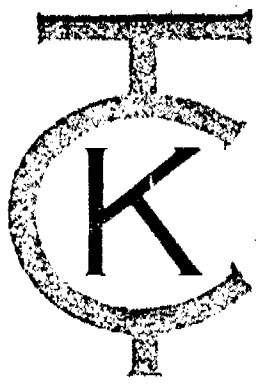
CITY OF KERRVILLE, TEXAS

STORM DRAINAGE SYSTEM STUDY



APRIL 1983

HOGAN & RASOR, Inc.

Engineers • Planners • Consultants

Suite 800
13355 Noel Road

One Galleria Tower
Dallas, Texas 75240

HOGAN & RASOR, Inc.

Engineers • Planners • Consultants

April 12, 1983

Honorable Mayor and City Council
City of Kerrville
600 Main Street
Kerrville, Texas 78028

Re: Storm Drainage System Study

Gentlemen:

We are very pleased to submit herewith our final report on the Storm Drainage System Study, for the City of Kerrville, which was prepared in accordance with the scope of services outlined in our Engineering Agreement, dated January 12, 1982.

The results of this planning work and the recommendations are presented on the following pages for your consideration and implementation.

It has been a pleasure to perform this study for you, and we look forward to assisting you with the development of the proposed projects.

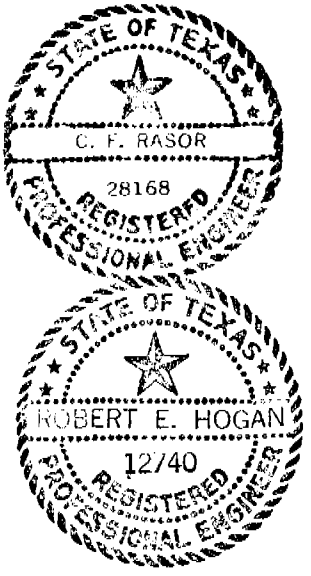
Respectfully submitted,

HOGAN & RASOR, INC.

By Eduardo H. Peña
Eduardo H. Peña
Project Planner

By C. F. Rasor, P.E.
C. F. Rasor, P.E.
Executive Vice President

By Robert E. Hogan, P.E.
Robert E. Hogan, P.E.
President



Suite 800
13355 Noel Road

214/392-4600

One Galleria Tower
Dallas, Texas 75240

CITY OF KERRVILLE, TEXAS

STORM DRAINAGE SYSTEM STUDY

APRIL 1983

HOGAN & RASOR, INC.

Engineers . Planners . Consultants

Suite 800
13355 Noel Road

One Galleria Tower
Dallas, Texas 75240

CITY OFFICIALS

MAYOR

Thomas W. Pollard

COUNCILMEN

W. G. Stacy, III
Jack Brough
Maurice McAshan
Jack Furman

CITY MANAGER

J. Louis Odle

CLERK

Sheila L. Brand

DIRECTOR OF ENGINEERING

Frank Hicklen

DIRECTOR OF PUBLIC WORKS

Calvin Neely

CITY OFFICIALS

MAYOR

Thomas W. Pollard

COUNCILMEN

W. G. Stacy, III
Jack Brough
Maurice McAshan
Jack Furman

CITY MANAGER

J. Louis Odle

CLERK

Sheila L. Brand

DIRECTOR OF ENGINEERING

Frank Hicklen

DIRECTOR OF PUBLIC WORKS

Calvin Neely

TABLE OF CONTENTS

LIST OF PLATES

STORM DRAINAGE SYSTEM STUDY
CITY OF KERRVILLE, TEXAS

PART I - INTRODUCTION

A. Authorization of Report

On January 12, 1982, the City of Kerrville, Texas, authorized a study of the storm drainage system needs within the area of the present City Limits and the surrounding area of extraterritorial jurisdiction (ETJ). This planning area consists of approximately 29,000 acres and contains a total overall drainage area of 43,000 acres which ultimately discharge storm water flows into the Guadalupe River from Goat Creek, Town Creek, Quinlan Creek, Camp Meeting Creek, and Third Creek.

The planning and drainage area map, noted as PLATE 1, is included on the following page and indicates the approximate limits of the study area.

B. Purpose and Scope of Study

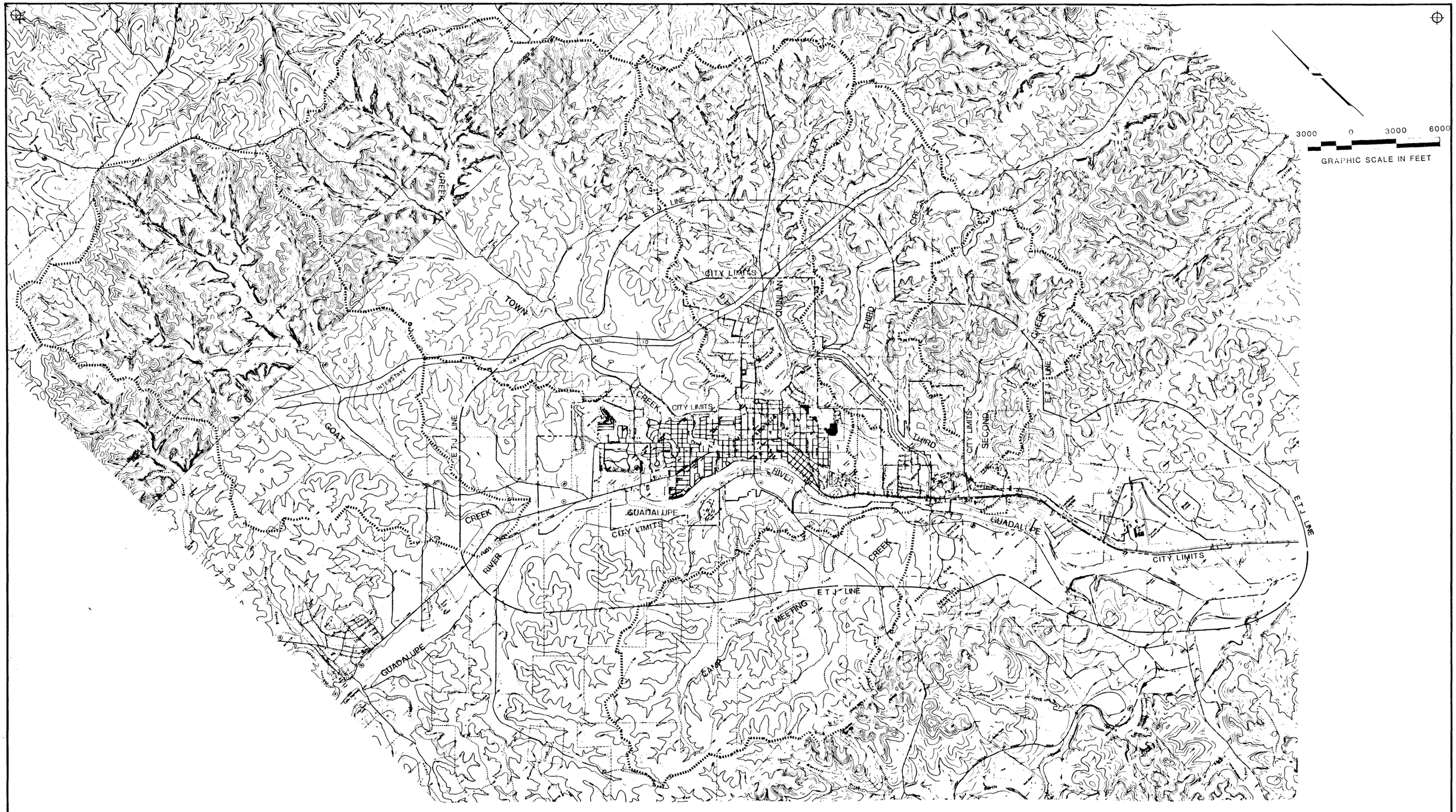
The purpose of this study is to investigate and analyze the existing drainage facilities, and, based on the planning and design criteria adopted by the City, a master development plan is to be developed for a storm drainage system which would provide adequate capacity to handle the storm water run-off within the existing and anticipated growth areas of Kerrville.

The general scope of work for this study is to include:

1. A review of all available drainage, zoning, and land-use information furnished by the City from previous reports, studies, system layouts, or other data pertinent to the system planning.

2. Field surveys, performed by City personnel, to obtain elevations at street intersections, low points, and flow lines of existing drainage structures.

3. Windshield observations during rainstorms, performed by City personnel, to determine paths of storm water flow in gutters, around corners, across properties, etc.



CITY OF KERRVILLE, TEXAS

OVERALL DRAINAGE AREA MAP

HOGAN & RASOR, Inc.
Engineers • Planners • Consultants
Dallas, Texas

4. Measurements, performed by City personnel, of sizes of existing drainage structures, such as pipes, culverts, channels, etc.

5. A review of the City's current planning and design criteria for drainage facilities and recommendations presented for revisions and/or additions.

6. A planning and design criteria storm drainage manual prepared as a separate document to include:

   a. Recommended formulas for calculation of run-off;

   b. Recommended formulas for determination of sizes of drainage facilities to accommodate the calculated run-off;

   c. Explanation of formulas, and suggested limited numbers and coefficients to be used in each formula component;

   d. Standard forms for calculating run-off and sizes of drainage facilities;

   e. Examples for using the standard forms;

   f. Charts for use in determining street and inlet capacities and pipe sizes, velocities, slopes, capacities, etc.; and,

   g. Standard details for construction of inlets, headwalls, earth and concrete-lined channels, pipe lines, and other related appurtenances.

7. A map prepared at a convenient scale to show the existing facilities within the planning area and the boundaries of the drainage areas and acreages for each.

8. An analysis of the storm drainage area, which is to be divided into four major drainage areas, and, within each major drainage area, subdrainage areas are to be determined for the analysis of only the currently developed area of the City. The major drainage areas considered in this study all discharge into the Guadalupe River and are as follows:

Drainage Area
Town Creek
Quinlan Creek
Camp Meeting Creek
Third Creek

9. An analysis of the topography of the planning area and the areas subject to flooding to determine the adequacy of the existing system to meet the current and forecasted needs.

10. A general plan and layout for the proposed improvements to the drainage system prepared to eliminate deficiencies in the existing system.

11. The existing facilities and the proposed storm drainage and flood protection plan prepared on a topographic map at a convenient scale approved by the City.

12. A recommended plan of implementation, with cost estimates, prepared for the proposed improvements, with priorities assigned to each phase of the improvement program.

PART II - PLANNING AND DESIGN CRITERIA

A. General

The planning and design criteria storm drainage manual was prepared as a separate document for the specific purpose of providing a set of guidelines for planning and designing storm drainage facilities within the jurisdictional limits of the City of Kerrville, Texas. In addition, the planning and design criteria was used to determine the adequacy of the existing storm drainage facilities and to develop a master plan for a storm drainage system. It is recommended that the City adopt this storm drainage manual whereby it will be utilized by the City, consulting engineers employed by the City, and other engineers employed for private developments in the City.

B. Procedures for the System Analysis and Planning

1. Selection of Storm Sewer Pipe Sizes

The proposed diameters for the pipes in the storm sewerage systems were established through the use of the McDonnell Douglas Automation Company (MCAUTO) computer program SEWER. As a subsystem of MCAUTO'S Integrated Civil Engineering System (ICES), the SEWER program provides the ability to design and analyze storm drainage systems.

The parameters used in this process of determining the pipe sizes included the contributing drainage area, the intensity for each time of concentration, the beginning time of concentration, the run-off coefficient, the surface elevation of the ground at each end of the pipe, the length of pipe, and the friction factors for the pipe. All pipes were designed as flowing full, where possible.

The pipe sizes indicated on the master plan of the storm drainage systems should be considered as preliminary and for planning purposes only. The general information and field data furnished for this study will provide a good reliable basis for beginning the more detailed design and preparation of the plans and specifications. During the design phase, certainly, a more detailed investigation of the particular area of service will need to be made to identify any special or unique conditions, exact elevations along the proposed alignment, and other factors that would have some effect on selecting an adequate size for the proposed pipes.

2. Water Surface Profiles (100-Year Flood Plain Boundaries)

The water surface profiles for Third Creek, Goat Creek, and Camp Meeting Creek were established by the use of the HEC-2 (Water Surface Profiles) computer program of the U. S. Army Corps of Engineers. This computer program was the same used previously for the City of Kerrville and Kerr County for their flood insurance study performed by the Federal Emergency Management Agency (FEMA). The water surface profiles were obtained from FEMA and used in the system planning for the Quinlan Creek and Town Creek areas. The results of the additional profile studies in the other watersheds would then be consistent throughout this study.

PART III - EXISTING STORM DRAINAGE SYSTEM

A. Facility Survey and Inventory

Within the boundaries previously defined as the study area, a review was made of all the existing drainage facilities. It was found that the storm drainage systems of the City consisted primarily of corrugated metal pipe, reinforced concrete pipe, and several reinforced concrete box culverts installed at street intersections, driveways, creeks, or ditches. There were several enclosed storm sewer systems found which provided some capacity for carrying a portion of the storm water run-off.

Most of the existing drainage culverts were constructed of circular pipe in sizes ranging from 12 inches through 120 inches in diameter, with some interim diameters constructed with oval or arch-shaped pipe. The reinforced concrete box culverts constructed ranged in size from 3' x 2' through 12' x 12'.

A brief description of each of the existing enclosed storm drainage systems is as follows:

1. Jefferson Street

This System is located along West Jefferson Street from Circle Avenue east to Lewis Street and along West Main Street from Cox Street west to Lewis Street. The system continues northward along Lewis Street to Jefferson Street and then to Town Creek to its discharge point. This existing storm sewer system consists of circular pipe in sizes ranging from 15 inches through 48 inches in diameter which provide some capacity for drainage of the storm water into Town Creek.

2. Lewis Street - Junction Highway

This storm sewer begins at Lois Street and continues northward along Lewis Street to the Junction Highway. The system then turns southward along the Junction Highway to its discharge point into Town Creek. This existing storm sewer system consists of circular pipe in sizes ranging from 24 inches through 60 inches in diameter and provides some capacity for the drainage of the storm water into Town Creek.

3. Harper Road - Guadalupe Street

This system begins on Harper Road at approximately 150 feet south of Lois Street and continues southward along Harper Road and Guadalupe Street to its discharge point into the Guadalupe River. This existing storm sewer system consists of two 60-inch diameter corrugated galvanized metal pipes which provide sufficient capacity for the drainage into the Guadalupe River.

4. McFarland Street - North Street

This existing storm sewer system runs eastward along McFarland Street from Hays Street to Clay Street and continues southward along Clay Street to North Street, then eastward along North Street to the abandoned railroad right-of-way of the Southern Pacific Railroad. The system then turns in a southerly direction and discharges the storm water flows into Quinlan Creek. This existing storm sewer system consists of a combination of storm sewer structures and open channels beginning with 27" x 43" and 31" x 50" corrugated galvanized metal pipes arches, single 4' x 3' through 7' x 4' reinforced concrete box culverts, double 6' x 3' and 5' x 5' reinforced concrete box culverts, and reinforced concrete-lined channels and earth channels. This existing system intercepts some of the storm water run-off from the north which would normally reach the Downtown area and does provide some capacity for the drainage into Quinlan Creek.

5. Other Systems

There exist several minor enclosed storm sewer systems that discharge into the Guadalupe River which are located along Clay, Sidney Baker, Earl Garrett and Washington Streets. These existing storm sewer systems consist of circular pipe in sizes ranging from 12 inches through 36 inches in diameter, with the system located along Washington Street consisting of a 2'-6" x 3'-0" reinforced concrete box culvert. These existing storm sewer systems provide a very limited capacity for the drainage that is discharged into the Guadalupe River.

The storm water drainage within the remaining limits of the study area is carried along the existing rights-of-way of City streets, natural drainage courses, and constructed open ditches and earth channels.

Photographs of several of the existing drainage facilities are shown on PLATES 2, 3, 4, 5, 6, and 7 following this page.

B. Capacity

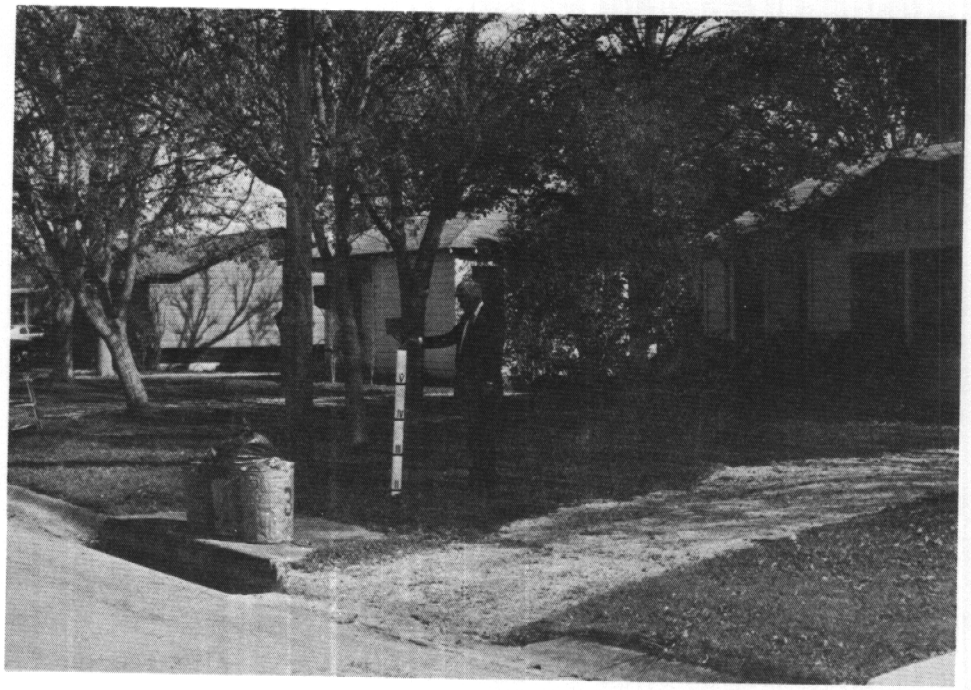
The analysis of the existing storm sewer facilities revealed that most were not of adequate size nor at such elevations where they could be made a part of the planning of the proposed drainage systems; however, in such instances where the analysis of the existing facilities did indicate that they can be incorporated in the planning for the future drainage system, the recommendations presented herein do reflect the consideration of using those facilities to the fullest extent possible.

PLATES 8 through 22, following the photographs of the existing facilities, are topographic maps prepared to show the locations of the existing drainage pipes and structures relative to the City's street layout.

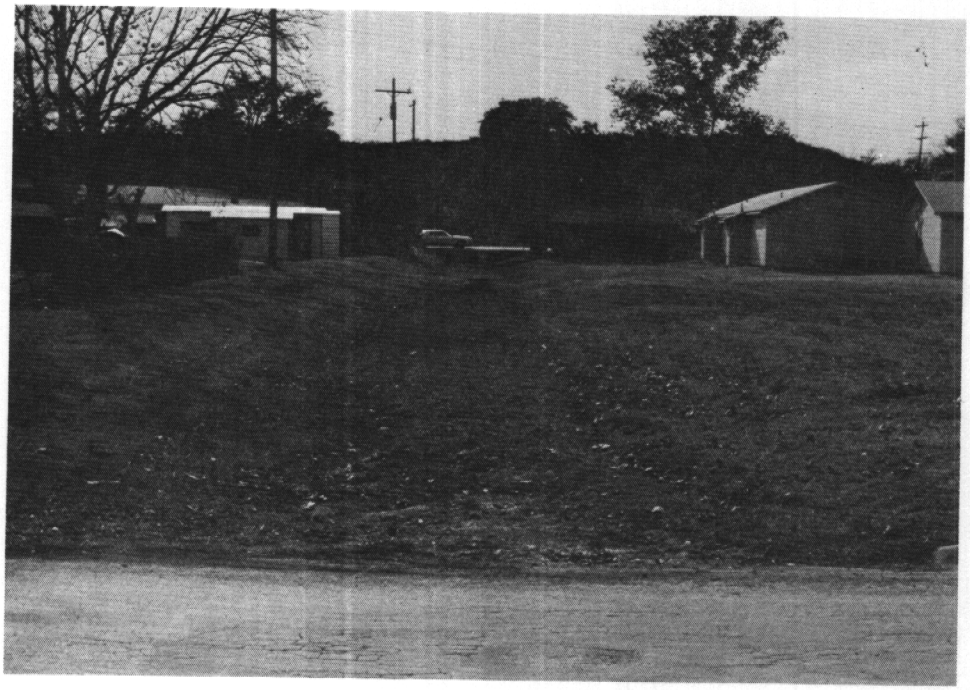
PART IV - STORM DRAINAGE SYSTEM ANALYSIS

A. General

The study, analysis, and planning for the proposed system presented herein is predicated on drainage criteria which will provide the existing and future developments within the study area a reasonable amount of protection from property damage due to flooding. In fully developed areas, storm frequencies of 5 or

