La importancia geomorfológica, hidrológica y las condiciones climáticas para lograr un manejo

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Manejo de humedales para técnicos en México II
LAGUNA MEXICANOS CHIHUAHUA
Club Raramuri
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The Basis of Good Habitat Management

- Start with abiotic conditions
- Add biology of plants next
- Understand the role of invertebrates in system ecology and as a protein source
- Then add animal ecology
- Put the abiotic and biotic in a temporal setting
- Don’t forget the social and economic considerations

ESSENTIAL TO IDENTIFY LANDSCAPE SETTING

- GEOMORPHIC SETTING
  - GEOLOGY
  - FORMATIVE PROCESSES
  - ABIOTIC PROCESSES
- HYDROLOGIC CONDITIONS
  - SURFACE
  - SUBSURFACE
- CLIMATE

Geomorphic, **Hydrologic, and Climate Setting** for Successful Management

- Essential to know where you are in space.
- Essential to understand temporal scale

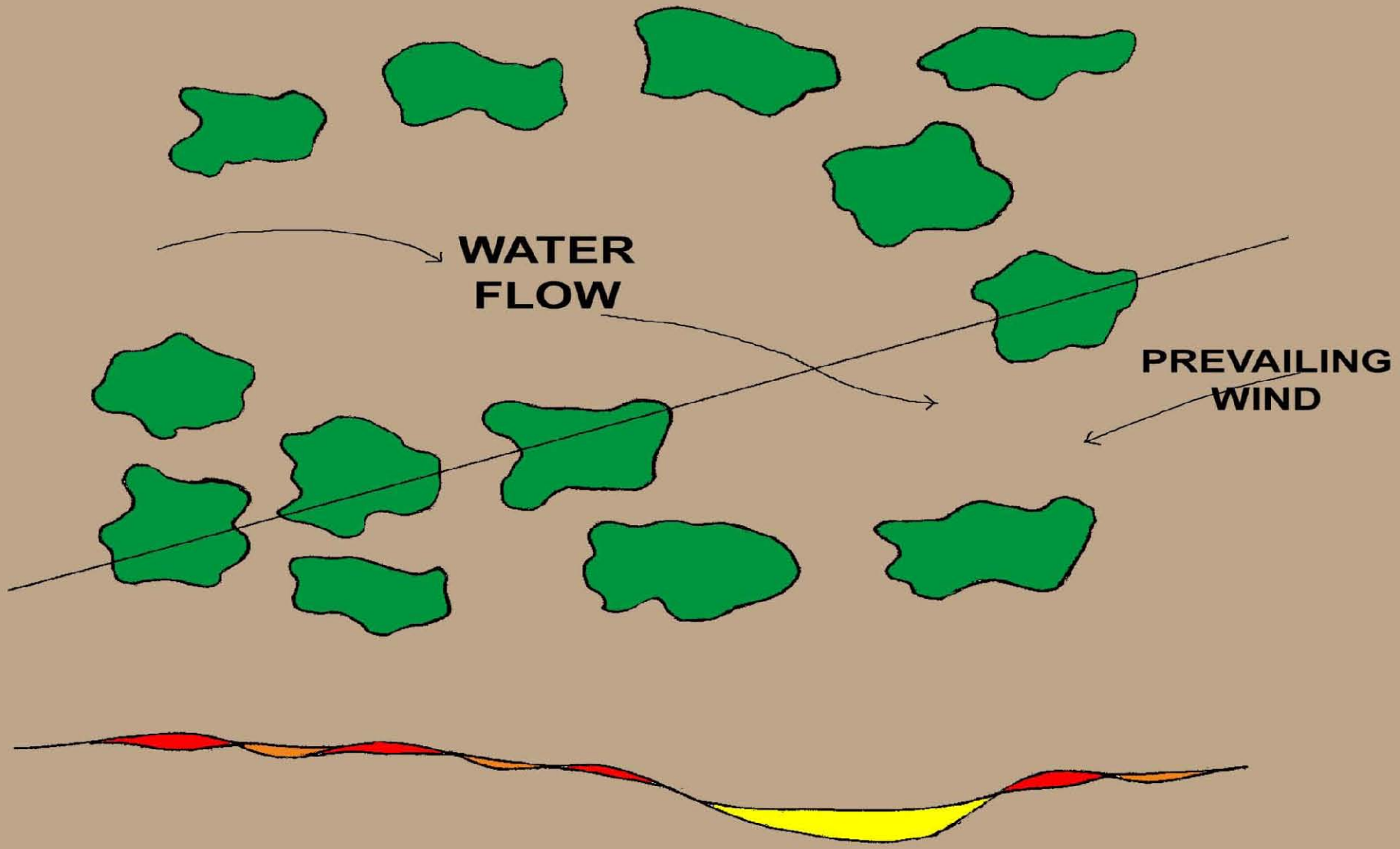
HOW DO YOU KNOW WHERE YOU ARE IN TIME AND SPACE??

- GEOMORPHIC SETTING
- FORMATIVE PROCESSES
- HOW DOES GEOMORPHIC SETTING INFLUENCE WATER AVAILABILITY AND FLOW?
- HOW OLD IS THE SURFACE AND HOW WAS IT FORMED?
- WHAT ARE THE FEATURES OF THE SURFACE?

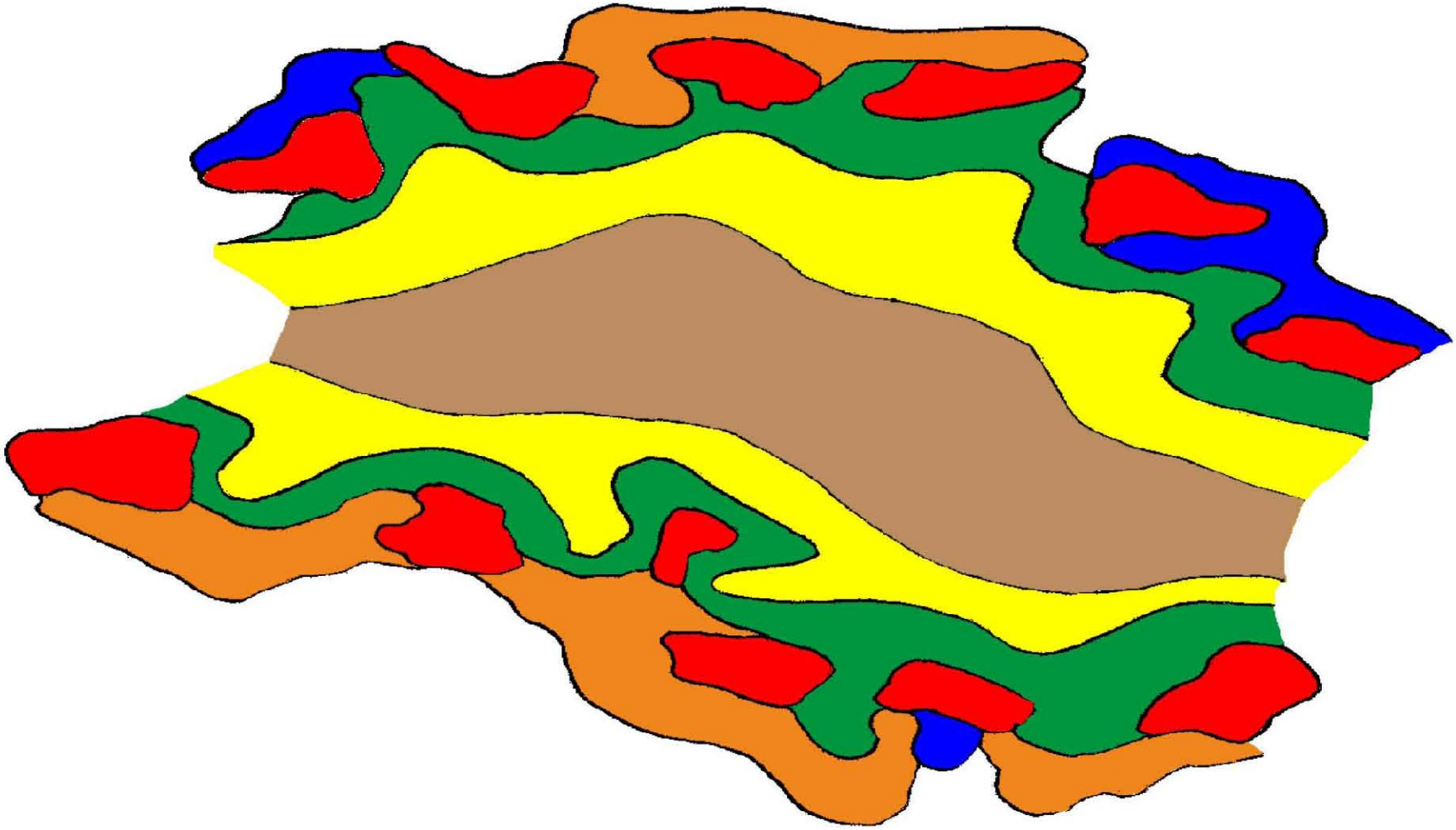
Formative Processes

- Always more than one
  - Water
  - Wind
  - Freezing
- Always on-going
  - Some subtle and steady
  - Some dramatic
- Constant change in influencing factors
  - Wet vs dry

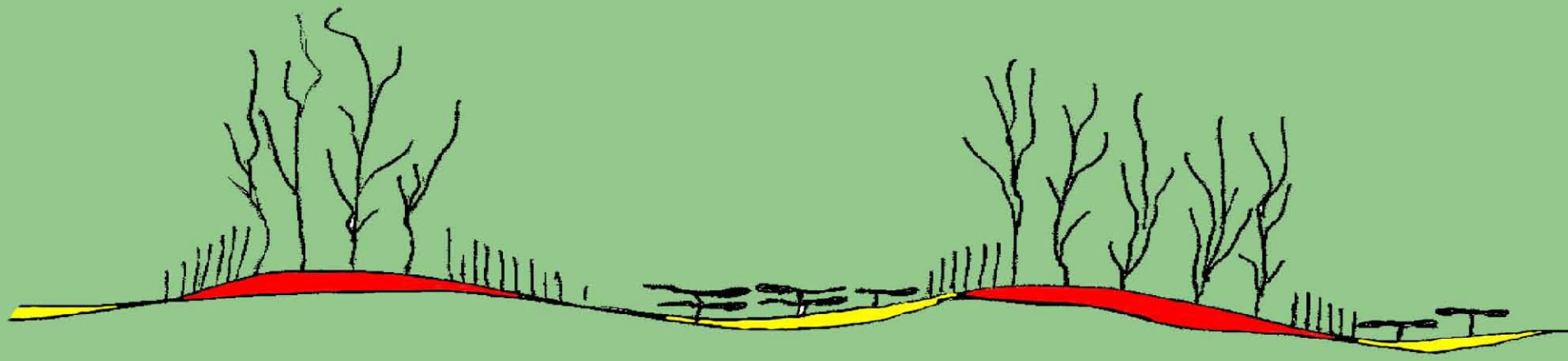
DEVELOPMENT OF TEXTURAL HETEROGENEITY



PLANT DISTRIBUTION AND HETEROGENEITY



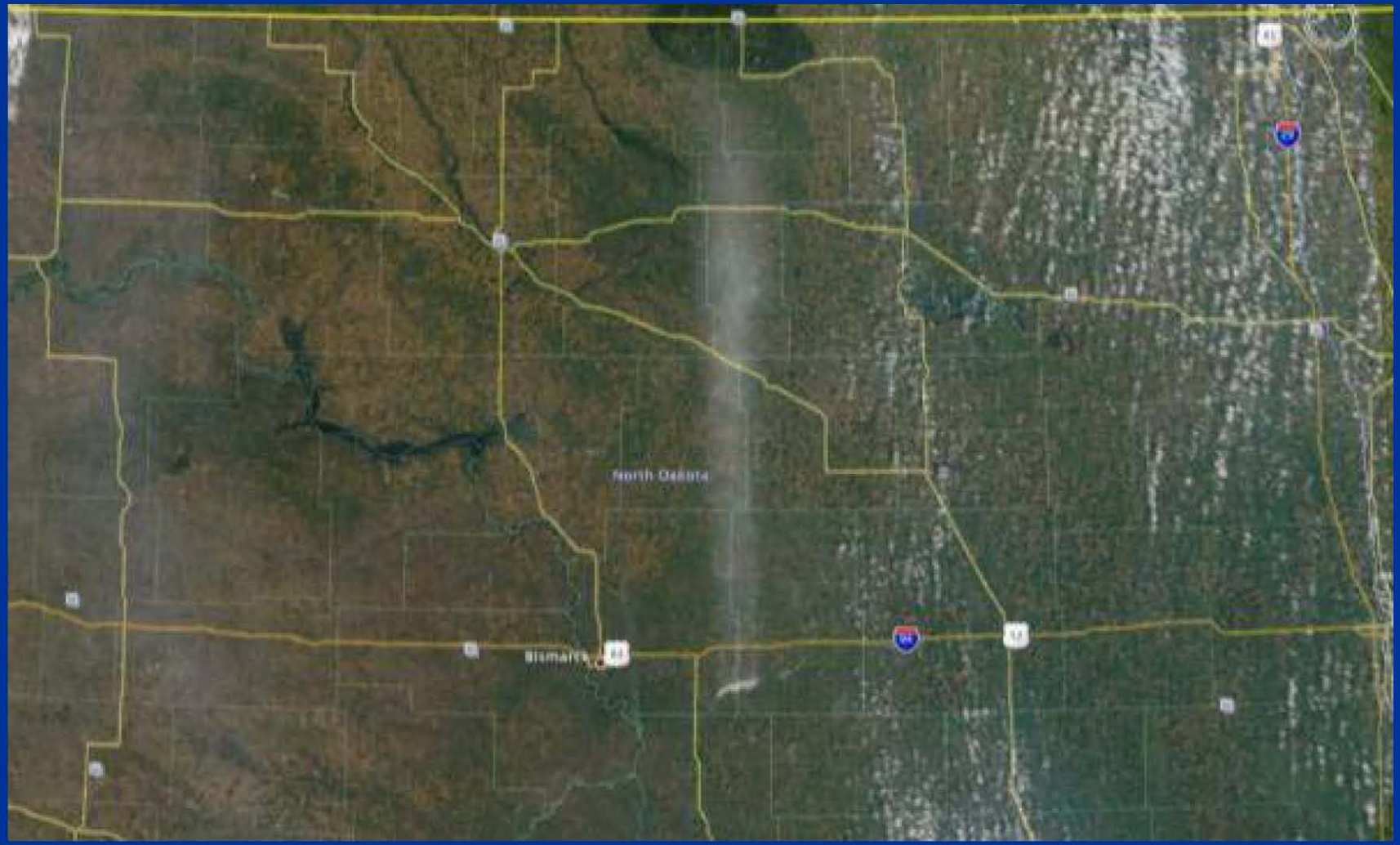
PLANT RESPONSE TO MICROTOPOGRAPHIC AND TEXTURAL VARIABILITY



Las Vegas NWR New Mexico


LONG LAKE NWR SALT MOVEMENT

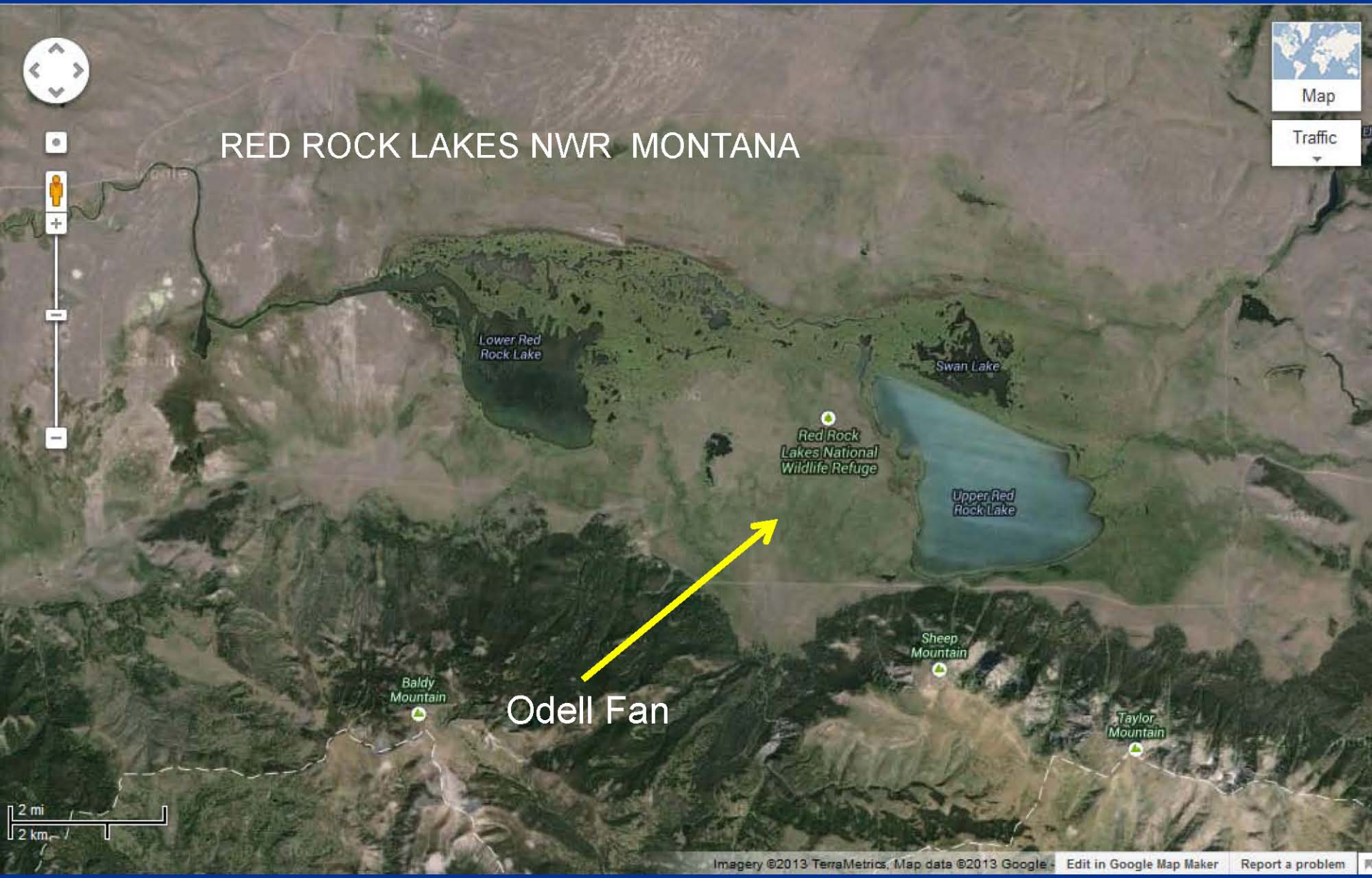
Long Lake NWR Salt Movement



ALLUVIAL DEPOSITS

- NATURAL LEVEES – COARSE TEXTURE
- POINT BARS – TEND TOWARD COARSE TEXTURE
- BACK SWAMP – FINE TEXTURED
- CREVASSE SPLAY – COARSE TEXTURE
- ABANDONED CHANNEL – TEND TOWARD FINE TEXTURE
- BRAIDED CHANNEL – VERY HETEROGENOUS
- ALLUVIAL FANS -- VERY HETEROGENOUS


ALLUVIAL FAN


RED ROCK LAKES NWR MONTANA
Lower Red Rock Lake
Swan Lake
Red Rock Lakes National Wildlife Refuge
Upper Red Rock Lake
Sheep Mountain
Baldy Mountain
Odell Fan
Taylor Mountain
Map
Traffic
2 mi
2 km
Imagery ©2013 TerraMetrics, Map data ©2013 Google
Edit in Google Map Maker
Report a problem

RED ROCK LAKES NWR MONTANA

CRITICAL INFORMATION

- TOPOGRAPHY
- TEXTURAL VARIABILITY
- PRESENCE OF RESTRICTIVE LAYER
- DEPTH TO RESTRICTIVE LAYER
- SLOPE OF RESTRICTIVE LAYER
- GROUND WATER DISCHARGE

Glaciated

- Poorly developed drainage
- Complex groundwater movements
- Complex intermixed soil textures and strata
- Historic lake beds with many different areas of different textures and microtopography

