

David Paul



David B. Paul, P.E., is a Senior Technical Advisor for Dams and Levees for HDR Inc., Denver Office. He retired from the US Army Corps of Engineers (USACE) at the end of 2018 after 42 years of Federal service, as the Dam Safety Officer for the Mosul Dam Task Force which is providing technical assistance to the Government of Iraq in to mitigate dam safety issues associated with Mosul Dam. He also served as Special assistant for Dam Safety at the U.S. Army Corps of Engineers (USACE) headquarters in Washington, D.C., responsible for managing the USACE's portfolio of 715 dams. He is a national specialist on critical infrastructure design, dam design, levee design, construction engineering, engineering risk assessments, interim risk reduction measures (IRRM), and dam and levee safety modifications. He recently participated in the Risk Assessment for Oroville Dam. Mr. Paul is a Trustee of DFI, and a member of the United States Society of Dams (USSD), Association of State Dam Safety Officials (ASDSO) and American Society of Civil Engineers (ASCE). He is DFI Trustee for the Seepage Control and Grouting Committees and serves on the USSD Committees on Construction and Embankment Dams. He is the USSD Representative to the ICOLD Embankment Dams Committee.

**Remediation against internal erosion through foundations –
selection and installation of cut-off walls**



**ICOLD-CIGB 2019 SYMPOSIUM:
SUSTAINABLE AND SAFE DAMS AROUND THE WORLD
UN MONDE DE BARRAGES DURABLES ET SÉCURITAIRES**



AV Watkins Dam Internal Erosion Case History

David Paul, P.E.



Dr. Ralph Peck

- *“No man can hope to be truly an artist in the practice of subsurface engineering without a rich background of personal experience, or without an adequate knowledge of the experiences of his contemporaries and predecessors.”*

- -Ralph Peck
 - (Art and Science in Subsurface Engineering)



