Fence Segments O-1, O-2, O-3

2D Hydraulic Analysis of the Rio Grande Floodplain

International Boundary and Water Commission

United States Section

Engineering Services Division

August 29, 2012

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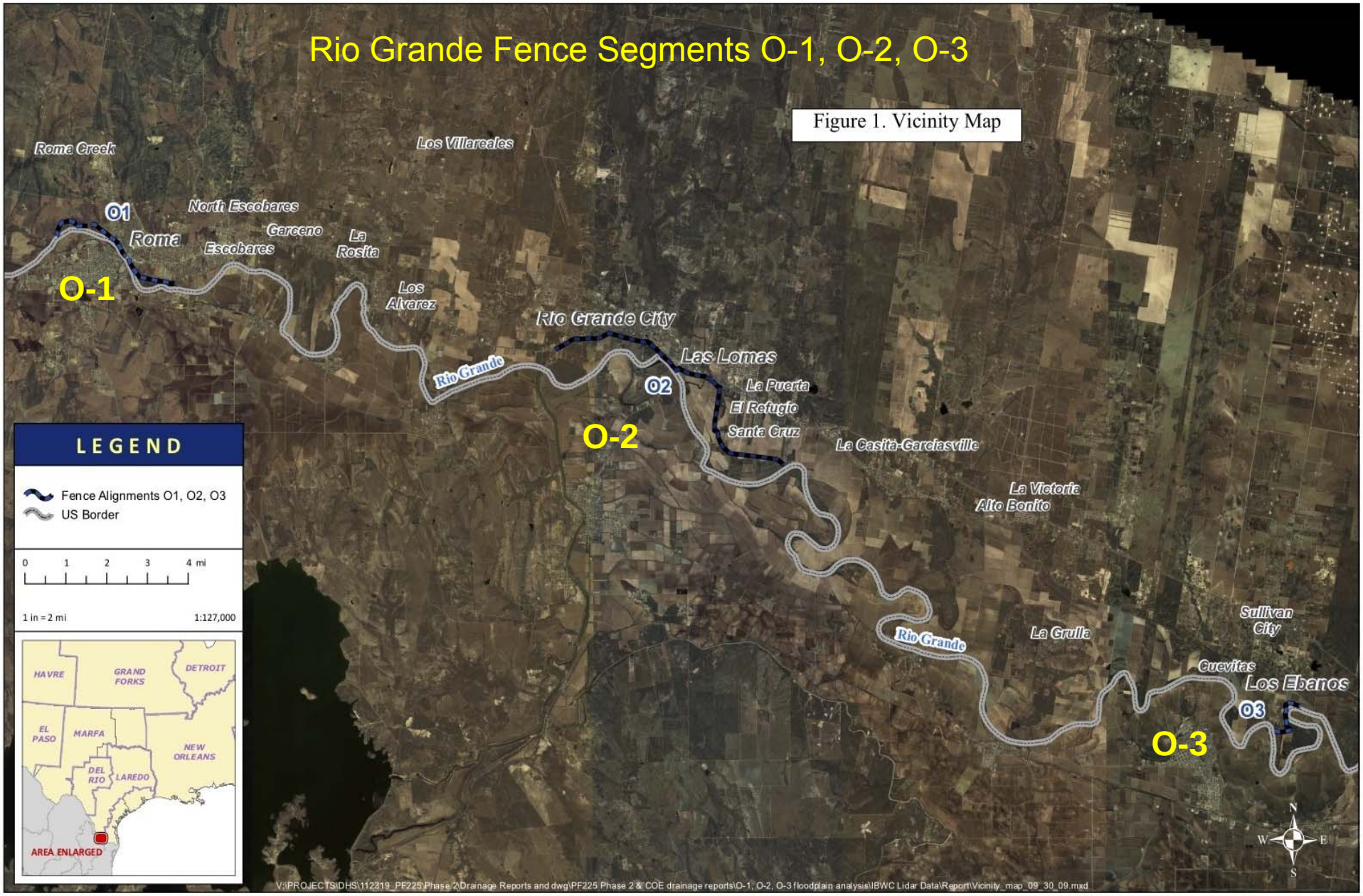

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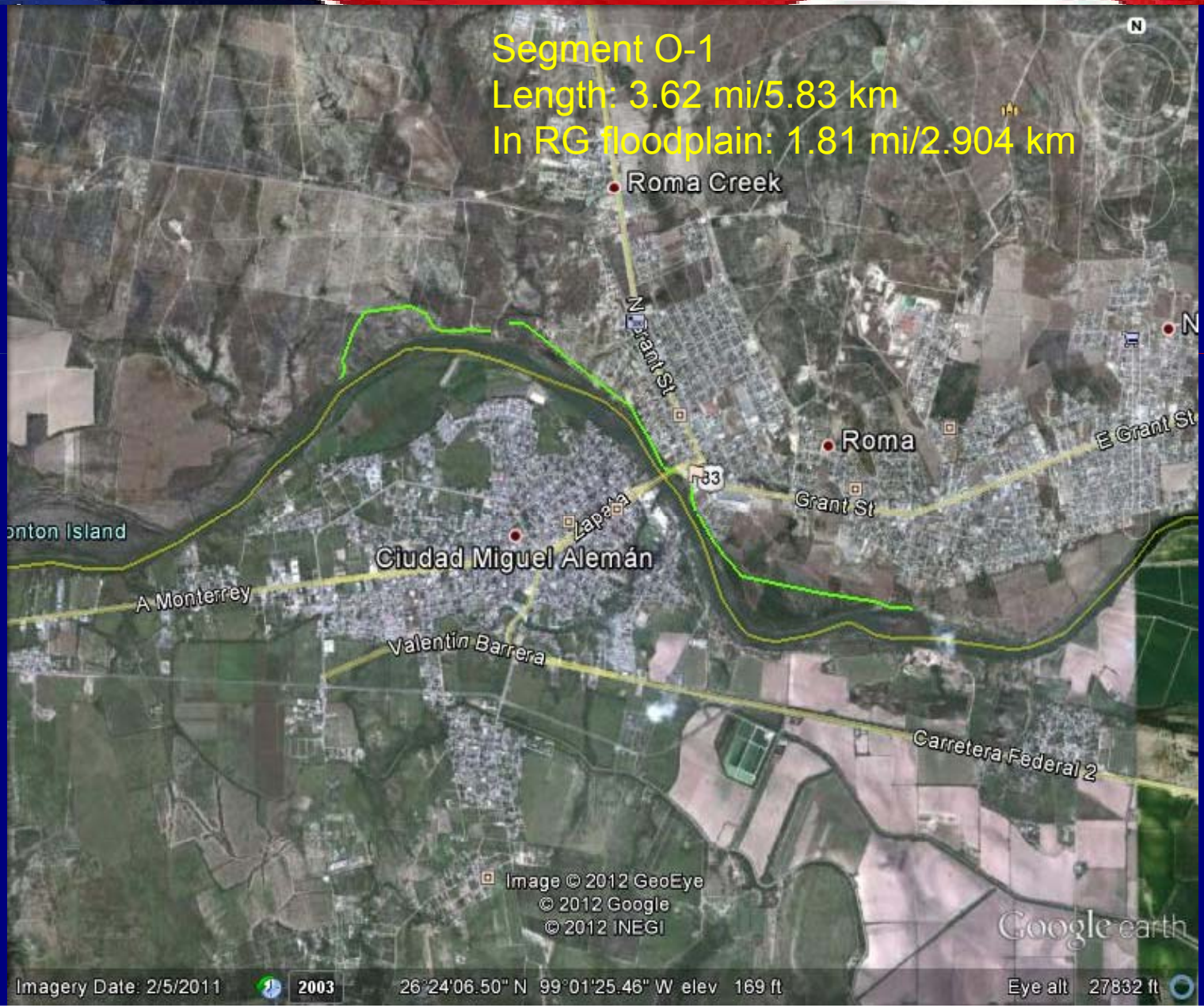

