



# **Upper Brownsville Geotechnical Site Investigation Update**

**International Boundary and Water Commission**  
United States Section  
Engineering Services Division

**February 11, 2015**



# International Boundary and Water Commission Engineering Services Division

## UPPER BROWNSVILLE LEVEE



- 12.0 levee miles (from San Pedro to International Blvd in Brownsville)
- \$8.8 million contract to LECON Inc.
- Notice to Proceed issued June 1, 2013
- Substantially Completed October 2, 2014
- 100% Complete



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## UPPER BROWNSVILLE LEVEE





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# Timeline of Events

- **Nov 2013:** Levee height was raised and widened by 2 to 3 feet.
- **Mar 2014:** Rapid drawdown in Rio Grande water surface elevations of between 5 to 7 feet.
- **Mar 2014:** Levee cracks appeared downstream of Gateway International Bridge in Brownsville, Texas.
- **May 2014:** USIBWC contacted USACE to perform geotechnical study.
- **June 2014:** USIBWC entered into an interagency agreement with USACE.
- **July 2014:** USACE conducted preliminary site inspection.
- **August 2014:** Cone-penetrometer tests taken.
- **September to October 2014:** Borings drilled and inclinometers installed.
- **October 2014 through December 2014:** Cross-sections developed.
- **December 2014 to Present :** Development of Final Site Investigation Report to include three remediation options.



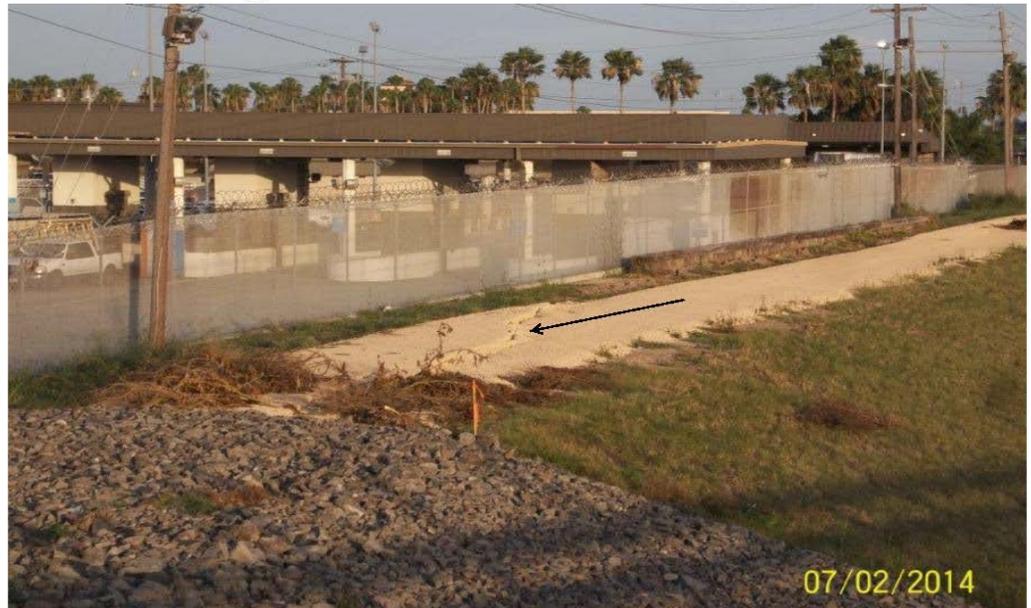
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## Levee Cracking

