

# Barragens de Rejeitos

## Evolução da Segurança

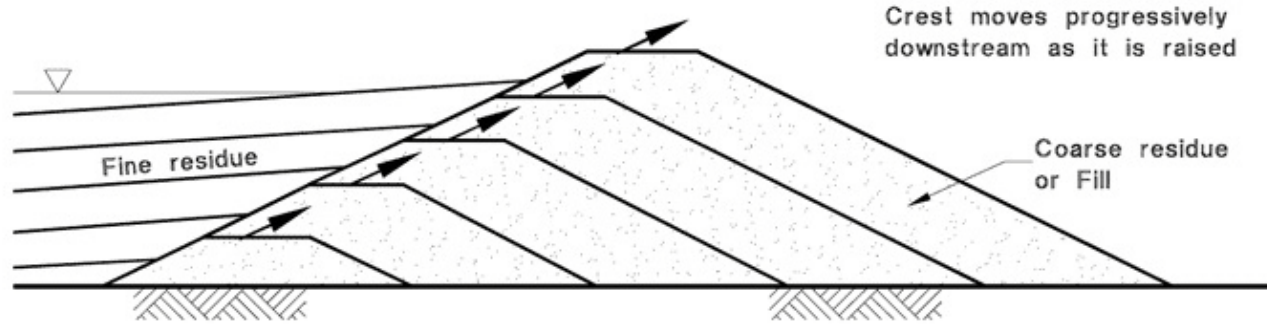


# Barragens de rejeitos diferem das demais barragens de terra

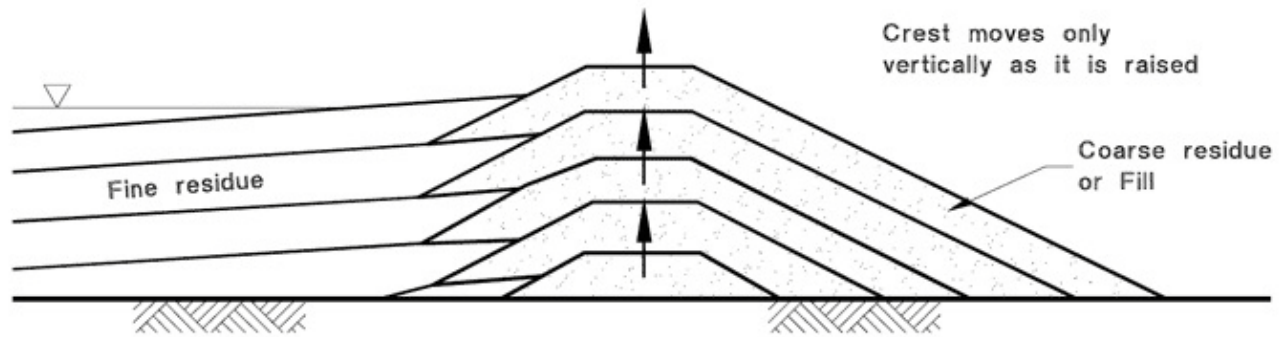
- A construção é por período muito mais extenso
- O projeto pode e deve ser otimizado com o tempo
- Ensaaios e instrumentação produzem dados reais ao longo da construção
- Construção com aterros hidráulicos não compactados

# Performance deficiente em barragens de rejeitos - causas

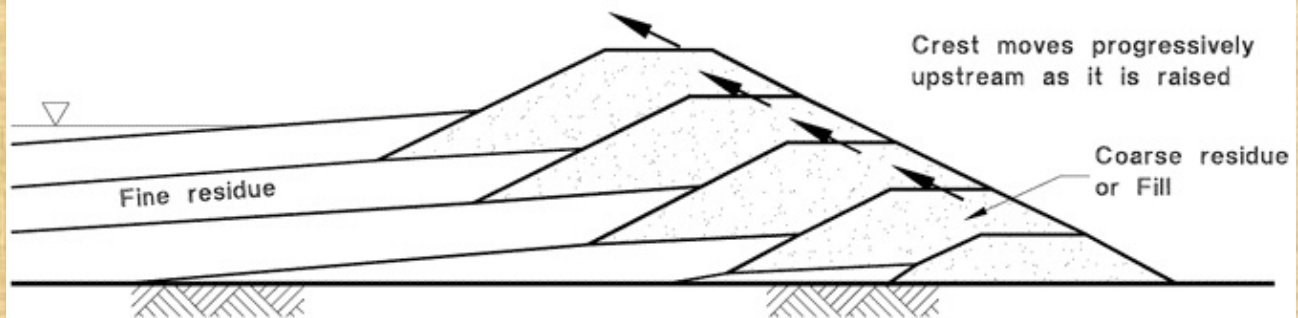
- Percolação inadequada
- Drenagem deficiente
- Densidade inadequada
- Instabilidade devida a liquefação
- Insuficiência do sistema extravasor



