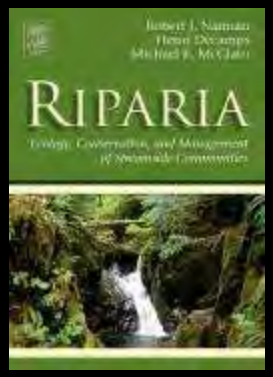
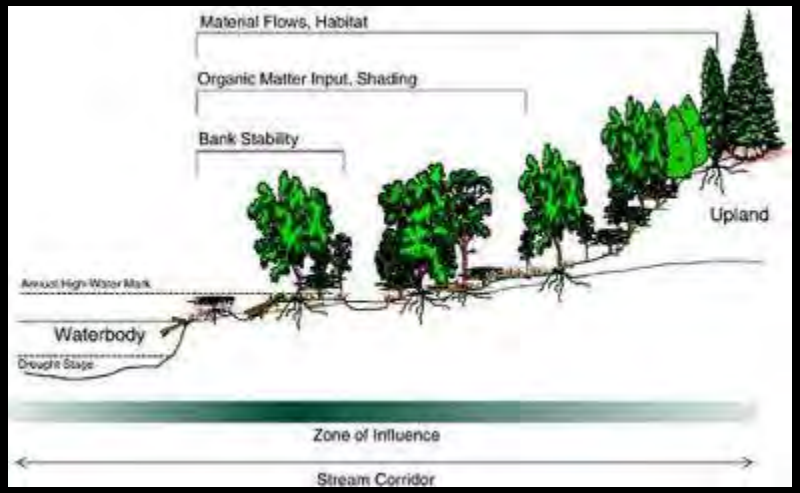
Riparia: Life at the River's Edge

Kevin Anderson, Ph.D.

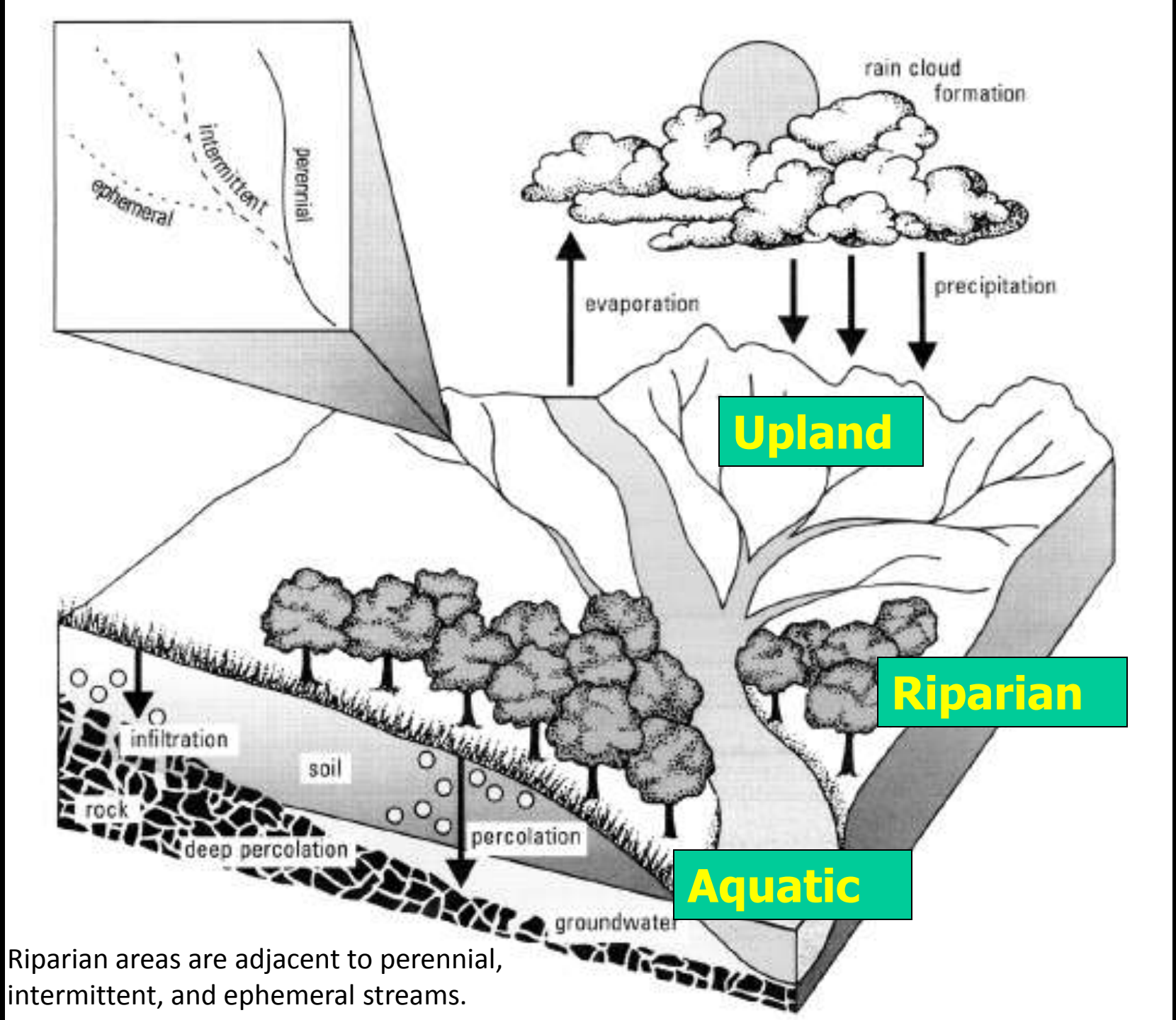
Austin Water - Center for Environmental Research