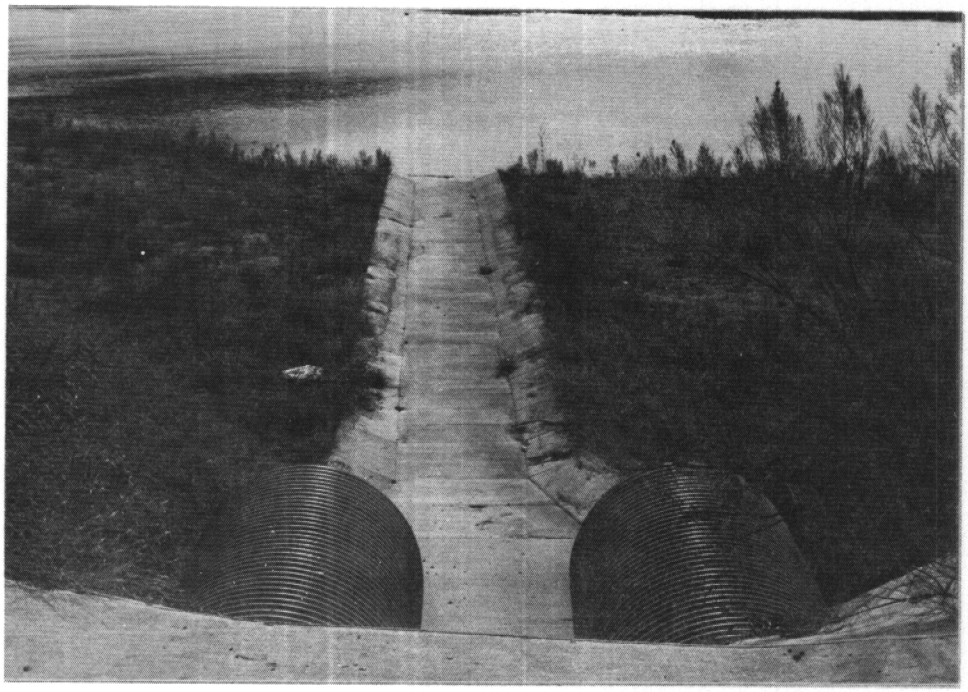


LEWIS STREET and LOIS STREET
INTERSECTION



EARTHEN CHANNEL
From Lois Street to State Highway 27

PLATE NO. 2

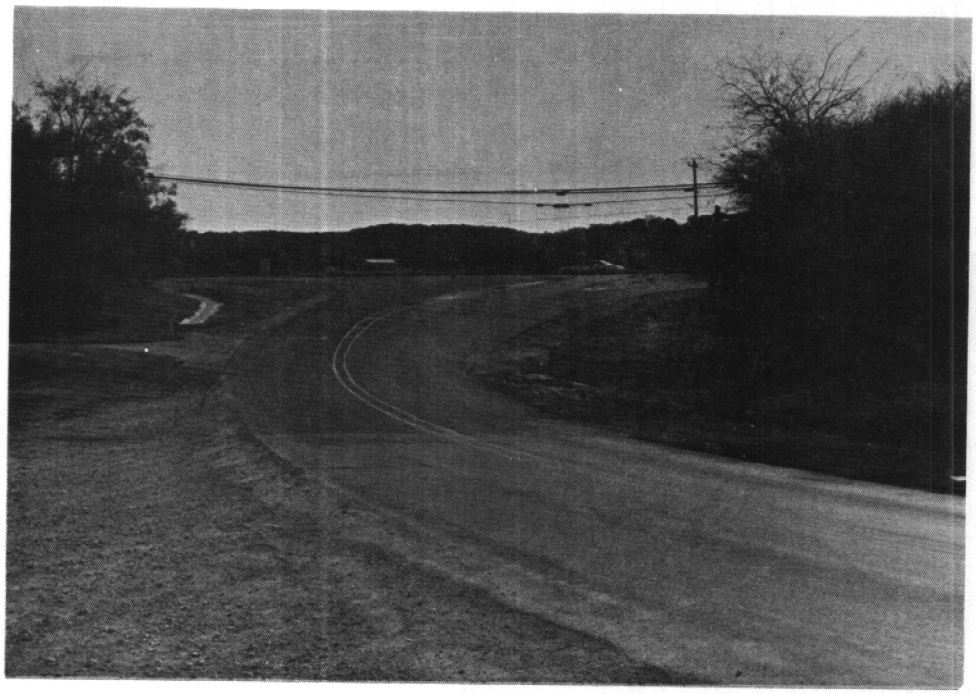


DISCHARGE STRUCTURE at HARPER STREET

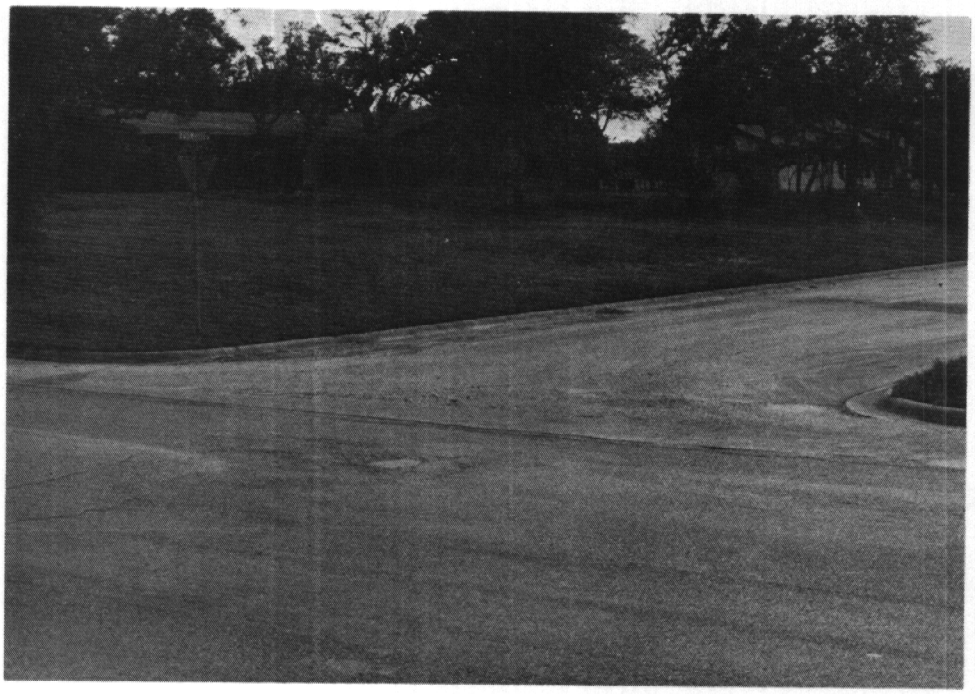
EARTHEN CHANNEL

South of State Highway 27 and East of Travel Park

PLATE NO. 3



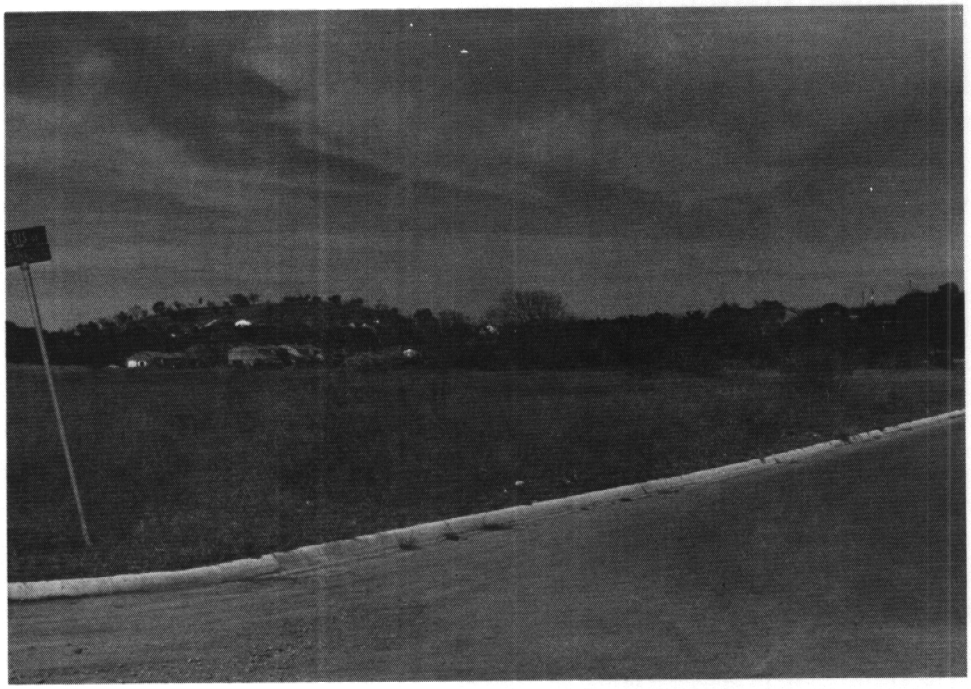
GOAT CREEK ROAD
North of State Highway 27



BOB WHITE DRIVE and JACKSON ROAD
INTERSECTION

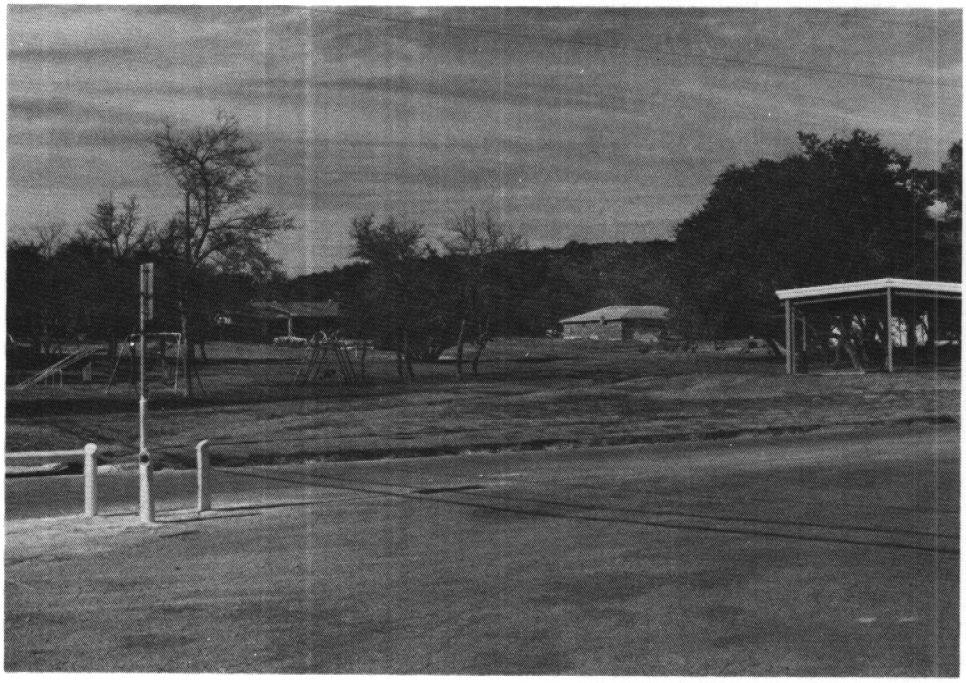
PLATE NO. 4

LOIS STREET and CRESTWOOD STREET
INTERSECTION

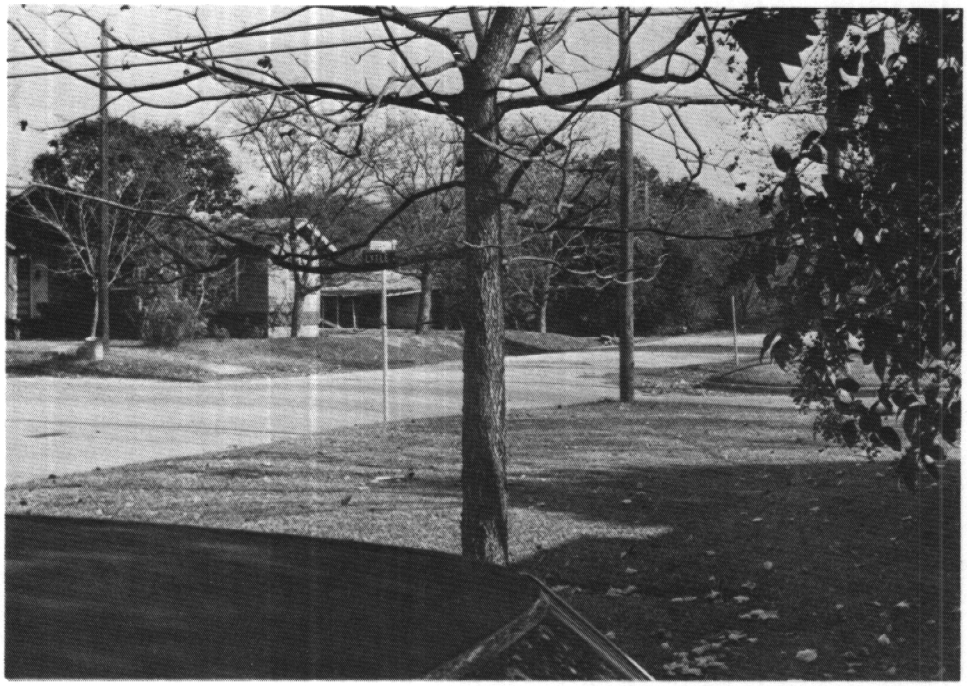


LOIS STREET and CORONADO DRIVE
INTERSECTION

PLATE NO. 5

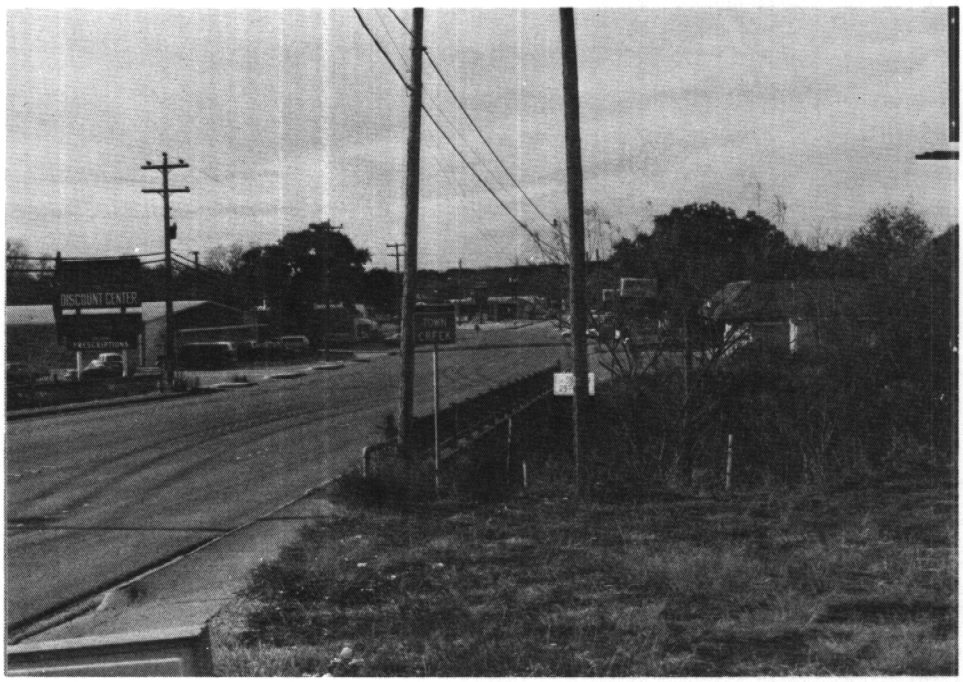


EAST LANE and GLENN STREET
INTERSECTION

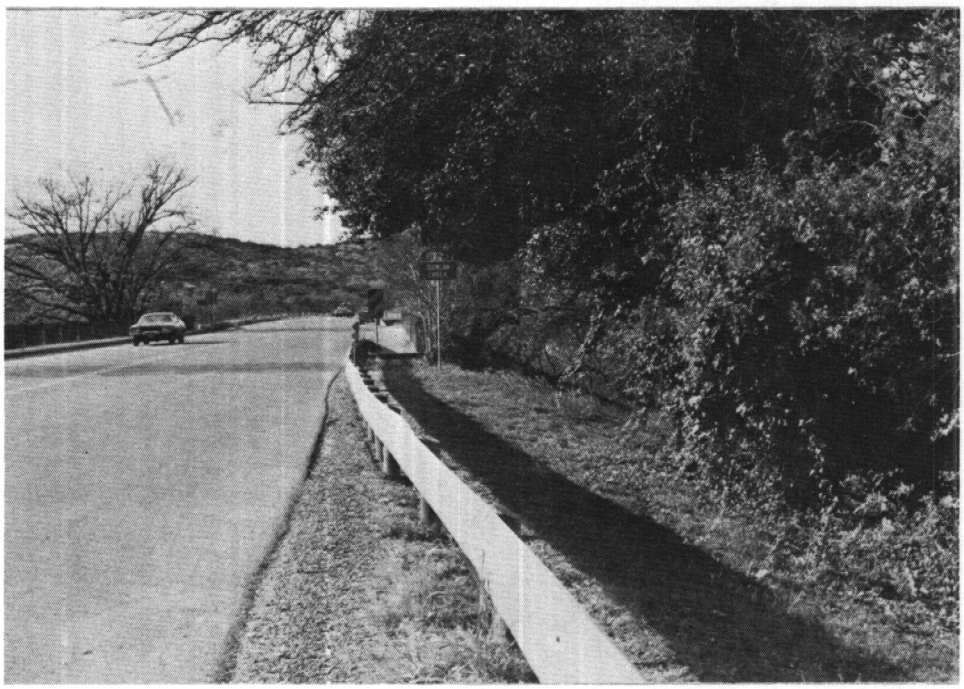


JEFFERSON STREET and LYTLE STREET
INTERSECTION

PLATE NO. 6

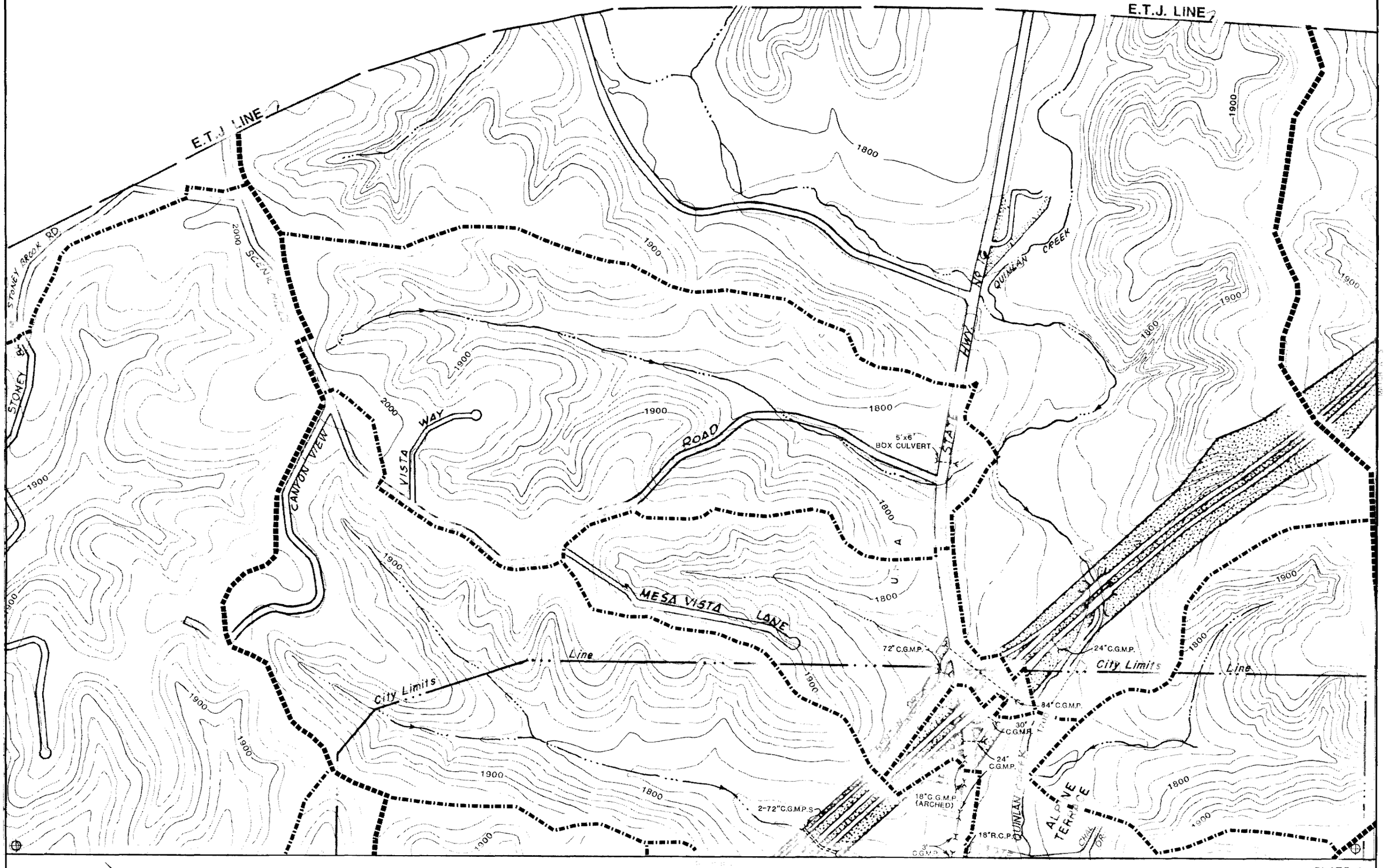


TOWN CREEK
Under State Highway 27



QUINLAN CREEK
Under State Highway 27

PLATE NO. 7



400 200 0 400 800

GRAPHIC SCALE IN FEET

LEGEND

- CONCRETE CHANNEL
- EARTH CHANNEL
- CURB INLET
- 18" EXIST. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE

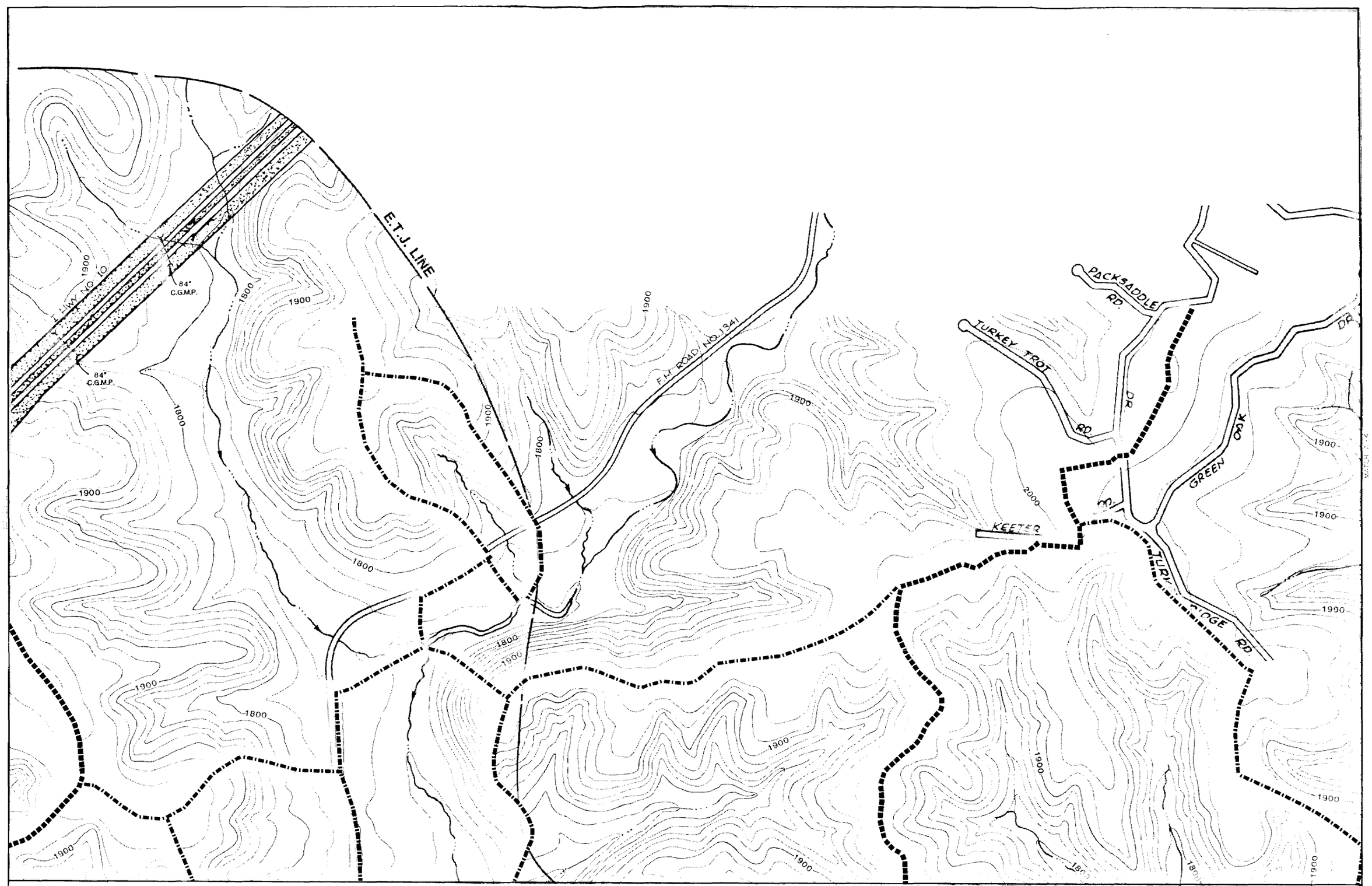
PLATE 8

A-2

CITY OF KERRVILLE, TEXAS

EXISTING
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers • Planners • Consultants
Austin/Dallas, Texas