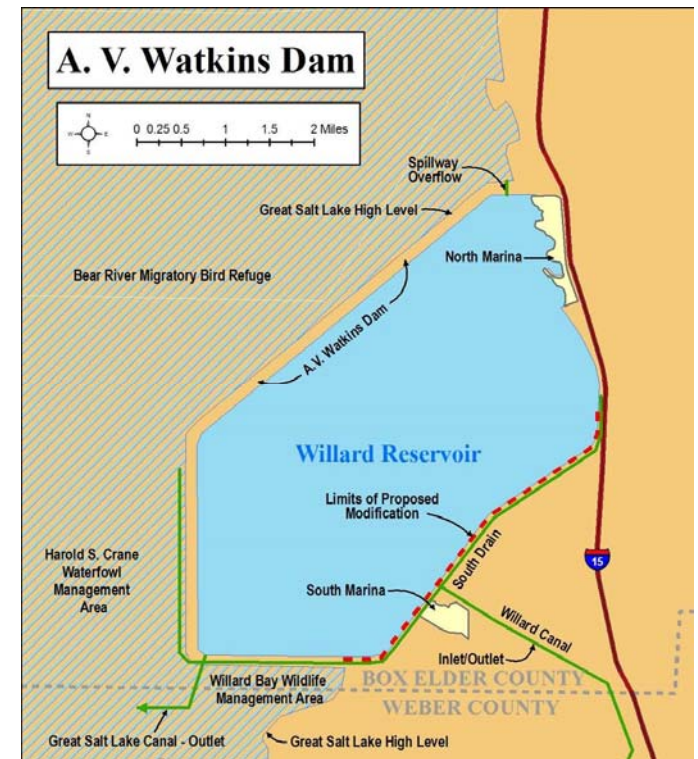
AV Watkins Dam





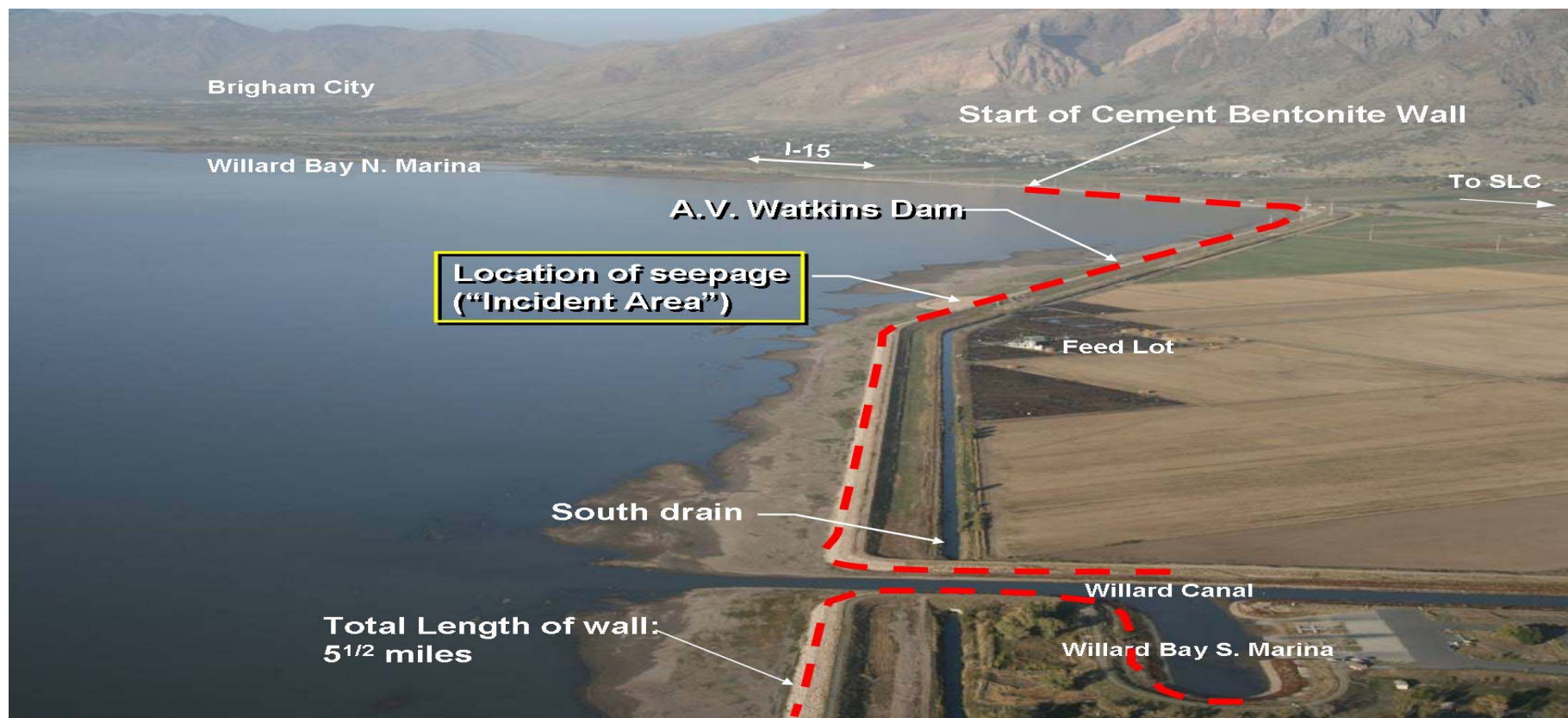
AV Watkins Dam

- Impounds Willard Reservoir
- Dam is 14 miles long
- Earthfill Structure
- Maximum Ht. = 36 ft (approx. 20 ft in incident area)
- November 13, 2006; active piping was noticed at approx. sta. 639+00
- Intervention was successful in preventing failure