(a) Downstream Method



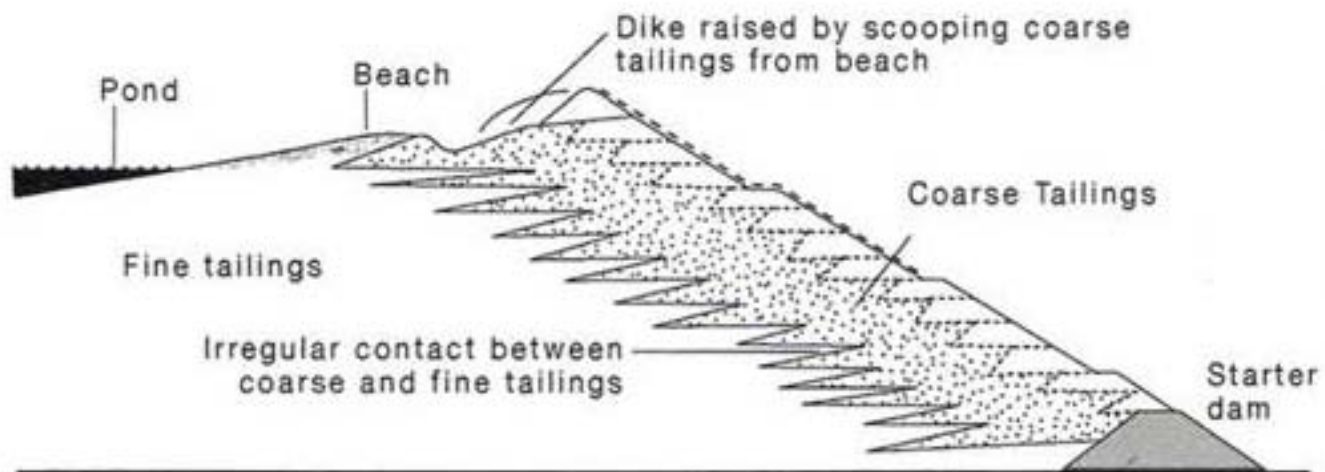
(b) Centreline Method



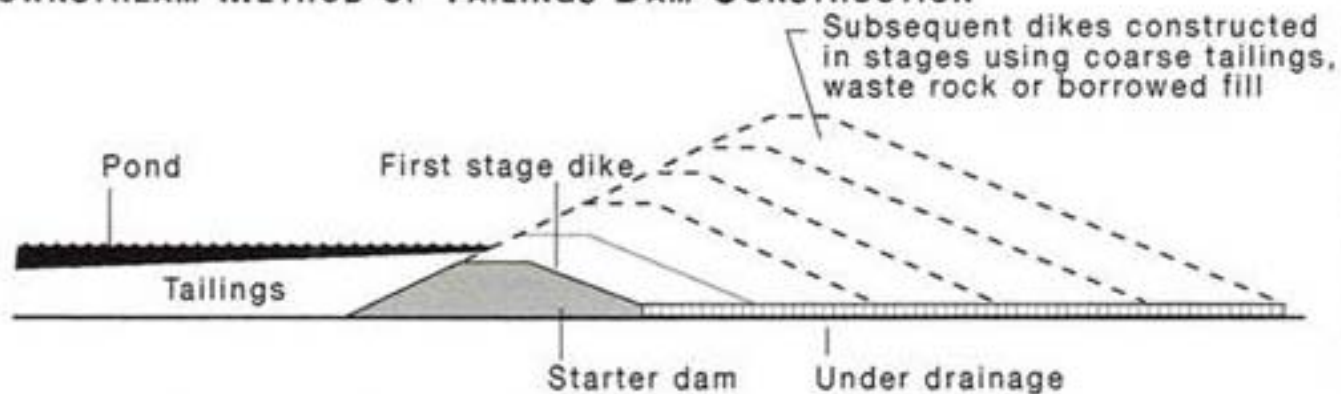
(c) Upstream Method



