DRAINAGE MASTER PLAN
2005

Prepared for:

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DRAINAGE MASTER PLAN STUDY REPORT

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AUTHORITY

On September 28, 2004, the Killeen City Council authorized the City Manager to enter into an agreement with Carter & Burgess to provide storm water drainage master planning services for the City of Killeen, including preparation and submittal of a Drainage Master Plan Study Report.

ACKNOWLEDGEMENTS

Carter & Burgess prepared the Drainage Master Plan with input and support from the City of Killeen Water/Sewer/Drainage Committee and City staff from the Public Works Department. We express our sincere thanks to the following:

Water/Sewer/Drainage Committee

Mr. Scott Cosper, Chair

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Mr. Dan Corbin

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EXECUTIVE SUMMARY

- This report documents the City of Killeen Drainage Master Plan Study. It is designed to provide City of Killeen staff and elected officials with a summary of existing drainage system problems, a process for prioritization of potential major capital improvement projects (CIP), comprehensive solutions to major CIPs, other influences that affect the drainage system and cost of implementation.

- The 2002 Federal Emergency Management Agency flood insurance rate map re-study was updated to calculate the effects of development since the 2002 study and also to calculate the effects of ultimate development. Existing development conditions (as of 2005) have not significantly increased peak discharges or water surface elevations; however, ultimate development conditions will cause increases in peak discharges and water surface elevations in many areas.

- The Drainage Master Plan report was performed following the Scoping Study phase of drainage master planning to provide additional data on the City of Killeen's drainage system and to prioritize major CIPs.

- The Drainage Master Plan Study developed twenty-eight potential capital improvement projects to correct existing drainage problems, including:

Bermuda/Ronstan Ditch
South Nolan Creek at Odom Dr.
Stewart Ditch
South Nolan Creek at Stallion Dr.
WS Young
K3C Drainage
Patriotic Ditch at Zephyr Rd.
South Nolan Creek at Dimple St.
Dogwood Blvd at Bus. 190
South Nolan Creek at 10th St.
South Nolan Creek at 2nd St.
Still Forest
Bending Trail Creek
Acorn Creek Headwaters
Little Nolan Creek, Trib 1 at Caprock Dr.
Lagrone
El Dorado Dr.
Little Nolan Creek, Trib 1 at Cantabrian Dr.
Industrial Ditch
Valley Ditch
Little Nolan Creek at WS Young
Little Nolan Creek at 2410
Long Branch Tributary
Dickens Ditch
Caprice Ditch
Wolf Ditch
Greenforest Circle
Long Branch

- The Drainage Master Plan Report proposes funding for 18 CIPs in an $8.0 million bond package.

- The current drainage utility rate structure does not provide the necessary revenue to support the proposed drainage utility programs, including the proposed CIP program. A proposed rate structure is included in the Drainage Master Plan that achieves the necessary revenue.

Drainage Master Plan

2005

- A drainage maintenance plan is suggested to protect the flood carrying capacity of the City of Killeen's drainage system. A drainage maintenance plan will also provide vital data to maintenance crews, information for future phases of Drainage Master Plan design, and will identify illicit discharges within the drainage system.

- The Drainage Master Plan Report incorporates recommended future actions, including revisions to the Drainage Utility Rate structure, implementation of the major CIP program, development of a drainage maintenance plan, development of a detention policy, and revisions to City drainage design criteria and ordinances.

1.0 INTRODUCTION

1.1 PROJECT BACKGROUND

In Fiscal Year 2002-2003, the City of Killeen initiated a process to guide its Drainage Utility capital improvement program (CIP) and to address drainage system stresses. Stresses on the City's storm drainage infrastructure include localized flooding, deteriorated components, and degraded water quality. Because outdated and insufficient data existed for most portions of the City's drainage network, a project scope of work was developed to assess the City's drainage needs, to identify system constraints, and to develop a sound technical approach in realistic storm water management solutions.

The City of Killeen entered into a contract with Carter & Burgess to initiate drainage master planning services. Carter & Burgess was tasked to conduct a detailed Drainage Master Plan Scoping Study, the results of which were presented to the Water/Sewer/Drainage Committee on May 11, 2004. Based on input received from Committee members, a final Drainage Master Plan Scoping Study Report was provided on September 14, 2004. Concurrent with this report, a detailed Project Scope of Work, a list of future Project Deliverables, and an Estimate of Probable Costs for implementing the next phase of drainage master planning services were prepared.

On September 28, 2004, the Killeen City Council authorized the City Manager to implement the Phase I Design of the City's Drainage Master Plan. This report represents the completion of the Phase I Design.

1.2 PROJECT SETTING

The City of Killeen is located in Bell County in Central Texas. According to 2000 U.S. Census data, Killeen experienced a 36 percent growth in population from 1990 to 2000, exceeding the state-wide average of 23 percent. This growth is primarily attributed to an increase in military personnel at nearby Fort Hood military base. Killeen's economy is closely tied to Fort Hood: over 50 percent of the area's jobs are associated with the military base. The current population, estimated at 101,000, is expected to increase this year when an additional 5,000 U.S. troops and their families relocate to the Killeen/Fort Hood area[1]. The population of Killeen reflects a diverse racial heritage, which includes individuals of White (46%), African American (34%), Hispanic/Latino (18%), Asian (4%) and Native American (1%) backgrounds[2].

The City of Killeen is located in the Brazos River Basin and includes portions of the Nolan Creek, Trimmier Creek, Reese Creek, and Rock Creek watersheds, with their incorporated multiple creeks and tributaries. The Drainage Master Plan covers the portion of each watershed located within the City of Killeen and associated streams, creeks and drainage ways of those

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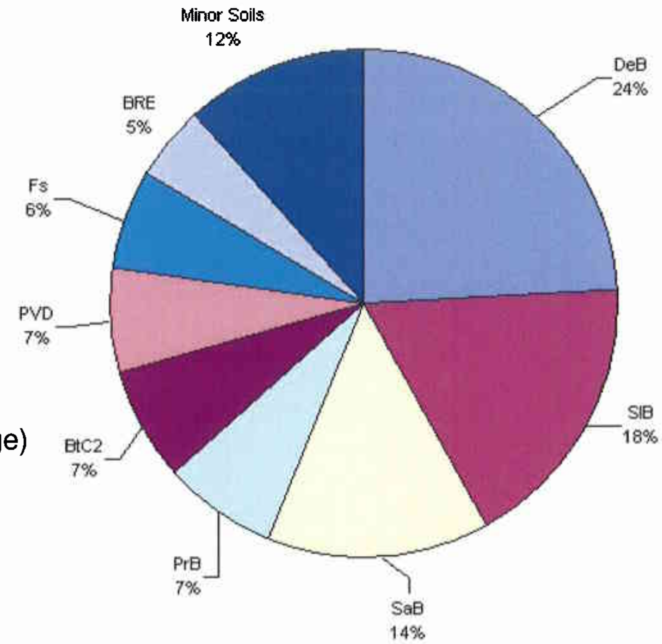
[1] Information from Central Texas Economic Corridor (CTEC) web site (http://www.centraltexas.org).
[2] U.S. Census Bureau Data, 2000

watersheds. **Exhibit A-1, Appendix A** illustrates the City of Killeen Drainage Service Area. The majority of the City drains to South Nolan Creek, designated by TCEQ as Segment 1218; however, the Lampasas River (Segment 1217) and Stillhouse Hollow Lake (Segment 1216) also receive storm water from the southern portion of the City.

Area soils are primarily clays and silty clays. Within the Killeen city limits, over 63 percent of the soils are silty clays. The dominant soil type is Denton silty clay, comprising 24% of area soils, followed by Slidell silty clay and San Saba clay, covering 24 and 18 percent of the City, respectively. The following soil types were identified within the Killeen city limits:

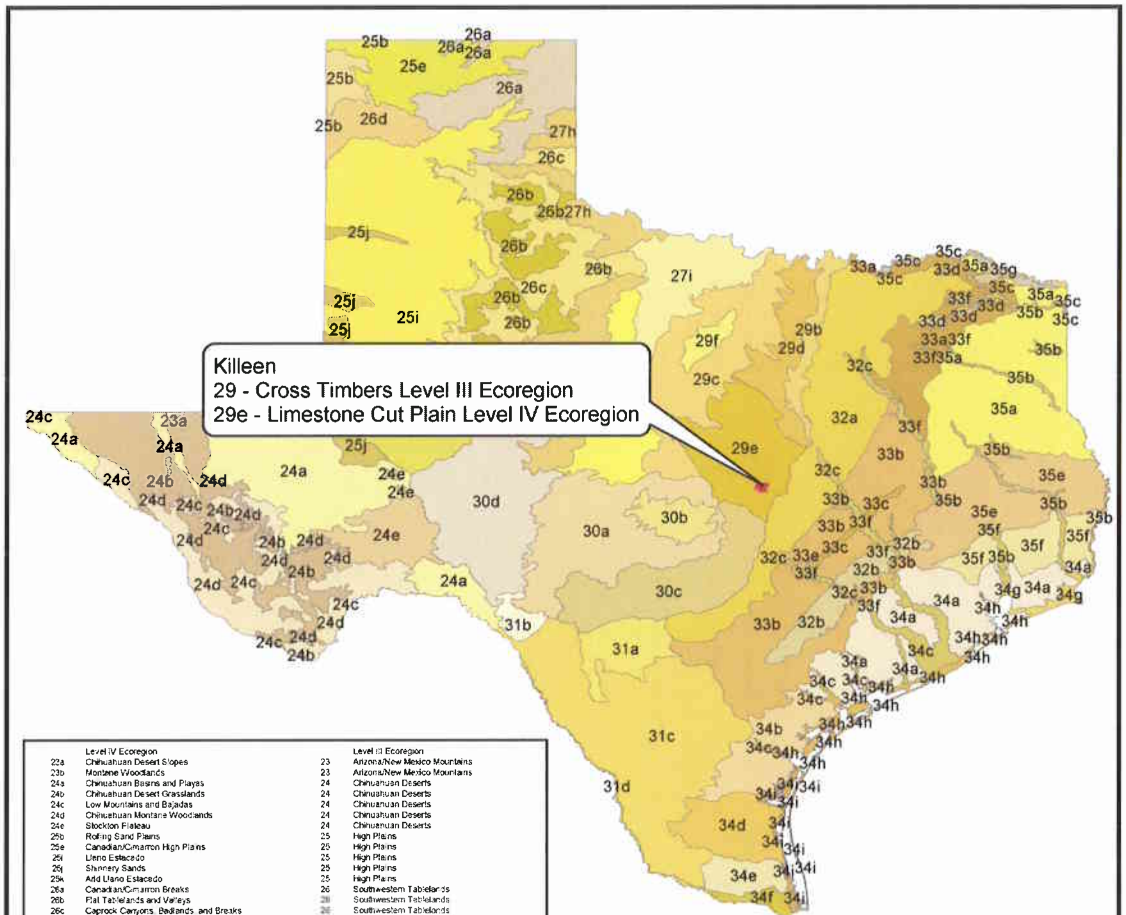
- 24% DeB - Denton silty clay
- 18% SIB - Slidell silty clay
- 14% SaB - San Saba clay
- 7% PrB - Purves silty clay
- 7% BtC2 - Topsey clay loam
- 7% PVD - Purves association
- 6% Fs - Frio silty clay
- 5% BRE - Brackett association
- 12% Minor soils (< 5% aerial coverage)



The geology of the region consists of lower cretaceous limestone outcrops. The majority of the City is underlain by the Walnut Clay formation of the Fredericksburg Group that is comprised of clay, limestone and shale. This formation ranges in thickness from 125 to 175 feet. The northeast portion of the City is located on geologic strata of the lower Washita Group and Edwards Limestone formation. A narrow band of the Comanche Peak Limestone formation outcrops between the strata of the Fredericksburg and Washita Groups.

Killeen is located in the Cross Timbers Level III ecoregion (**Exhibit 1.1**) and the Limestone Cut Plain Level IV ecoregion. This Level IV ecoregion is characterized by mesas that alternate with broad intervening valleys in a stairstep topography that is underlain by Lower Cretaceous limestones. The Limestone Cut Plain features flatter topography, lower drainage density, and more open woodland character than the Balcones Canyonlands to the south. Vegetation of the ecoregion includes post oak, white shin oak, cedar elm, Texas ash, plateau live oak, and bur oak. Although the grasslands of the Limestone Cut Plain are a mix of tall, mid, and short grasses, it is considered the westernmost extension of the tallgrass prairie, which distinguishes this ecoregion from the Edwards Plateau Woodland. This ecoregion includes grasses such as big bluestem, little bluestem, yellow Indiangrass, silver bluestem, Texas wintergrass, tall dropseed, sideoats grama, and common curlymesquite.

Although the City of Killeen obtains its drinking water exclusively from Lake Belton, groundwater aquifers may be used as sources of drinking water in rural areas within Killeen's extraterritorial jurisdiction (ETJ). Groundwater may also serve as source water for irrigation of cropland. **Exhibit 1.2** depicts the major aquifers of Texas. The Trinity aquifer consists of early Cretaceous age formations of the Trinity Group extending through the central part of the state in all or parts of 55 counties, including Bell County. Formations comprising the Trinity Group are (from youngest to oldest) the Paluxy, Glen Rose, and Twin Mountains-Travis Peak.



	Level IV Ecoregion		Level III Ecoregion
23a	Chihuahuan Desert Slopes	23	Arizona/New Mexico Mountains
23b	Montane Woodlands	23	Arizona/New Mexico Mountains
24a	Chihuahuan Basins and Playas	24	Chihuahuan Deserts
24b	Chihuahuan Desert Grasslands	24	Chihuahuan Deserts
24c	Low Mountains and Bajadas	24	Chihuahuan Deserts
24d	Chihuahuan Montane Woodlands	24	Chihuahuan Deserts
24e	Stockton Plateau	24	Chihuahuan Deserts
25b	Rolling Sand Plains	25	High Plains
25e	Canadian/Cimarron High Plains	25	High Plains
25i	Llano Estacado	25	High Plains
25j	Shinnery Sands	25	High Plains
25k	Arid Llano Estacado	25	High Plains
26a	Canadian/Cimarron Breaks	26	Southwestern Tablelands
26b	Flat Tablelands and Valleys	26	Southwestern Tablelands
26c	Caprock Canyons, Badlands, and Breaks	26	Southwestern Tablelands
26d	Semiarid Canadian Breaks	26	Southwestern Tablelands
27h	Red Prairie	27	Central Great Plains
27i	Broken Red Plains	27	Central Great Plains
27j	Limestone Plains	27	Central Great Plains
29b	Eastern Cross Timbers	29	Cross Timbers
29c	Western Cross Timbers	29	Cross Timbers
29d	Grand Prairie	29	Cross Timbers
29e	Limestone Cut Plain	29	Cross Timbers
29f	Carbonate Cross Timbers	29	Cross Timbers
30a	Edwards Plateau Woodland	30	Edwards Plateau
30b	Llano Uplift	30	Edwards Plateau
30c	Balcones Canyonlands	30	Edwards Plateau
30d	Semiarid Edwards Plateau	30	Edwards Plateau
31a	Northern Nueces Alluvial Plains	31	Southern Texas Plains
31b	Semiarid Edwards Bajada	31	Southern Texas Plains
31c	Texas-Tamaulipan Thornscrub	31	Southern Texas Plains
31d	Rio Grande Floodplain and Terraces	31	Southern Texas Plains
32a	Northern Blackland Prairie	32	Texas Blackland Prairies
32b	Southern Blackland/Fayette Prairie	32	Texas Blackland Prairies
32c	Floodplains and Low Terraces	32	Texas Blackland Prairies
33a	Northern Post Oak Savanna	33	East Central Texas Plains
33b	Southern Post Oak Savanna	33	East Central Texas Plains
33c	San Antonio Prairie	33	East Central Texas Plains
33d	Northern Prairie Outliers	33	East Central Texas Plains
33e	Bastrop Lost Pines	33	East Central Texas Plains
33f	Floodplains and Low Terraces	33	East Central Texas Plains
34a	Northern Humid Gulf Coastal Prairies	34	Western Gulf Coastal Plain
34b	Southern Subhumid Gulf Coastal Prairies	34	Western Gulf Coastal Plain
34c	Floodplains and Low Terraces	34	Western Gulf Coastal Plain
34d	Coastal Sand Plain	34	Western Gulf Coastal Plain
34e	Lower Rio Grande Valley	34	Western Gulf Coastal Plain
34f	Lower Rio Grande Alluvial Floodplain	34	Western Gulf Coastal Plain
34g	Texas-Louisiana Coastal Marshes	34	Western Gulf Coastal Plain
34h	Mid-Coast Barrier Islands and Coastal Marshes	34	Western Gulf Coastal Plain
34i	Laguna Madre Barrier Islands and Coastal Marshes	34	Western Gulf Coastal Plain
35a	Tertiary Uplands	35	South Central Plains
35b	Floodplains and Low Terraces	35	South Central Plains
35c	Pleistocene Fluvial Terraces	35	South Central Plains
35e	Southern Tertiary Uplands	35	South Central Plains
35f	Flatwoods	35	South Central Plains
35g	Red River Bottomlands	35	South Central Plains

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N

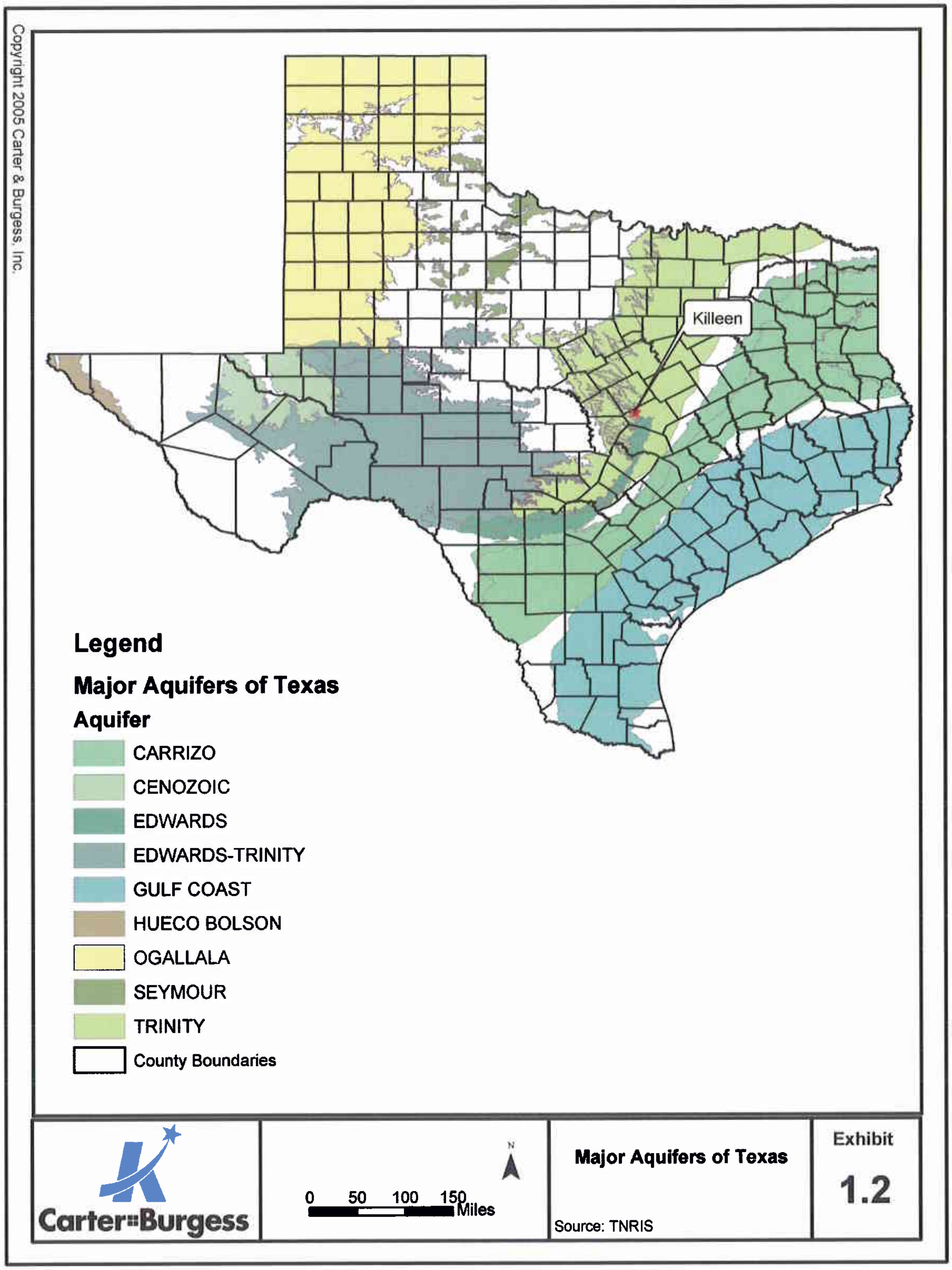
0 50 100 150 Miles

Ecoregions of Texas

Source: USEPA, 2004

Exhibit

1.1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Killeen
Legend
Major Aquifers of Texas
Aquifer
CARRIZO
CENOZOIC
EDWARDS
EDWARDS-TRINITY
GULF COAST
HUECO BOLSON
OGALLALA
SEYMOUR
TRINITY
County Boundaries
Carter::Burgess
N
0 50 100 150 Miles
Major Aquifers of Texas
Source: TNRIS
Exhibit
1.2

1.3 PROJECT SCOPE AND OBJECTIVES

The Drainage Master Plan represents the second phase of the City of Killeen's on-going Drainage Master Planning activities. It follows the Drainage Master Plan Scoping Study and uses the information provided in that report to develop a short list of major drainage CIPs, update existing hydrology and hydraulic models for the City, provide administrative solutions to assist City staff with floodplain management, and provide preliminary information for drainage utility rates. Preparation of the Drainage Master Plan included the following tasks: data collection and a kick-off meeting, field investigation, hydrologic and hydraulic modeling, development of system alternatives, CIP prioritization, and presentation of the final report to the Water/Sewer/Drainage Committee. The objective of the Drainage Master Plan is to prioritize potential major CIPs, assist the City in development of storm water management practices, and provide tools to assist the City with ongoing storm water management.

2.0 GLOSSARY

2.1 ABBREVIATIONS

BFE – Base Flood Elevation

BMP – Best Management Practices

BRA – Brazos River Authority

CAV – Community Assistance Visit

CIP – Capital Improvement Project

CLOMR – Conditional Letter of Map Revision

CTP – Cooperative Technical Partner

CWA – Clean Water Act

DMP – Drainage Master Plan

EMC – Event Mean Concentration

ETJ – Extra-Territorial Jurisdiction

FEMA – Federal Emergency Management Agency

FIRM – Flood Insurance Rate Map

FIS – Flood Insurance Study

GIS – Geographic Information System

HEC-HMS – Hydrologic Engineering Center-Hydrologic Modeling System

HEC-RAS – Hydrologic Engineering Center-River Analysis System

H&H – Hydrology and Hydraulics

IDF – Intensity, Duration and Frequency

LOMA – Letter of Map Amendment

LOMR – Letter of Map Revision

MEP – Maximum Extent Practicable

MS4 – Municipal Separate Storm Sewer System

NEPA – National Environmental Policy Act

NFIP – National Flood Insurance Program

NPDES – National Pollutant Discharge Elimination System

NPS – Non-Point Source

OSSF – On-Site Sewage Facility

SCS – Soil Conservation Service, now known as the Natural Resources Conservation Service (NRCS)

SWMP – Storm Water Management Program

TIAER – Texas Institute for Applied Environmental Research

TCEQ – Texas Commission on Environmental Quality

TMDL – Total Maximum Daily Load

TPDES – Texas Pollutant Discharge Elimination System

USACE – United States Army Corps of Engineers

USEPA – United States Environmental Protection Agency

WLA – Waste Load Allocation

2.2 DEFINITIONS

Base Flood – Flood event having a one percent chance of occurrence each year

CWA Section 404 – Establishes a program to regulate the discharge of dredged and fill material into waters of the United States, including wetlands

CWA Section 319(h) – Establishes a Non-point Source Management Program

Detention – Process of delaying the progress of storm water runoff in a controlled manner.

FEMA Map Modernization – Federal project to increase the quality, reliability and availability of flood hazard maps and data

Flooding – Temporary inundation of normally dry land

Floodplain – Any land area susceptible to being inundated by water from any source

Floodway – Channel of a watercourse and the adjacent land area that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height

Flood Storage – Detention volume provided within the floodplain

Flume - A permanent concrete-lined channel constructed on a slope for the purpose of conveying storm water runoff safely down the face of a slope without causing erosion problems on or below the slope

Impervious Area – Area that limits rainfall infiltration

Infiltration – Process of water entry into a soil from rainfall or irrigation

Low Impact Development – Development approach to reduce the impacts of new development

Non-Point Source – Pollution from many diffuse sources

Point Source – Pollution emanating from a confined discrete source

Prioritization Matrix – Ranking tool to select watersheds in need of capital improvement project

Retention – Process that halts the downstream progress of storm water runoff.

Runoff – Overland flow of rainfall that is not infiltrated into soil

Stakeholder – Member of community used to sample the opinions of the citizens of Killeen

State 303(d) List – Water bodies identified for which effluent limitations are not stringent enough to implement state water quality standards

Storm Water Management Program – Management program to address storm water quality in response to the National Pollutant Discharge Elimination System requirements

Stressor – An item or need within the drainage system that does not allow the system to function optimally

USEPA Phase II – Expansion of the National Pollutant Discharge Elimination System to smaller MS4s in urbanized areas and smaller construction areas

Watershed – The area drained by a stream or drainage system

3.0 GENERAL PROVISIONS

3.1 STORM WATER MANAGEMENT

To effectively control the problems of urban storm water runoff, the City of Killeen needs to adopt a comprehensive integrated approach to storm water management through a storm water management plan. This approach must link storm water quantity control with water quality protection, protection of streambanks and riparian corridors, floodplain management, habitat preservation and restoration, and use of storm water facilities for multiple purposes. The purpose of a storm water management plan is to:

- Minimize adverse impacts of storm water runoff within the City of Killeen
- Meet state and federal requirements
- Ensure that the City of Killeen's priorities and needs are being met with new development and re-development

To establish and sustain a functional management plan, the storm water management plan must include:

- A system baseline study
- Adequate legal authority
- Performance standards for development
- Design assistance and guidance
- Program funding and staffing
- Commitment to enforcement
- Public education and involvement
- A plan for system improvement
- A plan for system maintenance

3.2 FLOOD DAMAGE PREVENTION

Floodplain management is the primary tool used to reduce flood damage within the City of Killeen. This involves designating flood-prone areas and limiting their uses to those compatible with the risk. Since areas of residential and commercial development already exist within the floodplain, an active response is required to reduce potential flood damage, as addressed in the major and minor capital improvement programs. Floodplain management and restrictions on future development within the floodplain will also prevent future flood damage in developing areas. Review and approval of drainage plans for new development must be evaluated to ensure the protection of public health, safety, and general welfare and to minimize public and private losses due to flood conditions.

3.3 LAND DEVELOPMENT

New development that is designed, constructed, maintained, and regulated effectively will improve quality of life from an economic, aesthetic, social, and recreational perspective. However, new development impacts the environment and, in particular, the drainage system and those impacts must be addressed before development is underway. When land is developed, the hydrology is disrupted and altered because clearing and grading removes vegetation that intercepts, slows, and returns rainfall to the air through evaporation and transpiration. Development also replaces topsoil with impervious cover and eliminates or significantly reduces the amount of rainfall that infiltrates, so rainfall that once seeped into the ground now runs off the surface rapidly and through the downstream drainage system.

Development not only affects the quantity of storm water runoff but also the quality and increases both the concentration and types of pollutants carried by runoff. As storm water flows over paved surfaces and other impervious cover, it lifts and transports a variety of contaminants and pollutants to downstream water bodies. The loss of vegetation and topsoil also removes a valuable filtering mechanism for storm water runoff. The cumulative impact of development and urban activities and the resultant changes to storm water quantity and quality control the integrity and usability of the water bodies within the City of Killeen.

3.4 DRAINAGE SYSTEM OPERATION AND MAINTENANCE

An essential component of any storm water management program is the ongoing operation and maintenance of the various components of the storm water drainage system. Failure to provide effective maintenance can reduce the flood carrying capacity of the system and increase potential flood losses. Operation and maintenance must include an initial assessment of each stream segment to determine what is required to establish baseline conditions. Routine maintenance must be scheduled to periodically restore the reach to the baseline condition. Recommendations for the City of Killeen Drainage Master Plan are included in Section 10.0 of this report.

4.0 DRAINAGE SYSTEM EVALUATION

4.1 HISTORICAL RECORDS

Historical records of drainage-related issues and flood events are maintained by the City of Killeen Public Works Department and analyzed by the Drainage Utility program. Problem areas are documented by Drainage Utility personnel during on-site field visits and drainage system inspections. Inspections are initiated by either citizen complaints or at the request of City staff. Documentation is provided by an on-site field report detailing the nature of the problem and includes the location, date, photographs and remedies/suggestions to alleviate the problem. The information from the field report is entered into a flood events record database. This database was evaluated to assess drainage issues.

The flood event data was enhanced by a public information survey initiated by the City in October 2003. A public survey form was mailed to residents with their monthly water bills and posted on the City's website to solicit citizen input on flooding issues and drainage problems. The survey form contained a brief explanation of the need for additional data and a series of pertinent questions. Approximately 200 forms have been submitted to date. The Drainage Utility's database was updated to include drainage problems reported on the survey forms and flood event data collected through February 2004.

4.2 FIELD INVESTIGATION

Carter & Burgess, with Drainage Utility staff, performed a field investigation of reported drainage problem locations. The field investigation was conducted December 6th-8th, 2004. A photo inventory was compiled during the field investigation and is included in **Appendix H**, to this report.

4.3 PROBLEM CATEGORIES

Drainage problems can arise at any location that receives or conveys storm water: residential lots, parking lots, streets, gutters, flumes, creeks, man-made channels, ponds, and lakes. Drainage problems range from minor inconveniences to substantial flood damage or loss of life. The causes of drainage problems vary greatly and include but are not necessarily limited to:

- Over-grown vegetation
- High flow velocity
- Debris blockage
- Structure failure
- Undersized structure or inadequate design
- Inadequate construction methods
- Increased flows caused by upstream development
- Unauthorized changes to drainage paths
- Floodplain encroachment

Typical reported drainage problems in Killeen included street flooding, residential lot flooding, overflow of drainage channels, erosion in drainage channels, and overgrown vegetation in drainage ways. Reported drainage problems were reviewed and categorized based on available data into the following seven categories:

- Channel maintenance/ overgrown vegetation – Channel or drainage way is clogged with vegetative growth, blocking flow of water.
- Erosion – Channel or drainage way experiences high velocities that erode channel banks or other areas.
- Debris – Channel or drainage way clogged by trash or debris, blocking flow of water.
- Structure failure – Drainage structure has collapsed or failed and does not function properly.
- Under-sized structure/ inadequate design – Drainage structure is too small. Possible upstream development has increased flow to the drainage structure.
- Flood-prone location/ street flooding – Natural low area or flooding of street.
- Inadequate grading – Ponding water or runoff from adjacent property flows toward structure.

Categorizing reported drainage problems allows for identification of repeated problems and possible drainage system inadequacies. Identifying system inadequacies will allow for a systematic solution to correct many individual drainage problems rather than small solutions to fix individual reported problems.

The documented drainage problems were analyzed with respect to the frequency of reported incidents and geographic distribution. Results of these analyses are discussed in the following sections.

4.4 PROBLEM CATEGORY STATISTICS

Reported drainage problems were divided into the individual categories identified in Subsection 4.3, and the percentage of reported problems were calculated. **Table 4.1** illustrates the seven drainage problem categories, total number of events reported, and percentage of total events reported.

Table 4.1: Reported Drainage Problem, by Category

Category	Description	Number of Problems	Percentage of Total
1	Channel Maintenance – Vegetative	40	7.05
2	Erosion	22	3.88
3	Debris	67	11.81
4	Structure-Failure	9	1.59
5	Undersize Structure – Inadequate Design	56	9.88
6	Flood-Prone Location – Street Flooding	284	50.09
7	Inadequate Grading	89	15.70

Based on the percentage of reported incidents, Flood-Prone Location – Street Flooding is a major concern to Killeen residents. In fact, out of a total of 567 reported incidents, over fifty percent of reported drainage problems were categorized as Flood-Prone Location – Street Flooding (**Figure 4.1**).

This high figure could be attributed to the fact that the City of Killeen currently allows streets and roadways to be used for conveyance of storm water, making it one of the most highly visible and used parts of the City's drainage infrastructure. In contrast, a drainage event in an isolated area along the drainage system may not be noticed except by those living in the immediate area.

A moderate number (greater than 10 percent) of reported problems were attributed to Inadequate Grading, Undersized Structure-Inadequate Design, Debris, and Channel Maintenance-Vegetation. Less frequently reported were problems associated with Structure-Failure and Erosion, which comprised less than 5 percent of the total incidents in the database.

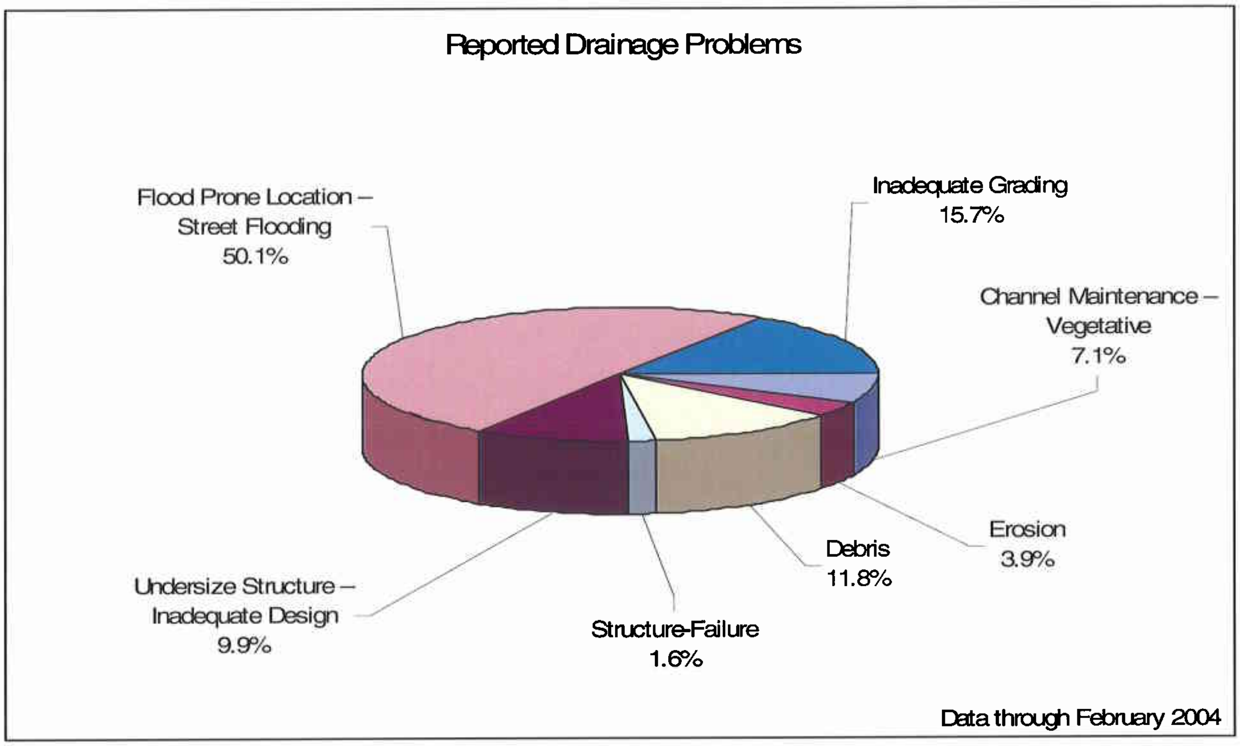


Figure 4.1: Reported Drainage Problem Categories

4.5 WATERSHEDS

The geographical distribution of reported drainage problems was evaluated on a watershed basis through use of a Geographic Information System (GIS). GIS mapping tools were used to overlay reported drainage problems on a map of the City (**Appendix B**). The City of Killeen was then divided into the sixteen major watersheds taken from the draft Halff FIS Re-study dated January 2003 and shown on **Exhibit B-1, Appendix B**. This exhibit indicates the wide-spread nature of drainage problems as well as localized problem areas.

4.6 WATERSHED STATISTICS

Reported drainage problems were mapped within each watershed, and the percentage of reported problems within each watershed were calculated. **Table 4.2** lists the sixteen watersheds, total number of events reported, and percentage of total events.

Table 4.2: Reported Drainage Problem, by Watershed

Watershed Number	Watershed Name	Number of Problems	Percent of Total
1	Long Branch	63	11.11
2	Caprice Ditch	20	3.53
4	Stewart Ditch	39	6.88
6	Liberty Ditch	7	1.23
7	Valley Ditch	20	3.53
9	Industrial Ditch	9	1.59
10	Atkinson Ditch	15	2.65
11	Hallmark Ditch	8	1.41
12	Bermuda Ditch	45	7.94
13	South Nolan Creek, South of 190	32	5.64
14	South Nolan Creek, North of 190	100	17.64
16	Little Nolan Creek, Tributary 1	90	15.87
17	Little Nolan Creek, North of 190	26	4.59
18	Stillwood Ditch	10	1.76
19	Little Nolan Creek, South of 190	29	5.11
20	Trimmier Creek	54	9.52

Table 4.2 indicates that the South Nolan Creek Watershed, north of U.S. Highway 190, (watershed number 14) exhibits the most drainage problems, closely followed by Little Nolan Creek, Tributary 1 Watershed (watershed number 16), and the Long Branch Watershed (watershed number 1). Combined, these three watersheds account for 44.52 percent of reported drainage problems. The prioritization of response activities within these watersheds must account for the total number of reported drainage problems, size of the watershed, and type of drainage problem. Administrative solutions could be used for developing watersheds that have had no significant drainage problems reported and have lower priority ranking.

5.0 REGULATORY INFLUENCES

5.1 TEXAS WATER CODE

Section 11.086(a) of the Texas Water Code prohibits a person from diverting or impounding the natural flow of "surface water" in a manner that damages the property of another from the overflow of water diverted or impounded. On its face, this section of the Texas Water Code would appear to be a prohibition of any sort of drainage-related action that might cause harm to another.

However, over the years, the courts have held that surface water means diffused surface water. As soon as surface water reaches some sort of channel or defined course, it is no longer diffused surface water and the provisions of Section 11.086(a) no longer apply. In fact, courts have often held that downstream property owners have a certain obligation to accept upstream water in existing watercourses, even if the upstream flow has been changed somewhat as a result of an action of an upstream landowner.

Thus, Texas Water Law and subsequent common law court interpretations provide little guidance for municipalities related to many drainage issues involving upstream and downstream landowners. The failings of Section 11.086 in defining landowner rights related to drainage are so great that a recent Texas appeals court noted "a landowner might divert the entire Brazos River across his neighbor's property without subjecting himself to liability under Section 11.086 of the Texas Water Code."

Texas Courts have slowly provided more definition related to the rights of landowners and cities related to drainage. One case that bears watching is "City of Keller v. Wilson". In this case, a downstream landowner (Wilson) sued the City of Keller on an inverse condemnation theory related to the City's approval of drainage plans for an upstream developer. Wilson argued that perceived future damages resulting from the City's approval of the upstream developer's plans resulted in a taking of Wilson's property. The lower courts ruled in Wilson's favor, and the case is currently awaiting a hearing with the Supreme Court of Texas.

5.2 NATIONAL FLOOD INSURANCE PROGRAM

Established by the National Flood Insurance Act of 1968, the National Flood Insurance Program (NFIP) is an insurance program with some regulatory elements. The program was developed by the federal government to ensure that the nation's citizens could purchase affordable flood insurance for their property. Insurance is obtained from private insurance companies, but the federal government underwrites the program.

To reduce the federal government's exposure to flood loss costs, a national flood mapping system was initiated and a regulatory program was designed around the flood mapping system. Since the NFIP is a voluntary program, state and local governments have the ability to opt into or out of the program. If they elect to participate in the program, citizens within the local government's boundaries have the ability to purchase flood insurance at federally controlled rates provided by private insurers. In return for opting into the program, participants agree to implement a local regulatory program designed to reduce flood losses.

If a community elects not to participate in the NFIP, citizens within the local boundaries will not be able to purchase flood insurance at federally controlled rates. Flood insurance might, in theory, be available from private insurers, although in practice, it usually is not available or is available only at market rates.

When communities elect to participate in the NFIP, the Federal Emergency Management Agency (FEMA) agrees to provide flood mapping (flood insurance rate maps otherwise known as FIRMs) for the community (although flood mapping studies may not be performed for several years). Communities, in turn, agree to adopt an ordinance regulating floodplain development and to establish minimum standards for structures to be constructed in and around the floodplain. The minimum ordinance standards usually establish a local permit program requiring floodplain development permits for proposed fill in the floodplain. Minimum finished floor elevations must be established at least 1 foot above the 100-year floodplain water surface elevation. FEMA has the ability to drop communities from the flood insurance program for continued lack of compliance with the regulatory aspects of the program.

Flood mapping to support the program is normally based on a set of computer hydrologic and hydraulic (H&H) models. Depending on the work proposed around or in the floodplain, it may be necessary for floodplain development permit applicants to revise the computer H&H models to reflect the proposal.

As the program is established, local communities act as the gatekeeper for letters of map revision (LOMRs), conditional letters of map revision (CLOMRs), and letters of map amendment (LOMAs), which are methods used by FEMA to adjust flood maps based on floodplain development permit submittals. The permit review, approval, and map revision gatekeeper function provided by local communities is usually tasked to the community floodplain administrator. In Killeen, the duties of floodplain administrator reside with the Building Official.

FEMA audits local community programs on a periodic basis through Community Assistance Visits (commonly called CAVs). A CAV was performed for the City in September 2003. Items noted by FEMA during the CAV included two potentially significant issues:

- Property owners appear to be underinsured (i.e., not enough structures appear to be insured in proportion to the potential flood risk).
- The City's flood mapping studies and FIRMs are outdated.

Both of these items are largely out of the City's control. For example, the decision to purchase flood insurance by a property owner is not controlled by the City. If the City's residents are underinsured, it is possibly due to a rapid property turnover rate. Nevertheless, the City will want to increase public information efforts associated with the need for flood insurance as part of its overall storm water management program public education efforts. Although the number of residences located within the mapped 100-year floodplain number less than 100, it should be noted that, nationally, at least one-third of flood damage occurs in areas outside of mapped 100-year floodplains.

FEMA began remapping much of the city (primarily along the main stem of Nolan Creek) in early 2002. However, map production was delayed by resource conflicts at FEMA. FEMA is now conducting a Map Modernization Project for Bell County to produce digital floodplain maps, which will include the 2002 study data. However, FEMA is not conducting any new studies within Killeen to enhance the level of detail for the floodplain mapping. The City of Killeen contracted with Carter & Burgess to prepare hydrologic and hydraulic analysis for approximately 25 miles of floodplain to be provided to FEMA for inclusion in the FEMA Map Modernization Project.

The NFIP policy claims data and the location of floodplain boundaries within the City are included in **Appendix C**.

5.3 TEXAS POLLUTANT DISCHARGE ELIMINATION SYSTEM PROGRAM

National efforts to improve the quality of surface water bodies started in 1977 with the passage of the Clean Water Act (CWA). The main emphasis of this legislation was to establish a system to control pollution from point sources, with the goal of reducing pollutants so the nation's lakes and streams are both fishable and swimmable. To achieve this goal, the CWA established the National Pollutant Discharge Elimination System (NPDES). The NPDES requires that anyone discharging a pollutant from a municipal wastewater or industrial point source must obtain an NPDES permit, which specifies effluent limits, monitoring requirements, and enforcement mechanisms.

Over the past two decades, the CWA has evolved and now contains regulations to address pollution from storm water discharges. Phase I of the NPDES storm water regulations initiated with the passage of the Water Quality Act amendments of 1987, which required medium and large municipalities with populations to classify their storm water runoff and develop plans to reduce the pollutants in their runoff. Most Phase I cities are now well into their initial five-year permit terms.

The draft Phase II NPDES regulations were published on January 9, 1998 and the final Phase II regulations were published on December 8, 1999. Phase II extended the NPDES program to include most cities under 100,000 population and also lowered the Phase I construction storm water discharge permit threshold from five acres to one acre. Phase II also removed certain industrial storm water discharge permit exemptions that previously applied to smaller cities. Based on a survey of successful Phase I municipal programs, the EPA recognized that successful municipal storm water quality programs included six minimum control measure program elements:

- Educate the public on storm water impacts
- Involve the public in the development and operation of the program
- Establish procedures to detect and eliminate storm water pollutant discharges

- Control storm water runoff from construction sites
- Require permanent controls for post-construction storm water runoff
- Include good housekeeping practices for municipal operations

Phase II cities must develop a storm water management program addressing the six minimum control measures. A Notice of Intent (NOI) document must also be submitted to the permitting authority indicating the commitment of the Phase II city to comply with a general permit to be developed by the permitting authority.

The state of Texas is delegated by the EPA to manage the NPDES program in Texas (hence the Texas Pollutant Discharge Elimination System or TPDES). The Texas Commission on Environmental Quality (TCEQ) is the NPDES permitting authority for the state of Texas.

In 2002, TCEQ published a draft general permit for Phase II municipal separate storm sewer systems (MS4s) that would apply to cities such as Killeen. The permit was intended to take effect no later than March 10, 2003, which was the regulatory deadline for Phase II cities to have obtained their MS4 permit. However, TCEQ conflicts and an ongoing federal lawsuit regarding the provisions of the Phase II storm water program have delayed the TCEQ permit release.

A revised draft general permit for Phase II MS4s was released August 16th, 2005. It is open for another round of public comment until September 29th, 2005. Initial opinion is that TCEQ will have the permit finalized to become effective January 1, 2006.

On the surface, the Phase II program appears to be a water quality program with little impact on water quantity issues. However, Phase II requirements are actually far reaching and could positively impact the City's drainage program in several ways, including:

- Educational efforts could reduce illegal dumping and floatables into the city's storm water system, reducing the tendency for drainage features to clog.
- City enforcement efforts for the illicit discharge program could also reduce illegal dumping and floatables into the storm water system, reducing the tendency for drainage features to clog.
- Educational and enforcement efforts for the construction runoff program could reduce floatables and sediment to the City's drainage features, reducing the tendency for drainage features to clog.
- Runoff mitigation efforts associated with the post-construction control program could reduce flow in the City's drainage network and reduce channel erosion
- Increased City maintenance resources required as a result of the program could be used for water quantity maintenance as well as water quality maintenance.

The Phase II program encourages cities to look at integrated storm water management solutions. While traditional drainage design focused on removal of water from a city as quickly as possible, Phase II encourages comprehensive programs for drainage design that address both the water quality and water quantity components.

The City has been very proactive in addressing Phase II requirements and is poised for compliance with the regulations as soon as the TCEQ general permit is released. Continued drainage system maintenance is a key Phase II requirement that must complement the City's ongoing drainage maintenance program.

5.4 USACE SECTION 404 PERMIT

The CWA Section 404 permit program regulates the placement of dredged or fill materials into the nation's waterways. The program is administered by the U.S. Army Corps of Engineers under agreement with the U.S. Environmental Protection Agency. The EPA maintains oversight responsibility for the program similar to the oversight responsibility that EPA maintains over state storm water programs.

The Section 404 program has its roots in a similar federal program that sought to ensure the nation's navigable waterways would not be blocked by the dumping of fill material into those waterways. As such, the program impacted only discharges of fill into the nation's largest waterways. Over the years, the program has expanded greatly in scope. Today, the program regulates even the smallest discharges (above very low threshold levels) into waters of the United States and adjacent wetlands. The waters of the United States definition is now very broad as well. Virtually any stream or natural drainage way in the City of Killeen potentially falls under the existing Section 404 program. While the program formerly focused on the protection of navigation interests, the existing program focuses on maintaining all the functions and values provided by natural stream corridors. As the program is now defined, the emphasis is on the protection of habitat for both the flora and fauna that commonly use or reside in the nation's stream corridors.

The current goals of the Section 404 permit program are consistent with the goals of this drainage master plan because evolving drainage practice focuses on usage of existing natural corridors rather than wholesale modification as practiced in the past. From a practical standpoint, virtually any fill or excavation activity within drainage ways (even man-made trapezoidal channels that were formerly natural drainage ways) requires a Section 404 permit.

Permits range from simple Nationwide Permits (somewhat similar to a NPDES general permit) to very complex Individual Permits. In many instances, the Corps seeks comments from related federal and state resource agencies on permit applications. For Individual Permits, the Corps will also seek public comment. For very complex projects, the Corps can require development of an Environmental Assessment or an Environmental Impact Statement.

To minimize impacts to the nation's waterways, the program is based on the concepts (in priority order) of avoidance of impacts, minimization of impacts, and mitigation of impacts. In other words, the Corps first requires that projects be designed to avoid or minimize impacts to the nation's waterways. If impacts are unavoidable, projects must be designed with mitigation to replace the stream or wetland functions impacted. Mitigation is usually required at ratios well above 1:1. For example, if a project impacts one acre of bottomland hardwoods, the Corps might require the applicant to construct a mitigation area with three acres of bottomland hardwoods as replacement for the area impacted.

Table 5.1 lists some examples of how the Section 404 permit program impacts typical urban drainage projects.

Table 5.1 Typical Project Impacts of Section 404 Permit Requirements

Type of Project	**Type of Permit Likely Required**	**Type of Mitigation Required**	**Favored Corps Solution**
Roadway Drainage Culvert	Nationwide Permit	Possibly None	Bridge or ConSpan Crossing, Road Rerouting
Small Closed Storm Drainage System in Minor Drainage Way	Nationwide Permit	Possibly None	Reroute Road, Do Not Enclose Drainage way, Use Open System
Large Closed Storm Drain System in Urban Creek	Individual Permit	Replacement of Stream Functions at Ratios Greater than 1:1	Reroute Road, Do Not Enclose Drainage way, Use Open System
Open Grass-Lined Trapezoidal Channel	Nationwide or Individual Permit	Replacement of Stream Functions at Ratios Greater Than 1:1	Leave Existing Creek in Natural State
Open Concrete Lined Trapezoidal Channel	May Not Be Permittable – If Permittable, Individual Permit Likely	Replacement of Stream Functions At Very High Ratios	Leave Existing Creek In Natural State

In recognition of the Section 404 program requirements, the City requires a note on all plat submittals indicating that the development applicant recognizes the potential need for Section 404 permitting and agrees to obtain such permitting, if required.

In Texas, the Corps has focused most of its Section 404 enforcement efforts in the Dallas-Fort Worth Metroplex. As a result, the rules are relatively well understood in North Texas. However, in many parts of the state, the Section 404 requirements are virtually unknown or misunderstood.

