MONITORING PERSPECTIVES

Northwest Hydro Forum – Session 7, Dam Safety

Kimberly Pate | May 17, 2017

OUTLINE

- Dam-Foundation Design Assumptions
  - Two 1960s thin-arch, double-curvature dams
- Potential Failure Mode Perspectives
- Boundary Dam 2010 Potential Failure Mode
  - 1960s Plan View to 3D Model
- Boundary Dam 2015 Potential Failure Mode
  - 2017 3D Model to Plan View – Evolved Perspective
- Monitoring and Surveillance Journey

1960'S THIN ARCH DAMS – TWO EXAMPLES

- Morrow Point Dam (USBoR)
  - Thin arch, double-curvature arch dam (*first of this type for Bureau*)
  - Dam completed by Fall 1967
  - 468 ft high, 12 ft crest, 52 ft base

- Boundary Dam (SCL):
  - Thin arch, double-curvature arch dam
  - Dam completed with initial generation by Fall 1967
  - 340 ft high, 8 ft crest, 32 ft base

DAM-FOUNDATION ASSUMPTIONS

- *Thin-arch dam* based on base thickness, <0.2H; up to *Arch-gravity* at <0.5H
- Arch dam transfer of loads into abutments and foundation: both horizontal arches and vertical cantilever action