Cracks at levee toe



Cracking and settlement at top of levee

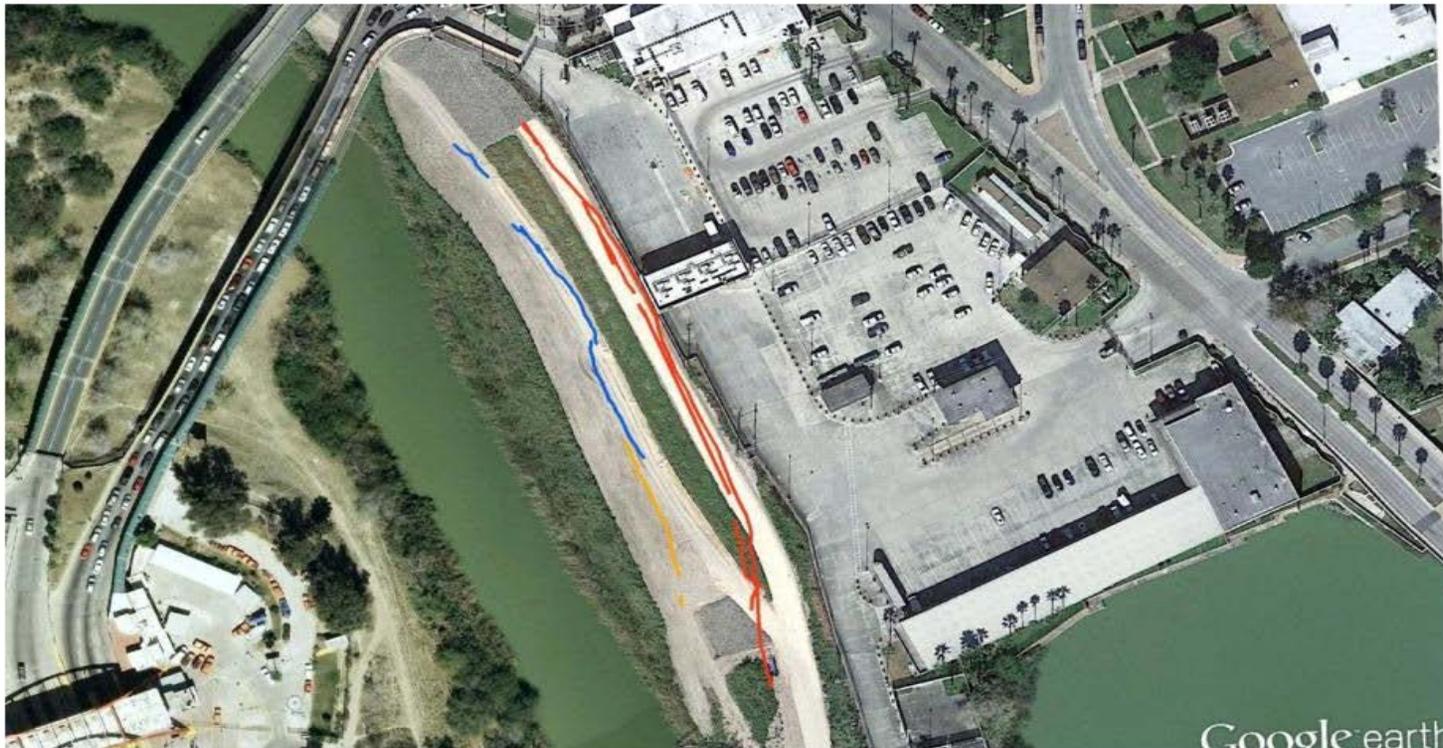




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# Levee Cracking adjacent to Gateway International Bridge