400 200 0 400 800

GRAPHIC SCALE IN FEET

LEGEND

- CONCRETE CHANNEL
- EARTH CHANNEL
- CURB INLET
- 18" EXIST. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE

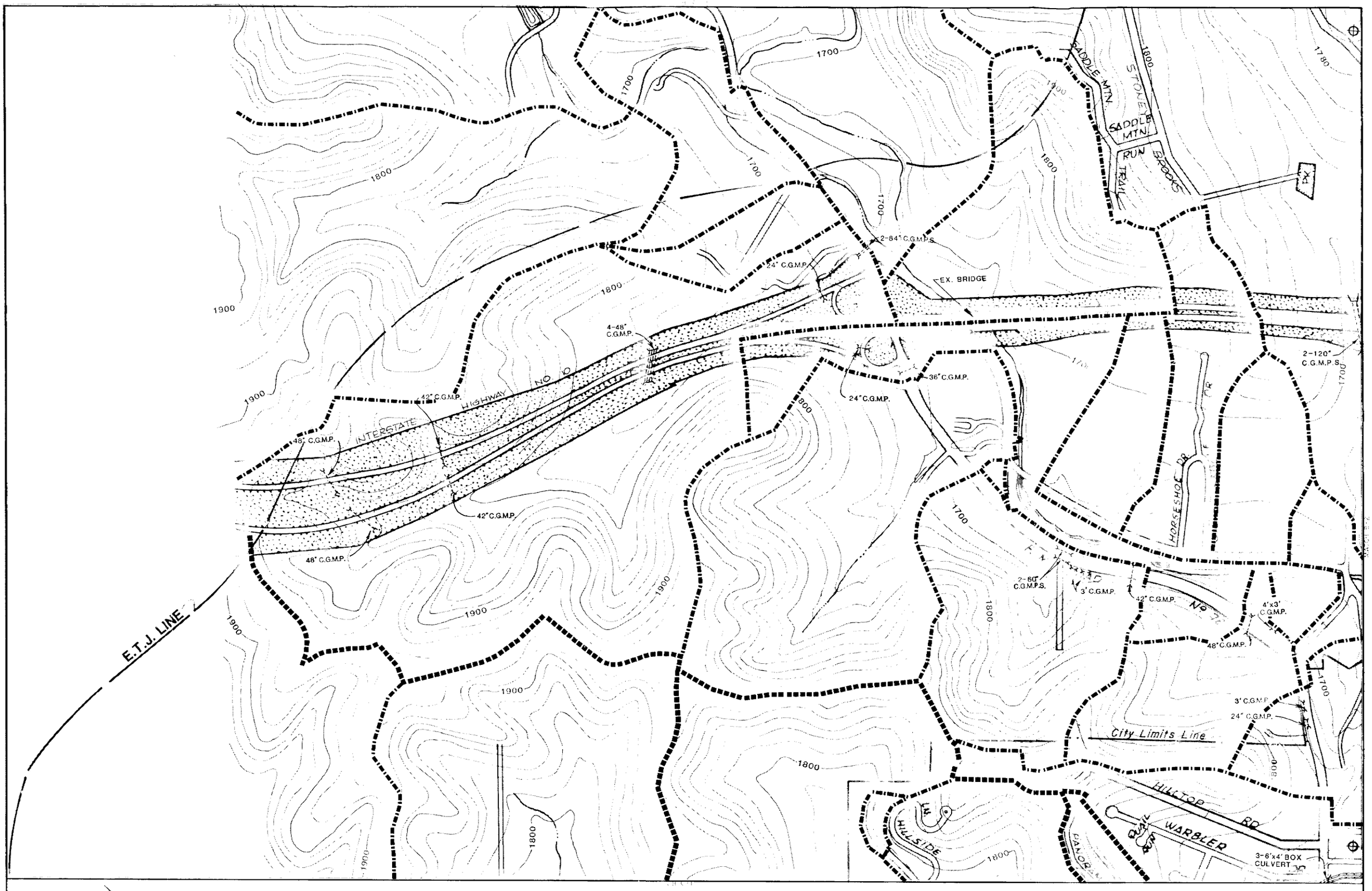
PLATE 9

A-3

CITY OF KERRVILLE, TEXAS

EXISTING
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers • Planners • Consultants
Austin/Dallas, Texas



LEGEND

- CONCRETE CHANNEL
- EARTH CHANNEL
- CURB INLET
- 18" EXIST. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE

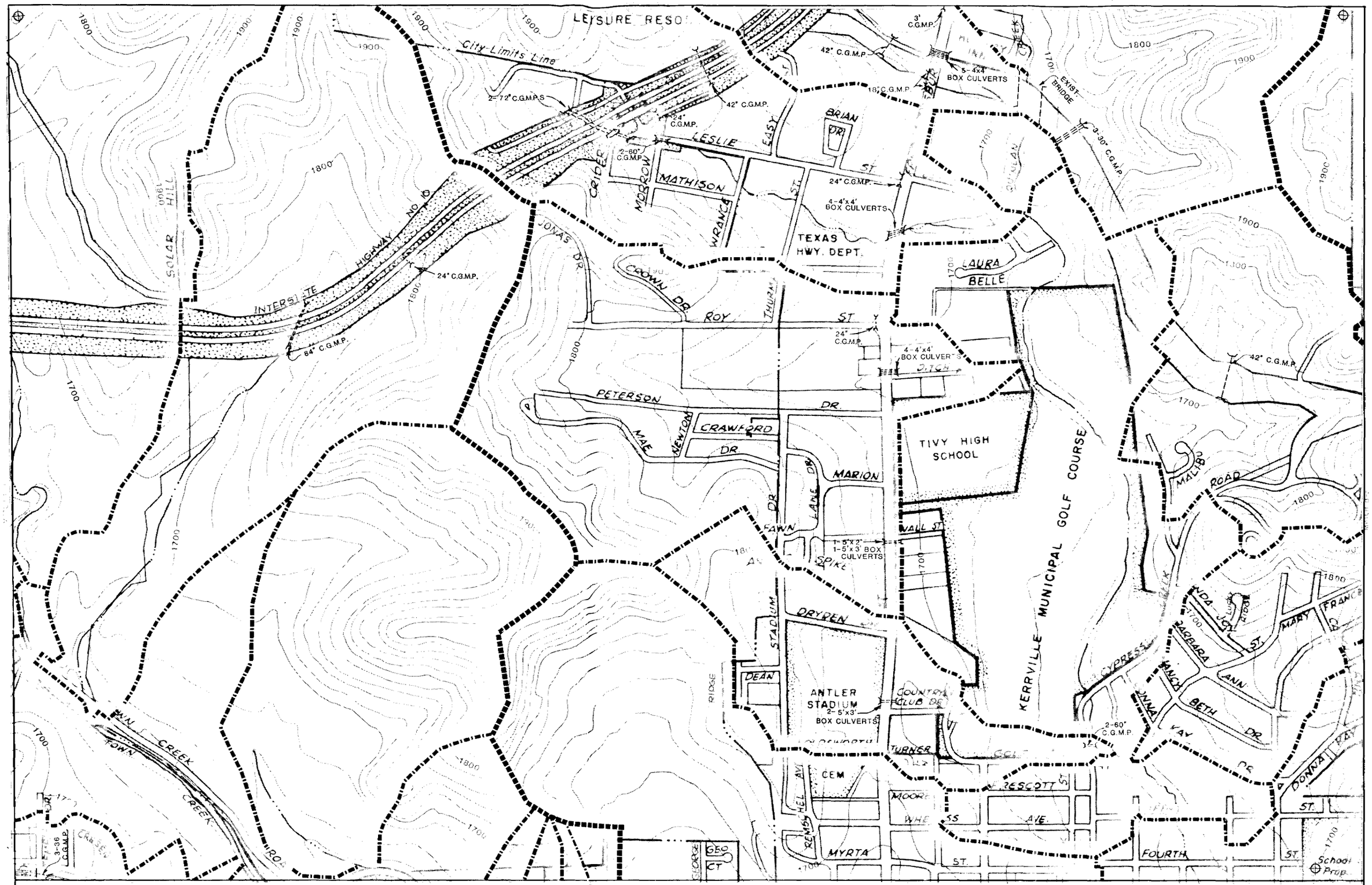
PLATE 10

B-1

CITY OF KERRVILLE, TEXAS

EXISTING
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers • Planners • Consultants
Austin/Dallas, Texas



LEGEND

- CONCRETE CHANNEL
- EARTH CHANNEL
- CURB INLET
- 18" EXIST. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE

PLATE II

B-2

CITY OF KERRVILLE, TEXAS

EXISTING
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers • Planners • Consultants
Austin/Dallas, Texas

E.T.J. LINE

F.M. ROAD No. 534

30" C.G.M.P.

72" C.G.M.P.

54" C.G.M.P.

City Limits Line

LOOP No. 534

84" C.G.M.P.

City Limits Line

MIDVALE TRAIL

DANIELLE LA

BLUE MOON

400 200 0 400 800

GRAPHIC SCALE IN FEET

LEGEND

- CONCRETE CHANNEL
- EARTH CHANNEL
- CURB INLET
- 18" EXIST. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE

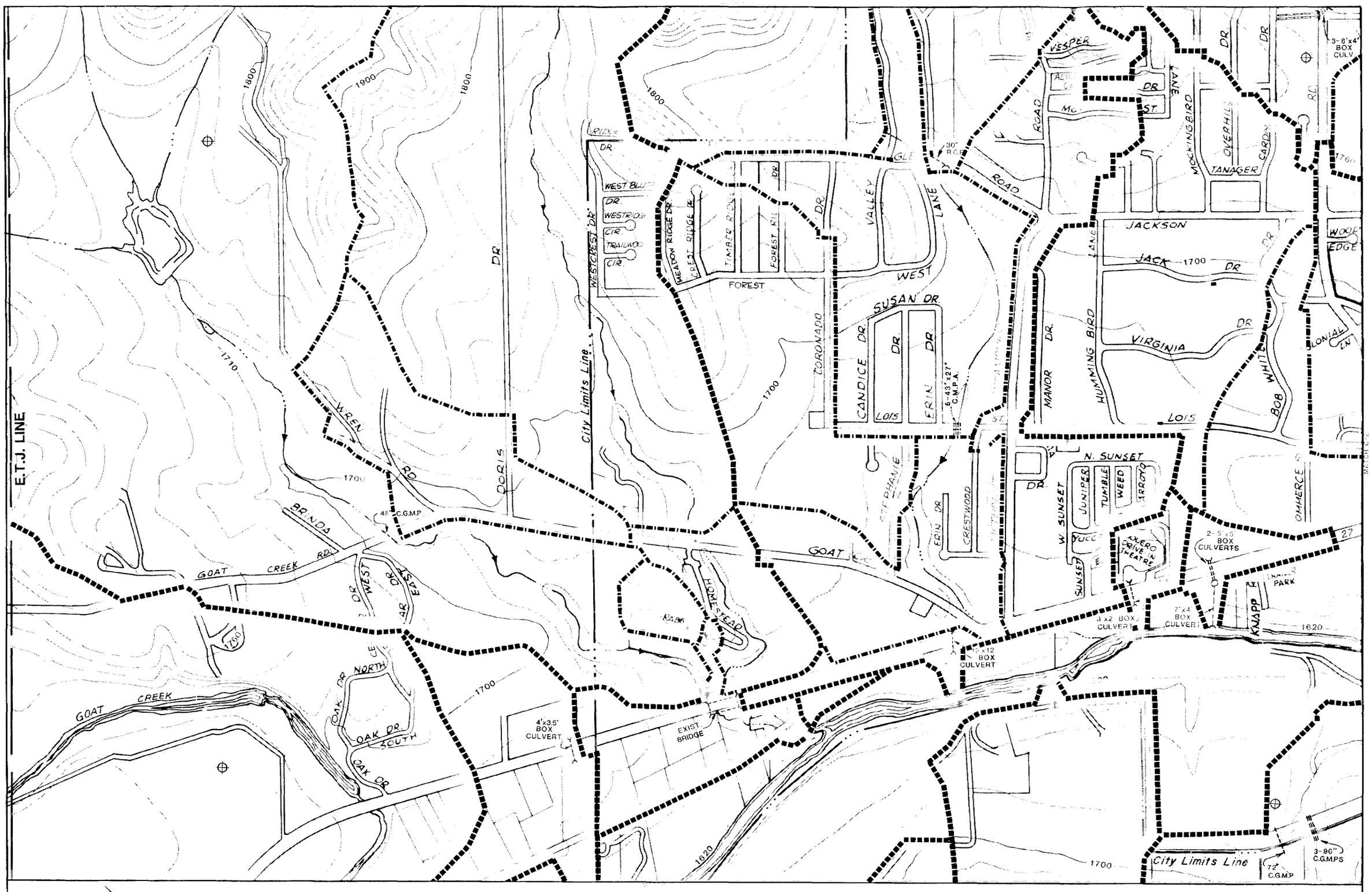
PLATE 12

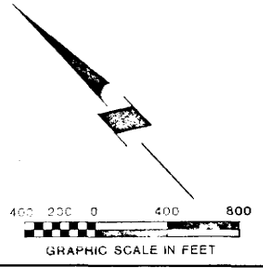
B-3

CITY OF KERRVILLE, TEXAS

EXISTING
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers • Planners • Consultants
Austin/Dallas, Texas





LEGEND

- CONCRETE CHANNEL
- EARTH CHANNEL
- CURB INLET
- 18" EX. ST. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE

PLATE 13

C-1

CITY OF KERRVILLE, TEXAS

EXISTING
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers • Planners • Consultants
Austin/Dallas, Texas

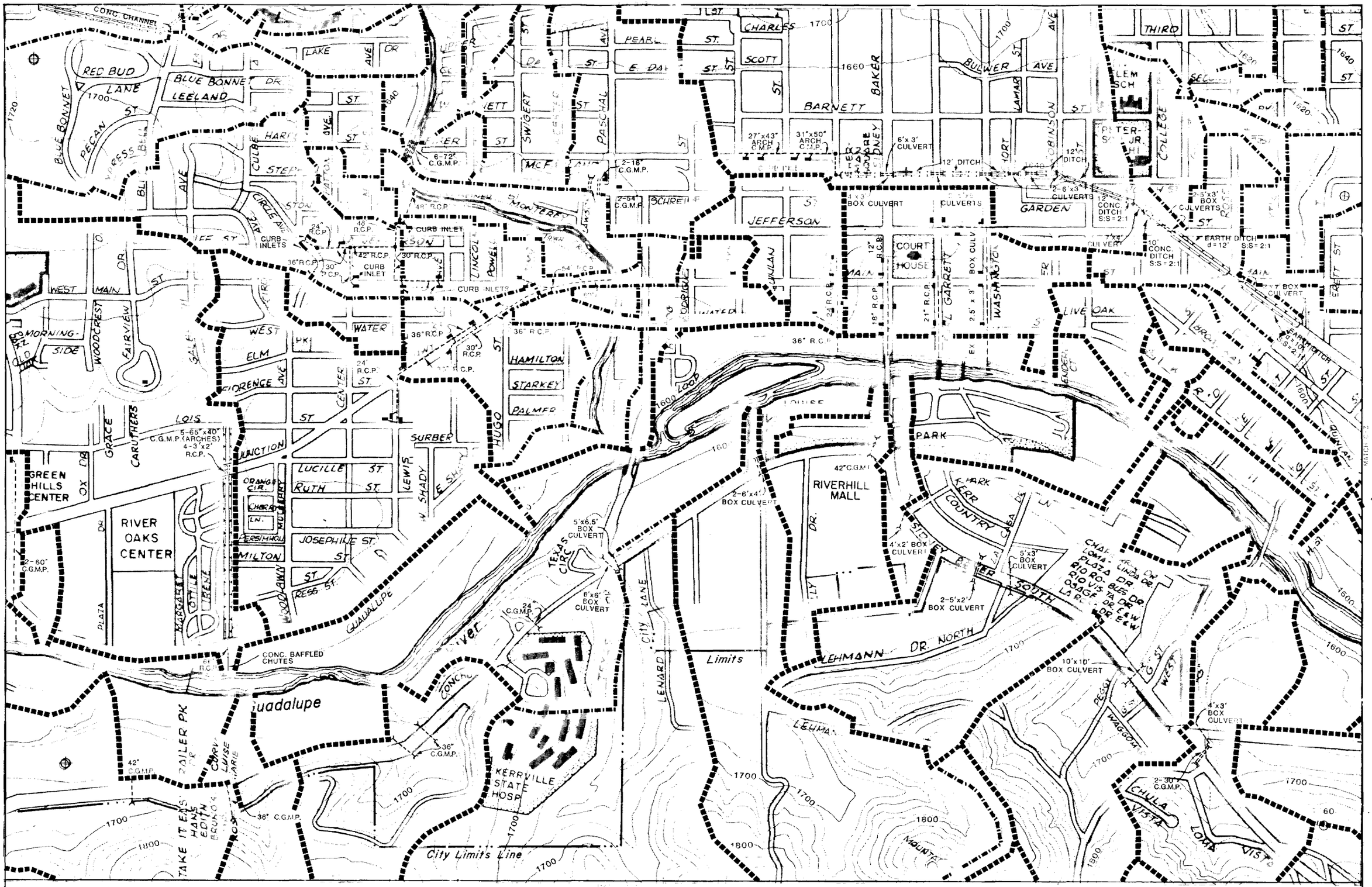


PLATE 14

C-2

CITY OF KERRVILLE, TEXAS

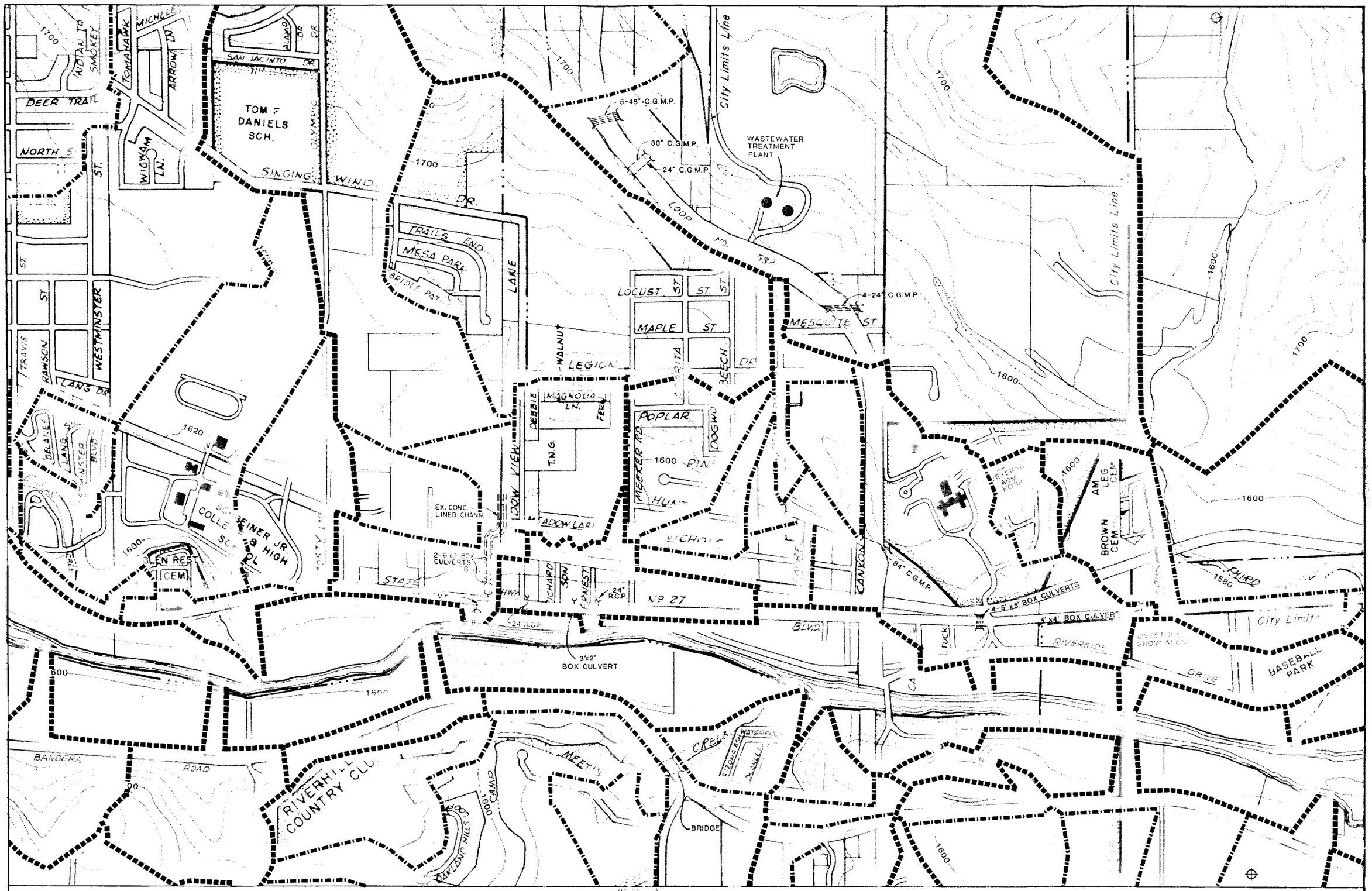
EXISTING
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers · Planners · Consultants
Austin / Dallas, Texas

LEGEND

- CONCRETE CHANNEL
- EARTH CHANNEL
- CURB INLET
- 18" EXIST. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE

400 200 0 400 800
GRAPHIC SCALE IN FEET



400 200 0 400 800

GRAPHIC SCALE IN FEET

LEGEND

- CONCRETE CHANNEL
- EARTH CHANNEL
- CURB INLET
- 18" EXIST. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE

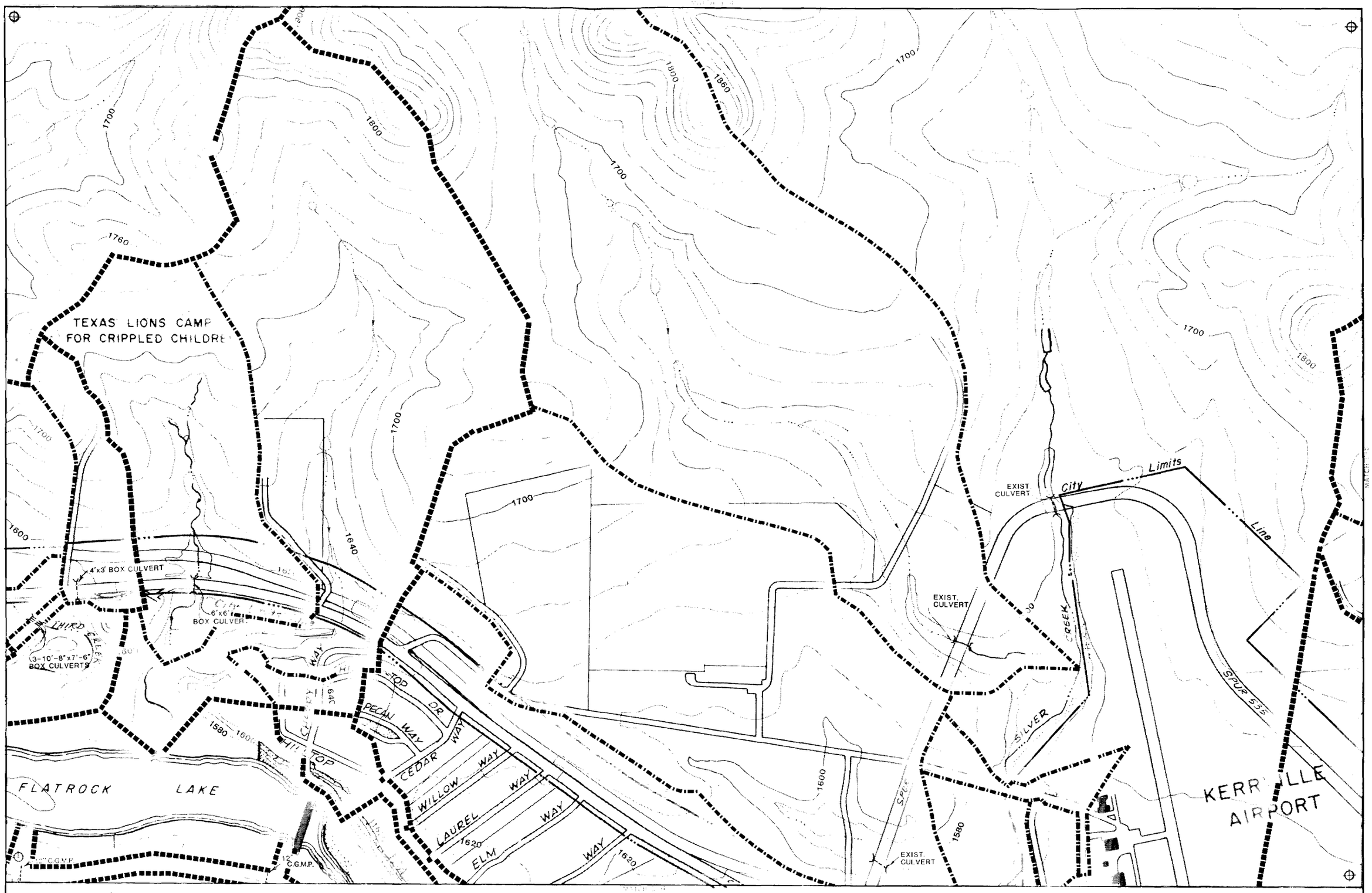
PLATE 15

C-3

CITY OF KERRVILLE, TEXAS

EXISTING
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers • Planners • Consultants
Austin/Dallas, Texas