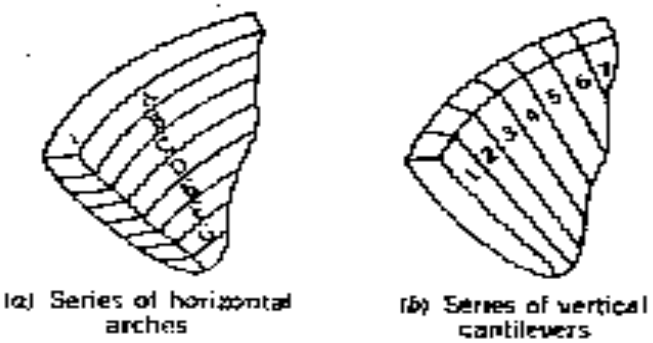
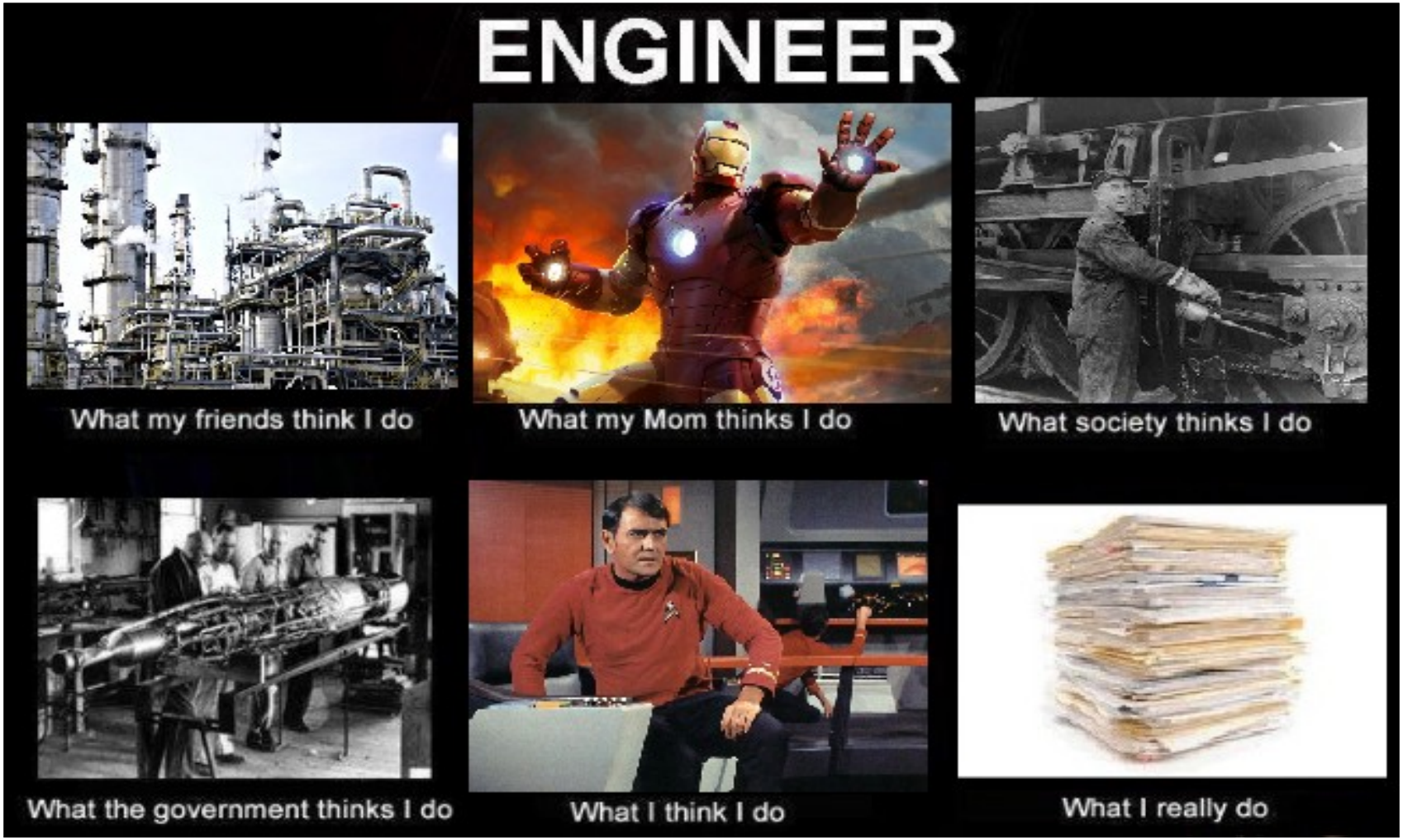
