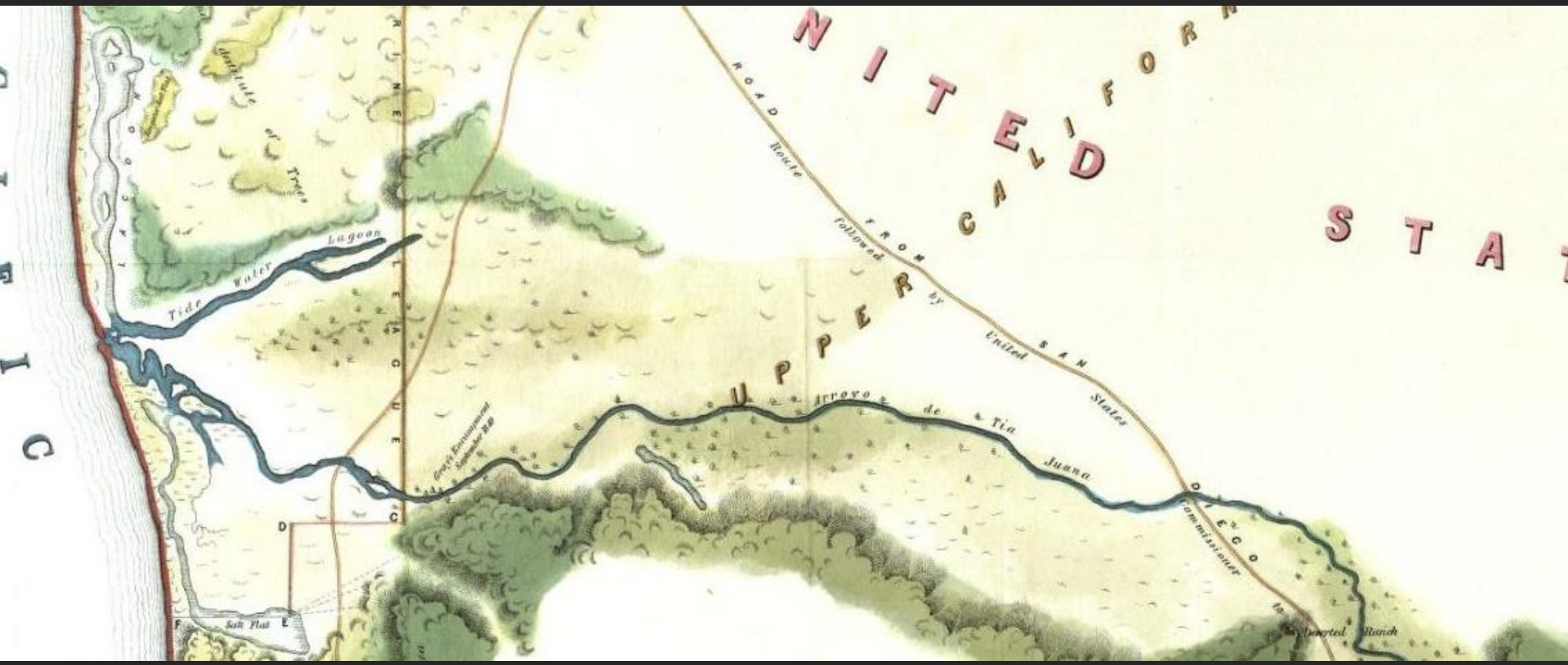
The Historical Ecology of the Tijuana Estuary & River Valley

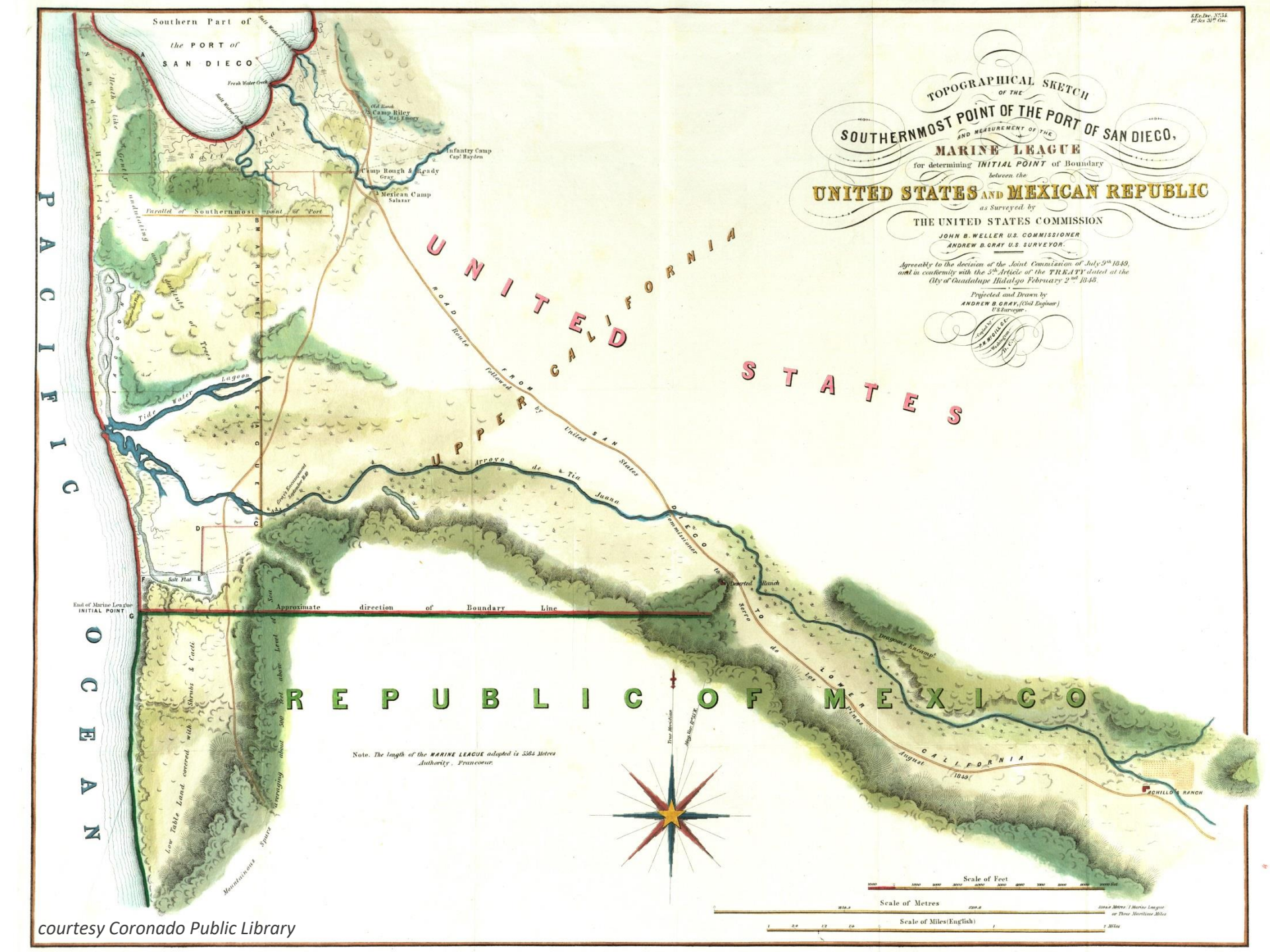


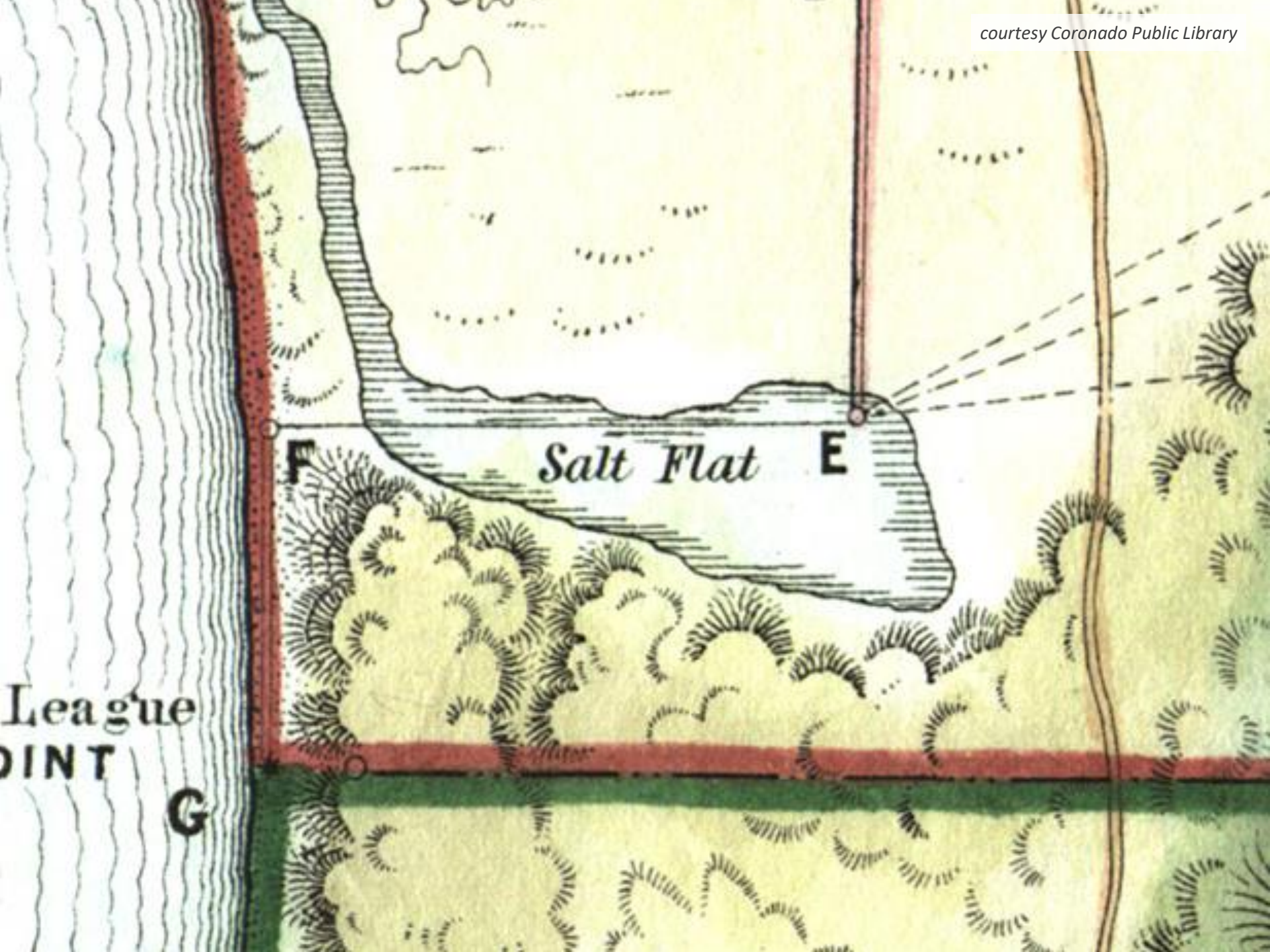
Sam Safran
San Francisco Estuary Institute

Long Beach, CA • December 12, 2018
Restore America's Estuaries

Co-authors:
Sean Baumgarten, Erin Beller, Danielle Bram, Jeff Crooks, Shawna Dark, Robin Grossinger, Travis Longcore, Julio Lorda, Eric Stein

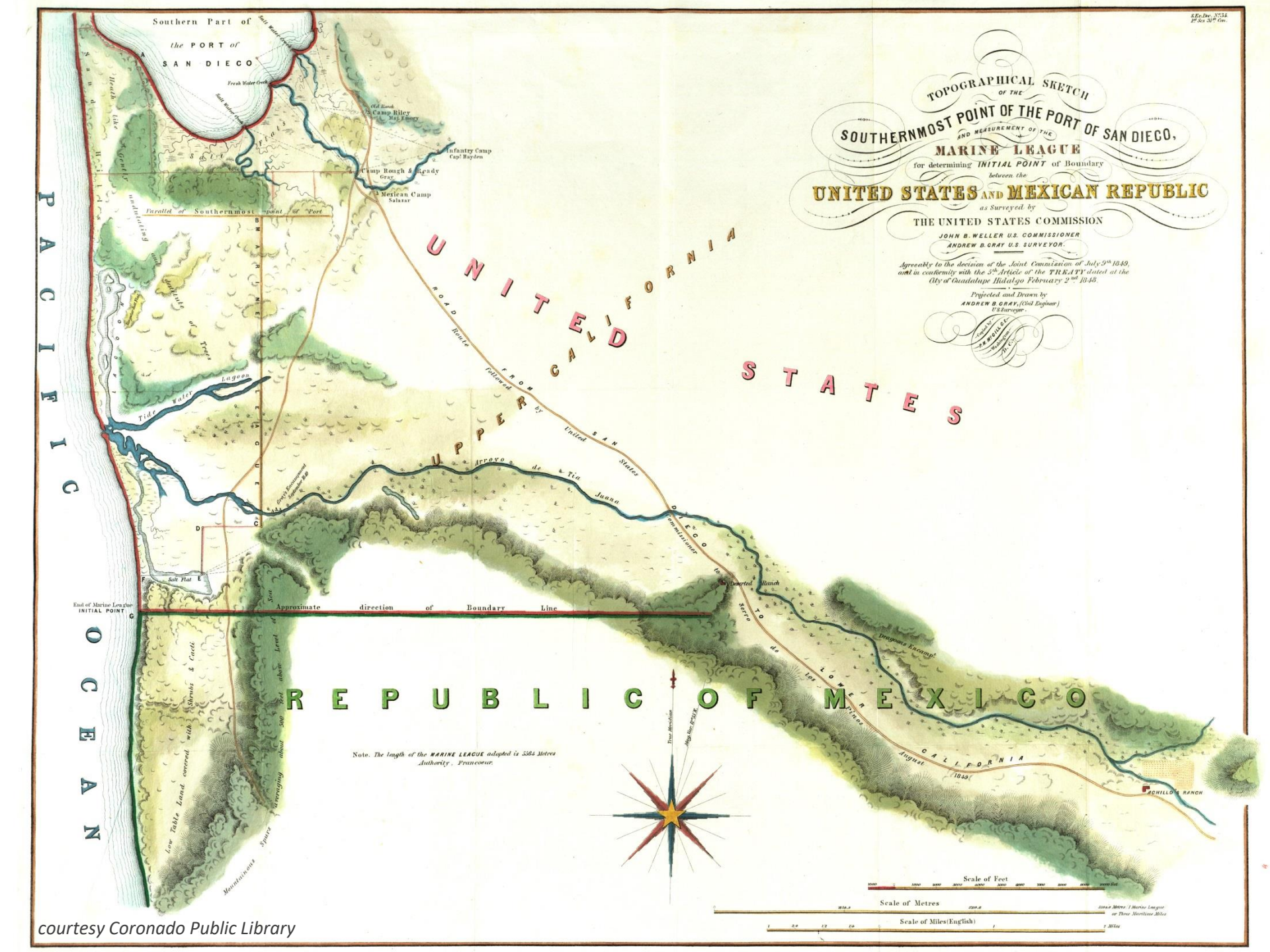
Funded by:
The California State Coastal Conservancy




courtesy Coronado Public Library
F
Salt Flat
E
League
DINT
G

courtesy Coronado Public Library


courtesy Coronado Public Library
Dragoons Encamp.t
LOWER
MEXI
Pinos
August
CALIFORN