SOIL TEXTURE AND PLANT ASSOCIATIONS

FINE TEXTURE

NUTSEDGES

SMARTWEED

CATTAIL

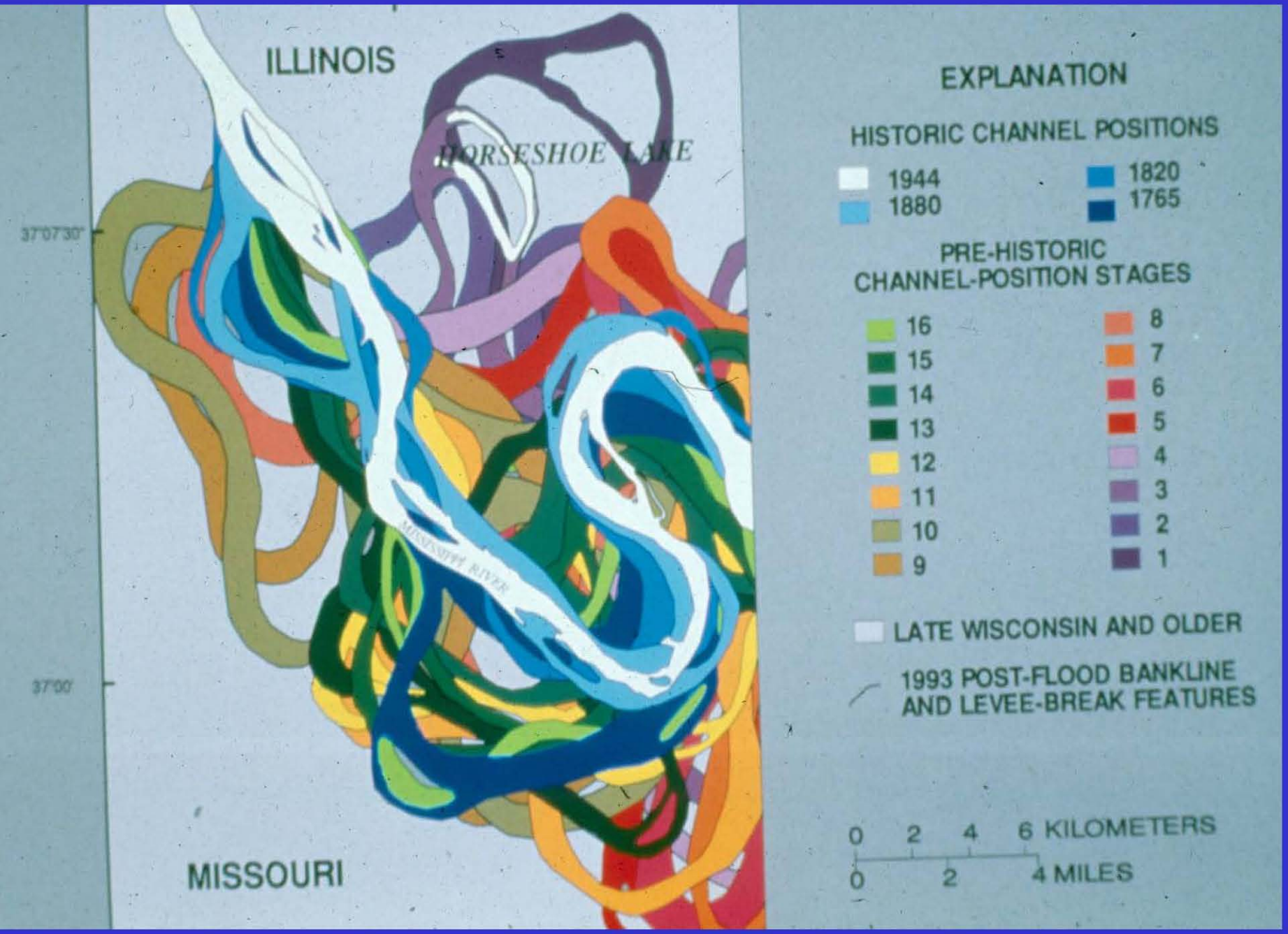
COARSE TEXTURE

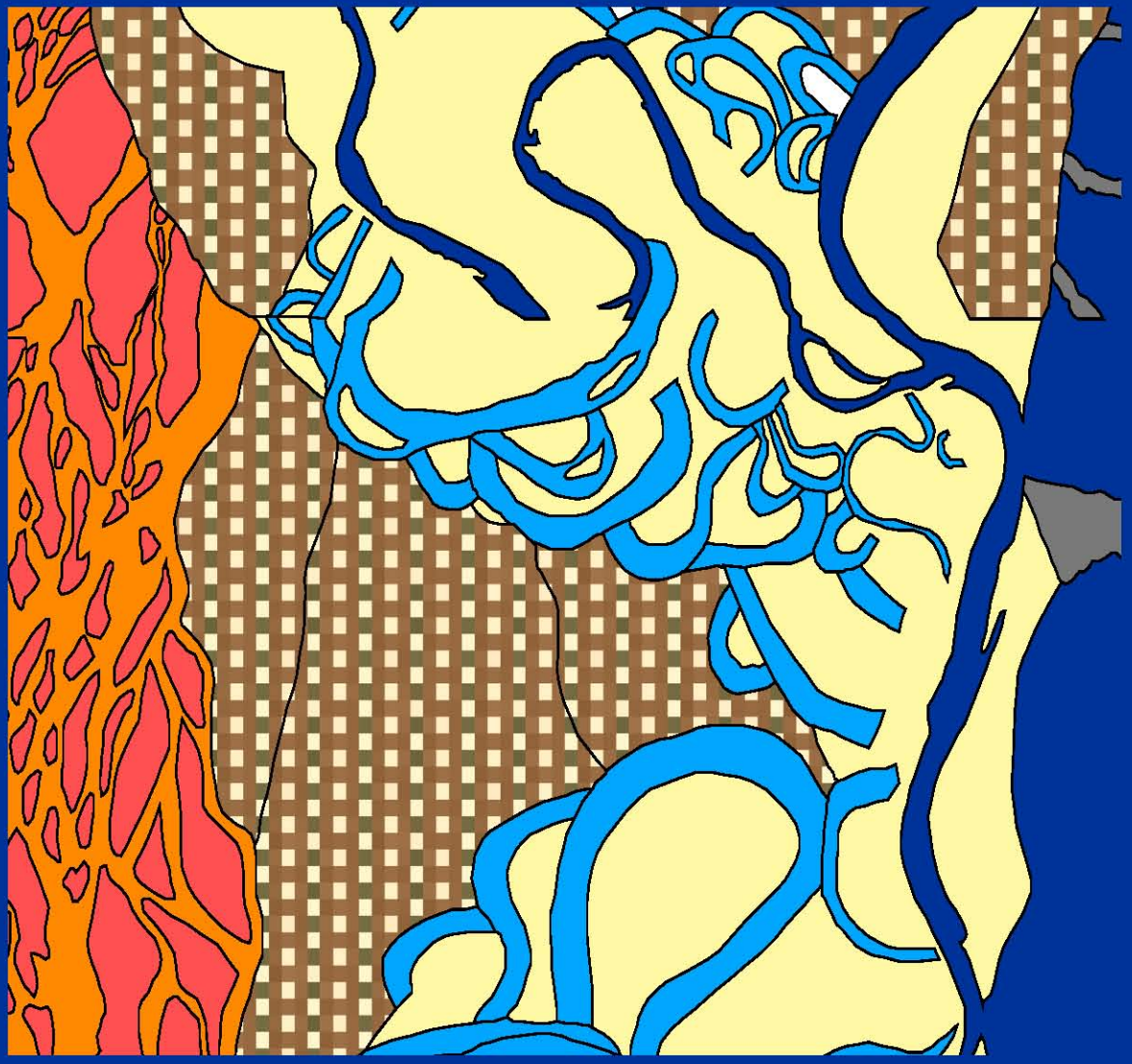
MILLETS

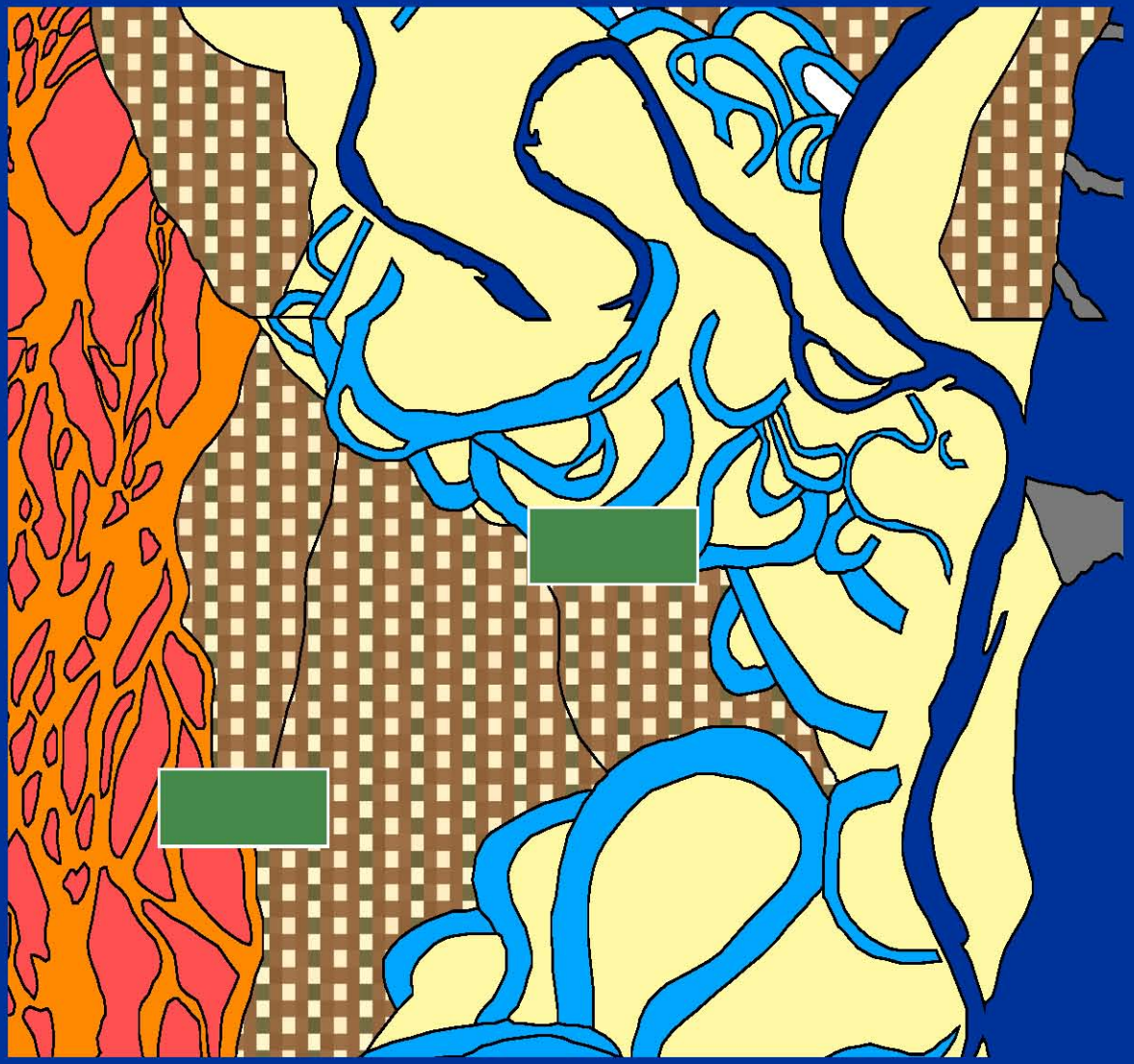
HARDSTEM BULRUSH

EFFECTS OF GROUND WATER AND SOILS

- MILLETS WITH MUCH HIGHER PRODUCTION WHERE RESTRICTIVE LAYER IS CLOSER TO SURFACE
- CHANGES IN SOIL MOISTURE RATES INFLUENCED BY DEPTH TO GROUND WATER


ILLINOIS
HORSESHOE LAKE
MISSOURI
37°07'30"
37°00'
EXPLANATION
HISTORIC CHANNEL POSITIONS
1944
1880
1820
1765
PRE-HISTORIC CHANNEL-POSITION STAGES
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
LATE WISCONSIN AND OLDER
1993 POST-FLOOD BANKLINE AND LEVEE-BREAK FEATURES
0 2 4 6 KILOMETERS
0 2 4 MILES


8
0
8
16 Miles


8
0
8
16 Miles

Coverage	Acres	Potential Acres
State WMU's	7,997	9,588
Private Lands	4,680	13,245
Federal WMU's	8,301	9,625
MOP	44,021	-
Flooded Forest	50,566	-

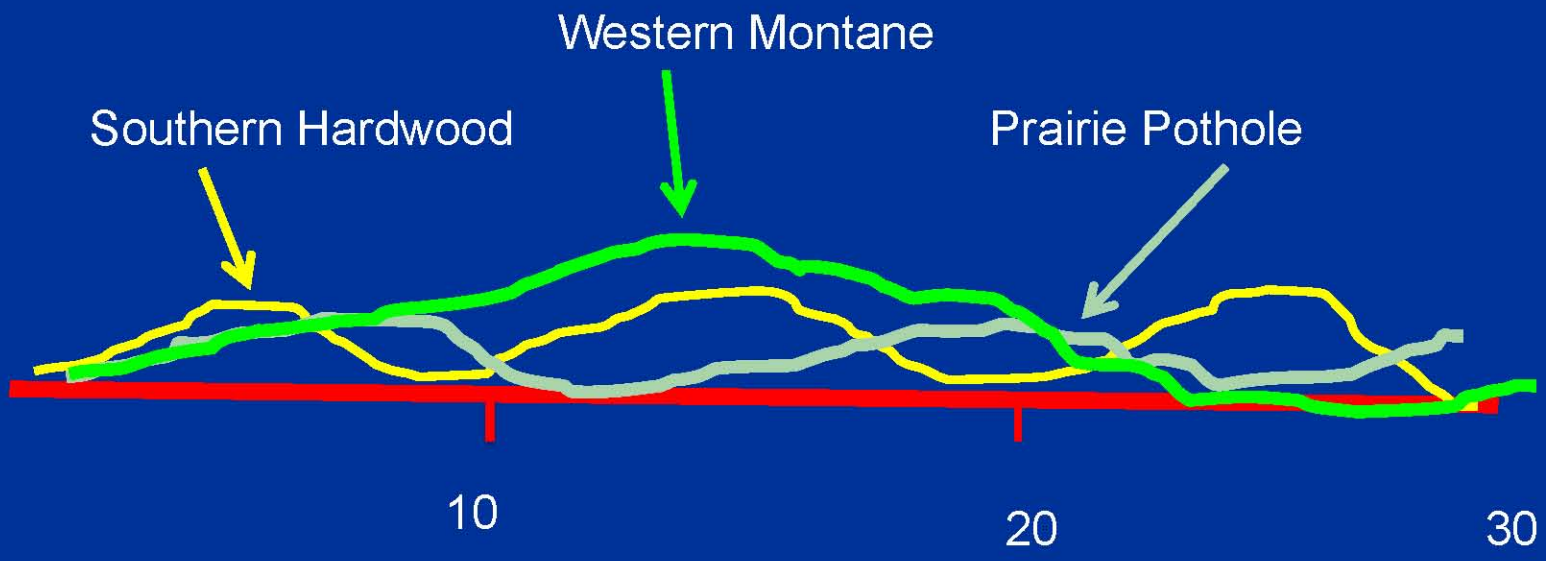
Background Imagery: Landsat 7 p23r34 and

HYDROLOGIC VARIATION

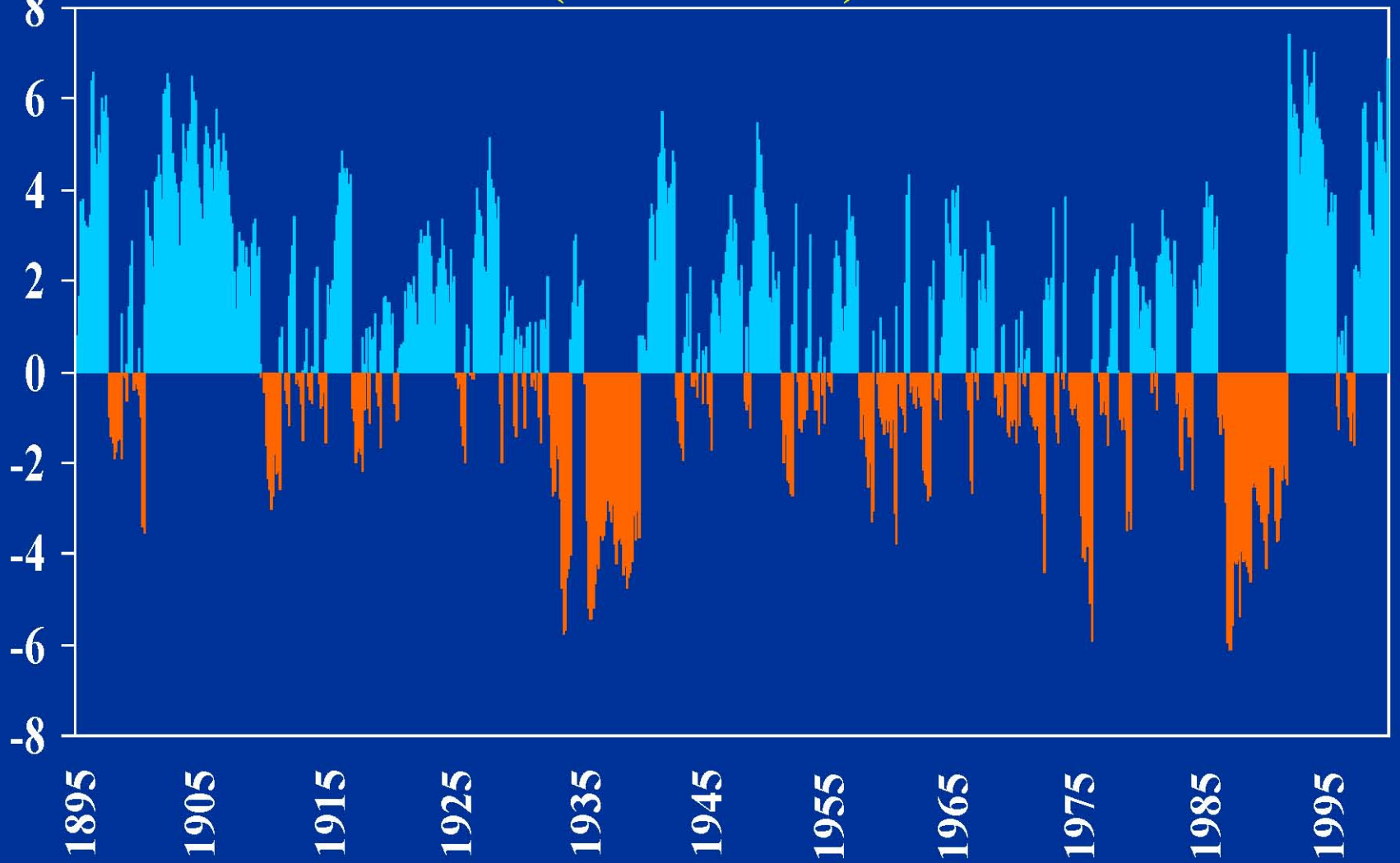
- SHORT AND LONG-TERM VARIATION
- TIMING OF FLOWS
- DURATION OF FLOWS
- HIGH/LOW FLOWS
- SURFACE OR SUBSURFACE
- CONNECTION CONTINOUSLY AND DISCONTINOUSLY

OVER RIDING HYDROLOGIC CONDITIONS ARE KEY

WETLAND CYCLE DURATION



Palmer Drought Severity Index, Division 5, ND (1895 to 2001)