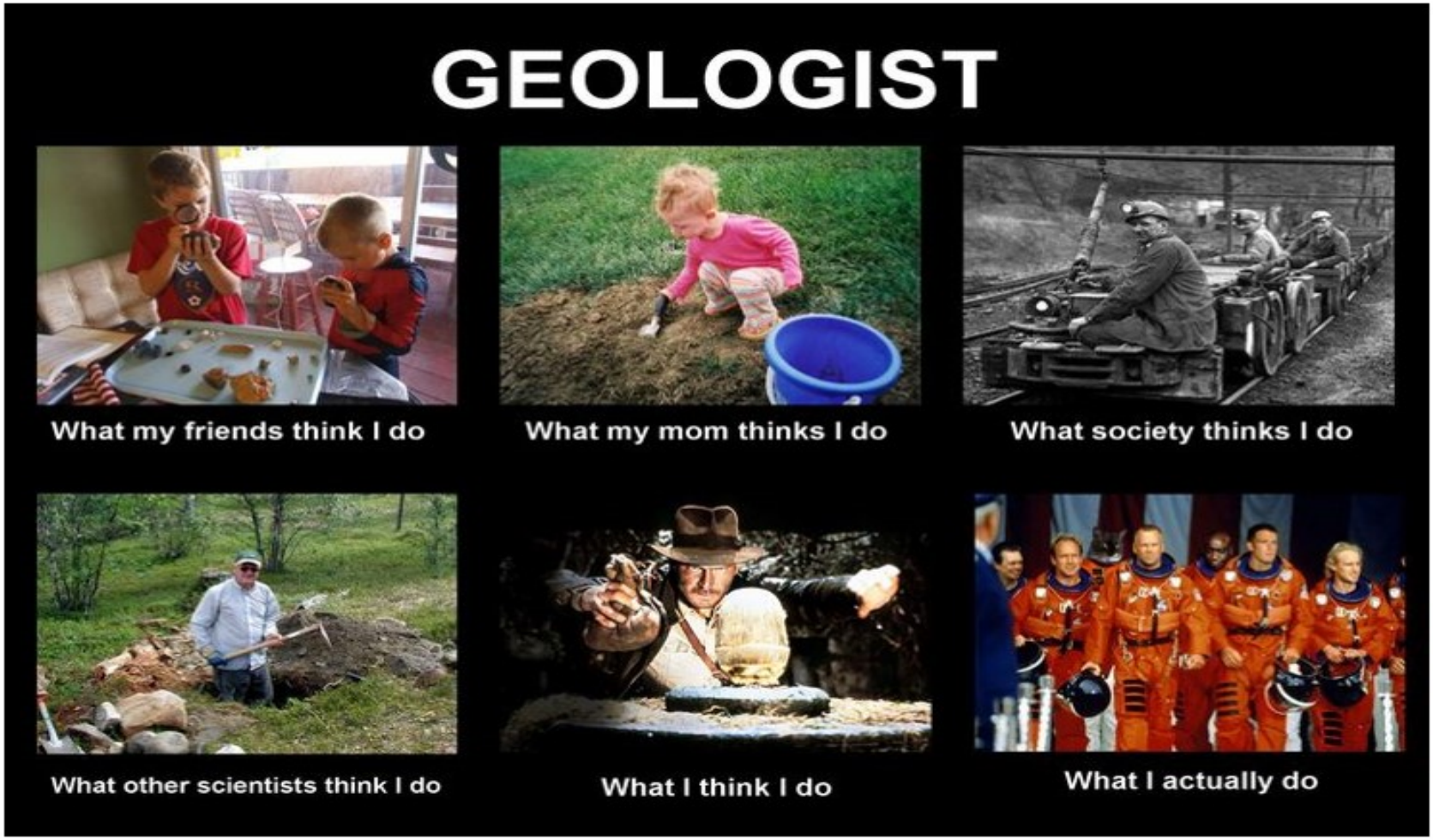