Remarking the boundary, ca. 1894

IBC 1898, courtesy University of North Texas

Mendenhall 1905, courtesy USGS

Botanizing on Mesa, 1905

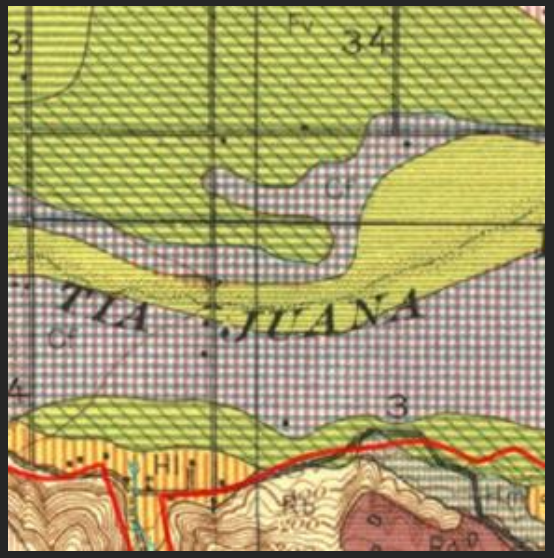
Travelling to Mexico, ca. 1890

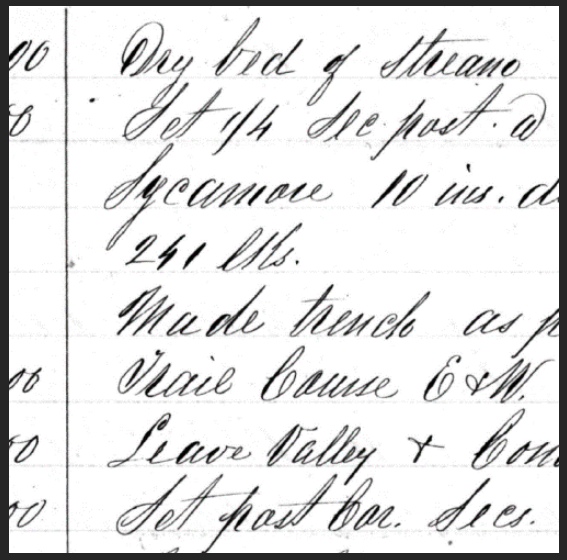
San Diego History Center


848 From Mexico to America

Trestle
ich 6 piles
CALIFORNIA ACADEMY OF SCIENCES
№ 572794
Linn
If last finder will receive
five Dollars Reward.
11 Rosewood Road
Berkeley,
1928
178-32

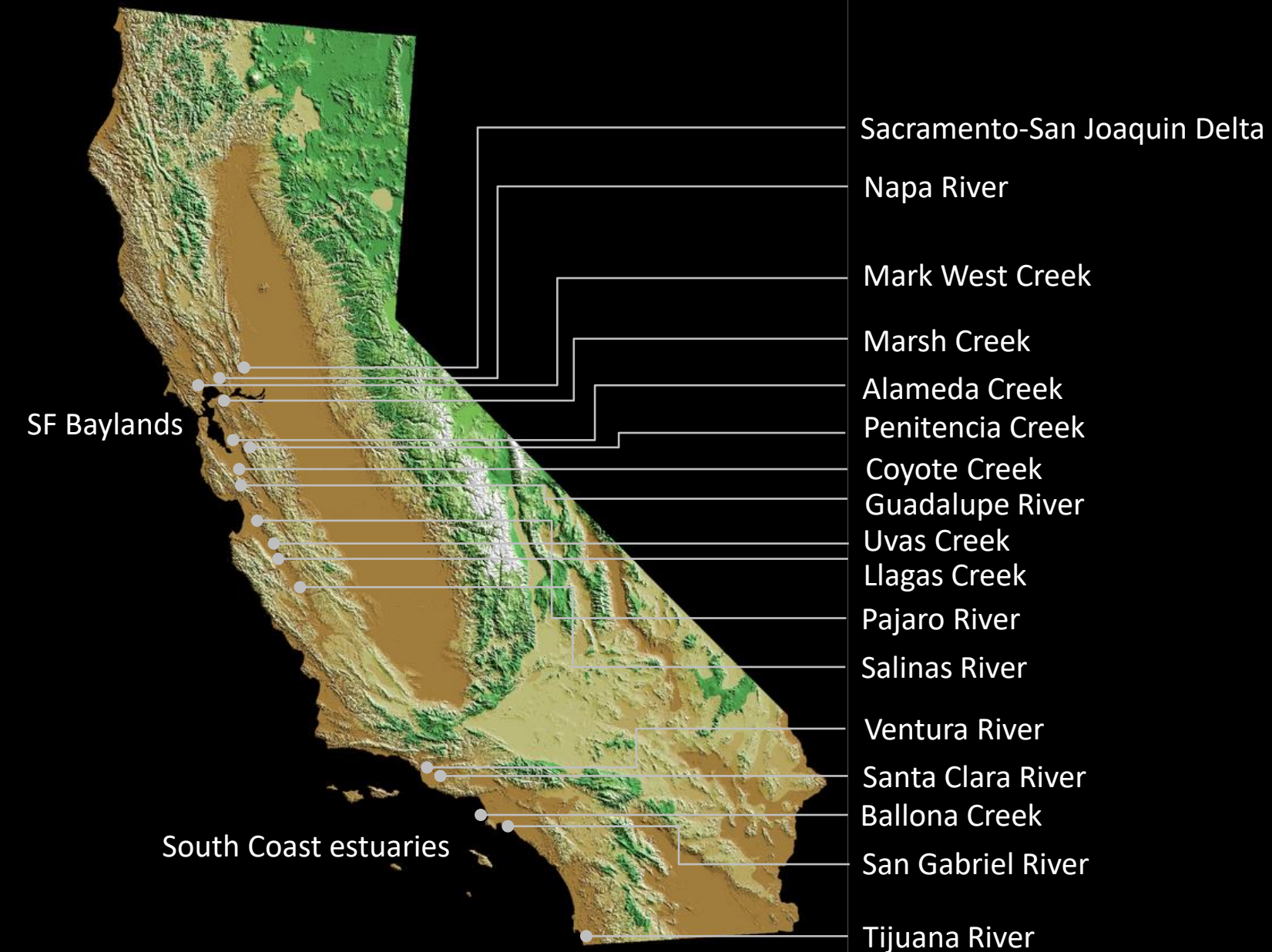
Using the past to understand the present landscape and envision its future potential





- Not about recreating the past!
- Understand ecological and physical patterns/process that shaped the landscape
- Not just the "way things were," but the "way things work"

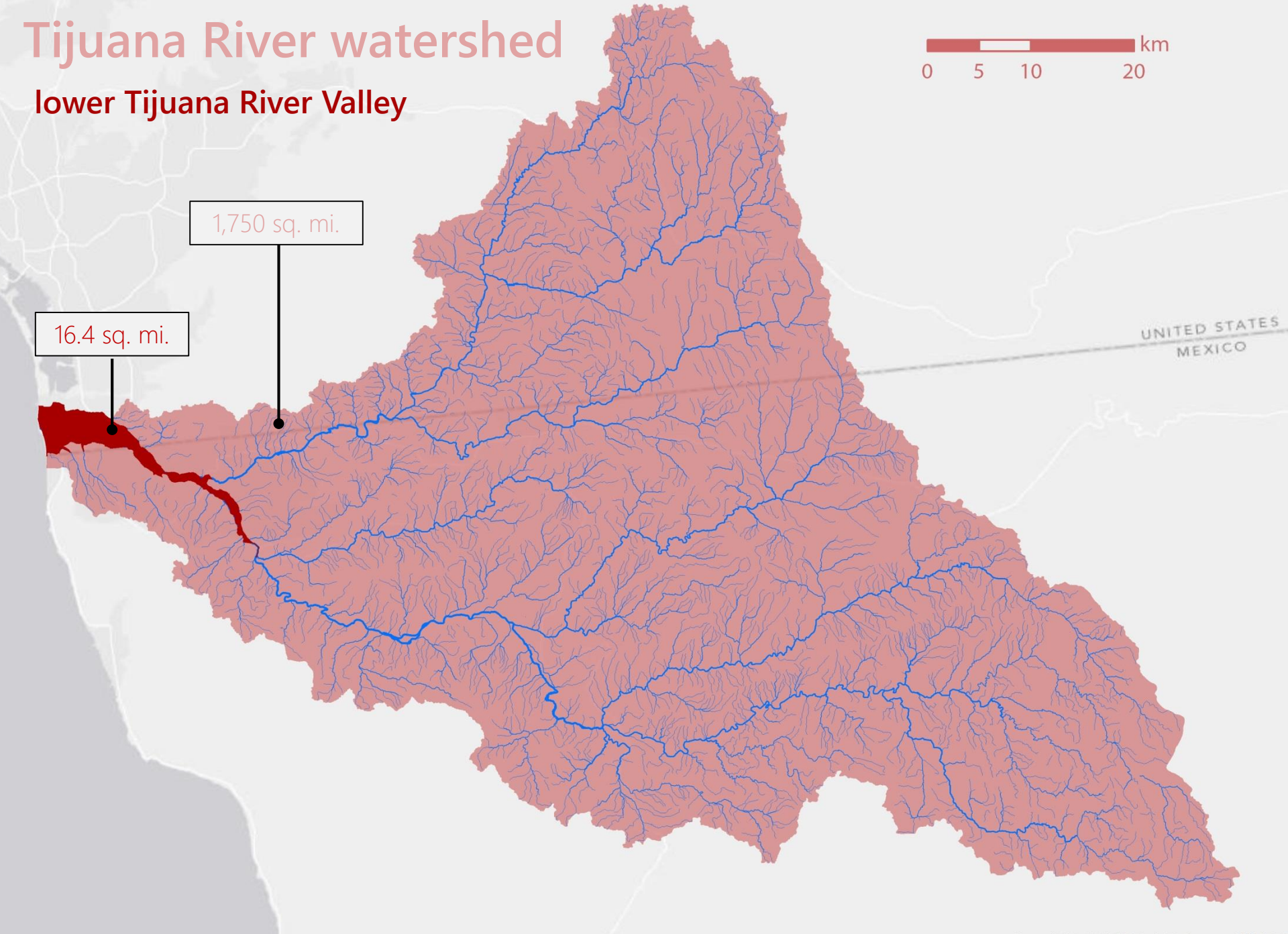
Streams and estuaries reconstructed



Streams and estuaries reconstructed

Tijuana River watershed

lower Tijuana River Valley



Methods

Collect archival data

Methods

Collect archival data

Extract relevant information

Methods

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Extract relevant information

