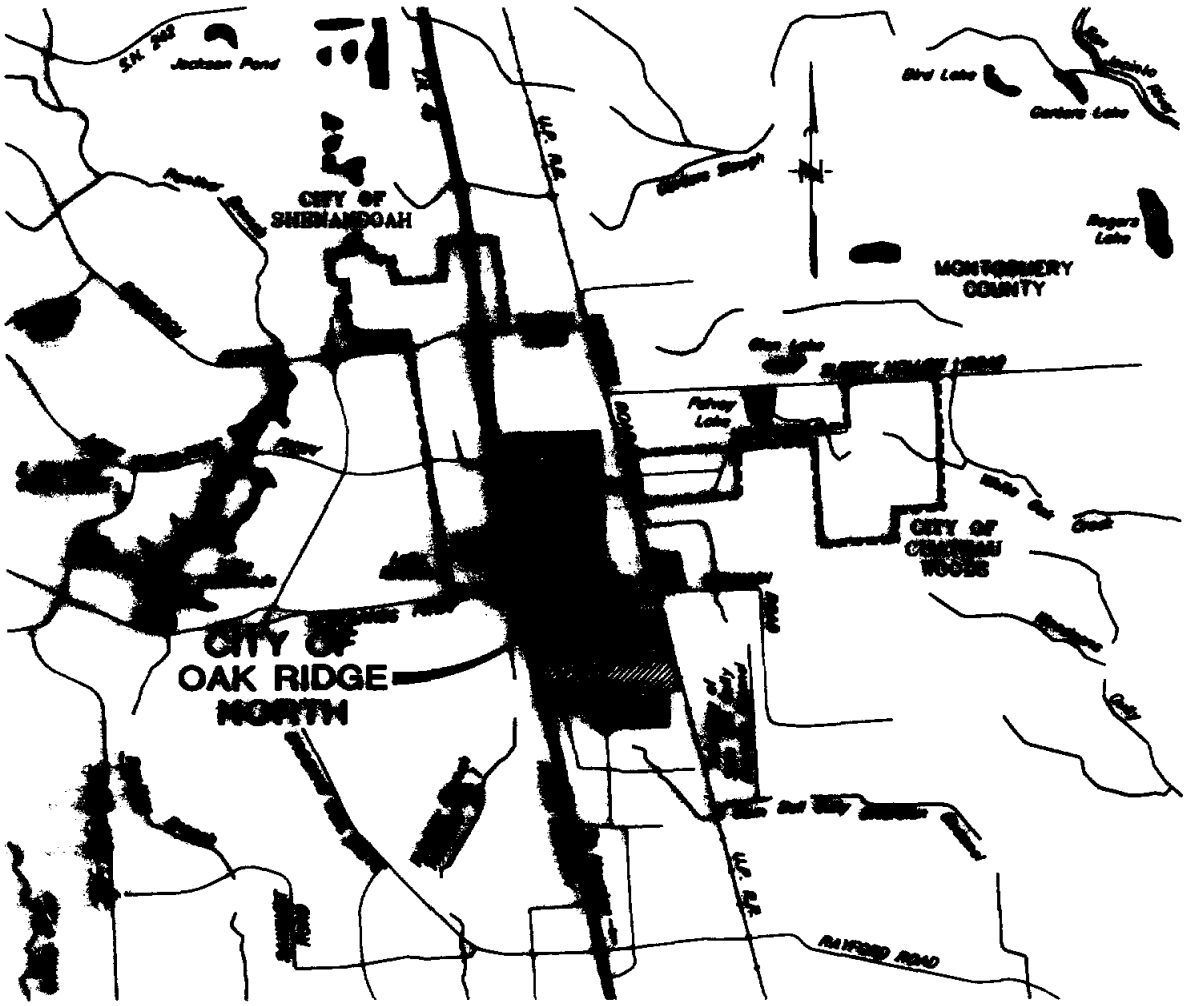
MASTER DRAINAGE PLAN
FOR
CITY OF OAK RIDGE NORTH
MONTGOMERY COUNTY, TEXAS



FEBRUARY 2001

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February 8, 2001

The Honorable Mayor and City Council
City of Oak Ridge North
27424 Robinson Road
Oak Ridge North, Texas 77385

Re: Master Drainage/Flood Mitigation Plan
City of Oak Ridge North

Dear Council:

We are pleased to submit our evaluation of proposed improvements to reduce or eliminate the 100-year floodplain along Spring Oaks Channel. The scope of this report includes a hydrologic and hydraulic analysis of the Spring Oaks Channel and an evaluation of the existing drainage facilities.

If you have any questions or feel you need additional information, please call.

Sincerely,

Scott C. Saenger, P.E.

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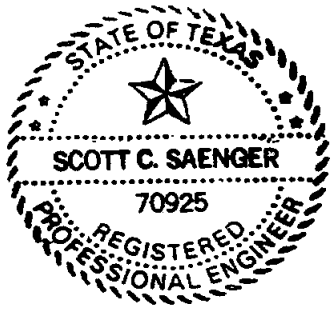
Attachments



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MONTGOMERY COUNTY, TEXAS

Prepared by:
Jones & Carter, Inc.

February 2001

TABLE OF CONTENTS

Page No.

Table of Contents ii
List of Tables iii
List of Photographs iii
List of Exhibits iv

I. Introduction 1
A. Authorization 1
B. Purpose and Scope 1
C. Area Description 1

II. 100-Year Floodplain - Spring Oaks Channel 3
A. Description of Problem 3
B. Previous Studies/Improvements 3
C. Proposed Solutions 4
1. Method 1: Levees 5
2. Method 2: Channel Improvements 5
3. Method 3: Storage Volume 7
4. Method 4: Diversions 9
5. Method 5: Removal of Structures from the Floodplain 11

III. Upstream Drainage Factors 13
A. Woodland Metro Center MUD 13
B. Texas Department of Transportation/Interstate 45 drainage 13

IV. Localized Drainage Problems 15
A. Maplewood Drive Crossing 15
B. Robinson Road Storm Sewer Capacity 15
C. Jimmy Lane/Pyeatt Lane 16
D. East Oak Hill Drive 17
E. Woodson Road Storm Sewer 18

V. Summary 19
VI. Conclusions 21
VII. Recommendations 22

VIII. Tables T-1
IX. Photographs P-1
X. Exhibits E-1

List of Tables

Page No.

Preliminary Construction Cost Estimates

Table 1 Option 1, 1994 Drainage Alternative Evaluation ultimate improvements T-1

Table 2 Option 2, Improvement A: Channel Widening T-2

Table 3 Option 2, Improvement B: Diversion Along Pipeline Easement T-3

Table 4 Option 3: Marilyn Edgar Park Excavation T-4

Table 5 Option 4: Pipeline Easement Excavation T-5

Table 6 Option 5: Oak Ridge Baptist Church Excavation T-6

Table 7 Option 6: Oak Ridge Baptist Church Elevation T-7

Table 8 Option 7: Oak Ridge Baptist Church Diversion T-8

Table 9 Option 8: Diversion Parallel to Hillside T-9

Table 10 Option Summary T-10

List of Photographs

Page No.

Photo 1 Option 3, Marilyn Edgar Park, Looking South P-1

Photo 2 Option 3, Marilyn Edgar Park, Looking Southeast P-2

Photo 3 Options 2A and 4, Adjacent to Oak Ridge Baptist Church, Looking Northwest P-3

Photo 4 Options 2A and 4, Adjacent to Oak Ridge Baptist Church, Looking North P-4

Photo 5 Options 5-6, Oak Ridge Baptist Church parking lot, Looking Southwest P-5

Photo 6 Option 7A, Oak Ridge Baptist Church campus, Construct concrete box (North/South between buildings), Looking North P-6

Photo 7 Option 7B, Hillside diversion entrance, Looking Southwest P-7

INTRODUCTION

Authorization

The City of Oak Ridge North (the City) authorized Jones & Carter, Inc. to evaluate proposed improvements to reduce or eliminate the 100-year floodplain along Spring Oaks Channel. This report was prepared utilizing a Flood Mitigation Planning Grant received from the Federal Emergency Management Agency (FEMA) through the Texas Water Development Board. The preliminary investigation determined that Montgomery County Drainage District No. 6 (MCDD No. 6) was evaluating their drainage facilities, including the lower portion of Spring Oaks Channel and possible downstream improvements to the channel. Based on preliminary discussions with the engineers for MCDD No. 6, the scope of this report was revised to include internal drainage improvements within the City, the impact from upstream projects, and possible localized improvements to Spring Oaks Channel that provide the greatest benefit to the City.

Planning Process and Public Involvement

The Flood Mitigation Plan was substantially completed in November of 1999. The Flood Mitigation Plan was presented to City Council and the public on November 8, 1999 at a regularly scheduled public meeting. Since November 1999, a draft of the Flood Mitigation Plan has been available for public review at City Hall.

Upon several months of consideration and discussion, City Council formally adopted the plan on January 22, 2001 at a regularly scheduled public meeting. A public workshop was held on January 27, 2001 to discuss the plan in detail and perform site observations. The Engineering Monthly Status Reports, City Council and Workshop minutes, and letter from the City Administrator concerning the adoption of the Flood Mitigation Plan are attached as exhibits 7 thru 9.

Purpose and Scope

The purpose of this report is to review, investigate, and evaluate existing flooding problems within the City of Oak Ridge North, define drainage improvements to reduce the flooding, and estimate the costs and benefits of various improvement projects.

The scope of this report includes a hydrologic and hydraulic analysis of the Spring Oaks Channel watershed, including an evaluation of the existing drainage facilities. The report focuses on areas with a history of excessive water accumulation and/or structural flooding. The analysis includes:

- Review of the 1994 Drainage Alternative Evaluation
- Review of the 1997 Letter of Map Revision (LOMR) for the Robinson Road diversion
- Site visits to observe and evaluate areas where flooding occurs or drainage concerns exist
- Evaluation of possible Spring Oaks Channel improvements (Section II)
- Evaluation of ongoing Texas Department of Transportation/Interstate 45 drainage (Section III)
- Analysis of localized drainage problems (Section IV)

Area Description

The City of Oak Ridge North is located in Montgomery County, approximately three miles north of the Harris County boundary and east of Interstate 45 (see Exhibit 1, Vicinity Map). The area is approximately ninety percent (90%) developed with single family residential and small commercial and retail development. Runoff from the City flows to the two major drainage channels, Spring Oaks Channel in the west and the MCDD No. 6 Channel, designated as DD No. 6, in the east (see Exhibit 2, HEC-1 Watershed Map). The eastern half of the City (the area shaded light blue on Exhibit 2) drains into DD No. 6 (the channel shaded blue). The western half of the City (the area shaded yellow) drains into Spring Oaks Channel (the channel shaded green). A wide range of drainage methods are utilized within the City of Oak Ridge North including roadside ditches, storm sewer, and areas that "sheet flow" directly into Spring Oaks Channel.

The Spring Oaks Channel watershed extends as far north as the Woodland Metro Center Municipal Utility

District (MUD) on the west side of I-45. Runoff from the Woodland Metro Center MUD is routed through Lake Robbins, which serves as a detention facility to offset the developed flow. A control weir limits the flow from Lake Robbins into Spring Oaks Channel. The routed Lake Robbins outflow is conveyed through dual six-foot by six-foot (2-6'x6') concrete box culverts into Spring Oaks Channel. Future plans for the proposed Town Center Riverwalk Improvements may reduce the flow from the Woodland Metro Center MUD into Spring Oaks Channel. The Woodland Metro Center MUD runoff and weir are discussed in more detail in Section III: Upstream Drainage Factors.

Spring Oaks Channel is part of the San Jacinto River basin. The tributaries can be traced from Spring Oaks Channel (Harris County Flood Control District (HCFCD) Unit No. A109-03-00), to DD No.6 (HCFCD No. A109-00-00). The confluence is located approximately one mile south of the City's southern border. Evaluation of the DD No. 6 drainage area is not within the scope of this report. DD No.6 drains to Spring Creek approximately 3.5 miles farther downstream. Spring Creek joins Clear Creek, and Clear Creek combines with the San Jacinto River just north of US Highway 59.