400 200 0 400 800

GRAPHIC SCALE IN FEET

LEGEND

- CONCRETE CHANNEL
- EARTH CHANNEL
- CURB INLET
- 18" EXIST. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE

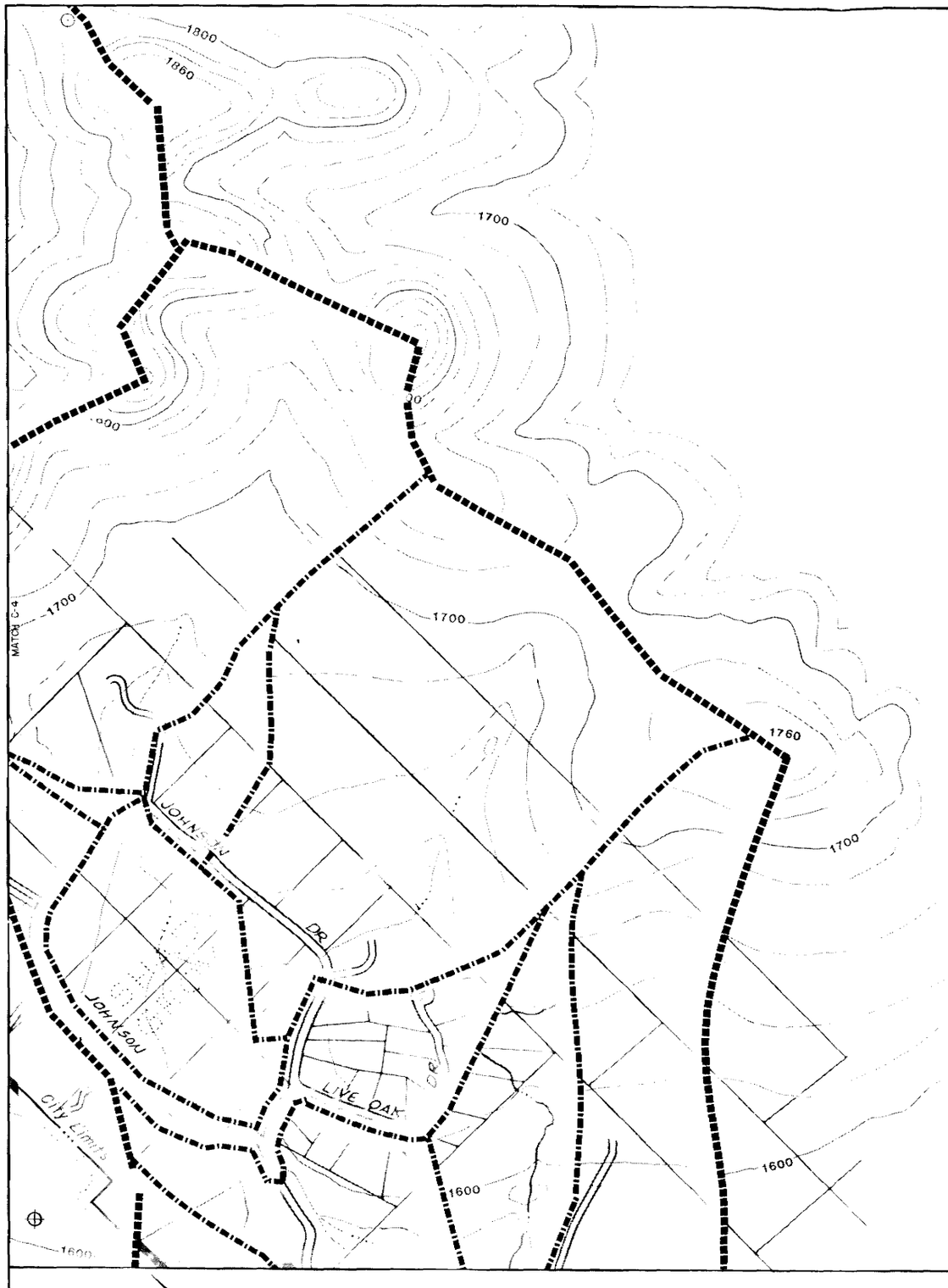
PLATE 16

C-4

CITY OF KERRVILLE, TEXAS

EXISTING
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers • Planners • Consultants
Austin/Dallas, Texas



400 200 0 400 800

GRAPHIC SCALE IN FEET

LEGEND

- CONCRETE CHANNEL
- EARTH CHANNEL
- CURB INLET
- 18" EXIST. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE

PLATE 17

C-5

CITY OF KERPVILLE, TEXAS

EXISTING
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers • Planners • Consultants
Austin/Dallas, Texas

400 200 0 400 800

GRAPHIC SCALE IN FEET

LEGEND

- CONCRETE CHANNEL
- EARTH CHANNEL
- CURB INLET
- 18" EXIST. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE

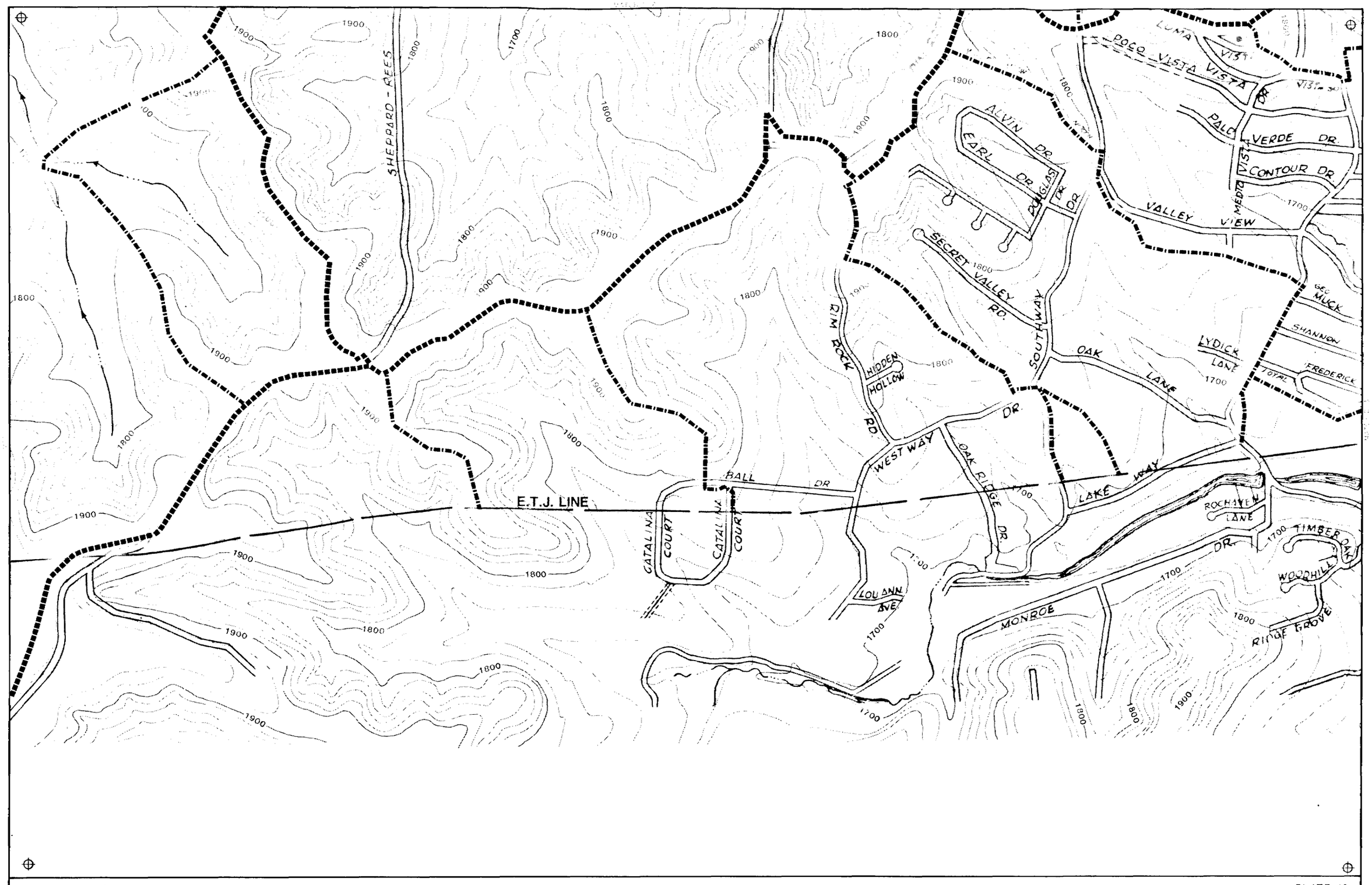
PLATE 18

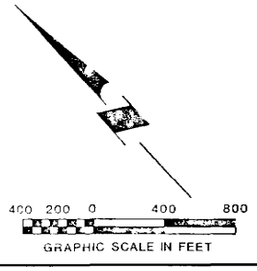
D-1

CITY OF KERRVILLE, TEXAS

EXISTING
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers · Planners · Consultants
Austin/Dallas, Texas





LEGEND

- CONCRETE CHANNEL
- EARTH CHANNEL
- CURB INLET
- 18" EXIST. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE

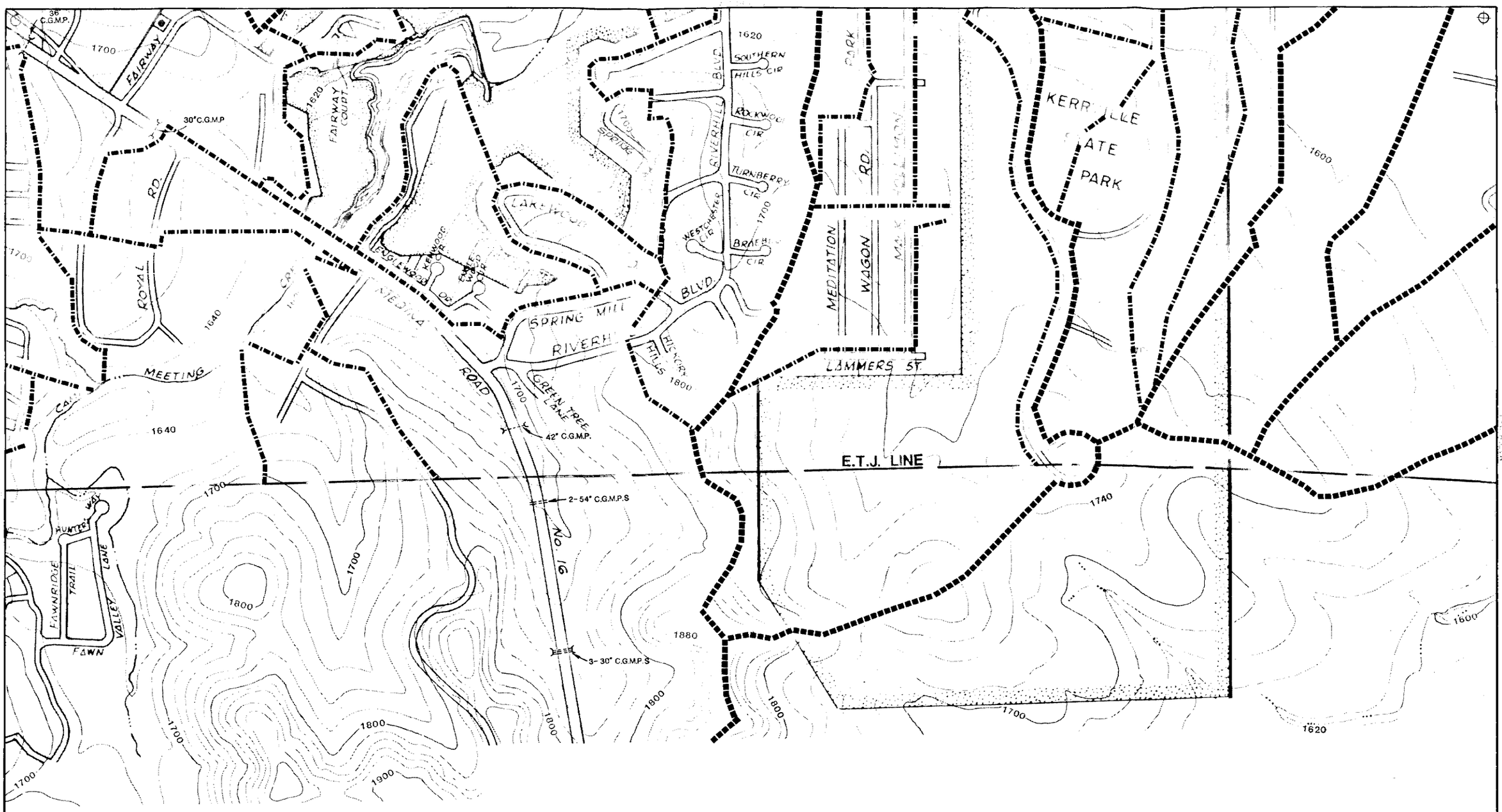
PLATE 19

D-2

CITY OF KERRVILLE, TEXAS

EXISTING
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers • Planners • Consultants
Austin/Dallas, Texas



400 200 0 400 800

GRAPHIC SCALE IN FEET

LEGEND

- CONCRETE CHANNEL
- EARTH CHANNEL
- CURB INLET
- 18" EXIST. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE

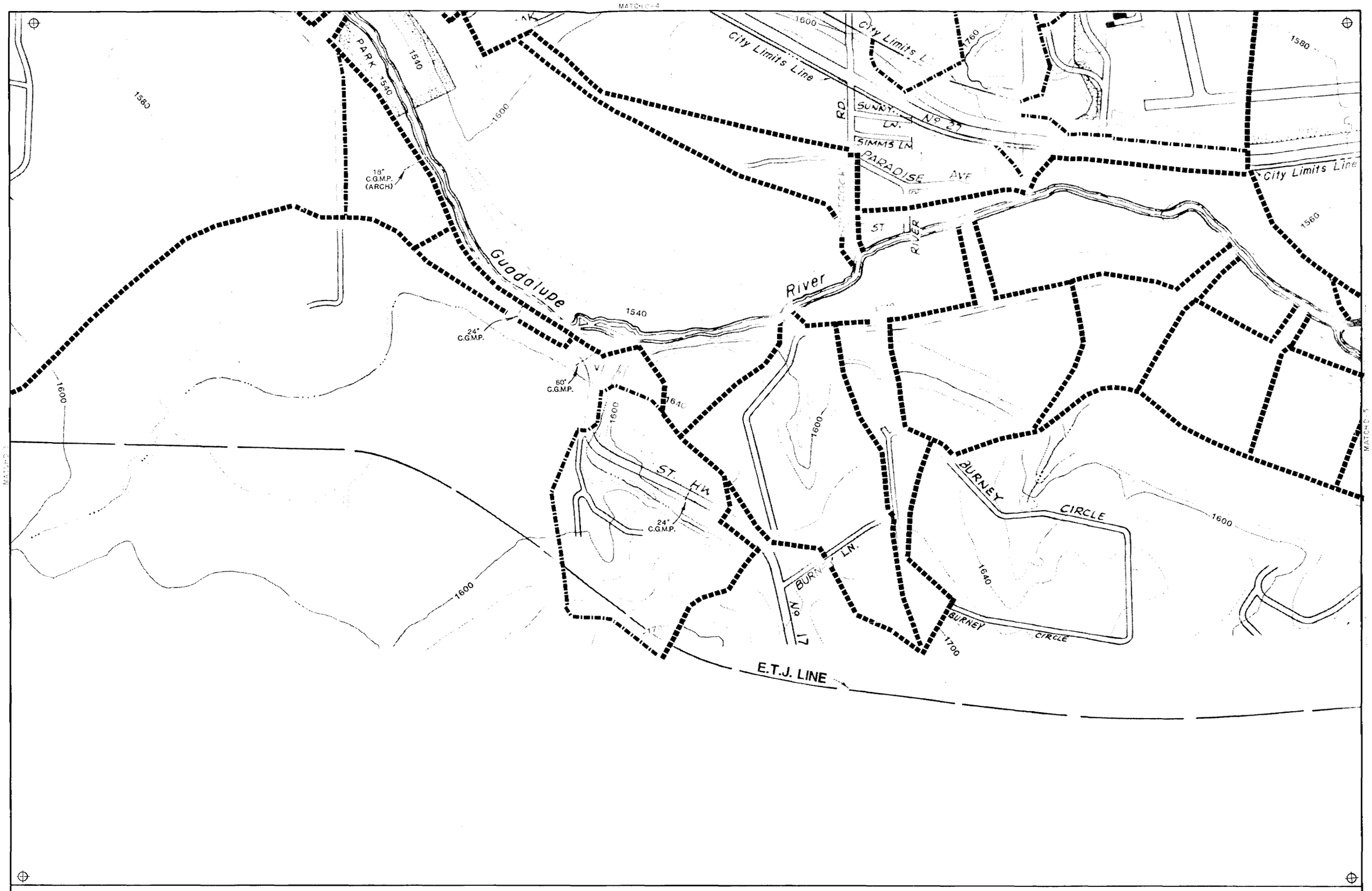
PLATE 20

D-3

CITY OF KERRVILLE, TEXAS

EXISTING
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers • Planners • Consultants
Austin/Dallas, Texas



400 200 0 400 800

GRAPHIC SCALE IN FEET

LEGEND

- CONCRETE CHANNEL
- EARTH CHANNEL
- CURB INLET
- 18" EXIST. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE

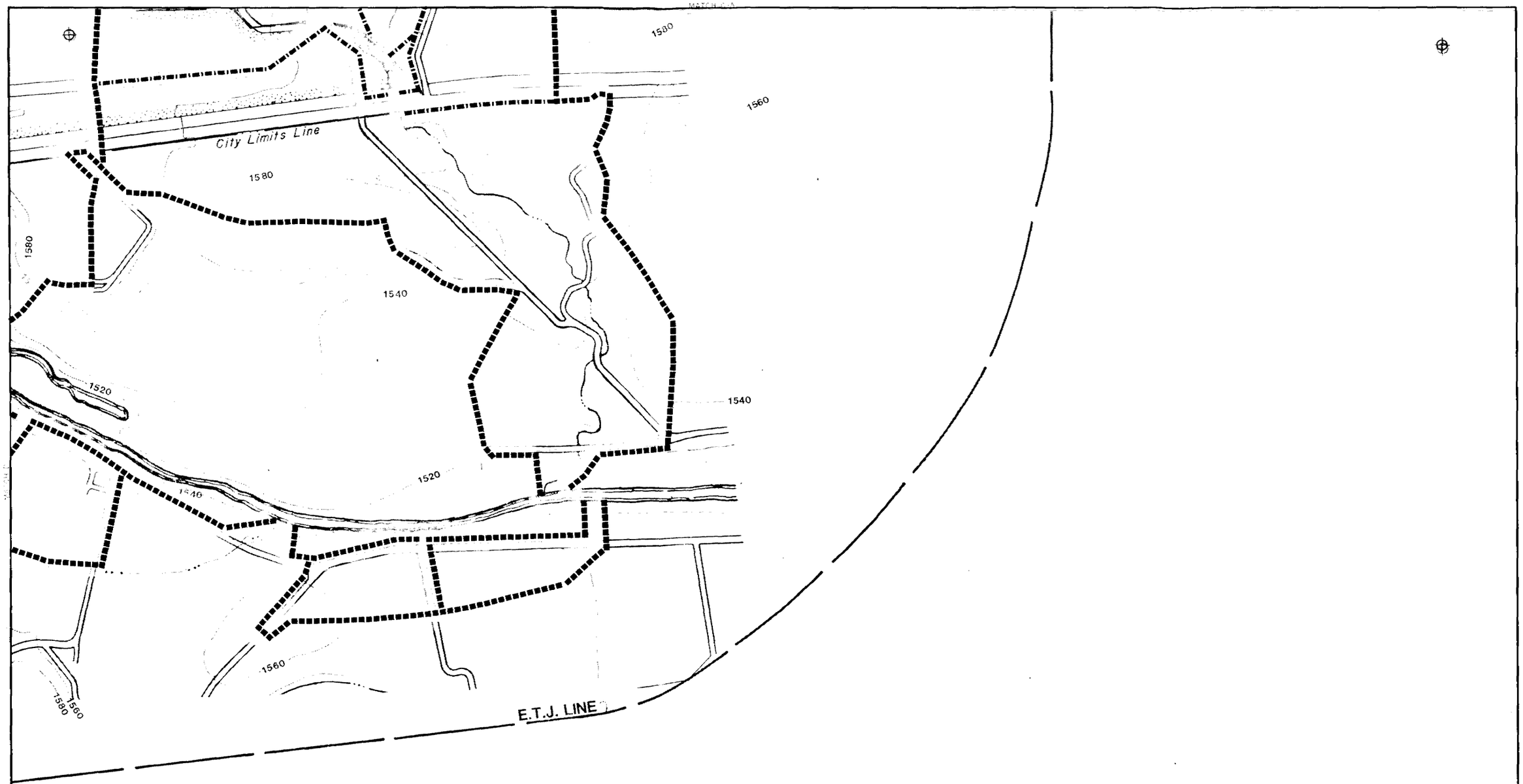
PLATE 21

D-4

CITY OF KERRVILLE, TEXAS

EXISTING
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers · Planners · Consultants
Austin/Dallas, Texas



400 200 0 400 800

GRAPHIC SCALE IN FEET

LEGEND

- CONCRETE CHANNEL
- EARTH CHANNEL
- CURB INLET
- 18" EXIST. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE

PLATE 22

D-5

CITY OF KERRVILLE, TEXAS

EXISTING
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers • Planners • Consultants
Austin/Dallas, Texas

10 years do not normally provide sufficient flood protection, and the reduction in the capacity of a drainage system will increase the potential of heavy property losses caused from flood damage. For this reason, the master plan for the proposed drainage system within a residential area having a drainage area of 40 acres or less is planned, as a minimum, for a storm frequency of 15 years. The storm frequency for residential areas exceeding a drainage area of 40 acres have been increased to 25 years. Multi-family, industrial, and commercial areas are proposed to have a drainage system planned, as a minimum, for a storm frequency of 25 years. This plan will, thus, provide, as nearly as practicable, a uniform degree of flood protection throughout the planning area.

