

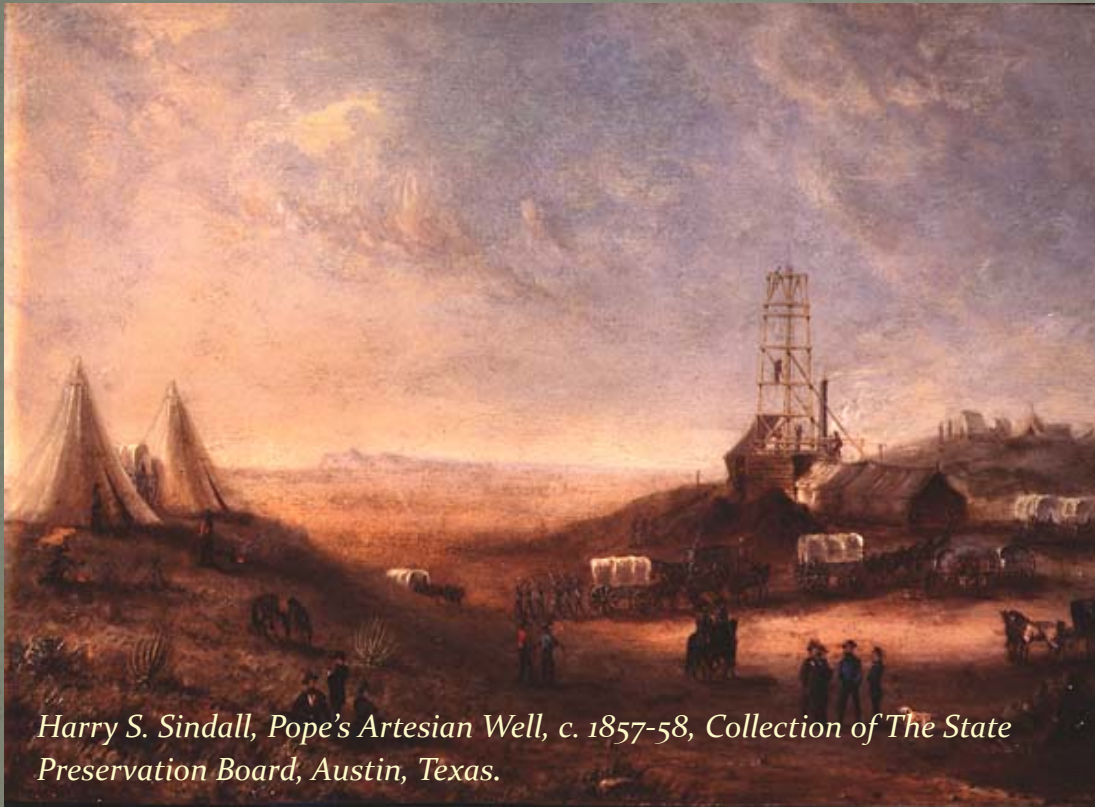
A painting depicting a river crossing. In the foreground, a wagon pulled by several oxen is wading through the water. Several riders on horseback are also crossing the river. The background shows a large, hazy mountain range under a dramatic, cloudy sky. The overall scene is one of a rugged, historical landscape.

A Salty Tale...

Malaga Bend on the Pecos River

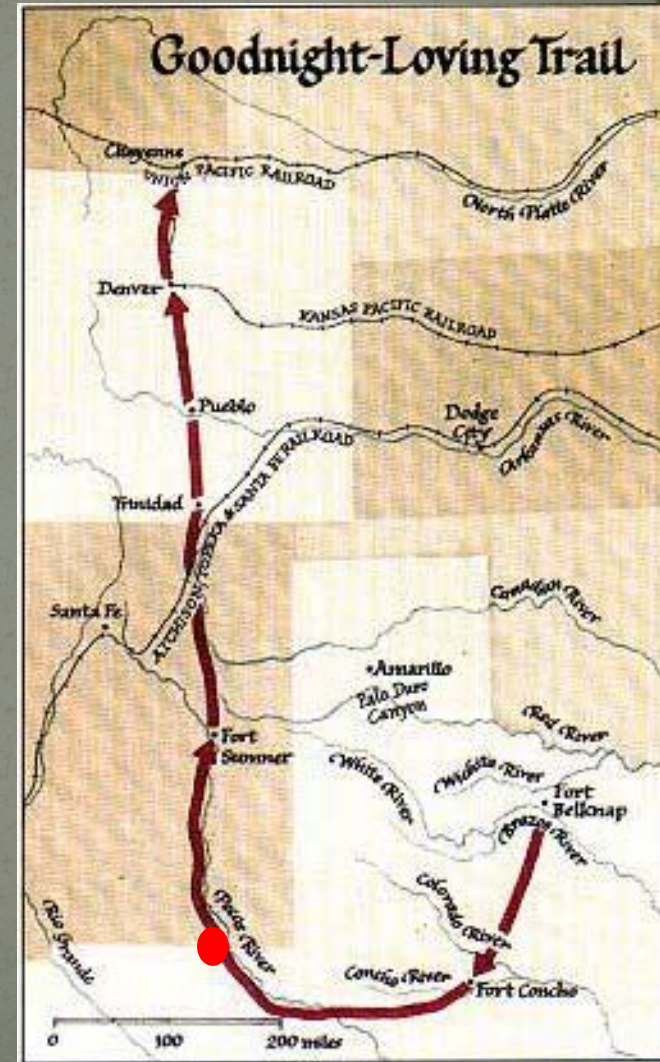
Suzy Valentine
Pecos River Commission
2014 Annual Meeting
Marfa, Texas

Looking for Fresh Water



Harry S. Sindall, *Pope's Artesian Well*, c. 1857-58, Collection of The State Preservation Board, Austin, Texas.

