

Mel Price-Wood River Problem Seepage Area Background

Wood River D&LD - Upper

Presented by: Ryan Goetz, P.E. (USACE)

Date: 11 November 16



US Army Corps of Engineers
BUILDING STRONG®

Outline

- Background
- Description of Underseepage
- Problem Discovery
- Problem Analysis
- Develop a Permanent Solution
- Revise the Permanent Solution using a “Risk Informed” Decision Making Process
- Current Path Forward

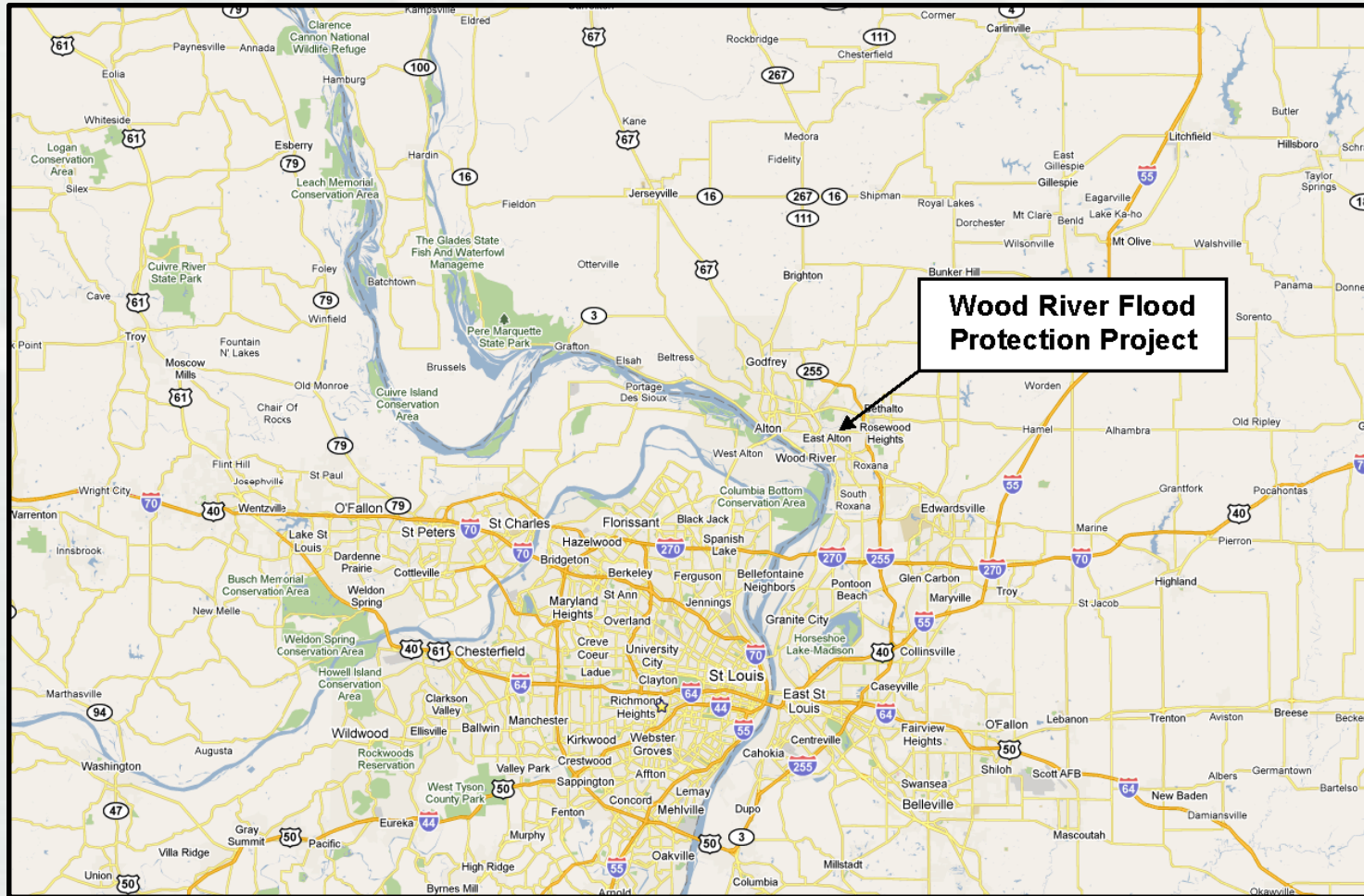


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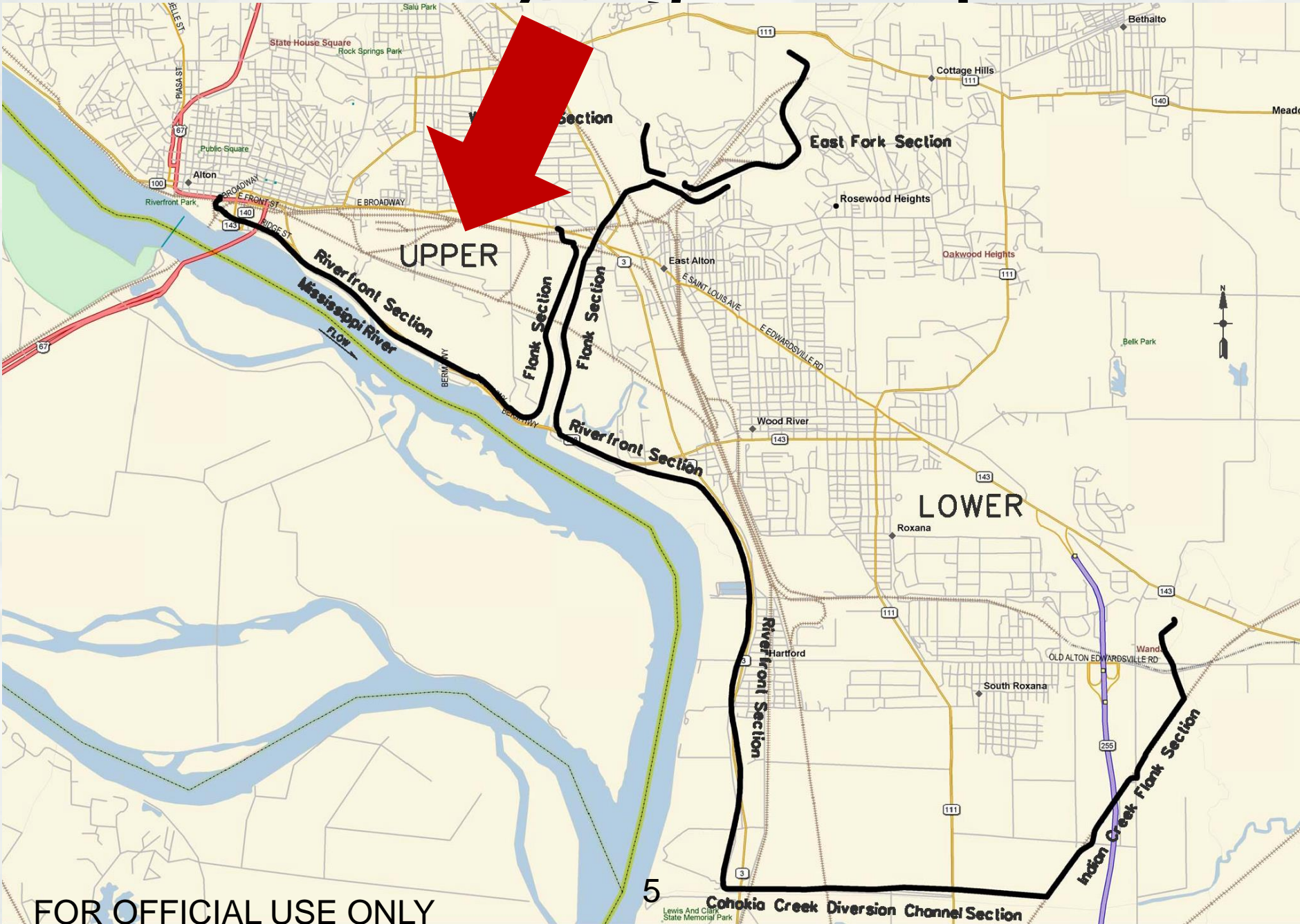
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Project Regional Map

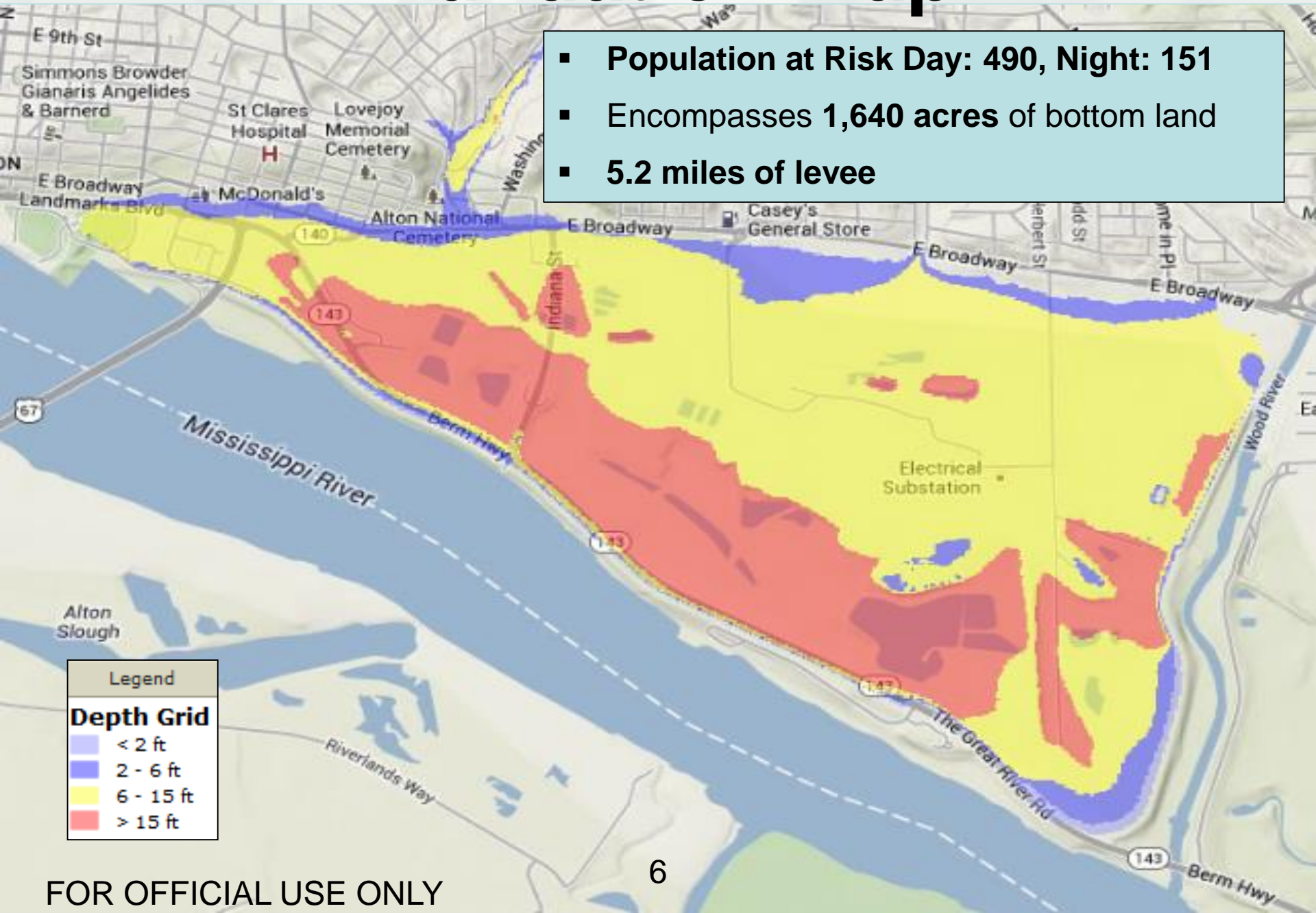


Vicinity/Segment Map



Inundation Map

- Population at Risk Day: 490, Night: 151
- Encompasses 1,640 acres of bottom land
- 5.2 miles of levee