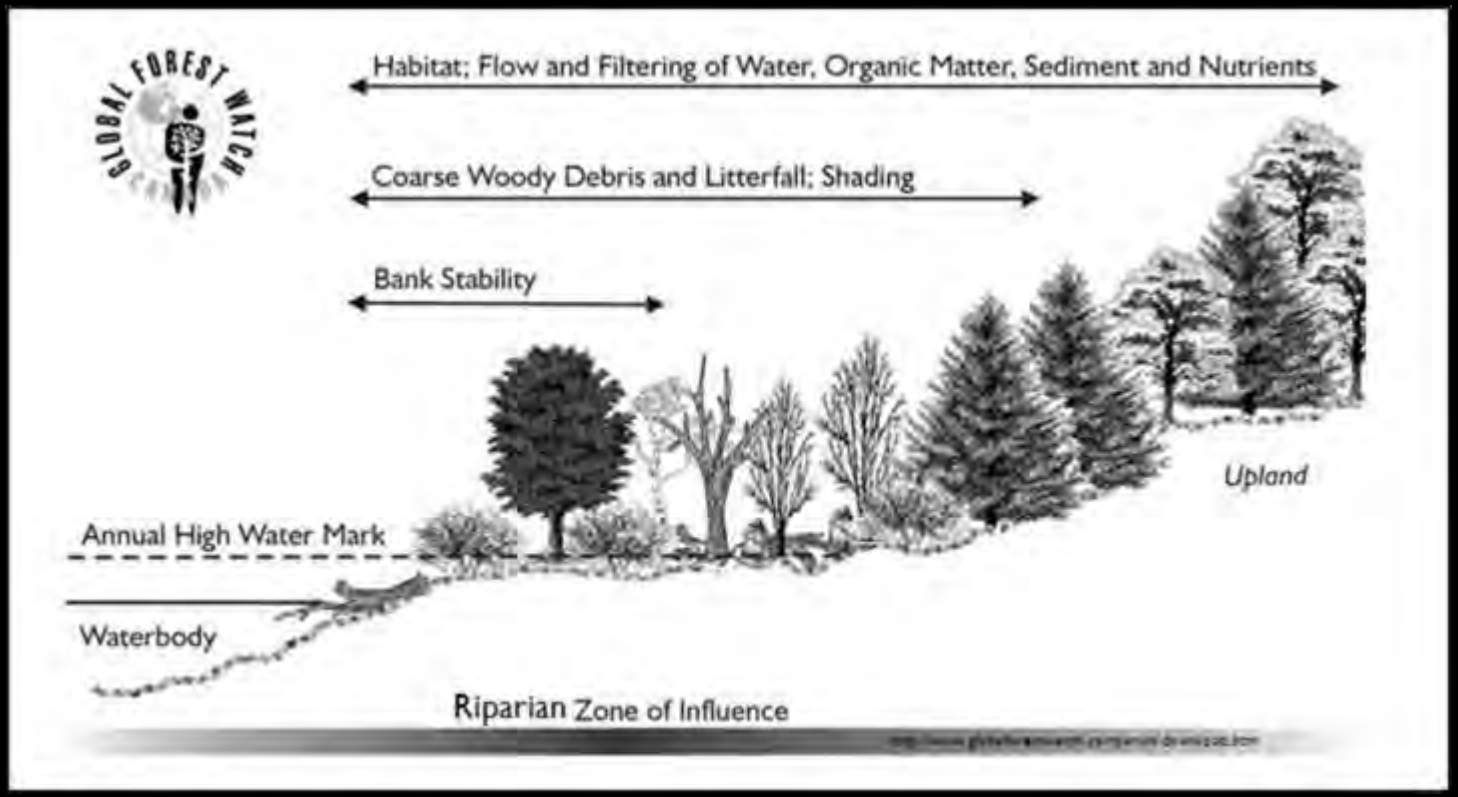


Riparian = Waterway Margins

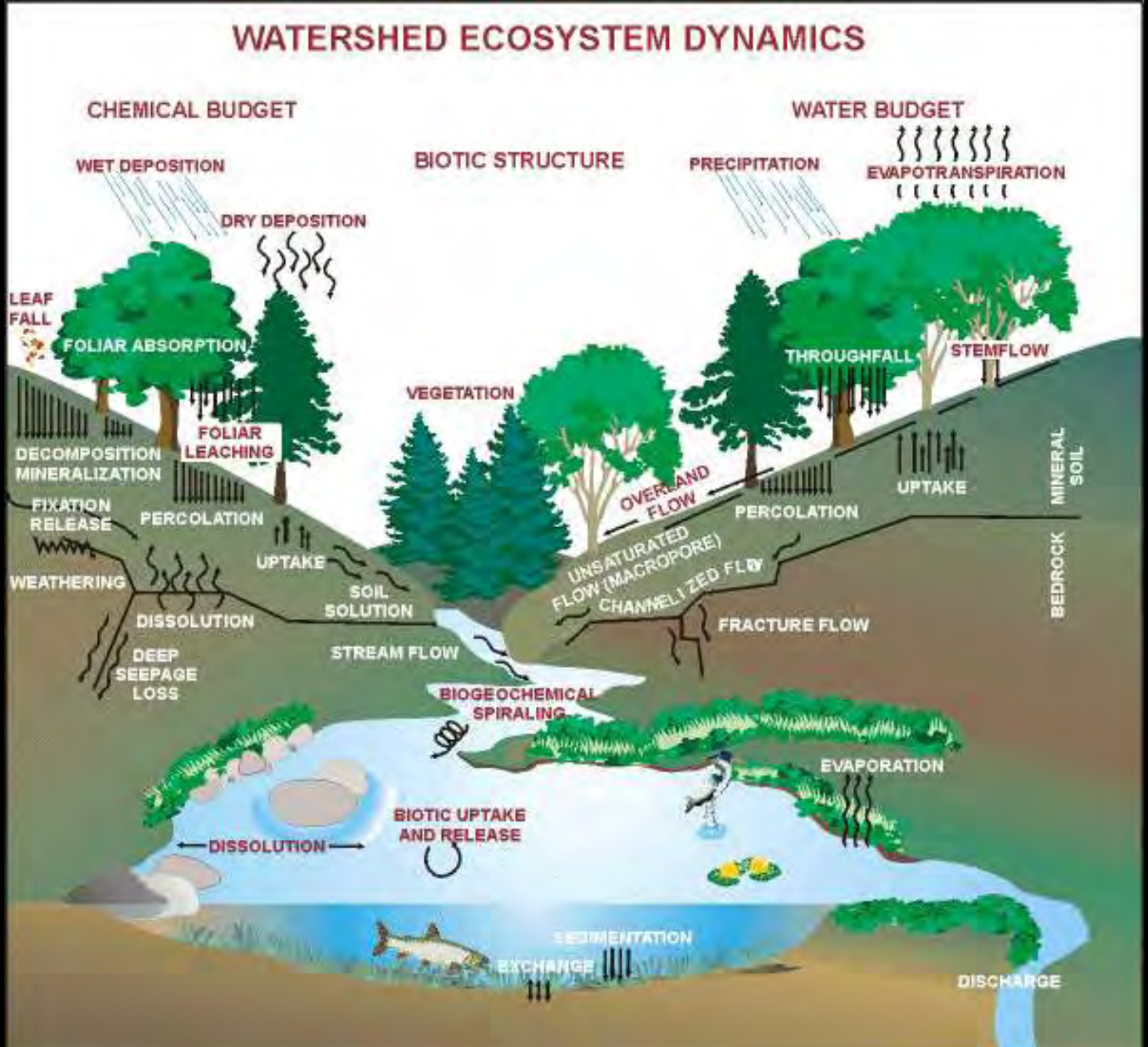
Riparian areas are transitional zones between terrestrial and aquatic ecosystems.

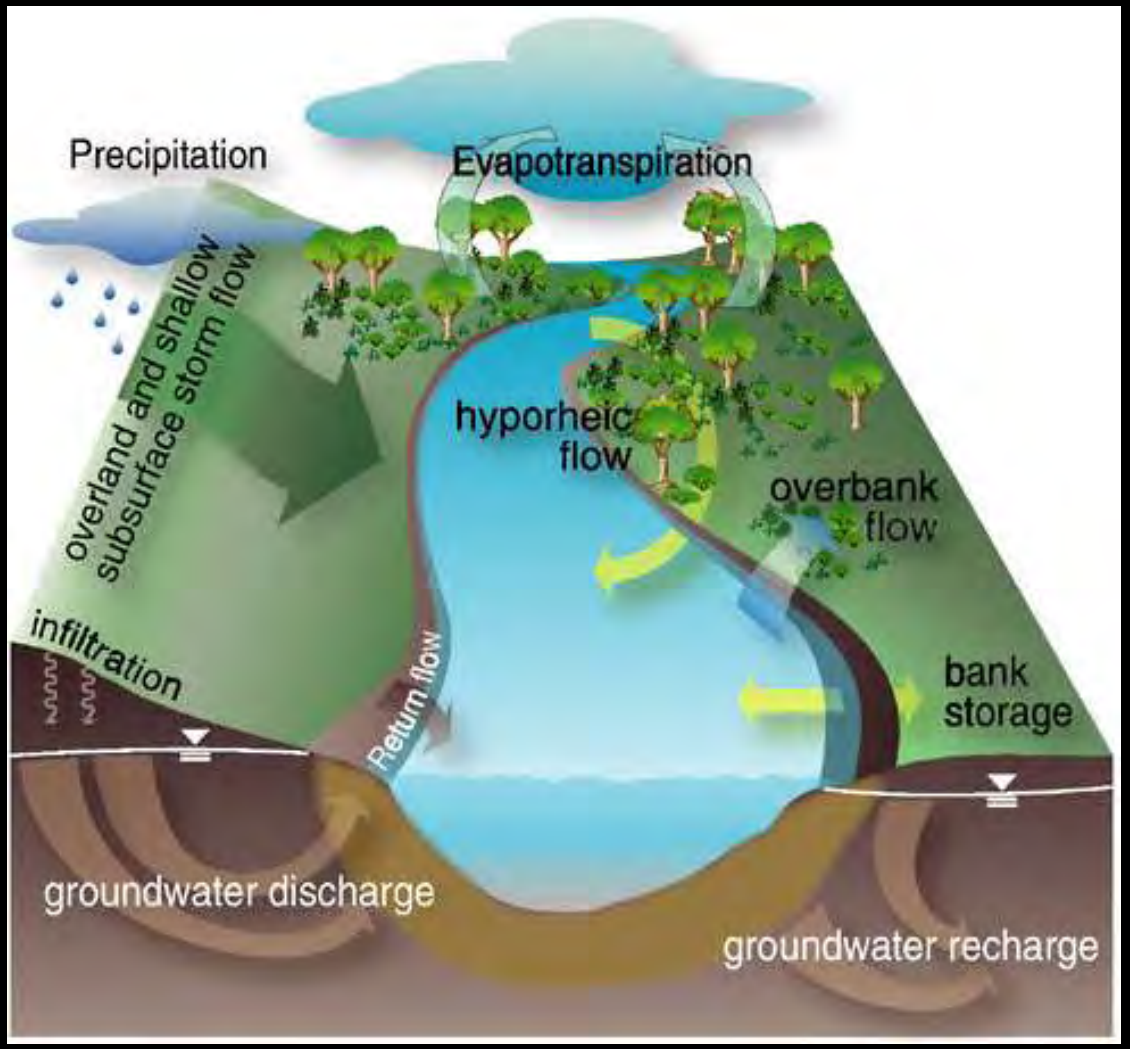


Riparian areas are adjacent to perennial, intermittent, and ephemeral streams.



They include those portions of terrestrial ecosystems that significantly influence exchanges of energy and matter with aquatic ecosystems.


WATERSHED ECOSYSTEM DYNAMICS
CHEMICAL BUDGET
WATER BUDGET
BIOTIC STRUCTURE
WET DEPOSITION
DRY DEPOSITION
PRECIPITATION
EVAPOTRANSPIRATION
LEAF FALL
FOLIAR ABSORPTION
FOLIAR LEACHING
VEGETATION
THROUGHFALL
STEMFLOW
DECOMPOSITION MINERALIZATION
FIXATION RELEASE
PERCOLATION
UPTAKE
OVERLAND FLOW
PERCOLATION
UPTAKE
MINERAL SOIL
WEATHERING
SOIL SOLUTION
UNSATURATED FLOW (MACROPORE)
CHANNELIZED FLOW
BEDROCK
DISSOLUTION
FRACTURE FLOW
DEEP SEEPAGE LOSS
STREAM FLOW
BIOGEOCHEMICAL SPIRALING
EVAPORATION
BIOTIC UPTAKE AND RELEASE
DISSOLUTION
SEDIMENTATION
EXCHANGE
DISCHARGE



Riparian Zone and Hyporheic Flows

They are areas through which surface and subsurface hydrology connect water bodies with their adjacent uplands.