- Captain John Pope's Expedition and Artesian well drilling site
- Gave up looking for fresh water after 3 years
- Landmark on Goodnight-Loving Cattle Trail



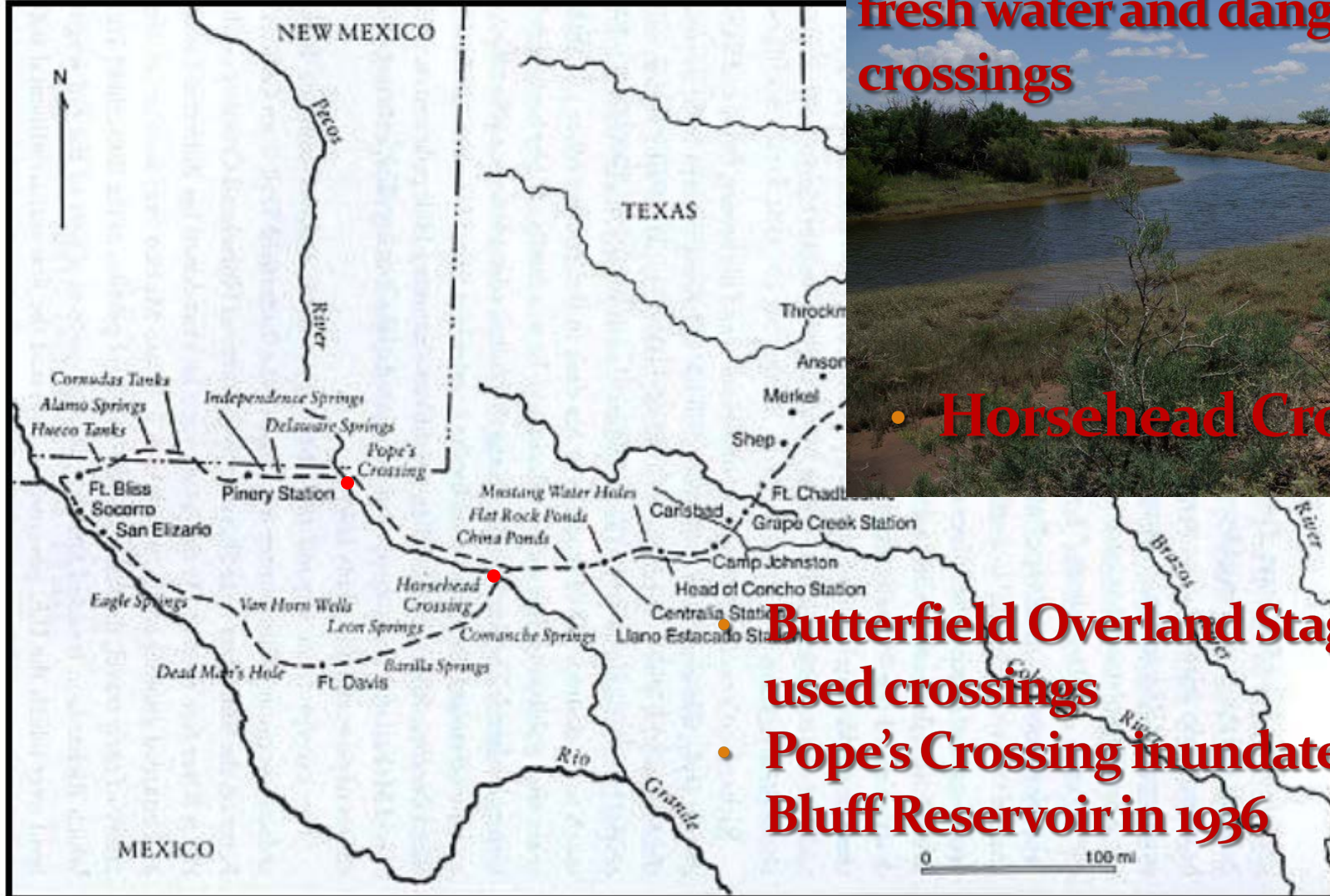
Crossing the Pecos River

- No margin for error – little fresh water and dangerous crossings

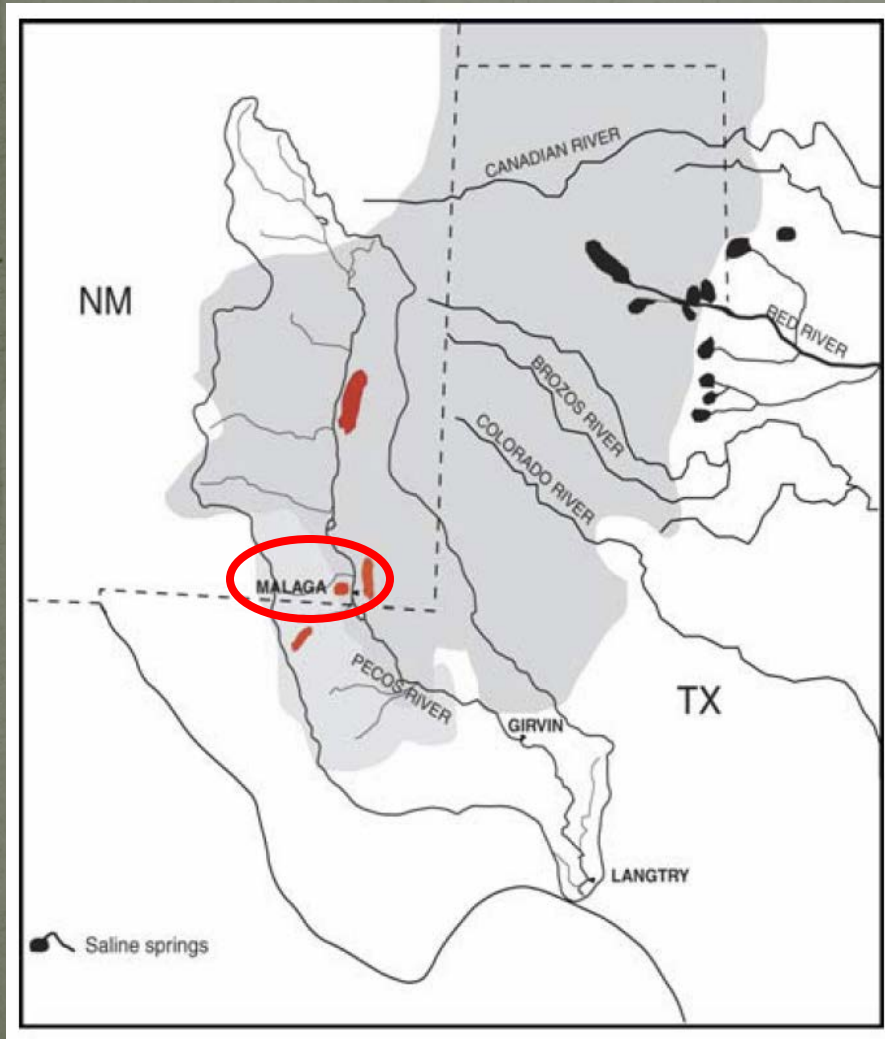
• Horsehead Crossing

• Butterfield Overland Stage Route used crossings

- Pope's Crossing inundated by Red Bluff Reservoir in 1936



Salinity Sources at Malaga Bend



- Permian period shallow sea - 245 million years ago
- Sea advanced and retreated
- Formation of evaporite deposits
- Groundwater dissolution formed collapsed sinkholes
- Pecos River salt springs
 - Up to ~172,000 tons per year
 - Salinity up to 4,100 ppm
- As flows declined in river = less dilution made conditions worse

from Miyamoto & others (2007)

