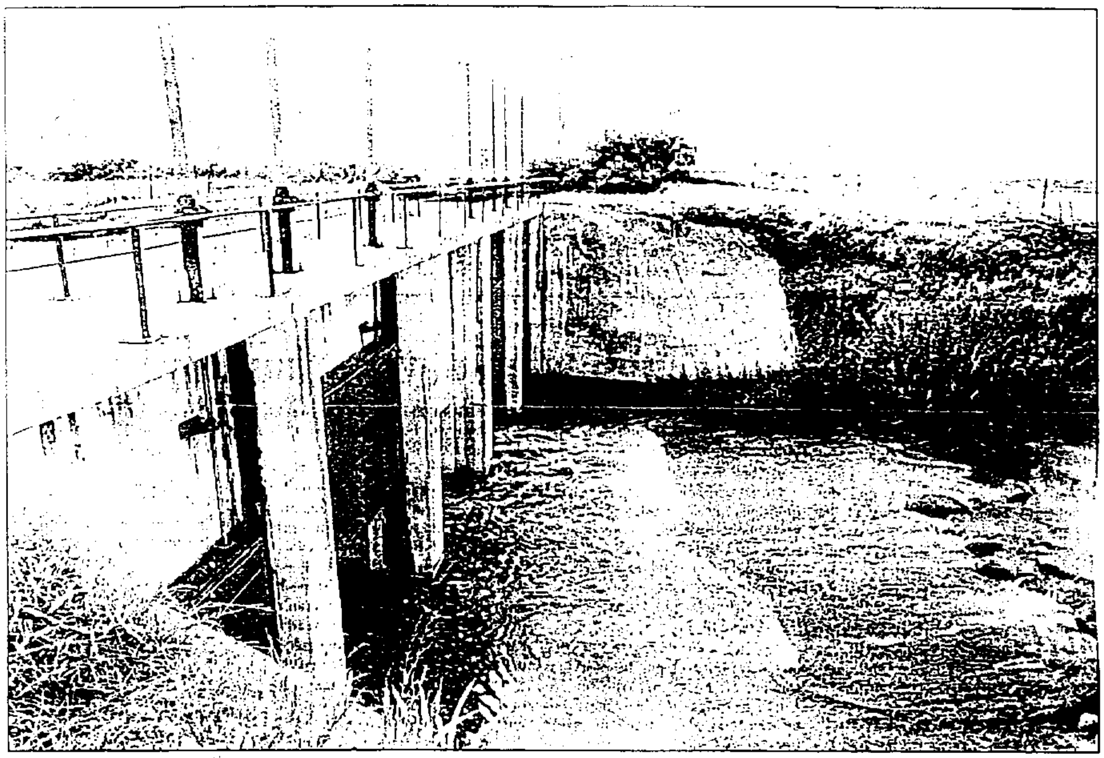
"The growth in Hidalgo County is predicted to double by the year 2010," Garza said. "Our system is based on agriculture."

The master drainage plan has worked as expected, so far

See PIPE page 9A

C. Garza
A. Patala
R. Saucedo

Pipe Continued from page one



Larry W. Clubb / The Monitor

Drainage Control: Water flows through a control structure recently along the drainage system in eastern Hidalgo County.

but it has yet to be tested by serious flood storms because the Valley has been in a 10-year drought, said Vona Walker, right-of-way manager for the county.

A dream system — one that could drain a hurricane — would cost the county $160 million, not including the cost of buying right-of-way property to expand drainage ditches, Walker said.

The estimate comes courtesy of the U.S. Army Corps of Engineers, and does not include the $440 million the Corps would chip in for construction.

That's a lot of money for a county with a total annual budget of $67 million and an average per capita income of $10,000, about $8,000 below the state average.

Until the big-picture solution becomes more affordable, county officials are having to bail water with a bucket — they clean ditches, take over private drainage canals and build small tributaries to the master drainage canal, hoping to alleviate pockets of flooding across the county with each hard, fast rain.