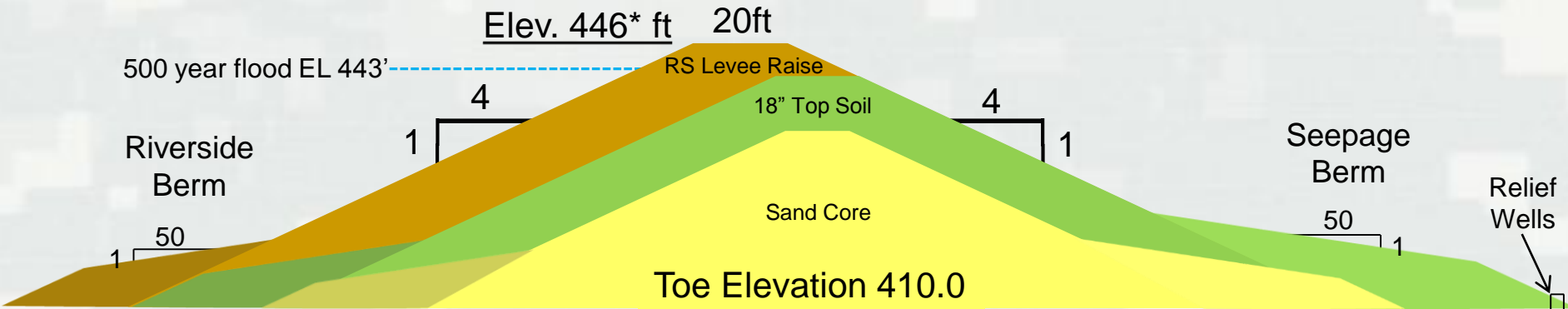


Typical Sections

Mainline Levee Embankment

Riverside

Landside



Approx Crest Height:
 Crest Width:
 Foundation Geology:
 Levee Materials /Zoning:
 Riverside Erosion Protection:

33Ft
 20 Ft
 Clay Blanket then Aquifer Sand
 Hydraulic Fill and Clay cap
 Grass



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*Minimum Levee Profile Elevation @ Sta 175+00
 Reference Hydraulics slide for details regarding
 determination of elevations

Geomorphology / Foundation Geology

interpreted from CEMVS Exploration

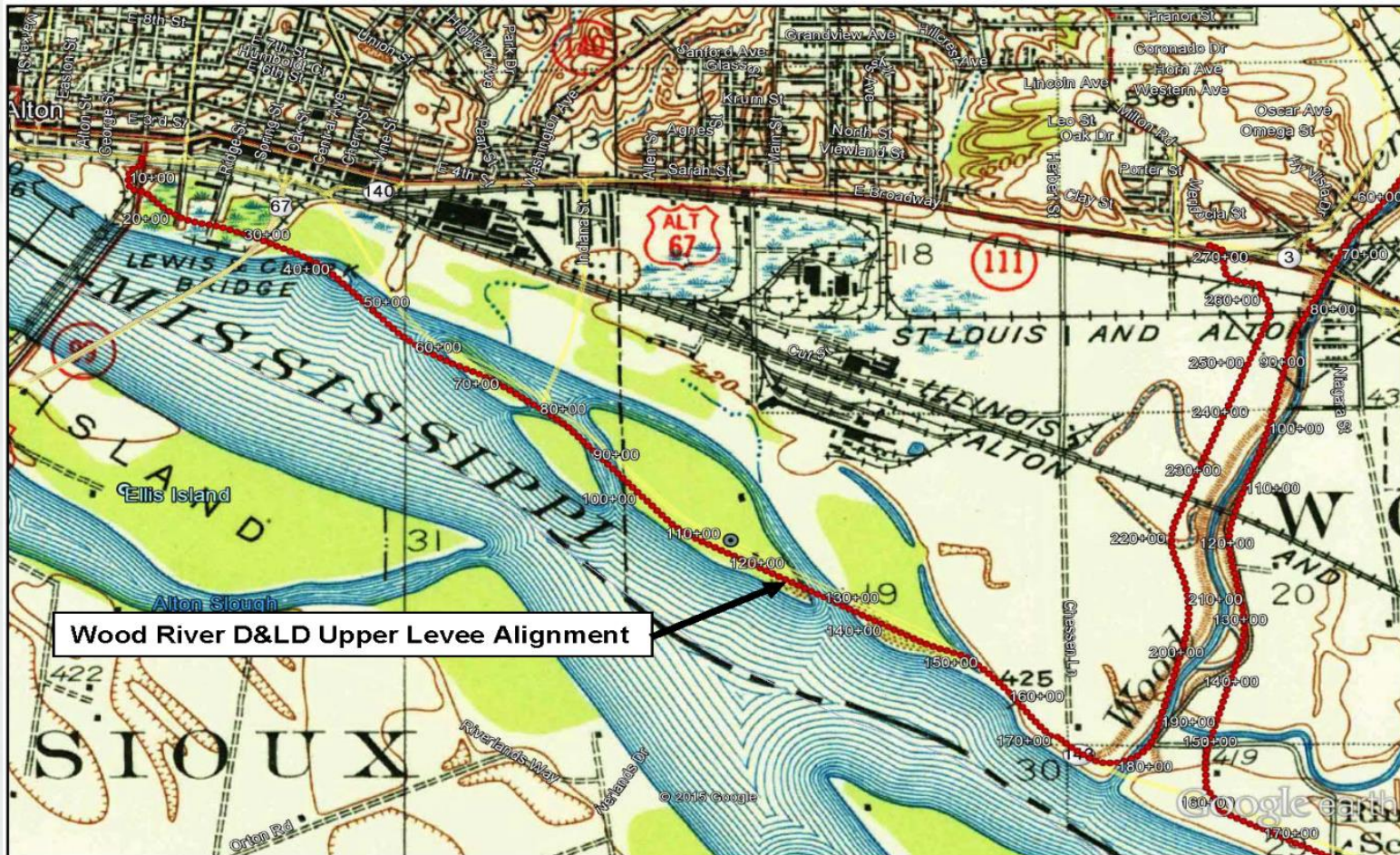


*Thickness is highly variable



Project Geomorphology (1927)

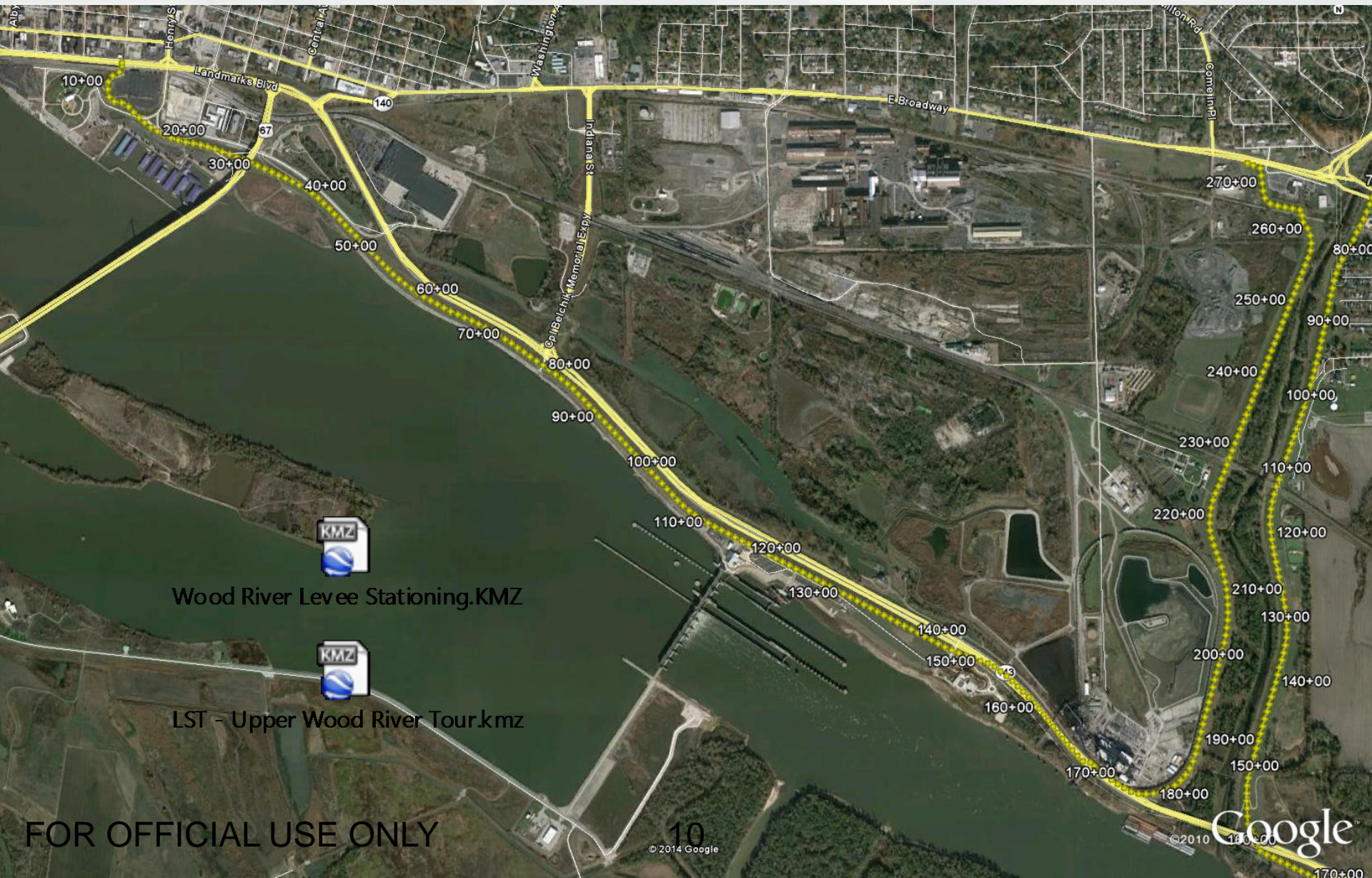
Prior to Levee Construction – Proposed Alignment in Red



Many features alongside the river still controlled more by natural forces and less by manmade changes.