B. Analysis For The System Planning

Inasmuch as the planning area within the present City Limits is fully developed, the existing land uses were utilized in determining the storm water run-off. Most of the areas outside the present City Limits and within the proposed planning area have not yet been fully developed. Should the trend of development substantially change in the future from the land-use patterns presently considered, the estimated quantities for the storm water run-off should be reviewed and adjusted. The master plan can then be re-evaluated to determine what effect there might be on the carrying capacity of the systems already constructed at that time.

The total planning area was divided into four major drainage areas and four major sub-areas. The drainage from all these areas will ultimately reach the Guadalupe River. A brief description of the planning limits, the existing conditions, and the general plan for the proposed system within each area is as follows:

1. Town Creek Area

The area referred to herein as the Town Creek Area located within the planning area is generally bounded on the north by the extraterritorial jurisdiction line, on the south by the Guadalupe River, and on the west and east by the major drainage divide lines of the Town Creek watershed. This planning area contains a total of approximately 3,060 acres and is predominantly residential development; however, some retail and commercial establishments are scattered along Junction Highway (State Highway No. 27). The overall drainage area within the Town Creek watershed contains a total of approximately 12,900 acres.

The terrain of the Town Creek study area varies from steeply sloping grades (18.0%) to fairly flat grades (0.3%), with the most southerly portion of the area having the least amount of relief. The general trend for the direction of drainage varies from southerly to southwesterly.

In utilizing the factors of street elevations, future land-use, and the recommended planning criteria, the total estimated quantity of storm water run-off in each sub-drainage area was calculated. According to the master plan layout of the proposed drainage system, the points of discharge to Town Creek and the Guadalupe River will be from new facilities constructed throughout the planning area of the Town Creek drainage area.

The proposed drainage systems include an estimated 69,900 linear feet of pipe in diameters ranging from 18 inches through 72 inches, inlets with openings 4 feet through 14 feet, headwalls, manholes, laterals, and other related appurtenances. The master plan for the storm drainage systems is shown on PLATES 24, 25, 27, 28, 30, and 31, included in the Appendix of this report.

2. Quinlan Creek Area

The area referred to herein as the Quinlan Creek Area that is within the planning area is generally bounded on the north by the extraterritorial jurisdiction line, on the south by North Street, Broadway Street and the Guadalupe River, and on the west and east by the major drainage divide lines of the Quinlan Creek watershed. This planning area contains approximately 3,270 acres with over one-half of the area being residential development. Some multi-family development exists along Loop No. 534, and retail and commercial establishments are located along Sidney Baker Road (State Highway No. 16). The overall drainage area within the Quinlan Creek watershed contains a total of approximately 6,350 acres.

The terrain of the study area of Quinlan Creek varies from very steep slopes at grades of about 18.0% to more gently sloping grades of 0.3% nearer to Broadway Street on the south. The general trend of the drainage flow is in a southerly direction.

The planning and layout for the proposed storm drainage systems was based on 15 and 25-year storm frequencies. The points of discharge into Quinlan Creek will be from new facilities constructed throughout the Quinlan Creek watershed.

The proposed system of drainage improvements in the Quinlan Creek area includes approximately 74,500 linear feet of storm sewer pipe in diameters ranging from 18 inches through 72 inches, and approximately 6,550 linear feet of reinforced concrete box culverts ranging in sizes from 9' x 6' through 10' x 10'. Inlets with openings of 4 feet through 14 feet, headwalls, manholes, laterals, and other related appurtenances will also be a part of the storm drainage system.

The master plan for the proposed storm drainage systems in the Quinlan Creek area is shown on PLATES 25, 28, 29, 31, and 32, included in the Appendix of this report.

3. Camp Meeting Creek Area

The Camp Meeting Creek Area located south of the Guadalupe River and within the planning area is generally bounded on the north by the Guadalupe River, on the south by Monroe Drive and the extraterritorial jurisdiction line, on the west by Sheppard Rees and Rim Rock Roads, and on the east by Meditation and Box Elder Drives. The planning area within Camp Meeting Creek includes approximately 1,410 acres and is predominantly residential development. The overall drainage area in Camp Meeting Creek is approximately 5,640 acres.

The terrain of the Camp Meeting Creek area varies from steep slopes of about 12.0% in the southern part to more gently sloping grades of 0.3% nearer to the Guadalupe River on the north. The trends of drainage flow are in both a south to southwesterly direction and in a north to northeasterly direction.

The planning and layout for the proposed storm drainage system was based on 15 and 25-year storm frequencies. Based on this, points of discharge into Camp Meeting Creek were determined to occur from new facilities constructed throughout the Camp Meeting Creek watershed.

The proposed system for the planning portion of the Camp Meeting Creek area will include approximately 37,820 linear feet of storm sewer pipe in diameters ranging from 18 inches through 72 inches. Also, inlets with openings of 4 feet through 14 feet, headwalls, manholes, laterals, and other related appurtenances will be a part of the storm drainage system.

The master plan for the proposed storm drainage systems in the Camp Meeting Creek Area is shown on PLATES 32 and 36, included in the Appendix of this report.

4. Third Creek Area

The area of Third Creek, which lies north of the Guadalupe River and within the planning area, is generally bounded on the north by Interstate Highway No. 10, on the south by the Guadalupe River, on the west by the most northeasterly City Limit line, and on the east by the major drainage divide line between Third Creek and Second Creek. The planning area of Third Creek equals approximately 2,630 acres and has an overall drainage area of 7,460 acres, with approximately 2,950 acres draining into Third Creek from Second Creek. This planning area is currently about 10 percent developed with residential-type land-use.

The terrain of the Third Creek area varies from very steep sloping grades on the northeast section to the more gently sloping grades nearer to the Guadalupe River on the south. The general trend of drainage flow is in a southerly direction.

The planning and layout for the proposed storm drainage system was based on the recommended drainage criteria contained in the manual. The points of discharge will be made throughout the Third Creek area through new facilities.

The proposed system, as shown on the master plan for the Third Creek area, will include approximately 7,500 linear feet of storm sewer pipe in diameters ranging from 18 inches through 72 inches. Other related appurtenances will also be a part of the storm drainage system.

The master plan for the proposed storm drainage system in the Third Creek Area is shown on PLATES 26, 29, and 32, included in the Appendix of this report.

5. Other Areas

The other drainage areas that are located outside of the four drainage areas outlined above, but still within the planning area, are the Starkey Manor Area, the Downtown Area, the Meadow View Lane-Loop 534 Area, the Kerrville State Hospital-Sidney Baker South Area, the area southeast of the Texas Lion Camp for Crippled Children, and the Kerrville State Park. These areas all drain directly into the Guadalupe River. About sixty percent (60%) of these areas have been developed, with residential growth being the predominant land-use.

The points of discharge into the Guadalupe River will be made through new facilities constructed throughout these areas.

The proposed system, as shown on the master plan for these areas, will consist of storm sewer pipe in diameters ranging from 18 inches through 72 inches and reinforced concrete box culverts ranging in size from 7' x 6' through 10' x 8'. Inlets, headwalls, manholes, laterals, and other related appurtenances will also be a part of the storm sewer system.

The master plan for the proposed storm drainage system in these areas is shown on PLATES 30 through 39, included in the Appendix of this report.

PART V - STORM DRAINAGE SYSTEM MASTER PLAN

From the analysis and conclusions developed in this study of the City's storm drainage system for each of the planning areas, the future system of drainage improvements will carry the run-off, for the most part, in the direction of the existing natural flow and without transfer of the storm water run-off to other drainage courses or watersheds.

PLATES 24 through 39 each show the general layout of the system relative to the City street pattern. The locations for the proposed storm sewer system are approximate, and the facilities will be planned for construction within existing dedicated rights-of-way, where possible. In other areas of new construction, easements may need to be acquired.

PART VI - CAPITAL IMPROVEMENTS AND COST ESTIMATES

A. General

A description of the proposed facilities and related estimates of costs are presented herein for the City to further develop its capital improvements programs. The cost estimates are based on 1983 prices and include allowances for construction contingencies and technical services. The project costs presented herein do not, however, include the costs for legal or fiscal fees nor the costs for acquiring easements for the drainage rights-of-way.

B. Construction Priorities

In scheduling the initial phase of proposed projects, consideration was given to constructing the improvements felt to be the most needed, and these have been assigned first priority. These improvements consist primarily of constructing the drainage

facilities to give some relief to the areas of frequent flooding as well as provide the needed capacity at the point or points of discharge to the major streams.

Each phase of improvements thereafter should be planned for construction to systematically alleviate the most critical needs in flood protection. Where street paving improvements are to be made and where storm drainage facilities are planned in the same area, the drainage improvements should be constructed with the paving project.

To keep the plan active beyond the implementation of the initial phase of capital improvements presented herein, an assessment of the past accomplishments and future needs should continue on an annual basis. This yearly re-evaluation of the improvements completed and those projects needed will be extremely important for purposes of updating cost estimates, budgeting, and establishing the priorities for the next year's improvements.

C. Schedule of Proposed Improvements and Cost Estimates

The following is an outline of recommended capital improvements and their estimates of cost.

1. Westgate Place Area

Project No. 1 -

From the south end of an existing earth channel west of the intersection of Coronado Drive with Lois Street to Coronado Drive to Stephanie Drive, thence to Goat Creek Road.	$ 330,000

2. Starkey Manor Area

Project No. 2 -

From McAllen Street and Tanglewood Drive southwesterly to Jackson, Jack, Virginia, Lois, and State Highway No. 27, and thence to the Guadalupe River.	1,600,000

3. Lois Street - Take It Easy Trailer Park Area

Project No. 3 -

In Lois Street from Ox Drive to existing ditch west of Woodlawn Avenue, thence southwesterly in an existing ditch to State Highway No. 27, Guadalupe Street and to the Guadalupe River.	1,190,000

4. Lois Street - Lewis Street Area

Project No. 4 -

In Lois Street from Woodlawn Avenue to Lewis Street and Surber, thence southeast along Surber to East Shady to Guadalupe Street, and thence to the Guadalupe River. 950,000

5. Five Points Area

Project No. 5 -

In Water Street from Junction Highway to Hugo Street, thence along Hugo Street to Hamilton, thence along Hamilton to Lawry Street, and thence to Town Creek. 360,000

6. Downtown Area

a. Project No. 6 -

In Jefferson Street from a point just southeast of Clay Street to Washington Street, thence southwesterly along Washington to Water Street, thence in Water Street to Enderle Court, and thence southwesterly along Enderle Court to the Guadalupe River. 1,105,000

b. Project No. 6P

Street paving improvements in Water Street from Washington Street southeasterly to Enderle Court. 240,000

7. Westminster Area

Project No. 7 -

In an existing ditch southeast of Westminster Street and parallel to Westminster Street southwesterly to the abandoned Southern Pacific Railroad right-of-way, thence north along abandoned railroad right-of-way to Travis Street, and thence southwesterly along Travis Street to Quinlan Creek. 1,180,000

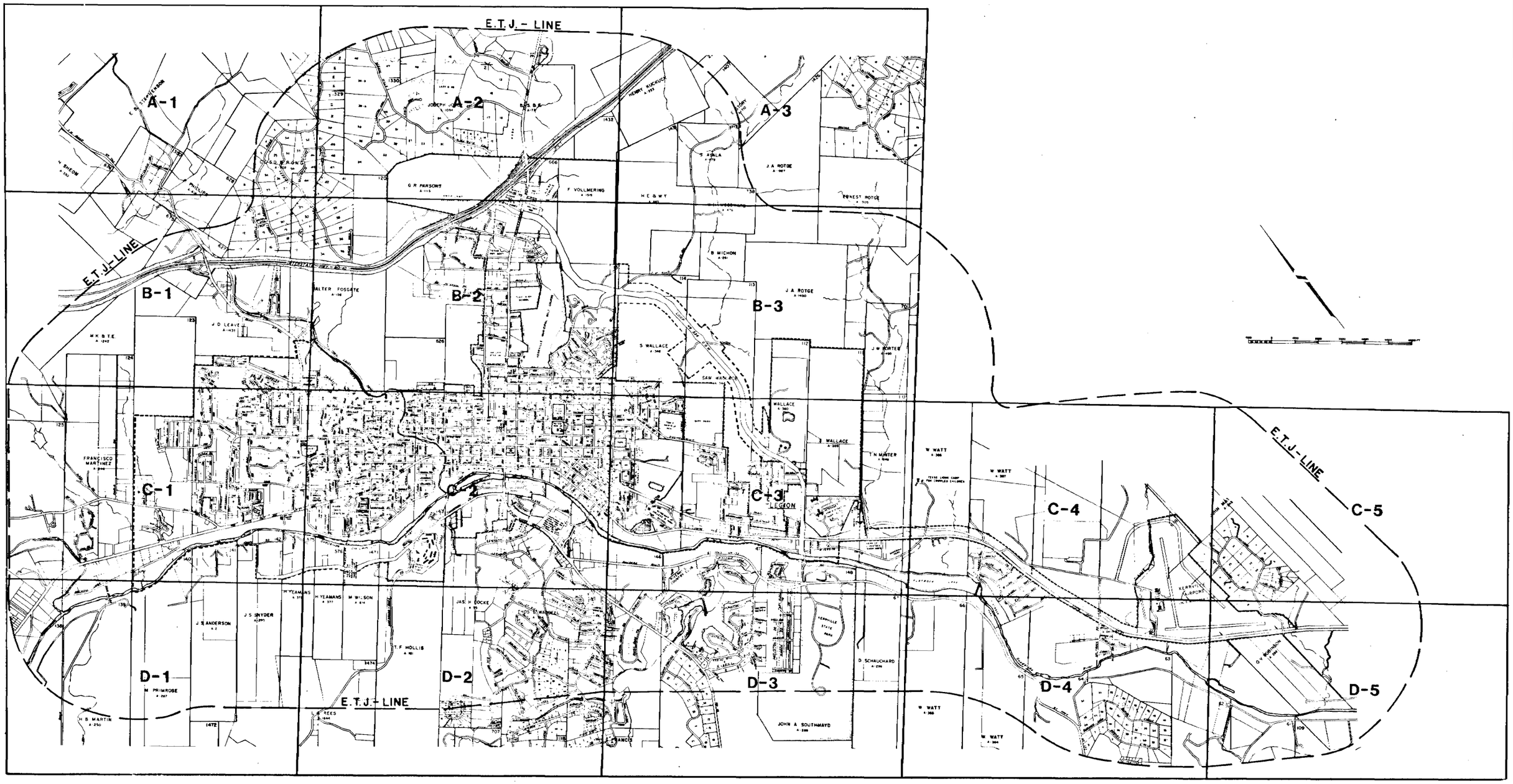
8. Country Club Area

Project No. 8 -

In Country Club Drive from Sidney Baker Road southeasterly, thence southwesterly to Golf Avenue and thence along the northeast side and parallel to Golf Avenue to a point approximately 250 feet southeast of Washington Street. 320,000

PLATES 40, 41, 42, and 43 were prepared to show the locations of the proposed capital improvements and are included in the Appendix of this report.

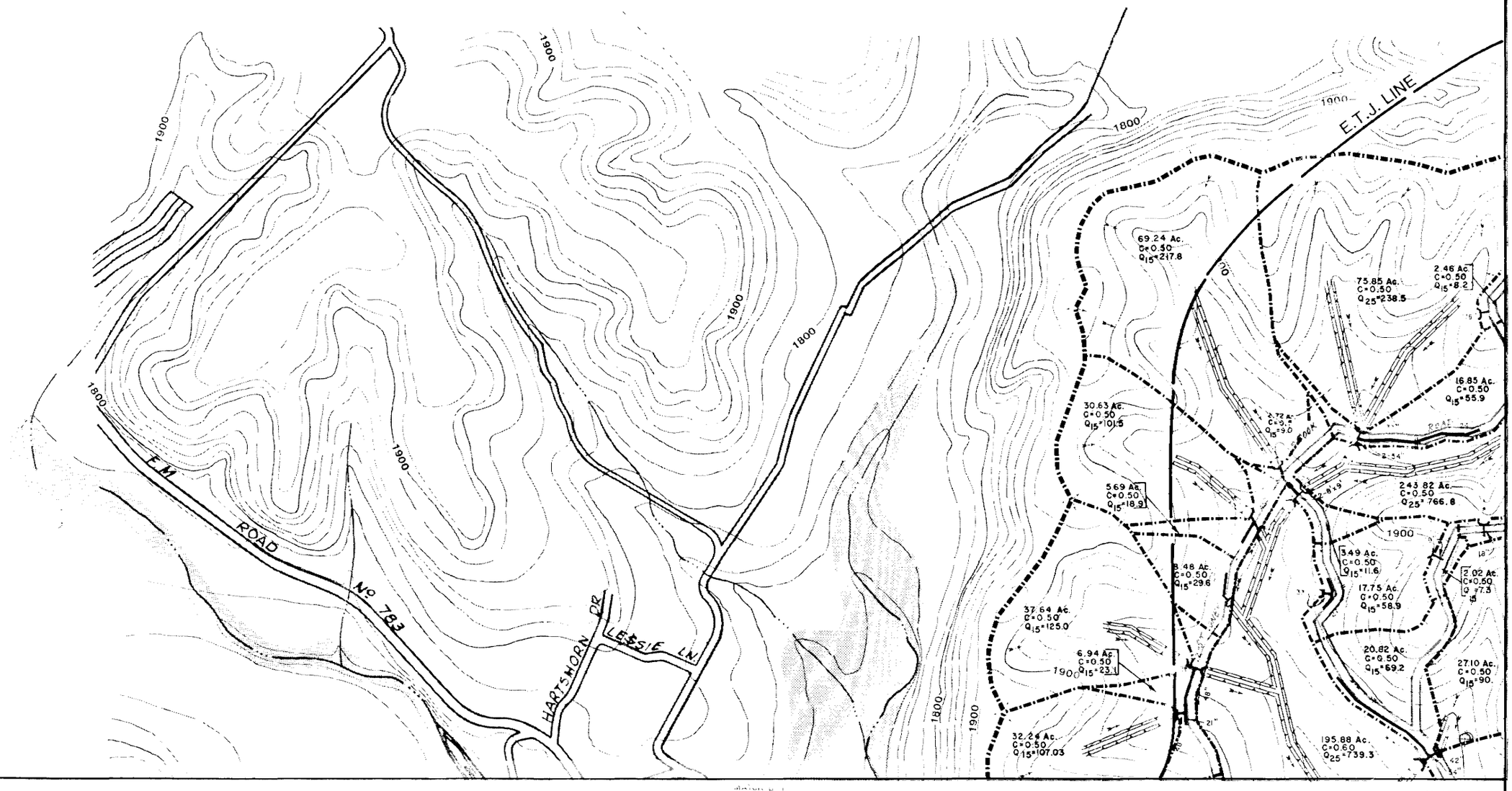
APPENDIX



CITY OF KERRVILLE, TEXAS

INDEX MAP

HOGAN & RASOR, Inc.
Engineers • Planners • Consultants
Dallas/Austin, Texas



400 200 0 400 800

GRAPHIC SCALE IN FEET

LEGEND

- PROP. CHANNEL
- 18" PROP. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE
- SUB-MINOR DRAINAGE DIVIDE

PLATE 24

A-1

CITY OF KERRVILLE, TEXAS

PROPOSED
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers · Planners · Consultants
Austin/Dallas Texas

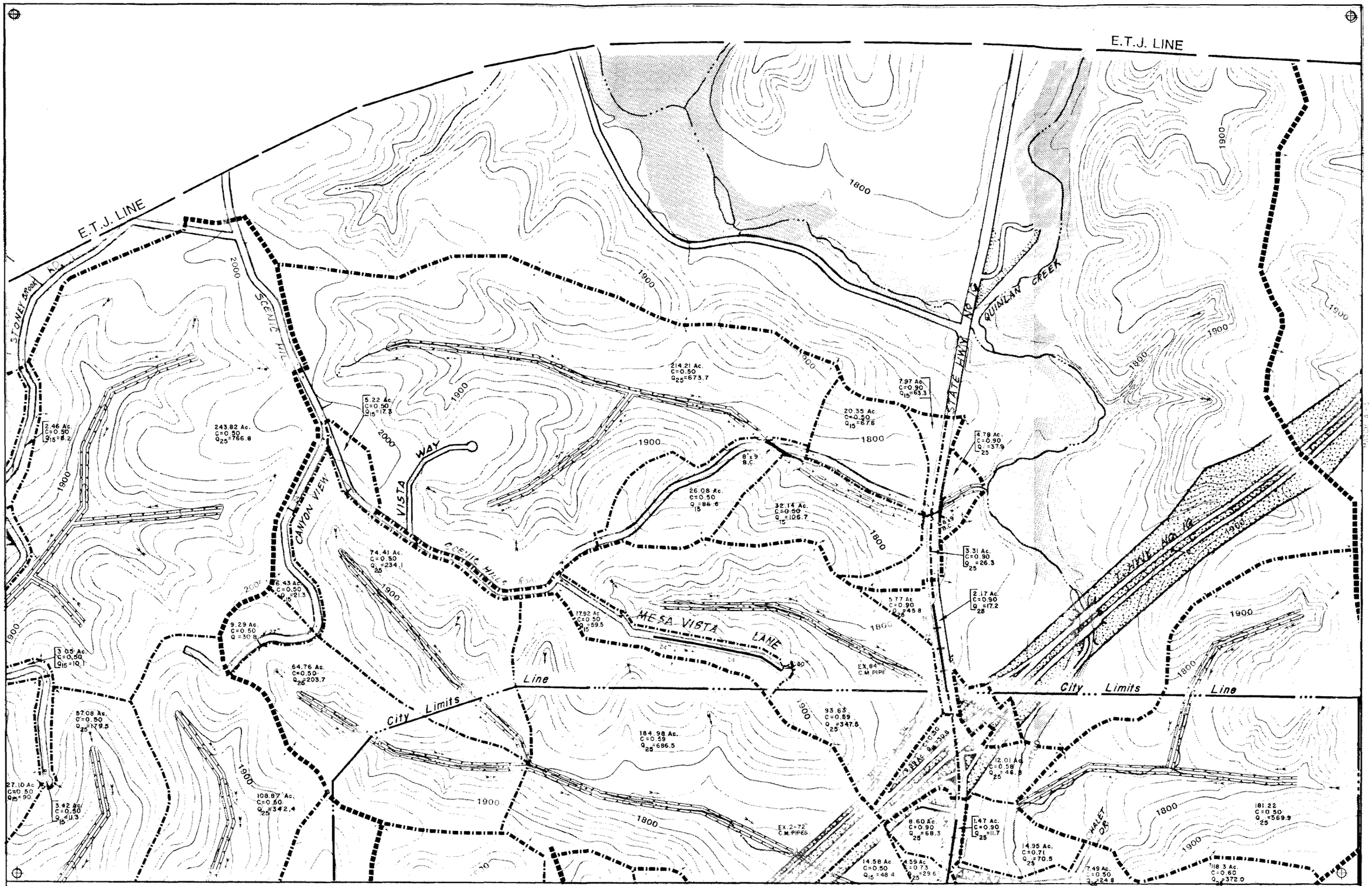


PLATE 25

A-2

CITY OF KERRVILLE, TEXAS

PROPOSED
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers · Planners · Consultants
Austin/Dallas, Texas