100-YEAR FLOODPLAIN – SPRING OAKS CHANNEL

Description of Problem

Spring Oaks Channel drains from north to south along the west side of the City of Oak Ridge North (the City) from Maplewood Drive to Paula Lane. Spring Oaks Channel is a trapezoidal channel with varying depths and widths, but is approximately five feet deep with a bottom width of six feet and side slopes of approximately two feet horizontal to one foot vertical (2:1) at the bend near the Eastwood Drive/Westwood Drive intersection (see Photographs 3 and 5 for visual aid and Exhibit 3 for location). The channel is lined with gunnite, a cementitious material. During the 100-year rainfall event, the capacity of the channel is exceeded and water spills out of the banks. The floodplain extends several hundred feet into the low-lying area along Eastwood Drive, Hillside Drive, and Spring Pines Drive. The Federal Emergency Management Agency (FEMA) floodplain from Flood Insurance Rate Map (FIRM) panel 481560-0001-B (City of Oak Ridge North) is approximated on Exhibit 2, HEC-1 Watershed Map. Since the capacity of Spring Oaks Channel is limited and side swales and storm sewers are unable to efficiently outfall into the channel, localized flooding occurs near Spring Oaks Channel (even in areas not flooded by the Channel directly). Spring Oaks Channel is further described and analyzed in the following sections.

Previous Reports/Improvements

In 1994, Jones & Carter, Inc. prepared the study, Drainage Alternative Evaluation (1994 study), for Oak Ridge Municipal Utility District (MUD), in which Spring Oaks Channel was analyzed in detail. Several sources provided information for the report. These included the Comprehensive Flood Protection Plan (CFPP) for Southern Montgomery County by D. A. Vogt Engineering, Inc. and Dodson & Associates, Inc. (1989), the Oak Ridge MUD Drainage and Pavement Improvement Study by Snowden Engineering, Inc. (1991), and the Southern Montgomery County MUD Drainage Study by Bernard Johnson, Inc. (1992).

The 1994 study concluded that Spring Oaks Channel is undersized for the area it serves; Spring Oaks Channel cannot convey the runoff within the channel banks. During the 100-year rainfall event, water rises out of the banks and spreads across the natural terrain, as approximated on Exhibit 2, HEC-1 Watershed Map. The resulting elevated water surface is the cause of many of the drainage related problems in the City.

The 1994 study concluded that the most viable option for eliminating the 100-year floodplain outside the channel banks was a combination of flow diversion and channel improvements (channel lining and lowering the flowline). The 1994 study recommended the most cost effective option as a Phase I project. Phase I was the construction of a concrete box under Robinson Road from Spring Oaks Channel to DD No. 6. This project was authorized and completed in October 1996 and provided a significant reduction to the 100-year floodplain. The Letter of Map Revision for the Robinson Road diversion was approved on March 22, 1999. The diversion removed approximately 275 acres from the Spring Oaks Channel watershed and resulted in removing approximately 200 houses from the 100-year floodplain. However, approximately 50 acres in the City remain in the 100-year floodplain.

Proposed Solutions

The 1994 study proposed ultimate improvements that would reduce the 100-year floodplain to within the channel banks along Spring Oaks Channel. The improvements included replacing the channel with a rectangular cross section and lowering the flowline (as described in the 1994 study). These ultimate improvements have not yet been implemented. The estimated cost of the proposed 1994 improvements was approximately $5,000,000 in 1994. The cost for these improvements with current prices is approximately $6,550,000 (see Table 1). Several drainage improvement options have been evaluated for the purpose of reducing areas within the 100-year floodplain at a cost lower than ultimate improvements presented in the 1994 study. However, the benefits from these options do not provide the same benefits described in the 1994 study. The improvement options in this report provide the most cost effective benefits to reduce flood prone areas within the City of Oak Ridge North. Table 10, Option Summary, includes costs and acres removed from the floodplain for each of the options proposed in this report.

The Spring Oaks Channel improvements are separated into the five basic drainage improvement methods for reducing the 100-year flood hazard. These five methods include:

1) Constructing levees
2) Building channel improvements
3) Excavating detention storage
4) Diverting excess flow
5) Buying or removing structures from the floodplain

Method 1: Levees

Levees are constructed to raise the banks of the channel. Higher banks reduce the risk of channel bank overtopping and limit flooding of areas behind the levee. Levees are not cost effective for Spring Oaks Channel for three key reasons:

a) Right-of-way (R.O.W.) along Spring Oaks Channel is limited (see Photograph 10). Levees would require either additional R.O.W. or a structural levee.

b) The low-lying areas behind the levees would still be at risk of flooding from the backwater of Spring Oaks Channel through the roadside ditches and storm sewers. Drainage relief would require storm water pump stations to reduce local flooding.

c) Storm water pump stations require storage areas behind the levee for consistent pumping.

The necessary construction for a levee project would include building sheet pile levees, acquiring land for a storage area, and installing storm water pump stations and would only reduce the floodplain by approximately 7 acres. Consequently, levee construction is not a cost effective solution for Spring Oaks Channel flooding.

Method 2: Channel Improvements

The purpose of channel improvements is to increase conveyance within the channel, preferably reducing the peak water surface elevation to within the channel banks. The three ways to increase conveyance with channel improvements are:

a) Increase the slope of the channel

b) Reduce impedance in the channel

c) Increase channel cross sectional area.

Increasing the slope of the channel increases the velocity of the flow in the channel. The increased velocity results in additional conveyance within the channel banks. Increasing the slope of Spring Oaks Channel would be expensive because it would include tearing out the existing channel, lowering the existing twenty-four-inch (24") sanitary sewer, and pouring concrete for the new channel. This improvement would not be cost effective because the 1994 study ultimate improvements discussed later in this section ("Increase cross sectional area") have the same cost, but a greater benefit.

Reducing impedance in the channel can be done either by reducing the Manning's "n" coefficient of the channel (the friction factor) or by removing bends in the channel alignment. Decreasing the friction of the channel is not a feasible solution because the channel bottom is already paved with concrete and the side slopes are lined with gunnite, a cementitious material. Both of these materials have a low friction factor.

Realignment, or straightening, of the channel is done in areas where bends occur. Realignment of the channel eliminates bends and allows a higher velocity flow, increasing the channel conveyance. A major bend occurs in Spring Oaks Channel near the Eastwood Drive/Westwood Drive intersection. However, realignment of the bend would place an open channel in between Oak Ridge Baptist Church buildings (see Photograph 6). An open channel in this area appears to be infeasible with the existing structures along the alignment. Consequently, reducing the friction factor and channel realignment are not practical solutions for Spring Oaks Channel flooding. However, a diversion option along this route does appear to be feasible and is presented in Section II.C.4, Method 4: Diversions (Option 7, Improvement A).

Increasing the channel cross sectional area is a way to increase the conveyance capacity without raising the water surface elevation or lowering the existing water surface elevations (if the flow remains the same). Increasing cross sectional area can be done in several ways:

i) Changing the shape of the channel
ii) Lowering the flowline
iii) Expanding the channel laterally

Changing the geometry of the channel and lowering the flowline are the ultimate improvements that were proposed in the 1994 study. These improvements, designated as Option 1, are effective, but costly. As discussed previously, these improvements involve removing the existing channel, lowering the existing 24" sanitary sewer, lowering the Spring Oaks Channel flowline, and repaving the channel. The cost of these improvements is approximately $6,550,000 (see Table 1). Breaking this option into phases would reduce the financial impact of this project by spreading the cost over several years.

Expansion of Spring Oaks Channel laterally for additional conveyance was previously discarded because the channel is already built to the existing right-of-way (see Photograph 10). However, there is a pipeline

easement adjacent and parallel to Spring Oaks Channel along the reach near Oak Ridge Baptist Church. The pipeline appears to be located approximately fifty feet (50') from the Spring Oaks Channel top of bank. Expanding the channel bottom of Spring Oaks Channel to a total width of twenty-five feet (25') along this reach would increase capacity of the channel enough to convey almost the entire 100-year runoff of 722 cubic feet per second (cfs). This option, designated as Option 2, Improvement A (see Exhibit 4 and Table 2, Preliminary Cost Estimate and Table 10, Option Summary) is dependent on plan approval of the pipeline company and accurate location of the pipeline. This option provides the greatest benefit when combined with the downstream improvements in Option 2, Improvement B (discussed in Section II.C.4, Method 4: Diversions).

Method 3: Detention Storage

The most common use of detention storage is to reducing the peak flow of a waterway. Reducing the 100-year peak flow to within the channel banks of Spring Oaks Channel would require approximately forty acre-feet (40 ac-ft) of usable detention storage. As discussed in the 1994 study, neither undeveloped acreage, nor additional right-of-way is available in the amount necessary to completely remove the 100-year floodplain. However, small amounts of storage volume are available in several areas along Spring Oaks Channel near the Eastwood Drive/Westwood Drive intersection. The amounts discussed in the following options may not seem significant; however, any volume of water stored in the low areas of proposed detention is volume removed from the subdivision and consequently, results in a reduction of local flooding. The locations for possible detention storage are:

a) Marilyn Edgar Park
b) The pipeline easement
c) The Oak Ridge Baptist Church parking lot
d) Future land acquired from buy-out or other means

Marilyn Edgar Park (park) is located west of the Hillside/Westwood intersection (see Option 3 on Exhibit 5). The park covers approximately three acres (3 acres) and has many amenities including a swimming pool, a covered basketball court pavilion, a tennis court, a baseball diamond, a T-ball diamond, and a lighted jogging path (see Photographs 1 and 2). The excavation of this area would be limited to the northern half of the park (including the ballfields), from the pipeline easement to Spring Oaks Channel.

Removal and replacement of the baseball and T-ball diamonds and a portion of the jogging path are included in the preliminary cost estimate (see Table 4).

Option 3 includes excavating the northern area of the park (approximately 1 acre) 2 feet in depth. This excavation would provide approximately 2 acre-feet of storage volume. The shallow depth would prevent the park from flooding during small storms, yet would provide some relief during larger storms. The shallow depth would eliminate the need for a structure to control flow in and out of the park from Spring Oaks Channel.

Excavating the park deeper than two feet would result in two problems. First, the Hillside Diversion would require adjustments. Cover for the Hillside Diversion is approximately 3.75 feet at the lowest natural ground point along the reach of the park. Consequently, excavating the park deeper than two feet would require adjustments or alterations. The second problem with excavating the park more than two feet is an increase in flooding frequency. The benefit of the excavation would be an additional acre-foot of storage volume per acre excavated; however, the park would flood much more frequently. Repetitive flooding results in increased erosion and reduced park availability to the residents. In this case, the cost of repetitive flooding with low flows exceeds the benefit of an additional one acre-foot (1 ac-ft) of storage.

The pipeline easement is the second location for possible detention. The pipeline excavation alternative is designated as Option 4. Existing structures limit the available area (see Area 4 on Exhibit 5); however, a small amount of land (approximately 1 acre) located between Oak Ridge Baptist Church and Spring Oaks Channel could be excavated for detention. Most of this land is on the pipeline easement discussed in Section II.C.2.c.iii, Channel Widening. Therefore, assuming the pipeline company agreed to the improvements, only one of the two options, 2A or 4, could be constructed. The available depth of excavation is dependent on the depth of the pipe(s). Assuming adequate clearance, an area of one acre excavated two feet (2′) in depth would provide approximately two acre-feet (2 ac-ft) of detention. Additional depth may be available, depending on the exact location of the existing pipelines. Table 5 includes an estimate of the preliminary costs associated with this option.

The third location for possible detention is the Oak Ridge Baptist Church parking lot. The parking lot is located west of Spring Oaks Channel and south of the bend (see Area 5 on Exhibit 5). The parking lot

covers approximately two acres (2 ac) of land. Several alternatives were explored in determining the most beneficial method of combining storage volume with the existing parking lot:

- Lowering the parking lot
- Constructing multiple corrugated metal pipes (CMP) underneath the parking lot
- Excavating underneath the parking lot

Lowering the parking lot two feet, Option 5, would provide approximately four acre-feet (4 ac-ft) of detention. However, several problems exist with this alternative. First, the parking lot would be unusable during high rainfall events. Second, if a large storm event occurred at a time when vehicles were in the parking lot, the vehicles would be at risk of flooding. Although this alternative is the least costly of the three alternatives (see Table 6), the risk of property damage during a storm event greatly exceeds the benefit of four acre-feet of storage volume.

Storage volume could be gained while leaving the parking lot at or above the existing elevation by installing a series of parallel corrugated metal pipes (CMP) under the Oak Ridge Baptist Church parking lot underground. Considering the shallow depth, the largest pipe size that could fit underground without raising the parking lot would be a thirty-six inch (36") CMP. Twenty (20') thirty-six-inch (36") pipes, each four hundred feet (400') in length, could fit in the area. This configuration would provide approximately 1½ acre-feet of storage. Unfortunately, this alternative has much greater construction cost than the previous alternative.

The third alternative, Option 6, involves building a "bridge-like" structure. The parking lot would consist of box beams and slabs supported by concrete columns. The remaining space under the slabs would be used as a large underground vault for detention storage. This alternative has construction cost smaller than the second alternative (see Table 7), but the available storage much greater than either of the two previous alternatives because a greater depth can be utilized. However, the cost per acre is still high in comparison to the other detention options discussed, Options 3 and 4 (see Table 10, Option Summary).