Present Day



Wood River Levee Stationing.KMZ



LST - Upper Wood River Tour.kmz

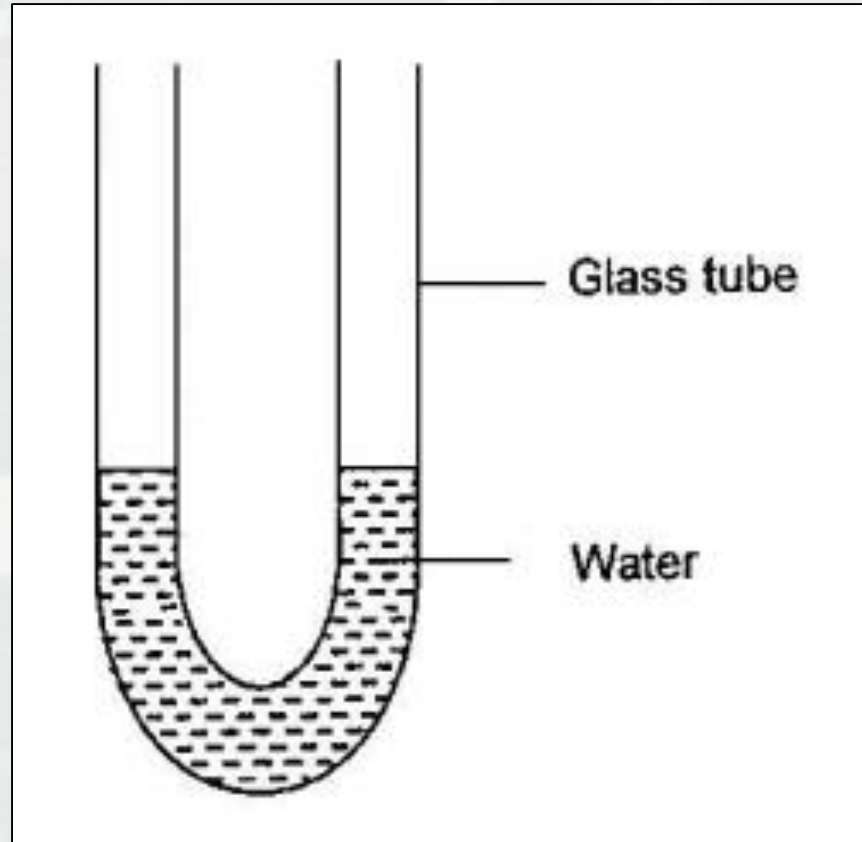
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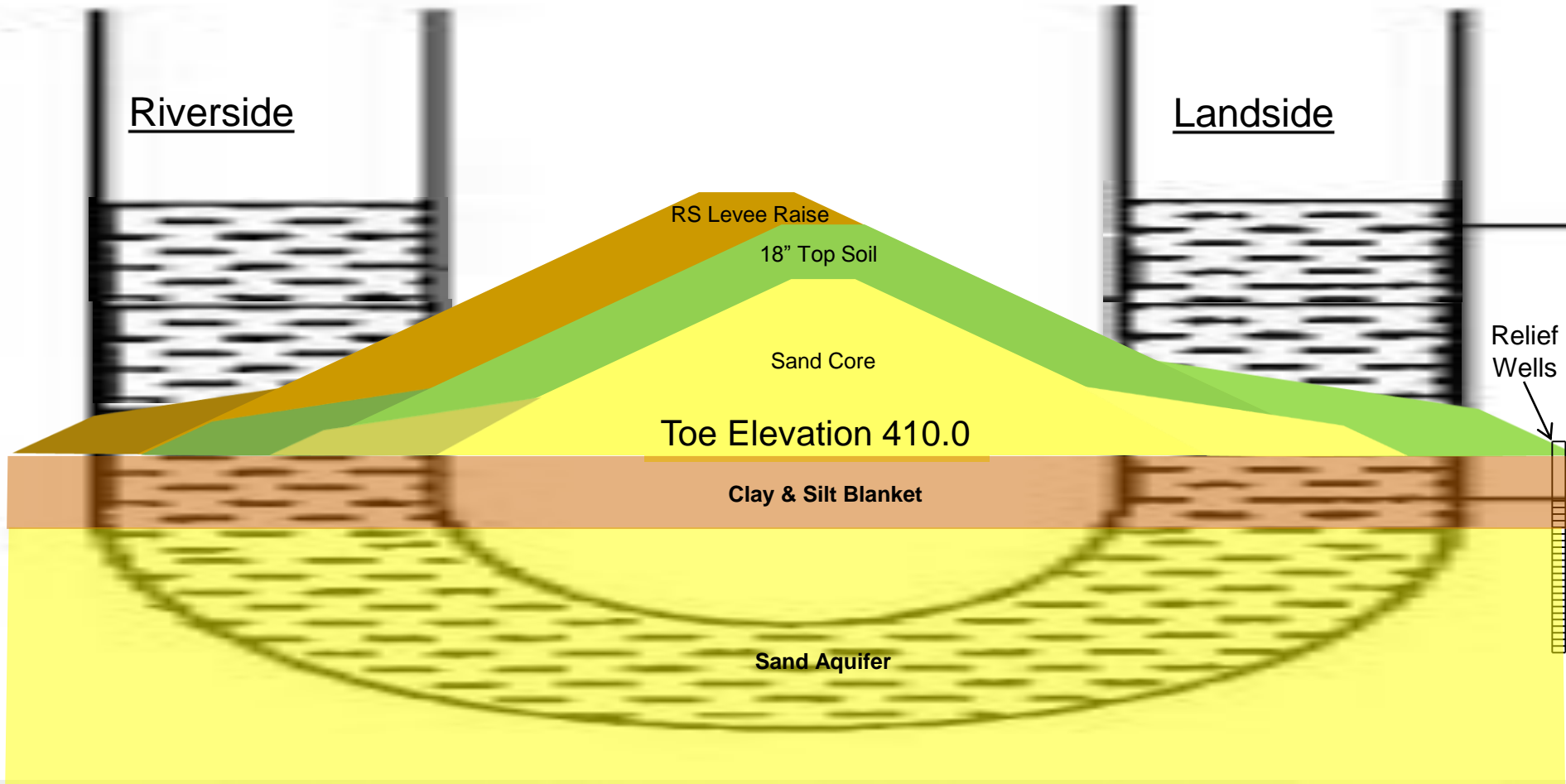
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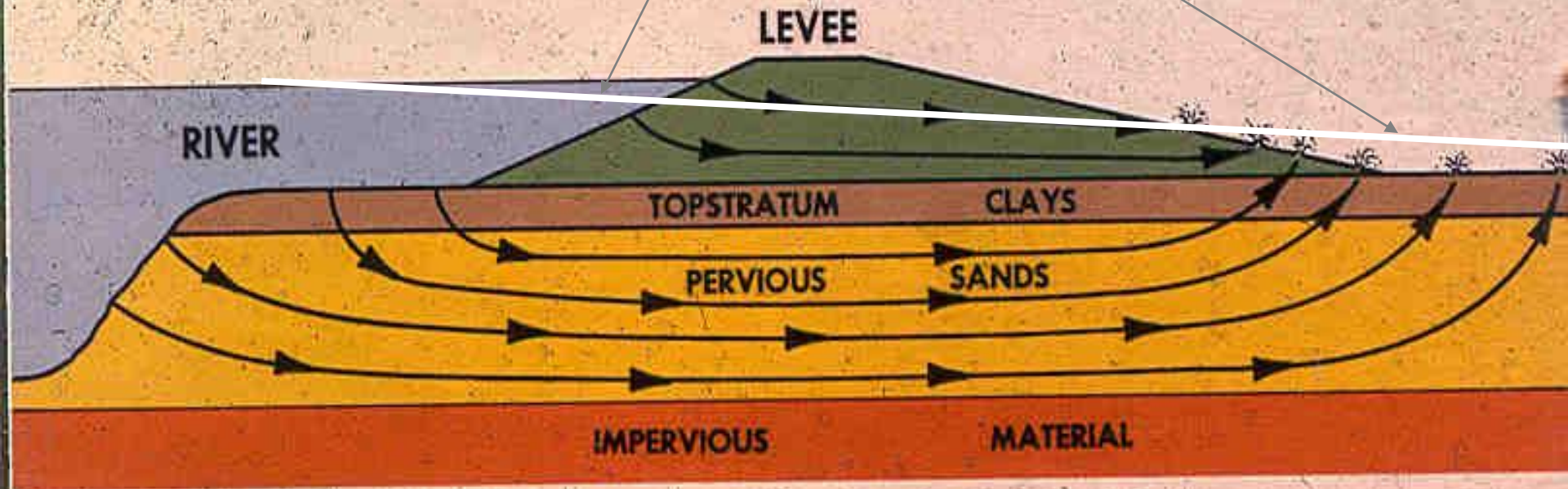
Simplified Explanation of Underseepage