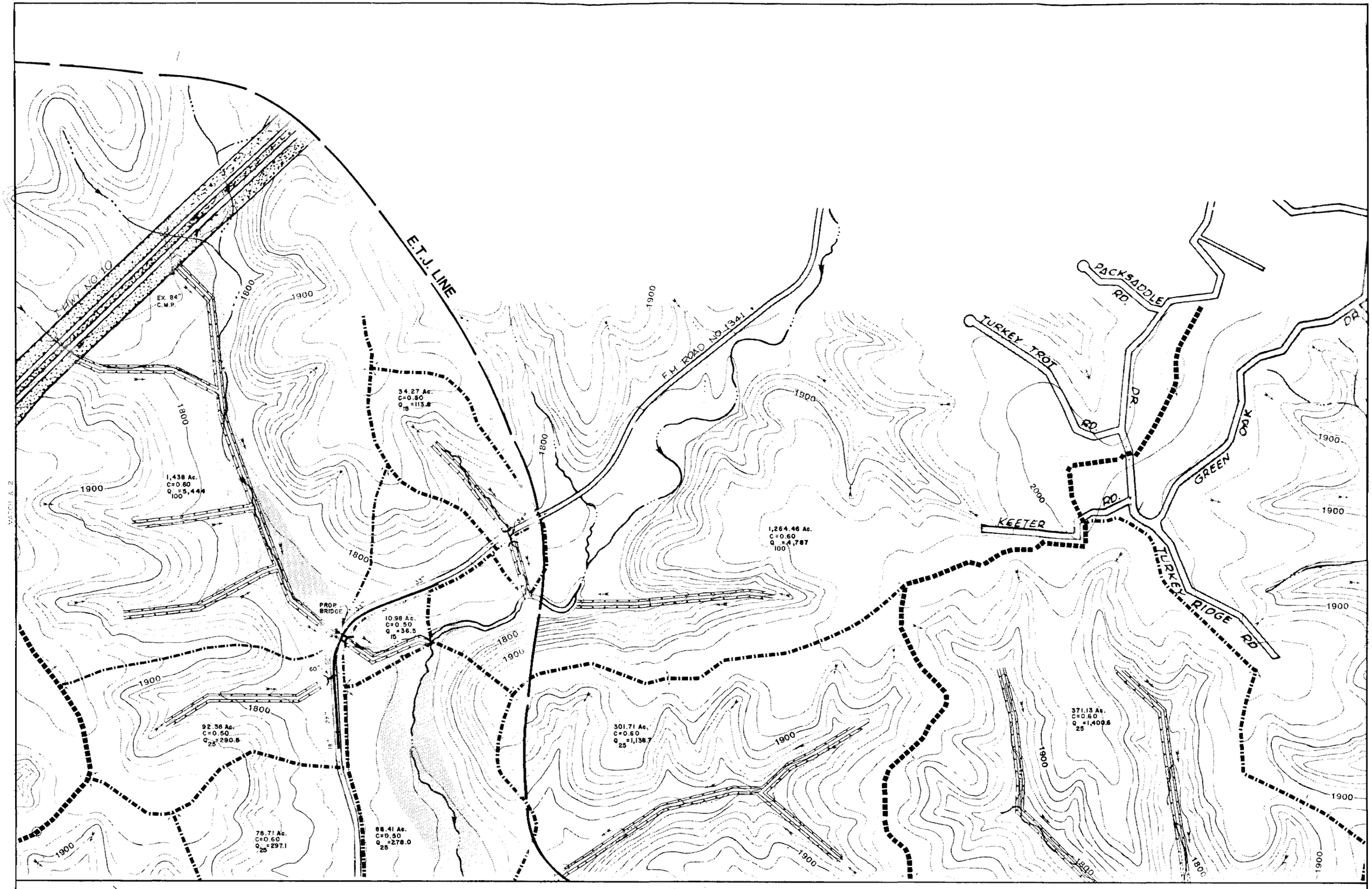


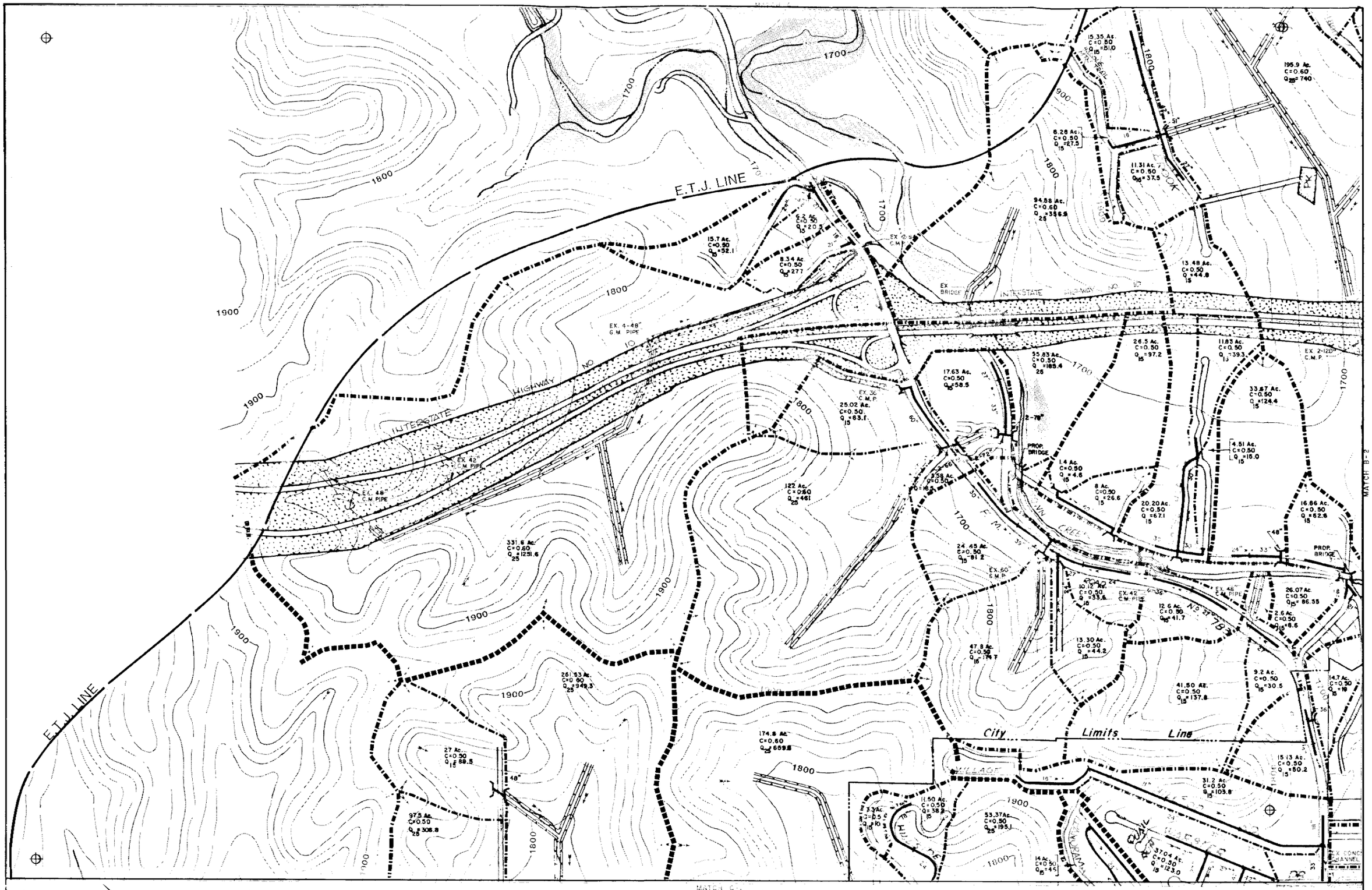
PLATE 26

A-3

CITY OF KERRVILLE, TEXAS

PROPOSED
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers • Planners • Consultants
Austin/Dallas, Texas



LEGEND

- PROP. CHANNEL
- 18" PROP. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE
- SUB-MINOR DRAINAGE DIVIDE

400 200 0 400 800

GRAPHIC SCALE IN FEET

PLATE 27

B-1

CITY OF KERRVILLE, TEXAS

PROPOSED
STORM DRAINAGE SYSTEM

HOGAN & RASOR, inc.
Engineers • Planners • Consultants
Austin/Dallas, Texas

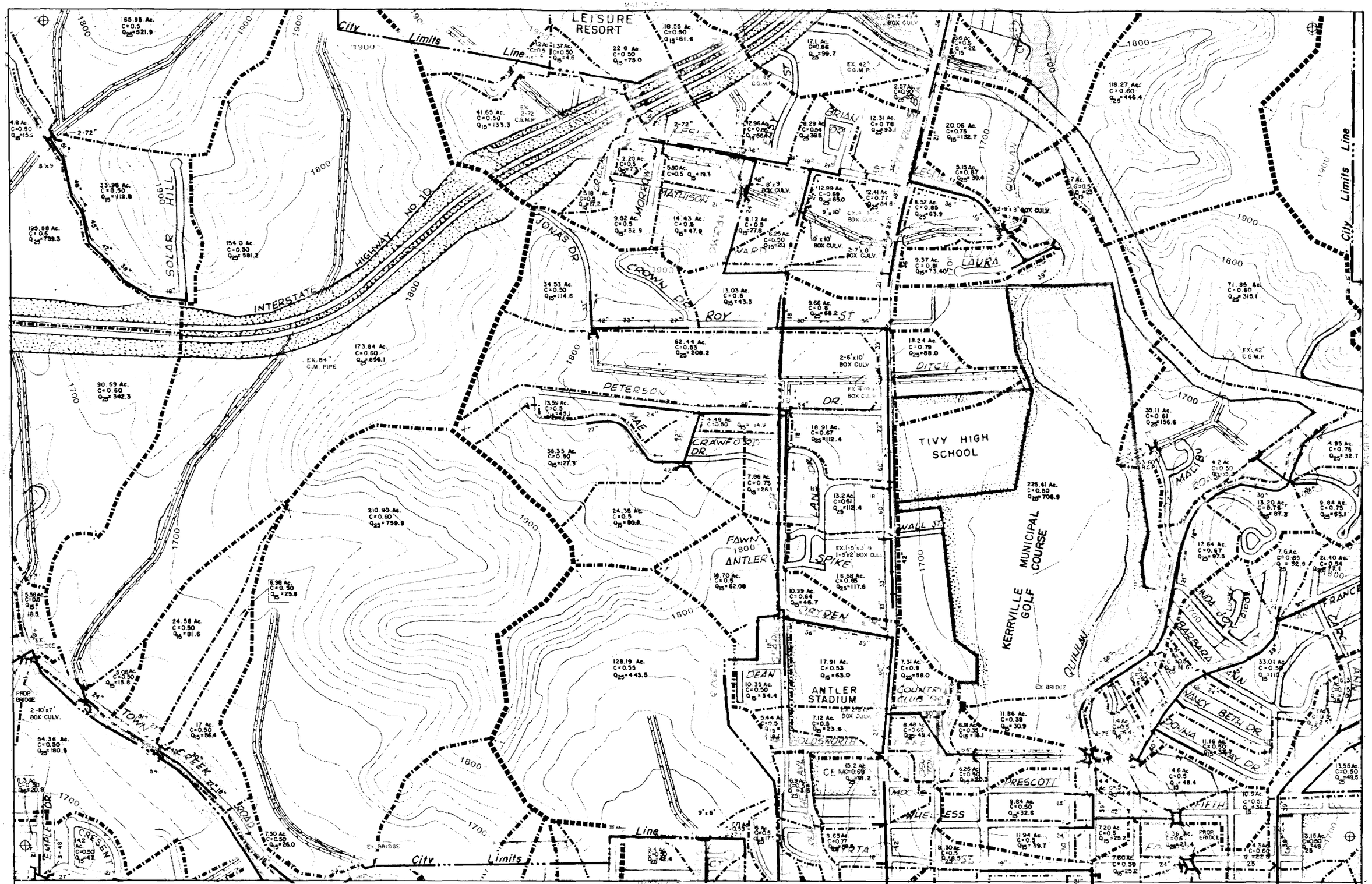


PLATE 28

B-2

CITY OF KERRVILLE, TEXAS

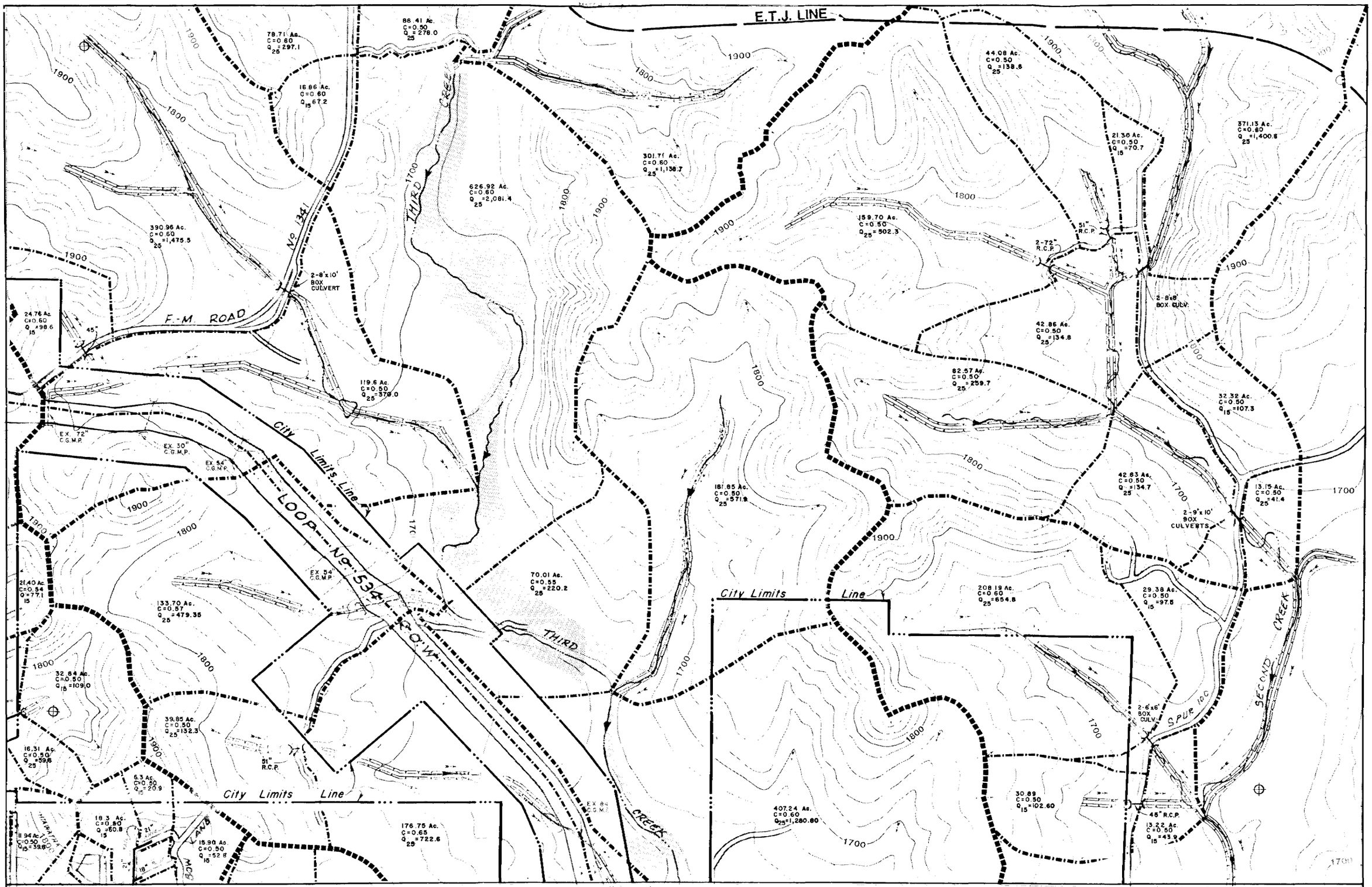
PROPOSED
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers · Planners · Consultants
Austin/Dallas, Texas

LEGEND

- PROP. CHANNEL
- PROP. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE
- SUB-MINOR DRAINAGE DIVIDE

400 200 0 400 800
GRAPHIC SCALE IN FEET



LEGEND

- PROP. CHANNEL
- 18" PROP. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE
- SUB-MINOR DRAINAGE DIVIDE

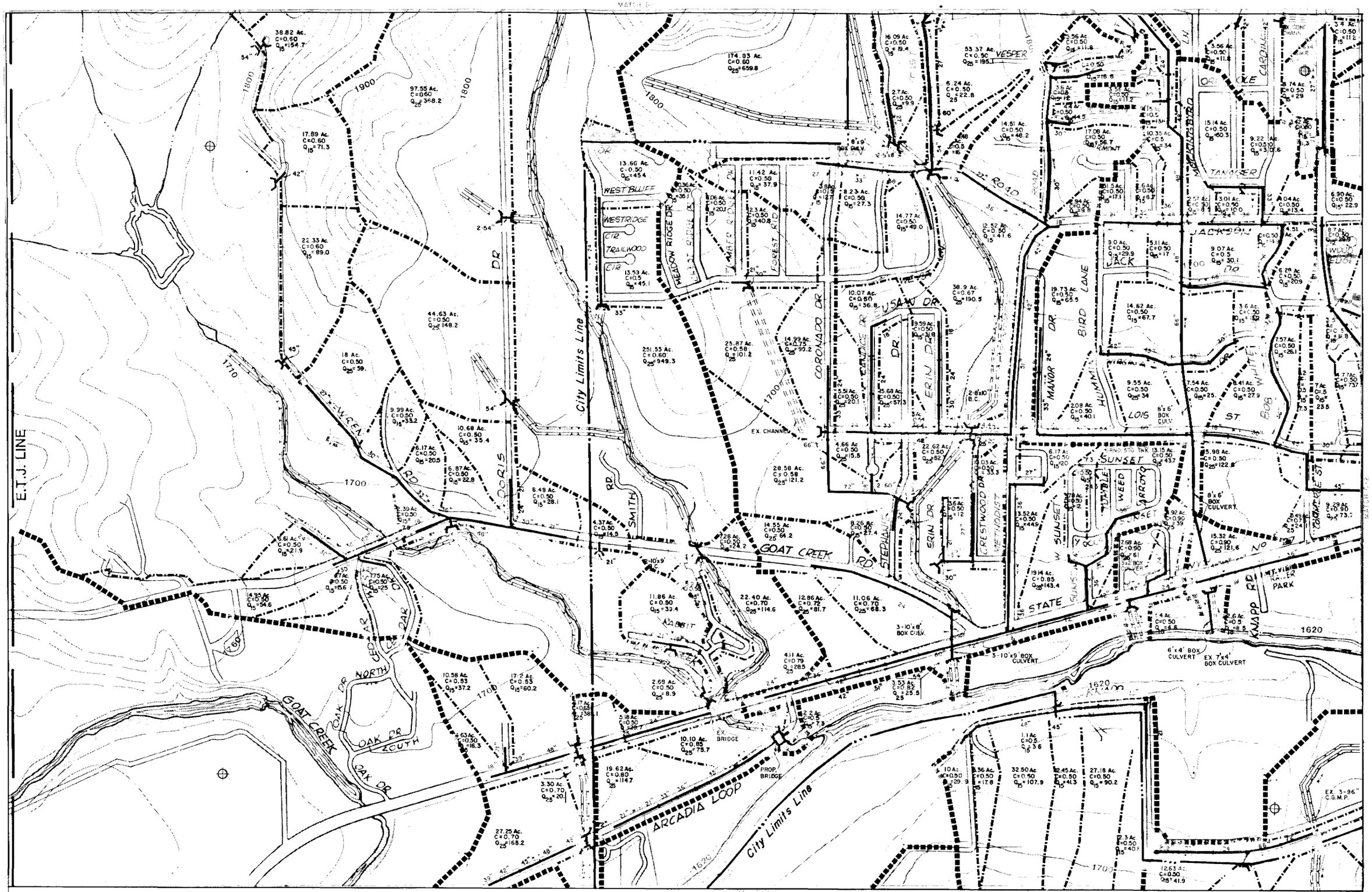
PLATE 29

B-3

CITY OF KERRVILLE, TEXAS

PROPOSED
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers • Planners • Consultants
Dallas/Austin, Texas



400 200 0 400 800

GRAPHIC SCALE IN FEET

LEGEND

- PROP. CHANNEL
- 18" PROP. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE
- SUB-MINOR DRAINAGE DIVIDE

PLATE 30

C-1

CITY OF KERRVILLE, TEXAS

PROPOSED
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers • Planners • Consultants
Austin/Dallas, Texas