Overlay, synthesize

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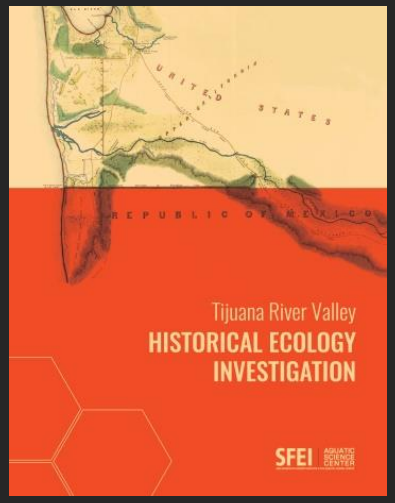
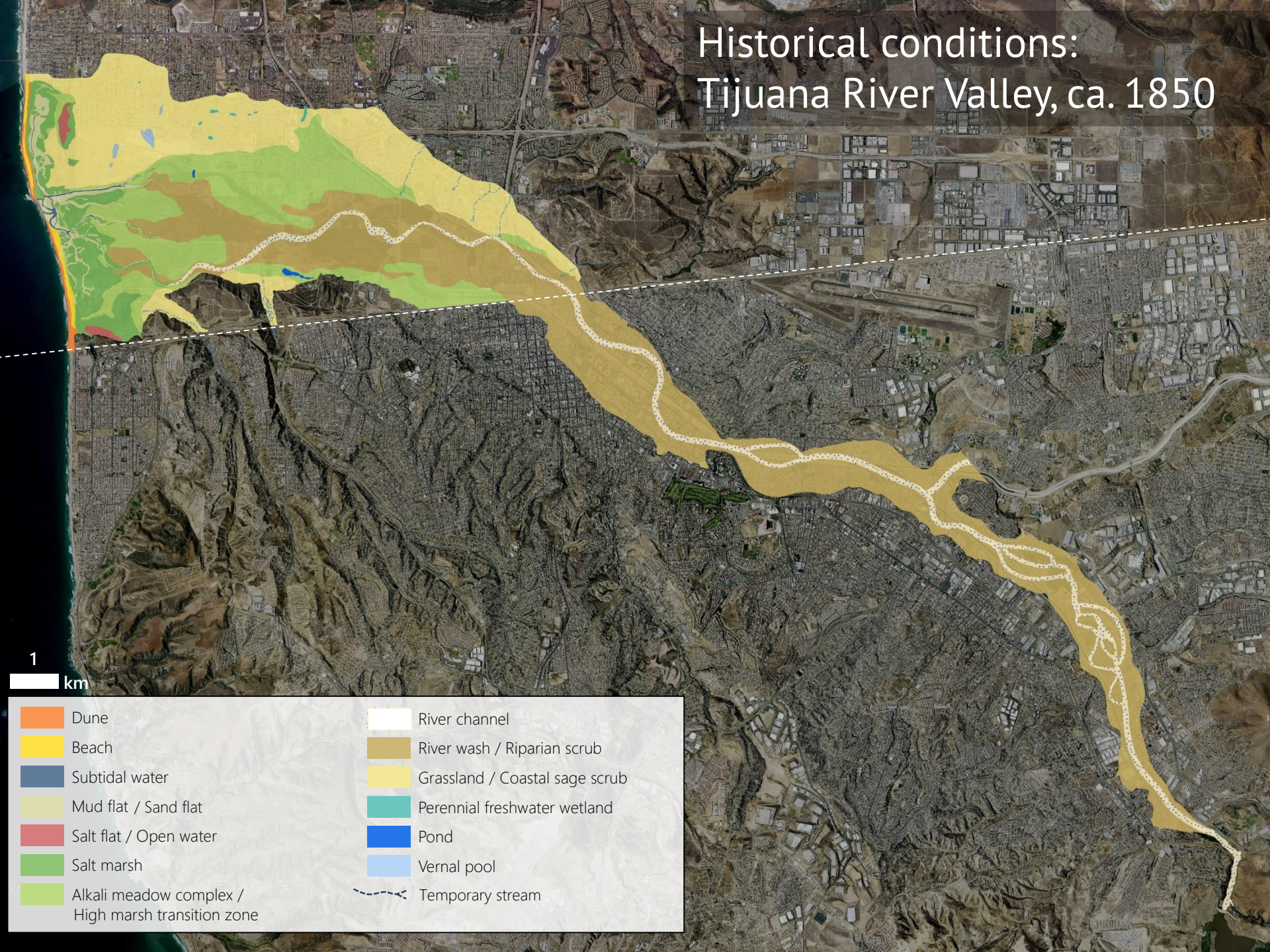
Extract relevant information

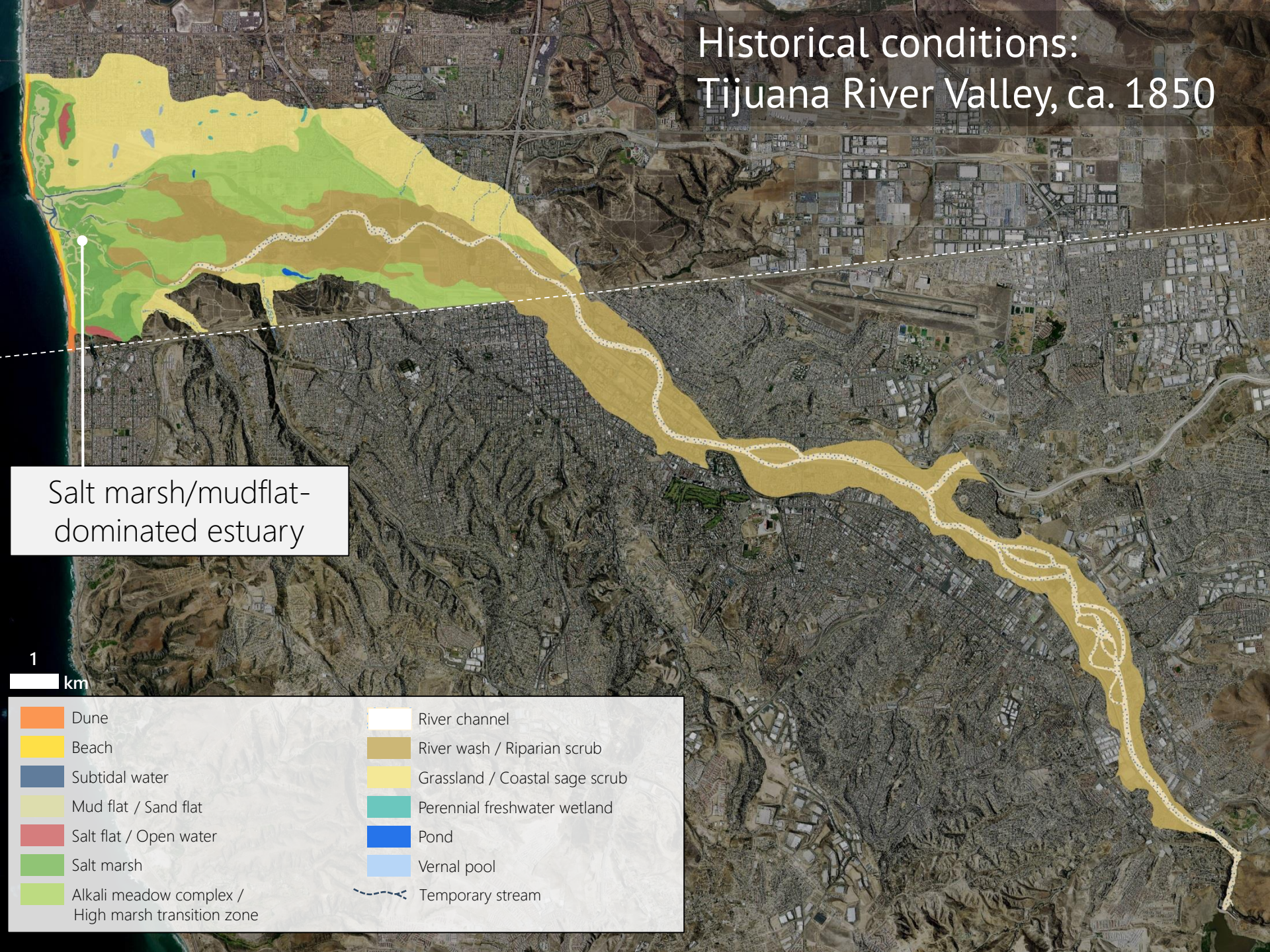
Overlay, synthesize

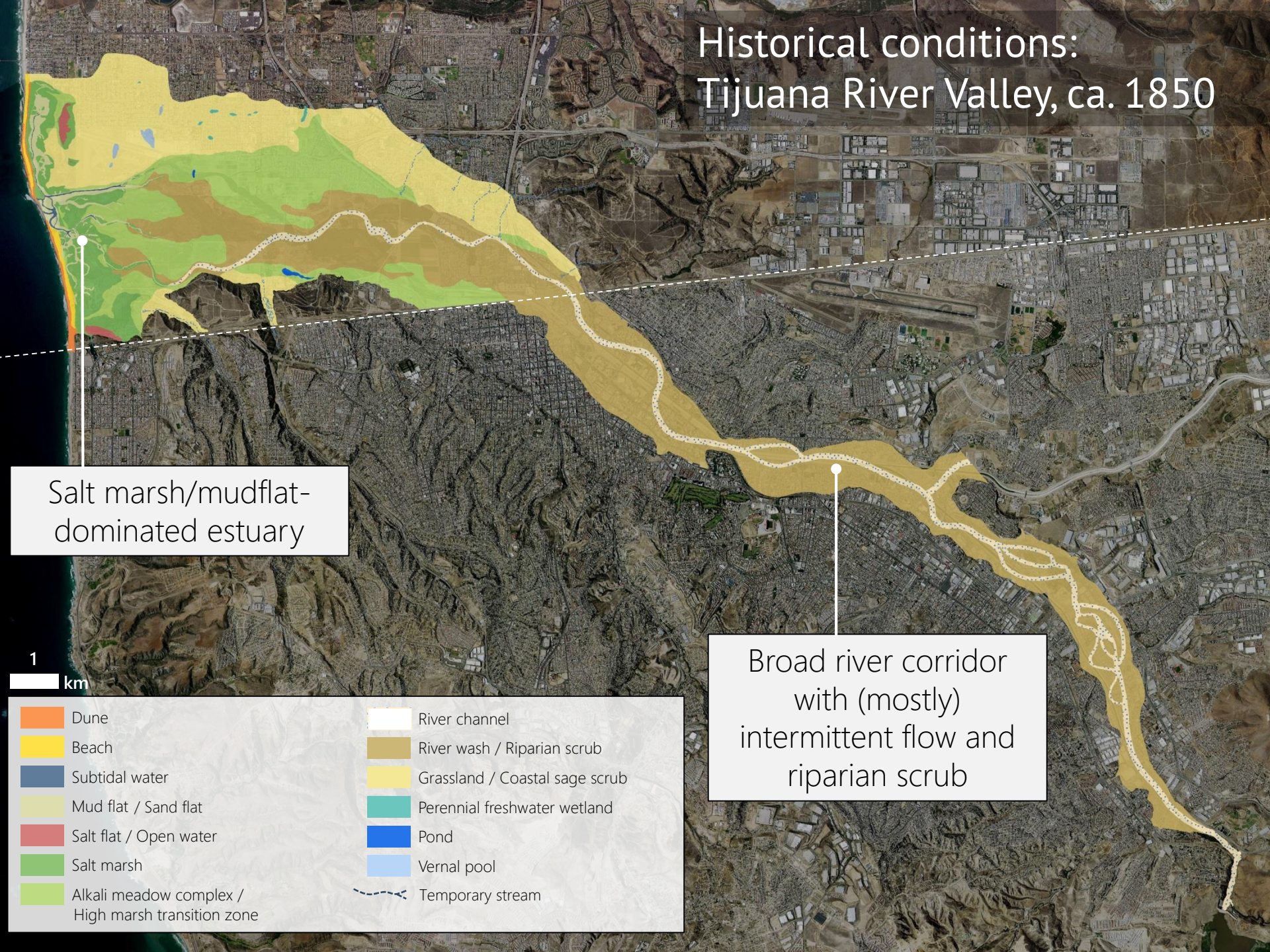


Create map
(and other products)

Historical conditions: Tijuana River Valley, ca. 1850




Historical conditions:
Tijuana River Valley, ca. 1850
Salt marsh/mudflat-dominated estuary
1
km
Dune
Beach
Subtidal water
Mud flat / Sand flat
Salt flat / Open water
Salt marsh
Alkali meadow complex / High marsh transition zone
River channel
River wash / Riparian scrub
Grassland / Coastal sage scrub
Perennial freshwater wetland
Pond
Vernal pool
Temporary stream