Figure 2.10. Series of horizontal arches and vertical cantilevers

PERSPECTIVES – ENGINEER AND GEOLOGIST



PERSPECTIVES – ENGINEER AND GEOLOGIST

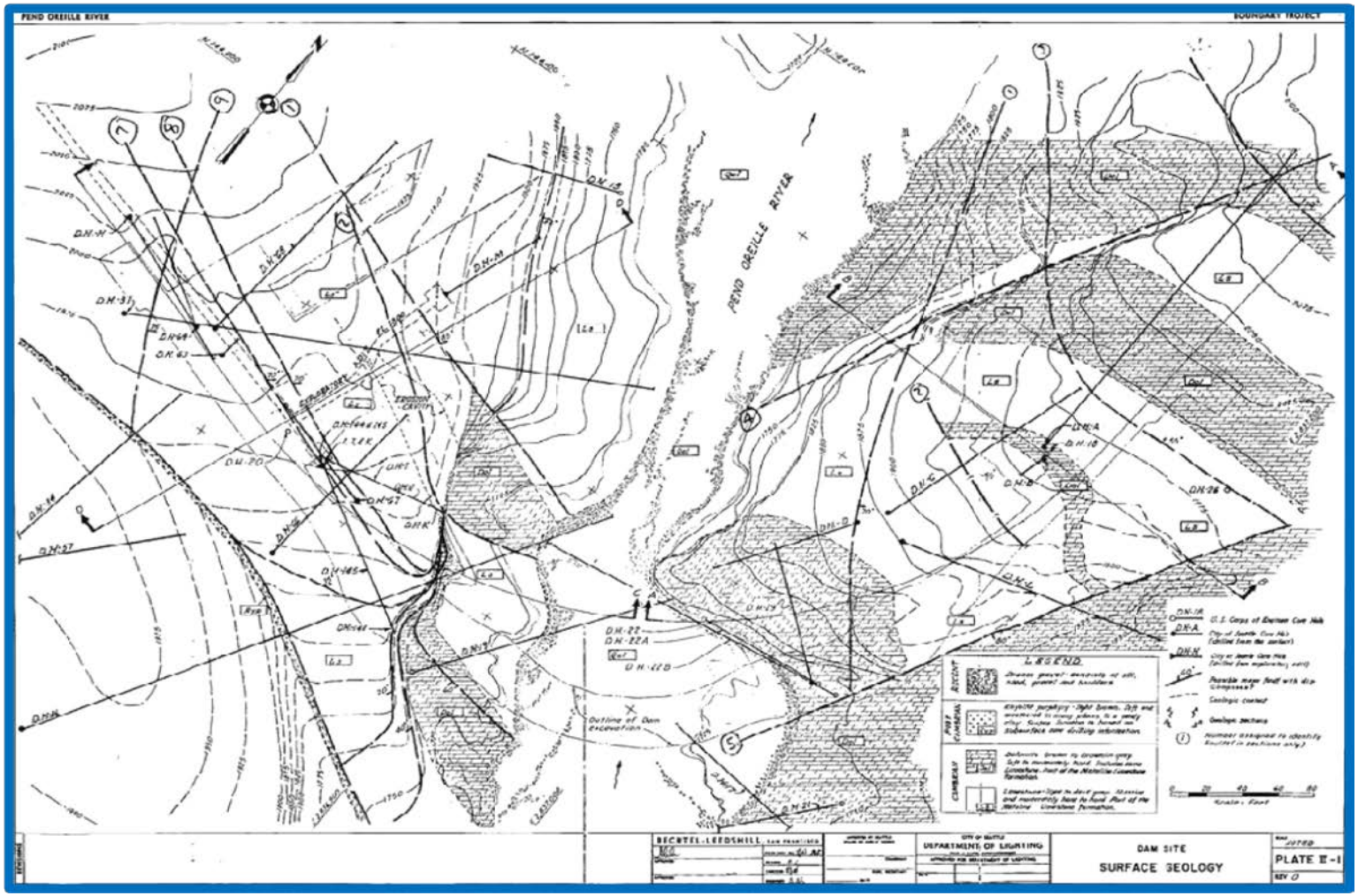


POTENTIAL FAILURE MODE PERSPECTIVES

- 2010 Boundary Dam PFM Description:
  - N1 - *Rock in wedge 6-9-1 deforms (left abutment), loses load which is transferred to the foundation for Spillway 1,overstressing it, causing loss of ground and one or more arch cantilevers to crack and either slide or rotate, resulting in an uncontrolled release of the reservoir (Category II)*
  - No right abutment PFM
- 2015 Boundary Dam PFM Descriptions:
  - PFM 1 – *Dam Failure due to Left Abutment Instability Under Normal Loads (Category III)*
  - PFM 2 – *Dam Failure due to Right Abutment Instability Under Normal Loads (Category III)*