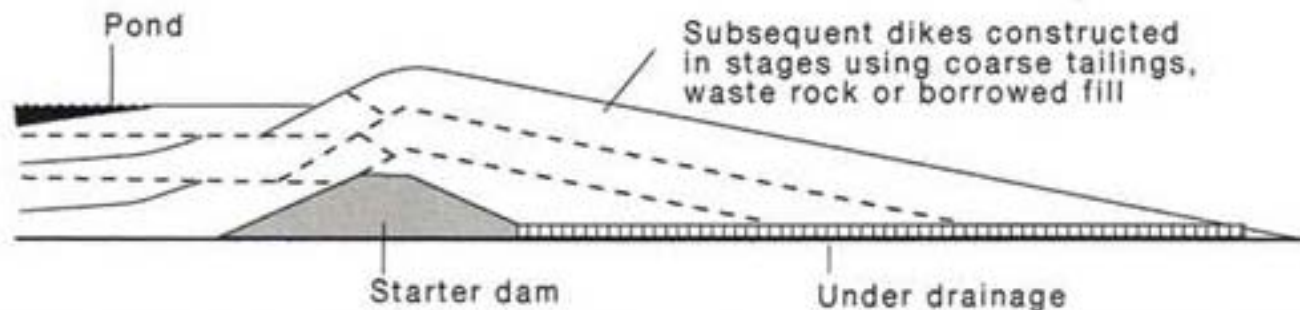
### UPSTREAM METHOD OF TAILINGS DAM CONSTRUCTION

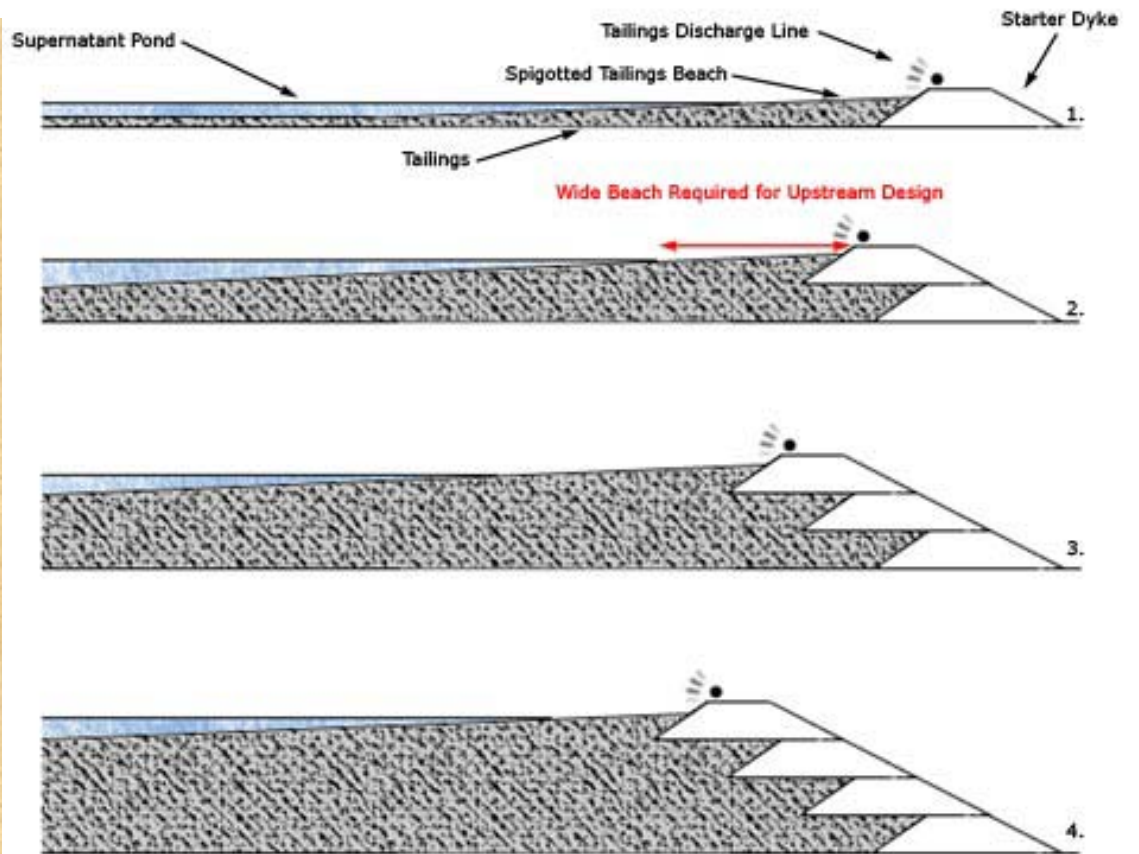
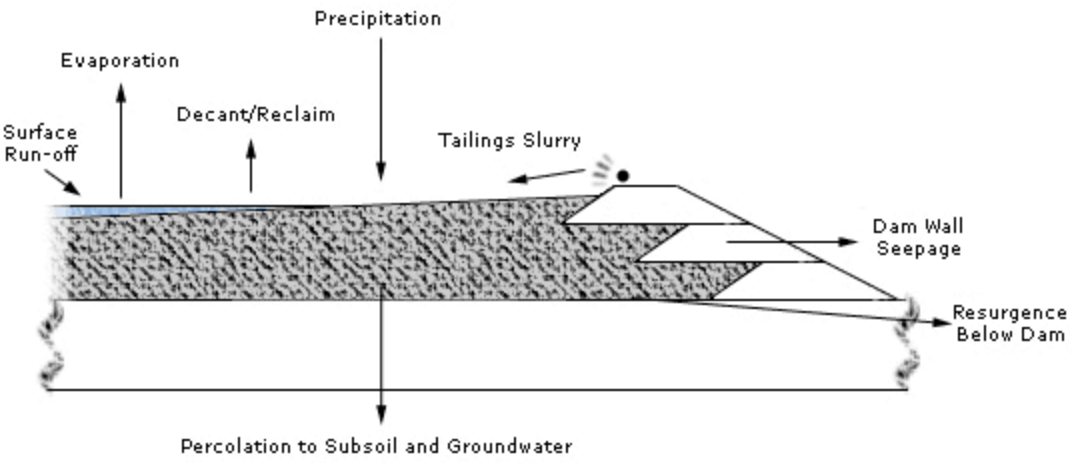