5.5 National Dam Safety Program

Congress established the National Dam Safety Program in 1978. Similar to other regulatory programs, this program has been passed down to the states to implement.

In Texas, the TCEQ implements the program. The program establishes minimum requirements for dam design, including embankment and spillway design requirements. In Texas, water impoundments greater than 6 feet in height are classified as dams.

The requirements of this program could take on greater importance as the City of Killeen moves forward with its Drainage Master Plan and Phase II Storm Water Management Plan because impoundments with embankments greater than six feet in height could form an important component of the City's drainage program. The City will need to develop specific design and maintenance requirements to ensure the ongoing safety and proper operation of such dams.

Permanent surface water impoundments could also be subject to TCEQ water appropriations permitting. Proposed ponds or existing stock tanks that are undergoing a land-use change would require water appropriations permits from TCEQ. New ponds or existing stock tanks that lose their exempt status are required to submit and receive a permit to impound state water. The City must ensure these permit requirements are being addressed during plat review.

5.6 Related Regulatory Programs

In addition to the programs described in this section, influences from other agencies could impact the City's Drainage Master Plan efforts, including the following:

- Texas Department of Transportation Requirements
- Department of the Army Requirements
- State or Federal Agency NEPA Requirements
- Adjacent Local Government Requirements

6.0 DRAINAGE SYSTEM DESIGN CRITERIA

6.1 GENERAL REQUIREMENTS

The current City of Killeen's Drainage Design Criteria (**Appendix D**) were established on November 4, 1992. The purpose of the criteria is to establish design standards for drainage systems within the City of Killeen.

6.2 HYDROLOGIC METHODS

The first consideration in the design of a drainage system is the determination of runoff or flow (Q). The current drainage design criteria allow the Rational Method to be used for drainage areas less than 600 acres that are not in a designated FEMA floodway. The Rational Method is a simple equation: Q=C*I*A, where:

Q = storm flow at a given point in (cubic feet per second or cfs)

C = runoff coefficient based on ratio of runoff to rainfall (unitless)

I = average intensity of rainfall (in inches per hour based on time of concentration to the design point)

A = drainage area (in acres)

The drainage design criteria provide a table of runoff coefficients and an Intensity-Duration-Frequency (IDF) curve that supplies values for C and I.

Calculations to determine runoff from larger areas (i.e. those greater than 600) acres or those areas mapped by FEMA—are required to use Soil Conservation Service (SCS) (now known as the Natural Resource Conservation Service) Unit Hydrograph techniques. The current drainage design criteria refer to SCS Technical Release 55 (TR-55), Urban Hydrology.

6.3 HYDRAULIC METHODS

Hydraulic calculations for pipes and open channels are to be determined by the Manning's Formula. The Manning's Formula is a simple equation: $Q= 1.486/n*A*R^{2/3}*S^{1/2}$, where:

Q = discharge, storm flow at a given point (in cfs)

n = Manning's roughness coefficient (unitless)

A = cross sectional area (in square feet)

R = hydraulic radius, surface of channel in contact with water (in feet)

S = channel slope (in feet/feet)

6.4 SYSTEM ANALYSIS

Drainage systems that include several hydraulic elements (e.g. pipes, channels, and culverts) are required to use both the Rational Method and the SCS Unit Hydrograph method for hydrologic analysis. Hydraulic analyses are also required for the drainage system to determine if flow depth and velocity meet City requirements.

6.5 DESIGN ALTERNATIVES

The drainage design criteria allow for deviations from the standard city policy. Deviations from the criteria must be fully explained and include supporting documentation verifying that the deviation is within standard engineering practices.

A variety of computer models developed by the U.S. Army Corps of Engineers Hydrologic Engineering Center are readily available in the public domain for more detailed hydrologic and hydraulic analyses. These programs include HEC-HMS, HEC-RAS and other computer models that are standard applications for hydrologic and hydraulic analysis.

7.0 STORM WATER MANAGEMENT PLAN

7.1 PURPOSE OF PLAN

The objective of the Phase II Storm Water Management Plan (SWMP) is to develop a program with which the City of Killeen can reduce the discharge of pollutants to the Maximum Extent Practicable (MEP). This plan was developed with the input and direction of a stakeholders group to structure a proposed program for Killeen that meets state and federal program requirements and takes credit for current activities, addresses issues that will provide the greatest return on investment and is economically feasible.

The Texas Commission on Environmental Quality (TCEQ) has issued a digital general permit (Proposed General Permit No. TXR040000) for regulated small Municipal Separate Storm Sewer Systems (MS4s) covering eligible storm water and certain types of non-storm water discharges to surface water in the state. The proposed general permit provides requirements for operators of small MS4s for the development, implementation, and maintenance of a storm water management program.

7.2 PLAN DEVELOPMENT

Activities that were performed to support the Storm Water Management Plan development for the City of Killeen include:

- Review of existing storm water program information provided by the City
- Legal review of the City's storm water related ordinances
- Review of the City's existing storm water mapping information
- Detailed review of available water quality data in the Killeen area
- Preparation of a technical report summarizing the above information
- Three meetings of the Storm Water Stakeholders Group
- Business Stakeholders Group meeting
- Public Input Meeting
- Facilitatation of meetings with City departments
- Meetings with the City's GIS Coordinator
- Review of City facilities

The Storm Water Stakeholders Group assisted the City of Killeen in the development of their SWMP. The stakeholders group consisted of 23 citizens who represent a broad cross section of the City's constituency. The stakeholders included representatives from Texas Department of Transportation, Beautify Killeen, Fort Hood, City of Harker Heights, Texas State Soil and

Water Conservation Board, Bell County Public Health Department, as well as several homeowners, restaurant owners and developers.

Three meetings were conducted at the City of Killeen community meeting room at 207 W. Avenue D. The meetings typically began with a brief PowerPoint presentation, followed by a review of the BMP summary notebook for each minimum control measure and a discussion of the applicability of each BMP to Killeen. Each meeting concluded with the stakeholders voting on their "top five" BMPs for each minimum control measure. The proposed BMPs discussed in the following sections were selected based on input from the stakeholder group. Stakeholder meeting minutes are included in **Appendix J**.

7.3 Proposed Minimum Control Measures

The draft Phase II TPDES regulations were published on January 9, 1998, and the final Phase II regulations were published on December 8, 1999. Based on a survey of successful Phase I municipal programs, the EPA recognized that successful storm water quality programs have several things in common, including that they:

- Educate the public on storm water impacts
- Involve the public in the development and operation of the program
- Review City facilities
- Control storm water runoff from construction sites
- Require permanent controls for post-construction storm water runoff
- Include good housekeeping practices for municipal operations

The EPA refers to these items as "Minimum Control Measures," and the Phase II regulations require the City of Killeen to "develop, implement, and enforce a storm water program to reduce the discharge of pollutants to the Maximum Extent Practicable, protect water quality, and satisfy the appropriate water quality requirements of the Clean Water Act."

7.3.1 Public Education and Outreach

An effective public education program can significantly reduce other program costs, such as inspection and enforcement costs for the illicit discharge program. Informed citizens and business owners will usually take steps to reduce potential pollution from their own activities. The following list of Best Management Practices (BMPs) has been developed to modify the method and message on a regular basis in order to keep the program fresh and effective.

- Utility Bill Messages
- Storm Water Brochures
- Storm Water Web Site

- Public Service Announcements
- School Book Covers
- Classroom Education

7.3.2 PUBLIC PARTICIPATION AND INVOLVEMENT

In order for any regulatory program to be successful, especially a program dealing with storm water runoff where program benefits may not be readily apparent, public "buy in" to the regulatory process must be obtained. The following BMPs have been developed to easily allow the public to become involved in this storm water program.

- Storm Drain Stenciling
- Stream Cleanup Projects
- Storm Water Hotline

7.3.3 ILLICIT DISCHARGE DETECTION AND ELIMINATION

This program element is designed to ensure the elimination of illegal connections and discharges to the City of Killeen's storm water system. The regulatory language for the program element is very prescriptive and leaves little latitude for regulatory interpretation. However, the City is already performing some of the requirements of this program. The following list of BMPs includes current and new activities that meet regulatory requirements in the elimination of illicit discharges.

- Storm Drain System Mapping
- Illicit Discharge Ordinance
- Dry Weather Screening
- Illicit Discharge Investigations
- Sanitary Sewer Overflow Reduction
- Household Hazardous Material Disposal Options
- Reduction of Illegal Dumping
- Eliminate Failing Septic Systems

7.3.4 CONSTRUCTION SITE STORM WATER RUNOFF CONTROL

To date, control of construction site runoff has been the most publicly visible element of the storm water program. During a short period of time, construction sites can contribute more sediment to streams than can be deposited naturally during several decades. Therefore, this program may generate more enforcement activity than all other storm water program elements combined. The following BMPs promote and monitor compliance with this program element.

- Construction General Permit Training
- Plan Review Procedures
- Construction Inspection
- Development Stakeholder Group
- Erosion Control Ordinance

7.3.5 POST-CONSTRUCTION STORM WATER MANAGEMENT IN AREAS OF NEW DEVELOPMENT AND REDEVELOPMENT

Numerous studies have documented that storm water runoff from developed sites contributes significant pollutant loads to receiving waters. To address this issue and comply with the regulatory requirements for this program element, the following BMPs have been recommended.

- Development/Redevelopment Stakeholder Group
- Post-Construction Ordinance
- Long-Term Operation and Maintenance of BMPs
- List of Water Quality CIP Projects

7.3.6 POLLUTION PREVENTION/GOOD HOUSEKEEPING FOR MUNICIPAL OPERATIONS

It is difficult to convince citizens of the need for storm water pollution prevention if the municipality is not "practicing what it preaches." Therefore, an effective municipal storm water program must be founded on an effective pollution prevention program for municipal facilities and field operations. Below is a list of currently performed and new BMPs, which are necessary to meet regulatory requirements for this program element.

- Storm Water Pollution Prevention Training
- Vehicle Maintenance
- Vehicle Washing
- Vehicle Fueling
- Landscape and Lawn Care
- Roadway Cleaning
- Storm Drain System Cleaning
- Hazardous Materials Storage and Disposal
- Used Oil Collection & Recycling

7.4 PLAN IMPLEMENTATION

While the City of Killeen is currently performing some of the previously listed BMPs under existing programs, the Storm Water Management Plan will be implemented after the final General Permit No. TXR040000 has been issued. TCEQ has issued a revised draft permit and is accepting public comment. Initial opinion is that the permit will be finalized January 1, 2006. The specific implementation schedule and measurable goals are summarized in the following table. The City of Killeen Plan Summary is included in **Table 7.1**.

Table 7.1 Proposed Storm Water Best Management Practices

	STORM WATER MANAGEMENT PLAN	***PLAN SUMMARY***
	The table below lists the measurable goals developed for each BMP and the year in which they are to be implemented.	

BMP	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
Utility Bill Inserts	1 catalog 2 inserts mailed	2 inserts mailed	2 inserts mailed	2 inserts mailed	2 inserts mailed
Storm Water Brochures	1 list of topics 1 catalog 1 summary brochure	1 list of locations 1 new topical brochure	1 new topical brochure	1 new topical brochure	1 new topical brochure 1 catalog
Storm Water Web Site	Web site online by end of Year 1	2 new pages	1 new page	1 new page	1 new page
Public Service Announcements	Number of available slots Catalog - cable access PSAs	24 cable broadcasts Catalog - radio PSAs	24 cable broadcasts	24 cable broadcasts 4 radio broadcasts	24 cable broadcasts 4 radio broadcasts
School Book Covers	1 catalog	1 mock-up book cover	5,000 covers provided	5,000 covers provided 1 winning design	5,000 covers provided
Classroom Education	None	Catalog of curricula Meeting with ISD Set of modifications	List of grades List of teachers Packets for each teacher	1 session for each teacher	1 session for each teacher
Storm Drain Stenciling	1 catalog 1 mock up packet selected design	1 summary flyer GIS inlet map At least 1 stenciling event	At least 2 stenciling events	At least 3 stenciling events	At least 3 stenciling events
Stream Cleanup Projects	None	List of locations 1 mock up packet	1 summary flyer at least 1 clean up event	1 summary flyer at least 1 clean up event	1 summary flyer at least 1 clean up event
Storm Water Hotline	1 hotline established List of investigations	List of investigations	List of investigations	List of investigations	List of investigations
Storm Drain System Mapping	Little Nolan Creek watershed mapped	South Nolan Creek watershed mapped	Long Branch watershed mapped	Hay Branch watershed mapped	Reese and Trimmier Creek watershed mapped
Illicit Discharge Ordinance	1 draft ordinance	1 adopted ordinance	Written enforcement procedures	None	None
Dry Weather Screening	List of parameters Purchase order	South Nolan and Little Nolan watershed screening map	Long Branch watershed screening map	Hay Branch watershed screening map	Reese and Trimmier Creek watershed screening maps

Table 7.1 Proposed Storm Water Best Management Practices **(continued)**

STORM WATER MANAGEMENT PLAN

PLAN SUMMARY

The table below lists the measurable goals developed for each BMP and the year in which they are to be implemented.

BMP	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
Illicit Discharge Investigations	List of investigation types and locations	List of investigation types and locations	List of investigation types and locations	List of investigation types and locations	List of investigation types and locations
Eliminate Sanitary Sewer Overflows	Clean 350,000 ft / year TV 12,000 ft / year	Clean 350,000 ft / year TV 12,000 ft / year	Clean 350,000 ft / year TV 12,000 ft / year	Clean 350,000 ft / year TV 12,000 ft / year	Clean 350,000 ft / year TV 12,000 ft / year
Household Chemical Disposal	Written tracking procedure List of requests	Flyer / brochure / web page List of requests	Flyer / brochure / web page List of requests	List of requests Evaluation report	List of requests
Reduce Illegal Dumping	GIS map of dump locations	GIS map of dump locations	GIS map of dump locations	GIS map of dump locations	GIS map of dump locations
Reduce Failing Septic Systems	Map of septic systems	Mock-up brochure	List of distribution locations Map of new sewer and conversions	List of distribution locations Map of new sewer and conversions	List of distribution locations Map of new sewer and conversions
Construction General Permit Training	Attendance sheet from 1 class	Attendance sheets from 2 classes	None	None	None
Plan Review Procedures	Compliance report	Compliance report	Compliance report	Compliance report	Compliance report
Construction Inspection	None	Adopted procedures	List of inspections	List of inspections	List of inspections
Development Stakeholder Group	Flyers Invitation list	Minutes of 2 meetings	Minutes of 2 meetings	None	None
Strengthen Erosion Control Ordinance	Draft ordinance	Written procedures	Adopted ordinance	None	None
Development Stakeholder Group	Flyers Invitation list	Minutes of 2 meetings	Minutes of 2 meetings	None	None
Post-Construction Ordinance	None	Catalog of ordinances	None	Adopted ordinance	Design manual
Long-Term Operation and Maintenance of BMPs	None	List of BMPs	None	BMP GIS coverage	BMP GIS coverage
List of Water Quality CIP Projects	None	List of water quality CIP projects	None	BMP GIS coverage	None

Table 7.1 Proposed Storm Water Best Management Practices (continued)

STORM WATER MANAGEMENT PLAN	PLAN SUMMARY
The table below lists the measurable goals developed for each BMP and the year in which they are to be implemented.	

BMP	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
Storm Water Pollution Prevention Training	BMP/SOP manual 1 training per department	1 training per department	1 training per department	1 training per department	1 training per department
Vehicle Maintenance	Document measures	Document measures	Document measures	Document measures	Document measures
Vehicle Washing	Maintenance log	Maintenance log	Maintenance log	Maintenance log	Maintenance log
Vehicle Fueling	UST system report 1 speed bump	UST system report Verification of containment	UST system report Verification of containment	UST system report	UST system report
Landscape and Lawn Care	Licensed applicators	Licensed applicators	Licensed applicators	Licensed applicators	Licensed applicators
Roadway Cleaning	5,000 lane miles	5,000 lane miles	5,000 lane miles	5,000 lane miles	5,000 lane miles
Storm Drain System Cleaning	None	GIS inlet coverage	GIS inlet coverage	GIS inlet coverage	GIS inlet coverage
Hazardous Materials Storage & Disposal	Additional storage units Written procedures	2 training sessions	2 training sessions	2 training sessions	2 training sessions
Used Oil Collection & Recycling	Document disposal	Document disposal	Document disposal	Document disposal	Document disposal

8.0 NON-POINT SOURCE POLLUTION ASSESSMENT

The nature and extent of non-point source (NPS) pollution associated with urban areas within the City of Killeen and its extraterritorial jurisdiction (ETJ) is being assessed through a surface water quality monitoring program. This program will include wet-weather and ambient monitoring of stream water quality parameters at 14 sites in the South Nolan Creek and Lampasas River watersheds. The water quality monitoring program was initiated in fiscal year (FY) 2004-2005 and included nine sites in the South Nolan Creek watershed. In FY 2005-2006, the monitoring will be expanded to include five additional sites in the Lampasas River watershed.

Funding for the water quality monitoring program was secured through federal grants administered by the United States Environmental Protection Agency (EPA). Two NPS Clean Water Act (CWA) Section 319(h) grants were approved by the EPA and the Texas Commission on Environmental Quality (TCEQ) for funding. The FY 2004-2005 NPS grant encompassed monitoring activities within the South Nolan Creek watershed. The FY 2005-2006 grant extends the monitoring activities to areas of the city that drain to the Lampasas River and Stillhouse Hollow Lake. Both grant projects will continue for three years from the date of the award. CWA Section 319(h) grants require a 40 percent local match for each project. EPA reimburses the grantee 60 percent of the total project cost. The City's 40 percent local match will be provided by a combination of "in-kind" services performed by city personnel and professional services contracts related to grant activities.

Depending on the findings and recommendations resulting from the initial studies, the City may decide to continue monitoring at selected sites to document trends or the effectiveness of storm water BMPs.

The purpose, scope and objectives of Killeen's surface water quality monitoring program is discussed in the following sections.

8.1 PURPOSE OF PROJECTS

The purpose of both NPS grant projects is to address water body impairments that have been documented by TCEQ and determine the extent to which the City of Killeen may be contributing to water quality problems.

8.1.1 CURRENT WATER QUALITY STATUS AND POTENTIAL TMDLS

Both South Nolan Creek, which drains the northern portion of the city, and the Lampasas River, which receives storm water runoff from the southern portion of the city, are listed on the State's 303(d) list for impairment of contact recreation use due to elevated bacteria concentrations. The source of the bacterial contamination is unknown. Based on the location of historical state monitoring sites, it is unknown whether the urban areas of Killeen are a major source of contamination. Killeen's surface water quality monitoring program will enable the City to document the occurrence of pollutants and identify areas of the City that are major contributors.

The State's 303(d) list, so named because of provisions in Section 303(d) of the federal CWA, is published by TCEQ in even-numbered years and is subject to EPA approval. Water bodies that do not meet State water quality standards are listed on the 303(d) list and may be targeted by TCEQ for a comprehensive analysis called a Total Maximum Daily Load (TMDL) study. A TMDL study examines all the point sources (end-of-pipe discharges) and non-point sources (diffuse discharges) of a particular pollutant in a watershed. The TMDL then allocates the amount that can be discharged while maintaining the beneficial use of the water. The allocations of point sources are called waste load allocations (WLAs), and the allocations of non-point sources are called load allocations (LAs). The TMDL must also consider natural background sources that may be present and include a margin of safety for the assessment. The following equation represents the components of a TMDL:

$$\text{TMDL} = \sum \text{LAs} + \sum \text{WLAs} + \text{Background} + \text{MOS}$$

where:

TMDL = Total Maximum Daily Load (kg/day)
$\sum$ LAs = Sum of Load Allocations (Non-Point Sources) in a watershed
$\sum$ WLAs = Sum of Waste Load Allocations (Point Sources) in a watershed
Background = Background Load from natural sources in a watershed
MOS = Margin of Safety

Background pollutant loads originate from natural sources in the watershed that are not related to human activities. For bacteria, natural sources may include native wildlife populations. As a component of a TMDL, background loads cannot be readily controlled or reduced and are therefore static in the TMDL equation. To meet the TMDL that is allowable in the watershed, the LAs and WLAs are reduced from current levels. From a regulatory standpoint, the load reductions are imposed through effluent limits placed in new and renewed permits issued by TCEQ. This can affect future MS4 permits, as well as discharge permits for municipal wastewater treatment plants that discharge to impaired water bodies.

Once a water body becomes impaired, there are three options the TCEQ has for addressing the impairments. The first option is to conduct a TMDL study and develop a plan to implement it. If there are some questions about the validity of the water quality standards or the data used to assess the water quality, the TCEQ may opt to postpone the TMDL study while a review of the water quality standards or additional data collection is being performed. Further evaluation may be necessary to determine if the current standard is appropriate or to determine the cause of the impairment.

The State of Texas is under mandate by the EPA to develop quantitative numerical criteria for nutrients as part of its water quality standards. Currently, Texas uses narrative criteria to govern acceptable quantities of nutrients in water bodies. The ill-defined narrative criteria are somewhat subjective and are evaluated by comparisons to TCEQ adopted screening levels. Nutrients are deemed a concern when a prescribed number of the samples exceed the screening level. The timeline set forth by TCEQ for nutrient criteria development focuses on reservoirs first with anticipated development by 2006. Nutrient criteria for rivers and streams are anticipated to be developed by 2010.

The TCEQ has determined that additional data is needed for South Nolan Creek and the Lampasas River before a TMDL study is scheduled. Because TMDLs may be imposed in either of these watersheds, it is critical that the City of Killeen characterize its contribution to water quality impairment. Because TMDL implementation within a watershed brings with it additional regulatory requirements that can be imposed on permitted dischargers, it is important that regulatory decisions be based on accurate data and sound science. It is also important that the data reflect contributions from Killeen, rather than a composite view of several urban areas based on a downstream sampling site.

In addition to the bacterial impairment, historically elevated levels of nutrients such as nitrogen and phosphorus are documented in samples collected from South Nolan Creek. Over 70 percent of the samples collected by TCEQ show elevated concentrations of nitrate plus nitrite nitrogen, orthophosphate phosphorus, and total phosphorus. These pollutants are currently listed as a concern and are not included on the 303(d) list. With efforts underway by the State to develop numeric nutrient criteria, these pollutants may be upgraded from a concern to an impairment in the future.

8.1.2 DESIGNATED USES AND WATER QUALITY STANDARDS

The City of Killeen's surface water monitoring program will address urban NPS pollutant contributions from urbanized areas in three classified segments: South Nolan Creek (Segment 1218), the Lampasas River (Segment 1217), and Stillhouse Hollow Lake (Segment 1216). South Nolan Creek receives storm water runoff from the northern and western portions of the city, and the Lampasas River and Stillhouse Hollow Lake receive storm water from the southern portion of the city.

Designated uses for water bodies receiving storm water runoff from the City of Killeen include aquatic life use, contact recreation use, general use, fish consumption use, and public water supply (**Table 8.1**). For each of the designated uses that a water body is determined to have, a set of specific State of Texas water quality criteria are imposed by TCEQ. Water quality criteria relevant to receiving water bodies are listed in **Table 8.2**.

Table 8.1 Designated Uses

Segment ID	Water Body Name	Designated Uses: Contact Recreation	Aquatic Life	Public Water Supply	General	Fish Consumption
1216	Stillhouse Hollow Lake	X	Exceptional	X	X	X
1217	Lampasas River Above Stillhouse Hollow Lake	X	High		X	X
1218	Nolan Creek/ South Nolan Creek	X	High		X	X

Table 8.2 Water Quality Criteria

Segment ID	Water Body Name	Chloride[1] mg/l	Sulfate[1] mg/l	Dissolved Solids[1] mg/l	Dissolved Oxygen[2] Minimum mg/l	Min pH[3]	Max pH[3]	E.Coli[4]	Fecal Coliform[4]	Temperature[5] Maximum F
1216	Stillhouse Hollow Lake	100	75	500	6	6.5	9	126	200	93
1217	Lampasas River Above Stillhouse Hollow Lake	500	100	1200	5	6.5	9	126	200	91
1218	Nolan Creek/ South Nolan Creek	100	75	500	5	6.5	9	126	200	93

[1] chloride, sulfate, and dissolved solids criteria are expressed as a maximum annual average
[2] dissolved oxygen criteria relate to the minimum 24-hour mean
[3] pH criteria are set for the minimum and maximum values expressed in standard units
[4] E. coli and Fecal Coliform expressed as the geometric mean in CFU/100mL
[5] temperature criteria are the maximum values allowed at any site within the segment

As previously discussed, the TCEQ uses screening levels in the absence of nutrient criteria to identify concerns associated with the narrative criteria. The screening levels for nutrients and chlorophyll-a are the same statewide but vary depending on the type of water body. The TCEQ has established screening levels for freshwater streams, reservoirs, tidal streams, and estuaries. The screening levels that are applicable to water body types that will be monitored for NPS pollution are listed in **Table 8.3**.

Table 8.3 Narrative Criteria (TCEQ Screening Levels) for Nutrients and Chlorophyll-a

Water Quality Parameter	Freshwater Streams	Reservoirs
Ammonia Nitrogen (mg/L)	0.17	0.106
Nitrate plus Nitrite Nitrogen (mg/L)	2.76	0.32
Orthophosphate Phosphorus (mg/L)	0.5	0.05
Total Phosphorus (mg/L)	0.8	0.18
Chlorophyll-a (mg/L)	11.6	21.4

8.2 PROJECT SCOPE AND OBJECTIVE

Surface water quality monitoring will be coupled with implementation of the City's Storm Water Management Program to address problem areas that are identified through monitoring. Killeen's SWMP will include several BMPs that will reduce the quantity of bacteria contamination. In addition to E. coli bacteria, the City will monitor typical NPS pollutants associated with urban runoff, including sediment, nutrients, metals, oil/grease, biochemical oxygen demand, and physicochemical parameters such as dissolved oxygen, conductivity, pH, and temperature. The major objectives identified for the NPS assessment projects include:

OBJECTIVE 1: PROJECT ADMINISTRATION

Goal: To effectively administer the functions necessary to coordinate and monitor all work performed for the 319 grant projects, including technical and financial supervision, preparation of status reports, and maintenance of project files and data.

Progress reports will document all activities performed by any subcontractor(s) and will be submitted no later than thirty (30) days after the close of the quarter.

OBJECTIVE 2: WATER QUALITY MONITORING & DATA COLLECTION

Goal: To quantify non-point source pollutants within the South Nolan Creek and Lampasas River watersheds and, through analysis of the data, identify priority areas within the City of Killeen for BMP implementation related to bacterial sources.

This process requires an inventory of the potential sources within the watershed, site identification, installation of automatic samplers for wet-weather monitoring, and initiation of a routine monitoring program. Monitoring efforts and data collection will be conducted by the City of Killeen with assistance from the Texas Institute for Applied Environmental Research (TIAER).

OBJECTIVE 3: WATERSHED CHARACTERIZATION

Goal: To obtain information on potential sources of bacteria in the watershed and to characterize the nature of bacterial sources above each sampling site.

The City will characterize the location of potential pollutant sources in the watershed, particularly those sources related to bacteria. A GIS-based coverage will be developed of On-Site Sewage Facilities (OSSFs) in the watershed. The watershed characteristics will be used in conjunction with monitoring results to target priority areas in the watershed for BMP implementation.

OBJECTIVE 4: COORDINATION AND STAKEHOLDER INVOLVEMENT

Goal: To coordinate with other monitoring groups and share information with local stakeholders regarding water quality monitoring programs in the Lampasas River Watershed.

A representative from Killeen will participate in regularly scheduled meetings of the Lake Stillhouse Hollow Clean Water Steering Committee and share information regarding monitoring program status and results. A City representative will also participate in coordinated monitoring meetings held at the Brazos River Authority office in Waco, Texas.

OBJECTIVE 5: FINAL REPORT

Goal: To provide TCEQ and EPA with a comprehensive report on the activities conducted by the City of Killeen during the course of this project.

To accomplish this goal, the City will consolidate water quality and watershed characteristics into a spreadsheet or similar database suitable for tabulating, sorting, and analyzing the data. Statistical techniques will be used to summarize the data and examine relationships and trends. Based on the results, the City will identify priority areas for BMP implementation as part of its Phase II MS4 SWMP.

8.3 PROJECT IMPLEMENTATION

8.3.1 MONITORING IN THE SOUTH NOLAN CREEK WATERSHED

The surface water monitoring program in the South Nolan Creek Watershed will include routine and wet-weather monitoring at six sites on South Nolan Creek and three tributaries flowing into South Nolan Creek (**Exhibit 8.1**) for bacteria, nutrients, organics, sediment, oil and grease, and metals as identified in **Table 8.4**. Sampling for E. coli bacteria will occur on a monthly basis at nine sites. Other water quality parameters will be monitored semi-annually at sites along the main stem of South Nolan Creek. A GIS coverage of OSSF locations within the city will be used in conjunction with water quality data to identify priority areas for OSSF inspections, sewer conversions, and targeted public education.

Table 8.4 Water Quality Constituents

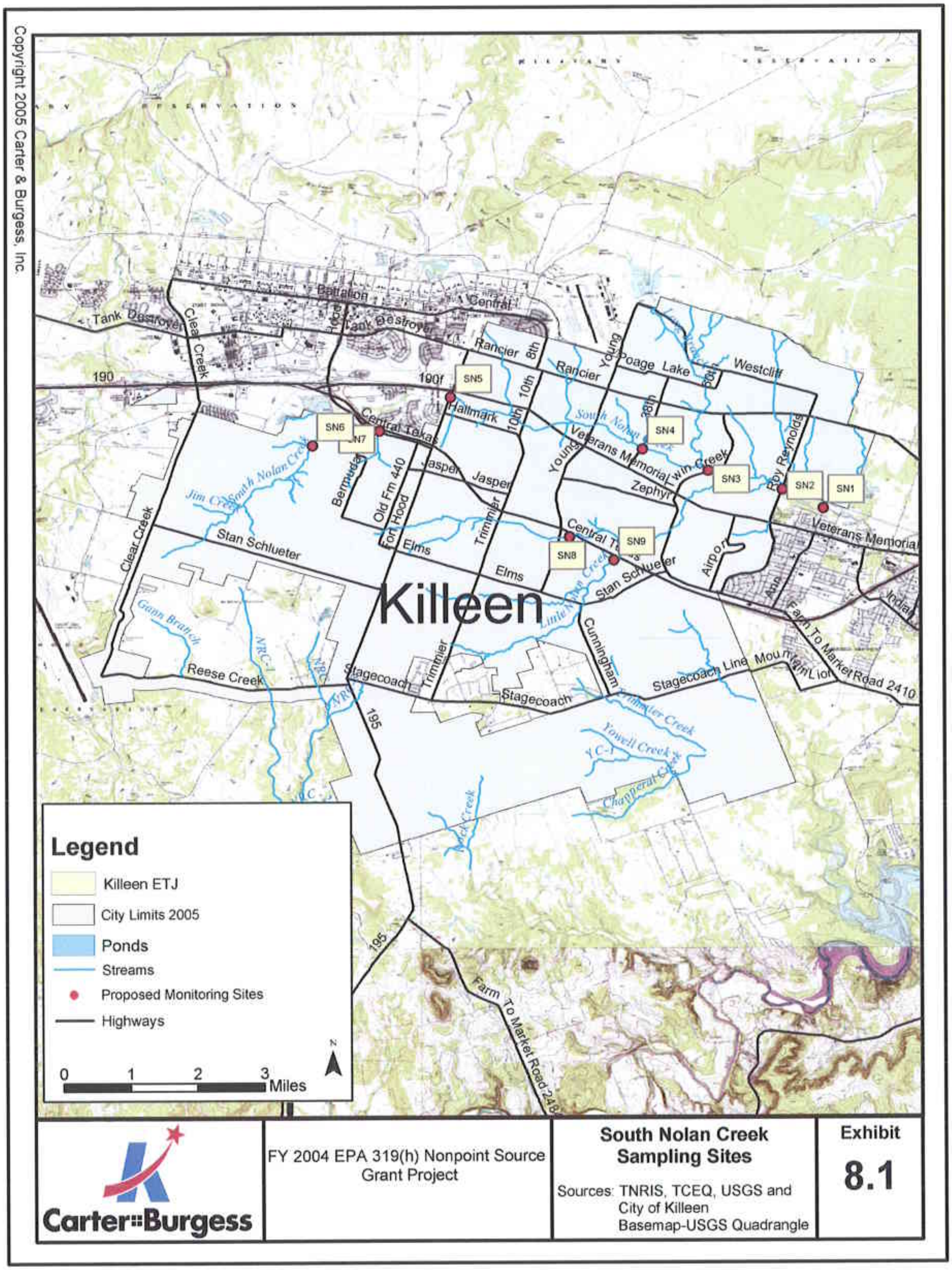
NO_2+NO_3-N	Nitrite + Nitrate Nitrogen
NH_3-N	Ammonia Nitrogen
TKN	Total Kjeldahl Nitrogen
PO_4-P	Ortho-Phosphate Phosphorus
TP	Total Phosphorus
TSS	Total Suspended Solids
O & G	Oil & Grease
BOD5	Biochemical Oxygen Demand (5-day)
E. Coli	*Eschericia coli* bacteria
DO	Dissolved Oxygen
pH	pH
Cond	Specific Conductance
Temp	Water Temperature

8.3.2 MONITORING IN THE LAMPASAS RIVER WATERSHED

The monitoring program in the Lampasas River Watershed will include the same types of constituents as described above for the South Nolan Creek monitoring program. Monitoring will be conducted at five sites within the Lampasas River Watershed (**Exhibit 8.2**). Wet-weather monitoring with automated samplers will be implemented at three tributary sites (Sites LR1, LR2, and LR3), and routine monitoring will be conducted on a quarterly basis at two sites (Sites LR4 and LR5) on the Lampasas River. Two major tributaries were selected for monitoring storm water contributions from the City. These include Trimmier Creek, which drains the southeastern portion of the City and flows into Stillhouse Hollow Lake, and Reese Creek, which drains the southwestern portion of the City and conflows with the Lampasas River. Both the Trimmier Creek and Reese Creek watersheds contain residential areas that utilize on-site sewage facilities (OSSFs) and are representative of urban watershed contributions from the City of Killeen. Storm water sampling on Trimmier and Reese Creeks will allow the City to characterize pollutant event mean concentrations (EMCs) from urban storm water runoff that may impact the quality of water in the Lampasas River and Stillhouse Hollow Lake. Stream flow in Reese and Trimmier Creeks are intermittent in nature and will be sampled only during storm events.

In addition to storm water monitoring at three sites (Sites LR1, LR2, and LR3), the City will perform routine monitoring at two sites on the Lampasas River (Sites LR4 and LR5). These sites were chosen to isolate the contributions from the Reese Creek watershed using an upstream-downstream approach. Site 5, located upstream from the Reese Creek confluence, is not impacted by storm water runoff from the City of Killeen. Site 5 will be used to characterize stream concentrations from the upper watershed. Site 4 is located on the Lampasas River at SH 195, downstream from the Reese Creek confluence. Other than the Reese Creek watershed, the interceding drainage area between Sites 4 and 5 is minimal. The minor tributaries that confluence with the Lampasas River between Sites 4 and 5 drain undeveloped areas, with no significant sources of pollution identified. Comparison of stream concentrations observed at these two sites will quantify the impact of urban runoff from the Reese Creek watershed. A paired t-test or comparable non-parametric statistical test will be used to determine if significant differences exist between these two sites.

Routine monitoring will include monthly sampling for *E. coli*. All other parameters will be monitored on a quarterly basis. Quarterly sampling is proposed to ensure that a sufficient number of samples are collected to utilize parametric statistical tests when analyzing the data. Monthly sampling for *E. coli* bacteria will ensure consistency with monitoring programs in portions of the city that drain into South Nolan Creek.



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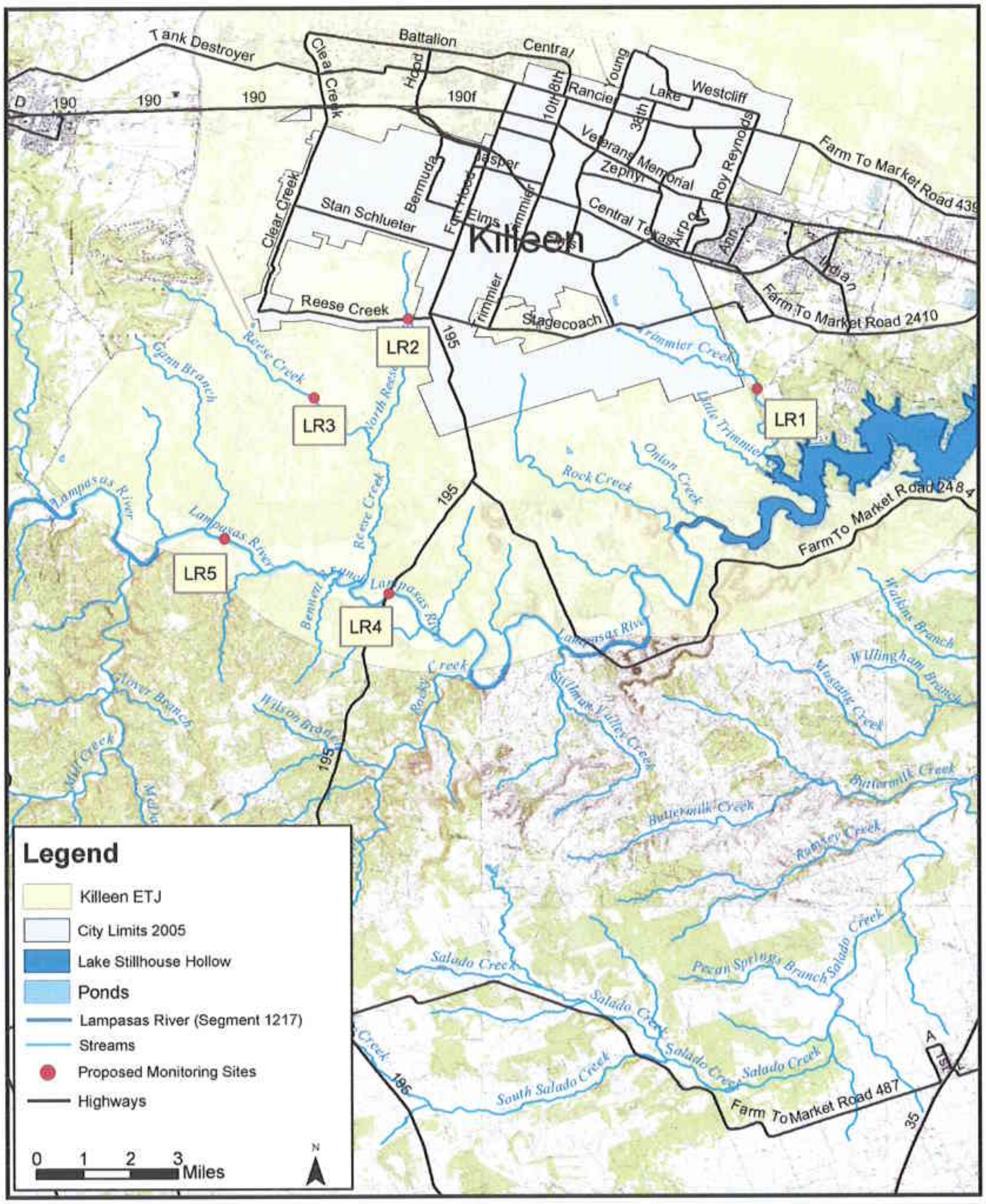
Killeen
Legend
Killeen ETJ
City Limits 2005
Ponds
Streams
Proposed Monitoring Sites
Highways
0 1 2 3 Miles
N
SN1
SN2
SN3
SN4
SN5
SN6
SN7
SN8
SN9
Tank Destroyer
Clear Creek
Battalion
Central
Rancier
8th
10th
Young
Poage
Lake
Westcliff
190
Hallmark
Central Texas
South Nolan Creek
Veterans Memorial
Twin Creek
Roy Reynolds
Jasper
Zephyr
Jim Creek
Bermuda
Old Fm 440
Fort Hood
Trimmier
Stan Schlueter
Elms
Airport
Gann Branch
Reese Creek
NRC-1
Stagecoach
Cunningham
Stagecoach Line
Farm To Market Road 2410
Trimmier Creek
Yowell Creek
YC-1
Chaparral Cr.
195
Farm To Market Road 2484
Carter::Burgess
FY 2004 EPA 319(h) Nonpoint Source Grant Project
South Nolan Creek Sampling Sites
Sources: TNRIS, TCEQ, USGS and City of Killeen Basemap-USGS Quadrangle
Exhibit
8.1



Carter::Burgess	FY 2005 EPA 319(h) Nonpoint Source Grant Project	**Lampasas River Watershed Sampling Sites** Sources: TNRIS, TCEQ, USGS and City of Killeen Basemap-USGS Quadrangle	**Exhibit** **8.2**

9.0 CAPITAL IMPROVEMENT PROJECT PROGRAM

9.1 PROJECT PRIORITIZATION PROCESS

Because the City of Killeen does not have the financial capacity to fund all CIPs immediately, a prioritization matrix was created to determine the order in which short-list CIPs are designed and constructed.

A preliminary CIP Prioritization Matrix was created as part of the Drainage Master Plan Scoping Study. Factors in that matrix included:

- Long-Term Maintenance Reduction
- Cost
- Regional Solution
- Environmental Concerns
- "At-Risk" Conditions
- Design Data Requirements
- Reduction in Flood Losses
- Project Life
- Adverse Site Conditions
- Citizen Concerns
- Utility Relocation
- Water Quality Improvements
- Political Concerns
- Easement/ROW Requirements
- Nuisance Flooding
- Aesthetics
- Schedule
- NFIP Claim Reduction

As part of the Drainage Master Plan Scoping Study, the City of Killeen established a Stakeholder Committee to provide public input on the proposed factors for prioritization of CIP projects. The committee consisted of members of the Landscape Ad Hoc Committee as well as other interested citizens. Approximately 21 stakeholders attended the January 28, 2004 meeting. The stakeholders ranked the importance of each factor. The stakeholders indicated the importance of reducing long-term maintenance, providing cost efficient solutions, providing environmentally sound solutions and examining regional solutions to drainage issues. These four factors received more votes than the other factors combined. The importance of each factor is reflected in the CIP Prioritization Matrix. Minutes of the Stakeholder Committee meeting are included in **Appendix J**.

The preliminary CIP Prioritization Matrix was revised for the Drainage Master Plan Phase 1 design to incorporate additional factors. The final prioritization matrix is included in **Table 9.1**. City of Killeen staff added:

- Historical Flooding
- Deteriorated Infrastructure
- Chronic Maintenance Concerns
- Water Quality Degradation
- Engineering Design Insufficiencies
- Technical Complexities
- Water in Residence
- Utility Conflicts and Lack of Easements
- Community or Neighborhood Concerns
- Public Safety or Other Liabilities
- High Visibility
- Implementation Costs

Table 9.1 CIP Prioritization Matrix

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	
Long-Term Maintenance Reduction	Does the proposed CIP reduce long-term maintenance requirements	0 to +4	>50% = +4 10-30% = +2 30-50% = +3 0-10% = +1	
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns, City liability, or flooding in residences	0 to +4	Y(Public safety) = +2 Y(City liability) = +2 Y(Residence Flooding) = +4 N=0	
Cost	What percentage does the proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 10-30% = 0 50-75% = -2 0-10% = +1 30-50% = -1	
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	Small regional impact = +1 Medium regional impact = +2 Large regional impact = +3	
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	Adverse impacts = -1 No significant impact = 0 Improves wildlife habitat = +1 Protects or restores natural vegetation = +1	
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	Extremely complex engineering/design = -2 Complex engineering/design = -1 N = 0 No engineering/design = +1	
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 Minimal reduction = +1 N = 0	
Project Life	What is the estimated project life	-1 to +2	0-5YRS = -1 10-20 YRS = +1 5-10YRS = 0 >20 YRS = +2	
Adverse Site Conditions	Does the project site have adverse site conditions that would hinder site access or construction	-1	Y = -1 N = 0	
Visibility	Is the proposed CIP highly visible	+1	Y = +1 N = 0	
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y = +1 N = 0	
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y = -1 N = 0	
Water Quality Improvements	Does the proposed CIP improve water quality or reduce future water quality degradation	+1	Y = +1 N = 0	
Political Concerns	Are there political concerns/influences pushing this project	+1	Y = +1 N = 0	
Easement/ROW Requirements	Does the proposed CIP require additional easements or ROW	-1	Y = -1 N = 0	
Nuisance Flooding	Does the proposed CIP reduce nuisance flooding in the project area	+1	Y = +1 N = 0	
Aesthetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative impact = -1 No significant change = 0 Positive impact = +1	
Schedule	Can the proposed CIP quickly be implemented and solve drainage problem	0 to +1	Y = +1 N = 0	
NFIP Claims Reduction	Does the proposed CIP remove or reduce potential losses to structures with prior NFIP Claims	0 to +1	Y = +1 N = 0	

9.2 MINOR PROJECTS

The City of Killeen currently maintains a Minor CIP program to address minor drainage problems. These projects typically address isolated problems or do not affect large areas. The City currently (as of April 1, 2005) keeps a list of approximately 120 potential minor CIPs that have been approved by the Water/Sewer/Drainage Committee. There are also approximately 20 other small projects, with budgets under $6000, that could be added to the Minor CIP list. Minor CIPs are ranked based on a prioritization matrix using factors including:

- Design Data Requirements
- Adverse Site Conditions
- Political Concerns
- Citizen Concerns
- Utility Relocation
- Easement Requirements
- “At-Risk” Conditions
- Water Quality Improvement
- Long-Term Maintenance Reduction
- Project Cost

The City intends to continue funding minor CIPs with a minor CIP budget for 2006 of $721,000. The goal of the minor CIP program is to complete minor CIPs within 2-3 years of the project being added to the list. The current minor CIP list is shown in **Table 9.2** and is also included in **Appendix F**.

Table 9.2: Minor CIPs

Project	Score	Est. Project Cost	Project	Score	Est. Project Cost	Project	Score	Est. Project Cost
2202 Hidden Hills Dr.	78	$1,000	3318 Viewcrest Dr.	54	$1,000	406/410 Phyllis Dr.	47	$9,000
2413 Southport Dr.	76	$5,000	3701 Stallion Dr.	54	$1,000	3311 Bermuda Dr.	47	$18,000
2901 St Francis St.	67	$3,000	4307 Greenlee Dr.	54	$1,000	504-610 Odom Dr.	47	$30,000
2003 Schwald Rd. (Long Branch)	66	$2,000	508 Weiss Dr.	54	$1,000	2614 Willow Springs Rd. (Bermuda)	47	
Carrie Ave. and Conder St., Conder Park Trib.	66	$30,000	5402 Birdcreek Dr.	54	$1,000	4910 Bending Trl. (Bending Trail)	47	
3719 Lakecrest Dr.	64		708 Houston St.	54	$1,000	5113 Glenwood Dr. (Bending Trail)	47	
5300 Birdcreek Dr.	64	$3,000	1107 Patriotic St. (Patriotic)	54		203 Collins Ave. (Fowler)	46	$9,000
Windfield Dr. and Waterproof Dr.	64	$3,000	403 E Hallmark Ave.	54	$28,000	208/210 Fowler Ave. (Fowler)	46	$9,000
2004 Grey Fox Tr. (LNCT 1 Trib.)	63	$39,000	Vive Les Arts Complex	54	$60,000	210 Bryce Ave. (Fowler)	46	$9,000
1807 Ledgestone Dr. (LNCT 1 Trib.)	61	$39,000	606 Donne Dr.	53	$6,000	3901 Trotwood Trl.	46	$9,000
1401 Windsor Cr.	60	$1,000	702 E Ave. E	53	$30,000	500 Block of Utah St. (Gilmer)	46	$30,000
2401 Haven Dr.	60		2808 Cheaney Dr.	53	$60,000	108 Garth Dr.	45	$6,000
602/605/606 Shad Cr.	60	$1,000	1812 Michelle Dr.	52	$6,000	1220 Chippendale Dr.	45	$6,000
902 San Antonio St.	60		1101 August Dr.	51	$18,000	1504 Becker Dr.	45	$6,000
807/808 Evergreen Dr.	60	$30,000	910/912 Kern Rd.	51	$18,000	1509 Janis Dr.	45	$6,000
3400 Granite Dr.	59	$25,000	1400 Barbara Ln. (Ronstan)	51	$42,000	1701 Waterford Dr.	45	$6,000
3201 Cody Poe Road	59	$60,000	1101 Karen Dr.	50	$3,000	1708 Bristol Dr.	45	$6,000
802/806/811 Skyline Ave.	48	$84,000	1204 Bristol Dr.	50	$3,000	2308 Waterfall Dr.	45	$6,000
3232/3234 Cantabrian Dr .(Old Florence)	41	$30,000	4202 Fawn Dr.	50	$3,000	2410 Royal Crest Cir.	45	$6,000
1710 Joy Dr.	68	$18,000	Caprice Dr. & Cross Timbers Dr.	50	$3,000	3201 Levy Ln.	45	$6,000
1300 Block of S 2nd St.	64	$6,000	Daybreak Dr. & Misty Ln.	50	$3,000	4901 Greenlee Dr.	45	$6,000
4500 John David Dr.	63	$18,000	Honeysuckle Cir. & Shawn Dr.	50	$3,000	620 Bishop Dr.	45	$6,000

Table 9.2: Minor CIPs (continued)

Project	Score	Est. Project Cost	Project	Score	Est. Project Cost	Project	Score	Est. Project Cost
3610/3612 Palmtree Ln.	60	$18,000	Morning Glen Ln. & Shawn	50	$3,000	1604/1606 Linda Ln. (Ronstan)	45	$8,000
3601 Woodrow Dr.	60	$36,000	5200 Block of Daybreak Dr.	50	$6,000	1001/1103 Charrise St. (Patriotic)	44	
4201 Zephyr Rd. (Patriotic)	59		3008-3110 Tallwood Dr.	50	$18,000	3700 Block of Lakecrest Dr.	44	$30,000
1107 York Ave.	59	$30,000	3101-3003 Paintrock Dr.	50	$18,000	407/409 Baumann Dr.	42	$6,000
1401 Fox Creek Dr.	58	$3,000	2807 Cheaney Dr.	50	$28,000	3504 Chandler Dr.	42	$9,000
1901 Moonstone Dr.	58	$3,000	1907 Lava Ln.	50	$50,000	2903 Cheaney Dr.	42	$30,000
3104 Minthorn Dr.	58	$3,000	2501/2503 Magnum Cr. (Dickens)	50		208 N 28th St. (Conder Park)	42	$39,000
Lake Rd. and Tucker Dr.	58	$6,000	301/302/311 Baumann Dr. (LNC Trib. 1)	50		2700 Block of Lucille Dr.	41	$30,000
4101 Embers Dr. (Embers)	58	$50,000	1300 Block of Greenwood Ave. (Stewart)	49		106/112 Daffodil Dr.	41	$36,000
4401 Twin Oaks Cr. (Embers)	58	$50,000	510 Cardinal Ave. (Stewart)	49		2100 Block of Wright Way (Long Branch)	41	
3009 Sungate Dr.	57	$6,000	1603 Goode Dr.	48	$6,000	4406 Acorn Creek Tr. (Trimmier Trib.)	41	
1203 Liberty Bell Lp. (Patriotic)	57		219 Turtle Creek Dr. (LNC Trib. 1)	48	$18,000	4606 Acorn Creek Tr. (Trimmier Trib.)	41	
6006/6100 Stillwood Drive (Harker Heights)	57	$30,000	4523 Jacobs Ln.	48	$25,000	4812/4904/4906 Acorn Creek Tr. (Trimmier Trib.)	41	
3702 Soloman Drive (LNC Trib. 2)	57	$50,000	1908/1911 Bundrant Dr.	48	$30,000	5104 Acorn Creek Tr. (Trimmier Trib.)	41	
2302 Estelle Ave.	56	$6,000	10th St. & Little Ave.	48	$35,000	1102 Duval Dr.	38	$6,000
3707 Zephyr Rd. (Patriotic)	56	$18,000	1411 Camilla Rd. (Ronstan)	48	$40,000	2003 Westwood Dr. (Bermuda)	38	$17,000
1301 Janis Dr. (Bermuda)	55		5803 Greenforest Cr.	48	$58,000	1503 Daude Dr. (Ronstan)	38	$18,000
1206 Westway Cir.	54	$1,000	WS Young Dr. & Terrace Dr.	48	$72,000			
2907 Reed Ln.	54	$1,000	4602 Whitmire Dr.	47	$6,000			

9.3 MAJOR PROJECTS

The Drainage Master Plan has compiled a list of potential major CIPs to address flooding and drainage problems throughout the City of Killeen. Potential CIPs were compiled through coordination with City staff, review of reported drainage problems, field investigation, and mapping review. A short list of 28 potential CIPs was developed for prioritization, schematic analysis, and cost estimation. The major CIP list is shown in **Table 9.3**, and individual maps for each project area are included in **Appendix G**.

