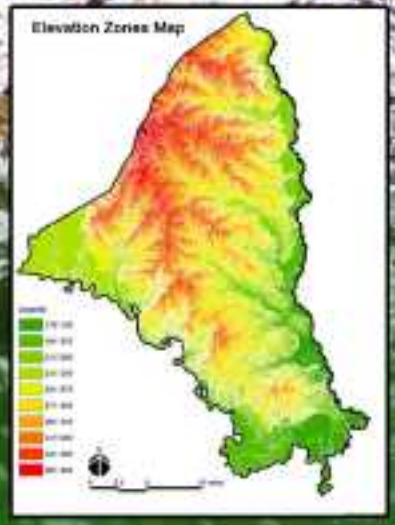
Watershed Conservation Planning

Brazos County, Texas Case Study

Xinyi Bu, BLA, MLA
Dingding Ren, BUP, MLA
Jon Rodiek, FASLA
Yaxuan Han, BLA, MLA
Xueqi Song, BUP, MLA

A collaborative effort between the MLA students of Spring LAND 621 Studio and LAND 684 Class



Watershed Conservation Planning
Brazos County, Texas

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Texas A&M University College of Architecture
Landscape Architecture and Urban Planning Department
College Station, TX 77843-3137

Dedication

The Watershed Conservation Planning, Brazos County, Texas and the creation of this E. Book were produced by the advanced year MLA students in the graduate program of Landscape Architecture in the Department of Landscape Architecture and Urban Planning at Texas A&M University, College Station, Texas.

We dedicate this E.Book to all of the people who contribute their time to support the ongoing environmental protection efforts to preserve riparian area, wildlife habitats, and open space in the Brazos County.

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Dedication

To Individuals in the Natural Sciences

Keith L. Caldwell asked the question, "Will humans adapt their ways of life to conserve the natural systems upon which their future and living world depend? "Caldwell, 1990, "Between Two Worlds"

Caldwell's words reframed the concept many of us in the Landscape Planning world have been engaged in resolving since the passage of the National Environmental Policy Act of 1969. His explanation advanced our thinking and our procedures for approaching the task.

Our thinking on this subject has been revised, influenced and improved over the years by many scholars who have the gift of superior thinking power. These people know that we perceive many factors, we make decisions between many options and most critically we observe the patterns that underlie the behavior of things around us.

This glorious collaboration yields better insights. We have come a long way since humans first attempted to differentiate the natural scene that lies before them. We have benefitted greatly from those whose life's work has guided our efforts.

Herein are some individuals who have made our challenges more tolerable having been elevated by the insights these people have created.

With respect and appreciation for them we shall carry on.

Dr. Jon Rodiek

Dr. Robert Bailey
USDA Forest Service

Dr. Ann Bartuska
USDA Forest Service

Dr. Carl Carlozzi
University of Massachusetts

Professor Bill MacConnell
University of Massachusetts

Dr. Forster Ndubisi
Texas A&M University

Dr. Jack Thomas
USDA Forest Service

Dr. Bill Wilen
USFWS National Wetlands Inventory

Dr. Erv Zube
University of Massachusetts

Dedication

To those organizations who support Landscape Conservation.

Landscape Conservation is a growing practice of people working together across large geographic areas, regardless of political boundaries to conserve our natural and cultural heritage so as to ensure a future for both people and nature. (The Network for Landscape Conservation)

Landscape Conservation promotes the concept of how to shape a relationship with the land and to practice activities that will sustain the land and our future generations who will live on it.

Our Landscape Architecture Programs at Texas A&M University are organized to educate our students to learn concepts, procedures and planning strategies that will apply to the advancement of this mission statement. We are able to do so because of the resources our University, State and citizens provide for us.

Here is a short list of those agencies, private groups and public organizations that have inspired us throughout this project.

Bayou Land Conservancy
Houston, Texas

Borderlands Research Institute
Alpine, Texas

Nueces River Authority
Uvalde, Texas

Rice Design Alliance
Houston, Texas

Timber Lane Utility District
Cypress, Texas

Texas Parks and Wildlife
Austin, Texas

The Wildlife Society
Bethesda, Maryland

Sanibel-Captiva Conservation Foundation, Sanibel Island, Florida

USDA Forest Service
Washington, D.C.

USFWS National Wetlands Inventory, Washington, D.C.

USFWS Region 2
Arlington, Texas

Whidbey Camano Land Trust
Green Bank, Washington

Team Members

Dingding Ren
BUP: Yunnan University
(2006-2011)
MLA: Texas A&M University
(2015-2018)

Xueqi Song
BUP: Beijing University of Technology
(2010-2015)
MLA: Texas A&M University
(2015-2018)

Xinyi Bu
BLA: Beijing Forestry University
(2010-2014)
MLA: Texas A&M University
(2015-2018)

Yaxuan Han
BLA: Tianjin Agricultural University
(2010-2014)
MLA: Texas A&M University
(2015-2018)

TABLE OF CONTENTS

Chapter 1 INTRODUCTION 1-14

Chapter 2 PART 1. THE STUDY AREA 15-24

Chapter 3 PART 2. STUDIO PROCEDURE 25-28

Chapter 4 PART 3. RESULT OF THE STUDIO FINDINGS 29-80

Chapter 5 OUTCOMES & CONCLUSIONS 81-92

Chapter 6 APPENDIX 1. LANDSCAPE CLASSIFICATION 93-116

Chapter 7 APPENDIX 2. RIPARIAN SYSTEM DETAILS 117-144

Chapter 8 REFERENCE 145-151

Introduction

Watershed Conservation Planning
Brazos County, Texas

TABLE OF CONTENTS

I. Introduction 1
I. Introduction - A. The Setting 2-3
I. Introduction - B. The Premise 4
I. Introduction - C. The Problem 5-6
II. Targeting the Problem Geographically 7
III. Simplifying the Ecosystem Perspective 8-11
IV. Linking Planning to Research 12-14

I. Introduction

The business of educating students in the techniques, procedures, skills and philosophy of landscape planning is a daunting task. What begins as an adventure in creative thinking and problem solving quickly turns into issues of overwhelming complexity and conflicts that seem impossible to remedy. There arises an inescapable ambiguity in the relationship between plans and results. The serious student soon realizes there are many deterrents to sound landscape plan policy making. Without reliable knowledge of the conditions for landscape planning, policies are most likely to result in compromises, failures and unsatisfactory end points.

Landscape planning, like most intellectual activities, is an orientation of the sprit and the mind. It is not the belief that something will turn out well but the conviction that the plan will make sense regardless of how it turns out. The design studio is organized to make that happen.

I. Introduction - A. The Setting

Texas A&M University MLA Program

The Landscape Architecture graduate program here at Texas A & M University is an accredited program sanctioned to train entry level students to join the profession. It offers a three year program including a studio sequence that brings organized problems of land planning to the student for resolution.




MLA Studio

Each studio is structured to expose real problems of planning and design in an accelerated manner.

Year One	Focused on general planning and design conditions.
Year Two	Brings to the student more refined leading edge problems.
Year Three	Student selects a contemporary problem and organizes their own solution response.This third year is much like the real world of practice they will face upon graduation.

Souce: https://i.vimeocdn.com/portrait/3977118_640x640 Texas A&M Landscape Architecture Face book

I. Introduction - B. The Premise

The Team

This work presented herein is the product of a second year spring semester studio.
Fifteen students engaged the project over a fifteen week semester.


Bao, Mengfei


Bu, Xinyi


Han, Yaxuan


Hegde, Manasa


Liu, Yao


Ruan, Danna


Rojas, Carolina Pena


Ren, Dingding


Song, Xueqi


Tao, Zhihan


Wang, Zehao


Ye, Kaidi


Zhao, Bingjie


Zhao, Liang


Zhu, Rui

I. Introduction - B. The Premise

Questions Needed to Be "Answered"

Question 1

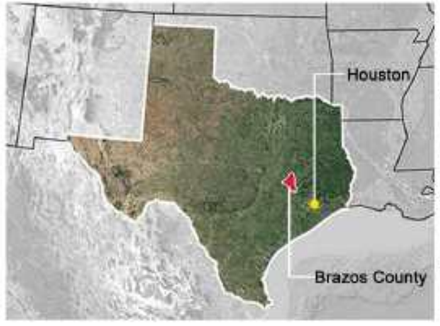
"Is it possible for urbanization and landscape protection to be integrated into a positive activity where growth brings with it the reality of landscape protection and conservation? "

Question 2

"How can the goal of resource and landscape protection within the urbanized environments of the Brazos County be achieved? "

Site Location

Brazos County borders on the northern edge of the greater Houston Area. Houston is the fourth largest city in the United States. When put in this context the dimensions of the planning problem change dramatically. A more comprehensive perspective is needed if the studio is to be a meaningful and useful experience.



Source: Google Earth Combined Files

I. Introduction - C. The Problem: Human Population Growth

Introduction

Science plays an ever-increasing role in the landscape planner's formulation of concepts directed at solving our problems. Recently the environment shows signs of major and long term dysfunctions to their operation. Six issues that constitute threats and problems to the integrity and renewability of our biosphere have been identified (Caldwell 1990).

1. Loss of topsoil through erosion and deterioration.	2. Depletion and degradation of fresh water.	3. Contamination of the biosphere (air, water, soil, living things).
		
4. Devegetation of the land.	**5. Destruction of natural habitats.**	**6. Loss of biosphere diversity and variety.**
		

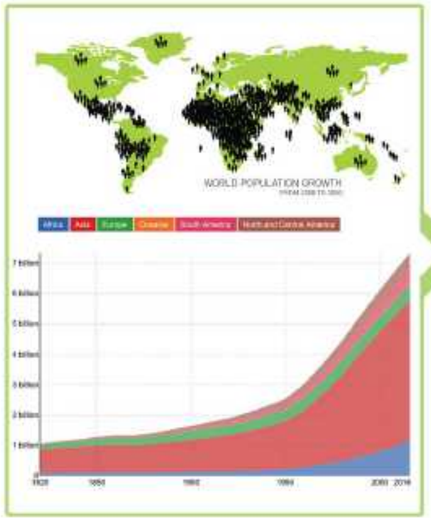
Souce: http://www.tiredearth.com/sites/default/files/deforestation-impacts-soil-erosion-HI_36828.jpg https://comfortablyunaware.files.wordpress.com/2014/11/79462_990x742-cb1399479545.jpg http://www.thestar.com.my/lifestyle/features http://www.islandschoolhistory.com/uploads/1/4/9/6/14967012/clearcut-1.jpg https://actionsprout-actions.s3.amazonaws.com/WFSHGRhcQX6fXmjdXBEg.jpeg http://www.globalpowerinmotion.com/v1/wp-content/uploads/2016/03/sumatra_deforestation1_custom-39040cba07f740c9627ec3f75c5fd0982029db73-1024x681.jpg

I. Introduction - C. The Problem: Human Population Growth

Result of Population Growth

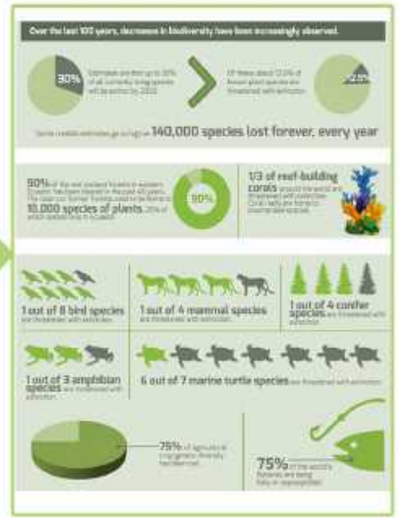
These disruptions have evolved over the long term and are seen as abusive to the natural environment. They have arisen as a result of the increase in human population growth. This large scale habitat degradation and fragmentation is believed to be the major cause of biodiversity loss world wide (Enoksson, B., et al 1995, Fahrig 2003, Ewers, R.M., R. K. Didham, 2006, Vitousek et al 1997, Hobbs and Yates 2003). Resource use is on the rise. Land, water and natural vegetation are converted into human environments. Habitat is lost. Biological species diversity and variety that comes under this human influence are reduced. Human population growth spirals upward to 6.7 billion people and counting.

Population Growth



Habitat degradation and fragmentation

Biodiversity Loss



Souce: HYDE Global Population by Region https://www.flickr.com/photos/laurenmanning/2979974719 http://outdoornebraska.gov/habitatloss/ http://www.earthrangers.com/wildlife/take-action/western-bumble-bee/ https://www.pinterest.com/pin/233131718186969428/

II. Targeting the Problem Geographically

10 U.S. "Megapolitan Areas"

Our increased numbers have resulted in unprecedented expansion into our natural environments. Robert Lang and Dawn Dhavale give us a real perspective on the problem (Lang and Dhavale 2005). Their study identifies 10 U.S. "Megapolitan Areas" or clustered networks of metropolitan areas that exceed 10 million total residents (or will pass that mark by 2040).

Six areas lie in the eastern half of the U.S. while four are found in the west. Urbanization contained within these regions has a population equal to France, Germany, and the United Kingdom combined. That is by anyone's measure a significant change in the landscape.

Megapolitan Land Area And Population

	Megapolitan Areas	Total (sq. miles)	2003 Population
East	Midwest	119,822.2	40,082,288
	Piedmont	91,093.1	19,318,992
	Northeast	70,061.6	50,427,921
	Peninsula	37,644.3	13,708,165
	Gulf Coast	68,540.4	12,064,600
	I-35 Corridor	75,125.7	15,315,317
West	Cascadia	46,532.0	7,412,248
	NorCal	34,065.5	12,024,173
	Southland	51,722.2	22,173,291
	Valley of the Sun	23,787.2	4,486,206

Source: Beyond Megalopolis: Exploring America's New "Megapolitan" Geography.pdf.

The Megapolitans

Interstates and Megapolitans

III. Simplifying the Ecosystem Perspective

Overview

Land use planning strategies have attempted to bring ecological concerns into the planning process. The results have not been very impressive. The difficulty is ecological science and planning concepts have not been successful in merging their separate interests into a working scheme. The problem is the conflicts that arise when the ecological strategy of maximum biomass production and protection collides with the human strategy of maximum consumption of biomass production.

Eugene Odum believes that a meaningful land use policy begins by recognizing the ecological basis of the conflict between humans and nature (Odum 1969). The goal of intensive forestry or agriculture is to achieve high rates of harvestable products leaving little standing crop left on the landscape. A high P/B (production/biomass) efficiency is realized. Nature's strategy realized in the outcome of successional stages of plant growth is directed toward the reverse efficiency – a high B/P (biomass /production) ratio.

III. Simplifying the Ecosystem Perspective

Problem

Humans are focused on production by developing and maintaining early stage successional types of ecosystems, usually some type of monocultures. Humans have taken for granted the gaseous exchange, water purification, nutrient cycling and related protective functions of self-maintaining ecosystems.

Two Solutions

Solution 1 Compromise between quantity of yield and quality of living space.




Solution 2 Compartmentalize the landscape so as to maintain highly productive and predominantly protective types as separate units subject to different management strategies.

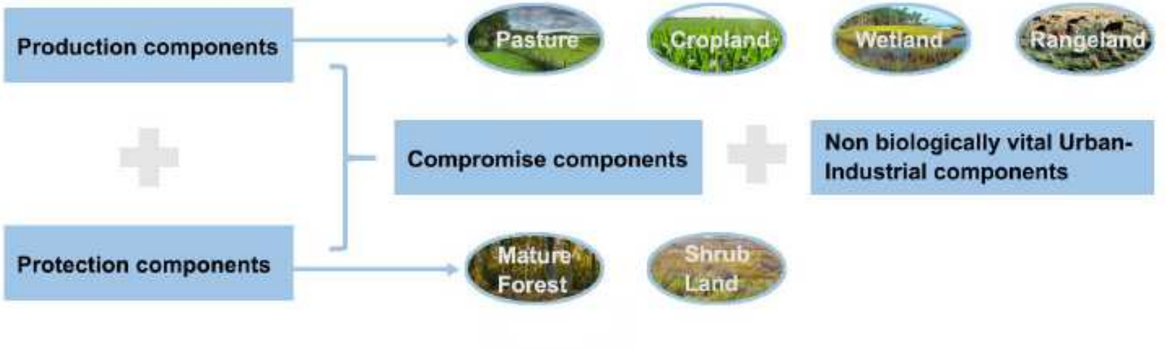



https://en.wikipedia.org/wiki/Human_impact_on_the_environment
Barbour MG et al. 1999. Terrestrial Plant Ecology. Benjamin Cummings, Menlo Park, CA

III. Simplifying the Ecosystem Perspective

Odum Concept

Odum conceptualizes the management of a planned area to be composed of Production components (pastures, croplands, wetlands, rangelands etc.); Protection components (mature forests, shrub lands etc.) in which gaseous exchange, water purification, nutrient cycling, and other functions take place; Compromise components made up of Protection and Production components; and finally non biologically vital Urban- Industrial components exist.



The System of Management

By continually refining the size and output of these units overtime it would be possible to determine the limits that must eventually be imposed on each component in order to maintain regional or even national balances of energy and materials. This system of management would allow us to determine when we are getting too much of a good thing. It could also allow for the evaluation of energy draws imposed on ecosystems by pollution, harvest or other stresses (H.T. Odum 1967)

https://i.vimeocdn.com/portrait/3977118_640x640

III. Simplifying the Ecosystem Perspective

Compartmental Model

The compartmental model could be used to create a kind of zoning system of landscape types for the protection and conservation of those most highly productive and protection components. A county that is experiencing growth (change in landscape structure and function) could install a zoning ordinance that accommodates growth but does so by incorporating protection and conservation additions to the growth areas so as to guarantee a more robust kind of growth. These growth areas would include a mix of urban, rural, wild land and suburban areas.

Production and protection function assessment would allow for a diverse growth but one that is determined to be more sustainable and desirable.

Bryan and College Station Growth

1985 2000 2016

Increased urbanization from 1985- 2016 has resulted in natural landscape losses.

Souce: Google earth

IV. Linking Planning to Research

USDA Forest Service

A final consideration will help validate the studio decision making process. We want to link our planning decisions to a real research and development operation. The USDA Forest Service serves this need well. They have been conducting extensive research work to guide management of wild lands, rangelands and forestlands for over 90 years. Good planning work is based on sound research and development practices. The Forest Service is one of the most preeminent agencies of this type.

Research Work

https://www.fs.fed.us/

IV. Linking Planning to Research

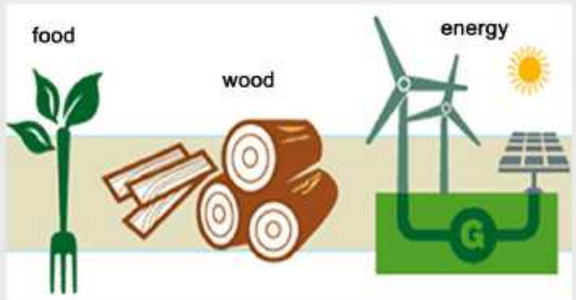
Ann Bartuska's Concept

We support the concept developed by former Deputy Director of Research Ann Bartuska. She stated in her annual report in January 2005 that the agency will continue to seek ways to live in harmony with our dynamic environment. She felt it important for her agency to play a major part in developing and protecting our natural resources. She believes the intercommunications between society and the environment are profound and must be the basis for our future science endeavors.

She put forth several major themes to serve as drivers for research and management programs within the scientific community. These include (Bartuska 2005):

Restoration and Recovery-managing with Change

Capturing Value in Ecosystems



Source: https://www.montgomerycountymd.gov/DEP/Resources/Images/PosterPamphlets/Restoring_Montgomery_Countys_Streams.JPG http://www.nerc-bess.net/wp-content/uploads/2017/02/UNESCO-EcosystemServices.gif

IV. Linking Planning to Research

Ann Bartuska's Concept

Understanding Social Dynamics and Resource Use

Providing Urban Natural Resource Leadership

Linking Land Use and Water

We shall adopt these themes as part of our effort to create a conservation and protection plan for Brazos County.

Source: http://www.bedfordcountyconservation.com/Images/watershed_diagram1.jpg http://www.graycompanies.com/images/NEW/main/IMG_8943-2.jpg http://tpwd.texas.gov/jobs/images/tpwd-brochure-cover.jpg http://www.texasranchlife.com/uploads/6/3/1/7/63178860/2878341_orig.jpg

Part 1. The Study Area

Watershed Conservation Planning
Brazos County, Texas

TABLE OF CONTENTS

The Study Area - Brazos County..... 15-18
I. Goals - Primary..... 19-21
II. Goals - Secondary..... 22
III. Objectives..... 23-24

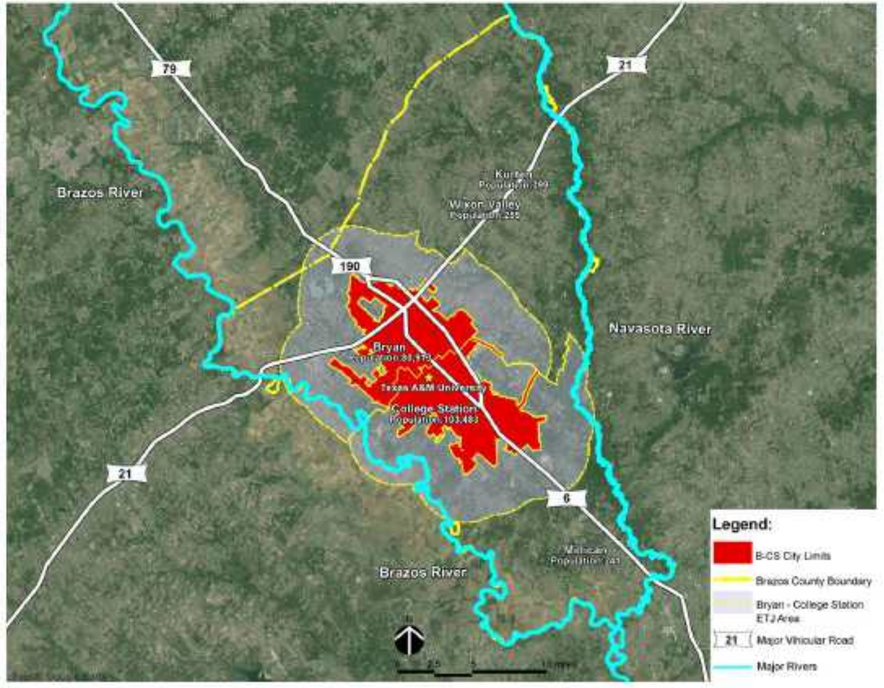
Part 1. The Study Area – Brazos County

Brazos County

Brazos County was formed in 1841. It has a total of 591 square miles of land. Two of the county's borders are defined by major rivers. The Brazos River forms the western border. The Navasota forms the eastern border. The county has one major urban center, the Bryan/College Station metropolitan area. There are four smaller urban centers that are out riders to this urban core.

B/CS Area

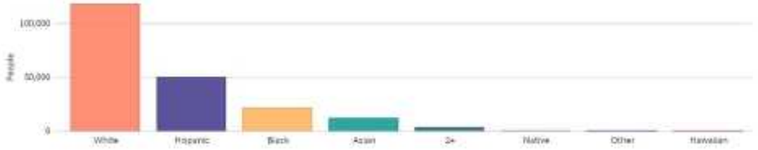
The B/CS is dominated by the influence of Texas A & M University. This major institution is a source of significant growth and development in the county.



Source: Google Earth

Part 1. The Study Area – Brazos County

Population Distribution

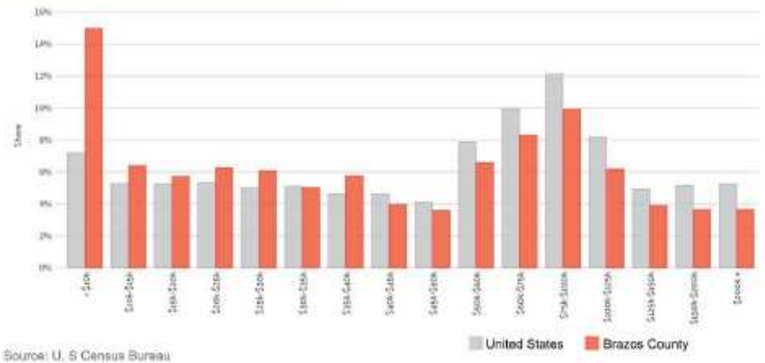


The population distribution shows 74.45% white, 19.72 % Black or African Americans and 0.36 % Native Americans.

Age Breakdown

The age breakdown shows 76% within the 18 to 44 YOA and 20% over the age of 44 YOA.

Yearly Income



The per capita income is $16,212 (2000 census). 14% of families and 26.9% of households exist below the poverty line. These statistics reflect a large group of young people existing at low economic levels. This may be due to the large number of students attending the university.

