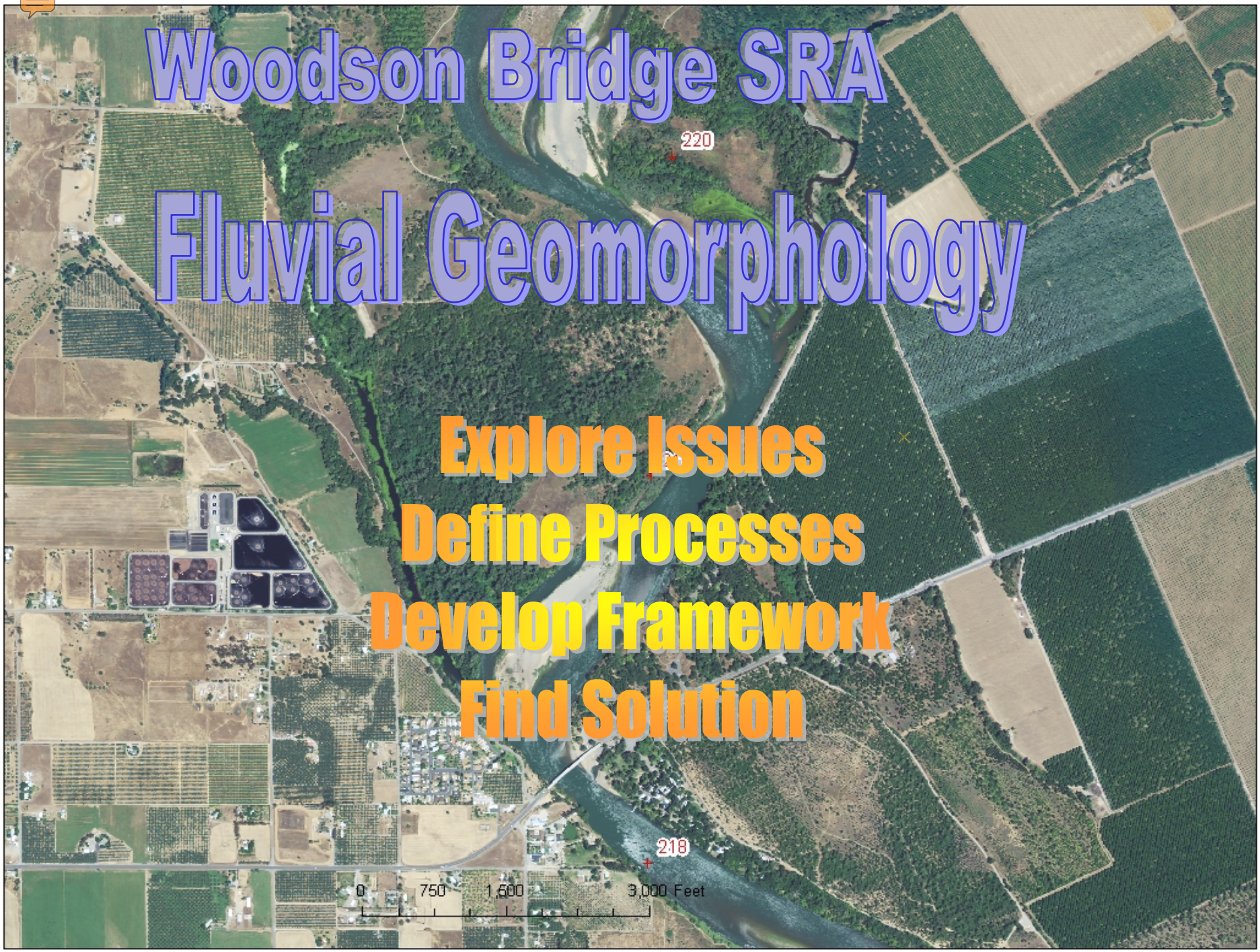

Woodson Bridge SRA
Fluvial Geomorphology
Explore Issues
Define Processes
Develop Framework
Find Solution
220
218
0
750
1,500
3,000 Feet

RIVER CLASSIFICATION

- MOSTLY ALLUVIAL
- GEOLOGIC CONTROL IN PLACES
- MEANDERING AND ANABRANCHING
- CHARACTERISTIC REACHES

RIVER CLASSIFICATION, cont.

- ROSGEN C3, LOW GRADIENT, MEANDERING GRAVEL-BED CHANNEL

RIVER CLASSIFICATION, cont.

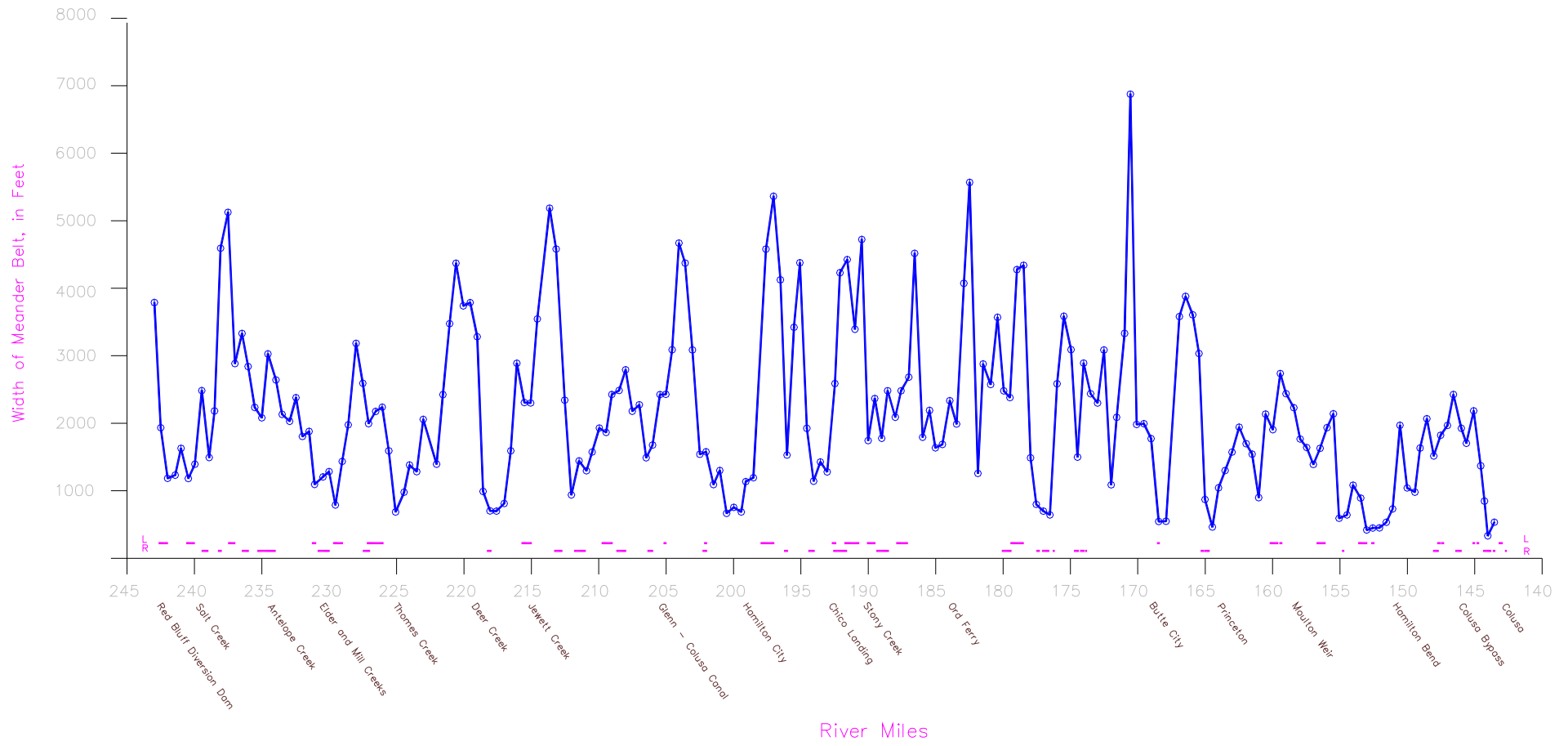
- SLIGHTLY CONFINED- low gradient channel with erodible streambanks and low amount of stream power to transport sediments. Deposition is the driving force for lateral migration. The river moves across its relatively wide floodplain, eroding the banks on one side and depositing sediment on the other.
- LOW TO MODERATE SINUOSITY- measured by dividing the length of the river and dividing by the length of the valley


RIVER REACHES

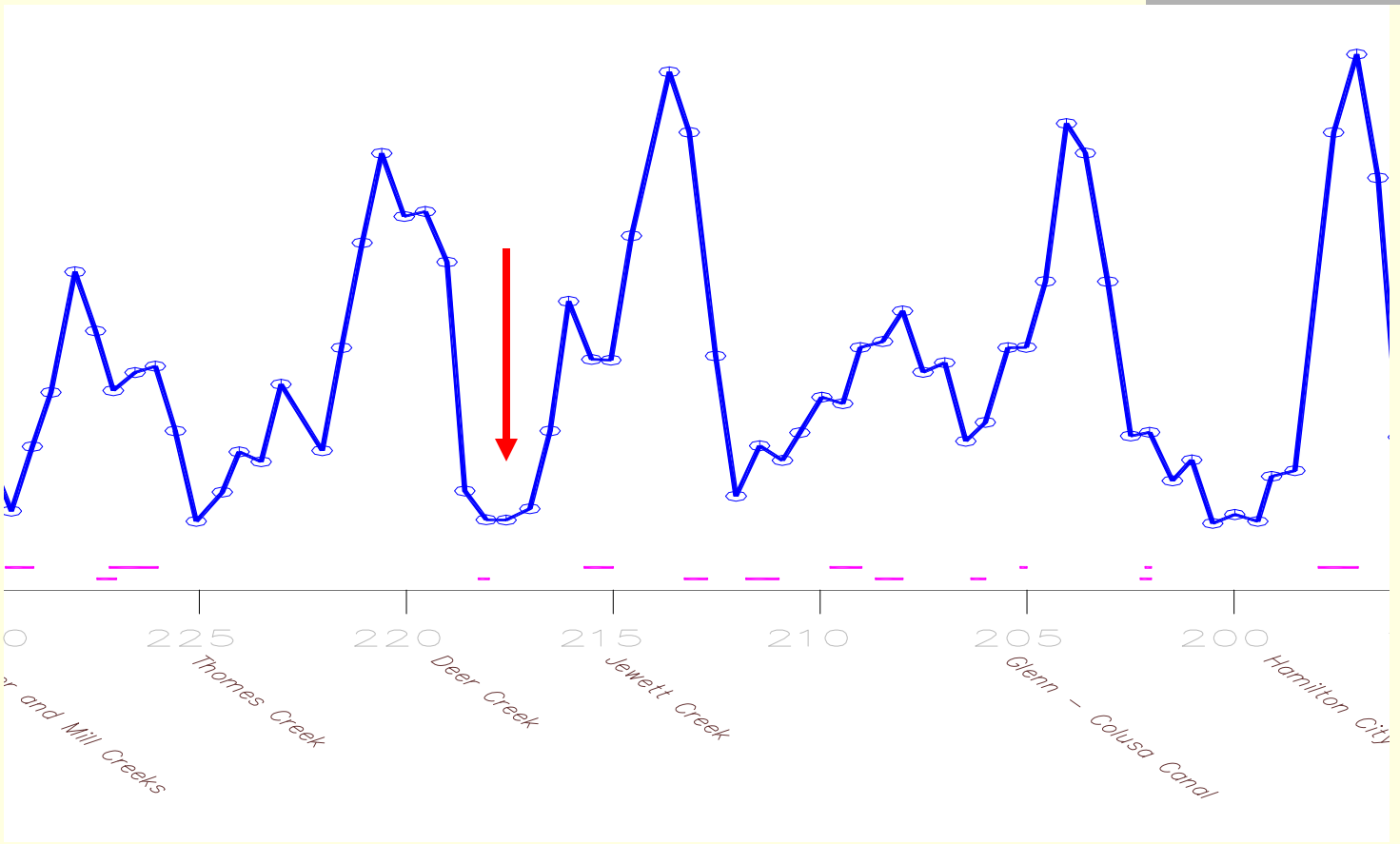
RIVER REACHES

- REACHES 1TO 5 – REDDING TO RED BLUFF
- REACH 6 – RED BLUFF TO CHICO LANDING, 6A TO 6H
- REACH 7 – CHICO LANDING TO BUTTE CITY, 7A TO 7C
- REACH 8- BUTTE CITY TO COLUSA, 8A TO 8C

