Efficient measures for controlling irrigation canal losses in the Rio Grande Project area

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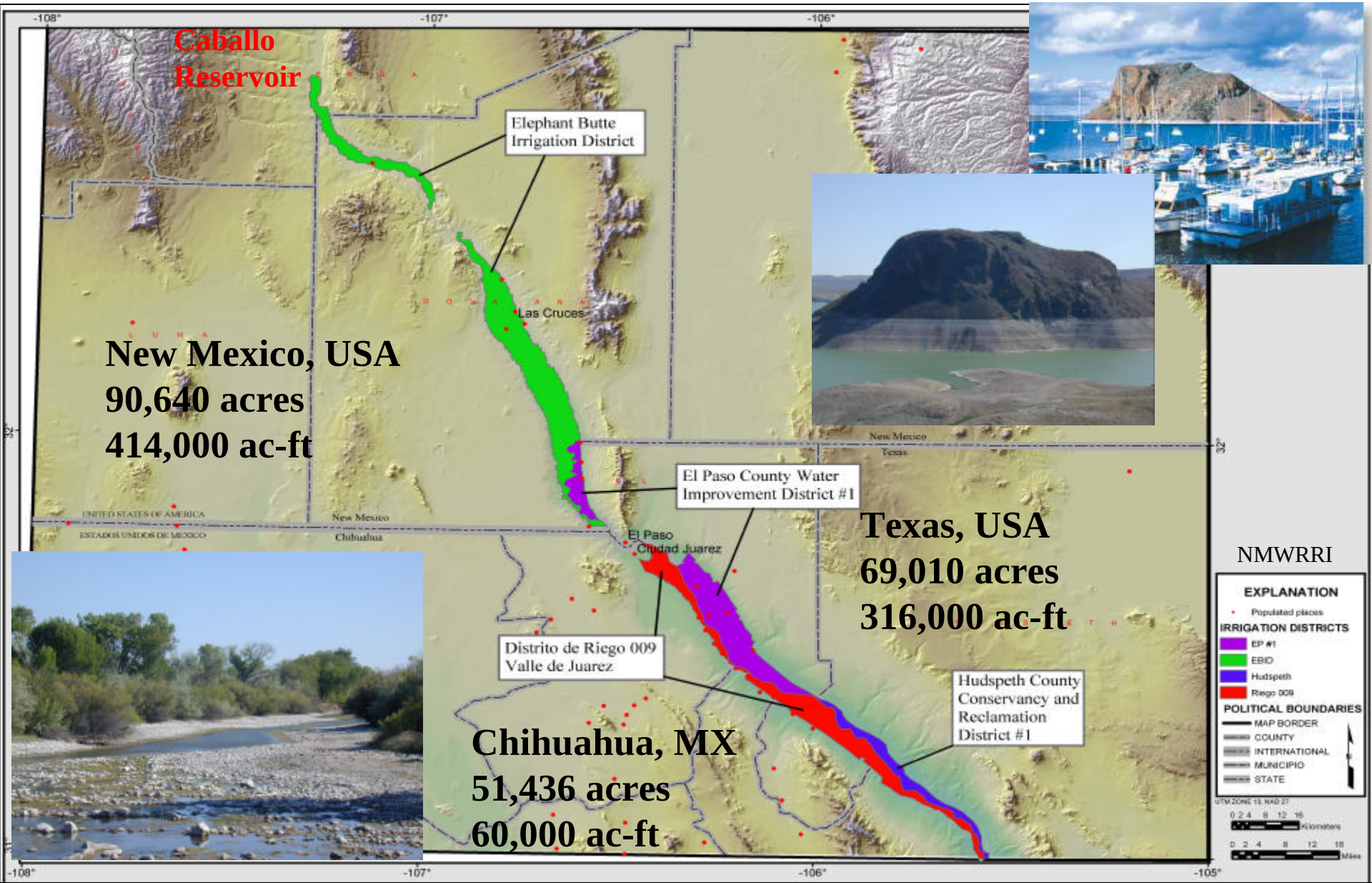
Topics Covered

- Overview of Rio Grande Project area
- Objectives of the Study
- Methodology
- Case Studies: Seepage Losses and Conservation
- Conclusions and Recommendations