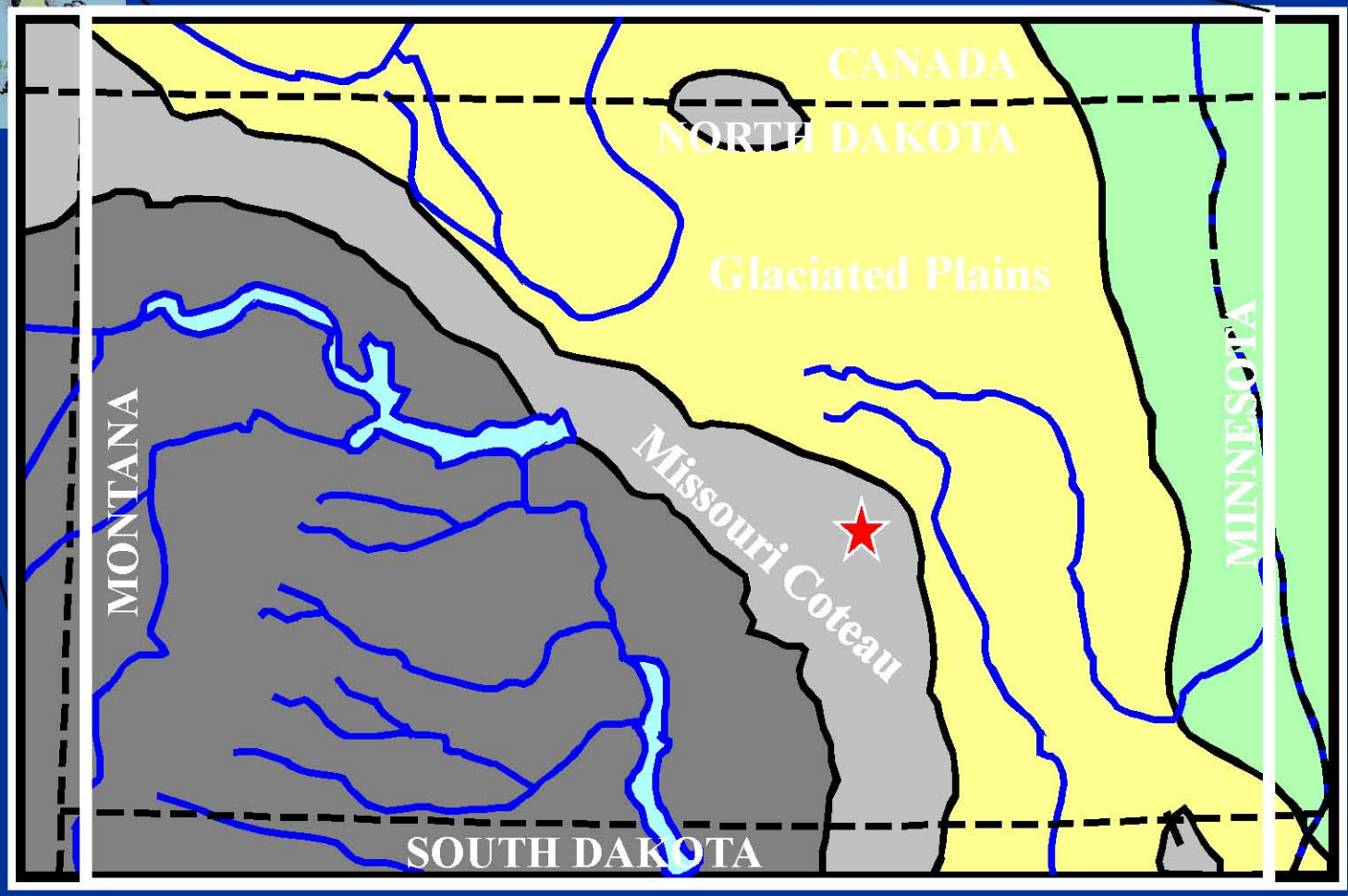
USGS
science for a changing world

TEMPORAL SCALE

- CLIMATIC AND HYDROLOGIC VARIATION
  - DAILY
  - ANNUAL
  - LONG-TERM
    - WITHIN A LIFE TIME
    - OVER THOUSANDS OF YEARS
- FREQUENCY OF BREEDING OR GERMINATION TO MAINTAIN POPULATIONS
  - ONCE ANNUALLY??
  - ONCE EVERY ?? YEARS

WHAT IS POTHOLE COUNTRY?

- DIVERSITY OF GEOMORPHIC SURFACES
  - MORAINES
  - THE COTEAUS
  - ABANDONED FLOODWAYS
  - LAKE BEDS
- DIVERSITY OF HYDROLOGIC SETTINGS
  - SURFACE AND SUBSURFACE
- DIVERSITY OF ANTHROPOGENIC CHALLENGES
  - AGRICULTURE
  - WATER PROJECTS
  - ALL OTHER INFRASTRUCTURE



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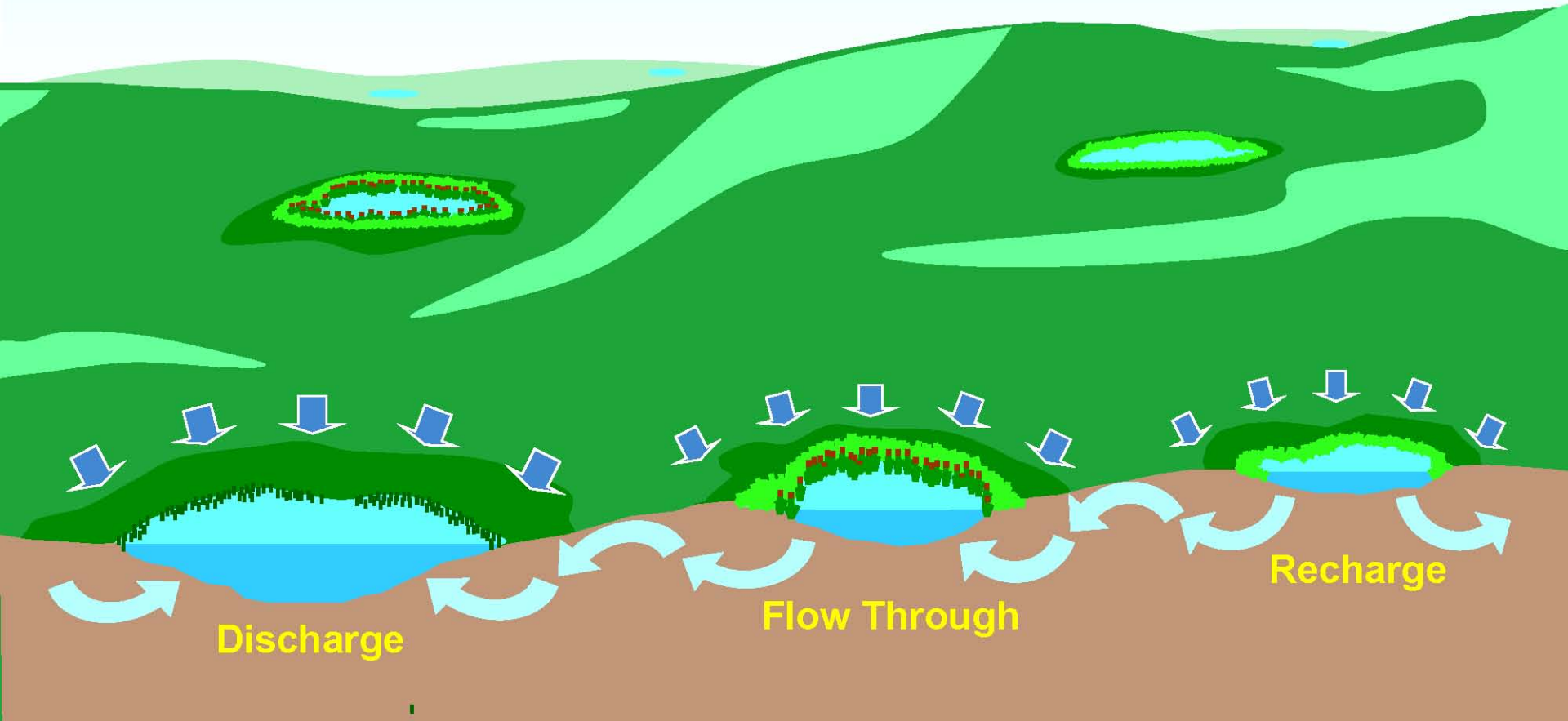
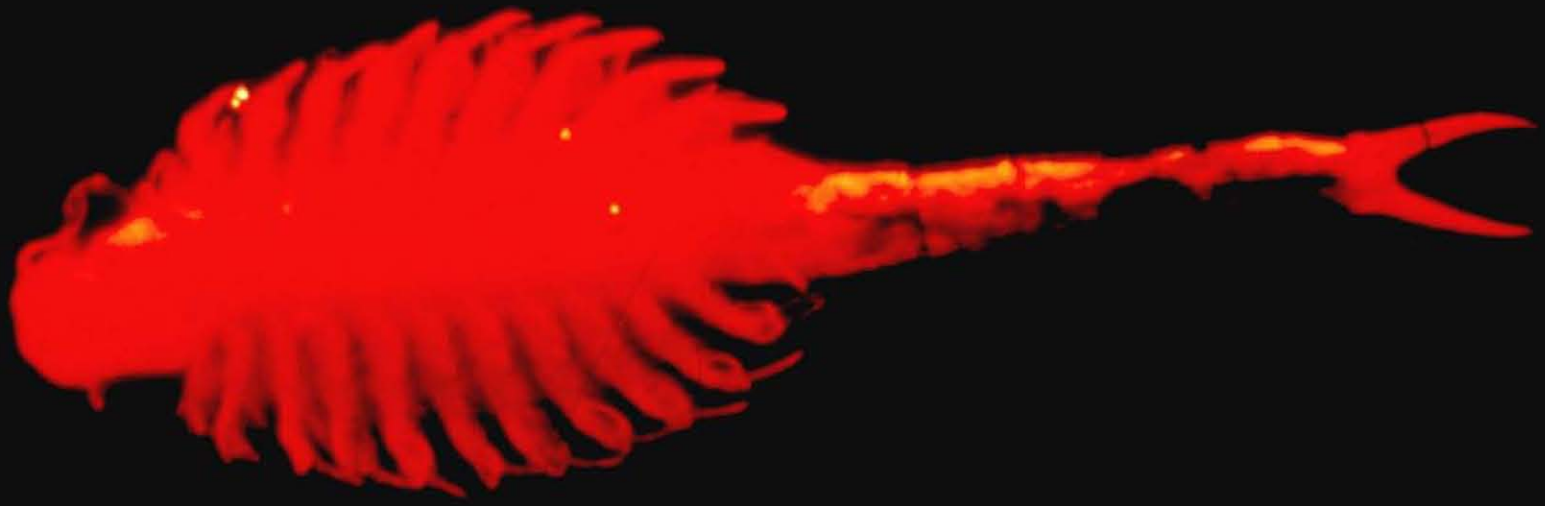
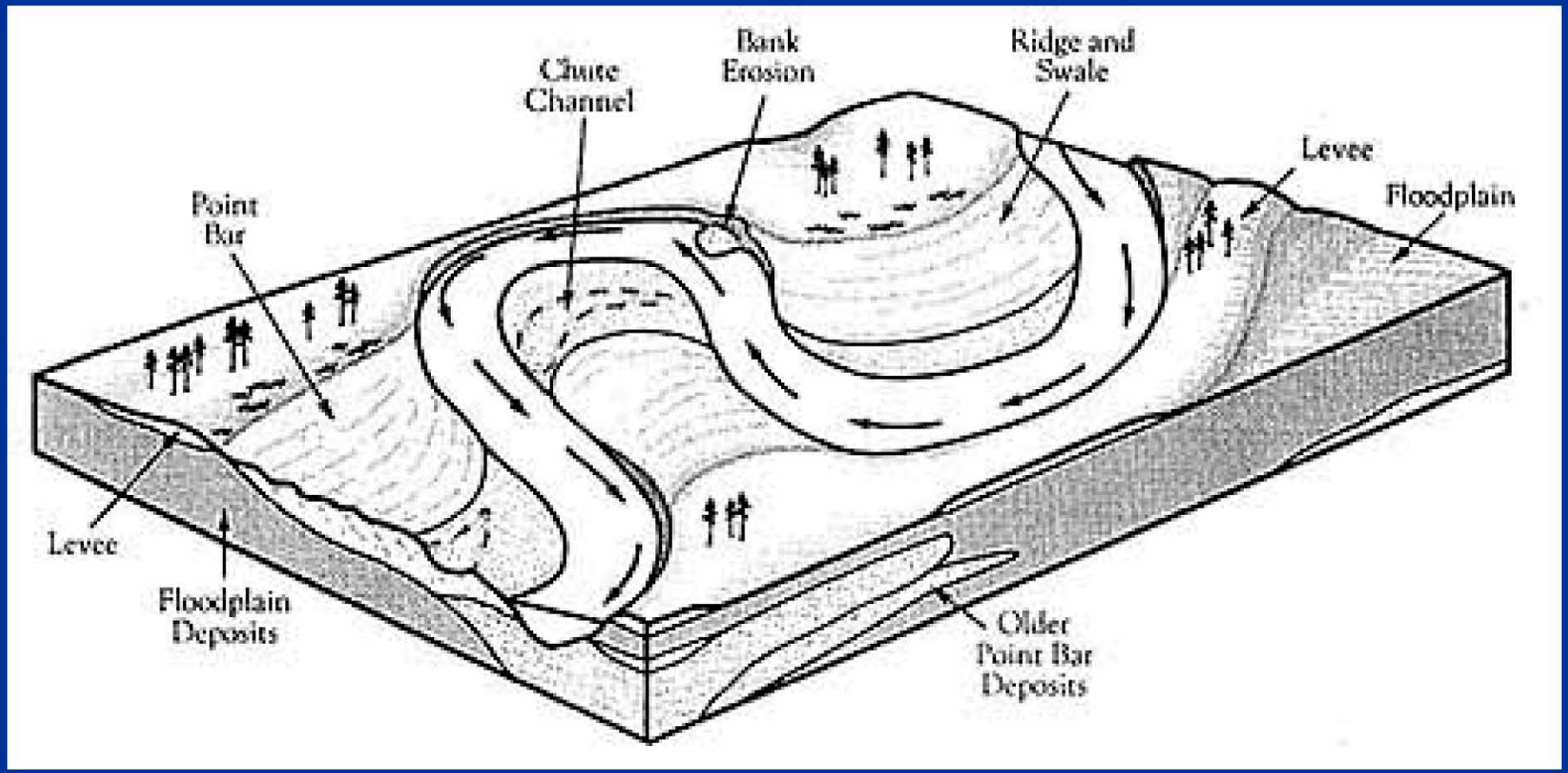
Wetland Hydrological Functions