100-YEAR MEANDER BELT WIDTH



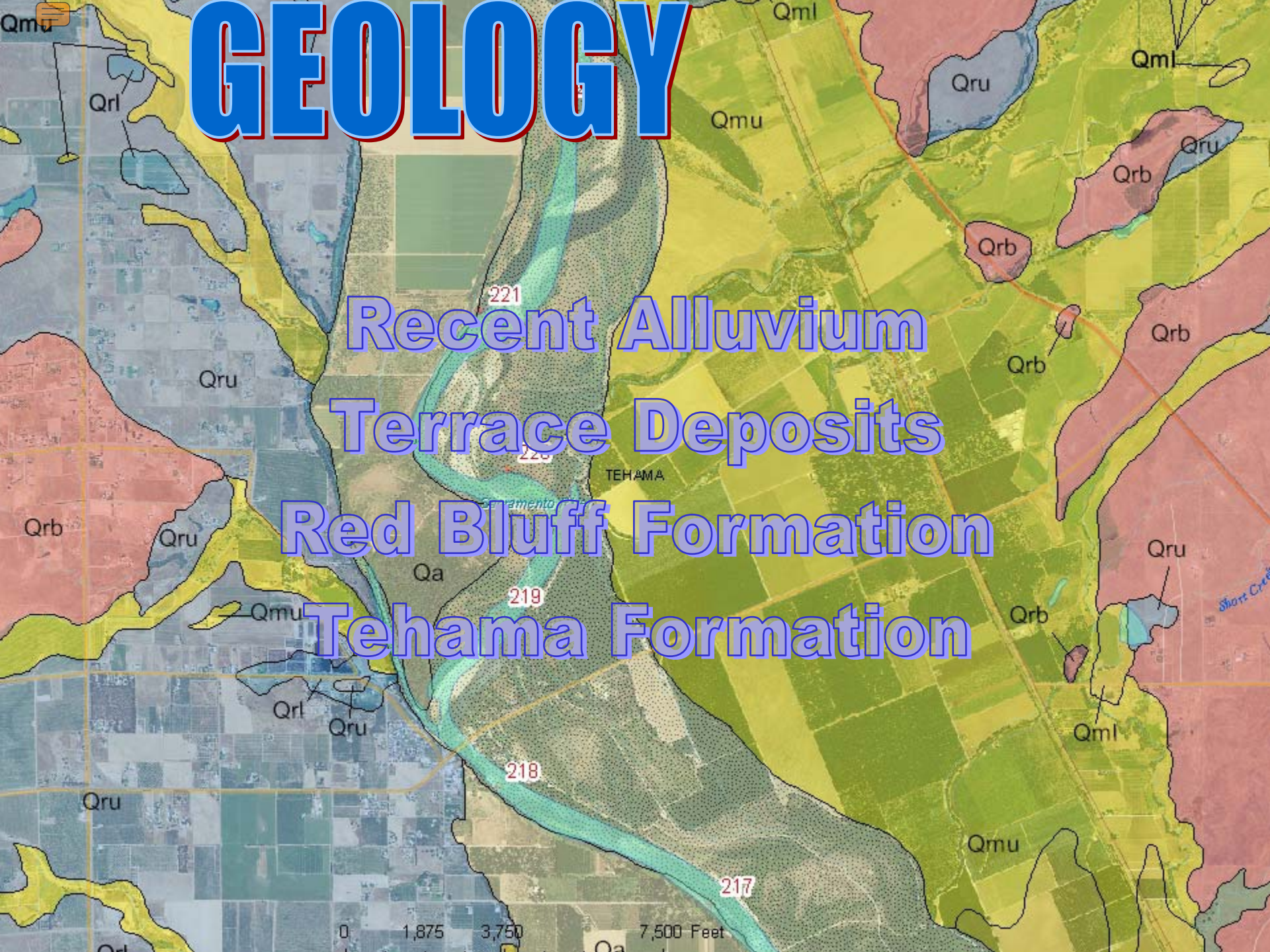
Woodson Bridge



REACH 6D AND 6E

- 6D IS SINUOUS WITH HIGH BANK EROSION AND .00054 GRADIENT
- 6E IS STRAIGHT WITH LOW BANK EROSION, .00030 GRADIENT AND GEOLOGIC CONTROL
- 6F IS SINUOUS WITH HIGH BANK EROSION AND .00054 GRADIENT

GEOLOGY


Recent Alluvium
Terrace Deposits
Red Bluff Formation
Tehama Formation
Qml
Qru
Qmu
Qrb
Qa
Qrl
TEHAMA
221
219
218
217
0
1,875
3,750
7,500 Feet

TEHAMA FORMATION

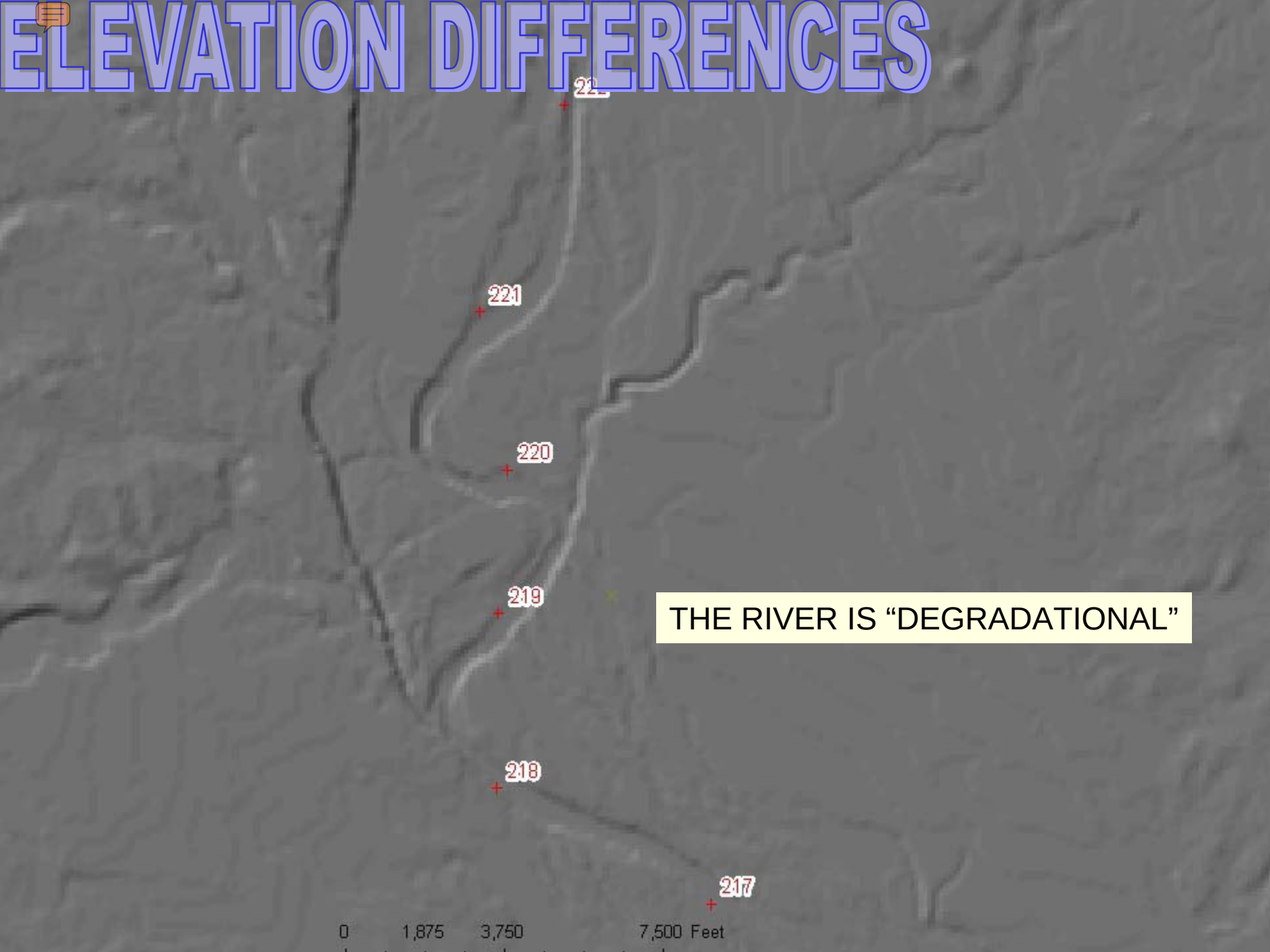
- 1 TO 3.6 MILLION YEARS OLD
- FLUVIAL DEPOSITS VARYING IN THICKNESS UP TO OVER 1,000 FT
- YELLOW TAN TO LIGHT GREEN
- UNDERLIES ENTIRE VALLEY
- COMPACTED CLAYEY DEPOSIT IS GEOLOGIC CONTROL

RED BLUFF FORMATION

- BRICK RED CLAYEY GRAVEL
- 0.5 TO 1.0 MILLION YEARS OLD
- PEDIMENT FORMED FROM GLACIAL OUTWASH
- NEXT OLDEST UNIT IN THE AREA


TERRACE DEPOSITS
Modesto- upper and lower
Riverbank- upper and lower
Qml
Qru
Qrl
Qmu
Qrb
Qa
221
219
218
217
Sacramento River