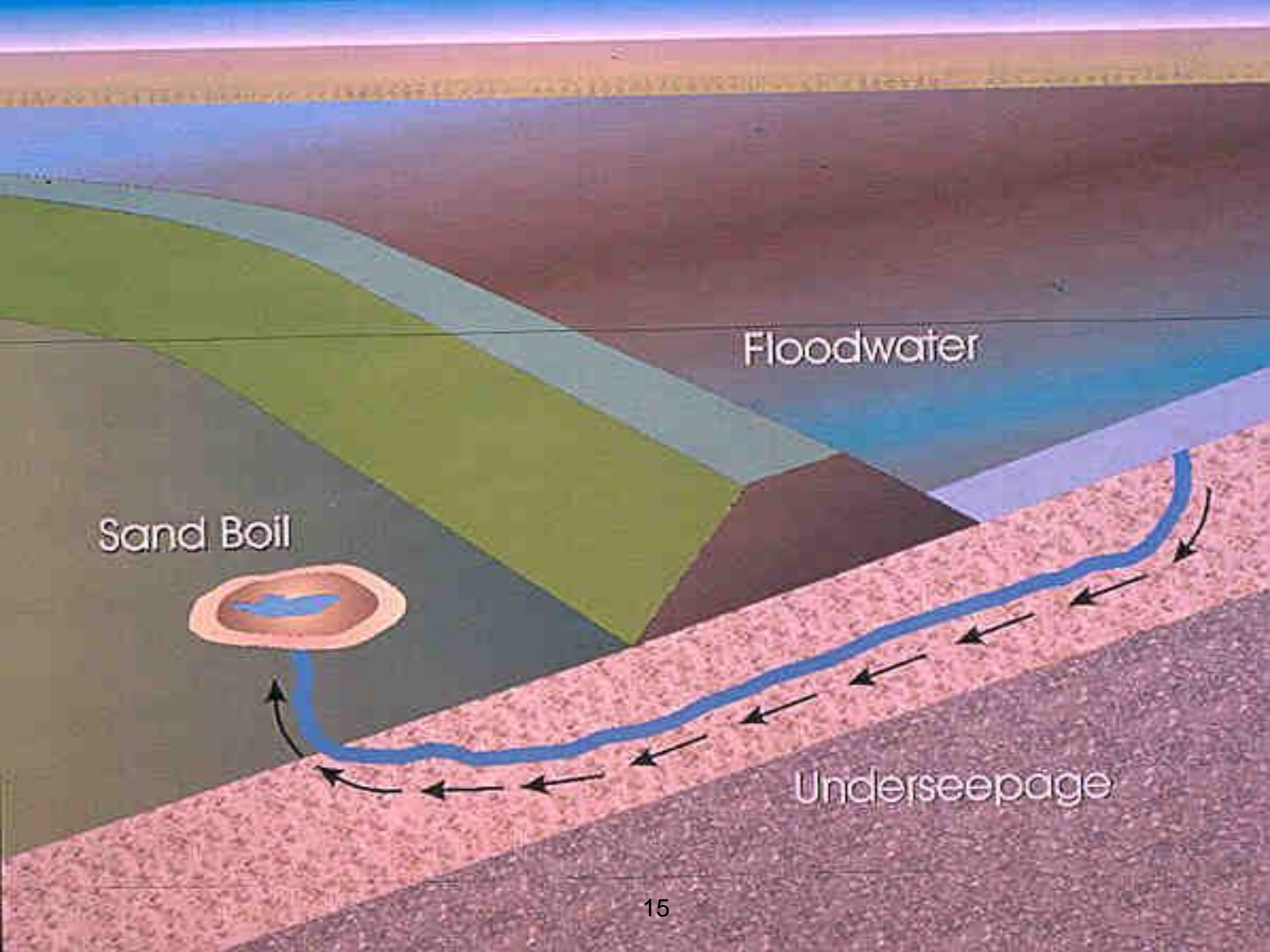
Simplified Explanation of Underseepage



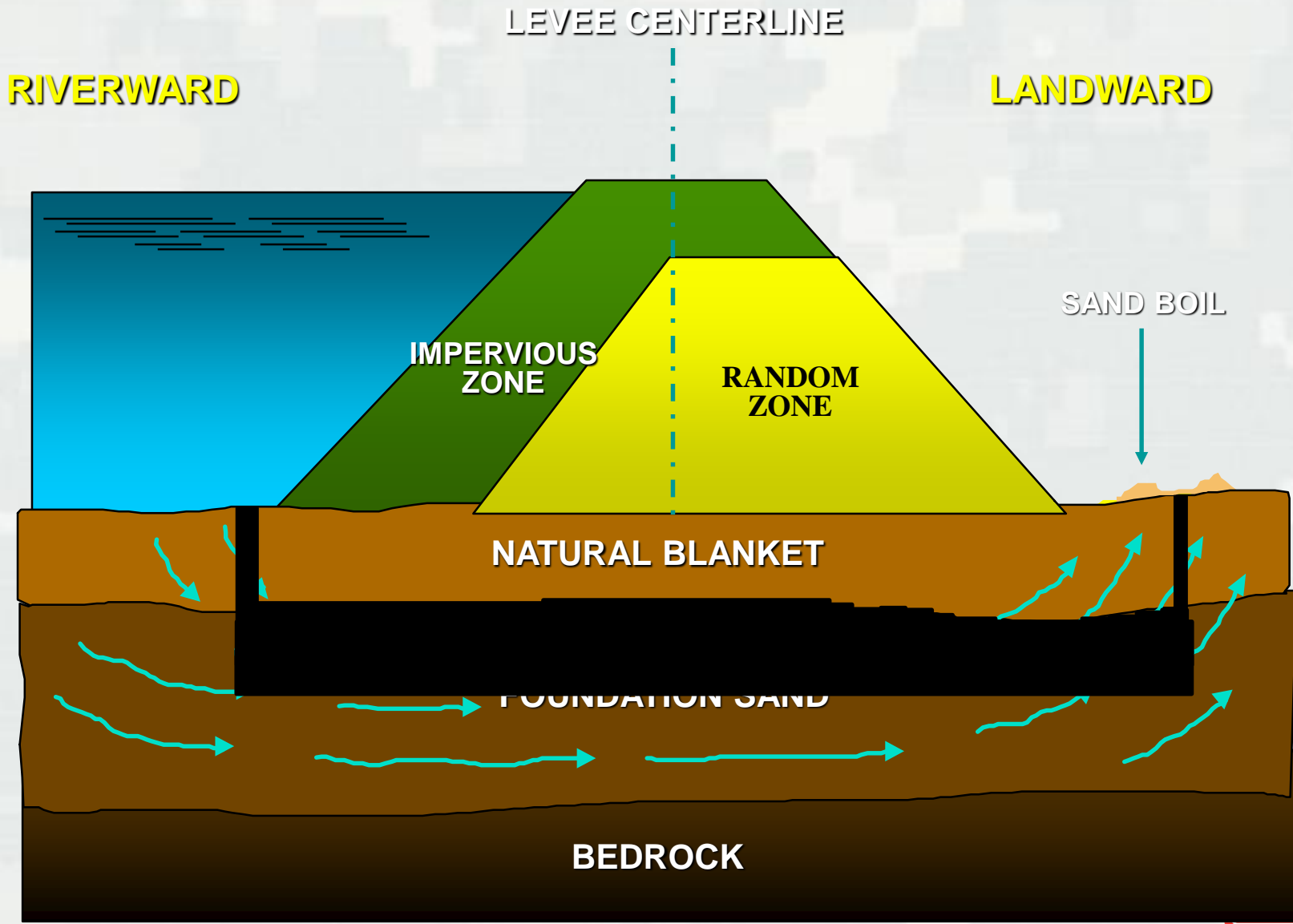
Piezometric Pressure Due to Seepage

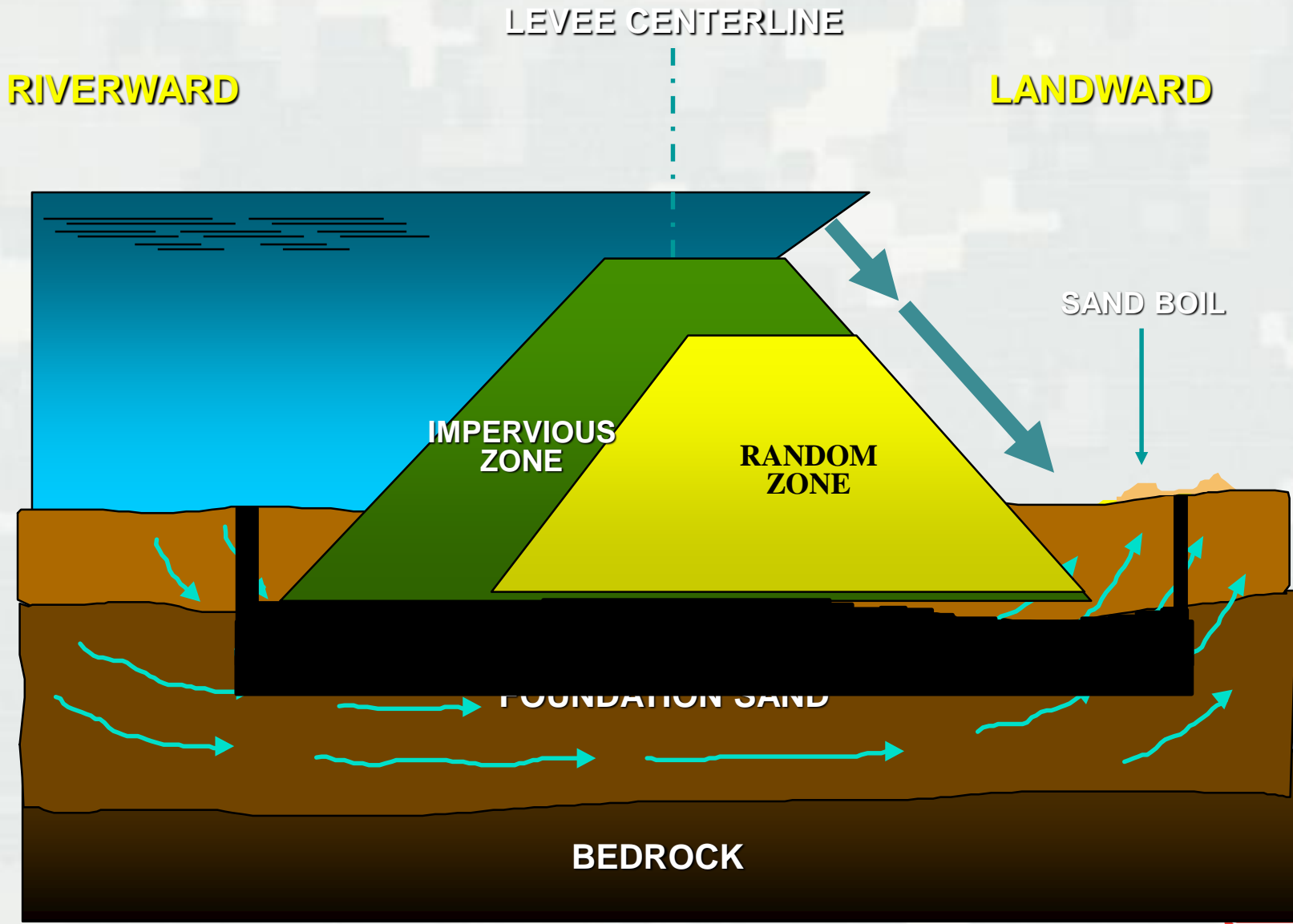


SEEPAGE THROUGH LEVEE AND FOUNDATION





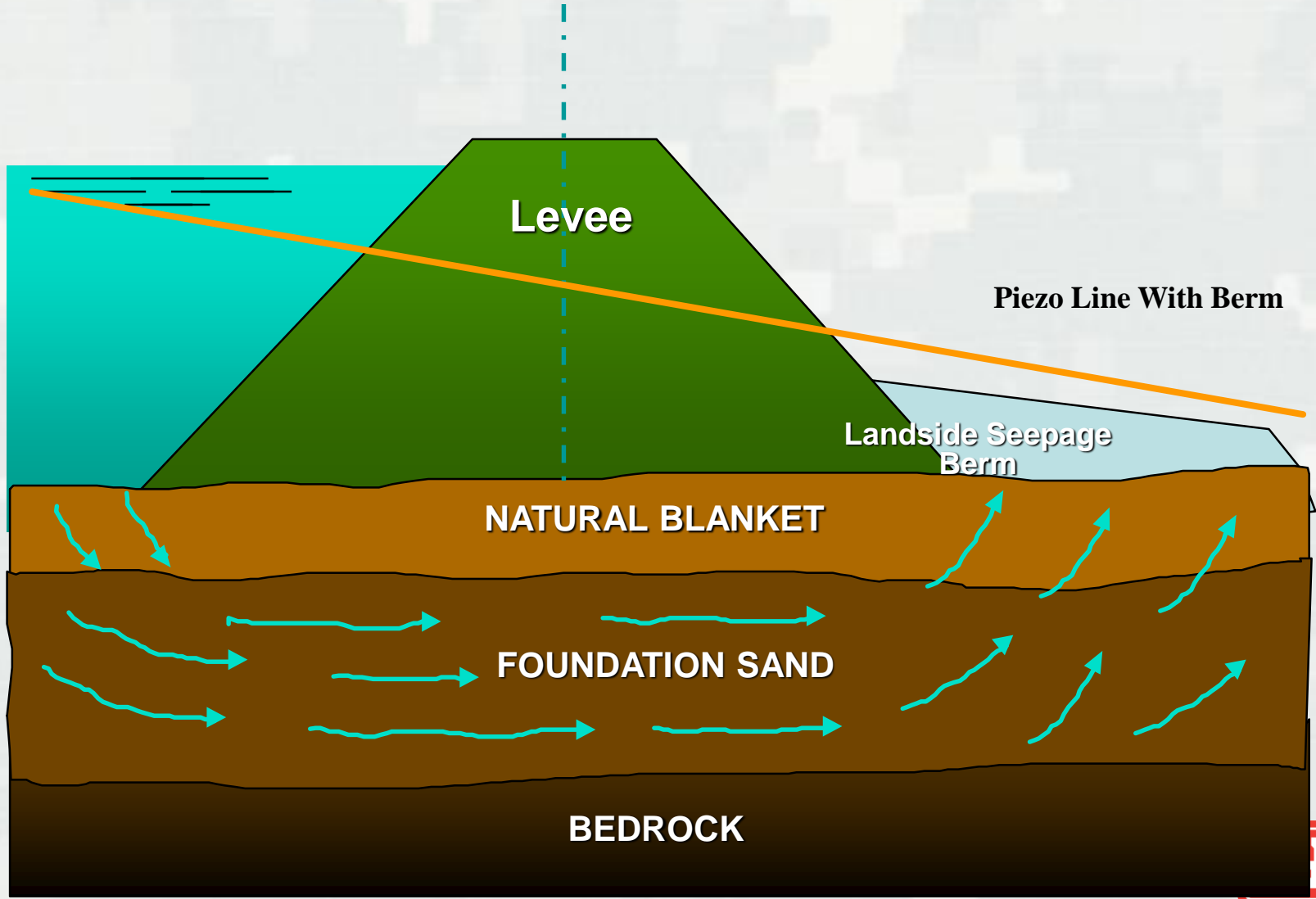




Riverside

Landside

LEVEE CENTERLINE



Levee

Piezo Line With Berm

Landside Seepage Berm

NATURAL BLANKET

FOUNDATION SAND

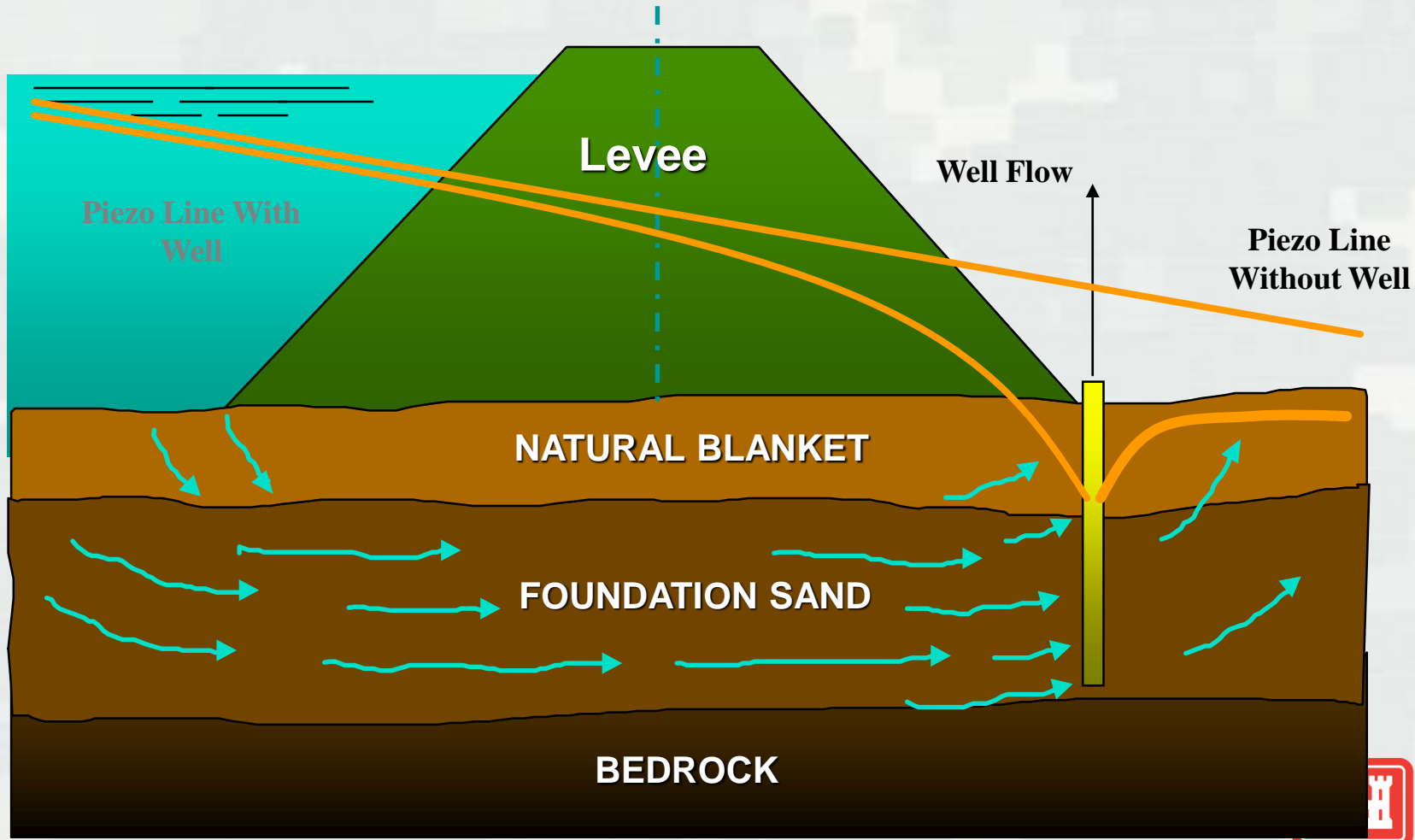
BEDROCK



Riverside

Landside

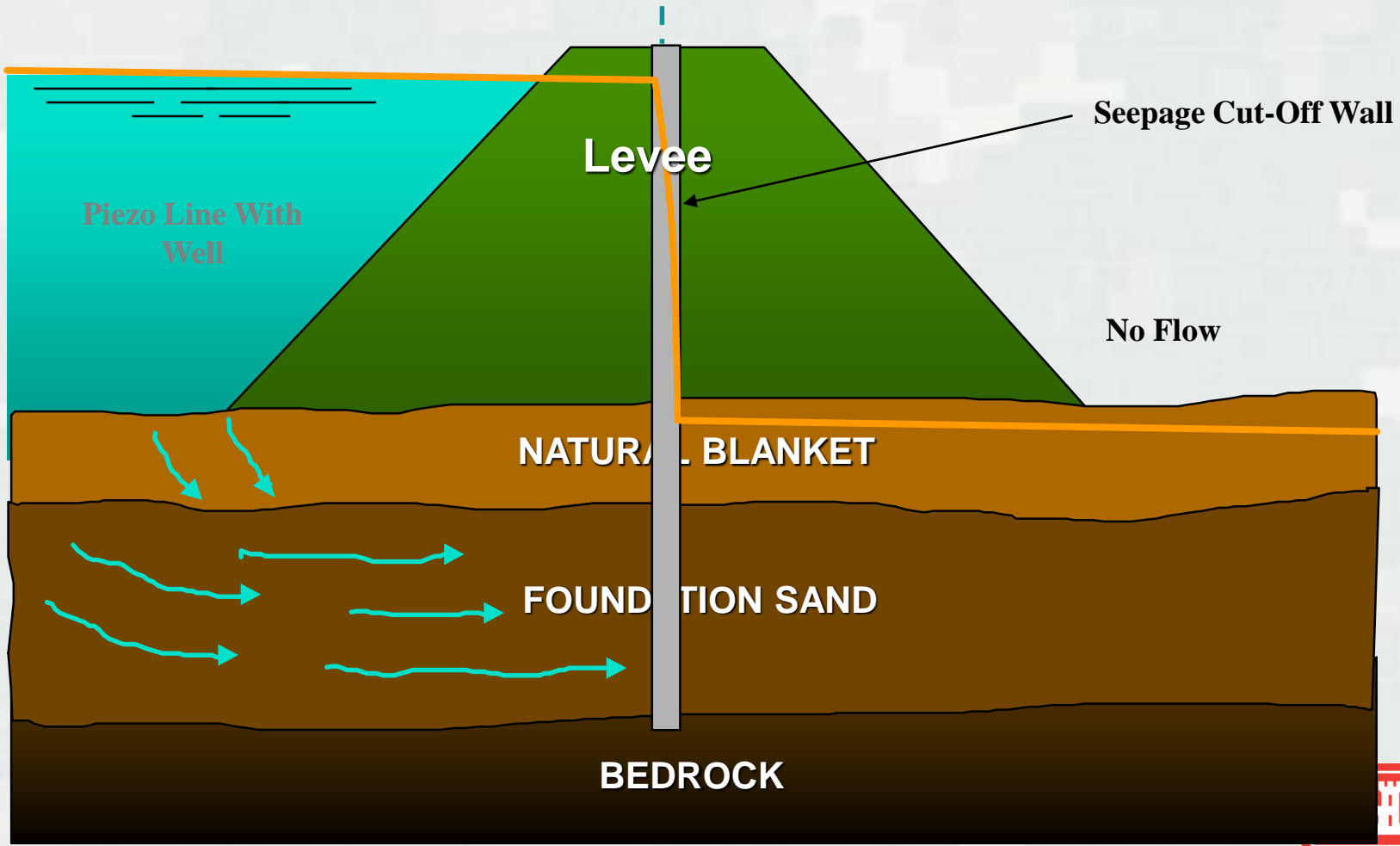
LEVEE CENTERLINE



Riverside

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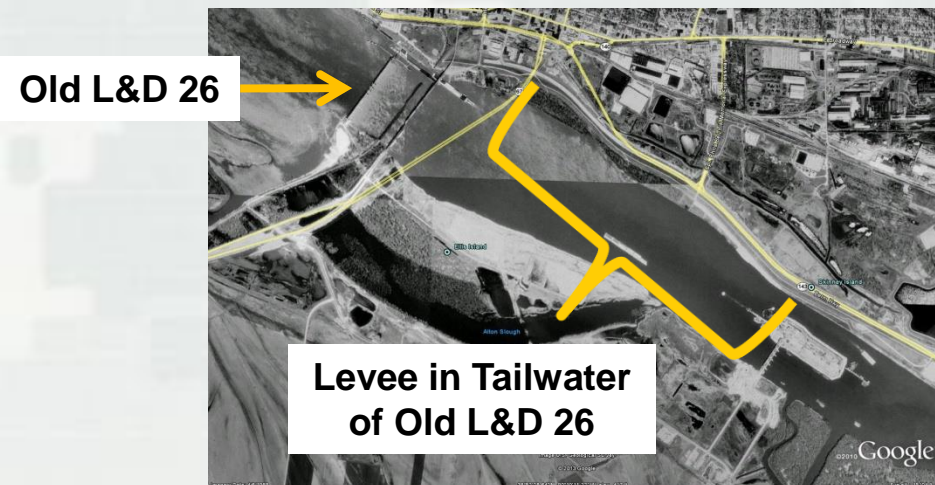


Performance History Mel Price Seepage Area

- Relocation of old Lock & Dam 26 two miles downstream to Mel Price Locks & Dam caused a permanent pool to be placed on the Upper Wood River Levee from Sta 0+00 to Sta 115+24.