Three Major Crack Sets – 1 July 2014





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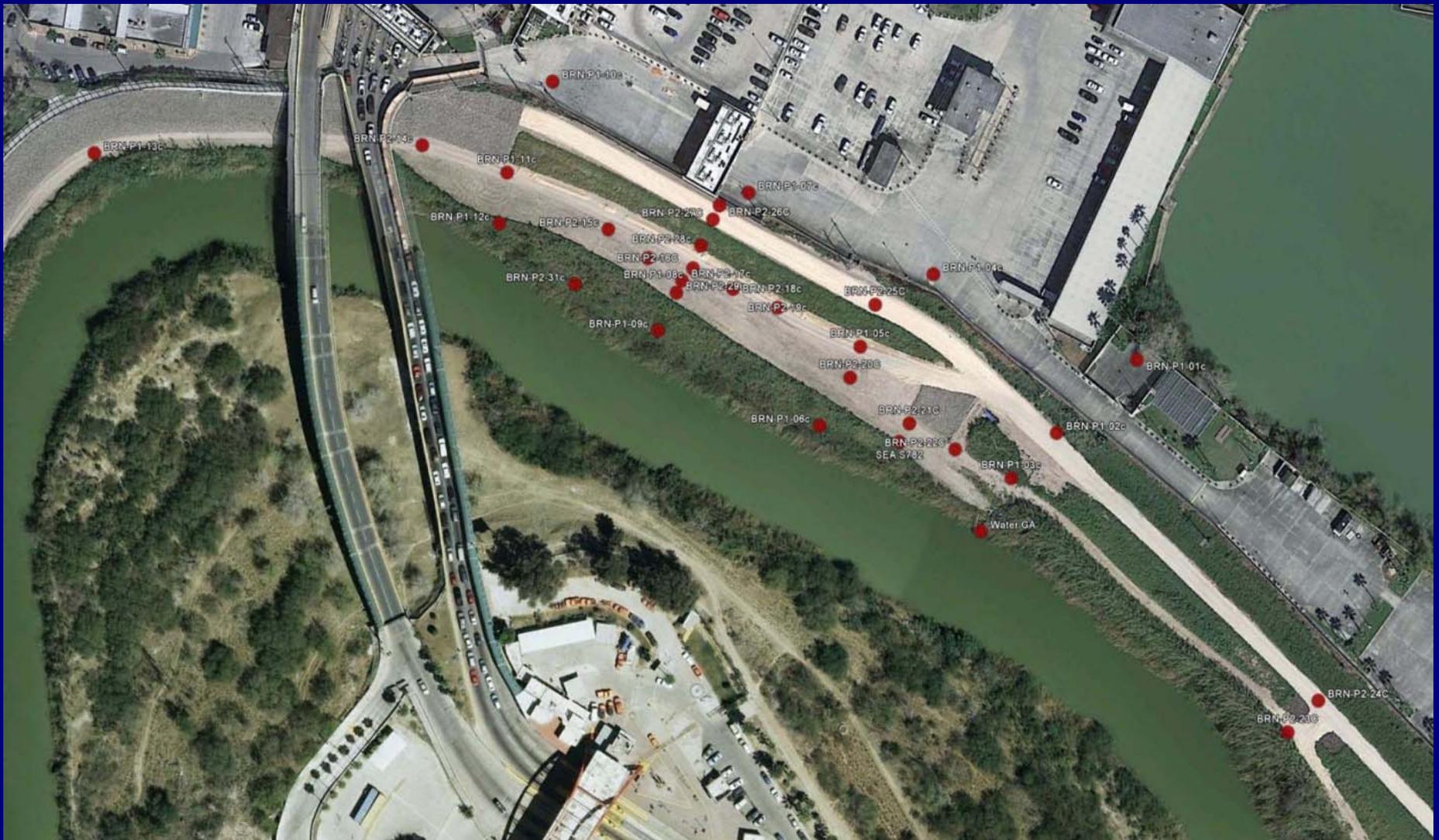
## Approach

- Conduct a geotechnical investigation of the levee reach to identify source leading to cracking
  - Field investigation **(July – Nov 2014, completed)**
    - Perform preliminary site visit
    - Cone Penetration Tests (CPT)
    - Soil borings
    - Slope movement monitoring
    - Waterborne geophysical survey
  - Laboratory analyses **(Nov 2014 – Dec 2014, completed)**
    - Geotechnical index properties
  - Historic assessment **(July – September 2014, completed)**
  - Slope stability modeling **(in progress)**
  - Technical report **(Delivery date: February 16, 2015)**