Historical conditions:
Tijuana River Valley, ca. 1850
Salt marsh/mudflat-dominated estuary
Broad river corridor with (mostly) intermittent flow and riparian scrub
1
km
Dune
Beach
Subtidal water
Mud flat / Sand flat
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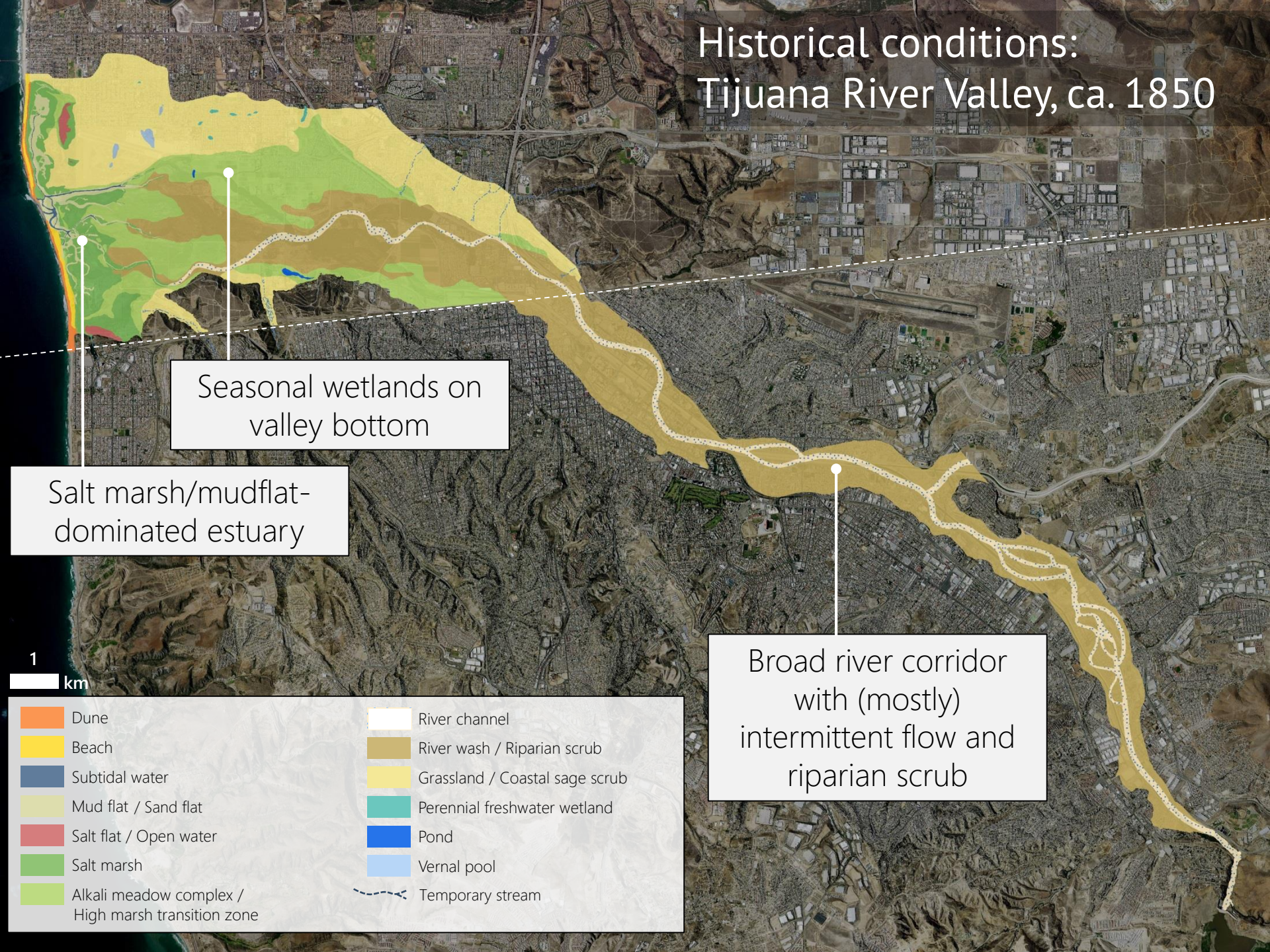
Historical conditions:
Tijuana River Valley, ca. 1850
Seasonal wetlands on valley bottom
Salt marsh/mudflat-dominated estuary
Broad river corridor with (mostly) intermittent flow and riparian scrub
1
km
Dune
Beach
Subtidal water
Mud flat / Sand flat
Salt flat / Open water
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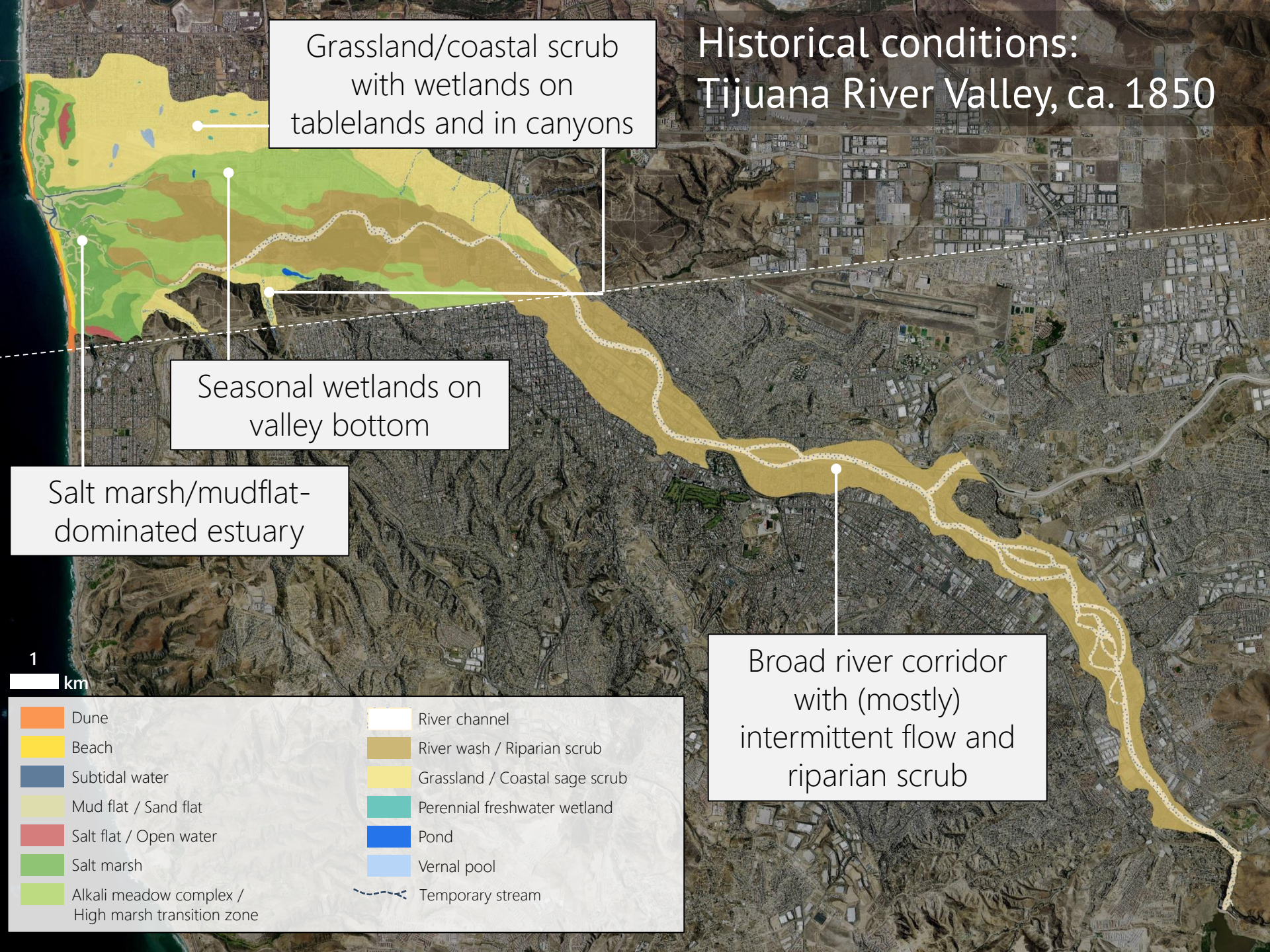
Historical conditions:
Tijuana River Valley, ca. 1850
Grassland/coastal scrub with wetlands on tablelands and in canyons
Seasonal wetlands on valley bottom
Salt marsh/mudflat-dominated estuary
Broad river corridor with (mostly) intermittent flow and riparian scrub
1
km
Dune
Beach
Subtidal water
Mud flat / Sand flat
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Key messages for today

1. The valley supported a diverse array of wetlands in a dry climate.

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Management implications of these changes

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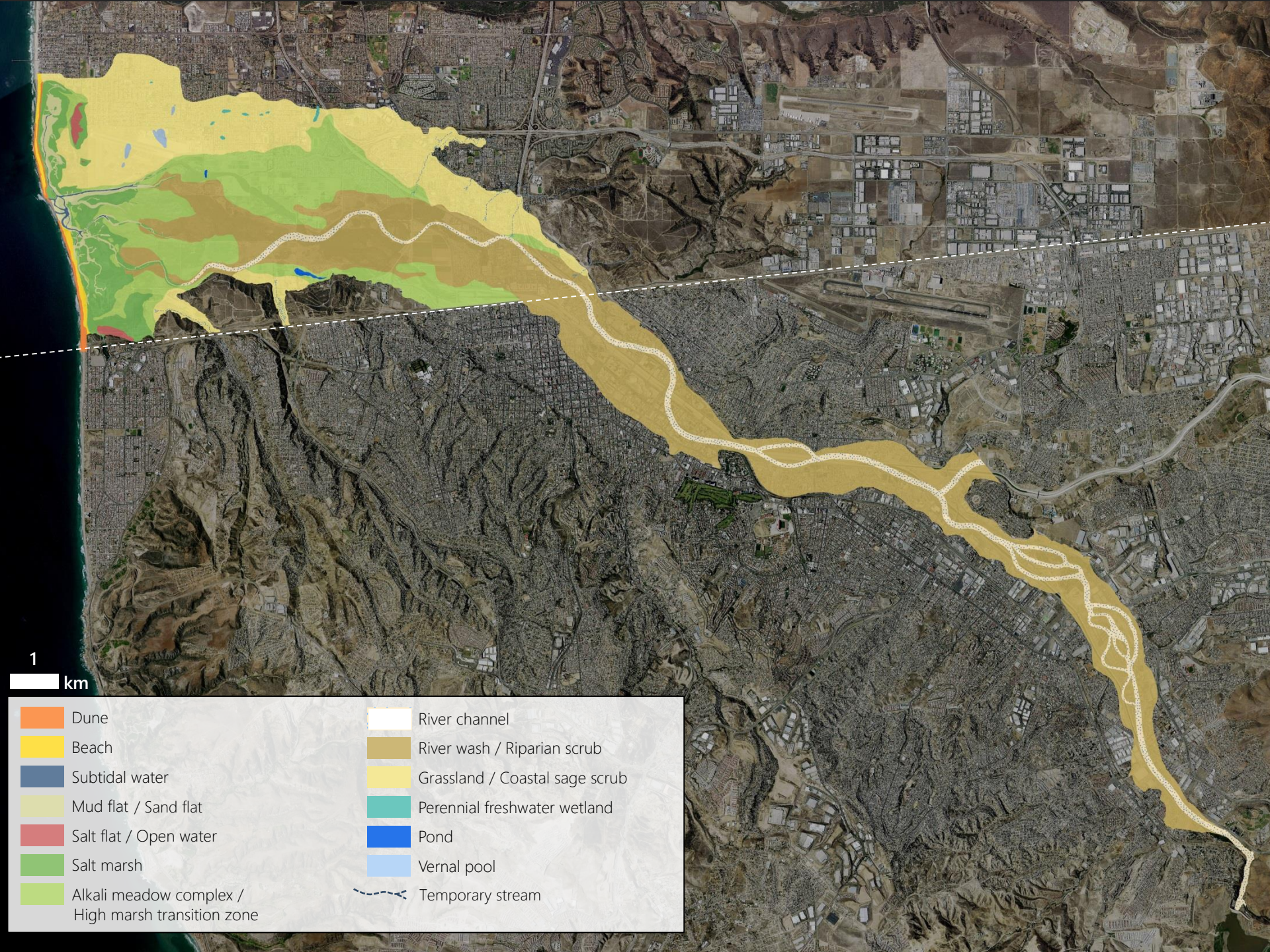
Management implications of these changes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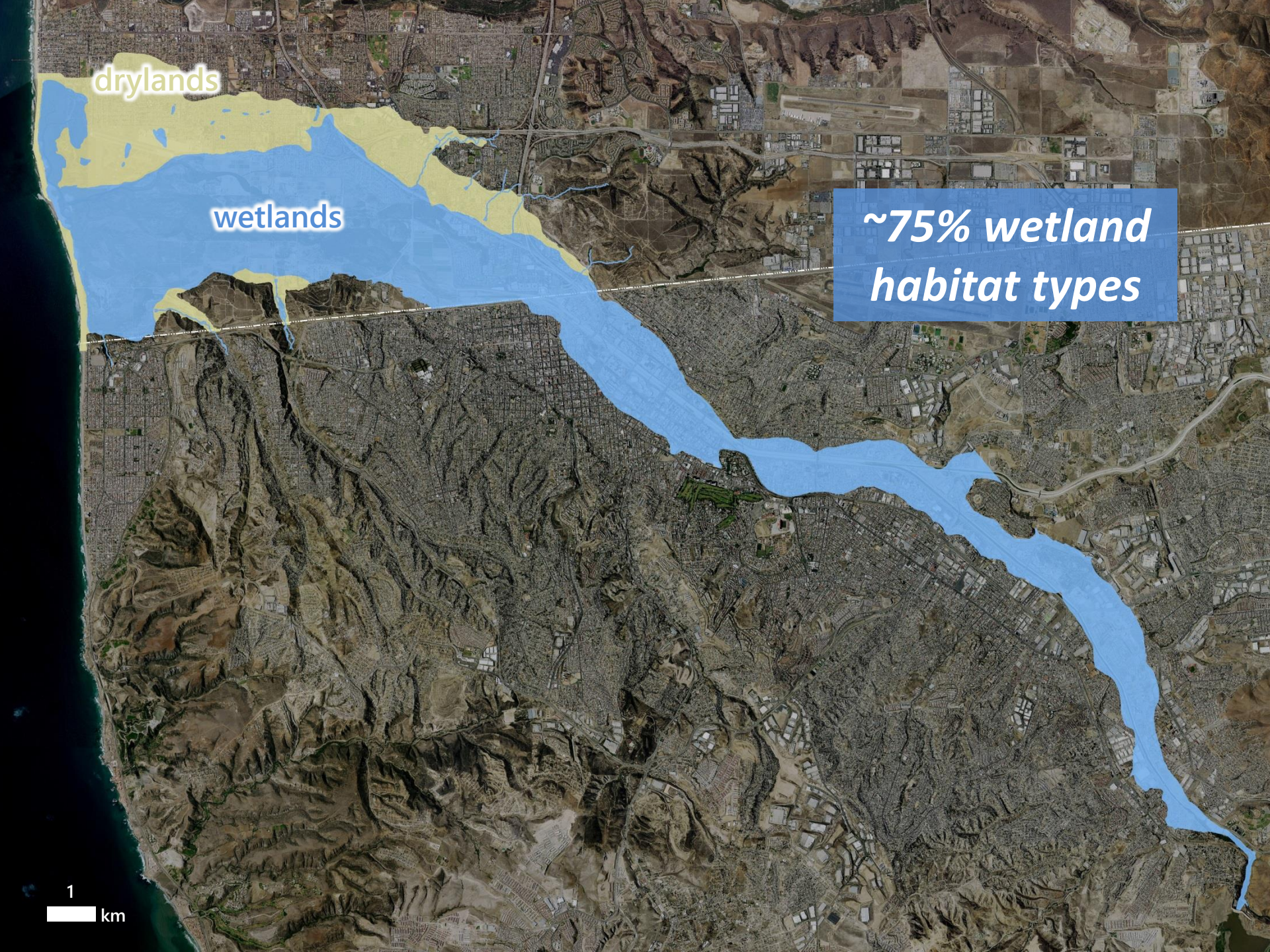
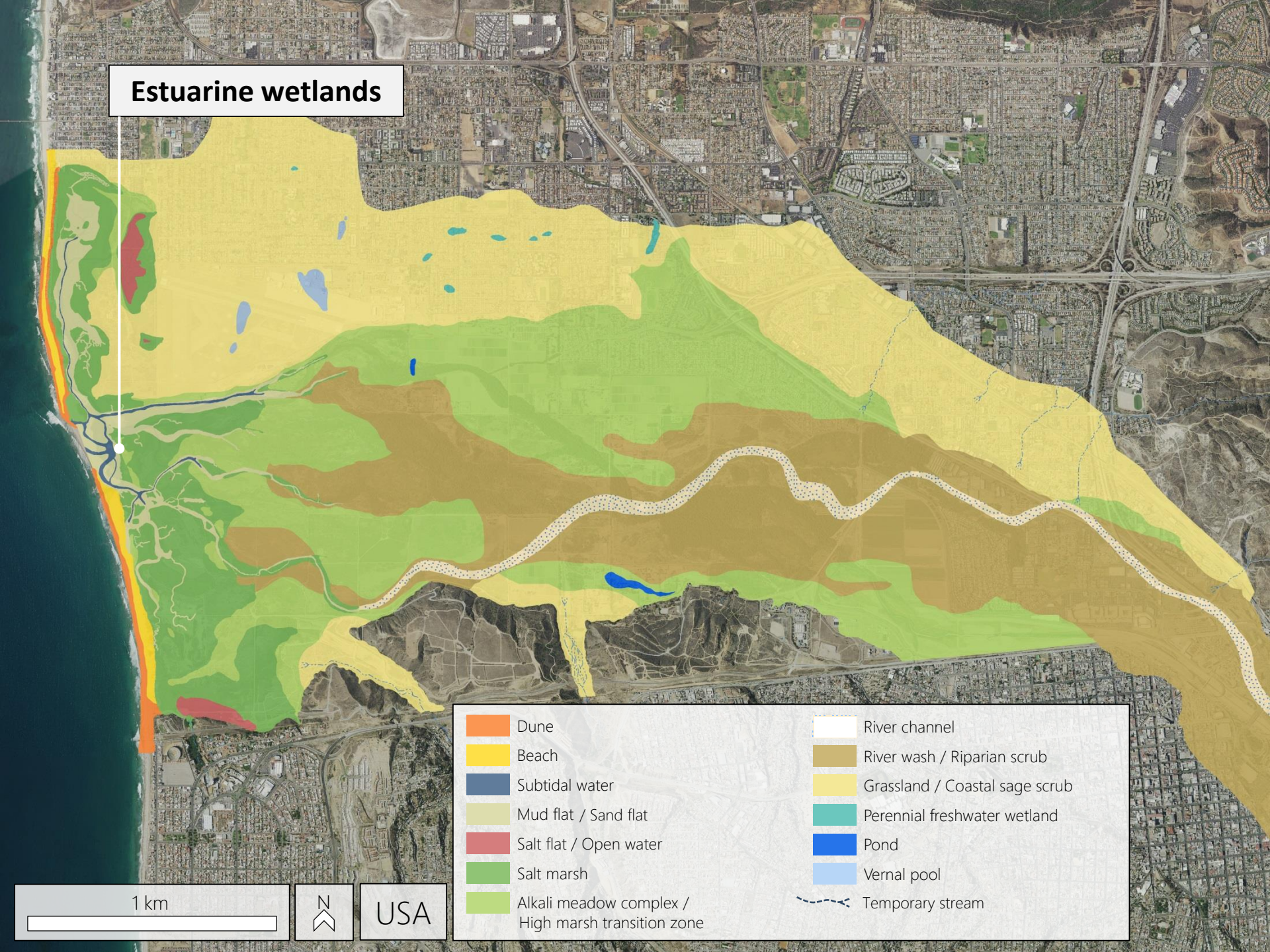