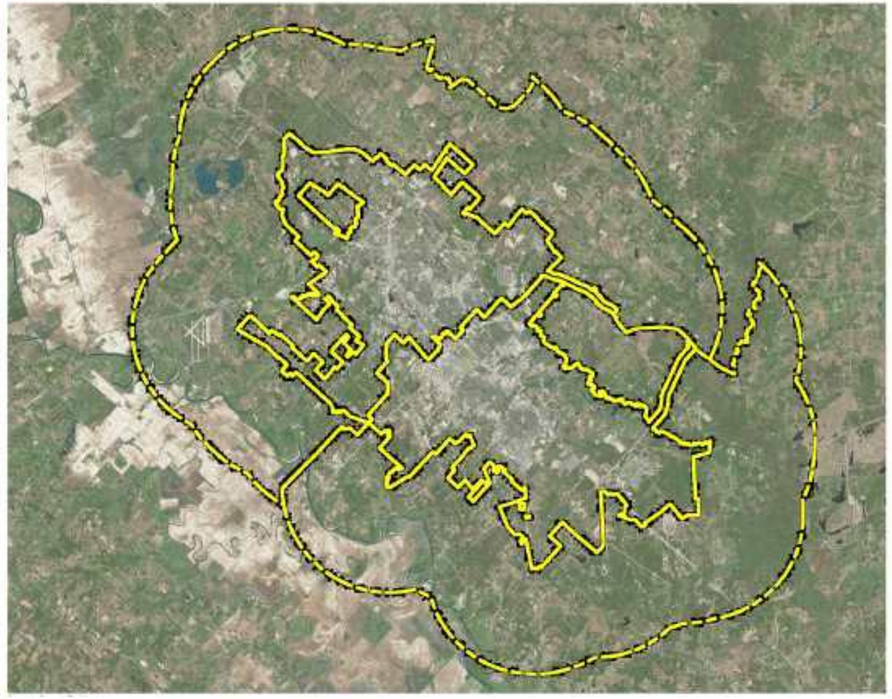
Source: U. S Census Bureau

Part 1. The Study Area – Brazos County

ETJ Zones

The future for the county is largely based on the expansion of the Bryan/College Station urban center. TAMU plays a major role in defining this economic direction and growth. The B/CS area has developed no effective means to deal with the environmental issues that lie outside the development of the B/CS and ETJ zones (Extra Territorial Jurisdiction).

Environments within the ETJ are viewed as zones of urban development. There is a need to develop an environmental protection plan for landscapes, habitats and open space that exist in the ETJ and the surrounding land exterior to the ETJ.



Source: Google Earth

Part 1. The Study Area – Brazos County

Reasons to Consider This Plan

There are three basic reasons to consider that this protection plan could be supported by the county residents.

First	There is a large amount of area that is still in a natural condition. Forests, pastures, riparian streams and open space abound just outside the development zone.
Second	There are a large number of informed and active people within the population who know the value of this natural resource base. They are aware that there are ways to change the current situation both from a planning and social point of view. Many of the young people come from the surrounding region within 200 miles of the B/CS area. They know this kind of development is happening in their former areas as well. This is not a local problem. This is a state-wide problem that can be addressed.
Finally	The problem of resolving this issue has state and national solutions of how to go about changing urban expansion to be more sensitive to the problem. This problem is well within the capacity of county and state governments to do something about this.

Forest

Riparian Stream

Pasture

http://miriadna.com/desctopwalls/images/max/Pasture.jpg http://www.digitalistmag.com/files/2015/11/forest.jpg http://today.agrilife.org/wp-content/uploads/2013/11/Riparian-Pic-1.jpg

Part 1. The Study Area – Brazos County

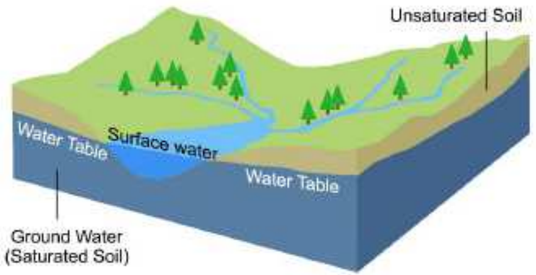
I. Goals - Primary

There are two primary goals for this project. They were taken directly from the deputy director's goals stated above. If we are to make a valid statement about conserving and protecting landscapes and habitats that make up the bulk of the open space afforded the citizens of the county we must identify the most significant ones for special treatments. These landscapes are kept viable because of their link to the county's drainage network. We need to create goals that will guide our selection and protection zoning procedure.

Goal 1 — **Link land use to water**

The selected landscapes shall be those that are by their characteristics of structure and function linked to surface and ground water resources.

Protection and conservation zoning are to be assigned to these landscapes so as to protect the landscape and the water resources as one functioning unit.



Part 1. The Study Area – Brazos County

I. Goals - Primary

Goal 2 — **Capture the value in ecosystems found on those sites**

Landscape structure controls the redistribution of organisms, material and energy among landscape components. Landscape functions for these landscapes are seen to be linked to spatial heterogeneity and functional heterogeneity.

Spatial heterogeneity is a property generally ascribed to a landscape or to a population. It refers to the uneven distribution of various concentrations of each species within an area. ... Plant species richness directly reflects spatial heterogeneity in an ecosystem.

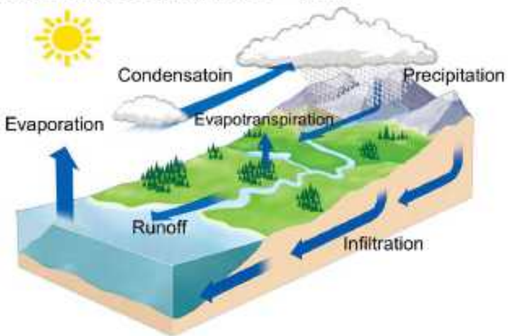
Functional heterogeneity focuses on equilibrium such as energy balance and energy transfers.

Spatial heterogeneity

Vegetation Distribution | **Water Resource Distribution**

Functional heterogeneity

Energy Balance and Transfers -- Water



Source: https://res.cloudinary.com/dk-find-out/image/upload/q_80,w_1440,f_auto/Water_Cycle_mockup_ap5kal.jpg, TNRIS GIS Data

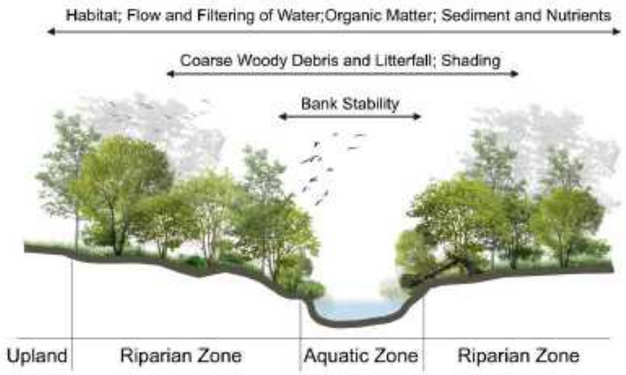
Part 1. The Study Area – Brazos County

I. Goals - Primary: Goal 2 Cont.

A landscape's value is determined by its spatial modification characteristics and by the plant community species found there. Our primary landscape Frp (Forest Riparian) is valued because the plant species found there are influenced by the interaction of the various plants and the movement of plant species, through succession, to locations that are more favorable as they mature and develop more specific capabilities to survive in this changing habitat.

As the plant community groups move and change over time they in turn modify the environment and the habitat through energy exchange differences and environmental adjustments to these plant growth and location changes.

Frp (Forest Riparian)



Brazos River, Brazos County

Part 1. The Study Area – Brazos County

II. Goals - Secondary

Goal 3

Link the conservation and protection of the landscape in the county to the local understanding and social dynamics of land use.

We know the land ethic is strong as evidenced in the use of land in the surrounding countryside. We must instill in our planning efforts a spirit and respect for the land that is already being practiced there. The ranching and farming land uses are to be a part of our conceptualization of future of the county.

Goal 4

Provide assistance for local, regional and state resource leadership groups.

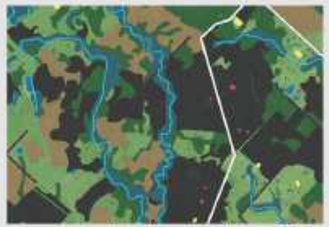
The greater Houston area, the state's TPWD and related resource groups along with national and state alliances can form a significant stakeholder group to assist in the protection of a county's resources.

III. Objectives

Objective 1

Identify the most significant landscape resources in the county and map them for consideration for protection and conservation.

Aerial



Landscape Interpretation

Objective 2

Assess the distribution of these landscape resources on a watershed basis.

Watershed # 2

Watershed # 1

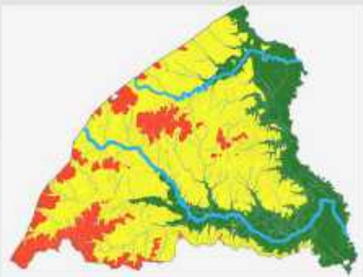
Part 1. The Study Area – Brazos County

III. Objectives

Objective 3

Link these resources to the unique character of each of the seven watersheds found in the county.

Watershed # 2

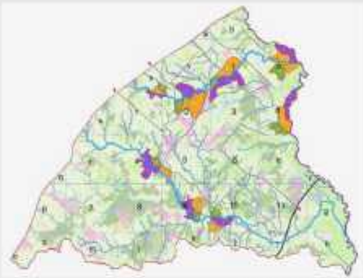


Watershed # 1

Objective 4

Develop a package of resource protection zoning types that reflects the natural and cultural condition of the people and land use types found in each of these watersheds.

Watershed # 2



Watershed # 1

Part 2. Studio Procedure

Watershed Conservation Planning
Brazos County, Texas

TABLE OF CONTENTS

Phase I. Research and Inventory.....25
Phase II. Analysis.....26
Phase III. Synthesis.....27-28

Part 2. Studio Procedure

The studio procedure follows a three-step process

Phase I. Research and Inventory

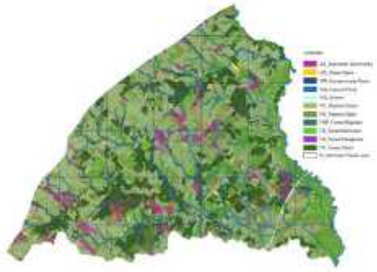
The research and inventory phase identifies the research issues related to the planning problem and then carries out the inventory of the County's natural landscapes. The inventory involves interpretation of landscape cover types found in the county.

Site inventory

Interpretation of landscape cover

Drainage Network

Aerial Grid System



Landscape Cover Types

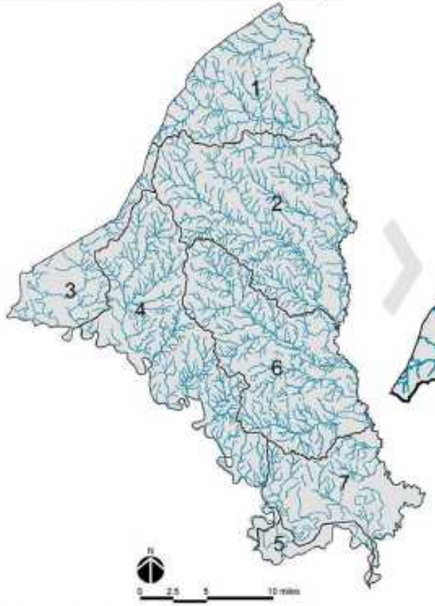
Souce: Google earth

Part 2. Studio Procedure

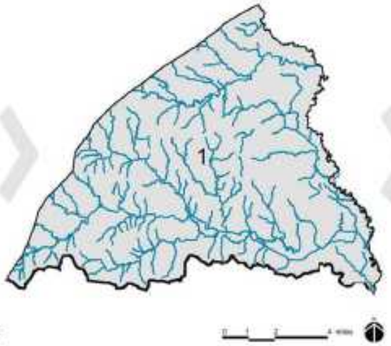
Phase II. Analysis

The analysis phase uses the inventory to assess the distribution and character of landscapes found in the county's seven watersheds. This inventory establishes a five components land classification system. Forests, Pasture, Water/stream channel, Urban and Road systems are classified. Once a baseline condition is established it is possible to select conservation and protection zoning sites that would serve to keep those landscapes intact as urban growth expands into the ETJ, Rural and Wild lands in the various watersheds.

Watersheds of Brazos County



Watershed #1



Aerial of area

Souce: Google earth

Part 2. Studio Procedure

Phase III. Synthesis

The synthesis phase will create a planning process that selects representative landscape types found throughout the seven watersheds. A second selection will be made at the watershed level to identify one site for creating a county park to serve the recreation and open space needs of the county's. This park will contain landscapes that are to be put under protection and developed as conservation sites for the habitats and wildlife forms found there. Finally a one-acre site located within the county park will be planned and designed as a demonstration site.

Example 1

Watershed #2

Segment Within Watershed

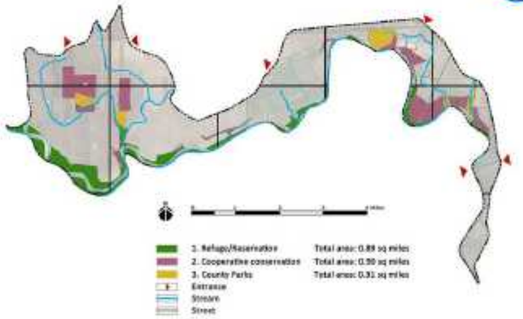
Site Level County Park

Souce: Google earth

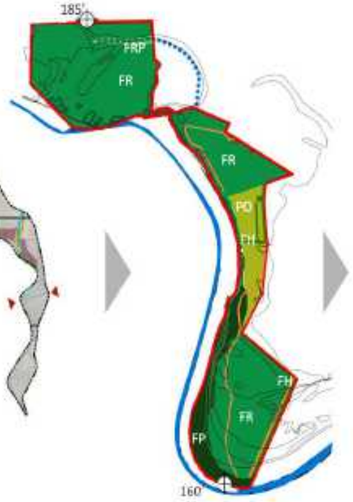
Part 2. Studio Procedure

Phase III. Synthesis

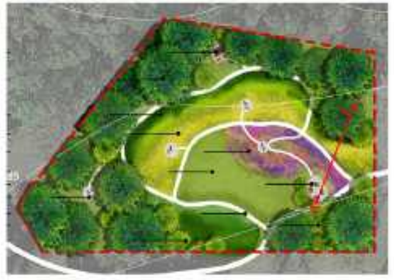
Example 2



Watershed #5



Segment Within Watershed



Site Level County Park

Part 3. Result of the Studio Findings

Watershed Conservation Planning
Brazos County, Texas

TABLE OF CONTENTS

Phase I. Research and Inventory

Goals and Objectives 29
12 Landscape Cover Subtypes 30-35
Drainage Network Map 36

Phase II. Analysis

Goals and Objectives 37
Primary Landscapes 37-38
Secondary Landscapes 39-40
Development Landscapes 41-42
Site Selecting Process 43-44

Phase III. Synthesis 45

Design Package 46-80

Part 3. Results of the Studio Findings - Phase I. Research and Inventory

Goals and Objectives

Goal 2 "Capture the value in the ecosystems found on the site"

Objective 1 "Identify the most significant landscape resources in the county and map them for potential protection and conservation zoning"

An aerial photo classification and interpretation system was developed, tested, and validated. The study teams then applied the system of interpretation to the County's seven watersheds. (See appendix) The range of landscape cover types was organized into 5 types: Forest, Pasture/Open space; Water/Stream channels; Urban types and Roads. These five types had a total of 12 subtypes. This range of cover types is a simplification of the of the diverse conditions of land cover that exist in the county. The classification system attempts to simplify the conditions into a user friendly package that is comprehendible to the general public. It is here where the communication of all findings is targeted. If we are successful here we can anticipate understanding. If our system of knowledge generation becomes too complex it loses comprehensiveness and therefore utility.

Forest

Pasture/Open Space

Water/Stream Channels

Urban Types

Roads

http://www.diamondfire.com/wp-content/uploads/2016/02/DJI_0105-244x163.jpg http://c5le236.uf.daum.net/image/1510433C4EF7F2CC15B640 https://static1.squarespace.com/static/d3754/t/5d5db0bee3e111663/Picture1.jpg

Part 3. Results of the Studio Findings - Phase I. Research and Inventory

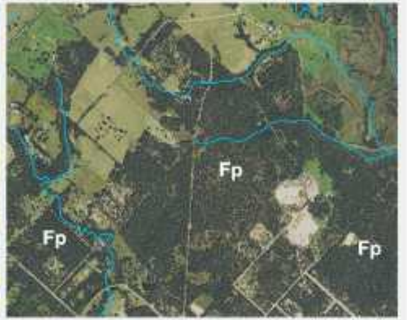
12 Landscape Cover Subtypes

Forest: Forest Patch (Fp)

Fp

Forest Patch (Fp)

Forest Patch (Fp)



Aerial Photo

Forest: Forest Hedgerow (Fh)

Fh

Forest Hedgerow (Fh)

Forest Hedgerow (Fh)

Aerial Photo

http://www.ambietica.com.br/fotos/fragmentos%20mata.JPG https://imgs.mongabay.com/wp-content/uploads/sites/25/2015/12/03173517/forest_resilience3.png

12 Landscape Cover Subtypes

Forest: Forest Remnant (Fr)

Forest: Forest Riparian (Frp)

http://conservationcorridor.org/wp-content/uploads/remnant_forest-400x267.jpg https://travel.mongabay.com/costa_rica/600/costa-rica-d_0183.jpg http://mongabay-images.s3.amazonaws.com/780/-rica-d_0180.jpg

12 Landscape Cover Subtypes

Pasture: Pasture Grass (Pg)

Pasture: Pasture Open (Po)

https://basik.ru/images/nature_wallpapers_462/48_nature.jpg http://1wallpaper.net/grass-field-pasture-trees-wallpaper.html#.WVQdRoyIEY

12 Landscape Cover Subtypes

Water: Stream (Ws)

Water: Human-made Pond (Wp)

https://www.opotikinews.co.nz/images/228222/fenced_waterway.jpg https://ak6.picdn.net/shutterstock/videos/11230025/thumb/1.jpg?i10c=img.resize(height:160)

Part 3. Results of the Studio Findings - Phase I. Research and Inventory

12 Landscape Cover Subtypes

Water: Natural Pond (Wn)

Urban: Suburban Community (Us)

https://hermitsdoor.files.wordpress.com/2013/06/p1040996.jpg http://1wallpaper.net/grass-field-pasture-trees-wallpaper.html#.WVQdRojytEY

Part 3. Results of the Studio Findings - Phase I. Research and Inventory

12 Landscape Cover Subtypes

Urban: Urban Open (Uo)

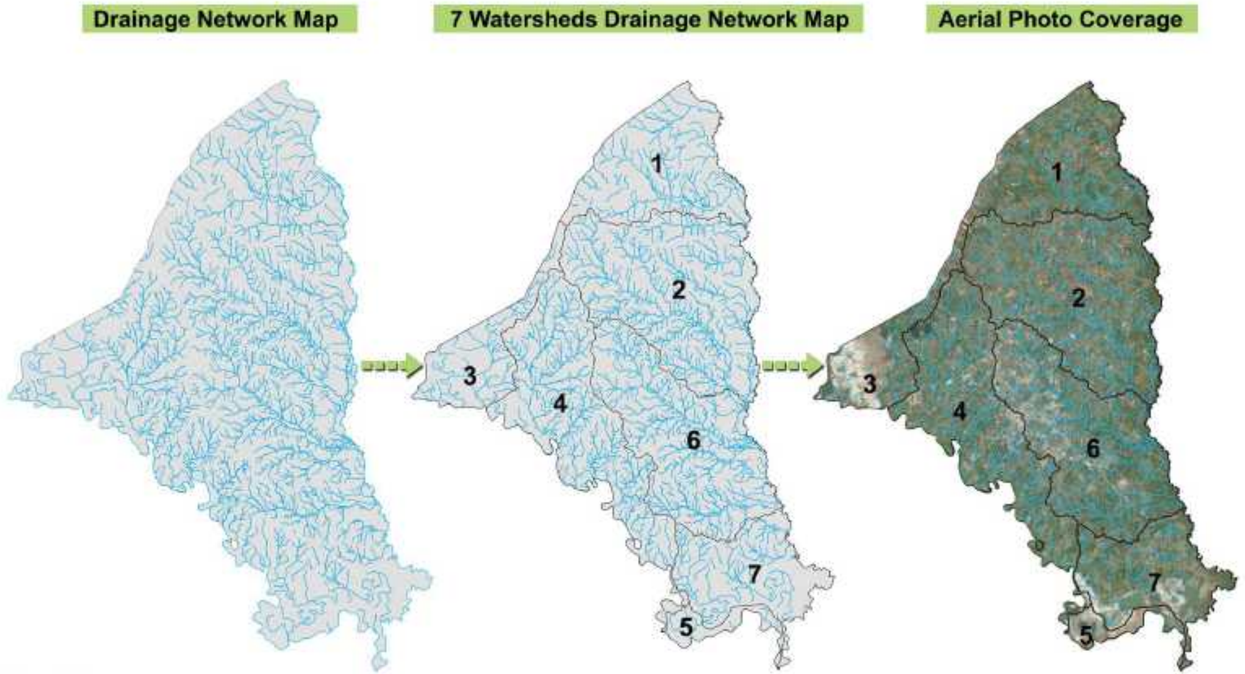
Roads: Vehicular Travel Lane (R)

http://drcinfo.org/wp-content/uploads/2015/02/SaltwaterDisposalWellBakken_140856234079O3.jpg https://cdn.landsofamerica.com/inv/2108713/2108713-1412091353174186-o.jpg

Part 3. Results of the Studio Findings - Phase I. Research and Inventory

Drainage Network Map

Each watershed was placed into a drainage network map. Aerial photo coverage was obtained from available G.I.S. files. The watershed study areas were then placed into a watershed/drainage network where aerial photo imagery was overlaid upon drainage conditions.This watershed map was then ready for interpretation and analysis.



Source: G.I.S

Part 3. Results of the Studio Findings - Phase II. Analysis

Goals and Objectives

Goal 1 Link land use to water

Objective 2 Assess the distribution of these landscape resources on a watershed basis

The study teams identified three types of landscapes. The primary landscape types were deemed to be most productive based on an ecological interpretation of their structure and function.

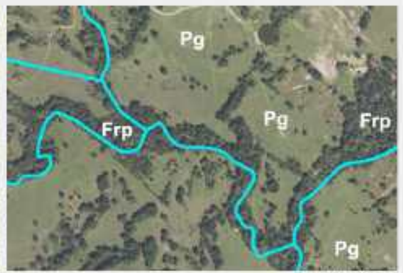
Primary Landscapes

Frp (riparian forests) coupled with Pg (high production pasture lands).

Frp + Pg

Forest Riparian and Grass Pasture

Forest Riparian and Grass Pasture



Aerial Photo

Source: Google Earth http://www.chesapeakebay.net/images/blog/sept_6_16big.jpg https://upload.wikimedia.org/wikipedia/commons/7/71/Riparian_strip.jpg

Part 3. Results of the Studio Findings - Phase II. Analysis

Primary Landscapes

In addition Frp + Fr (Forest remnant), Frp + Fp (Forest Patch) were also considered most productive

Frp + Fr

Forest Riparian and Forest Remnant

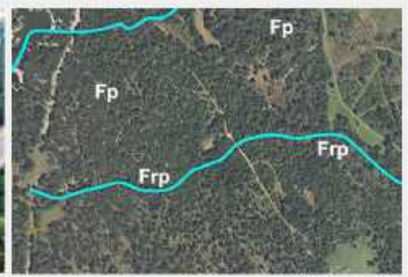
Forest Riparian and Forest Remnant

Aerial Photo

Frp + Fp

Forest Riparian and Forest Patch

Forest Riparian and Forest Patch



Aerial Photo

Source: Google Earth http://updateranchandland.com/wp-content/uploads/2015/10/0-FM-283-Eliasville-76481-Dax-Pass-Briggs-Freeman-Sotheby-ranch-and-land-for-sale-in-Texas-Chrystal-Falls-Ranch-river.jpg https://upload.wikimedia.org/wikipedia/commons/3/30/Anjajavyforestrazorback.jpg http://static.panoramio.com/photos/large/77465974.jpg http://www.riverpartners.org/img/beehive_bend_2008_760.jpg

Part 3. Results of the Studio Findings - Phase II. Analysis

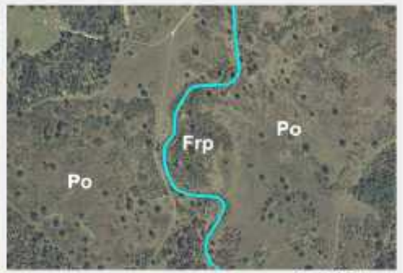
Secondary Landscapes

Secondary landscapes were deemed of secondary productive importance. Frp (Forest Riparian) coupled with + Po (Pasture overgrazed/ ecologically degraded)

Frp + Po

Forest Riparian and Pasture Overgrazed

Forest Riparian and Pasture Overgrazed



Aerial Photo

Source: Google Earth http://ian.umces.edu/imagelibrary/albums/userpics/11062/normal_ill-eco-en-00049.jpg http://forestry.ky.gov/LandownerServices/Publishing/Images/riparianbufferstripexample.jpg

Part 3. Results of the Studio Findings - Phase II. Analysis

Secondary Landscapes

In addition Fp + Po , Fr + Po were considered productive.