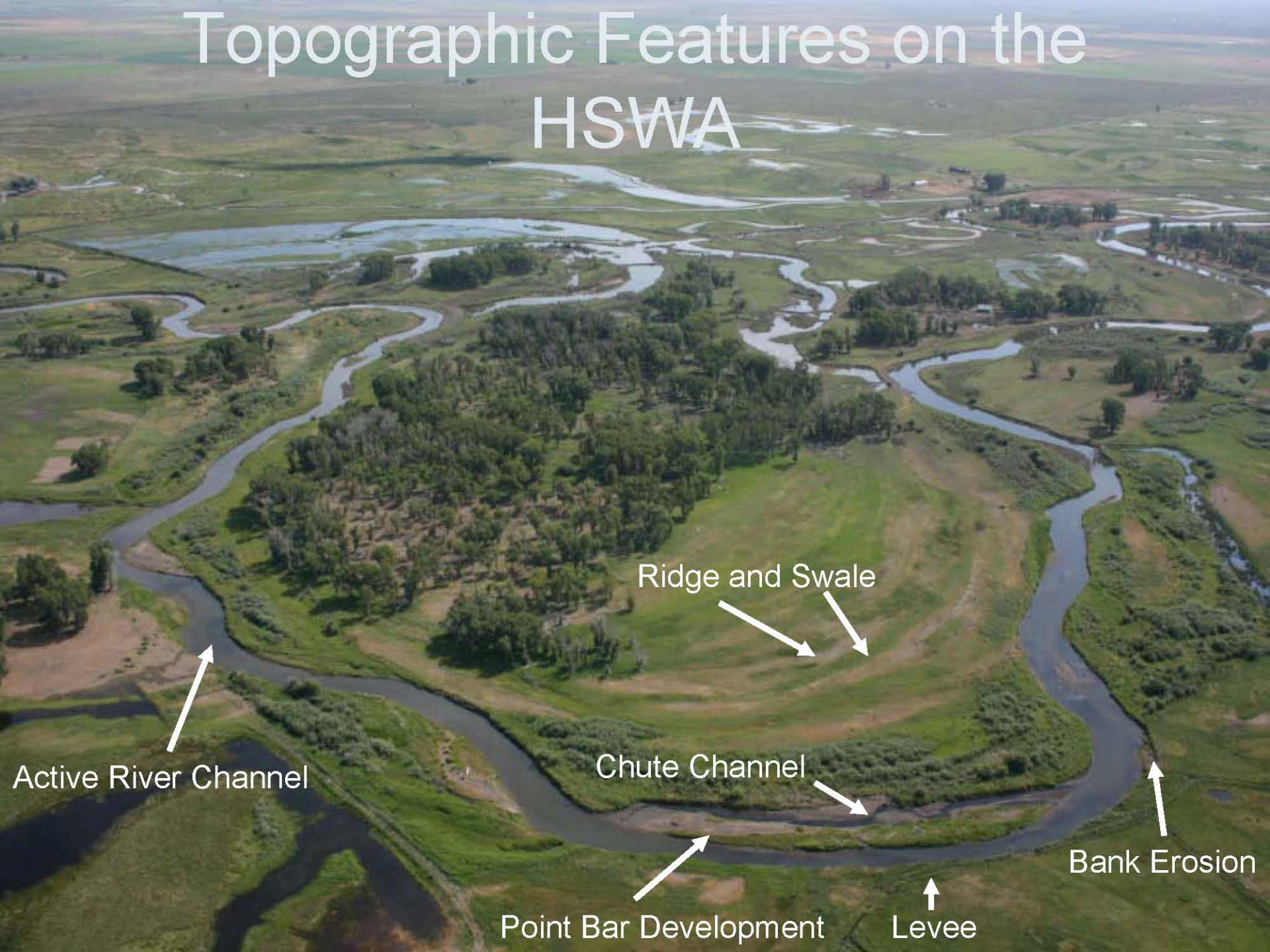


Fluvial systems

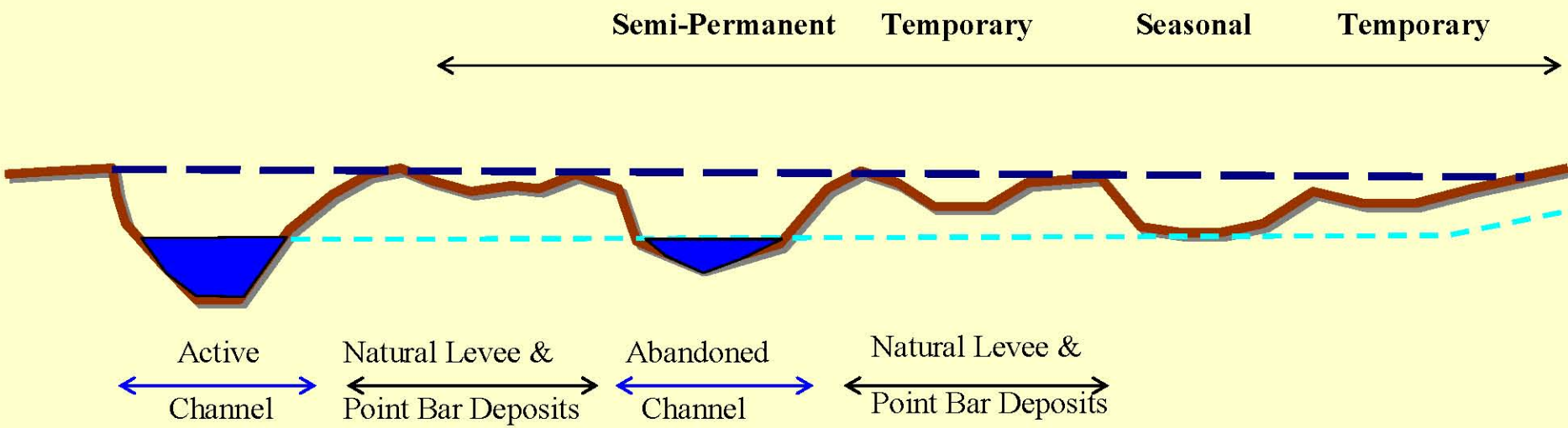
Topographic Features



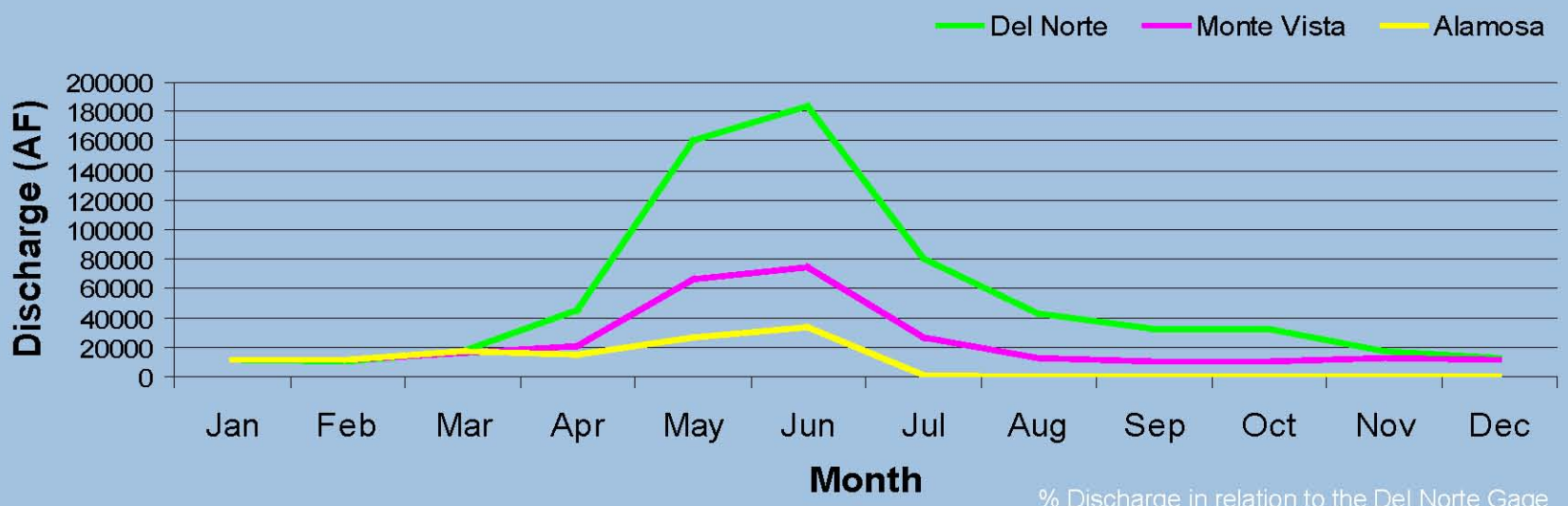
Topographic Features on the HSWA



Hydrologic Linkage and Juxtaposition of Riparian Wetland Environments



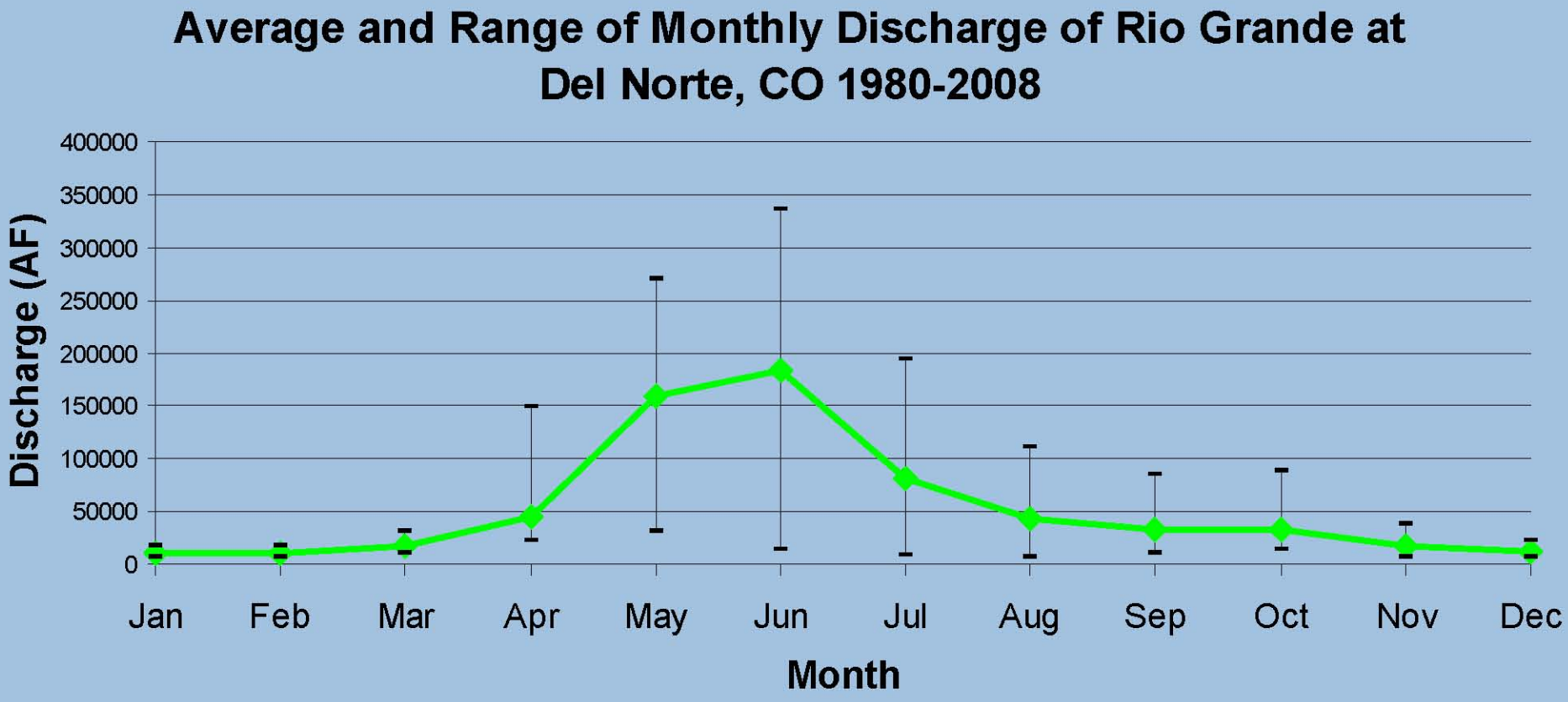
Average Monthly Discharge of Rio Grande at Del Norte, Monte Vista and Alamosa, CO 1980-2008



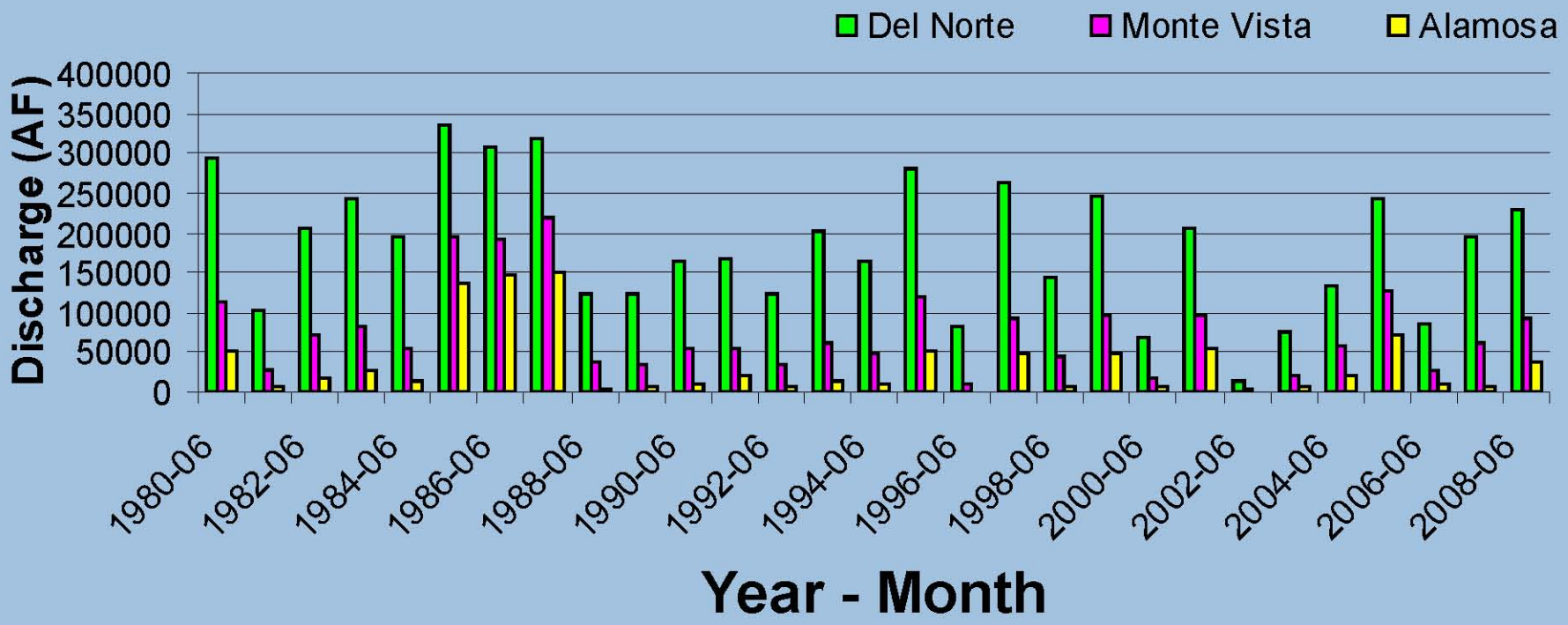
- **Dampening of the hydrograph**
- **Alterations of fluvial processes**
- **Non-connectivity between the River and Floodplain**

% Discharge in relation to the Del Norte Gage

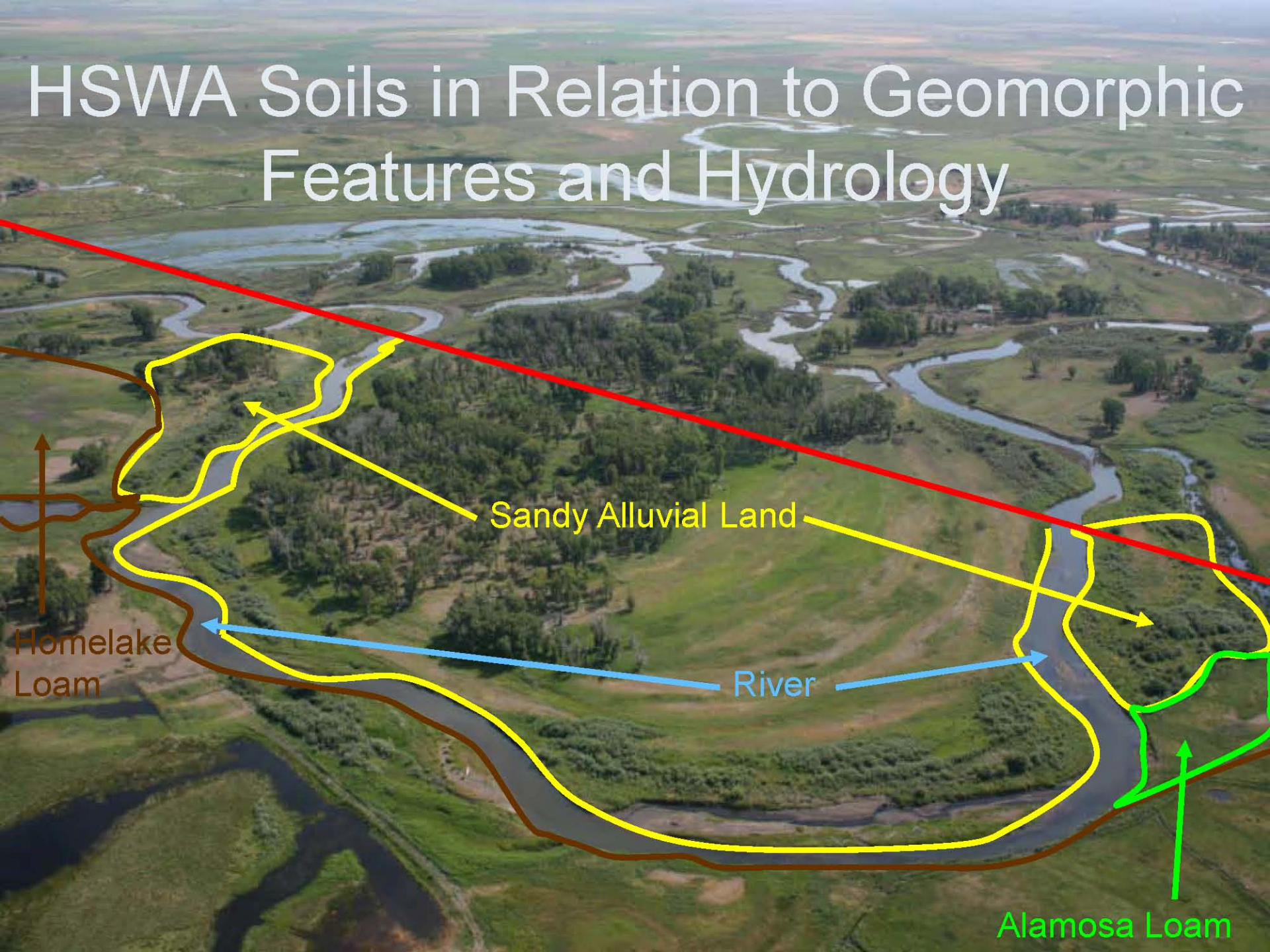
Month	% Monte Vista	% Alamosa
Jan	102.71	108.81
Feb	105.82	114.28
Mar	91.75	102.14
Apr	46.21	33.82
May	41.74	16.81
Jun	40.42	18.51
Jul	33.74	1.16
Aug	30.84	1.06
Sep	33.77	1.16
Oct	32.99	1.18
Nov	74.23	2.65
Dec	96.95	3.46


Average and Range of Monthly Discharge of Rio Grande at Del Norte, CO 1980-2008
Discharge (AF)
400000
350000
300000
250000
200000
150000
100000
50000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

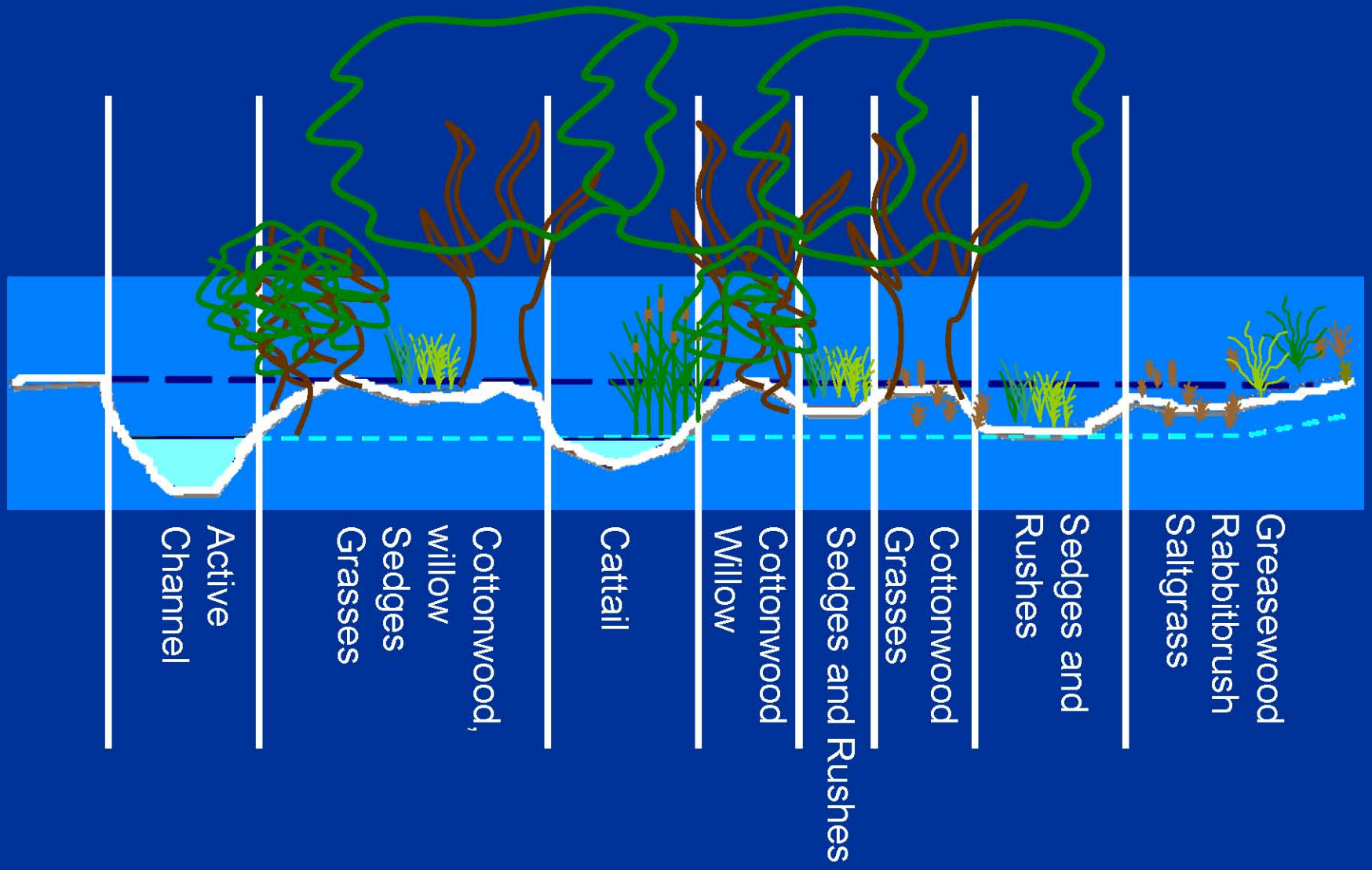
Average Monthly Discharge for June from Del Norte to Alamosa (1980 - 2008)



HSWA Soils in Relation to Geomorphic Features and Hydrology



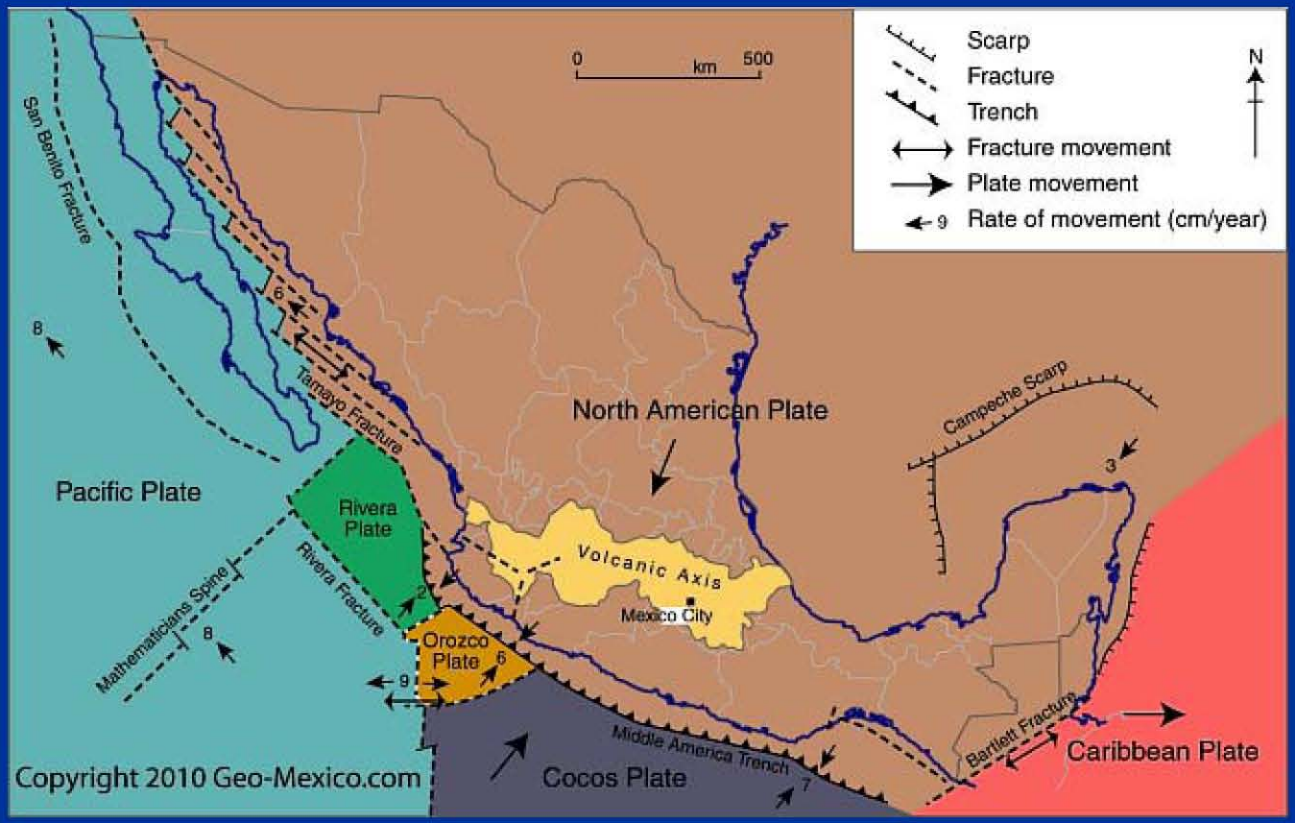
Vegetation in Relation to Hydrology and Salts Through the Wetlands