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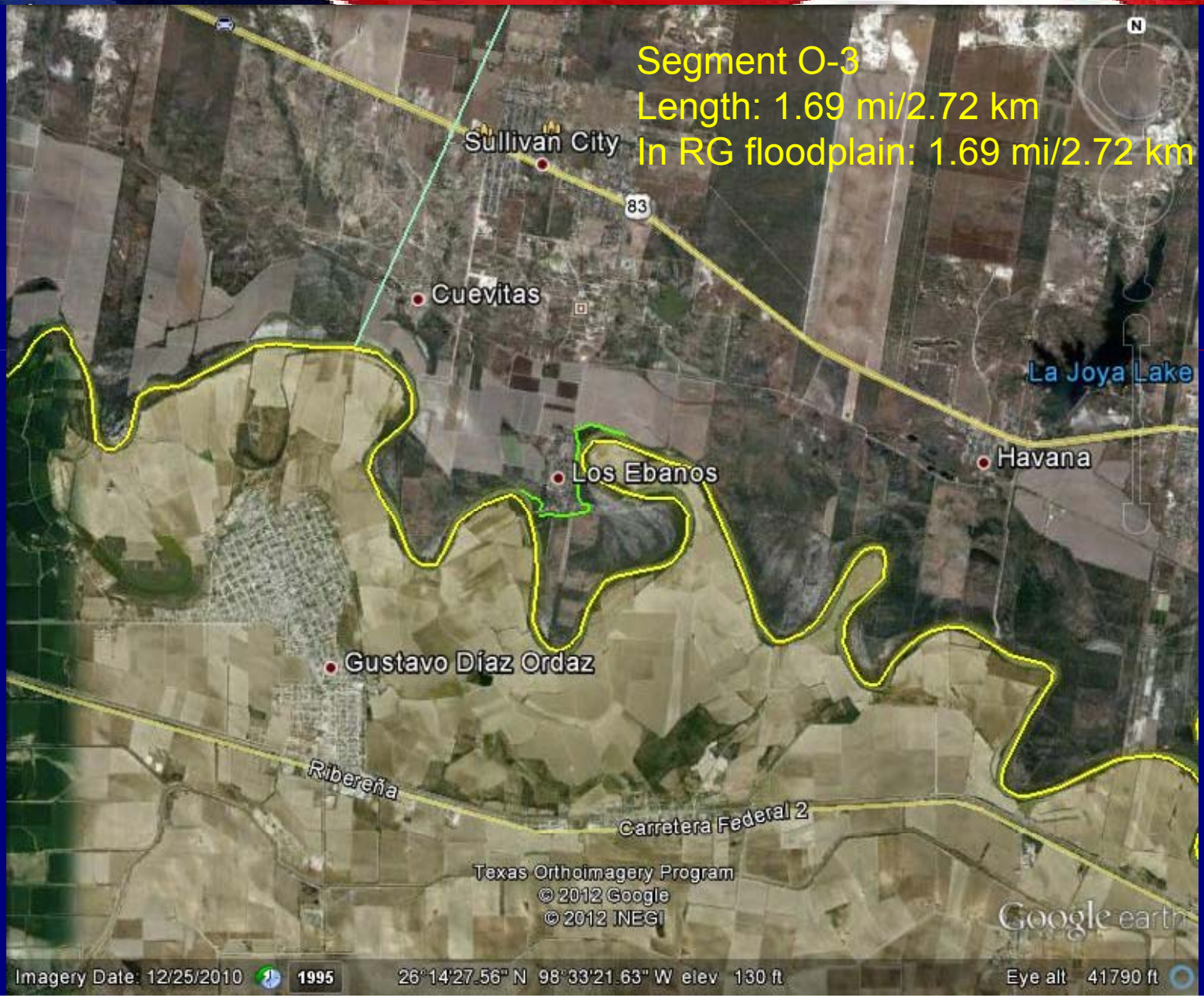
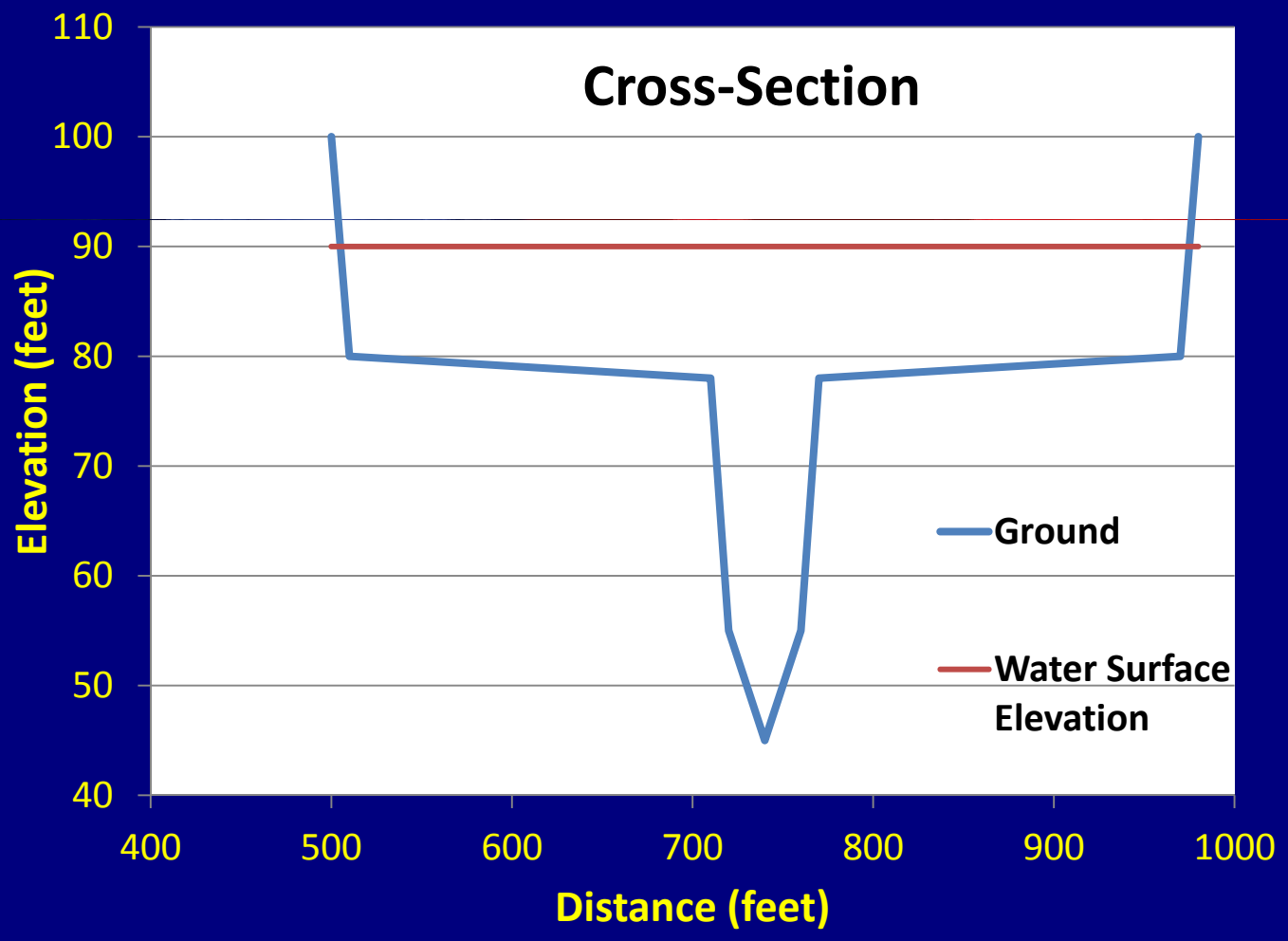


Some Definitions

- Cross-Section
- Water Surface Elevation (feet)
- Discharge (cubic feet per sec or cfs)
- Hydrograph
- Bollard Fence

Some Definitions



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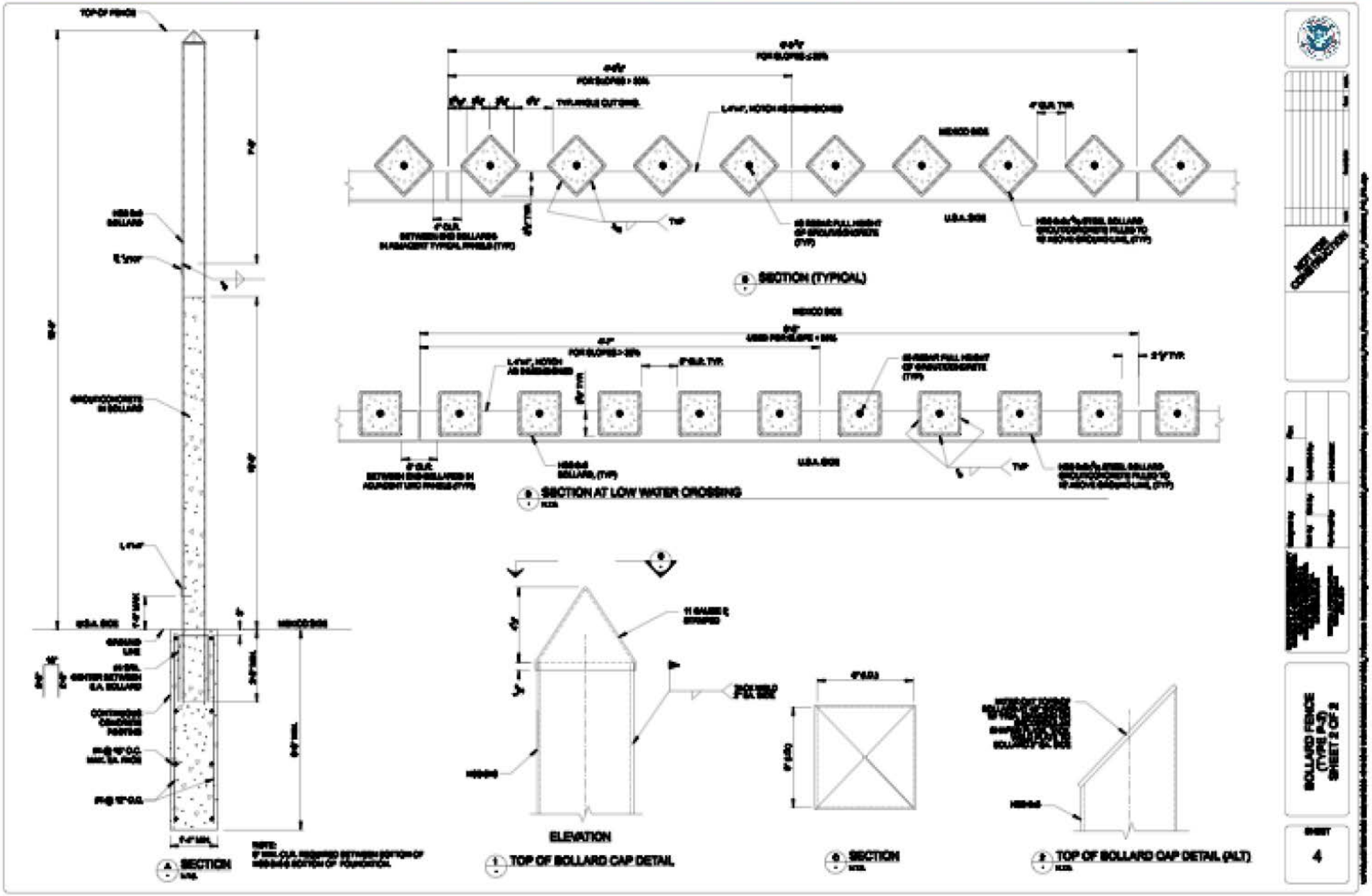

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Timeline of Analysis

- March, 2008: DHS submitted post in floodplain based HEC-RAS report to US Section.
- May, 2008: DHS investigated removable bollard and found this to be impractical.
- Jan, 2010: DHS presented results of additional HEC-RAS modeling to US Section.
- May 2010: Commissioner Drusina requested DHS to study fence hydraulic impacts with a two-dimensional model.