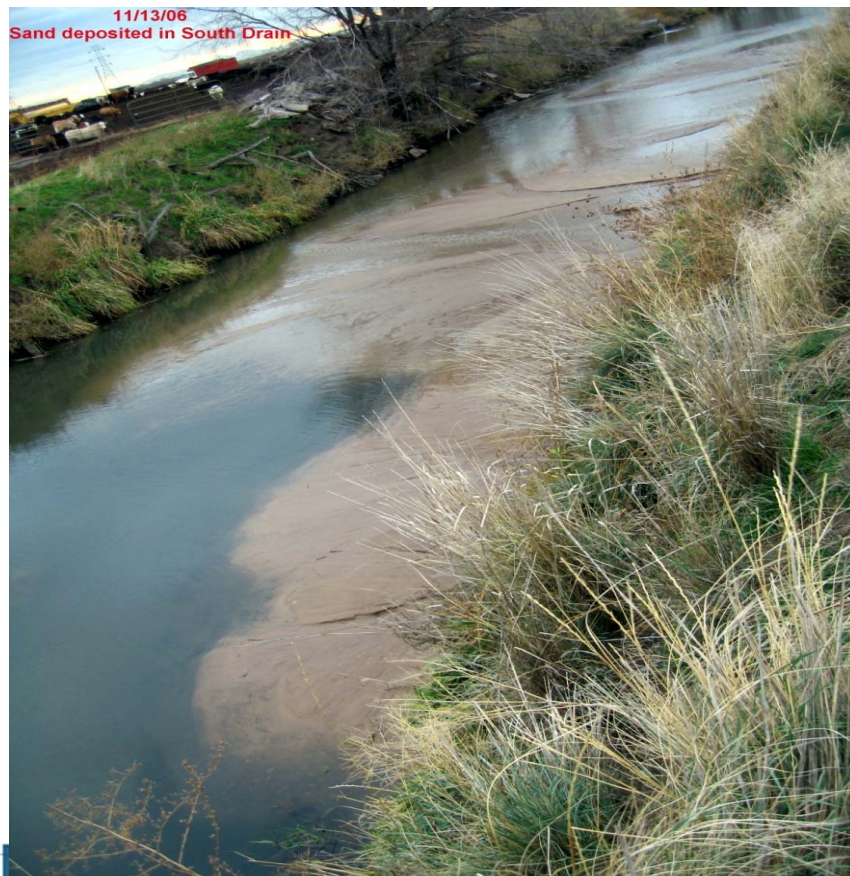


AV Watkins Dam

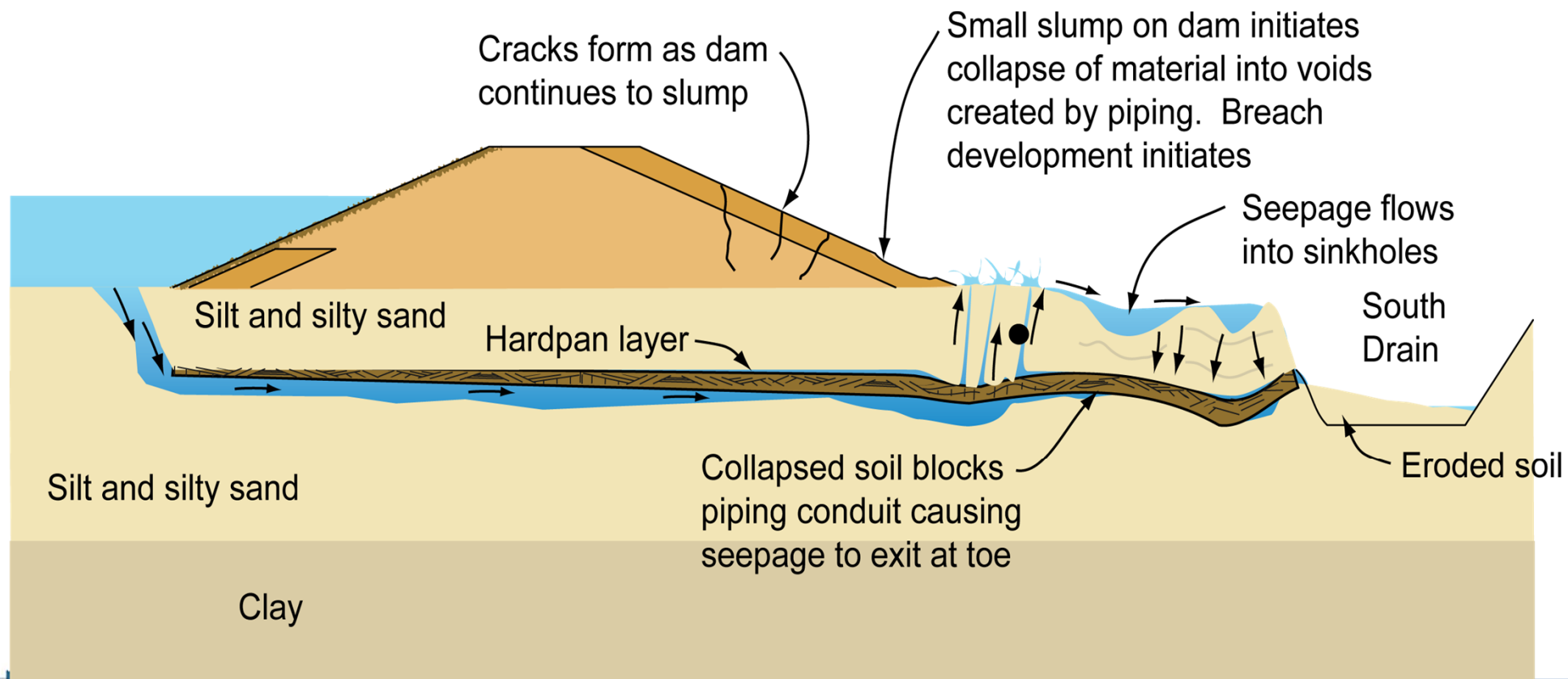




Backward Erosion



AV Watkins – Internal Erosion





Purpose of a Cutoff in Dams and Levees

- Prevent internal erosion
 - Control exit gradients
 - Control hydraulic pressures
 - Intercept concentrated leaks
- Decrease uplift pressures
- In rare cases, our objective may be to reduce seepage losses, however this is often a result of our efforts to control erosion.