Dr. Bayani Cardenas, University of Texas Jackson School of Geosciences

Riparian Zone and Hyporheic Flows

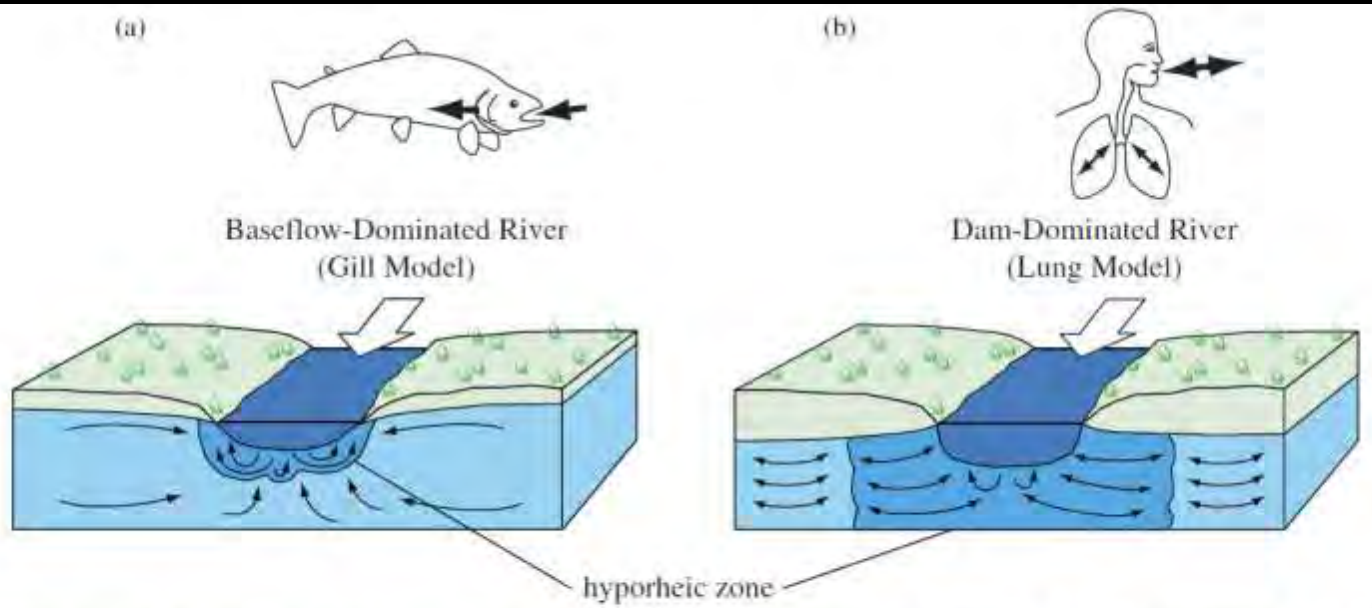


Figure 10. (a) Conceptual model of a natural river-groundwater system in a reach dominated by baseflow. During most of the year, groundwater flows steadily through the riparian aquifer in one direction like water through a gill. Groundwater discharge to the river limits the size of the hyporheic zone. (b) Conceptual model of a river-groundwater system downstream of a dam. Due to frequent stage fluctuations, river water flows in and out of the riparian aquifer like air flowing in and out of lungs. The hyporheic zone includes all flow paths that start and end in the channel

The Riparian Sponge

One of the attributes of a properly functioning riparian area is the sponge effect and water storage capacity within the riparian area.

This large absorbent sponge of riparian soil and roots will soak up, store, and then slowly release water over a prolonged period.

This riparian sponge can be managed in a way to greatly increase and improve this storage or it can be managed in a way to decrease and degrade water storage.

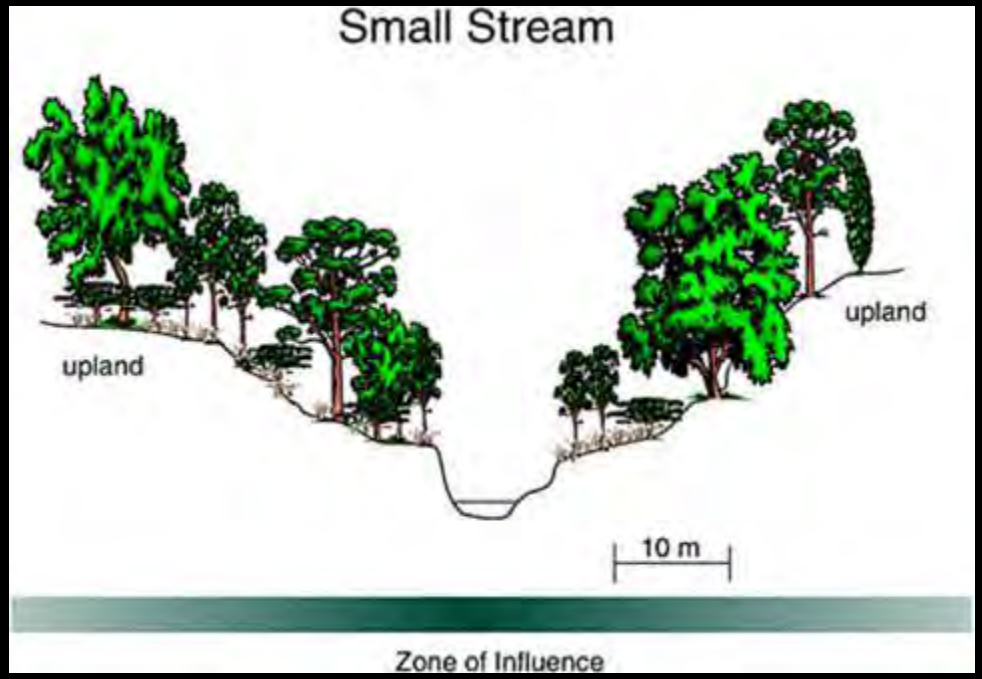
Environmental Flows and the Riparian Sponge

Storage capacity – Bear Creek, Central Oregon study

12 acres of riparian area per mile = 12 acre feet of water per mile

Interaction zone between - Surfacewater and Groundwater

Interface with the Alluvial Aquifer


Small Stream
upland
upland
10 m
Zone of Influence

Riparian Vegetation

The functionality of riparian zones is determined by a combination of erosion, deposition, hydrology and riparian vegetation.

The factor you can most easily influence is the plant community that exists in the riparian zone.

Different plant species, or groups of plants, support riparian zone ecosystem function.

A diversity of plants, both in species and structure, is needed to provide optimum ecosystem functionality.

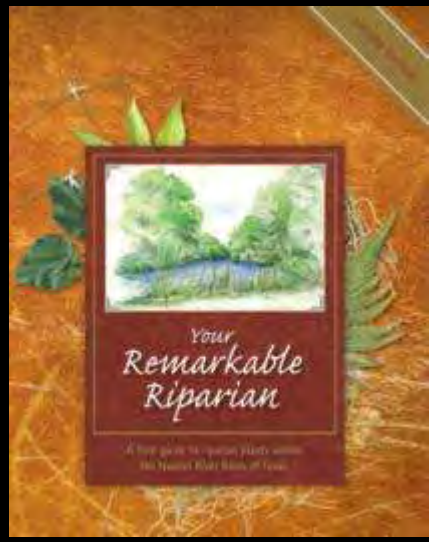
The plant community is also critical to streambank stability.

Stable streambanks usually need a mix of species that include those with both fine roots and those with larger, more substantial roots. In most cases, this requires a mixture of sedges or rushes, grasses and woody species.

Riparian Vegetation

Plant community structured by hydrology

Hydric Soils



Riparian Vegetation

Above Permanent Waterline

American Elm
Honey Locust
Roughleaf dogwood
Eve's Necklace
Box elder
Buttonbush
Green ash
Baccharis
Black willow
Western soapberry
Pecan
Bur oak
Cottonwood
Sycamore
Little walnut
False indigo
Wafer ash (Hop tree)
Live oak
Mulberry

Black Hickory
Yaupon
Switchgrass
Eastern gamagrass
Big bluestem
Indiangrass
Little bluestem
Virginia wildrye
Texas bluegrass
Purpletop
Inland sea-oats
Texas wintergrass
Maximilian sunflower
Illinois bundleflower
Dogbane
Buffalograss
Herbaceous mimosa
Redbud
Gum Bumelia

Vertical structure – groundcover, understory, canopy

At Permanent Waterline, not saturated year-long

- Elder berry
- Buttonbush
- Dwarf willow
- Sandbar willow
- Black willow
- Box elder
- Sycamore
- False indigo
- Roughleaf dogwood
- Bald cypress
- Baccharis
- River Hemp [Sesbania]
- Southern wildrice (Zizaniopsis)
- Texas Sophora (Eve's Necklace)
- Eastern Gamagrass
- Switchgrass
- Horsetail (Scouring rush)
- Soft rush
- Bulrushes
- Sedges
- Bushy bluestem
- Smartweed
- Cattails
- Spikerushes

In the water, or permanently saturated:

Bald Cypress

Bulrushes

Horsetail

Soft rush

Reeds

Cattails

Spikerushes

Ludwigia

Types of Vegetation:

Colonizers

Stabilizers

Woody

Ecosystem Process - Nonequilibrium dynamics

Non-native species – are foreigners good or bad?

Elephant ear, coco yam, wild taro

Colocasia esculenta

Tobacco Tree

Nicotiana glauca

Proper Functioning Condition

Riparian areas are functioning properly when adequate vegetation is present

- dissipate stream energy associated with high waterflows, thereby reducing erosion and improving water quality

- filter sediment, capture bedload, and aid in floodplain development; improve flood-water retention and groundwater recharge

- develop root masses that stabilizes streambanks against cutting action and store water

- develop diverse ponding and channel characteristics to provide habitat and the water depth and temperature necessary for fish, waterfowl, benthic macroinvertebrates, and other fauna

- support greater biodiversity

Large Woody Debris

Tree limbs that fall into streams and rivers increase habitat heterogeneity.