Timeline of Analysis

- Feb, 2011: USIBWC met with DHS, USACE and Consultant to discuss and finalize FLO-2D modeling methodology.
- Aug, 2011: DHS submitted FLO-2D Report to USIBWC with review comments addressed.
- Sept, 2011: USIBWC shared the Drainage Report and FLO-2D models with the Mexican Section.
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HEC-RAS (1D) vs FLO-2D (2D) Capabilities

HEC-RAS	FLO-2D
►One-dimensional Flow	►Flow with Significant Transverse Components
►Confined Flow	►Nonconfined Flow
►Floodplain Storage Negligible	►Floodplain Storages Significant and Important
	►Flood Attenutation is Important
	►Braided Flow
	►Nonuniform Flow Patterns
	►Better Approximation of Complex Hydraulics
►Constant WSEL for Cross-Section	►Transverse Variation in WSELs, Velocities
	►More Detailed Hydraulic Information

Note: WSEL = Water Surface Elevation

FLO-2D Applications

- Hydrology, Hydraulics, Urban Flooding, Sediment Transport, Alluvial Fan Flow, Mudflow, Dam Breach
- California Department of Water Resources, CA
- California Aqueduct
- Maricopa County Flood Control District, Arizona
- Hydraulics Applied Research & Engineering Consulting (HAREC), Rome, Italy
- Truckee River (CA, NV) – urban flooding from a river channel
- Cerro Grande River, Venezuela – flooding and debris flow

FLO-2D Applications

- FEMA Approved Software for Assessment of Flooding Hazards
- USACE: Rio Grande Canalization Project (Caballo Dam to American Dam in El Paso, 105 mi/169 km) in support of the Upper Rio Grande Water Operations Model
- USACE: Rectification Reach (80 mi/130 km from American Dam to Fort Quitman, Texas)
- USIBWC: Lower Rio Grande Study from Penitas to Brownsville and Off-River Floodways in support of levee rehabilitation

FLO-2D Applications

- USACE: Ongoing Falcon Dam Inundation Mapping Study
- Draft results discussed at Binational Meeting with the Mexican Section and CONAGUA on August 3, 2012.
- Comments provided by both the U.S. and Mexican Sections and are being addressed by the USACE.
- Results will be used by emergency managers along the Rio Grande.

Flows in 1970 Treaty Article IV B (1)

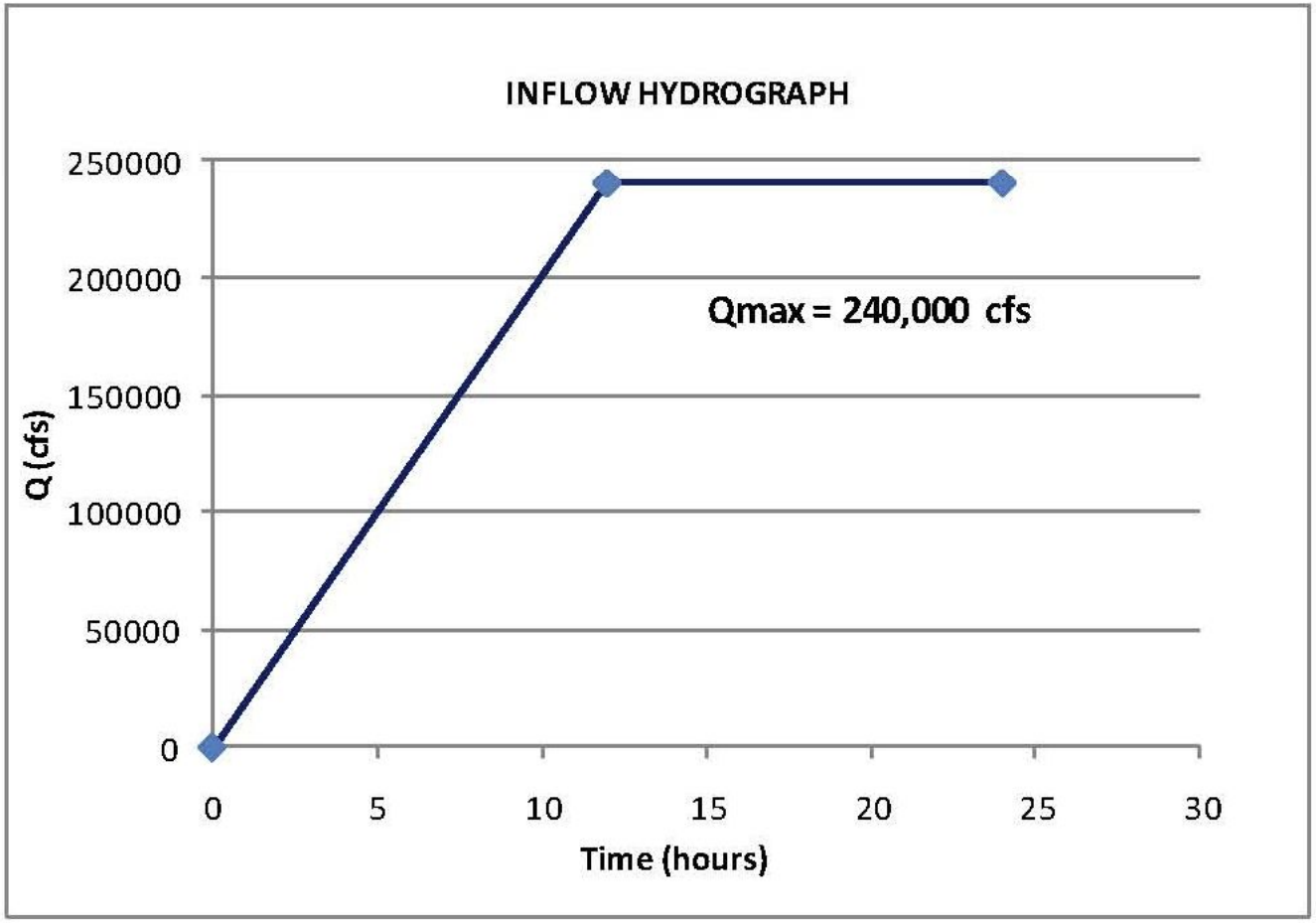
Both in the main channel of the river and on adjacent lands to a distance on either side of the international boundary recommended by the Commission and approved by the two Governments, each Contracting State shall prohibit the construction of works in its territory which, in the judgment of the Commission, may cause deflection or obstruction of the normal flow of the river or of its flood flows.

FLO-2D Methodology

- Grid Size
- Inflow Hydrograph (peak based on Hurricane Beulah)
- Detailed Channel Representation
- Fence as Hydraulic Structures (Rating Curves)
- Spacing, Debris Considered for Rating Curves
- Volume Balance (< 0.001%)
- Numerical Stability
- Grid Based Water Surface Elevations
- Floodplain Cross-Section Hydrographs
- Channel Element Hydrographs

FLO-2D Methodology

Rio Grande discharge based on original IBWC HEC-RAS



Hydraulic Impact Thresholds

Water Surface Elevation Increases
(Proposed Condition – Existing Condition)

- Urban Cells (3 inches)
- Rural Cells (6 inches)

Percent Deflections

- Floodplain Cross-Sections (< +5%)
- Channel Elements (< +5%)

Proposed Condition to be similar to Existing Condition
Use Gates if Impacts Exceed Thresholds