Some conditions in Mexico

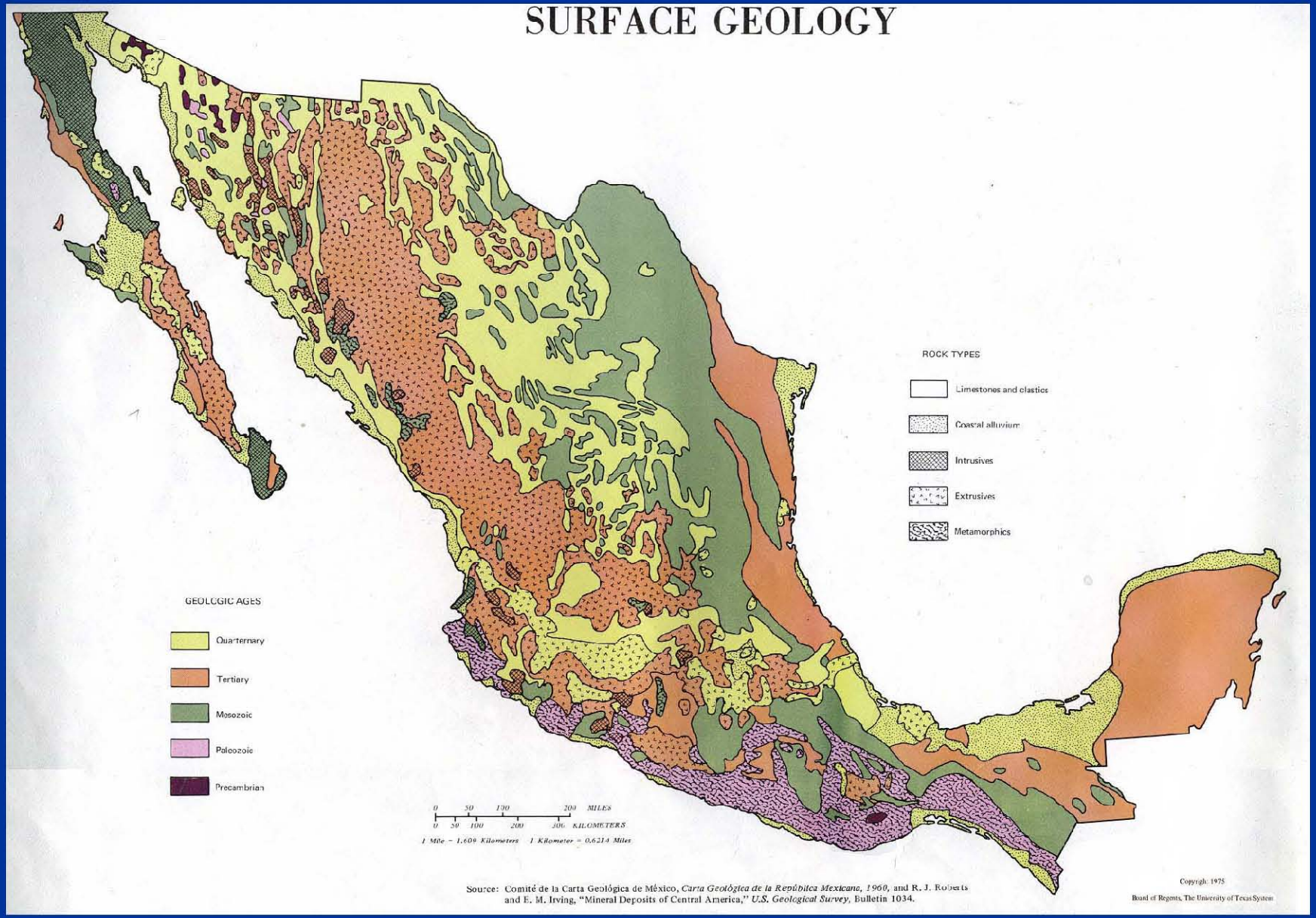
- Highly variable
  - Latitude
  - Elevation
  - Formative process
  - Proximity to ocean

Tectonic Plates



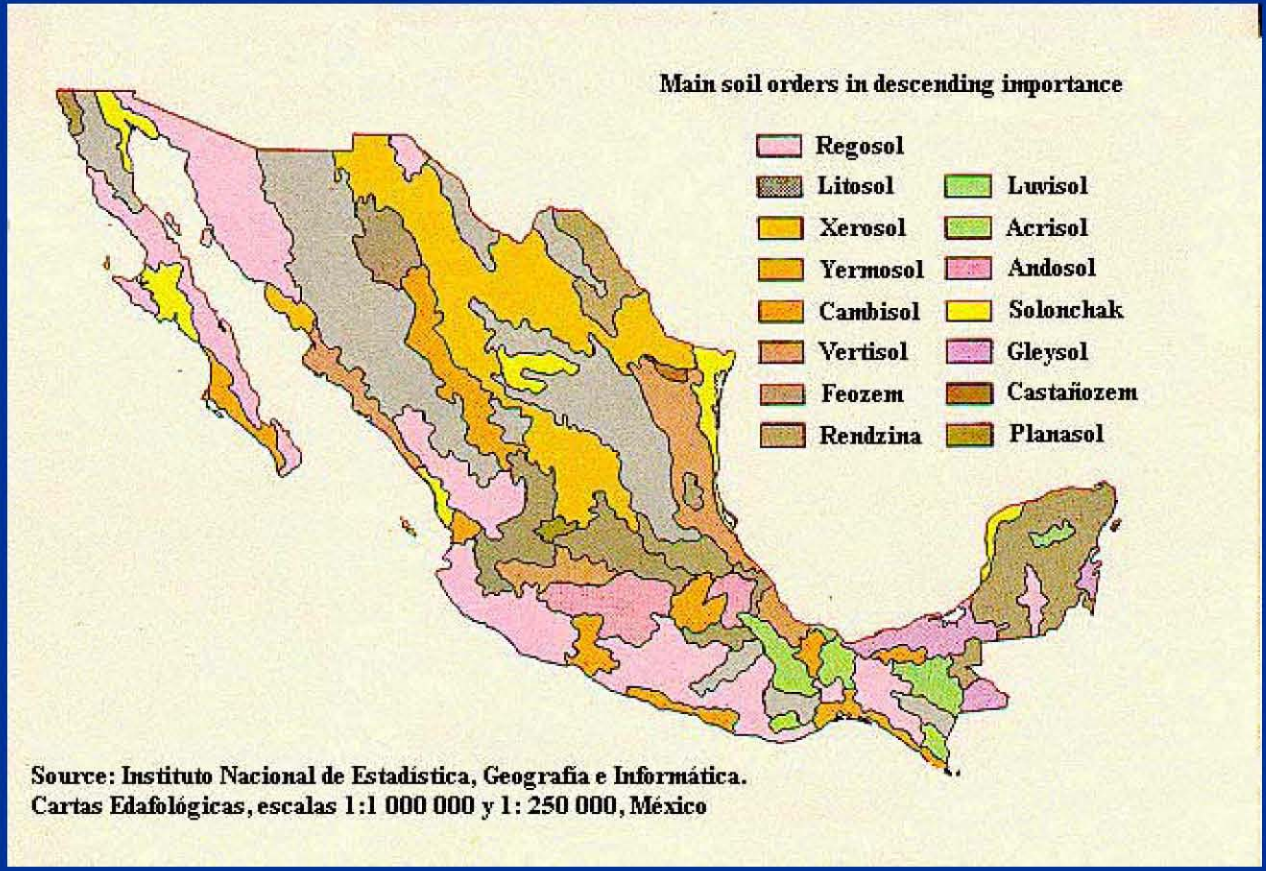
From: http://geo-mexico.com/?p=6277

SURFACE GEOLOGY



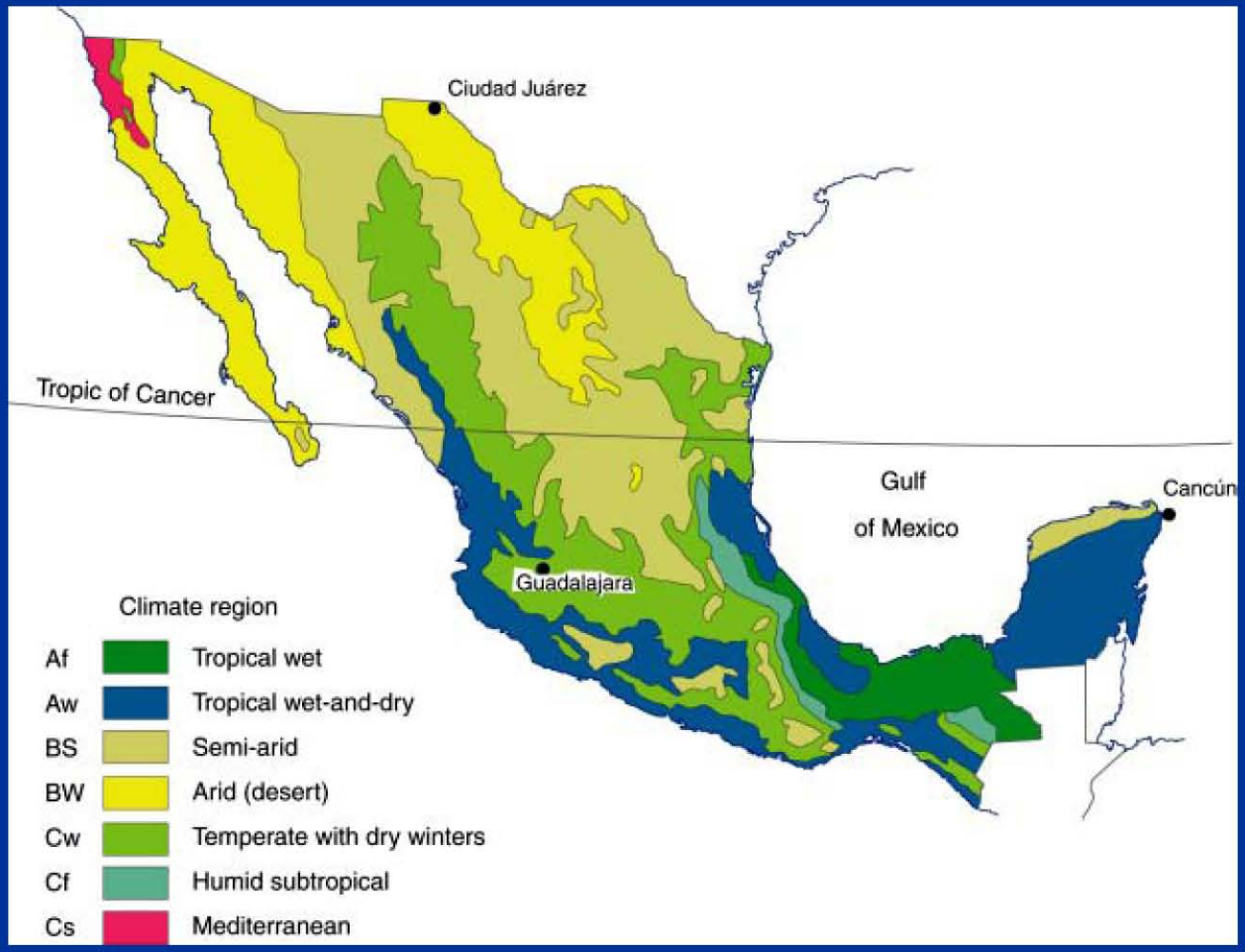
Source: Comité de la Carta Geológica de México, *Carta Geológica de la República Mexicana, 1960*, and R. J. Roberts and E. M. Irving, "Mineral Deposits of Central America," *U.S. Geological Survey*, Bulletin 1034.

Soil Orders in Mexico



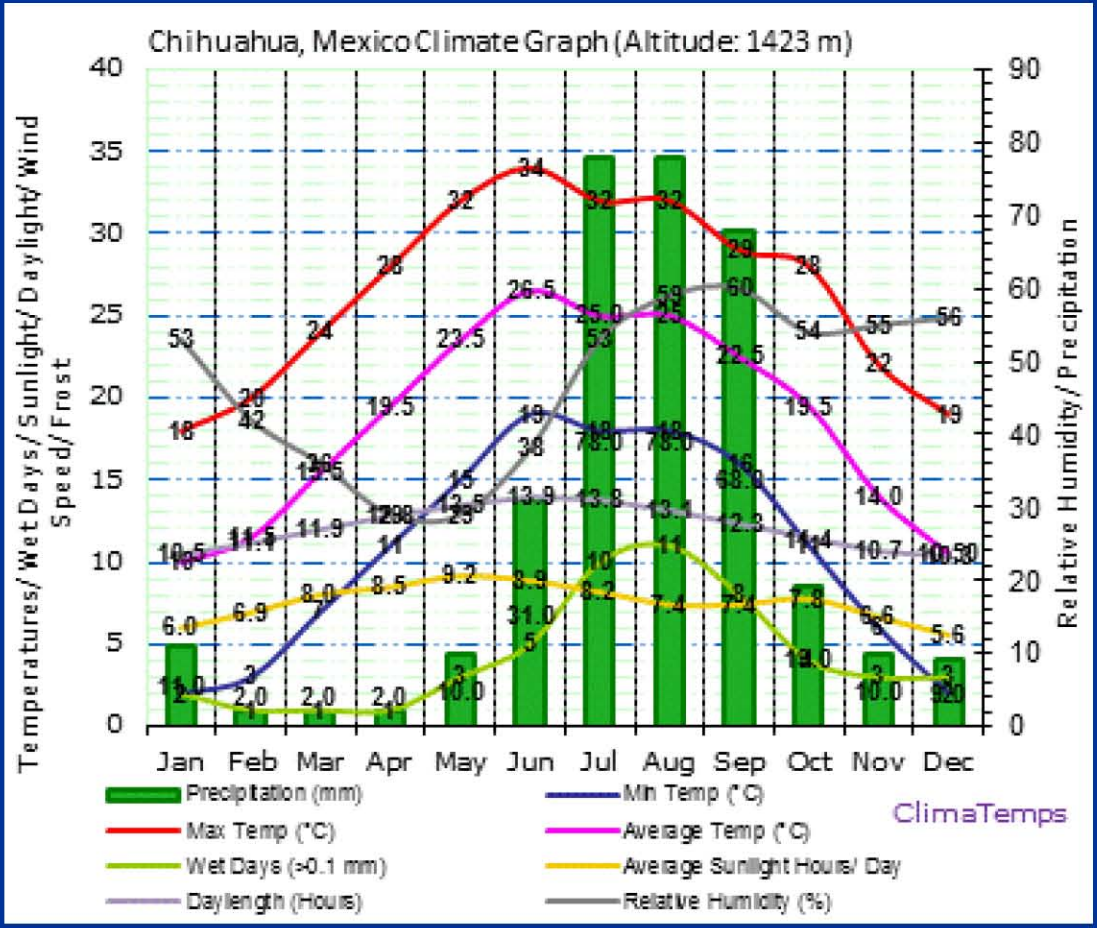
From: http://www.fao.org/ag/agp/AGPC/doc/Counprof/Mexico/Mexico.htm