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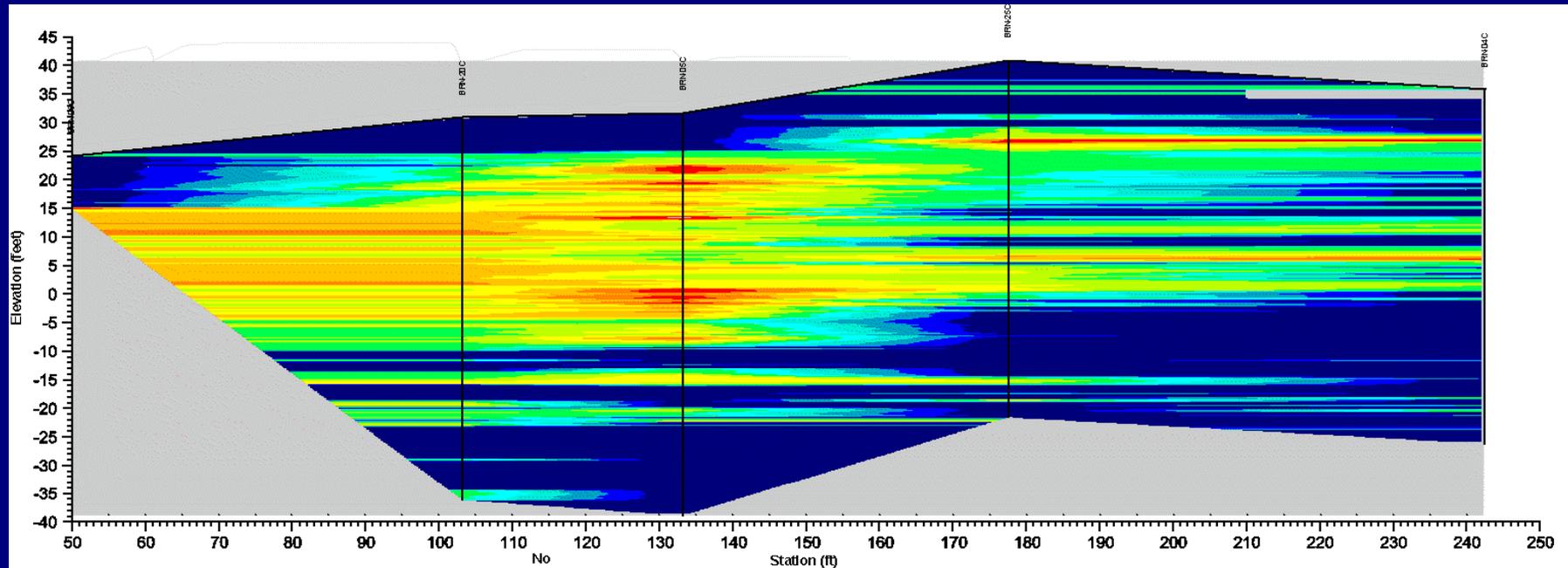
## Cone Penetration Tests



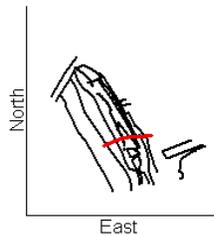


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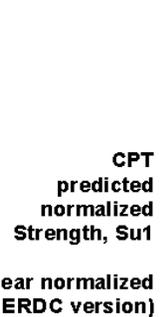
## Cone Penetration Tests



(this cross section is 192 feet long)



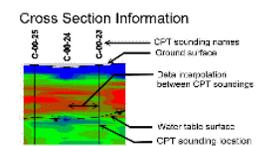
Cross Section: R2



■ In Situ anomaly causing data processing error

1.3  
1.2  
1.1  
1.0  
0.9  
0.8  
0.7  
0.6  
0.5  
0.4  
0.3  
0.2  
0.1

Normally NC to slightly OC clay  
underconsolidated or organic clay  
highly underconsolidated or high organics



**CPT Evaluation**

NOTES: CPT cross sections were generated using soil layer tracing to connect soil conditions between CPT soundings. For proper evaluation of a given section, the cross sections of CPT predicted soil type, strength, and normalized strength should be available for comprehensive interpretation. These CPT predicted techniques are based on advanced evaluation techniques developed at USACE ERDC over the last 25 years. Site based verifications between measured and CPT predicted strengths is still required. These CPT predicted strengths are for all soil type and strength level, ranging from undrained strengths for clays to drained strength for sands. The Academic Quality Index (AQI) is a simple but powerful tool, great data has an A grade or about 95% (great for correlations) and poor data has a D grade or about 65% (only good for tracking geologic layers boundaries). This visualization is a high graphic high detailed representation of a complex geology - final interpretation must be performed by a qualified expert in CPT data evaluation and stratigraphic evaluation.

**Cross Section of R2  
CPT predicted Strength (ERDC version)**

"Isaac Stephens PE, USACE ERDC GSL"  
IWBC Brownsville TX



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## Soil Borings





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## Field Activity: Soil Borings



- USACE drilling crew conducting split-spoon sampling of site in logging soil samples.



- Photo of split-spoon being disassembled by USACE engineer to expose soil sample for visual inspection and characterization.



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## Slope movement monitoring

- Three methods of monitoring:
  - Monthly surveys
  - Inclinometers
  - Piezometers
- The results show there has been little to no movement from August 2014 to Present Day.