2010 BOUNDARY DAM POTENTIAL FAILURE MODE

1960'S PLAN VIEW – SURFACE GEOLOGY



2010 BOUNDARY DAM POTENTIAL FAILURE MODE

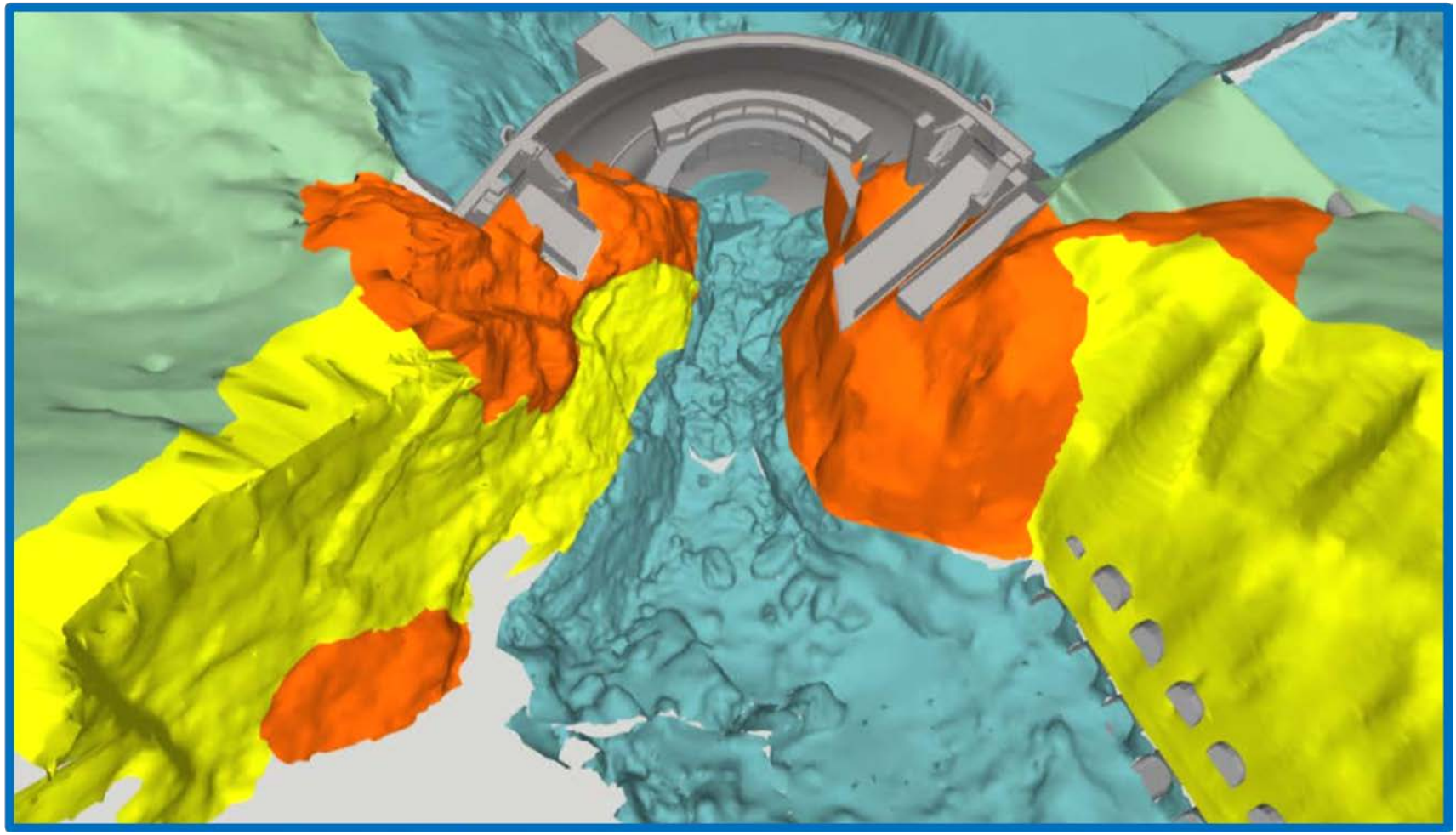
1960s PLAN VIEW TO 3D MODEL

2010 BOUNDARY DAM POTENTIAL FAILURE MODE

1960s PLAN VIEW TO 3D MODEL

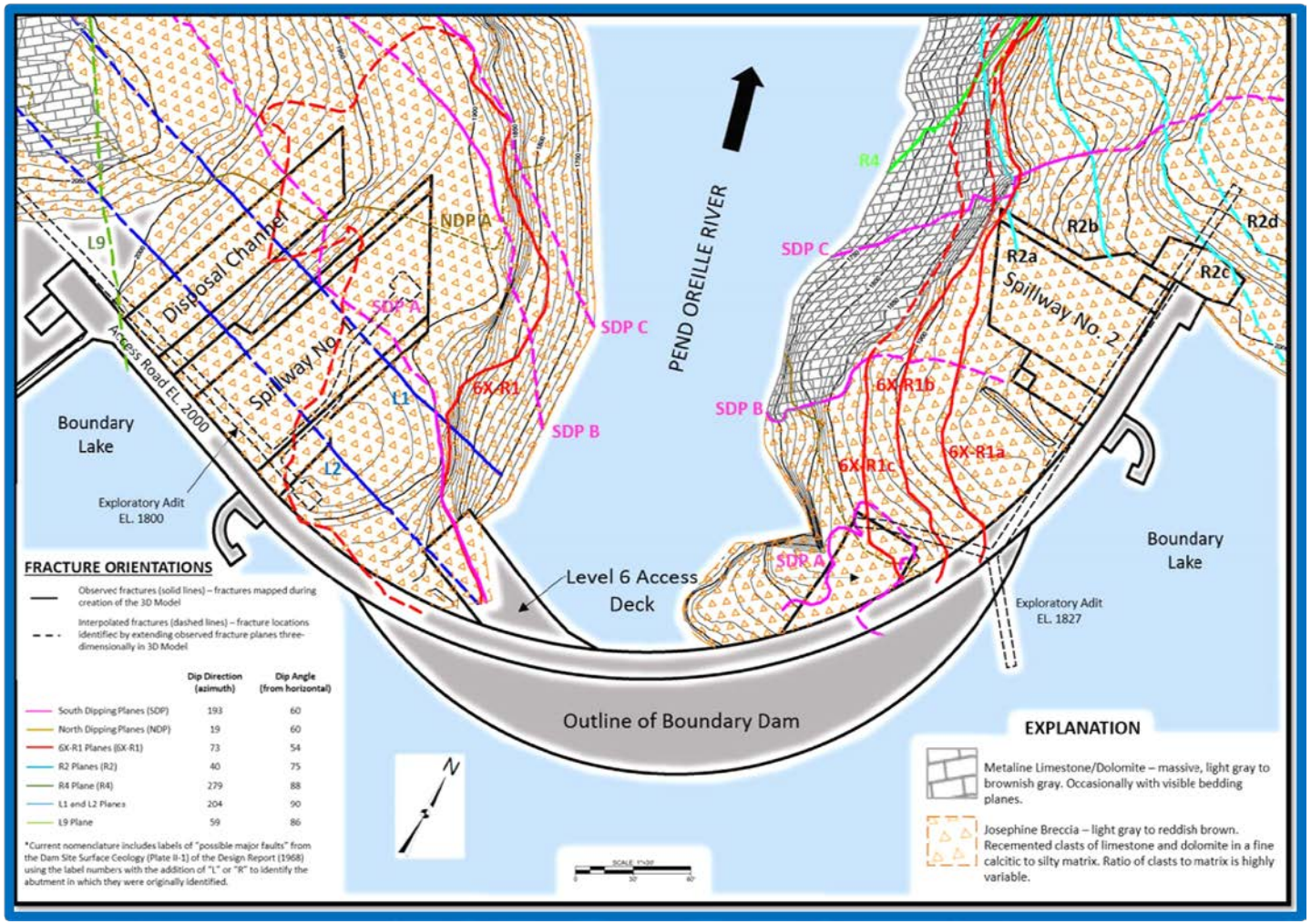
2015 BOUNDARY DAM POTENTIAL FAILURE MODE