Cutoff Wall Design Criteria

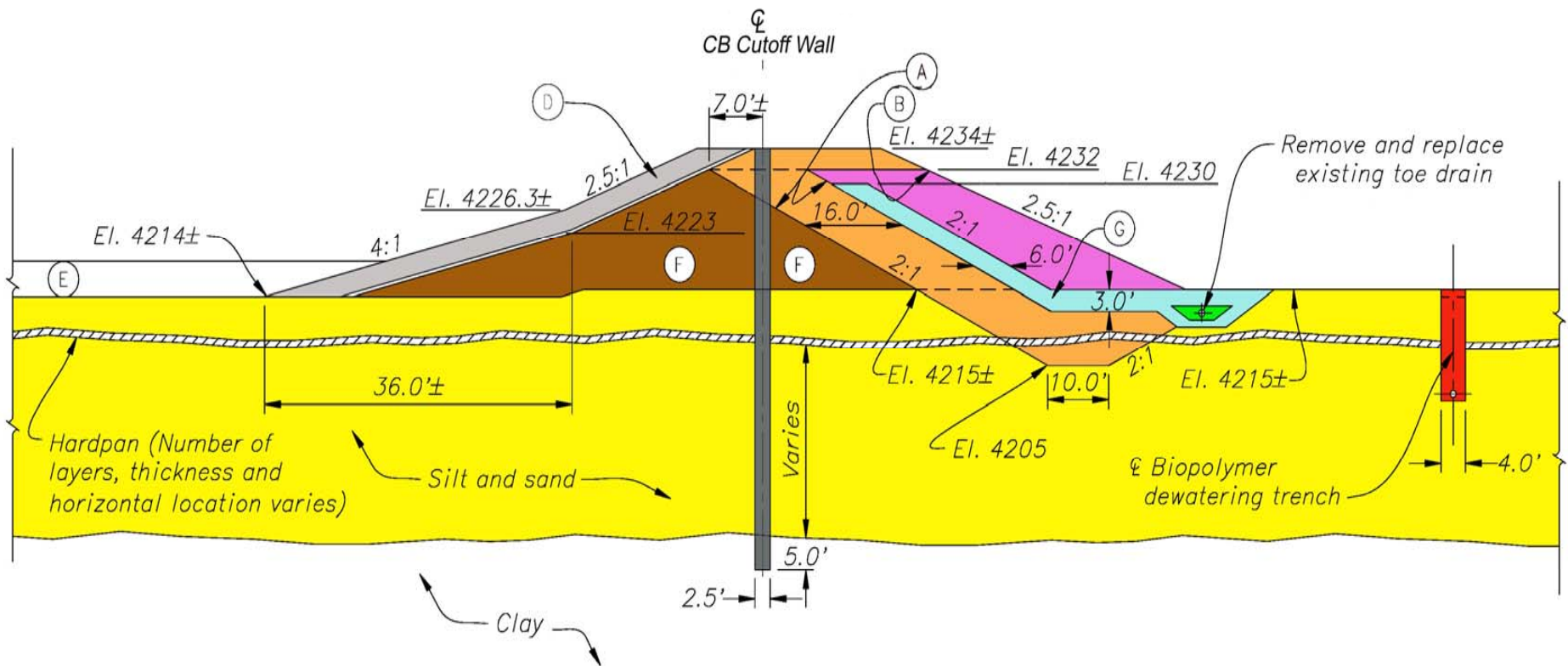
- Define needed reduction in hydraulic pressure or gradient
- Identify and assess areas of potential seepage concentration
- Assess concentration of seepage due to wall
- Identify backfill performance criteria
- Construction Stability



Elements of Cutoff Design

- Length and depth
 - Reduce seepage condition
 - Prevent unprotected gradient increase
- Wall location
 - Construction
 - Stability
 - performance
- Wall backfill material
- Excavation method

AV Watkins Dam - Repair





AV Watkins Dam





AV Watkins Dam





Cutoff Wall Excavation





Cement Bentonite Backfill





Dr. James Sherard

“Many aspects of designing and constructing large earth dams will probably always fall within that group of engineering problems for which there are no universally accepted and uniquely correct procedures”

James Sherard, 1963