Submerged woody debris persists for long periods in streams and rivers, with a calculated half-life of ~20 years.

Woody debris can stabilize river beds, modify erosion and deposition, create essential fish habitat, and help form pools that retain organic matter, extending the availability of seasonal food resources.

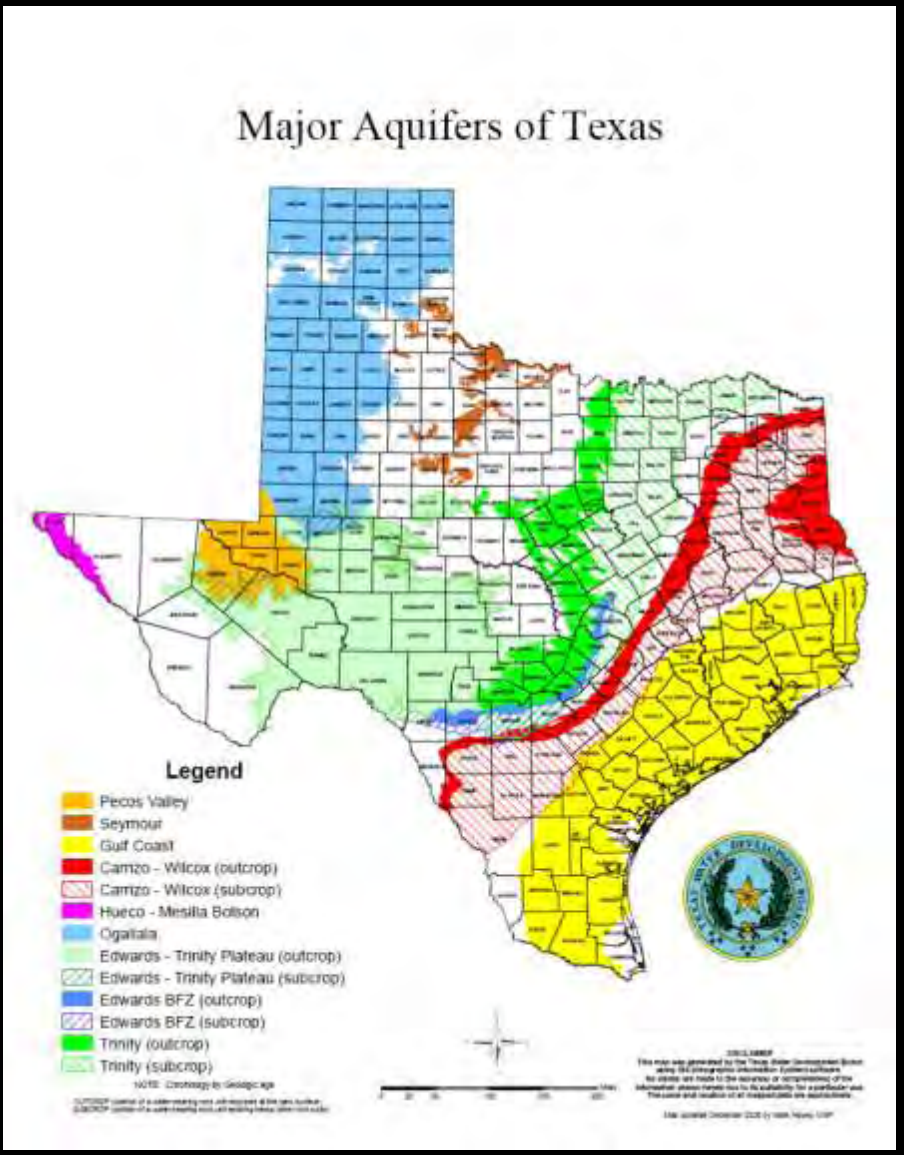
Experimentally manipulated woody debris was shown to increase both macroinvertebrate and fish colonization.

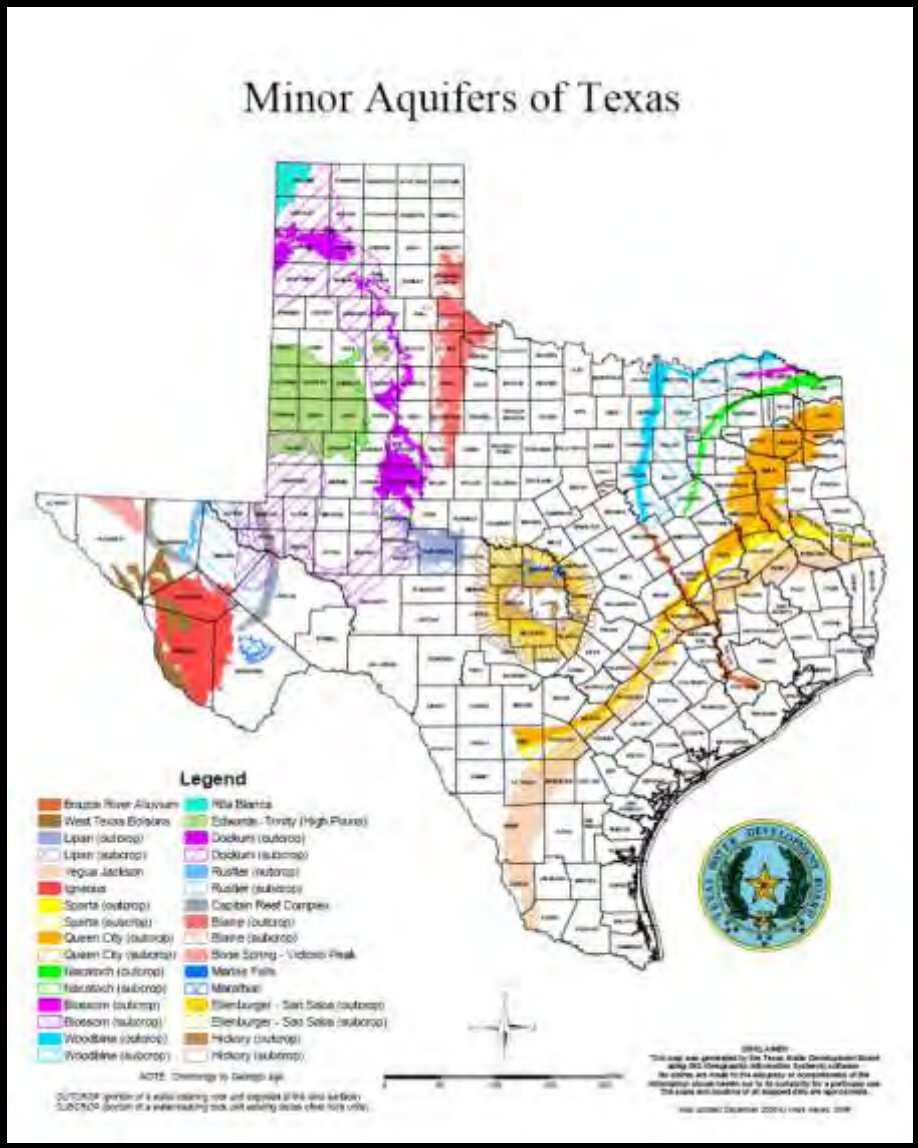
Riparian Areas in Proper Functioning Condition

Ecosystem Services

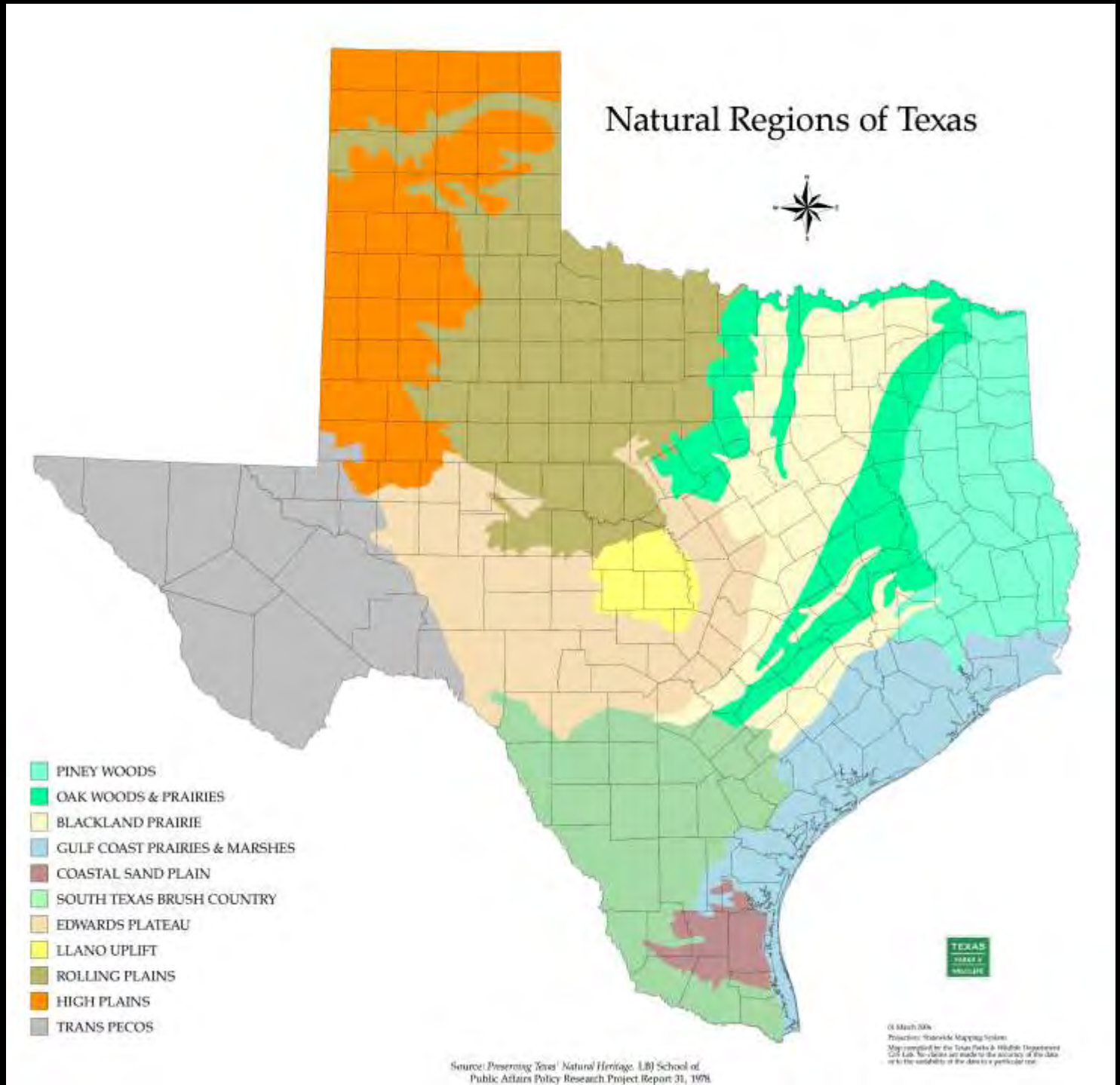
- Water Quality
- Erosion Control
- Flood Buffer
- Wildlife Habitat
- Aquatic Habitat
- Water Storage