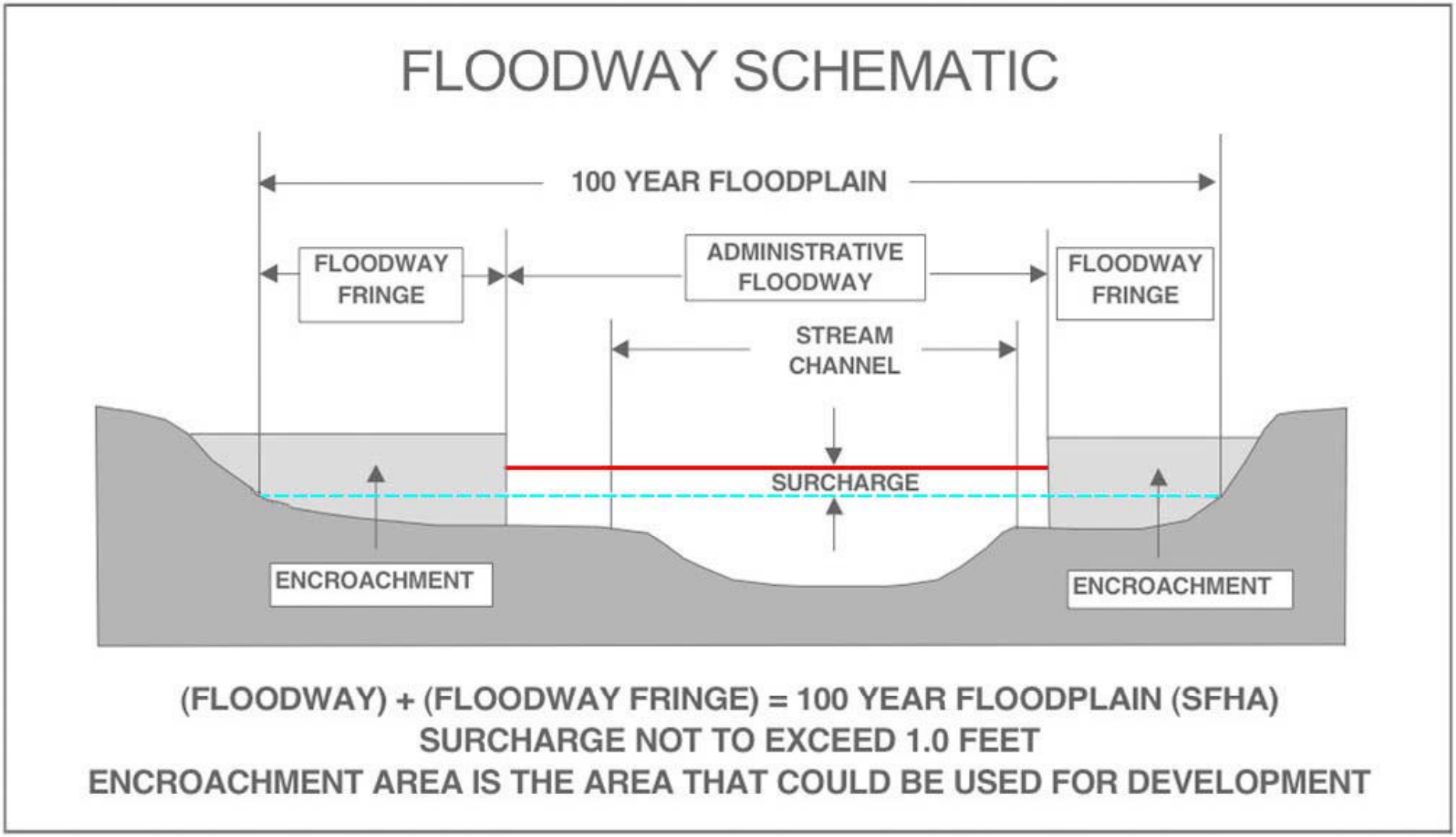
Hydraulic Impact Thresholds

FEMA Floodplain and Floodway

(Maximum water surface elevation rise allowed by construction in floodplain = 1 foot)

U. S. Section thresholds are more conservative (3 inches and 6 Inches than FEMA)

FEMA Floodway



FLO-2D Results

- Volume Balance (< 0.001%)
- Numerical Stability
- Typical Velocities
- Water Surface Elevations (Urban < 3 in; Rural < 6 in)
- Deflections: Floodplain Cross-Sections (< +5%)
- Deflections: Channel Elements (< +5%)

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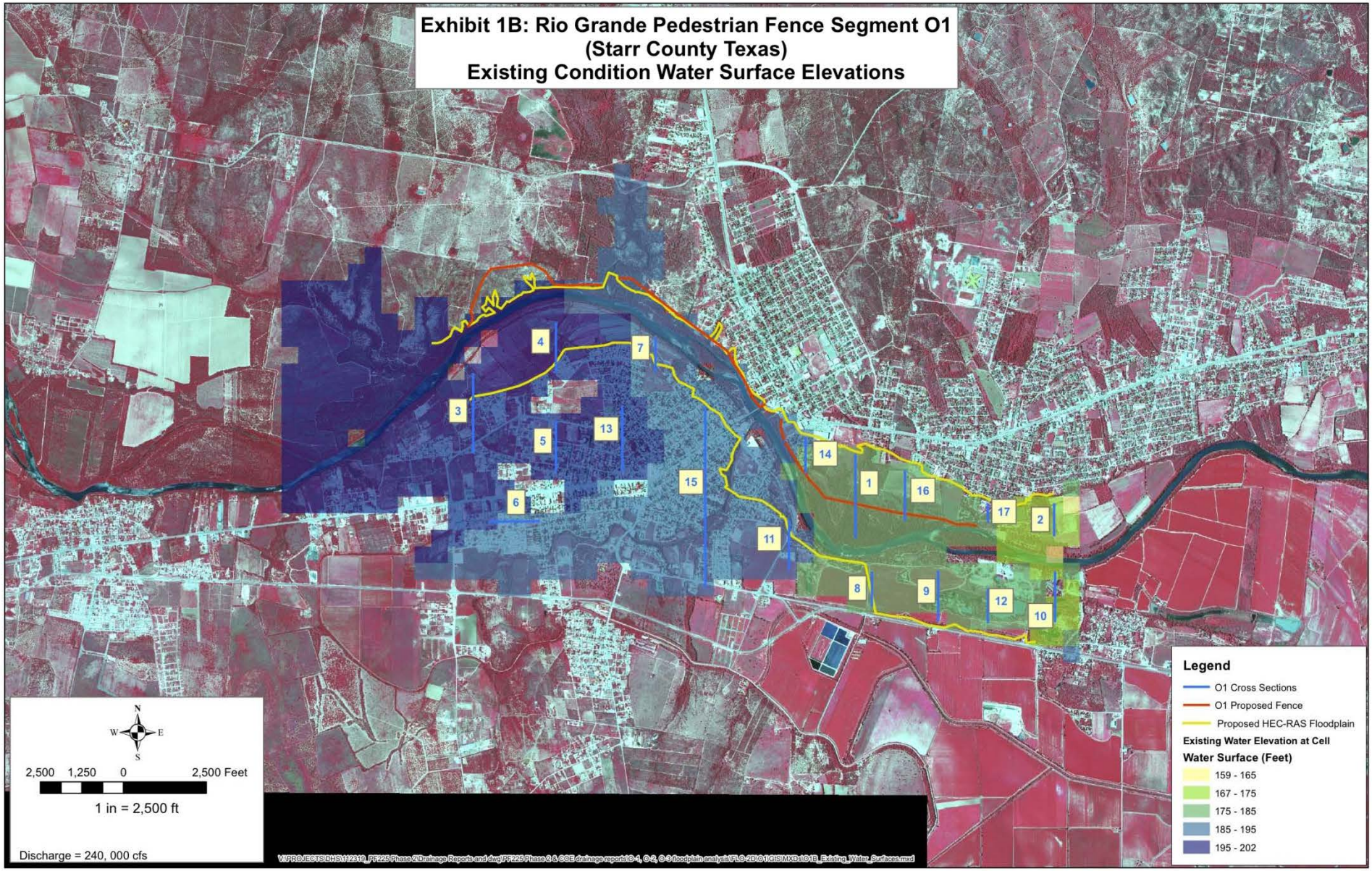