Fp + Po

Forest Patch and Pasture overgrazed

Forest Patch and Pasture overgrazed

Aerial Photo

Fr + Po

Forest Remnant and Pasture overgrazed

Forest Remnant and Pasture overgrazed

Aerial Photo

Source: Google Earth https://cdn.landsofamerica.com/inv/3897747/3897747-170501130122314 7-o.jpg http://1.bp.blogspot.com/-1W65mn9yuTU/TgDBqngEVxI/AAAAAAAABDM/Nb7ocpPZPs4/s1600/bluebells.jpg http://www.chassmiddleton.com/blog/wp-content/uploads/2016/02/88A2249-large-720x518.jpg https://mdc.mo.gov/sites/default/files/media/images/2014/11/27-12-2014.jpg

Part 3. Results of the Studio Findings - Phase II. Analysis

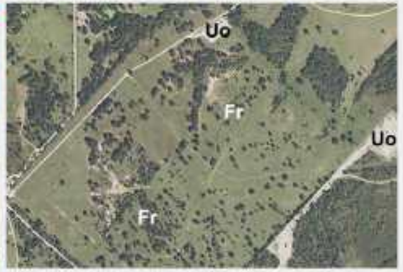
Development Landscapes

Combinations of Uo or Us with Po or Fr, Fp were considered to be most desirable Urban development sites

Uo + Fr

Urban Open and Forest Remnant

Urban Open and Forest Remnant

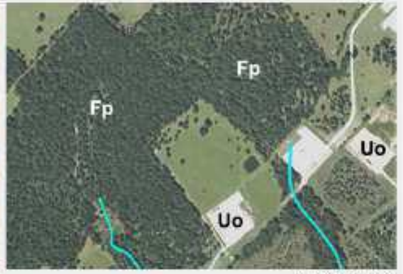


Aerial Photo

Uo + Fp

Urban Open and Forest Patch

Urban Open and Forest Patch



Aerial Photo

Source: Google Earth http://www.theguardian.pe.ca/content/dam/tc/the-guardian/images/2014/1/17/20140117-fracking-2534263.jpg http://1.bp.blogspot.com/-1W65mn9yuTU/TgDBqngEVxI/AAAAAAAABDM/Nb7ocpPZPs4/s1600/bluebells.jpg https://pmewswire2-a.akamaihd.net/p/1883751/sp/189375100/thumbnail/entry_id/1_xyq27d9h/def_height/1200/def_width/1600/version/100011/type/1 https://www.fractracker.org/a5ej20sjfwe/wp-content/uploads/2015/02/Loyasock-Stem-2013.jpg

Part 3. Results of the Studio Findings - Phase II. Analysis

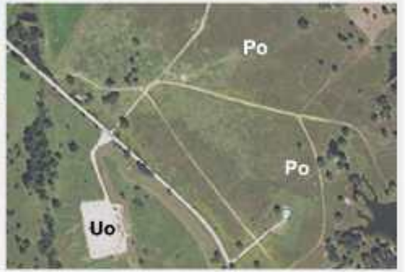
Development Landscapes

Combinations of Uo or Us with Po or Fr, Fp were considered to be most desirable Urban development sites

Uo + Po

Urban Open and Pasture overgrazed

Urban Open and Pasture overgrazed



Aerial Photo

Us + Po

Urban Suburban and Pasture overgrazed

Urban Suburban and Pasture overgrazed

Aerial Photo

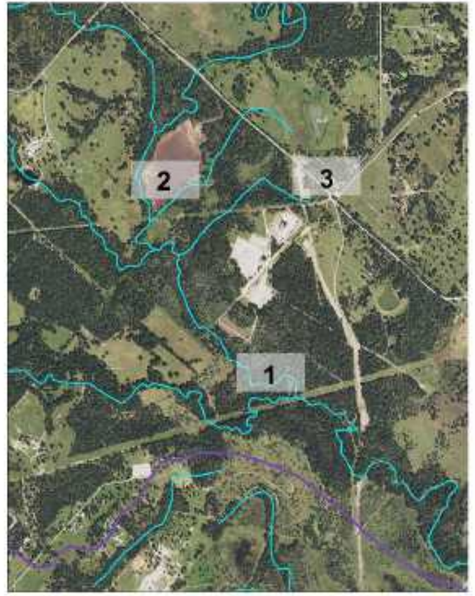
Source: Google Earth http://cdn.oilprice.com/a/img/content/article/718x300/fcd944815787c781a57effed68cc9652.jpg https://i0.wp.com/blog.mysanantonio.com/eagle-ford-fix/files/2013/04/LutherAerial.jpg https://www.google.com/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&ved=0ahUKEwjd4v-SguTUAhUC7oMKHeMEBo8QjBwIBA&url=http%3A%2F%2Fcdn8.dissolve.com%2Fp%2FD634_15_266%2FD634_15_266_0004_600.jpg&psig=AFQjCNEXPZDGsisMbW-vKqvX_rcB4eZHRA&ust=1498858746481874&cad=rjt

Part 3. Results of the Studio Findings - Phase II. Analysis

Site Selecting Process

Once the landscape cover types were established a zoning conservation and protection plan could be created. It was important for the teams to integrate a consideration of existing land use cover types for zoning in this process. Each watershed has evolved its own particular land use patterns. Protection and conservation zoning has to recognize the degree and type of land uses that have been built into a watershed system. What might be a good choice for zoning in one watershed might be unimportant or conflicting if imposed upon another watershed.

Site Aerial Photo



1. Primary Landscapes: Frp + Fp

2. Secondary Landscapes: Frp+ Po

3. Development Landscapes: Uo + Fr

Source: https://upload.wikimedia.org/wikipedia/commons/0/07/Brazos_River_below_Possum_Kingdom_Lake%2C_Palo_Pinto_County%2C_Texas.jpg
http://img.cxnewsweb.com/C/07/18/00/image_7800187.jpg, http://blairwells.com/wp-content/gallery/photos-132015/Initial-Set-up.PNG

Part 3. Results of the Studio Findings - Phase II. Analysis

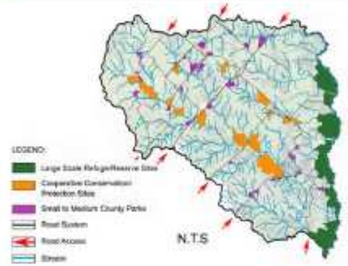
Site Selecting Process Cont.

The Analysis phase was designed to assess the landscapes in its watershed and to determine a process for selecting the most important ones to be saved or zoned for protection by the plan. The criteria for selection included:

1 **Elevation zone location**

2 **Linkage to stream where longer stream length is valued**

3 **Proximity to other primary landscape clusters**



4 **Proximity to major drainage channels (Navasota and Brazos Rivers)**

5 **Proximity to B/CS population center and access roadway**

This interpretation and selection process allowed for a better final location, distribution and arrangement of the clusters of Primary Landscapes to be zoned for protection within the county.

Part 3. Results of the Studio Findings - Phase III. Synthesis

Goals and Objective

Goal 3 Link the conservation and protection of the landscape in the county to the local understanding and social dynamics of land use.

Goal 4 Provide assistance for local, regional and state resource leadership groups.

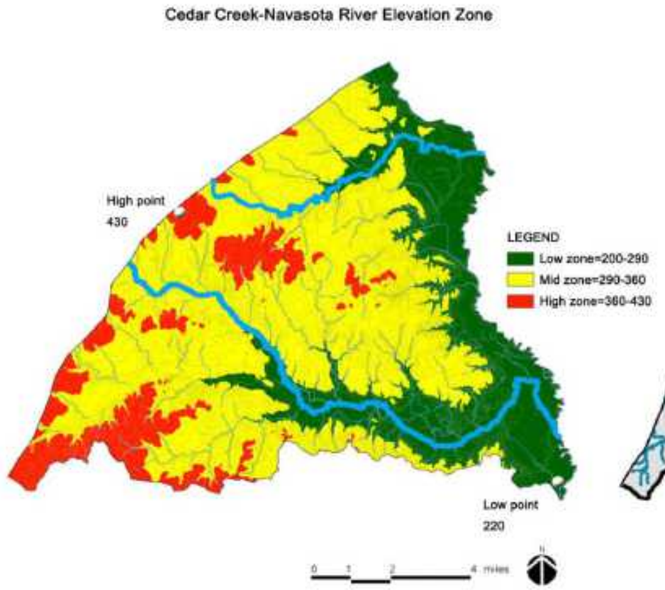
Objective 3 Link these resources to the unique character of each of the seven watersheds found in the county.

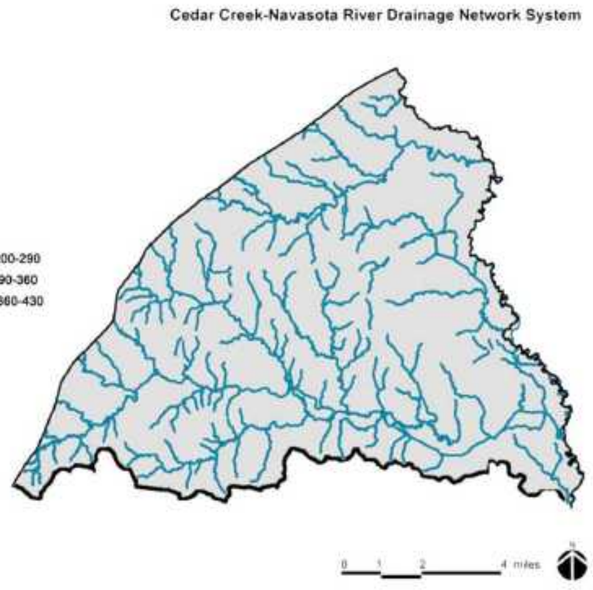
Objective 4 Develop a package of resource protection zoning types that reflects the natural and cultural condition of the people and land use types found in each of these watersheds.

Part 3. Results of the Studio Findings

1. Elevation Zones – Longest 2 Stream Channels in Watershed

Watershed #1 Cedar Creek-Navasota River



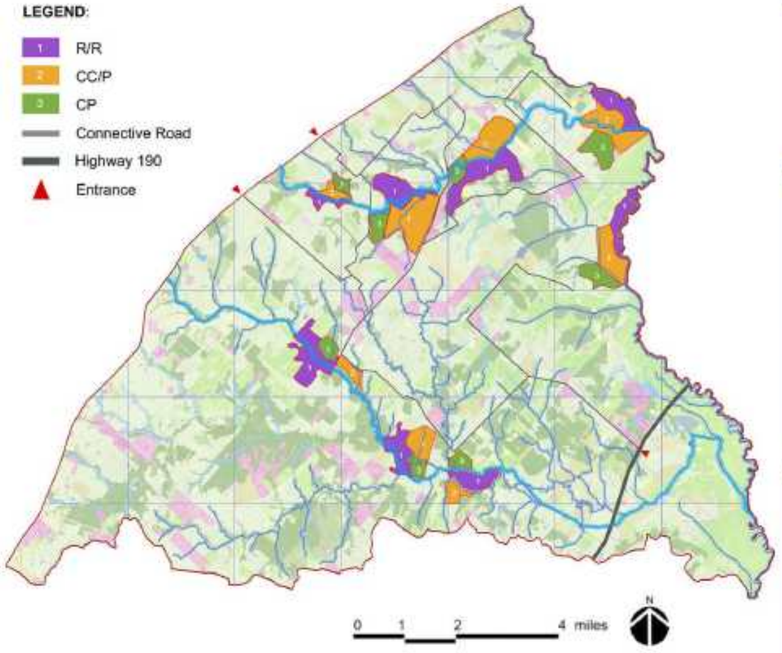


Part 3. Results of the Studio Findings

2. Protection/Conservation Sites Selected in Water Dispersal Strategy

Watershed #1 Cedar Creek-Navasota River

Cedar Creek-Navasota River Drainage Network System



Executive Summary

Large Scale Refuge/Reserve Sites

Frist of all, the conservation sites should be located near major streams of the Navasota River and the two longest streams flowing into the Navasota River. Secondly, we choose the sites with dense green canopies that are not disturbed by human development. Finally, we selected the sites with riparian zones.

Cooperative Conservation/Protection Sites

Firstly, the cooperative conservation sites located adjacent to the county park sites are transition zones between the conservation sites and other land-use areas. Secondly, the cooperative conservation areas are located along the main tributaries of the Navasota River. The main tributaries of the two longest streams flowing into the Navasota River and Frp (forest riparian) will maximize the protection of the hydrologic resources. Finally, those areas covered by Pg (pasture) are selected to bring fields, forests, streams, and wildlife back to health. This can enhance these private lands.

Small to Medium County Parks

Country parks are selected based upon accessibility and availability of natural resources. Firstly, the parks are located close to existing roads with easy access. Secondly, areas near the conservation and cooperative conservation areas with good natural resources can provide educational opportunities in county parks. Thirdly, the sites include areas covered with Fp (forest patch) and Pg (pasture) so as to create spaces with various characteristics and recreational uses.

Part 3. Results of the Studio Findings

3. Site Selection - One Prototype for Master Planning County Park Multiple Acre Park

Proposed Property Boundary, Cedar Creek-Navasota River Watershed #1, Brazos County, Texas

Watershed #1 Cedar Creek-Navasota River

Aerial Photo Acre: 424acres

Reference: Texas statewide imagery and GIS data
https://tnris.org/data-download/#/statewide

Legend

1. Shaped Site + Roads
   - Site Boundary
   - Main Roads
2. High / Low Point
   - 330' High Point
   - 285' Low Point
3. Existing Water
   - Water Streams
4. Contours
   - Contour (10 ft interval)
5. Land Types
   - US_Suburban Community
   - UO_Urban Open
   - WP_Human-made Pond
   - WN_Natural Pond
   - WS_Stream
   - PG_Pasture Grass
   - PO_Pasture Open
   - FRP_Forest Riparian
   - FR_Forest Remnant
   - FH_Forest Hedgerow
   - FP_Forest Patch
   - R_Vehicular Travel Lane

Description

1. **Landform**: Generally, the elevation changes from northwest to southeast. It is higher in the northwest and lower in the southeast.
2. **Water:** There is one major tributary of Navasota river that passes through the site.
3. **Access:** There is an existing road passing through the site in the north-south direction which provides convenient access for the visitors.
4. **Vegetation:** Based upon airphoto interpretation, the site is mainly covered by the forest patches and forest riparian, which are the most valuable nature resources that should be preserved.

Part 3. Results of the Studio Findings

3. Site Selection - One Prototype for Master Planning County Park Multiple Acre Park

Elevation Zones, Cedar Creek-Navasota River Watershed #1, Brazos County, Texas

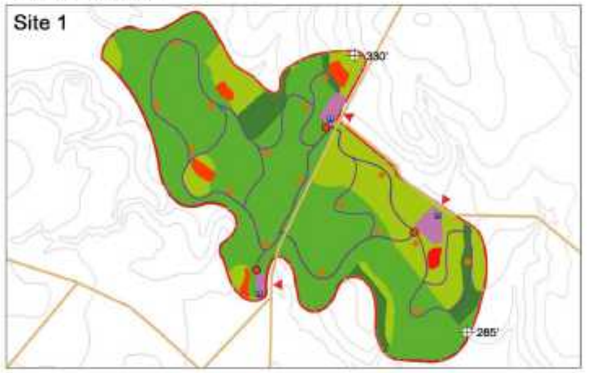
Part 3. Results of the Studio Findings

3. Site Selection - One Prototype for Master Planning County Park Multiple Acre Park

Land Use Planning strategy, Cedar Creek-Navasota River Watershed #1, Brazos County, Texas

Proposed Site Selection: Watershed #1 Regional park

Proposed Zoning



Legend

1. Shaped Site + Roads
   - Site Boundary
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2. High / Low Point
   - 330' High Point
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   - Water Streams
4. Contours
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   - PO_Pasture Open
   - FRP_Forest Riparian
   - FR_Forest Remnant
   - FH_Forest Hedgerow
   - FP_Forest Patch
   - R_Vehicular Travel Lane

Legend

Protection Zone
- Natural Habitats Existing
- Natural Habitats Proposed
- Buffer Zones

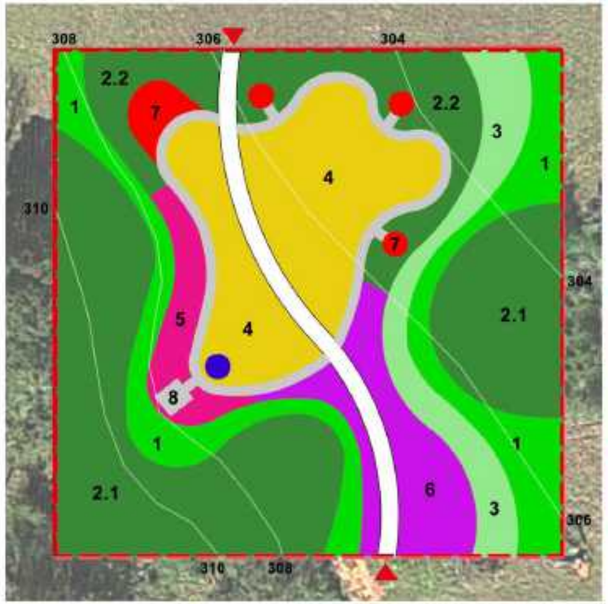
Urban
- Existing Road
- Parking
- Access
- Restroom

Recreational Zone
- Rest Stops
- Trails Head
- Picnic Sites
  - 1 table sites
  - Group tables sites
  - Pavillion sites
- Hiking Trail

Part 3. Results of the Studio Findings

4. Site Selection – One Prototype for Master Planning One Acre within Park

Land Use Zoning Plan, Cedar Creek- Navasota River Watershed #1



Pg	Zone 1 Ecotone area	Small shrub Large shrub
Fp Fr	Zone 2 Forest Patches	2.1 Existing forest 2.2 Native patches(planted)
Pg	Zone 3 Pasture	Existing pasture
Pg	Zone 4 Native Meadow	Restoration of prairie
Pg	Zone 5 Deer Forage	Forage crops
Pg	Zone 6 Wildflower Garden	Native wilderflowers
Pg	Zone 7 Picnic Area	Groves of trees + tables Trail sites
Pg	Zone 8 Animal Blind	

0 50 100 200 ft

Legend

Recreatinal Zone	Protection Zone	Special Features	Urban
Picnic Sites	1 Ecotone Area	4 Native Meadow	Access
Rest Stops	2 Forest Patches	5 Deer Forage	
Hiking Trails	3 Pasture	6 Wildflower Garden	
Hiking & Biking		8 Animal Blind	

Index Map

Site location

One-acre site

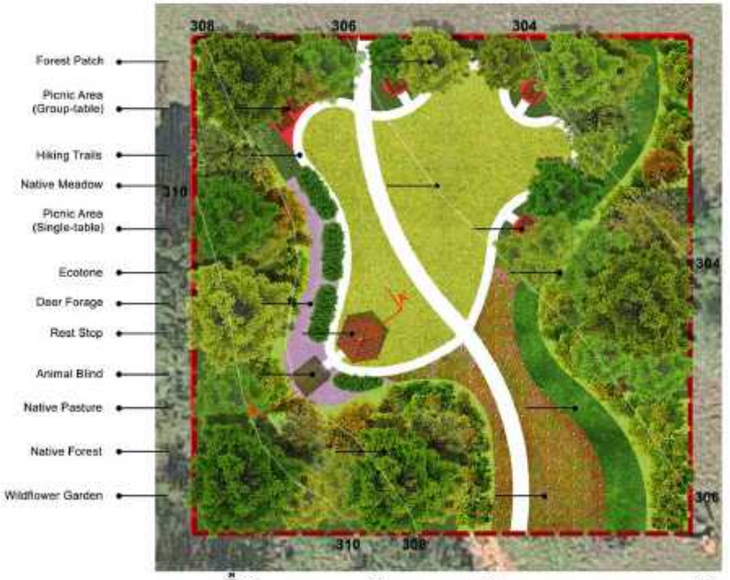
N.T.S

Part 3. Results of the Studio Findings

4. Site Selection – One Prototype for Master Planning One Acre within Park

Master Plan, Site Plan Rendering, Cedar Creek- Navasota River Watershed #1

Legend

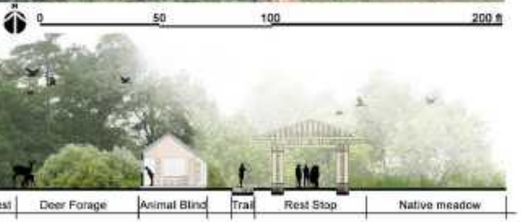


Existing Site

1 acre Park Boundary
Existing Contour

N.T.S

Section A-A'



Part 3. Results of the Studio Findings

4. Site Selection – One Prototype for Master Planning One Acre within Park

Plant list, Master plan, Cedar Creek-Navasota River Watershed #1

Tree List

Eastern Red Cedar
(Juniperus virginiana)

Little Gem Magnolia
(Magnolia grandiflora 'Little Gem')

Afghan Pine
(Pinus eldarica)

Arizona Cypress
(Cupressus arizonica)

Cedar Elm
(Ulmus crassifolia)

Texas Red Oak
(Quercus buckleyi)

Shrub List

Agarito
(Berberis trifoliolata)

American Beautyberry
(Callicarpa americana)

Apache Plume
(Fallugia paradox)

Barberry
(Berberis thunbergii 'Crimson')

Dwarf Burning Holly
(Euonymus alata 'Compacta')

Compact Nandina
(Nandina domestica 'compacta')

Source: http://www.txsmartscape.com/plant_search/getplantdatasingle.asp

Part 3. Results of the Studio Findings

4. Site Selection – One Prototype for Master Planning One Acre within Park

Plant list, Master plan, Cedar Creek-Navasota River Watershed #1

Groundcover

Asiatic Jasmine
(Trachelospermum asiaticum)

Frog Fruit
(Phyla nodiflora)

Ground Ivy
(Glechoma hederacea)

Alfalfa
(Medicago sativa)

Blue Grama
(Bouteloua gracillis)

Bushy Bluestem
(Andropogon glomeratus)

Wildflowers

Garden Verbena
(Glandularia hybrida)

Texas Bluebonnet
(Lupinus texensis)

Poppy
(Papaver spp.)

