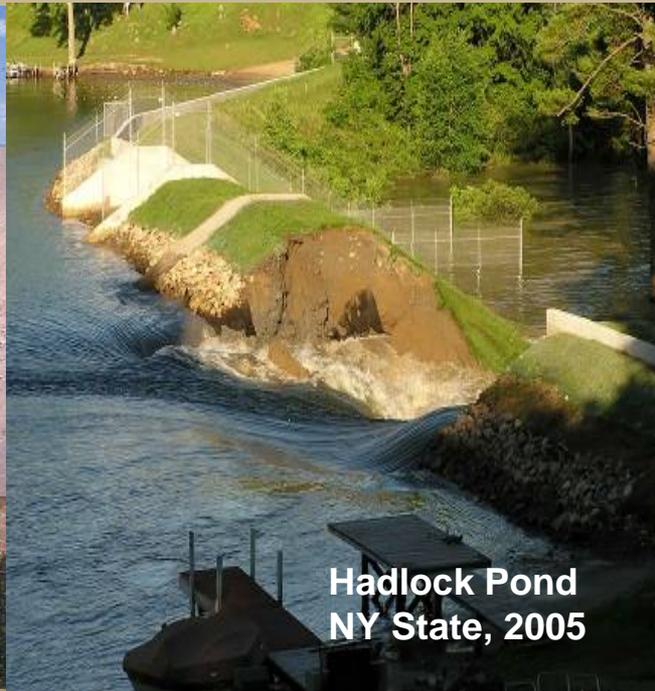
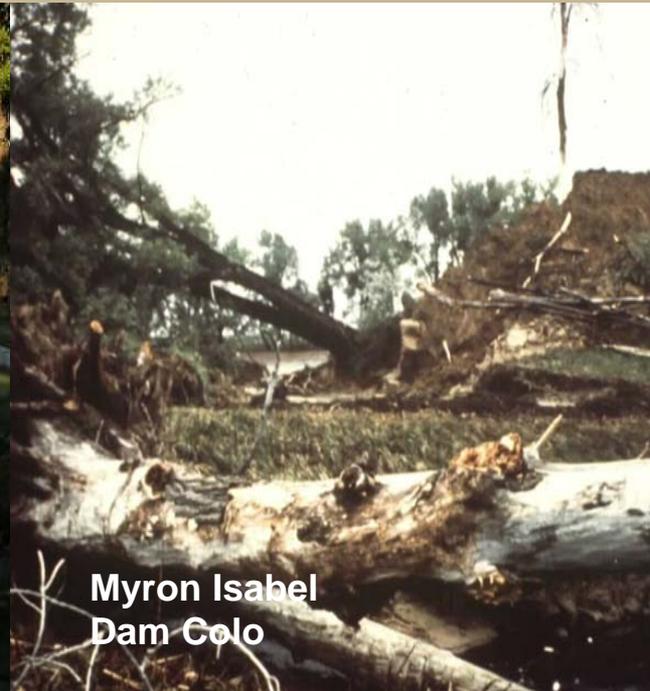




Teton Dam – BOR  
Idaho 1976



Hadlock Pond  
NY State, 2005



Myron Isabel  
Dam Colo

# Repair of Embankment Dams with Seepage Problems

Oregon Dam Safety Conference, 2013

E. George Robison, Ph.D, PE, D.WRE

# Outline

---

- Anecdotal Talk – Several examples of detected and fixed seepage problems
- How a seepage failure works
- Detection and Various Types of Seepage fixes
- Applying knowledge to Problems, 5 Cases
  - Croft Reservoir (West Salem)
  - Akutan Dam, AK
  - Klamath Levee (on Klamath Lake)
  - Lambs Lake, ND
  - Drews Reservoir (near Lakeview)