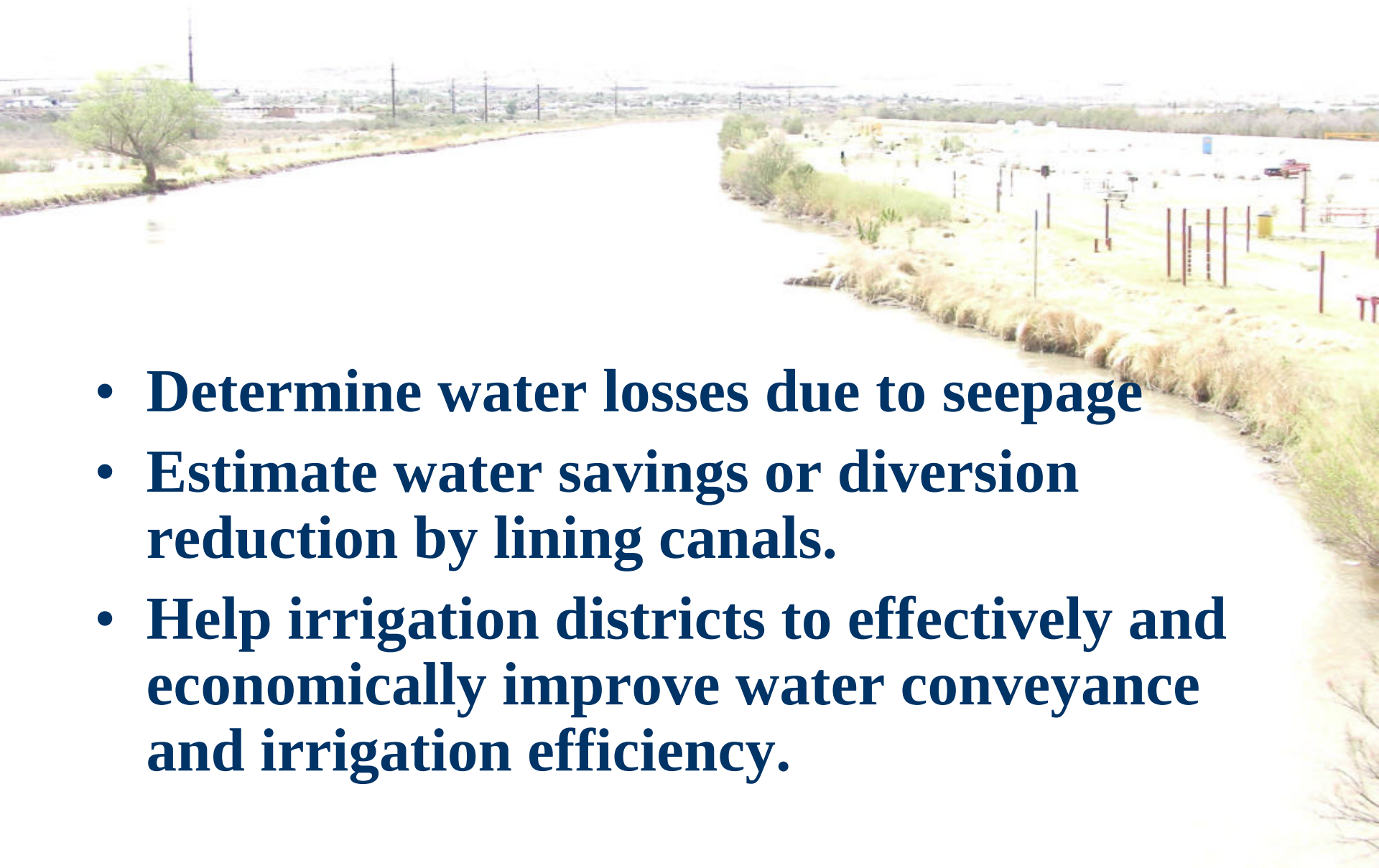
Overview of Rio Grande Project area



Overview (cont.)

- **EPCWID No. 1:**
  - 316, 000 ac-ft of the Rio Grande project water.
  - Irrigation – 47k out of 69,010 acres with water rights
  - M&I uses – 60,000 ac-ft by water utilities.
  - 37 miles of canals and laterals in the upper valley and 216 miles in the lower valley.
- **EBID:**
  - 414,000 ac-ft of the Rio Grande project water.
  - Irrigation – 74k out of 90,640 acres with water rights.
  - 76 miles of canal and laterals in the Rincon Valley and 281 miles in Mesilla Valley.

Objectives of the Study



- **Determine water losses due to seepage**
- **Estimate water savings or diversion reduction by lining canals.**
- **Help irrigation districts to effectively and economically improve water conveyance and irrigation efficiency.**

Methodology - Ponding Test

- Block the selected canal section with earth dams to create a ponding area.
- Collect information of the canal geometry and ponding sites.
- Feed water into the ponding area.
- Take water level readings using pre-installed staff gauges or pressure transducers for several consecutive days.
- Assess evaporation rate and calculate the unit seepage rate over the wetted area.
- Estimate total water savings by lining the canal.