Table 9.3: Major CIPs

Project	Score	Est. Project Cost	Project	Score	Est. Project Cost
Bermuda/Ronstan Ditch	21	$2,226,000	Little Nolan Creek, Trib 1 at Caprock Dr	16	$642,390
South Nolan Creek at Odom Dr	20	$556,850	Lagrone	15	$72,675
Stewart Ditch	20	$587,650	El Dorado Dr	15	$119,625
South Nolan Creek at Stallion Dr	20	$589,260	Little Nolan Creek, Trib 1 at Cantabrian Dr - Phase 1 & Phase2	15	$662,200
WS Young	19	$441,300	Industrial Ditch	14	$73,275
K3C Drainage	19	$557,250	Valley Ditch	14	$353,150
Patriotic Ditch at Zephyr Rd	18	$56,550	Little Nolan Creek at WS Young	13	$225,190
South Nolan Creek at Dimple St	18	$84,245	Little Nolan Creek at 2410	12	$613,900
Dogwood Blvd at Bus. 190	18	$87,525	Long Branch Tributary	11	$56,400
South Nolan Creek at 10th St	18	$99,975	Dickens Ditch	11	$291,480
South Nolan Creek at 2nd St	18	$195,750	Caprice Ditch	11	$314,930
Still Forest	18	$300,000	Wolf Ditch	11	$500,220
Bending Trail Creek	18	$400,750	Greenforest Circle	10	$20,730
Acorn Creek Headwaters	16	$415,835	Long Branch	8	$653,800

10.0 DRAINAGE MAINTENANCE PLAN

10.1 CONDITION ASSESSMENT

Before establishing a maintenance plan for the City of Killeen's drainage system, an initial assessment must be conducted to determine existing standards, initial maintenance needs, and potential risks. A protocol for field inspection of the stream corridors must be prepared so that a field crew can easily implement the protocol while walking the stream corridors. Once a protocol is developed, all open channel stream corridors in the city will be investigated. Field investigation will provide initial condition assessment and maintenance needs of each section. Upon completion of the field investigation, initial maintenance will be conducted to establish a baseline condition for all sections of the stream corridors.

A routine maintenance plan will be developed to maintain the stream corridors and periodically return them to baseline conditions. It will include a schedule of maintenance activities for each section and for resource needs. The maintenance plan will also coordinate with City maintenance staff regarding existing resources and maintenance techniques. It will also provide suggestions to reduce future maintenance requirements or provide City maintenance staff easier access for maintenance activities. Maintenance of the stream corridors will protect flood carrying capacity and could also reduce the possibility of man-made drainage ways becoming jurisdictional waters under the CWA. Maintenance of jurisdictional waters is more complicated and costly than non-jurisdictional waters; thus, the maintenance plan will address maintenance of jurisdictional waters.

10.2 EXISTING DRAINAGE INFRASTRUCTURE MANAGEMENT

Culverts, bridges, storm drains, channels, and stream corridors are part of the drainage infrastructure and require management similar to water, sanitary sewer, and transportation infrastructure. The City's GIS program will include all drainage infrastructure within the storm data layer. This information will provide a management tool to schedule maintenance, inspection, and, if necessary, replacement. Proper management of drainage infrastructure will reduce the need for minor and major CIPs.

10.3 PLANNED DRAINAGE INFRASTRUCTURE MANAGEMENT

As the City of Killeen develops and grows, the City's drainage infrastructure will grow. The City must review and approve all proposed drainage infrastructure to ensure it meets City requirements and minimize the need for fixing or replacing inadequate drainage structures. As drainage infrastructure is constructed and accepted by the City, the infrastructure must be added to the City GIS system and maintenance plan.

11.0 ADMINISTRATIVE SOLUTIONS

Physical improvements are not always the primary means to improve the drainage system and remove drainage stressors. Alternately, soft or administrative solutions can be implemented to reduce stressors and improve efficiency of the drainage system. These solutions can involve code and policy changes, or additional program resources.

11.1 ORDINANCE DEVELOPMENT

Potential administrative solutions related to city ordinances were identified in the City of Killeen Drainage Master Plan Scoping Study. Revisions to the City of Killeen Code of Ordinances and drainage criteria would elevate the level of flood protection, improve the function and the health of drainage infrastructure, and reduce chronic maintenance problems. Recommendations for revised or new city ordinances were outlined:

- Establishment of minimum finished floor elevations at 18-inches above the FEMA regulatory 100-year water surface elevation
- Use of ultimate development conditions to determine peak discharges and flood elevations
- Establishment of erosion and sediment control ordinance for all construction sites greater than one acre

Revisions to the Code of Ordinances and drainage criteria that establish a minimum finished floor elevation 18-inches above the 100-year water surface elevation would reduce flood claims, improve the community rating, and lower flood insurance rates for the community.

The City currently follows FEMA policy, which allows for the use of existing development conditions for the evaluation of peak discharge. For rapidly developing watersheds, this policy may not accurately represent development impacts on flood levels. The City of Killeen is experiencing rapid development in some areas, particularly in the headwaters of the watersheds. As the City's watersheds are developed, the 100-year water surface elevations could increase 1 to 3 feet downstream from recent and future development. Modifications to the Code and drainage criteria requiring the use of ultimate development discharges would provide an increased level of flood protection, thereby reducing future flooding problems and reducing the need for future CIPs related to flooding and drainage problems.

Establishment of an erosion and sediment control ordinance for all construction sites greater than one acre would reduce or eliminate problems caused by grading and development activities. Such an ordinance would be consistent with TCEQ storm water program requirements. The TCEQ storm water program also requires cities to develop a construction runoff control program. The City of Killeen could opt to implement general requirements as outlined by the TCEQ or could choose to adopt local erosion and sedimentation requirements tailored to the City's needs. Establishment of an erosion and sediment control ordinance would reduce drainage infrastructure maintenance, support drainage infrastructure performance, improve water quality, protect habitat and water supply, and support compliance with TPDES storm water permit requirements.

11.2 DRAINAGE DESIGN CRITERIA REVISIONS

The current drainage design criteria were established November 4, 1992, for simplicity of design and review. However, standard civil engineering practices have evolved since 1992, and alternative methods that provide more detailed analysis are readily available. Computer modeling has become an industry standard for hydrologic and hydraulic analysis, which provides more detailed information during the design of drainage systems. The City of Killeen must incorporate revised criteria for hydraulic analysis to be consistent with standard industry practices.

Hydrologic analysis of small watersheds is still commonly performed using the Rational Method. However, industry standards have redefined the limits of "small" watersheds. FEMA currently limits the use of the Rational Method to watersheds under 200 acres; many municipalities in Texas have even smaller thresholds.

Hydraulic analysis of storm drains and small drainage systems is still commonly performed using Manning's equation. However, computer modeling that provides more detailed information is readily available to perform hydraulic analysis for these and open channel systems. Hydraulic modeling provides information on the system or channel reach, whereas the Manning's equation provides information at an isolated location. The complexities of drainage systems and channel reaches require information through the entire system to effectively evaluate hydraulic conditions. Hydraulic modeling also provides a valuable tool for future drainage infrastructure management.

Typical channel sections provided in the current drainage design criteria do not provide the City with a preferred channelization alternatives. Trapezoidal channels are efficient means to convey flood discharges; however, they do not address stream stability during low flow and many other factors that affect stream and channel sections. The concrete section is no longer industry standard, and adverse impacts are created with its use. Both trapezoidal earthen and concrete lined channel sections are difficult to permit under the Clean Water Act Section 404 Program. In accordance with evolving practices, channelization must be designed on a site-by-site basis to utilize beneficial items located within the existing channel reach and provide channel stability.

In recognition of the Section 404 program requirements, the City requires a note on all plat submittals indicating the development applicant recognizes the potential need for Section 404 permitting and agrees to obtain such permitting, if required. However, the City development review process does not have any means in place to ensure that plat applicants comply with Section 404 permit requirements. The City should consider amending its development review process to require that plat applicants submit documentation that they have complied with any applicable Section 404 permit requirements. There are several milestones in the development review process where such proof of Section 404 compliance could be required. Proof could be required before plat approval, before building permit issuance, before public infrastructure acceptance, or before issuance of other related permits such as the City Floodplain

Development permit in those development situations where such permits are required. However, the 404 permit process can be quite time consuming – many permits require up to 18 months to process – so an up front proof of compliance requirement could delay development cycles by several months.

As part of its ongoing Drainage Master Plan and Phase II storm water management program efforts, the City should also consider educational efforts to educate the public and development community about Section 404 requirements.

TCEQ water appropriations and dam safety programs also require permitting that should be addressed during the platting of a proposed development. The City should also require a note on all plat submittals indicating the development applicant recognizes the potential need for a TCEQ Water Appropriations Permit, including possible dam safety analysis. The City should amend its development review process to require proof that plat applicants have complied with any applicable TCEQ water appropriations permit requirements. Similar to the Section 404 permit process, the TCEQ approval process can also be time consuming and requirement of such proof of compliance can also delay development cycles. Some smaller projects may not require TCEQ permitting or dam safety approval.

City of Killeen acceptance of ownership of TCEQ permitted dams and impoundments will shift TCEQ compliance requirements (periodic inspections, annual reporting, etc.) to the City. Some cities include extensive language in their development code and platting requirements to avoid acceptance of dam and pond ownership and liability from developers. In practice, such avoidance usually shifts ongoing maintenance, liability, and TCEQ reporting to a property owners association after the project developer has sold off the development properties. Maintenance and reporting by a property owners association can be problematic; so many cities eventually take over such projects to ensure ongoing project performance, maintenance and public safety. Many issues related to City acceptance of dam infrastructure are political, legal and socio-economic issues that are beyond the realm of an engineering study.

11.3 DETENTION POLICY

Development of watersheds often increases downstream discharges, flooding, and channel erosion. Impervious surfaces associated with development also collect pollutants and discharge them downstream during rainfall events. The City of Killeen currently does not have formal detention requirements to reduce these development impacts. The City's staff currently identifies the need for detention on a site by site basis; however, modification to the code and drainage design criteria must require that proposed developments assess downstream impacts and detention considerations. TPDES Phase II Storm Water regulations, once formalized by TCEQ, will require the City of Killeen address storm water runoff from re-development and new development. Development of detention criteria could address TPDES water quality requirements as well as reduce the effects of development on downstream discharges, flooding, erosion, and pollution transport.

Evolving practice in other jurisdictions includes the following typical detention requirements:

- The provision for water quality storage, with a water quality volume equal to 0.5 inches to 1.5 inches of runoff times the area draining to the detention pond. This volume of storage is normally infiltrated slowly into the soil comprising the pond bottom after a rainfall event.

- The provision for channel protection storage with a volume sufficient to store the runoff from the 1-year return period storm for a time period of 24 hours. This volume of water is discharged slowly through a small pond outlet at a metered rate to ensure that downstream channels are not eroded by frequent storm events.

- The provision for so-called "whole hydrograph" detention that requires that the post development discharge from multiple storm events (such as the 1-year, 10-year and 100-year return period events) be detained to reduce the pond outflow rates to less than pre-development discharge rates. This storage is designed to protect downstream structures and flood control facilities.

The detention policy outlined above is rapidly becoming standard practice in other jurisdictions and is very responsive to various regulatory requirements. It provides the most benefit to the City for the protection of existing drainage infrastructure, the reduction of flooding and the protection of water quality.

However, there are numerous complex issues involved in the establishment of such a comprehensive policy. Many issues that must be resolved are political, legal and socio-economic issues that are beyond the realm of an engineering study. Most jurisdictions that adopt such policies either do so in a step wise fashion over several years or engage numerous stakeholder groups to obtain buy-in to an expedited adoption and implementation process.

For that reason, we recommend that the City engage a stakeholder group as soon as possible to implement such a policy. As an alternate the City could implement a stepwise implementation approach based on some or all of the following elements:

- Detention at discretion of City Engineer
- Detention of a single event, such as the 25-year return period event
- Detention/downstream impact analysis for all non-residential development (i.e. a formal detention policy for commercial/industrial/institutional areas)
- Integrated detention for residential development
- Off-site or regional detention
- Payment in lieu of detention agreements
- Incentives for low-impact development

- Water quality storage requirements (i.e., detention of "first flush")
- A stepwise implementation of the comprehensive policy described above, beginning with adoption of detention requirements for the larger flooding events

Establishment of Detention Criteria will help mitigate increased flows from development, improve water quality, and help the City meet TPDES Phase II new development and redevelopment minimum control measure requirements.

11.4 CITY-DEVELOPER AGREEMENTS

City-developer agreements between developers and municipalities stipulate how improvements built by a developer are conveyed to the municipality. The City of Killeen's city-developer agreements cover the developer's construction of infrastructure and subsequent transfer of ownership and maintenance to the City. The city-developer agreement must require construction of infrastructure to City design standards and a warranty period to ensure the infrastructure is functioning as designed. After the warranty period, ownership and maintenance responsibilities of the infrastructure would be transferred from the developer to the City. This frees the developer of on-going maintenance and allows the City to provide city-wide infrastructure management. It is imperative that the City require that the infrastructure be designed and constructed to City standards so that new infrastructure does not become a liability to the City and require repairs or replacement by the City.

11.5 REGIONAL PARTICIPATION

The City of Killeen is located at the upper reaches of the Nolan Creek, Trimmier Creek, Reese Creek, and Rock Creek watersheds. The majority of runoff that flows through the city comes from rainfall within the city limits; however, portions of the Nolan Creek watershed drain the Fort Hood U.S. Military Reservation. Runoff from Fort Hood flows into South Nolan Creek, Valley Ditch, Stewart Ditch, Liberty Ditch, Long Branch, and Caprice Ditch. For the City of Killeen to effectively manage runoff from these streams, the City must identify the storm water management activities Fort Hood conducts. Regional participation with Fort Hood would help the City of Killeen manage the Nolan Creek watershed upstream from the city limits and control water quantity and quality that flows into the city.

Because the remainder of runoff is from rainfall within the city, the City of Killeen is in direct control of runoff flowing through its drainage system. However, downstream entities will have an interest in the runoff that leaves Killeen. Nolan Creek flows east into Harker Heights; Trimmier Creek, Reese Creek, and Rock Creek flow south into unincorporated Bell County to Stillhouse Hollow Lake. Harker Heights and other communities downstream, as well as other agencies and organizations (i.e. Brazos River Authority, Bell County Water Control and Improvement District (WCID #6), Lake Stillhouse Hollow Clean Water Steering Committee), could have an interest in managing these watersheds and minimizing the quantity and quality of runoff that leaves Killeen. Regional participation with downstream entities will assist the City of Killeen with implementation of storm water management projects and/or practices.

12.0 FINANCIAL ANALYSIS

12.1 DRAINAGE UTILITY RATE ADJUSTMENT

The City of Killeen's Drainage Utility was created in October 2001 to improve the function and health of the City's drainage infrastructure. The City's initial rate structure featured two rates: residential properties paid a $2.00 monthly fee, and non-residential properties paid a $4.00 monthly fee. That initial rate structure is still in place and provides an annual revenue of approximately $700,000.

Current City of Killeen Drainage Utility annual base revenue requirements are $1,167,064. Base revenue requirements include operation and maintenance costs for drainage infrastructure, drainage utility staff, and the minor CIP program. The Drainage Master Plan recommends a bond package of $8,000,000 to fund the major CIP program; the estimated annual debt service for the bond package is $567,620. This brings total revenue requirements for the City of Killeen Drainage Utility to approximately $1,734,684.

The annual revenue provided by the current drainage utility rate structure is not adequate for current needs. The current rate structure is also disproportionate. More densely developed non-residential properties typically have significantly more impact on the drainage system than residential properties. The City of Killeen will revise its drainage utility rate structure to provide needed revenue and a more equitable rate between residential and non-residential properties.

A preliminary drainage utility rate structure was prepared with the Drainage Master Plan. The rate structure is based on available parcel and billing data; however, an audit of City of Killeen water billing is required to determine the final number of parcels for each customer class and actual revenue provided.

The proposed drainage utility rate increases the number of customer classes from two (residential and non-residential) to six: residential, multi-family, and four tiers of commercial properties. The monthly rate for multi-family properties is based on the total number of units. Multi-family properties pay the base residential fee for the first unit plus a fraction of the base residential rate for each additional unit. At the request of the City Council's Water/Sewer/Drainage Committee, the top multi-family rate was capped at $150. The monthly rate for commercial properties is based on the impacts of those property types as compared to a single-family property. Commercial properties were categorized into four groups based on size of the property and impacts to the drainage system as described below.

Commercial Group 1 - Less than 326,000 sq. ft. (7.48 acres) total land area
Commercial Group 2 - Greater than 326,000 sq. ft. (7.48 acres) and less than 651,000 sq. ft. (14.94 acres) total land area
Commercial Group 3 - Greater than 651,001 sq. ft. (14.94 acres) and less than 977,000 sq. ft. (22.43 acres) total land area
Commercial Group 4 - Greater than 977,001 sq. ft. (22.43 acres) total land area

The monthly rate for residential properties was established at $3.00 per month; multi-family and commercial classes are based on multiples of this $3.00 rate. The proposed drainage utility rate structure is shown in **Table 12.1**.

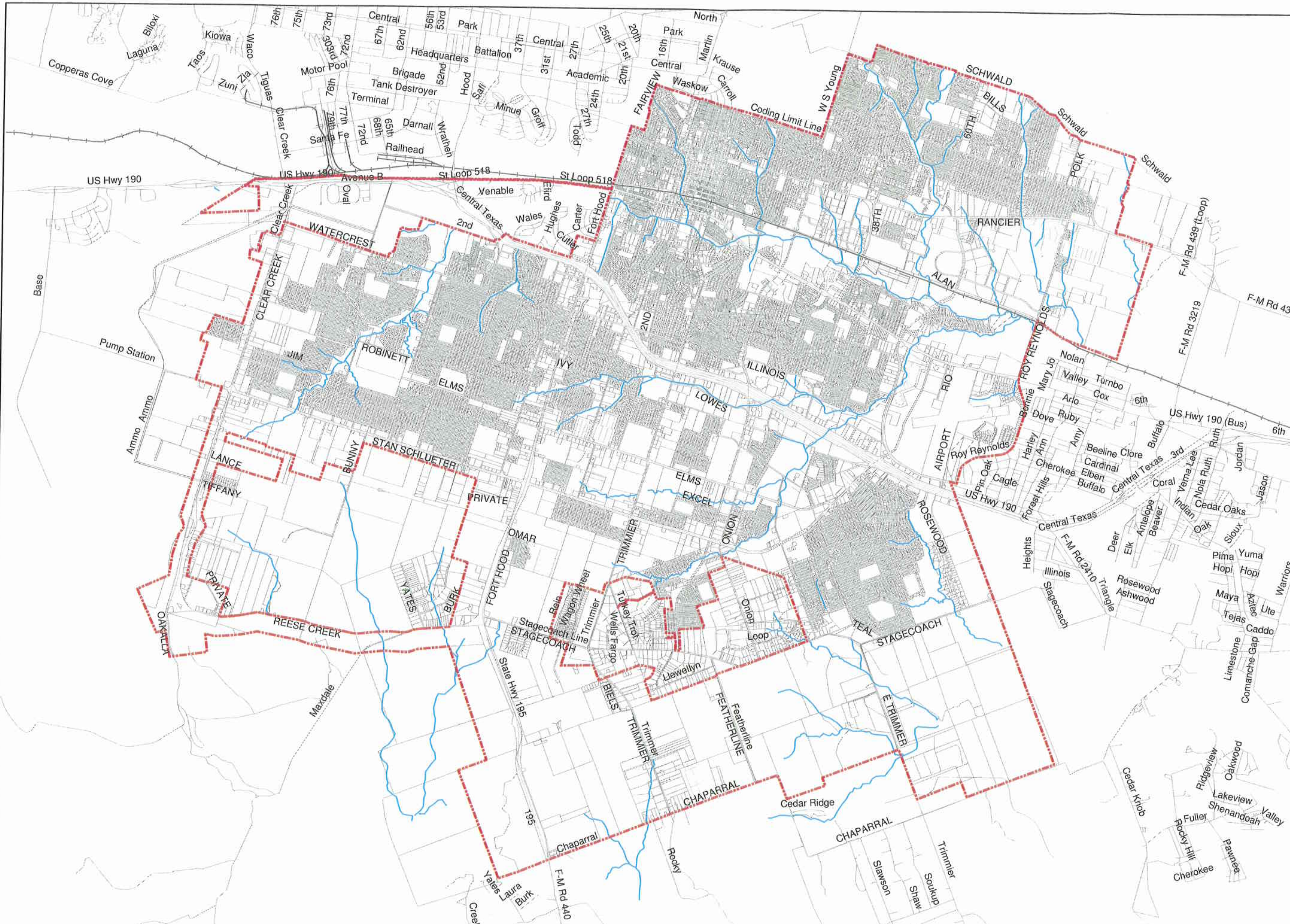
Table 12.1 Proposed Drainage Utility Rate Structure

Customer Class	Monthly Rate	Monthly Revenue	Annual Revenue
Residential	$3.00	$88.950	$1,067,400
Multi-Family[1]	$3+$2.10*additional units	$24,886	$298,637
Commercial – 1st Group	$15.00	$24,750	$297,000
Commercial – 2nd Group	$45.00	$1,890	$22,680
Commercial – 3rd Group	$75.00	$1,275	$15,300
Commercial – 4th Group	$150.00	$2,850	$34,200
Total		**$144,601**	**$1,735,217**

[1] - Capped at a maximum of $150 at Water/Sewer/Drainage Committee request.

APPENDIX A

CITY OF KILLEEN DRAINAGE SERVICE AREA



Legend

- Rail
- Stream
- City Limit
- Street
- Parcel

0 1,250 2,500 3,750 Feet

Location Inset

Carter::Burgess

Exhibit A-1

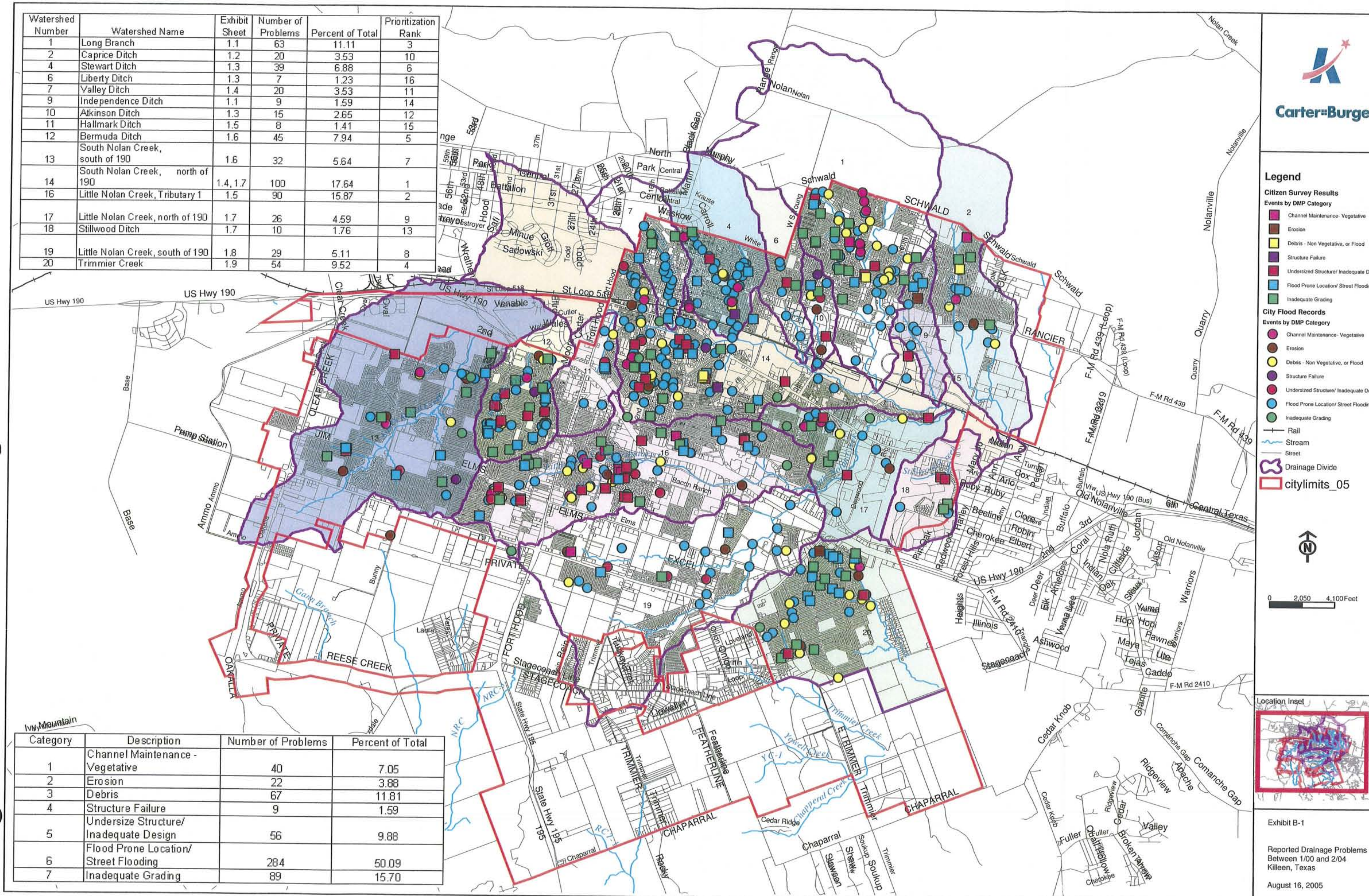
City of Killeen
Drainage Service Area
Killeen, Texas

August 16, 2005

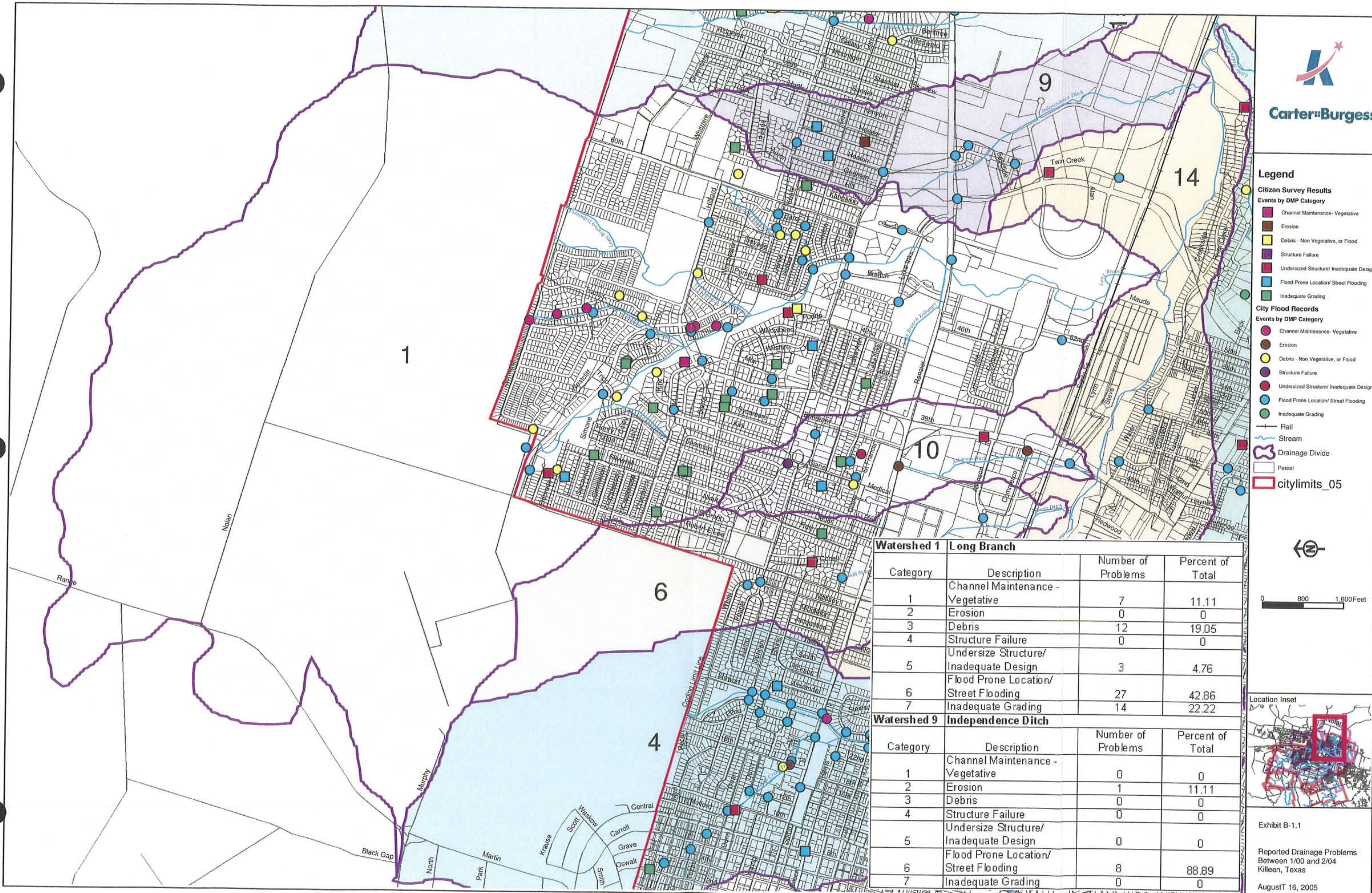
APPENDIX B

PROBLEM LOCATIONS AND WATERSHED BOUNDARIES

Watershed Number	Watershed Name	Exhibit Sheet	Number of Problems	Percent of Total	Prioritization Rank
1	Long Branch	1.1	63	11.11	3
2	Caprice Ditch	1.2	20	3.53	10
4	Stewart Ditch	1.3	39	6.88	6
6	Liberty Ditch	1.3	7	1.23	16
7	Valley Ditch	1.4	20	3.53	11
9	Independence Ditch	1.1	9	1.59	14
10	Atkinson Ditch	1.3	15	2.65	12
11	Hallmark Ditch	1.5	8	1.41	15
12	Bermuda Ditch	1.6	45	7.94	5
13	South Nolan Creek, south of 190	1.6	32	5.64	7
14	South Nolan Creek, north of 190	1.4, 1.7	100	17.64	1
16	Little Nolan Creek, Tributary 1	1.5	90	15.87	2
17	Little Nolan Creek, north of 190	1.7	26	4.59	9
18	Stillwood Ditch	1.7	10	1.76	13
19	Little Nolan Creek, south of 190	1.8	29	5.11	8
20	Trimmier Creek	1.9	54	9.52	4



Category	Description	Number of Problems	Percent of Total
1	Channel Maintenance - Vegetative	40	7.05
2	Erosion	22	3.88
3	Debris	67	11.81
4	Structure Failure	9	1.59
5	Undersize Structure/ Inadequate Design	56	9.88
6	Flood Prone Location/ Street Flooding	284	50.09
7	Inadequate Grading	89	15.70



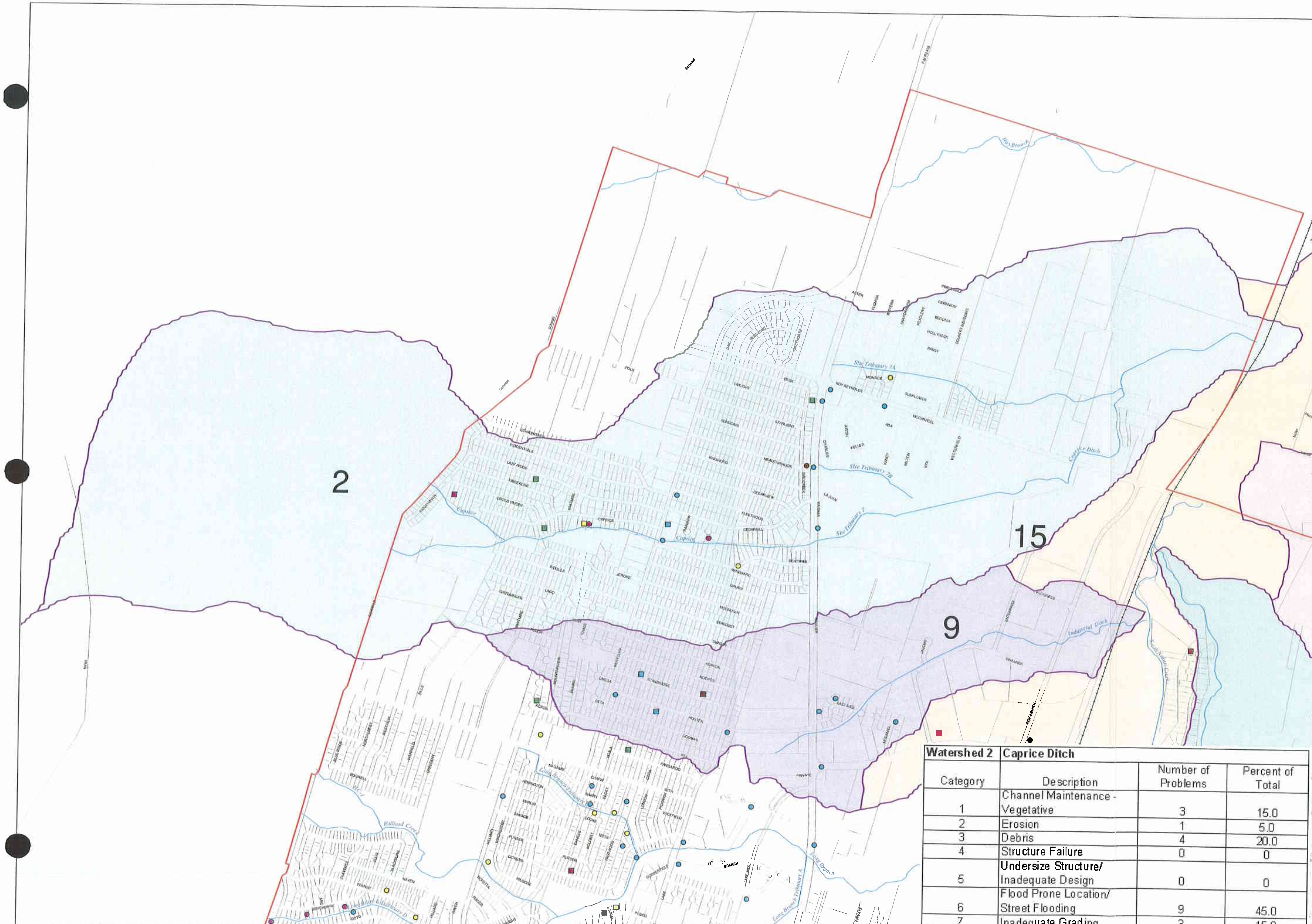
Watershed 1	Long Branch		
Category	Description	Number of Problems	Percent of Total
1	Channel Maintenance - Vegetative	7	11.11
2	Erosion	0	0
3	Debris	12	19.05
4	Structure Failure	0	0
5	Undersize Structure/ Inadequate Design	3	4.76
6	Flood Prone Location/ Street Flooding	27	42.86
7	Inadequate Grading	14	22.22

Watershed 9	Independence Ditch		
Category	Description	Number of Problems	Percent of Total
1	Channel Maintenance - Vegetative	0	0
2	Erosion	1	11.11
3	Debris	0	0
4	Structure Failure	0	0
5	Undersize Structure/ Inadequate Design	0	0
6	Flood Prone Location/ Street Flooding	8	88.89
7	Inadequate Grading	0	0

Exhibit B-1.1

Reported Drainage Problems Between 1/00 and 2/04 Killeen, Texas

AugustT 16, 2005



Watershed 2	Caprice Ditch		
Category	Description	Number of Problems	Percent of Total
1	Channel Maintenance - Vegetative	3	15.0
2	Erosion	1	5.0
3	Debris	4	20.0
4	Structure Failure	0	0
5	Undersize Structure/ Inadequate Design	0	0
6	Flood Prone Location/ Street Flooding	9	45.0
7	Inadequate Grading	3	15.0

Carter::Burgess

Legend

Citizen Survey Results

Events by DMP Category

- Channel Maintenance- Vegetative
- Erosion
- Debris - Non Vegetative, or Flood
- Structure Failure
- Undersized Structure/ Inadequate Design
- Flood Prone Location/ Street Flooding
- Inadequate Grading

City Flood Records

Events by DMP Category

- Channel Maintenance- Vegetative
- Erosion
- Debris - Non Vegetative, or Flood
- Structure Failure
- Undersized Structure/ Inadequate Design
- Flood Prone Location/ Street Flooding
- Inadequate Grading

Rail
Stream
Street
Drainage Divide
Parcel
citylimits_05

EXHIBIT B-1.2

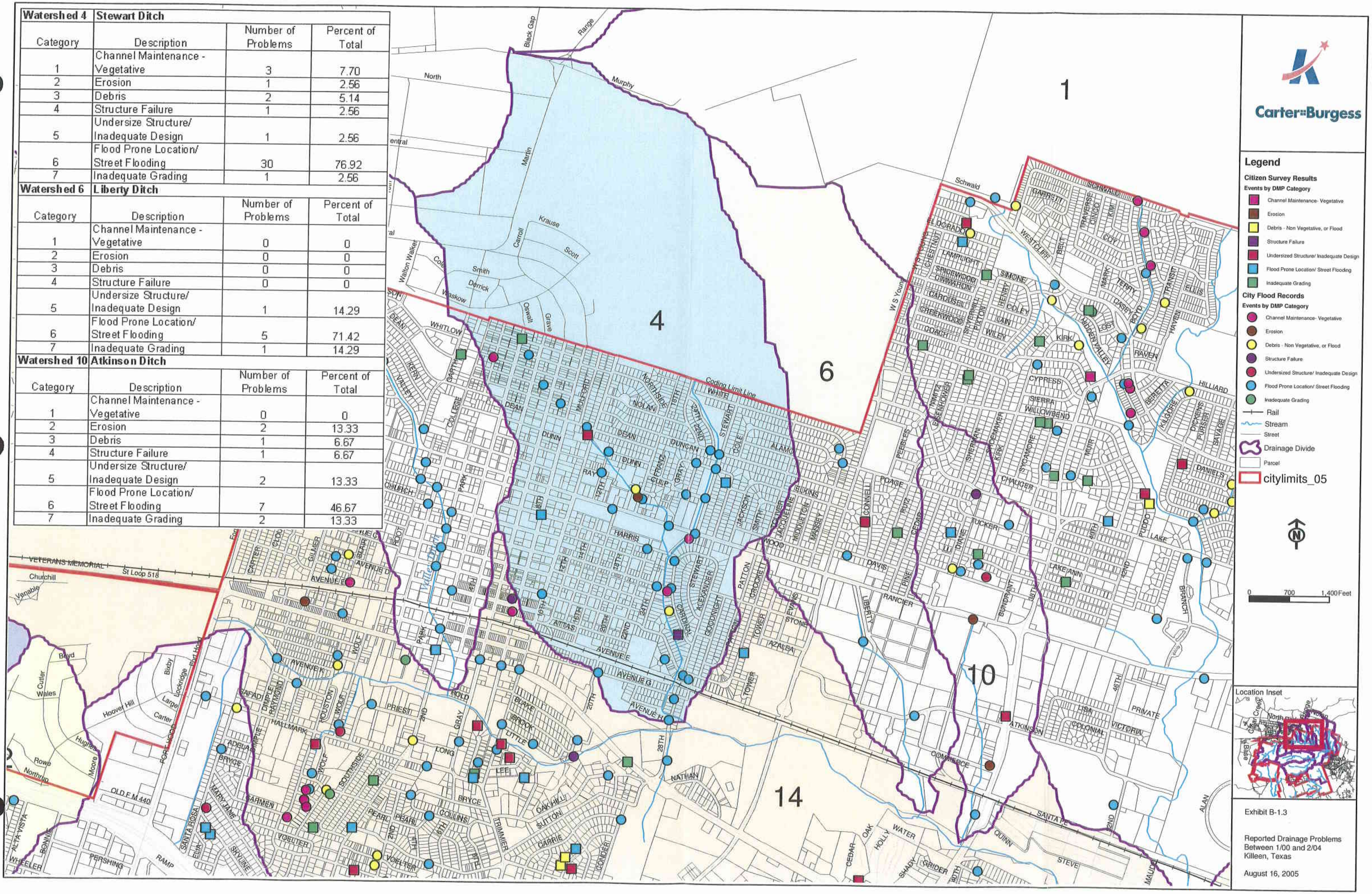
Reported Drainage Problems
Between 1/00 and 2/04
Killeen, Texas

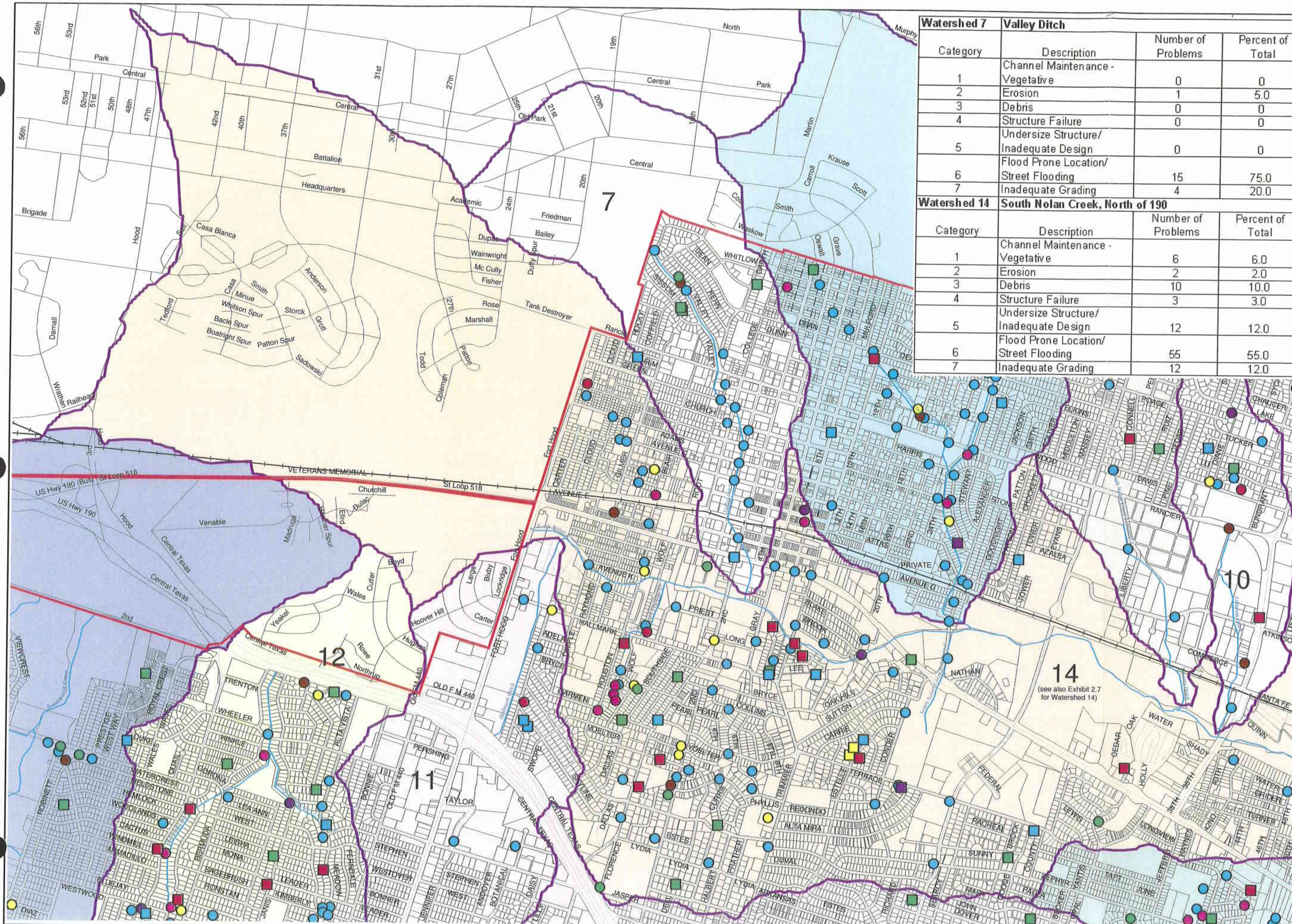
August 16, 2005

Watershed 4	Stewart Ditch		
Category	Description	Number of Problems	Percent of Total
1	Channel Maintenance - Vegetative	3	7.70
2	Erosion	1	2.56
3	Debris	2	5.14
4	Structure Failure	1	2.56
5	Undersize Structure/ Inadequate Design	1	2.56
6	Flood Prone Location/ Street Flooding	30	76.92
7	Inadequate Grading	1	2.56

Watershed 6	Liberty Ditch		
Category	Description	Number of Problems	Percent of Total
1	Channel Maintenance - Vegetative	0	0
2	Erosion	0	0
3	Debris	0	0
4	Structure Failure	0	0
5	Undersize Structure/ Inadequate Design	1	14.29
6	Flood Prone Location/ Street Flooding	5	71.42
7	Inadequate Grading	1	14.29

Watershed 10	Atkinson Ditch		
Category	Description	Number of Problems	Percent of Total
1	Channel Maintenance - Vegetative	0	0
2	Erosion	2	13.33
3	Debris	1	6.67
4	Structure Failure	1	6.67
5	Undersize Structure/ Inadequate Design	2	13.33
6	Flood Prone Location/ Street Flooding	7	46.67
7	Inadequate Grading	2	13.33





Watershed 7	Valley Ditch		
Category	Description	Number of Problems	Percent of Total
1	Channel Maintenance - Vegetative	0	0
2	Erosion	1	5.0
3	Debris	0	0
4	Structure Failure	0	0
5	Undersize Structure/ Inadequate Design	0	0
6	Flood Prone Location/ Street Flooding	15	75.0
7	Inadequate Grading	4	20.0

Watershed 14	South Nolan Creek, North of 190		
Category	Description	Number of Problems	Percent of Total
1	Channel Maintenance - Vegetative	6	6.0
2	Erosion	2	2.0
3	Debris	10	10.0
4	Structure Failure	3	3.0
5	Undersize Structure/ Inadequate Design	12	12.0
6	Flood Prone Location/ Street Flooding	55	55.0
7	Inadequate Grading	12	12.0

Carter::Burgess

Legend

Citizen Survey Results

Events by DMP Category

- Channel Maintenance- Vegetative
- Erosion
- Debris - Non Vegetative, or Flood
- Structure Failure
- Undersized Structure/ Inadequate Design
- Flood Prone Location/ Street Flooding
- Inadequate Grading

City Flood Records

Events by DMP Category

- Channel Maintenance- Vegetative
- Erosion
- Debris - Non Vegetative, or Flood
- Structure Failure
- Undersized Structure/ Inadequate Design
- Flood Prone Location/ Street Flooding
- Inadequate Grading