drylands
wetlands
~75% wetland habitat types
1
km


Estuarine wetlands
Dune
Beach
Subtidal water
Mud flat / Sand flat
Salt flat / Open water
Salt marsh
Alkali meadow complex /
High marsh transition zone
River channel
River wash / Riparian scrub
Grassland / Coastal sage scrub
Perennial freshwater wetland
Pond
Vernal pool
Temporary stream
1 km
N
USA

Estuarine wetlands

80 ha (200 acres) of intertidal flats

- 21 km of tidal channels
- at least double today's area

US Coast Survey 1852

Estuarine wetlands

80 ha (200 acres) of intertidal flats
- 21 km of tidal channels
- at least double today's area

250 ha (600 ac) of salt marsh
- 10% of all vegetated estuarine wetlands in SoCal
- 75% more than today

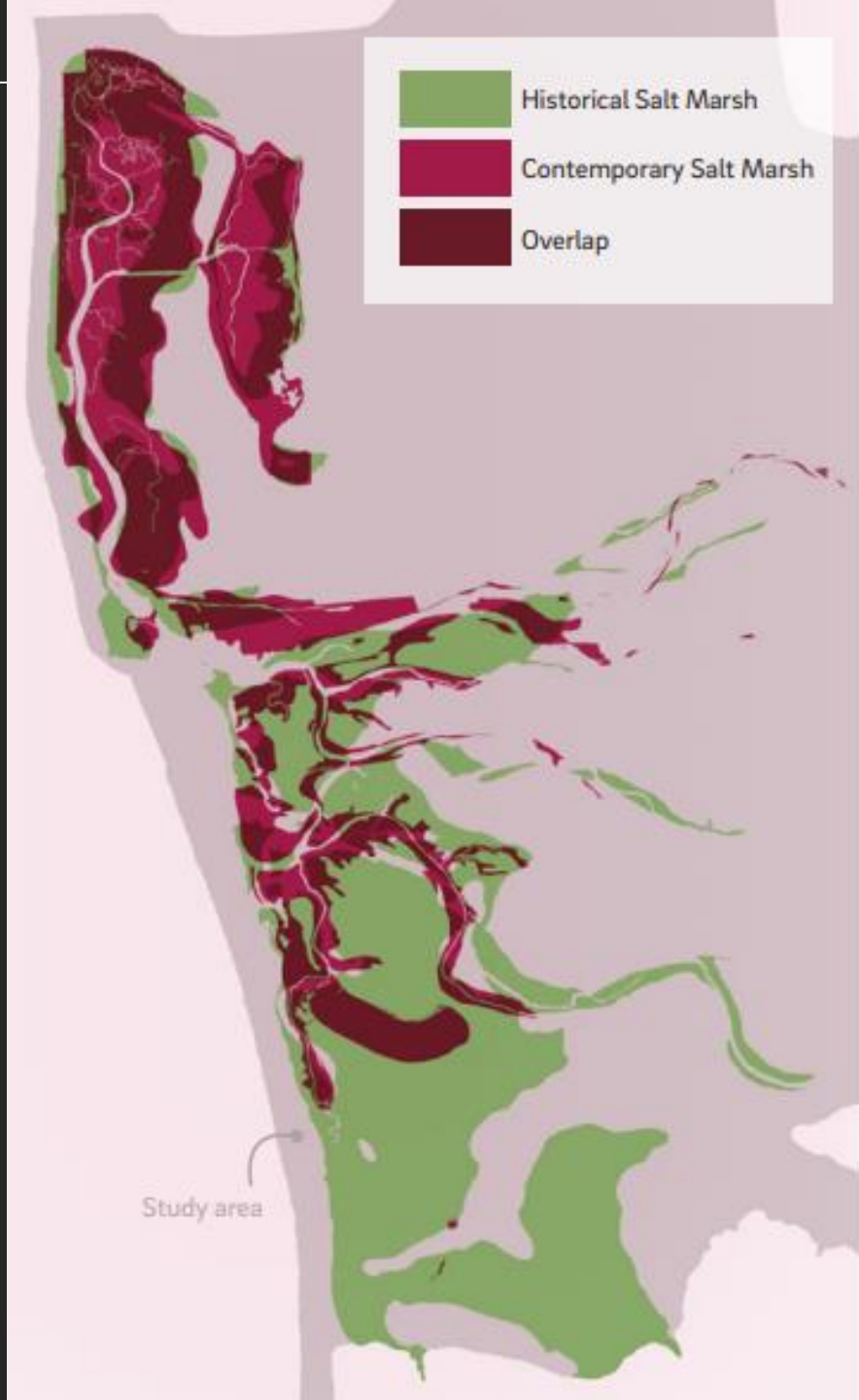
US Coast Survey 1852

Estuarine wetlands

- Salt marsh loss concentrated in southern part of the estuary
- Thought to be driven by local sedimentation and associated decrease in tidal prism (minus 55-85%)

Management implications

- Supports continued efforts to restore intertidal habitat and increase tidal prism
- Highlights future management concern (will sediment become more of a resource as SLR accelerates?)

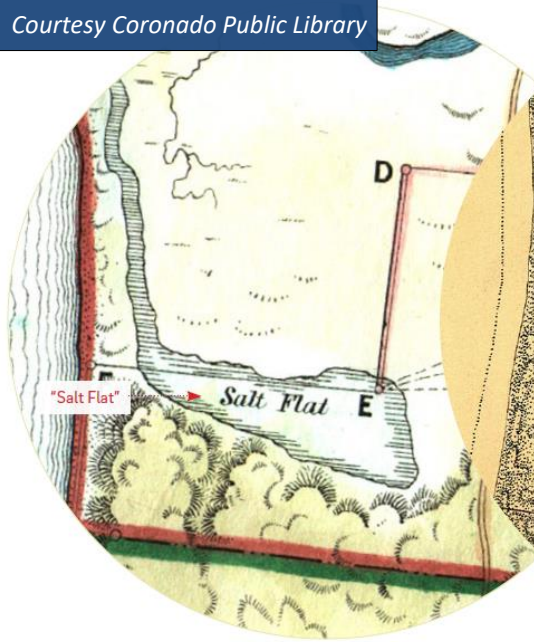


Estuarine wetlands

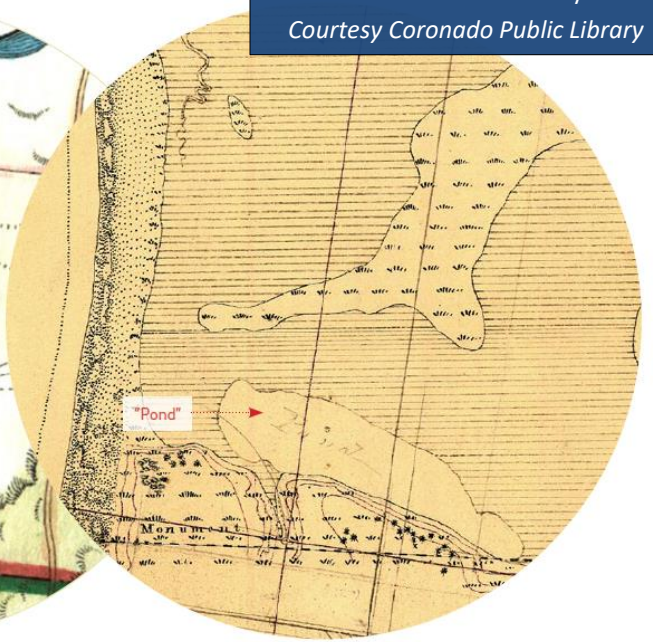
17 ha (40 ac) of salt flat

Gray 1849
Courtesy Coronado Public Library

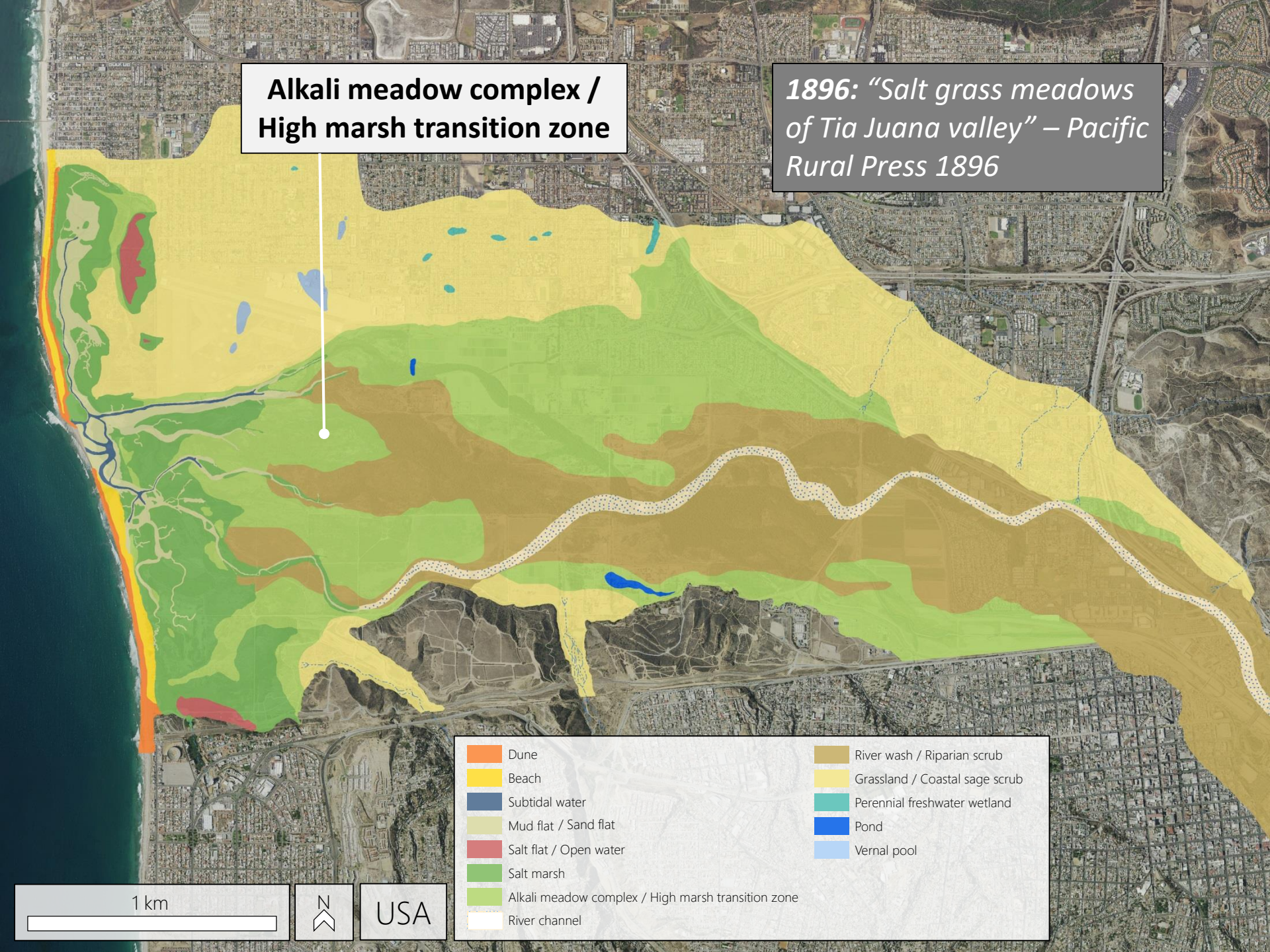
Gray 1849
Courtesy Coronado Public Library