Gazania
(Gazania rigens)

Brown-eyed Suan
(Rudbeckia hirta)

Texas Lantana
(Lantana urticoides)

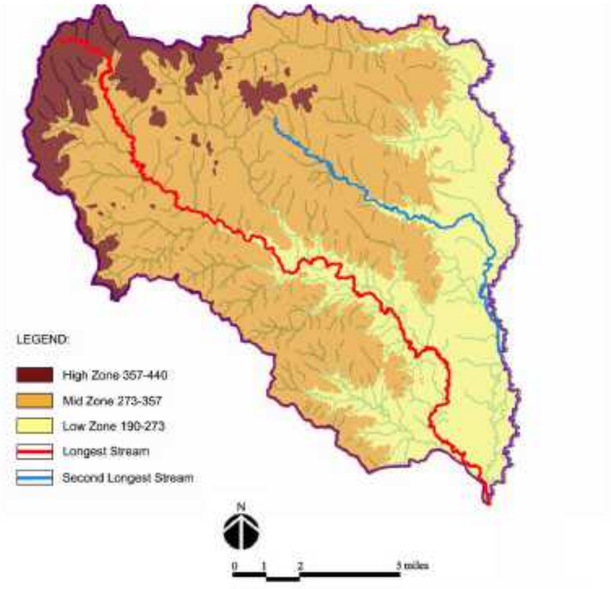
Source: http://www.txsmartscape.com/plant_search/getplantdatasingle.asp

Part 3. Results of the Studio Findings

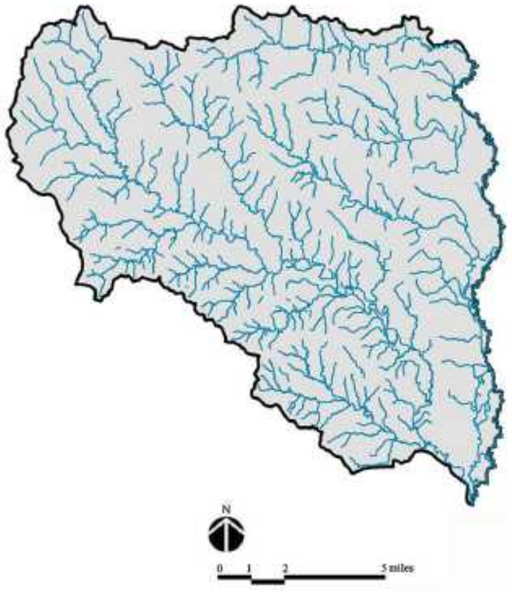
1. Elevation Zones – Longest 2 Stream Channels in Watershed

Watershed #2 Wickson Creek-Navasota River

The Two Longest stream in Wickson Creek-Navasota River Watershed



Wickson Creek-Navasota River Drainage Network System

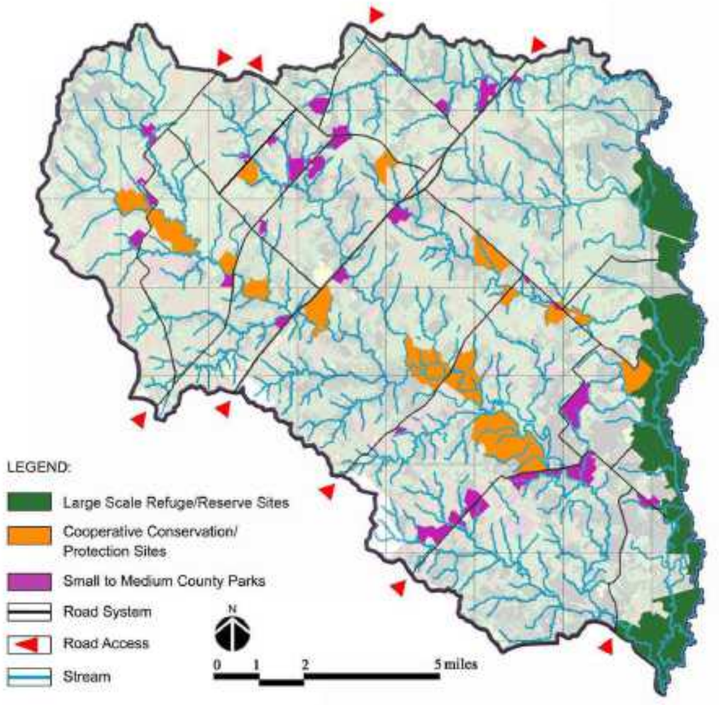


Part 3. Results of the Studio findings

2. Protection/Conservation Sites Selected in Water Dispersal Strategy

Watershed #2 Wickson Creek-Navasota River

Wickson Creek-Navasota River Drainage Network System



Executive Summary

Large Scale Refuge/Reserve Sites

Large Scale Refuge/Reserve Sites are selected near the Navasota river. The cover types are forest patch (Fp), forest remnant (Fr) and forest riparian patch (Frp) adjacent to the tributaries to the Navasota River. These sites will preserve the regional river systems and connect people with the river systems by creating some visitor trails. People could visit, recreate in and travel through the sites to gain the experience of environmental protection, education and conservation.

Cooperative Conservation/Protection Sites

Cooperative Conservation/Protection Sites are the relatively large forest riparian patch (Frp) and pasture grass (Pg) areas located nearby the two longest streams and roadways in the watershed. The two longest streams can bring water onto the sites. Good accessibility will encourage human use on these sites. These CCP sites also have great potential to be habitat islands, wildflower meadows and song habitats.

Small to Medium County Parks

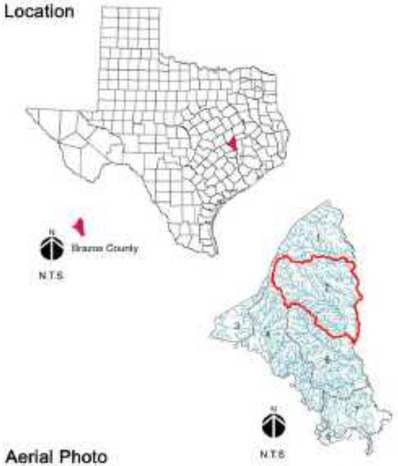
County Parks are relatively small areas consisting of forest riparian patch (Frp) and pasture grass (Pg) , scattered throughout the site. They are mainly located near the two longest streams , some of them are located near urban development areas. All the selected areas have direct road access to them. They can be reached easily. CP areas can provide habitat for wildlife, improve the hydrological condition and provide aesthetic, ecological and educational opportunities for visitors, i.e. wetland sites, visual screens and with specific riparian treatments greatly enhance the area.

Part 3. Results of the Studio Findings

3. Site Selection - One Prototype for Master Planning County Park Multiple Acre Park

Proposed Property Boundary, Wickson Creek-Navasota River Watershed #2, Brazos County, Texas

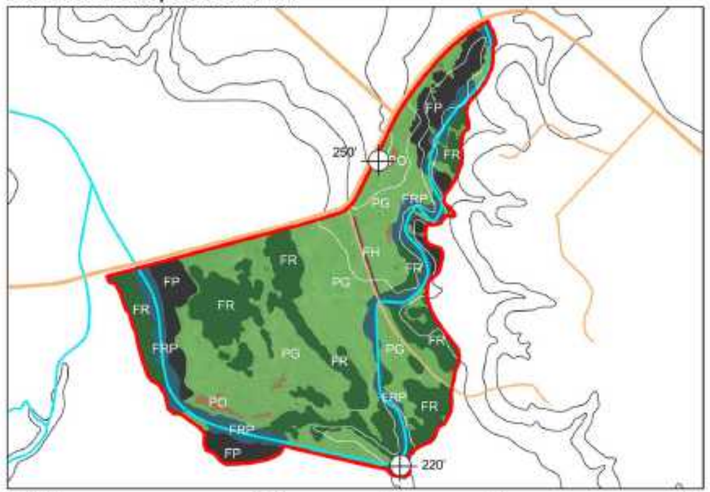
Location



Aerial Photo

Area: 115 acre N.T.S

Final Site Landscape Classification



Legend

1. Shaped Site & Roads
   - Site Boundary
   - Existing Roads
2. High / Low Point
   - 250' High Point
   - 220' Low Point
3. Existing Water
   - Streams
4. Contours
   - Contour (10 ft interval)
5. Land Types
   - Forest Patch (FP)
   - Forest Remnant (FR)
   - Forest Riparian (FRP)
   - Pasture Grazed (PG)
   - Pasture Open (PO)
   - Forest Hedgerow (FH)

0 0.15 0.3 0.6 mile

Description

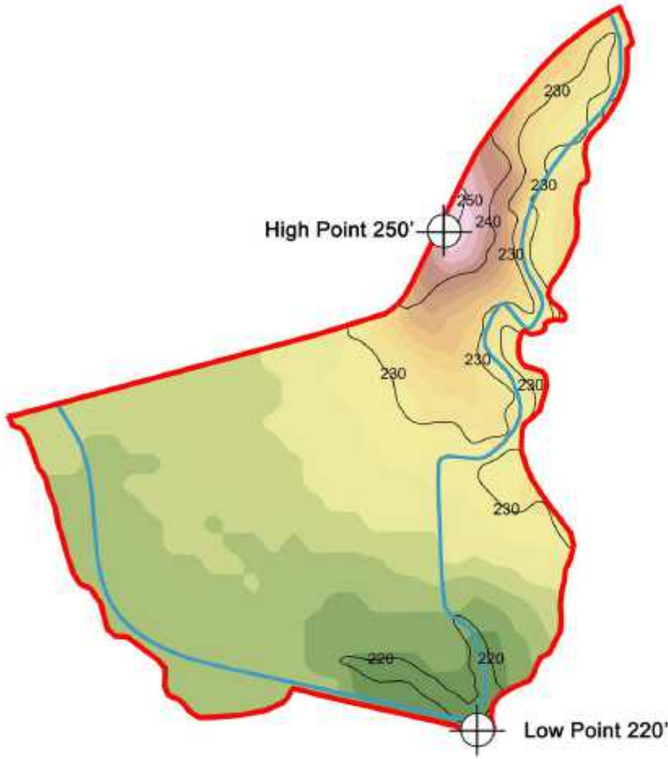
1. **Landform:** The site is relatively flat. The elevation in the north is higher than it in the south. The highest elevation is in the northern part, which is 250ft. While the lowest elevation is 220 feet in the north east of the site.
2. **Water:** There are two existing streams going through. It occupies 1.4-mile length of the site.
3. **Access:** There is an existing road going along the west boundary of the site. Besides, there is one path going across the site, which will provide excellent accessibility.
4. **Vegetation:** The site has 6 landscape types, including Fp, Fr, Frp, Pg, Po and Fh. Although the canopy is not that dense in the site, the large Pg and abundant Frp, Fp and Fr along the existing streams will also provide valuable resources and should be preserved carefully.

Reference: https://tnris.org/data-download/#/search/Brazos%20East

Part 3. Results of the Studio Findings

3. Site Selection - One Prototype for Master Planning County Park Multiple Acre Park

Elevation Zones, Wickson Creek-Navasota River Watershed #2, Brazos County, Texas



Legend

- High 250
- Low 220

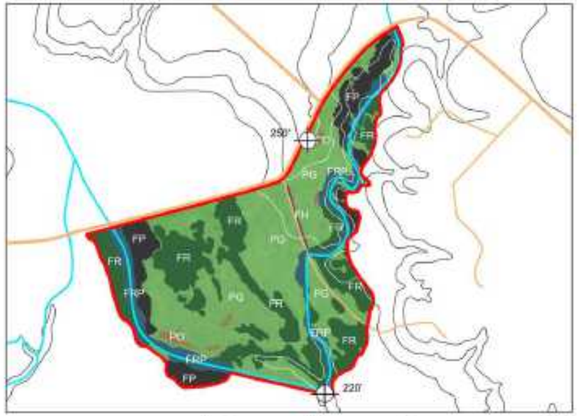
Reference: Geospatial Data Gateway USDA
https://gdg.sc.egov.usda.gov/

Part 3. Results of the Studio Findings

3. Site Selection - One Prototype for Master Planning County Park Multiple Acre Park

Land Use Planning strategy, Wickson Creek-Navasota River Watershed #2, Brazos County, Texas

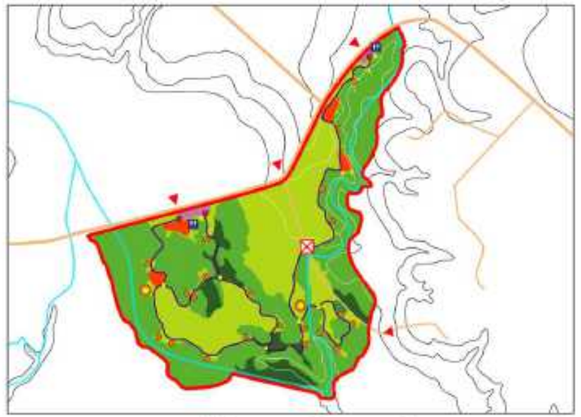
Final Site Selection (Area: 115 Acre)



Legend

1. Shaped Site & Roads
   - Site Boundary
   - Existing Roads
2. High / Low Point
   - 250' High Point
   - 220' Low Point
3. Land Types
   - Forest Patch (FP)
   - Forest Remnant (FR)
   - Forest Riparian (FRP)
   - Pasture Grazed (PG)
   - Pasture Open (PO)
   - Forest Hedgerow (FH)
4. Contours
   - Contour *(10 ft interval)*
5. Exisitng Water
   - Streams

Proposed Zoning



Legend

Protection Zone
- Existing Natural Habitats
- Prairie Restoration
- Proposed Natural Habitats

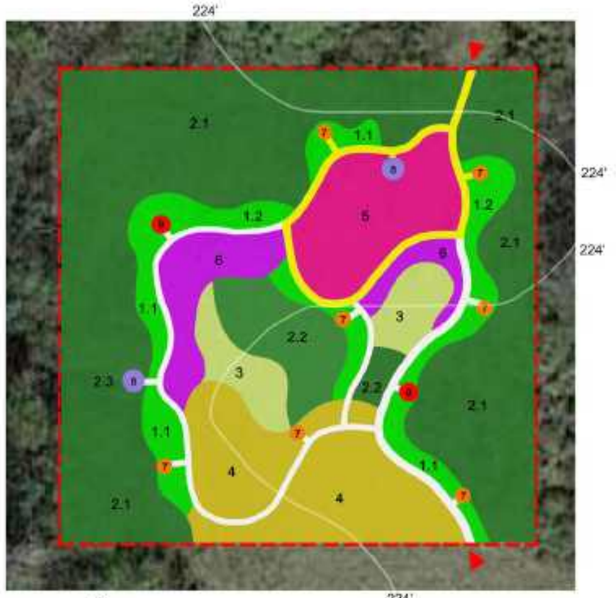
Urban
- Existing Road
- Parking
- Access
- Restroom

Recreational Zone
- Pedestrian Crossing
- Wayfinding Signs
- Education Corner
- Rest Stops
- Trails Head
- Picnic Sites
  - 1 table sites
  - Group tables sites
  - Pavilion sites
- Hiking Trail

Part 3. Results of the Studio Findings

4. Site Selection – One Prototype for Master Planning One Acre within Park

Land Use Zoning Plan, Wickson Creek- Navasota River Watershed #2



Legend

Recreational Zone
- 7 Rest Stops
- 8 Picnic Sites
- 9 Interactive Stops
- Senior Trails 280ft
- Hiking Trails 514ft

Protection Zone
- 1 Ecotone Area
- 2 Forest Patch
- 3 Pasture Grass

Special Features
- 4 Native Meadow
- 5 Nectar Patch
- 6 Wildflower Garden

Urban
- Access
- Contour

Pg	Zone 1 Ecotone Area	1.1 Small and Large shrub 1.2 Deer forage area
Fp Fr Pg	Zone 2 Forest Patch	2.1 Existing forest 2.2 Habitat island 2.3 Songbird Habitat
Pg	Zone 3 Existing Pasture	Restoration of existing pasture
Pg	Zone 4 Native Meadow	A mix of native plants and grasses
Pg	Zone 5 Nectar Patch	Mix of native flowering plants
Pg	Zone 6 Wildflower Garden	Native wildflowers
Pg	Zone 7 Rest Stops	Rest stops with bench
Fr Pg	Zone 8 Interactive Stops	Birds, butterflies observation
Pg	Zone 9 Picnic Sites	Picnic areas with shade and picnic tables

Index Map

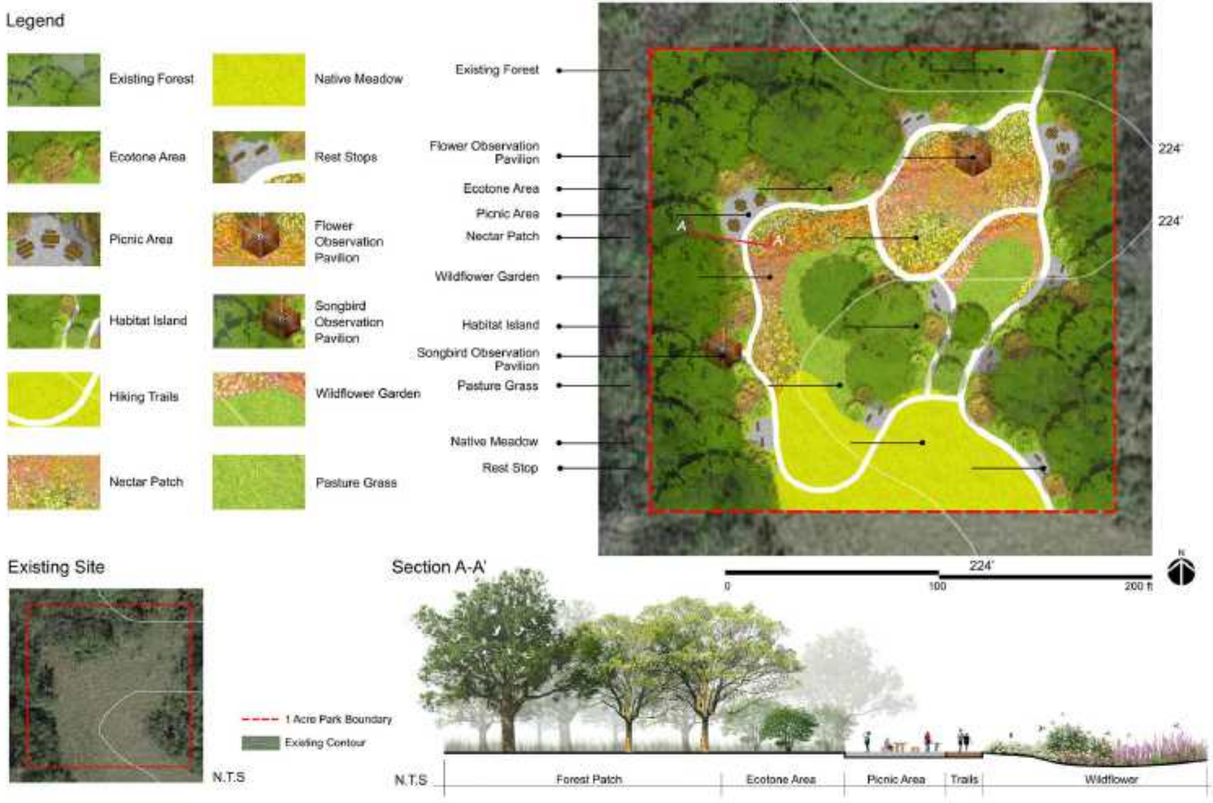
Site Location N.T.S

One-acre Site N.T.S

Part 3. Results of the Studio Findings

4. Site Selection – One Prototype for Master Planning One Acre within Park

Master Plan, Site Plan Rendering, Wickson Creek- Navasota River Watershed #2



Part 3. Results of the Studio Findings

4. Site Selection – One Prototype for Master Planning One Acre within Park

Plant list, Master plan, Wickson Creek-Navasota River Watershed #2

Tree List

Bald Cypress
(Taxodium distichum)

Live Oak
(Quercus virginiana)

Shumard Red Oak
(Quercus shumardii)

Eastern Red Cedar
(Juniperus virginiana)

Chinkapin Oak
(Quercus muehlenbergii)

American Holly
(Ilex opaca)

Shrub List

Coralberry
(Symphoricarpos orbiculatus)

American Beautyberry
(Callicarpa americana)

Wax Myrtle
(Morella cerifera)

Barbados Cherry
(Malpighia glabra)

Yellow Bells
(Tecoma stans)

Texas Sage
(Leucophyllum frutescens)

Source: https://www.wildflower.org

Part 3. Results of the Studio Findings

4. Site Selection – One Prototype for Master Planning One Acre within Park

Plant list, Master plan, Wickson Creek-Navasota River Watershed #2

Ground Cover List

Buffalograss
(Bouteloua dactyloides)

Little Bluestem
(Schizachyrium scoparium)

Prairie Rosinweed
(Silphium terebinthinaceum)

Cedar Sage
(Salvia roemeriana)

Tall Thimbleweed
(Anemone virginiana)

Lawnflower
(Calyptocarpus vialis)

Flower List

Purple Coneflower
(Echinacea purpurea)

Common Milkweed
(Asclepias syriaca)

Texas Bluebonnet
(Lupinus texensis)

Pink Ladies
(Oenothera speciosa)

Blue Mistflower
(Conoclinium coelestinum)

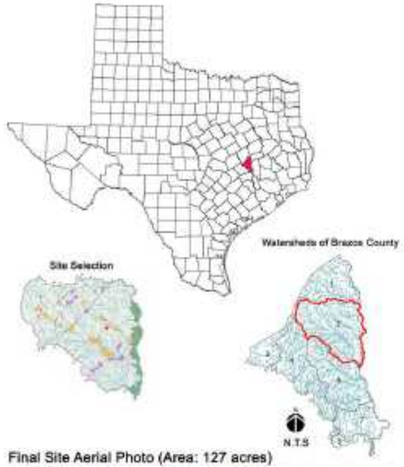
Drummond Phlox
(Phlox drummondii)

Source: https://www.wildflower.org

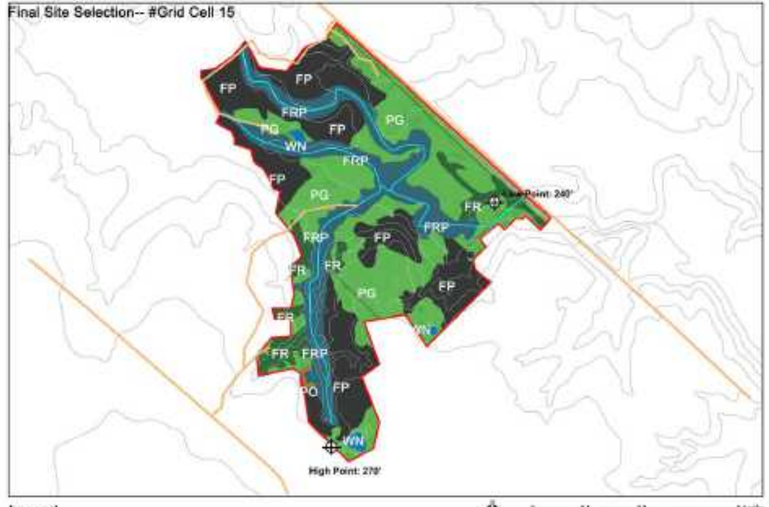
Part 3. Results of the Studio Findings

3. Site Selection - One Prototype for Master Planning County Park Multiple Acre Park

Proposed Property Boundary, Wickson Creek-Navasota River Watershed #2, Brazos County, Texas



Final Site Aerial Photo (Area: 127 acres)



Legend

1. Shaped Site + Roads
   - Site Boundary
   - Main Roads
2. High / Low Point
   - 270' High Point
   - 240' Low Point
3. Existing Water
   - Water Streams
4. Contours
   - Contour: 10 ft interval
5. Land Types
   - FRP_Forest Riparian
   - FR_Forest Remnant
   - FH_Forest Hedgerow
   - FP_Forest Patch
   - WN_Natural Pond
   - PG_Pasture Grass
   - PO_Pasture Open

Description

1. Landform: The elevation in the west is higher than that in the east. The overall water is drained to the existing stream within the site. The highest elevation is in the southwest, which is 280 feet. The lowest elevation is 240 feet, located in the northeast of the site.

2. Water: There are four streams going through the site as well as cross together at middle of the site and four natural ponds near the streams would be a great destination for the visitors.

3. Access: There is an existing road going through the site from southeast to northwest who provide convenient access for visitors coming to the park.

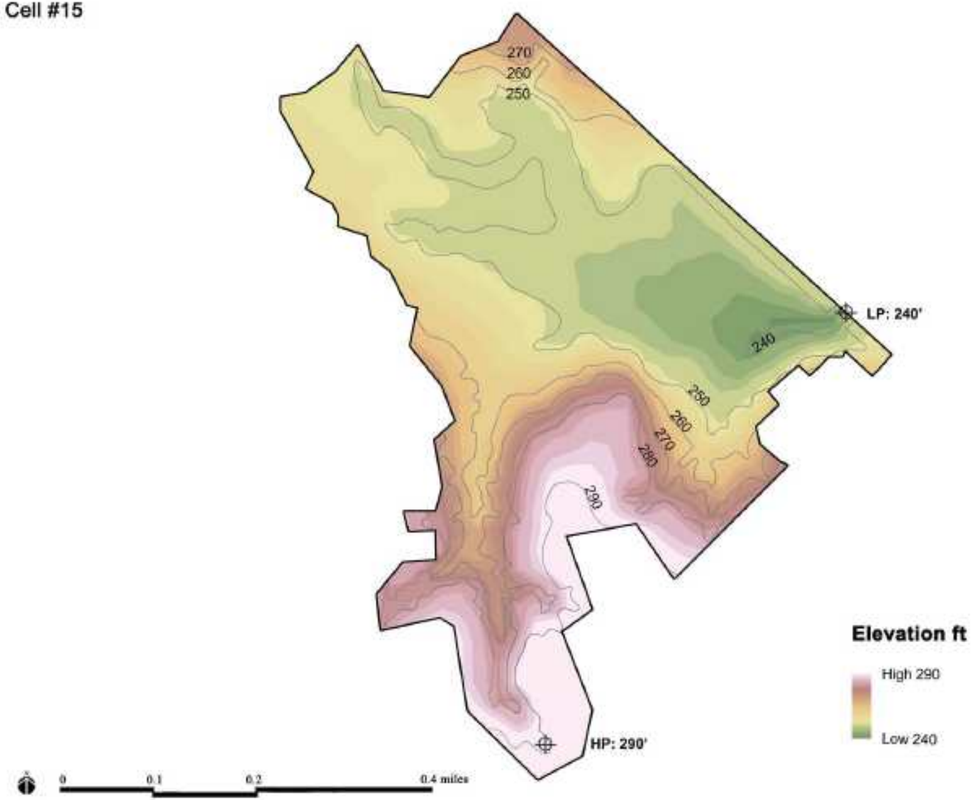
4. Vegetation: After a careful airphoto interpretation, we depict the land into 7 categories landscape types. There include forest patches, forest remnant, forest riparian, forest hedgerow, pasture open, pasture grazed and natural water. Overall, the site is consisted of the forest patches, forest riparian, and pasture grazed, which are the most valuable resources to be preserved and design for people and wildlife.