Salinity Impacts

• Red Bluff Reservoir

- Salt loading total = 560,000+ tons per year
 - 478,000 tons per year from Pecos R.
 - 80,000 tons per year from Delaware R.
- Reservoir Outflow
 - 410,000 tons/year
 - TDS of water = 6,000 ppm
 - Too high for most crops
 - Marginal for livestock
 - Limits biodiversity of species
- Salinity at Girvin: 12,000 ppm

• Salt loading for Lake Amistad

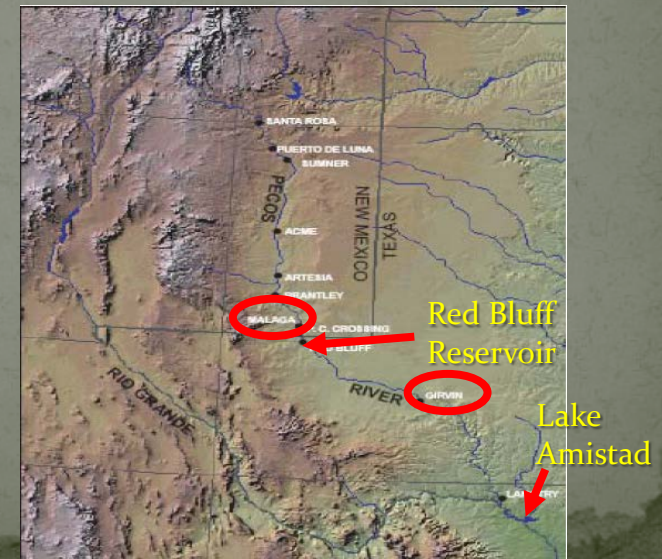
- 26% from Pecos River (<10% flow)
- Upper limit of drinking water standards

from Miyamoto & others (2007-8)

Red Bluff Reservoir



Pecos River at Amistad



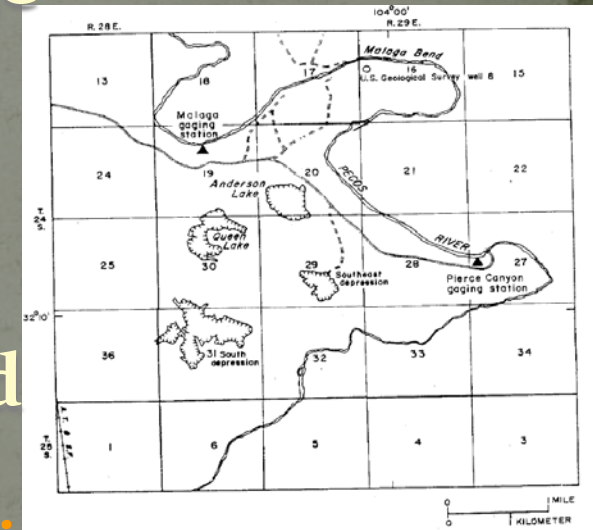
Springs and Seeps discharging into the Pecos River at Malaga Bend



from *Malaga Bend Experimental Salinity Alleviation Project – A Comprehensive Interim Report*, Eddy Co., NM, 1970
By John S. Havens, prepared for the USGS in cooperation with the Pecos River Commission

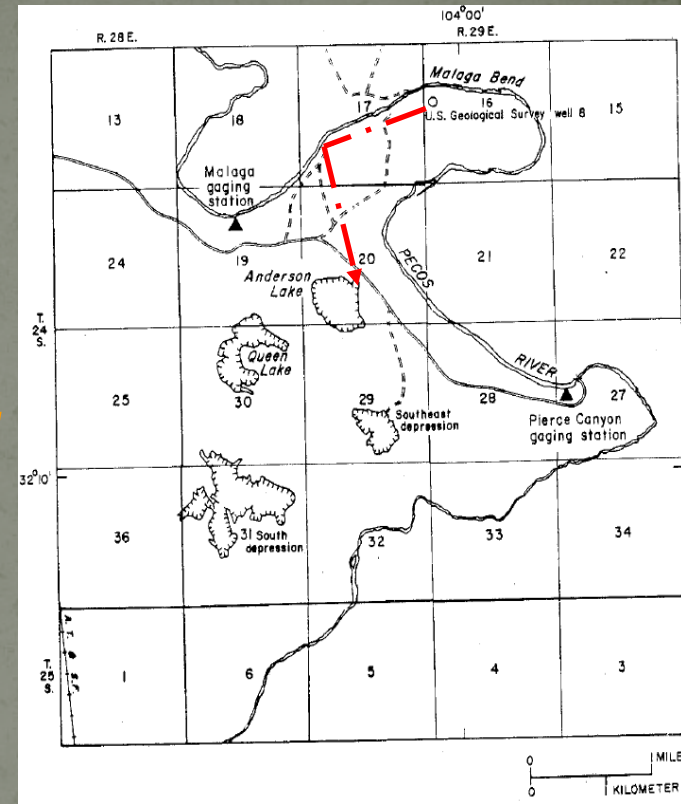
Pecos River Commission

- 1938-1955 – PRC was active in sponsoring reports that identified brine discharge near Malaga Bend
- USGS proposed solution of pumping brine to lower aquifer and reduce discharge
- 1958 – Congress Authorizes Water Salvage Alleviation Project
 - McMillan Delta Salvage Channel
 - Brine pumping at Malaga Bend
- First salt control project of its kind in the U.S.
 - Construction by Bureau of Reclamation
 - Data collection by USGS
 - Right of way acquired by New Mexico
 - Operation and maintenance by Texas



Malaga Bend Salinity Alleviation Project

- 1963: Pumping starts
 - 220 ft well, ~2 miles of pipe
 - Discharge to unlined but compacted 50-acre evaporation pond called Anderson Lake
- Pumping from 1963 to 1976
 - By December 1964, 1,000 acre-feet of water pumped removing 300,000 tons of salt
 - Decreased brine inflow to river by 70%
 - About 3,878 acre-feet of brine is pumped
- 1970, 1976, 1979, 1980: USGS reports with concerns mounting over leakage from disposal lake
- 1972-1977: Brine pumped to Culberson County (Texas) for enhanced oil recovery (EOR) but stops due to pump and casing problems