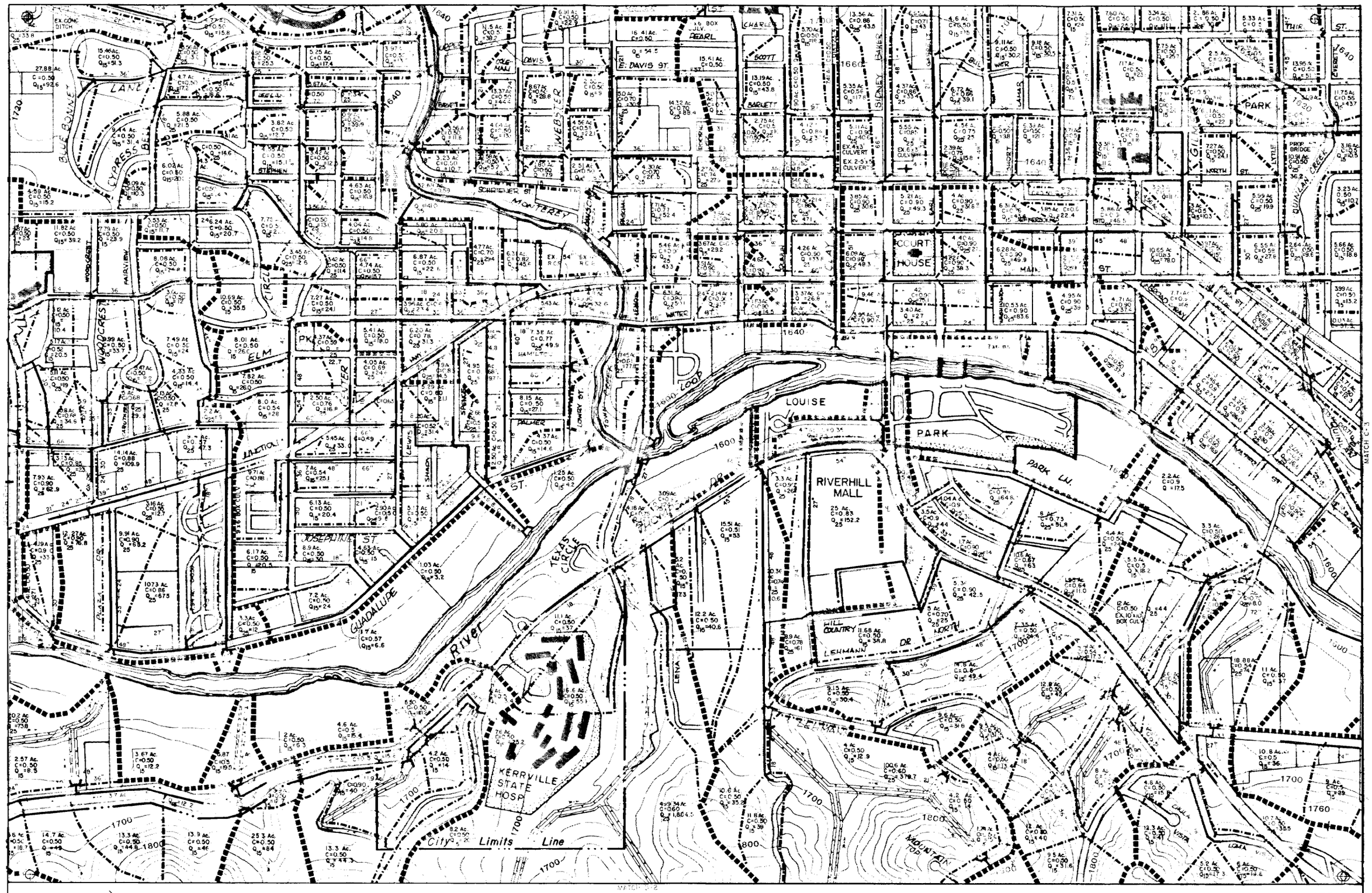


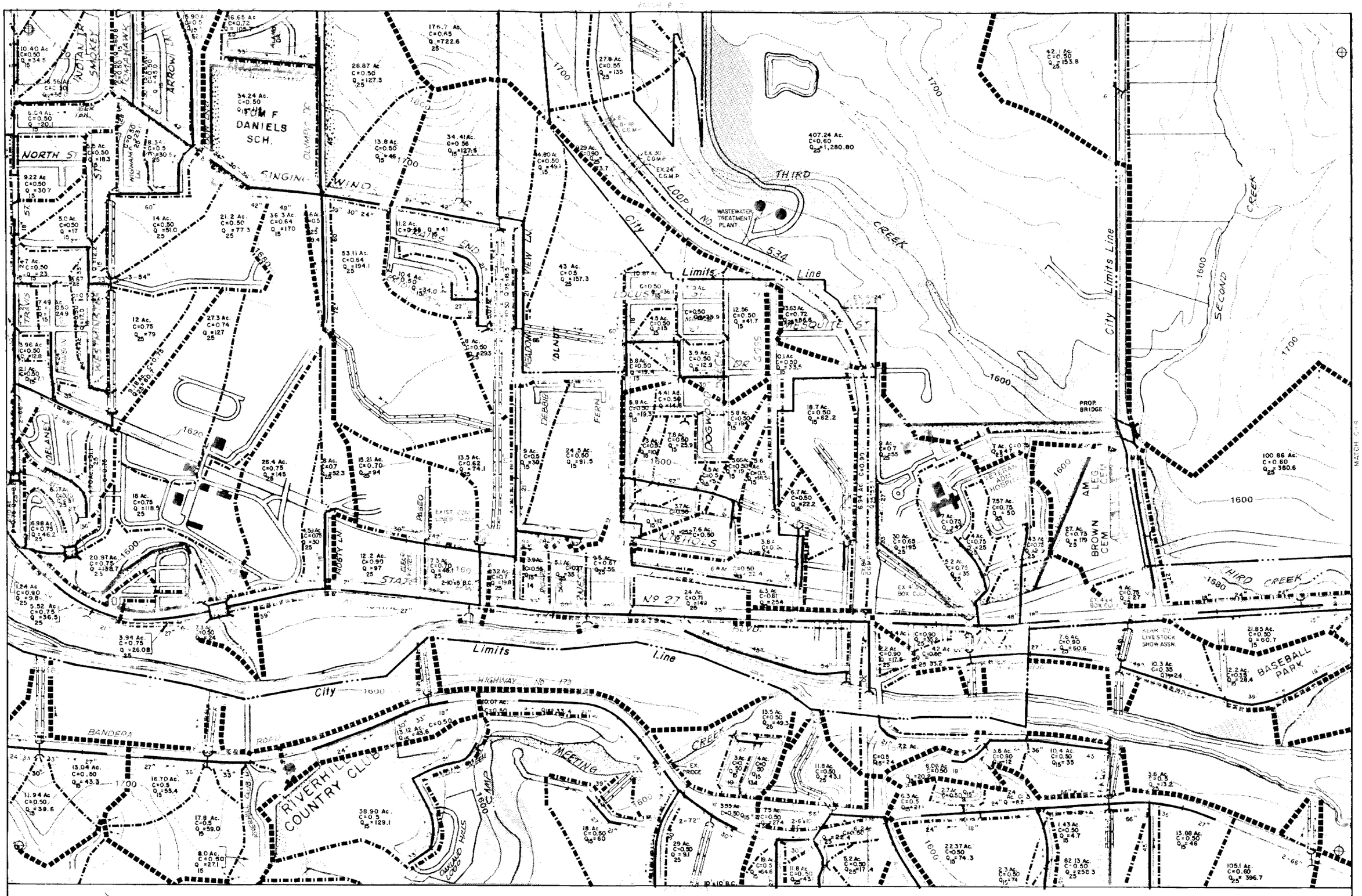
PLATE 31

C-2

CITY OF KERRVILLE, TEXAS

PROPOSED
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers • Planners • Consultants
Austin/Dallas, Texas



400 200 0 400 800

GRAPHIC SCALE IN FEET

LEGEND

- PROP. CHANNEL
- 18" PROP. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE
- SUB-MINOR DRAINAGE DIVIDE

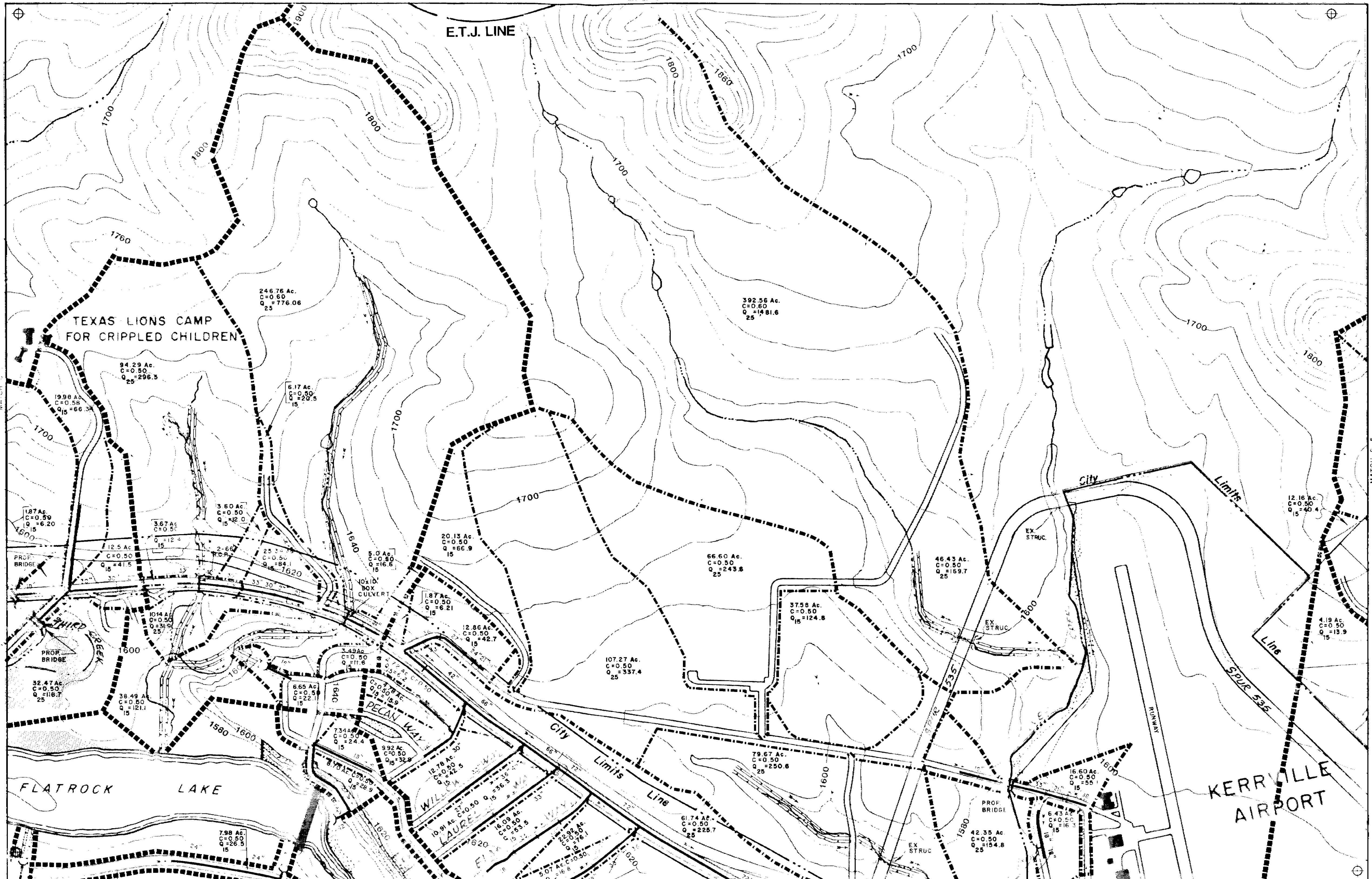
PLATE 32

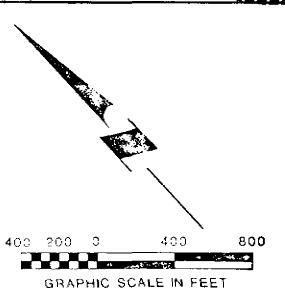
C-3

CITY OF KERRVILLE, TEXAS

PROPOSED
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers • Planners • Consultants
Austin/Dallas, Texas





LEGEND

- PROP. CHANNEL
- PROP. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE
- SUB-MINOR DRAINAGE DIVIDE

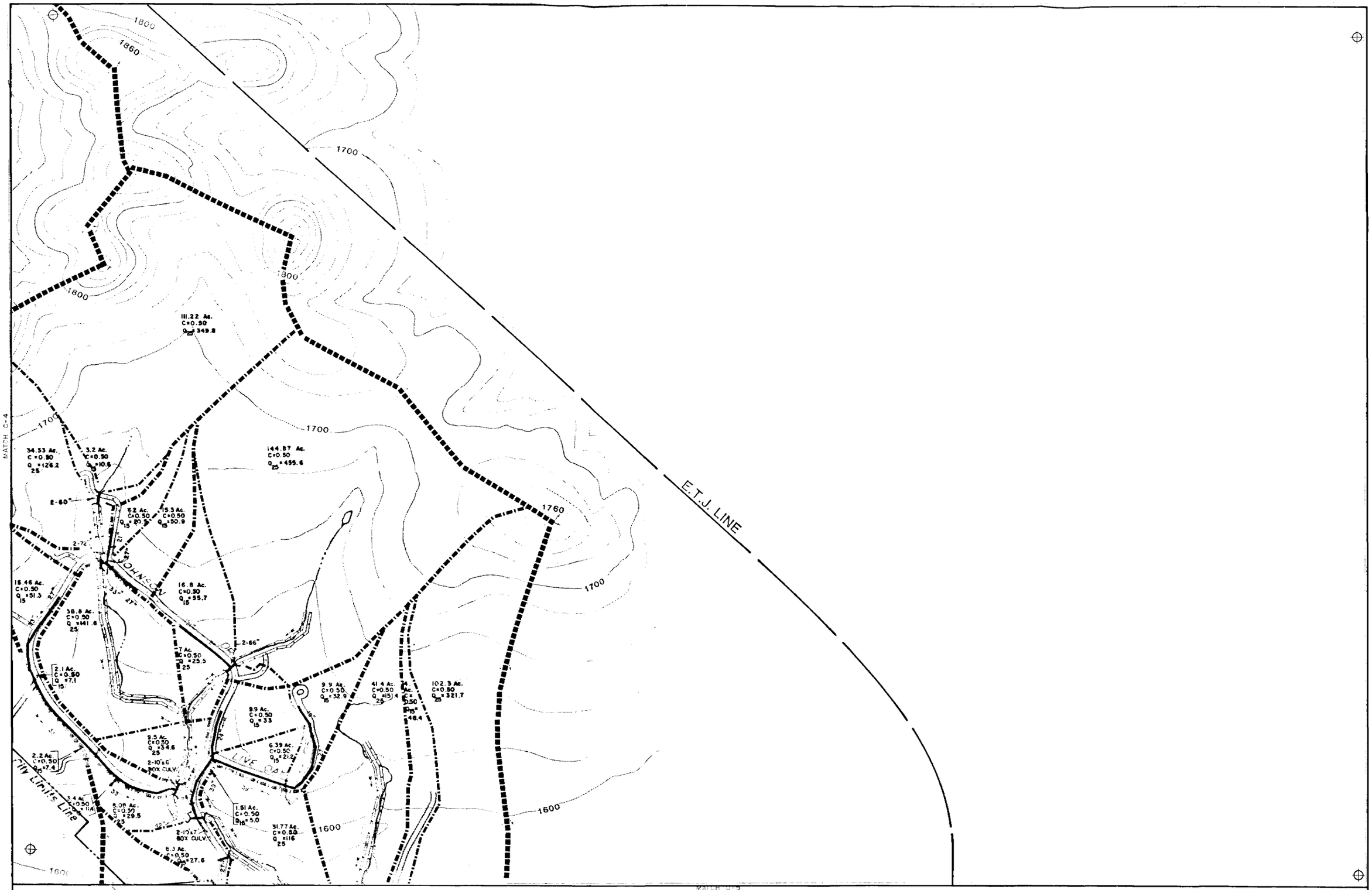
PLATE 33

C-4

CITY OF KERRVILLE, TEXAS

PROPOSED
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers · Planners · Consultants
Austin/Dallas, Texas



LEGEND

- PROP. CHANNEL
- 18" PROP. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE
- SUB-MINOR DRAINAGE DIVIDE

PLATE 34

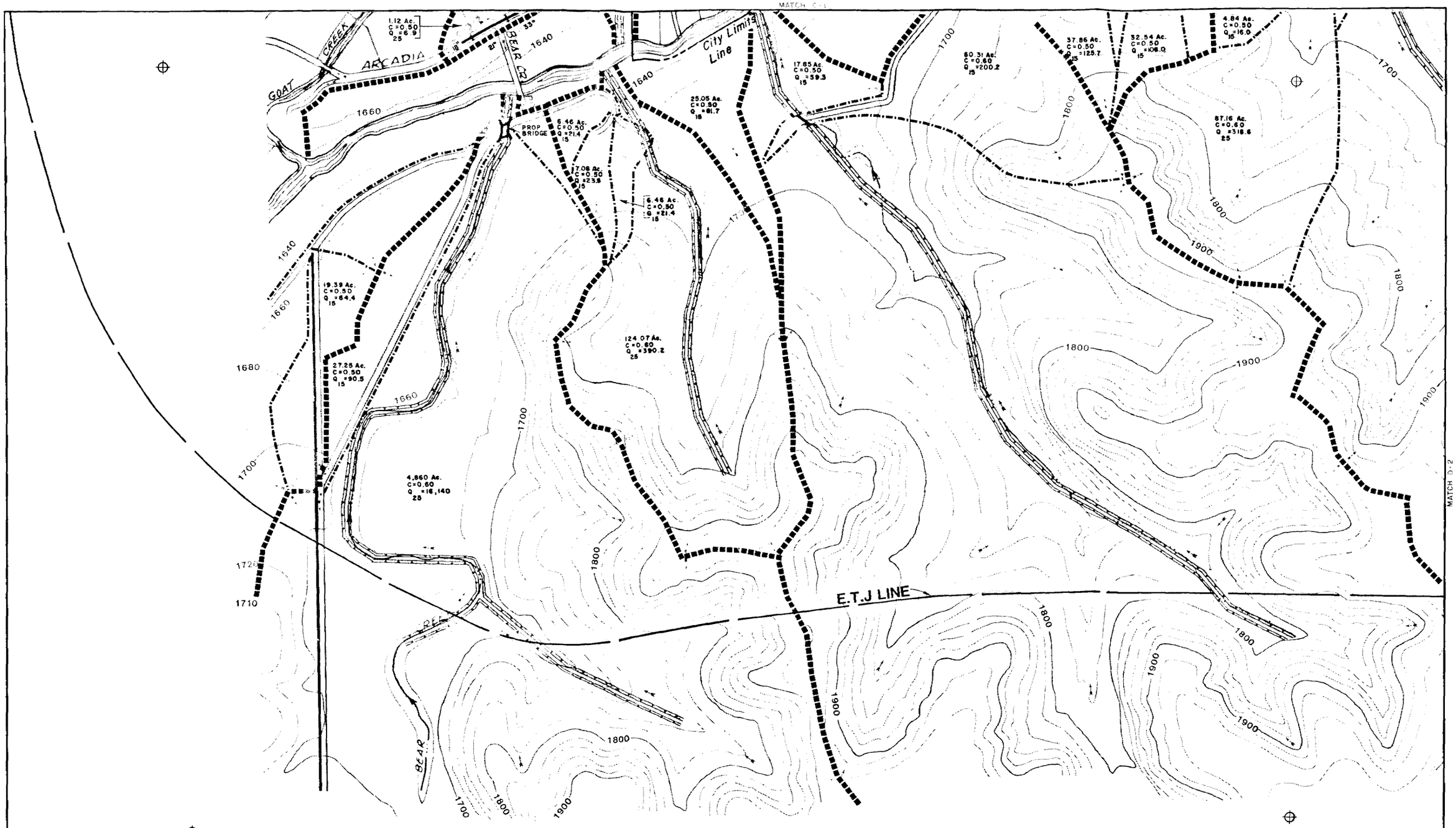
C-5

CITY OF KERRVILLE, TEXAS

PROPOSED
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers · Planners · Consultants
Austin/Dallas, Texas

MATCH D-1



MATCH D-2

400 200 0 400 800
GRAPHIC SCALE IN FEET

LEGEND

- PROP. CHANNEL
- 18" PROP. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE
- SUB-MINOR DRAINAGE DIVIDE

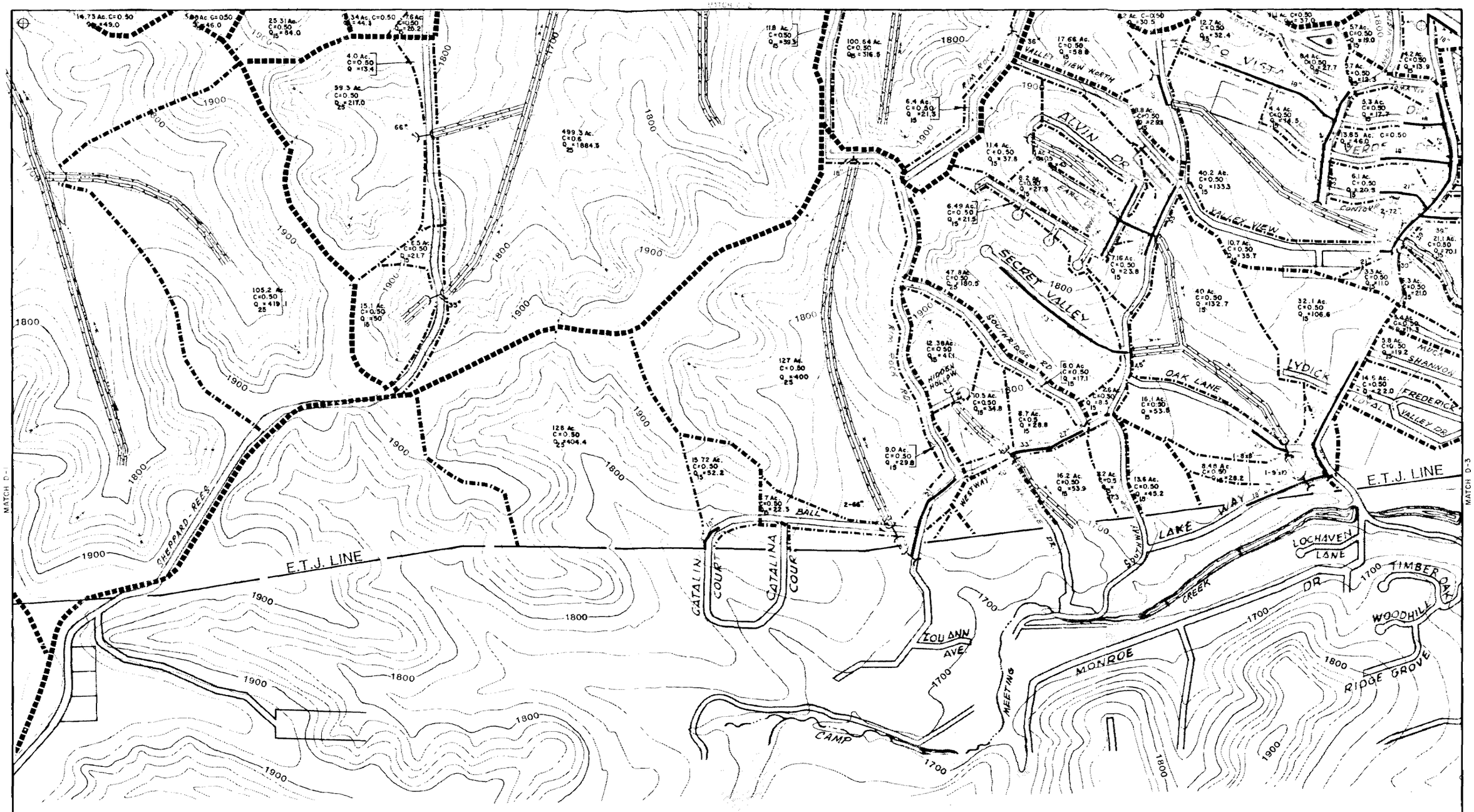
PLATE 35

D-1

CITY OF KERRVILLE, TEXAS

PROPOSED
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers · Planners · Consultants
Austin/Dallas, Texas



400 200 0 400 800
GRAPHIC SCALE IN FEET

LEGEND

- PROP. CHANNEL
- 18" PROP. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE
- SUB-MINOR DRAINAGE DIVIDE

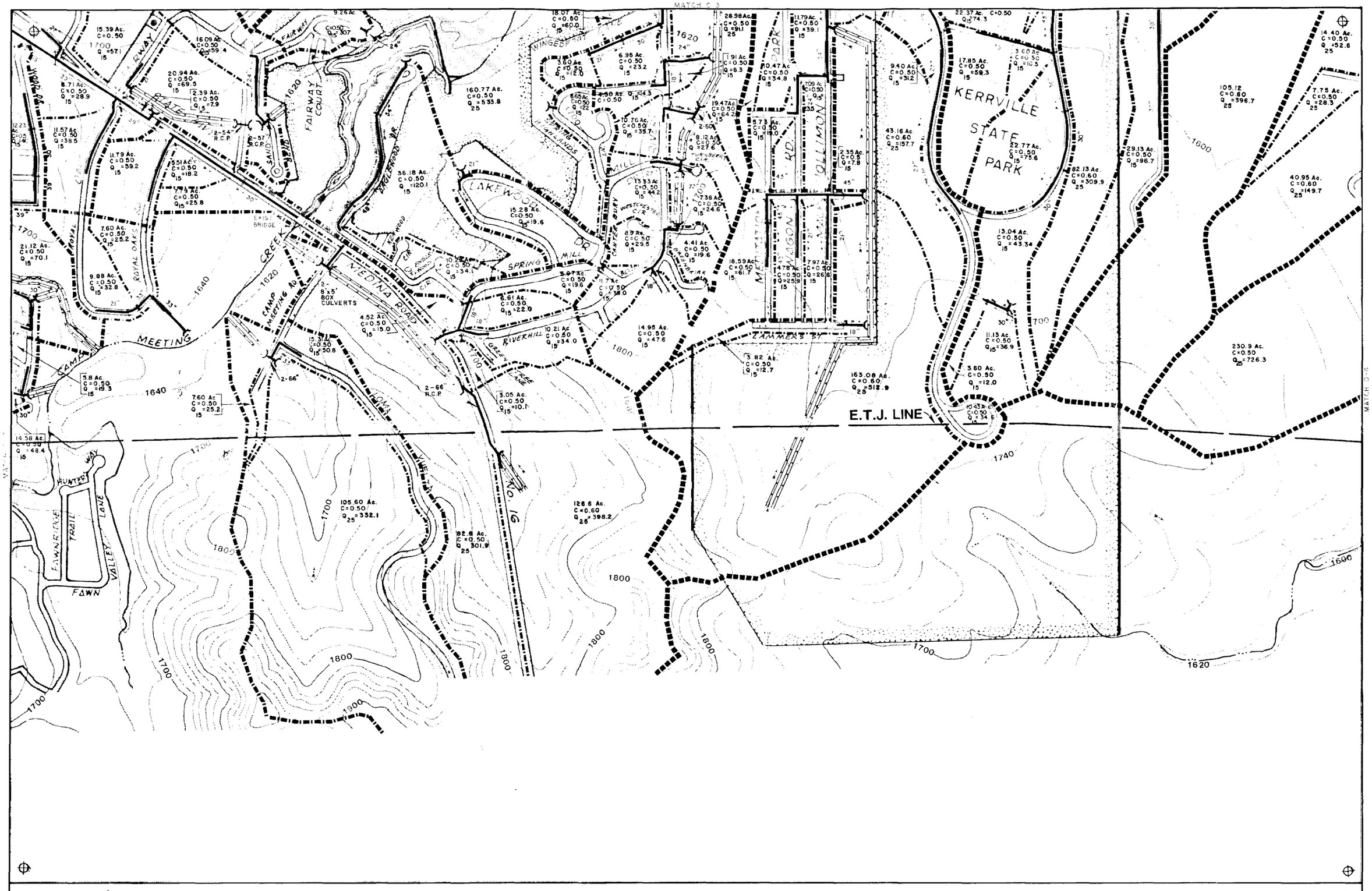
PLATE 36

D-2

CITY OF KERRVILLE, TEXAS

PROPOSED
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers • Planners • Consultants
Austin/Dallas, Texas