April 1988

August 2012



Mel Price Seepage Area

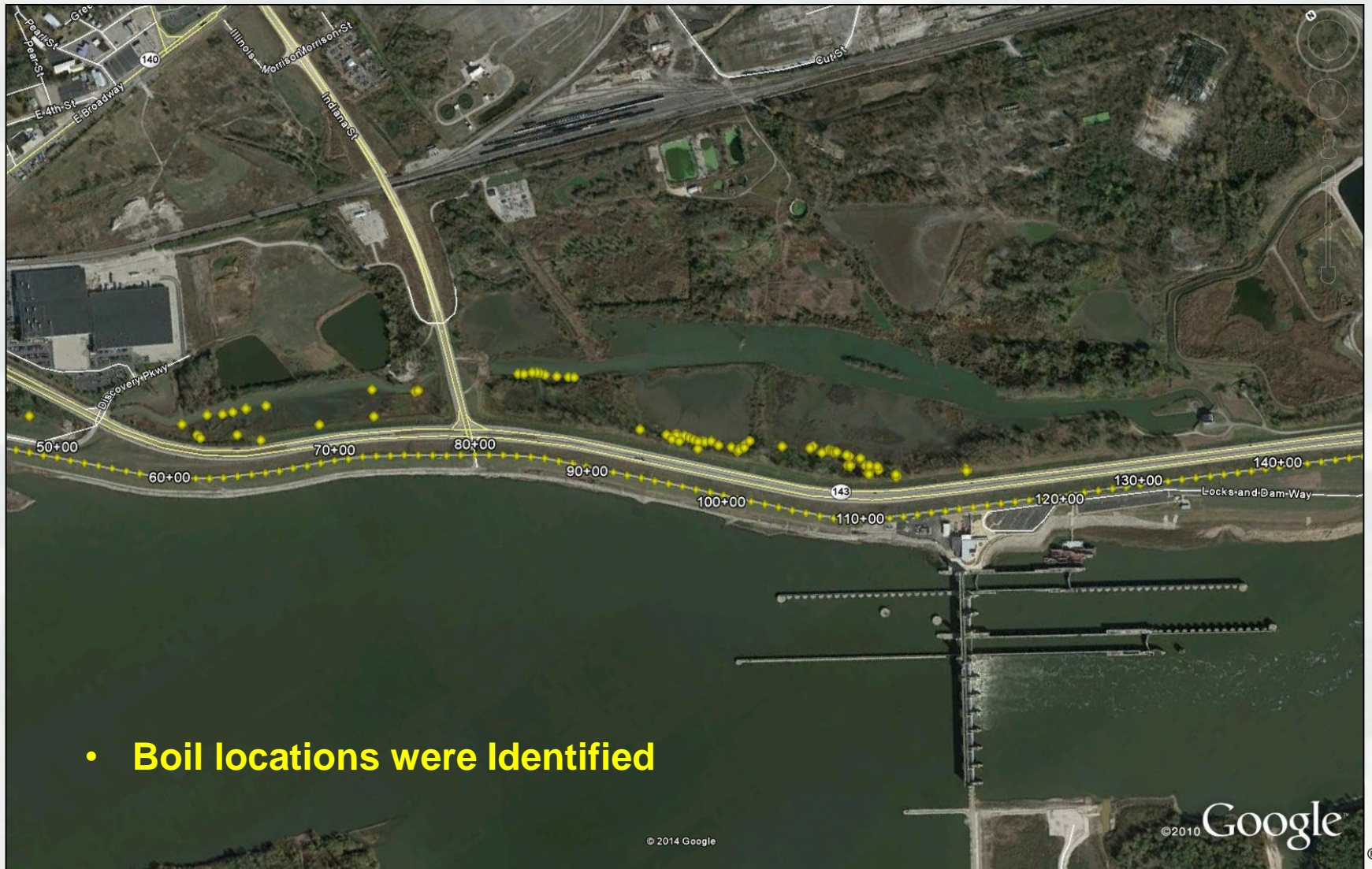


Problem Discovery – 2009

- Data Gathering to refine LIDAR information
- Discovered clear flowing seepage



Problem Discovery



Problem Discovery – November 2009

Uncontrolled Seepage and Sand Boils



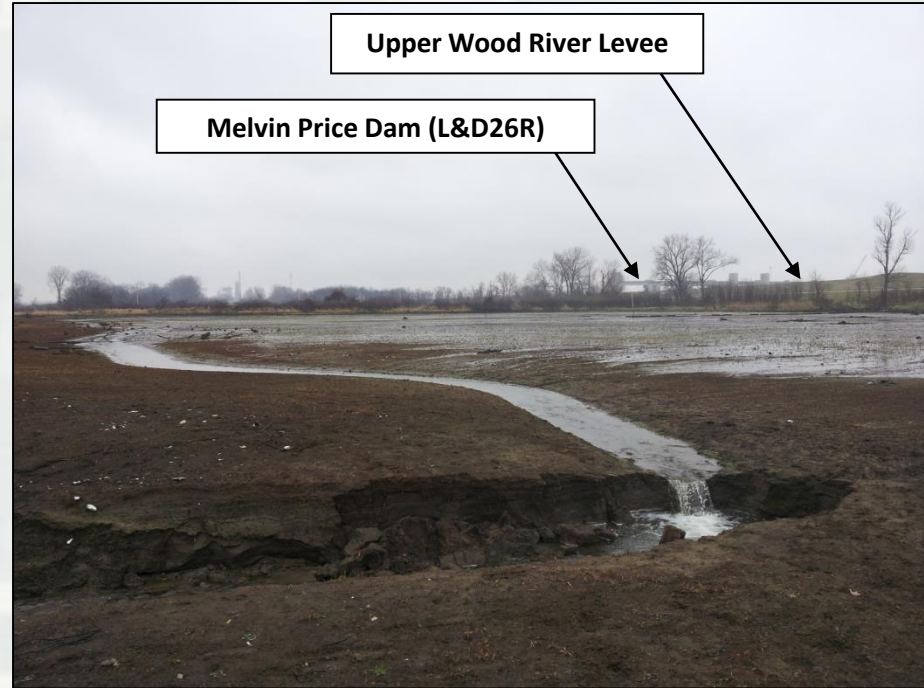
Ongoing Uncontrolled Seepage and Sand Boils.
Caused by constant differential head created by normal pool at Melvin Price Locks and Dam.



EMBANKMENT SEEPAGE SUPPORTING PHOTOS



**Uncontrolled Underseepage
Creating a Sand Boil**



**Sheet flows of
Underseepage Collecting
and causing Head Cutting
Erosion**



Outline

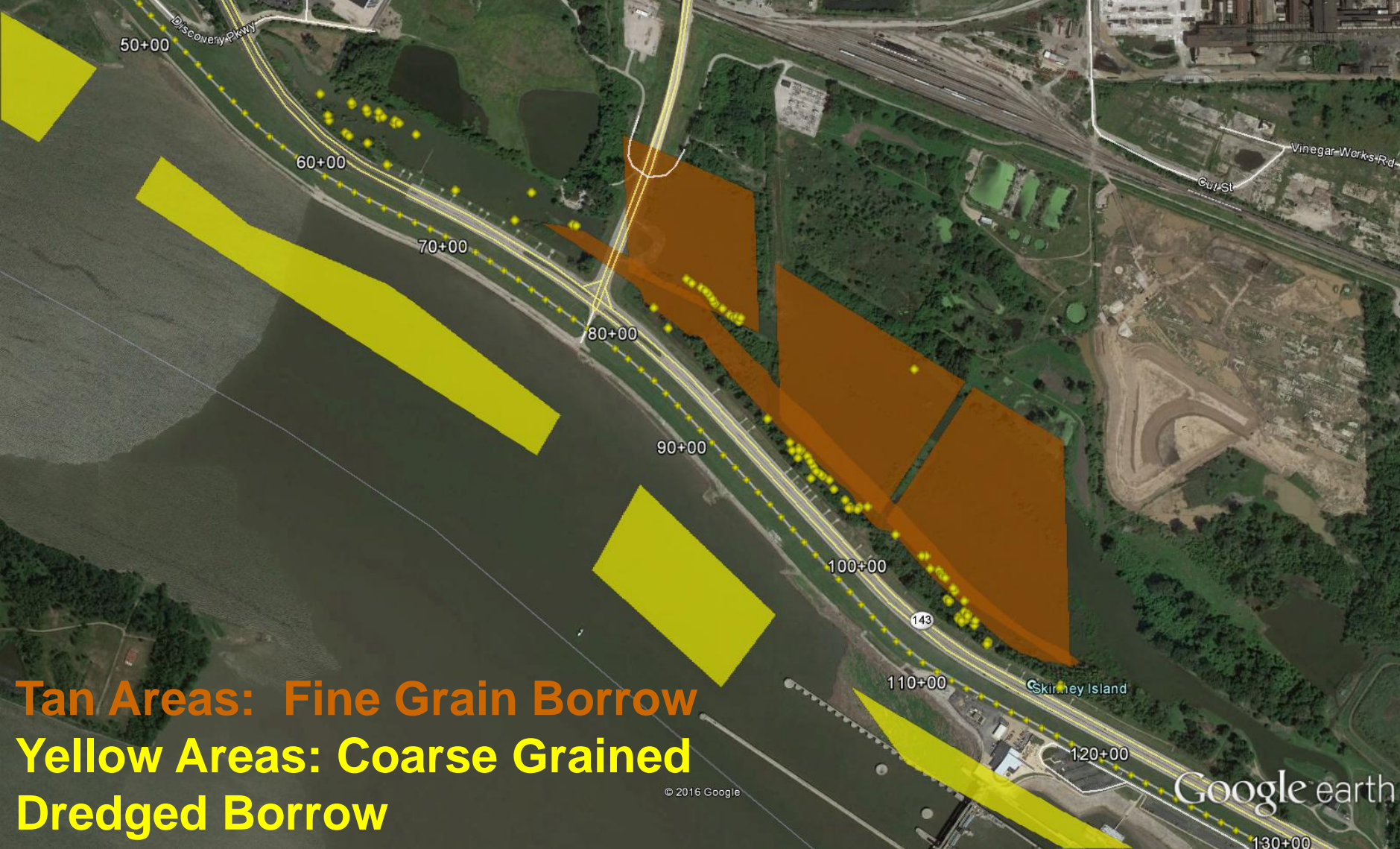
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Soil Probes – Identify Blanket Thickness