Method 4: Diversions

Diversions reduce the flow by routing excess flow to locations where the channel has adequate conveyance,

usually either to a nearby channel with excess capacity such as the Robinson Road Diversion or farther downstream in the same channel, such as the Hillside Diversion. The three diversion options presented in this section are all diversions of the later kind. At first glance, routing flow to a point downstream in the same channel may not seem to be much of a solution; however, this type of diversion provides two benefits. First, the diversion provides a place for water to drain and flow at a lower elevation rather than the excess flow staying in the channel at a higher elevation. And second, in heavily developed areas, such as Oak Ridge North, downstream locations many times have wider right-of-ways for larger channels and additional green areas for detention.

The first proposed diversion, Option 2, Improvement B, consists of constructing dual six-foot by five-foot (2-6'x5') concrete boxes from the bend near the Eastwood Drive/Westwood Drive intersection to Spring Oaks Channel south of Maplewood Drive (see Table 3, Preliminary Construction Cost Estimate). These boxes would provide approximately 370 cubic feet per second (cfs) of additional conveyance. Additionally, storm sewers could be branched off to Eastwood Drive for added drainage relief to that area. This option provides the greatest benefit when combined with Option 2, Improvement A. As with Option 2, Improvement A, this option is dependant on cooperation with the pipeline company.

The second and third proposed diversions, Option 7, Improvements A and B (respectively), provide the greatest benefit when built jointly.

The second diversion, Option 7, Improvement A, is an eight-foot by four-foot (1-8'x4') concrete box that runs from the bend near Westwood Court to the bend near the Oak Ridge Baptist Church parking lot (see Table 8, Preliminary Construction Cost Estimate). The alignment is between existing Oak Ridge Baptist Church buildings (see Photograph 6). This diversion provides approximately two hundred (200) cfs of additional conveyance along this reach. This option would required coordination and approval of the Oak Ridge Baptist Church.

Conveyance downstream of the proposed Option 7, Improvement A is maximized when Option B is increased also. Option 7, Improvement B, a six-foot by four-foot (1-6'x4') reinforced concrete box would provide the necessary compliment for the upstream option (see Table 9, Preliminary Construction Cost Estimate). The box would run from Spring Oaks Channel (near the Eastwood/Westwood intersection)

through Marilyn Edgar Park and under Hillside Drive (parallel to the Hillside Diversion). The diversion box outfalls into Spring Oaks Channel downstream of Maplewood Drive. A 6'x4' box would provide 108 cfs of conveyance along the described reach. The addition of a second box would not only allow flow to be diverted from Spring Oaks Channel in the area, but would also allow the possibility of extending a storm sewer system up Eastwood to help drainage in that area. Additionally, the entrance to the Hillside Diversion should be modified to capture the water more effectively. The combination of Option 7, Improvements A and B would decrease the floodplain by approximately eight acres (8 ac).

Method 5: Removal of Structures from the Floodplain

The removal of structures from the floodplain is the last option considered. The two most common ways of removing structures from the floodplain are:

a) Purchasing homes in the floodplain

b) Raising foundations of homes to an elevation above the 100-year floodplain

These options are usually pursued only when none of the other options are feasible or the cost to perform them is excessive. For example, a good candidate for buy-out (purchase of the home in the floodplain) would be a structure with a history of repeated flooding that is situated near a large channel. Large channels generally require extensive improvements to decrease the water surface elevation. Also, a structure with repetitive flooding many times means that the structure's foundation is built below the 100-year water surface elevation. FEMA's definition of a repetitive loss structure is a building that has incurred flood related damages on two (2) occasions during a 10-year period, in which the cost of repairing the flood damage exceeds 25-percent (25%) of the market value of the building. Purchasing the building or repetitive loss structure would be more cost effective than performing extensive improvements for the removal of a single structure (or even several structures) from the floodplain.

Buy-out of homes in the existing floodplain is an option that has been previously considered, but not evaluated due to the large cost involved. Approximately sixty homes remain in the existing Spring Oaks Channel floodplain in Oak Ridge North, of which none meet FEMA's definition of a repetitive loss structure. The cost of buying these homes is approximately $7,800,000 (assuming an approximate cost of $130,000 per home). This high cost could be reduced with the help of federal grants set aside by the FEMA for homes with evidence of repetitive flood losses. A hidden cost to buying the homes is the City's property

tax base loss. If the homes were bought, the property could be used for several purposes such as park sites or detention basins to both reduce flooding of Spring Oaks Channel and improve the aesthetics of the community.

Alternatively, the foundations of the properties could be raised to an elevation above the floodplain. The cost of this type of improvement could vary from $1,200,000 to $3,000,000 ($20,000 to $50,000 per structure). The cost varies because each structure must be evaluated individually. Each home is different, and variations such as size of the foundation, type of masonry veneer, age of the structure, and method of construction all affect the price of the work. The variables in raising structures include construction equipment, type of new support, and material types used (concrete, grout, beams, etc). Even though the cost of this option is relatively low, the risk of damaging the structures is high. Additionally, the floodplain would not be reduced (streets and cars would still be at risk of flooding). Consequently, the possible maximum cost of this option is much higher than the base cost for performing the work.

UPSTREAM DRAINAGE FACTORS

Woodland Metro Center MUD

The Woodlands currently drains approximately 314 acres of land through Lake Robbins, across I-45 and into the Spring Oaks Channel. The amount of flow from the Woodlands was quantified in a 1993 agreement to limit 100-year flows from the Woodlands to a maximum of 316 cubic feet per second (cfs). In 1993, a Cippoletti weir was constructed on Lake Robbins to control flows to 298 cfs at a water surface elevation of 138.28'. More recently, the Woodlands has embarked on improvements to the Town Center project which will connect Lake Robbins with Lake Woodlands and create a proposed waterway development.

In July 1996, the preliminary design for the proposed project limited flows through the Lake Robbins weir to 270 cfs. Subsequent designs have further modified the structure and a related structure draining towards Lake Woodlands. It is our understanding that the final weir design will insure that the initial flood waters will drain towards Lake Woodlands with a maximum flow through the Lake Robbins weir limited to less than 300 cfs for 100-year flow. The construction of this facility is expected in the upcoming year and we expect to review construction drawings and drainage calculations.

Texas Department of Transportation/Interstate 45 Drainage

The computer modeling program, HEC-1, was used for modeling storm events in the City of Oak Ridge North. The program was developed by the U. S. Army Corps of Engineers and is widely used in the United States for approximating runoff from rainfall events. The drainage areas used in the HEC-1 model for Spring Oaks Channel were reevaluated because changes had been made to the Interstate 45 (I-45) drainage design by the Texas Department of Transportation (TxDOT). The changes in the drainage design include drainage area modifications and outfall structure changes (see Exhibit 2, HEC-1 Watershed Map for subarea locations). Almost every HEC-1 subarea that contributes to Spring Oaks Channel has changed.

The net effect is a transfer of flow from the upper end of Spring Oaks Channel to the lower end near the Marilyn Edgar Park. For specifics on the models, see the following appendices:

LOCALIZED DRAINAGE PROBLEMS

Maplewood Drive Crossing

The Maplewood Drive crossing of Spring Oaks Channel was analyzed to determine if the crossing creates a restriction to flow during high flow conditions. The opening under Maplewood Drive appears to have a capacity of approximately eight hundred cubic feet per second (800 cfs). Under the existing conditions, the crossing restricts flow. The two basic methods to relieve the restriction are:

- Increasing the crossing capacity
- Reducing the flow

The crossing capacity can be increased either by deepening or widening the channel. Deepening the channel is a costly option because multiple existing utility lines lie just beneath the flowline. Widening the channel would not provide much benefit because the channel is built to the limits of the right-of-way and the channel geometry is near rectangular. However, if the 1994 study ultimate improvements were constructed, the opening would be larger and would not be a constriction.

The problem of the Maplewood Drive restriction can be solved with a reduction in flow. This is accomplished with a diversion of flow, as in Options 2B and 7B. If Option 2B is constructed, the flow in Spring Oaks Channel would be reduced such that the Maplewood Drive crossing would no longer be a restriction. However, if Option 7B is constructed, the flow would be reduced, but the crossing would remain as a restriction (albeit a smaller one).

Robinson Road Storm Sewer Capacity

The Robinson Road storm sewer does not have excess capacity. When the Robinson Road project was developed in the 1994 study, the option of oversizing the storm sewer for additional capacity was analyzed. The 1994 study concluded that an oversized storm sewer would not provide much benefit and would not be cost effective. Consequently, the Robinson Road cannot be used as a solution to localized flooding because excess capacity does not exist in the storm sewer.

Jimmy Lane/Pyeatt Lane

Jimmy Lane and Pyeatt Lane are two cul-de-sacs located immediately south of Woodson Road and east of Harlan Road (see Exhibit 3, City of Oak Ridge North Overall Map). Based on complaints from residents and observation from City employees, these cul-de-sacs flood during moderately heavy rainfall events. A topographic survey revealed that the street elevations were lower than the Spring Oaks Channel top of bank. Consequently, it is impossible to efficiently drain runoff to Spring Oaks Channel from these areas during heavy rainfall events.

Three alternatives were developed to relieve the Jimmy Lane/Pyeatt Lane flooding problem. The following alternatives were considered as solutions:

1) Construct an extreme event swale to Blueberry Hill Road
2) Upgrade the onsite storm water pump station
3) Increase Jimmy Lane storm sewer inlet capacity
4) Construct a storm sewer pipe from Pyeatt Lane to the existing Woodson Road storm sewer system

The most cost effective alternative was constructing an extreme event swale at the back of the Jimmy Lane cul-de-sac. The extreme event swale was proposed to convey storm water from the Jimmy Lane area during heavy rainfall events through a drainage easement to Blueberry Hill Road and eventually to Montgomery County Drainage District No. 6 (MCDD No. 6). Although constructing an extreme event swale was the most cost effective, the required drainage easement was neither existing nor available through land owner donation.

The second possible alternative for relieving the flooding in the Jimmy Lane area was upgrading the existing onsite storm water pump station. The storm water pump station is located on the north side of Jimmy Lane and pumps via a 10-inch (10") force main to MCDD No. 6. The storm water pump station only provides a small amount relief during heavy rainfall events. The pump station required substantial upgrades to achieve the capacity necessary to convey the local runoff. The cost to make the required hardware upgrades was high. Additionally, yearly operations and maintenance costs associated with a large storm water pump station would be added to the initial hardware costs. Therefore, upgrading the pump station was not cost effective.

After reviewing the gravity flow storm system that served the Jimmy Lane area, the storm sewer lines were determined to have surplus capacity. However, the inlet capacity was less than the local storm runoff. Additionally, a 24-inch reinforced concrete pipe (24" RCP) was designed to convey storm water from the Pyeatt Lane inlets to the Woodson Road storm sewer. The 24" RCP was designed to provide relief during heavy rainfall events when the inlets become submerged. The cost for installing an additional inlet and a 24" RCP was relatively inexpensive and did not require any additional easements. Consequently, a combination of the third and fourth alternatives was chosen as the solution.

Upon completion of the improvements along Jimmy Lane and Pyeatt Lane, the storm sewer system is expected to convey additional runoff during heavy rainfall events. Although installing the storm sewer along Pyeatt Lane and the inlet on Jimmy Lane will not solve all the drainage problems, these improvements are expected to give relief to the area during heavy rainfall events.

East Oak Hill Drive

Preliminary observations of the area reveal that the commercial and residential lots along the south side of Alana Lane drain south through the residential lots along East Oak Hill Drive (see Exhibit 3, City of Oak Ridge North Overall Map). During heavy rainfall events, the storm water ponds on the north side of East Oak Hill Drive. Due to low slab elevations of the homes along East Oak Hill Drive, the storm water comes within inches of flooding homes during moderate rainfall events.

D.A. Vogt Engineering and Alliance Development have been contacted to help in the design of adequate storm sewer capacity within the proposed Oak Hill Village East. Surplus storm sewer capacity may be utilized to convey the storm water that ponds along the north side of East Oak Hill Drive to Spring Oaks Channel. The storm sewer may be routed through the proposed Oak Hill Village East. Although an agreement for providing the additional storm sewer capacity has not been finalized, the proposed improvements are expected to relieve the drainage problems along East Oak Hill Drive.