Rail

Stream

Street

Drainage Divide

Parcel

citylimits_05

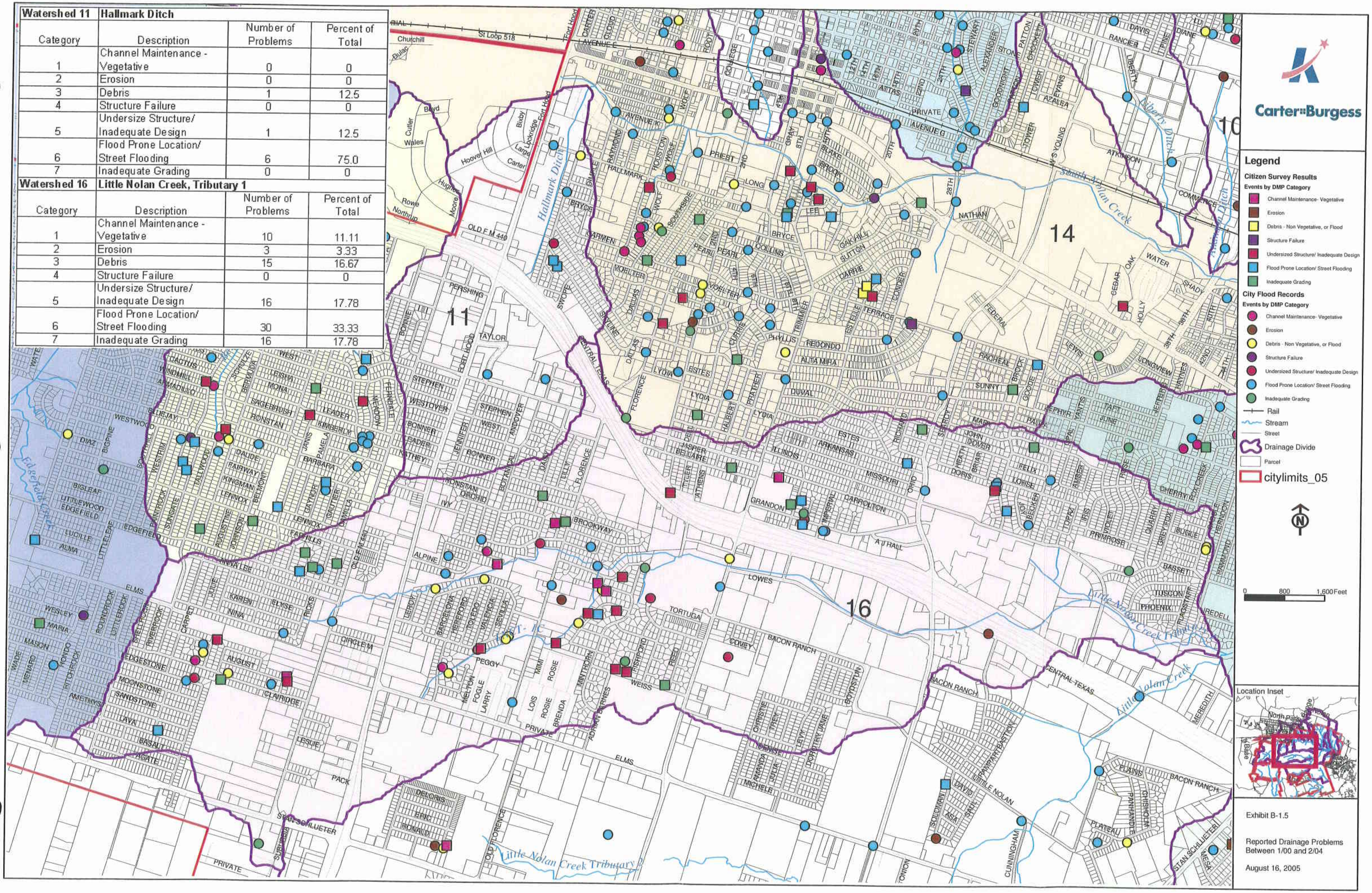
Exhibit B-1.4

Reported Drainage Problems Between 1/00 and 2/04
Killeen, Texas

August 16, 2005

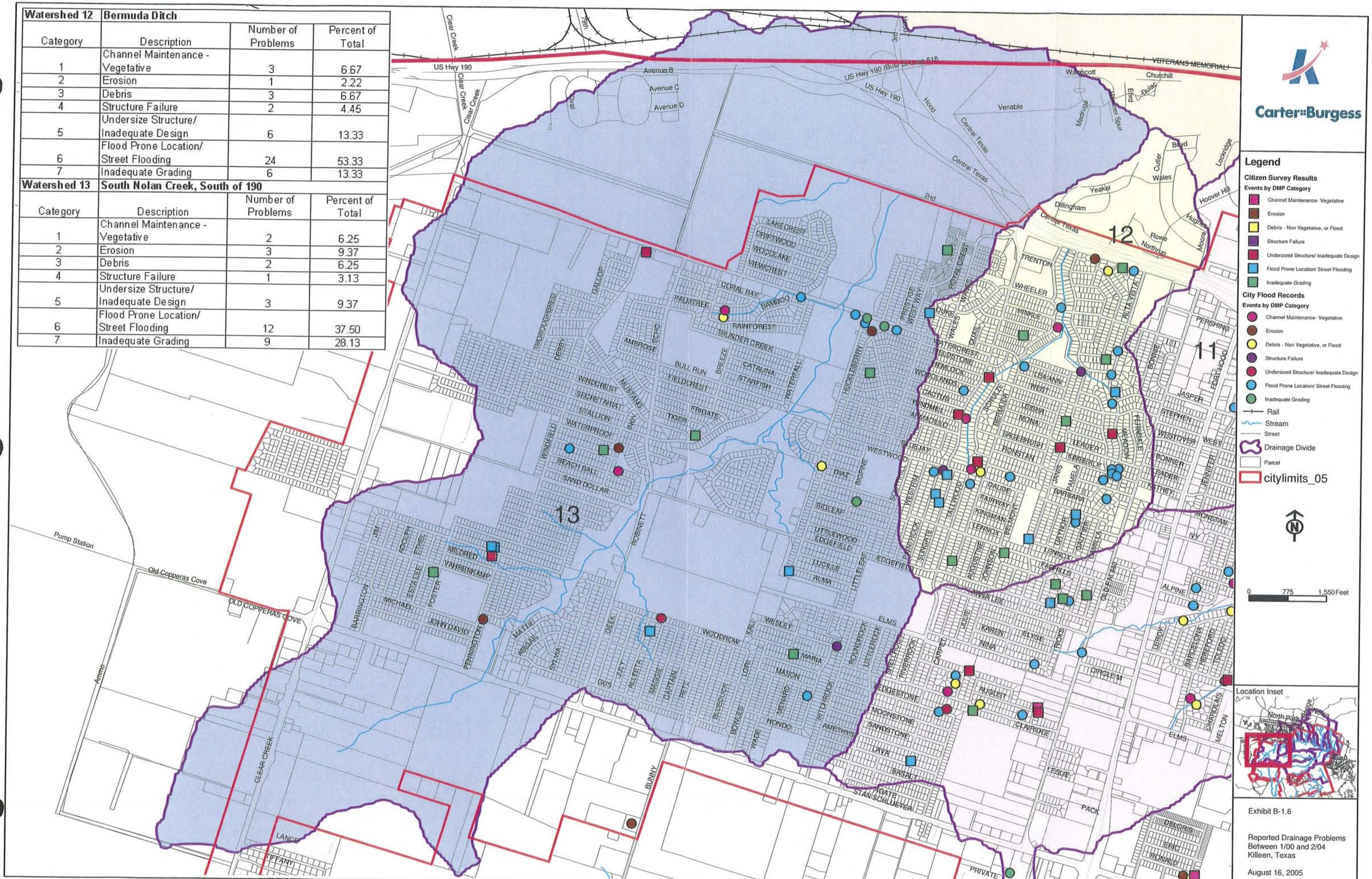
Watershed 11	Hallmark Ditch		
Category	Description	Number of Problems	Percent of Total
1	Channel Maintenance - Vegetative	0	0
2	Erosion	0	0
3	Debris	1	12.5
4	Structure Failure	0	0
5	Undersize Structure/ Inadequate Design	1	12.5
6	Flood Prone Location/ Street Flooding	6	75.0
7	Inadequate Grading	0	0

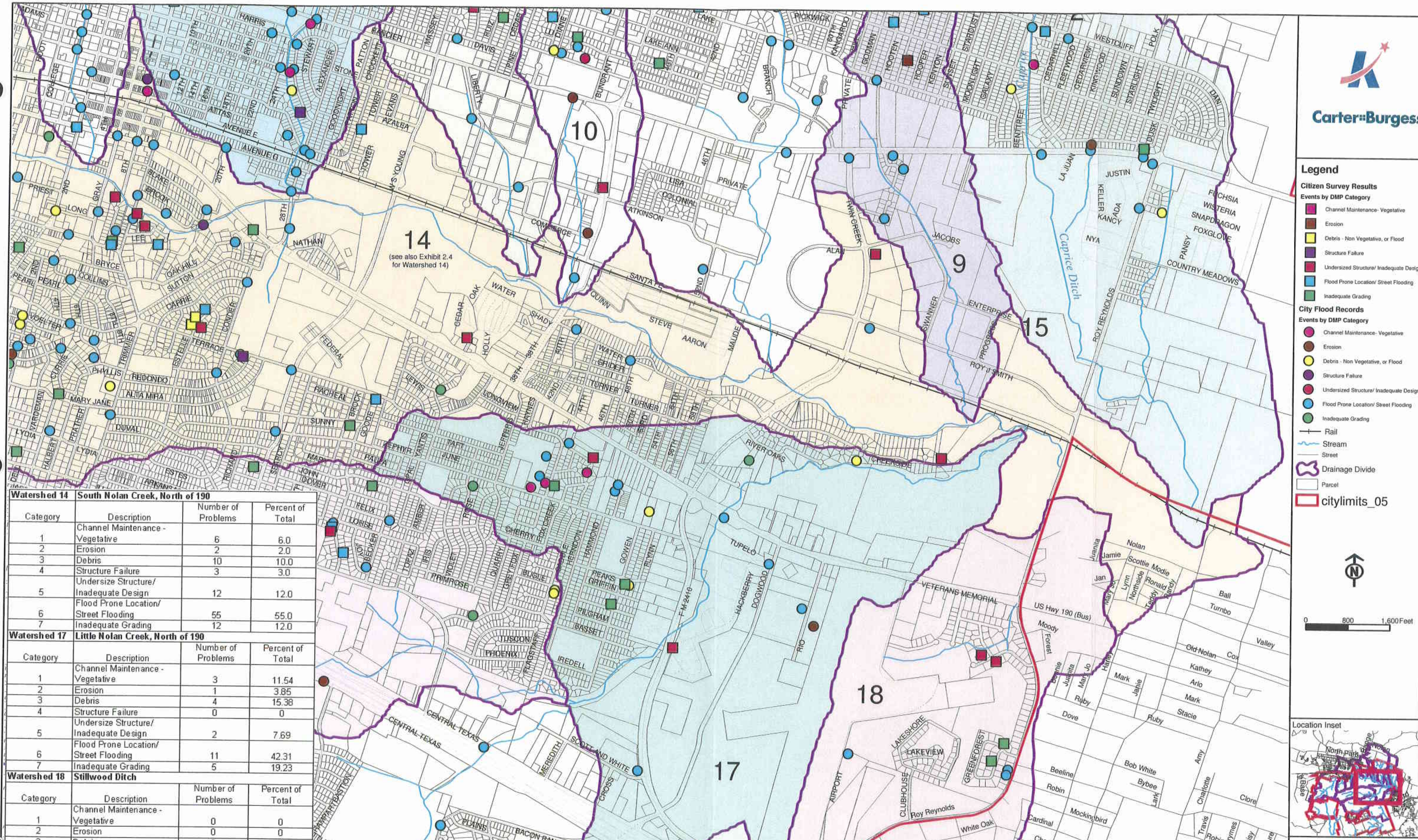
Watershed 16	Little Nolan Creek, Tributary 1		
Category	Description	Number of Problems	Percent of Total
1	Channel Maintenance - Vegetative	10	11.11
2	Erosion	3	3.33
3	Debris	15	16.67
4	Structure Failure	0	0
5	Undersize Structure/ Inadequate Design	16	17.78
6	Flood Prone Location/ Street Flooding	30	33.33
7	Inadequate Grading	16	17.78



Watershed 12	Bermuda Ditch		
Category	Description	Number of Problems	Percent of Total
1	Channel Maintenance - Vegetative	3	6.67
2	Erosion	1	2.22
3	Debris	3	6.67
4	Structure Failure	2	4.45
5	Undersize Structure/ Inadequate Design	6	13.33
6	Flood Prone Location/ Street Flooding	24	53.33
7	Inadequate Grading	6	13.33

Watershed 13	South Nolan Creek, South of 190		
Category	Description	Number of Problems	Percent of Total
1	Channel Maintenance - Vegetative	2	6.25
2	Erosion	3	9.37
3	Debris	2	6.25
4	Structure Failure	1	3.13
5	Undersize Structure/ Inadequate Design	3	9.37
6	Flood Prone Location/ Street Flooding	12	37.50
7	Inadequate Grading	9	28.13





Watershed 14	South Nolan Creek, North of 190		
Category	Description	Number of Problems	Percent of Total
1	Channel Maintenance - Vegetative	6	6.0
2	Erosion	2	2.0
3	Debris	10	10.0
4	Structure Failure	3	3.0
5	Undersize Structure/ Inadequate Design	12	12.0
6	Flood Prone Location/ Street Flooding	55	55.0
7	Inadequate Grading	12	12.0

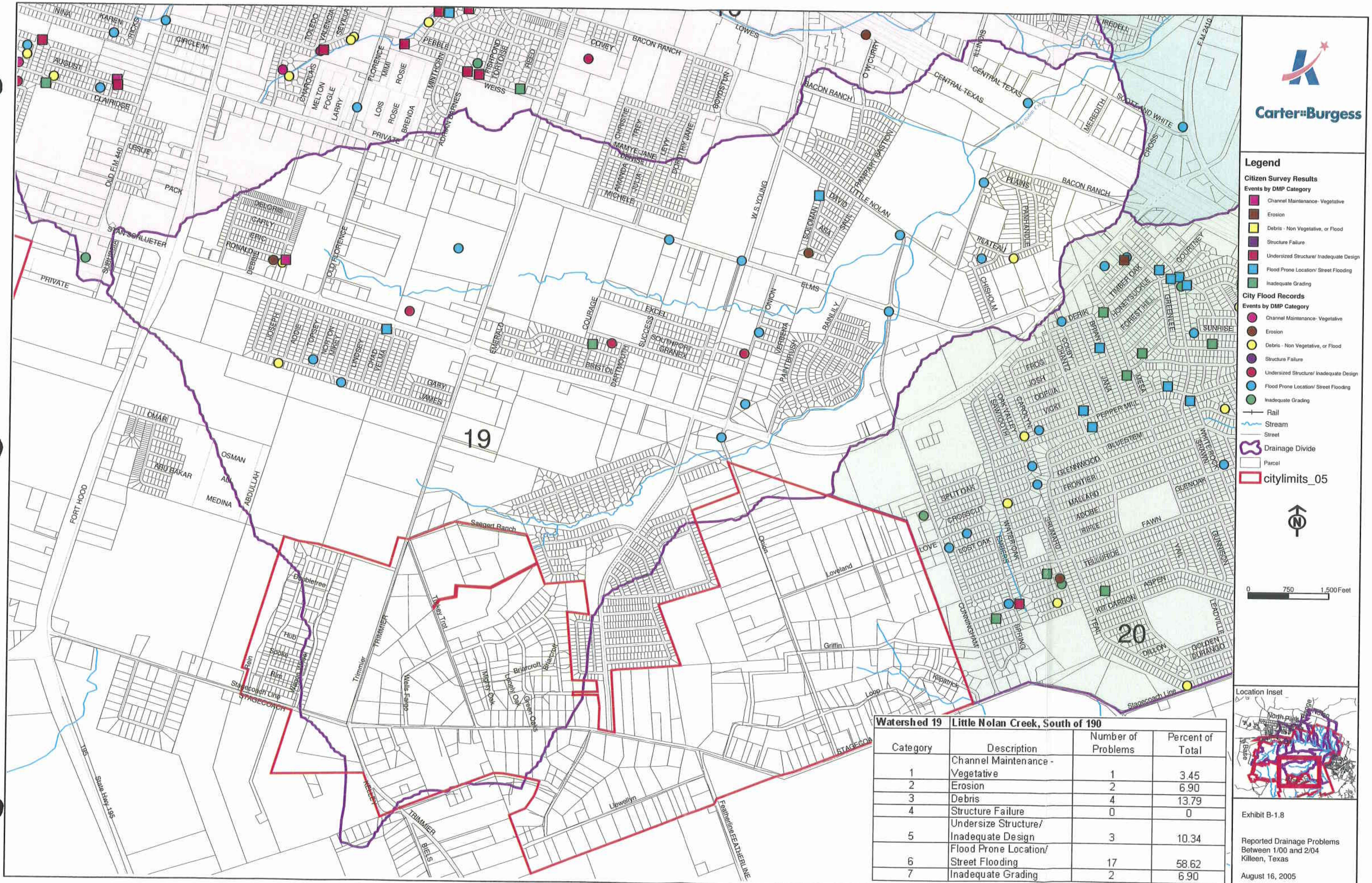
Watershed 17	Little Nolan Creek, North of 190		
Category	Description	Number of Problems	Percent of Total
1	Channel Maintenance - Vegetative	3	11.54
2	Erosion	1	3.85
3	Debris	4	15.38
4	Structure Failure	0	0
5	Undersize Structure/ Inadequate Design	2	7.69
6	Flood Prone Location/ Street Flooding	11	42.31
7	Inadequate Grading	5	19.23

Watershed 18	Stillwood Ditch		
Category	Description	Number of Problems	Percent of Total
1	Channel Maintenance - Vegetative	0	0
2	Erosion	0	0
3	Debris	0	0
4	Structure Failure	0	0
5	Undersize Structure/ Inadequate Design	4	40.0
6	Flood Prone Location/ Street Flooding	4	40.0
7	Inadequate Grading	2	20.0

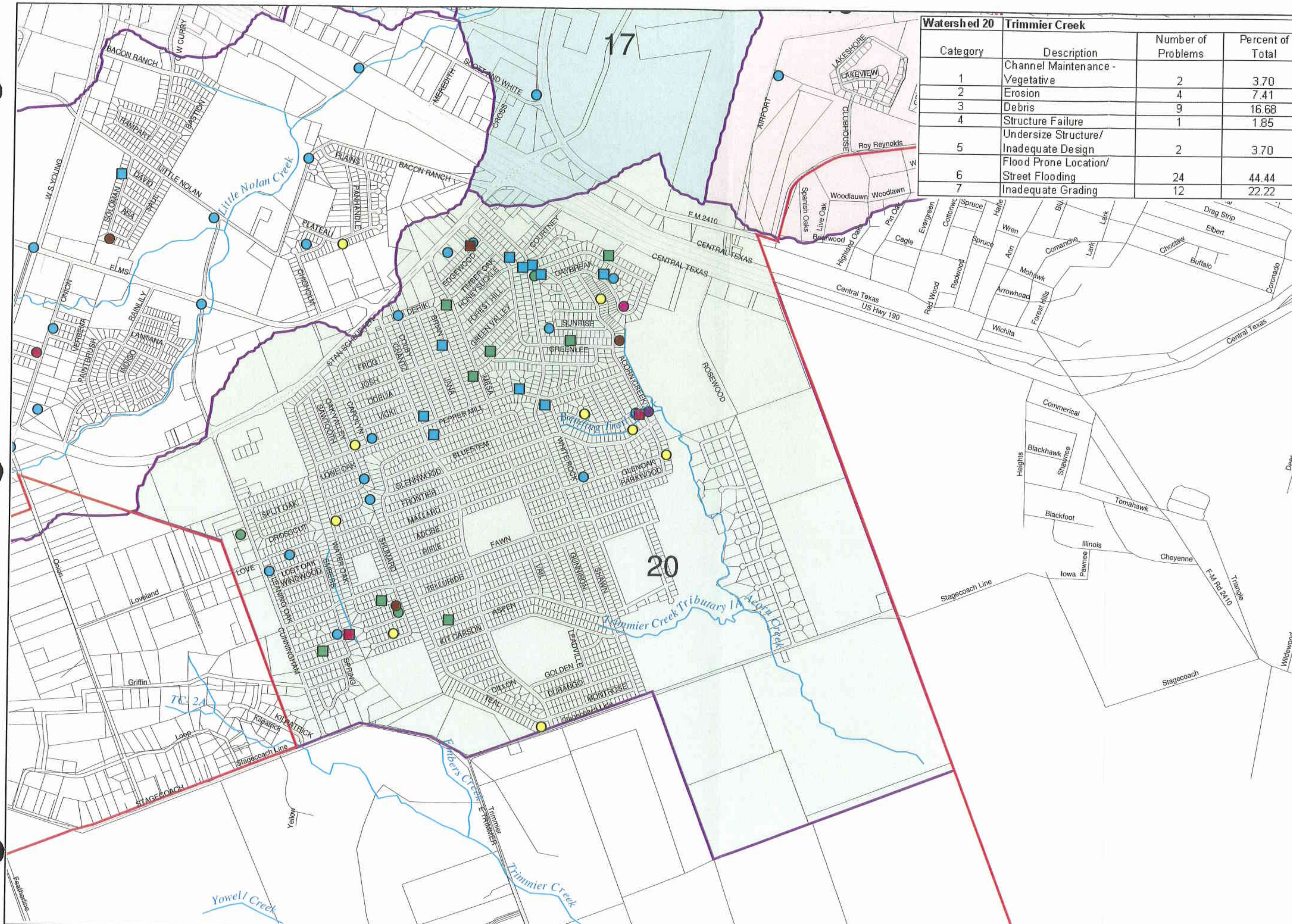
Exhibit B-1.7

Reported Drainage Problems Between 1/00 and 2/04
Killeen, Texas

August 16, 2005



Watershed 19	Little Nolan Creek, South of 190		
Category	Description	Number of Problems	Percent of Total
1	Channel Maintenance - Vegetative	1	3.45
2	Erosion	2	6.90
3	Debris	4	13.79
4	Structure Failure	0	0
5	Undersize Structure/ Inadequate Design	3	10.34
6	Flood Prone Location/ Street Flooding	17	58.62
7	Inadequate Grading	2	6.90



Watershed 20	Trimmier Creek		
Category	Description	Number of Problems	Percent of Total
1	Channel Maintenance - Vegetative	2	3.70
2	Erosion	4	7.41
3	Debris	9	16.68
4	Structure Failure	1	1.85
5	Undersize Structure/ Inadequate Design	2	3.70
6	Flood Prone Location/ Street Flooding	24	44.44
7	Inadequate Grading	12	22.22

Carter::Burgess

Legend

Citizen Survey Results

Events by DMP Category

- Channel Maintenance- Vegetative
- Erosion
- Debris - Non Vegetative, or Flood
- Structure Failure
- Undersized Structure/ Inadequate Design
- Flood Prone Location/ Street Flooding
- Inadequate Grading

City Flood Records

Events by DMP Category

- Channel Maintenance- Vegetative
- Erosion
- Debris - Non Vegetative, or Flood
- Structure Failure
- Undersized Structure/ Inadequate Design
- Flood Prone Location/ Street Flooding
- Inadequate Grading

- Rail
- Stream
- Street
- Drainage Divide
- Parcel
- citylimits_05

Location Inset

Exhibit B-1.9

Reported Drainage Problems Between 1/00 and 2/04
Killeen, Texas

August 16, 2005

APPENDIX C

NFIP POLICY/CLAIMS DATA AND FLOODPLAIN BOUNDARIES

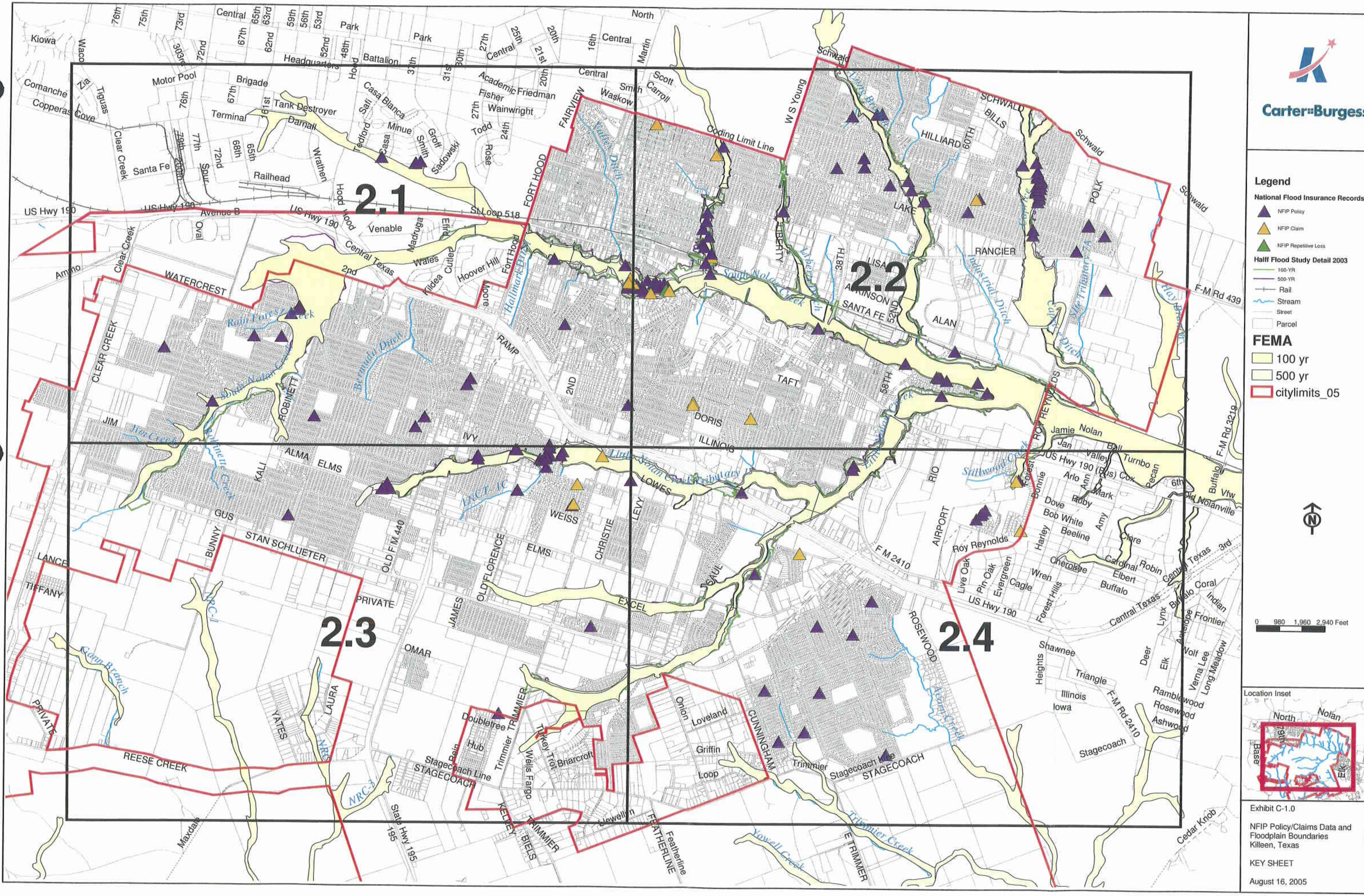
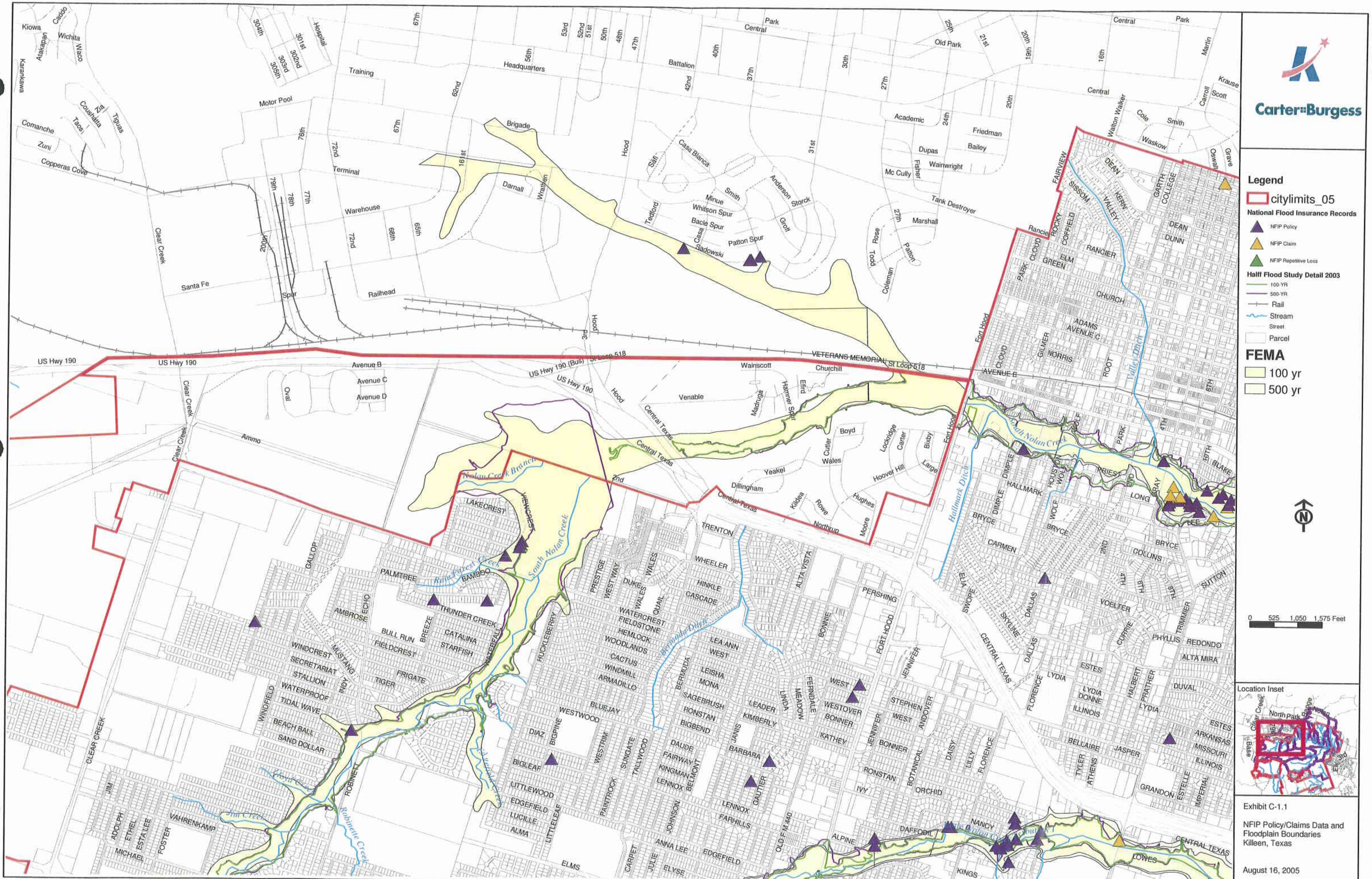


Exhibit C-1.0

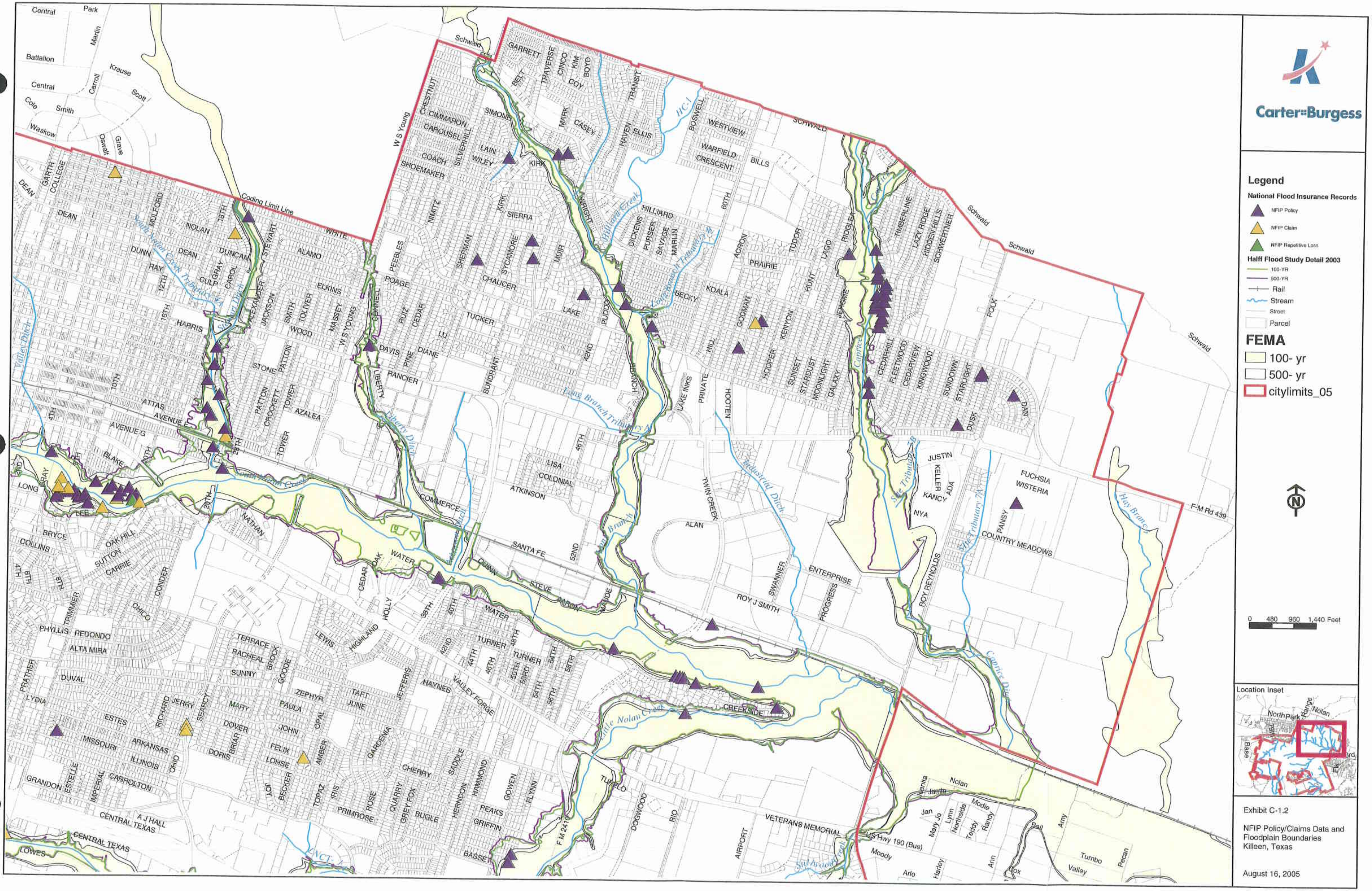
NFIP Policy/Claims Data and Floodplain Boundaries
Killeen, Texas

KEY SHEET

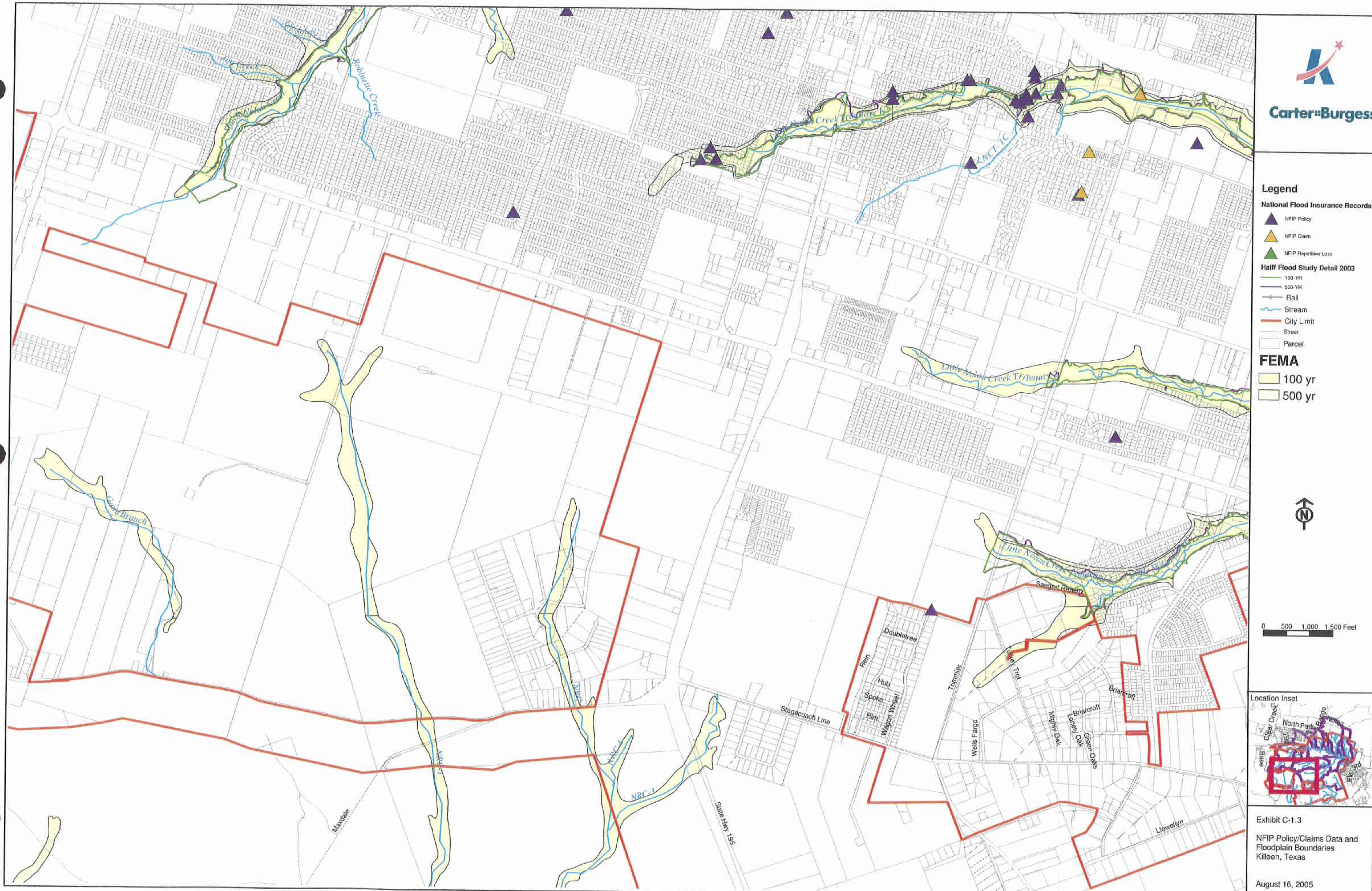
August 16, 2005

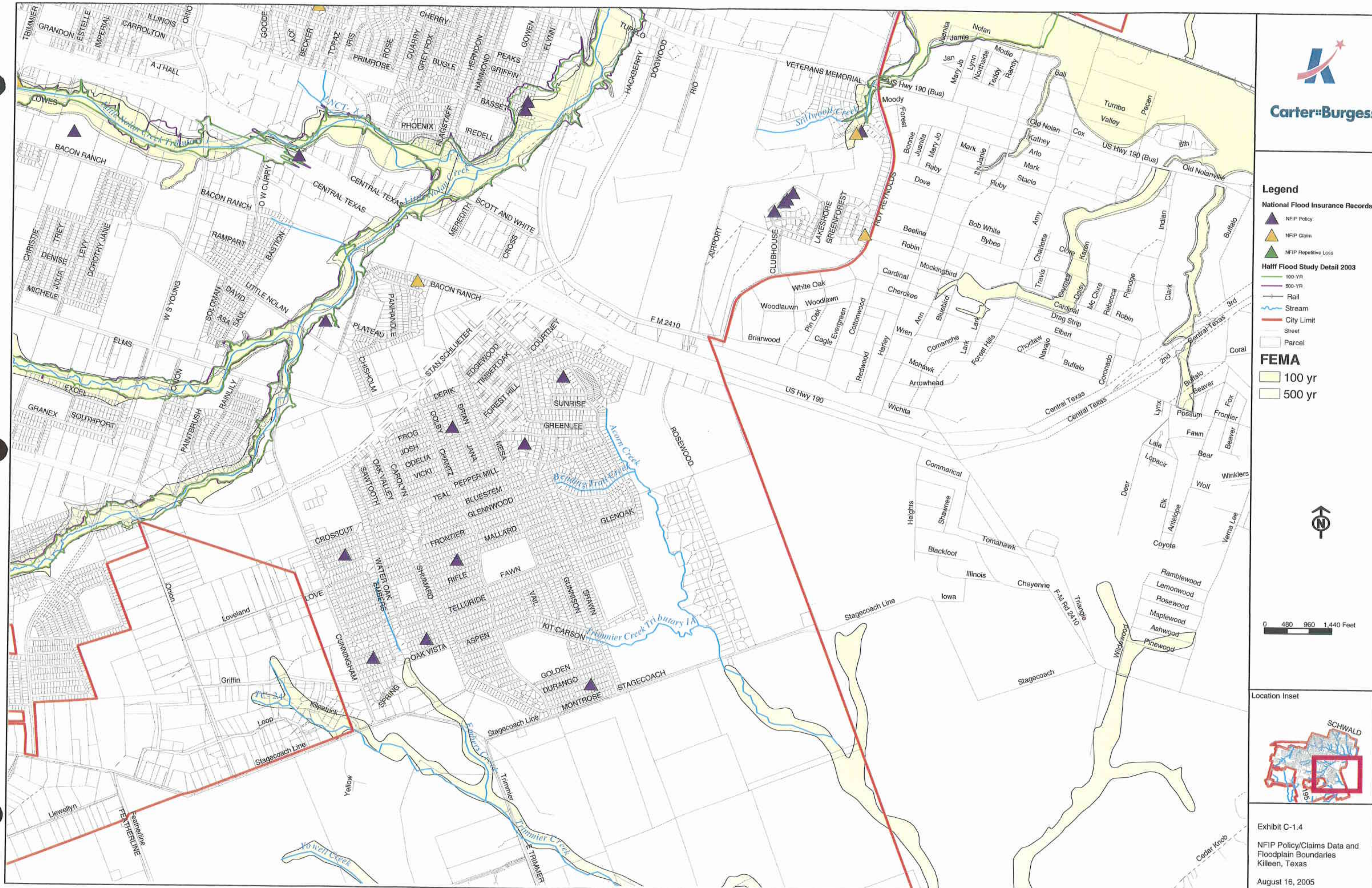


Carter::Burgess
Legend
citylimits_05
National Flood Insurance Records
NFIP Policy
NFIP Claim
NFIP Repetitive Loss
Halff Flood Study Detail 2003
100-YR
500-YR
Rail
Stream
Street
Parcel
FEMA
100 yr
500 yr
0 525 1,050 1,575 Feet
Location Inset
Exhibit C-1.1
NFIP Policy/Claims Data and Floodplain Boundaries
Killeen, Texas
August 16, 2005



Carter::Burgess
Legend
National Flood Insurance Records
NFIP Policy
NFIP Claim
NFIP Repetitive Loss
Halff Flood Study Detail 2003
100-YR
500-YR
Rail
Stream
Street
Parcel
FEMA
100- yr
500- yr
citylimits_05
0 480 960 1,440 Feet
Location Inset
Exhibit C-1.2
NFIP Policy/Claims Data and Floodplain Boundaries
Killeen, Texas
August 16, 2005


Carter::Burgess
Legend
National Flood Insurance Records
NFIP Policy
NFIP Claim
NFIP Repetitive Loss
Halff Flood Study Detail 2003
100-YR
500-YR
Rail
Stream
City Limit
Street
Parcel
FEMA
100 yr
500 yr
N
0 500 1,000 1,500 Feet
Location Inset
Jim Creek
Robinette Creek
Little Nolan Creek Tributary
LNCT-1C
Little Nolan Creek Tributary
Little Nolan Creek Tributary
Card Branch
NRC-1
NRC-3
Maxdale
State Hwy 195
Stagecoach Line
Doubletree
Rein
Hub
Spoke
Rim
Wagon Wheel
Trimmier
Saegert Ranch
Trot
Wells Fargo
Mighty Oak
Lonely Oak
Green Oaks
Briarcroft
Briarcroft
Llewellyn
Exhibit C-1.3
NFIP Policy/Claims Data and Floodplain Boundaries
Killeen, Texas
August 16, 2005



Carter::Burgess
Legend
National Flood Insurance Records
NFIP Policy
NFIP Claim
NFIP Repetitive Loss
Halff Flood Study Detail 2003
100-YR
500-YR
Rail
Stream
City Limit
Street
Parcel
FEMA
100 yr
500 yr
0 480 960 1,440 Feet
Location Inset
SCHWALD
Little Nolan Creek
Stillwood Creek
Acorn Creek
Bending Trail Creek
Trimmier Creek Tributary 1A
Trimmier Creek
Embers Creek
Yowell Creek
US Hwy 190
F M 2410
US Hwy 190 (Bus)
Exhibit C-1.4
NFIP Policy/Claims Data and Floodplain Boundaries
Killeen, Texas
August 16, 2005

APPENDIX D

DRAINAGE DESIGN CRITERIA

DRAINAGE DESIGN CRITERIA
NOVEMBER 4, 1992

The criteria presented here is for the purpose of designing drainage systems within the City of Killeen, Texas. All coefficients and tables have been established for simplicity of design and review. Special circumstances may require deviations from the established criteria. Each deviation must be fully explained by the design engineer as to the extent of deviation, reason for deviation, and supporting documentation verifying the deviation is within standard practices of civil engineering. Each deviation will be judged on its own merits.

I. <u>The first consideration in the design of a drainage system is the determination of the runoff "Q".</u>

A. <u>Run-off Calculations for Small Areas</u>

1. <u>Rational Method</u>

For drainage areas less than 600 acres and not in a designated FEMA floodway, the Rational Method will be used. This will include all on-street drainage inlets.

The Rational Method is as follows:

$Q = CIA$, where

Q is the storm flow at a given point in cubic feet per second (CFS);

C The portion of the total rainfall that will reach the point of design, depending upon the porosity of imperviousness of the watershed, as well as the slope of the watershed surface.

I is the average intensity of rainfall in inches per hour, equal to the greatest time of flow from any point of the drainage area to the design point of interest in the storm sewer system; and,

A is the tributary area to the design point, in acres.

2. Run-Off Coefficient

The run-off coefficient (C) shall consider the slope of the terrain, the character of the land-use, the length of overland flow and the imperviousness of the drainage area and shall be determined from the ultimate land development. The run-off coefficient for the appropriate land uses shall be as follows. For combination areas, use weighted averages.

TABLE 1

RUN-OFF COEFFICIENT "C"

Commercial Areas	0.90
Industrial Areas	0.70
Apartment Areas	0.70
Residential Areas	0.50
Park Areas and Open Spaces	0.35

3. Rainfall Intensity-Frequency

The rainfall intensity-frequency curves which are shown on FIGURE 1 are plotted from data by the Texas Department of Transportation and Hydraulic Manual for Bell County.

The intensity (I) in the formula Q = CIA is determined from the curves by arriving at a time of concentration and adopting a storm frequency upon which to base the drainage improvements.

The time of concentration, which is the greatest time of flow from any point of the drainage area to the first inlet in the system, consists of the time required to flow overland plus the time required to flow in the gutter to the inlet.

The minimum time of concentration and design storm frequency is summarized in Table 2.

4. Area

The area (A) in determining flows by the Rational Method shall be calculated by subdividing a map into the drainage areas within the basin contributing storm water run-off to the system. The design must include the entire drainage basin, not just the subdivision under design.

B. Run-off Calculations for Large Areas

For drainage areas greater than 600 acres, or where the Flood Insurance Administration, Federal Emergency Management Agency (FEMA) has mapped an area, Soil Conservation Service (SCS) Unit Hydrograph techniques will be used to compute run-off volumes and peak discharges. This methodology can be found in the SCS Technical Release 55 Urban Hydrology. For project areas that have several hydraulic elements combined (I.E., pipes, channels, and culverts), both the Rational Method and the SCS Unit Hydrograph Method should be used. Where this occurs, the higher discharge from the two methods should be utilized.

II. Design Storm Frequency

The second consideration in the design of a drainage system is the storm frequency to be adopted for a particular drainage structure or water course, depending upon the degree of flood protection desired. The storm frequency may be defined as the average interval of time within which the given flood will be equalled or exceeded once.

The following Table will be used to determine the design storm frequency.

TABLE 2

DESIGN STORM FREQUENCY

Structure Type	Time of Concentration (Minutes) Minimum	Time of Concentration (Minutes) Maximum	Design Frequency (Years)
Residential streets	10	30	25
Enclosed storm sewers and inlets in residential areas with some scattered business or commercial	10	30	25
Culverts and open channels where drainage areas equal 100 acres or less *	10	30	25
Drainage areas where storm run-off concentrates at low points °, †	10	30	50

Culverts and open channels, drainage areas more than 100 acres and less than 600 acres *, °, †	15	45	50
Culverts, bridges, and open channels with drainage areas more than 600 acres †	30	60	100

* A one-foot channel freeboard above design water surface shall be added to all channel depths.

† Concrete lining, where required for erosion velocity protection, will extend to the design elevation of the 25-year water surface. The remainder of the design storm water surface (plus 1-foot freeboard) will be contained in the grass-lined portion above the 25-year water surface of the channel section. Engineering drawings and calculations showing how the concrete is tied into the earth lining are required. Consideration must be given to erosion of the earth lining caused by scouring at the earth concrete interface. Side slopes on the earthen portion will be a maximum of 3:1.

° Provide documentation that 100 year storm can be contained in easement or ROW.

III. SIZING OF DRAINAGE FACILITIES

The third consideration in the design of a drainage system is the type, size, and course of the facility to accommodate the design runoff. The selection culverts and bridges will be based on hydraulic principles, on the most economical size and shape, and with a resulting headwater depth which should not cause appreciable damage to adjacent property. Open channels will be designed with concrete lining. Earth Channels may be used provided there are no existing concrete channels abutting immediately upstream and velocities are less than the design velocity shown in Table 3 below. Use concrete lining on alignment angles greater than 45°.

Design of drainage systems must take the water from the subdivision under design to the nearest public drainage way (street, open channel, or lateral storm sewer) or natural stream. Further analysis is required on the downstream channels to ensure that depth and spread of water criteria are not exceeded for these areas as well as within the subdivision.

Water channeled into special flood hazard areas will meet all FEMA requirements as stated in Section 12, Flood Damage Prevention of the City Ordinances.

FEMA must approve any modification of channels designated as special flood hazard areas. The hydraulic profiles shall be submitted by the developer's engineer thru the City to FEMA.

TABLE 3
MAXIMUM PERMISSIBLE VELOCITIES FOR CHANNELS

CHANNEL DESCRIPTION	MAX PERMISSIBLE MEAN VELOCITY fps
VEGETATED CHANNELS	
CLAYS (BERMUDA GRASS)	6
SANDY AND SILTY SOILS (BERMUDA GRASS)	4
NON-VEGETATED CHANNELS	
CONCRETE LINED CHANNELS	15
RIPRAP (BROKEN CONCRETE)	15
NATURAL EARTH CHANNELS WITHOUT VEGETATION:	
SANDY SOILS	2
SILTS	1
SANDY SILTS	3
CLAYS	4
COARSE GRAVELS	7
SHALE	8
ROCK	15

A. Manning's Formula

Sizes of pipes and open channels are determined by the use of Manning's Formula for velocity which is:

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2} \text{ where,}$$

"Q" is the discharge, in cubic feet per second, "A" is the cross-sectional area, in square feet, "S" is the slope, in feet per foot, "R" is the surface in contact with the water. Roughness coefficients for Manning's Formula for velocity are listed in Table 4. Closed storm sewers should be designed with the hydraulic gradient well below inlet throats.

TABLE 4

ROUGHNESS COEFFICIENTS TO BE USED IN MANNING'S FORMULA FOR VELOCITY

GRASS COVERED SMALL NATURAL CHANNELS, SHALLOW DEPTH	.045
NATURAL MINOR STREAMS	
FAIRLY REGULAR	.040
IRREGULAR, SLIGHT MEANDER	.050
FLOOD PLAIN (ADJACENT TO NATURAL STREAMS)	
GRASS COVERED	.035
BARE OR CULTIVATED	.040
HEAVY WEEDS, SCATTERED BRUSH	.060
UNLINED CHANNELS	.035
EARTH, STRAIGHT AND UNIFORM	
EARTH, WINDING AND SLUGGISH	
STONY BED, WEED ON BANK	
LINED CHANNELS	
CONCRETE	.015
CEMENT RUBBLE	.040
PIPE	
CORRUGATED STEEL (½")	.024
CORRUGATED STEEL (2")	.030
CONCRETE OR CLAY	.015

B. Maximum Spread of Water

The following table will be used to determine street capacities for the design. This table will also be used in spacing and/or sizing of curb inlets when lateral storm sewers are required.