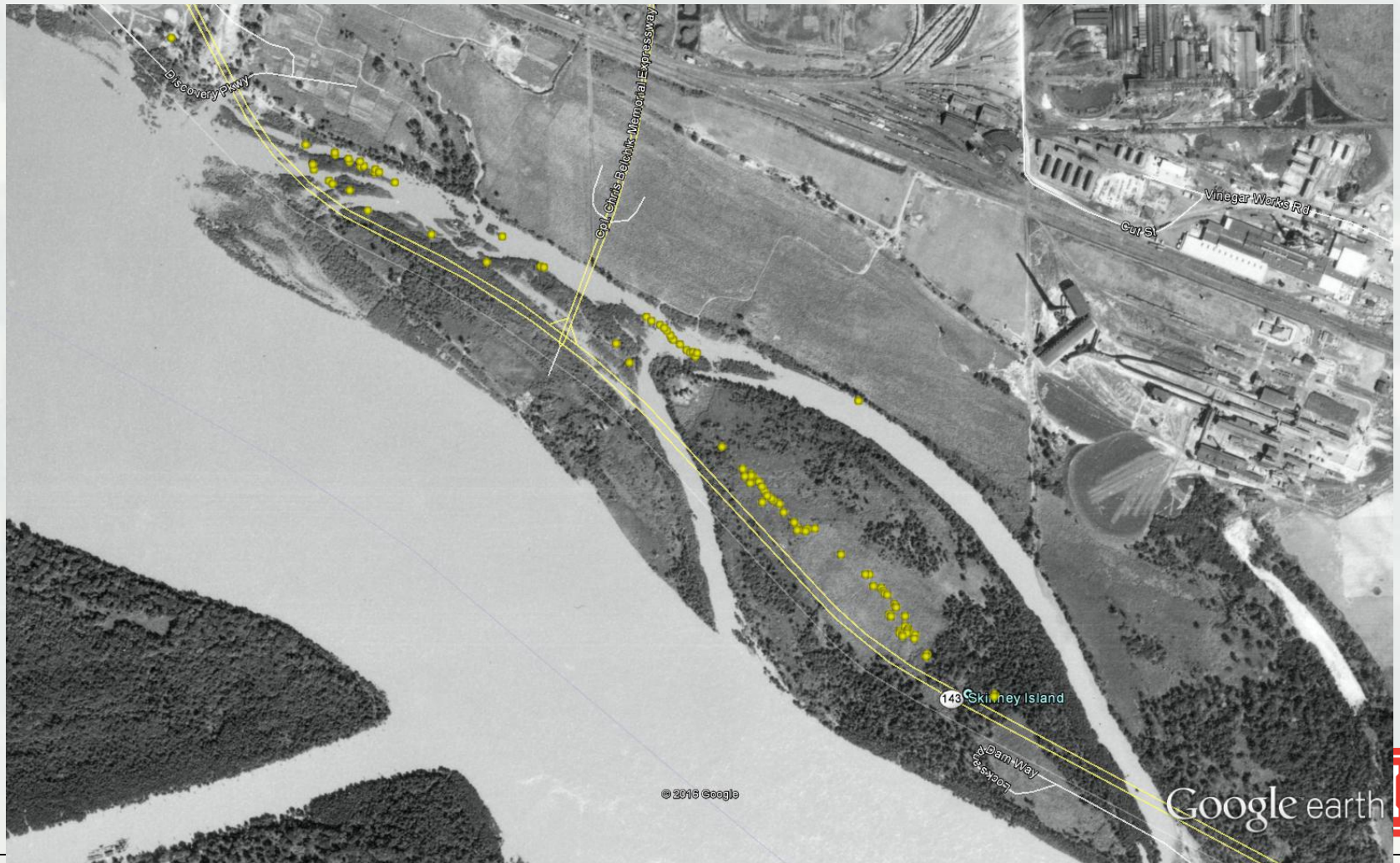


Borrow Locations with Seepage Location Overlaid



Tan Areas: Fine Grain Borrow
Yellow Areas: Coarse Grained Dredged Borrow

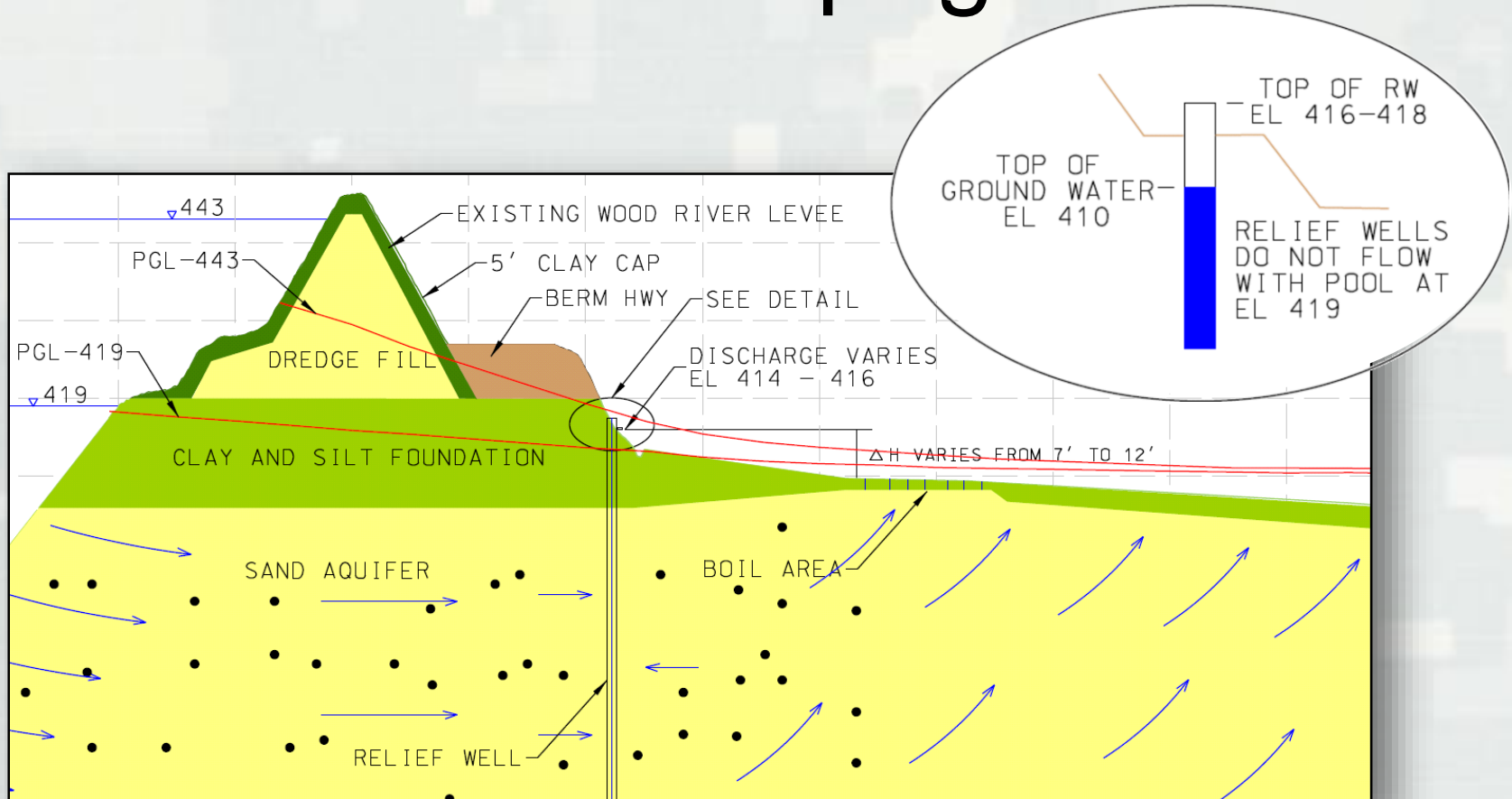
1941 Aerial with Seepage Location Overlaid



Originally Installed Wooden-Stave Relief Wells



Mel Price Seepage Area



Original Piezometer Layout

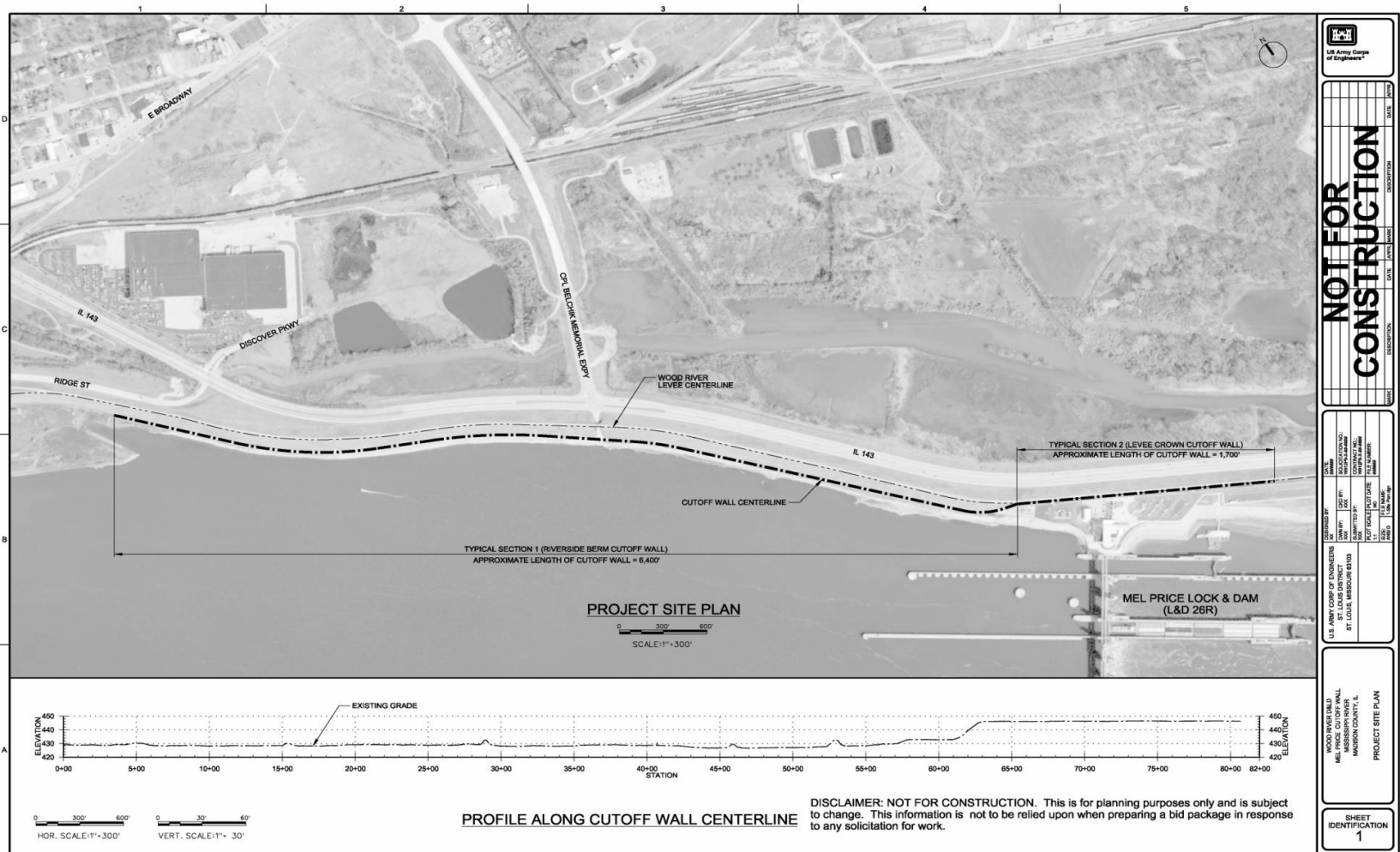


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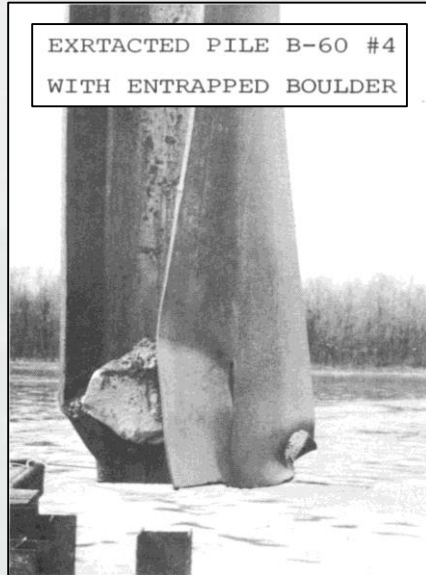