**Movement from Aug 26 to Sept 9 (Total Station)**





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## Slope movement monitoring



**Monitoring equipment being retrieved and read to evaluate groundwater information.**



**Removing finished inclinometer casing cover.**



**USACE drill crew installing inclinometer casing at levee crest.**



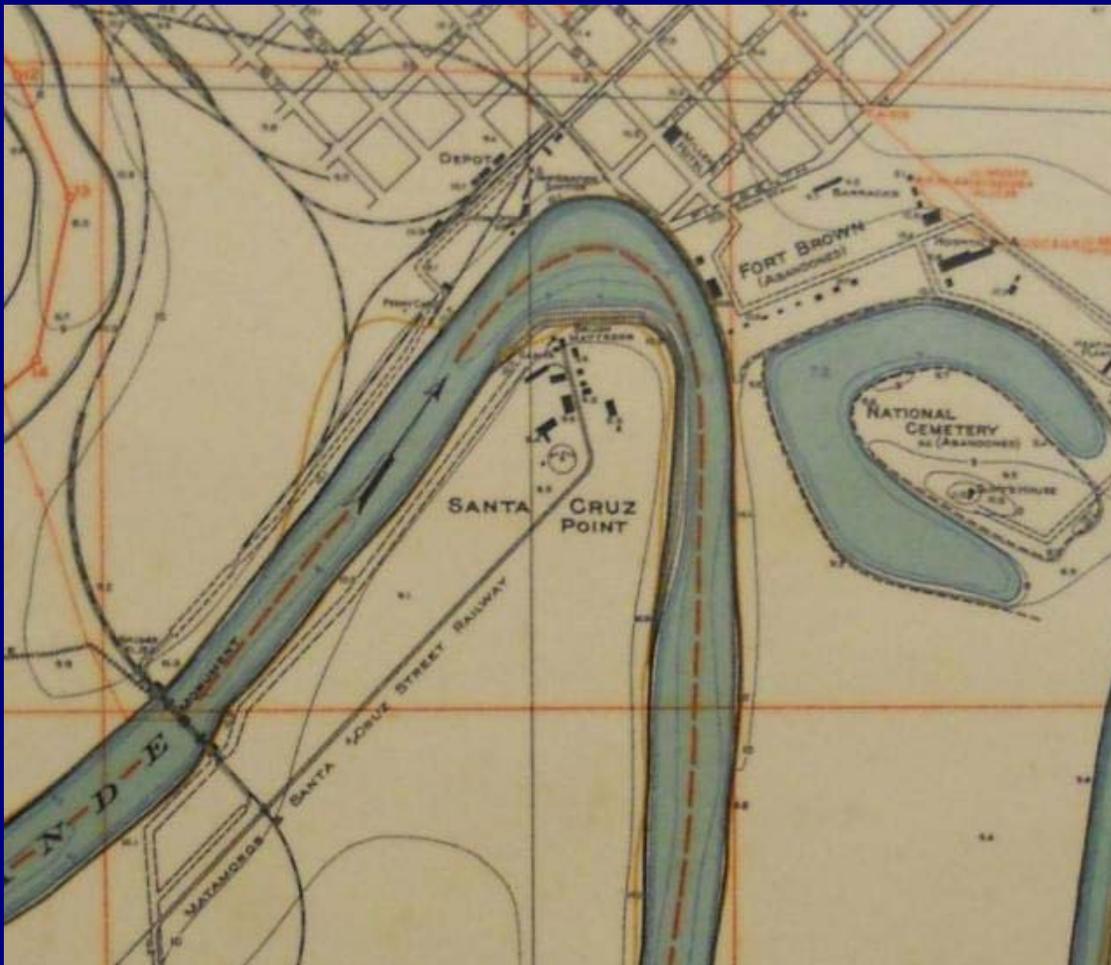
# Laboratory Analyses

- Laboratory tests
  - Particle-size analysis
  - Void ratio, porosity, degree of saturation
  - Liquid limit, plastic limit, plasticity index
  - Soil compaction
  - Un-compressive strength test
  - Tri-axial compressive strength test
  - Pore pressure measurements



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# 1911 Topographic Map by IBWC



- Scour pool in the river bend nearly 30 ft deep based on contours shown on 1911 map
- Note the Customs building adjacent to levee area of interest as landmark for historic photos that follow