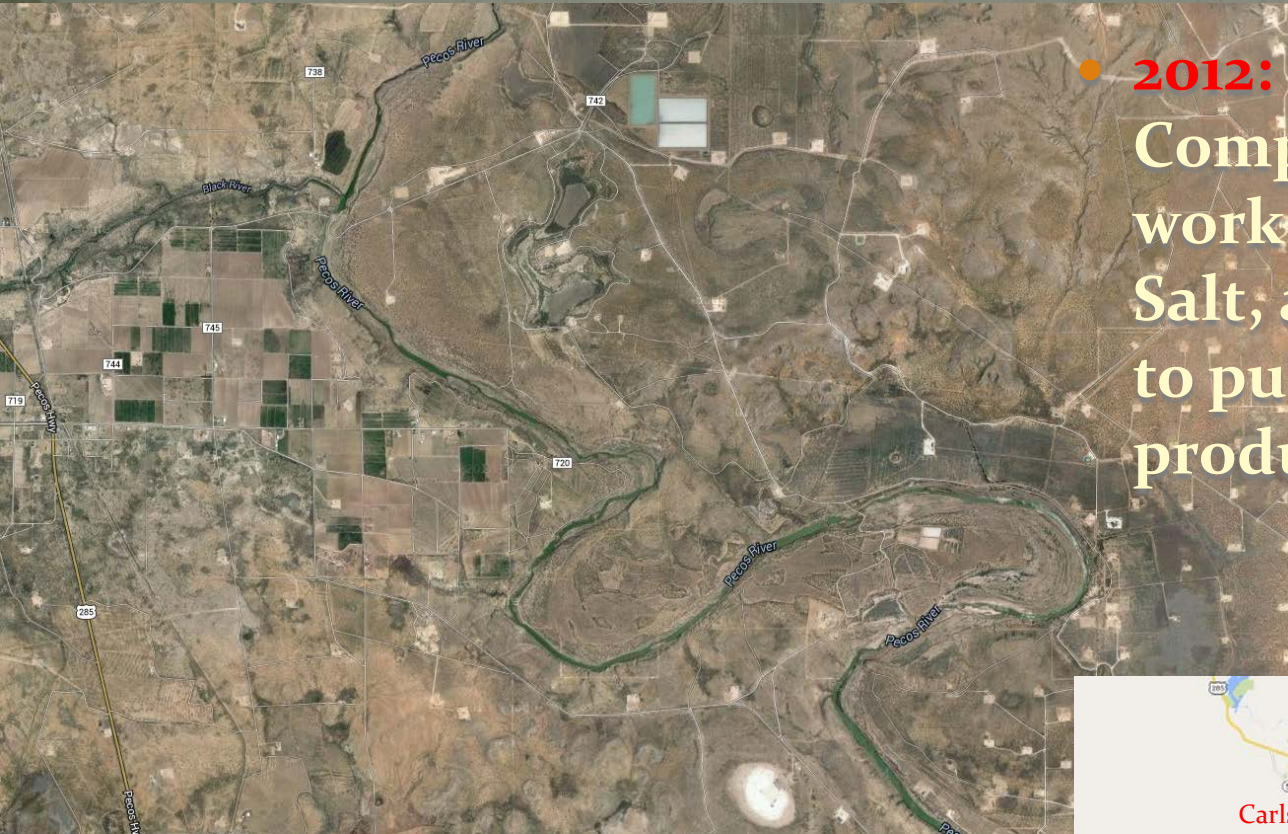


From Havens, 1970.

Recent Salinity Control History

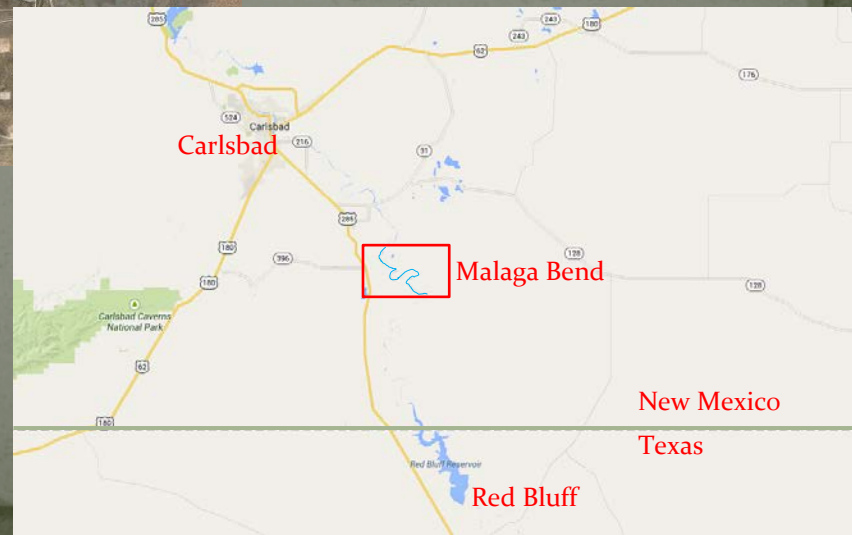
- **1992:** Private companies propose to pump at Malaga Bend to “harvest” salt for sale
- **1993:** Pumping stops due to:
 - A need to re-engineer the pond
 - Concerns that pond was hazard to water fowl
 - Lack of interest by United Salt Company to operate facility
- **2000 - 2005:** Private companies were once again offering proposals to mine salt
- **2010:** Pecos River Water Quality Coalition Forms
 - Coordinate efforts of PRC, lawmakers, stakeholders and Federal and State agencies
- **2012:** Pecos Initial Assessment by U.S. Army Corps of Engineers and conducted by USGS
- **2013:** Southwest Salt Company begins Malaga Bend project
- **2013:** Pecos Watershed Assessment Project
 - Part of Rio Grande Salinity Management Program
 - Non-Federal sponsors: Texas TCEQ and New Mexico ISC
 - Funds provided by Texas Water Development Board
 - Contracts and Agreements signed in March 2014
 - Kickoff Meeting in May