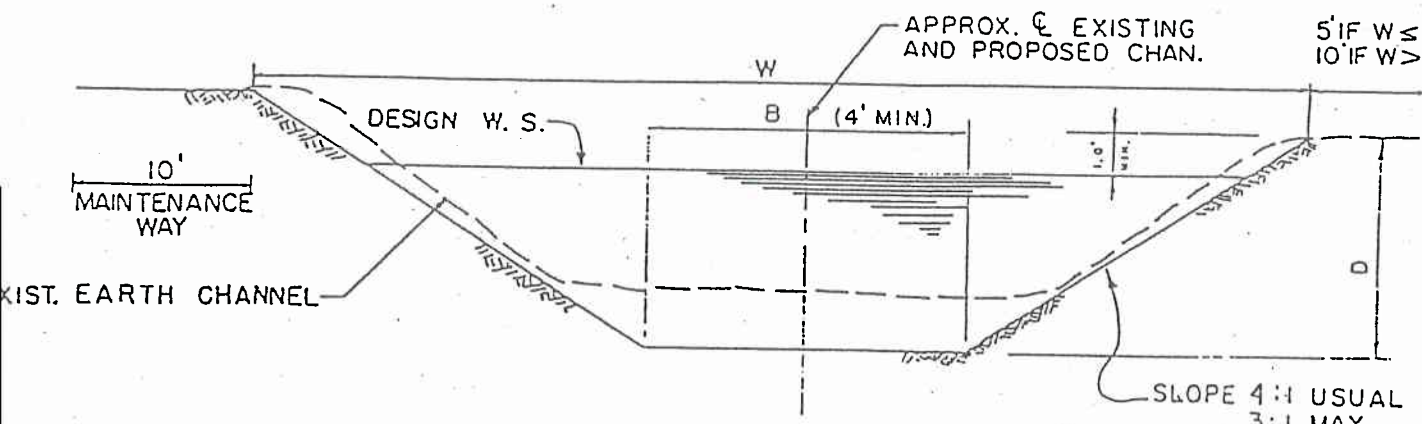
TABLE 5

MAXIMUM SPREAD OF WATER

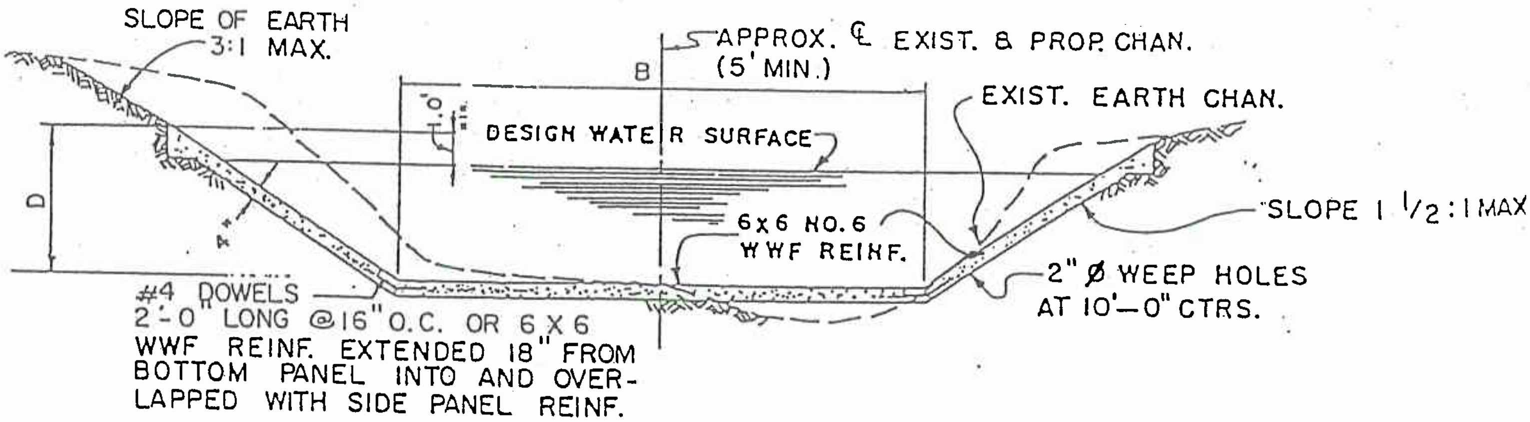
TYPE OF STREET	MAXIMUM GUTTER DEPRESSION	MAXIMUM PERMISSIBLE PONDING DURING DESIGN STORM
Expressway	2"	8 feet from outside face of curb. Maximum spacing 500'.
Major Arterial (Divided) (A+)	3"	One traffic lane clear each way.
Major and Minor Arterial (Undivided) (A, B+, B)	3"	Two traffic lanes clear.
Major Collector (C)	4"	One traffic lane clear.
Minor Collector (D)	4"	6" depth of flow at the face of curb or when the street is just covered, whichever produces least depth.
Residential Street	4"	
Velocity ≤ 10 FPS		6" above top of curb, provided width of flow does not exceed the street property line width, less 4', and total depth of flow does not exceed 12" anywhere between curb faces.
Velocity > 10 FPS		Depth of water must be reduced until the velocity is less than or equal to 10 FPS.

C. Typical Sections

The following typical sections will be used when designing earth or concrete lined channels. Other sections may be designed and presented for approval by the design engineer. Each transition from earth to concrete or concrete to earth must be engineered to account for velocity changes and turbulence to ensure that undermining of the concrete structure will not occur.



TYPICAL SECTION – EARTH CHANNEL
N. T. S.

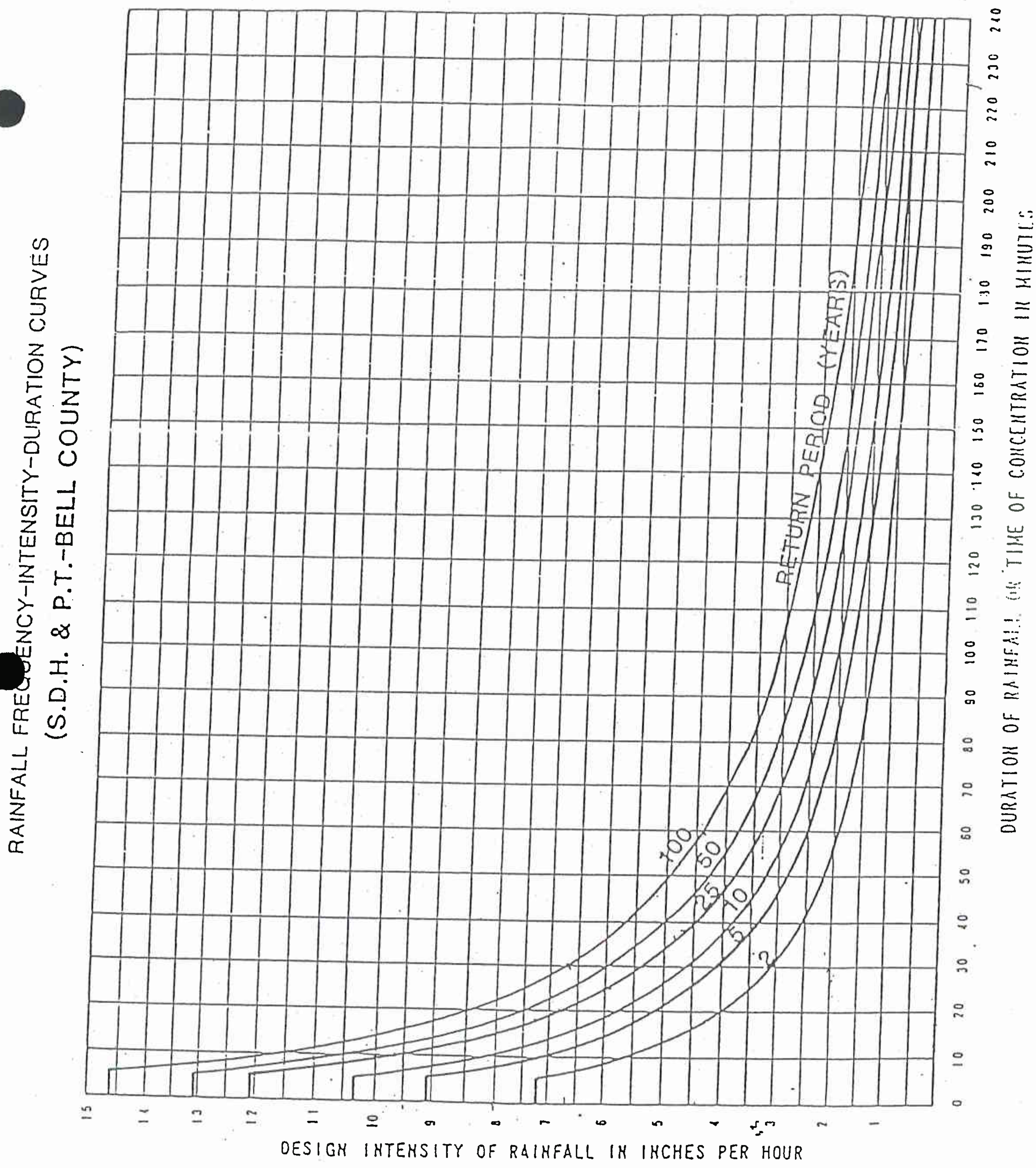


TYPICAL SECTION – CONCRETE LINED CHANNEL
N. T. S.

Physical and legal (easements) access must be provided to concrete lined channels at all street crossings.

D. Typical Details

Typical curb inlets and flume designs are contained on the City of Killeen Standards Drawing sheets, "Standard Curb Inlet" and "Paving Details".



CITY OF KILLEEN, TEXAS

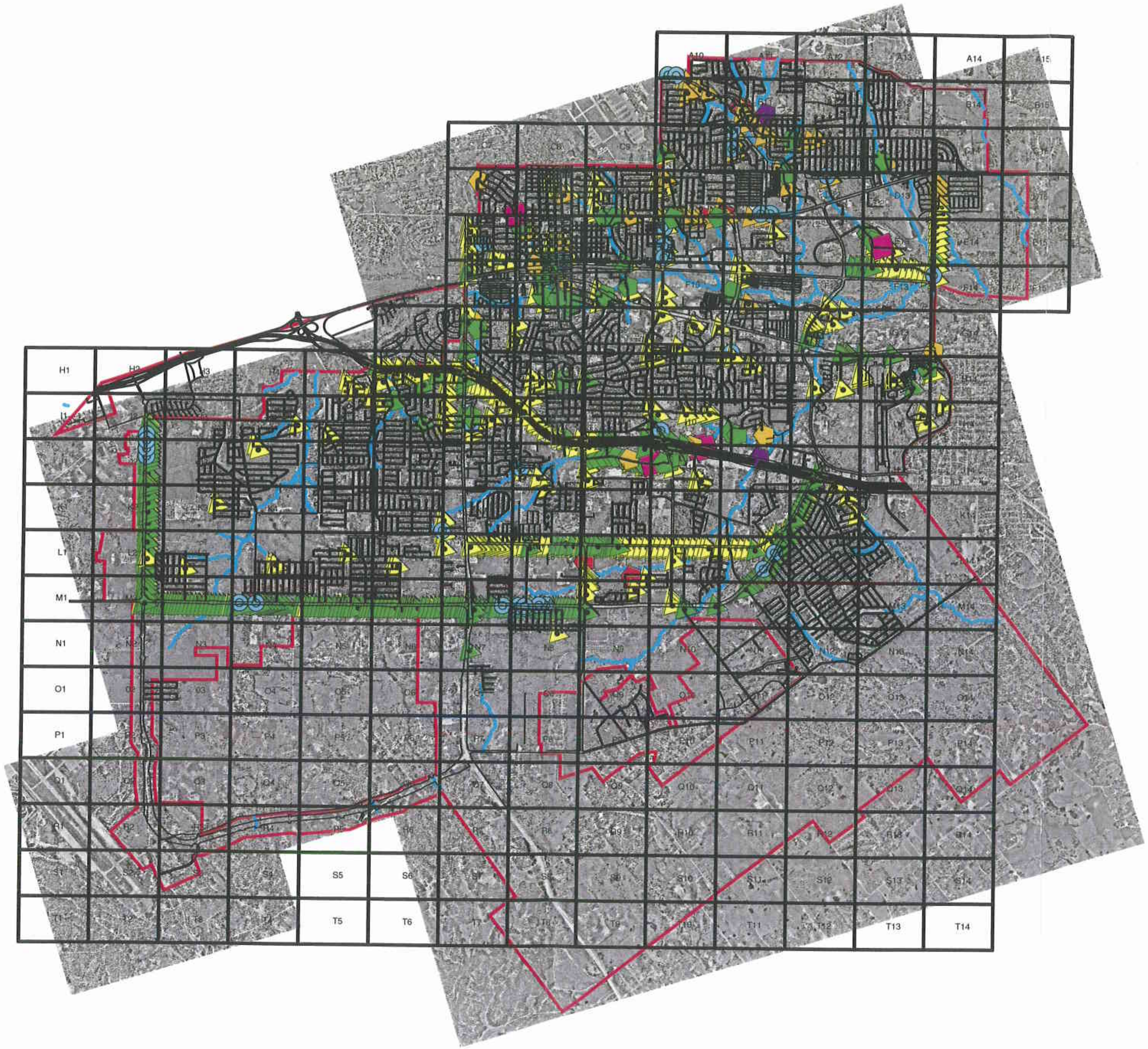
RAINFALL INTENSITY CURVE

FIGURE 1

APPENDIX E

DRAINAGE SYSTEM INFRASTRUCTURE SUMMARY

Carter-Burgess



Legend

Survey Point Type (Merged)*

- Storm Sewer Manhole (34)
- Box Culvert (5)
- Curb Inlet (696)
- Grate Inlet (423)
- Miscellaneous Inlet (105)
- Ductile Iron Pipe (12)
- PVC Pipe (3)
- Reinforced Concrete Pipe (58)
- Miscellaneous Pipe (10)
- Stream
- ROW
- Grid
- citylimits_05

N

0 2,500 5,000 7,500 Feet

* Merged file contains points from the original dataset and the updated dataset. These files were merged and duplicates removed.

Exhibit E.1
City of Killeen

Survey Points Sample

September 16, 2005

APPENDIX F

MINOR CIP PROJECT LIST

City of Killeen Drainage Master Plan

Minor CIP List

Prv List	Project (Tributary)	Incident Type	1	2	3	4	5	6	7	8	9	10	Total Score	Project Est Cost	Rank	Cumulative Sum
			Ranking Criteria													
	2202 Hidden Hills Dr	Ponded Water	8	8	2	8	9	9	8	8	8	10	78	$1,000	P2-1	$1,000
	2413 Southport Dr	Ponded Water	5	8	8	8	9	9	8	8	8	5	76	$5,000	P2-2	$6,000
	2901 St Francis St	Ponded Water	8	8	5	8	9	9	2	8	2	8	67	$3,000	P2-3	$9,000
	2003 Schwald Rd (Long Branch)	Flume Blockage	8	8	2	8	9	5	2	8	8	8	66	$2,000	P2-4	$11,000
	Carrie Ave and Conder St (Conder Park Trib)	Street Flooding	5	8	8	5	2	9	8	8	8	5	66	$30,000	P2-5	$41,000
	3719 Lakecrest Dr	Culvert Blockage	8	8	2	2	9	9	2	8	8	8	64		P2-6	$41,000
	5300 Birdcreek Dr	Ponded Water	8	8	8	2	9	9	2	2	8	8	64	$3,000	P2-7	$44,000
	Windfield Dr and Waterproof Dr	Unsecured Inlet	8	8	5	5	9	9	8	2	2	8	64	$3,000	P2-8	$47,000
	2004 Grey Fox Tr (LNCT 1 Trib)	Channel Erosion	5	2	5	8	9	5	8	8	8	5	63	$39,000	P2-9	$86,000
	1807 Ledgestone Dr (LNCT 1 Trib)	Property Flooding	5	2	8	5	9	9	2	8	8	5	61	$39,000	P2-10	$125,000
	1401 Windsor Cr	Ponded Water	8	8	2	8	9	9	2	2	2	10	60	$1,000	P2-11	$126,000
	2401 Haven Dr	Ponded Water	8	8	2	2	9	9	8	2	2	10	60		P2-12	$126,000
	602/605/606 Shad Cr	Ponded Water	8	8	2	8	9	9	2	2	2	10	60	$1,000	P2-13	$127,000
	902 San Antonio St	Ponded Water	8	8	2	8	9	9	2	2	2	10	60		P2-14	$127,000
	807/808 Evergreen Dr	Ponded Water	5	8	5	8	2	9	2	8	8	5	60	$30,000	P2-15	$157,000
Y	3400 Granite Dr	Property Flooding	5	8	8	8	2	5	8	8	2	5	59	$25,000	P2-16	$182,000
	3201 Cody Poe Road	Property Flooding	5	8	8	8	5	5	8	2	8	2	59	$60,000	P2-17	$242,000
Y	802/806/811 Skyline Ave	Street Flooding	5	8	8	8	2	9	2	2	2	2	48	$84,000	P2-41	$326,000
Y	3232/3234 Cantabrian Dr (Old Florence)	Channel Blockage	2	8	8	2	2	5	2	8	2	2	41	$30,000	P2-49	$356,000
	1710 Joy Dr	Groundwater Seep	5	8	8	10	5	9	8	2	8	5	68	$18,000	P3-1	$374,000
	1300 Block of S 2nd St	Groundwater Seep	5	8	2	8	9	9	8	2	8	5	64	$6,000	P3-2	$380,000
	4500 John David Dr	Groundwater Seep	5	8	8	8	2	9	8	2	8	5	63	$18,000	P3-3	$398,000
	3610/3612 Palmtree Ln	Channel Blockage	8	8	5	2	5	9	2	8	8	5	60	$18,000	P3-4	$416,000
Y	3601 Woodrow Dr	Street Flooding	5	8	5	8	2	9	8	2	8	5	60	$36,000	P3-5	$452,000
Y	4201 Zephyr Rd (Patriotic)	Channel Blockage	8	8	8	2	5	5	2	8	8	5	59		P3-6	$452,000
Y	1107 York Ave	Flood Prone Location	5	8	8	8	2	5	8	2	8	5	59	$30,000	P3-7	$482,000
	1401 Fox Creek Dr	Groundwater Seep	5	8	2	5	9	9	2	2	8	8	58	$3,000	P3-8	$485,000
Y	1901 Moonstone Dr	Property Flooding	8	8	2	2	9	9	2	2	8	8	58	$3,000	P3-9	$488,000
Y	3104 Minthorn Dr	Ponded Water	8	8	2	2	9	9	2	2	8	8	58	$3,000	P3-10	$491,000
Y	Lake Rd and Tucker Dr	Street Flooding	8	8	5	2	9	9	2	2	8	5	58	$6,000	P3-11	$497,000
	4101 Embers Dr (Embers)	Channel Erosion	5	2	5	8	9	9	2	8	8	2	58	$50,000	P3-12	$547,000
Y	4401 Twin Oaks Cr (Embers)	Channel Erosion	5	2	5	8	9	9	2	8	8	2	58	$50,000	P3-13	$597,000
	3009 Sungate Dr	Property Flooding	8	8	8	8	9	5	2	2	2	5	57	$6,000	P3-14	$603,000
	1203 Liberty Bell Lp (Patriotic)	Channel Blockage	8	8	2	2	5	9	2	8	8	5	57		P3-15	$603,000
Y	6006/6100 Stillwood Drive (Harker Heights)	Property Flooding	5	8	8	8	2	9	8	2	2	5	57	$30,000	P3-16	$633,000
Y	3702 Soloman Drive (LNC Trib 2)	Channel Erosion	2	8	5	8	5	9	2	8	8	2	57	$50,000	P3-17	$683,000
	2302 Estelle Ave	Street Flooding	2	8	8	8	2	5	8	2	8	5	56	$6,000	P3-18	$689,000
	3707 Zephyr Rd (Patriotic)	Channel Blockage	8	8	5	2	5	5	2	8	8	5	56	$18,000	P3-19	$707,000
Y	1301 Janis Dr (Bermuda)	Structural Failure	5	2	5	2	9	9	8	2	8	5	55		P3-20	$707,000
	1206 Westway Cir	Flume Blockage	8	8	2	2	9	9	2	2	2	10	54	$1,000	P3-21	$708,000
	2907 Reed Ln	Ponded Water	8	8	2	2	9	9	2	2	2	10	54	$1,000	P3-22	$709,000
	3318 Viewcrest Dr	Flume Blockage	8	8	2	2	9	9	2	2	2	10	54	$1,000	P3-23	$710,000
	3701 Stallion Dr	Flume Blockage	8	8	2	2	9	9	2	2	2	10	54	$1,000	P3-24	$711,000
Y	4307 Greenlee Dr	Ponded Water	8	8	2	2	9	9	2	2	2	10	54	$1,000	P3-25	$712,000
	508 Weiss Dr	Ponded Water	8	8	2	2	9	9	2	2	2	10	54	$1,000	P3-26	$713,000
	5402 Birdcreek Dr	Flume Blockage	8	8	2	2	9	9	2	2	2	10	54	$1,000	P3-27	$714,000
	708 Houston St	Ponded Water	8	8	2	2	9	9	2	2	2	10	54	$1,000	P3-28	$715,000
Y	1107 Patriotic St (Patriotic)	Channel Blockage	8	8	2	2	5	9	2	2	8	8	54		P3-29	$715,000
Y	403 E Hallmark Ave	Property Flooding	5	2	5	8	2	9	8	2	8	5	54	$28,000	P3-30	$743,000
	Vive Les Arts Complex	Property Flooding	2	8	8	8	5	9	2	2	8	2	54	$60,000	P3-31	$803,000
	606 Donne Dr	Groundwater Seep	5	8	2	8	5	5	2	2	8	8	53	$6,000	P3-32	$809,000
	702 E Ave E	Flood Prone Location	5	8	8	8	2	5	2	2	8	5	53	$30,000	P3-33	$839,000
Y	2808 Cheaney Dr	Flood Prone Location	5	8	8	8	2	2	8	2	8	2	53	$60,000	P3-34	$899,000
	1812 Michelle Dr	Channel Erosion	5	8	2	2	9	9	2	8	2	5	52	$6,000	P3-35	$905,000
	1101 August Dr	Channel Blockage	5	8	2	5	9	5	2	8	2	5	51	$18,000	P3-36	$923,000
	910/912 Kern Rd	Street Flooding	5	8	2	8	2	9	2	2	8	5	51	$18,000	P3-37	$941,000
Y	1400 Barbara Ln (Ronstan)	Culvert Blockage	2	2	8	8	2	9	2	8	8	2	51	$42,000	P3-38	$983,000
	1101 Karen Dr	Groundwater Seep	5	8	2	5	5	5	2	2	8	8	50	$3,000	P3-39	$986,000
	1204 Bristol Dr	Groundwater Seep	5	8	5	2	5	5	2	2	8	8	50	$3,000	P3-40	$989,000
	4202 Fawn Dr	Groundwater Seep	5	8	5	2	5	5	2	2	8	8	50	$3,000	P3-41	$992,000
	Caprice Dr & Cross Timbers Dr	Groundwater Seep	5	8	5	2	5	5	2	2	8	8	50	$3,000	P3-42	$995,000
	Daybreak Dr & Misty Ln	Groundwater Seep	5	8	5	2	5	5	2	2	8	8	50	$3,000	P3-43	$998,000
	Honeysuckle Cir & Shawn Dr	Groundwater Seep	5	8	5	2	5	5	2	2	8	8	50	$3,000	P3-44	$1,001,000
	Morning Glen Ln & Shawn Dr	Groundwater Seep	5	8	5	2	5	5	2	2	8	8	50	$3,000	P3-45	$1,004,000
	5200 Block of Daybreak Dr	Groundwater Seep	5	8	5	2	5	5	2	2	8	8	50	$6,000	P3-46	$1,010,000
	3008-3110 Tallwood Dr	Groundwater Seep	5	8	8	8	2	2	2	2	8	5	50	$18,000	P3-47	$1,028,000
	3101-3003 Paintrock Dr	Groundwater Seep	5	8	8	8	2	2	2	2	8	5	50	$18,000	P3-48	$1,046,000
Y	2807 Cheaney Dr	Flood Prone Location	5	8	8	8	2	2	8	2	2	5	50	$28,000	P3-49	$1,074,000

Prv List	Project (Tributary)	Incident Type	1	2	3	4	5	6	7	8	9	10	Total Score	Project Est Cost	Rank	Cumulative Sum
			Ranking Criteria													
	1907 Lava Ln	Street Flooding	2	8	8	8	2	2	8	2	8	2	50	$50,000	P3-50	$1,124,000
Y	2501/2503 Magnum Cr (Dickens)	Channel Blockage	5	8	5	8	2	2	2	8	8	2	50		P3-51	$1,124,000
Y	301/302/311 Baumann Dr (LNC Trib 1)	Channel Blockage	2	8	8	8	2	2	8	8	2	2	50		P3-52	$1,124,000
	1300 Bloock of Greenwood Ave (Stewart)	Structural Failure	5	2	2	5	9	9	2	2	8	5	49		P3-53	$1,124,000
	510 Cardinal Ave (Stewart)	Structural Failure	5	2	2	5	9	9	2	2	8	5	49		P3-54	$1,124,000
	1603 Goode Dr	Property Flooding	8	8	2	5	9	5	2	2	2	5	48	$6,000	P3-55	$1,130,000
	219 Turtle Creek Dr (LNC Trib 1)	Channel Erosion	5	2	2	2	9	5	2	8	8	5	48	$18,000	P3-56	$1,148,000
Y	4523 Jacobs Ln	Channel Erosion	5	2	5	2	2	9	2	8	8	5	48	$25,000	P3-57	$1,173,000
Y	1908/1911 Bundrant Dr	Street Flooding	5	8	5	8	2	9	2	2	2	5	48	$30,000	P3-58	$1,203,000
	10th St & Little Ave	Street Flooding	5	2	8	5	2	9	8	2	2	5	48	$35,000	P3-59	$1,238,000
Y	1411 Camilla Rd (Ronstan)	Channel Blockage	2	2	8	8	2	9	8	2	2	5	48	$40,000	P3-60	$1,278,000
Y	5803 Greenforest Cr	Property Flooding	5	2	8	8	2	9	8	2	2	2	48	$58,000	P3-61	$1,336,000
	WS Young Dr & Terrace Dr	Street Flooding	2	2	5	8	2	9	8	2	8	2	48	$72,000	P3-62	$1,408,000
	4602 Whitmire Dr	Groundwater Seep	5	8	5	2	5	5	2	2	8	5	47	$6,000	P3-63	$1,414,000
	406/410 Phyllis Dr	Property Flooding	8	8	2	2	5	5	2	8	2	5	47	$9,000	P3-64	$1,423,000
	3311 Bermuda Dr	Groundwater Seep	5	8	2	5	5	5	2	2	8	5	47	$18,000	P3-65	$1,441,000
Y	504-610 Odom Dr	Flood Prone Location	5	2	8	8	2	5	8	2	2	5	47	$30,000	P3-66	$1,471,000
Y	2614 Willow Springs Rd (Bermuda)	Channel Blockage	2	2	5	8	2	2	8	8	8	2	47		P3-67	$1,471,000
	4910 Bending Trl (Bending Trail)	Channel Erosion	5	2	5	8	2	5	2	8	8	2	47		P3-68	$1,471,000
	5113 Glenwood Dr (Bending Trail)	Channel Erosion	5	2	5	8	2	5	2	8	8	2	47		P3-69	$1,471,000
	203 Collins Ave (Fowler)	Structural Failure	5	2	2	2	9	9	2	2	8	5	46	$9,000	P3-70	$1,480,000
	208/210 Fowler Ave (Fowler)	Structural Failure	5	2	2	2	9	9	2	2	8	5	46	$9,000	P3-71	$1,489,000
	210 Bryce Ave (Fowler)	Structural Failure	5	2	2	2	9	9	2	2	8	5	46	$9,000	P3-72	$1,498,000
	3901 Trotwood Trl	Structural Failure	5	2	2	2	9	9	2	2	8	5	46	$9,000	P3-73	$1,507,000
	500 Block of Utah St (Gilmer)	Flood Prone Location	5	2	2	8	9	9	2	2	2	5	46	$30,000	P3-74	$1,537,000
	108 Garth Dr	Property Flooding	8	8	2	2	9	5	2	2	2	5	45	$6,000	P3-75	$1,543,000
	1220 Chippendale Dr	Property Flooding	8	8	2	2	9	5	2	2	2	5	45	$6,000	P3-76	$1,549,000
	1504 Becker Dr	Property Flooding	8	8	2	2	9	5	2	2	2	5	45	$6,000	P3-77	$1,555,000
	1509 Janis Dr	Property Flooding	8	8	2	2	9	5	2	2	2	5	45	$6,000	P3-78	$1,561,000
	1701 Waterford Dr	Property Flooding	8	8	2	2	9	5	2	2	2	5	45	$6,000	P3-79	$1,567,000
	1708 Bristol Dr	Property Flooding	8	8	2	2	9	5	2	2	2	5	45	$6,000	P3-80	$1,573,000
	2308 Waterfall Dr	Property Flooding	8	8	2	2	9	5	2	2	2	5	45	$6,000	P3-81	$1,579,000
	2410 Royal Crest Cir	Property Flooding	8	8	2	2	9	5	2	2	2	5	45	$6,000	P3-82	$1,585,000
	3201 Levy Ln	Property Flooding	8	8	2	2	9	5	2	2	2	5	45	$6,000	P3-83	$1,591,000
	4901 Greenlee Dr	Property Flooding	8	8	2	2	9	5	2	2	2	5	45	$6,000	P3-84	$1,597,000
	620 Bishop Dr	Property Flooding	8	8	2	2	9	5	2	2	2	5	45	$6,000	P3-85	$1,603,000
Y	1604/1606 Linda Ln (Ronstan)	Flume Blockage	8	8	2	5	2	9	2	2	2	5	45	$8,000	P3-86	$1,611,000
Y	1001/1103 Charrise St (Patriotic)	Channel Blockage	8	8	5	2	2	2	2	8	2	5	44		P3-87	$1,611,000
	3700 Block of Lakecrest Dr	Street Flooding	2	8	5	8	2	2	2	2	8	5	44	$30,000	P3-88	$1,641,000
	407/409 Baumann Dr	Property Flooding	8	8	2	2	9	2	2	2	2	5	42	$6,000	P3-89	$1,647,000
	3504 Chandler Dr	Structural Failure	5	8	2	2	9	5	2	2	2	5	42	$9,000	P3-90	$1,656,000
Y	2903 Cheaney Dr	Property Flooding	5	8	5	2	2	9	2	2	2	5	42	$30,000	P3-91	$1,686,000
Y	208 N 28th St (Conder Park)	Street Flooding	5	8	2	2	9	5	2	2	2	5	42	$39,000	P3-92	$1,725,000
	2700 Block of Lucille Dr	Flood Prone Location	2	8	2	8	2	2	8	2	2	5	41	$30,000	P3-93	$1,755,000
Y	106/112 Daffodil Dr	Street Flooding	5	8	2	2	2	5	8	2	2	5	41	$36,000	P3-94	$1,791,000
Y	2100 Block of Wright Way (Long Branch)	Channel Blockage	2	2	8	8	2	5	2	8	2	2	41		P3-95	$1,791,000
Y	4406 Acorn Creek Tr (Trimmier Trib)	Channel Blockage	2	2	5	8	2	2	2	8	8	2	41		P3-96	$1,791,000
Y	4606 Acorn Creek Tr (Trimmier Trib)	Channel Blockage	2	2	5	8	2	2	2	8	8	2	41		P3-97	$1,791,000
Y	4812/4904/4906 Acorn Creek Tr (Trimmier Trib)	Channel Blockage	2	2	5	8	2	2	2	8	8	2	41		P3-98	$1,791,000
Y	5104 Acorn Creek Tr (Trimmier Trib)	Channel Blockage	2	2	5	8	2	2	2	8	8	2	41		P3-99	$1,791,000
	1102 Duval Dr	Groundwater Seep	5	8	2	8	2	2	2	2	2	5	38	$6,000	P3-100	$1,797,000
Y	2003 Westwood Dr (Bermuda)	Flume Blockage	5	2	5	8	2	5	2	2	2	5	38	$17,000	P3-101	$1,814,000
Y	1503 Daude Dr (Ronstan)	Channel Blockage	8	2	5	2	2	2	2	8	2	5	38	$18,000	P3-102	$1,832,000
Y	3902/3904 Peaks Dr	Property Flooding	5	8	2	2	2	5	8	2	2	2	38	$47,000	P3-103	$1,879,000

Key

Minor Drainage Phase II CIP Project (Designed)
Minor Drainage Phase II (City-Dev Agreement)
Minor Drainage Phase III CIP Project (Proposed)
Major Drainage Phase I CIP Bond Project

General Range per Criterion

1	2	3	4	5	6	7	8	9	10
Sig=2	Yes=2	No=2	Low=2	> One=2	> One=2	No=2	No=2	No=2	High=2
Mid=5		Unkn=5	Unkn=5	One=5	One=5				Mid=5
Min=8	No=8	Yes=8	High=8	None=9	None=9	Yes=8	Yes=8	Yes=8	Low=8

Ranking Criteria

1. Design Data Required — complex engineering design data required; Master Planning analysis required
2. Adverse Site Conditions — deteriorated infrastructure; adverse topography; GW flows/hydrostatic pressure; incompatible infrastructure
3. Political Concerns — lack of attention; failed past initiatives; high visibility
4. Citizen's Concerns — community activism; ongoing concerns
5. Utility Relocations — water, sewer, electrical, gas, telephone, cable, or other utilities present
6. Easements Required — easements required to perform work
7. "At-Risk" Condition — public safety concern or liability exists that could be corrected
8. Water Quality Improvement — structural BMP yields storm water quality improvement; reduce standing water
9. Long-Term Maintenance Reduction — structural BMP reduces chronic maintenance problem
10. Project Cost — estimated time & materials cost

APPENDIX G

MAJOR CIP PROJECT LIST

City of Killeen Drainage Master Plan

CIP Prioritization Summary

9/1/2005

Rank	Score	CIP	Problem	Description of project	Cost	Cumulative Cost
1	21	Bermuda/Ronstan Ditch	undermined infrastructure, undersized infrastructure, property flooding	channel restoration, detention, channel clearing, upsize storm drain	$2,226,000	$2,226,000
2	20	South Nolan Creek at Odom Dr	undermined infrastructure, undersized infrastructure, houses in floodplain	add detention volume along Little Ave, stabilize channel banks, increase channel capacity	$556,850	$2,782,850
3	20	Stewart Ditch	undersized infrastructure, houses in floodplain	create detention in park area, stream restoration	$587,650	$3,370,500
4	20	South Nolan Creek at Stallion Dr	undersized infrastructure, street flooding, property flooding	detention, direct SNC away from flume	$589,260	$3,959,760
5	19	WS Young	undermined infrastructure, street flooding	storm sewer along WS Young near Killeen Conference Center	$441,300	$4,401,060
6	19	K3C Drainage	undermined infrastructure, street flooding	storm sewer at Killeen Civic and Conference Center	$557,250	$4,958,310
7	18	Patriotic Ditch at Zephyr Rd	undersized infrastructure, property flooding	add curb inlets on Zephyr Rd	$56,550	$5,014,860
8	18	South Nolan Creek at Dimple St	undermined infrastructure	reconstruct abutment, stabilize banks, armor piers, excavate under bridge to provided added conveyance	$84,245	$5,099,105
9	18	Dogwood Blvd at Bus. 190	undersized infrastructure, street flooding, property flooding	replace culvert under Dogwood, outfall to concrete channel along SH190B, add storm sewer and curb inlet	$87,525	$5,186,630
10	18	South Nolan Creek at 10th St	undermined infrastructure, property flooding	reconstruct abutment, stabilize banks, armor piers, excavate under bridge to provide added conveyance	$99,975	$5,286,605
11	18	South Nolan Creek at 2nd St	undermined infrastructure	stabilize channel bank, excavate for detention volume, increase conveyance area	$195,750	$5,482,355
12	18	Still Forest	street flooding	culvert and associated drainage improvements	$300,000	$5,782,355
13	18	Bending Trail Creek	undermined infrastructure	stabilize channel	$400,750	$6,183,105
14	16	Acorn Creek Headwaters	street flooding	construct storm sewer, channel clearing	$415,835	$6,598,940
15	16	Little Nolan Creek, Trib 1 at Caprock Dr	undermined infrastructure	stabilize channel banks, detention, armor culvert	$642,390	$7,241,330
16	15	Lagrone	undermined infrastructure	stabilize channel banks, stream restoration	$72,675	$7,314,005
17	15	El Dorado Dr	street flooding, property flooding	construct storm sewer and curb inlets	$119,625	$7,433,630
18	15	Little Nolan Creek, Trib 1 at Cantabrian Dr - Phase 1	undermined infrastructure, houses in floodplain	detention	$566,370	$8,000,000
		Initial Bond Package	*$8,000,000*	**Phase I CIP cost estimate**	**$8,000,000**	
18	15	Little Nolan Creek, Trib 1 at Cantabrian Dr - Phase 2	undermined infrastructure, houses in floodplain	detention	$95,830	$8,095,830
19	14	Industrial Ditch	undermined infrastructure	stabilize channel banks, armor culvert	$73,275	$8,169,105
20	14	Valley Ditch	undersized infrastructure, street flooding, property flooding	detention	$353,150	$8,522,255
21	13	Little Nolan Creek at WS Young	undermined infrastructure	stabilize outfalls, vegetate, remove sediment	$225,190	$8,747,445
22	12	Little Nolan Creek at 2410	undersized infrastructure, houses in floodplain	channel excavation and detention	$613,900	$9,361,345
23	11	Long Branch Tributary	undermined infrastructure	stream restoration, clear storm drain outfalls	$56,400	$9,417,745
24	11	Dickens Ditch	undersized infrastructure	channel clearing and channel excavation	$291,480	$9,709,225
25	11	Caprice Ditch	undersized infrastructure, houses in floodplain	channel clearing and detention	$314,930	$10,024,155
26	11	Wolf Ditch	undersized infrastructure	replace storm sewer	$500,220	$10,524,375
27	10	Greenforest Circle	street flooding, property flooding	construct storm sewer and curb inlet	$20,730	$10,545,105
28	8	Long Branch	undersized infrastructure, houses in floodplain	detention downstream of 38th St	$653,800	$11,198,905
				Phase II CIP cost estimate*	**$3,198,905**	
			Total CIP Cost Estimate		**$11,198,905**	

* Lower ranked projects may be funded depending on the cost performance of Phase I CIP Projects

CIP Prioritization

Location	Problem:	Proposed:
Bermuda/Ronstan Ditch	undermined infrastructure, undersized infrastructure, property flooding	channel restoration, detention, channel clearing

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	3
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	4
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	1
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	4
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	0
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	3
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	2
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	-1
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	2
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	1
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	-1
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	1
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	1
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	-1
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	1
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	0
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	0
Aesthetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	1
Schedule	problem	0 to +1	Y=+1 N=0	0
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	0
			Total	**21**

CIP RANK 1
CIP SCORE 21
COST $2,226,000

Legend

- 72" RCP and Inlets
- StreetCenterline
- stream
- City Limit
- Channel Clearing
- Detention Area

N

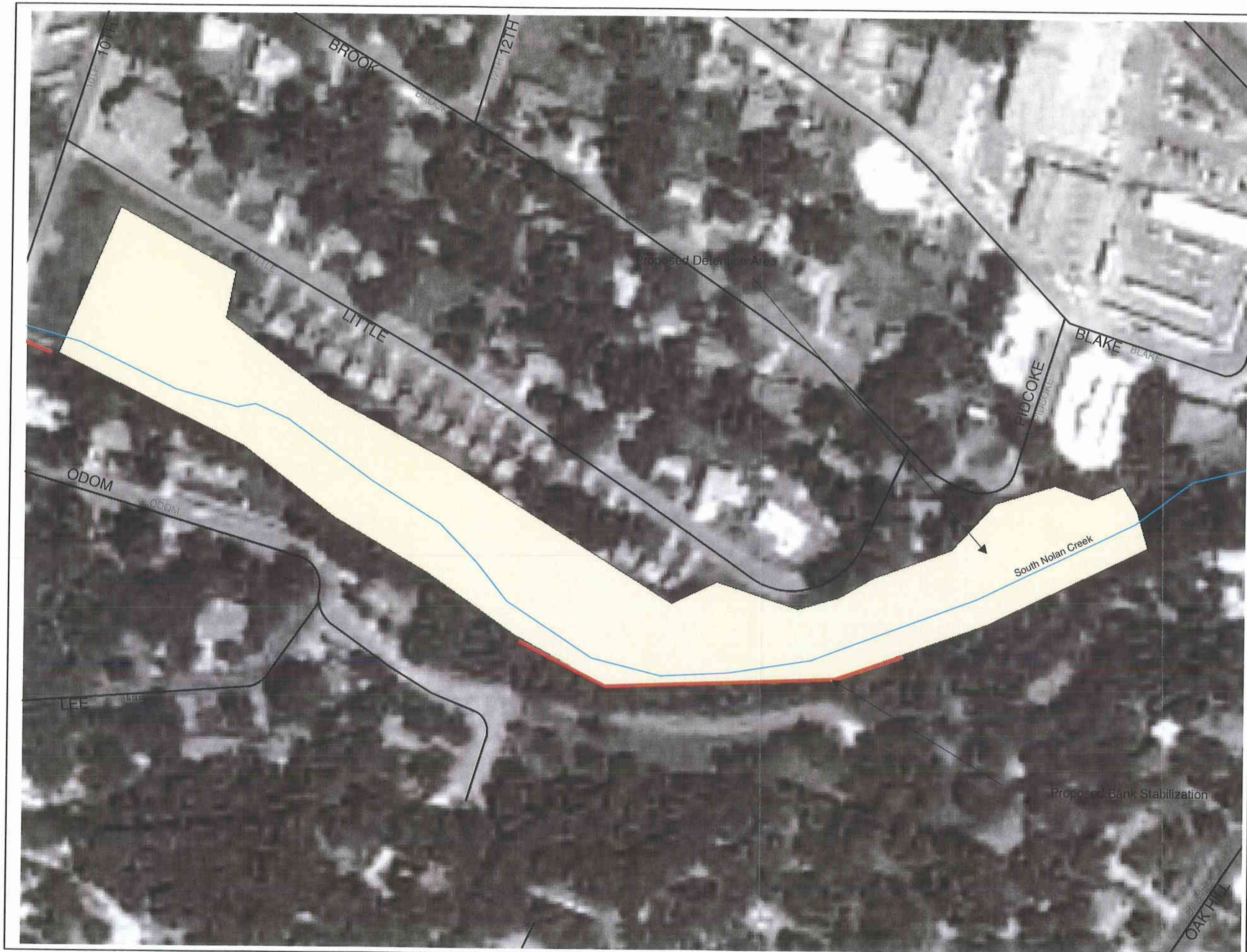
0 0.045 0.09 Miles

Bermuda/Ronstan Ditch
Killeen, Texas
September 2nd, 2005

CIP Prioritization

Location	Problem:	Proposed:
South Nolan Creek at Odom Dr	undermined infrastructure, undersized infrastructure, houses in floodplain	add detention volume along Little Ave, stabilize channel banks, increase channel capacity

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	4
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	1
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	1
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	4
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	2
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	2
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	-1
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	2
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	2
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	-1
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	1
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	0
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	0
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	0
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	0
Aesthetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	1
Schedule	problem	0 to +1	Y=+1 N=0	0
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	1
			Total	**20**



Carter::Burgess

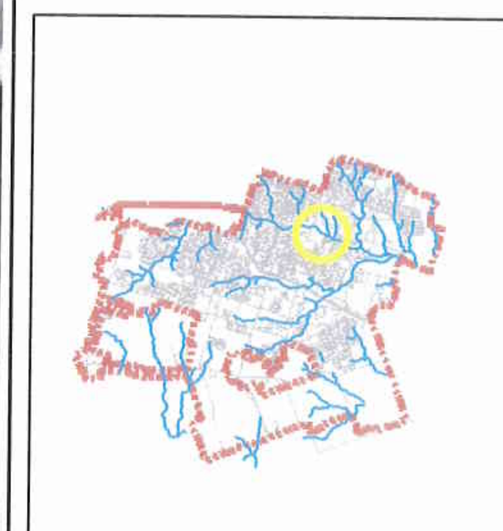
CIP RANK 2
CIP SCORE 20
COST $556,850

Legend

- StreetCenterline
- Bank Stabilization
- stream
- City Limit
- Detention Area

N

0 0.015 0.03 Miles



SNC @ Odom Dr.
Killeen, Texas
September 2, 2005

CIP Prioritization

Location	Problem:	Proposed:
Stewart Ditch	undersized infrastructure, houses in floodplain	create detention in park area, stream restoration

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	4
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	0
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	0
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	2
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	3
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	2
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	-1
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	2
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	2
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	0
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	1
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	0
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	1
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	0
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	1
Aesthetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	1
Schedule	problem	0 to +1	Y=+1 N=0	0
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	1
			Total	**20**

Carter::Burgess

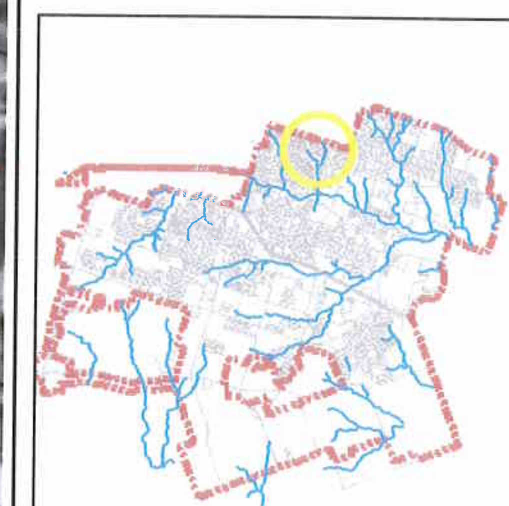
CIP RANK 3
CIP SCORE 20
COST $587,650

Legend

- StreetCenterline
- stream
- City Limit
- Detention Area

N

0 0.03 0.06 Miles

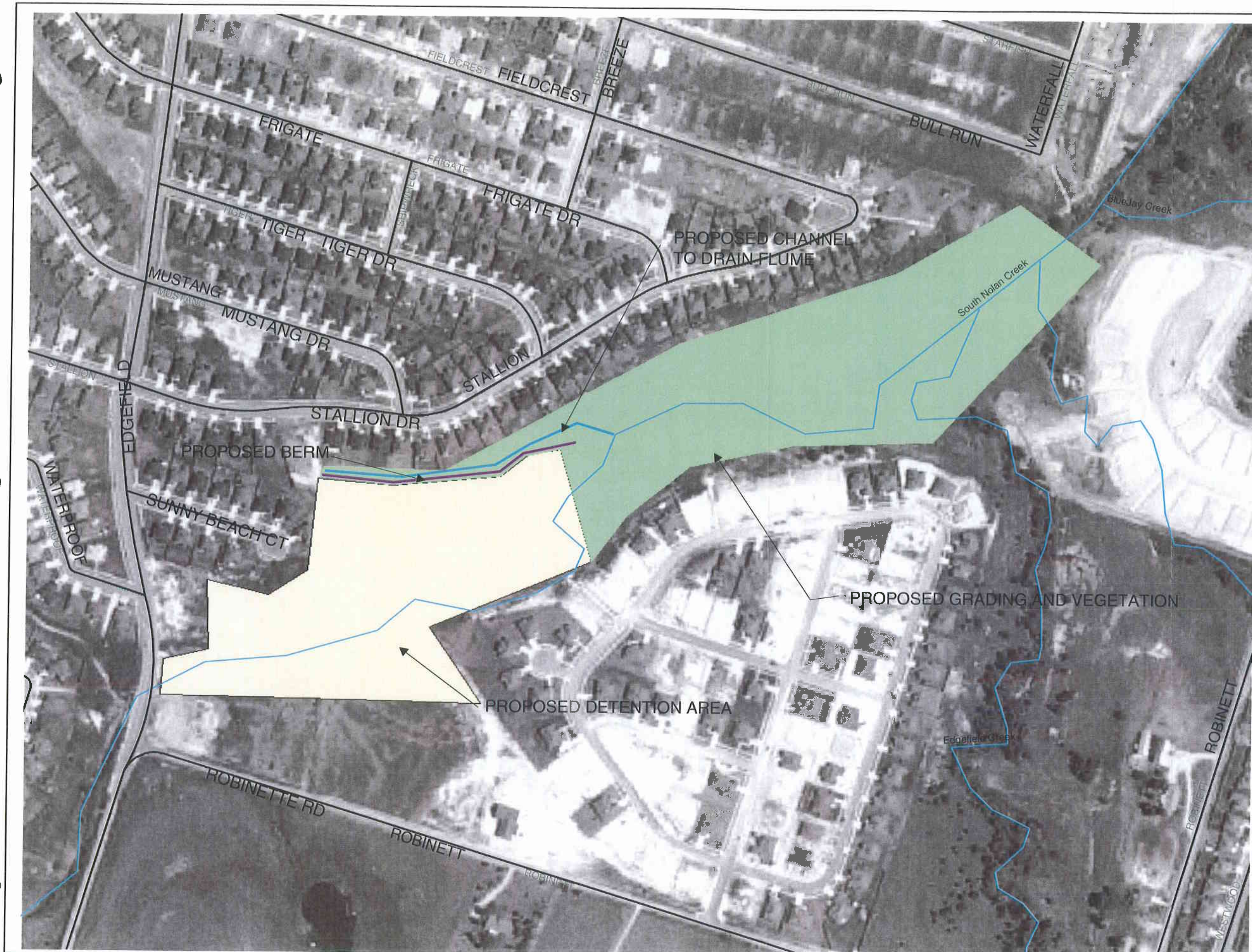


Stewart Ditch
Killeen, Texas
September 2,2005

CIP Prioritization

Location	Problem:	Proposed:
South Nolan Creek at Stallion Dr	undersized infrastructure, street flooding, property flooding	detention, direct SNC away from flume

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	4
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	3
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	1
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	2
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	2
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	2
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	-1
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	2
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	1
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	0
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	0
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	0
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	1
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	0
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	1
Aesthetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	1
Schedule	problem	0 to +1	Y=+1 N=0	0
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	0
			Total	**20**