SUMMARY

1. All options for improvements to Spring Oaks Channel were evaluated preliminarily, and thus, all values for acreage, volumes, and costs are approximate.
2. Option 1, the 1994 Drainage Alternative Evaluation ultimate improvements, will remove 39 acres from the floodplain at a cost of $5,000,000.
3. Option 2A, channel widening, and Option 2B, a diversion along the pipeline easement, will remove 26 acres from the floodplain at a total cost of $2,709,000.
4. Option 3, Marilyn Edgar Park excavation, will remove 1 acre from the floodplain at a cost of $112,000.
5. Option 4, pipeline easement excavation, will remove 1 acre from the floodplain at a cost of $103,000.
6. Option 5, Oak Ridge Baptist Church parking lot excavation, will remove 2 acres from the floodplain at a cost of $527,000.
7. Option 6, Oak Ridge Baptist Church parking lot elevation, will remove 4 acres from the floodplain at a cost of $1,121,000.
8. Option 7A, the Oak Ridge Baptist Church diversion, and Option 7B, a diversion parallel to Hillside, will remove 8 acres from the floodplain at a cost of $1,539,000.
9. Option 8, buy-out of homes within the 100-year floodplain, will cost approximately $7,800,000.
10. Option 9, raising the foundations of homes to an elevation above the 100-year floodplain, will cost between $1,200,000 and $3,000,000.

SUMMARY

11. The current TxDOT drainage design provides two benefits. First, it reduces upstream runoff by routing more flow downstream. Second, it utilizes the excess Woodson Road storm sewer capacity by routing 13 acres from the Spring Oaks Channel watershed to the existing Woodson Road system

12. The Maplewood Drive crossing is a constriction to the existing flow. If either Option 1 or 2 were constructed, Maplewood Drive would no longer be a constriction.

13. There is no excess capacity in the Robinson Road Diversion.

14. The Jimmy Lane/Pyeatt Lane localized flooding problem has been relieved with the addition of an inlet and a 24" RCP to the Woodson Road storm sewer.

15. D.A. Vogt Engineering and Alliance Development have been contacted to help in the design of surplus storm sewer capacity to relieve the localized flooding along East Oak Hill Drive.

CONCLUSIONS

1. Option 1, the 1994 Drainage Alternative Evaluation ultimate improvements, reduces the Spring Oaks Channel 100-year floodplain (approximately 39 acres in the City of Oak Ridge North) to within the channel banks. The project could be phased over several years to lessen the financial impact of the $5,000,000 project cost.

2. Option 2, channel widening and the pipeline easement diversion, provides a substantial benefit (removes 26 acres from the floodplain) at a cost approximately half as much as the 1994 study's ultimate improvements ($2,709,000 versus $5,000,000). This option requires cooperation with the pipeline company.

RECOMMENDATIONS

Part of the purpose of this report is define drainage improvements to reduce the flooding, and estimate the costs and benefits of various projects, specifically, projects that provide benefits similar to the 1994 study's ultimate improvements, but with a lesser cost. Of the options evaluated, Option 2 provides a substantial benefit in floodplain reduction (removes 26 acres) at a lesser cost ($2,709,000). We recommend constructing Option 2 as an interim alternative to the ultimate improvements (assuming pipeline coordination). The Option 2 improvements include:

- Widening the Spring Oaks Channel bottom to 25′ in the pipeline easement along the reach between the bend near Westwood Court and the bend near the intersection of Eastwood Drive and Westwood Drive
- Improving the inlet to the Hillside Diversion to provide a more efficient inlet for flow
- Constructing dual 6′x5′ reinforced concrete boxes from the bend near the intersection of Eastwood Drive and Westwood Drive to Maplewood Drive

TABLE 1

PRELIMINARY CONSTRUCTION COST ESTIMATE
FOR OPTION 1
1994 DRAINAGE ALTERNATIVE EVALUATION
ULTIMATE IMPROVEMENTS

Item No.	Description	Unit	Quantity	Unit Price	Total
1.	Move in and start up	L.S.	1	$15,000	$15,000
2.	Lift Station	L.S.	1	$100,000	$100,000
3.	Demo Existing Slope Pavement	S.Y.	15,000	$8.00	$120,000
4.	Excavation	C.Y.	21,000	$10.00	$210,000
5.	Structural Concrete	C.Y.	12,000	$350.00	$4,200,000
6.	Replace Culverts at Robinson Road	L.S.	1	$100,000	$100,000
				Subtotal	$4,745,000
				Contingencies	$950,000
				Engineering	$855,000
				Total	$6,550,000

TABLE 2

PRELIMINARY CONSTRUCION COST ESTIMATE FOR OPTION 2, IMPROVEMENT A CHANNEL WIDENING

Item No.	Description	Unit	Quantity	Unit Price	Total
1.	Move in and start up	L.S.	1	$15,000	$15,000
2.	Excavate Material	C.Y.	3,500	$6.00	$21,000
3.	Slope paving in channel complete-in-place	S.Y.	2,000	$25.00	$50,000
4.	Easement Acquisition (30'x600')	S.F.	22,000	$1.00	$22,000
5.	Remove and replace fence	L.F.	600	$10.00	$6,000
				Subtotal	$114,000
				Contingencies	$23,000
				Engineering	$21,000
				Total	$158,000

TABLE 3

PRELIMINARY CONSTRUCTION COST ESTIMATE FOR OPTION 2, IMPROVEMENT B DIVERSION ALONG PIPELINE EASEMENT

Item No.	Description	Unit	Quantity	Unit Price	Total
1.	Move in and start up	L.S.	1	$15,000	$15,000
2.	Remove and replace top soil	C.Y.	4,000	$2.00	$8,000
3.	2-6'x5' box complete-in-place	L.F.	2,600	$640.00	$1,664,000
4.	Inlet structure	L.S.	1	$5,000	$5,000
5.	Maplewood crossing	L.S.	1	$10,000	$10,000
6.	Easement acquisition	S.F.	131,000	$1.00	$131,000
7.	Hydromulch seeding of disturbed areas	AC	3.0	$5,000	$15,000
				Subtotal	$1,848,000
				Contingencies	$369,600
				Engineering	$333,400
				Total	$2,551,000

TABLE 4

PRELIMINARY CONSTRUCTION COST ESTMATE
FOR OPTION 3
MARILYN EDGAR PARK EXCAVATION

Item No.	Description	Unit	Quantity	Unit Price	Total
1.	Move in and start up	L.S.	1	$15,000	$15,000
2.	Excavtion	C.Y.	3,500	$6.00	$21,000
3.	Remove and replace T-ball field	L.S.	1	$5,000	$5,000
4.	Remove and replace baseball field	L.S.	1	$5,000	$5,000
5.	Remove and replace soccer field	L.S.	1	$2,000	$2,000
6.	Remove and replace fence	L.F.	300	$10.00	$3,000
7.	Sodding	S.Y.	5,000.0	$3.00	$15,000
8.	Miscellaneous site work	L.S.	1.0	$10,000	$10,000
				Subtotal	$76,000
				Contingencies	$16,000
				Engineering	$20,000
				Total	$112,000

TABLE 5

PRELIMINARY CONSTRUCTION COST ESTIMATE
FOR OPTION 4
PIPELINE EASEMENT EXCAVATION

Item No.	Description	Unit	Quantity	Unit Price	Total
1.	Move in and start up	L.S.	1	$15,000	$15,000
2.	Excavtion	C.Y.	3,500	$6.00	$21,000
3.	Remove and replace fence	L.F.	400	$10.00	$4,000
4.	Place new fence	L.F.	100	$20.00	$2,000
5.	Sodding	S.Y.	5,000	$3.00	$15,000
6.	Easement acquisition	S.F.	12,000	$1.00	$12,000
				Subtotal	$69,000
				Contingencies	$14,000
				Engineering	$20,000
				Total	$103,000

TABLE 6

PRELIMINARY CONSTRUCTION COST ESTIMATE
FOR OPTION 5
OAK RIDGE BAPTIST CHURCH PARKING LOT EXCAVATION

Item No.	Description	Unit	Quantity	Unit Price	Total
1.	Move in and start up	L.S.	1	$15,000	$15,000
2.	Excavtion	C.Y.	7,000	$6.00	$42,000
3.	Place new fence	L.F.	200	$20.00	$4,000
4.	Asphalt Paving (incl. base & subgrade)	S.Y.	10,000	$23.00	$230,000
5.	Easement acquisition	S.F.	90,000	$1.00	$90,000
				Subtotal	$381,000
				Contingencies	$77,000
				Engineering	$69,000
				Total	$527,000

TABLE 7

PRELIMINARY CONSTRUCTION COST ESTIMATE
FOR OPTION 6
OAK RIDGE BAPTIST CHURCH PARKING LOT ELEVEATION

Item No.	Description	Unit	Quantity	Unit Price	Total
1.	Move in and start up	L.S.	1	$15,000	$15,000
2.	Excavate material	C.Y.	17,000	$6.00	$102,000
3.	Structural Concrete Storage Area	S.Y.	10,000	$60.00	$600,000
4.	Place new fence	L.F.	200	$20.00	$4,000
5.	Easement acquisition	S.F.	90,000	$1.00	$90,000
				Subtotal	$811,000
				Contingencies	$163,000
				Engineering	$147,000
				Total	$1,121,000

TABLE 8

PRELIMINARY CONSTRUCTION COST ESTIMATE FOR OPTION 7, IMPROVEMENT A OAK RIDGE BAPTIST CHURCH DIVERSION

Item No.	Description	Unit	Quantity	Unit Price	Total
1.	Move in and start up	L.S.	1	$15,000	$15,000
2.	1-8'X4' box complete-in-place	L.F.	800	$340	$272,000
3.	Concrete covering	S.Y.	1,100	$25.00	$27,500
4.	Inlet structure	L.S.	1	$5,000	$5,000
5.	Easement Acquisition (60'x800')	S.F.	48,000	$1.00	$48,000
				Subtotal	$367,500
				Contingencies	$73,500
				Engineering	$67,000
				Total	$508,000

TABLE 9

PRELIMINARY CONSTRUCTION COST ESTIMATE FOR OPTION 7, IMPROVEMENT B DIVESTION PARALELL TO HILLSIDE

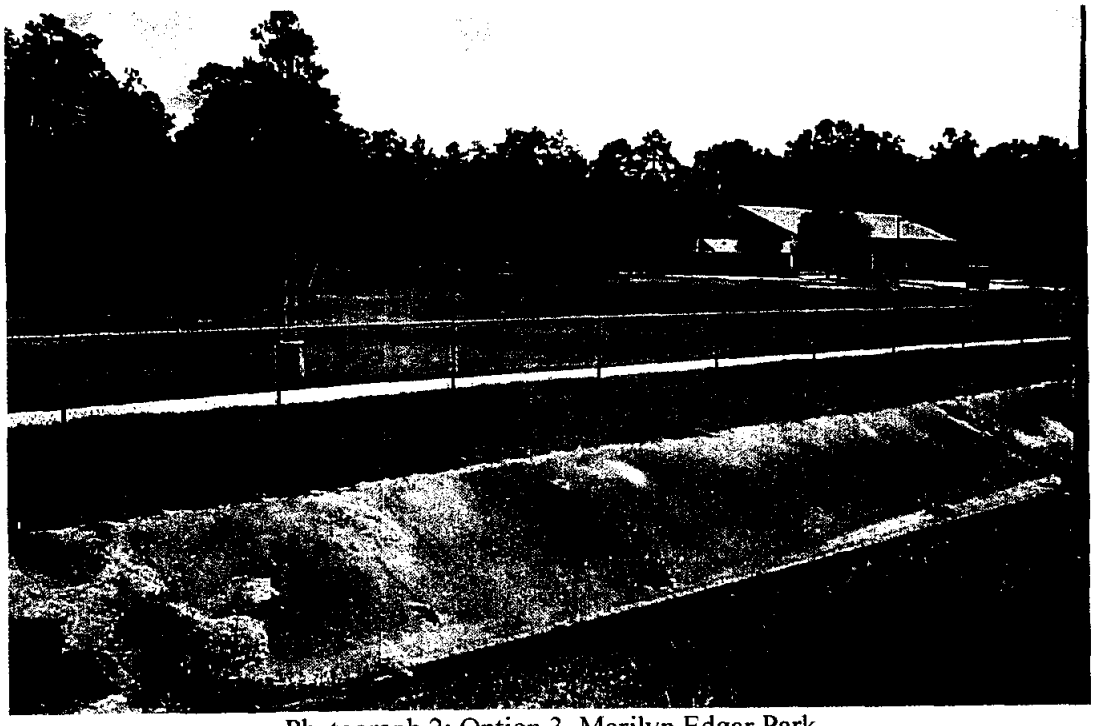
Item No.	Description	Unit	Quantity	Unit Price	Total
1.	Move in and start up	L.S.	1	$15,000	$15,000
2.	1-6'X4' box complet-in-place	L.F.	2,200	$290.00	$638,000
3.	Asphalt Paving (incl. base & subgrade)	S.Y.	3,200	$23.00	$73,600
4.	Inlet structure	L.S.	1	$5,000	$5,000
5.	Miscellaneous traffic control/temporary access	L.S.	1	$15,000	$15,000
				Subtotal	$746,600
				Contingencies	$149,400
				Engineering	$135,000
				Total	$1,031,000