Current Malaga Bend Project

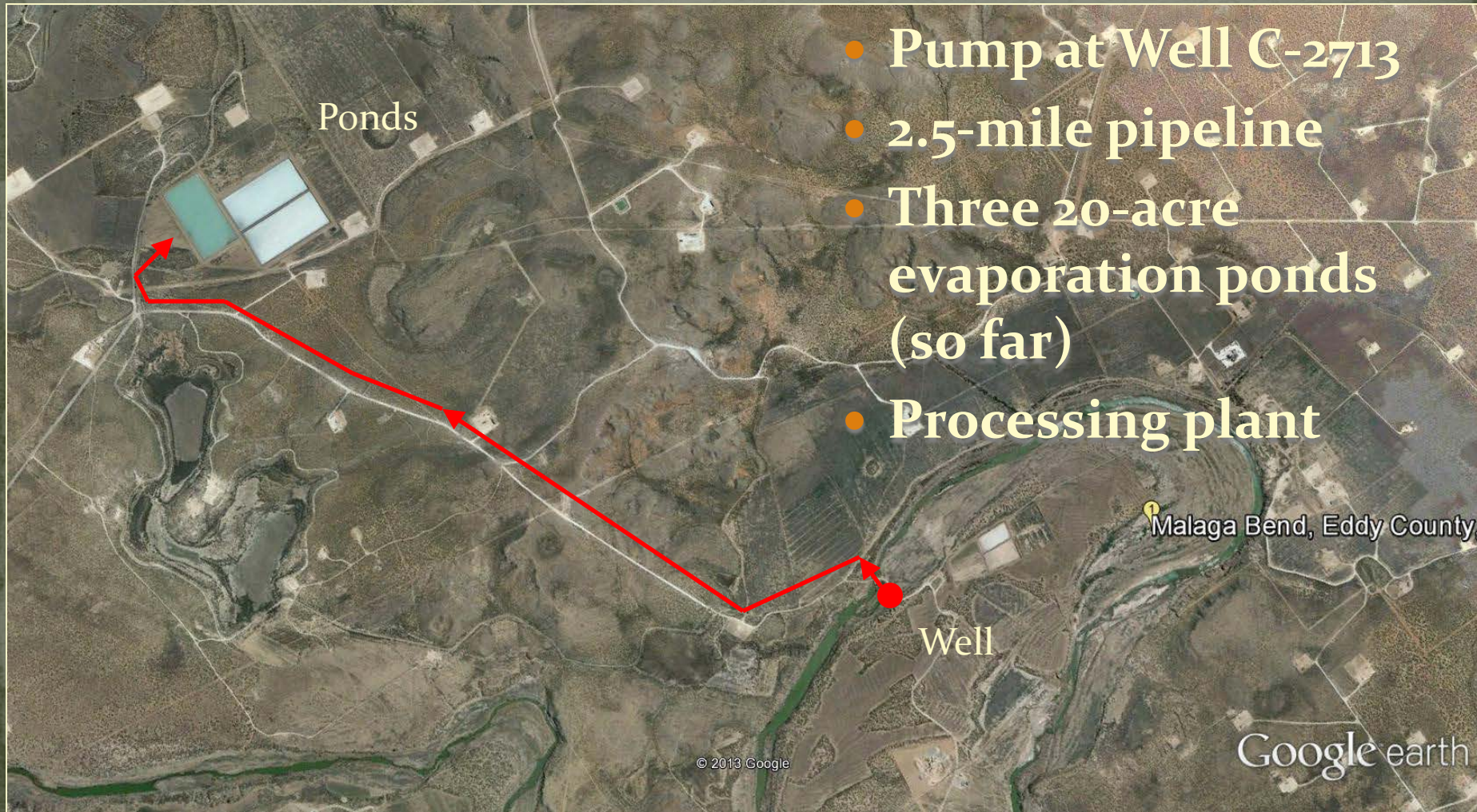


- **2012:** Pecos River Compact Commissioners work with Southwest Salt, a private company, to pump well again to produce salt

- **2013:** Pumping Begins

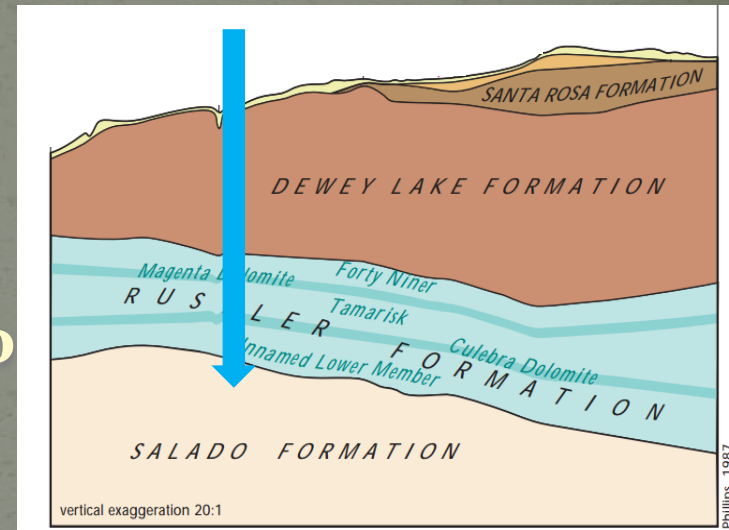


Pipeline/Ditch from Well to Ponds



Well C-2713 at Malaga Bend

- Well drilled into brine aquifer in Salado Formation
- Can produce 250,000 tons of salt per year
 - Would require up to 8 ponds
- Pond permit from New Mexico Environmental Dept. allows 4 ponds
- By end of 2014 - selling salt
- By end of 2015 - rate to increase to 6,000 tons per month
- By mid-2016 - plan to increase to 90,000 tons per year



New Ponds in Operation

- In 2013, 221 acre feet pumped to ponds
- 250 gallons per minute
- 90,000 tons of salt
- 1 foot of base salt required
- 1 foot of salt expected per year
- Salt can be harvested after 18 months



Onsite Processing Plant

- Processing facility and equipment
- Salt for water softening and cattle feed
- Initial delivery by truck
- Ultimately delivery by rail