Climate Regions of Mexico



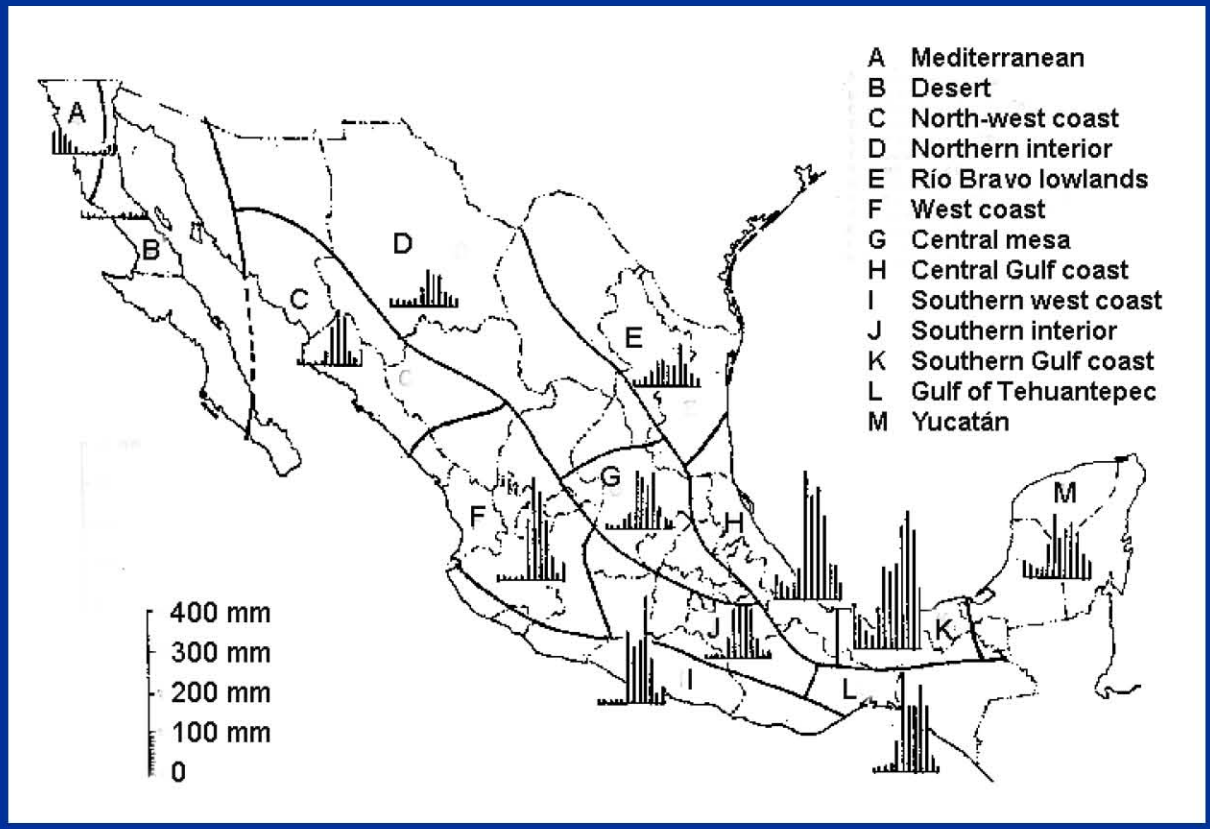
From: http://geo-mexico.com/?p=9512

Climate

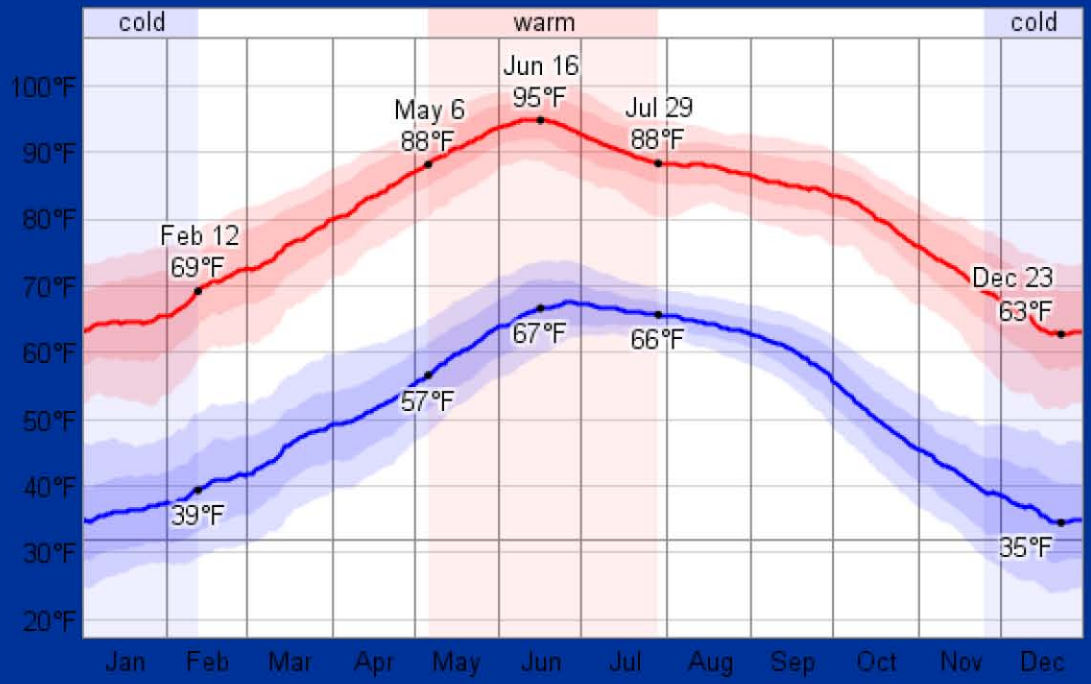


From: http://www.chihuahua.climatemps.com/

Precipitation Patterns In Mexico

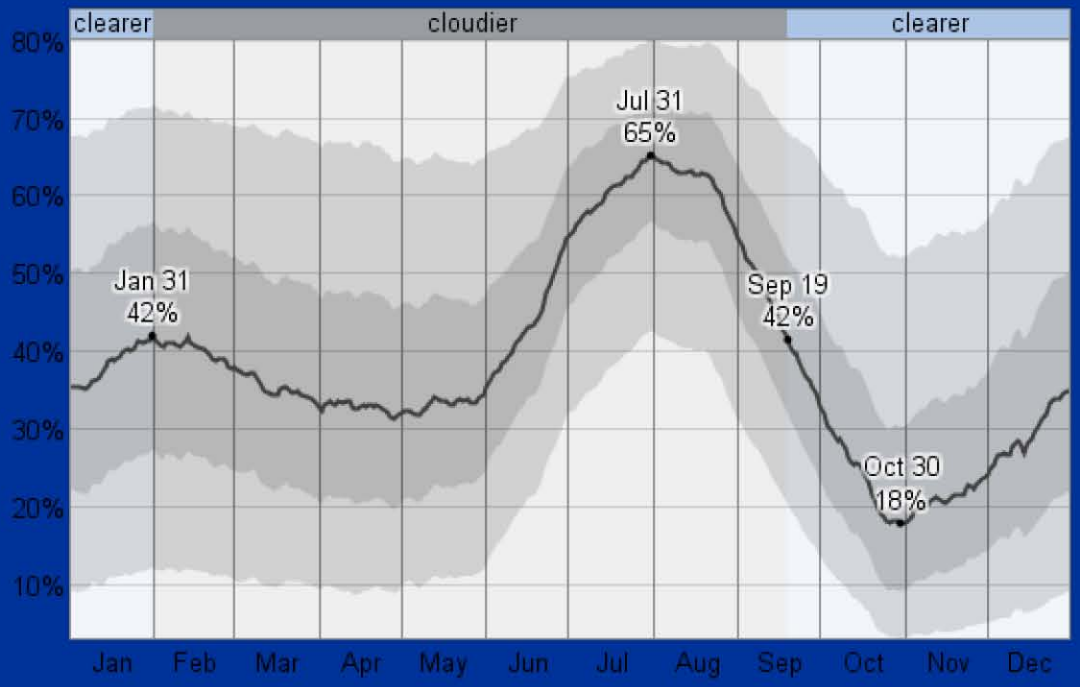


Average Daily Temperature 1990-2012 (Chihuahua City, Mexico)



From: weatherspark.com

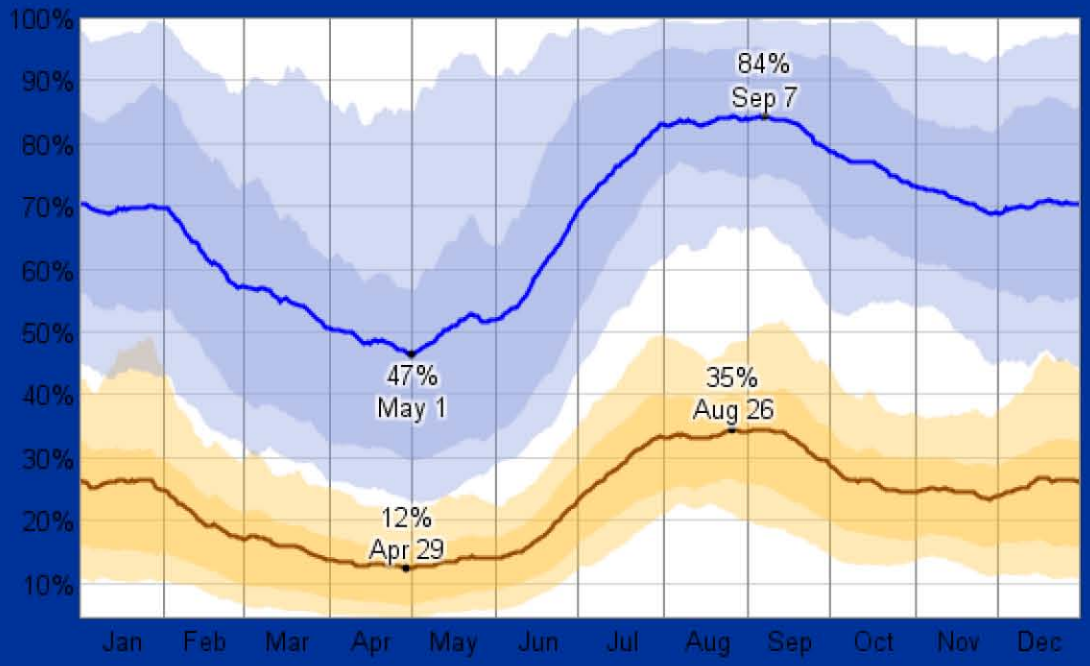
Median Cloud Cover (Chihuahua City, Mexico)



From: weatherspark.com

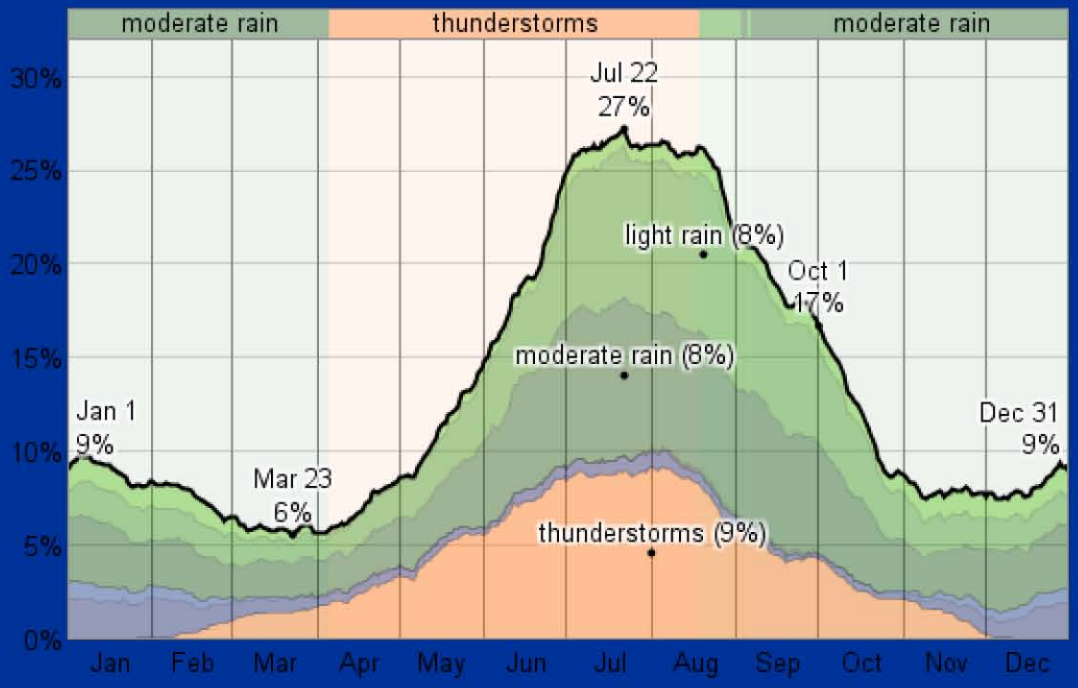
Average Daily High and Low Relative Humidity

(Chihuahua City, Mexico)



From: weatherspark.com

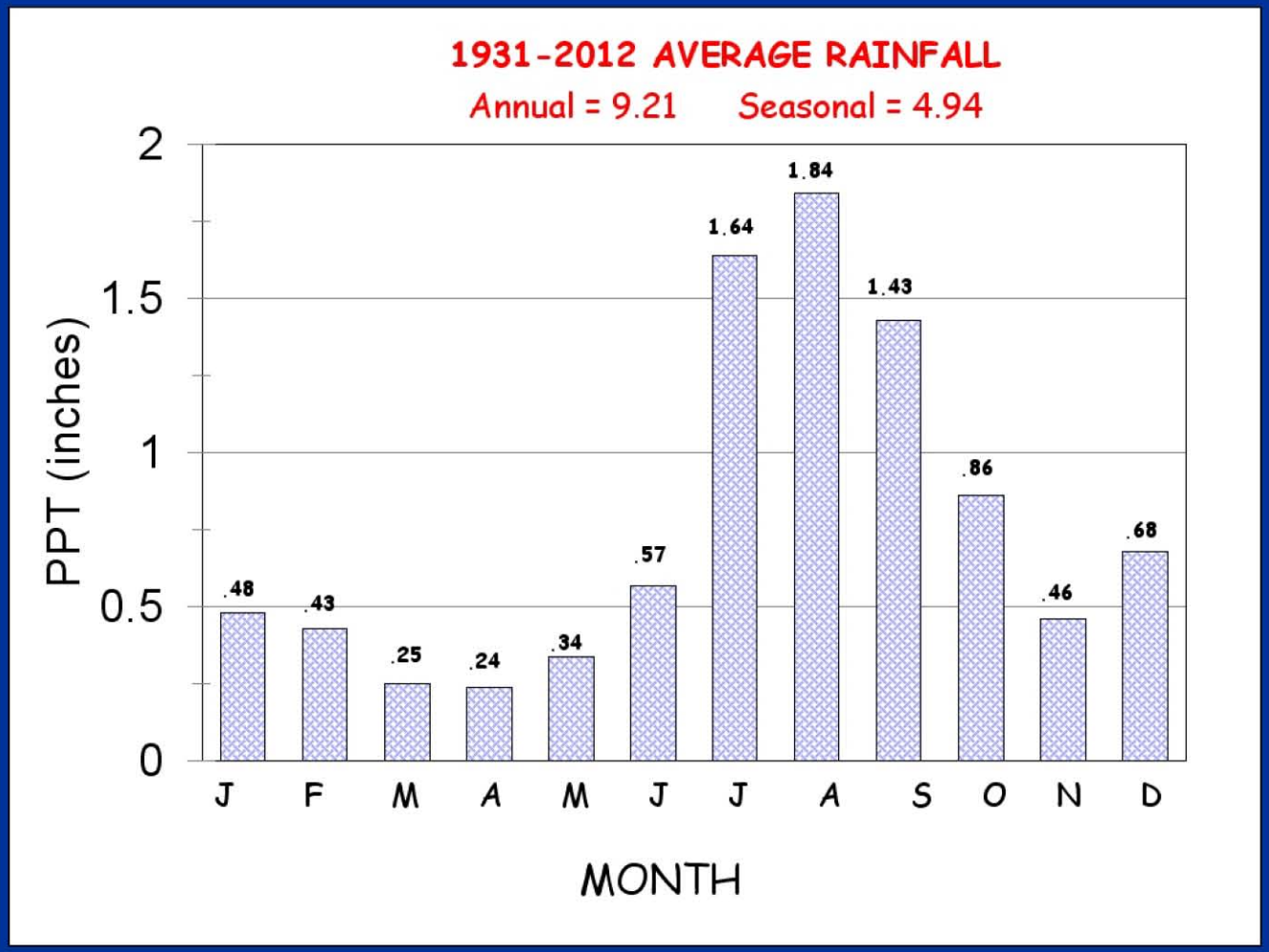
Probability of Precipitation (Chihuahua City, Mexico)



From: weatherspark.com

Long-term Average Precipitation

(Chihuahuan Desert Rangeland Research Center)



Reconstructed Palmer Drought Severity Index (PDSI) and Soil Moisture

(Averaged for Northern Mexico)

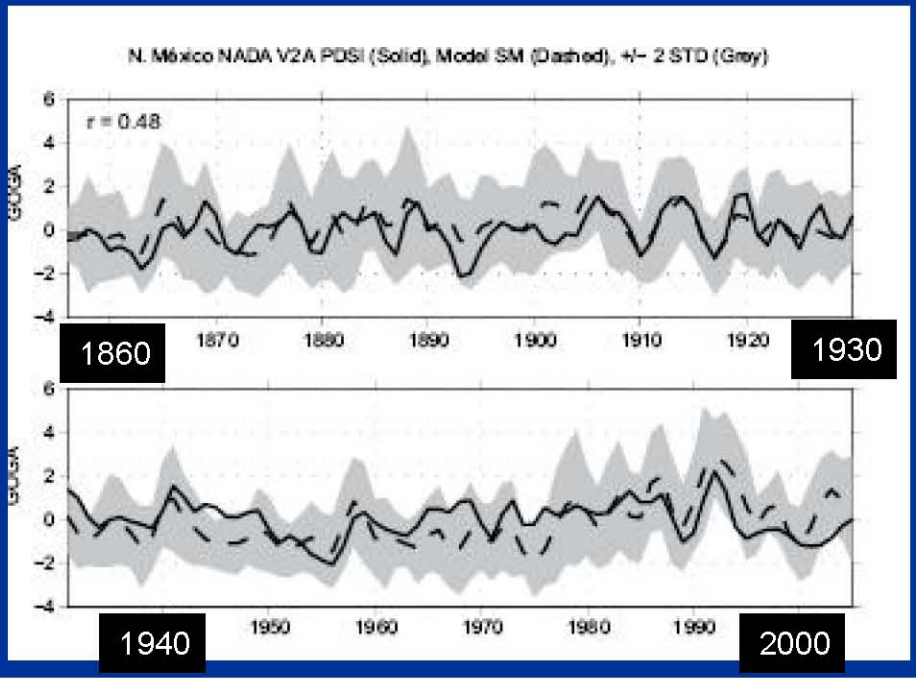


Fig. 11. The tree ring-reconstructed PDSI and the modeled soil moisture with (top) global SST forcing [redacted], average over northern México, for the 1856 to 2004 period. The time series are standardized and have been smoothed with a 3 year low pass filter. The shading is the two standard deviation spread of the model ensemble.

From Ting et al. 2009 Mexican drought: an observational modeling and tree ring study of variability and climate change

http://www.scielo.org.mx/scielo.php?pid=S0187-62362009000100001&script=sci_arttext

Paleoclimate Wet/Dry Periods

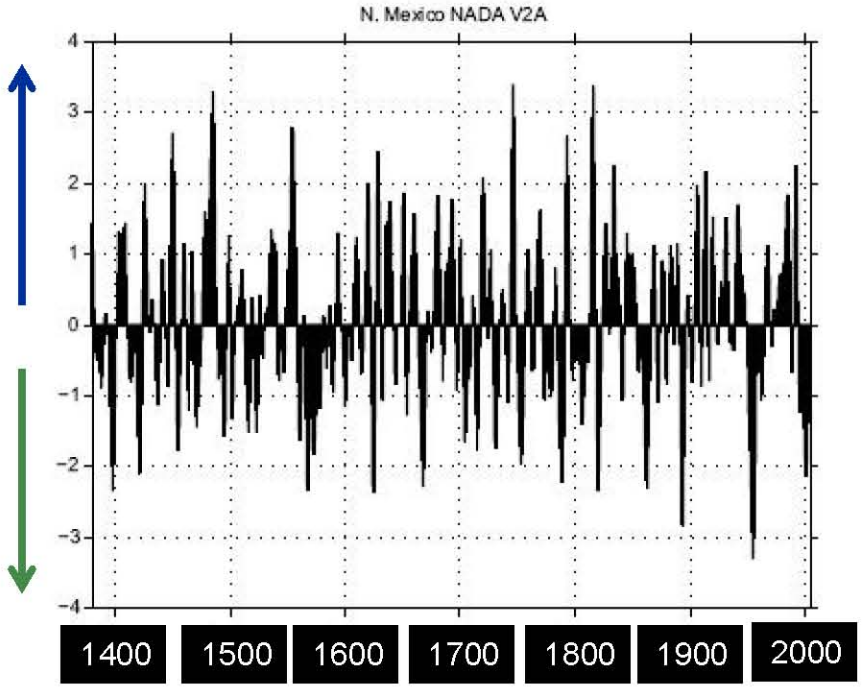
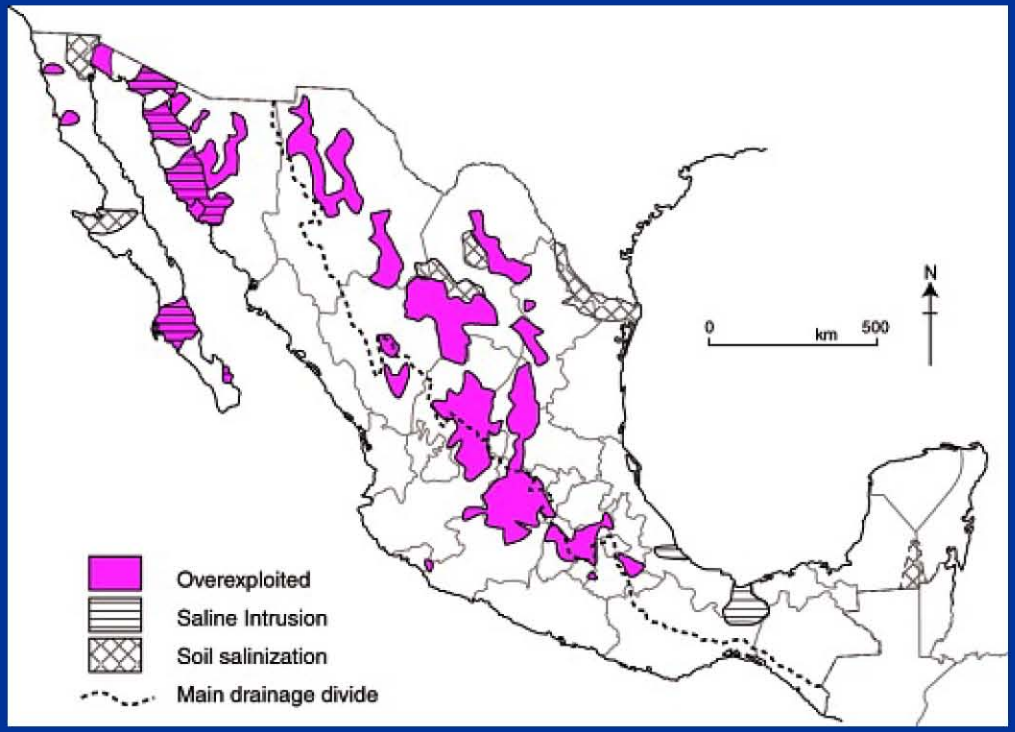


Fig. 13. The tree ring-reconstructed PDSI over northern México for 1380 to 2005 after smoothing with a six year low pass filter. Negative values stand for dry conditions and positive for wet conditions.