ELEVATION DIFFERENCES

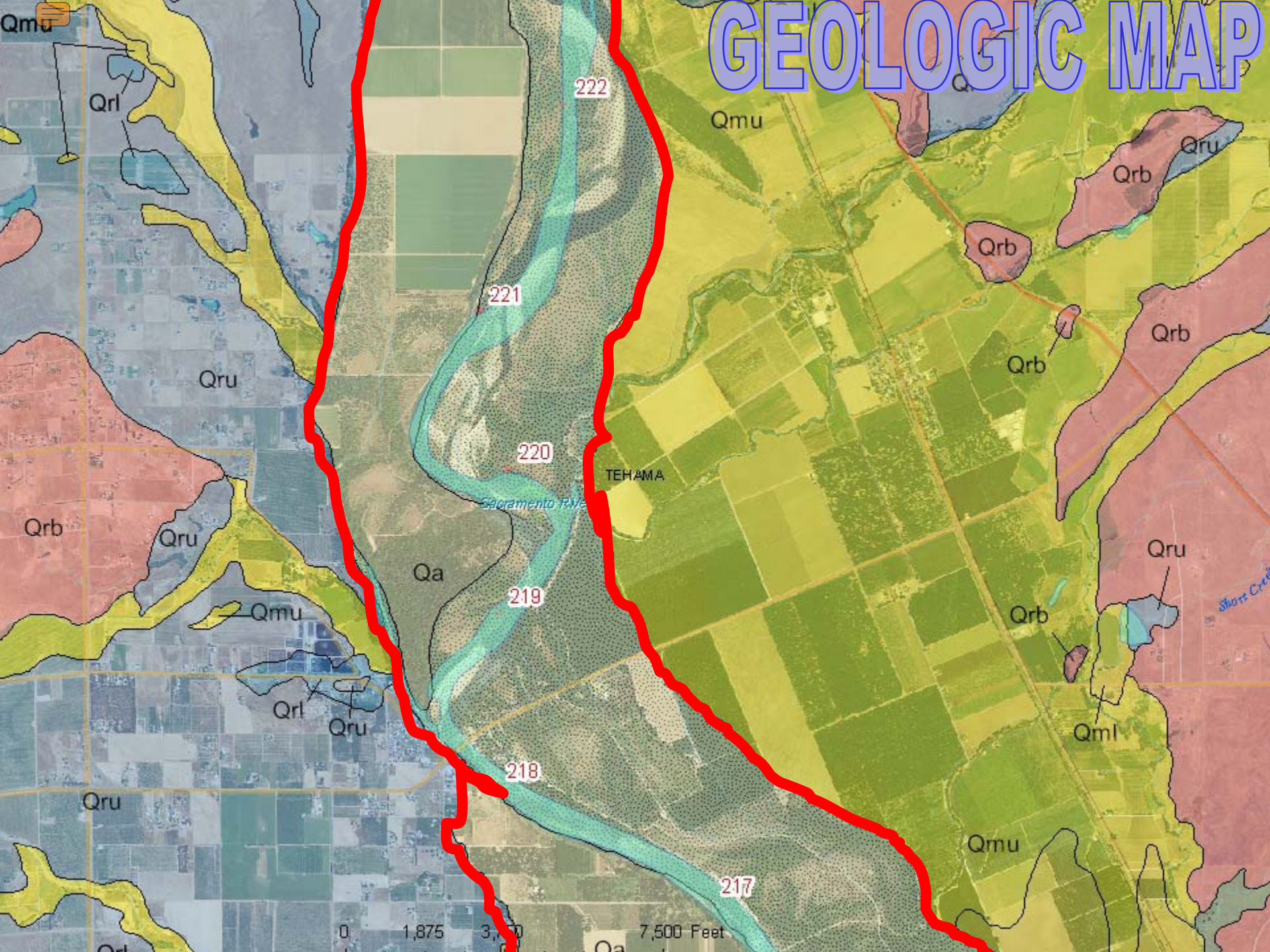


THE RIVER IS “DEGRADATIONAL”

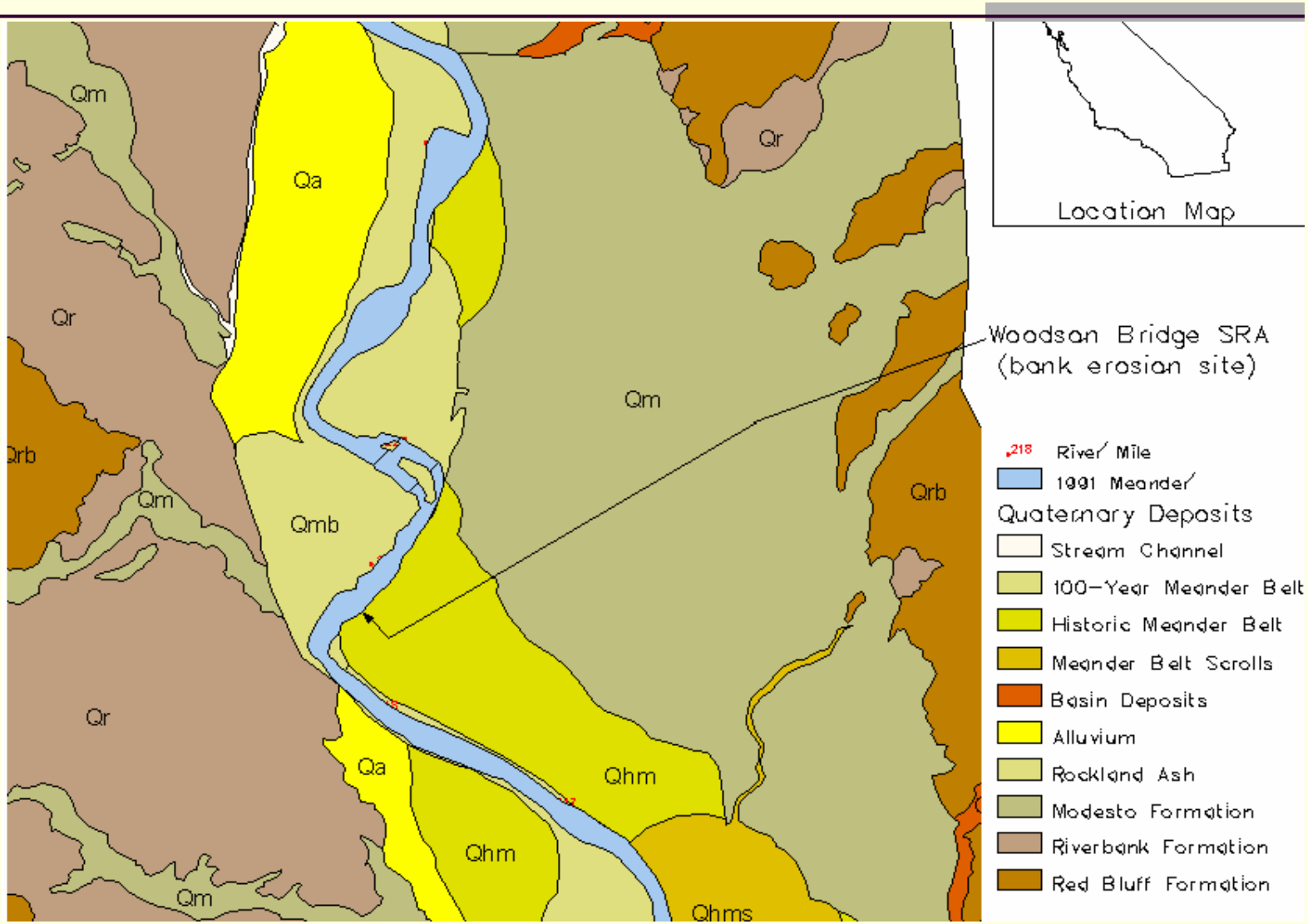
RIVERBANK AND TEHAMA

“GEOLOGIC CONTROL”

- OLDER, EROSION RESISTANT UNITS
- GENERALLY UNDERLAIN BY THE TEHAMA FORMATION
- VERY LOW BANK EROSION RATES


GEOLOGIC MAP
Qmu
Qrl
Qru
Qrb
Qa
Qml
222
221
220
219
218
217
TEHAMA
Sacramento R.
Short Cr
0
1,875
7,500 Feet

HISTORIC AND 100-YEAR MEANDER BELTS



BANK MATERIAL

- GEOLOGIC CONTROL AND RIPRAP
- CLAY AND SILT- OXBOW LAKE DEPOSIT
- SILT AND SAND- FLOODPLAIN DEPOSIT
- SAND AND GRAVEL- POINT BAR DEPOSIT

GEOLOGIC CONTROL AND BANK PROTECTION

- SLOWS OR STOPS BANK EROSION AND MEANDERING
- ERODES CHANNEL THALWEG
- DEPOSITION ON FAR SIDE
- CHANNEL NARROWS
- BED MATERIAL BECOMES COARSER

BANK PROTECTION INSTALLED IN 1963

CLAY AND SILT BANKS

- BANK EROSION RATES LOW
- “COHESION”
- OXBOW LAKE DEPOSITS OR “CLAY PLUGS”
- MORE CLAY MEANS LESS EROSION
- MORE SILT MEANS MORE EROSION


CLAY PLUG

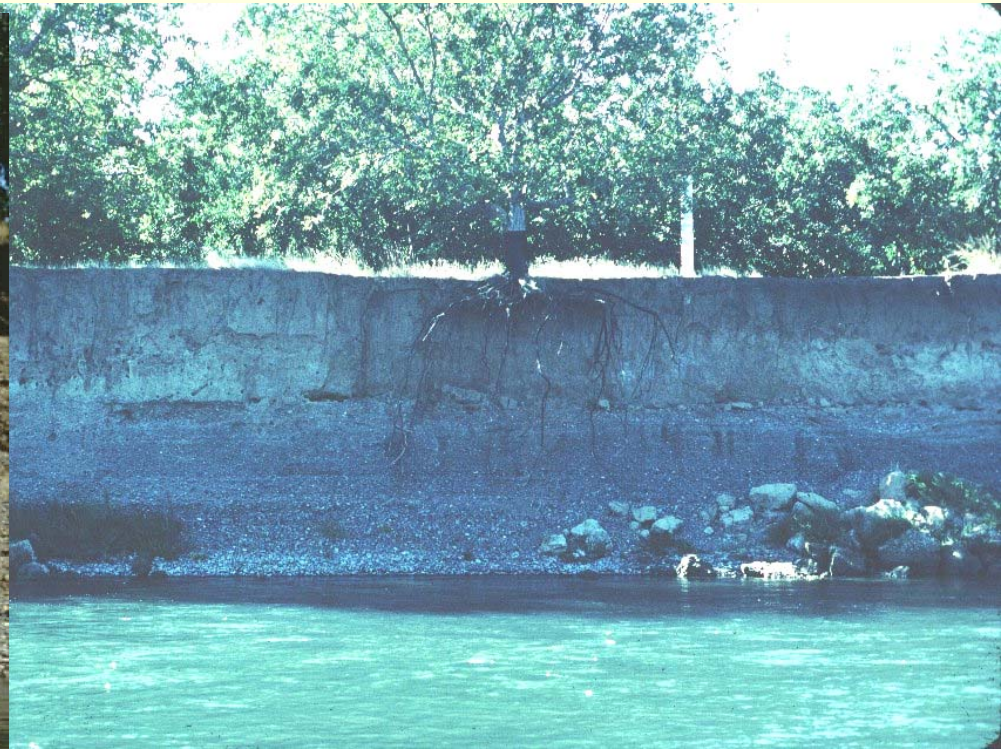
SILT AND SAND BANKS

- BANK EROSION RATES HIGH
- NO COHESION
- FLOODPLAIN DEPOSITS
- LOW STRENGTH WHEN WET
- SUBJECT TO COLLAPSE DURING RAPID DRAWDOWN