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# 1930 Aerial Photo

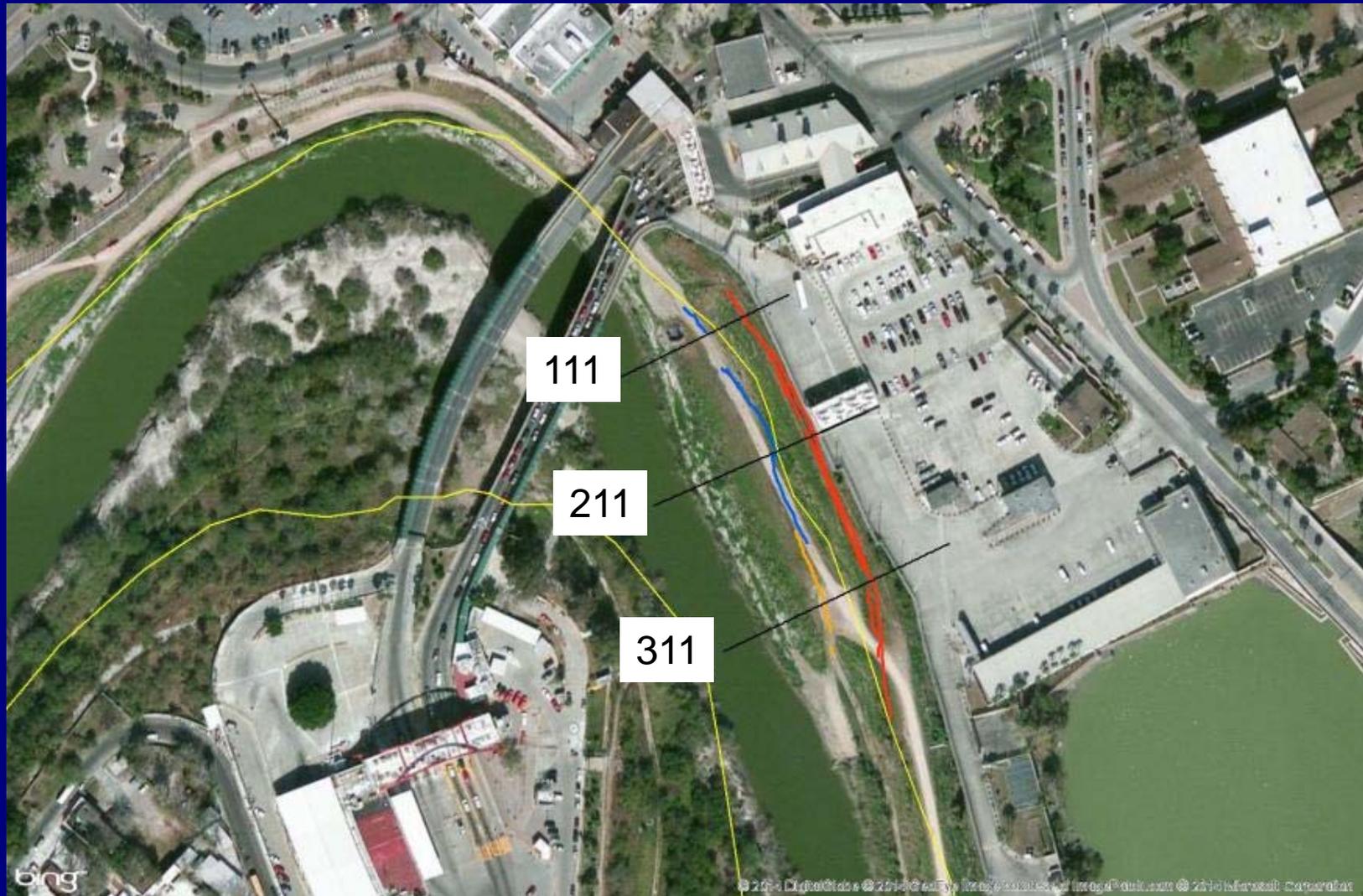
(note 3 section lines)





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Cracks, 1930 channel, section locations, on 2013 image