Reference: https://tnris.org/data-download/#/quad/Bryan%20East

3. Site Selection - One Prototype for Master Planning County Park Multiple Acre Park

Elevation Zones, Wickson Creek-Navasota River Watershed #2, Brazos County, Texas

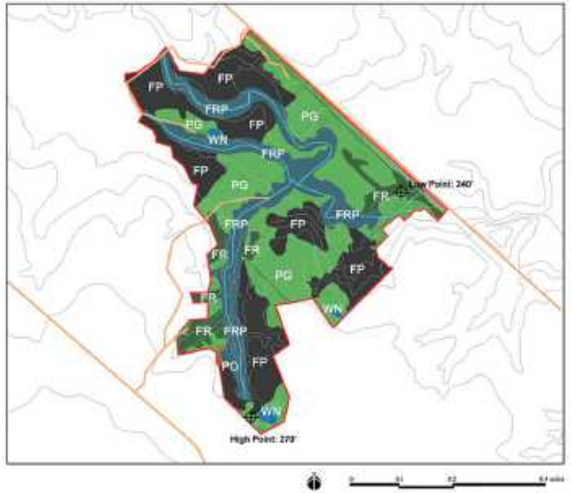
Grid Cell #15



3. Site Selection - One Prototype for Master Planning County Park Multiple Acre Park

Land Use Planning strategy, Wickson Creek-Navasota River Watershed #2, Brazos County, Texas

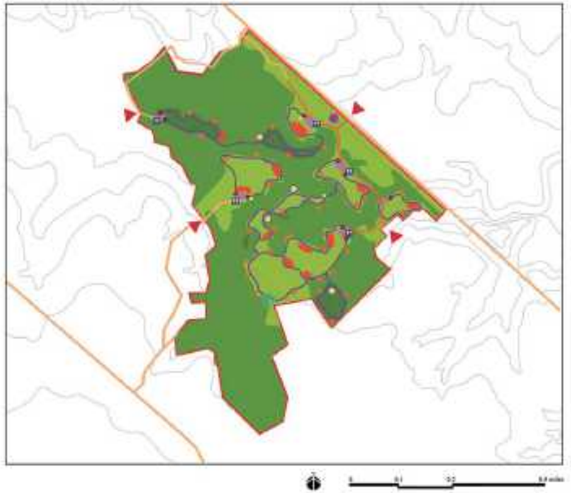
Proposed Site Selection: Watershed County Park



Legend

1. Shaped Site + Roads
   - Site Boundary
   - Main Roads
2. High / Low Point
   - 290' High Point
   - 240' Low Point
3. Existing Water
   - Water Streams
4. Contours
   - Contour: (0.5' interval)
5. Land Types
   - FRP_Forest Riparian
   - FR_Forest Remnant
   - FH_Forest Hedgerow
   - FP_Forest Patch
   - WN_Natural Pond
   - PG_Pasture Grass
   - PO_Pasture Open

Proposed Zoning



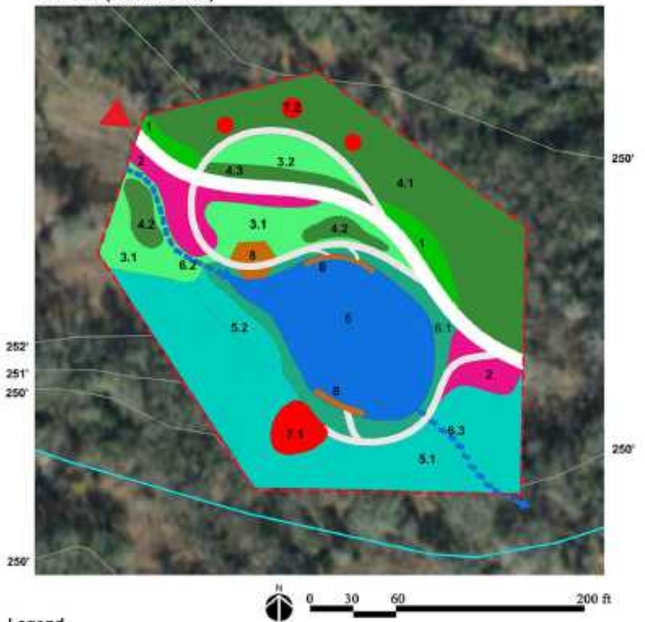
Legend

2. Protection Zone
   - Natural Habitats Existing
   - Natural Habitats Perposed
   - Buffer Zones
1. Urban
   - Existing Road
   - Parking
   - Access
   - Restroom
3. Recreational Zone
   - Rest Stops
   - Trails Head
   - Picnic Sites
     - 1 table sites
     - Group tables sites
     - Pavilion sites
   - Information Kiosk
   - Education Corner
   - Over Look
   - Wayfinding Sign
   - Primary Trail
   - Secondary Trail

4. Site Selection – One Prototype for Master Planning One Acre within Park

Land Use Zoning Plan, Wickson Creek- Navasota River Watershed #2

Final Site (Area: 1.5 acre)



Pg	Zone 1 Ecotone area	Native grass seed Small shrub	Large shrub
Pg	Zone 2 Wildflower Garden	Native Wildflowers	
Pg	Zone 3 Pasture Grass	3.1 Restoration of Prairie 3.2 Native meadow	
Fp	Zone 4 Forest Patches	4.1 Existing forest 4.2 Native Patches	4.3 Roadside hedge
Frp	Zone 5 Riparian Area	5.1 Existing forest riparian patch 5.2 Wildlife habitat	
Ws	Zone 6 Water Pond	6.1 Wetland 6.2 Inlet	6.3 Outlet
Fp	Zone 7 Picnic area	7.1 Group picnic area (Groves of trees) 7.2 Family picnic area (Trail sites)	
Ws	Zone 8 Observation Ducks	Water loving platform	

Legend

Recreational Zone	Protection Zone	Special Features	Urban
Primary Trail (Hiking)	3 Pg-Pasture Grazed	6.1 Wetland	Boundary
Secondary Trails (Hiking)	5 Frp-Forest Riparian Patch	5.2 Wildlife habitat	Contour
Picnic areas	4 Fp-Forest Patch	7 Wildflower garden	
8 Observation Ducks	6 Wp-Water Pond		
	6.1 Wetland		

Index Map

Site Location

1Acre Arial Photo

Part 3. Results of the Studio Findings

4. Site Selection – One Prototype for Master Planning One Acre within Park

Master Plan, Site Plan Rendering, Wickson Creek- Navasota River Watershed #2

Legend

Existing Forest Patch
Family Picnic Area
Native Meadow
Native Patch
Ecotone
Wildflower
Observation Ducks
Wildlife Habitat
Wetland
Hiking Trails
Group Picnic Area
Water Pond

Existing Site

1 acre Boundary
Contour

Section A-A'

Part 3. Results of the Studio Findings

4. Site Selection – One Prototype for Master Planning One Acre within Park

Plant list, Master plan, Wickson Creek-Navasota River Watershed #2

Tree List

Red Maple
(Acer rubrum)

Pecan
(Carya illinoinensis)

Sugarberry
(Celtis laevigeta)

Araucaria
(Araucaria spp.)

Sawtooth Oak
(Quercus acutissima)

Southern Red Oak
(Quercus falcata)

Shrub List

Common Honeylocust, thornless
(Gleditsia triacanthos inermis)

Red Buckeye
(Aesculus pavia)

Desert Willow
(Chilopsis linearis)

Goldenball Leadtree
(Leucaena retusa)

Mexican Olive
(Cordia boissieri)

Bottlebrush Buckeye
(Aesculus parviflora)

Source: https://plants.usda.gov

Part 3. Results of the Studio Findings

4. Site Selection – One Prototype for Master Planning One Acre within Park

Plant list, Master plan, Wickson Creek-Navasota River Watershed #2

Ground Cover List

Carolina Mosquito
(Azolla caroliniana)

Water Clover
(Marsilea vestita (M. uncinata))

Fanwort
(Cabomba caroliniana)

American Lotus
(Nelumbo lutea)

Strawberry
(Fragaria x ananassa)

Texas Grama
(Bouteloua regidiseta)

Flower List

Yarrow
(Achillea millefolium)

Oxblood Lily
(Rhodophiala bifida)

Hinckley's Columbine
(Aguilegia Hinkleyana)

German Red Carnation
(Dianthus carophyllus)

Summer Phlox
(Phlox paniculata)

Mexican Heathe
(Cuphea hyssopifolia)

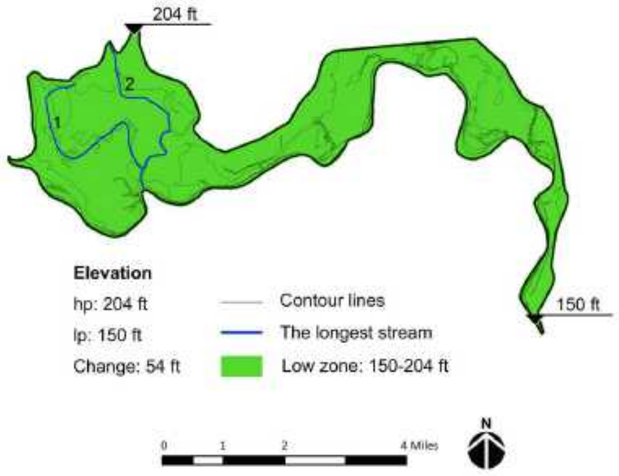
http://tx.audubon.org/sites/g/files/amh541/f/styles/hero_image/public/searfitzgerald110428_7032.jpg?itok=Cs1fP9xX

Part 3. Results of the Studio Findings

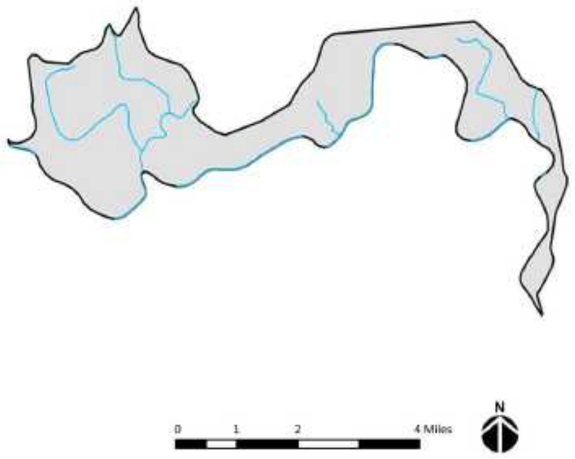
1. Elevation Zones – Longest 2 Stream Channels in Watershed

Watershed #5 Beason Creek-Brazos River

#5 Beason Creek-Brazos River Watershed Mosaic Grid



#5 Beason Creek-Brazos River Watershed Mosaic Grid

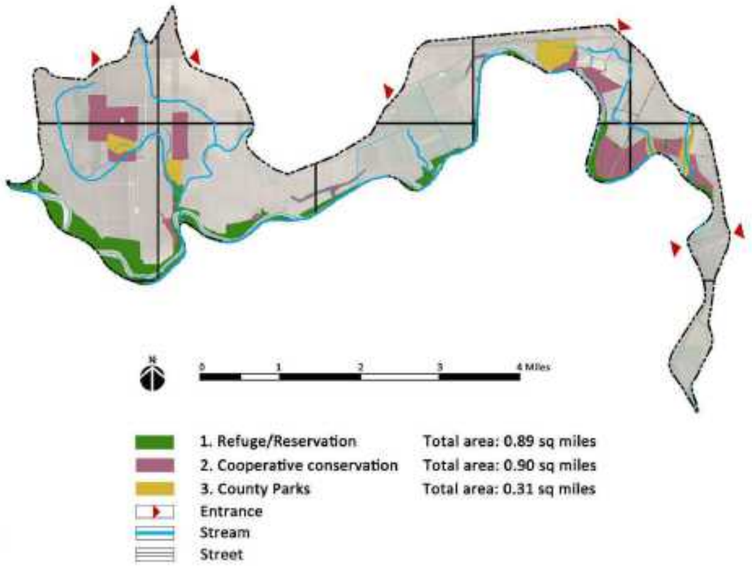


Part 3. Results of the Studio findings

2. Protection/Conservation Sites Selected in Water Dispersal Strategy

Watershed #5 Beason Creek-Brazos River

Protection/Conservation Zoning Map



Executive Summary

Refuge/Reservation (R/R)

Cover type combination:
FP_Forest Patch

Refuge areas are particularly rich in high quality water resources for wildlife and plant communities. These areas should be designated as low human activity areas. They possess dense forests that provide cover for the resident wildlife. The dense forests along the riparian system helps conserve the banks from erosion, maintains groundwater moisture and reduces the impact of flooding.

Cooperative conservation/Protection (CC/P)

Cover type combination:
FR_Forest Remant + PG_Pasture Grass
FRP_Forest Riparian + WS_Water Stream

The area includes rivers or streams for the healthy growth of plants and wildlife found there. The green coverage of the area is comparatively higher than the other sites. Forestlands provide sites for future landscape improvements. Grasslands provide sites for recreational activities.

County Parks (CP)

Cover type combination:
FR_Forest Remant + PG_Pasture Grass
FRP_Forest Riparian + WS_Water Stream

Park areas should connect directly with the existing road system. These parks provide exposure to the riparian system and their associtated ecotones. Habitats found there provide places for local residents to explore.

3. Site Selection - One Prototype for Master Planning County Park Multiple Acre Park

Proposed Property Boundary, Beason Creek-Brazos River Watershed #5, Brazos County, Texas

Site Selection Final: County Park

Grid Cell #d

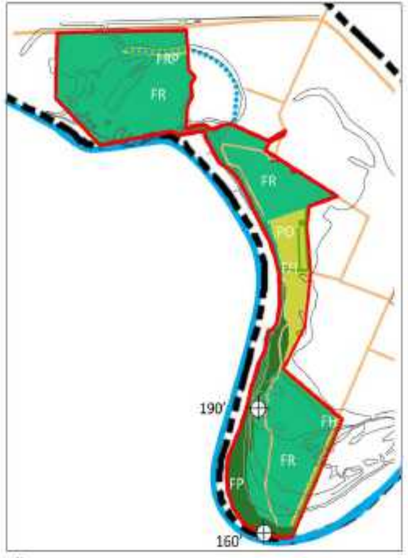
Brazos County, Texas

Brazos County seat is Bryan. Along with Brazoria County, the county is named for Brazos River, which forms its western border.

Site Selection- Air Photo

Size: 102.2 acre

Reference: TNRIS, https://tnris.org/data-download/#/quad/Bryan%20East



Legend

1. Shaped Site + Roads
   - Watershed Boundary
   - Site Boundary
   - Main Roads
2. High/ Low Point
   - 190' High Point
   - 160' Low Point
3. Existing Water
   - Water Streams (Google Earth)
   - Water Streams
4. Contours
   - Contour (5 ft interval)
5. Land Types
   - Forest Riparian (FRP)
   - Forest Remnant (FR)
   - Pasture Open (PO)
   - Forest Patch (FP)
   - Forest Hedge (FH)

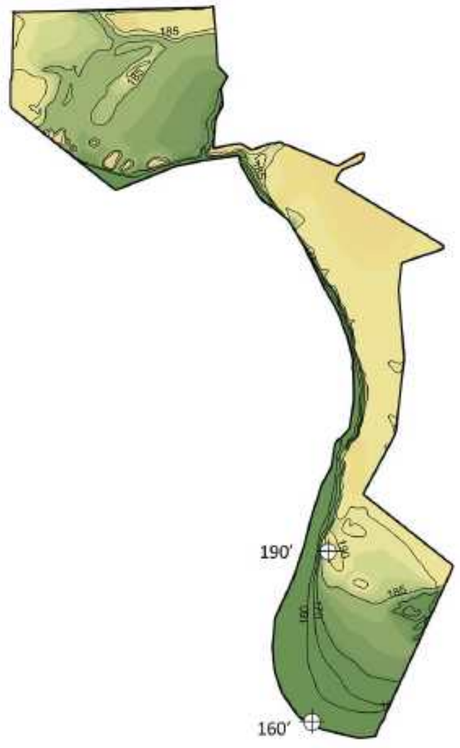
Description (Site area: 102.2 acre)

1. Landform: The site is located next to Brazos River. The runoff water is drained to the river. The highest point in the Northest is around 185 feet. The lowest point in the Southest is around 160 feet.
2. Water: There is a stream which can be observed from Google earth within the site. Forest riparian surrounds it. The site is adjacent to the Brazos River.
3. Access: A 2-lane highway is at the North of the site. It will be the major access into the site.
4. Vegetation: Canopy coverage on the site is around 32%. Most of trees are old live oaks and the area is defined as forest remnant or forest riparian. Exept large trees, the site is covered by pasture grass.

Part 3. Results of the Studio Findings

3. Site Selection - One Prototype for Master Planning County Park Multiple Acre Park

Elevation Zones, Beason Creek-Brazos River Watershed #5, Brazos County, Texas

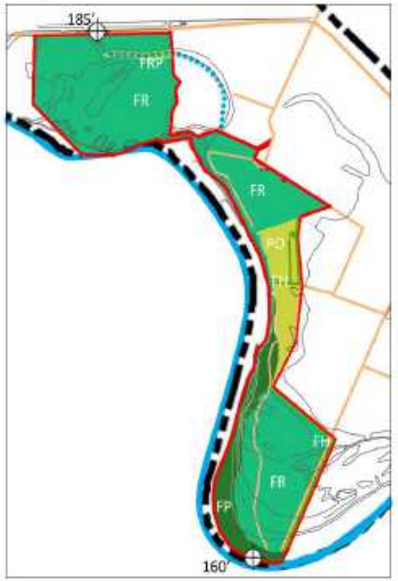


Part 3. Results of the Studio Findings

3. Site Selection - One Prototype for Master Planning County Park Multiple Acre Park

Land Use Planning strategy, Beason Creek-Brazos River Watershed #5, Brazos County, Texas

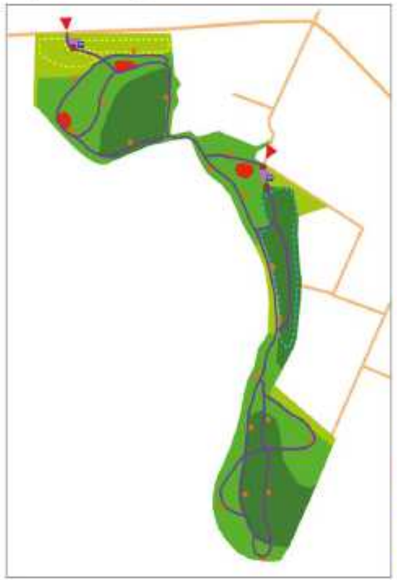
Proposed Site Selection **Site area: 102.2 acre**



Legend

1. Shaped Site + Roads
   - Watershed Boundary
   - Site Boundary
   - Main Roads
2. High/ Low Point
   - 185' High Point
   - 160' Low Point
3. Existing Water
   - Water Streams (Google Earth)
   - Water Streams
4. Contours
   - Contour (5 ft interval)
5. Land Types
   - Forest Riparian (FRP)
   - Forest Remnant (FR)
   - Pasture Open (PO)
   - Forest Patch (FP)
   - Forest Hedge (FH)

Proposed Zoning



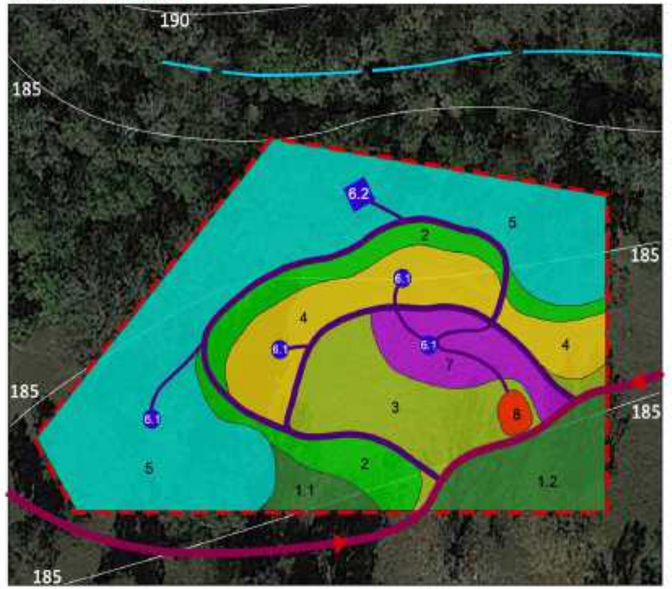
- Urban
  - Existing Road
  - Parking
  - Access
  - Restroom
- Recreational Zone
  - Rest Stops
  - Trails Head
  - Picnic Sites
    - 1 table sites
    - Group tables sites
    - Pavilion sites
  - Hiking Trail
- Protection Zone
  - Wildflower Arboretum
  - Migrating Birds Feeding Field
  - Natural Habitats Existing
  - Natural Habitats Proposed
  - Buffer Zones

Part 3. Results of the Studio Findings

4. Site Selection – One Prototype for Master Planning One Acre within Park

Land Use Zoning Plan, Beason Creek- Brazos River Watershed #5

Site area: 1.09 acre

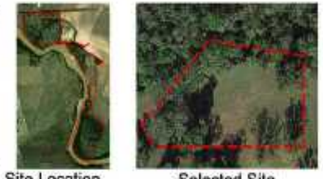


Fr Pg	Zone 1 Buffer	1.1 Small shrub buffer 1.2 Large tree buffer
Pg	Zone 2 Prairie Restoration	Restoration of pasture
Pg	Zone 3 Pasture Grass	Open space Reservation of existing grass
Pg	Zone 4 Native Grass	Native grass seed, small shrubs Migrating birds feeding
Fr	Zone 5 Forest Patch	Conservation of forest Songbird habitat
Fr Pg	Zone 6 Interactive Stops	6.1 Interactive rest stops 6.2 Bird blid
Pg	Zone 7 Wildflower Arboretum	Native wildflower Butterfly habitat
Pg	Zone 8 Picnic Area	Shade, tables and chairs

Legend

Recreational Zone	Protection Zone	Special Features	
8 Picnic Area	5 Forest Patch	4 Native Grass	Contour (5 ft interval)
6 Rest Stops	1 Buffer	7 Wildflower Arboretum	Boundary
Primary Trail (H+B) 110 ft	3 Pasture Grass	2 Prairie Restoration	Access
Hiking Trail 570 ft			Water Streams

Index Map



Site Location

Selected Site

Part 3. Results of the Studio Findings

4. Site Selection – One Prototype for Master Planning One Acre within Park

Master Plan, Site Plan Rendering, Beason Creek- Brazos River Watershed #5

Legend

- Bird Blind
- (Proposed) Prairie Restoration
- (Existing) Forest Patch
- (Proposed) Wildflower Arboretum
- (Proposed) Native Grass
- Interactive Stops
- (Existing) Pasture Grass
- Picnic Area
- (Existing) Large Tree Buffer
- Hiking Trails
- (Proposed) Small Shrub Buffer

Site area: 1.09 acres

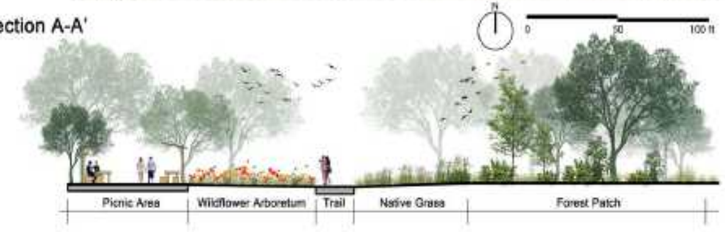
Existing Site

1.09 acres site boundary

Existing Contour

N.T.S.