Methodology - Assessment of Seepage

- **Wetted Perimeter:**

  $P_w = b+2h*Sqrt(1+Z^2)$

- **Measured Water Losses Per Unit Wetted Area Per Day:**

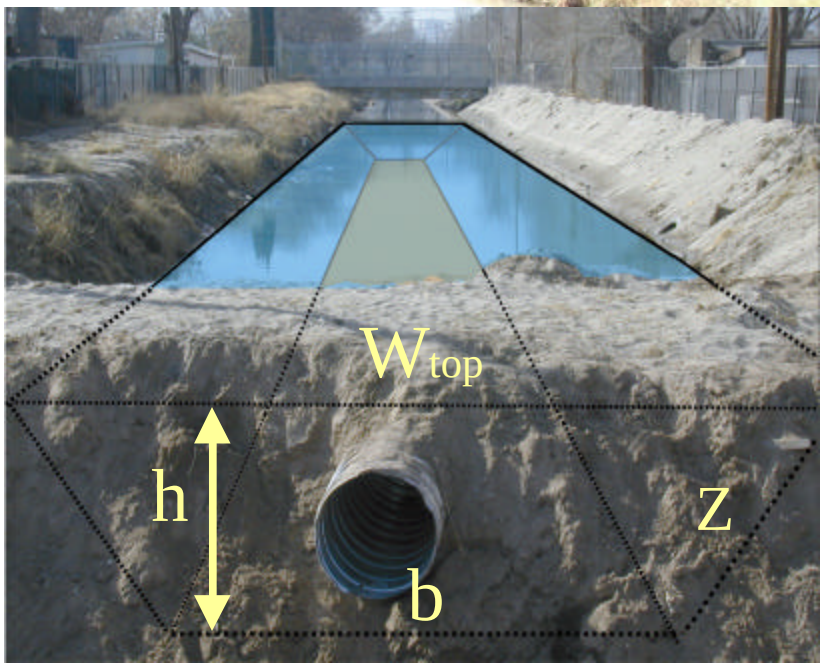
  $DWL = Dh*W_{top}/P_w$

- **Total Water Losses For the Irrigation Season:**

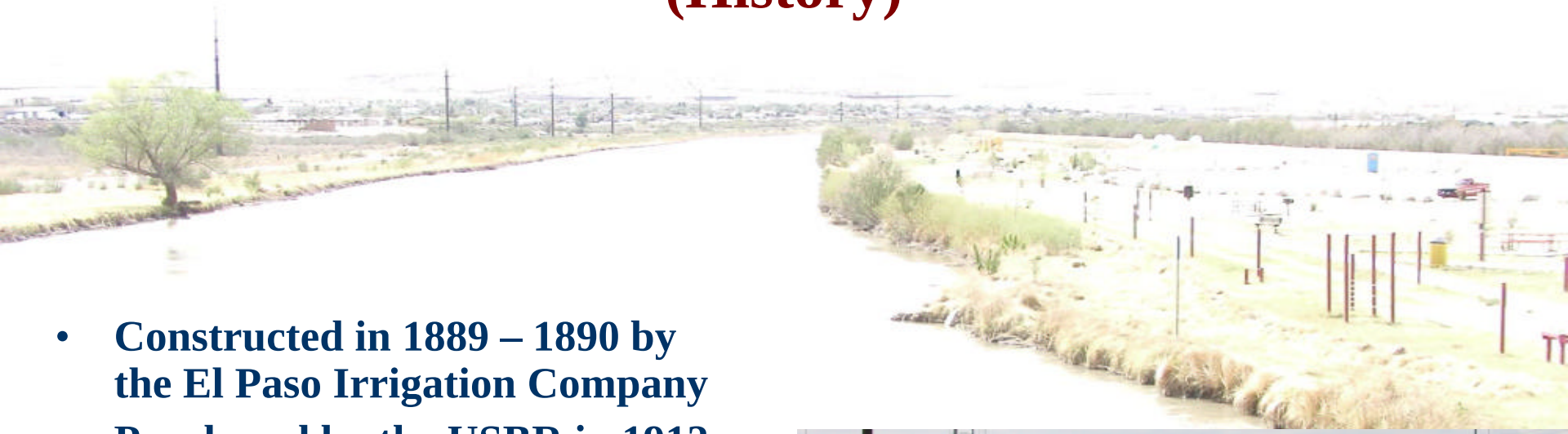
  $WL = DWL*P_w^{op}*L*243$

- **Seepage Losses (**DET = 0.08~0.12 **inches per day):**

  $SP = WL - (ET*W_{top}*L*243)$

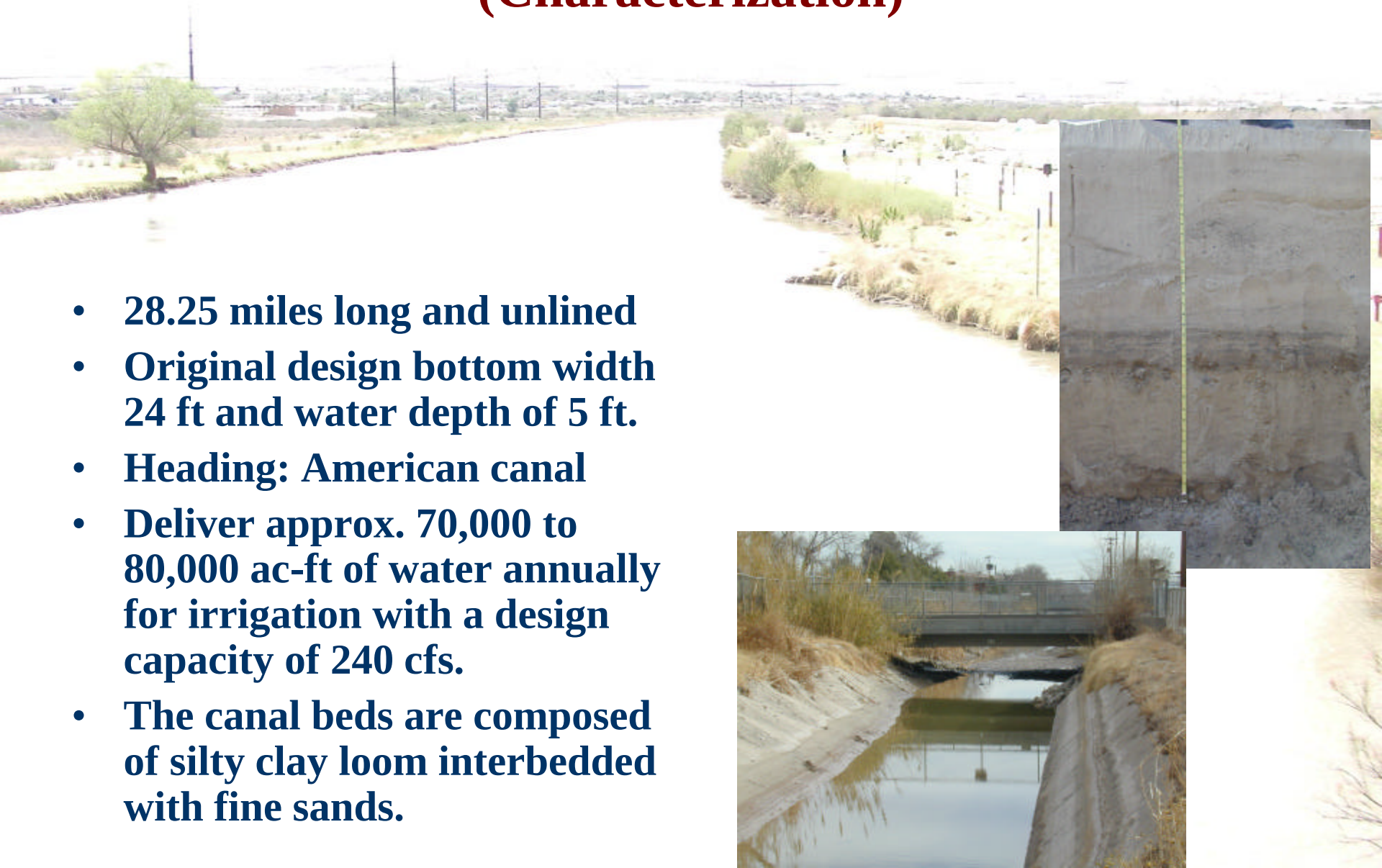