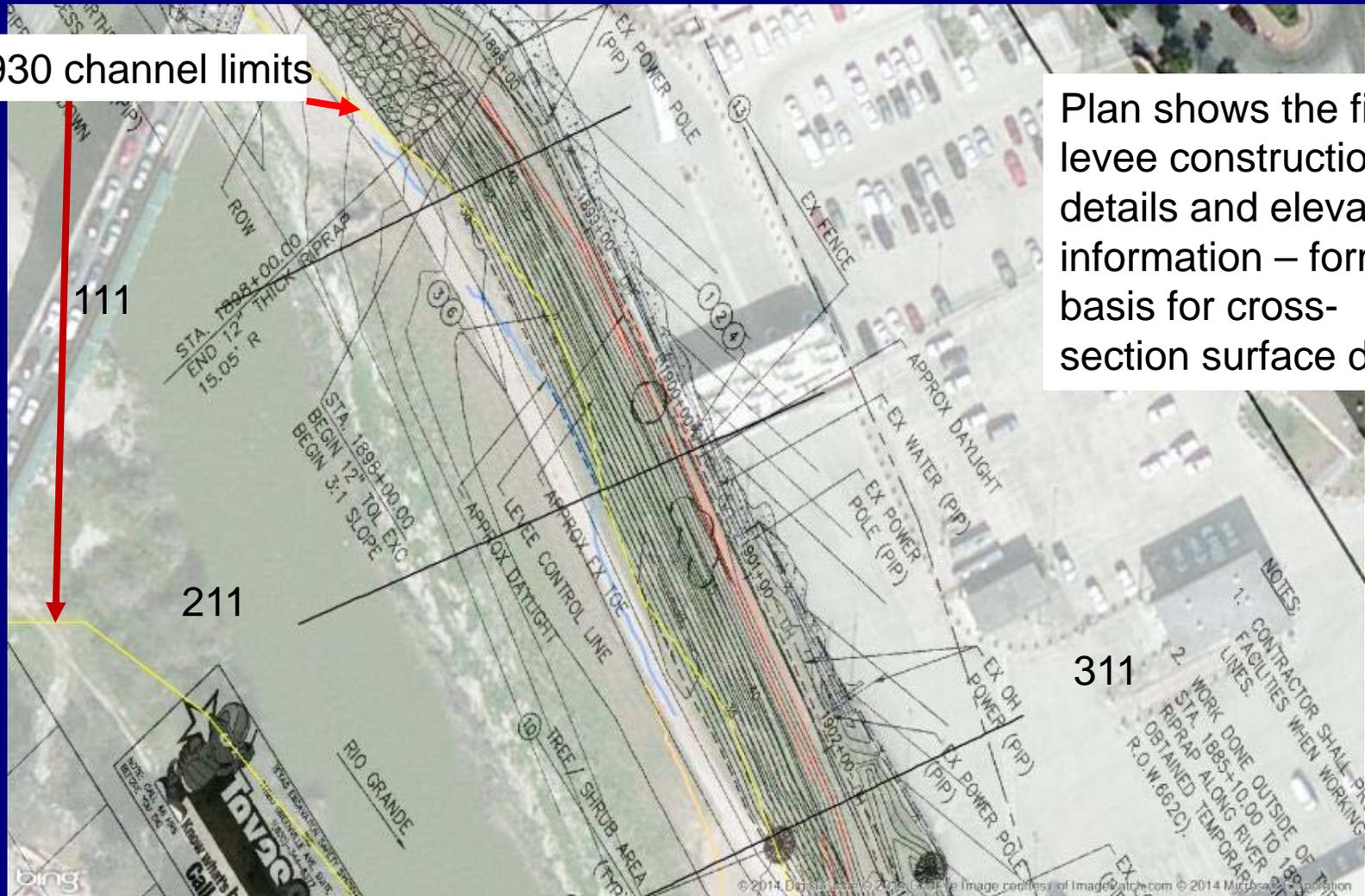




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## Construction Plans Geo-referenced