# How a seepage problem can fail a dam:

---





Lawn Lake, Colo



# Seepage (internal erosion piping failure)

---

- Seepage problems (internal erosion piping failures) accounts for 15-35% of all dam failures, depending on which compilation you use.
- Seepage Detection
  - Visual detection of flowing or seeping water or vegetation changes on dam or near toe or even downstream (for foundation seepage)
  - Measured flow with small weirs
  - Detection of other ancillary indicators such as sink holes, sand boils.
  - How to determine if seepage is really a problem versus something that is stable and unlikely to cause problems with a dam.
- Seepage Fixes
  - Work from Upstream side of dam (“blankets”), center of dam (curtain or installed core), or downstream side of the dam (buttressing)
    - Blankets (using soil or other material to attempt to stop seepage into dam or foundation) Example: Lambs Lake, Klamath Levee, Drews Reservoir
    - Create slurry wall or sheet pile or compacted clay layer down center of dam. Example: Akutan, Croft Reservoir
    - Create Buttressing on Downstream Side of Dam (No example here but Silverton Reservoir is an example)



# Croft Reservoir – Problem Detection

---



# Croft Reservoir – Problem Detection

---

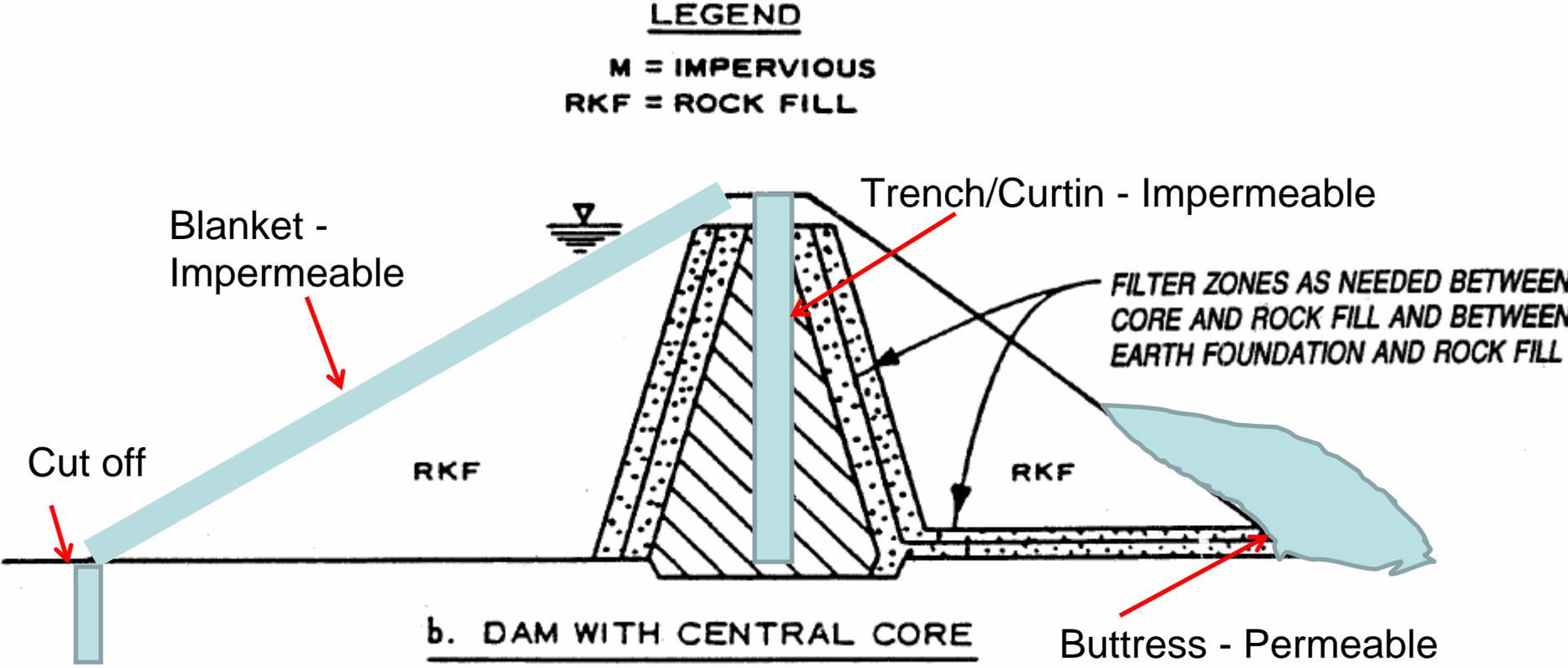


**Line of water seepage about 2/3 up the dam**





# Possible Fixes



# Center Trench and fill

---



# Uncompacted Layer?

---



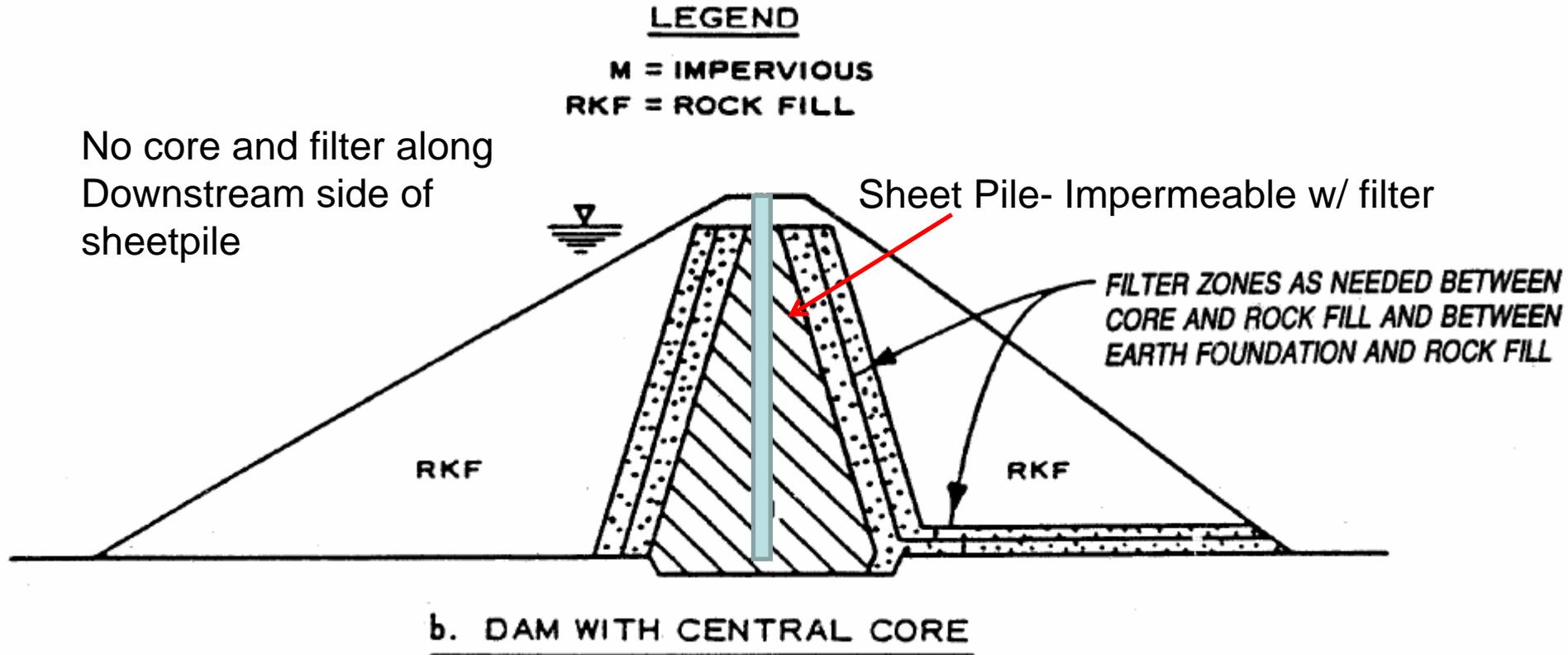
# Akutan Town Creek Dam



## Controlled vs. Uncontrolled Seepage



# Dam Configuration



# Town Creek - Finished Dam

---