TABLE 10
OPTION SUMMARY

Option	Improvement	Description	Cost	Acres Removed from 39-acre Floodplain	Approximate Cost per Acre	Exhibit #
1		1994 Drainage Alternative Evaluation Lower flowline, construct rectangular cross section	$6,550,000	39	$168,000	
2	A	Channel Widening	$158,000			
	B	Diversion Along Pipeline Easement	$2,551,000			
		Total Cost	$2,709,000	26	$104,000	E-4
3		Marilyn Edgar Park Excavation	$112,000	1	$112,000	E-5
4		Pipeline Easement Excavation	$103,000	1	$103,000	E-5
5		Oak Ridge Baptist Church Parking Lot Excavation	$527,000	2	$263,500	E-5
6		Oak Ridge Baptist Church Parking Lot Elevation	$1,121,000	4	$280,000	E-5
7	A	Oak Ridge Baptist Church Diversion	$508,000			
	B	Diversion Parallel to Hillside	$1,031,000			
		Total Cost	$1,539,000	8	$192,000	E-6
8		Buy-out of Floodplain Homes ($130,000 per home)	$7,800,000	39	$167,000	n/a
9		Raise Slab Elevations ($20,000 to $50,000 per home)	$1,200,000 to $3,000,000	39	$31,000 to $77,000	n/a

PHOTOGRAPHS 1-2

Photograph 1: Option 3, Marilyn Edgar Park
Looking South



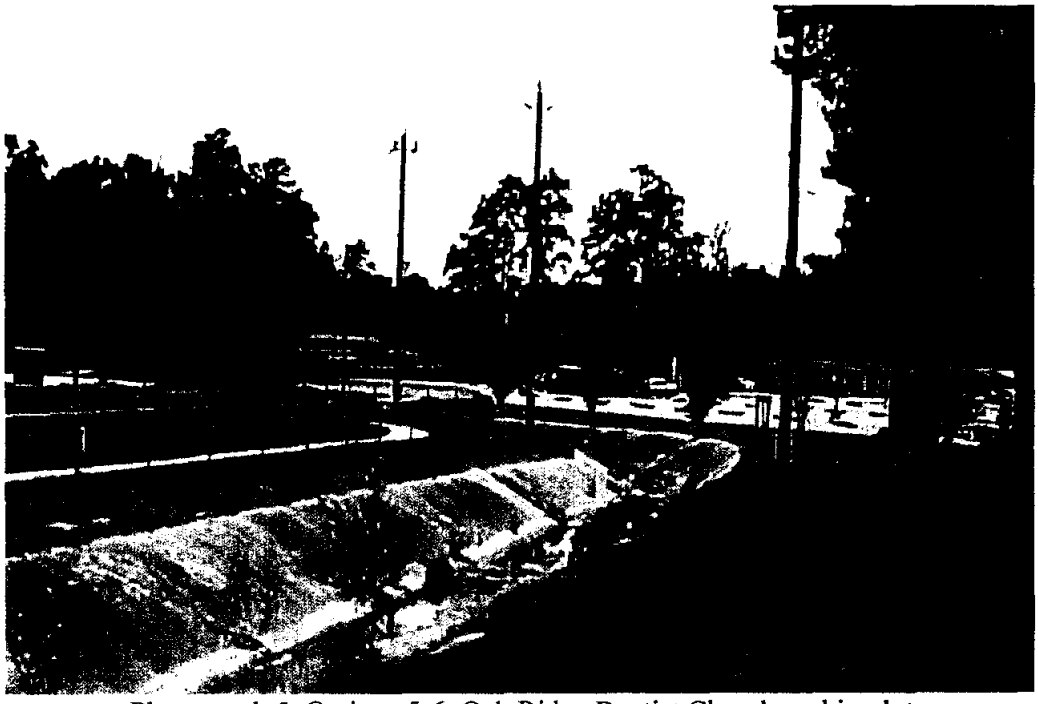
Photograph 2: Option 3, Marilyn Edgar Park
Looking Southeast

PHOTOGRAPHS 3-4

Photograph 3: Options 2A and 4, Adjacent to Oak Ridge Baptist Church
Looking Northwest

Photograph 4: Option 2A and 4, Adjacent to Oak Ridge Baptist Church
Looking North

PHOTOGRAPHS 5-6

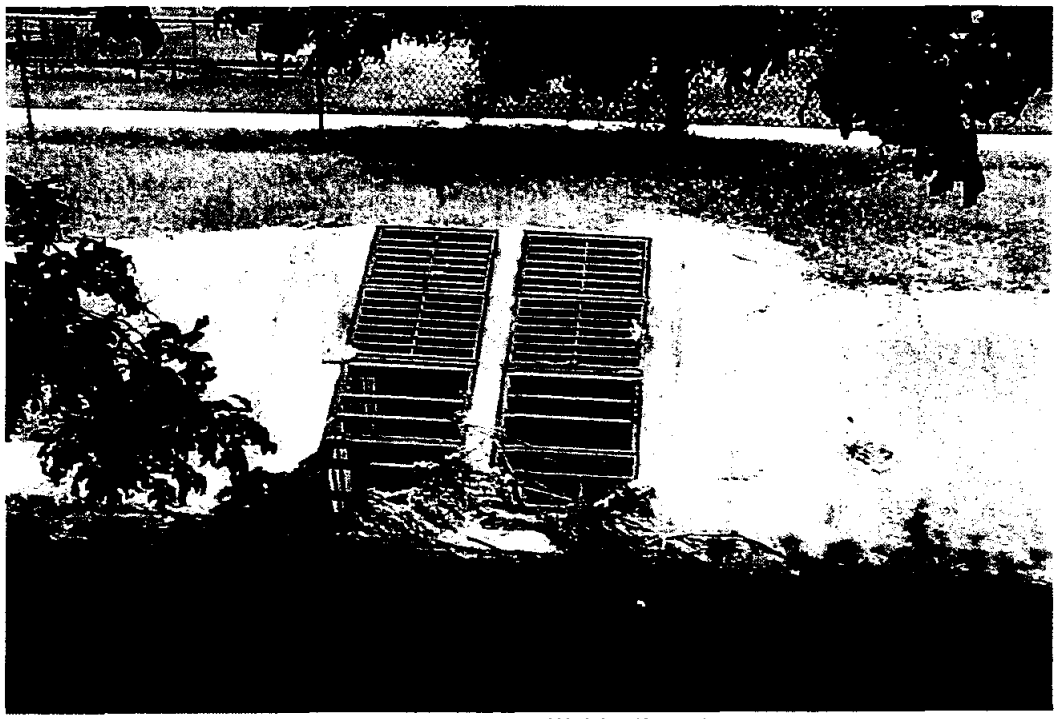


Photograph 5: Options 5-6, Oak Ridge Baptist Church parking lot
Looking Southwest

Photograph 6: Option 7A, Oak Ridge Baptist Church campus
Construct concrete box (North/South between buildings)
Looking North

PHOTOGRAPHS 7-8

Photograph 7: Option 7B, Hillside diversion entrance
Looking Southwest

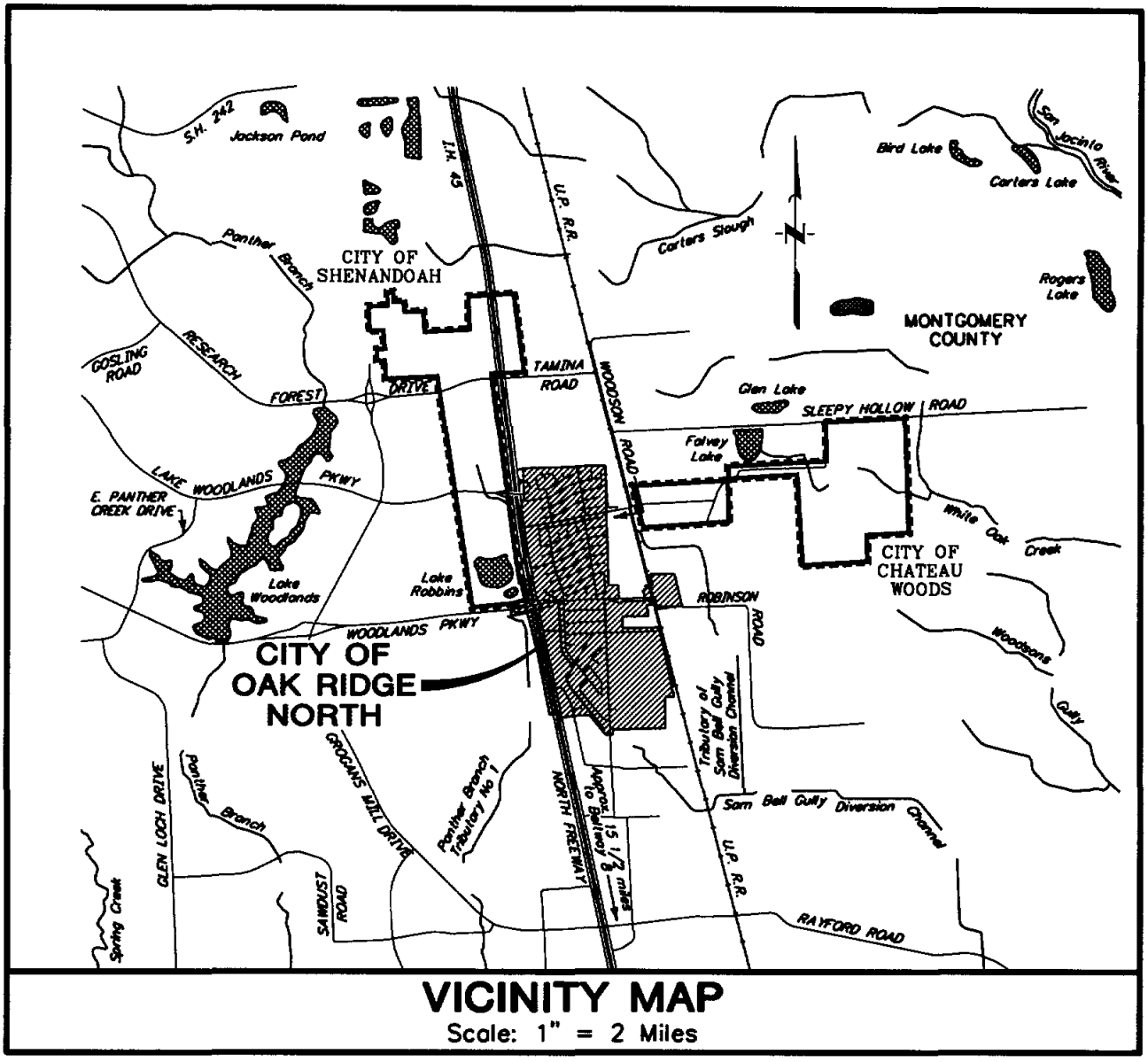


Photograph 8: Option 7B, Hillside diversion entrance
Looking Southeast

PHOTOGRAPHS 9-10

Photograph 9: Hillside diversion outfall into Spring Oaks Channel
Looking North

Photograph 10: Option 2B, Channel widening along
Spring Oaks Channel right-of-way
Looking Northwest