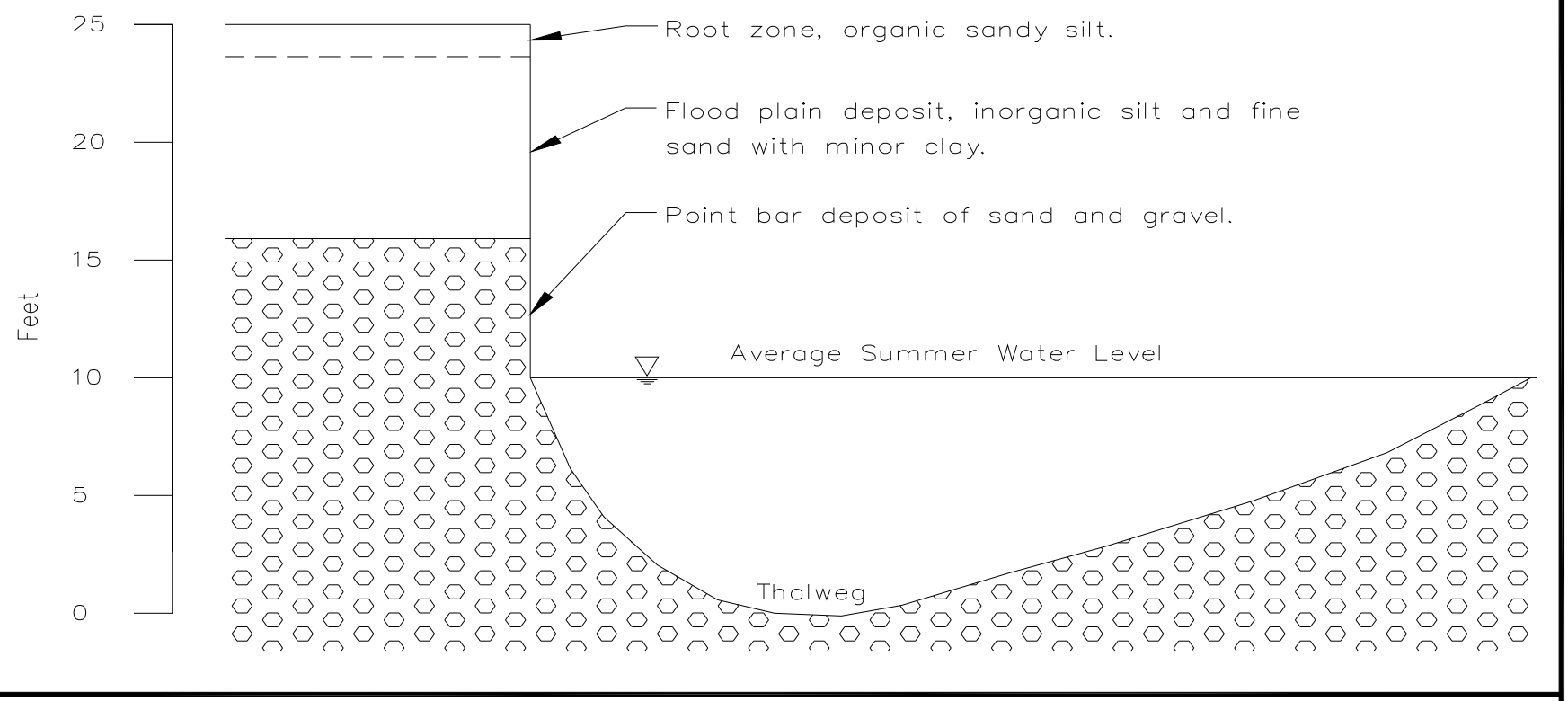
SAND AND GRAVEL BANKS

- MODERATE TO HIGH EROSION RATES DEPENDING ON SAND CONTENT
- LAYERS OF SAND CAUSE RAPID EROSION THROUGH BANK COLLAPSE
- GRAVEL BANKS ONLY ERODE AT MODERATE TO HIGH FLOWS

GRAVEL BANKS



“AVERAGE” BANK IS A COMPOSITE



Sacramento River
Bank Erosion Investigation

Average Eroding Bank Cross–Section Red Bluff to Ord Ferry

Figure 18

RADIUS OF CURVATURE

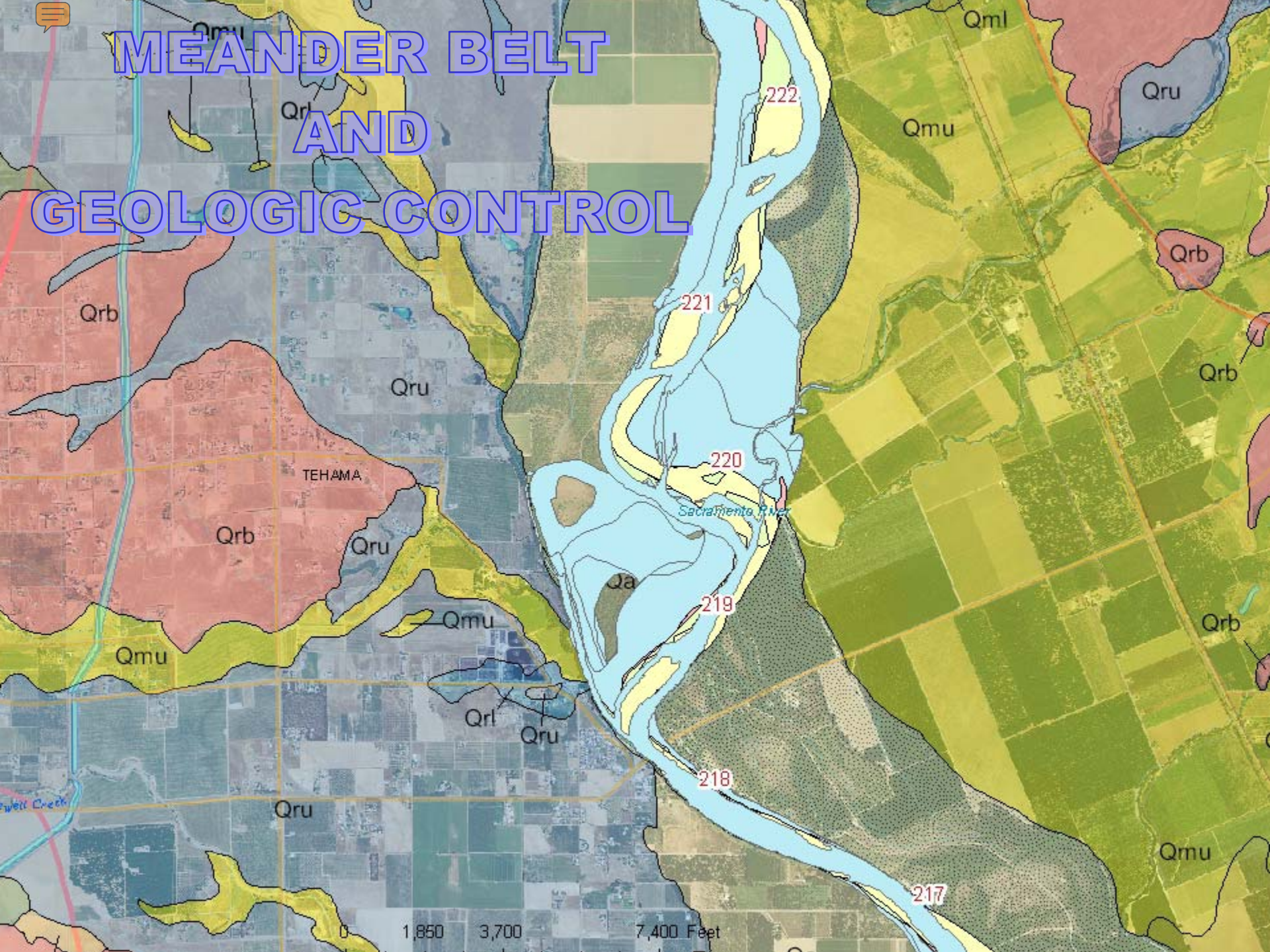
- LARGER RADIUS OF CURVATURE- SLOWER BANK EROSION
- SMALLER RADIUS OF CURVATURE- FASTER BANK EROSION
- CAUSED BY ANGLE OF INCIDENCE