Section A-A'



Part 3. Results of the Studio Findings

4. Site Selection – One Prototype for Master Planning One Acre within Park

Plant list, Master plan, Beason Creek-Brazos River Watershed #5

Tree List

Eastern Red Cedar
(Juniperus virginiana)

Loblolly Pine
(Pinus taeda)

Pecan
(Carya illinoinensis)

Texas Mulberry
(Morus microphylla)

Live Oak
(Quercus virginiana)

Sweet Acacia
(Acacia farnesiana)

Shrub List

American Beautyberry
(Callicarpa americana)

Barbados Cherry
(Malpighia glabra)

Turkscap
(Malvaviscus arboreus)

Wax myrtle
(Morella cerifera)

Prairie Crabapple
(Malus ioensis)

Chaste Tree
(Vitex agnus-castus)

https://plants.usda.gov/java/, https://www.wildflower.org

Part 3. Results of the Studio Findings

4. Site Selection – One Prototype for Master Planning One Acre within Park

Plant list, Master plan, Beason Creek-Brazos River Watershed #5

Ground Cover List

Bushy Bluestem
(Andropogon glomeratus)

Little Bluestem
(Schizachyrium scoparium)

Big Muhly
(Carya illinoinensis)

Plains Bristlegrass
(Setaria vulpiseta)

Sideoats Gramma
(Bouteloua curtipendula)

Buffalo Grass
(Bouteloua dactyloides)

Blue Grama
(Bouteloua gracilis)

Tall Thimbleweed
(Anemone virginiana)

Texas Frogfruit
(Phyla nodiflora)

https://plants.usda.gov/java/, https://www.wildflower.org

Part 3. Results of the Studio Findings

4. Site Selection – One Prototype for Master Planning One Acre within Park

Plant list, Master plan, Beason Creek-Brazos River Watershed #5

Flower List

Prairie Verbena
(Glandularia bipinnatifida)

Pink Evening Primrose
(Oenothera speciosa)

Common Yarrow
(Achillea millefolium)

Bluebonnet
(Lupinus texensis)

Texas Indian Paintbrush
(Castilleja indivisa)

Brown-Eyed Susan
(Gaillardia aristata)

Mexican Hat
(Ratibida columnifera)

Winecup
(Callirhoe digitata)

Texas Lantana
(Lantana urticoides)

https://plants.usda.gov/java/, https://www.wildflower.org

Outcomes & Conclusions

Watershed Conservation Planning
Brazos County, Texas

TABLE OF CONTENTS

Overview 81-83
Project Outcomes 84-85
Project Conclusions 86-89
Closing Remarks 90-92

V. Outcomes & Conclusions

Overview

The Watershed Conservation Planning project was created to bring an academic procedure into the Landscape Planning arena. This concept has been developed and expressed many times. There is a reason for doing it in this academic setting. This exercise has not been attempted by an MLA studio here at Texas A&M University. We believe we have the intellectual and technical resources to demonstrate the possibilities for undertaking such a project that could make a significant difference in protecting the county's resources.

We want to contribute our effort to the ever growing movement to protect our yet to be developed natural resource base. The natural landscapes found in the county are plentiful and priceless commodities worthy of our attention. A look at the trend in land development in the large urban centers in the state reflects a decreasing concern for our state heritage. It is possible to do something about changing this trend. Herein we have created a procedure that could contribute to the improved end product of urban expansion and protection for the natural landscapes of the county.

Natural Landscapes

Urban Expansion

Source: http://waccheartoftexas.com/wp-content/uploads/2013/05/Bosque-River-01.jpg https://cdn.landsofamerica.com/lnv/3901039/3901039-1705051424046201-o.jpg
http://q.likesuccess.com/83/4141531-urban-sprawl.jpg https://urbanedge.blogs.rice.edu/files/2016/04/housprawl-tpavrv.jpg

V. Outcomes & Conclusions

Overview Cont.

Modern urban areas should not be viewed as isolated places or restricted areas separated from their surrounding but rather as part of a city system of growth that respects and incorporates natural landscapes of varying size and scale as the urban area expands. These new development sites unlike their precursors might integrate natural landscapes into the fabric of their development plans. In so doing a new urban fabric would gradually be realized.

Source: https://www.asla.org/uploadedImages/CMS/Professional_Resources/Guides_and_Toolkit/adaptation_large.jpg https://www.kyvernitis.gr/wp-content/uploads/2013/07/Central-Park-aerial.jpg
http://tavistockdevelopment.com/wp-content/uploads/2013/10/20090717_NONA_0177-1030x686.jpg https://springfieldohio.gov/wp-content/uploads/2015/09/Springfield-Ohio-Skyline-by-Rod-Hatfield.jpg

V. Outcomes & Conclusions

Overview Cont.

The project has several outcomes that we believe could offer an alternative to uncontrolled urban sprawl. The concept is a simple one.

First — We identify the landscapes and landscape systems in need of protection and conservation actions.

Second — We locate those landscapes as they occur across the seven watersheds that make up Brazos County.

Thirdly — We place these landscapes into primary and secondary protection zones to accompany growth within these areas.

Finally — We modify the development growth plan to include some natural landscapes within their plans for development so as to help in securing the quality growth of the county's various expanding urban areas.

The Watershed Conservation Plan is technically feasible to produce. The outcomes of such an endeavor are likely to be most rewarding for the urban realm and the people who will live in these landscapes.

V. Outcomes & Conclusions

Project Outcomes

Outcome 1

A classification system that identifies the landscape cover types of natural quality within the county.

Landscape Classification

Outcome 2

A system that identifies "Primary" and "Secondary" natural landscape types found within the next to be developed lands in the ETJ and the soon to be developed lands found in the rural areas of the county. These areas can be viewed as potential protection areas and conservation areas for inclusion into the newly developed areas that will accommodate urban growth.

Primary Landscape

Secondary Landscape

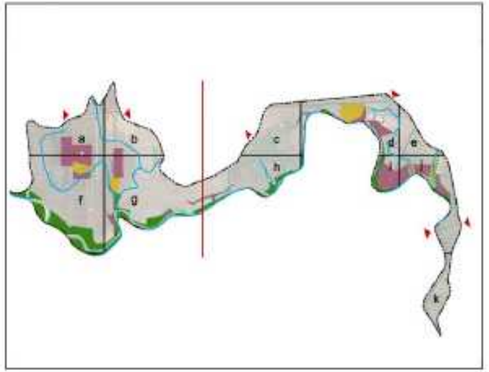
Source: Google Earth

V. Outcomes & Conclusions

Project Outcomes

Outcome 3

These primary and secondary areas can serve to provide "Refuge and Reservation" zones for the watersheds. They can serve as "Conservation Cooperation" zones for the associated lands surrounding or adjacent to the development zones. Finally the landscapes could possibly serve as small sites for watershed county parks to bring urban residents to nearby recreation and open spaces.



Watershed #5

Outcome 4

This concept, if made operational at the county level, could create a major change in the quality of life for its growing population and a guaranteed healthier natural landscape system that is sustainable and economically better for all concerned residents.

Source: Google Earth http://www.naturalnews.com/gallery/640/Men/Man-Woman-Walking-Forest-Trees-Redwoods-Bridge.jpg

V. Outcomes & Conclusions

Project Conclusions

1. The identification of the most significant landscapes in the county were judged to be the following:
   Primary Landscapes: High ecological value, High land value, High aesthetic value

   A. Frp + Pg - Forest riparian plus Pasture (High quality grazing sites)
   B. Frp + Fr and Frp + Fp - Forest riparian plus Forest patch or Forest remnant

These sites should be considered as sites for protection and conservation zoning. The sites are the best natural, continuous landscapes to be found in the county. If left in tact and if upgraded over time to become more continuous landscape systems the county might realize an unprecedented condition for attracting long term, high quality urban development. The plan is to create long term sustainable development by first creating ecological communities (Primary and Secondary landscapes) around which high quality development could take place. These sites would be the county's investment in landscape protection banking.

Primary Landscapes

Primary Landscapes

Source: http://www.zarealestate.com/backend/wp-content/uploads/2014/07/3-DJI00234-1024x576.jpg http://www.zarealestate.com/backend/wp-content/uploads/2014/07/4-DJI00240.jpg

V. Outcomes & Conclusions

Project Conclusions Cont.

Secondary Landscapes: Good ecological value, good land value, aesthetic value

A. Frp +Po – Forest riparian plus Pasture (overgrazed sites, poor soil)
B. Fp + Po and Fp + Po, Fr + Po – Forest patch and Pasture, Forest remnant plus Pasture

These sites are of enormous value for the maintenance of the existing Mosaic. These sites could be places where continued ranch and farmland uses would be encouraged to take place. These landscapes could be a buffer of lower intensity land uses between the Natural landscapes and Future Development landscapes. These sites would be the county's zoning buffer and amenity investment in the future.

Before Development

After Development

Source: https://cdn.landflip.com/photos/113805/113805_1274299.jpg https://cdn1.shop.justlifeshop.com/wp-content/uploads/2017/03/08164927/Babybio-cow.jpg

V. Outcomes & Conclusions

Project Conclusions Cont.

2. Combinations of Uo or Us with Po or Fr, Fp could be considered high quality development sites. Potential to upgrade to good ecological sites, good land value, potentially good aesthetic sites.

A. Uo + Fr, Uo + Fp – Urban estate and Forest remnant, Urban estate and Forest patch
B. Uo + Po, Us + Po – Urban estate and open pasture, Urban community and open pasture.

These landscape parcels would be the designated urban zoning sites for future development. These areas would contain infrastructure, transportation and public zones for the accommodation of new schools, hospitals, commercial areas etc.

Before Development

After Development

Source: http://jwhughes.com/wp-content/uploads/2013/03/Otex.jpg http://c8.alamy.com/comp/DAKNG6/aerial-view-of-a-commercial-areas-in-a-field-and-forest-landscape-DAKNG6.jpg

V. Outcomes & Conclusions

Project Conclusions Cont.

3. Protection zoning would include Refuge/Reserve landscapes (RR), Conservation Cooperation landscapes (CCP) and County open space and parks landscapes (CP).

Here the habitats for wild lands, cooperative conservation habitats and open space and recreation sites away from urban areas are created within the various Frp + Pg sites and dispersed strategically around the watershed to serve all the citizens and stake holders of the county on a watershed by watershed basis.

Natural Habitat

Recreation Sites

4. Access to these sites is by existing county roads. The criteria for locating the RR, CCP, CP sites in the 7 watersheds was based on their proximity to: elevation zones; stream linkage to major rivers; linkage to other primary clusters and the travel time from the B/CS area.

Source: http://tpwd.texas.gov/state-parks/fort-boggy/gallery/fort-boggy_1391.jpg http://tpwd.texas.gov/state-parks/brazos-bend/gallery/brazos-bend_8275.jpg

V. Outcomes & Conclusions

Closing Remarks

Landscape Planning is an extension of Landscape Architecture. It is a vital part of the future of the profession. At least that is the concept under which this studio was organized. We want to educate young aspiring students in the program to know that the future of our built landscapes need to be planned with an elevated sense of purpose. That purpose is to protect and conserve natural landscapes within the growth sectors of the expanding urban realm.

The business of land development has been to create project sites that serve the public need. The end products are measured by the quality of the component parts and the level of professionalism applied to their completion. As good as these efforts are we realize we are not effectively solving the problem of urban expansion as it impacts natural landscapes. We realize humans are both creators and destroyers of natural resources and are unlikely ever to be otherwise. What can we do to alter this outcome?

V. Outcomes & Conclusions

Closing Remarks Cont.

Stakeholders external to this business remind us in countless ways the folly of our end products - the altered landscape. The questions stated at the outset of our studio asks, "Is it possible to bring landscape protection into play with an urbanizing environment? How can the goal of resource and landscape protection be integrated into the land planning process?"

Our studio efforts revealed one approach. There are in fact many possibilities. The catalyst for realizing a favorable action to occur is linked to the values and beliefs held by those who are engaged in the planning.

V. Outcomes & Conclusions

Closing Remarks Cont.

Our students created a procedure that in theory will prevent landscape loss and contribute to the creation of new landscapes that encourage and educate others to their value and perhaps even support more actions to begin to reverse the conspicuous consumption of our resource base.

Landscape Planning that improves our capacity to create sustainable environments and leave a portion of natural landscapes around to support urban growth is possible. The process is much like that of a moving glacier. It is progressive but in the long run it is a slow grind. We hope to improve on the process and increase the rate of change for the better. Hope springs eternal.

Appendix 1. Landscape Classification

Watershed Conservation Planning
Brazos County, Texas

TABLE OF CONTENTS

Forest: Forest Patch (Fp) 93-94
Forest: Forest Hedgerow (Fh) 95-96
Forest: Forest Remnant (Fr) 97-98
Forest: Forest Riparian (Frp) 99-100
Pasture: Pasture Grass (Pg) 101-102
Pasture: Pasture Open (Po) 103-104
Water: Stream (Ws) 105-106
Water: Human-made Pond (Wp) 107-108
Water: Natural Pond (Wn) 109-110
Urban: Urban Community (Uc) 111-112
Urban: Suburban Community (Us) 113-114
Roads: Vehicular Travel Lane (R) 115-116

Landscape Classification

Forest: Forest Patch (Fp)

Texas County Map

Brazos County and Watershed

Site Context and Watershed

Site Location and Watershed

Source: Google Earth

Landscape Classification

Forest: Forest Patch (Fp)

Section A-A'
Forest Patch Cross Section Sample Scale 1"=4'-0"

Landscape Classification

Forest: Forest Hedgerow (Fh)

Texas County Map

Brazos County and Watershed

Site Context and Watershed

Site Location and Watershed

Source: Google Earth

Landscape Classification

Forest: Forest Hedgerow (Fh)

Section A-A'
Forest Hedgerow Cross Section Sample Scale 1"=4'-0"

Landscape Classification

Forest: Forest Remnant (Fr)

Texas County Map	Brazos County and Watershed	Site Context and Watershed	Site Location and Watershed
			

Source: Google Earth

Landscape Classification

Forest: Forest Remnant (Fr)

Section A-A'
Forest Remnant Cross Section Sample Scale 1"=4'-0"

Landscape Classification

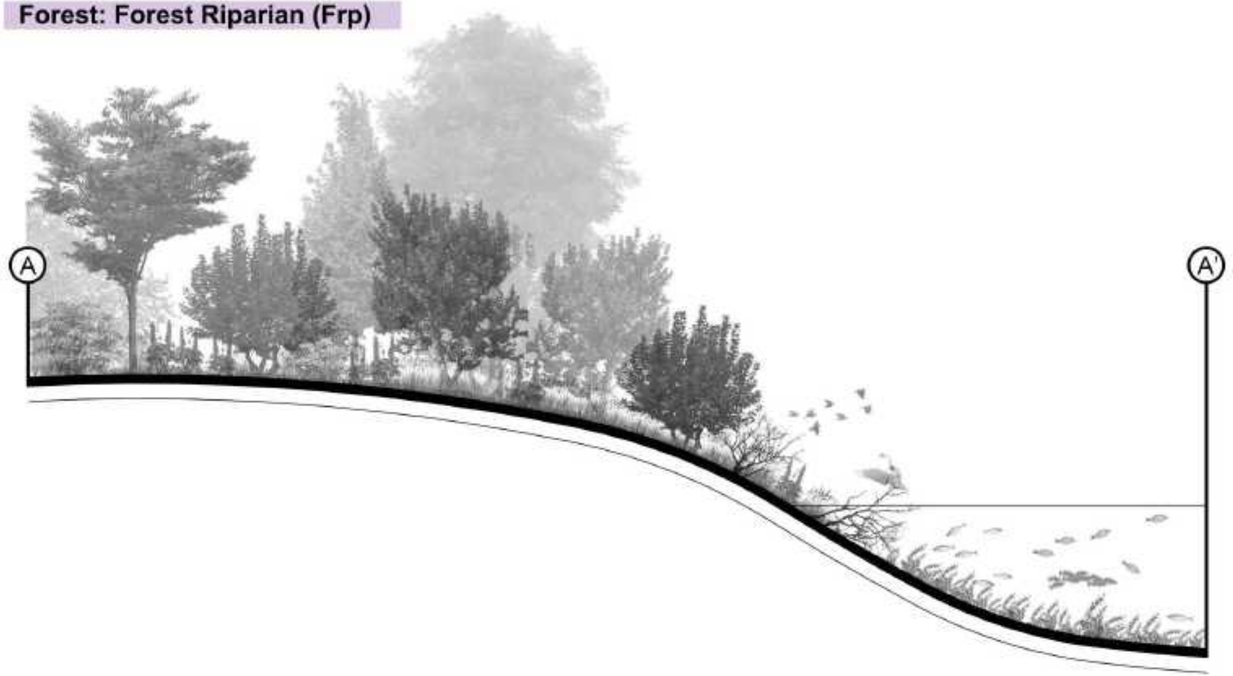
Forest: Forest Riparian (Frp)

Texas County Map	Brazos County and Watershed	Site Context and Watershed	Site Location and Watershed
			

Source: Google Earth

Landscape Classification

Forest: Forest Riparian (Frp)



Section A-A'
Forest Riparian Cross Section Sample Scale 1"=4'-0"

Landscape Classification

Pasture: Pasture Grass (Pg)

Texas County Map

Brazos County and Watershed

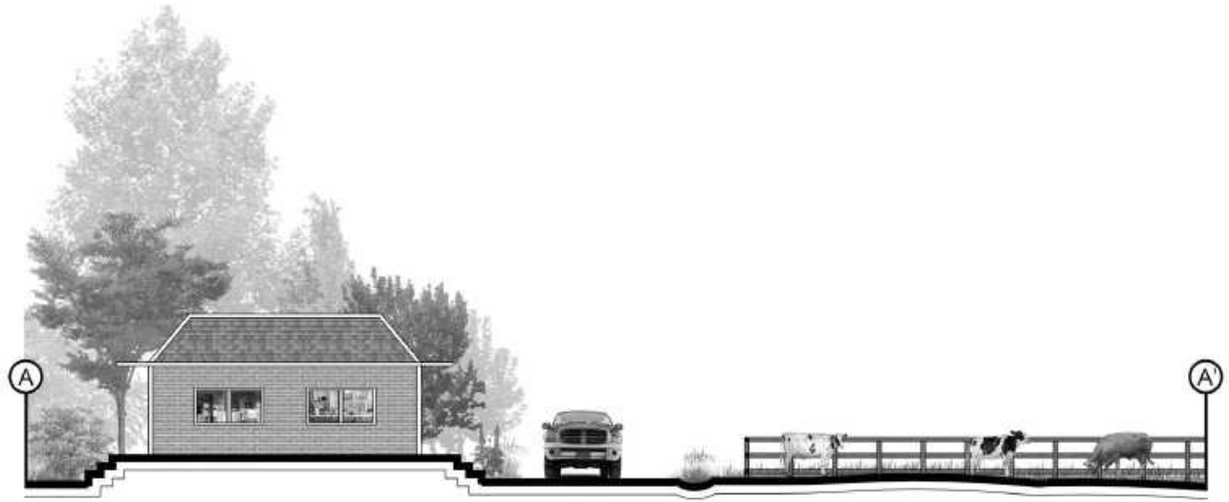
Site Context and Watershed

Site Location and Watershed

Source: Google Earth

Landscape Classification

Pasture: Pasture Grass (Pg)



Section A-A'
Open Pasture Cross Section Sample Scale 1"=9'-0"

Landscape Classification

Pasture: Pasture Open (Po)

Texas County Map

Brazos County and Watershed

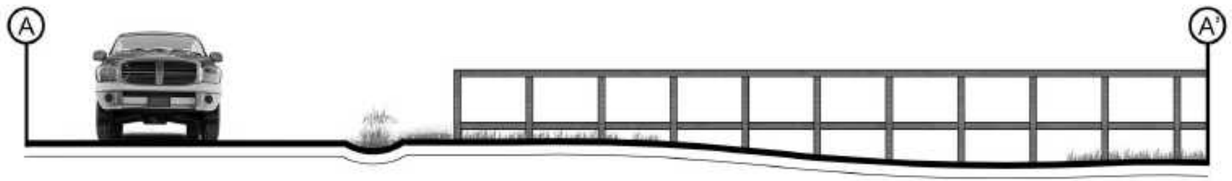
Site Context and Watershed

Site Location and Watershed

Source: Google Earth

Landscape Classification

Pasture: Pasture Open (Po)



Section A-A'
Barren Pasture Cross Section Sample Scale 1"=6'-0"

Landscape Classification

Water: Stream (Ws)

Texas County Map

Brazos County and Watershed

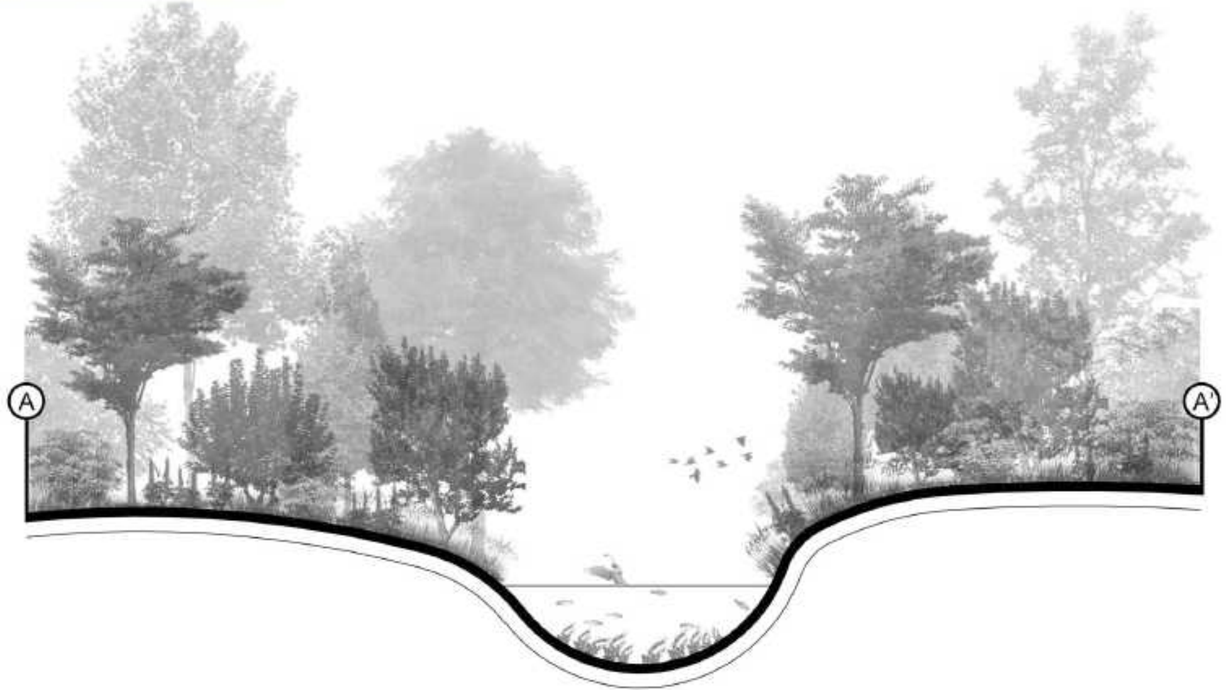
Site Context and Watershed

Site Location and Watershed

Source: Google Earth

Landscape Classification

Water: Stream (Ws)



Section A-A'
Stream Cross Section Sample Scale 1"=4'-0"

Landscape Classification

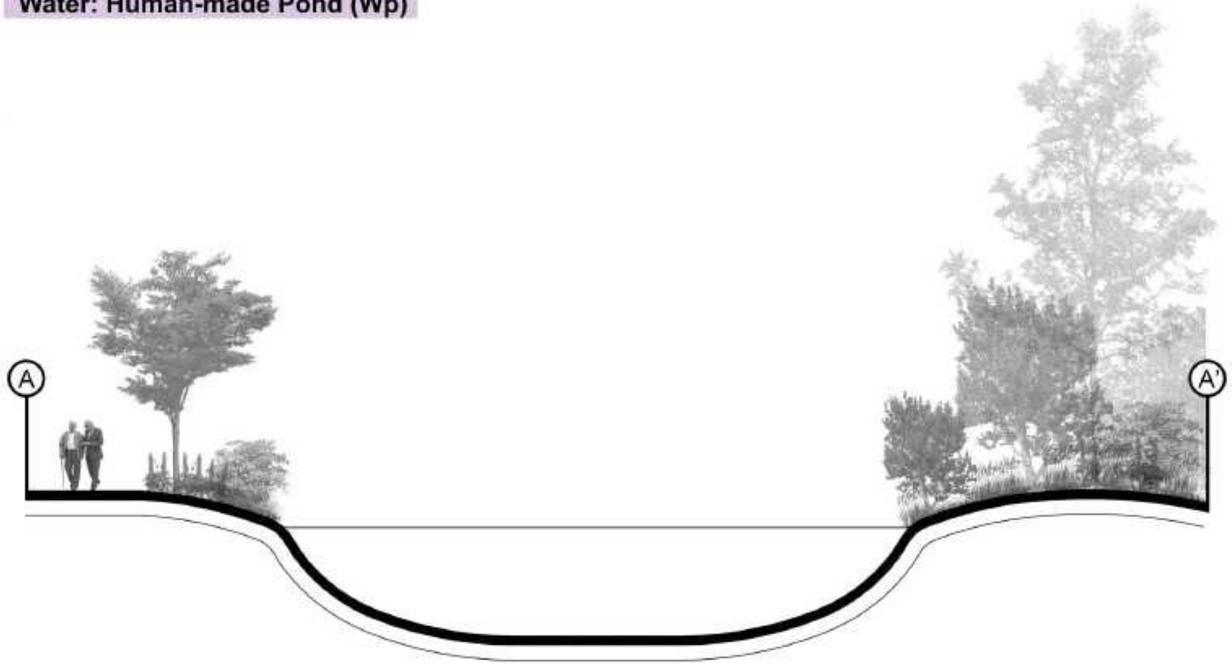
Water: Human-made Pond (Wp)