# Klamath Dike – Near Lakeview Gardens

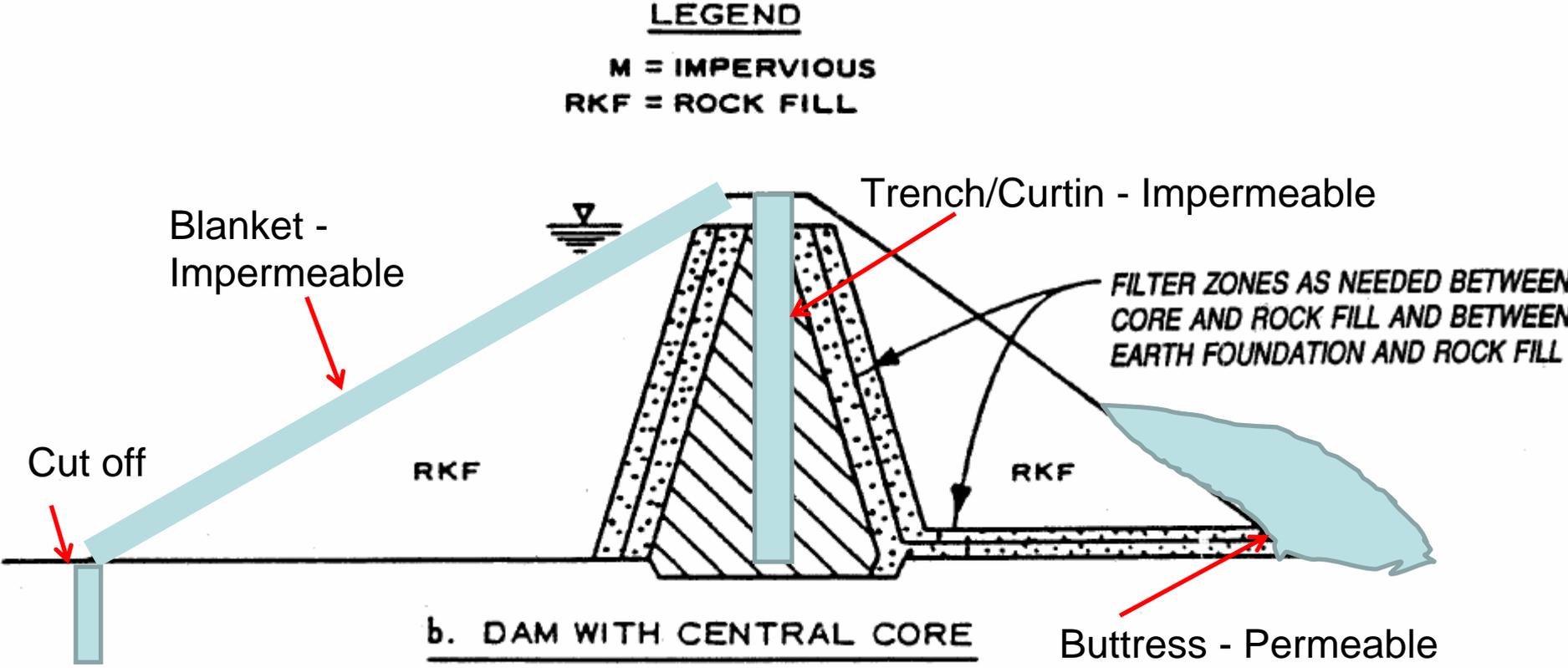
---







# Possible Fixes



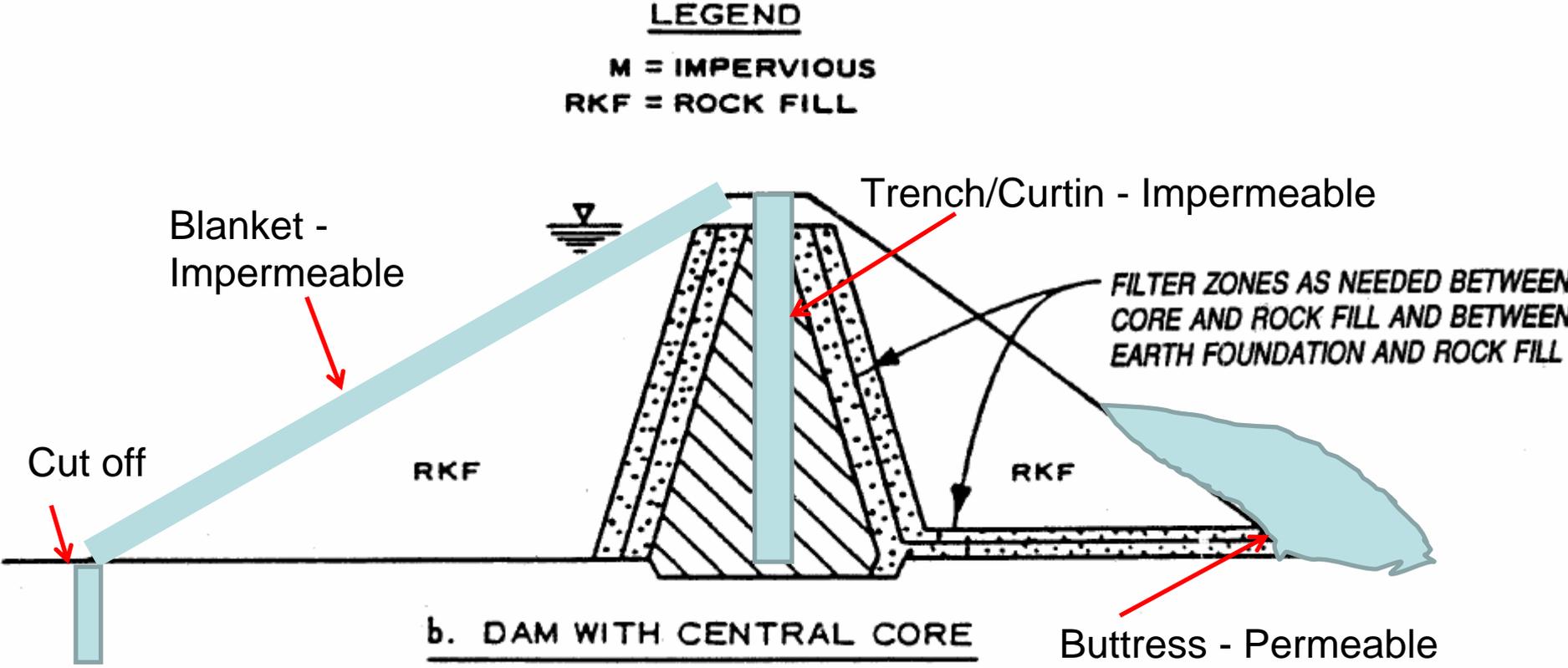


# Lambs Lake, ND

---

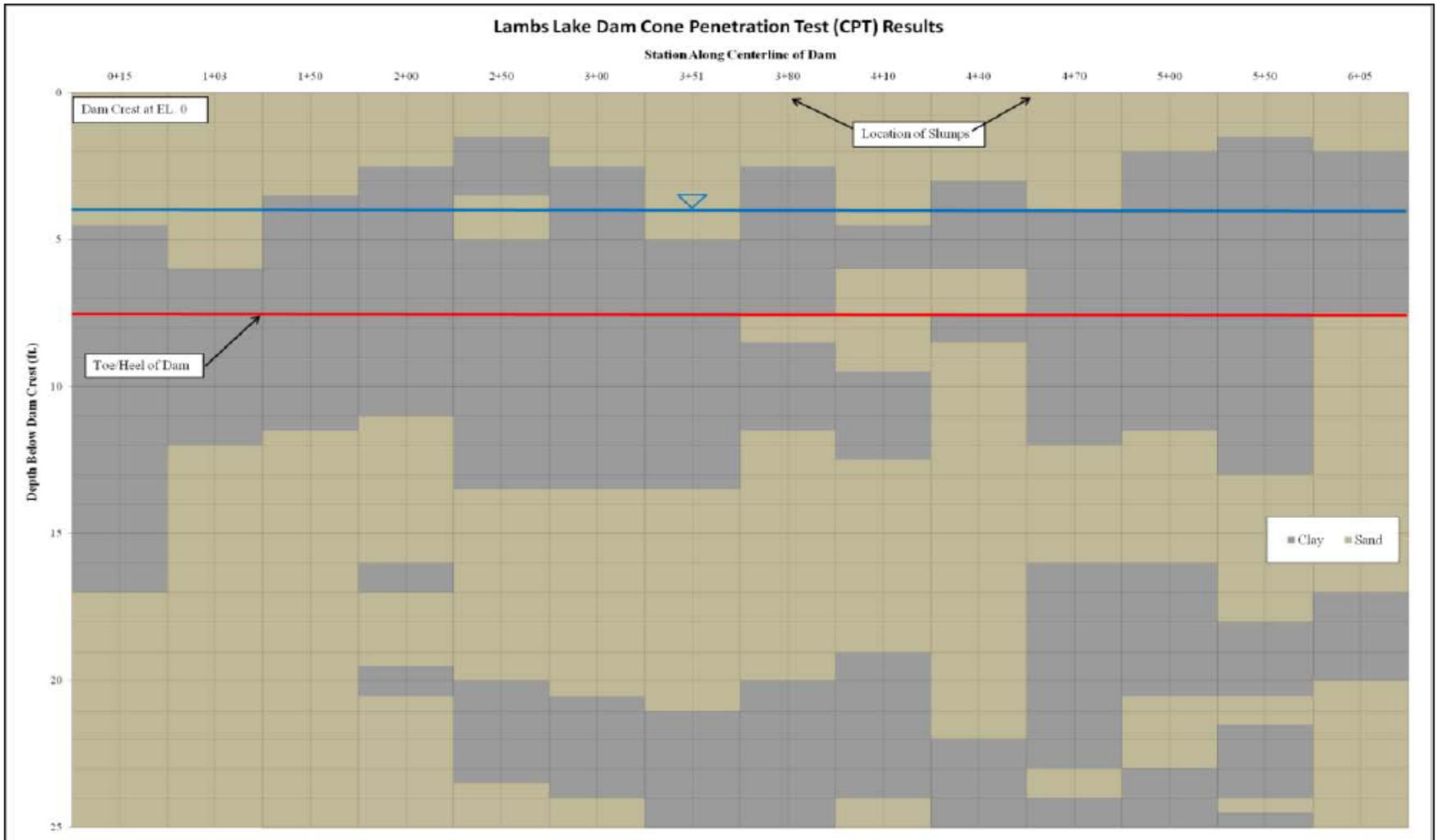


# Possible Fixes



# Lambs Lake, ND

## Appendix A - Visual Representation of CPT Results



# Lambs Lake, ND

---



# Drews Reservoir, near Lakeview OR

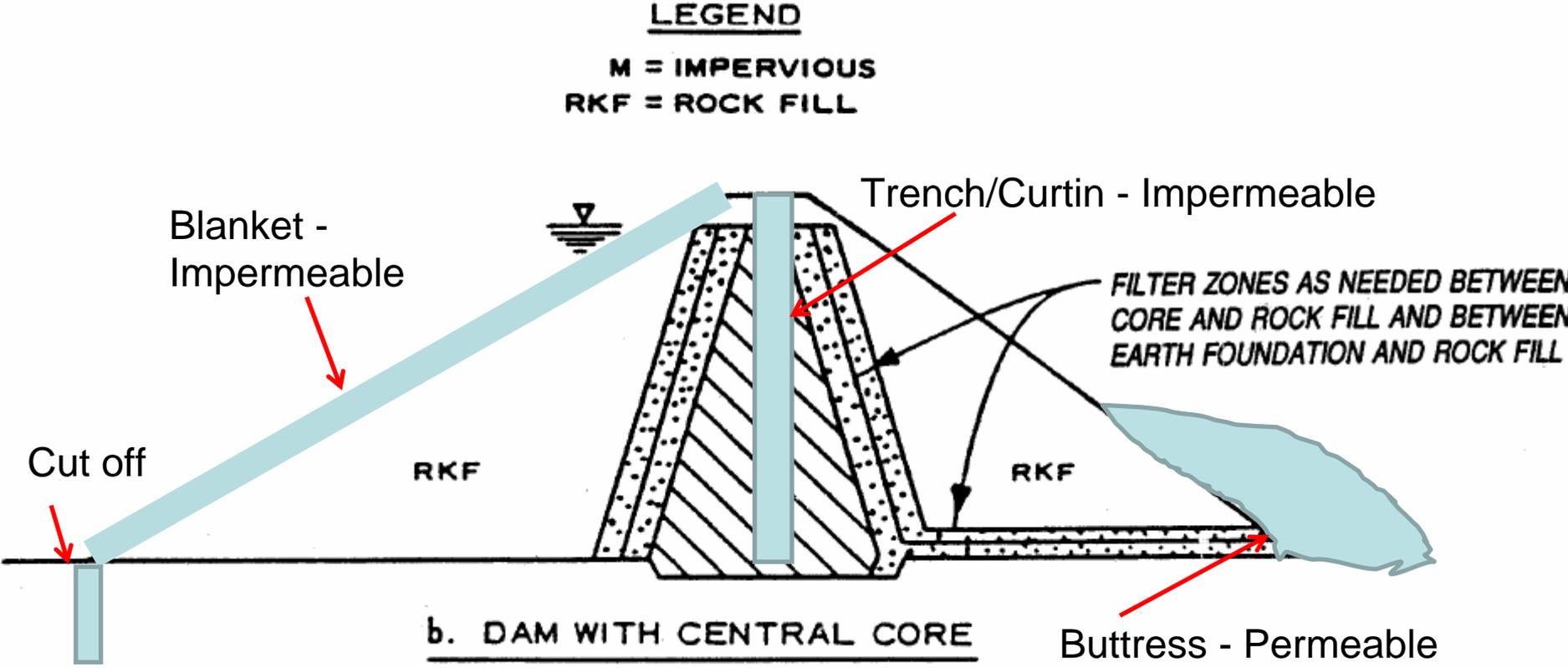


# Seepage from Dregs

---



# Possible Fixes



# Drews after construction



# Seepage (some lessons learned from cases)

---

- Seepage issues can be attacked from the downstream, middle, or upstream side of the dam.
- Prefer upstream solutions with blankets because it dewateres the dam and the bulk of the blanket (especially soil blankets) helps stabilize the dam and leads to greater stability overall.
- Buttrussing means you are now managing seepage through the dam to slow it down so it does not internally erode and that is more complicated and problematic.
- Center Dam Solutions are best for high on the dam seepage issues (Croft Dam) or very small dams (Akutan) and less effective or feasible for deep seepage at base or in foundation of taller dams.
- Seepage Detection and Discernment
  - Visual detection of flowing or seeping water or vegetation changes on dam or near toe or even downstream (for foundation seepage) (Can be missed – Croft Dam?)
  - Detection of other ancillary indicators such as sink holes (Lambs Lake), sand boils.
  - How to determine if seepage is really a problem versus something that is stable and unlikely to cause problems with a dam (Akutan).