Coast Survey 1852
Courtesy Coronado Public Library



US Coast Survey 1852


Alkali meadow complex / High marsh transition zone
1896: "Salt grass meadows of Tia Juana valley" – Pacific Rural Press 1896
Dune
Beach
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Pond
Vernal pool
1 km
N
USA

Alkali meadow complex / High Marsh Transition Zone

Wandering skipper (*Panoquina errans*)

- candidate for listing under ESA
- host plant is salt grass
- today considered to be restricted to salt marshes…

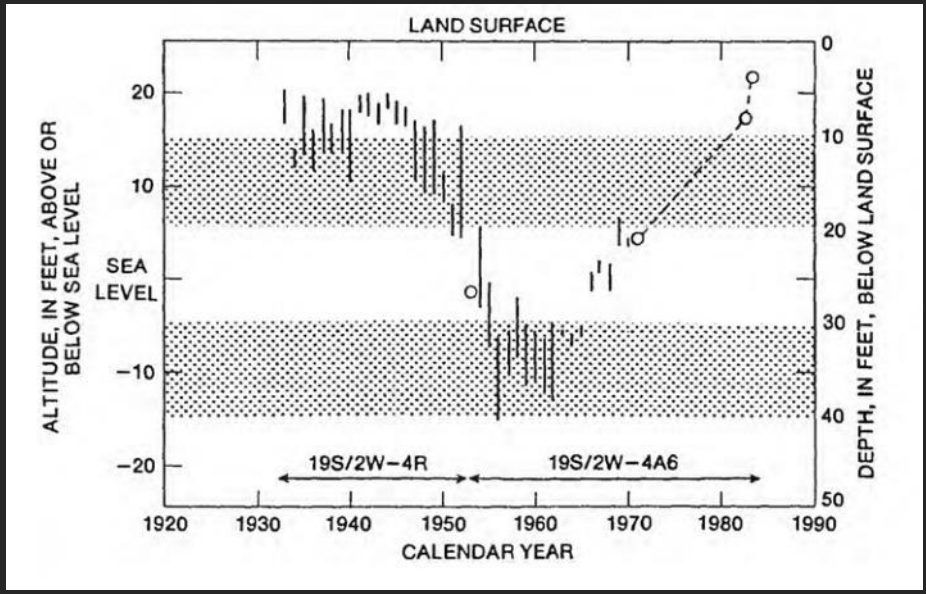
… but possible this species once also thrived further inland.

ca. 1850

ca. 2012

Alkali meadow complex / High Marsh Transition Zone

- Loss associated with conversion to more xeric grass/scrub habitats (not development)
- Likely driven by early groundwater declines



Alkali meadow complex / High Marsh Transition Zone

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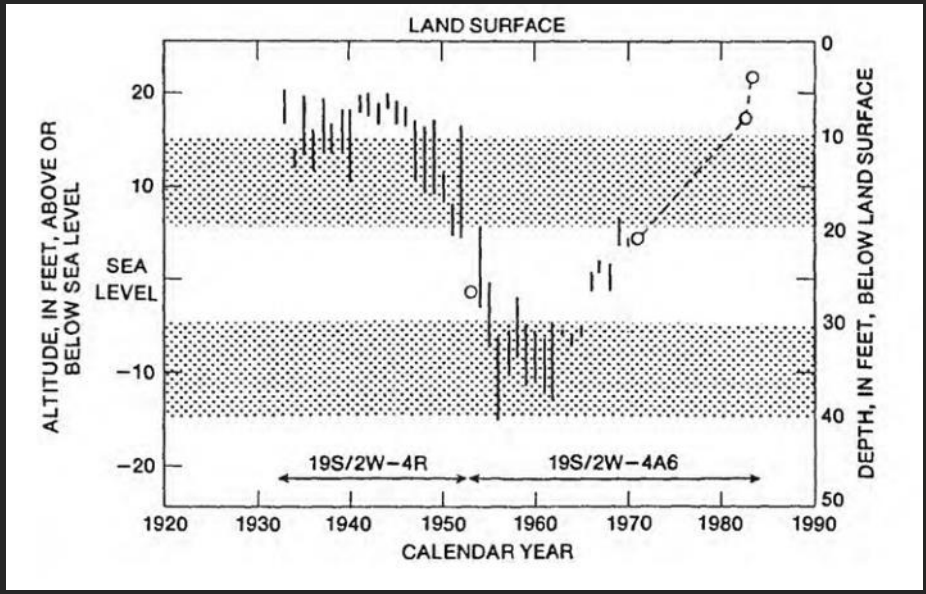
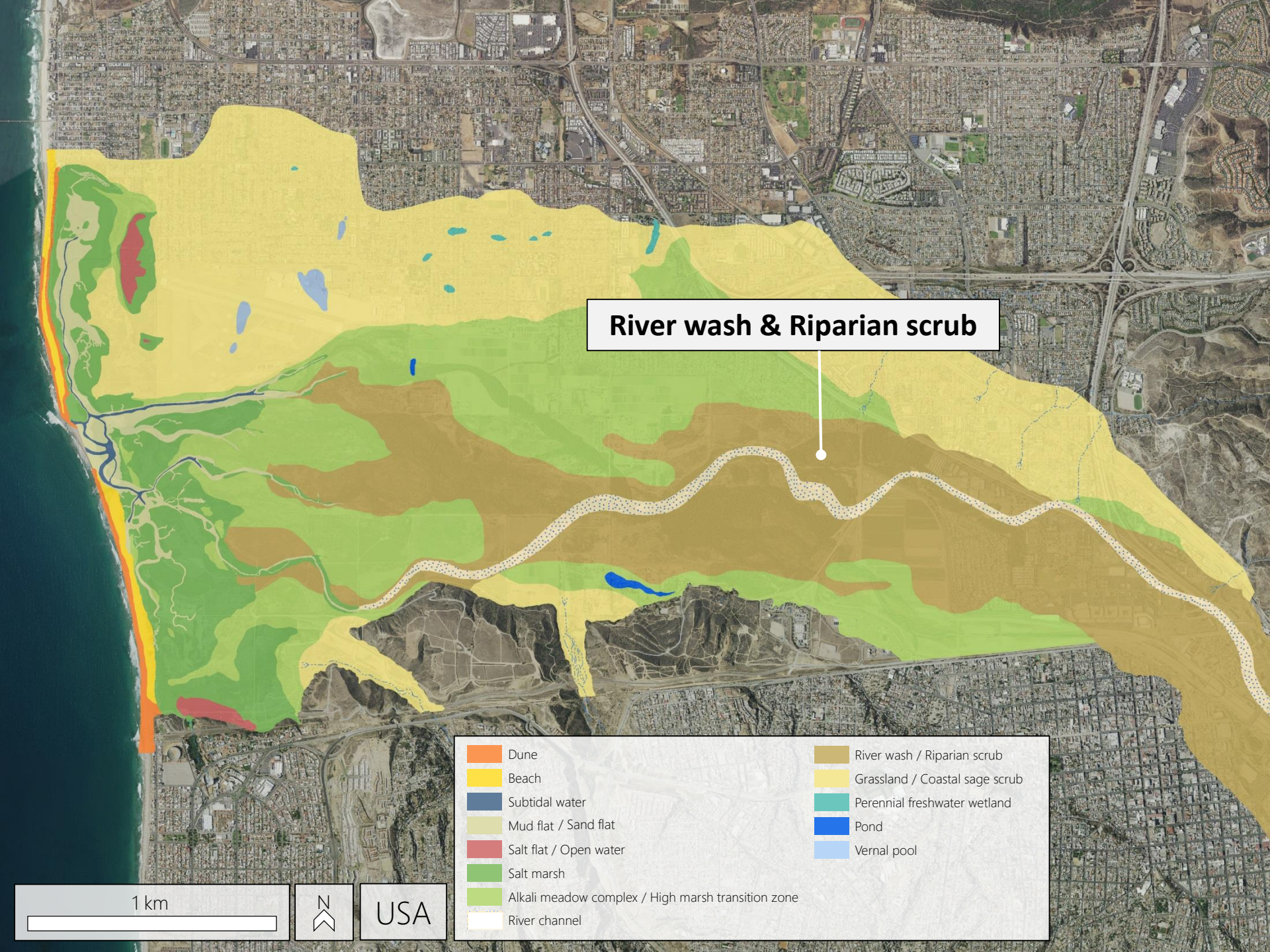


- Groundwater levels have rebounded
- Can we recover "missing" wetlands and associated functions?


River wash & Riparian scrub
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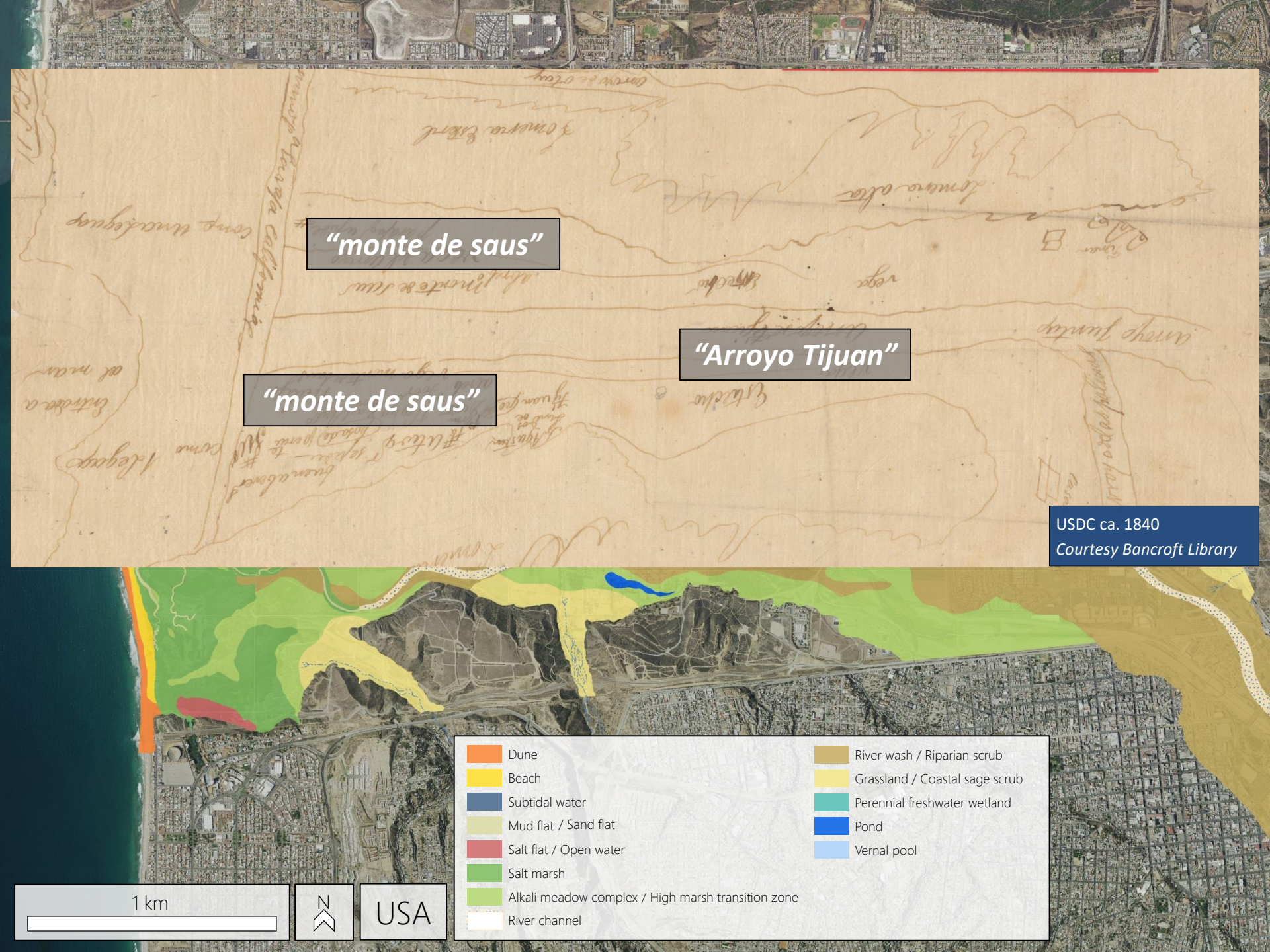
“monte de saus”
“Arroyo Tijuan”
“monte de saus”
USDC ca. 1840
Courtesy Bancroft Library
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1 km
N
USA

Primarily willow scrub, but broad range of species

Common Name	Latin Name
Trees	
sandbar willow	*Salix exigua*
Goodding's willow	*S. gooddingii*
red willow	*S. laevigata*
arroyo willow	*S. lasiolepis*
cottonwood	*Populus* sp.
California sycamore	*Platanus racemosa*
Shrubs	
mulefat	*Baccharis salicifolia*
black sage	*Salvia mellifera*
white sage	*S. apiana*
common sagebrush	*Artemisia tridentata*
arrowweed	*Pluchea sericea*
Bush senecio	*Senecio douglasii*
fourwing saltbush	*Atriplex canescens*
chaparral mallow	*Malacothamnus fasciculatus*
northwest willow	*Salix sessilifolia*
California fagonia	*Fagonia laevis*
blue elderberry	*Sambucus nigra* subsp. *caerulea*