Franklin Canal Case Study
(History)



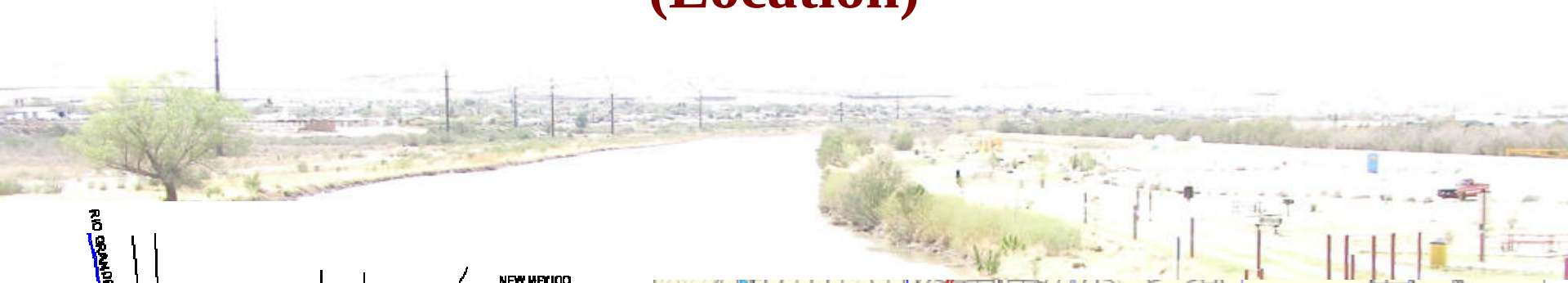
- Constructed in 1889 – 1890 by the El Paso Irrigation Company
- Purchased by the USBR in 1912
- Transferred ownership to the El Paso County Water Improvement District No. 1 in 1996
- A Texas Civil Engineering Landmark in 1976
- The National Register of Historic Places on June 19, 1992.

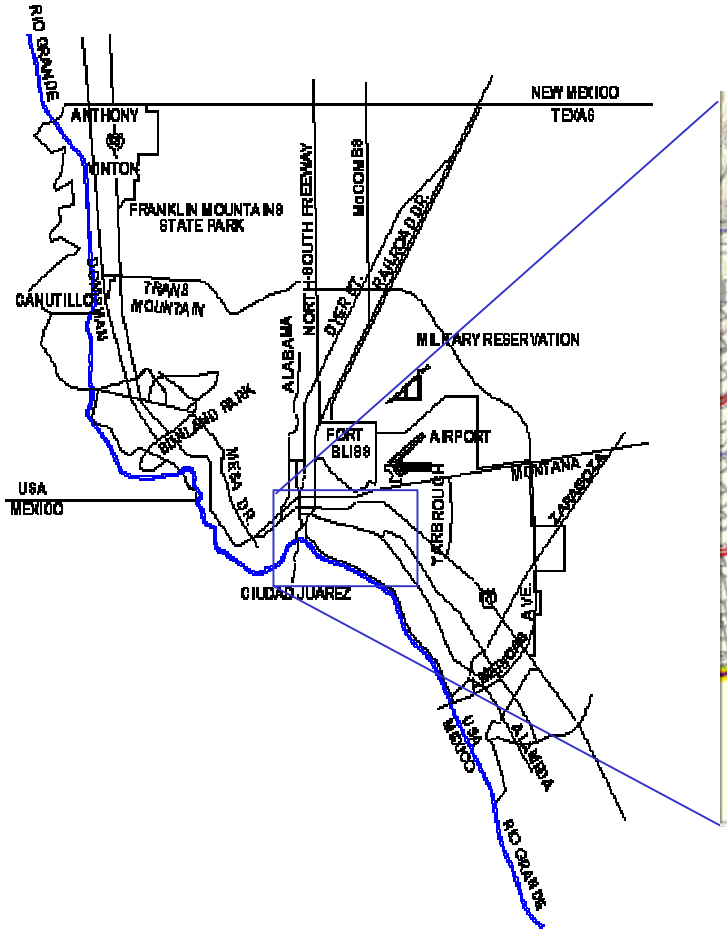
Franklin Canal Case Study
(Characterization)