Carter::Burgess

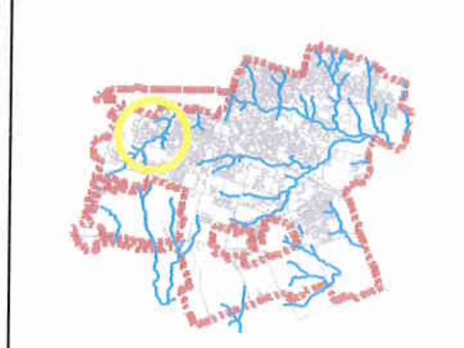
CIP RANK 4
CIP SCORE 20
COST $589,260

Legend

- StreetCenterline
- Drain Flume
- BERM
- stream
- City Limit
- Streets
- Grading and Vegetate
- Detention Area

N

0 0.045 0.09 Miles



SNC @ Stallion Dr.
Killeen, Texas
September 2, 2005

CIP Prioritization

Location	Problem:	Proposed:
WS Young	undermined infrastructure, street flooding	storm sewer along WS Young near Killeen Conference Center

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	4
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	0
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	4
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	4
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	0
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	0
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	-1
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	1
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	2
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	-1
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	1
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	1
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	0
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	1
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	1
Aesthetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	0
Schedule	problem	0 to +1	Y=+1 N=0	1
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	0
			Total	**19**

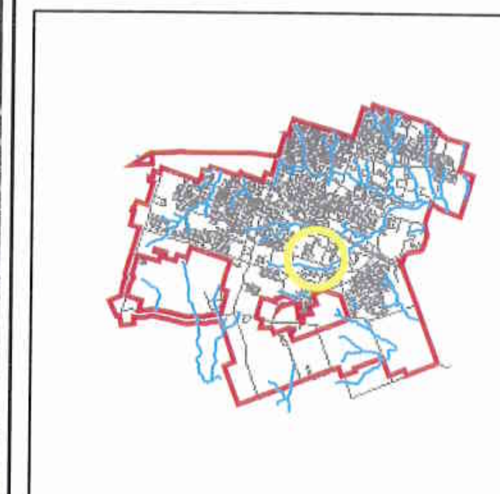
Carter :: Burgess

CIP RANK 5
CIP SCORE 19
COST $441,300

* Note- This CIP was added by City Staff. Project details not available

N

0 0.05 0.1 Miles



WS Young
Killeen, Texas
September 2, 2005

CIP Prioritization
Location
K3C

Problem:
undermined infrastructure, street flooding

Proposed:
storm sewer at Killeen Civic and Conference Center

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	4
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	0
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	4
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	4
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	0
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	0
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	-1
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	1
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	2
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	0
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	1
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	0
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	0
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	1
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	1
Aesthetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	0
Schedule	problem	0 to +1	Y=+1 N=0	1
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	0
			Total	**19**

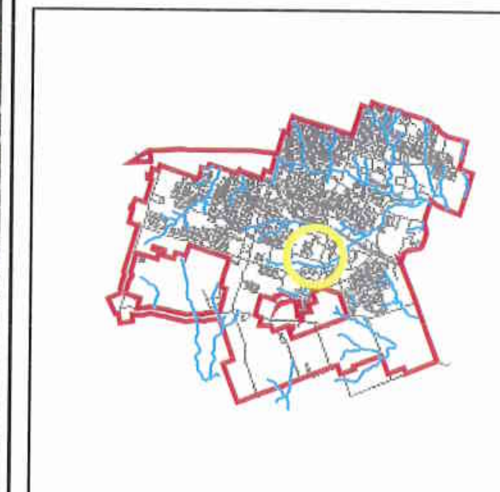
Carter :: Burgess

CIP RANK 6
CIP SCORE 19
COST $557,250

* Note- This CIP was added by City Staff.
Project details not available

N

0 0.05 0.1 Miles

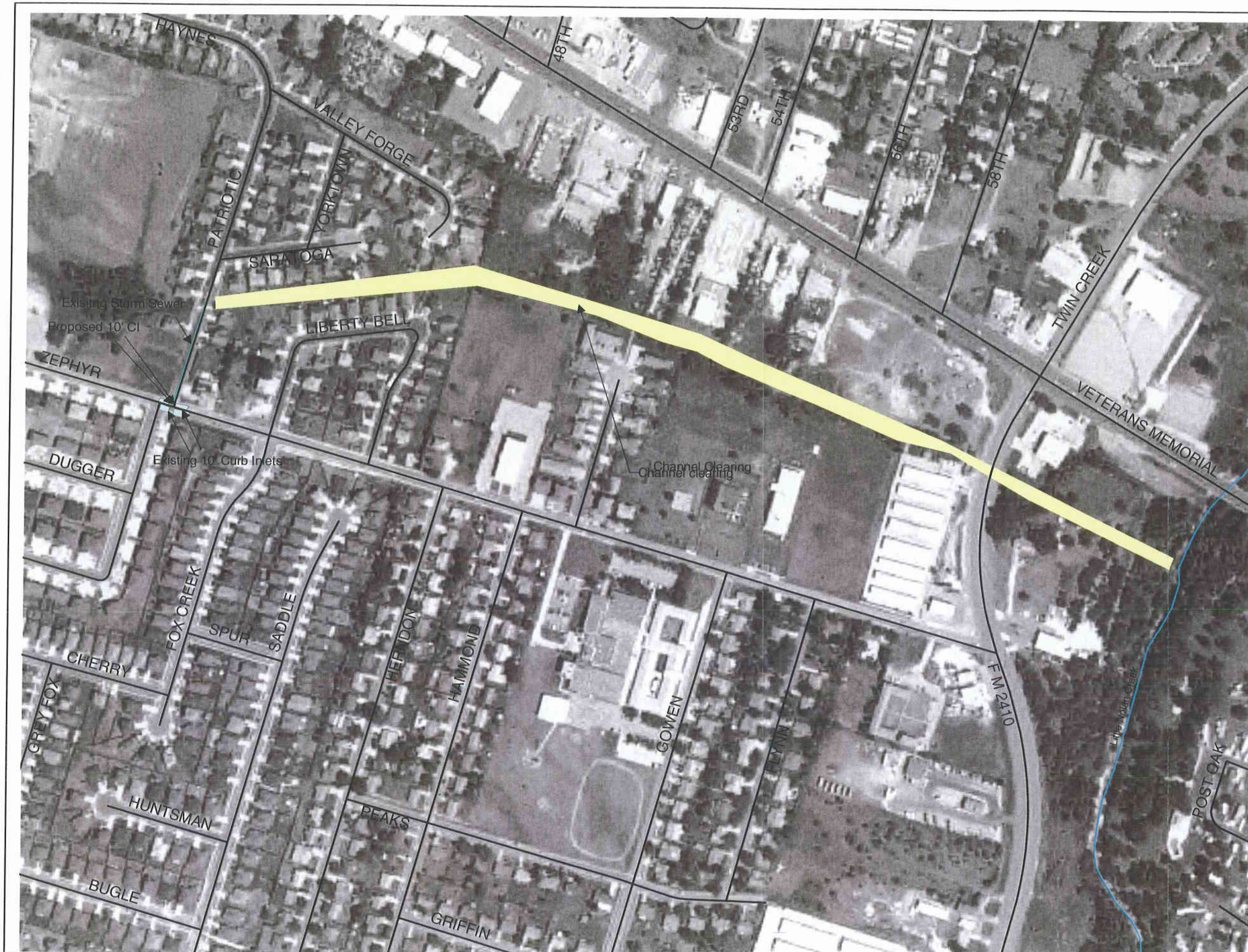


K3C Drainage
Killeen, Texas
September 2, 2005

CIP Prioritization

Location	Problem:	Proposed:
Patriotic Ditch @ Zephyr Rd	undersized infrastructure, property flooding	add curb inlets on Zephry Rd

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	4
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	2
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	1
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	4
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	0
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	0
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	0
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	2
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	2
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	0
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	1
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	0
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	0
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	0
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	1
[illegible]hetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	0
Schedule	problem	0 to +1	Y=+1 N=0	0
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	0
			Total	**18**



Carter::Burgess

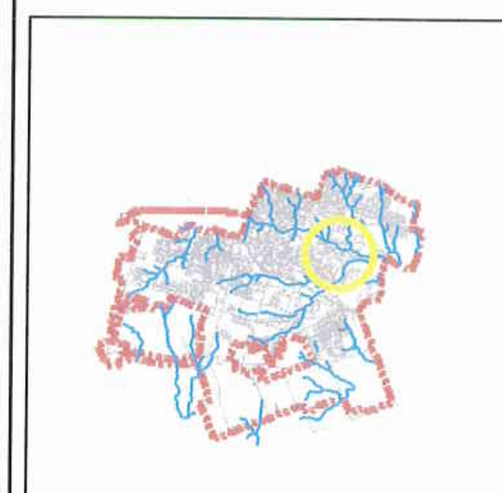
CIP RANK 7
CIP SCORE 18
COST$56,550

Legend

- StreetCenterline
- Storm Sewer
- stream
- City Limit
- Curb Inlets
- Channel Clearing

N

0 0.045 0.09 Miles



Patriotic Ditch @ Zephyr rd.
Killeen, Texas
September 2, 2005

CIP Prioritization

Location	Problem:	Proposed:
South Nolan Creek at Dimple	undermined infrastructure	reconstruct abutment, stabilize banks, armor piers, excavate under bridge to provide additional conveyance

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	1
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	4
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	1
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	4
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	2
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	0
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	0
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	1
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	2
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	-1
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	1
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	0
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	1
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	0
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	0
Aesthetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	0
Schedule	problem	0 to +1	Y=+1 N=0	1
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	0
			Total	**18**

Carter::Burgess

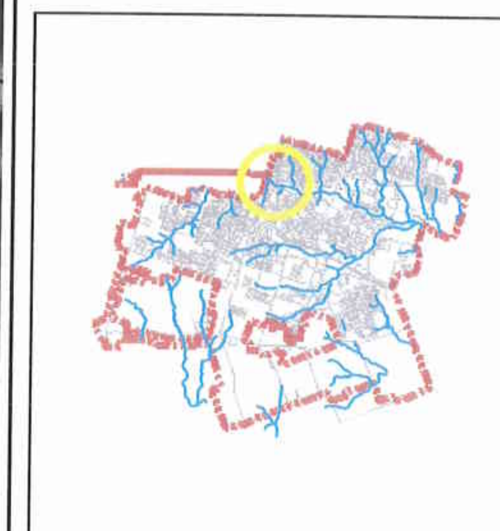
CIP RANK 8
CIP SCORE 18
COST $84,245

Legend

- StreetCenterline
- Bank Stabilization
- stream
- City Limit
- Excavation

N

0 0.015 0.03 Miles



SNC @ Dimple St
Killeen, Texas
September 2, 2005

CIP Prioritization

Location	Problem:	Proposed:
Dogwood Blvd at Bus 190	undersized infrastructure, street flooding, property flooding	replace culvert under Dogwood, outfall to concrete channel along SH190B, add storm sewer and curb inlet

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	4
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	4
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	2
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	2
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	0
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	0
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	0
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	1
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	2
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	0
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	1
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	0
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	0
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	0
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	0
Esthetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	0
Schedule	problem	0 to +1	Y=+1 N=0	1
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	0
			Total	**18**

Carter::Burgess

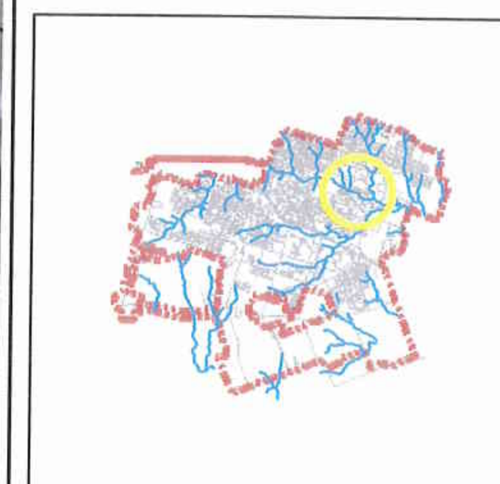
CIP RANK 9
CIP SCORE 18
COST $87,525

Legend

- StreetCenterline
- Proposed Storm Sewer
- Existing
- Proposed
- stream
- City Limit
- Culvert
- Curb Inlet

N

0 0.015 0.03 Miles



Dogwood Blvd. @ BUS. 190
Killeen, Texas
September 2, 2005

CIP Prioritization

Location	Problem:	Proposed:
South Nolan Creek at 10th St	undermined infrastructure, property flooding	reconstrruct abutment, stablize banks, armor piers, excavate under bridge to provide added conveyance

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	1
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	4
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	1
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	4
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	2
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	0
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	0
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	1
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	2
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	-1
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	1
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	0
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	1
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	0
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	0
Aesthetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	0
Schedule	problem	0 to +1	Y=+1 N=0	1
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	0
			Total	**18**

Carter::Burgess

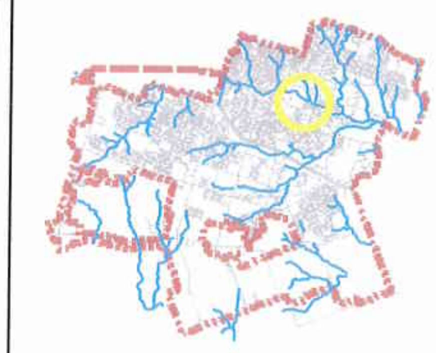
CIP RANK 10
CIP SCORE 18
COST $99,975

Legend

- StreetCenterline
- Bank Stabilization &Bridge Abutment
- stream
- City Limit
- Streets
- Armor Bridge Piers
- Excavation

N

0 0.02 0.04 Miles

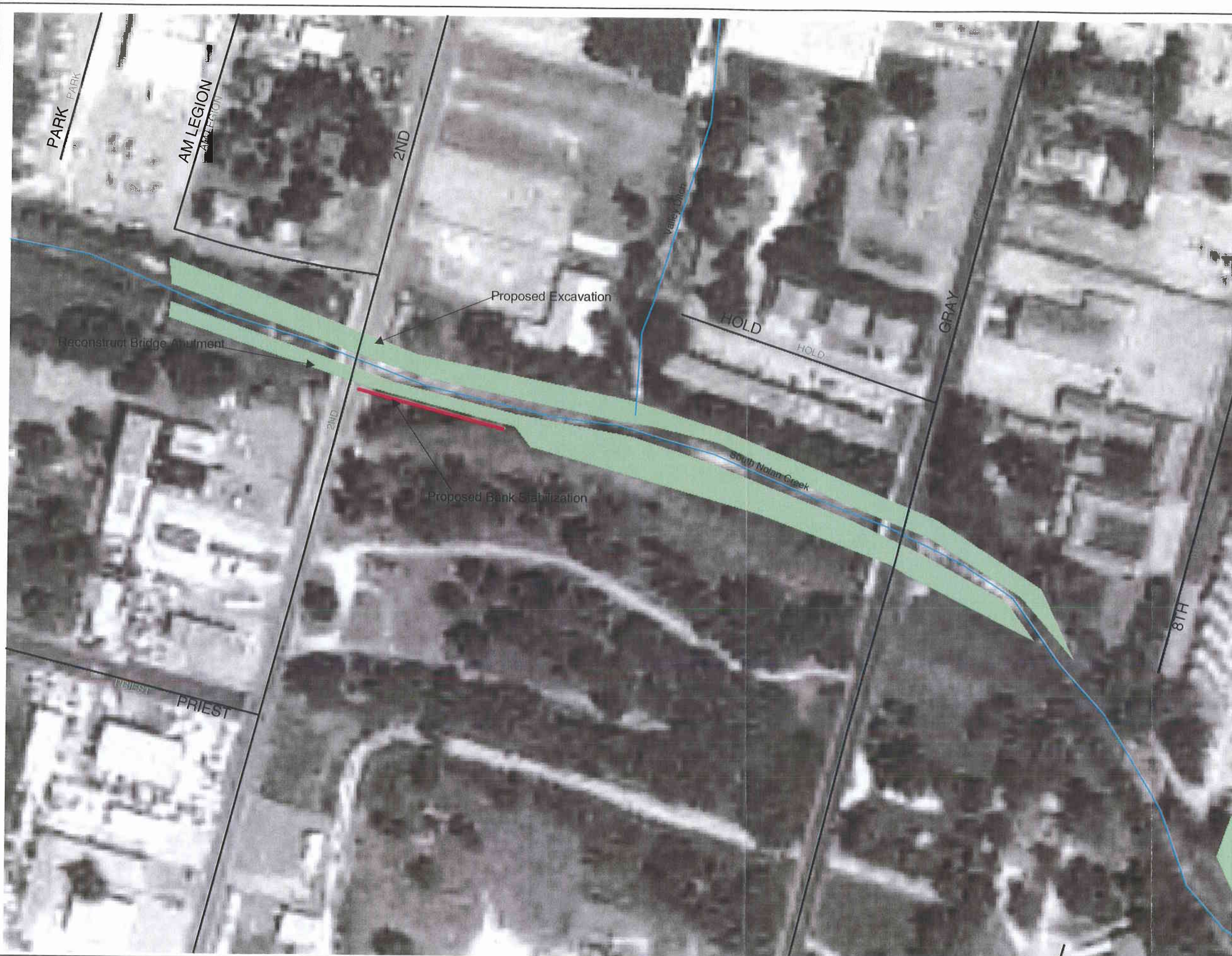


SNC @ 10th St
Killeen, Texas
September 2, 2005

CIP Prioritization

Location	Problem:	Proposed:
South Nolan Creek at 2nd St	undermined infrastructure	stabilize channel banks, excavate for detention volume, increse conveyance area

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	1
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	3
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	1
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	4
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	2
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	0
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	0
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	1
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	2
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	-1
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	1
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	0
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	1
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	0
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	0
[illegible]thetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	0
Schedule	problem	0 to +1	Y=+1 N=0	1
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	1
			Total	**18**



Carter::Burgess

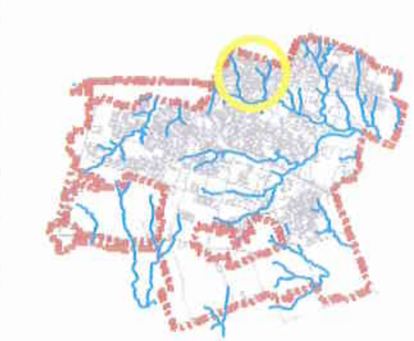
CIP RANK 11
CIP SCORE 18
COST $195,750

Legend

- StreetCenterline
- Bank Stabilization
- stream
- City Limit
- Excavation

N

0 0.02 0.04 Miles



SNC @ 2nd St.
Killeen, Texas
September 2, 2005

CIP Prioritization

Location	Problem:	Proposed:
Still Forest	street flooding	Culvert and associated drainage improvements

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	4
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	0
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	4
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	4
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	0
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	0
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	0
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	1
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	2
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	-1
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	0
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	1
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	0
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	1
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	1
Aesthetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	0
Schedule	problem	0 to +1	Y=+1 N=0	0
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	0
			Total	**18**

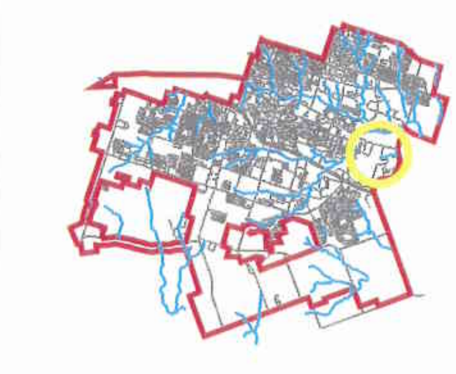
Carter - Burgess

CIP RANK12
CIP SCORE 18
COST $300,000

* Note- This CIP was added by City Staff. Project details not available

N

0 0.05 0.1 Miles



Still Forest
Killeen, Texas
September 2, 2005

CIP Prioritization

Location	Problem:	Proposed:
Bending Trail Creek	undermined infrastructure	stabilize channel

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	1
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	2
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	2
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	4
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	0
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	1
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	0
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	1
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	2
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	0
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	0
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	1
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	1
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	0
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	1
[illegible]sthetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	1
Schedule	problem	0 to +1	Y=+1 N=0	0
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	0
			Total	**18**

Carter::Burgess

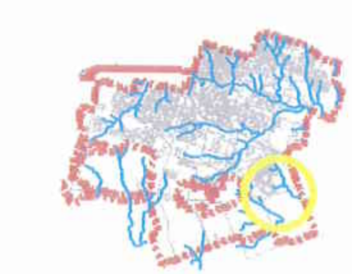
CIP RANK 13
CIP SCORE 18
COST $400,750

Legend

- StreetCenterline
- Channel Restoration
- stream
- City Limit
- CIP Polygon

N

0 0.04 0.08 Miles



Bending Trail Creek
Killeen, Texas
September 2, 2005

CIP Prioritization

Location	Problem:	Proposed:
Acorn Creek Headwaters	street flooding	construct storm sewer, channel clearing

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	4
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	1
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	4
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	2
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	1
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	0
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	-1
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	0
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	2
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	0
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	1
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	0
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	0
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	0
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	1
Aesthetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	0
Schedule	problem	0 to +1	Y=+1 N=0	0
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	0
			Total	**16**

Carter::Burgess

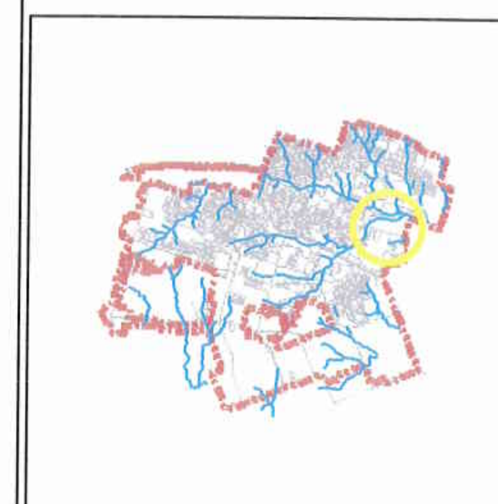
CIP RANK 14
CIP SCORE 16
COST $415,835

Legend

- StreetCenterline
- Existing Storm Sewer
- Proposed Storm Sewer
- stream
- City Limit
- Curb Inlet
- Channel Clearing

N

0 0.03 0.06 Miles



Acorn Creek Headwaters
Killeen, Texas
September 2, 2005

CIP Prioritization

Location	Problem:	Proposed:
LNC-1 at Caprock Dr	undermined infrastructure	stabilize channel banks, armor culvert, detention

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	0
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	4
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	3
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	2
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	3
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	2
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	-1
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	1
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	1
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	-1
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	0
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	0
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	1
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	0
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	0
Aesthetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	0
Schedule	problem	0 to +1	Y=+1 N=0	0
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	0
			Total	**16**

Carter::Burgess

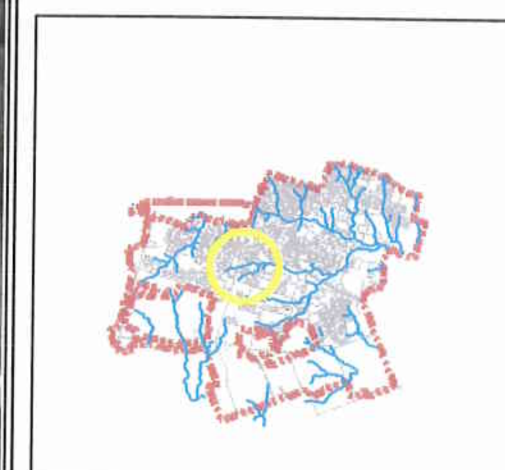
CIP RANK 15
CIP SCORE 16
COST $642,390

Legend

- StreetCenterline
- stream
- Bank Stabilization
- City Limit
- ARMOR CULVERT OUTFALL
- Detention Area

N

0 0.03 0.06 Miles

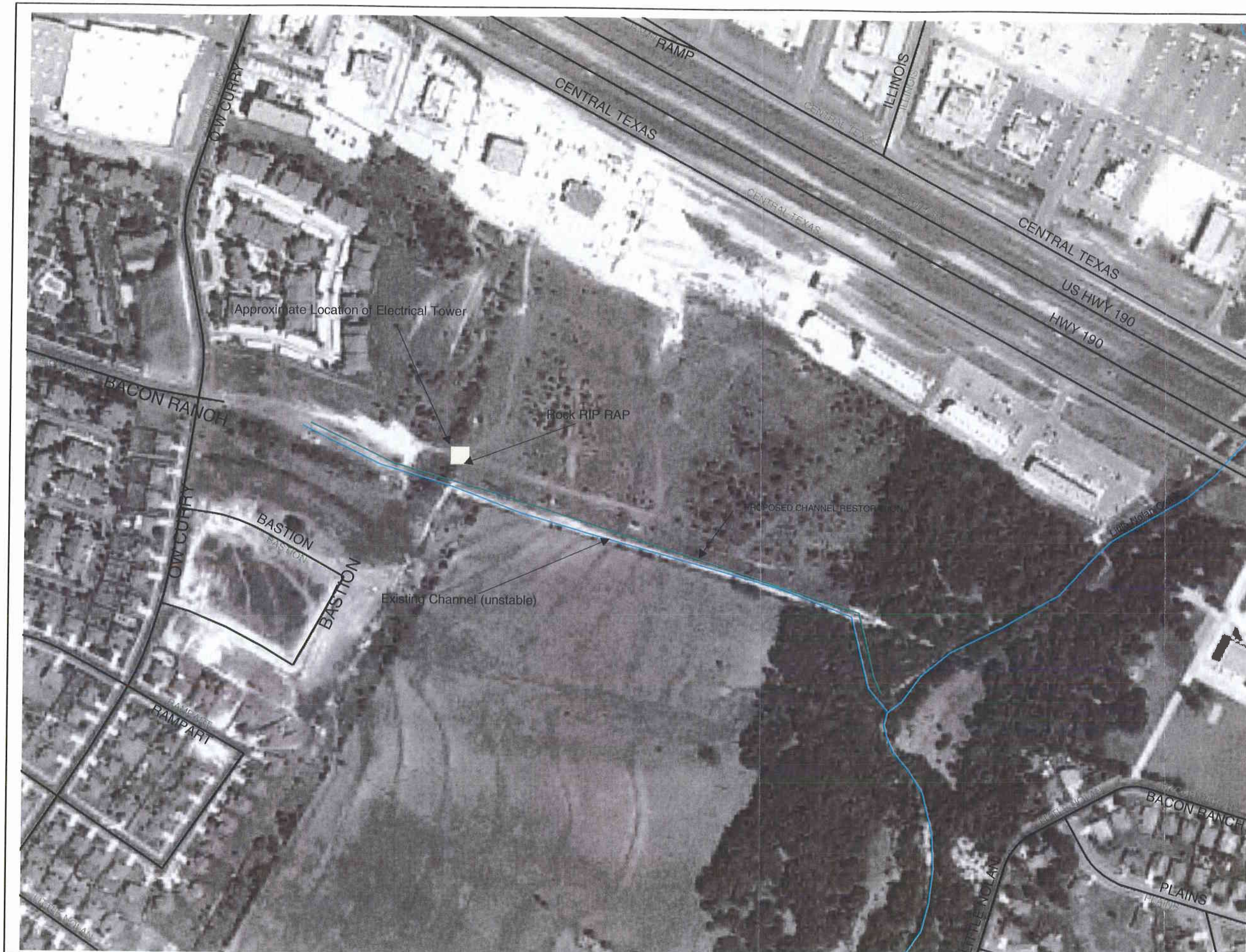


LNC-1 @ CapRock Dr.
Killeen, Texas
September 2, 2005

CIP Prioritization

Location	Problem:	Proposed:
Lagrone	undermined infrastructure	stabilize channel banks, stream restoration

actor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	0
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	2
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	2
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	4
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	0
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	2
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	1
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	0
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	1
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	0
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	0
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	0
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	1
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	0
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	-1
Nuisance Flooding	area	+1	Y=+1 N=0	0
sthetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	1
hedule	problem	0 to +1	Y=+1 N=0	1
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	0
			Total	**15**



Carter::Burgess

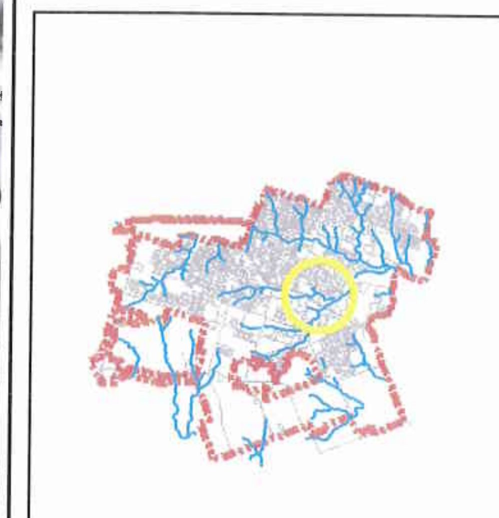
CIP RANK 16
CIP SCORE 15
COST $72,675

Legend

- StreetCenterline
- Channel Restoration
- Existing Channel
- City Limit
- Tower

N

0 0.04 0.08 Miles



Lagrone Ditch
Killeen, Texas
September 2, 2005

CIP Prioritization

Location	Problem:	Proposed:
El Dorado Dr	street flooding, property flooding	construct storm sewer and curb inlets

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	3
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	3
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	2
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	2
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	0
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	0
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	0
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	1
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	2
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	0
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	0
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	0
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	0
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	0
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	1
thetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	0
edule	problem	0 to +1	Y=+1 N=0	0
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	0
			Total	15

Carter::Burgess

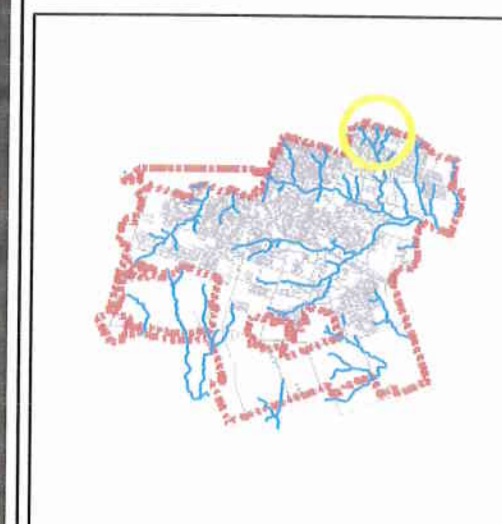
CIP RANK 17
CIP SCORE 15
COST $119,625

Legend

- DRAINAGE DITCH
- STORM SEWER
- StreetCenterline
- stream
- City Limit
- CHANNEL CLEARING

N

0 0.015 0.03 Miles

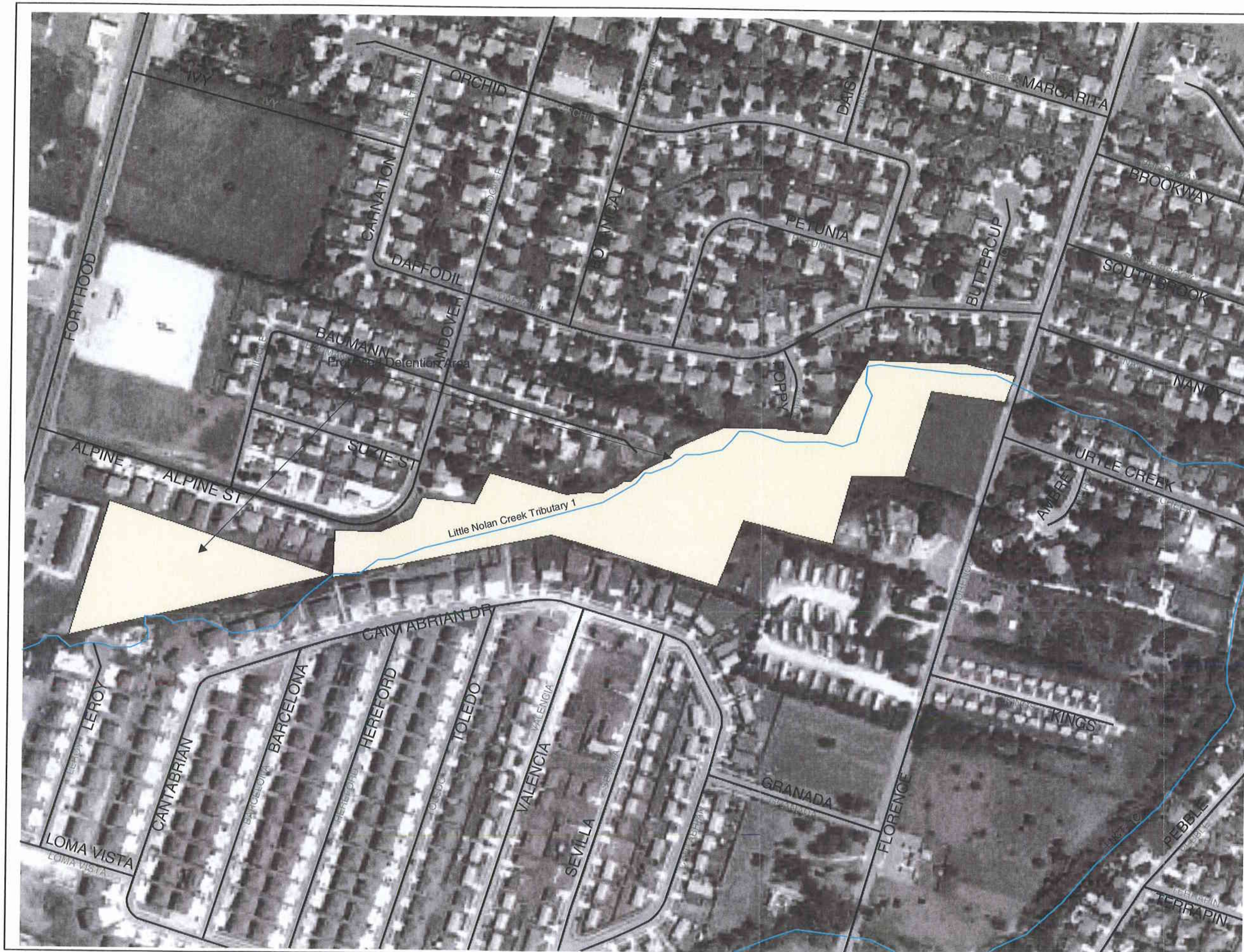


El Dorado Dr.
Killeen, Texas
September 2, 2005

CIP Prioritization

Location	Problem:	Proposed:
LNC-1 @ Cantabrian Dr	undermined infrastructure, houses in floodplain	detention

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	1
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	2
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	2
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	0
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	3
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	2
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	0
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	1
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	1
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	-1
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	0
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	0
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	1
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	0
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	0
Aesthetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	1
Schedule	problem	0 to +1	Y=+1 N=0	0
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	1
			Total	**15**



Carter::Burgess

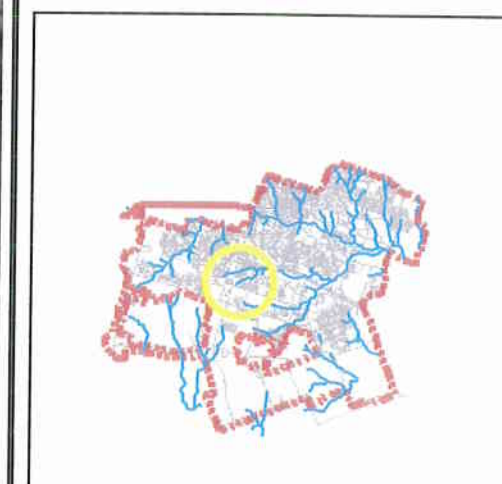
CIP RANK 18
CIP SCORE 15
COST $662,200

Legend

- StreetCenterline
- stream
- City Limit
- Streets
- Detention Area

N

0 0.045 0.09 Miles



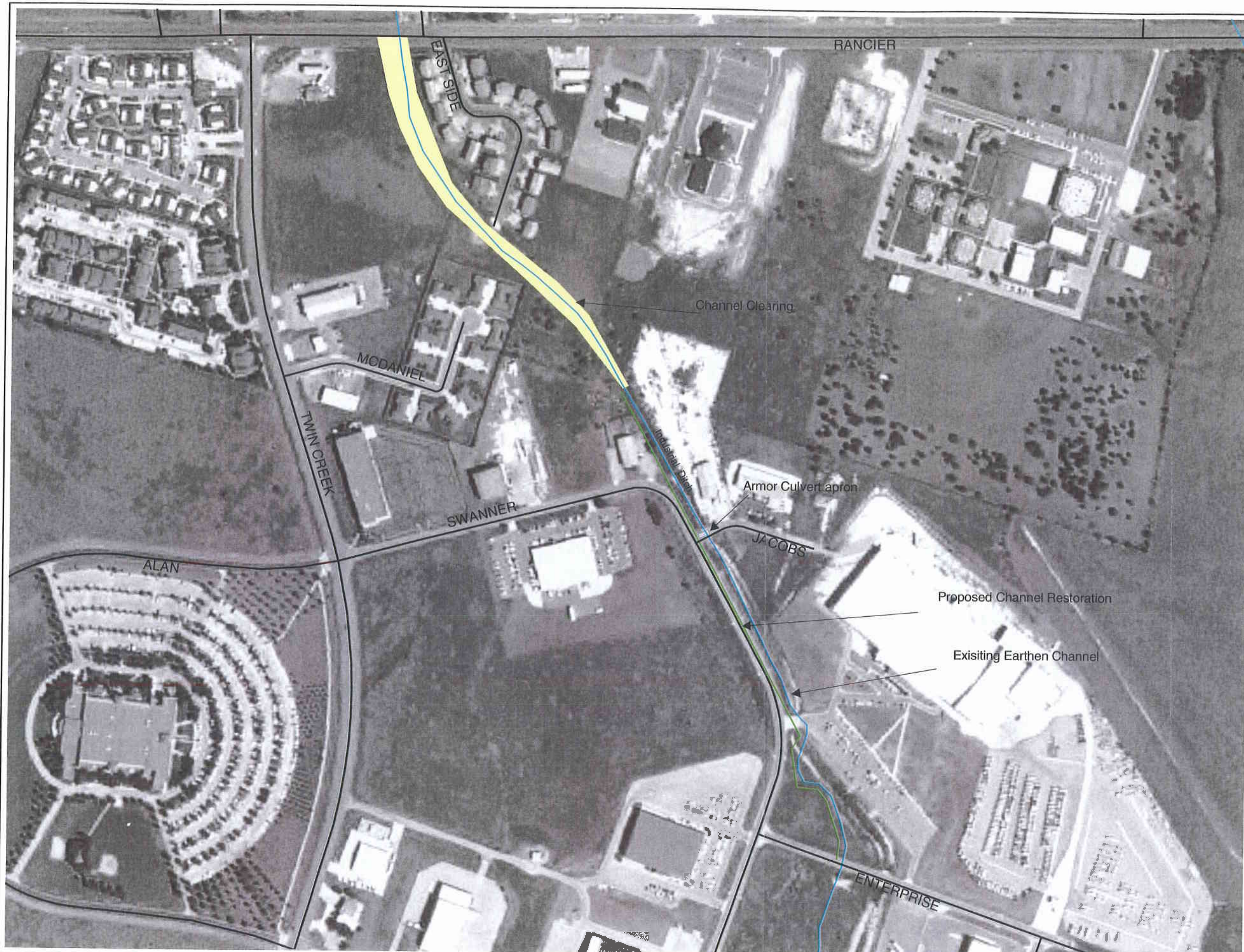
LNC-1 @ Cantabrian Dr.
Killeen, Texas
September 2, 2005

CIP Prioritization
Location
Industrial Ditch

Problem:
undermined infrastructure

Proposed:
stabilized channel, armor culvert

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	0
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	1
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	2
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	2
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	0
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	2
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	1
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	0
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	1
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	0
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	1
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	0
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	1
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	0
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	0
Aesthetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	1
Schedule	problem	0 to +1	Y=+1 N=0	1
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	0
			Total	**14**



Carter::Burgess

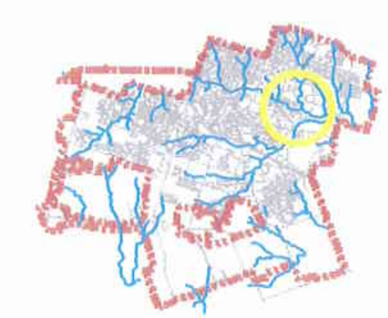
CIP RANK 19
CIP SCORE 14
COST $73,275

Legend

- StreetCenterline
- CHANNEL RESTORATION
- stream
- City Limit
- Armor Culvert Apron
- Channel Clearing

N

0 0.05 0.1 Miles



Industrial Ditch
Killeen, Texas
September 2, 2005

CIP Prioritization

Location	Problem:	Proposed:
Valley Ditch	undersized infrastructure, street flooding, property flooding	detention

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	3
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	0
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	0
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	4
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	3
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	1
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	-1
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	1
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	1
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	-1
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	1
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	0
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	1
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	0
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	0
Aesthetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	0
Schedule	problem	0 to +1	Y=+1 N=0	0
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	0
			Total	**14**

Carter::Burgess

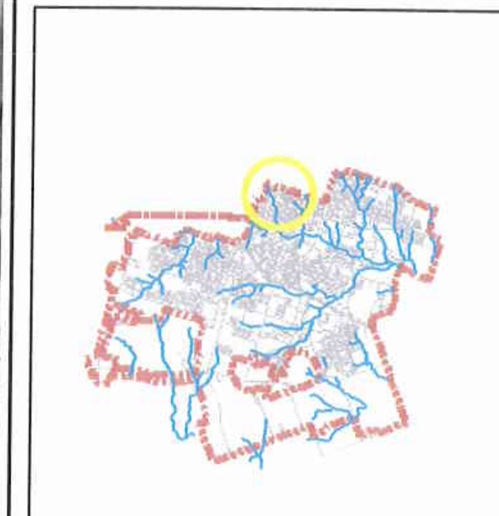
CIP RANK 20
CIP SCORE 14
COST $353,150

Legend

- StreetCenterline
- stream
- City Limit
- Detention Area

N

0 0.025 0.05 Miles



Valley Ditch
Killeen, Texas
September 2, 2005

CIP Prioritization

Location	Problem:	Proposed:
LNC at WS Young	undermined infrastructure	stabilize outfalls, vegetate, remove sediment

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	0
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	2
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	1
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	2
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	0
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	1
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	1
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	1
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	0
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	0
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	1
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	0
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	1
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	0
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	0
Aesthetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	1
Schedule	problem	0 to +1	Y=+1 N=0	1
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	0
			Total	**13**

Carter::Burgess

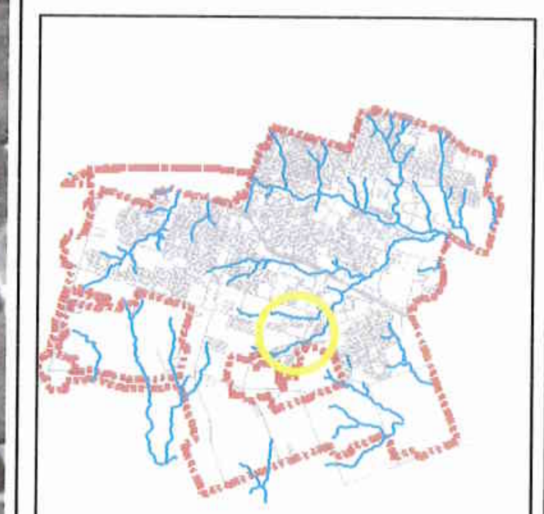
CIP RANK 21
CIP SCORE 13
COST $225,190

Legend

StreetCenterline
stream
City Limit
Sediment Removal
Vegetation Stabilization

N

0 0.05 0.1 Miles

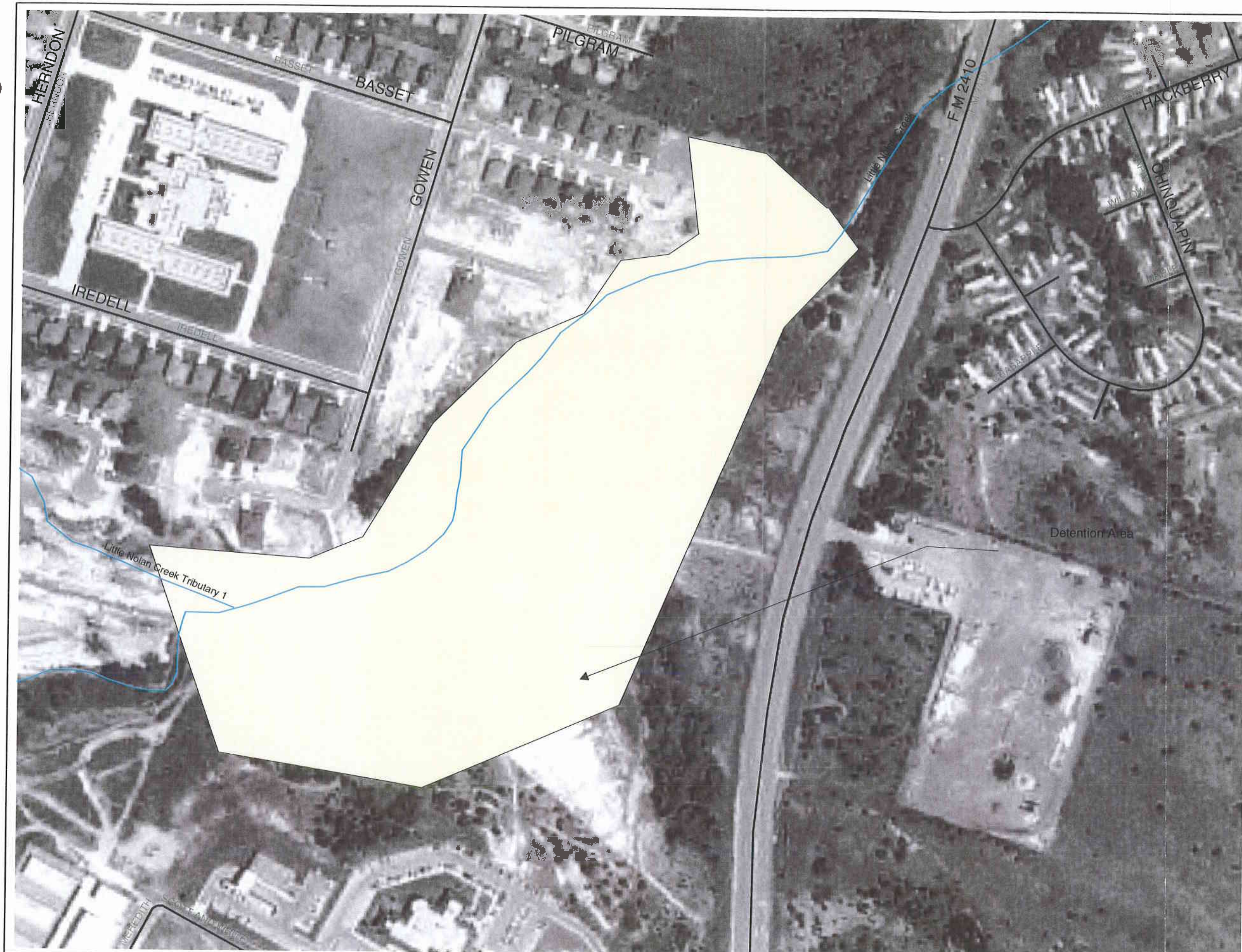


LNC@ WS Young
Killeen, Texas
September 2, 2005

CIP Prioritization

Location	Problem:	Proposed:
LNC at 2410	undersized infrastructure, houses in floodplain	channel excavation, detention

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	0
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	0
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	1
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	2
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	3
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	2
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	0
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	-1
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	1
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	-1
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	1
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	0
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	1
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	0
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	0
Aesthetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	1
Schedule	problem	0 to +1	Y=+1 N=0	0
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	1
			Total	**12**



Carter::Burgess

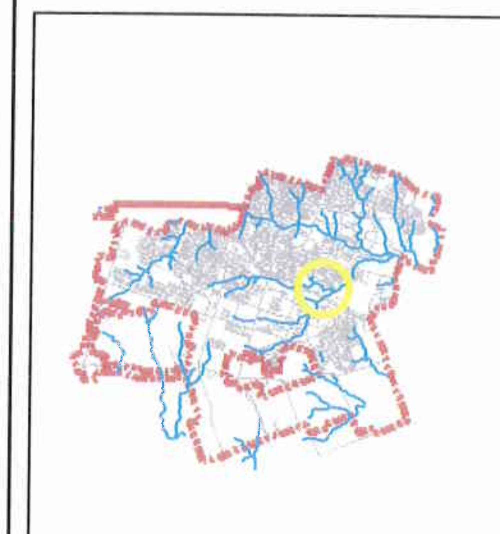
CIP RANK 22
CIP SCORE 12
COST $613,900

Legend

- StreetCenterline
- stream
- DETENTION AREA
- City Limit
- Streets

N

0 0.04 0.08 Miles



LNC @2410
Killeen, Texas
September 2, 2005

CIP Prioritization

Location	Problem:	Proposed:
Long Branch Tributary	undermined infrastructure	channel restoration, clear storm drain outfalls

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	0
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	1
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	1
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	2
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	0
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	1
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	0
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	0
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	1
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	0
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	1
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	0
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	1
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	0
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	0
[illegible]hetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	1
Schedule	problem	0 to +1	Y=+1 N=0	1
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	0
			Total	**11**

Carter::Burgess

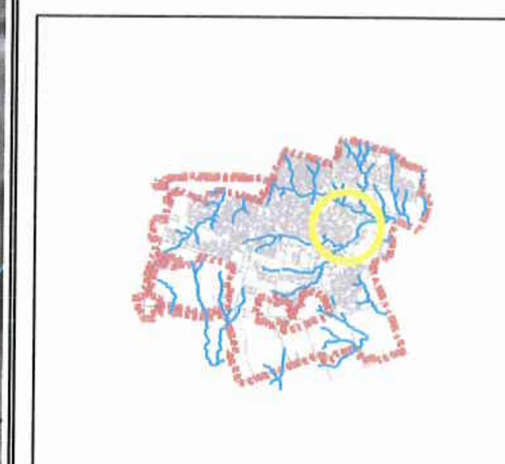
CIP RANK 23
CIP SCORE 11
COST $56,400

Legend

- StreetCenterline
- CHANNEL RESTORATION
- stream
- City Limit

N

0 0.02 0.04 Miles



Long Branch Trib.
Killeen, Texas
September 2, 2005

CIP Prioritization

Location	Problem:	Proposed:
Dickens Ditch	undersized infrastructure	channel clearing and channel excavation

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	3
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	0
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	1
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	2
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	1
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	0
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	0
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	1
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	1
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	1
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	0
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	0
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	0
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	0
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	0
Aesthetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	0
Schedule	problem	0 to +1	Y=+1 N=0	0
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	0
			Total	**11**