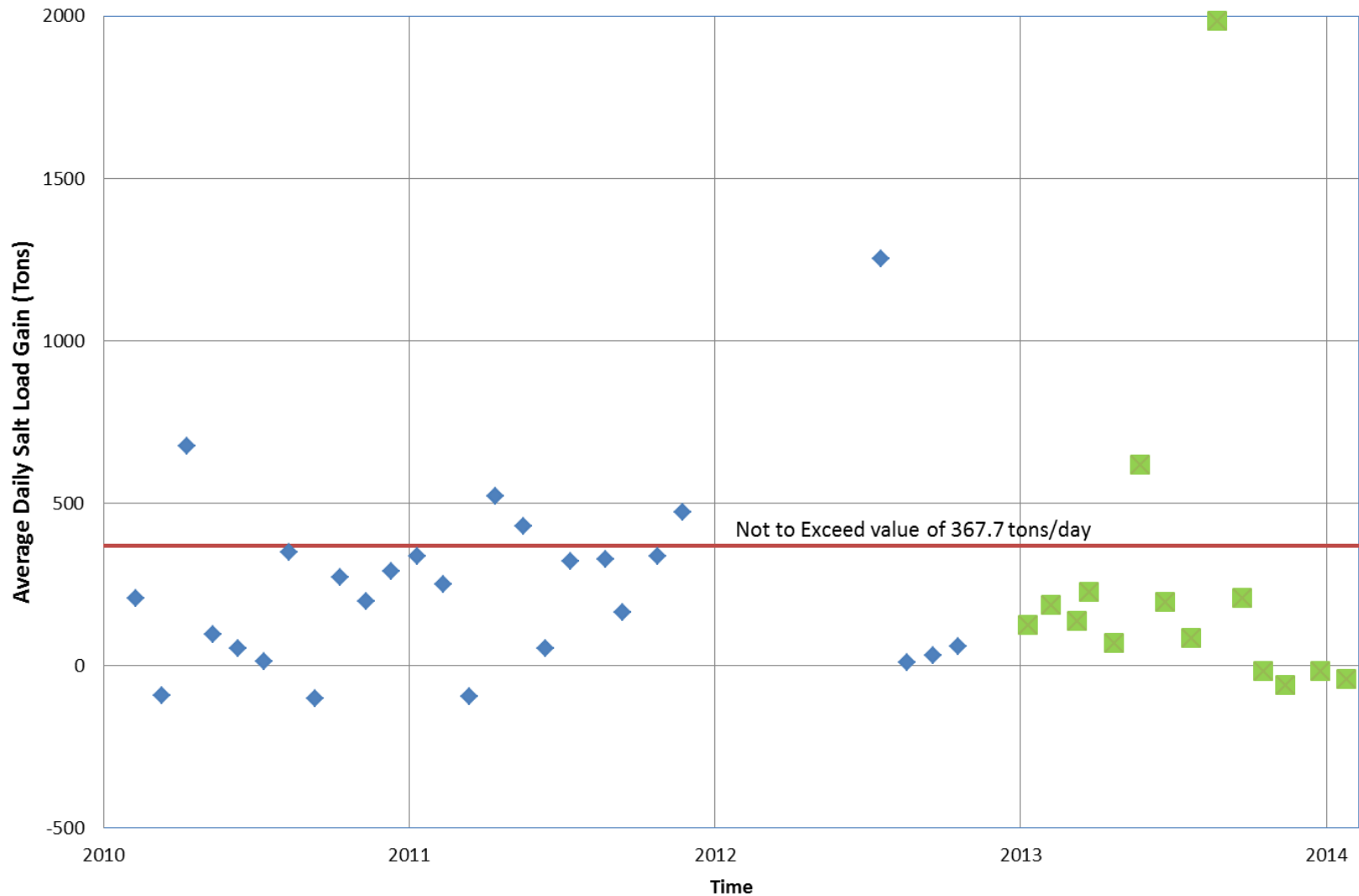
Malaga Bend Requirements for Pecos River Master Manual - 2012

- USGS Gages
 - Malaga Bend
 - Pierce Canyon Crossing
- Water Quality Testing
 - Center of Excellence for Hazardous Materials Management (CEHMM)
 - Twice a month
- Gain in Total Daily Salt Load
 - < 367.7 T/day