Herbs	
nightshade	*Solanum* sp.
clematis	*Clematis ligusticifolia*
branching phacelia	*Phacelia ramosissima*
Chinese parsley	*Heliotropium curassavicum*
rigid bird's beak	*Cordylanthus rigidus*
bladderpod	*Peritoma arborea*
skunkbush	*Navarretia squarrosa*
Matilija poppy	*Romneya coulteri*
California evening primrose	*Oenothera californica*
spiny rush	*Juncus acutus*
southwestern spiny rush	*Juncus acutus* subsp. *leopoldi*
California croton	*Croton californicus*
Heermann's lotus	*Acmispon heermannii*
Nuttall's lotus	*Lotus nuttallianus*
Beardless wild rye	*Elymus triticoides*
spiny goldenbush/ spiny chloracantha	*Chloracantha spinosa, C. spinosa* var. *spinosa*
bush seepweed	*Suaeda nigra*
slender woolly-heads	*Nemacaulis denudata* var. *gracilis*
scarlet lupine	*Lupinus concinnus*
California sealavender	*Limonium californicum*
Indian hemp	*Apocynum cannabinum*
mugwort	*Artemisia douglasiana*
wide throated yellow monkeyflower	*Mimulus brevipes*
volcanic gilia	*Gilia ochroleuca* ssp. *Exilis*
ropevine clematis	*Clematis pauciflora*

Species indicative of **wetter** zones (obligate and facultative wetland species)

Records from 1849-1949

Primarily willow scrub, but broad range of species

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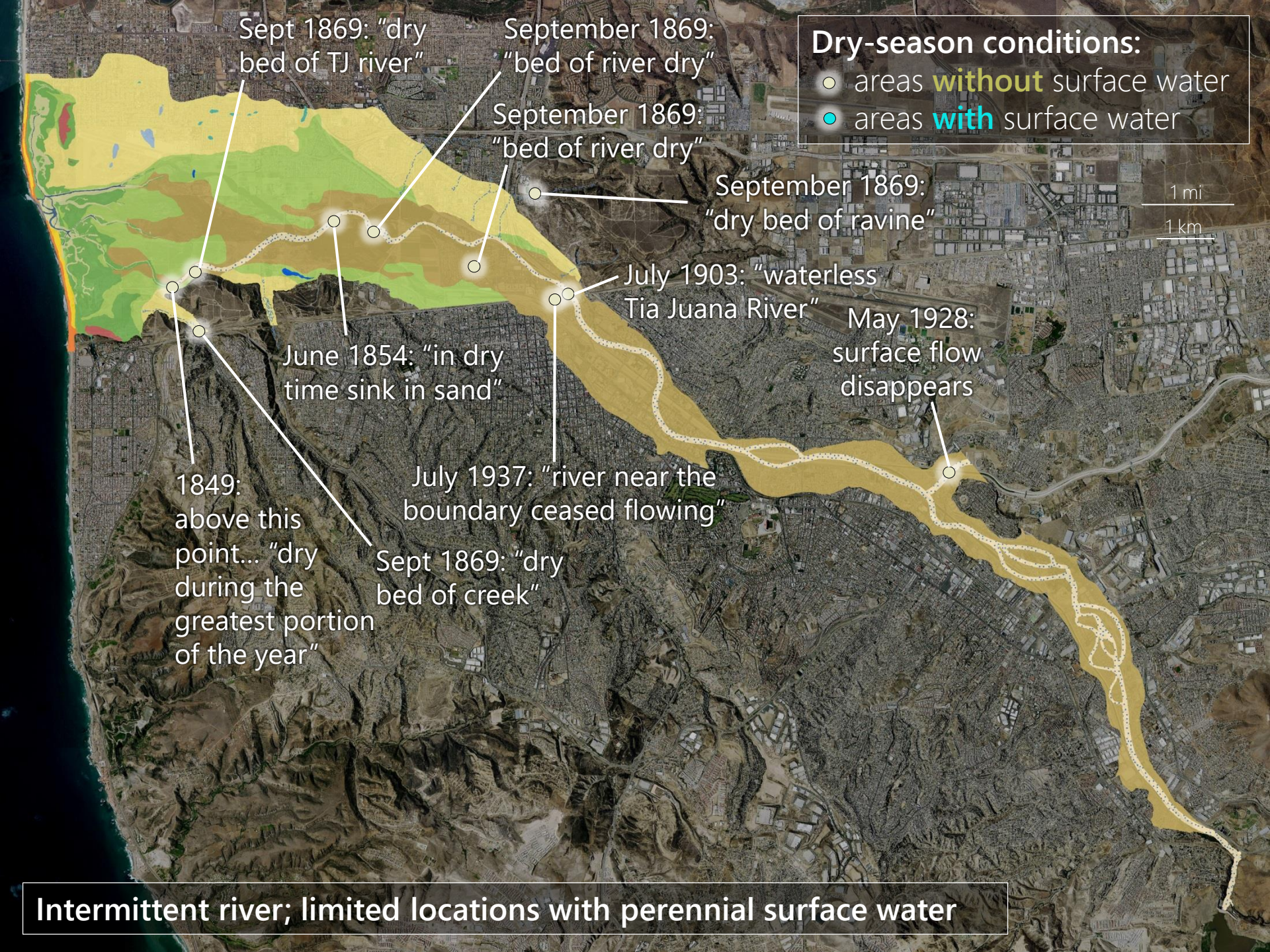
Species indicative of **wetter** zones (obligate and facultative wetland species)

Species indicative of **drier** zones (sage scrub species, generally more xeric)

Records from 1849-1949


Dry-season conditions:
areas without surface water
areas with surface water
1 mi
1 km
Intermittent river; limited locations with perennial surface water


Dry-season conditions:
areas without surface water
areas with surface water
Sept 1869: "dry bed of TJ river"
September 1869: "bed of river dry"
September 1869: "bed of river dry"
September 1869: "dry bed of ravine"
July 1903: "waterless Tia Juana River"
May 1928: surface flow disappears
June 1854: "in dry time sink in sand"
1849: above this point… "dry during the greatest portion of the year"
July 1937: "river near the boundary ceased flowing"
Sept 1869: "dry bed of creek"
1 mi
1 km
Intermittent river; limited locations with perennial surface water


Sept 1889: "spring"
Summer 1931: "Potholes" with water
Sept. 1869: "running water"
May 1769: "stream running with a good sized flow of water that… issues up out of the ground" [location very approximate]
Agua Caliente hot springs "agua permanente"
Jan 1910: river "water for some months to come" in Matanuco Cnyn.
July 1920: surface flow in photos
Dry-season conditions:
areas without surface water
areas with surface water
1 mi
1 km
Intermittent river; limited locations with perennial surface water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1 mi
1 km
Intermittent river; limited locations with perennial surface water

Perennial wetlands within the river corridor

courtesy Archivo Histórico del Agua

Key messages for today

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2. Floods maintained a large and dynamic river corridor.

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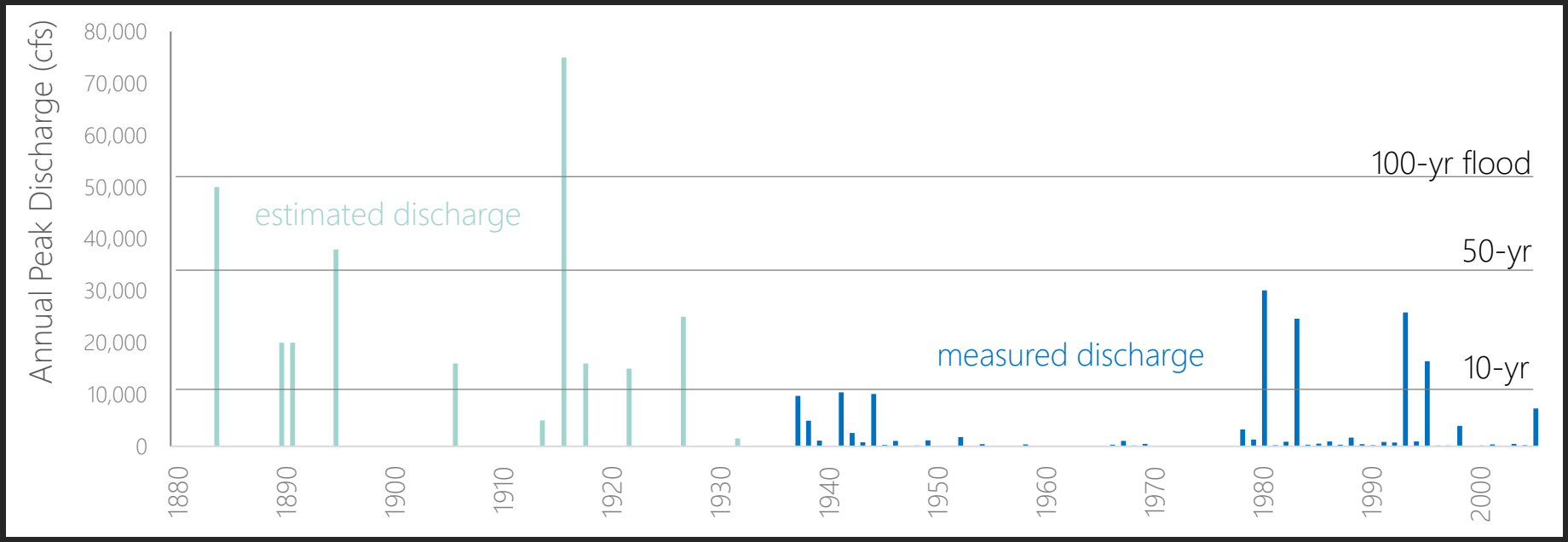
Periodic floods inundated most of the valley



Floods drove river movement

May 1941 (after sizeable floods in February, March, and April)

Erickson 1941, courtesy SDHC

Floods drove river movement

May 1941 (after sizeable floods in February, March, and April)

Erickson 1941, courtesy SDHC

Floods drove river movement

May 1941 (after sizeable floods in February, March, and April)

Erickson 1941, courtesy SDHC

Floods drove river movement

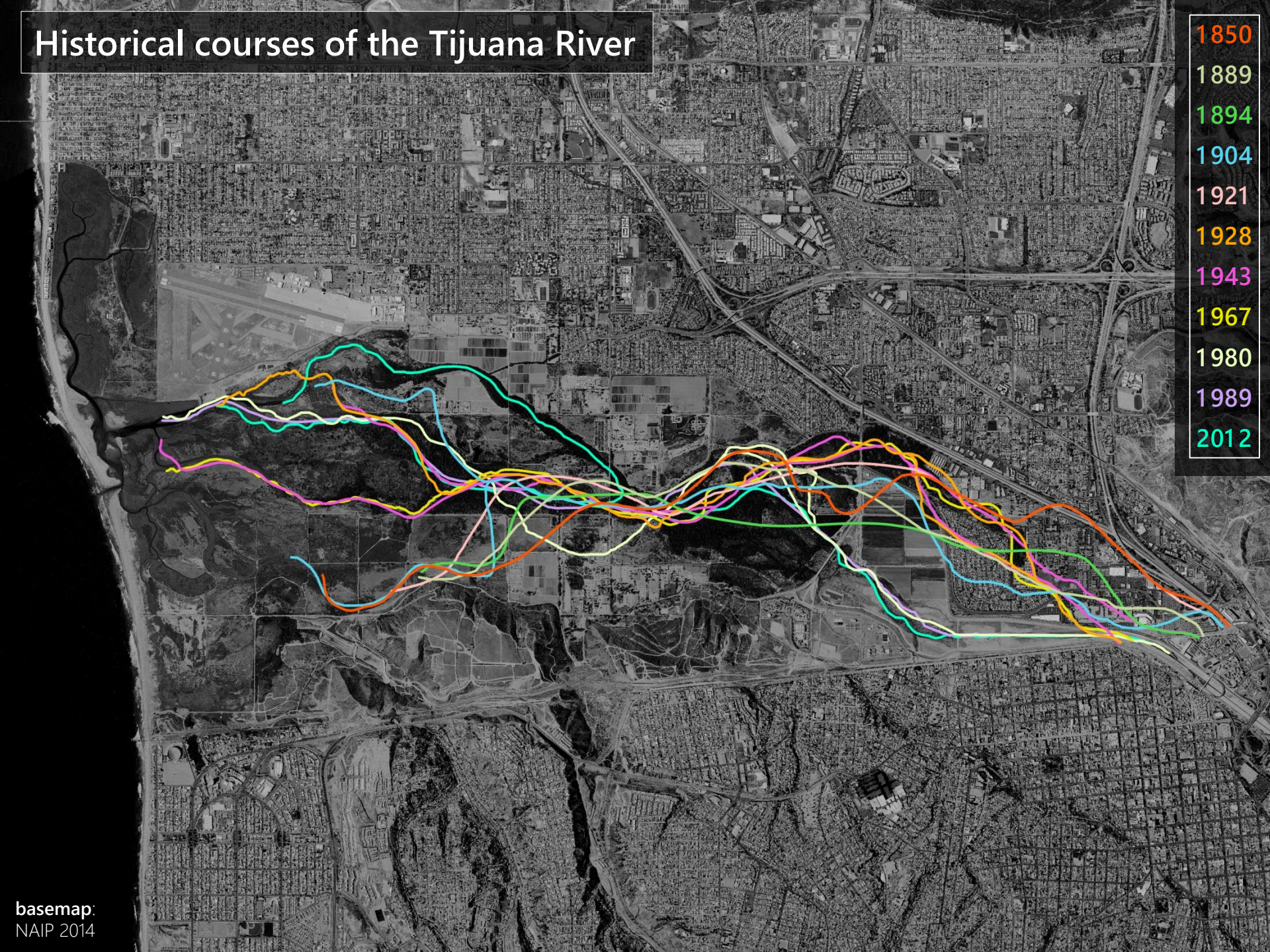
May 1941 (after sizeable floods in February, March, and April)