2017 3D MODEL TO PLAN VIEW – EVOLVED PERSPECTIVE



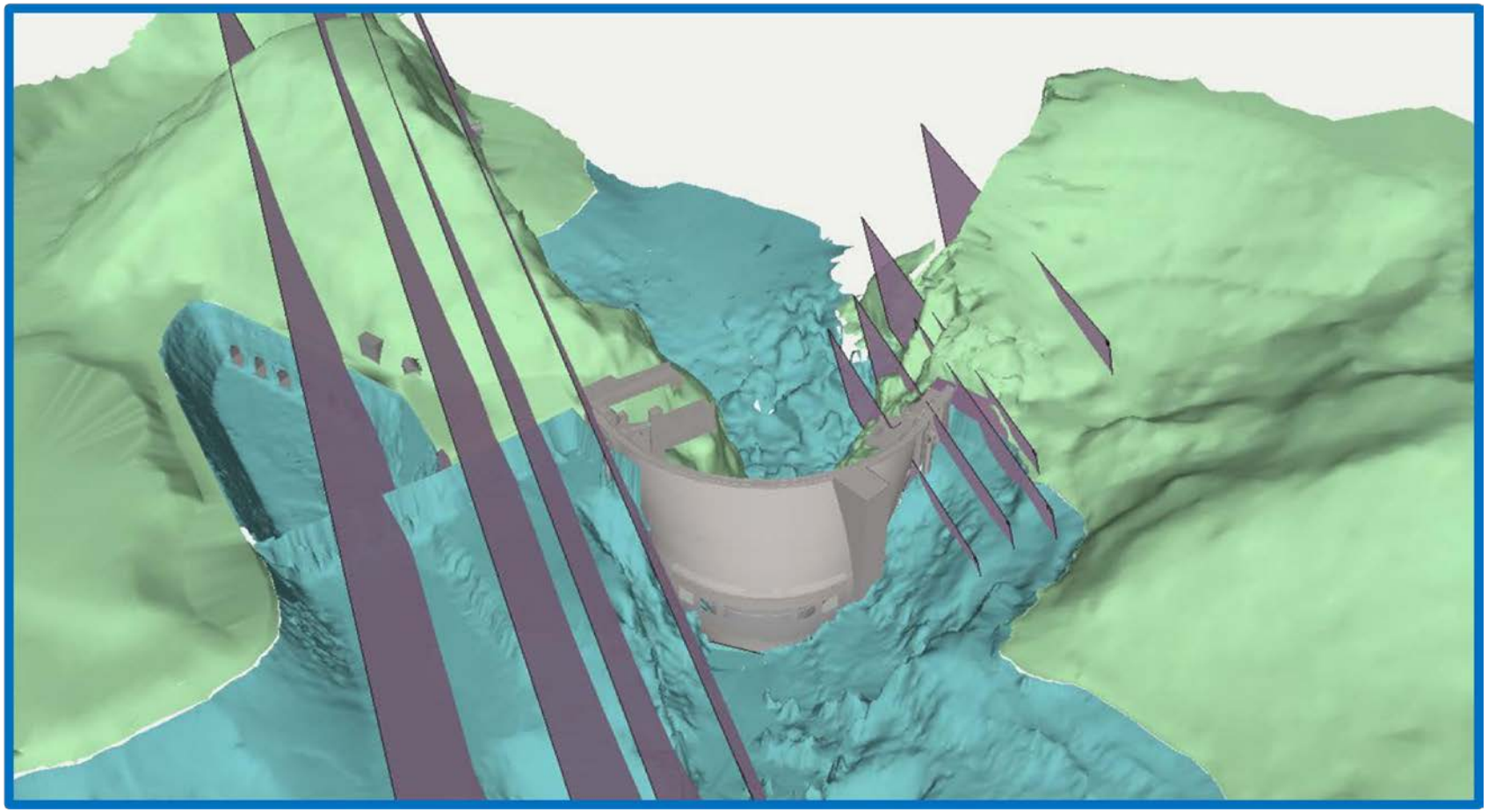
2015 BOUNDARY DAM POTENTIAL FAILURE MODE