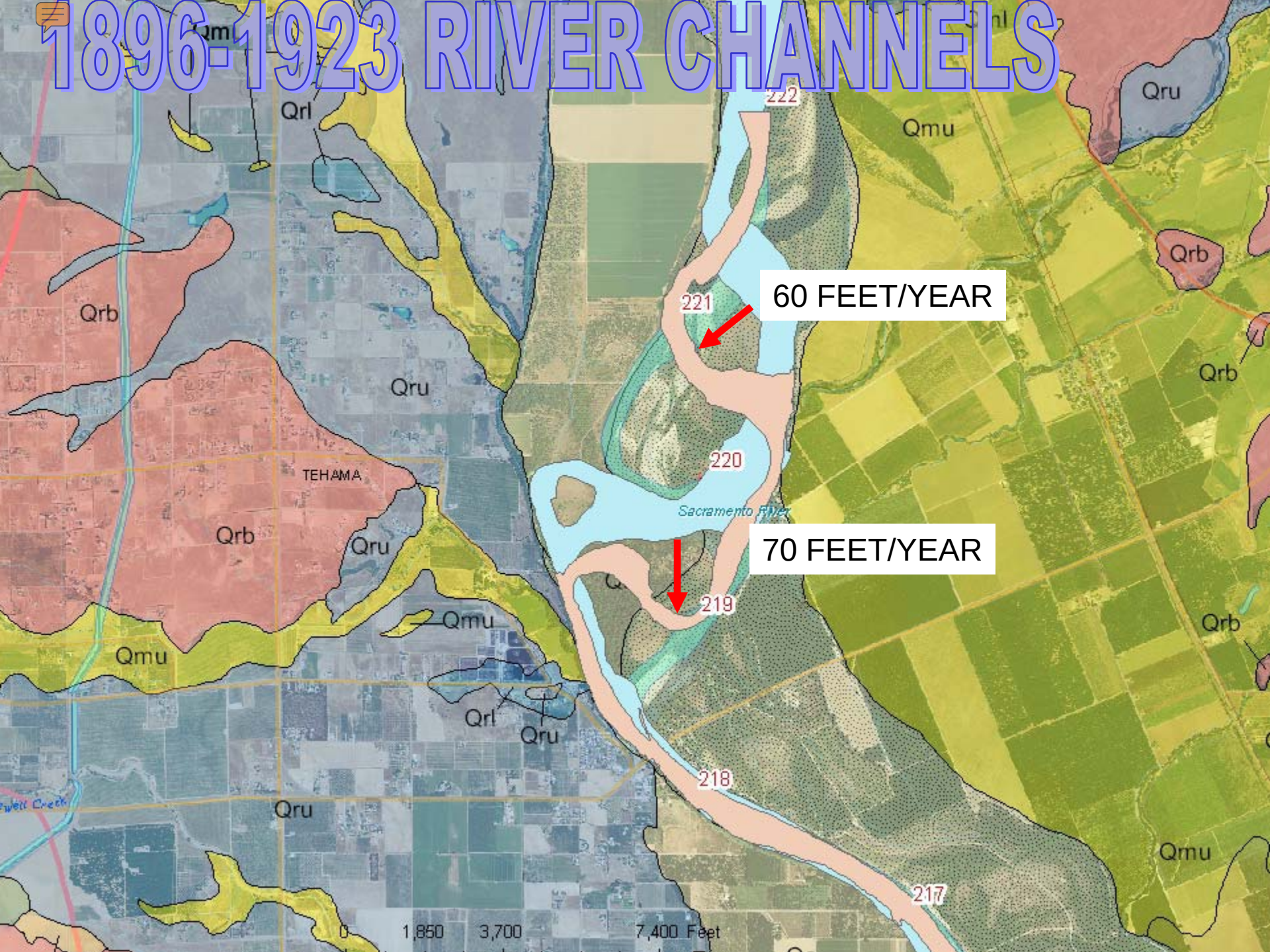
MOISTURE CONTENT

- MORE MOISTURE MEANS MORE WEIGHT
- WATER LUBRICATES
- WATER REDUCES SURFACE TENSION BETWEEN CLAY PARTICLES
- RISING LIMB VS. FALLING LIMB OF STORM
- FALL EROSION VS. SPRING EROSION

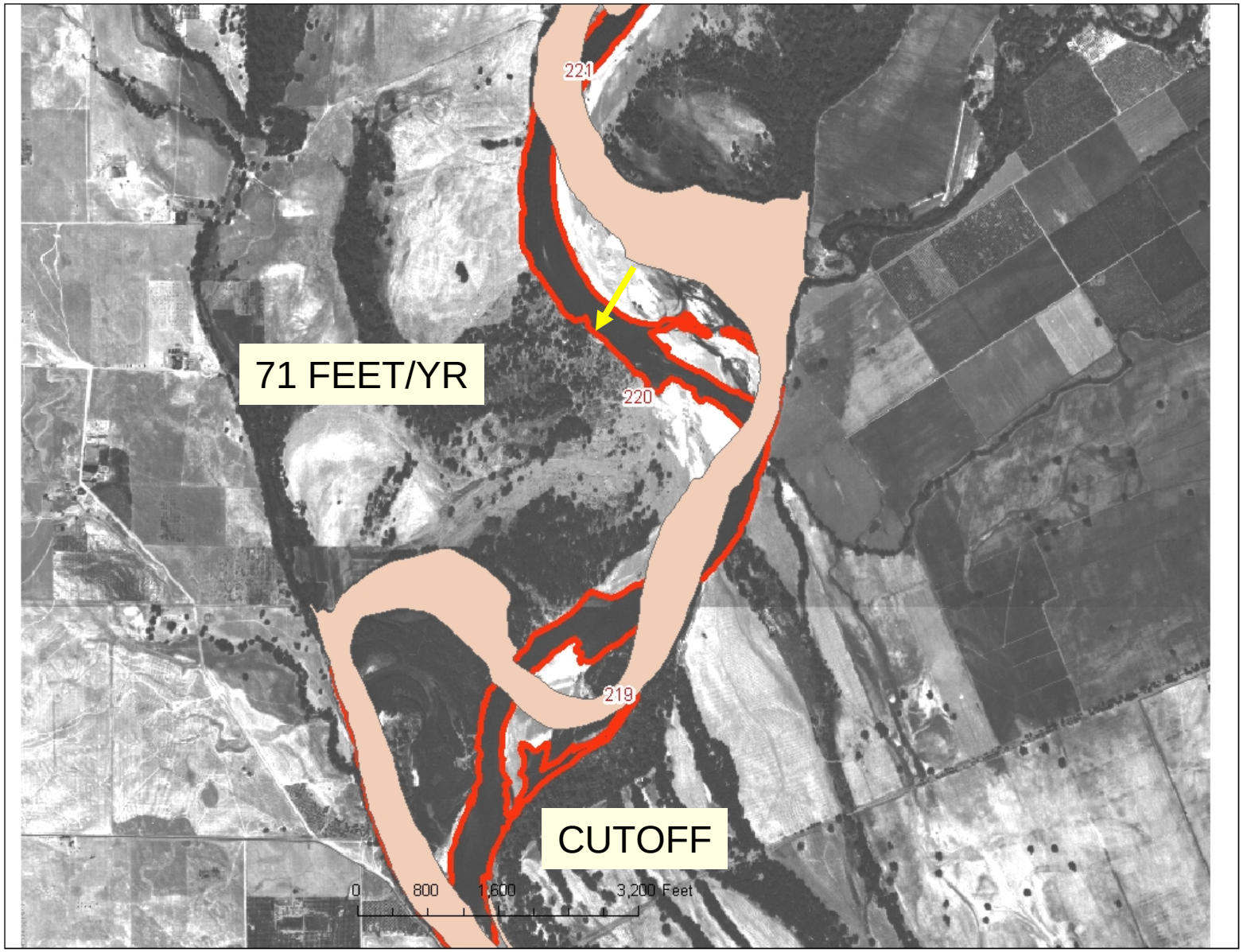
CHANNEL MIGRATION OR MEANDERING

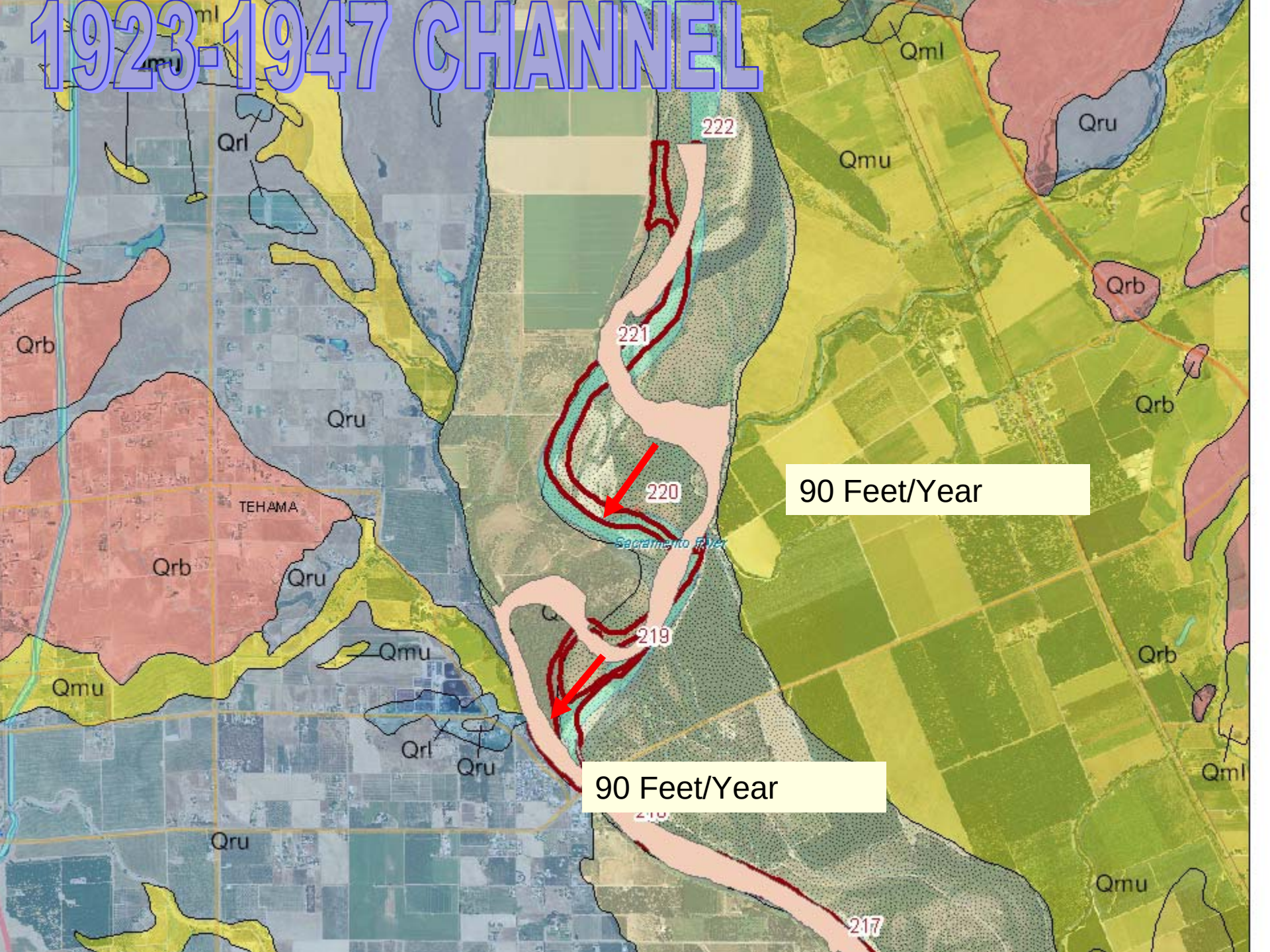
- BANK EROSION RATES
- OCCURRENCE OF MAJOR FLOOD EVENTS
- BEND SHAPE
- BANK COMPOSITION
- VEGETATION?
- BEND CUTOFFS