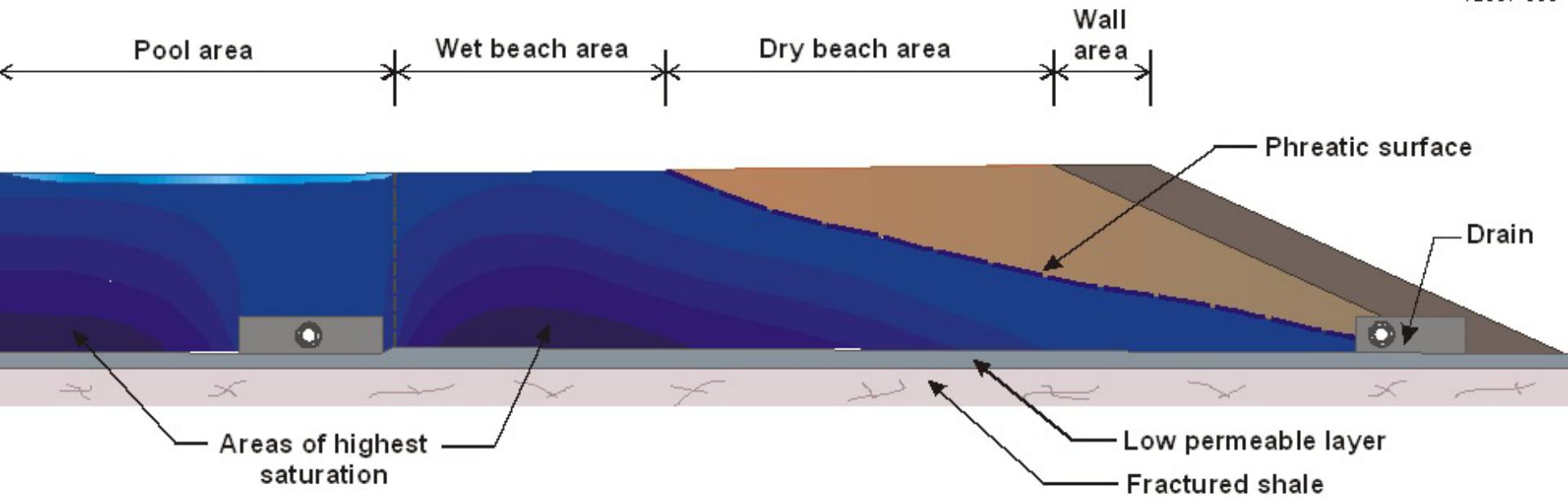
### DOWNSTREAM METHOD OF TAILINGS DAM CONSTRUCTION



### CENTERLINE METHOD OF TAILINGS DAM CONSTRUCTION