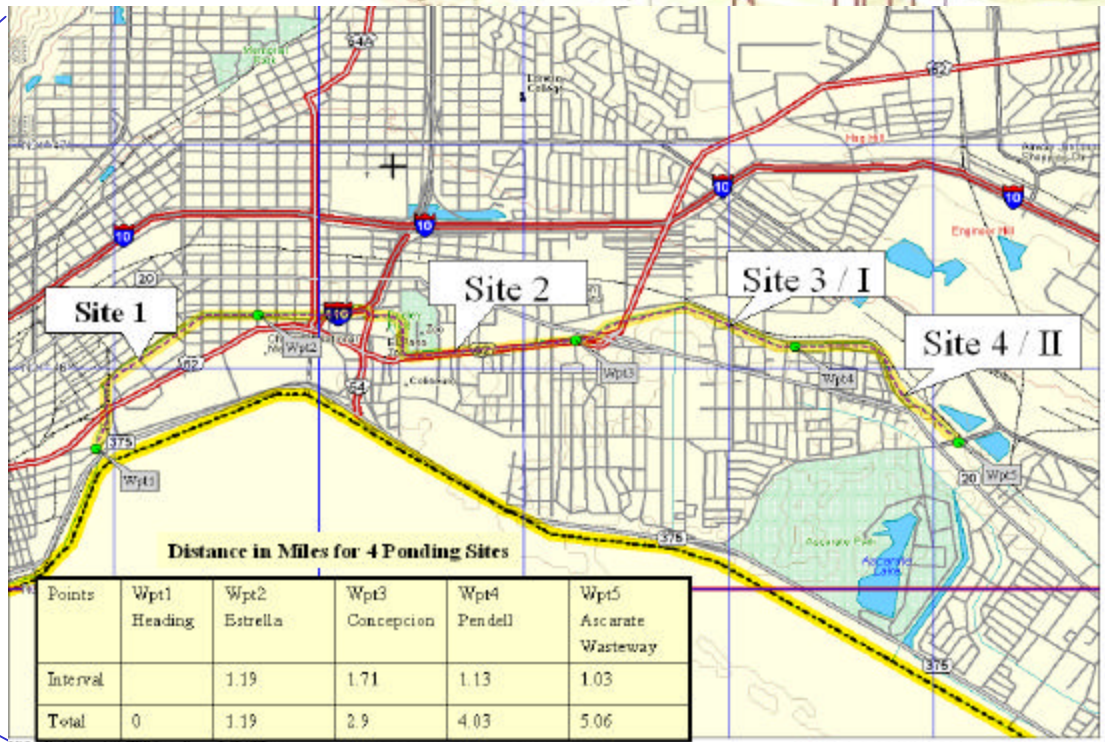


- 28.25 miles long and unlined
- Original design bottom width 24 ft and water depth of 5 ft.
- Heading: American canal
- Deliver approx. 70,000 to 80,000 ac-ft of water annually for irrigation with a design capacity of 240 cfs.
- The canal beds are composed of silty clay loom interbedded with fine sands.

Franklin Canal Case Study
(Location)