2017 PLAN VIEW – SURFACE GEOLOGY



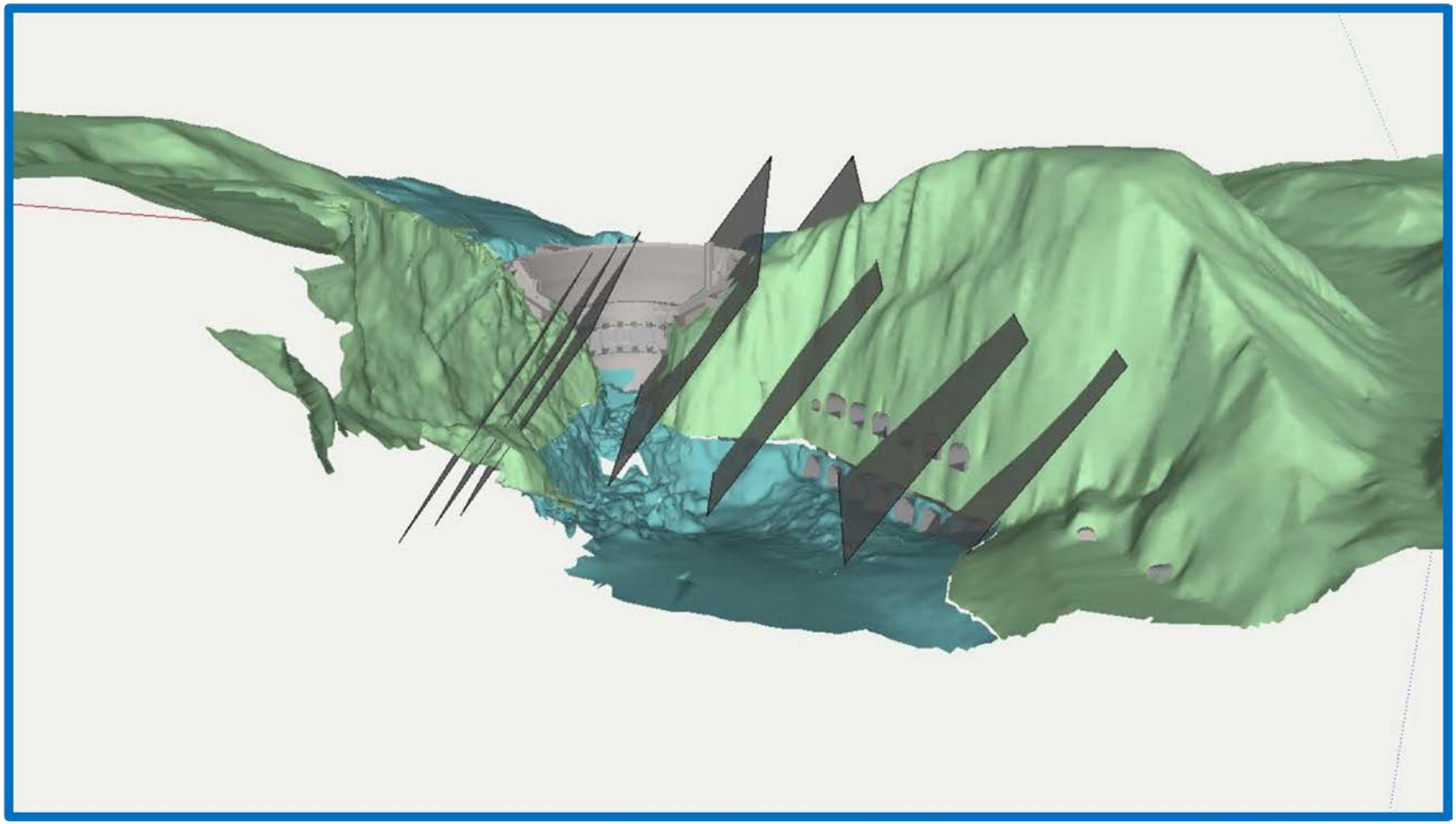
2015 BOUNDARY DAM POTENTIAL FAILURE MODE