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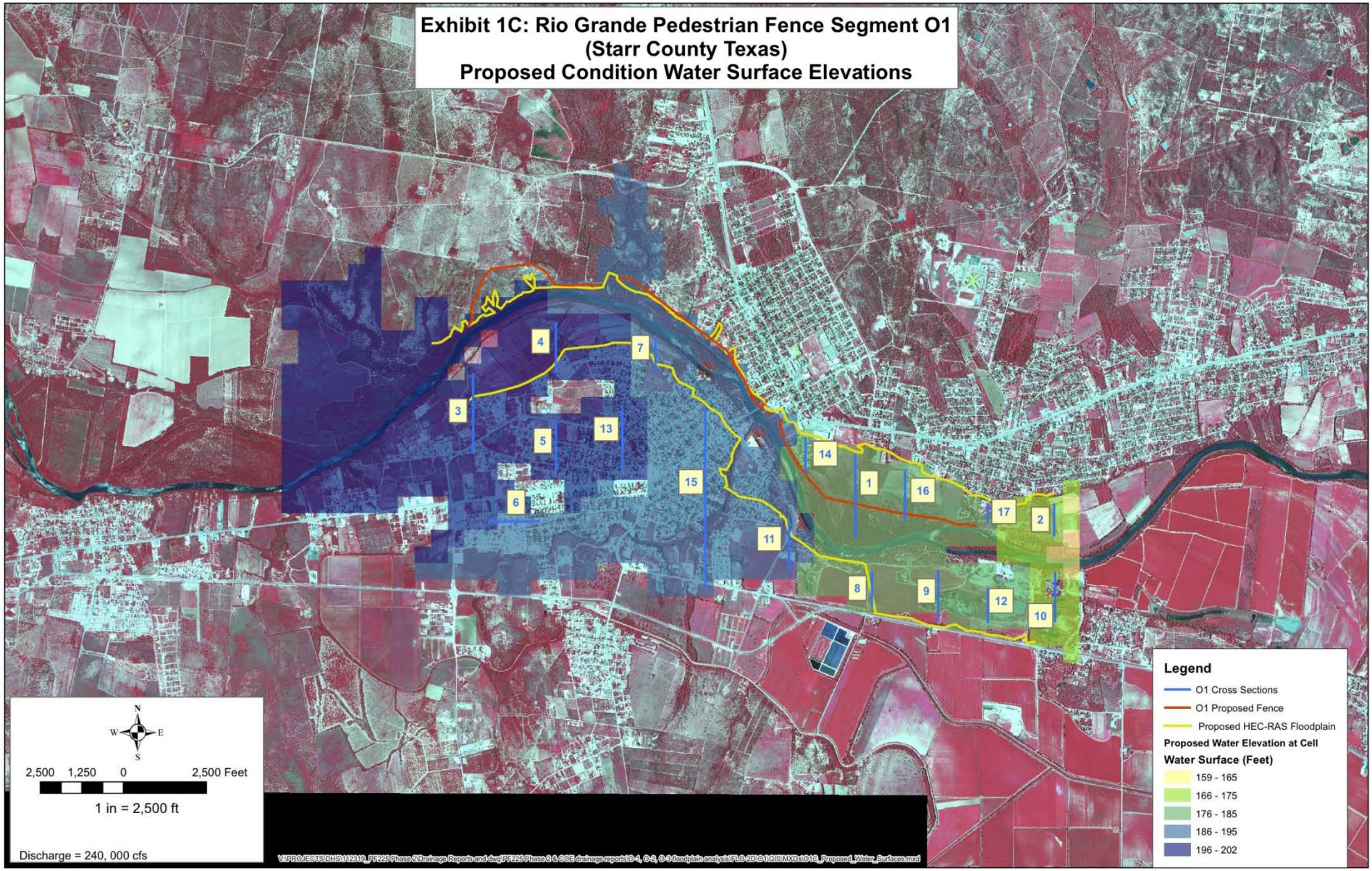

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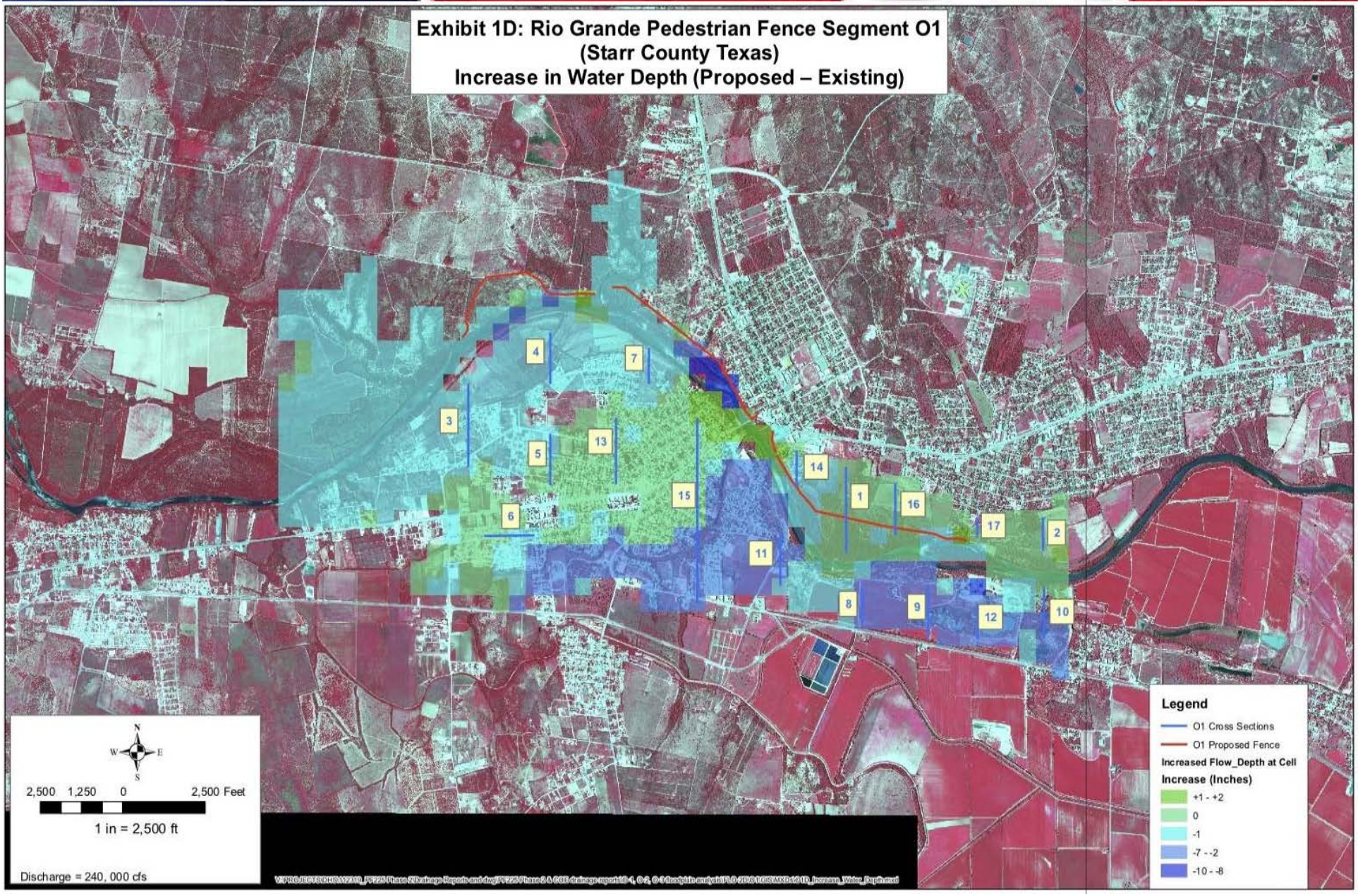

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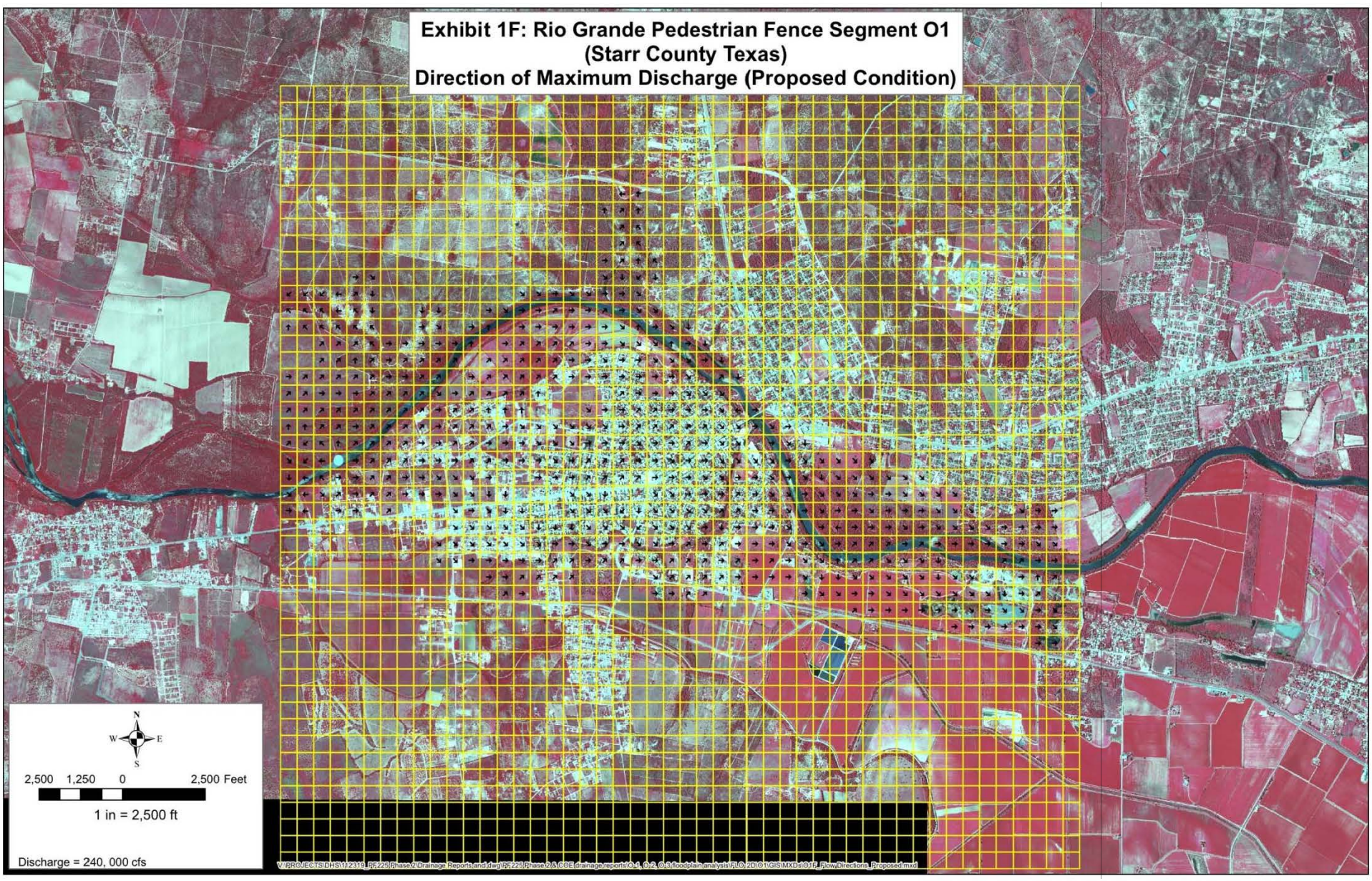