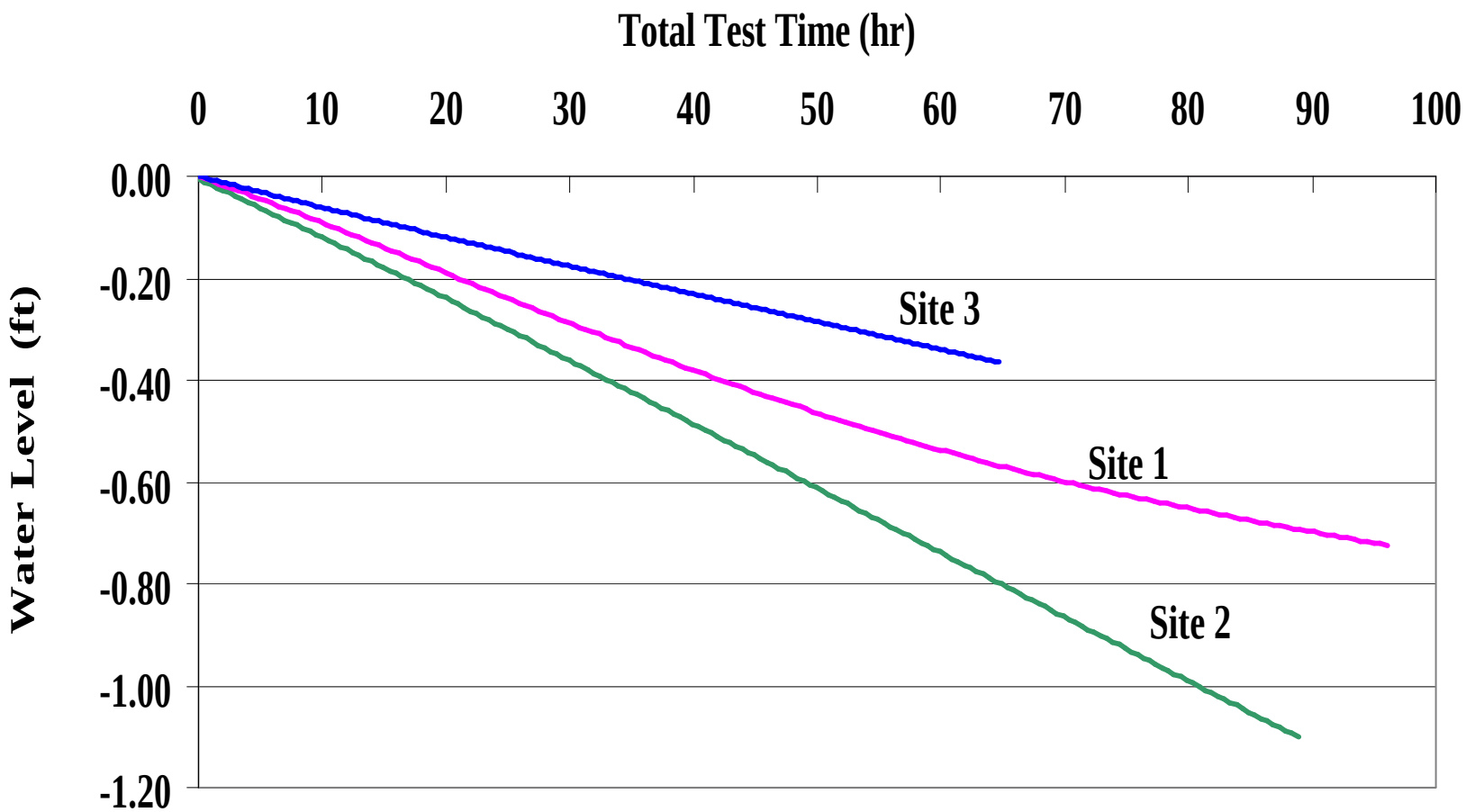




Distance in Miles for 4 Ponding Sites

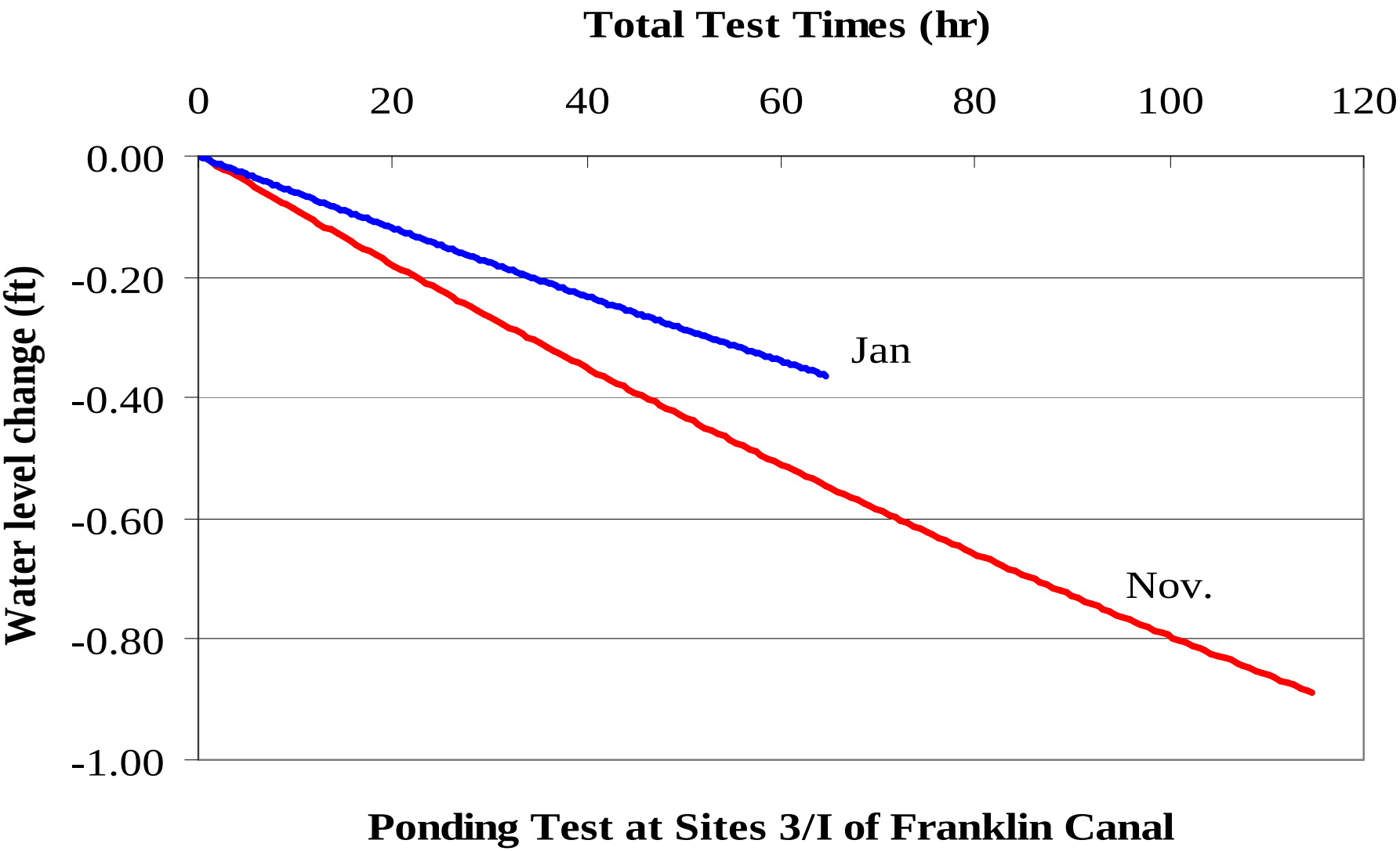
Points	Wpt1 Heading	Wpt2 Estrella	Wpt3 Concepcion	Wpt4 Pendell	Wpt5 Ascarate Wasteway
Interval		1.19	1.71	1.13	1.03
Total	0	1.19	2.9	4.03	5.06