In a colonia named Barbosa-Lopez, north of Weslaco, residents want their area to be more aggressive in eliminating their frequent flooding problems.

When Tranquilino Piñeda moved into the neighborhood 17 years ago, his was the only house. Now, the colonia has about 200 dwellings. Two nearby colonias mean an additional 300 houses in the area, all of which increases the need for better drainage.

Piñeda and his neighbors have found their own stop-gap solution.

"We try to make the drainage work by pulling out the bottles, cans and papers out of the pipes," he said. "Sometimes, the water doesn't move quickly, even with a light rain. Every time it rains a couple of inches, it floods."

When that doesn't work, they dig trenches to the main drainage ditch in their area.

County officials already have targeted the area for drainage improvements, and say they plan to start building more drainage ditches there by the beginning of the year. They understand how frustrated the residents are, they say, and are trying to stop the flooding, but the drainage infrastructure was not in place when the colonia was built.

Because the problem is so widespread, county officials said, they are working on a seven-year plan to clean the 360 miles of existing ditches, some of which are new to the system and formerly owned by irrigation districts or farmers.

"It's being addressed in a systematic manner," Garza said. "The Valley is growing so rapidly, it's a chain effect."

Weslaco Mayor Gene Braught said he has seen some of those county improvements. In the past, he said, Weslaco's 54-inch pipes drained into 32-inch county pipes. That caused water to back up in the city, flooding colonias and more upscale neighborhoods alike.

"All that's changing; we are getting good cooperation," Braught said. "They've done quite a bit of work with drain lines into the floodway."

With expensive costs for elaborate drainage systems, and the region's low, flat land, drainage always will be a concern, he said. And, as in Weslaco's case, taxpayers often have to absorb the costs.

"Drainage is a very expensive project and nobody wants their taxes raised," Braught said. "A hurricane would hurt us, sure. Anytime we get a heavy storm, we are going to be hurt by it, and we have to handle it the best we can with emergency crews."

One solution for new neighborhoods includes building a holding pond for the lowest-lying areas of the city.

"Even the engineers are trying to figure out what to do," Braught said. "Every Valley town has flooding problems."

But Valley cities generally operate more sophisticated drainage systems paid for by stronger tax bases. The county struggles with a smaller, poorer tax base and has less money to provide drainage services. However, it also faces heavier growth than most cities, from new neighborhoods — especially colonias — that contribute little to the tax base.

To buy a home, you generally need a federally protected loan from a bank, and houses bought with federal loans require flood insurance. But many of the new housing developments are poor, even substandard, and are built without federal loans, said Neil King, a partner in the firm Shepard, Walton, King Insurance Company.

"Apparently, the Commissioners Court is allowing people to develop in very flood-prone areas," King said. "It seems like every year we have more flooding because low-income housing is going into areas subject to flooding.

"I don't see these people buying more insurance. Maybe they can't afford it."

But Garza, the county drainage district director, said the county checks subdivisions and new development as best as it can, given limited staff and resources.

Experts say the benefit of insurance is that it requires homeowners and builders to elevate the house to a level that is least likely to flood. Insurance also pays the individual homeowner more money than disaster relief funds.

King, the flood insurance expert, advises property shoppers looking to stay high and dry to head for McAllen, Mission and Edinburg, because those cities have the most efficient drainage systems.

Garza agreed McAllen has good drainage — despite its own problem pockets of flooding — and advises other cities to follow suit.

"McAllen has been the most progressive," he said. "They eliminate flooding with holding ponds. I wish all cities would do that."

Hidalgo County Drainage District #1
Contract No. 97-483-216

The following maps are not attached to this report. Due to their size, they could not be copied. They are located in the official file and may be copied upon request.

Proposed Laterals for HCMDS and Drainage Area Map
Exhibit 5
Job No. 31-00300-001
December 1997

Proposed Laterals for HCMDS
Exhibit 6
Job 31-00300-001
December 1997

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