From Ting et al. 2009 Mexican drought: an observational modeling and tree ring study of variability and climate change

http://www.scielo.org.mx/scielo.php?pid=S0187-62362009000100001&script=sci_arttext

Groundwater Aquifer Conditions



From: http://geo-mexico.com/?p=5320

My interpretation

- Monsoons provide much of the input
- The precipitation events during monsoons are likely to be thunderstorms rather than fronts
- Higher elevations are cooler and hold less air moisture
- Mountains get more rainfall than basin floor


WARM WET AIR MASS
PACIFIC OCEAN
GULF OF MEXICO
MEXICO

My Interpretation contd

- Water infiltrates rapidly in coarse material and moves subsurface
- Some water reaches the surface through discharge points
- Coarse material is flooded because of high water table
- When fortunate several thunderstorms occur at the same location to re-flood previously wetted sites
- More ground water discharges as ET decreases

Number of Wetlands

	Historic	Current
Temporary	+ + + + +	+
Seasonal	+ + + +	+
Semi-Permanent	+ + +	+ +

HISTORIC CONDITION

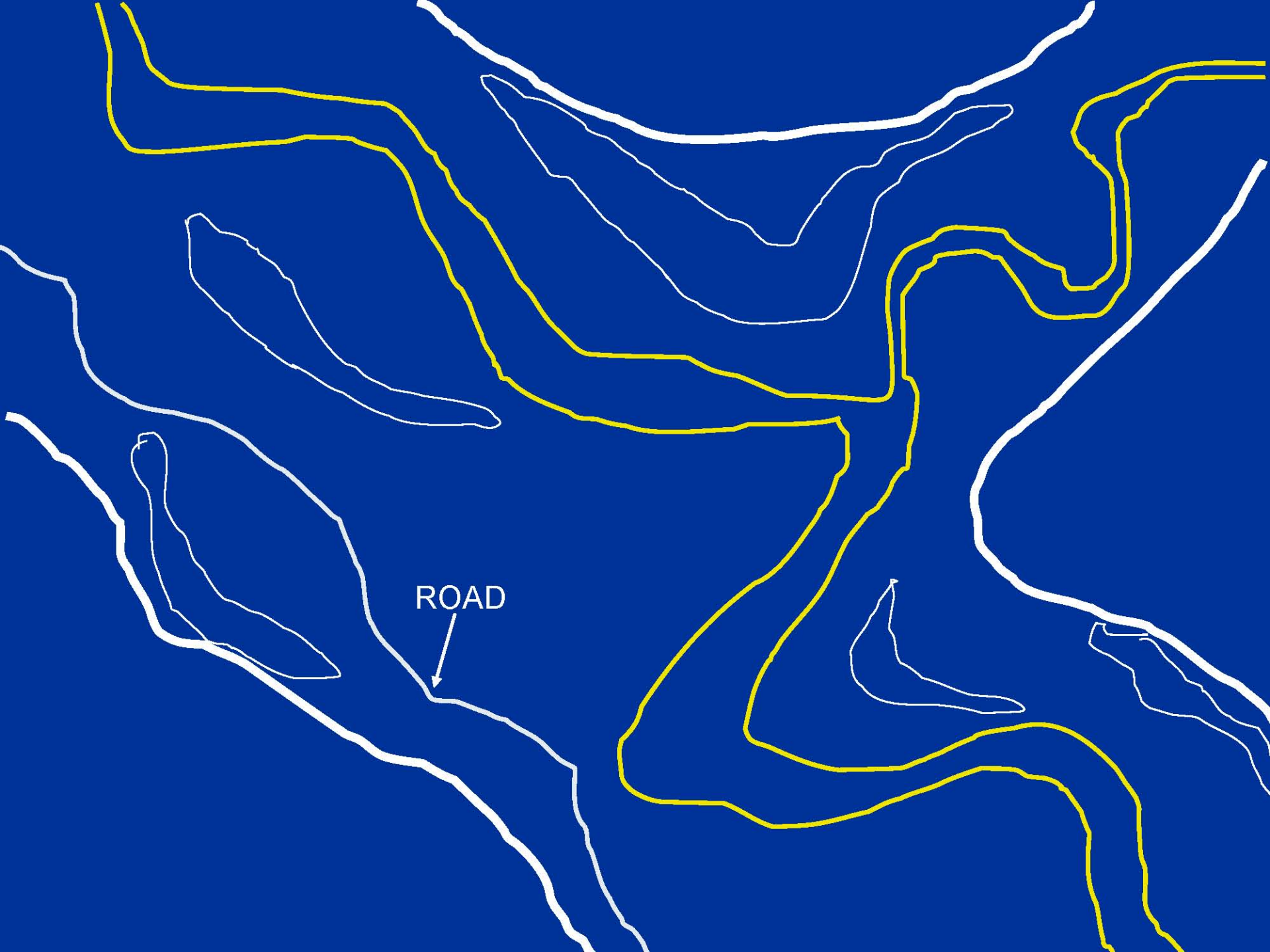
- A WIDE VARIETY OF WETLAND TYPES IN LARGE AND SMALL FLOODPLAINS ACROSS ANY REGION
- DIFFERENT HYDROPERIODS PROVIDED CONSTANTLY CHANGING HABITAT CONDITIONS RESULTING IN A DIVERSITY OF FOODS AND HABITAT STRUCTURE

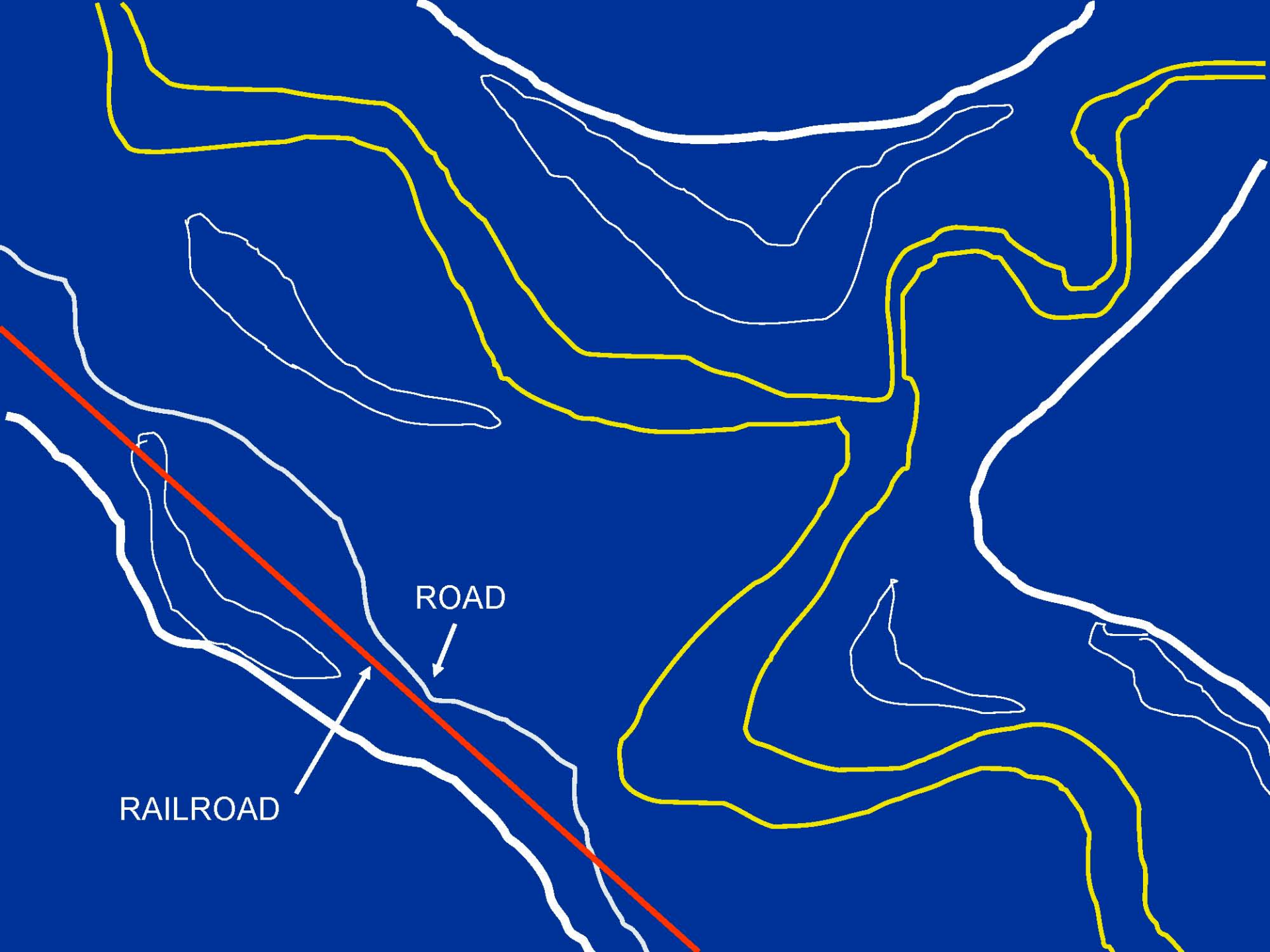
CHANGES TO LANDSCAPE

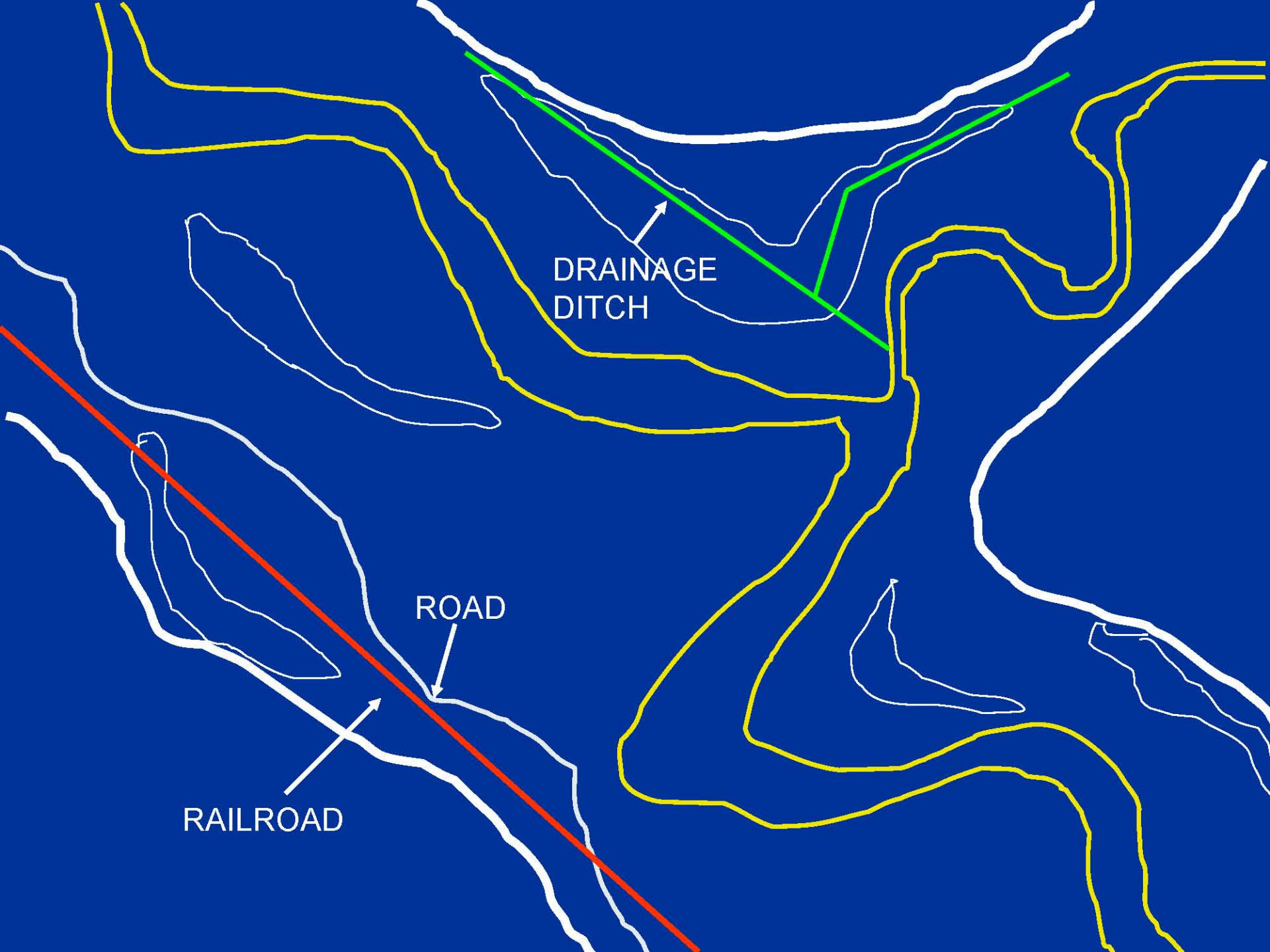
- REDUCED HABITAT AREA
- CHANGED COMPOSITION OF HABITAT TYPES
- CHANGED PHYSICAL CONDITIONS
- MODIFIED HABITAT FUNCTIONS

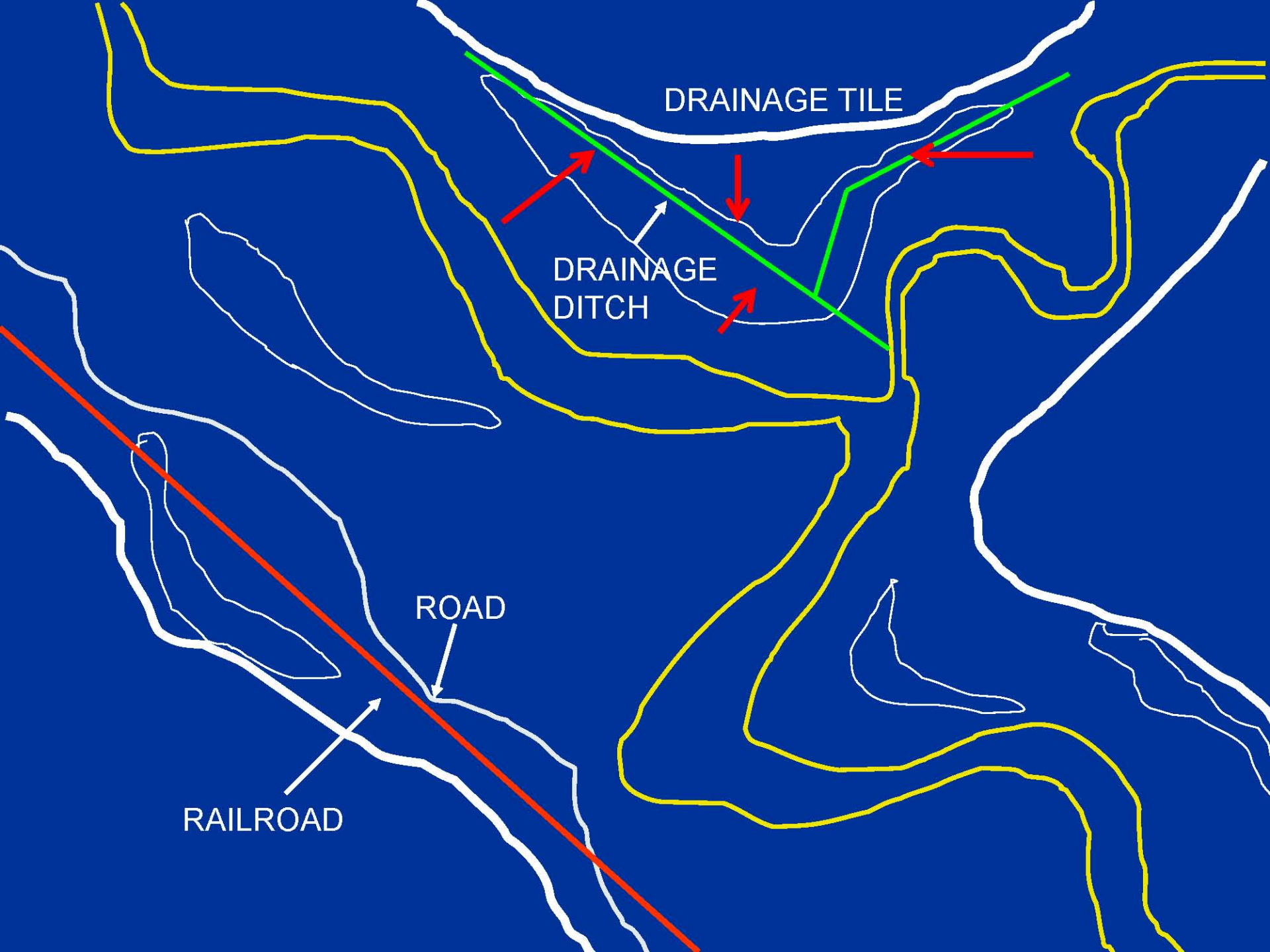
ANTHROPOMORPHIC MODIFICATIONS

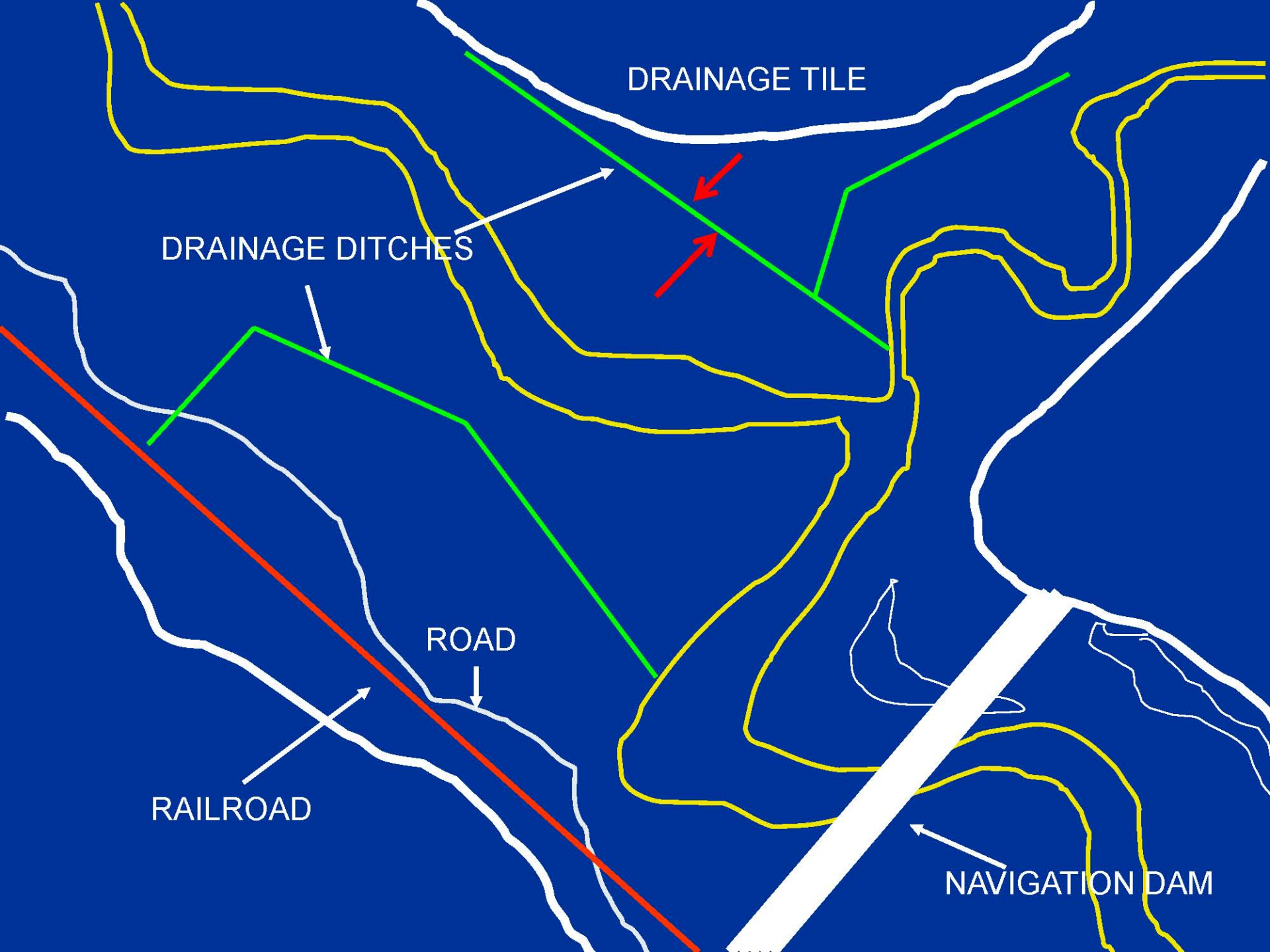
- ON SITE
- OFF SITE
- IN PHYSICAL CONDITION
- IN PROCESSES
- LOCAL/REGIONAL
- GLOBAL