Proposed Seepage Cut-Off Wall



Boulders/Cobbles Encountered during Construction of Mel Price L&D

2014 Pump Test



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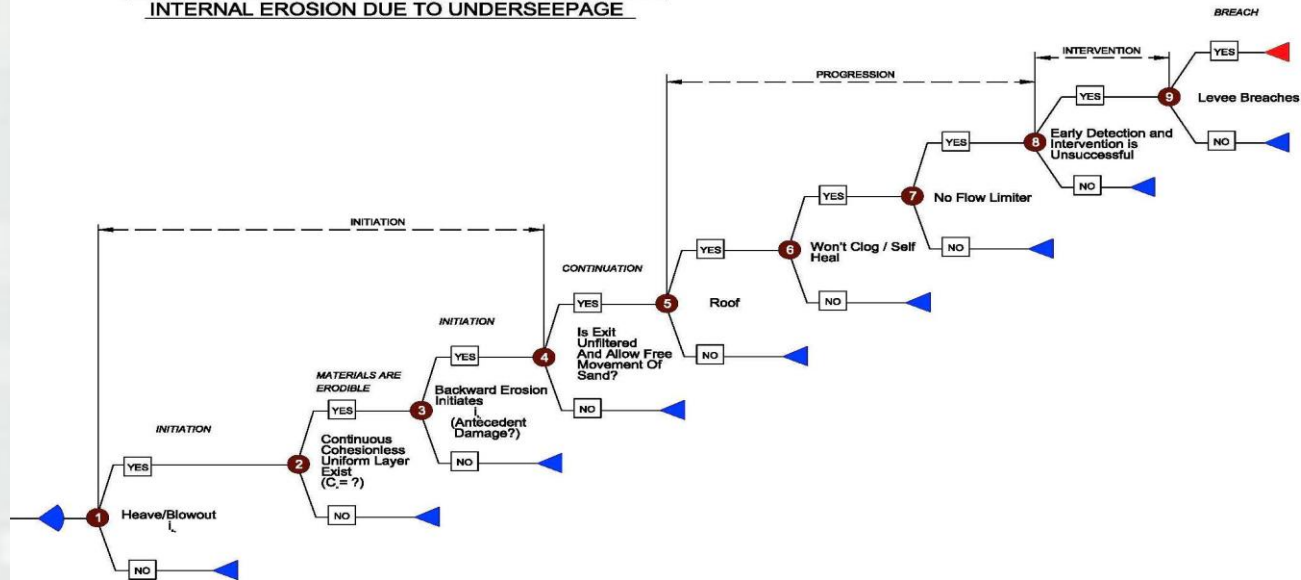
Risk Definitions

- Risk = $P(\text{load}) \times P(\text{failure})_{\text{given the load}} \times \text{Consequences}_{\text{given failure}}$
- Risk Analysis – A quantitative calculation or qualitative evaluation of risk
- Risk Assessment – The process of deciding whether risk reduction actions are needed



Failure Event Tree – Internal Erosion Due to Underseepage

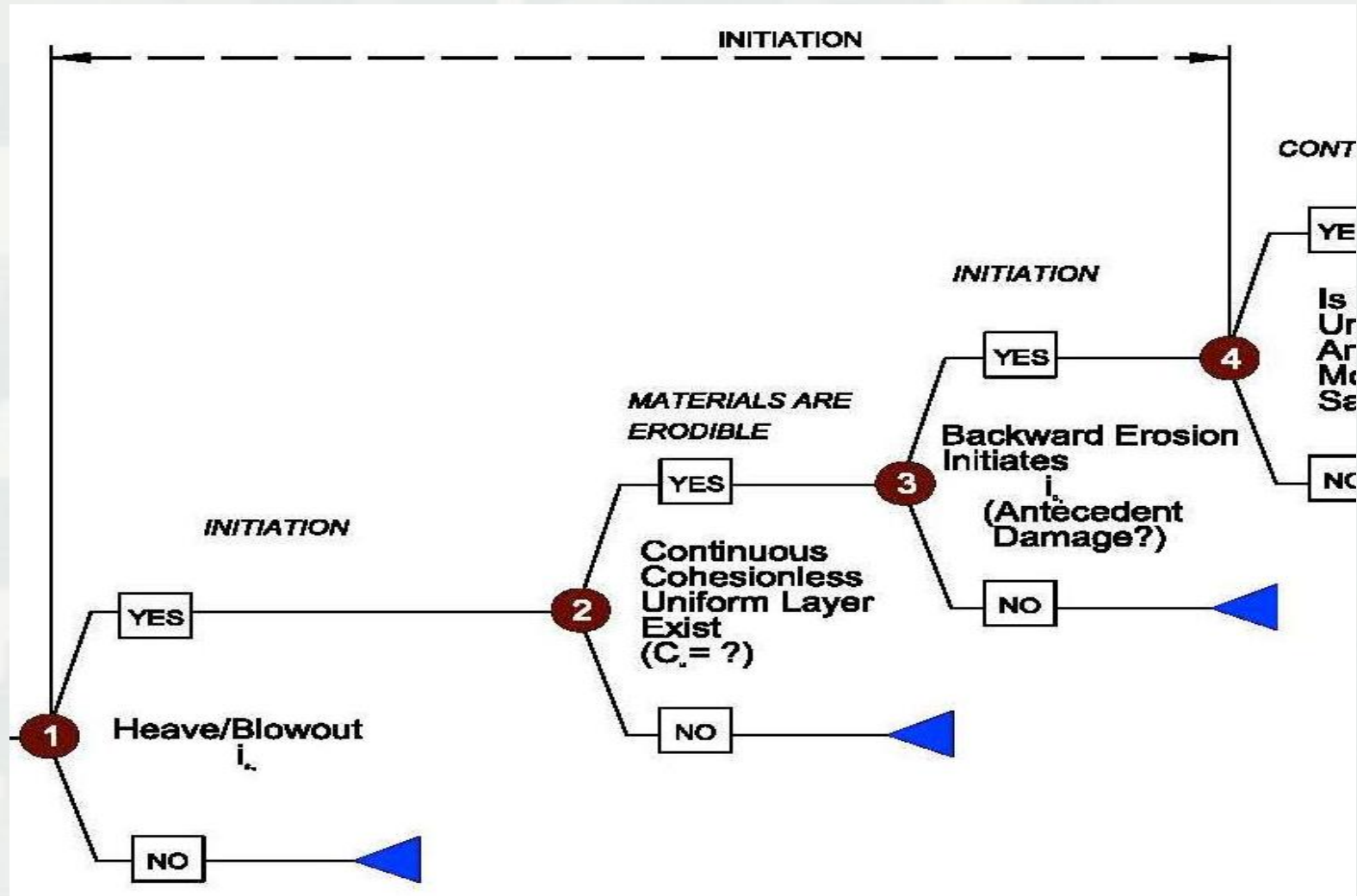
MELVIN PRICE WOOD RIVER FAILURE EVENT TREE
INTERNAL EROSION DUE TO UNDERSEEPAGE



INTERNAL EROSION DUE TO UNDERSEEPAGE
 (FLAW) A COMBINATION OF THE DEFECT/FLAW EXISTS WHICH COMPROMISES THE CONFINING LAYER WHICH PROVIDES A PATHWAY/CRACK THROUGH THE CONFINING LAYER.
 (UNFILTERED EXIT) BACKWARDS EROSION CAN CONTINUE BENEATH THE CONFINING LAYER FOUND UNDER THE LEVEE WHICH IS CAPABLE OF MAINTAINING A ROOF.
 (INITIATION) A RAINFALL EVENT RAISES THE MISSISSIPPI RIVER LEVEL ABOVE LEVEE TOE WHICH CAUSES SATURATION OF FOUNDATION SAND. HIGH PIEZOMETRIC PRESSURE IS THEN TRANSMITTED THROUGH THE FOUNDATION TO THE LANDSIDE OF THE LEVEE. THE GRADIENT IS DEVELOPED AT THE BASE OF THE DITCH TO THE POINT WHERE THE CRITICAL GRADIENT IS EXCEEDED AND MATERIAL TRANSPORTATION IS INITIATED.
 (PROGRESSION) THE CRITICAL LOADING DURATION IS SUFFICIENT TO ALLOW BACKWARDS EROSION TO PROGRESS THE PIPE DIRECTLY UNDER THE CONFINING LAYER TOWARD THE RIVER.
 (BREACH) THE PIPE LEADS TO GROSS ENLARGEMENT OF THE PIPE AND COLLAPSE OF THE CLAY ROOF WHICH LOWERS THE CREST BELOW THE FLOOD LEVEL. THIS ALLOWS OVERTOPPING AND EVENTUALLY BREACHES THE LEVEE.



Failure Event Tree – Nodes 1, 2, and 3 informed by piezometric data interpretation

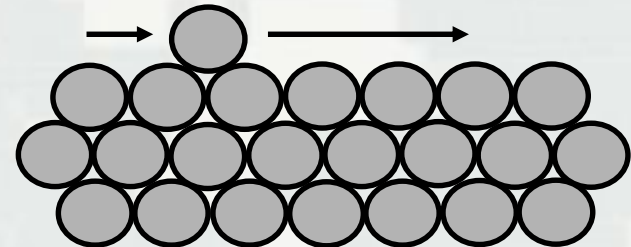
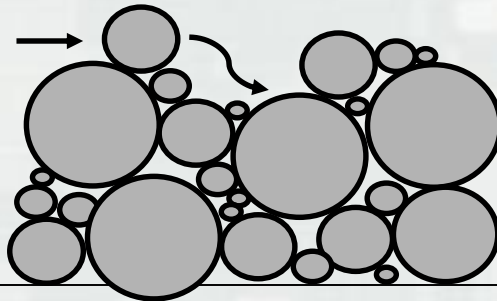
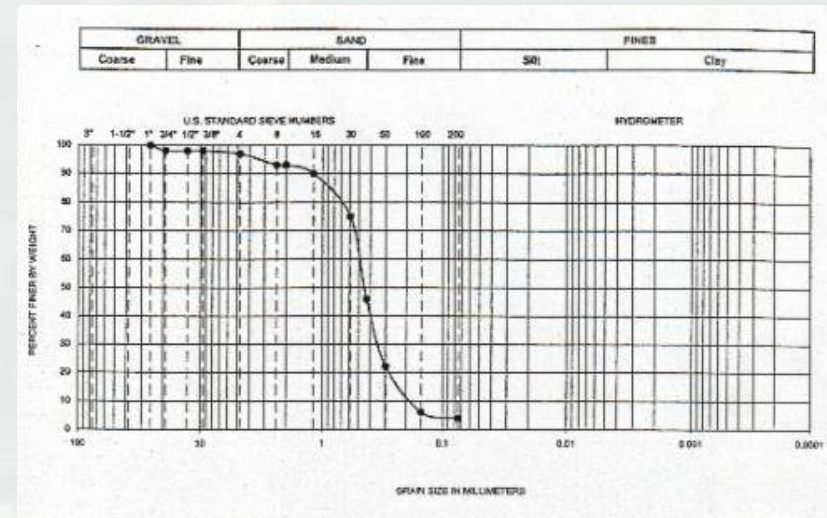
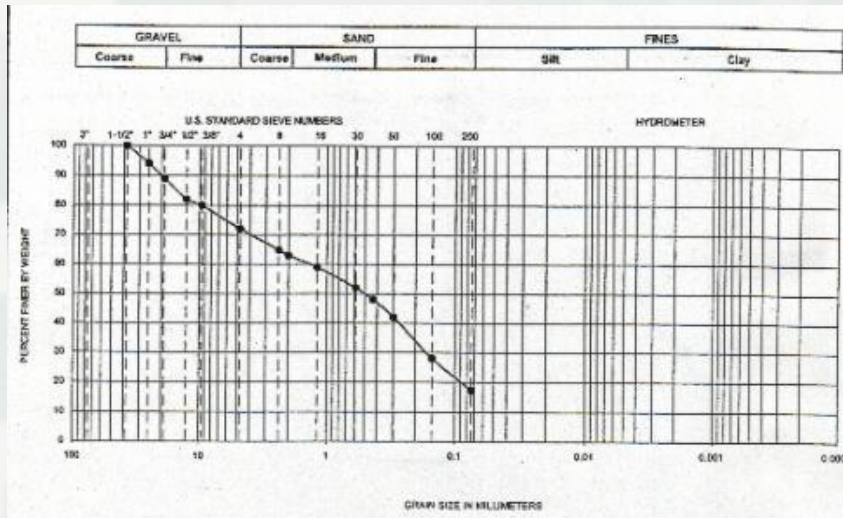