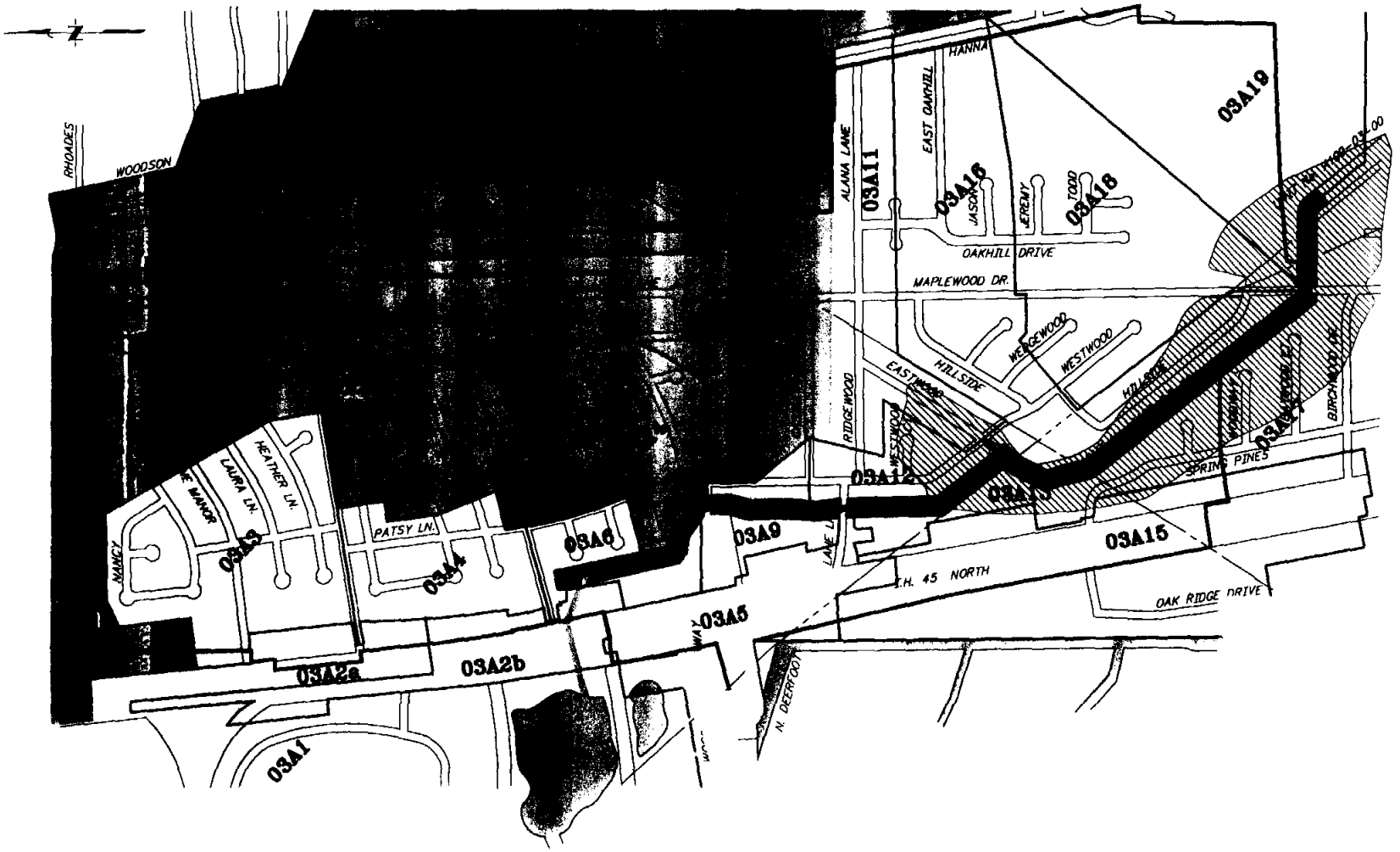
VICINITY MAP

Scale: 1" = 2 Miles

JONES & CARTER, INC.
Consulting Engineers
Houston, Texas

EXHIBIT 1
VICINITY MAP
PROPOSED STORAGE IMPROVEMENTS
CITY OF OAK RIDGE NORTH

J:\OAKRIDGE\MASTER-D\DIST-VM.dwg



SPRING OAKS CHANNEL WATERSHED

M.C.D.D. No. 6 CHANNEL WATERSHED

CITY OF OAK RIDGE NORTH

APPROXIMATE LIMITS OF THE EXISTING FEMA 100-YEAR FLOOD PLAIN

SPRING OAKS CHANNEL

M.C.D.D. No. 6 CHANNELS

JONES & CARTER, INC.
Consulting Engineers
Houston, Texas

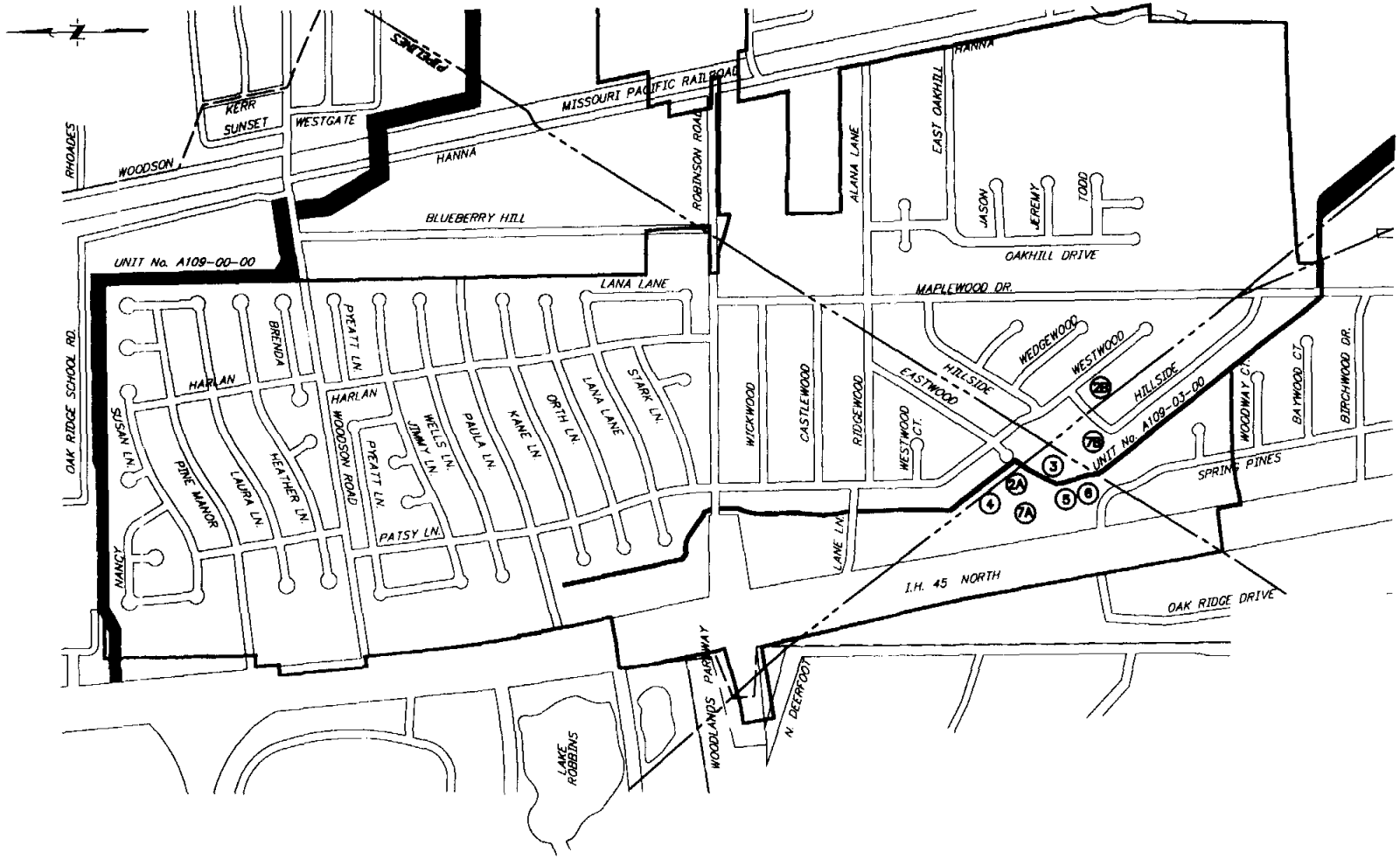
EXHIBIT 2

HEC-1 WATERSHED MAP

MASTER DRAINAGE PLAN

CITY OF OAK RIDGE NORTH

SCALE: 1" = 800'



JONES & CARTER, INC.
Consulting Engineers
Houston, Texas

CITY OF OAK RIDGE NORTH

(1) OPTION LOCATIONS

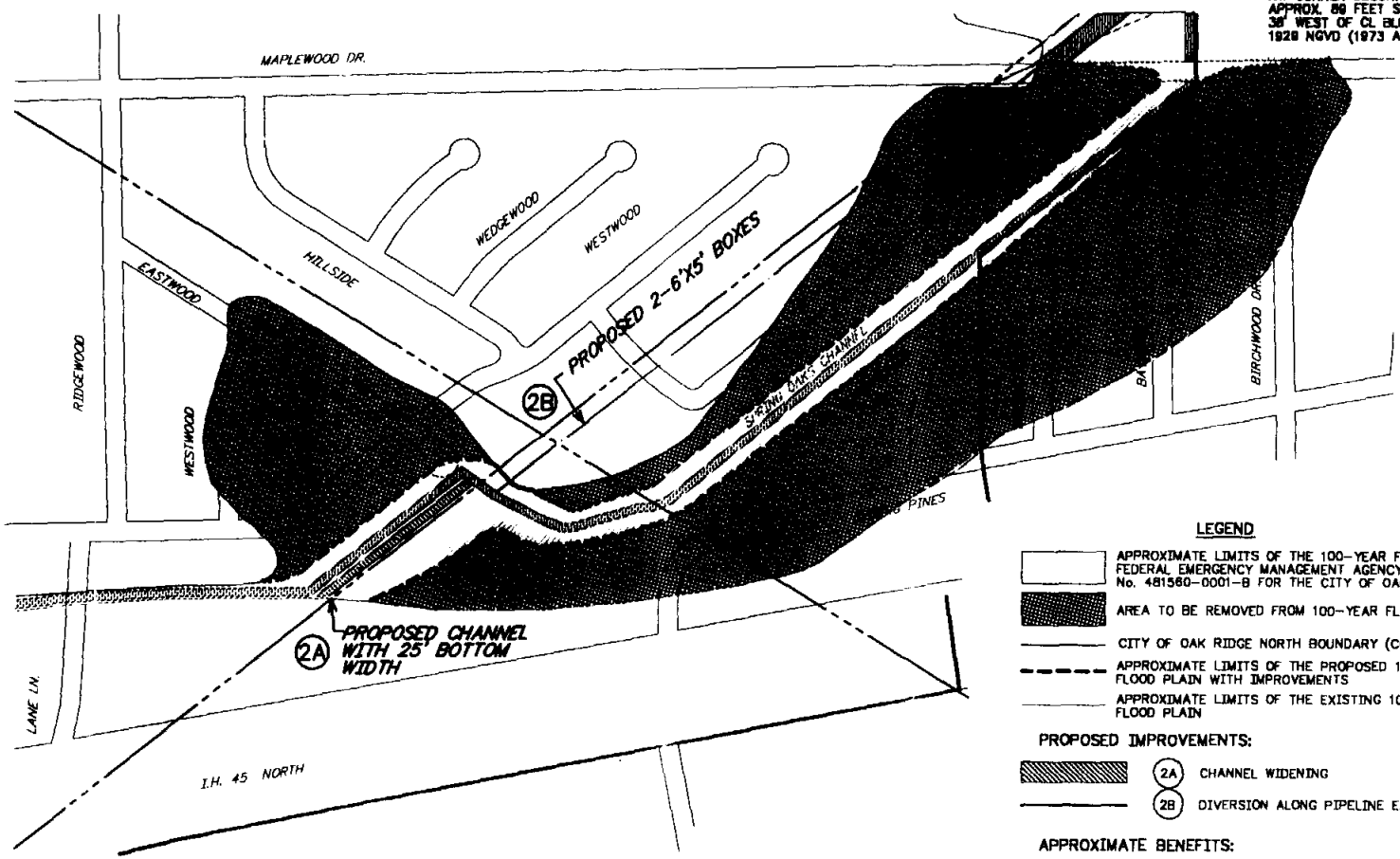
EXHIBIT 3

CITY OF OAK RIDGE NORTH

OVERALL MAP

CITY OF OAK RIDGE NORTH
SCALE: 1" = 800'

T.B.M. #2
"L" @ NW CORNER SIDEWALK NEAR
NW CORNER DECOR. HARDWARE BUILDING
APPROX. 80 FEET S. OF CL ROBINSON ROAD &
30' WEST OF CL BLUEBERRY HILL. ELEV. 132.49
1929 NGVD (1973 ADJUSTMENT)



LEGEND

- APPROXIMATE LIMITS OF THE 100-YEAR FLOOD PLAIN PER FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) PANEL No. 481560-0001-B FOR THE CITY OF OAK RIDGE NORTH
- AREA TO BE REMOVED FROM 100-YEAR FLOOD PLAIN BY OPTION 2
- CITY OF OAK RIDGE NORTH BOUNDARY (CORPORATE LIMITS)
- APPROXIMATE LIMITS OF THE PROPOSED 100-YEAR FLOOD PLAIN WITH IMPROVEMENTS
- APPROXIMATE LIMITS OF THE EXISTING 100-YEAR FLOOD PLAIN

PROPOSED IMPROVEMENTS:		ESTIMATED COST
(2A)	CHANNEL WIDENING	$ 158,000
(2B)	DIVERSION ALONG PIPELINE EASEMENT	$2,551,000
		$2,709,000