Riparian Protection in Texas?





Riparian
Habitat
In Texas?



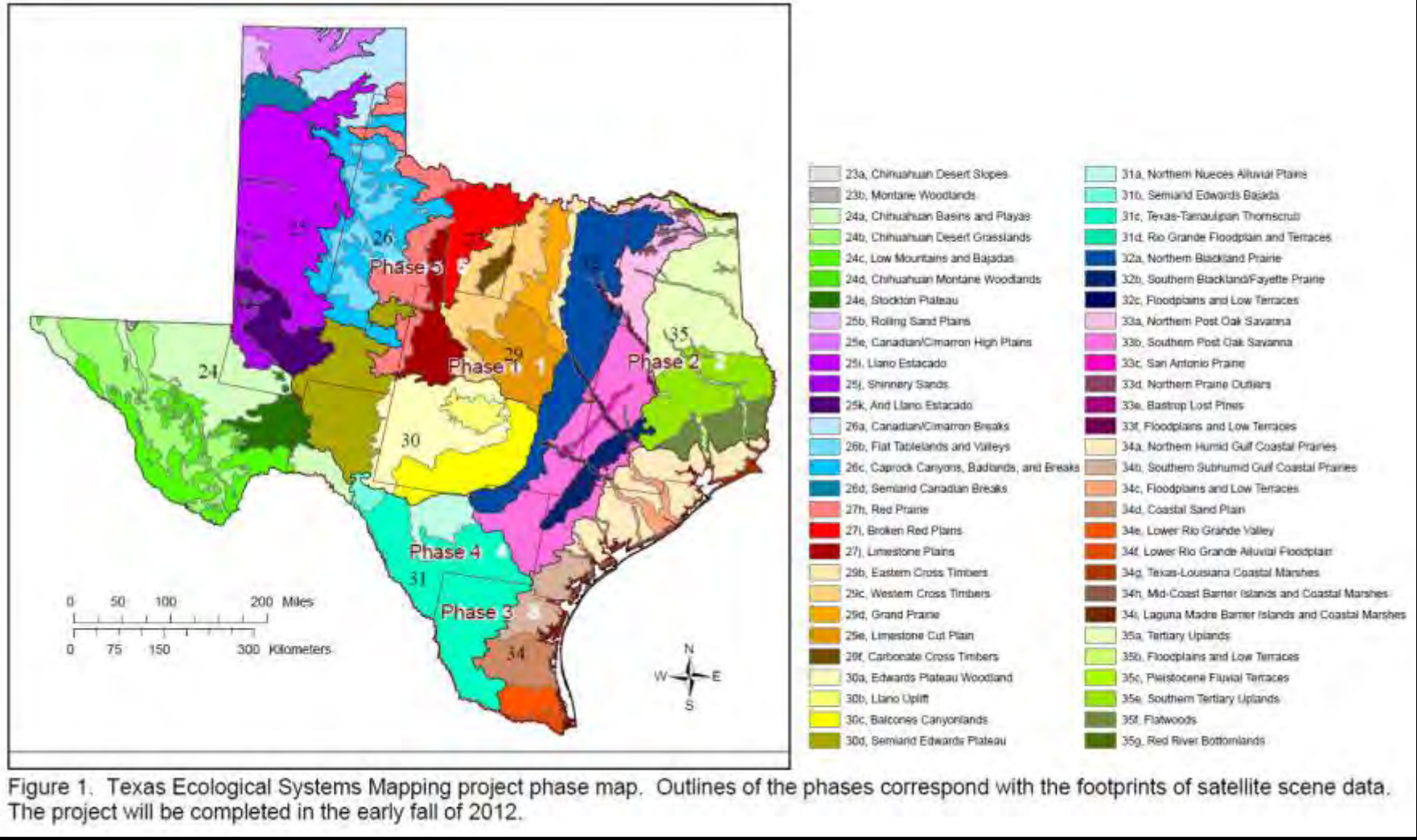


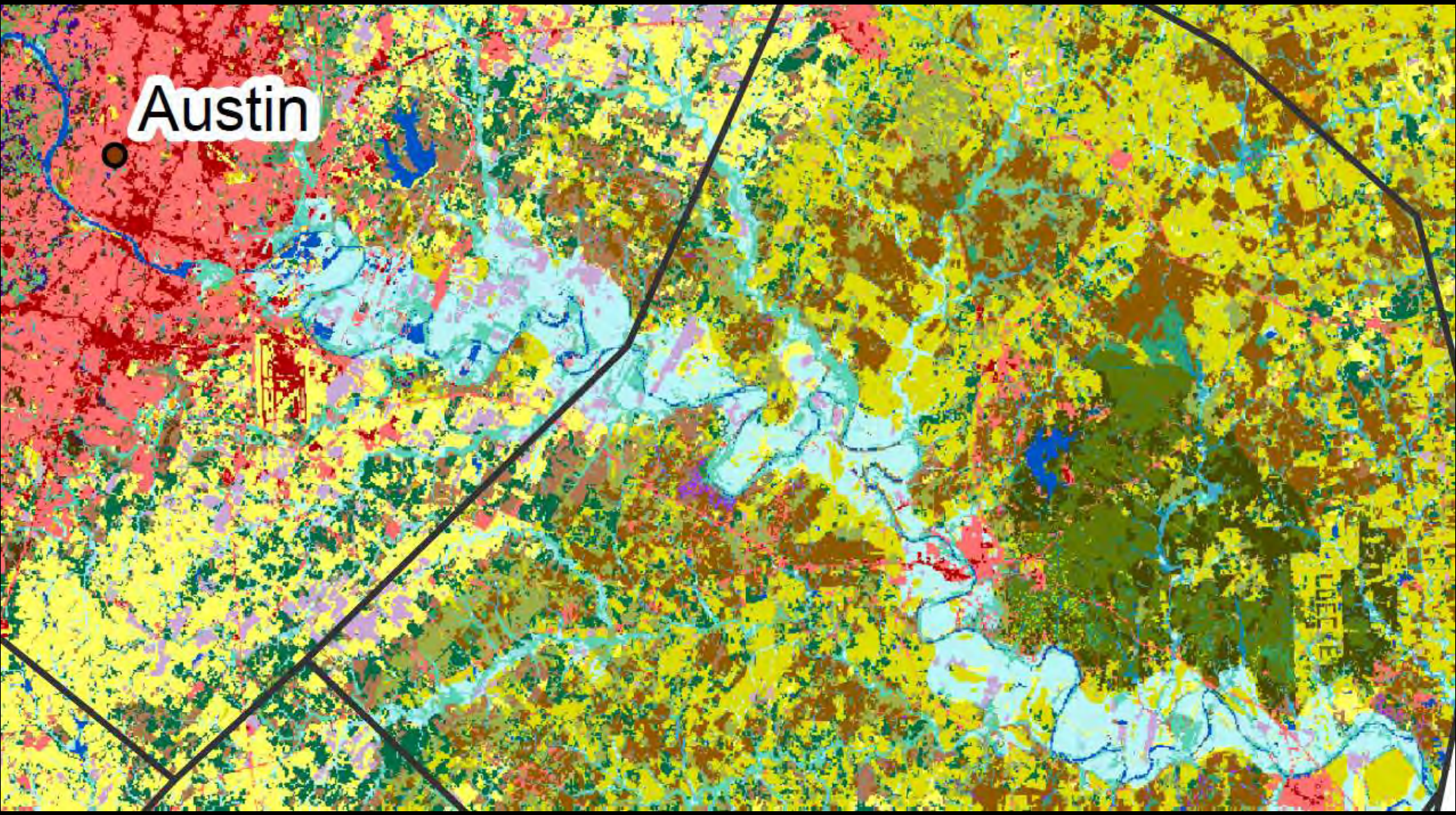
Figure 1. Texas Ecological Systems Mapping project phase map. Outlines of the phases correspond with the footprints of satellite scene data. The project will be completed in the early fall of 2012.