ROAD

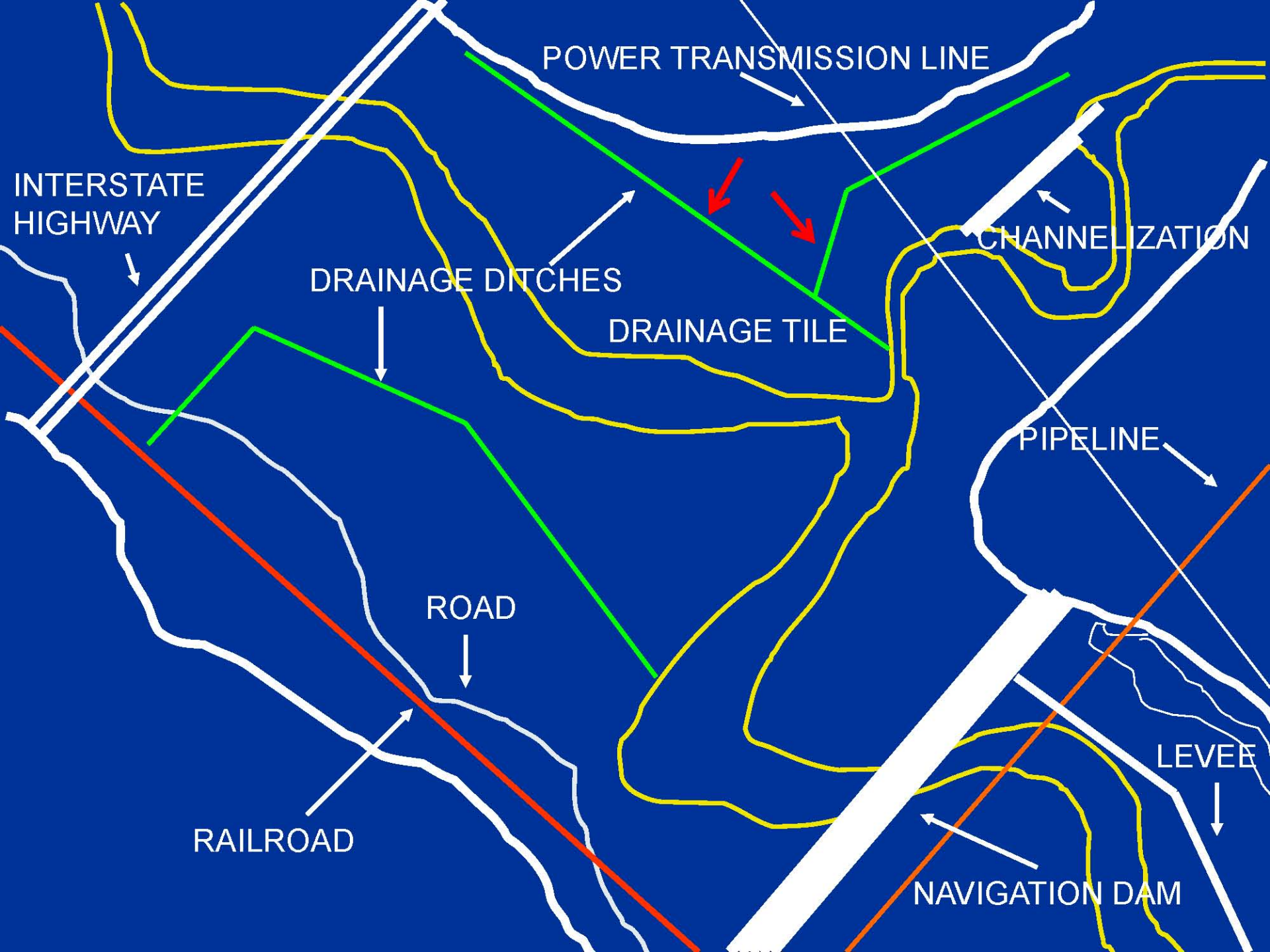

ROAD
RAILROAD

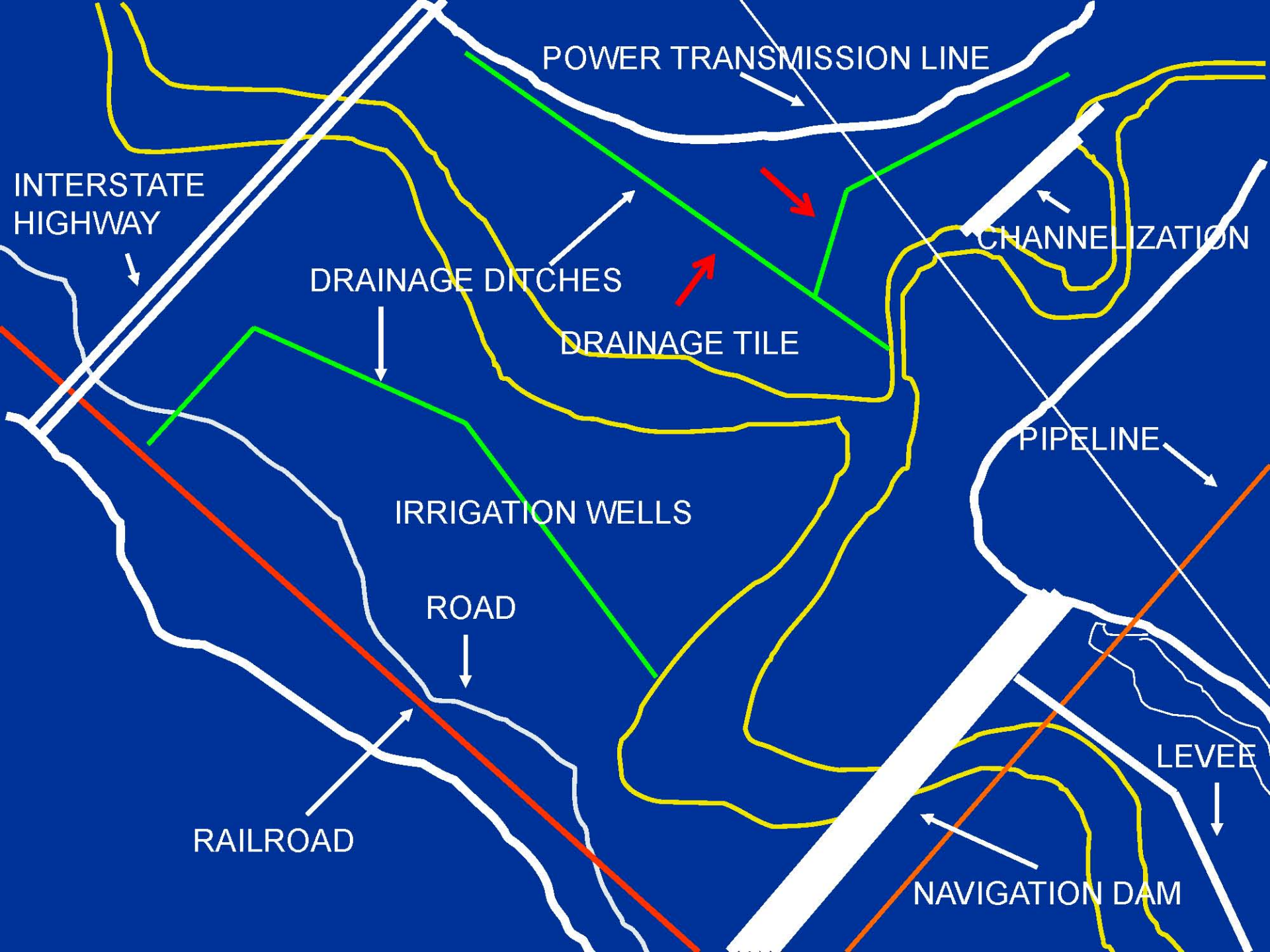

DRAINAGE
DITCH
ROAD
RAILROAD

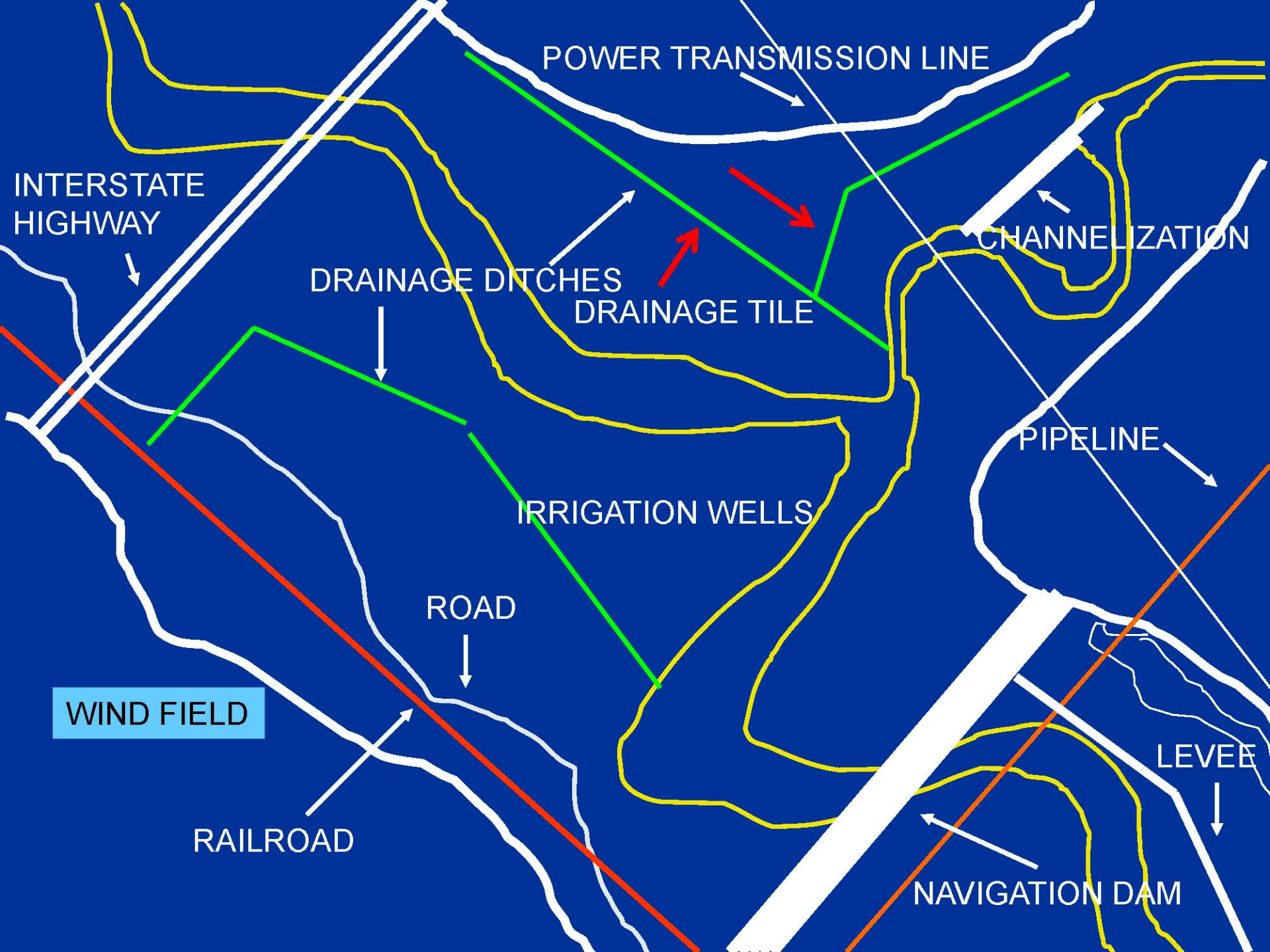

DRAINAGE TILE
DRAINAGE
DITCH
ROAD
RAILROAD


DRAINAGE TILE
DRAINAGE DITCHES
ROAD
RAILROAD
NAVIGATION DAM


DRAINAGE TILE
INTERSTATE HIGHWAY
DRAINAGE DITCHES
ROAD
RAILROAD
NAVIGATION DAM


POWER TRANSMISSION LINE
INTERSTATE HIGHWAY
DRAINAGE DITCHES
DRAINAGE TILE
CHANNELIZATION
PIPELINE
ROAD
RAILROAD
LEVEE
NAVIGATION DAM


POWER TRANSMISSION LINE
INTERSTATE HIGHWAY
DRAINAGE DITCHES
DRAINAGE TILE
CHANNELIZATION
PIPELINE
IRRIGATION WELLS
ROAD
LEVEE
RAILROAD
NAVIGATION DAM

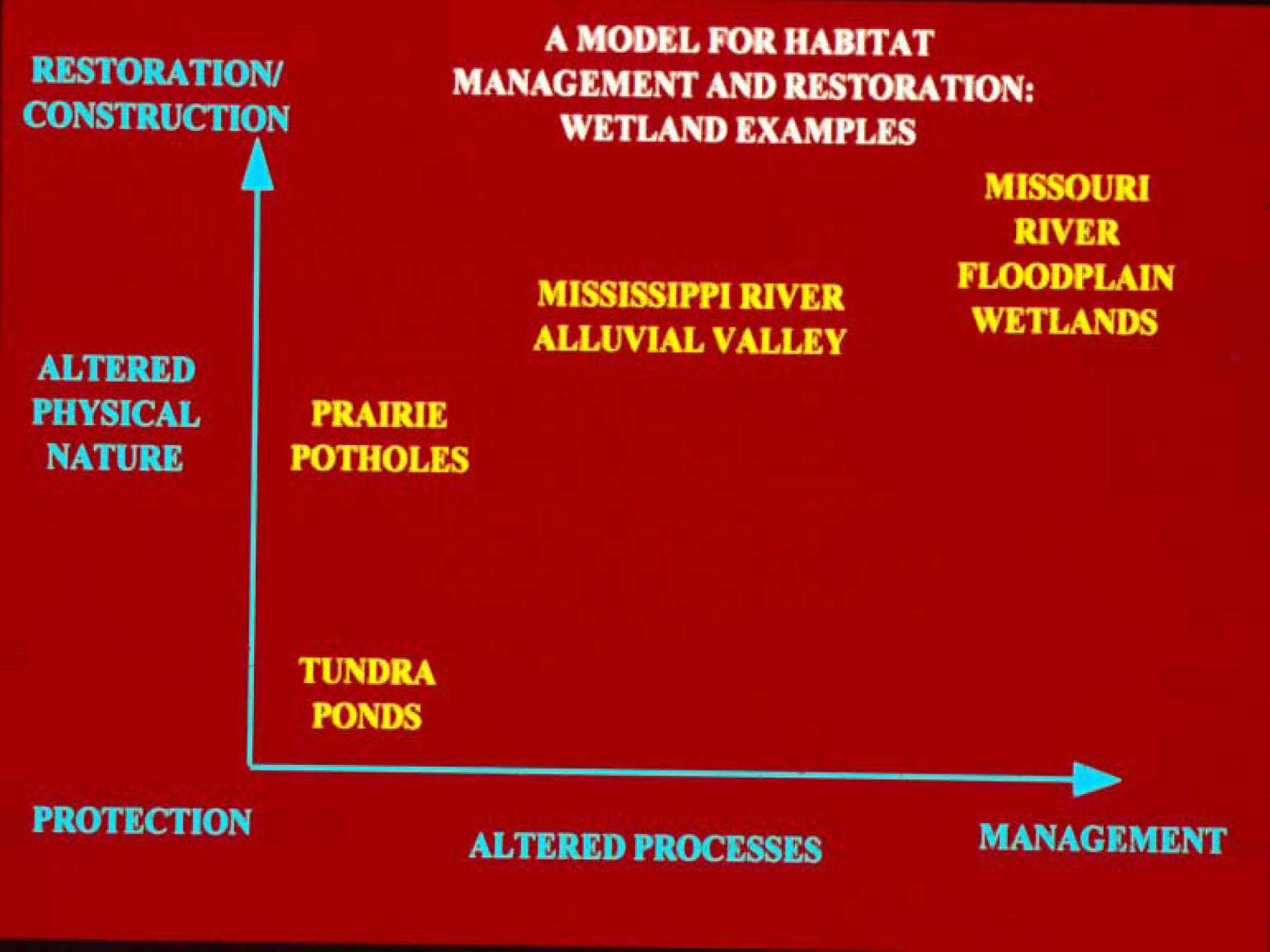

POWER TRANSMISSION LINE
INTERSTATE HIGHWAY
DRAINAGE DITCHES
DRAINAGE TILE
CHANNELIZATION
PIPELINE
IRRIGATION WELLS
ROAD
WIND FIELD
RAILROAD
LEVEE
NAVIGATION DAM

ECOLOGICAL PERTURBATIONS

- COMPROMISED SHEET FLOW
- CHANGED FLOW PATTERNS
- CONCENTRATED FLOW AT HIGH VELOCITY
- IMPEDED WATER MOVEMENTS
- REDUCED BASE FLOW
- MODIFIED GROUND WATER DISCHARGE

CHANGES IN ECOLOGICAL FUNCTIONS

- CHANGED PLANT COMMUNITIES
  - COMPOSITION
  - DISTRIBUTION
  - DYNAMICS
- CHANGED WILDLIFE COMMUNITIES
  - OFTEN SMALLER POPULATIONS OF DESIRED SPECIES
  - OFTEN LARGER POPULATIONS OF UNDESIRABLE SPECIES
  - CHANGES IN DISTRIBUTION


A MODEL FOR HABITAT MANAGEMENT AND RESTORATION: WETLAND EXAMPLES
RESTORATION/ CONSTRUCTION
ALTERED PHYSICAL NATURE
PROTECTION
ALTERED PROCESSES
MANAGEMENT
MISSOURI RIVER FLOODPLAIN WETLANDS
MISSISSIPPI RIVER ALLUVIAL VALLEY
PRAIRIE POTHOLES
TUNDRA PONDS

WHAT CAN WE DO TO BECOME BETTER HABITAT MANAGERS??

- BETTER PREPARATION PRE-EMPLOYMENT
- BETTER CONTINUING EDUCATION
- MONITOR AND EVALUATE IN A MORE MEANINGFUL MANNER
- LEARN TO BE A GOOD DECISION MAKER WITH LIMITED INFORMATION

HOW DO WE CHANGE??

- MENTORING BY THE PROS
- BE A SKEPTIC
- BE A GOOD LISTENER
- NEVER STOP LEARNING
- TRAVEL WHEN YOU CAN BUT WITH AN "OPEN EYE AND EAR"
- BE PATIENT
  - MODIFIED CONDITIONS TOOK YEARS TO DEVELOP
  - MAY TAKE 20 YEARS TO GAIN RANGE OF EXPERIENCE
  - SLOW CHANGES CAN LEAD TO SUCCESS
  - YOU MAY HAVE TO OUTLIVE SOME

OPPORTUNITIES IN FORMAL EDUCATION

- MORE DIRECT EXPOSURE TO SYSTEMS WHETHER NATURAL OR MODIFIED
- MORE HANDS ON EXPERIENCE IN THE FIELD
- EDUCATION THAT INCLUDES EXPOSURE TO PHYSICAL AND CHEMICAL ASPECTS THAT DRIVE THE BIOLOGICAL CONDITION
- MORE EXPERIENCE IN THE APPLICATION OF LIMITED INFORMATION IN DECISION MAKING

EFFECTIVE APPLICATION OF INFORMATION OR SCIENTIFIC METHOD

- GETTING BEAVERS TO DO YOUR WORK
- SIMPLE EXPERIMENTS

Management strategies change across the gradient of alteration