400 200 0 400 800
GRAPHIC SCALE IN FEET

LEGEND

- PROP. CHANNEL
- 18" PROP. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE
- SUB-MINOR DRAINAGE DIVIDE

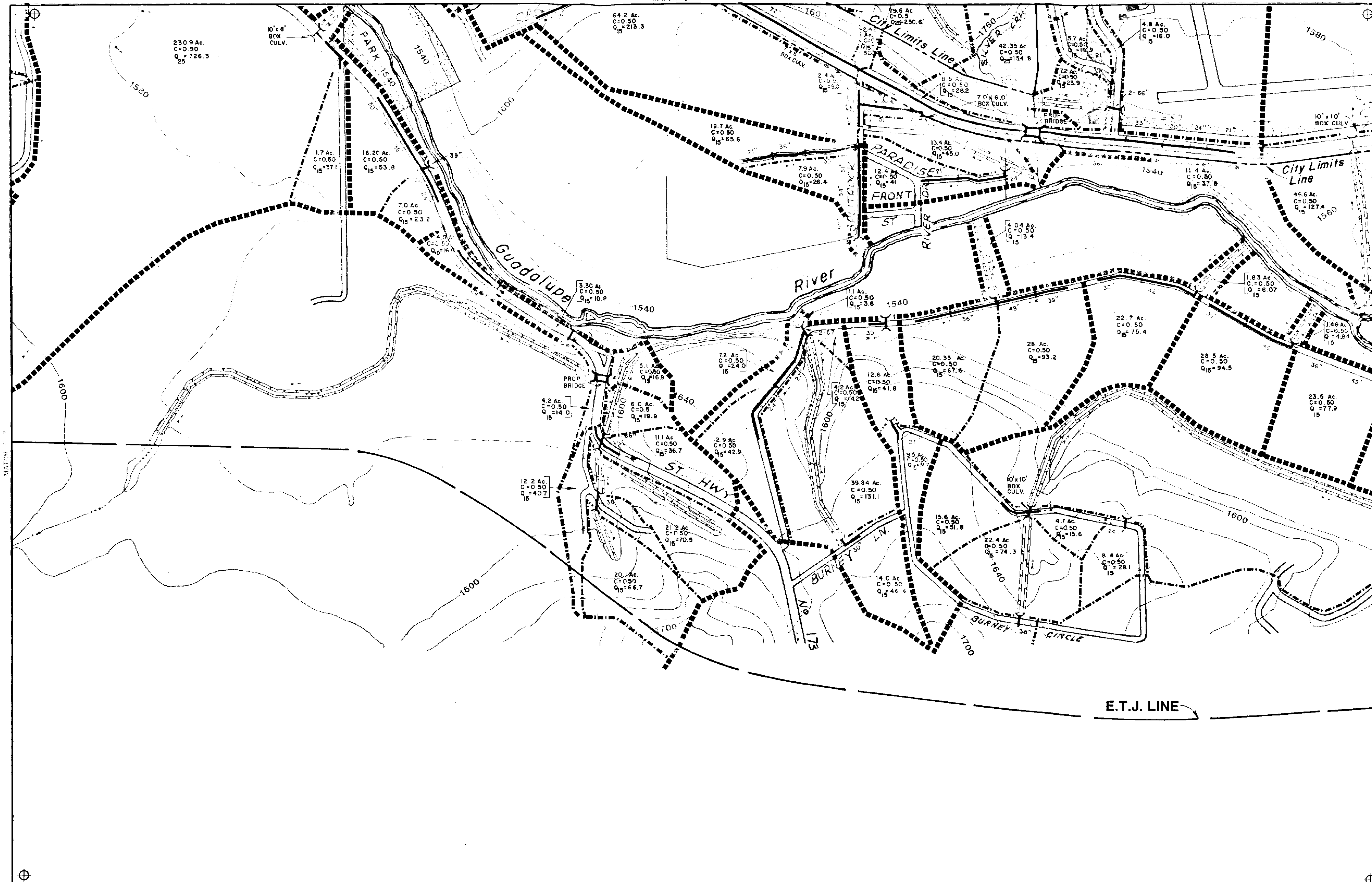
PLATE 37

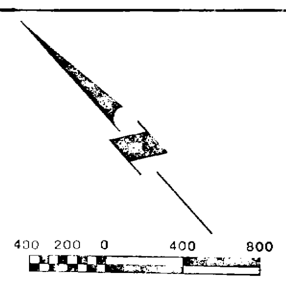
D-3

CITY OF KERRVILLE, TEXAS

PROPOSED
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers • Planners • Consultants
Austin/Dallas, Texas





LEGEND

	PROP. CHANNEL
16"	PROP. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
	MAJOR DRAINAGE DIVIDE
	MINOR DRAINAGE DIVIDE
	SUB-MINOR DRAINAGE DIVIDE

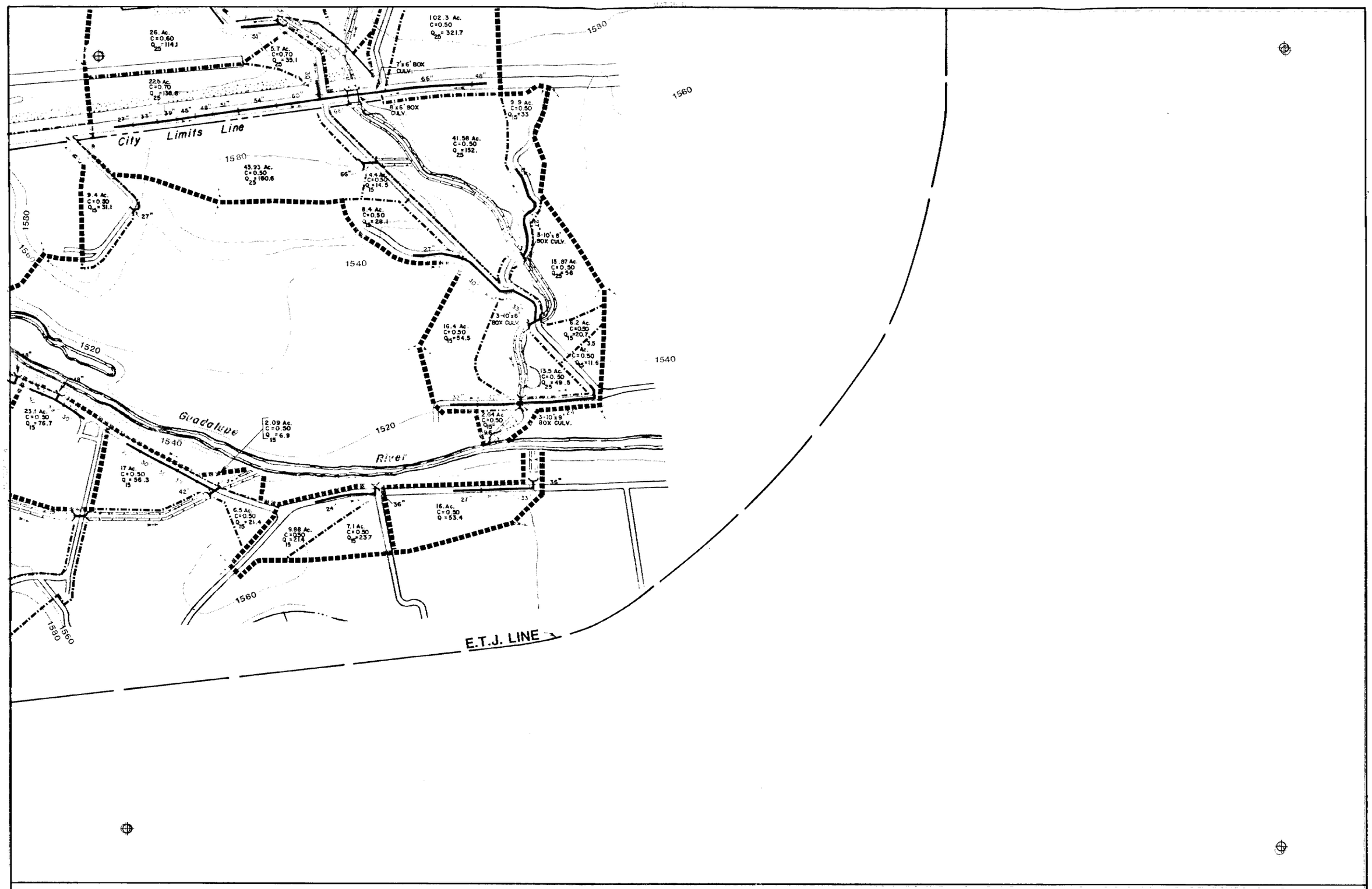
PLATE 38

D-4

CITY OF KERRVILLE, TEXAS

PROPOSED
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers • Planners • Consultants
Austin/Dallas, Texas



400 200 0 400 800
GRAPHIC SCALE IN FEET

LEGEND
- PROP. CHANNEL
- "9" PROP. STORM DRAINAGE SYSTEM (W/PIPE SIZE INDICATED)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE
- SUB-MINOR DRAINAGE DIVIDE

PLATE 39

D-5

CITY OF KERRVILLE, TEXAS

PROPOSED
STORM DRAINAGE SYSTEM

HOGAN & RASOR, Inc.
Engineers • Planners • Consultants
Austin/Dallas, Texas

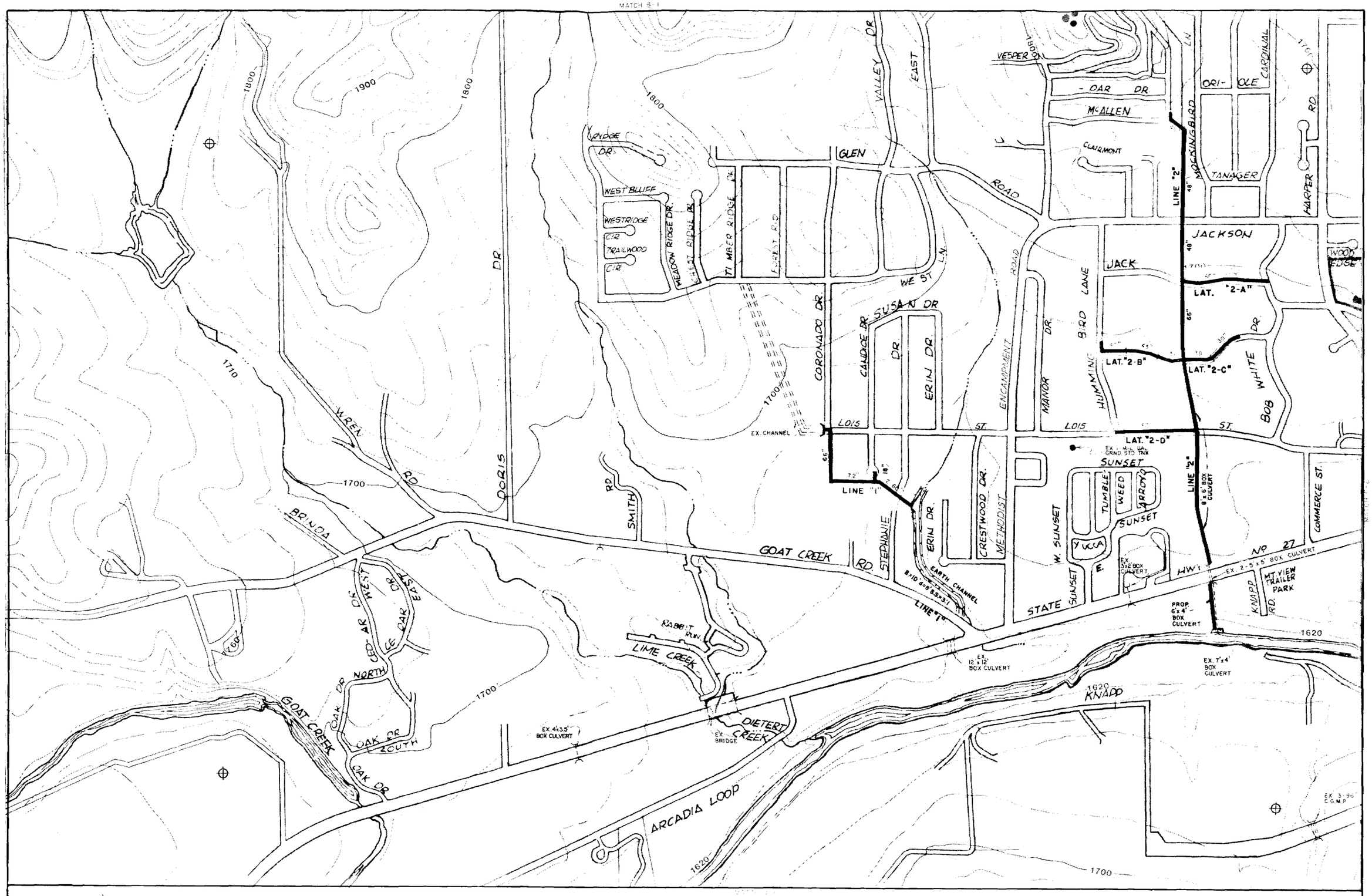
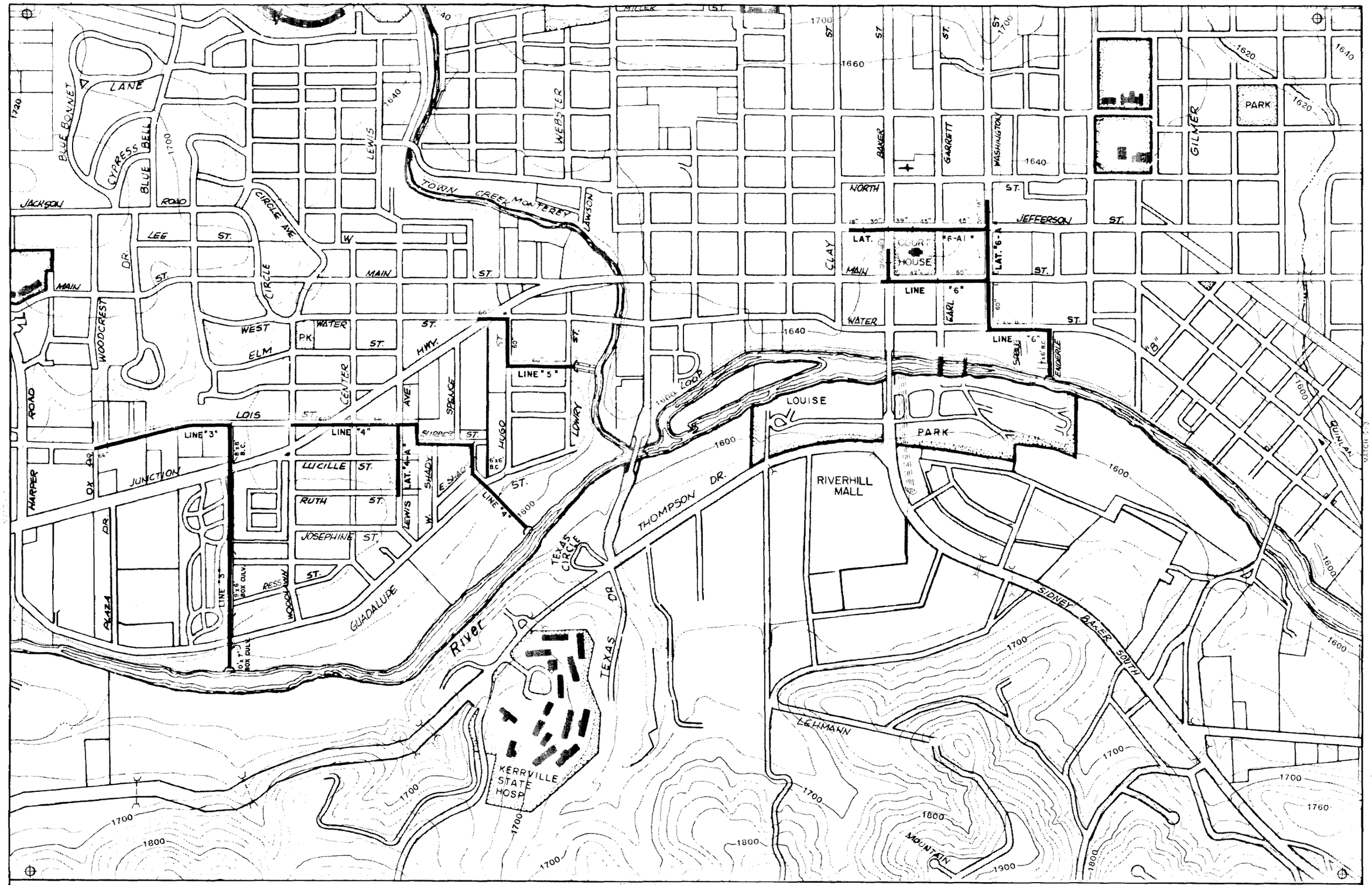


PLATE 40

C-1

CITY OF KERRVILLE, TEXAS
CAPITAL IMPROVEMENTS
FOR
STORM DRAINAGE FACILITIES

HOGAN & RASOR, Inc.
Engineers - Planners - Consultants
Austin/Dallas - Texas



400 200 0 400 800
GRAPHIC SCALE IN FEET

LEGEND
PROP. STORM SEWER
PROP. CHANNEL

PLATE 41

C-2

CITY OF KERRVILLE, TEXAS
CAPITAL IMPROVEMENTS
FOR
STORM DRAINAGE FACILITIES
HOGAN & RASOR, Inc.
Engineers - Planners - Consultants
Austin/Dallas Texas

LEGEND

PROP. STORM SEWER

PROP. CHANNEL

400 200 0 400 800

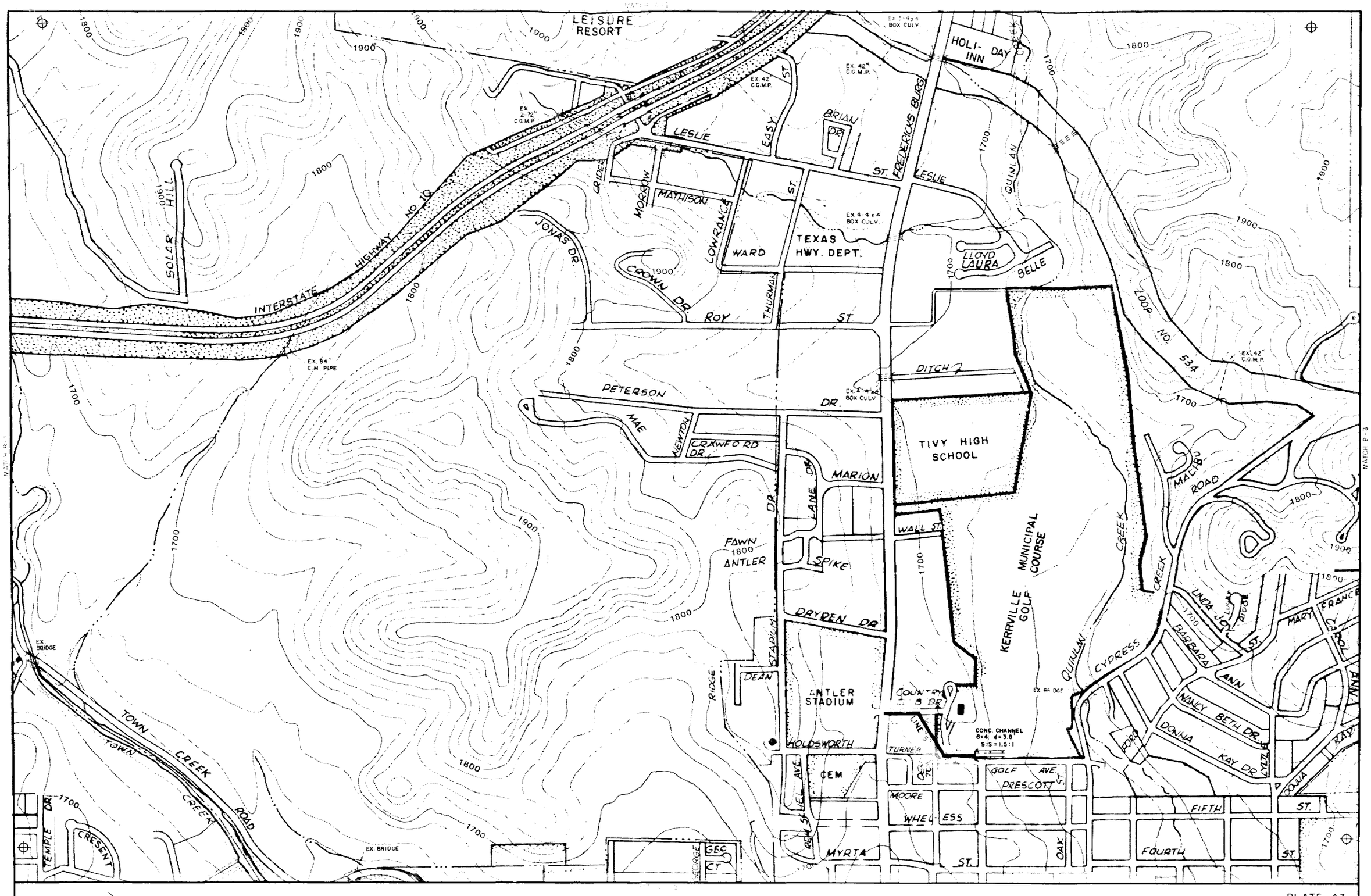
GRAPHIC SCALE IN FEET

PLATE 42

C-3

CITY OF KERRVILLE, TEXAS
CAPITAL IMPROVEMENTS
FOR
STORM DRAINAGE FACILITIES

BROWN & ROOT, Inc.
Engineers • Planners • Consultants
Austin/Dallas, Texas



400 200 0 400 800

GRAPHIC SCALE IN FEET

LEGEND

PROP. STORM SEWER

PROP. CHANNEL

PLATE 43

B-2

CITY OF KERRVILLE, TEXAS
CAPITAL IMPROVEMENTS
FOR
STORM DRAINAGE FACILITIES

HOGAN & RASOR, Inc.
Engineers · Planners · Consultants
Austin/Dallas Texas

MATCH B-3