Field Measurement



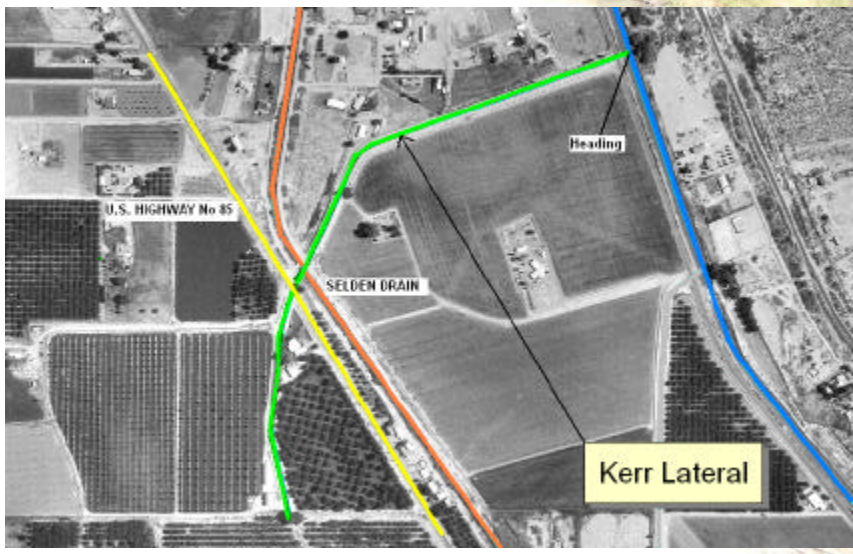
Ponding Test Observation at Franklin Canal in January

Field Measurement (cont.)



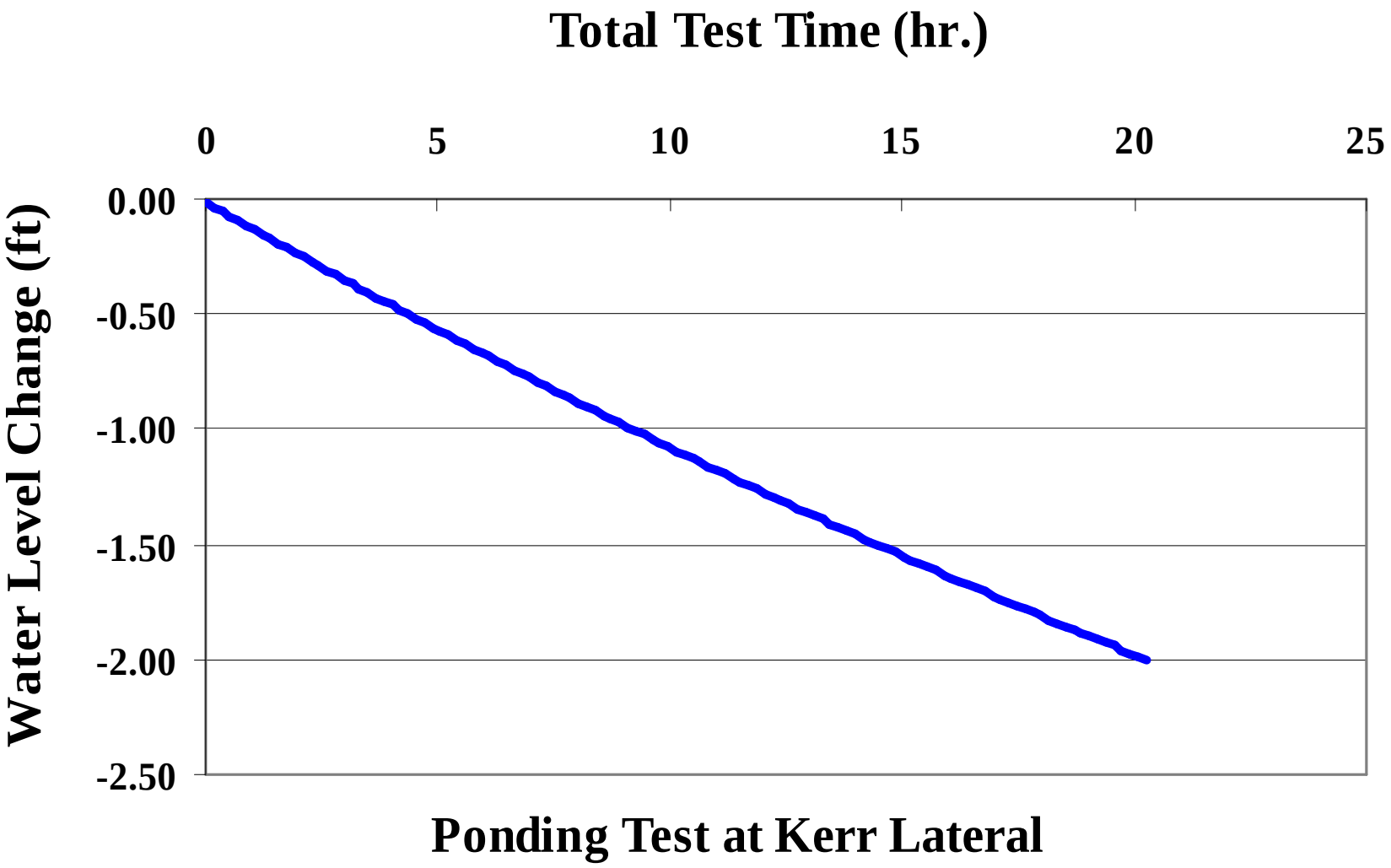
Kerr Lateral

- **Location: Unit 2A, about 10 miles north Las Cruces and about 0.7 mile east Rio Grande**
- **Heading: Leasburg Canal**
- **Length: 3,169 ft**
- **Irrigated land: 276 acres**
- **Capacity: 20 cfs**



(Source: Elephant Butte Irrigation District)

Field Measurement (cont.)