2017 EVOLUTION – JOINT SET R2 LOCATIONS/ORIENTATIONS



2015 BOUNDARY DAM POTENTIAL FAILURE MODE

2017 EVOLUTION – 6X, R1 PLANE LOCATIONS/ORIENTATIONS

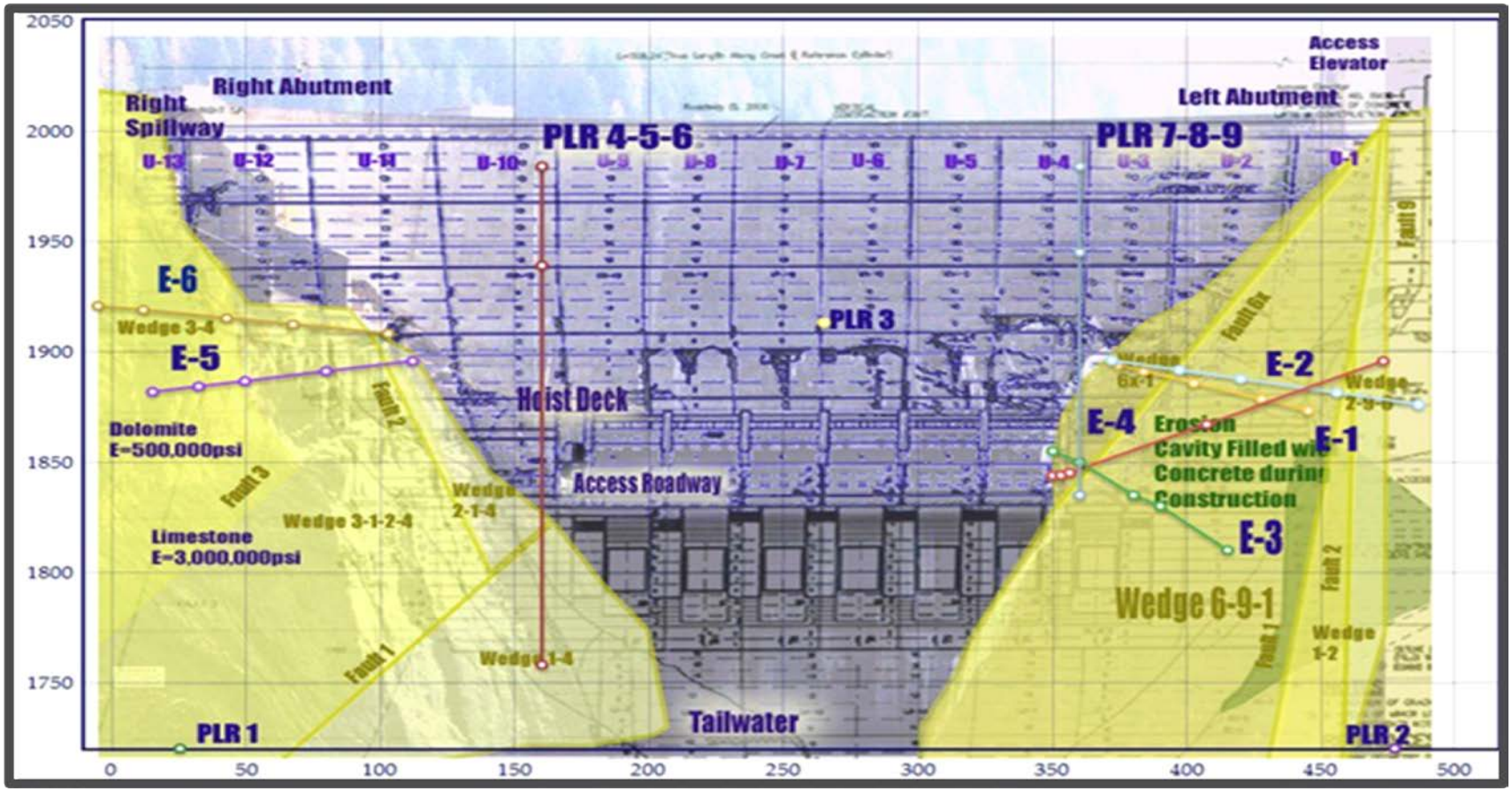


MONITORING AND SURVEILLANCE JOURNEY

- Evolved perspective – destination and process
  - Challenge preconceived ideas and comfort zone
- Upcoming Steps to Focused Monitoring:
  - Revise Surveillance and Monitoring Plan
- Performance Based Parameters
  - What, where, how, and why to pay attention to?
  - Thresholds as performance indicators

MONITORING AND SURVEILLANCE JOURNEY

- Revise Abutment/Foundation Instrumentation



REMINDERS
TIMELESS PERSPECTIVES

- Ralph Peck Quotes
  - http://peck.geoengineer.org/words.html
- Portia Nelson – "There's a hole in my sidewalk"
  - http://sites.uci.edu/mindful/files/2013/10/Autobiography-in-Five-Short-Chapters.pdf

OUR MISSION

Seattle City Light is dedicated to delivering customers affordable, reliable and environmentally responsible electricity services.

OUR VISION

We aspire to be the nation's greenest utility by fulfilling our mission in an environmentally and socially responsible manner.

OUR VALUES

Safety, Environmental Stewardship, Innovation, Excellence, Customer Care.

Seattle City Light