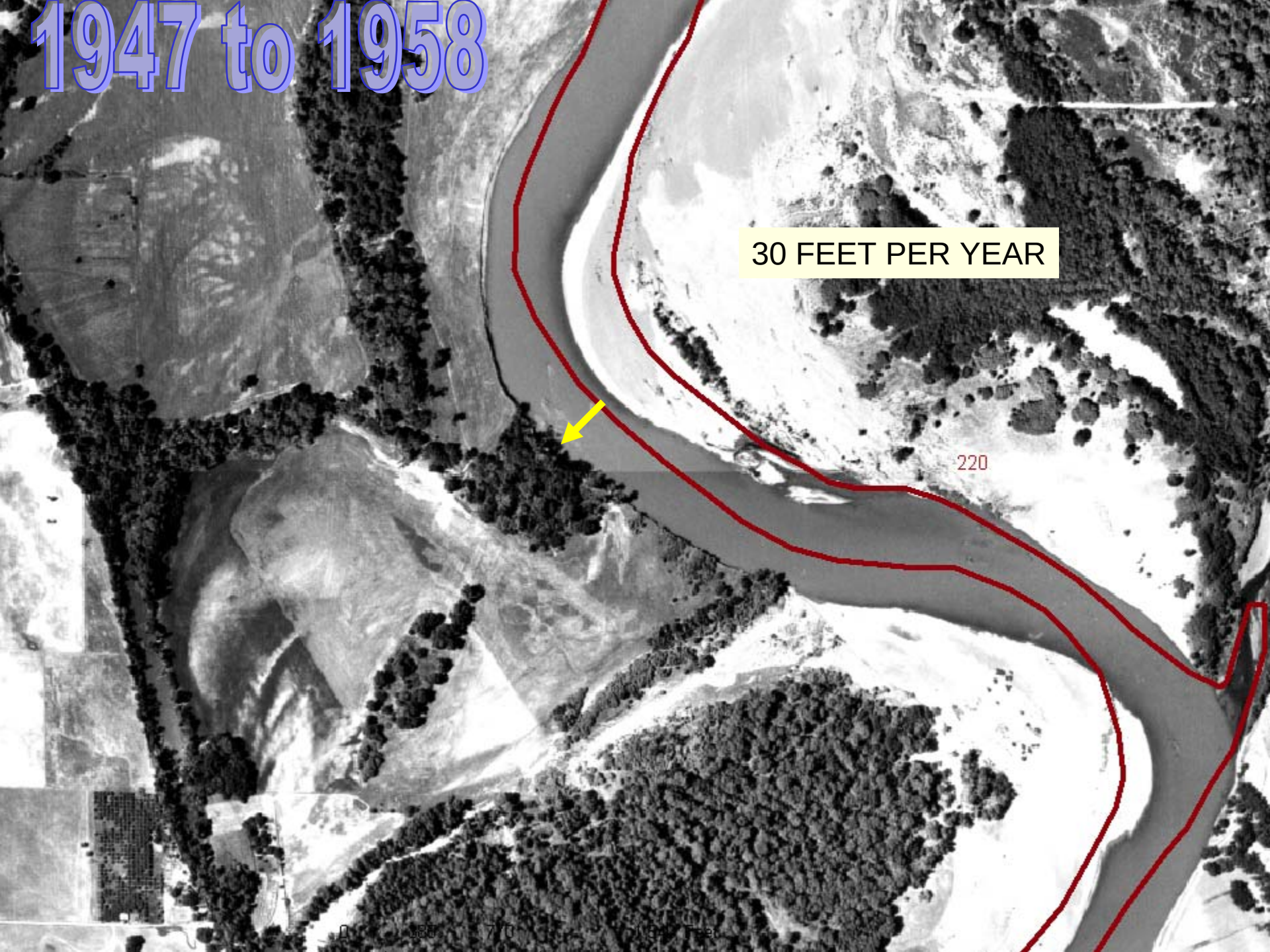

MEANDER BELT
AND
GEOLOGIC CONTROL
Qml
Qru
Qmu
Qrl
222
Qrb
221
Qru
Qrb
TEHAMA
220
Sacramento River
Qrb
Qru
Qa
219
Qmu
Qrb
Qmu
Qrl
Qru
218
Qru
Qmu
217
0
1,850
3,700
7,400 Feet


1896-1923 RIVER CHANNELS
60 FEET/YEAR
70 FEET/YEAR
222
221
220
219
218
217
Qrl
Qru
Qmu
Qrb
TEHAMA
Sacramento River
0
1,850
3,700
7,400 Feet

1923 to 1938 CHANNEL CHANGE




1923-1947 CHANNEL
Qml
Qru
Qrl
Qmu
Qrb
222
221
220
219
217
TEHAMA
Sacramento River
90 Feet/Year
90 Feet/Year