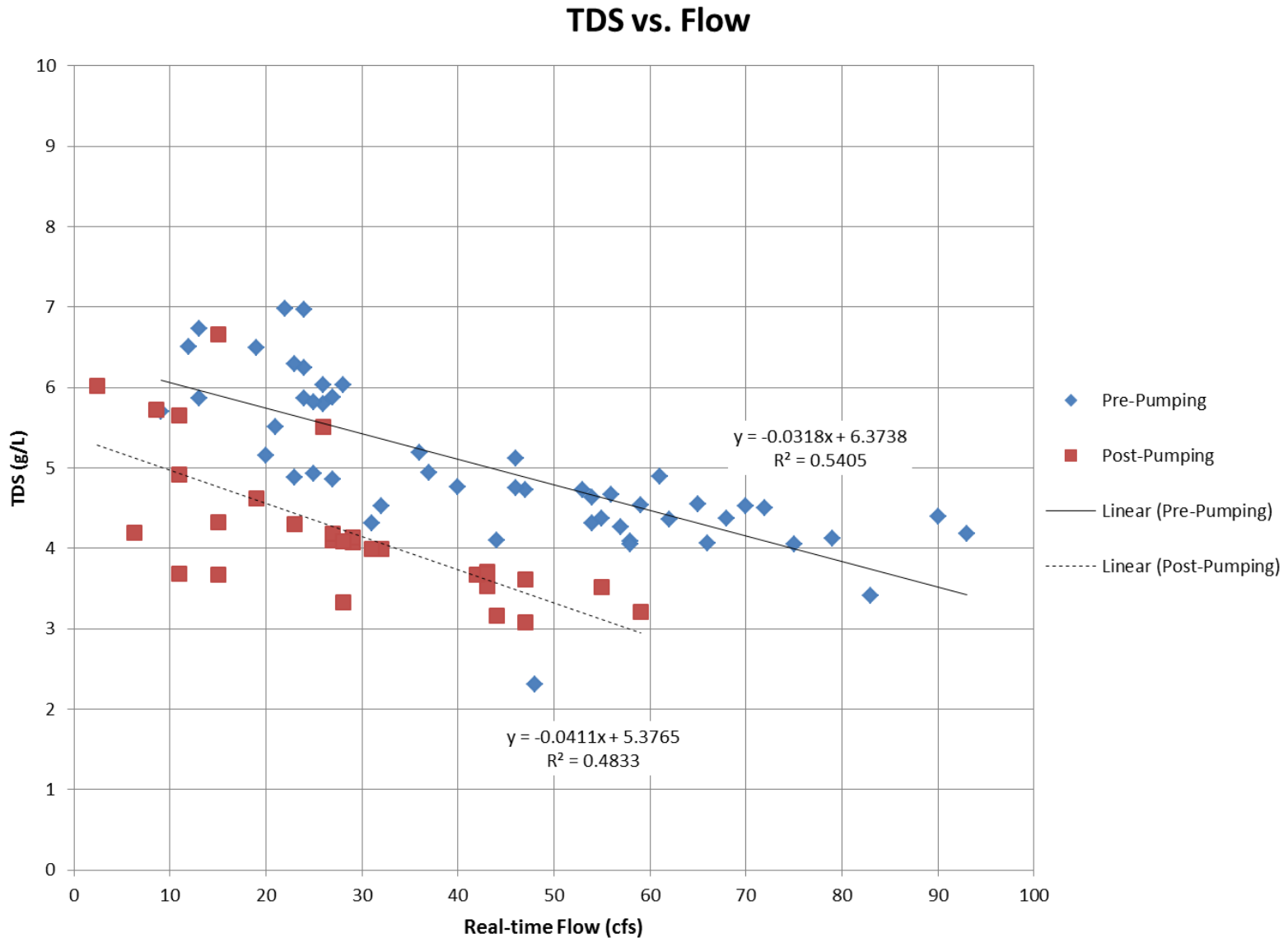


Quick Checks for Results

**Malaga Bend Average Daily Salt Gain
Between Upstream and Downstream Stations**



TDS Concentrations vs. Flow



#1 - Looking Upstream from Dog Town Road



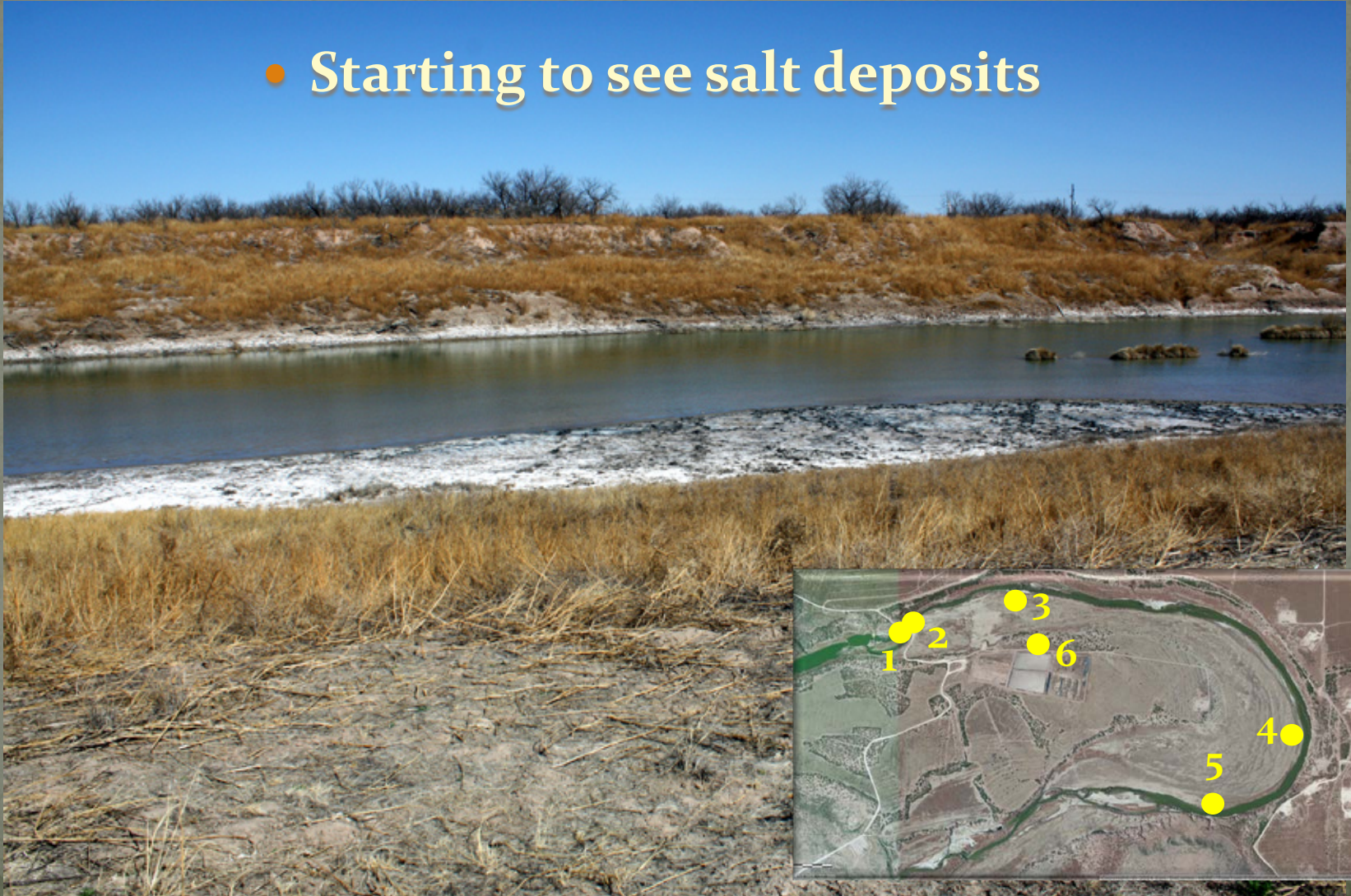
- Photos courtesy of Abe Van Luik
- Thoughts and Places.org, 2011
- Pre-project conditions