APPROXIMATE BENEFITS:

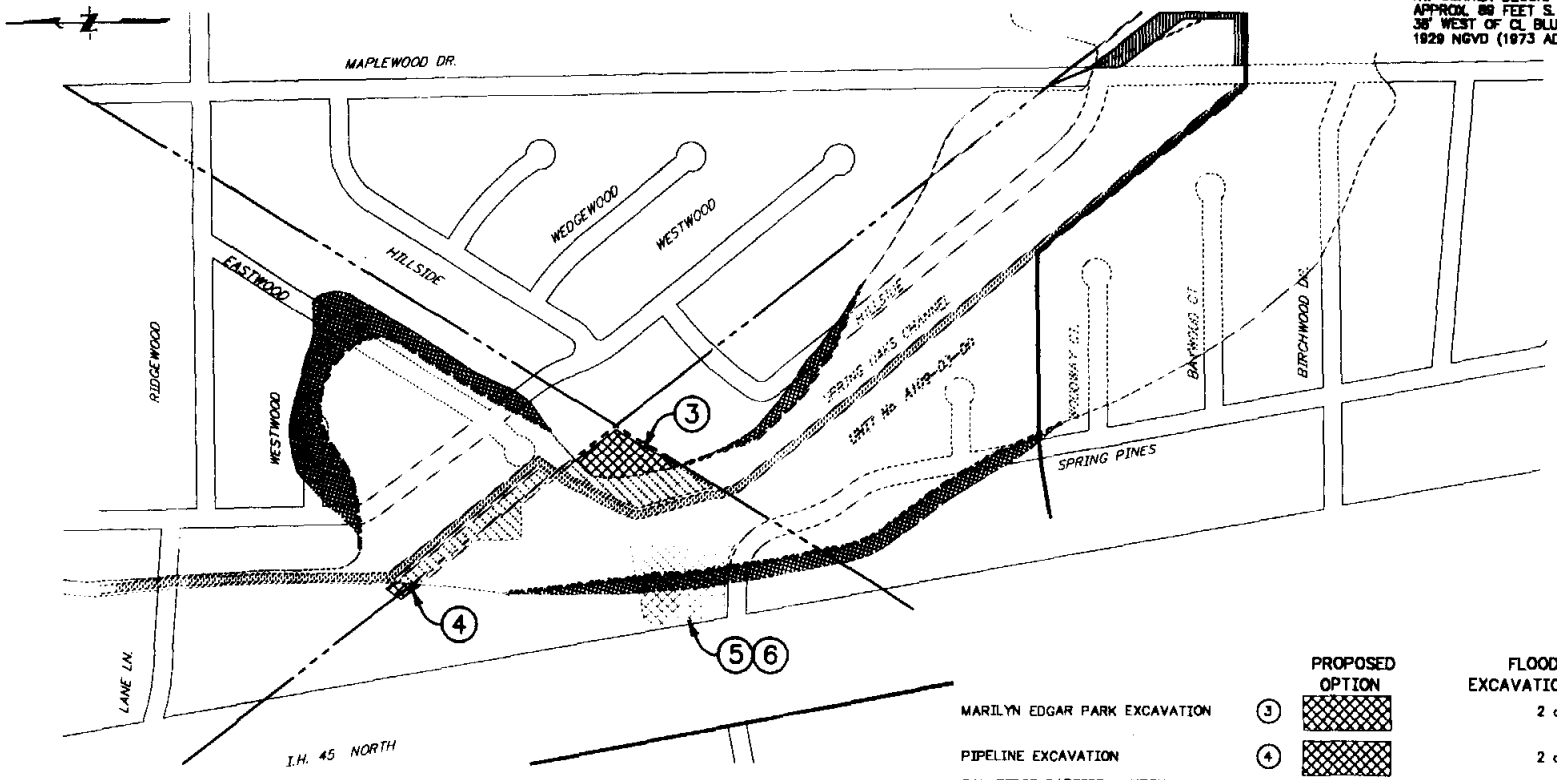
REMOVE 26 ACRES FROM FLOOD PLAIN

LOWERS ELEVATIONS 1/2' - 2'

EXHIBIT 4
OPTION 2
MASTER DRAINAGE PLAN
CITY OF OAK RIDGE NORTH
SCALE: 1" = 800'

JONES & CARTER, INC.
Consulting Engineers
Houston, Texas

T.B.M. #2
"T" @ NW CORNER SIDEWALK NEAR
NW CORNER DECOR. HARDWARE BUILDING
APPROX. 89 FEET S. OF CL ROBINSON ROAD &
38' WEST OF CL BLUEBERRY HILL. ELEV. 132.49
1929 NGVD (1973 ADJUSTMENT)



		PROPOSED OPTION	FLOOD PLAIN EXCAVATION STORAGE	ESTIMATED
MARILYN EDGAR PARK EXCAVATION	3		2 ac. ft.	$112,000
PIPELINE EXCAVATION	4		2 ac. ft.	$103,000
OAK RIDGE BAPTIST CHURCH PARKING LOT EXCAVATION	5		4 ac. ft.	$527,000
OAK RIDGE BAPTIST CHURCH PARKING LOT ELEVATION	6		8 ac. ft.	$1,121,000

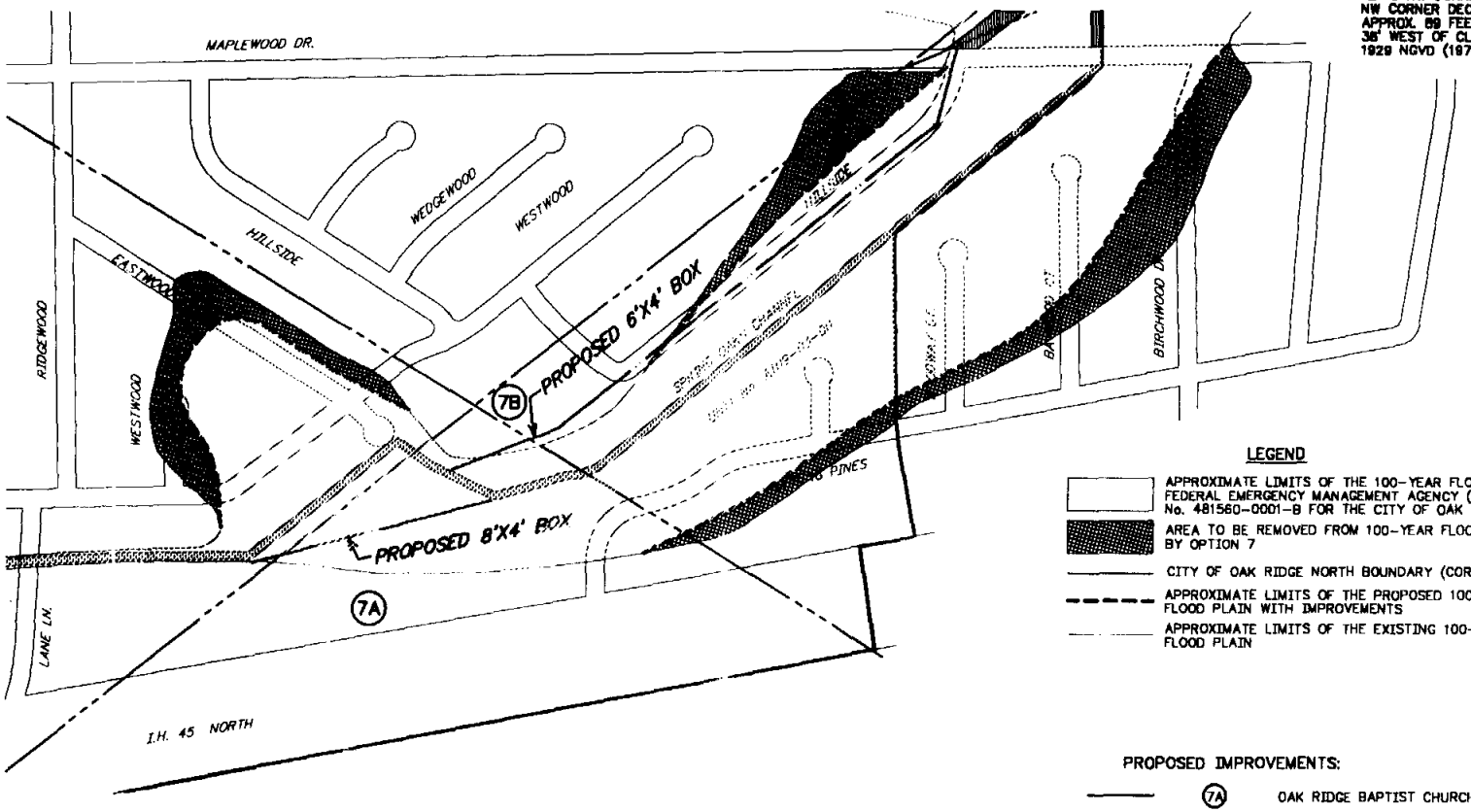
LEGEND

- APPROXIMATE LIMITS OF THE 100-YEAR FLOOD PLAIN PER FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) PANEL No. 481560-0001-B FOR THE CITY OF OAK RIDGE NORTH
- AREA TO BE REMOVED FROM 100-YEAR FLOOD PLAIN BY COMBINATION OF OPTIONS 3-5
- CITY OF OAK RIDGE NORTH BOUNDARY (CORPORATE LIMITS)
- APPROXIMATE LIMITS OF THE PROPOSED 100-YEAR FLOOD PLAIN WITH IMPROVEMENTS
- APPROXIMATE LIMITS OF THE EXISTING 100-YEAR FLOOD PLAIN

APPROXIMATE BENEFITS: REMOVES APPROXIMATELY 1/2 ACRES FROM FLOODPLAIN FOR EACH AC-FT OF DETENTION EXCAVATED

EXHIBIT 5
OPTIONS 3-6
MASTER DRAINAGE PLAN
CITY OF OAK RIDGE NORTH
SCALE: 1" = 800'

JONES & CARTER, INC.
Consulting Engineers
Houston, Texas



T.B.M. #2
"D" @ NW CORNER SIDEWALK NEAR NW CORNER DECOR, HARDWARE BUILDING APPROX. 89 FEET S. OF CL ROBINSON ROAD & 36' WEST OF CL BLUEBERRY HILL. ELEV. 132.49 1929 NGVD (1973 ADJUSTMENT)

LEGEND

- APPROXIMATE LIMITS OF THE 100-YEAR FLOOD PLAIN PER FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) PANEL No. 481560-0001-B FOR THE CITY OF OAK RIDGE NORTH
- AREA TO BE REMOVED FROM 100-YEAR FLOOD PLAIN BY OPTION 7
- CITY OF OAK RIDGE NORTH BOUNDARY (CORPORATE LIMITS)
- APPROXIMATE LIMITS OF THE PROPOSED 100-YEAR FLOOD PLAIN WITH IMPROVEMENTS
- APPROXIMATE LIMITS OF THE EXISTING 100-YEAR FLOOD PLAIN

PROPOSED IMPROVEMENTS:			ESTIMATED COST
———	(7A)	OAK RIDGE BAPTIST CHURCH DIVERSION	$ 508,000
———	(7B)	DIVERSION PARALLEL TO HILLSIDE	$1,031,000
			$1,539,000

APPROXIMATE BENEFITS:

REMOVES 8 ACRES FROMFLOOD PLAIN

LOWERS ELEVATIONS 1/2' – 1 1/2'

EXHIBIT 6
OPTION 7
MASTER DRAINAGE PLAN
CITY OF OAK RIDGE NORTH
SCALE: 1" = 800'

JONES & CARTER, INC.
Consulting Engineers
Houston, Texas

JONES & CARTER, INC.
Consulting Engineers
6335 Gulfton, Suite 200 713/777-5337
Houston, Texas 77081-1169 Fax 713/777-5976

November 8, 1999

The Honorable Mayor and City Council
City of Oak Ridge North
27326 Robinson Road, Suite 115
Oak Ridge North, Texas 77385

Re: City of Oak Ridge North

Dear Council:

The following should update you on our work on your behalf during the past month:

1. Blueberry Hill Waterline - We completed surveying Mr. Bill Robotham's property for a proposed waterline extension from the existing eight-inch (8") waterline on Paula Lane to serve the Blueberry Hill area. We are also evaluating alternatives for providing water service from the existing waterline on Robinson Road.

2. Pyeatt Lane Drainage - We completed the drawing for the extension of a 24-inch (24") storm sewer from the inlets along Pyeatt Lane to the Woodson Road storm sewer. The storm sewer will provide drainage relief for the Pyeatt Lane and Jimmy Lane drainage areas during extreme rainfall events. We also prepared a storm sewer easement to be conveyed to the City for future maintenance of the proposed storm sewer.