Coefficient of Uniformity, C_u

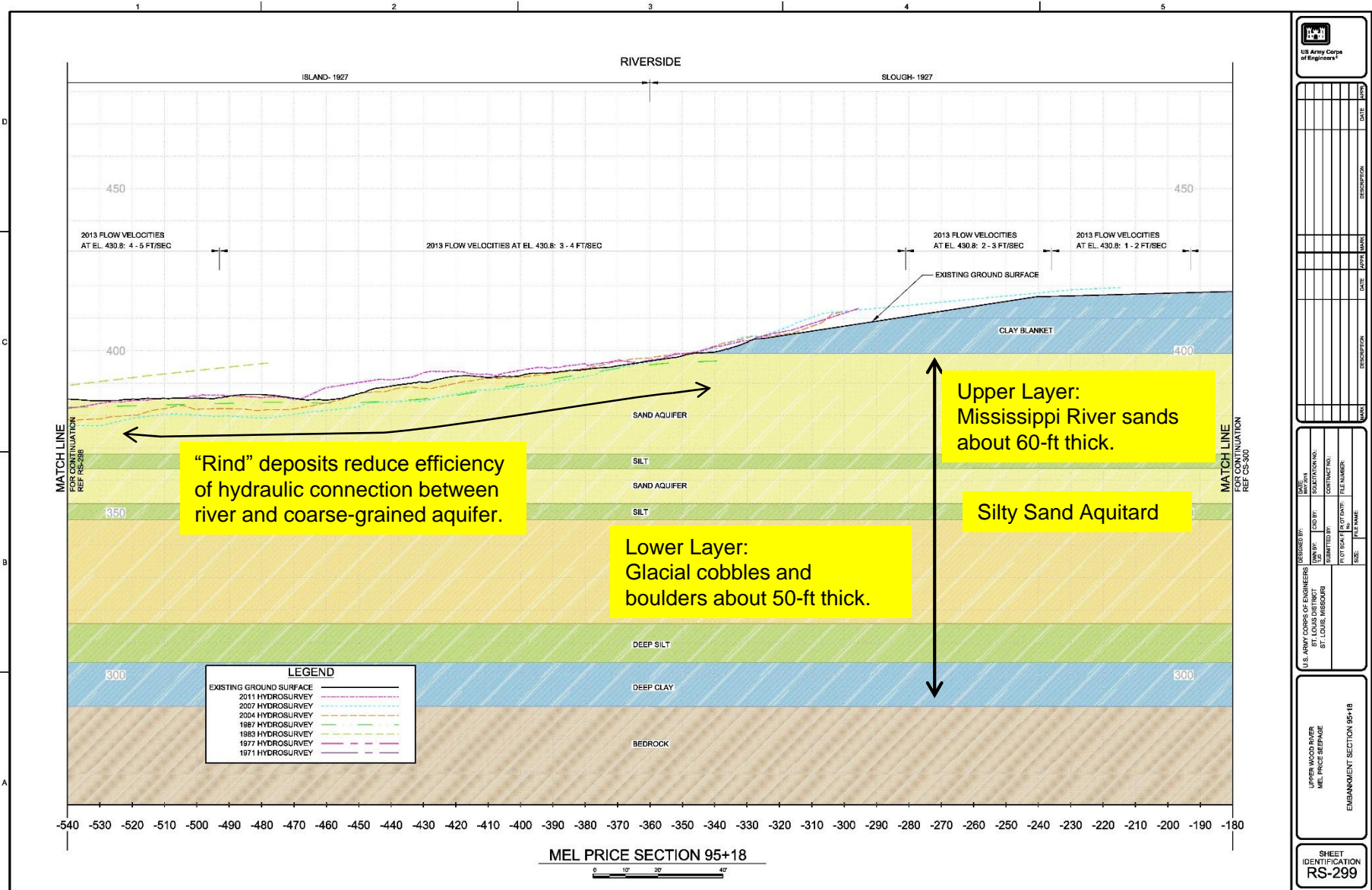
- $C_u = D_{60}/D_{10}$

SW
Higher C_u

SP
Lower C_u

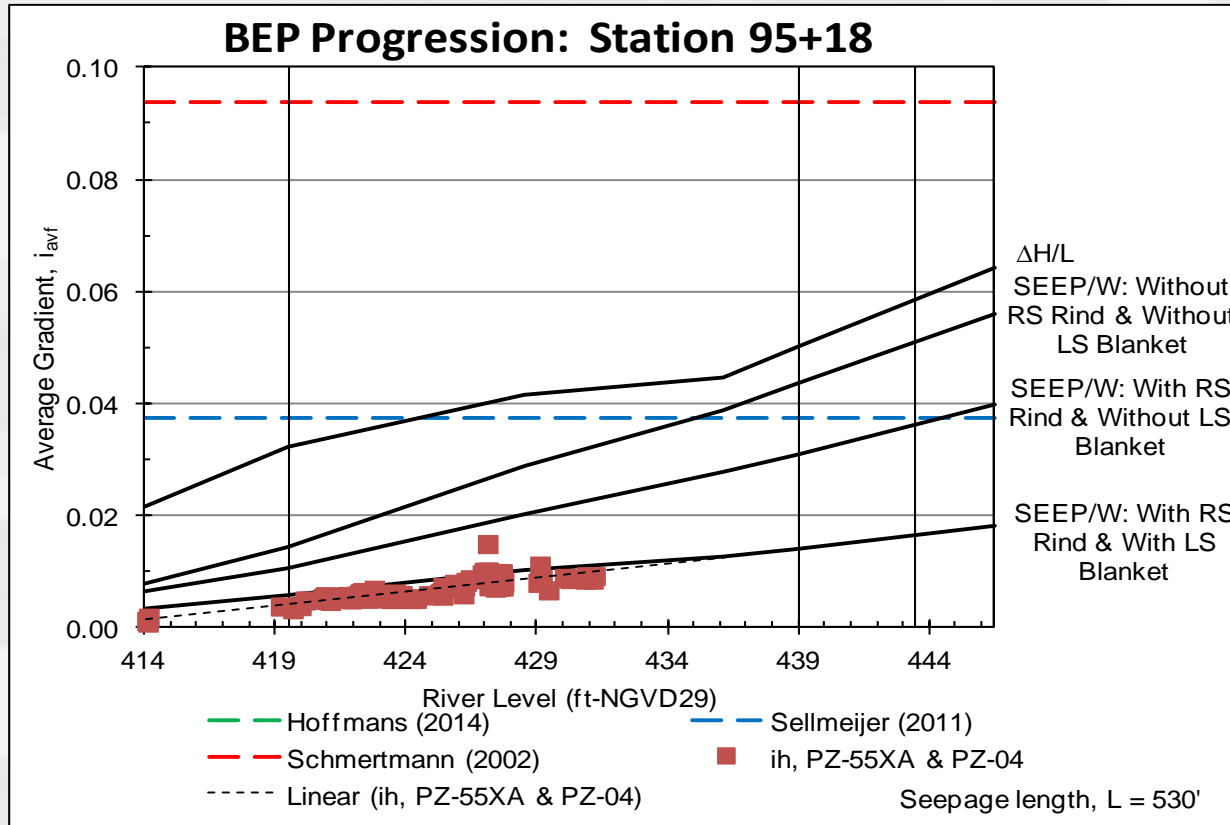


Detailed Riverside Stratigraphy: Station 95+18

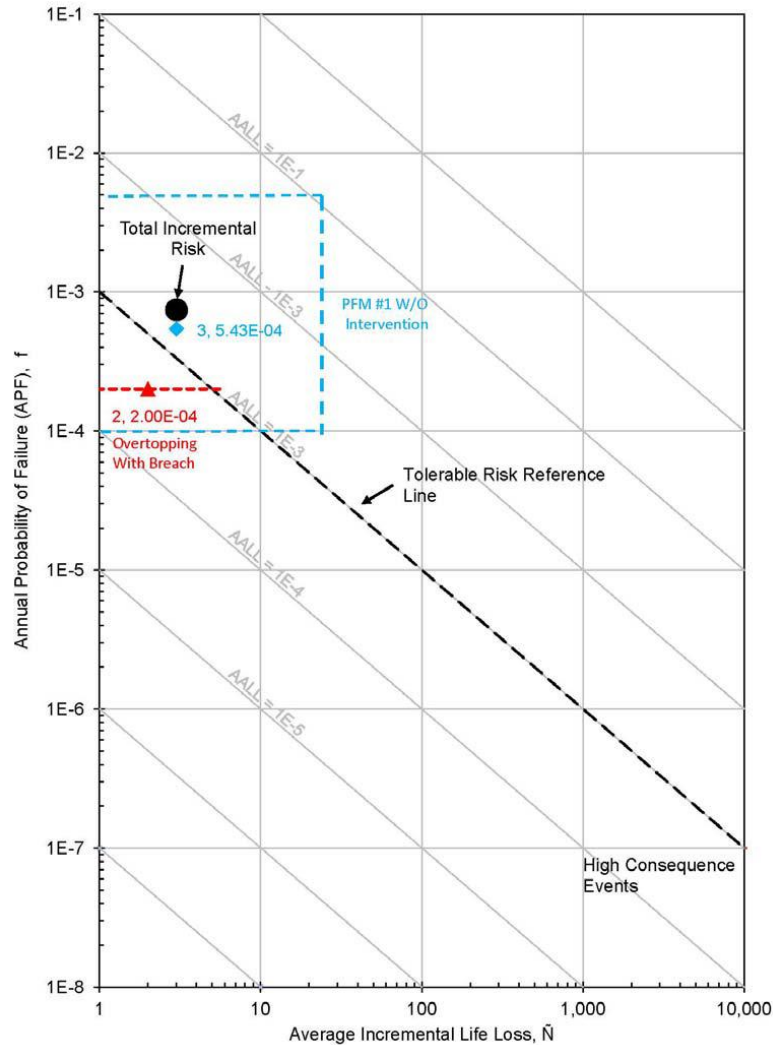


PFM 1 Node 3 - BEP Initiates

- Modeling results against critical



Risk Matrix



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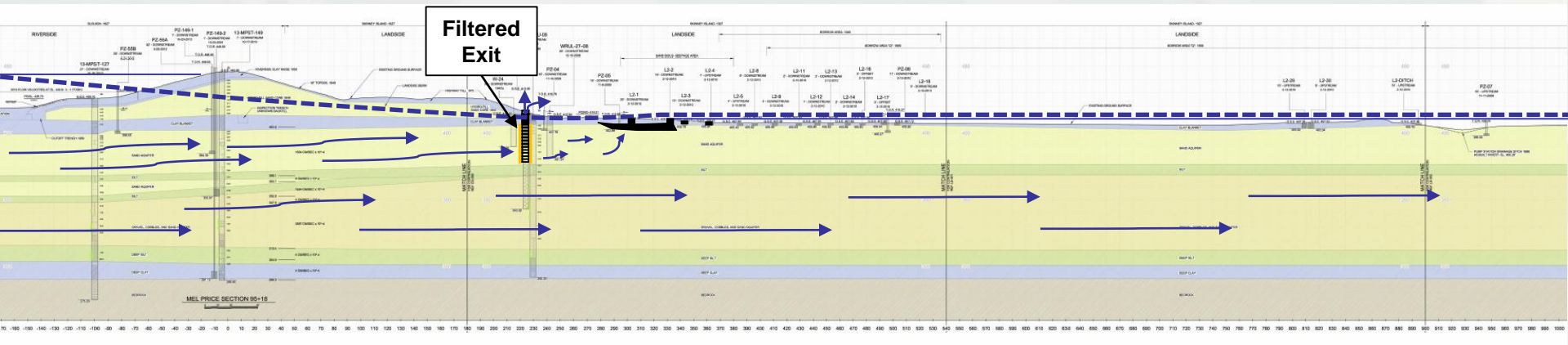
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Proposed Plan

Install 100 New Relief Wells

- Relief Wells Prevent Progression
 - ▶ Provides a Filtered Exit to Prevent Erosion of Foundation Sands



Proposed Plan Install 100 New Relief Wells



- **Lowered Relief Well Outlet Elevation**
 - ~7 feet lower



Questions?