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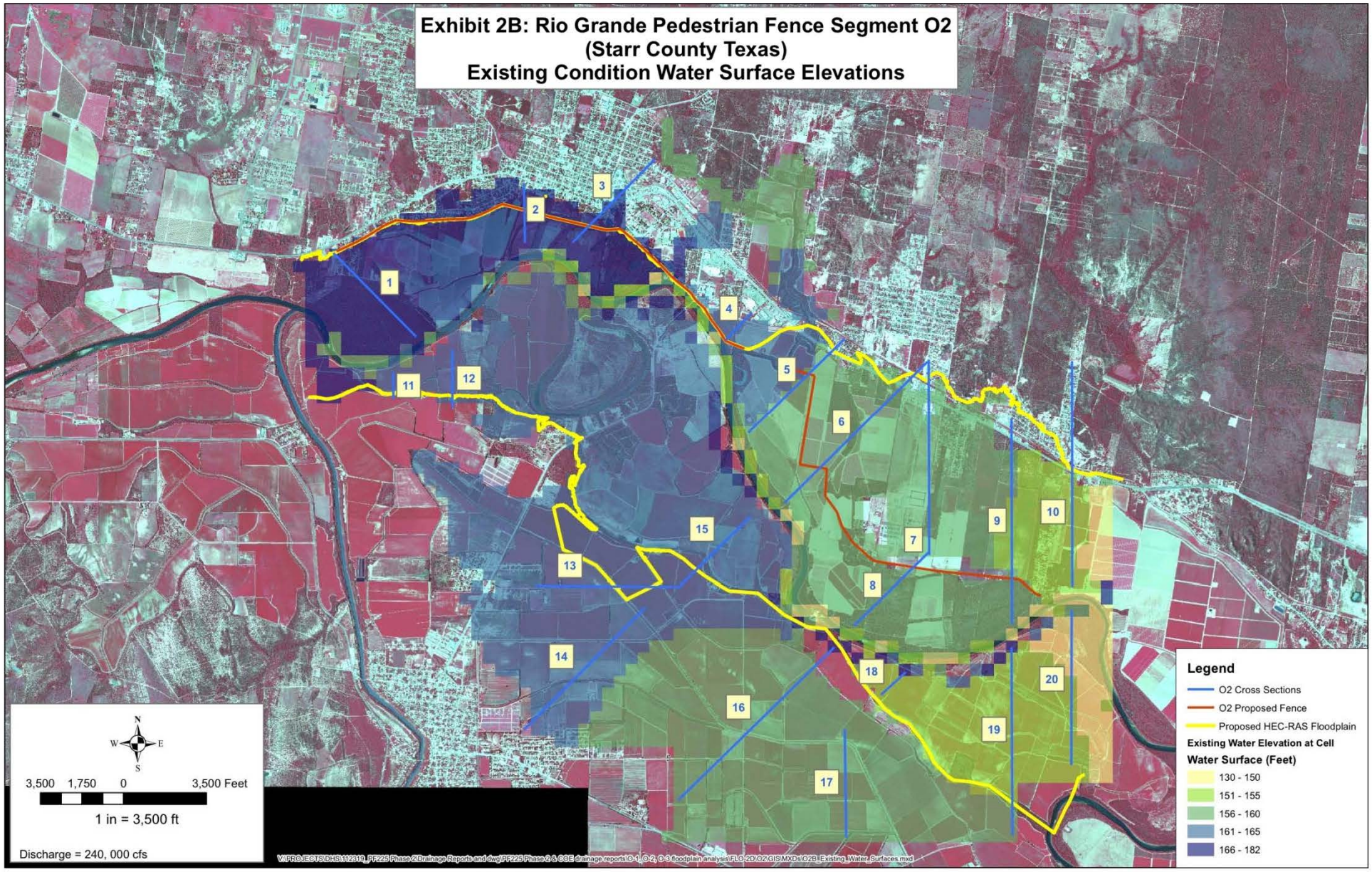

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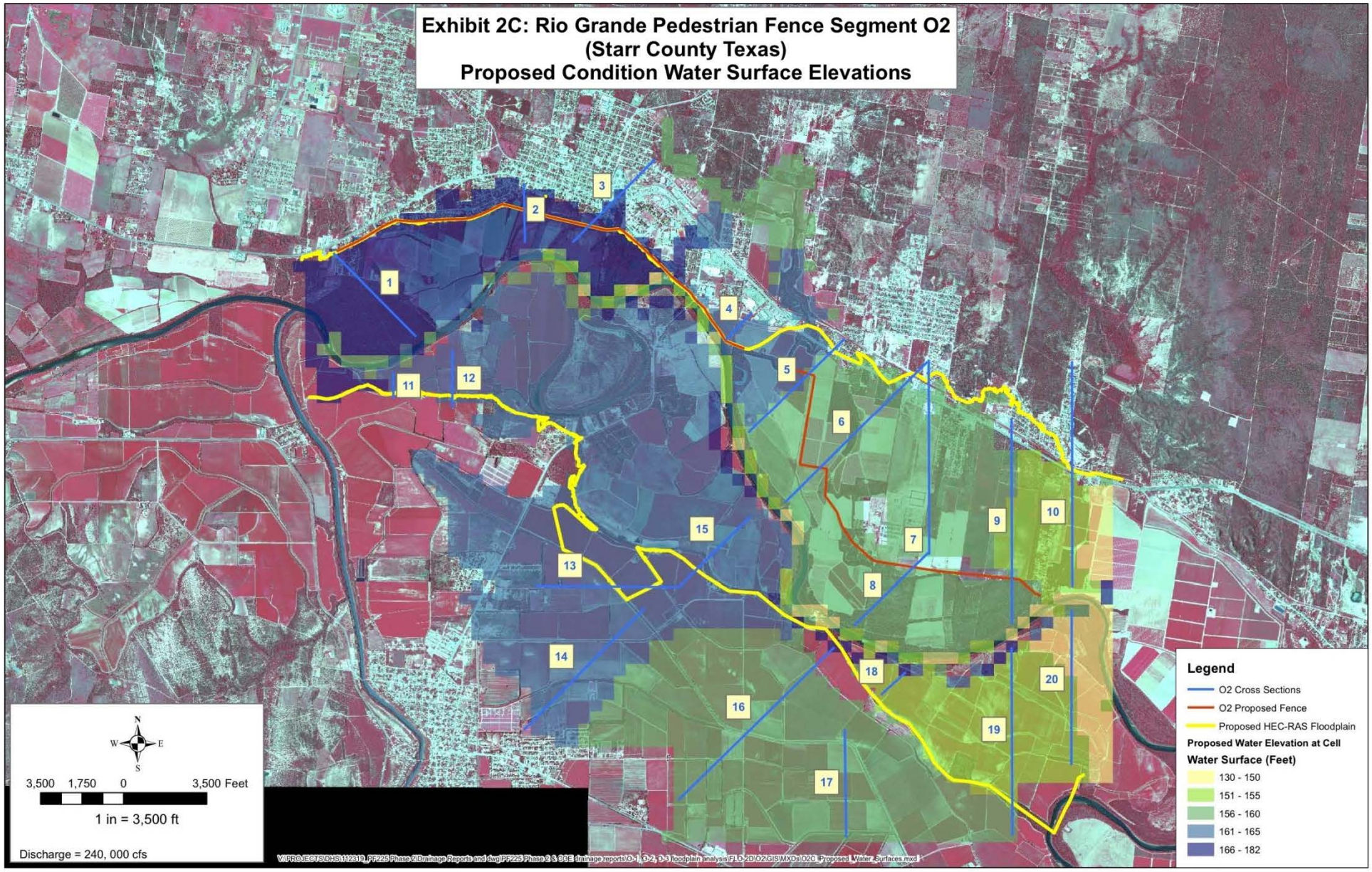