#2 - Looking Downstream from Dog Town Road Bridge

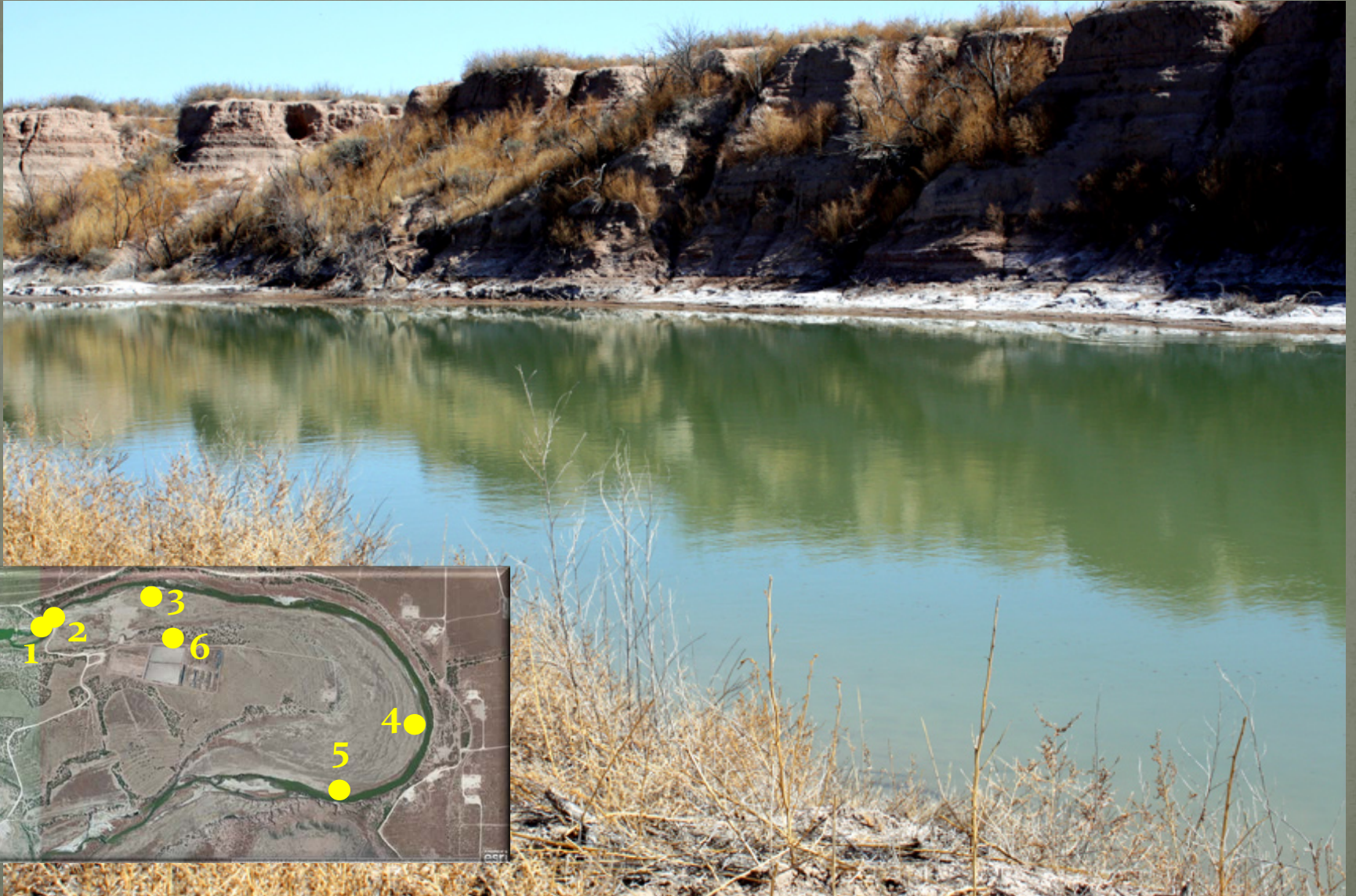


#3 - Looking Across River from Old USGS Pump

- Starting to see salt deposits



#4 - Continuing Around the Bend



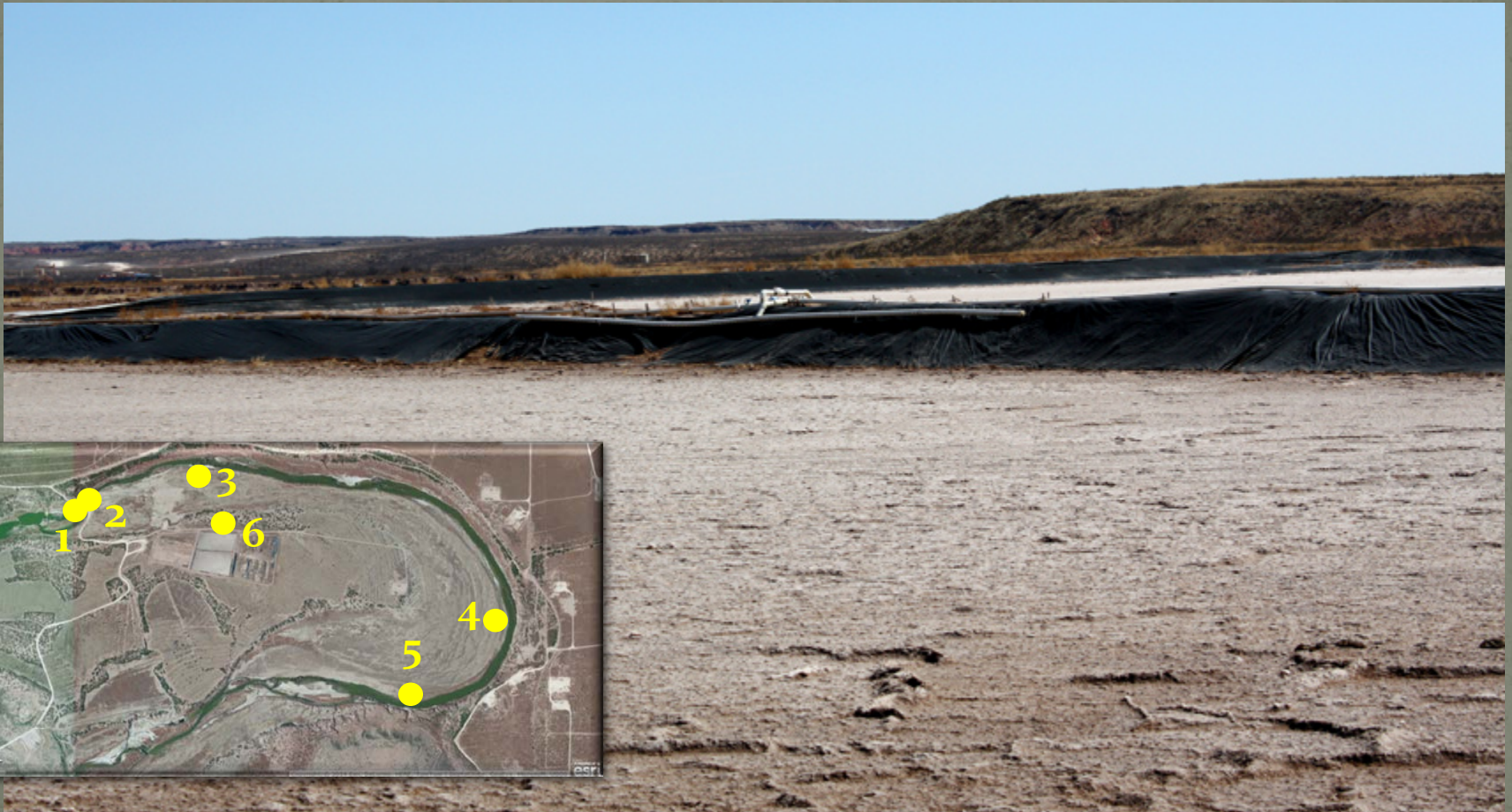
#5 - Toward End of the Bend



- Salt Deposits beginning to diminish

#6 – Old Evaporative Ponds in 2011

- Left over from last attempt



References

- Pecos River Commission, 1955. *Initial Development, Water Salvage and Salinity Alleviation Action Programs, Pecos River Basin.*
- Cox, E.H. and J.L. Kunkler, 1962. *Feasibility of Injecting Brine from Malaga Bend into the Delaware Mountain, Eddy County, NM.* USGS in cooperation with the Pecos River Commission.
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- Shepherd, C. 2014. Personal communication.