Carter::Burgess

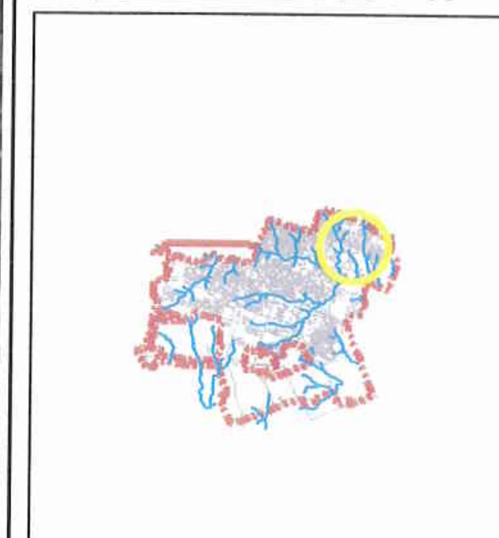
CIP RANK 24
CIP SCORE 11
COST $291,480

Legend

StreetCenterline
stream
City Limit
Channel Clearing
Proposed Excavation

N

0 0.03 0.06 Miles



Dickens Ditch
Killeen, Texas
September 2, 2005

CIP Prioritization
Location
Caprice Ditch

Problem:
undersized infrastructure, houses in floodplain

Proposed:
channel clearing, detention

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	1
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	0
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	1
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	2
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	2
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	2
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	0
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	1
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	1
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	-1
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	0
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	0
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	0
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	0
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	0
Aesthetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	0
Schedule	problem	0 to +1	Y=+1 N=0	0
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	1
			Total	**11**

Carter::Burgess

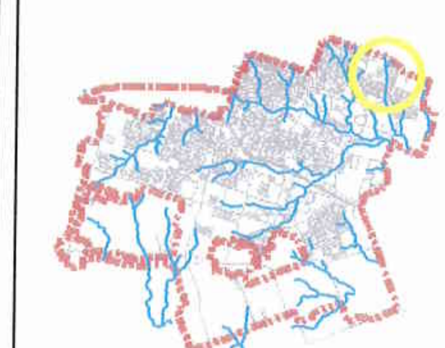
CIP RANK 25
CIP SCORE 11
COST $314,930

Legend

- StreetCenterline
- stream
- City Limit
- Channel Clearing
- Detention Area

N

0 0.05 0.1 Miles

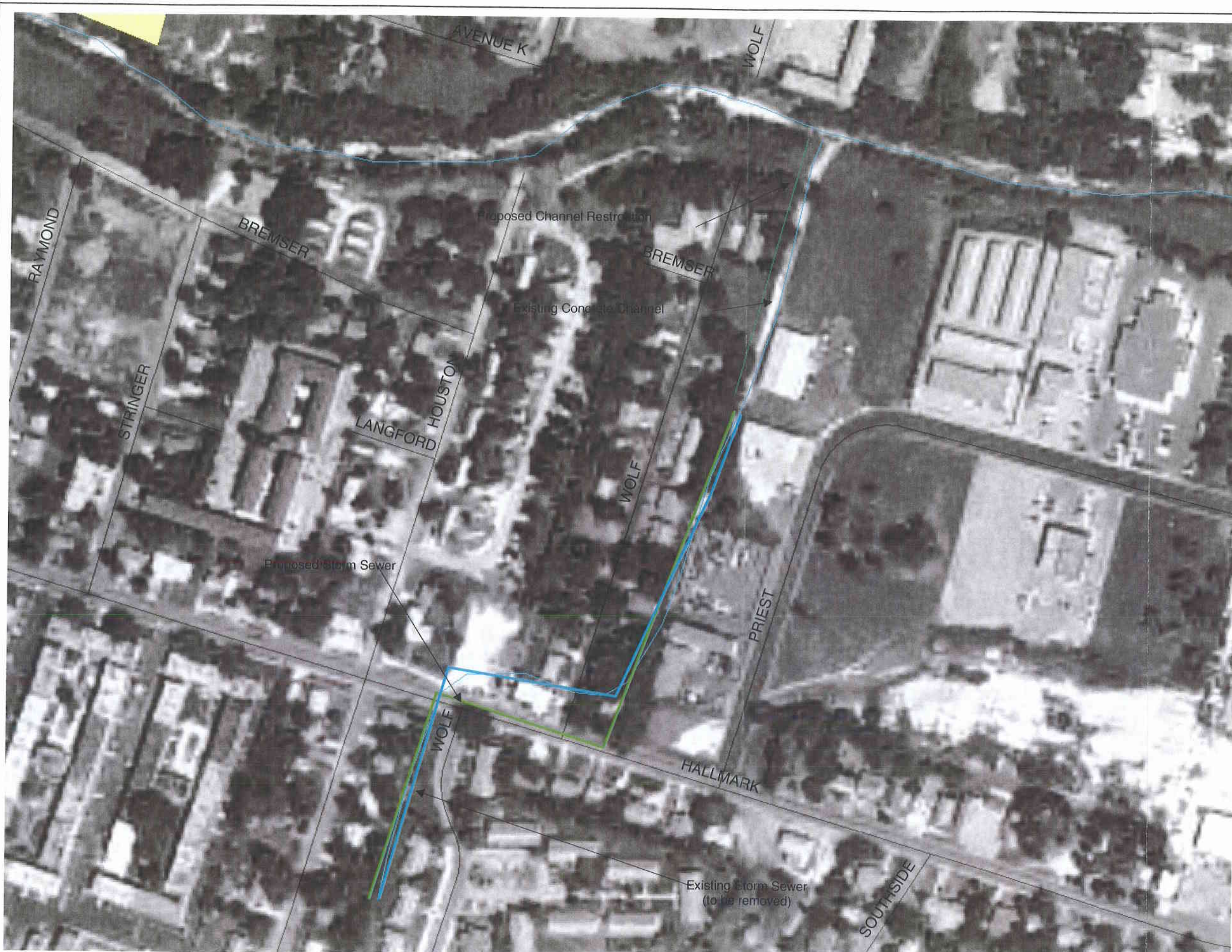


Caprice Ditch
Killeen, Texas
September 2, 2005

CIP Prioritization

Location	Problem:	Proposed:
Wolf Ditch	undersized infrastructure	reconstruct storm drain

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	3
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	1
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	2
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	2
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	0
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	0
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	-1
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	1
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	2
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	-1
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	1
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	0
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	0
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	0
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	0
Aesthetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	0
Schedule	problem	0 to +1	Y=+1 N=0	0
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	0
			Total	**11**



Carter :: Burgess

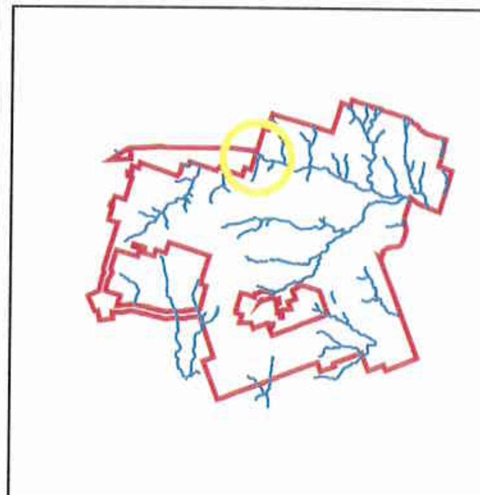
CIP RANK 26
CIP SCORE 11
COST $500,220

Legend

- Proposed Storm Sewer
- Existing Storm Sewer
- StreetCenterline
- stream
- Channel Restoration
- citylimits_05
- CIPStructures

N

0 0.025 0.05 Miles



Wolf Ditch
Killeen, Texas
September 2, 2005

CIP Prioritization

Location	Problem:	Proposed:
Greenforest Circle	street flooding, property flooding	construct storm drain and curb inlet

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	1
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	0
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	0
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	4
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	0
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	0
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	0
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	1
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	2
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	0
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	0
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	0
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	0
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	0
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	0
Aesthetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	0
Schedule	problem	0 to +1	Y=+1 N=0	1
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	0
			Total	**10**

Carter::Burgess

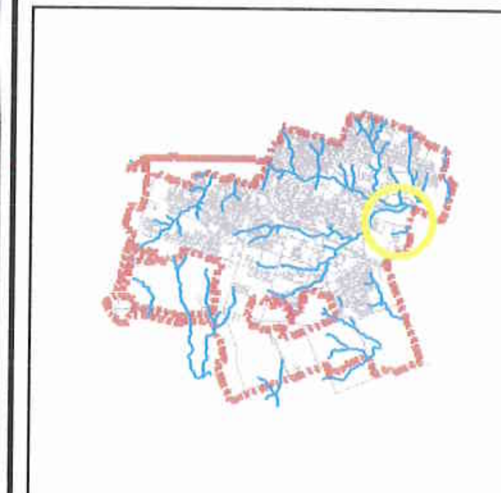
CIP RANK 27
CIP SCORE 10
COST $20,730

Legend

- StreetCenterline
- Existing Storm Sewer
- Proposed Storm Sewer
- stream
- City Limit
- Curb Inlets

N

0 0.01 0.02 Miles



Greenforest Circle
Killeen, Texas
September 2, 2005

CIP Prioritization

Location	Problem:	Proposed:
Long Branch	undersized infrastructure, houses in floodplain	detention downstream of 38th St

Factor	Factor Criteria	Possible Value	Score Guidance	Assigned Value
Historical Flooding	Does the proposed CIP reduce or eliminate historical flooding problems	0 to +4	Reduces chronic drainage problem = +4 Reduces reoccurring drainage problem = +3 Reduces occasional drainage problem = +1	2
Deteriorated Infrastructure	Does the proposed CIP replace deteriorated Infrastructure	0 to +4	Immediate replacement needed = +4 Replacement needed 1 to 2 years = +3 Replacement needed 2 to 3 years = +2 Replacement needed 3 to 5 years = +1	0
Long Term Maintenance Reduction	Does the proposed CIP reduce long term maintenance requirements	0 to +4	>50%=+4 30-50%=+3 10-30%=+2 0-10%=+1	2
"At-Risk" Conditions	Does the proposed CIP reduce public safety concerns or city liability	0 to +4	Y(public safety) = +2 Y(city liability)=+2 Residence Flooding = +4	0
Cost	What percentage does this proposed CIP represent of the total drainage budget	-3 to +1	>75% = -3 50-75%=-2 30-50%=-1 10-30%=0 0-10%=+1	1
Regional Solution	Does the proposed CIP provide drainage system improvements on a regional level	0 to +3	small regional impact=+1 medium regional impact=+2 large regional impact=+3	1
Environmental Concerns	Does the proposed CIP impact wildlife habitat, natural vegetation	-1 to +2	adverse impacts=-1 no significant impact = 0 improve wildlife habitat =+1 protects or restores natural vegetation=+1	0
Design Data Requirements	Does the proposed CIP require complex engineering or design prior to construction	-2 to +1	extremely complex engineering/design = -2 complex engineering/design=-1 N=0 No engineering/design = +1	0
Reduction of Flood Losses	Does the proposed CIP reduce potential flood losses	0 to +2	Significant Reduction = +2 minimal reduction =+1 N=0	1
Project Life	What is the estimated project life:	-1 to +2	0-5YRS=-1 5-10YRS=0 10-20 YRS =+1 >20 YRS =+2	1
Adverse Site Conditions	hinder site access or construction	-1	Y=-1 N=0	-1
Visibility	Is the proposed CIP highly visible	+1	Y=+1 N=0	0
Citizen Concerns	Are there citizen concerns/influences pushing this project	+1	Y=+1 N=0	0
Utility Relocation	Does the proposed CIP require utility relocation	-1	Y=-1 N=0	0
Water Quality Improvements	water quality degradation	+1	Y=+1 N=0	0
Political Concerns	Are there political concerns/influences pushing this project	+1	Y=+1 N=0	0
Easement/ROW Requirements	Does the proposed CIP require additional Easements or ROW	-1	Y=-1 N=0	0
Nuisance Flooding	area	+1	Y=+1 N=0	0
Aesthetics	Does the proposed CIP improve or detract from the aesthetics of the area	-1 to +1	Negative Impact = -1 No significant change=0 Positive Impact =+1	0
Schedule	problem	0 to +1	Y=+1 N=0	1
NFIP Claims Reduction	structures with prior NFIP Claims	0 to +1	Y=+1 N=0	0
			Total	**8**

Carter::Burgess

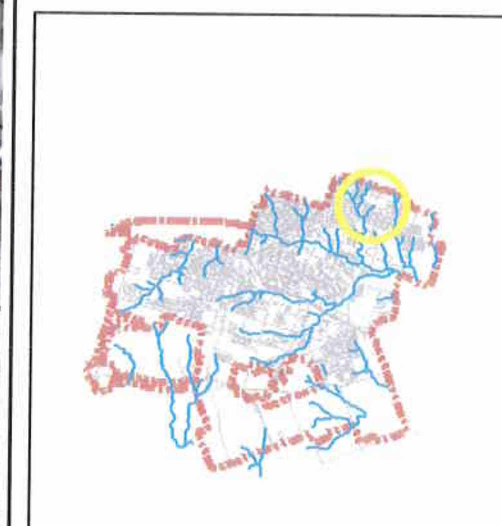
CIP RANK 28
CIP SCORE 8
COST $653,800

Legend

- StreetCenterline
- stream
- City Limit
- Detention Area

N

0 0.04 0.08 Miles



Long Branch
Killeen, Texas
September 2, 2005

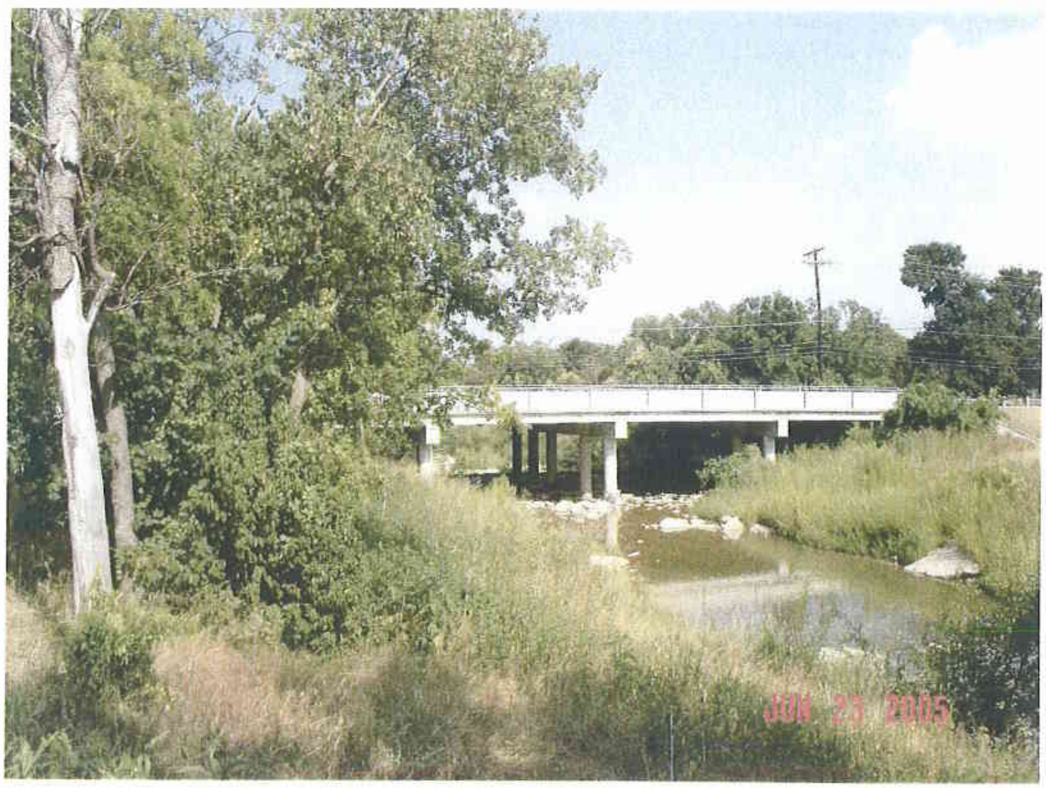
APPENDIX H

PHOTO INVENTORY

City of Killeen Master Drainage Plan
Field Investigation

Date:	6/23/2005		
Observer:	JMH		
Photo #:			
Site Type:	2nd Street Bridge at South Nolan Creek		
Photo Description:	Looking downstream at 2nd Street bridge		
Latitude:		Longitude:	

Photo:



Upstream face of 2nd Street bridge

Under 2nd St bridge

Channel bank grass, channel bottom rock

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City of Killeen Master Drainage Plan
Field Investigation

Date:	12/8		
Observer:	JMH/LFK		
Photo #:	10-28		
Site Type:	Acorn Creek		
Photo Description:	Channel photos		
Latitude:	31 04' 27"N	Longitude:	97 41' 34"

Photo:

Discharge of storm sewer system into Acorn Creek
Morning Star and Acorn Creek Trl

Storm sewer discharge

Looking downstream Acorn Creek

Looking upstream Acorn Creek

Upstream at earthen channel into drop structure

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Flume into Acorn Creek from Daybreak

end of concrete channel

view downstream


Flume into Acorn Creek just upstream of end of concrete, vegetation at the downstream outlet into the channel

Looking down the flume from the road.

City of Killeen Master Drainage Plan
Field Investigation

Date:	12/8		
Observer:	JMH/LFK		
Photo #:	10-16		
Site Type:	Headwaters of Acorn Creek		
Photo Description:	Street flow and gutter flow		
Latitude:	31 04' 33"N	Longitude:	97 41' 50"

Photo:

Gutter flow at GreenLee Dr and Honeysuckle Dr

Looking up Honeysuckle Dr from Shawn Dr

Looking downstream Shawn Dr from Honeysuckle Dr

Looking up Morning Glen from Misty Ln

Down Misty Ln,

Down Misty Ln, significant street and gutter flow

City of Killeen Master Drainage Plan
Field Investigation

Date:	12/8		
Observer:	JMH/LFK		
Photo #:	43-46		
Site Type:	Acorn Creek at Stagecoach Rd		
Photo Description:	Channel and road crossing		
Latitude:	31 38' 55"N	Longitude:	97 41' 06"

Photo:

New construction area, just downstream of Stagecoach Rd.

Bare soil around culvert at Stagecoach Road.

Downstream of culverts.

view upstream

City of Killeen Master Drainage Plan
Field Investigation

Photo #:	82-85		
Site Type:	Atkinson Ditch		
Photo Description:	channel		
Latitude:	31 07'24"N	Longitude:	97 42' 04"W

Flume from Poage Cir

Downstream from Tucker Dr

View upstream from Diane Dr flume

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view downstream from Diane Dr flume

Date:	12/7		
Observer:	JMH/LFK		
Photo #:	1-7		
Site Type:	Atkinson Ditch		
Photo Description:	Channel and road crossing		
Latitude:	31 07' 04"N	Longitude:	97 42' 40"

Upstream face of Rancier Ave culvert

channel upstream of Rancier Ave

Concrete slope protection along Rancier Ave undermined

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Downstream of Rancier Ave

Downstream face of Rancier Ave culvert

channel, just downstream of Rancier Culvert

Erosion at downstream face of Rancier Ave

Photo #:	82-85		
Site Type:	Atkinson Ditch		
Photo Description:	Downstream face of Atkinson Dr culvert		
Latitude:	31 07'24"N	Longitude:	97 42' 04"W

view downstream of Atkinson Dr

Upstream face of Atkinson Dr culvert

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channel upstream of Atkinson Dr

City of Killeen Master Drainage Plan
Field Investigation

Date:	12/8		
Observer:	JMH/LFK		
Photo #:	27-28		
Site Type:	Bending Creek		
Photo Description:	Channel photos		
Latitude:	31 04' 00"N	Longitude:	97 41' 33"

Photo:

Bending Creek, upstream face of Acorn Creek Trl culvert

View downstream from Acorn Creek Trl culvert

City of Killeen Master Drainage Plan
Field Investigation

Date:	12/8		
Observer:	JMH/LFK		
Photo #:	27-28		
Site Type:	Bending Creek		
Photo Description:	Channel photos		
Latitude:	31 04' 00"N	Longitude:	97 41' 33"

Photo:

Bending Creek, upstream face of Acorn Creek Trl culvert

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View downstream from Acorn Creek Trl culvert

City of Killeen Master Drainage Plan
Field Investigation

Date:	12/7		
Observer:	JMH/LFK		
Photo #:	97-104		
Site Type:	Bernuda Trib		
Photo Description:	Concrete channel		
Latitude:		Longitude:	

Photo:

At Janice Street
Downstream view of cracks in concrete channel

Concrete channel, looking downstream from Janis St

Concrete channel failure, at Janis St

Upstream concrete channel, from Janis St

Top of concrete slope exposed

looking downstream

Wheeler St. Upstream view of culverts with sediment and debris

City of Killeen Master Drainage Plan
Field Investigation

Date:	12/7		
Observer:	JMH/LFK		
Photo #:	105-106		
Site Type:	Bermuda Trib		
Photo Description:	Channel and banks		
Latitude:	31 06' 22"N	Longitude:	97 44' 55"

Photo:

At Bermuda St Downstream view of trees in channel

Upstream view at Bermuda

At Willow Springs St and Armadillo St
Downstream view from flume

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Upstream view from flume

City of Killeen Master Drainage Plan 12/04

Date:	12/7		
Observer:	JMH/LFK		
Photo #:	80-84		
Site Type:	Caprice Ditch		
Photo Description:	Channel and overbanks		
Latitude:	31 07' 14"N	Longitude:	97 40' 17"

Photo:

Upstream face of Westcliff Rd culvert

Caprice Ditch upstream of Westcliff Rd, concrete channel being undermined

Looking downstream from Westcliff Rd

Upstream face of Ridgehaven Dr culvert

Downstream face of Ridgehaven Dr culvert, scour

Looking downstream from Caprice Dr, downstream of confluences

Open area near confluence

Looking upstream from Caprice Dr.

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City of Killeen Master Drainage Plan
Field Investigation

Date:	12/7		
Observer:	JMH/LFK		
Photo #:	24-30		
Site Type:	Dickens Ditch		
Photo Description:	Culverts and channel		
Latitude:	31 07' 36"N	Longitude:	97 41' 18"

Photo:

Looking downstream from Trotwood Tr

downstream face of Trotwood Tr culvert

Upstream face of Trotwood Tr culvert

Looking east along Westcliff Rd, sidewalk depressed

upstream face of Westcliff Rd culverts

Looking downstream from Westcliff Rd, scour hole just downstream of concrete

downstream face of Westcliff Rd culvert

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Dickens Ditch at N 60^{th}, looking downstream

Looking upstream along N. 60^{th}

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Dickens Ditch, looking north from Magnum Cir

Water damage at house on Magnum Dr

Looking downstream along Magnum Cir

Channel bottom

Looking upstream along Magnum Cir

Further downstream from Magnum Cir

Looking upstream from Westcliff Rd

City of Killeen Master Drainage Plan 12/04

Date:	12/7		
Observer:	JMH/LFK		
Photo #:	52-55		
Site Type:	Detention		
Photo Description:	New detention area in new development		
Latitude:	31 06' 58"N	Longitude:	97 40' 49"

Photo:

Outlet to ditch along road

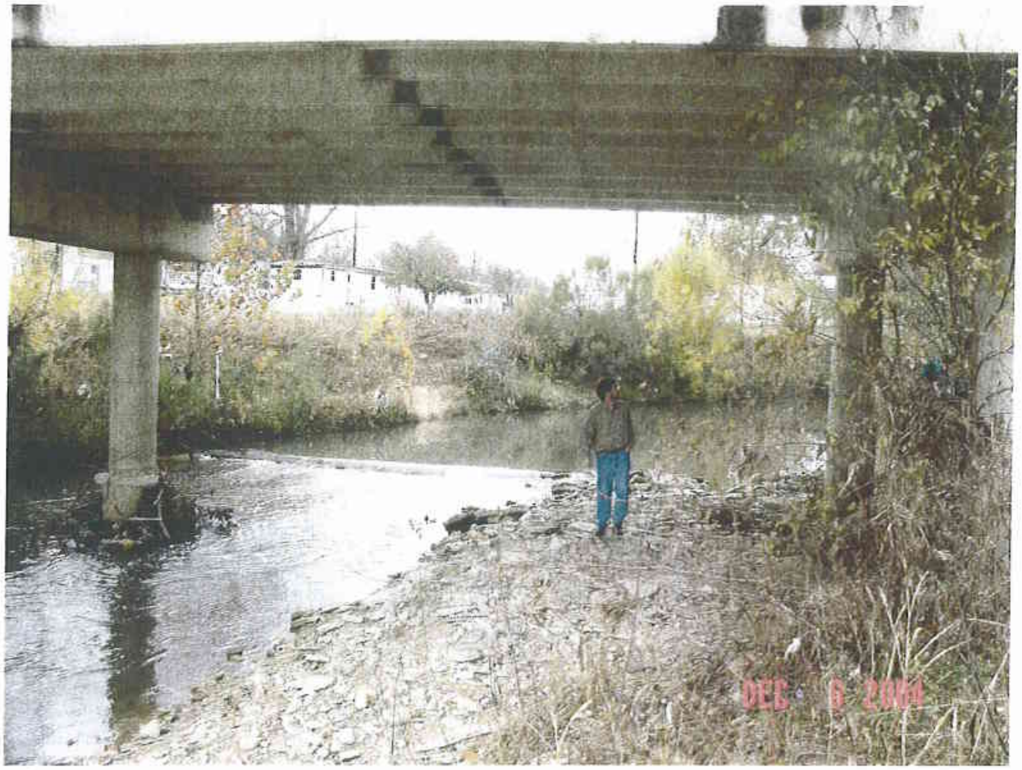
into pond

down the ditch


DEC 7 2004

City of Killeen Master Drainage Plan
Field Investigation

Date:	12/6		
Observer:	JMH/LFK		
Photo #:	196-193		
Site Type:	Bridge and channel		
Photo Description:	Bridge Scour, channel erosion		
Latitude:	31 06' 24"N	Longitude:	97 44' 01"



Looking downstream, bank erosion

Looking downstream, bank erosion

Looking upstream at Dimple St

Failed south abutment

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North overbank, just downstream of bridge

City of Killeen Master Drainage Plan
Field Investigation

Date:	12/7		
Observer:	JMH/LFK		
Photo #:	393-406		
Site Type:	Culvert and channel		
Photo Description:	Upstream face of Dogwood Rd culvert		
Latitude:	31 05’43”N	Longitude:	97 41’ 21”W

Photo:

Back of Inlet at Dogwood Blvd

DS side of Dogwood Blvd

Scour hole at end of concrete flume, just upstream of concrete channel.

Concrete channel along SH 190

Parking lot flows through flume, discharges upstream of concrete channel. Concrete channel failure in bend.

Debris and gravel accumulation upstream of driveway culvert

Backwater at end of concrete channel sections.

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Earthen channel downstream of concrete channel, vegetation overgrown

Upstream face of Little Nolan Creek bridge at SH 190

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Flow from Dogwood channel directed under bridge

Dogwood channel confluence with LNC under bridge, erosion at piers

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Confluence of Dogwood channel and LNC. Erosion at piers under 190

View of LNC upstream of SH 190

City of Killeen Master Drainage Plan
Field Investigation

Date:	12/7
Observer:	JMH/LFK
Photo #:	56-
Site Type:	Street and channel
Photo Description:	Street flow and channel
Latitude:	31 07' 50"N
Longitude:	97 41' 34"

end of El Dorado Dr, street flows into drainage ditch to Long Branch

drainage ditch from El Dorodo Dr to Long Branch

Looking upstream along north side of El Dorado Dr. Houses lower than street. Flow through front Yards

Looking downstream along El Dorado Dr

Looking upstream along El Dorado Dr

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City of Killeen Master Drainage Plan
Field Investigation

Date:	12/8		
Observer:	JMH/LFK		
Photo #:	29-42		
Site Type:	Embers Ditch		
Photo Description:	channel		
Latitude:	31 03' 55"N	Longitude:	97 42' 32"

Photo:

Trapezoidal channel between Embers Dr and Water Oak, looking upstream

looking downstream

Embers Ditch East Trib, from Water Oak Dr, West Trib across Embers Ditch

Downstream face of Water Oak Dr culvert on Embers Ditch, East Trib

undermined concrete apron for Embers Ditch, West Trib

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looking upstream from Water Oak Dr culvert, Embers Ditch East Trib

Looking upstream East Trib of Embers Ditch from Water Oak

Embers Ditch upstream of Fawn Dr

looking downstream Embers Ditch from Fawn Dr

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Erosion at flume from Embers Dr

Date:	12/8		
Observer:	JMH/LFK		
Photo #:	29-42		
Site Type:	Embers Creek		
Photo Description:	Culvert and channel		
Latitude:	31 03' 10"N	Longitude:	97 42' 10"

Upstream of Stagecoach Rd at Embers Ditch, erosion at northeast headwall

Erosion at northeast headwall

looking downstream from Stagecoach Rd

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downstream of Stagecoach Rd, concrete apron erosion from roadside ditch

City of Killeen Master Drainage Plan
Field Investigation

Date:	12/6		
Observer:	JMH/LFK		
Photo #:			
Site Type:	Fowler Ditch, Trib 3		
Photo Description:	Culverts and channel		
Latitude:	31 06' 27"N	Longitude:	97 43' 54"

Photo:

Culverts and channel

Looking downstream

Looking upstream

City of Killeen Master Drainage Plan 12/04

Date:	12/6		
Observer:	JMH/LFK		
Photo #:	191-189		
Site Type:	Fowler Trib 2		
Photo Description:	Fowler Trib 2 channel		
Latitude:	31 06' 23"N	Longitude:	97 44' 55"W

Fowler Trib 2 looking upstream

Fowler Trib 2 channel looking downstream

Seep

Downstream face of culvert

City of Killeen Master Drainage Plan
Field Investigation

Date:	12/6		
Observer:	JMH/LFK		
Photo #:	188-186		
Site Type:	Fowler Trib		
Photo Description:	Channel and culvert		
Latitude:	31 06' 27"N	Longitude:	97 43' 54"

Photo:

Fowler Trib US

Fowler Trib upstream

Fowler Trib downstream

City of Killeen Master Drainage Plan
Field Investigation

Date:	12/6		
Observer:	JMH/LFK		
Photo #:	162-145		
Site Type:	Gilmer Ditch		
Photo Description:	Street flow, gutter flow, channel		
Latitude:	31 07' 28"N	Longitude:	97 44' 17"

Photo:

Looking upstream from Rhode Island St

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looking east on Rhode Island St


looking upstream from Utah St

Looking downstream from Utah St
Flow crosses road through houses

Curb inlets on Utah Street just north of Adams Ave.

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High water marks on house on Vermont Street from Utah Street flow overtopping curb and gutter

Downstream face of Adams St culvert

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looking upstream from Wisconsin St


Downstream face of Wisconsin St culvert, standing water in culverts

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looking downstream from Wisconsin St

Downstream face of Gilmer Ditch culverts at Ave C

upstream face of Ave C culverts, debris blockage, failure of CMP

Railroad track culverts

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Downstream face of Norris St culverts

City of Killeen Master Drainage Plan
Field Investigation

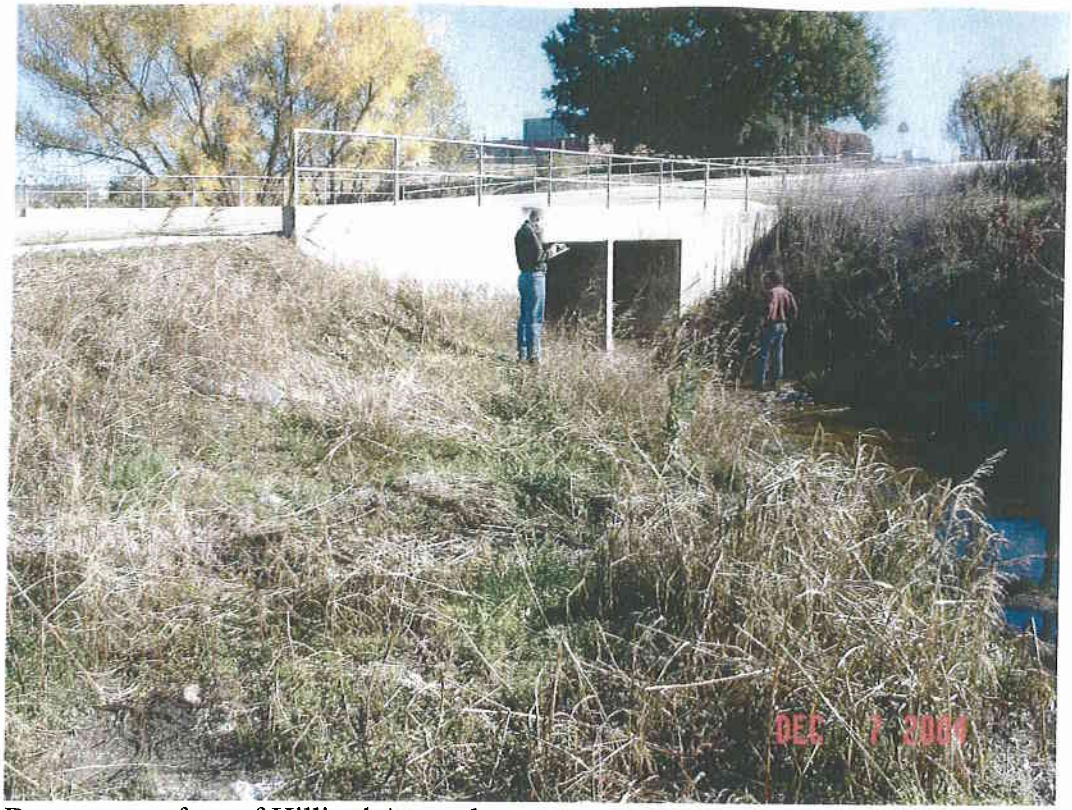
Date:	12/7		
Observer:	JMH/LFK		
Photo #:	64-74		
Site Type:	Hilliard Ditch		
Photo Description:	Channel and banks		
Latitude:	31 07' 49"N	Longitude:	97 41' 21"

Photo:

Hilliard Ditch between Westcliff Rd. and Hilliard Ave.

Dredged material left along Hilliard Ditch between Westcliff Rd and Hilliard Ave

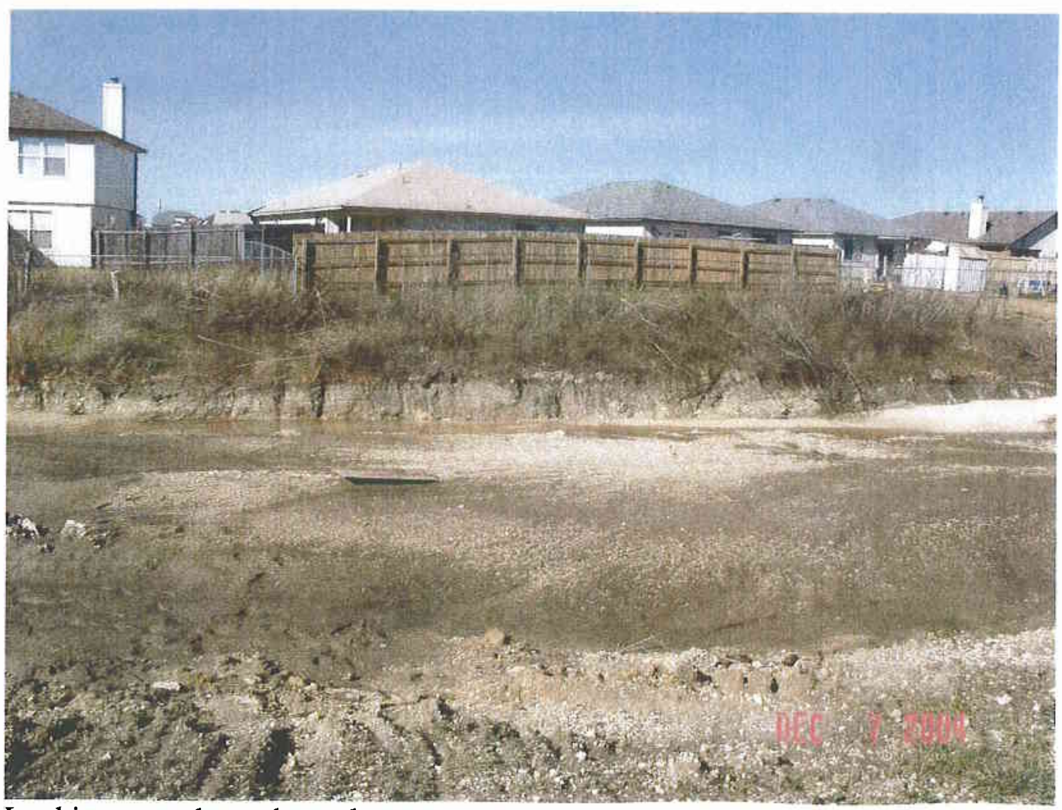
upstream face of Hilliard Ave culvert



Downstream face of Hilliard Ave culvert

scour at downstream face of Hilliard Ave culvert, concrete encased utility crossing exposed

Hillard Ditch, new development between Boswell Dr. and Blackburn Dr.
Looking upstream at confluence of Hilliard Ditch and Hilliard Ditch Tributary



Looking west, bare channel

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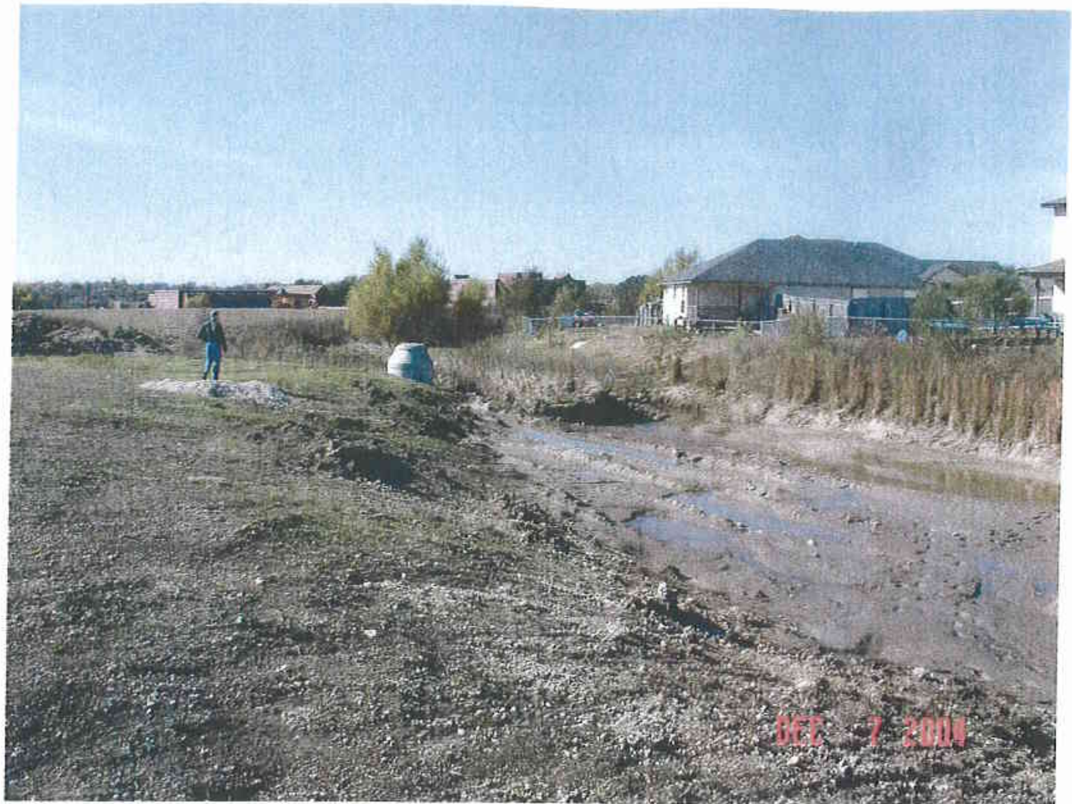

looking downstream

Exposed utility crossing

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Just downstream of new development

Hilliard Ditch Tributary, behind Boswell Dr houses

Hilliard Ditch Trib., looking downstream

Flume at Boswell Dr, drains to Hilliard Ditch Trib.

City of Killeen Master Drainage Plan
Field Investigation

Date:	12/7		
Observer:	JMH/LFK		
Photo #:	45-51		
Site Type:	Industrial Ditch		
Photo Description:	Channel and banks		
Latitude:	31 07' 44"N	Longitude:	97 42' 18"

Photo:

Erosion of bank just upstream of Jacobs Ln


Upstream face of Jacobs Ln culvert


Industrial Ditch upstream of Jacobs Ln

erosion from drainage off industrial yard

Industrial Ditch further upstream

Downstream face of Jacobs Ln culvert, scour hole at end of concrete

Industrial Ditch downstream of Jacobs Ln

City of Killeen Master Drainage Plan
Field Investigation

Date:	12/8		
Observer:	JMH/LFK		
Photo #:	70-73		
Site Type:	Little Nolan Creek, Trib 2a Lagrone		
Photo Description:	Eroding channel		
Latitude:	31 05'09"N	Longitude:	97 42' 47"W

Photo:

Looking upstream

Downstream view from tower

Downstream view of bank cutting or falling off

bank erosion at tower

City of Killeen Master Drainage Plan
Field Investigation

Date:	12/8		
Observer:	JMH/LFK		
Photo #:	79-81		
Site Type:	Liberty Ditch		
Photo Description:	Channel and banks		
Latitude:	31 06'53"N	Longitude:	97 42' 26"W

Photo:

View of upstream from Liberty St

downstream view from Liberty St

upstream face of Liberty St culverts with sediment and utility crossing

City of Killeen Master Drainage Plan
Field Investigation

Date:	12/7		
Observer:	JMH/LFK		
Photo #:	128-137		
Site Type:	Little Nolan Trib 1a at Turtle Creek Dr		
Photo Description:	Channel and banks		
Latitude:	31 05' 33"N	Longitude:	97 44' 30"

Photo:

Looking US from Turtle Creek Drive


Upstream face of culvert at Turtle Creek Dr


Downstream of culvert, scour hole

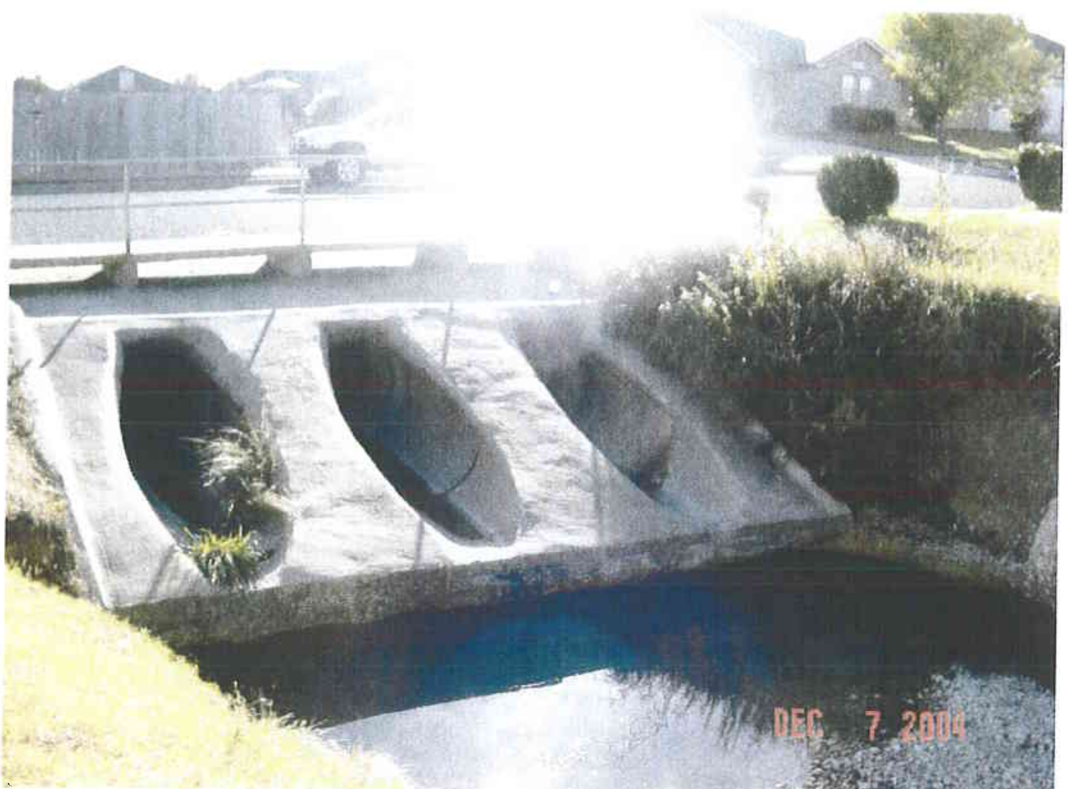
City of Killeen Master Drainage Plan
Field Investigation

Date:	12/8		
Observer:	JMH/LFK		
Photo #:	47-58		
Site Type:	Upper Little Nolan Creek, Trib 1		
Photo Description:	Channel and culvert		
Latitude:	31 05'18"N	Longitude:	97 5' 55"W

Photo:

looking upstream from Caprock Dr

looking downstream from Caprock Dr



downstream face of Caprock Dr culvert, scour hole

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Erosion of channel banks downstream of Caprock Dr

City of Killeen Master Drainage Plan
Field Investigation

Date:	12/6
Observer:	JMH/LFK
Photo #:	
Site Type:	Little Nolan Creek at 2410
Photo Description:	Channel and overbanks

Latitude:		Longitude:	

Photo:

Bare Channel, open space for detention, looking upstream from 2410

Open space along channel

Open space along channel, bare soil (under construction)

City of Killeen Master Drainage Plan
Field Investigation

Date:	12/8		
Observer:	JMH/LFK		
Photo #:	47-69		
Site Type:	Tributaries to LNC near Saegert Ranch		
Photo Description:	Channel, banks and culverts		
Latitude:	31 03'48"N	Longitude:	97 44' 08"W

Photo:

culverts in new subdivision
erosion has occurred

View downstream.

curb inlets and development area
bare soil eroding

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Little Nolan Creek Tributary
WS Young St and Rio Grande St
View looking Upstream

View downstream from Rio Grande culvert

LNC Tributary, drainage from northwest of Saegert Ranch

Upstream face of culvert from northwest drainage area
WS Young at Schorn Dr

View upstream of Schorn Dr

City of Killeen Master Drainage Plan
Field Investigation

Date:	12/8		
Observer:	JMH/LFK		
Photo #:	47-69		
Site Type:	New Construction on Little Nolan Creek		
Photo Description:	Channel and banks		
Latitude:	31 03'50"N	Longitude:	97 44' 08"W

Photo:

Channelization of LNC, no vegetation

erosion from street flow, erosion around manhole and storm drain discharge

Little Nolan Creek at WS Young and Schottische Dr (Saegert Ranch)

Upstream WS Young Culverts
Sediment deposit, eroding wingwall

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storm drain discharge undermined in channel bank

[redacted]

DS of WS Young Culvert

Flume from Rio Grande St

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View of culvert under Onion Street. Rock rip rap for Rio Grande St flume.