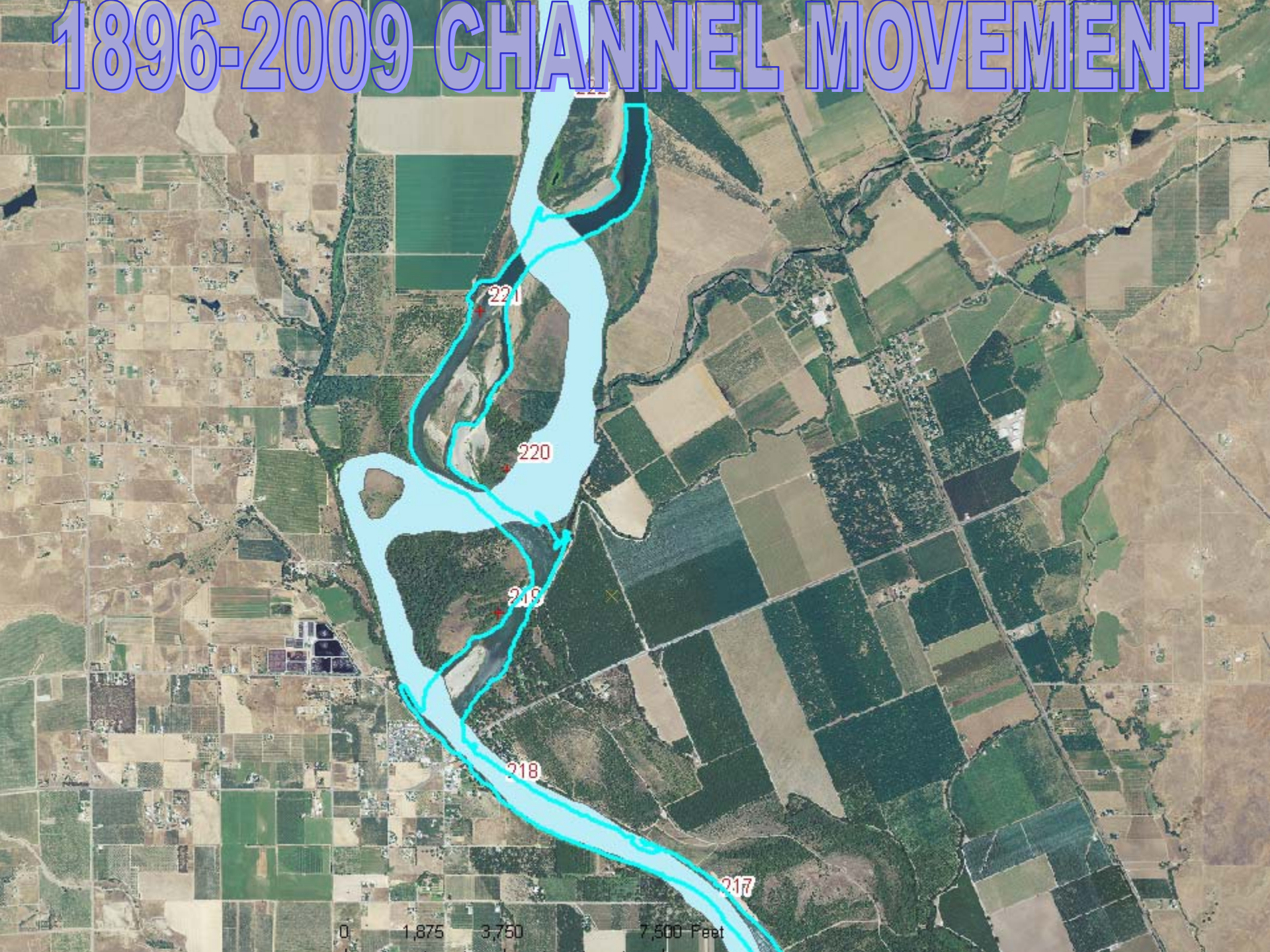

1947 to 1958
30 FEET PER YEAR
220


BANK PROTECTION
221
1963
220
219
218
217
0
1,875
3,750
7,500 Feet

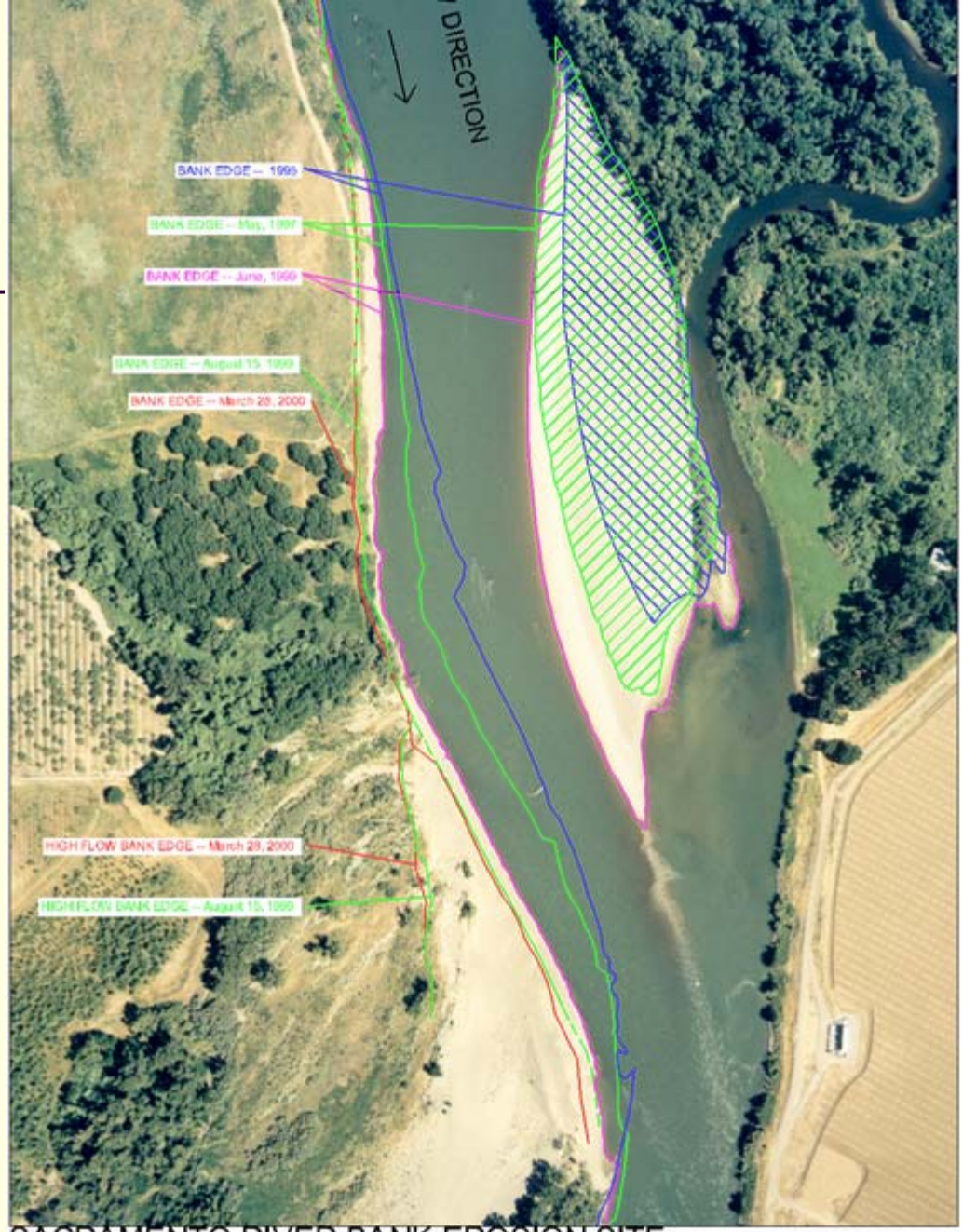
1981 TO1997 CHANNEL

1997 TO 2009 CHANNEL

1896-2009 CHANNEL MOVEMENT



PARALLEL MOVEMENT OF EROSION AND DEPOSITION



SACRAMENTO RIVER BANK EROSION SITE
M & T RANCH
June 14, 1999 Aerial Photo

BEND EVOLUTION

- ASYMMETRIC, MOVE FASTER IN A DOWNSTREAM DIRECTION
- AFFECTED BY GEOLOGIC CONTROL AND BANK PROTECTION

CUTOFFS

BEND CUTOFFS

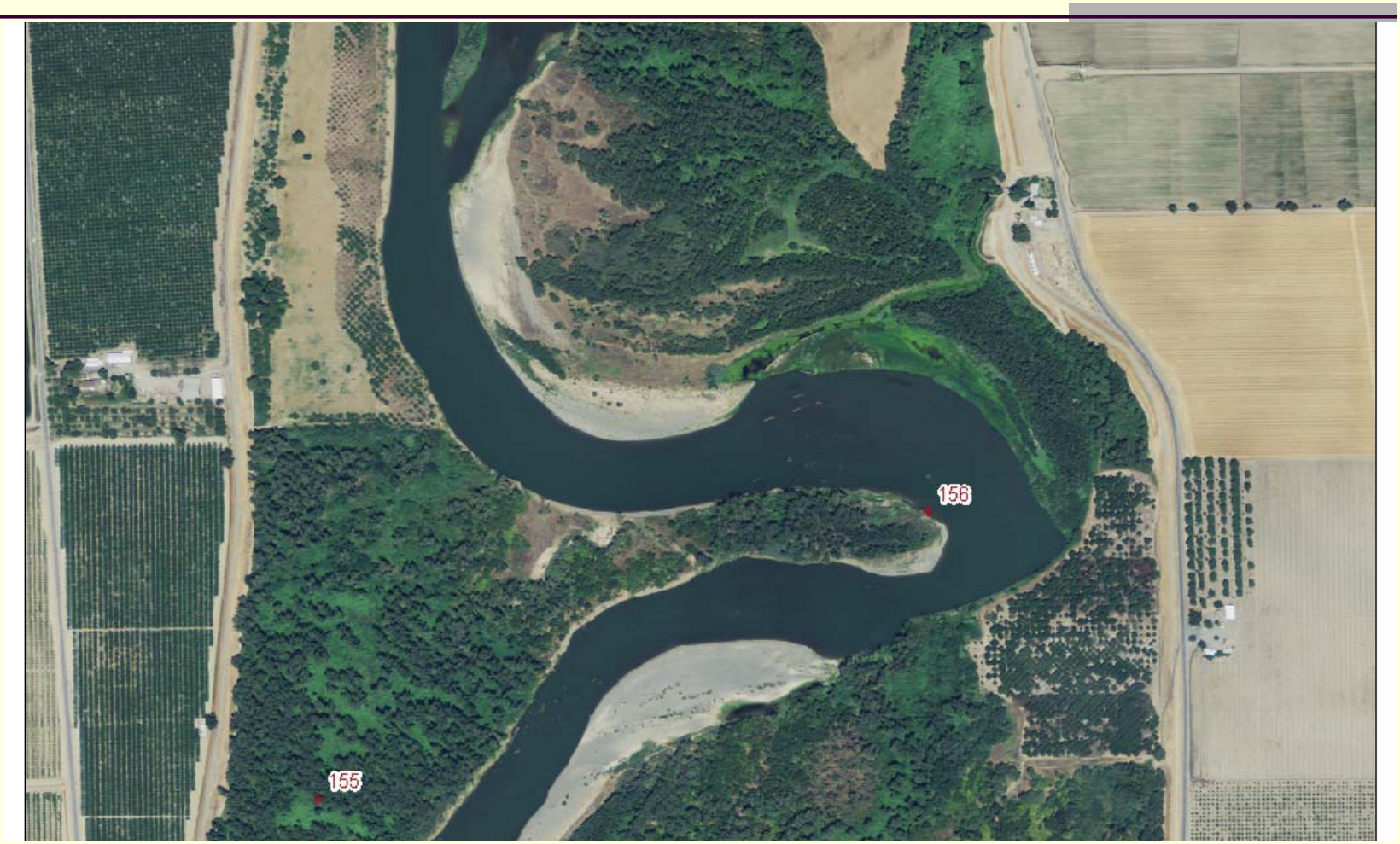
- WHEN UPSTREAM BEND CATCHES UP WITH DOWNSTREAM BEND
- GENERALLY OCCURS DURING MAJOR FLOODS
- GENERALLY, THE SMALLER THE HYDRAULIC RADIUS THE MORE LIKELY THE CUTOFF

HUMAN-INDUCED CUTOFFS

- BANK PROTECTION
- VEGETATION REMOVAL
- DRAINAGE


INCIPIENT CUTOFF???

JACINTO BEND



PROPOSED PROJECT

- BANK PROTECTION REMOVAL
- PILOT CHANNEL
- BANK PROTECTION PLACEMENT

BANK PROTECTION REMOVAL

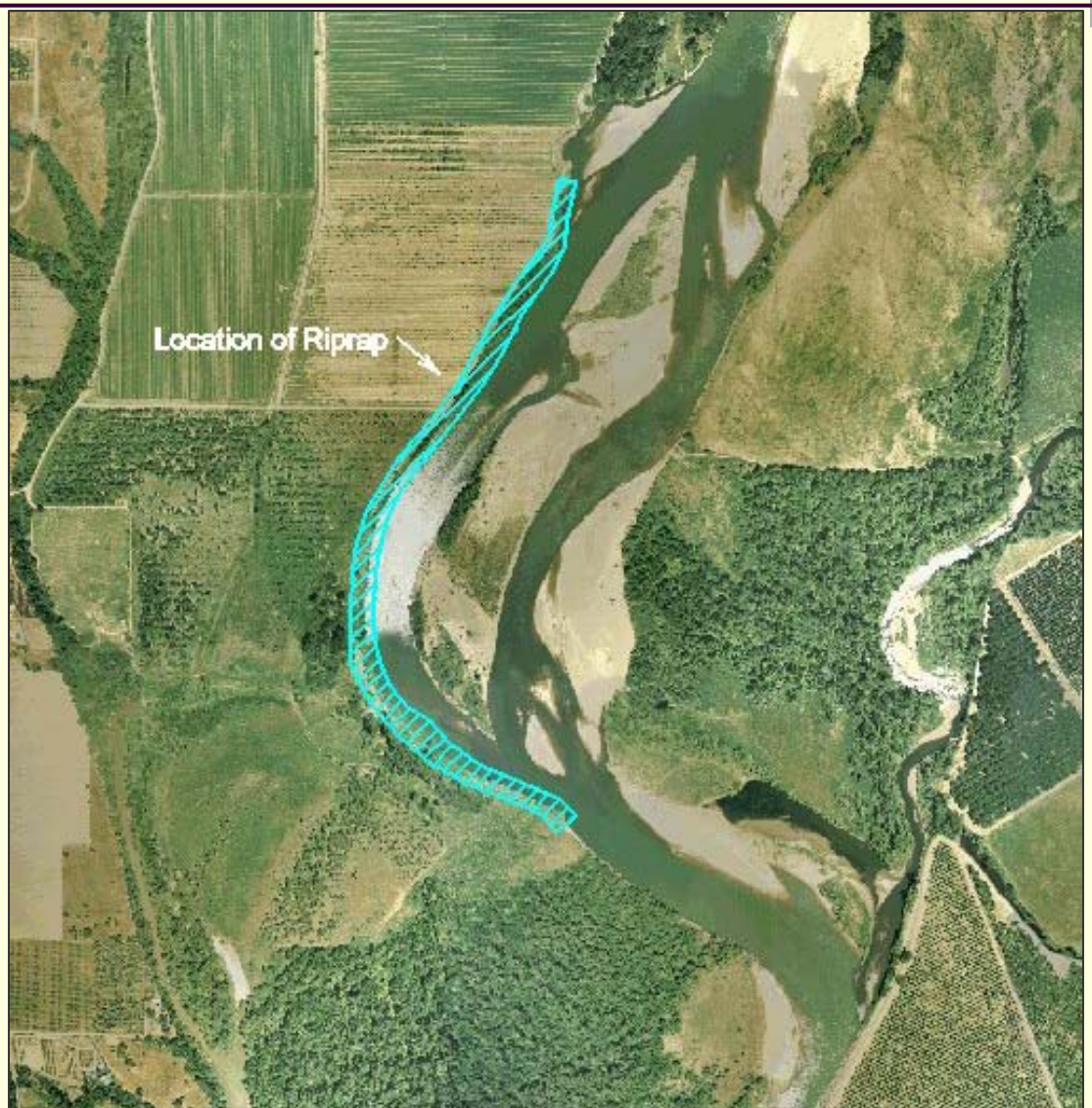
- BACK TO NATURE
- NATURE’S RESPONSIBILITY
- LIMITED LIABILITY
- NATURE KNOWS BEST
- NEW HABITAT

BANK PROTECTION REMOVAL

LOSS OF SRA

- BREAK AN EGG……..
- WOULD NOT BE THERE IF NO RIPRAP
- WOULD BE LOST ANYWAY
- THE SRA IS NOT NATURAL……
- CUTBANKS AND BANK SWALLOWS
- KEY IS TO RESTORE NATURAL FUNCTION