Texas County Map	Brazos County and Watershed	Site Context and Watershed	Site Location and Watershed
			

Source: Google Earth

Landscape Classification

Water: Human-made Pond (Wp)



Section A-A'
Human-made Pond Cross Section Sample Scale 1"=4'-0"

Landscape Classification

Water: Natural Pond (Wn)

Texas County Map

Brazos County and Watershed

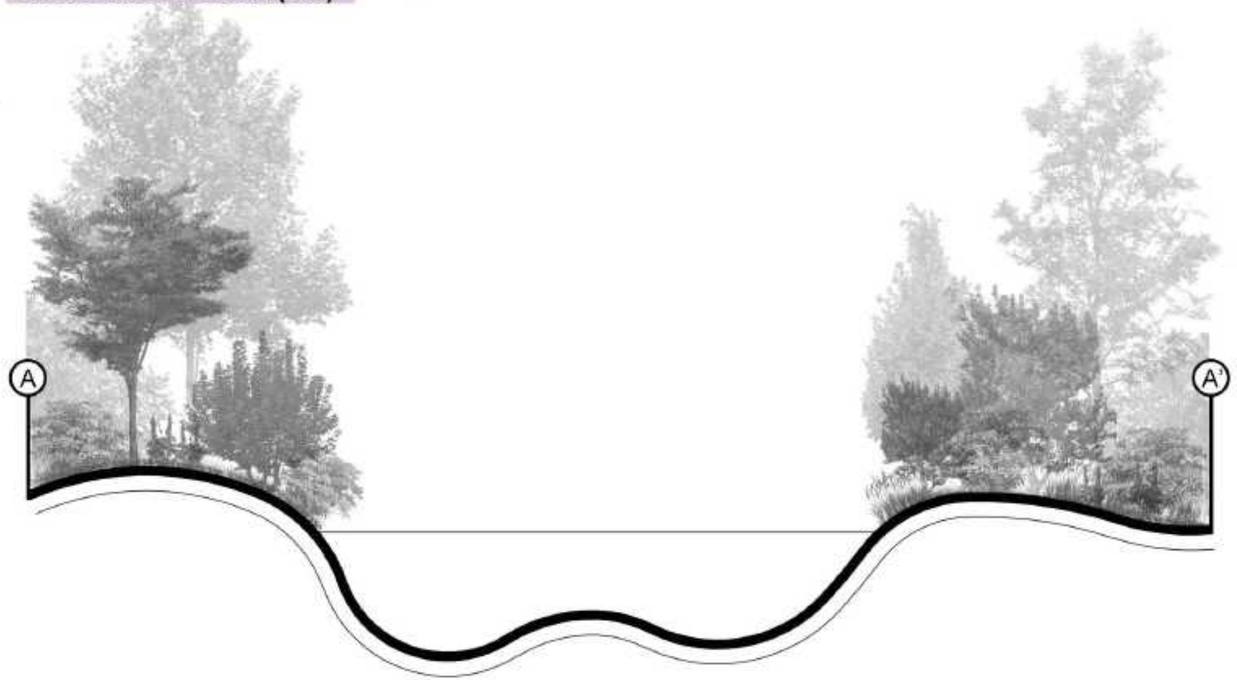
Site Context and Watershed

Site Location and Watershed

Source: Google Earth

Landscape Classification

Water: Natural Pond (Wn)



Section A-A'
Natural Pond Cross Section Sample Scale 1"=4'-0"

Landscape Classification

Urban: Urban Community (Uc)

Texas County Map	Brazos County and Watershed	Site Context and Watershed	Site Location and Watershed
			

Source: Google Earth

Landscape Classification

Urban: Urban Community (Uc)

Section A-A'
Urban Community Cross Section Sample Scale 1"=22'-0"

Landscape Classification

Urban: Suburban Community (Us)

Texas County Map

Brazos County and Watershed

Site Context and Watershed

Site Location and Watershed

Source: Google Earth

Landscape Classification

Urban: Suburban Community (Us)

Section A-A'
Sururban Community Cross Section Sample Scale 1"=12'-0"

Landscape Classification

Roads: Vehicular Travel Lane (R)

Texas County Map

Brazos County and Watershed

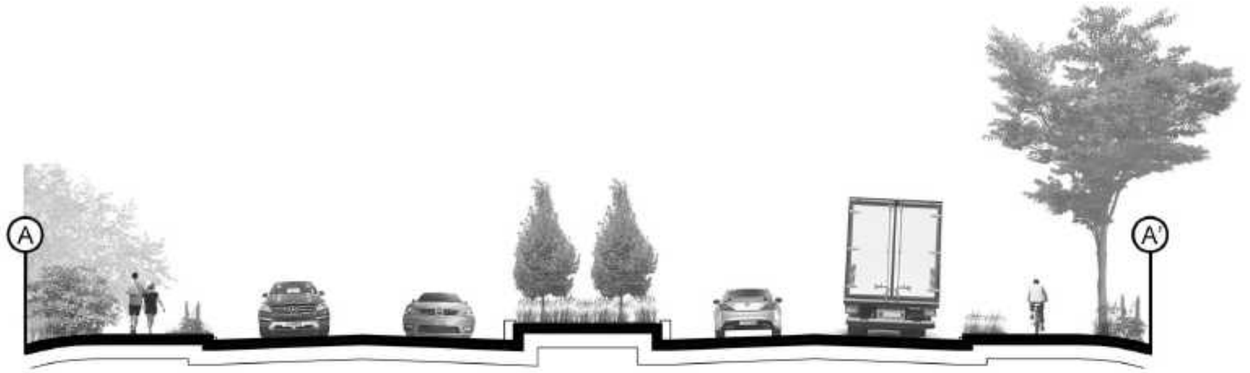
Site Context and Watershed

Site Location and Watershed

Source: Google Earth

Landscape Classification

Roads: Vehicular Travel Lane (R)



Section A-A'
Vehicular Travel Lane Cross Section Sample Scale 1"=7'-0"

Appendix 2. Riparian System Details

Watershed Conservation Planning
Brazos County, Texas

TABLE OF CONTENTS

Small but Special 117
Function Produces Value 118-119
Functional vs. Dysfunctional 120-121
The Riparian Sponge 122
Common Language 123
Reach Classification 124
Stream Order 125
There is a Balance 126-129
Channel Aggradation – Tell-tale Signs 130
Channel Degradation and Recovery 131-134
Riparian Indicators of Health Condition 135-144

Small but Special

Riparian Areas

"Riparian areas represent about one percent of the Texas landscape, but their contribution to the health of creeks of rivers is enormous- and largely misunderstood.

Since ancient times the springs, creeks, and rivers have been the lifeblood of Texas- providing drinking water for growing populations, irrigations for thirsty crops, and a place to cool off on a hot summer day. These special places were centers for native civilizations, prime sites for settlements, and critical watering holes for mustangs and longhorns. They continue today as life-giving resources for fish, wildlife and human beings."

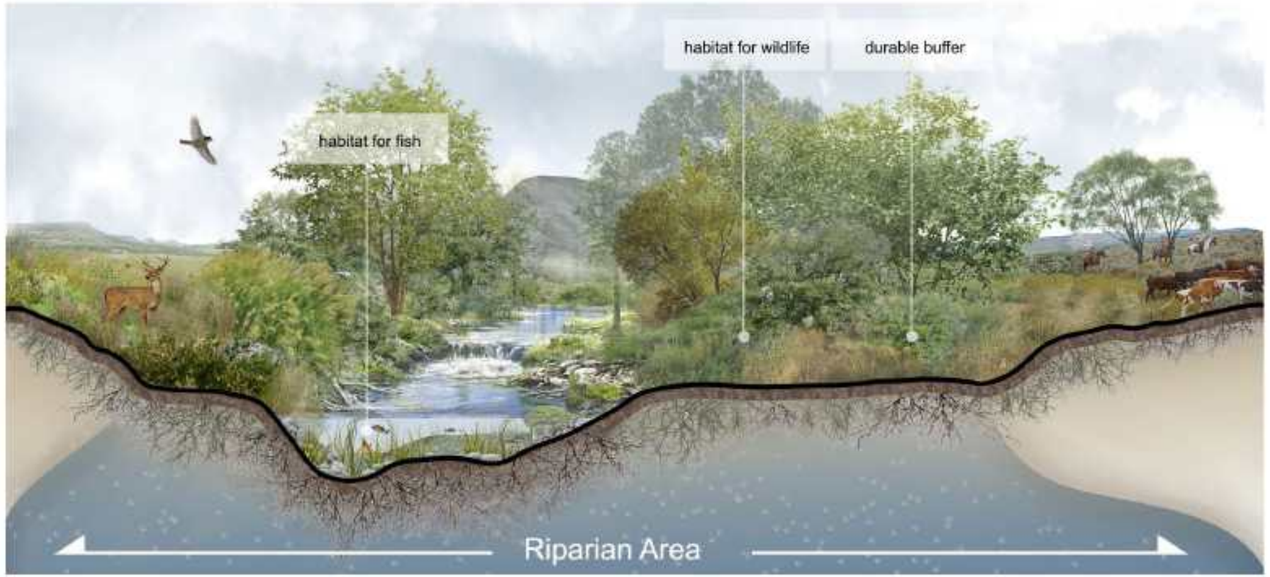
Source: Your Remarkable Riparian (Third edition), http://static.panoramio.com/photos/large/77465974.jpg

Function Produces Value

Riparian Areas 1.1

"Riparian areas are some of the most productive pieces of land. They can be reliable producers of forage, habitat for fish and wildlife, and clean abundant water. They can also provide a durable buffer against the extremes of drought and flood. Different people value different things about creeks and rivers. Functional riparian areas produce those values, and that function depends mostly on a specialized group of plants.

Clean abundant water in a river basin depends on an amazing natural system of tributary streams, creeks and riparian land that subtly works its magic-filtering, storing and releasing this precious resource. The transitional band of vegetation between waterways of all sizes and their uplands defines the critical riparian area. This zone is where water, soil and vegetation interact in remarkable ways."



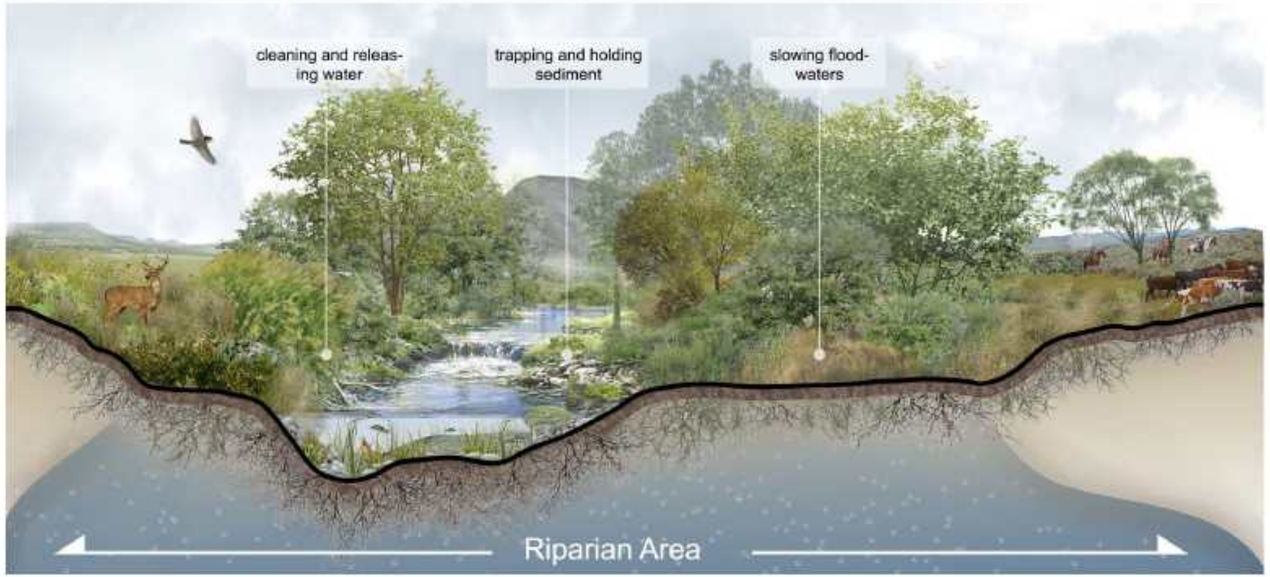
Source: Your Remarkable Riparian (Third edition)

Function Produces Value

Riparian Areas 1.2

"The specialized plants found within the riparian zone play a large role in determining its proper function-slowing floodwaters, trapping and holding new sediment, cleaning and releasing water. And it is this function, supported by these plants, that largely determines the amount and quality of water in our rivers, bays, and groundwater aquifers in Texas.

Within this introduction are key concepts for understanding just how all rivers and streams actually work- and how when functioning properly, they can deliver the values we most prize. Texas is deeply dependent on healthy river systems, and keeping them healthy is the ultimate goal of the remarkable riparian book series."

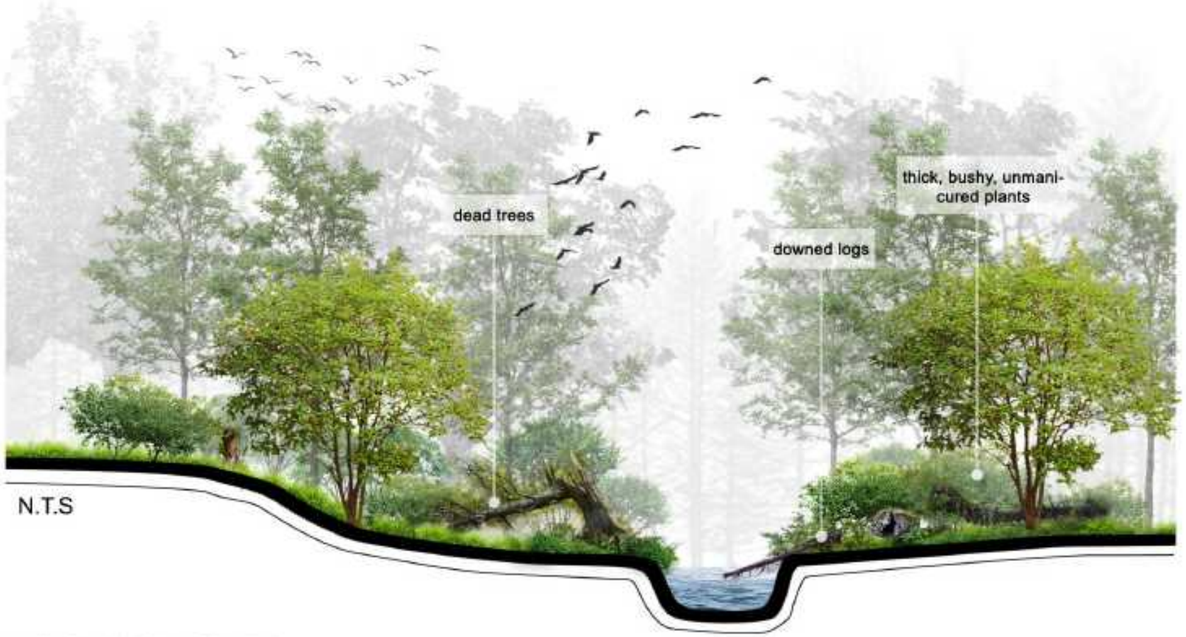


Source: Your Remarkable Riparian (Third edition)

Functional vs. Dysfunctional

Functional Riparian Areas

"Healthy, functional riparian areas have enough natural "stuff" in the channel, on the banks, and in the floodplain to slow water down. This "stuff" can be seen as thick, bushy, unmanicured plants, dead trees, downed logs, and brush piles or boulders that serve to dissipate the energy of floodwaters. Healthy, functioning riparian areas often appear unkempt, overgrown or shaggy. The value of a healthy, well-vegetated riparian area has, until recently, been poorly understood and under-appreciated."

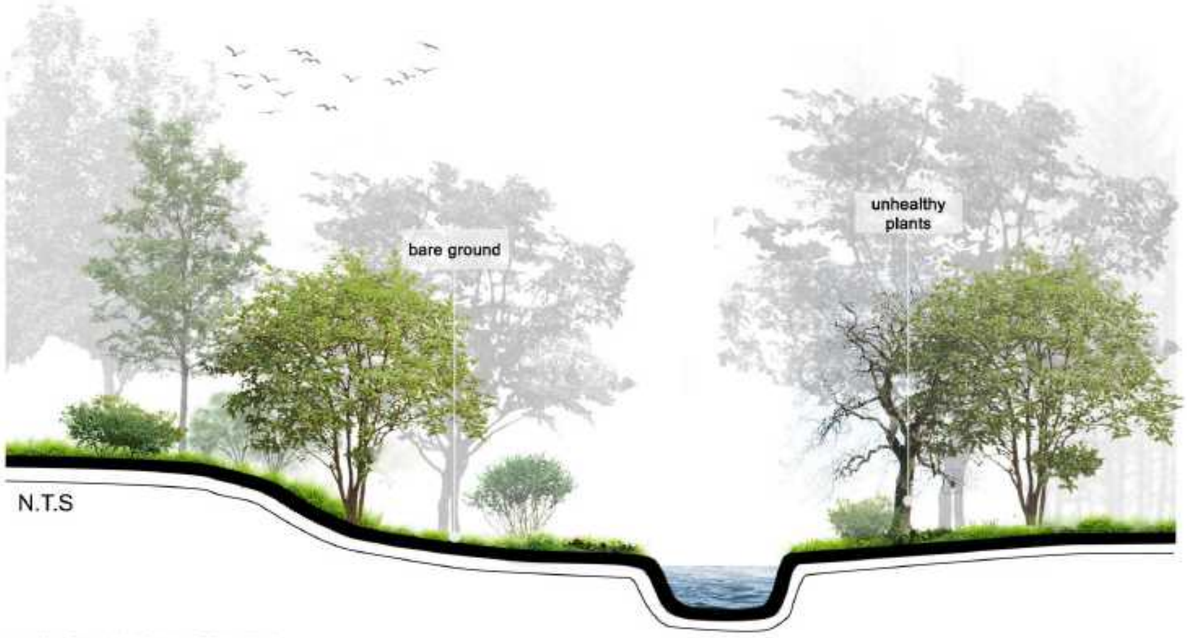


Source: Your Remarkable Riparian (Third edition)

Functional vs. Dysfunctional

Dysfunctional Riparian Areas

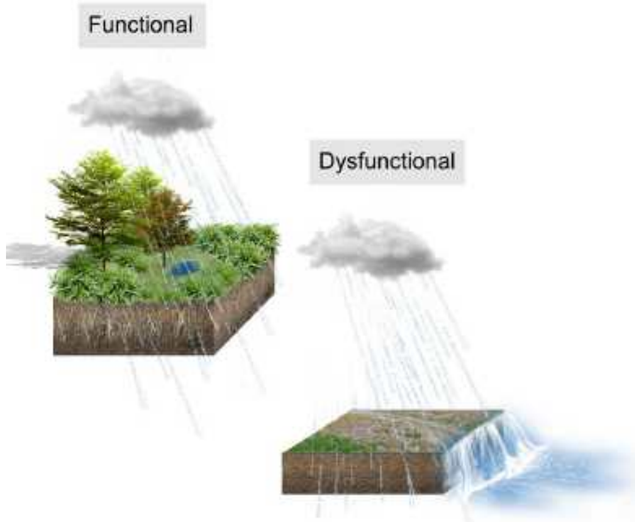
"Dysfunctional riparian areas simply do not have enough "stuff" to slow down floodwaters and catch sediment. Bare ground may be visible along with sparse or unhealthy plants; woody debris may have been removed or burned in a well-meaning but uniformed effort to "clean up" the riverbanks. A dysfunctional riparian area will further degrade under the energy of floodwater. However, when the riparian plants are allowed to grow, over time the functional condition will be restored. Dysfunctional riparian areas are made that way by human activity. They may seem clean, park-like, open and well-kept, but in reality these are signs of an unhealthy landscape."



Source: Your Remarkable Riparian (Third edition)

The Riparian Sponge

Sponge-collecting



"Think of a riparian area as a sponge-collecting, storing and slowly releasing water. Dewatering, compacting or disturbing the soil that makes up the sponge can inhibit this key attribute."

Source: Your Remarkable Riparian (Third Edition)

Root Basket

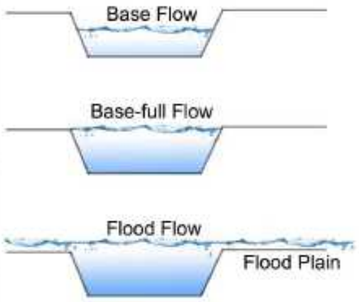
"A properly functioning riparian area supports a heavy stand of densely rooted vegetation. Riparian plant species are different from upland plants; their roots form an interconnected mass that helps maintain bank and channel stability. In functioning condition, the riparian 'root basket' acts like a cradle, holding the streambed in place and protecting the banks." Steve Nelle, range conservationist and wildlife biologist

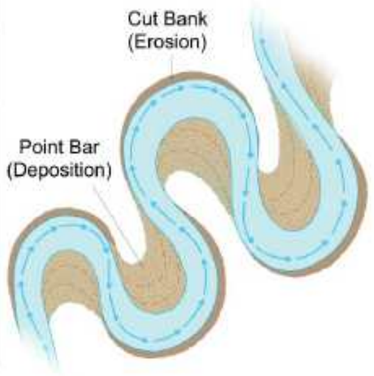
Common Language

Stream Flow

"Riparian health depends on a common understanding among people along a shared resource. Here are a few key terms to help build that common understanding."

Base Flow	"The normal amount of water flowing in a stream, sustained by groundwater discharge and water stored in banks being slowly released."
Bank-full Flow	"Does most of the work in a stream, moving sediment and forming channels. Occurs on average every one to two years."
Flood Flow Regular	"Drops sediment and builds water-storing capacity in the riparian area. Occurs regularly—some studies indicate at lease once every five years."
Erosion & Deposition	"Two opposing forces at work in the same stream—erosion and deposition are balanced when eroded materials are being deposited not for downstream on the opposite bank."
Degradation & Aggradation	"Out-of-balance erosion results in degradation, and out-of-balance deposition results in aggradation."
Cut Bank & Point Bar	"A cut bank is where erosion happens, and a point bar is where deposition is expected to occur."
Bed Load	"Sediment washed down from uplands or dislodged from banks and transported along the bed by regular flood flow."
Sinuosity	"A measure of the crookedness or meander of a stream channel. Increasing sinuosity increases length, reduces slope, and results in energy dissipation."



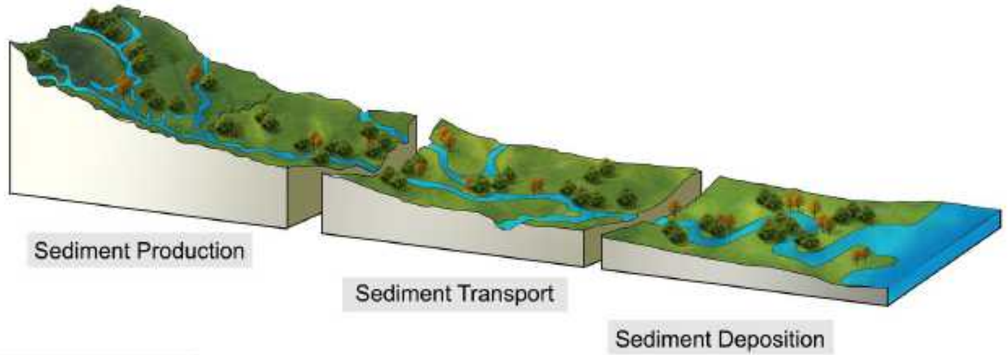


Source: Your Remarkable Riparian (Third Edition) https://en.wikipedia.org/wiki/Cut_bank

Reach Classifications

Stream Flow

"Most streams have at least three general reaches: a sediment production reach, a sediment transport reach, and a sediment deposition reach. Knowing the reach classification can aid in understanding a stream's plant communities and functional condition."