Erickson 1941, courtesy SDHC

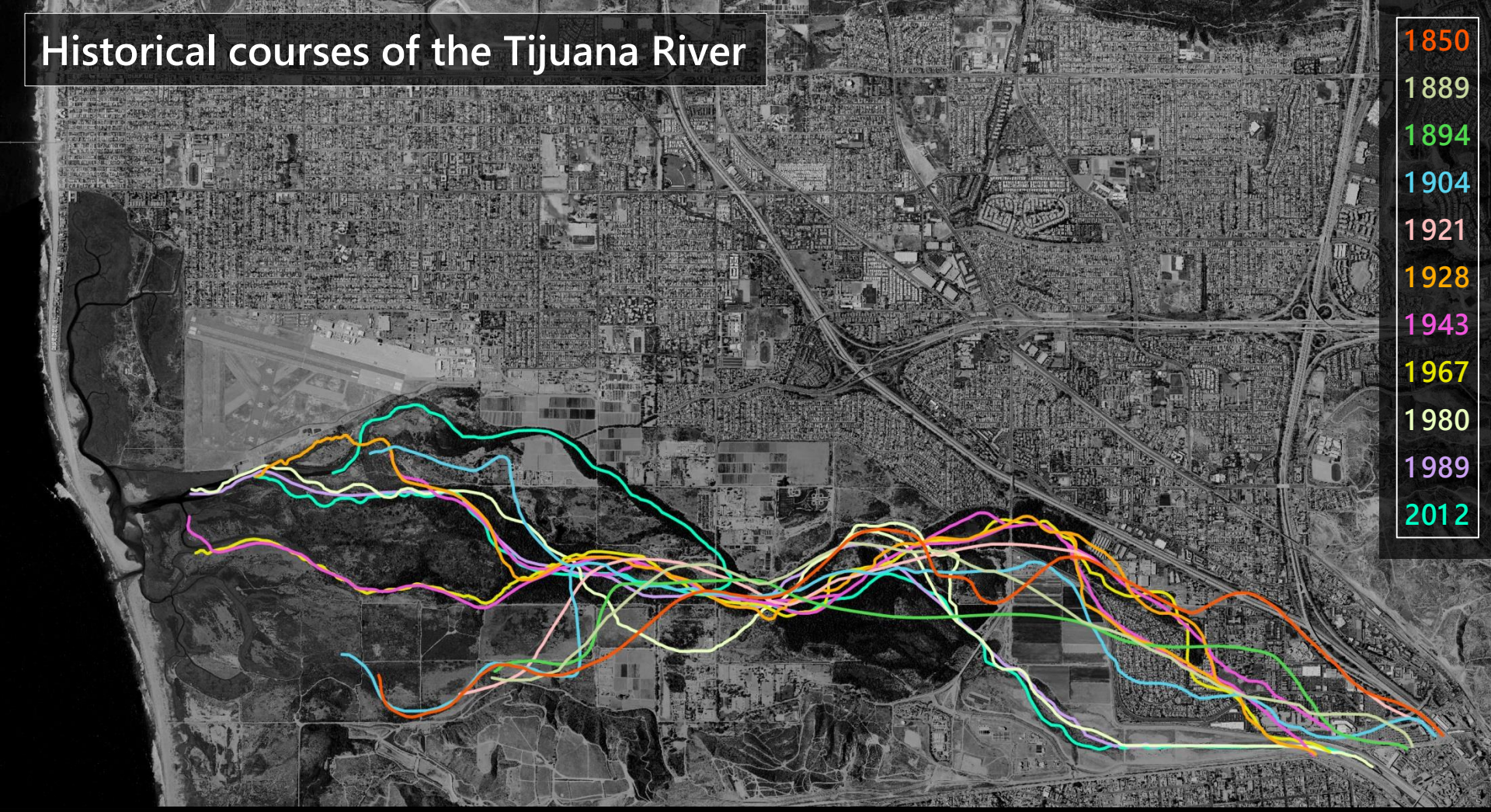
Floods drove river movement

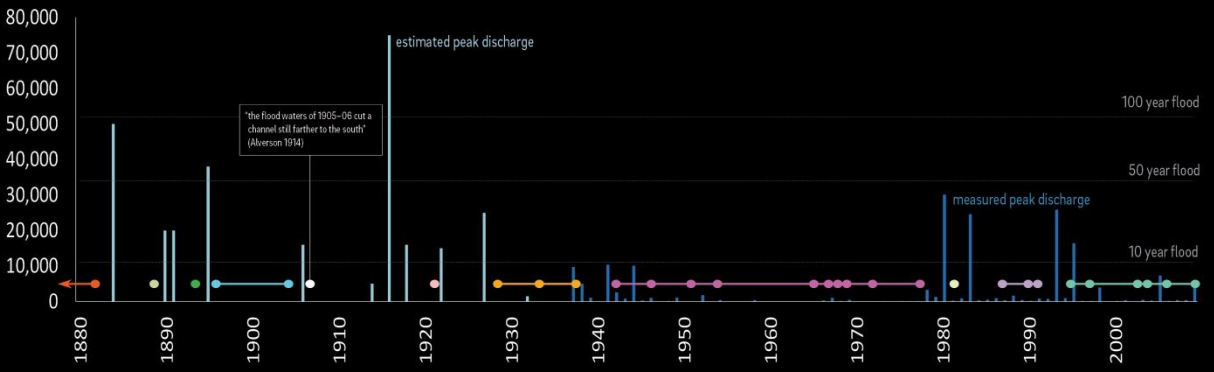
May 1941 (after sizeable floods in February, March, and April)

Erickson 1941, courtesy SDHC


Historical courses of the Tijuana River
1850
1889
1894
1904
1921
1928
1943
1967
1980
1989
2012
basemap:
NAIP 2014

Historical courses of the Tijuana River



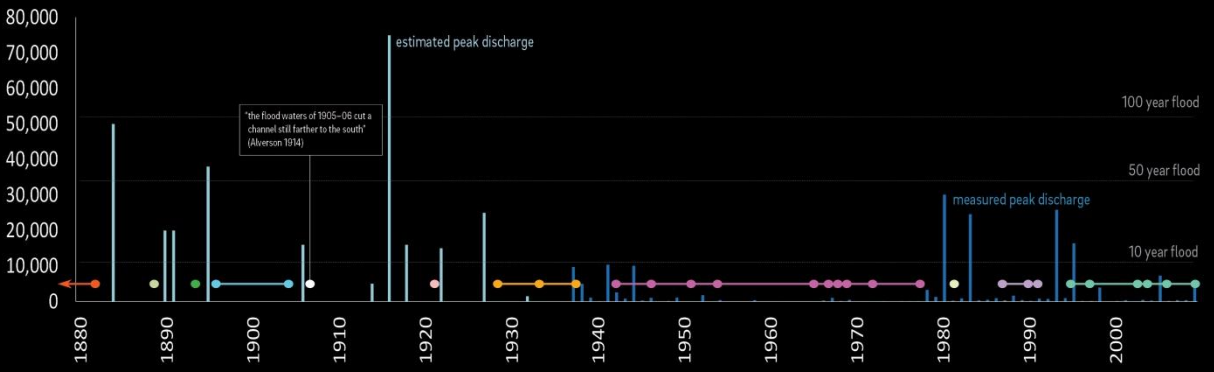


- Nearly all 10-year flood events have caused major channel movement
- Most smaller events do not.

Historical courses of the Tijuana River

- River movement is a natural, relatively-frequent process

1850
1889
1894
1904
1921
1928
1943
1967
1980
1989
2012



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Floods created habitat variability

Erickson 1941, courtesy SDHC

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- **Jack von Bloeker**
July 1931

Erickson 1941, courtesy SDHC

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July 1931

"In the summer…all that remains of the water…is found in **depressions** excavated by the current. **Western pond turtles** were quite abundant."

- **Robert Harwood**
August 1931

Erickson 1941, courtesy SDHC

Floods created habitat variability

- River movement is a natural, relatively-frequent process…
- …that helps maintain habitat heterogeneity and biodiversity
- Could be both practical and beneficial to allow for this movement

"After I entered the field, small **open spaces of alluvial river-bottom sand** were encountered that make an ideal situation for **pocket mice**"

- Jack von Bloeker
July 1931

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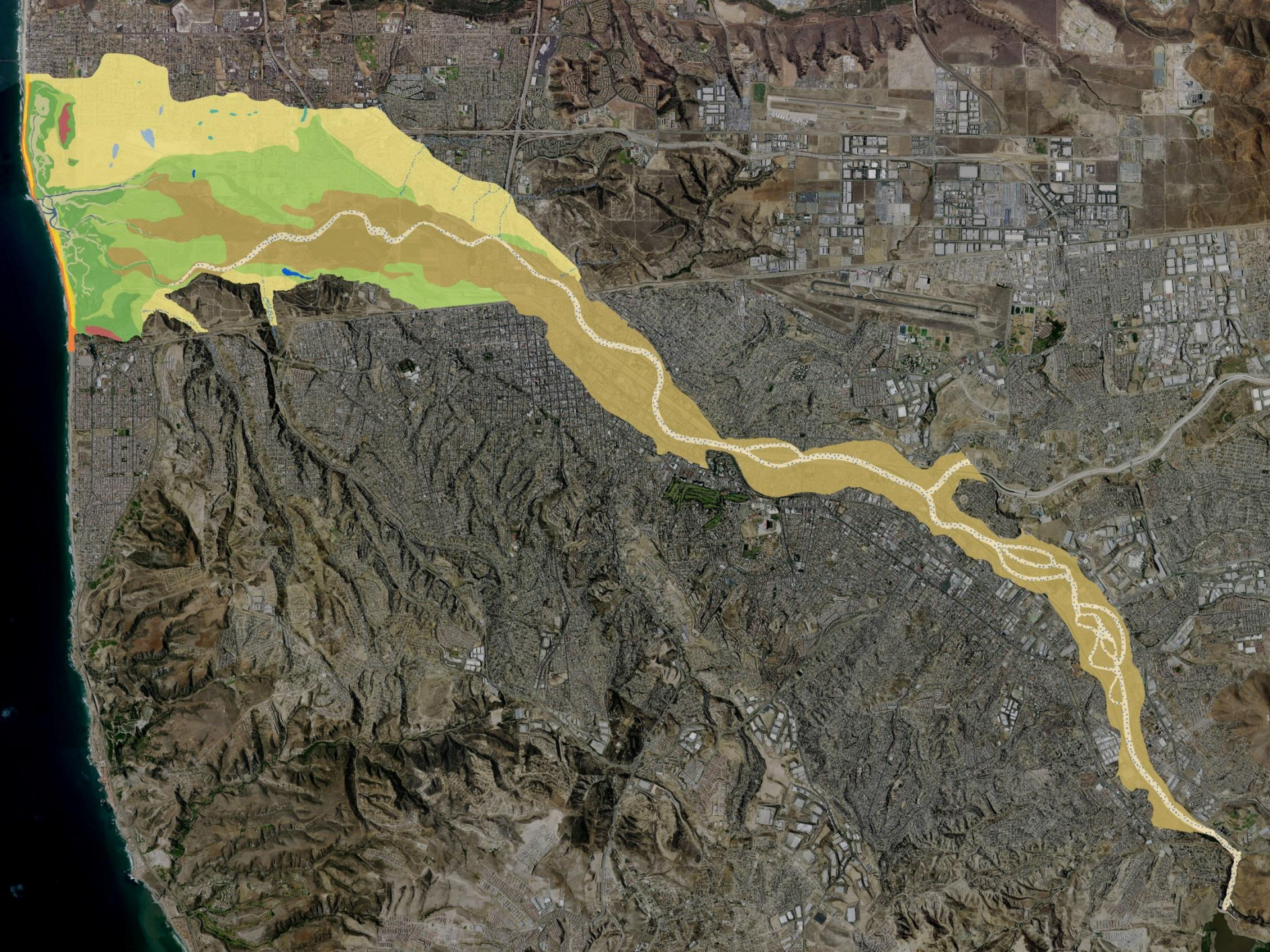
Key messages for today

1. The valley supported a diverse array of wetlands in a dry climate.

2. Floods maintained a large and dynamic river corridor.

Management implications of these changes



THANK YOU.

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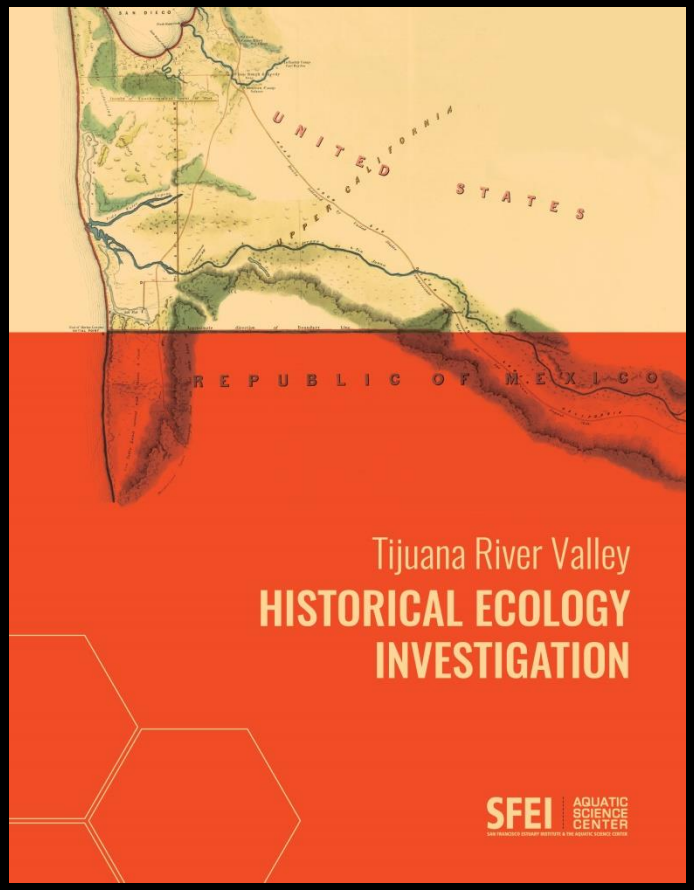
www.sfei.org/projects/tijuana



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