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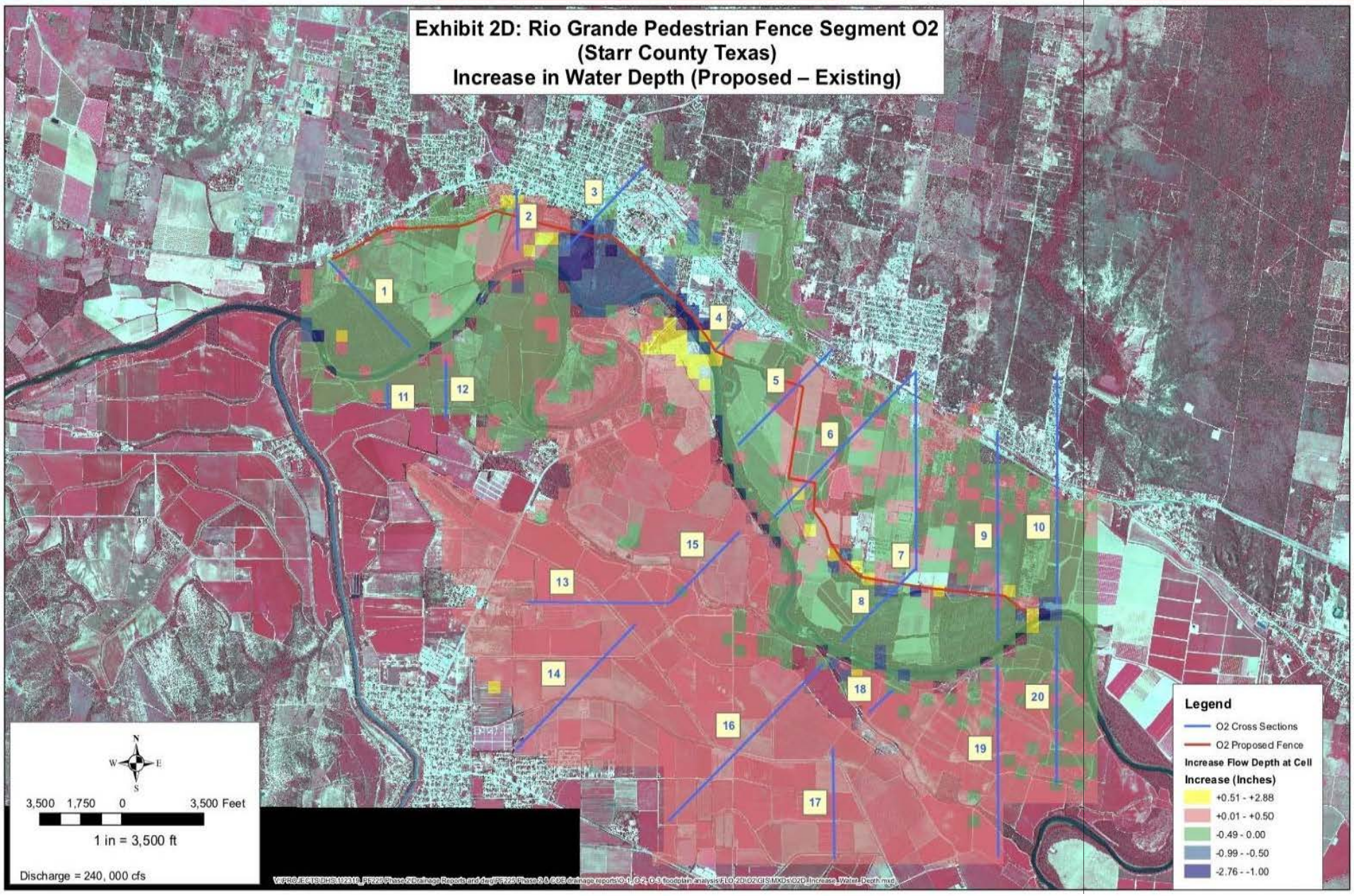

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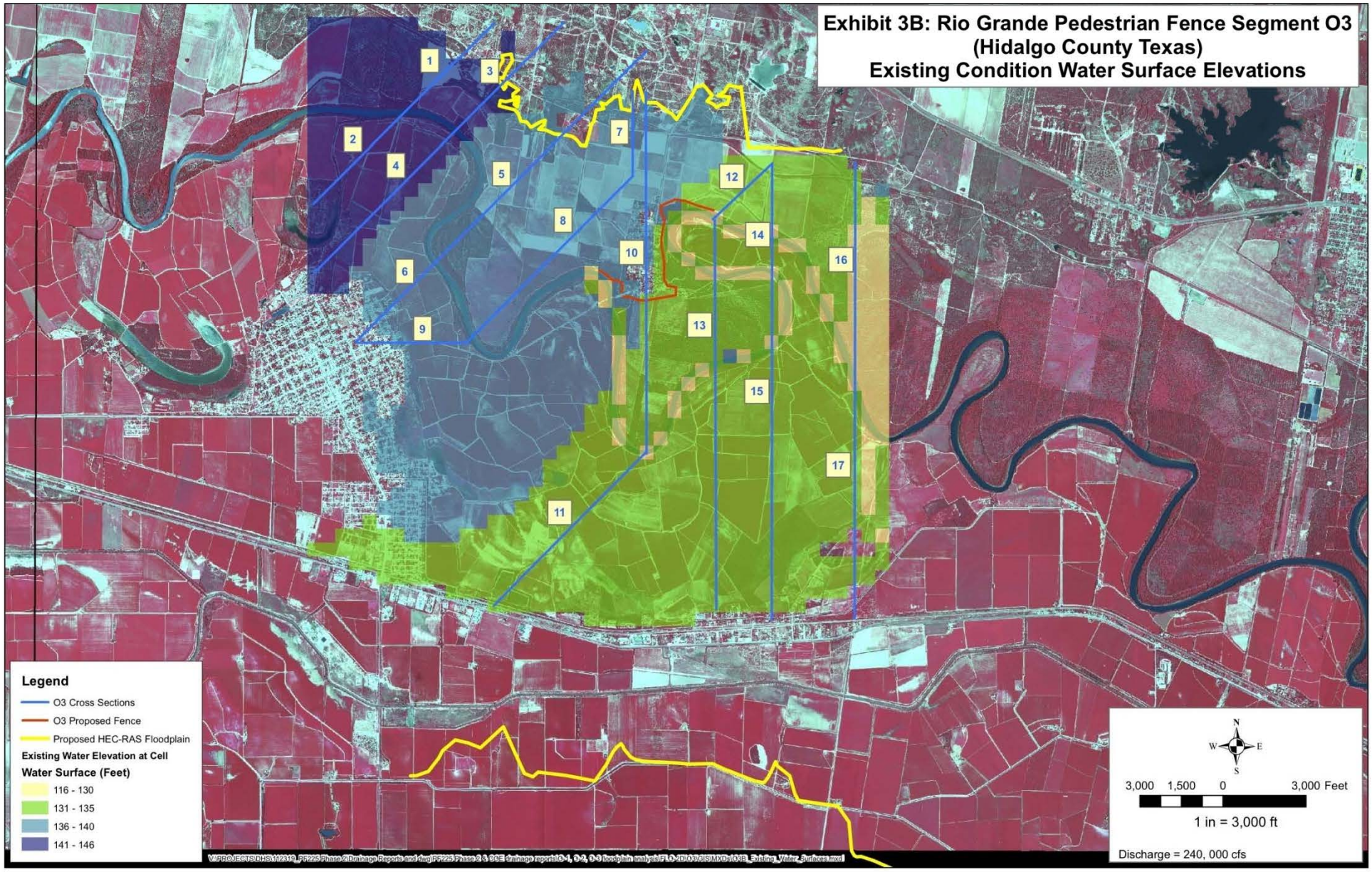

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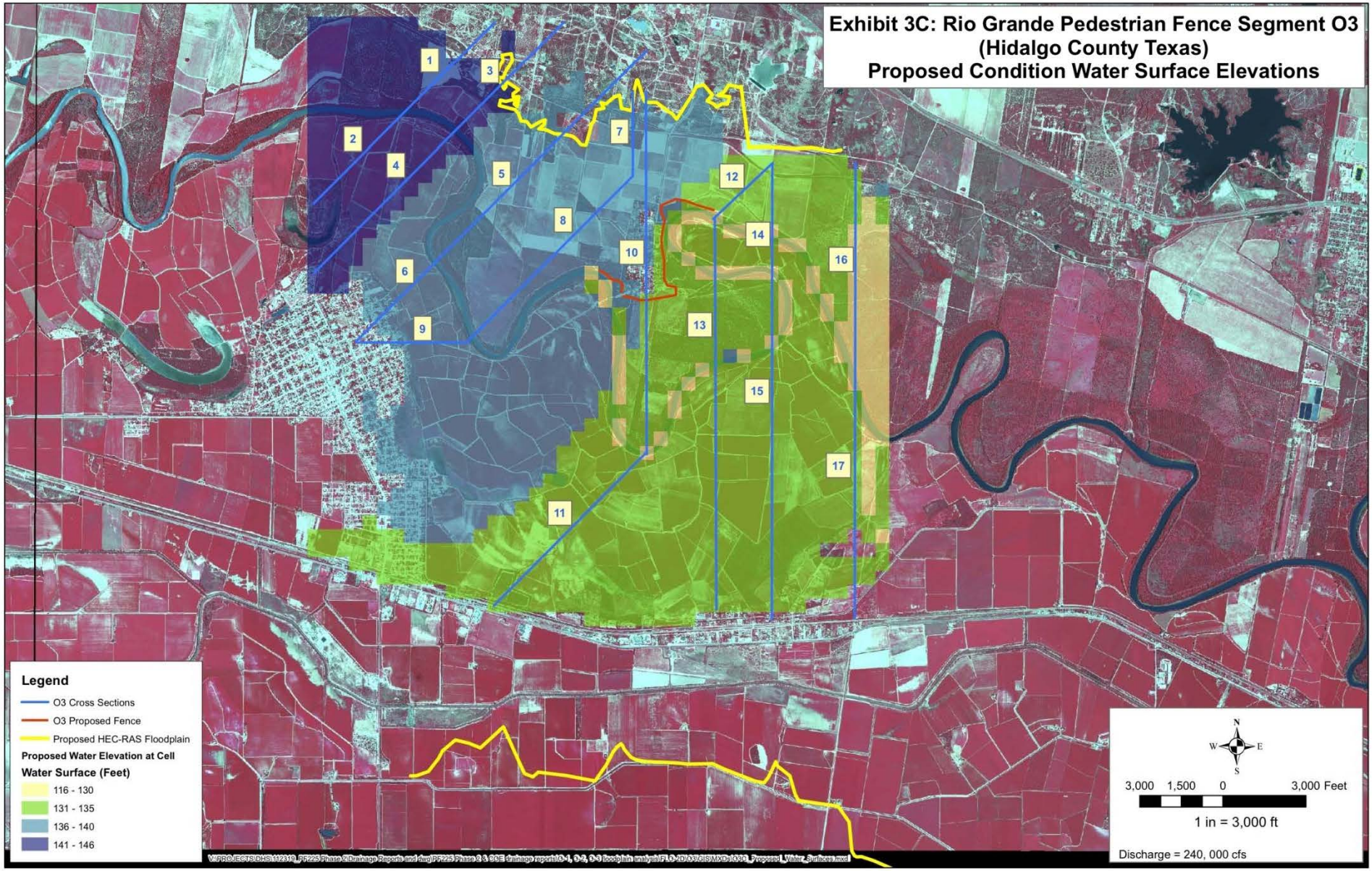