Texas Ecological Systems Project

The Texas Parks and Wildlife Department cooperated with private, state, and federal partners to produce a new land cover map for Texas, using an expansion and modification of the original NatureServe Ecological System Classification System. The resulting Mapping Subsystems are essentially land cover types within more broadly-defined ecological systems, which represent groups of related plant communities affected by similar processes, and occurring together within larger landscapes.


Southeastern Great Plains Riparian Forest
Central Texas: Riparian Juniper Forest
Central Texas: Riparian Live Oak Forest
Central Texas: Riparian Hardwood / Evergreen Forest
Central Texas: Riparian Hardwood Forest
Central Texas: Riparian Evergreen Shrubland
Central Texas: Riparian Deciduous Shrubland
Central Texas: Riparian Herbaceous Vegetation


Southeastern Great Plains Floodplain Forest
Central Texas: Floodplain Juniper Forest
Central Texas: Floodplain Live Oak Forest
Central Texas: Floodplain Hardwood / Evergreen Forest
Central Texas: Floodplain Hardwood Forest
Central Texas: Floodplain Evergreen Shrubland
Central Texas: Floodplain Deciduous Shrubland
Central Texas: Floodplain Herbaceous Vegetation


Austin

Results of Poor Riparian Management in Texas

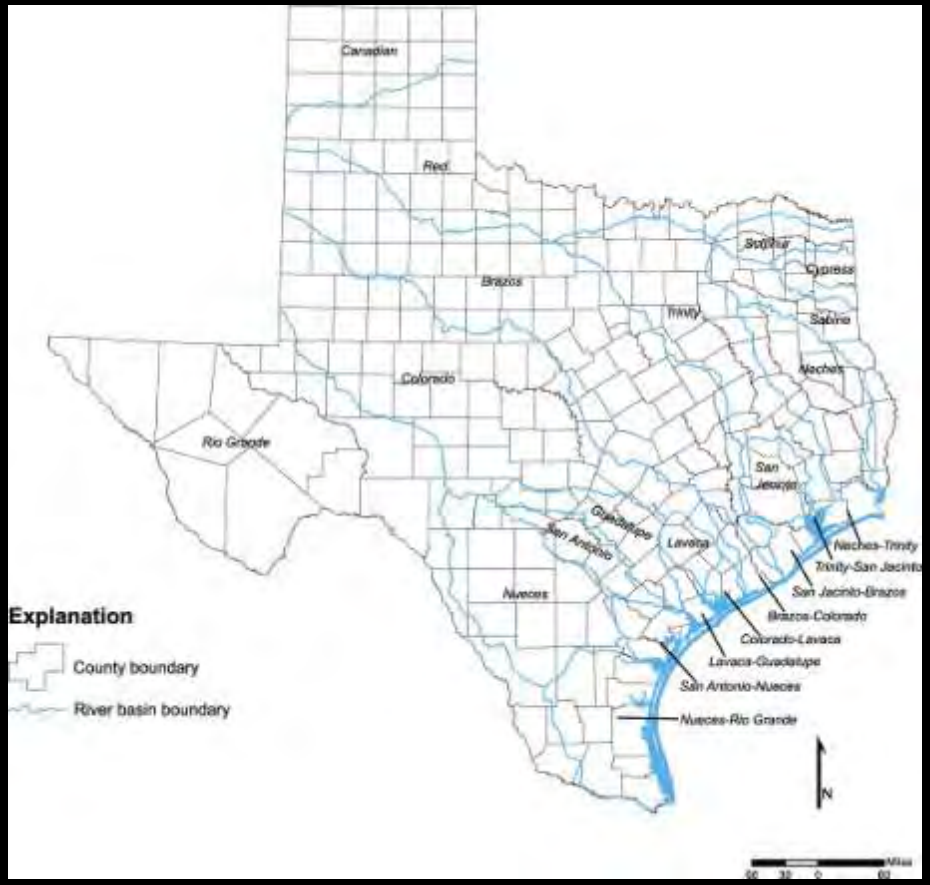
Most streams and rivers in Texas have been degraded resulting in increasingly damaging floods, high sediment loads, lower base flows, reduction of reservoir storage capacity,invasion of exotic species, loss of natural riparian habitats, and degraded water quality.

Intensive agriculture in rural zones

suburban sprawl in developing zones

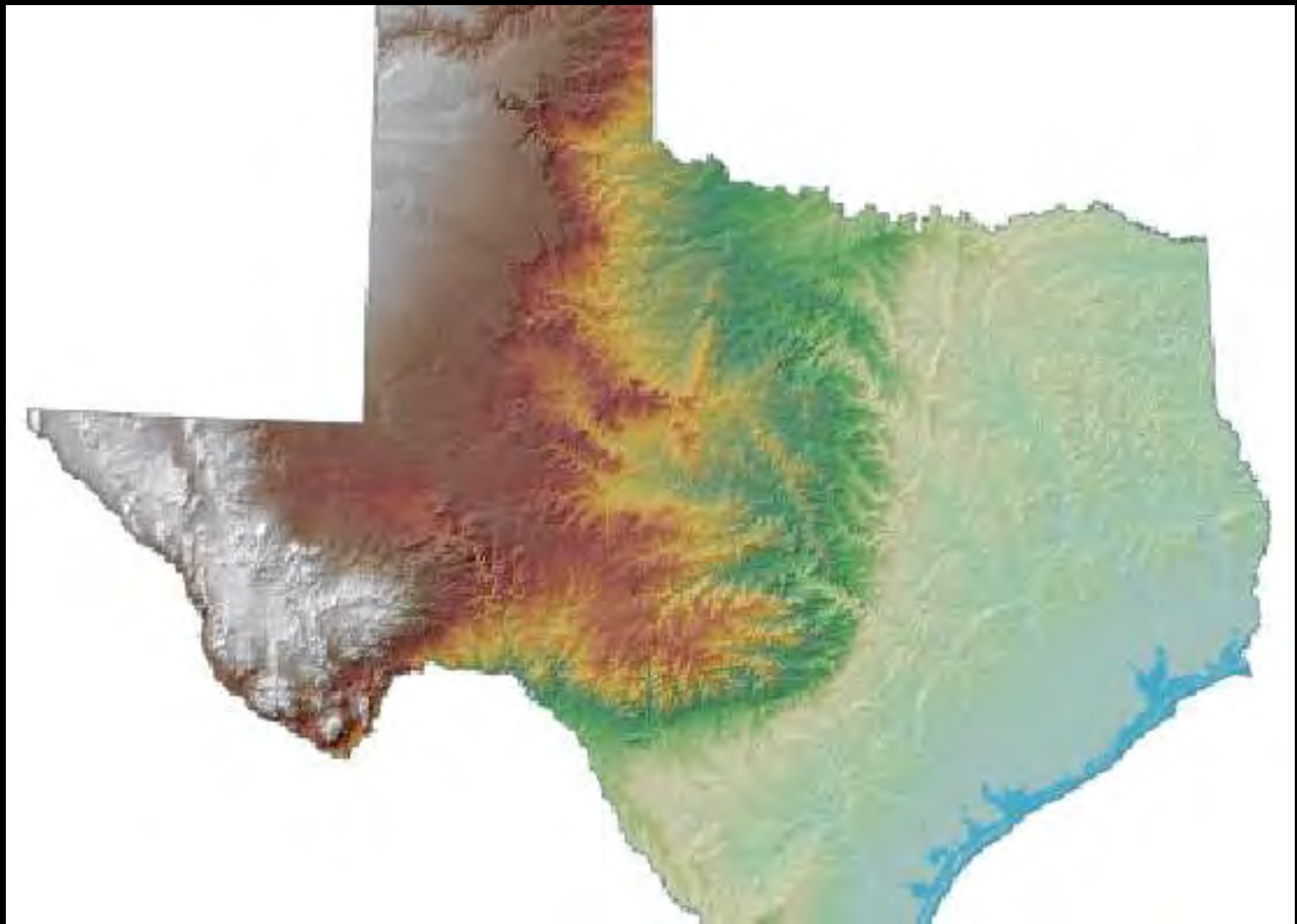
and impervious cover in urban zones

severely impact most riparian systems in Texas!