1930 channel limits



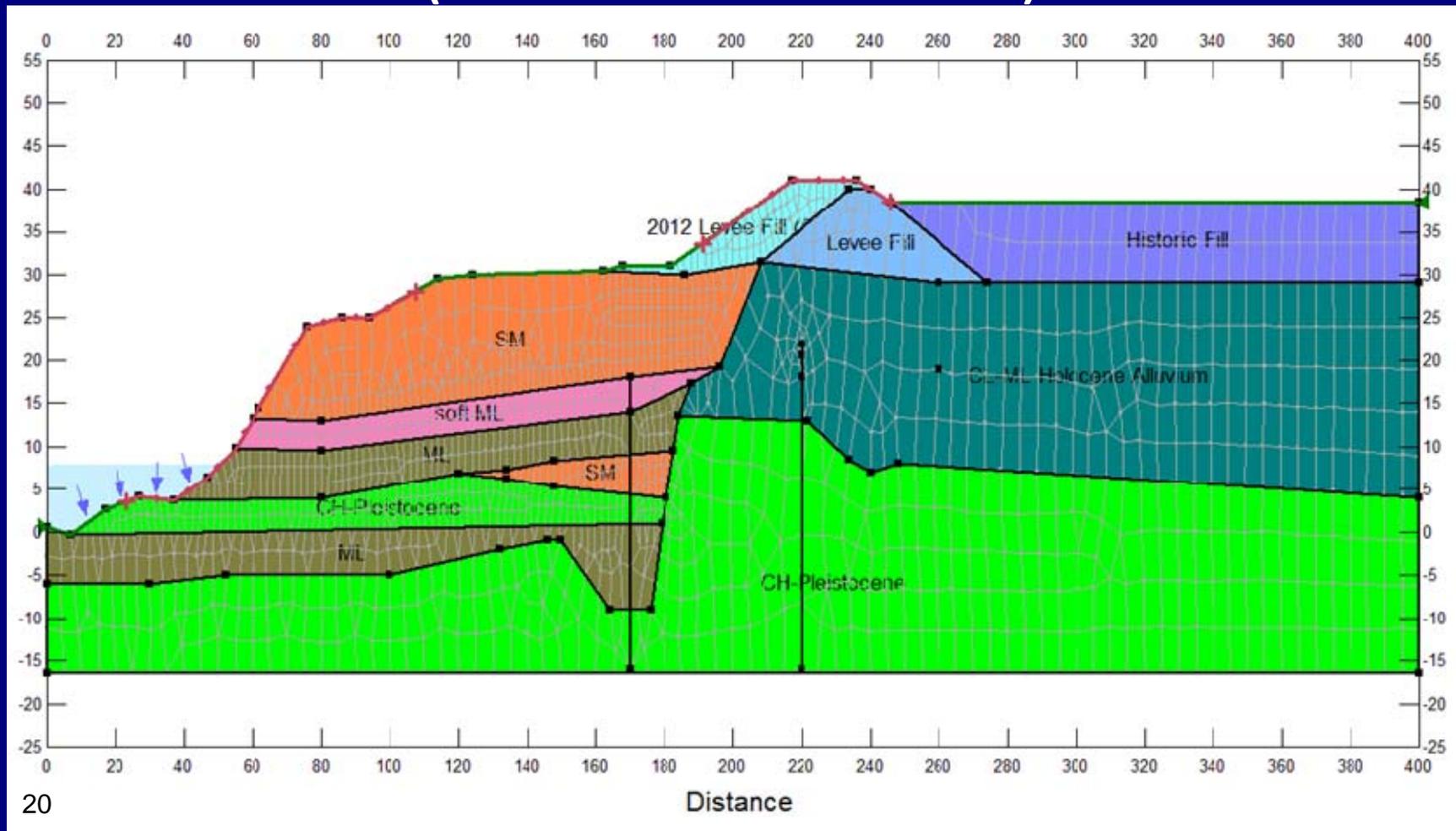
311





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# Slope Stability Modeling (Cross Section 211)





## Observations

- The Rio Grande channel has decreased in width from maximum of 225 feet in 1930s to less than 100 feet wide by 2014.
- Historic channel fill result of reduced water flow from construction of upstream main stem dams and increased irrigation for agriculture and water supply needs in the Lower Rio Grande Valley.
- Levee cracking occurs in the new levee construction and in the historic Rio Grande channel fill deposits that form the levee foundation.
- Levee toe marks the boundary of the 1930s channel.
- Unconsolidated channel fill deposits overlying a stiff, tan to reddish brown, dense clay (CH) identified from boring and CPT data.
- No reported incidents of damaged or leaking water mains.



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# Conclusion

- The USIBWC will be receiving the completed Site Investigation Report from the USACE by February 16, 2015.
- Report will:
  - Contain cause / causes of cracking.
  - Provide recommendation regarding need for temporary repairs.
  - Provide three recommendations for long term repair of area.
- After report is received and reviewed, USIBWC will select a long term repair option.
- USIBWC will then proceed with issuance of a design contract for selected repair option.
- Once design is completed, USIBWC will solicit construction project.



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