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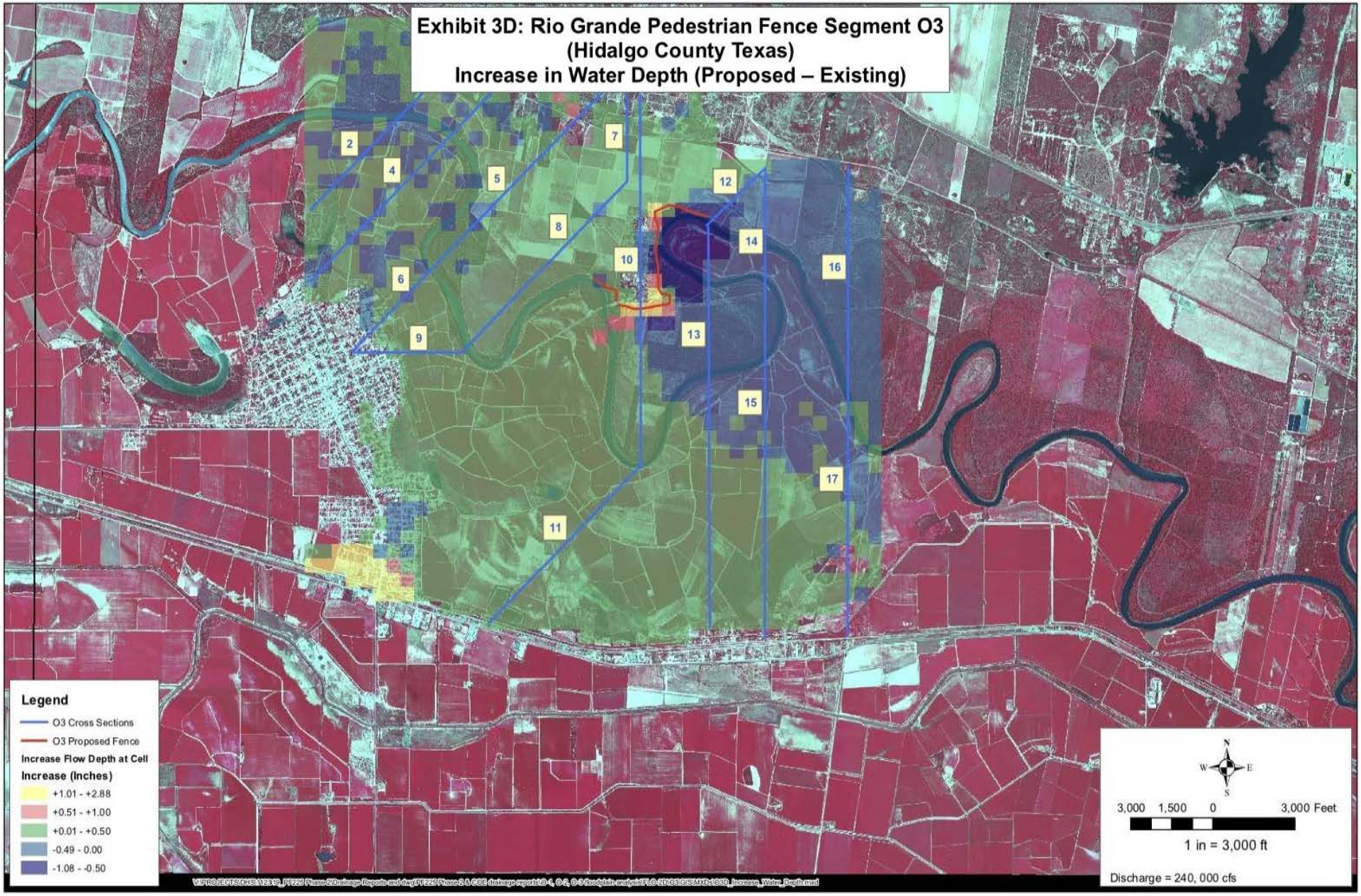

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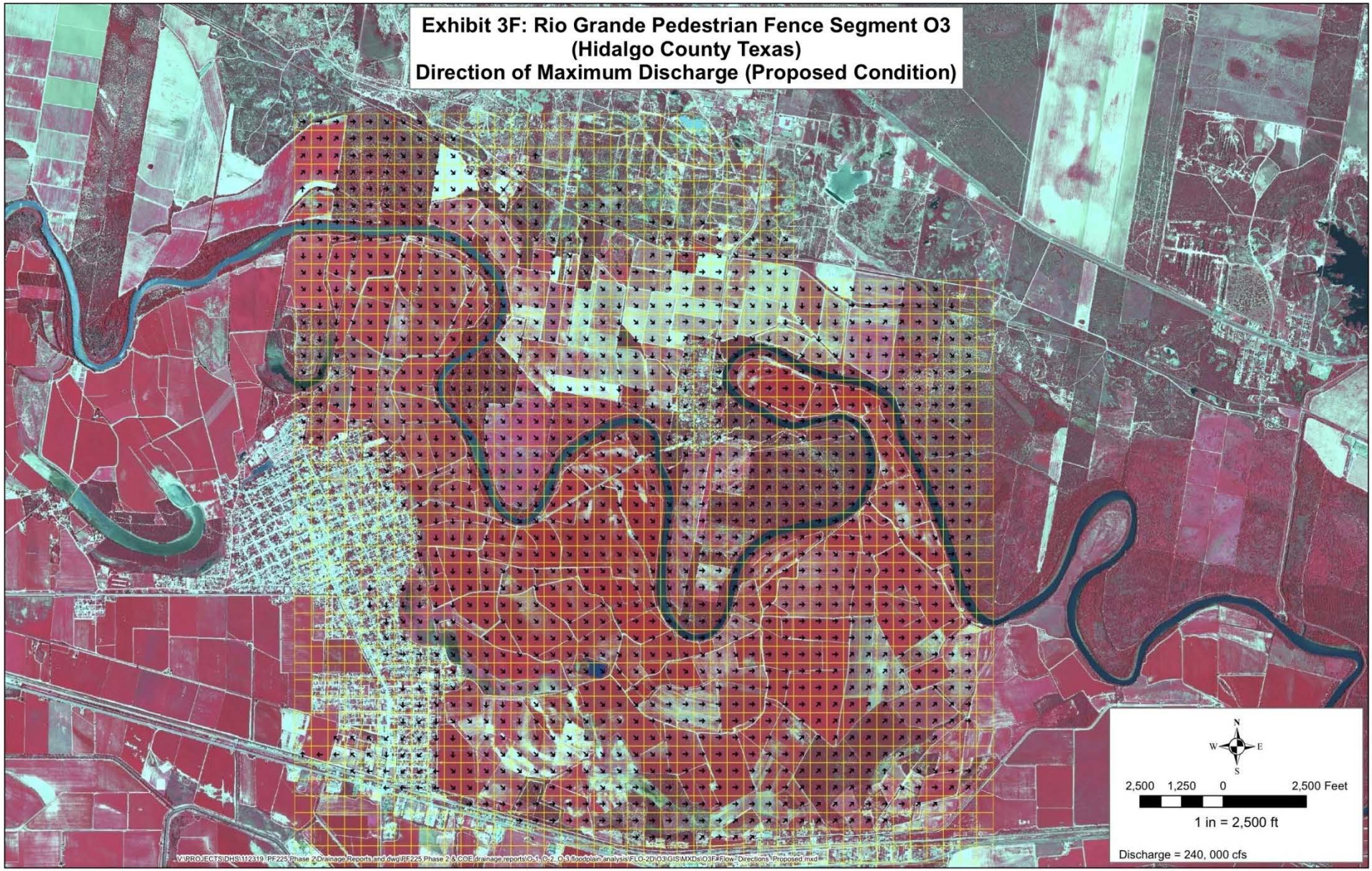

Summary

- Long term study beginning in 2008
- Widely used FLO-2D software used to evaluate impacts
- Methodology based on discussions with multiple agencies
- Impact thresholds adopted are more conservative than FEMA
- Bollard fence with reasonable debris blockage included
- Models met impact thresholds

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Engineering Services Division

4171 N. Mesa, Ste C-100

El Paso, TX 79902

(915) 832-4759

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