Looking upstream from Stan Schuetter Loop


Upstream face of LNC culverts at Stan Schuetter Loop


View of downstream from Stan Schuetter

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City of Killeen Master Drainage Plan
Field Investigation

Date:	12/7		
Observer:	JMH/LFK		
Photo #:	126-137		
Site Type:	Little Nolan Trib 1		
Photo Description:	Channel and banks		
Latitude:	31 05' 36"N	Longitude:	97 44' 46"

Photo:

View of Little Nolan Trib 1
Upstream view from Old 440

Looking downstream from Old 440

Flume discharging into LNC1

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erosion at end of flume

upstream view bank shot

Downstream View at Turtle Creek

View of channel banks at Turtle Creek

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end of flume at Cantabrian & Valencia St.

downstream view at Cantabrian & Valencia St.

end of flume at Alpine St

downstream of Alpine St flume

upstream of Alpine Street flume

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drop structure at Lowe's

Culvert at WS Young, upstream side

Upstream face of culvert at WS Young

Channel downstream of WS Young

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Storm sewer pipe undermined

Storm sewer pipe undermined

view upstream of wall

failed flume for run off from ditch and parking lot, just upstream of SH 190

culvert at 190

City of Killeen Master Drainage Plan
Field Investigation

Date:	12/7		
Observer:	JMH/LFK		
Photo #:	56-		
Site Type:	Long Ditch		
Photo Description:	Channel and overbanks		
Latitude:	31 07' 50"N	Longitude:	97 41' 34"

looking downstream from Westcliff Rd

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looking upstream from Westcliff Rd.

upstream face of Westcliff Rd. culvert

Date:	12/7		
Observer:	JMH/LFK		
Photo #:	56-		
Site Type:	Long at 38th and Wright St		
Photo Description:	Channel and overbanks		
Latitude:	31 07' 50"N	Longitude:	97 41' 34"

Photo:

Looking downstream from N. 38th St

downstream face of N. 38th Street culverts

Looking upstream from N. 38th St

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Long Branch Tributary, right side of photo

Downstream face of Long Branch Tributary culvert

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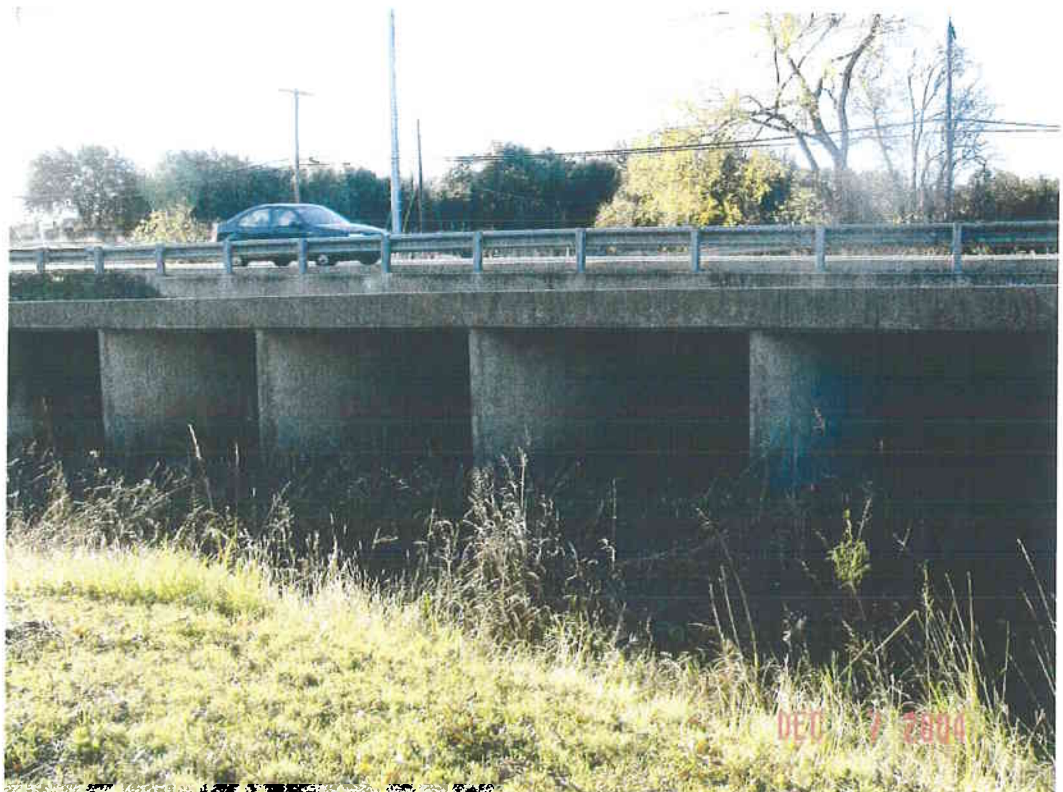
Flume from Wright Way

Looking upstream Long Branch upstream of Rancier Ave

Long Branch in park area



upstream face of Rancier Ave culverts

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City of Killeen Master Drainage Plan
Field Investigation

Date:	12/7		
Observer:	JMH/LFK		
Photo #:	8-23		
Site Type:	Long Branch Tributary		
Photo Description:	Channel and overbanks		
Latitude:	31 07' 04"N	Longitude:	97 41' 27"

Photo:

Looking upstream

Looking downstream Long Branch Tributary

debris in Long Branch Trib

eroding banks of Long Branch Tributary

undermined drop structure

Long Branch Tributary downstream of concrete channel from Lake Inks Ave

Upstream concrete channel into park

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Rancier Ave storm sewer discharge

Rancier storm sewer discharge to Long Branch Tributary, blocked by reeds

Upstream face of Branch Dr culverts

Undermining of Branch Dr at culvert

Downstream face of Branch Dr culverts

Erosion at northwest wingwall from Long Branch Tributary

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City of Killeen Master Drainage Plan
Field Investigation

Date:	12/7		
Observer:	JMH/LFK		
Photo #:	87-96		
Site Type:	Patriotic Ditch		
Photo Description:	Drainage Area upstream to Patriotic Ditch		
Latitude:	31 05' 56"N	Longitude:	97 42' 05"

Photo:

Street flow from Zephyr Rd overtops curb and flows through this vacant lot

looking upstream Zephyr Rd

End of Saratoga Ave flume

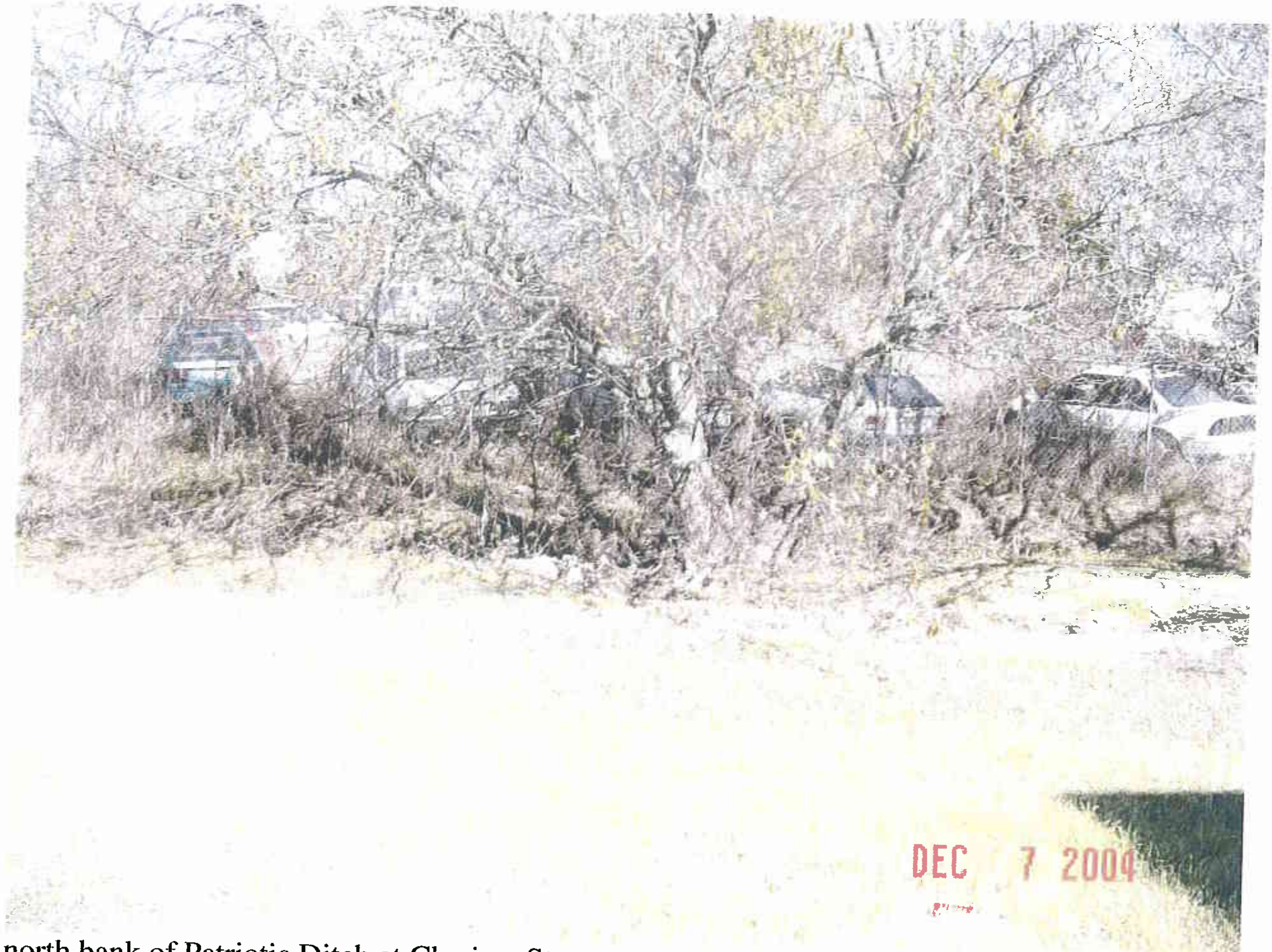
Looking downstream from Saratoga Ave flume

Looking upstream from Saratoga Ave flume

High water mark at end of flume – note debris

Patriotic Ditch at Charisse St, looking downstream

Patriotic Ditch at Charisse St, looking upstream



north bank of Patriotic Ditch at Charisse St

City of Killeen Master Drainage Plan 12/04

Date:	12/8		
Observer:	JMH/LFK		
Photo #:	47-69		
Site Type:	Little Nolan Creek Tributary		
Photo Description:	Saegert Ranch Detention		
Latitude:	31 03'48"N	Longitude:	97 44' 08"W

Photo:

Detention pond in Saegert Ranch

South end of pond

view of outlet structure

view of outlet discharge

Downstream view

Downstream of sediment pond. Small channel through field.

City of Killeen Master Drainage Plan
Field Investigation

Date:	12/6		
Observer:	JMH/LFK		
Photo #:	180-169		
Site Type:	South Nolan Creek at Odom Drive		
Photo Description:	Channel and banks		
Latitude:	31 06' 45"N	Longitude:	97 43' 25"

Photo:

Looking upstream from concrete channel bank armoring, Odom Drive

Looking downstream from concrete channel bank armoring, Odom Drive

Erosion at concrete bank armoring

Erosion of channel bank along Odom Drive

Left overbank, houses in floodplain

Upstream view of channel

Downstream Trees in and along channel leaving the rocky sediment area

view of eroded bank

Bank erosion

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Downstream bank erosion continues

Erosion on right bank near sewer crossing

hole in sewer pipe

view upstream, homes in floodplain

City of Killeen Master Drainage Plan
Field Investigation

Date:	12/7		
Observer:	JMH/LFK		
Photo #:	116-125		
Site Type:	Channel and floodplain		
Photo Description:	SNC at end of flume, 90 degree bend in SNC		
Latitude:	31 05' 57"N	Longitude:	97 47' 10"

Photo:

looking upstream SNC from flume

looking upstream SNC Tributary from Robinett Rd

Upstream of Robinett Rd

looking upstream SNC from Robinett Rd

Looking downstream SNC from Robinett Rd

Downstream face of Robinett culverts

City of Killeen Master Drainage Plan 12/04

Date:	12/7		
Observer:	JMH/LFK		
Photo #:	113-115		
Site Type:	S Nolan Creek		
Photo Description:	Drop off from flume in new subdivision		
Latitude:	31 06' 14"N	Longitude:	97 46' 39"

Photo:

Downstream of flume

SWPPP Failure in new development

City of Killeen Master Drainage Plan
Field Investigation

Date:	12/8		
Observer:	JMH/LFK		
Photo #:	86-114		
Site Type:	Channel		
Photo Description:	Stewart Ditch Looking upstream from Culp Ave		
Latitude:	31 07'30"N	Longitude:	97 42' 58"W

Photo:

looking downstream from Culp Ave

Upstream face of Culp Ave culvert

Downstream face of Culp Ave cuvlert

Looking upstream from Duncan Ave

Stewart Ditch Trib, looking upstream from 10th Street

Stewart Ditch Trib, looking downstream from 10th Street

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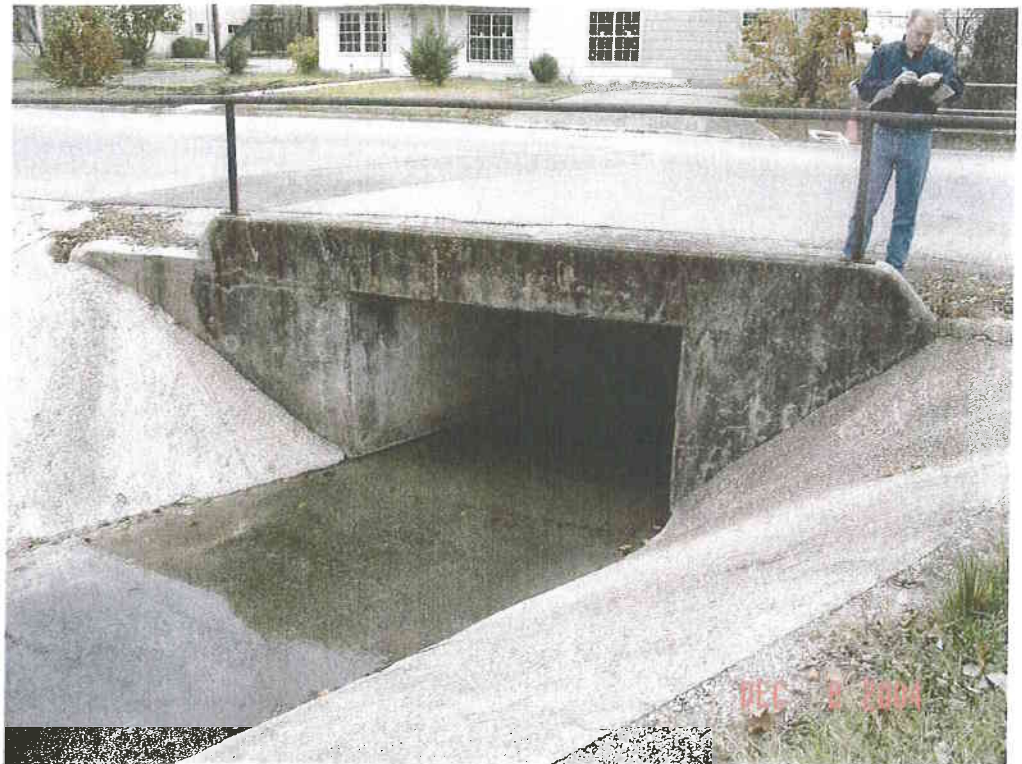
Stewart Ditch Trib, Upstream face of 12th Street culvert


Stewart Ditch Trib downstream of 12th Street

Stewart Ditch Trib, looking upstream from 18th Street

Stewart Ditch Trib, looking downstream from 18th Street

looking upstream Stewart Ditch Trib, downstream of Rancier Ave

looking upstream Stewart Ditch, downstream of Rancier Ave

looking downstream Stewart Ditch at Harris Ave

Looking upstream Stewart Ditch at Harris Ave

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looking downstream at confluence of Stewart Ditch and Stewart Ditch Trib

looking downstream Stewart Ditch from confluence

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looking downstream from Parmer Ave

Stewart Ditch downstream of Parmer Ave

flume at Greenwood Ave

Looking upstream from Greenwood Ave flume

missing concrete section

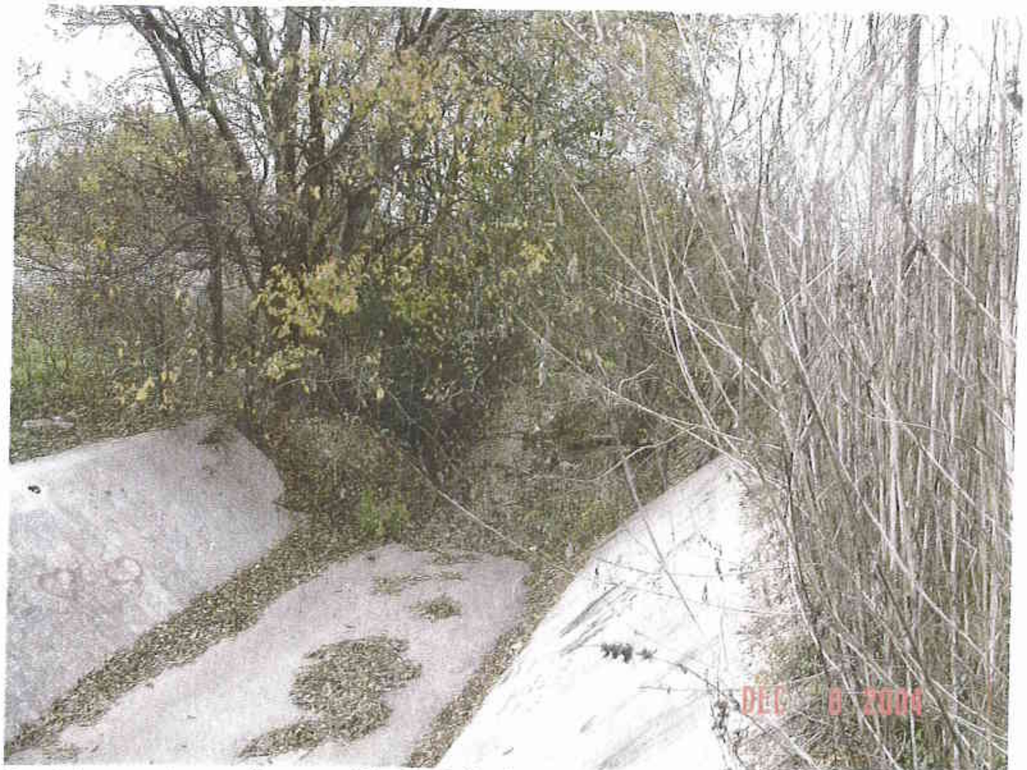
looking downstream

missing concrete section

Upstream face of Greenwood Ave culverts

looking upstream from Greenwood Ave

looking downstream from Greenwood Ave



Looking upstream Stewart Ditch Trib along railroad

Photo Description:	Upstream face of Railroad culvert/bridge		
Latitude:	31 07'02"N	Longitude:	97 43' 05"W

City of Killeen Master Drainage Plan
Field Investigation

Date:	12/8		
Observer:	JMH/LFK		
Photo #:	1-9		
Site Type:	Stillwood Ditch		
Photo Description:	Street flow and channel		
Latitude:	31 05' 04"N	Longitude:	97 40' 32"

Photo:

Street flow from Green Forest Cir directed at house

Looking downstream on Green Forest Cir

looking upstream from Stillwood Drive at ditch from golf course, flows into Stillwood Dr storm sewer

Looking east from golf course ditch and curb inlet

Looking downstream from Stillwood Dr, golf course ditch/ Stillwood storm sewer discharge

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Downstream face of Stillwood Dr storm sewer

Street overflow causing erosion of sidewalk and headwall

erosion at end of Dripping Springs Dr

Downstream face of new Dripping Springs Dr culvert, erosion from Stillwood Dr storm sewer

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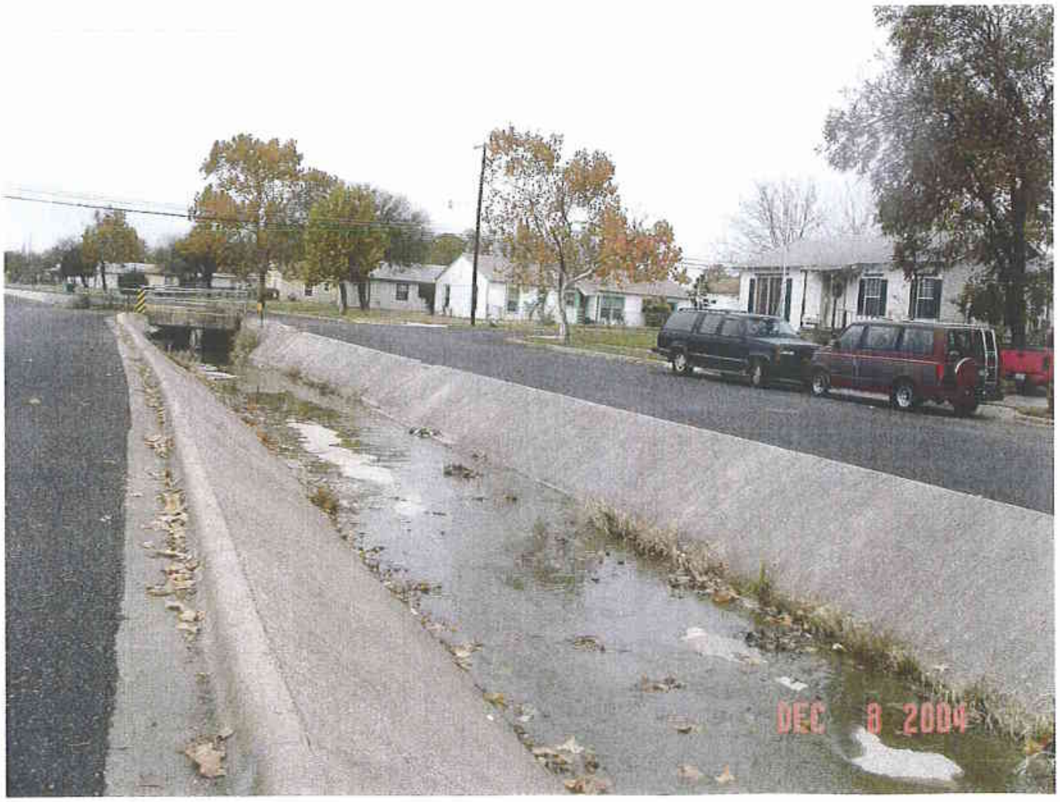
City of Killeen Master Drainage Plan
Field Investigation

Date:	12/8		
Observer:	JMH/LFK		
Photo #:	115-123		
Site Type:	Valley Ditch		
Photo Description:	Channel		
Latitude:	31 07'22"N	Longitude:	97 43' 51"W

Photo:

Looking upstream Valley Ditch

upstream end of Valley Ditch at Fairview Dr



Looking upstream at Hillcrest Dr

looking downstream from Hillcrest Dr

Looking upstream from Rancier Ave

Rancier Ave culvert

looking downstream from College and Church

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looking upstream from Ave A

Upstream face of Ave A culvert

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City of Killeen Master Drainage Plan
Field Investigation

Date:	12/7		
Observer:	JMH/LFK		
Photo #:	107-112		
Site Type:	Willow Tributary		
Photo Description:	Channel and banks		
Latitude:	31 06' 01"N	Longitude:	97 46' 02"

Photo:

At Willow Springs St and Armadillo St
Downstream view

Downstream View

Further Upstream view

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Further upstream

City of Killeen Master Drainage Plan
Field Investigation

Date:	12/6		
Observer:	JMH/LFK		
Photo #:	184-181		
Site Type:	Wolf Ditch		
Photo Description:	Concrete channel and storm drain		
Latitude:	31 06’ 40”N	Longitude:	97 44’ 19”

Photo:

Looking downstream from Bryce Ave.
Wolf Ditch flows to 42” CP

Looking upstream from Bryce Dr

Upstream face of Short Ave

APPENDIX I

Financial Model

Killeen Drainage Utility
Utility Rate Model

8/8/2005

Revenue Requirements	
Operation & Maintenance	$1,167,064
Debt Service	567,620
Total Revenue Requirements	**$1,734,684**

Term	25	years
Interest	5.00%	annual percentage rate
Principal	$8,000,000	

Multifamily Adjustment 70.00%

Killeen Drainage Utility
Utility Rate Model

Tiered Method-Rate Input -

Customer Class	Parcels	Equivalent Units	Tier Factors	Monthly Rate	Monthly Rate	Billing Unit	Monthly Revenues	Annual Revenues	Percent of Total Revenues
Residential	29,650	29,650	1.0	$3.00	$3.00	Per Residence	$88,950	$1,067,400	61.51%
Duplex	1,734	3,468	2.0	$5.10	$5.10	Per Duplex	8,843	106,121	6.12%
Multi-Family - 4	500	2,324	Units	$9.30	Multi-Family Accounts:		4,650	55,800	3.22%
Multi-Family - 5 to 9 units	250	1,845	Units	$16.40	$3.00	For First Unit Plus	4,100	49,200	2.84%
Multi-Family - 10 to 19 units	50	1,880	Units	$79.86	$2.10	Per Additional Unit	3,993	47,916	2.76%
Multi-Family - 20 or more	22	2,077	Units	$150.00	Max Rate:	$150	3,300	39,600	2.28%
Comm-First Group	1,650	8,250	5.0	$15.00	$15.00	Per Account	24,750	297,000	17.12%
Comm-Second Group	42	630	15.0	$45.00	$45.00	Per Account	1,890	22,680	1.31%
Comm-Third Group	17	425	25.0	$75.00	$75.00	Per Account	1,275	15,300	0.88%
Comm-Fourth Group	19	950	50.0	$150.00	$150.00	Per Account	2,850	34,200	1.97%
Totals	33,934						$144,601	**$1,735,217**	100.00%

Number of Commercial Accounts	1,728
Billing Percent of Total Parcels	52%

Adjustment for Apartment units 23%

APPENDIX J

STAKEHOLDER MEETING MINUTES

Carter::Burgess

Meeting Report

PROJECT: The City of Killeen Storm Water Program

PROJECT NO.: 011303.010.1.0001

PRESENT: Bruce Butscher – City of Killeen
Jim Butler – City of Killeen
Steve Veal – Carter Burgess
Joan Flowers – Carter Burgess
Lisa Soule – Killeen Daily Herald

DATE: 12/19/2002

TIME: 1:30 – 3:30 PM

<u>Storm Water Task Force Members</u>
Carol Aponte – Holmes Homes
Rick Young – Fort Hood, DPW-ENV
Michael Jahws – Bell County Public Health Department
Judy Parker – Clearwater Underground Water Conservation District
Joyce Hodson – Beautify Killeen
Colette Marshall – LeMay Homes
Bruce Whitis – W&B Development
Bob Mitchell _ Mitchell & Associates
Glen Grandy – WCID #6
Mark Hyde – City of Harker Heights
Richard Macchi – Bell County
Donna Long – Texas State Soil and Water Conservation Board
Walter Autry – Planning and Zoning

The following is our understanding of the subject matter covered in this meeting. If this differs from your understanding, please notify us within five working days.

The initial meeting of the city of Killeen's Storm Water Task Force (SWTF) was held on December 19, 2002 from 1:30 to 3:30 pm. The SWTF is comprised of representatives from city staff, regional and state governments, the Fort Hood military base, business professional organizations and citizens who have an interest in shaping the City's approach to storm water management. The purpose of the SWTF is to help guide the development of the City's Storm Water Management Program and provide feedback to the City on viable BMPs for implementation. The SWTF, through consensus and public education, is a valuable resource for the City in developing a successful storm water management program. The SWTF will report to the City's Water Sewer and Drainage Subcommittee, which will, in turn, report the City Council.

This meeting was the first of five meetings, which will be held between December 2002 and April 2003. The meeting was hosted by the city of Killeen and was held at the City's Community Meeting Room located at 207 W. Ave D. The meeting was well attended with 13 representatives from the task force participating. Also in attendance were two representatives from the city of Killeen, two Carter & Burgess representatives, and one reporter for the local newspaper. Refreshments (cookies and sodas) were provided by the City.

Bruce Butscher, the Director of Public Works for the city of Killeen, opened the meeting with a brief introduction on the purpose of the task force and welcomed the task force members. Bruce also initiated round-table introductions of those in attendance. Bruce introduced Steve Veal, the Carter Burgess project manager, who conducted the meeting in John Nett's absence.

Steve Veal explained the materials that were handed out at the meeting, which included a 3-ring binder of Best Management Practices (BMPs) and handouts corresponding to the presentation slides. Steve presented a PowerPoint slide show which provided a brief history of the NPDES / TPDES program and how if affects the city of Killeen. The presentation also described:

- the types of activities and geographic extent covered under the Phase II regulations,
- definitions of common acronyms,
- types of MS4's,
- designated urbanized areas,
- Phase II implementation schedule,
- goals of the Phase II Storm Water Management Plan,
- the six minimum control measures defined by EPA, and
- Internet sources for additional information on the Phase II NPDES/TPDES program.

Following the presentation, Steve Veal and City representatives provided answers to stakeholder questions. A representative from a homebuilder's association voiced concerns about recent fines that were levied on construction sites near Waco and inquired about what BMPs were required to meet permit requirements. Steve Veal and Donna Long addressed the questions that were raised regarding permit requirements for construction sites. A representative from Fort Hood inquired about whether the City planned to address the 7th minimum control measure. Answer: No, the City is not in favor of the 7th measure at this time.

Following the question and answer session, the SWTF was asked to form small discussion groups and develop a list of issues that they perceive as important. The SWTF was divided into 4 small discussion groups. Following their discussion, each group designated a spokesperson to present their list of concerns. The following list was compiled based on the issues identified. Note: Some issues were independently identified by several of the discussion groups and are duplicated in the list. ***This list is presented in random order and does not represent a prioritized list.***

List of Storm Water Issues

1. Visual Concerns
    a. Parking Lots
    b. Construction Sites
    c. Trash/Debris
2. Lack of Knowledge
3. Lack of Enforcement
    a. Paper versus action
4. Storm Water Drainage in the City (General)
5. Nolan Creek Drainage and Storm Water Runoff
6. Education/Classroom Needs
    a. Resources and grants
    b. Resources and curriculums for teachers
    Mary Ann Smith at Blackland Research and Extension Center in Temple has resources available.
7. Greenbelt Preservation/Maintenance
8. Litter in Creeks
9. Construction Site Runoff
10. Parking Lot Runoff
11. Lawn Maintenance/Pesticide Runoff
12. Illegal Dumping
13. Sewer Overflows

Carter::Burgess

The meeting concluded with a discussion of the best time for future meetings. The SWTF decided that the third Thursday of each month at 2:00 pm would best meet their schedules and would work well with the scheduled meetings of the Killeen City Council. The next meeting was scheduled for January 16, 2003 from 2:00 to 4:00 pm. The meeting would be held at the same location.

REPORTED BY: Joan Flowers

JDF/
cc: Attendees
Steve Veal
Joan Flowers
John Nett

Carter::Burgess

Meeting Report

PROJECT: City of Killeen TPDES Phase II Storm Water Program

PROJECT NO.: 011303.010.1.0001

PRESENT: John Nett – City of Killeen
Steve Veal – Carter Burgess
Joan Flowers – Carter Burgess

DATE: 1/16/2003

TIME: 2:00 p.m. – 4:00 p.m.

IN ATTENDANCE: Carol Aponte – Holmes Homes
Riki Young – Fort Hood, DPW-ENV
Michael Jahns – Bell County Public Health District
Cheryl Maxwell – Clearwater Underground Water Conservation District
Joyce Hodson – Beautify Killeen
Colette Marshall – LeMay Homes
Bob Mitchell – Mitchell & Associates
Glen Grandy – Bell County Water Control & Improvement District #6
Richard Macchi – Bell County Engineer
Donna Long – Texas State Soil and Water Conservation Board
Walter Autry – City of Killeen, Planning and Zoning Commission
Rod Gaskill
Chuck Ritz
Gayle Bass – B&B Builders
Bobby Ramthan – TxDOT - Belton
Jonathan Manning – Jay Manning Homes

The following is our understanding of the subject matter covered in this meeting. If this differs from your understanding, please notify us within five working days.

The second meeting of the city of Killeen's Storm Water Task Force (SWTF) was held on January 16, 2003, from 2:00 p.m. to 4:00 p.m. The meeting was hosted by the City of Killeen and was held at the City's Community Meeting Room located at 207 W. Ave D. Sixteen representatives attended the meeting from a wider list of potential task force participants. Present to coordinate the meeting were representatives from the City of Killeen and Carter & Burgess, the City's consultant for TPDES Phase II Storm Water Program Development. The focus of this meeting was to address two of the six minimum control measures defined by EPA for Phase II MS4 programs, Public Education and Public Involvement.

John Nett welcomed members of the SWTF and reemphasized the importance of stakeholder input in the development of Killeen's Storm Water Program. John initiated round-table introductions of those in attendance. Six new members were in attendance.

A video produced by the North Central Texas Council of Governments (NCTCOG) was presented, which described the TPDES Phase II Storm Water Program. The 19-minute video focused on three topics— the water quality problems that the program was designed to address, the rules and regulations, and the regional response (regional cooperative initiatives). Following the video John clarified a few items: 1) the Central Texas Council of Government was also involved in public education and training similar to the NCTCOG, 2) the Texas Natural Resource Conservation Commission (TNRCC) that was referred to in the video had recently changed its name to Texas Commission on Environmental Quality (TCEQ); and 3) the March 2003 deadline had been postponed until possibly June 2003 due to the fact that Texas had not yet adopted the final Phase II Small MS4 General Permit.

John introduced Steve Veal, Carter & Burgess' project manager, who coordinated the remainder of the meeting. Steve presented a PowerPoint slide show that provided descriptions of potential Best Management Practices (BMPs) that Killeen might want to adopt as part of the first two minimum control measures, Public Education and Public Involvement. Steve explained that the BMPs presented included those recommended by EPA but was by no means all-inclusive. Steve encouraged stakeholders to suggest other types of BMPs, if they were aware of BMPs that were more suitable to the local area.

The Public Education presentation focused on two aspects—the medium used to disseminate information to the public and specific educational topics. The Public Education topics were further categorized by target audiences such as homeowners, businesses, new development, or specific ethnic groups that required distribution of bilingual educational materials. The presentation described 10 different ways that educational materials and/or messages could be conveyed to the public and 21 specific educational topics. The Public Involvement presentation included 10 methods in which the public could participate in the city of Killeen's Storm Water Program. The list of BMPs reviewed is provided below.

Supplemental information was available on factsheets that were distributed at the initial SWTF meeting in December. The BMP factsheets included in the SWTF notebook provided a description for each BMP with the benefits and limitations identified as well as the applicability, pollutant removal, and costs for implementation, maintenance and training.

Public Education BMPs

1. Utility Bill Inserts
2. Brochures
3. Web Site
4. Public Service Announcements
5. Speaker's Bureau
6. Signs and Billboards
7. Educational displays
8. Door hangers
9. Neighborhood Association Newsletters
10. Classroom Education

Messages for Homeowners

1. Proper use of fertilizers and pesticides
2. Alternative methods of pest control
3. Composting or recycling of garden waste
4. Mulches
5. Xeriscape and landscape planning
6. Soil analysis
7. Home water conservation
8. Proper disposal of household hazardous waste
9. Pet waste management
10. Trash management (waste reduction and recycling)

Messages for New Development

1. Low Impact Development (LID)
2. Yard establishment techniques

Messages for Businesses

1. "Know your site" campaign
2. Proper storage and disposal of toxic chemicals
3. Waste management
4. Vehicle and equipment washing
5. Spill prevention and cleanup
6. Property maintenance
7. Eliminating improper discharges to storm drains
8. Proper parking lot cleaning techniques
9. Recycling and reusing automotive fluids and solvents

Public Participation BMPs

1. Storm Drain Stenciling
2. Stream Cleanup Projects
3. Volunteer Monitoring
4. Reforestation Programs
5. Wetland Planting
6. Adopt-A-Stream Programs
7. Watershed Organizations:
8. Stakeholders Meetings
9. Attitude Survey
10. Storm Water Hotlines

Following the slide presentation, Steve Veal and John Nett provided answers to questions from the attendees. A summary of stakeholder suggestions and comments are listed below.

- A number of stakeholders voiced concerns about storm water runoff from wrecking yards. Steve explained that automobile wrecking yards should have their own storm water permit and that EPA regulations require them to drain vehicle fluids and install berms to prevent runoff. If violations were observed, citizen complaints could be reported to the storm water inspector at TCEQ Region 6 in Waco.
- One stakeholder suggested that the city provide brochures to new homeowners at the time of sale containing friendly advice on lawn care and xeriscaping. Specific brochures could also be developed that target military personnel that are new to Texas. John said that developing educational brochures was one area that the Deputy City Manager wanted to focus on. Although Killeen does not have a landscape ordinance, it is an option.
- Several stakeholders voiced concerns about agricultural sources. There is not a large agricultural sector in the urbanized area but the City is involved with CAFO regulations.
- Concerns were voiced about classroom education advocating "tree-hugger" activities. Kids are very impressionable and they do not want to raise a generation of whistle-blowers. Steve commented that most of the classroom educational curriculum that he had seen was specifically directed toward home issues.
- Stakeholders expressed concerns over flooding. This is one of the toughest problems especially in the older neighborhoods. Easements are not the solution.
- Illegal dumping is a concern. Killeen does have scheduled pickup of bulk items. It could be an education problem, that people are not aware that this service is available. Killeen is also looking into household hazardous waste collection.
- The possibility of obtaining state or federal funding for educational programs was discussed. A number of specific sources of grant funds were discussed.

Following the question and answer session, the SWTF members were asked to fill out BMP ballots ranking their top five preferences from 1 (most preferable) to 5 (least preferable). Each SWTF member was asked to complete ballots ranking their preferences for Public Education

BMPs, Public Education Topics, and Public Involvement BMPs. The members were asked to also rank the Key Storm Water Management Issues that were identified by the SWTF at the previous meeting. Ballot summary tables of SWTF preferences are attached. Comments that were recorded on the ballots are listed below.

Comments on Key Storm Water Management Issues Ballots

Lack of Enforcement

- No matter what we do, if it isn't enforced-we've wasted our time.
- You need to hire people to do inspections and maintenance.

Lack of Knowledge

- The general public is unaware of this problem.

Lack of Knowledge & Educational/Classroom Needs

- These sort of go together.

Comments on Public Education Ballots

No comments

Comments on Public Education Topic Ballots

- Several of these could be combined since they overlap.

Eliminating improper discharges to storm drains

- This seems to encompass some of the others.

Proper disposal of household hazardous waste

- Do you do an annual household hazardous waste turn in?

Vehicle and equipment washing

- This applies to homeowners too.

Property maintenance & Proper parking lot cleaning techniques

- These go together.

Comments on Public Involvement Ballots

Adopt-A-Stream Programs

- It seems like this option includes some of the other like stream cleanup projects, reforestation programs, and wetland planting.

The next SWTF meeting was scheduled for Thursday, February 20, 2003, from 2:00 p.m. to 4:00 pm. at the same location.

REPORTED BY: Joan Flowers

JDF/attachments (7)

cc: Attendees
Steve Veal
Joan Flowers
John Nett

Carter::Burgess

Meeting Report

PROJECT: City of Killeen TPDES Phase II Storm Water Program

PROJECT NO.: 011303.010.1.0001

PRESENT: John Nett – City of Killeen
Steve Veal – Carter Burgess
Joan Flowers – Carter Burgess
Amy Truman - Carter Burgess

DATE: 2/20/2003

TIME: 2:00 p.m. – 4:00 p.m.

IN ATTENDANCE: Carol Aponte – Holmes Homes
Michael Jahns – Bell County Public Health District
Bob Mitchell – Mitchell & Associates
Bobby Ramthan – TxDOT - Belton
Judy Parker – CUWCD
Richard Macchi – Bell Co. Eng.
Mark Hyde – City of Harker Heights

The following is our understanding of the subject matter covered in this meeting. If this differs from your understanding, please notify us within five working days.

This third meeting of the city of Killeen's Storm Water Task Force (SWTF) was held on February 20, 2003, from 2:00 p.m. to 4:00 p.m. The meeting was hosted by the City of Killeen and was held at the City's Community Meeting Room located at 207 W. Ave D. Seven representatives attended the meeting from a wider list of potential task force participants. Present to coordinate the meeting were representatives from the City of Killeen and Carter & Burgess, the City's consultant for TPDES Phase II Storm Water Program Development. The focus of this meeting was to address three of the six minimum control measures defined by EPA for Phase II MS4 programs, Illicit Discharge Detection and Elimination, BMPs for Construction and BMPs for Post-Construction.

John introduced Steve Veal, Carter & Burgess' project manager, who coordinated the presentation of the BMPs. Steve presented a PowerPoint slide show that provided descriptions of potential Best Management Practices (BMPs) that Killeen might want to adopt as part of these three minimum control measures. Steve explained that the BMPs presented included those recommended by EPA but was by no means all-inclusive. Steve encouraged stakeholders to suggest other types of BMPs, if they were aware of BMPs that were more suitable to the local area. The list of BMPs reviewed is provided below.

Illicit Discharge Detection and Elimination BMPs

1. Storm Drain System Mapping - *Mandatory*
2. Dry Weather Screening
3. Wet Weather Screening
4. Fluorescent Dye Testing
5. Smoke Testing
6. Remote TV Camera Inspection
7. Sanitary Sewer Overflows - *Mandatory*
8. Household Hazardous Waste Disposal
9. Illegal Dumping - *Manadatory*
10. Wastewater Connections
11. Failing Septic Systems
12. Recreational Sewage

13. Storm Water Hotline

During and after the presentation, the stakeholder's had few questions; however, one stakeholder inquired as to whether abandoned cars in the flood plain were a violation. Another stakeholder responded that it's hard to change the mindset of people that look at abandoned cars as an investment.

The SWTF members were then asked to fill out BMP ballots ranking their top five preferences from 1 (most preferable) to 5 (least preferable). Each SWTF member was asked to complete ballots ranking their preferences for Illicit Discharge BMPs. Ballot summary tables of the SWTF preferences are attached. Comments that were recorded on the ballots are listed below.

Comments on Illicit Discharge Detection and Elimination Ballots

Sanitary Sewer Overflows

- Need further investigation to assess what waters & sewer division is currently performing.

Household Hazardous Waste Disposal

- Investigate Mobile HHW facility in Killeen this summer (Peter Dilillo).

Illegal Dumping

- Concerns arose regarding dumping in ETJ.

Recreational Sewage

- The magnitude of this problem has not been assessed.

After voting on the Illicit Discharge Elimination and Detection BMP's, Steve began the presentation for the Construction and Post-Construction BMPs. Between the presentation of the BMP's for each of these Minimum Control Measures, Steve also provided a brief presentation on Storm Water Detention Design at the request of John Nett. This discussion addressed the purpose of these systems, the impact of urbanization on urban runoff quality, the downstream impacts of increased discharges, a comparison between "old" and "new" designs, and several examples of these systems.

The list of Construction and Post-Construction BMPs reviewed is provided below.

Construction BMPs

1. Preserving Natural Vegetation
2. Construction Entrances
3. Check Dams
4. Filter Berms
5. Grass Lined Channels
6. RipRap
7. Chemical Stabilization
8. Mulching
9. Vegetation Establishment
10. Soil Roughening
11. Erosion Control Blankets
12. Temporary Slope Drain
13. Temporary Stream Crossing
14. Vegetated Buffers
15. Construction Sequencing
16. Dust control Measures
17. Temporary Diversion Dikes, Earth Dikes, and Interceptor Swales
18. Silt, Wind and Sand Fences

19. Brush Barrier
20. Sediment Basins and Rock Dams
21. Sediment Filters and Chambers
22. Sediment Traps
23. Storm Drain Inlet Protection
24. Contractor Certification/ Inspector Training

Post-Construction BMPs

1. Dry Extended Detention Basin
2. Wet Pond
3. Infiltration Basin
4. Infiltration Trench
5. Porous Pavement
6. Bioretention
7. Sand and Organic Filters
8. Storm Water Wetland
9. Interceptor Swales
10. Manufactured Products for Storm Water Inlets
11. Buffer Zones/Grass Filter Strips
12. Open Space/Cluster Design
13. Urban Forestry/Tree Ordinances
14. Conservation Easements
15. Narrower Residential Streets
16. Eliminating Curbs and Gutters
17. Green Parking
18. Alternative turnarounds
19. Zoning

During and after the presentation, the stakeholder's had several questions and comments, which are summarized below.

- One Stakeholder inquired if Carol Aponte's construction sites had ever been inspected, to which she replied that they had not.
- Another question was what keeps erosion control blankets from blowing away, to which the response was that they are staked to the ground.
- Carol stated that erosion control blankets work a lot better than silt fences.
- In regard to detention ponds, one question was who would maintain the ponds? Steve responded that in Austin residential areas the City will typically maintain the pond but in commercial areas, the maintenance is the responsibility of the commercial activity. However, some other cities will not maintain the ponds so the responsibility will typically fall on homeowners associations. TCEQ, in conjunction with Austin, has developed several demonstration projects. Austin is very progressive and has completed Clean Water Act Section 319 projects for wetlands.

The SWTF members were then asked to fill out BMP ballots ranking their top five preferences from 1 (most preferable) to 5 (least preferable) for each of these Minimum Control Measures.. Ballot summary tables of the SWTF preferences are attached. Comments that were recorded on the ballots are listed below.

Carter::Burgess

Comments on Construction Ballots

Vegetation Establishment

- Community service hours could be used for streamway clean ups.

Sediment Basins

- Need further investigation to assess what waters & sewer division is currently performing.

Comments on Post-Construction Ballots

Extended Dry Detention Basin

- 24 hour retention

Wet Pond

- lake

Infiltration Trench

- Expensive, "tight area"

Porous Pavement

- Sports stadiums in Florida

Storm Water Wetland

- mosquitos

Interceptor Swales

- Grass ditch

Manufactured Products for Storm Water Inlets

- Cigarette Butt, $15-30,000

Buffer Zones/Grassed Filter Strips

- Blood weeds & Johnson grass

Open Space Design

- County, not City

Urban Forestry

- Trees

Conservation Easements

- Not City

Narrower Residential Streets

- Safety Issues

Eliminating Curbs and Gutters

- Bar Ditch (Standing Water)

Green Parking

- Occasional Parking

Alternative Turnarounds

- Cul-de-Sac

Zoning

- Re-zoning, variances

John Nett also provided information on Compost Utilization Demonstration Project Contacts, which are provided below:

Carter::Burgess

Linda Brookins
TX Commission on Environmental Quality
lbrookins@tceq.stste.tx.us

and

Allen Jones
TX Water Resource Institute
cajones@tamu.edu

Additionally, John provided a newspaper article from the Killeen Daily Herald that was dated Feb 11, 2003 and highlighted an article about elementary student testing water quality. The article states that a group of Clear Creek Talented and Gifted third and fifth grade students were participating in a yearlong water-monitoring project. This activity is a great example of a classroom education BMP.

REPORTED BY: Amy Truman/Joan Flowers

JDF/attachments (7)

cc: Attendees
Steve Veal
Joan Flowers
John Nett
Amy Truman

Landscape Ad Hoc Committee
City Hall, Main Conference Room
January 28, 2004

Presiding: Chairman Dick Young

Attending: Mayor Maureen Jouett
Councilmember Kathy Gilmore

Also attending were ACM/Director of Community Services Bill Doss; Director of Public Works Bruce Butscher; Director of Planning Tom Dann; Project Engineer John Nett; Director of Parks & Recreation Glenn Morrison; Assistant City Attorney Traci Briggs; Secretary Vicki Wanken

Committee Members attending were Eddie Vale, Kim Kerr, Judy Parker, Ronda McClarren, JoAnn Purser, and Randy Doyle

Also attending were members from the local land development community Colette Marshall, Jack Barnes, Gayle Bass, Glenn Fidler, Don and Sonya Farek and Mike Emmons.

Chairman Young called the meeting to order at 10:02 a.m.

1. Approval of Agenda

Ms. Kathy Gilmore moved to approve the agenda, seconded by Mr. Eddie Vale. The motion was unanimously approved.

2. Approval of Minutes

Ms. Judy Parker moved to approve the minutes, seconded by Ms. Joanne Purser. The motion was unanimously approved.

3. Agenda Items

a. Presentation for Drainage Master Plan Stakeholders Group – Steve Veal and Joshua Hollon, Carter & Burgess

Project Engineer John Nett introduced Steve Veal and Joshua Hollon from Carter and Burgess. Mr. Nett explained the purpose of a Stakeholders Group and that the City has contracted with Carter and Burgess for several storm water management services. The City has previously conducted stakeholders group meetings that focused on water quality control; this stakeholders group will discuss quantity control. The City is preparing a Drainage Master Plan Scoping Study; the study will clarify what standards have to be met and what the key priorities are, and what should be done first in the way of water quantity control in the City.

Mr. Steve Veal began the presentation by introducing the drainage master planning process and gave an update on the scoping study. He stated that some of the benefits of the Drainage Master Plan include planning for future growth and development of the city; identifying potential problem areas; looking at existing issues; prioritizing capital improvements projects; addressing administrative problems; and establishing maintenance programs. The main objective the Drainage Master Plan is that the whole drainage management concept is looked at, which helps establish the cost for improvements and helps with the city's budget planning process. The Scoping Study is a way to look at what needs to be done and when to do it. This helps to define the city's philosophies, the direction to proceed, stressors to the drainage system, and key issues to be integrated into the plan.

Mr. Joshua Hollon discussed typical drainage problems that occur such as vegetation overgrowth, debris clogging water flow, undersized culverts, structure failures, erosion, and/or inadequate grading of channels. Development upstream will affect areas downstream. He stated that the City's practice of using streets for drainage causes some problems and is an inconvenience for residents. Mr. Hollon presented slides to the stakeholders showing examples of such problems. Carter and Burgess has evaluated the Drainage Survey that was mailed in the November 2003 utility bills, the city's flood records and citizen complaints to categorize perceived problems. Maps were presented that show locations of problem drainage areas within the city. The responses from the survey are color coded on the map and will be used in the Drainage Master Plan to develop and prioritize CIP projects. The Scoping Study will allow problems in the drainage system to be identified and corrected and enable the system to work more effectively. The DMP also has to meet the expectations of regulatory entities. The DMP provides an overview of the city's drainage system and summarizes reported drainage problems. Through stakeholders input, a priority list can be generated.

Mr. Randy Doyle expressed concern on how the neighboring cities/areas would affect the drainage of the city. Mr. Young asked Project Engineer Nett if Ft Hood, in the northern area of the city, is doing anything to slow the water flow coming from Ft. Hood or if the flows originate within our city limits?

Mr. Nett stated there is some water that comes from two tributaries where we need cooperation from Ft. Hood; they are Valley Ditch and Gilmer Ditch. Water from the old Anderson Golf Course flows into the older commercial area of Killeen along Ft. Hood Street. One way to alleviate some of the problem is to increase the capacity and to direct the flow to Nolan Creek.

Ms. Gilmore voiced concern regarding the law that requires a developer negotiate a letter of acceptance from an adjoining property owner regarding the release of runoff onto an adjoining property. Because Killeen is handling Harker Heights storm water run-off in the area of the Killeen Golf Course, Ms. Gilmore inquired if there is there any way that Killen can get money from their drainage fund?

Mr. Young asked if the city is doing a better job developing in the southern part of the city than in the northern part. Mr. Nett said that developers are leaving a buffer and limiting development in the floodplain, which helps curb the flooding in that section of Killeen.

Mayor Jouett asked if the current failures of the systems would be addressed in CIP?

Mr. Nett said that one of the immediate fixes so that the problem does not happen again is to decide what needs to be done now to correct the problem either in the ordinance or the review or the design so that development or redevelopment can continue without contributing to the problem.

The stakeholders were given a period of time to vote for what they considered to be priorities when evaluating potential CIP projects. The voting matrix included factors such as cost, ease of maintenance, and length of time that the improvement will last.

Mr. Young asked if there is a list of potential problem areas? Mr. Hollon stated that the stakeholders will be voting on the factors that they feel are potential problem areas.

b. Discuss draft City of Killeen Landscaping and Land Preservation Regulations

Mr. Dann introduced the Landscaping and Land Preservation Regulations. Mr. Dann asked Chairman Young if he wanted to fully discuss the proposed regulation. Mr. Young replied that only the highlights should be covered for this meeting with greater discussion at the next Landscape Ad Hoc Committee Meeting in February. Mr. Nett, for the benefit of the visiting businesses, read and explained the purpose of the proposed ordinance. Mr. John Nett discussed the main points of the draft Landscape Ordinance. Mr. Doyle suggested that the section on penalties reinforce the seriousness of non-compliance. Ms. Briggs stated that the format regarding penalties is consistent with the remainder of the code.

Mr. Don Farek expressed that he does not agree with the city's proposed approach to limit indiscriminately clearing of land. He doesn't believe that moving dirt from one part of land to another should be considered land stripping.

Ms. Sonya Farek asked the committee to keep in mind the cost to the builder and potential homeowner. She feels that if the costs are not kept in check, then homes would become too expensive for potential homeowners.

Ms. Colette Marshall of Barnes Builders is concerned with the standard for one and two family dwellings. She doesn't feel that the developer/builder should be responsible for installing and maintaining landscaping.

Mr. Dann reminded the committee that the proposed ordinance identifies what is going to be done and how it is to be done in advance. If more than an acre of land is to be developed then that is when the Land Disturbance Application would need to be completed.

Chairman Young suggested that the committee members review the proposed landscape ordinance, write down concerns and return to the committee meeting next month prepared to present to the other members their concerns and or recommendations for the ordinance.

c. Staff/Committee Comments

Ms. Marshall inquired about state and local inspections. Mr. Nett stated that when the city becomes a permitted MS4 city, the state will give the responsibility of enforcing storm water discharge permit compliance to the city. Ms. Farek asked if the proposed ordinance was a rewrite of existing ordinances or something new? Mr. Young replied that the majority of the proposed ordinance does not exist anywhere else in the city's ordinances and are required by changes in TCEQ's requirements for drainage. Mr. Vale asked if the next meeting could be moved to the third Wednesday in February? Mr. Young said that February 18, 2004, would be considered and the committee will be notified of the next meeting date.

4. Adjournment

Chairman Young adjourned the meeting at 11:45 p.m. The next meeting is tentatively scheduled for February 25, 2004.

____
Dick Young, Committee Chairperson

____
Vicki Wanken, Project Secretary