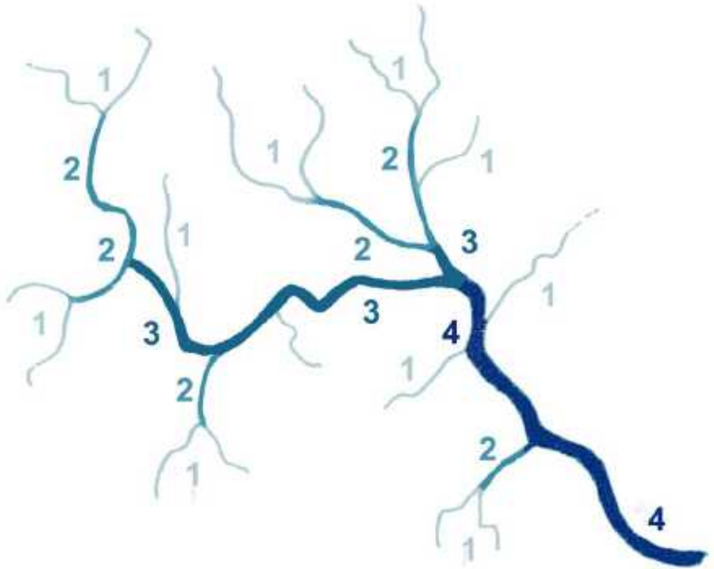
Flow Classification

Ephemeral	"Flows only in direct response to storm runoff and is not connected to a groundwater table. "
Seasonal or intermittent	"Flows occasionally but may flow for extended periods of time and is associated with a groundwater table."
Perennial	"Flows most of the time, except during severe drought and is connected to a groundwater table."
Interrupted	"Perennial streams that cross over aquifer recharge zones can lose all of their flow to aquifer recharge, creating seasonal or ephemeral conditions. Perennial streams can also be interrupted, temporarily or permanently, by over-pumping, channel incision, climate change, and dames or surface impoundments."

Source: Your Remarkable Riparian (Third Edition)

Stream Order

"Stream order is the characterization of perennial streams by their relative size within a drainage basin. Order classifications range from first order, the smallest and with no perennial tributaries, to the twelfth order, the largest. The world's largest river, the Amazon, is a twelfth order stream. The Rio Grande is an eighth order stream at its mouth where it meets the Gulf of Mexico. It can be useful to know the stream order and reach classification of a riparian area when examining its plants community."

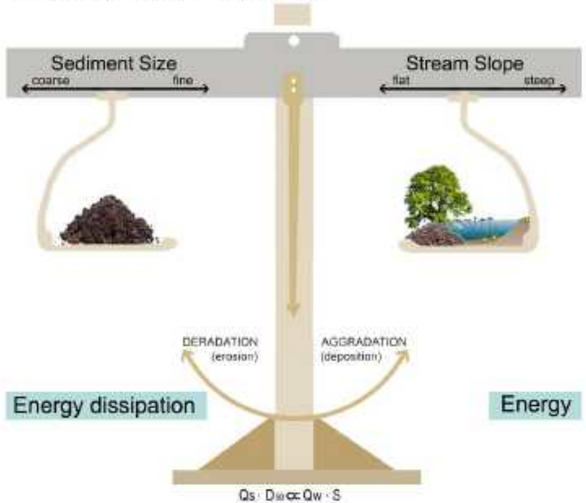


Source: Your Remarkable Riparian (Third Edition)

There is a Balance

Lane's Balance models

"Lane's Balance models the dynamic relationship between water and sediment using four basic variables: sediment discharge, sediment size, stream flow, and channel slope. When any of these variables change, the channel will react by either degrading or aggrading."



Qs = Sediment discharge

D50 = Sediment particle size

Qw = Stream flow

S = Channel slope

"If you look at each variable one at a time using Lane's Balance, it is easy to understand a channel's reaction to changes within its catchment. The examples presented next show what happens when only one variable is changed, and then how the channel becomes rebalanced. Remember, these types of channel reactions can be buffered substantially by healthy riparian vegetation."

Video demonstration

"A detailed demonstration on lane's Balance is on the Nueces River Authority's Remarkable Riparian YouTube Channel at Http://bit.ly/1ncy0IP"

Souce: Your Remarkable Riparian (Third edition)

There is a Balance

Degradation/Erosion: How it works

"Land management practices and changes in land use can increase the volume of run-off that ends up in the stream channel. One initial result can be channel degradation, seen as excessive erosion, down-cutting, and/or widening the stream channel-signs of too much energy, not enough energy dissipation. (See Figure A.)"

"This erosion of the materials from beds and banks will add more sediment to the stream. As a means of re-balancing over time, the channel may adjust its slope by incorporating the newly mined sediment to become flatter. This happens through the creation of meander bends, increasing sinuosity, that adds to the overall length and ultimately reduces or flattens the slope of the stream channel. (See Figure B.)"

Figure A

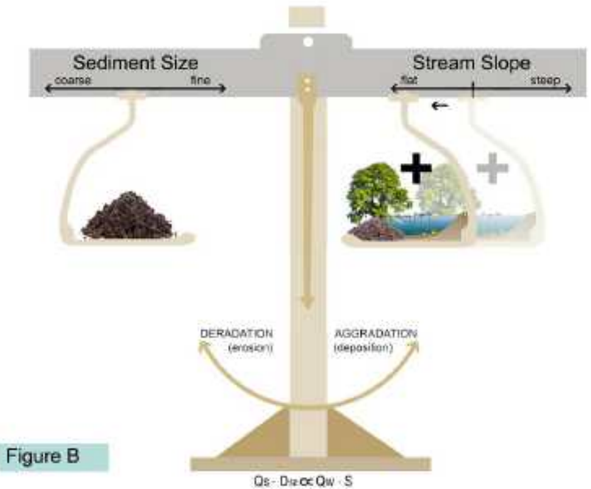


Figure B

Souce: Your Remarkable Riparian (Third edition)

There is a Balance

Aggradation/Deposition: How it works

"Land disturbances like gravel mining, road building, and other construction projects can release more sediment to a channel than it has the water, or energy, to manage. When the sediment side of the balance experiences as increase without a corresponding increase in water energy to more sediment through the system, the stream can experience aggradation, visible as build-up of sediment within a channel. Mid-channel deposits of gravel or sand can be signs of aggradation. (See Figure C.)"

"One way a channel can re-balance itself from an increase in sediment is to increase or steepen its slope. Channels become more steep by becoming straighter and therefore shorter in length. This steepening of the channel slope helps focus stream energy to more efficiently more the increased sediment. (See Figure D.)"

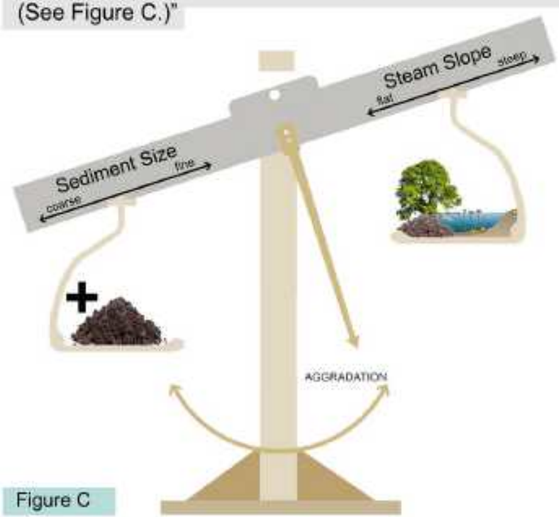


Figure C

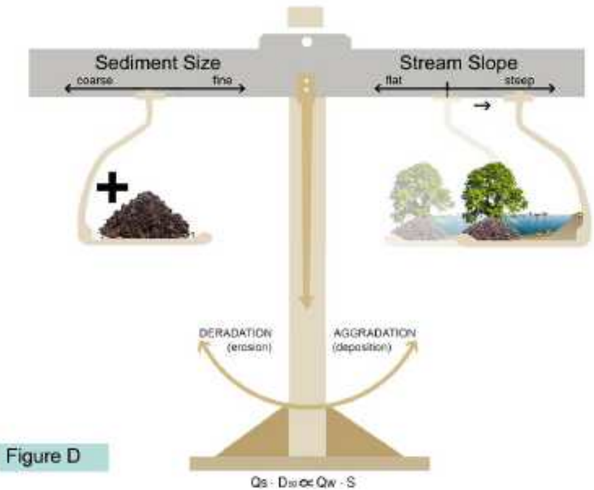


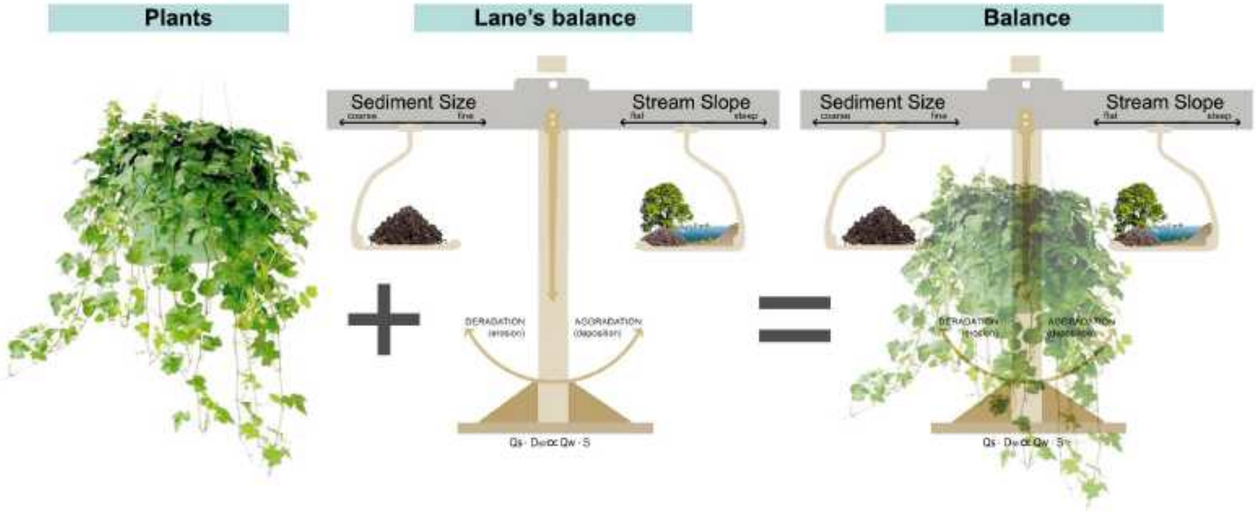
Figure D

Souce: Your Remarkable Riparian (Third edition)

There is a Balance

Plants Are the Key to Balance

"Lane's relationship does not mention riparian vegetation directly, but healthy riparian plants are essential to buffer extreme channel changes. While plants are key, informed people are also an important factor for riparian health."

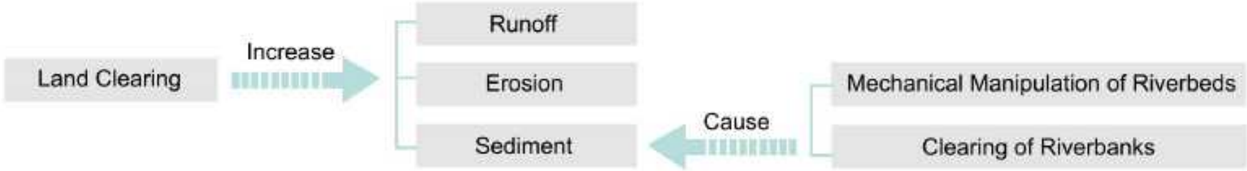


Souce: Your Remarkable Riparian (Third edition) https://www.turbosquid.com/3d-models/ivy-garden-3d-3ds/888125

Channel Aggradation - Tell-tale Signs

Cause of Channel Aggradation

"Land clearing, especially on slopes, can increase runoff and energy causing erosion and releasing additional sediment. Mechanical manipulation of riverbeds and clearing of riverbanks also produces sediment. These kinds of activities may add more sediment than the stream can quickly or easily process."



Result of Channel Aggradation

"Streams struggling to process excessive bed load often appear overly wide and shallow. One way a stream channel recovers from aggradation over time is by using the large volume of material to create meanders. This recovery is only possible when sediment-generating activities change, and vegetation is allowed to grow."

Nueces River | Layou River | North Pease River

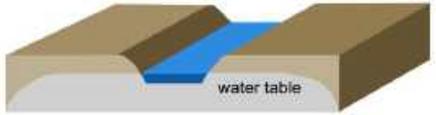
Source: Your Remarkable Riparian (Third Edition) Photos courtesy of Kenneth Mayben, NRCS. http://static.panoramio.com/photos/large/69094326.jpg

Channel Degradation and Recovery

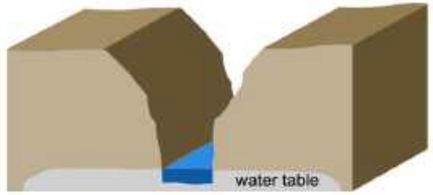
Cause of Channel Degradation

"Whether caused by too much flood energy and not enough energy dissipation or by intentional mechanical manipulation, stream channel degradation is a big and all too common problem. Luckily, degraded stream channels can and do heal themselves, returning to a healthy state once the activity that was interfering with recovery is halted.

The images right show what happens when a channel is down-cut. The water table becomes diminished, lowered, and inaccessible to plant life trying to grow within the former riparian zone."



Healthy Channel Connected to Water Table



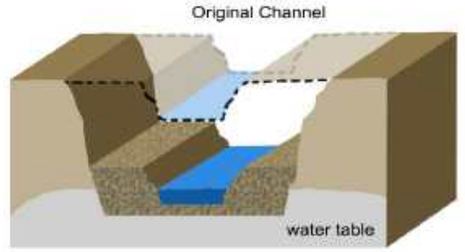
Degraded Channel and Diminished Water Table

A degraded channel on a tributary creek of the North Sulphur River in Lamar County, North Texas

Channel Degradation and Recovery

Recovery of Degraded Channel

"Luckily, degraded channels can and do recover. A return to functional condition is possible, even on a severely down-cut channel. Recovery can only begin when plants are allowed to grow. The recovered down-cut stream channel will always be at a lower elevation than before—resulting in a net loss in water storage capacity."



Down-cut channel can recover naturally, but at a lower elevation

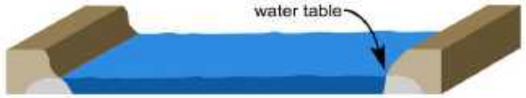
A recovering channel on Chambers Creek, Ellis County in North Texas

Channel Degradation and Recovery

Overly Wide Channel and Diminished Water Table

"The following images show what happens when a channel sitting on top of impermeable rock is degraded due to too much water energy. There's no place to go but out, and the channel becomes overly wide, diminishing the water table as well. This is a common sight on Hill County streams."

Healthy channel connected to water table



Overly wide channel and diminished water table

Overly wide channel on Blanco Creek, Uvalde County

Channel Degradation and Recovery

Recovery of Overly Wide Channel

"Overly wide channels can easily heal and completely recover their water table connections at the original elevation once plants are allowed to grow. The images below show recovery that began as a single plant, trapping and colonizing bits of sediments, slowly but surely rebuilding a healthy riparian area, and increasing the water storage capacity."

Channel can fully recover naturally

"Recovery always begins with a plant, a tough one that can survive in the degraded condition. There plants are called riparian pioneers on early-stage colonizers, and they can only do their work when they are allowed to grow—not mowed, trampled, over-browsed, or overgrazed."

Fully recovered channel on Cedar Creek, Kimble County

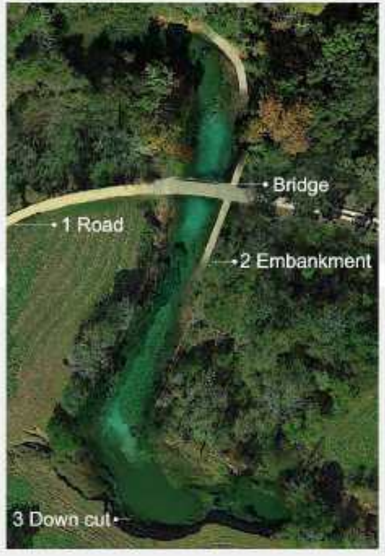
A similar channel recovery on Leila Lake Creek, Donley County in North Texas

Riparian Indicators of Health Condition

1. Active Floodplain

"A floodplain gives the flowing water a place to spread out and slow down. When streams are blocked by 1.roads, 2.concrete embankments or they are 3.down-cut, floodplains do not form or are inhibited from moving freely across the landscape.

Floodplains allow floodwaters to slow down and deposit their sediments- a necessary component of water storage. Organic matter in most flood sediment is known to increase the water holding capacity of soils, sands and gravels. Riparian areas can support stream flows during dry times by releasing stored waters."




Natural down cut


Road/bridge


Concrete embankment

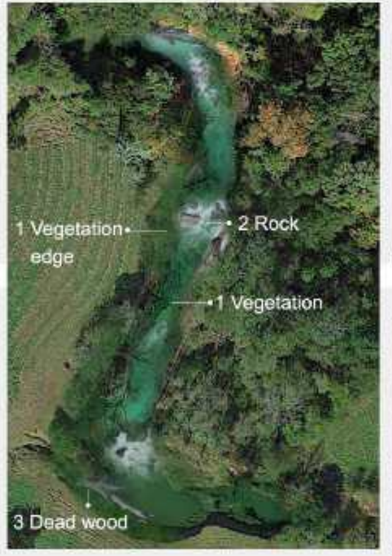

Channel and flood plain

Source: Your Remarkable Riparian (Third Edition) http://www.wikiwand.com/en/Kinzua_Creek https://pixabay.com/en/bridge-stream-rural-landscape-572675/ http://www.rpcltd.co.uk/contracts/revetment.html https://commons.wikimedia.org/wiki/File:A_point_bar_north_of_Llanelltyd_bridge_-_geograph.org.uk_-_723310.jpg

Riparian Indicators of Health Condition

2. Energy Dissipation

"Floodwaters carry a lot of energy. If enough 1.vegetation, 2.rocks or 3.large dead wood are present, then the floodwaters will be slowed down and their energy will be dissipated, or spread out across the rough surfaces of these items. Slowing water down and dissipating energy is essential for healthy functioning riparian areas."




Poor energy dissipation


Good energy dissipation


Good energy dissipation


Good energy dissipation

Source: Your Remarkable Riparian (Third Edition) http://frwa.org/what-we-do/advocacy/stream-flow/ http://www.themarkeworld.com/los-angeles/the-green-stream/ https://www.123rf.com/stock-photo/forest_stream.html http://www.bayjournal.com/blog/post/ounce_of_protection_is_worth_a_gallon_of_cure_for_rivers

Riparian Indicators of Health Condition

3. New Plant Colonization

"If floodwaters are being slowed down and sediment trapped, then those sediment need to be colonized by new plants in order to become stabilized and incorporated into the floodplain, eventually adding to the water storage capacity."


Before colonization


After colonization


Before colonization


After colonization

Source: Your Remarkable Riparian (Third Edition) https://commons.wikimedia.org/wiki/File:Enchanted_Rock,_grass.jpg http://www.cardiff.ac.uk/people/view/81302-vaughan-ian

Riparian Indicators of Health Condition

4. Stabilizing Vegetation

"It takes strong rooted vegetation to withstand the energy of floodwater. Plants are rated for their ability to withstand floods with a stability rating (SR) number. SR1 is bare ground and SR10 is equivalent in strength to anchored rock.

Good coverage with plants having SR ratings of six or higher is usually a minimum for weathering floods. When deep-rooted plants and high-stability plants are mixed with low-stability plants or large wood or boulders, the community stability is greatly enhanced as roots are often interlocked and incorporate the wood and rock material."

Poor Growing Cover


Low growing cover


Low SR plant types

Good Vegetation Cover


High Vegetation cover


High SR plant types

Source: Your Remarkable Riparian (Third Edition) http://www.fishhabitat.org/images/sized/images/uploads/_medium/MuddyBranch-700x380.jpg http://www.agr.gc.ca/resources/prod/img/tenf/images/unhealthy_riparian.jpg https://farm6.staticflickr.com/5588/15043997372_91ca200e08_b.jpg https://www.unce.unr.edu/programs/sites/nemo/images/riparian/LowerTruckeeNixon.jpg

Riparian Indicators of Health Condition

5. Age Diversity

"Age Diversity of riparian plants is an indicator of health. Plants of different ages can help provide stability during fluctuation in flow and climatic conditions. The presence of both young and old palatable plants can indicate that past and present grazing and browsing have not hindered function."

Lower Age Diversity

Younger aged plant forms

Good mix of shrubs, grasses and wetlands

Higher Age Diversity

Mix of trees and shrubs

Dense trees, shrub, grass cover

Riparian Indicators of Health Condition

6. Species Diversity

"In nature, diversity contributes to system stability and resilience. This is also true in riparian systems where the diversity of riparian plant species can help lead to better functional conditions. A diverse group of riparian plants creates a plant community that is more durable and functional than any single species could be on its own. This is especially important underground where an interlaced series of diverse roots can interlock to hold channels in place, even elevating them to create more water storage across an entire valley."

Good Diversity

Flat gradient, good species diversity

Steep gradient, good species diversity

Good Stability

Younger aged, good coverage

Younger aged, Diverse mix

Riparian Indicators of Health Condition

7. Plant Vigor

"Riparian plants that are browsed, mowed or grazed short continuously can become unhealthy. Unhealthy plants can have compromised root systems and may not be able to provide energy dissipation and bank stabilizing functions. If vigor is compromised, it is time to do something different, such as removing the hindrance causing the problem."

Poor Plant Vigor

Ornamental managed edge

Eroded edge

High Plant Vigor

Flat gradient, high plant vigor

High plant vigor

Source: Your Remarkable Riparian (Third Edition) http://www.themarkeworld.com/wp-content/uploads/2012/10/The-green-stream.jpg, http://www.hotel-r.net/im/hotel/ch/riverside-1.jpg
http://www.savefamilyfarming.org/uploads/4/4/3/1/44318955/9478392_orig.jpg, http://www.westernrivers.org/downloads/blog/Dan-Sorensen-fossil-creek-az-10.jpg

Riparian Indicators of Health Condition

8. Water Storage

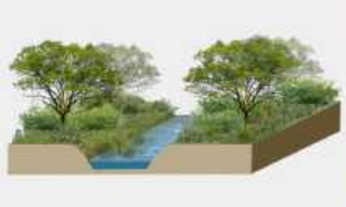
"One of the important services provided by riparian areas is the storage of water out of sight, below ground or within the banks for release to the stream during dry times. Water storage capacity is influenced by the volume of organic matter within soils and can be indicated by the presence of water loving plant species. A plant's wetland indicator status can tell you if water is regularly present below ground where it is growing."

Low Water Storage

Low plant volume

Low plant volume

Good Water Storage



High plant volume

High plant volume

Source: Your Remarkable Riparian (Third Edition) https://sunrobins.files.wordpress.com/2011/11/p1640046.jpg, https://blogs.ancientfaith.com/orthodoxbridge/wp-content/uploads/sites/27/2012/05/Dry_Ryegate.jpg
http://www.lizjohnsonrealestate.com/wp-content/uploads/2011/06/IMG_0168.jpg?w=640, https://www.unce.unr.edu/programs/sites/nemo/images/riparian/LowerTruckeeNixon.jpg,

Riparian Indicators of Health Condition

9. Bank and Channel Erosion

"Erosion is natural part of the riparian system, but like most things in nature, balance is needed. Erosion of stream banks should be compensated by deposition in the creation and maintenance of meandering bends. Meandering bends can aid in energy dissipation within a channel; the more crooked a stream becomes, the lower the gradient or the flatter the slope."


Sediment deposits


Dead wood deposits


Streamside down-cuts

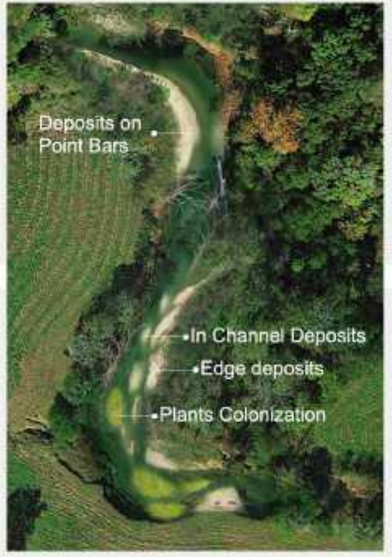

Edge erosion

Source: Your Remarkable Riparian (Third Edition) http://www.forwatershed.org/Projects/STEP/SForkErosion.jpg http://www.planat.ch/uploads/pics/P0282_15.jpg https://www.harrisonburgva.gov/sites/default/files/CleanStream/images/liberty%20park%20june06.jpg https://whfarmfoundation.org/wp-content/uploads/2014/02/hawksbillcreek.jpg

Riparian Indicators of Health Condition

10. Sediment Deposition

"A river moves and processes both sediment and water, and they must be in balance. If too much sediment is being delivered to the channel and there is not enough water energy to process it, sediment can build up in mid-channel and in other illogical places. When water and sediment are in balance, sediment are deposited on point bars and contribute to the natural meander pattern of a waterway."




In Channel deposits without plant colonization


In channel deposits with plant colonization


Sediment deposits (on point bars)


Sediment deposits (on point bars)

Source: Your Remarkable Riparian (Third Edition) https://www.nwfsc.noaa.gov/research/divisions/fe/wpg/ecosystem_processes/habitat.cfm https://cobbcounty.org/images/water/habitat/sedimentdeposition662x498.jpg https://c1.staticflickr.com/5/4076/4745515222_b0ba9d555e_b.jpg http://www.onegeology.org/extra/kids/images/meanderingRiver.jpg

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Page 93-116:
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Page 118-128
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