Riparian Gradient across Texas

From Upland to Lowland



Rural Zone Impacts

Unhealthy

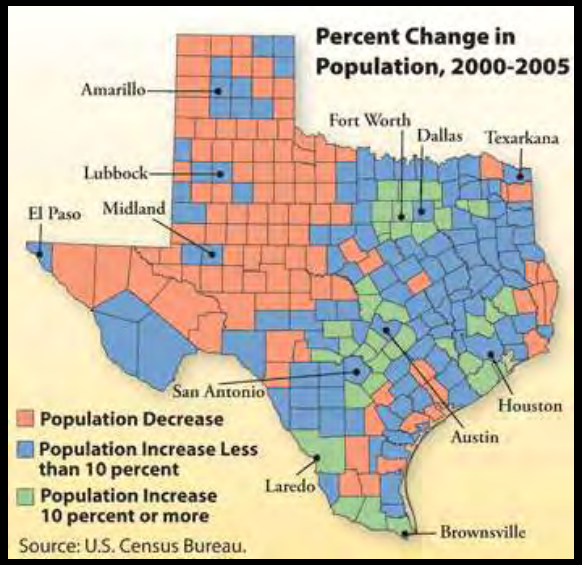
Uplands

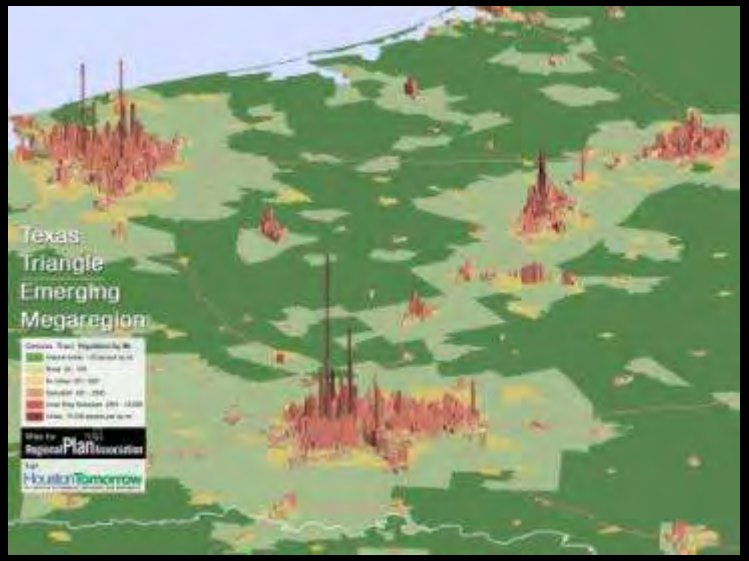
Healthy

Rural Zone Impacts

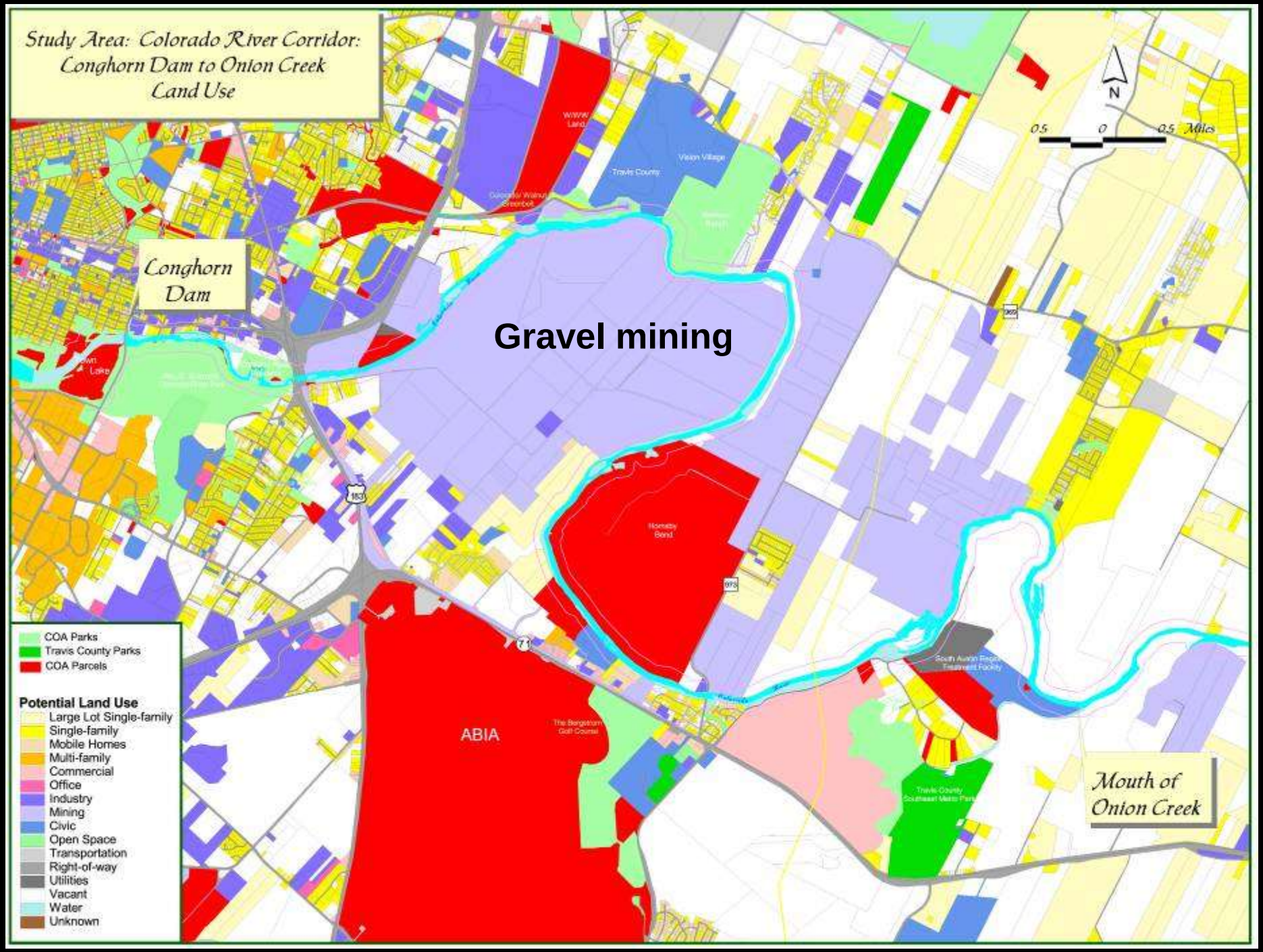
Lowland - Prairie, Plains, Alluvial Soils

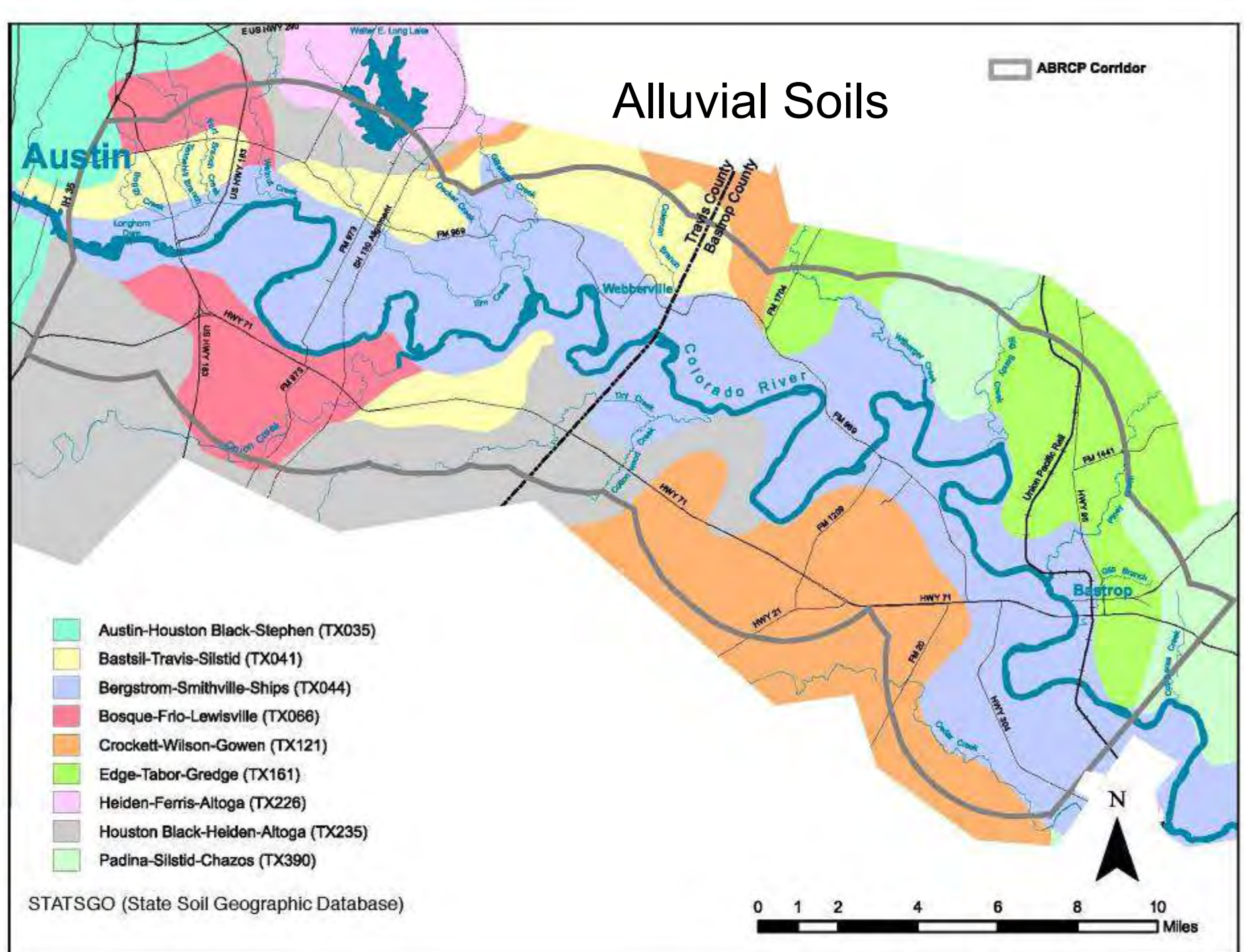
Developing Zone Impacts





Encroachment by Mining & Development


Study Area: Colorado River Corridor:
Conghorn Dam to Onion Creek
Land Use
Conghorn Dam
Gravel mining
ABIA
Mouth of Onion Creek
N
0.5 0 0.5 Miles
COA Parks
Travis County Parks
COA Parcels
Potential Land Use
Large Lot Single-family
Single-family
Mobile Homes
Multi-family
Commercial
Office
Industry
Mining
Civic
Open Space
Transportation
Right-of-way
Utilities
Vacant
Water
Unknown