FULL-LENGTH ROCK REMOVAL OPTION

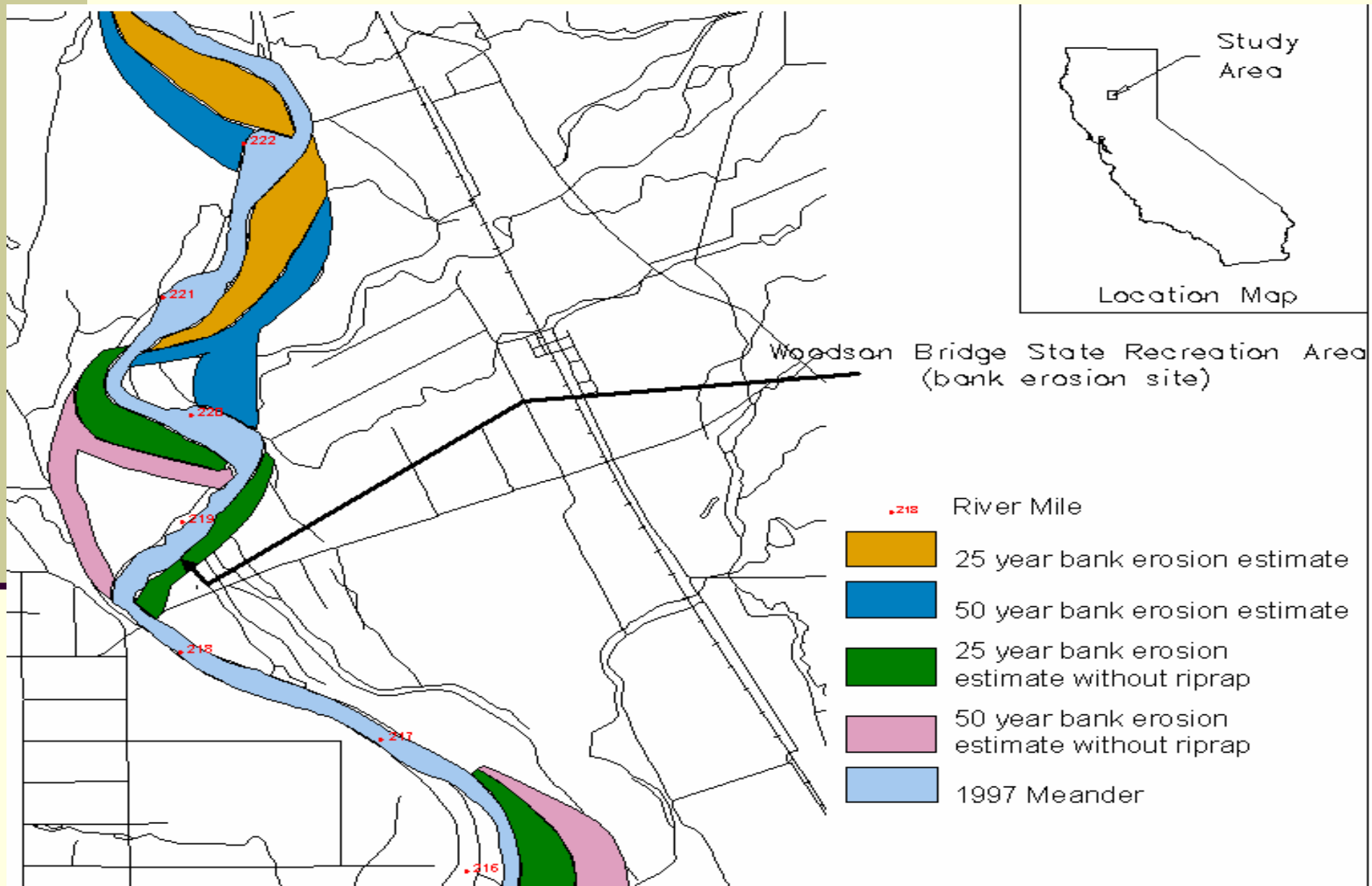


REMOVE

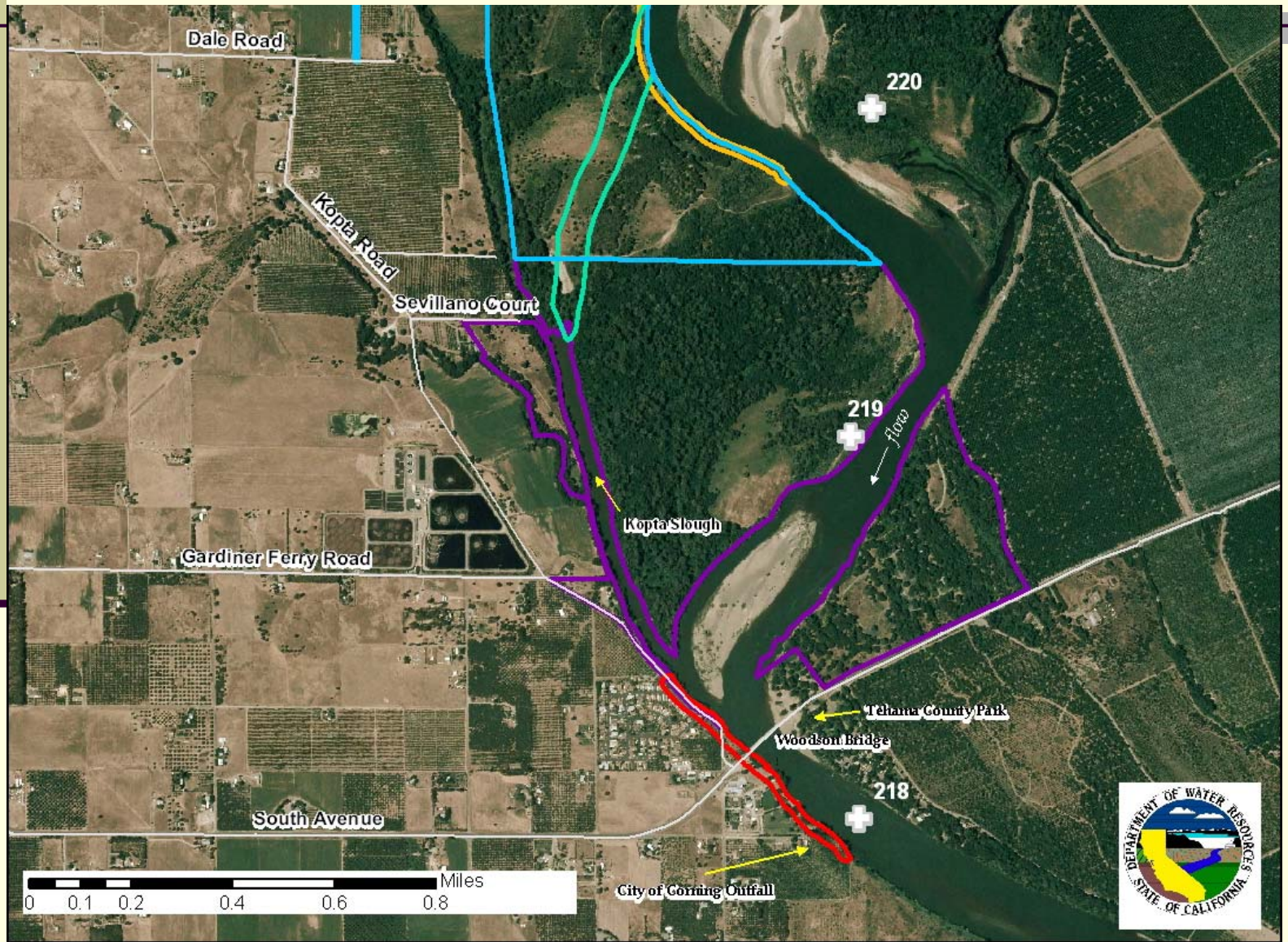
RE-USE

RELEASE

Future Erosion



WOODSON BRIDGE SRA
Cutoff Construction



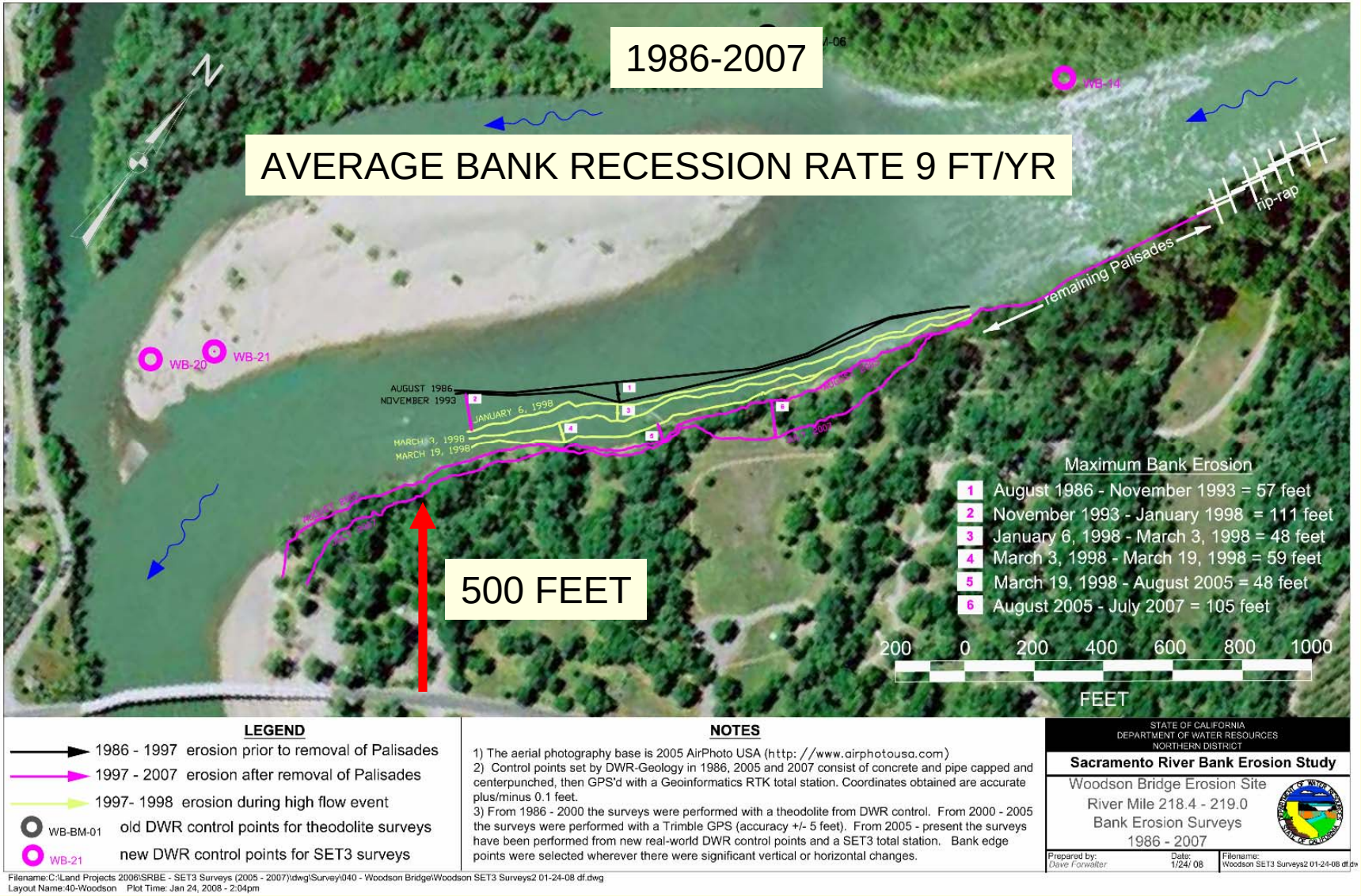
PILOT CHANNEL DISADVANTAGES

- COMPROMISE HABITAT CREATION ON OPPOSITE BANK
- BANK SWALLOWS AND NATURAL CUTBANKS
- LIABILITY
- EXPENSIVE
- COMPLICATES ENVIRONMENTAL CLEARANCE

NO TO THE PILOT CHANNEL- Let nature take over

PROTECTING THE PARK AND BRIDGE

BANK EROSION @ WB SRA



BANK PROTECTION PLACEMENT

BANK PROTECTION

- RIPRAPPING GEOLOGIC CONTROL DOES MINIMAL GEOMORPHIC HARM
- PROTECT INFRASTRUCTURE

BENDWAY WEIR OPTION

CONCLUSION

- REMOVE RIPRAP AND PLACE ON GEOLOGIC CONTROL
- PROTECT BRIDGE ABUTMENTS AND INFRASTRUCTURE AS NECESSARY
- RETURN TO “NATURAL” MEANDERING
- NO PILOT CHANNEL
- LIMIT LIABILITY
- RETURN TO RIPARIAN SUCCESSION


Riparian Succession


Hi!
THE END
“AND SEE YA LATER”