3. Texas Water Development Board (TWDB) Funding - Enclosed is the letter sent to the TWDB regarding their request for project scope of work and budget breakdown of the tasks for the Flood Mitigation Plan Grant Application.

4. Drainage Study - We are completing our evaluation of drainage alternatives to improve drainage in the City. We expect to submit a preliminary report to the City Administrator this week. Upon completion of his review, we will present the final report to Council.

5. The Woodlands Town Center Rainfall and Flow Data - The following table shows the maximum discharges and maximum rainfall rates from July 1999 to September 1999:

Month/Year	Max. Discharge (cfs)	Max. Rainfall Rate (inch/hr)
July - 1999	63	1.5
August - 1999	2	0.5
September - 1999	12	0.5

6. Rainfall Data Collection - The Woodlands Operating Company is working on revising the Lake Robbins weir/rainfall data collection agreement to include a remote automated rainfall data collection unit.

7. Alana Lane Water and Sanitary Sewer Extensions - We completed the design of the water distribution and sanitary sewer facilities along Alana Lane. We are currently obtaining approval from the Texas Natural Resource Conservation Commission (TNRCC) and private utility companies.

JONES & CARTER, INC.
Consulting Engineers
6335 Gulfton, Suite 200 713/777-5337
Houston, Texas 77081-1169 Fax 713/777-5976

October 28, 1999

Mr. Gilbert R. Ward
Texas Water Development Board
Research and Planning Fund - Grants Management
1700 North Congress Avenue
P.O. Box 13231
Austin, Texas 78711-3231

Re: Flood Mitigation Plan - Project Scope of Work
City of Oak Ridge North

Dear Mr. Ward:

As requested, on behalf of the City of Oak Ridge North, we are writing this letter to describe our project scope of work for the Flood Mitigation Plan (the Plan) and provide a general breakdown of costs. The City of Oak Ridge North has aggressively pursued improvements to the drainage for several years, such as the Robinson Road Diversion Project completed in 1996. The proposed Flood Mitigation Plan will provide the City with a strategy to continue improving the drainage and floodplain management.

The Plan will explain the results of the previous drainage improvements completed by the City. Existing Capital Improvement Plans and floodplain management programs will be included in the Plan. Based on flood mitigation goals developed by the City, the Plan will analyze existing drainage facilities, floodplain management, and flood hazards and develop alternatives for drainage improvements. The alternatives will be evaluated based on flood control, maintenance, land acquisition (including purchase of homes in the floodplain), and cost. After providing the Plan to adjacent affected entities and allowing a comment period the City Council will consider adoption of the Plan.

We expect development of the Flood Mitigation Plan to cost approximately $60,000. The project will include federal funds in the amount of $35,000 and City funds in the amount of $25,000. After execution of the grant award contract, the City will provide a summary of tasks with budget amounts for the Flood Mitigation Plan.

If you have any questions or comments, please call us.

Sincerely,

Bradley D. Jenkins, P.E.

BDJ/bpk
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cc: City Council - City of Oak Ridge North
Mr. Paul Mendes - City of Oak Ridge North

CITY OF OAK RIDGE NORTH
FLOOD MITIGATION PLAN
SUMMARY OF TASKS
BUDGET BREAKDOWN

Task Description		Budget Amount
Evaluation of Previous Improvements		$2,000
Evaluation of Existing Capital Improvment Plans		1,000
Evaluation of Existing Floodplain Management Programs		1,000
Development of Floodplain Mitigation Goals		2,000
Evaluation of Existing Drainage Facilities		19,000
Evalauation of Existing Floodplain Management		5,000
Evalaution of Existing Flood Hazards		5,000
Development of Drainage Improvement Alternatives		19,000
Review and Discussion of Plan with Adjacent Affected Entities		2,000
Evaluate Voluntary Land Buyouts		2,000
Implementation & Adoption of the Plan		2,000
	TOTAL	$60,000

November 1, 1999
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JONES & CARTER, INC.
Consulting Engineers
6335 Gulfton, Suite 200 713/777-5337
Houston, Texas 77081-1169 Fax 713/777-5976

February 10, 2000

The Honorable Mayor and City Council
City of Oak Ridge North
27326 Robinson Road, Suite 115
Oak Ridge North, Texas 77385

Re: City of Oak Ridge North

Dear Council:

The following should update you on our work on your behalf during the past month:

1. Drainage Study - We completed a draft evaluation of the drainage alternatives to improve drainage in the City. Upon completion of the City Administrator's review, we will present the final report to Council.

2. Alana Lane Water and Sanitary Sewer Extensions - We are prepared to begin advertising for bids for the construction of water distribution and sanitary sewer facilities along Alana Lane.

3. Robinson Road Park Improvements - We receive bids for the construction of the Robinson Road Park Improvements at City Hall on January 24, 2000 at 2:05 p.m. The low bidder for the project was MoBill Contractors, Inc. in the amount of $57,756.00. MoBill Contractors, Inc. is the contractor that completed the improvements to Marilyn Edgar Park. We will present a Recommendation of Award letter at the Council meeting.

4. Water Plant Inspection - Based on Texas Natural Resource Conservation Commission (TNRCC) rules, the City is required to perform an annual inspection of the water plant. We recommend performing the full water plant inspection including an electrical inspection. We estimated the cost of the inspection to be approximately $1,800.

5. Proposed Lake Robbins Weir - We are currently working with The Woodlands Corporation to raise the weir elevation from Lake Robbins to Spring Oaks Channel. The existing weir is planned to be modified in the Drainage Improvements to Serve the Town Center Pedestrian\Transit Corridor Phase I.

6. Oakhill Business Park Replat - We are reviewing the replat of the Oakhill Business Park submitted by Alliance Development, Inc. We will present our recommendation on the replat at Council meeting.

7. Taracorp Access Easement Request – Taracorp is requesting a 60 foot access easement from the City to provide access to Maplewood Drive. We will present a map showing the location of the proposed 60' access easement and our recommendation at the Council meeting.

Sincerely,

Bryan P. Kennedy

BPK
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6. CONSIDER AND, IF DETERMINED APPROPRIATE, ADOPT AN ORDINANCE AMENDING APPENDIX "A" OF THE CODE OF ORDINANCES OF THE CITY OF OAK RIDGE NORTH, TEXAS, SAID APPENDIX "A" BEING THE ZONING ORDINANCE OF THE CITY, BY DELETING THEREFROM ALL OF PARAGRAPH 2 OF SUBSECTION C OF SECTION 5-A AND SUBSTITUTING THEREFOR A NEW PARAGRAPH 2, AND BY DELETING THEREFROM ALL OF SUBSECTION D OF SECTION 5-A; PROVIDING IT UNLAWFUL TO PARK OR LEAVE A RECREATIONAL VEHICLE, BOAT, OR UTILITY TRAILER UPON THAT PORTION OF ANY LOT IN RESIDENTIAL DISTRICT R-1 BETWEEN THE PAVED PORTION OF ANY STREET AND THE ADJACENT RESIDENTIAL BUILDING OR GARAGE; MAKING CERTAIN EXCEPTIONS; PROVIDING THAT THE PARKING OR LEAVING OF RECREATIONAL VEHICLES, BOATS, OR UTILITY TRAILERS OTHERWISE IN VIOLATION HEREOF MAY BE CONTINUED AS A LAWFULLY EXISTING NONCONFORMING USE IF ESTABLISHED BY THE APPLICABLE OWNER OR OCCUPANT THAT SUCH USE EXISTED PRIOR TO THE ADOPTION HEREOF AND IF A REGISTRATION OF NONCONFORMING USE IS FILED WITH THE ZONING ADMINISTRATOR WITHIN NINETY (90) DAYS FOLLOWING ADOPTION HEREOF; PROVIDING A PENALTY OF AN AMOUNT NOT TO EXCEED $2,000 FOR EACH DAY OF VIOLATION.
Motion to adopt made by Anthony LeBlanc; seconded by Leah Gray – motion passed unanimously.

7. CONSIDER AND, IF DETERMINED APPROPRIATE, APPROVE MINUTES OF JANUARY 8, 2001 MEETING.
Motion to approve made by Fred Wagner; seconded by Leah Gray – motion passed unanimously.

8. CONSIDER AND, IF DETERMINED APPROPRIATE, AUTHORIZE DEGROOT WEB TO PREPARE A WEBSITE FOR OAK RIDGE NORTH AT A COST NOT TO EXCEED $1,750.00.
Motion to authorize by Fred Wagner; seconded by Leah Gray – 3 yes, 2 no – motion passed.

9. CONSIDER AND, IF DETERMINED APPROPRIATE, ADOPT FENCE ORDINANCE AND SCHEDULE THE DATE, TIME AND PLACE FOR A PUBLIC HEARING AND AUTHORIZE AND DIRECT PUBLICATION OF THE NOTICE OF SUCH PUBLIC HEARING.
Motion to accept and schedule Public Hearing for February 26, 2001 at 7:00 p.m.; seconded by Leah Gray – motion passed unanimously.

10. CONSIDER AND, IF DETERMINED APPROPRIATE, ACCEPT AND ADOPT DRAINAGE PLAN FROM JONES & CARTER.
Motion to accept by Fred Wagner; seconded by James Walton – motion passed unanimously.

7. ACTIVITY REPORTS

A. POLICE DEPARTMENT
B. CITY DEPARTMENTS
C. CITY COMMITTEES
D. CITY ADVISORS

Brian Kennedy of Jones & Carter gave an overview of their monthly report, a copy of which was given to council members. This report included the **Blueberry Hill** Waterline - surveying for a proposed water line connecting to Paula lane, or the alternative of connecting at Robinson Road. . **Pyeatt Lane Drainage** –would take water to the Woodson Road storm sewer, thus relieving both Pyeatt Lane and Jimmy Lane during extreme rainfall events. A letter has been sent to Texas Water Development Board Funding regarding the Flood Mitigation Plan Grant Application. A report will go to the city administrator this week regarding evaluation of drainage alternatives for improved drainage in the city. Mr. Kennedy provided council with a table showing the Lake Robbins weir flow data. He said the Woodlands Operating Company is working on revising the Lake Robbins weir/rainfall data collection agreement to include a remote automated rainfall data collection unit. The old equipment has tended to fail quite often. The design of the water distribution and sanitary sewer facilities along Alana Lane has been completed. Approval is being obtained from the Texas Natural Resource Conservation Commission and the private utility companies. The plans and specs for the Robinson Road Park Improvement Project are being prepared and will be ready to advertise for bids in the next 30 days. They are also preparing specifications for the replacement of the Water Plant Programmable Logic Controller.

Acting Chief of Police Andy Walters reported that **Officer Doug Barry**, patrolling DD6 last year, filed 110 cases and got 110 convictions. He also mentioned an increased number of minors in possession of alcoholic beverages and tobacco, and the need to know where they are buying it.

Richard Tramm of A-1 Utility reported that during the month of October nearly nineteen million gallons of water was pumped at the water plant. That is a drop of six million from September, and approximately half of the two months previous. The cooling trend would have prompted this. This figure is above last fall, primarily due to the lack of rain this year. He also reported that the EPA Consumer Confidence report that was mailed to the residents produced only one call that he is aware of. Evidently people were satisfied that the city does indeed have good water to drink.

- Persons not present during Citizens Comments were invited to speak at this time.

The City of Oak Ridge North

27424 Robinson Road • Oak Ridge North, Texas 77385
(281) 292-4648 • Metro: (281) 367-0727 • Fax: (281) 367-7729 • E-mail: city@ci.oak-ridge.tx.us

January 31, 2001

Mr. Gilbert R. Ward
Texas Water Development Board
Research & Planning Fund – Grants Management
1700 North Congress Avenue
P.O. Box 13231
Austin, Texas 78711-3231

Re: Master Drainage Plan/Flood Mitigation Plan

Dear Mr. Ward:

This is to advise you that the City of Oak Ridge North has received and adopted the Master Drainage Plan / Flood Mitigation Plan developed by our engineering firm, Jones & Carter, Inc. This Plan was completed in November 1999, presented and briefed to City Council and the public in January 2000 and revised and refined by Jones & Carter, Inc. based upon City Council and public input. The City Council voted unanimously to formally adopt the Master Flood Mitigation Plan for the City of Oak Ridge North at their regularly scheduled meeting on **January 22, 2001**. Attached is a copy of the minutes for this meeting. Additionally, a public workshop was held on January 27, 2001 to discuss the Plan.

If you have any questions or require any additional information, please feel free to contact me.

Very respectfully,

Paul P. Mendes
City Administrator

PPM:lg

Attachment – Copy of minutes of November 8, 1999 & Jan. 22, 2001 meetings