Alluvial Soils
ABRCP Corridor
Austin
Webberville
Travis County
Bastrop County
Colorado River
Bastrop
Austin-Houston Black-Stephen (TX035)
Bastsil-Travis-Silstid (TX041)
Bergstrom-Smithville-Ships (TX044)
Bosque-Frio-Lewisville (TX066)
Crockett-Wilson-Gowen (TX121)
Edge-Tabor-Gredge (TX161)
Heiden-Ferris-Altoga (TX226)
Houston Black-Heiden-Altoga (TX235)
Padina-Silstid-Chazos (TX390)
STATSGO (State Soil Geographic Database)
N
0 1 2 4 6 8 10
Miles

Urban Zone Impacts

West Bouldin Creek South 6th Street


before


after

Tannehill Branch Creek Givens Park


before


after

Blunn Creek Stacy Park


before


after

City of Austin WATERSHED PROTECTION

City of Austin Riparian Restoration

AUSTIN PARKS & RECREATION

Riparian Zone Restoration: Bartholomew Park

1. Persistent mowing in creek

2. Grow Zone intermediate stage

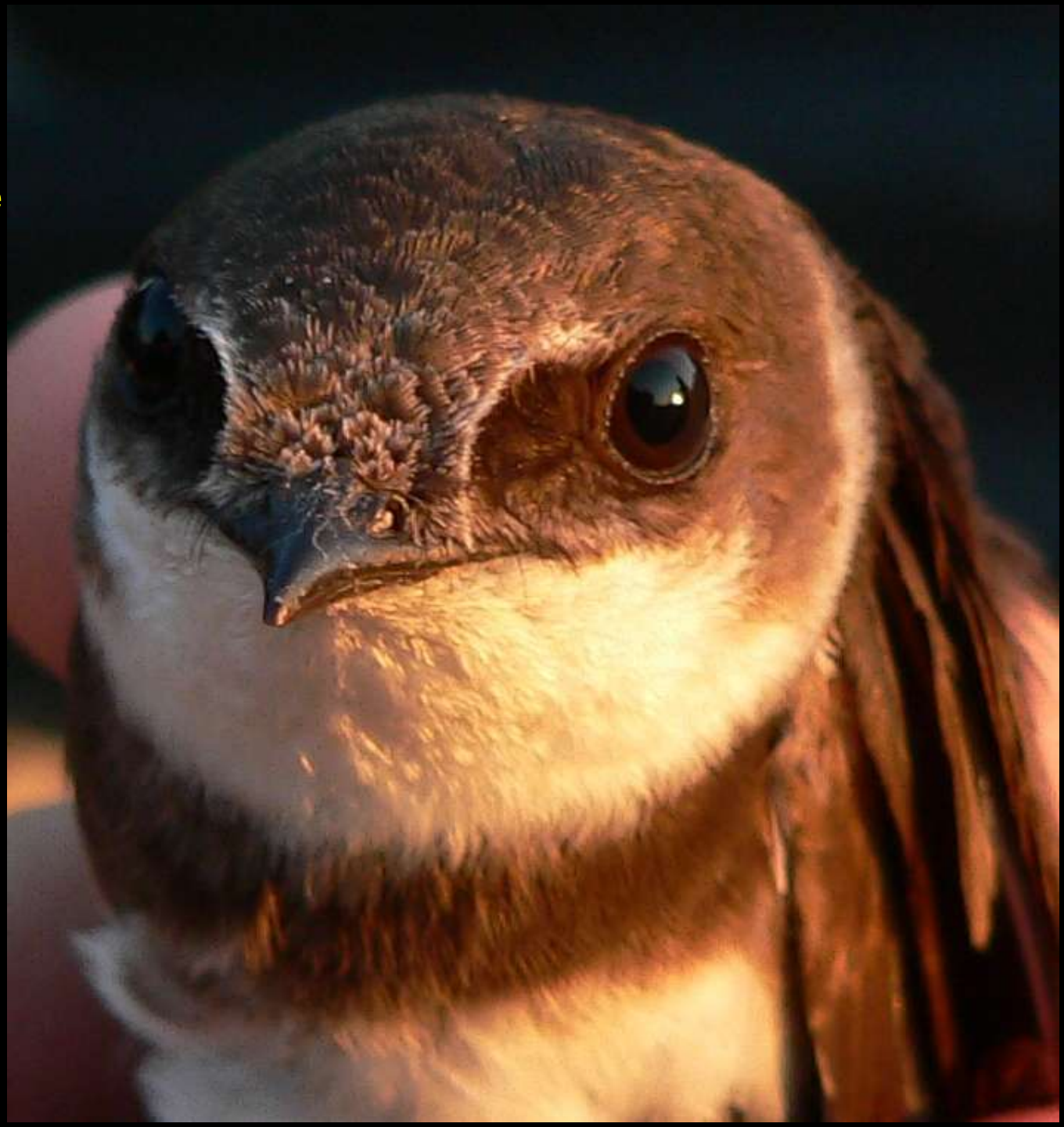
3. Grow Zone mature riparian woodland


Riparian Faunal Biodiversity

Life at the River's Edge

Riparia riparia
(Linnaeus, 1758)

Sand Martin
Bank Swallow



TEXAS

RIPARIAN

ASSOCIATION

Mission:

To encourage healthy riparian systems within Texas

3,700 named streams and 15 major rivers flowing through nearly 200,000 miles of Texas

www.texasriparian.org

Riparian = Waterway Margins

Riparian areas are transitional zones between terrestrial and aquatic ecosystems.


Applause!


Questions?

Center for Environmental Research at Hornsby Bend

Austin WATER
Clearly Reliable

The Geography of Rivers: Morphology, Ecology, and Culture

The 2013 Lunchtime Lectures will explore the geography of rivers.

River Systems – May to August

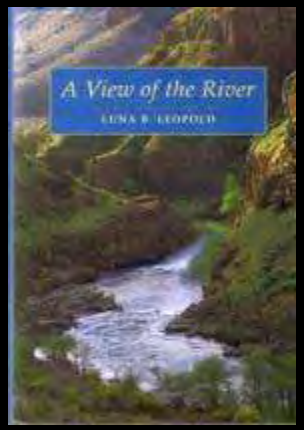
Rivers write their way across the surface of the Earth, inscribing deeply or shallowly depending on how resistant the surface is to the flow of water and sediment carried by the river. This morphology of the physical geography of the Earth is the starting point for geography, but a geographer must go beyond the physical shapes and shaping of rivers in order to fully understand them. The living river begins with the geochemistry of flowing water which merges with the biochemistry of aquatic organisms and then further merges with the terrestrial ecology of organisms living along the river's riparian and bottomland zones.

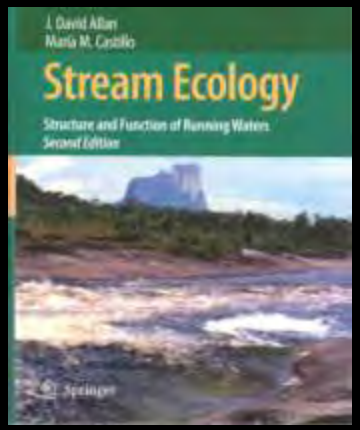
May 8 at Dougherty Arts Center – River Process: the Fluvial System and River Hydrology
May 15 at City Hall - River Process: the Fluvial System and River Hydrology

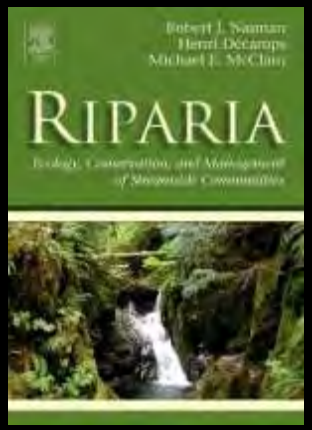
June 12 at Dougherty Arts Center – River Life: the Ecology of Flowing Water
June 19 at City Hall - River Life: the Ecology of Flowing Water

July 10 at Dougherty Arts Center – Riparia: Life at the River's Edge
July 17 at City Hall - Riparia: Life at the River's Edge

August 14 at Dougherty Arts Center – Bottomland: Floodplain Habitats
August 21 at City Hall - Bottomland: Floodplain Habitats







Rivers of Culture – September to December

The keystone organisms that impact all aspects of river systems are humans, who settle along rivers and transform hydrology and ecology as we turn natural landscapes into cultural landscapes.

September 11 at Dougherty Arts Center – Rivers of Empire: American Rivers
September 18 at City Hall - Rivers of Empire: American Rivers

October 9 at Dougherty Arts Center – Waters the Land: Texas Rivers
October 16 at City Hall - Waters the Land: Texas Rivers

November 13 at Dougherty Arts Center – Another Colorado: Rivertown Austin
November 20 at City Hall - Another Colorado: Rivertown Austin

December 11 at Dougherty Arts Center – Goodbye to the River: A Summary
December 18 at City Hall - Goodbye to the River: A Summary