Ponding Test Results Summary
(El Paso)

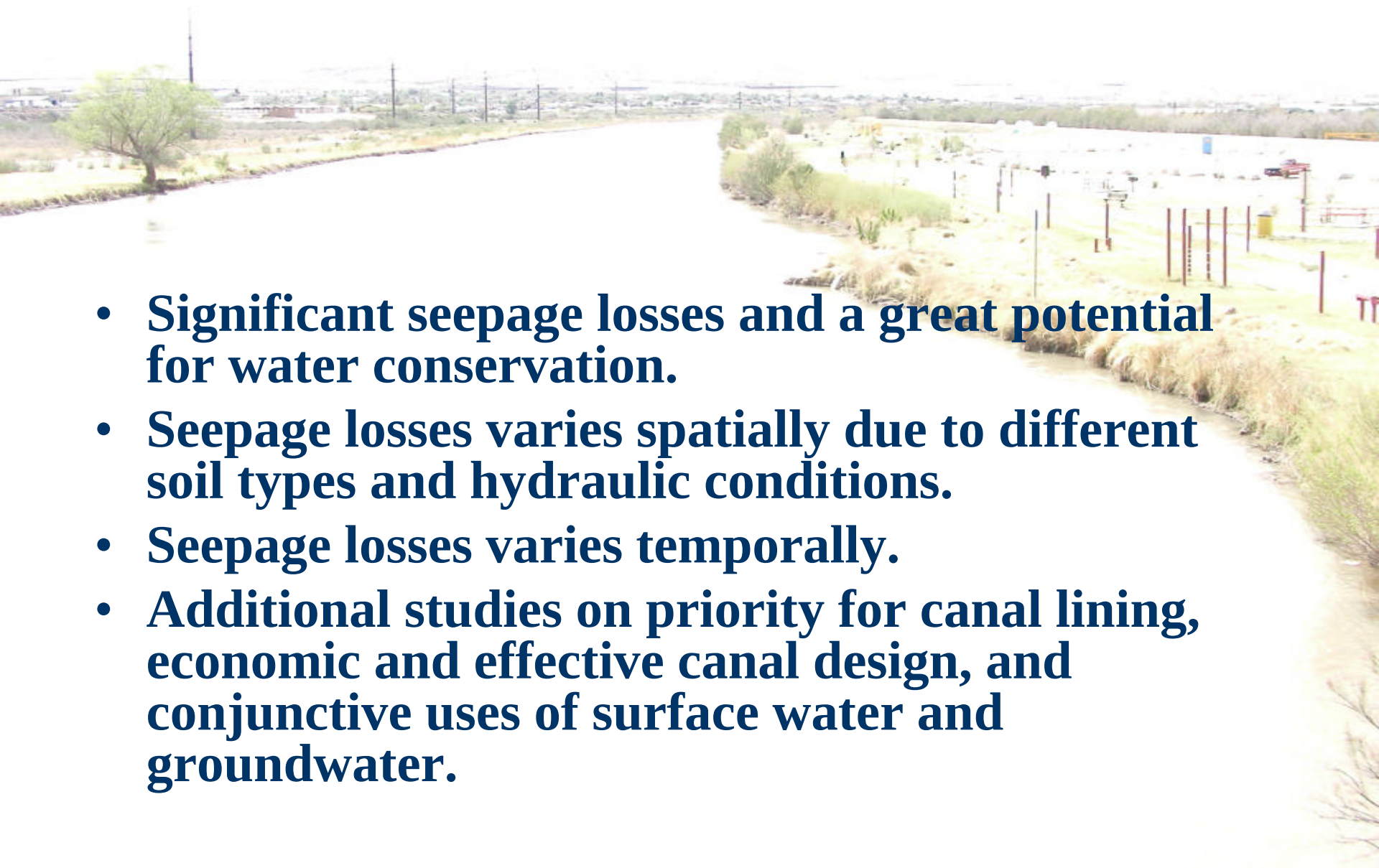
Ponding Site	Water Level Change Rate (ft/day)		Measured Unit Seepage Losses (cub ft/sq ft/day)	Estimated Unit Seepage Losses		Estimated Seepage Losses (ac-ft/ mile) for the Irrigation Season
				(cfs/mile)	(ac-ft/mile per day)	
Site 1 - Jan	Max	0.22	0.21	0.47	0.93	226
	Min	0.11	0.11	0.25	0.4689	114
Site 2 - Jan	Max	0.35	0.34	0.75	1.4911	362
	Min	0.29		0.63	1.25	305
Site 3 - Jan	Max	0.14	0.14	0.33	0.65	159
	Min	0.12		0.29	0.56	137
Site 3/I – Nov	Max	0.21	0.20	0.49	0.97	235
	Min	0.17		0.40	0.79	191
Site 4/II – Nov	Max	0.27		0.63	1.26	305
	Min	0.25		0.59	1.17	285
Kerr Lateral	Max	3.06	2.64	2.50	4.97	1207
	Min	2.24	1.96	1.79	3.55	862

Impacts and Significance

- Water conservation for agriculture (lining 10 miles to save water for 1,000 acres of crops) and extend limited resources for drought contingency

- Alternative sources for M&I supplies and enhance cooperation among stakeholders through data sharing

Conclusions and Recommendations



- **Significant seepage losses and a great potential for water conservation.**
- **Seepage losses varies spatially due to different soil types and hydraulic conditions.**
- **Seepage losses varies temporally.**
- **Additional studies on priority for canal lining, economic and effective canal design, and conjunctive uses of surface water and groundwater.**

Partnerships/Acknowledgement

- USDA – CSREES: Rio Grande Basin Initiative
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- El Paso County Water Improvement District No.1
- Elephant Butte Irrigation District
- Texas Water Resource Institute
- Texas Agricultural Experiment Station
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Thank You!