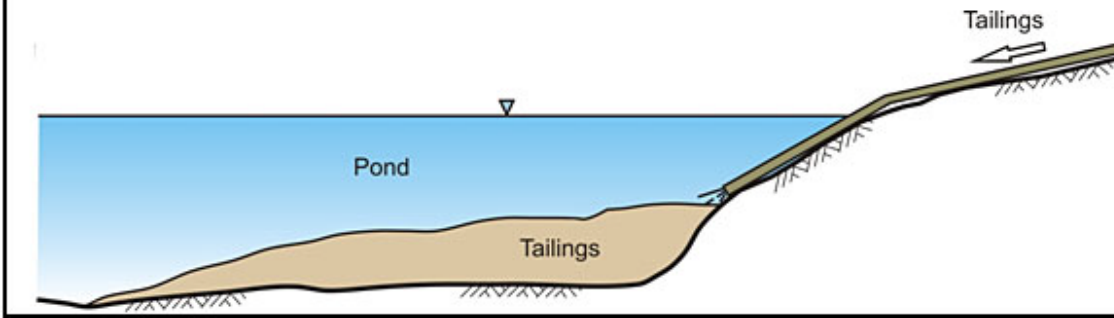
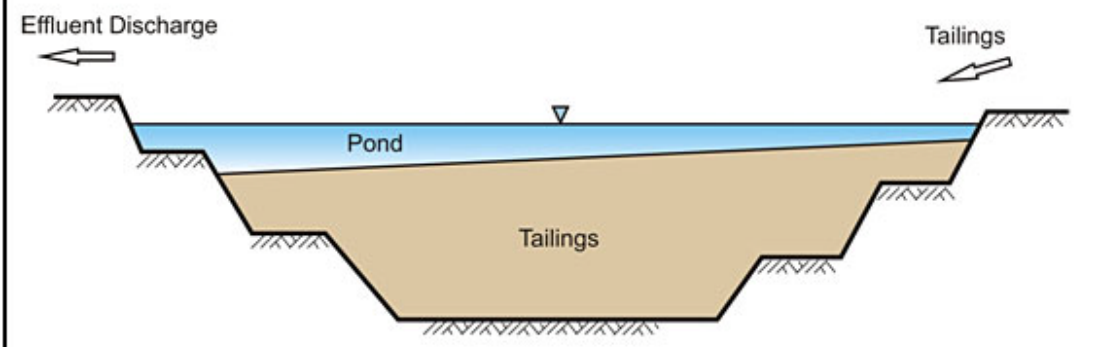
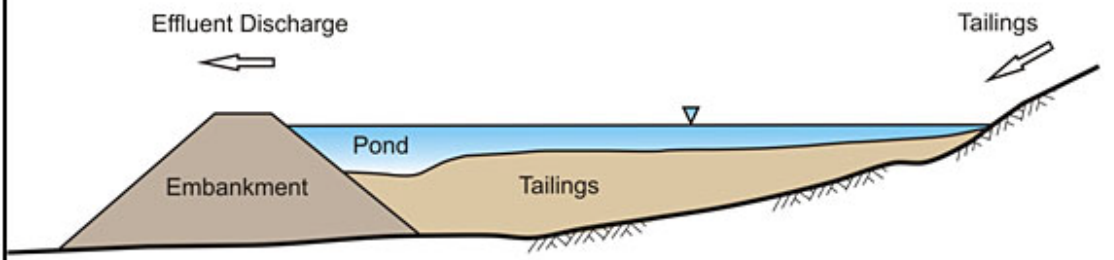
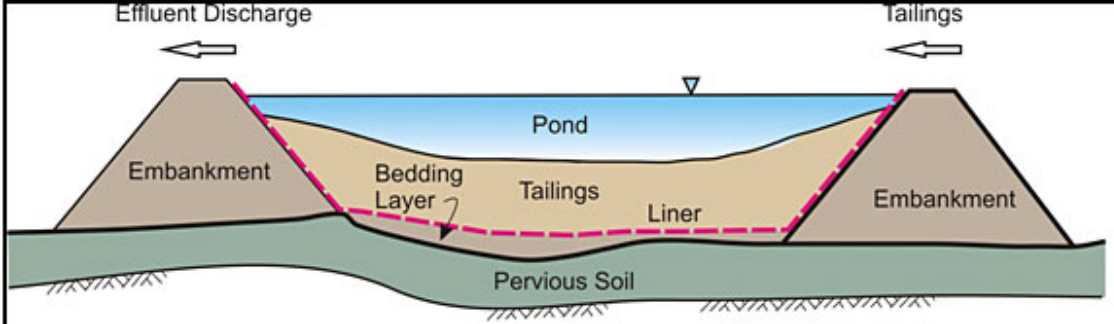




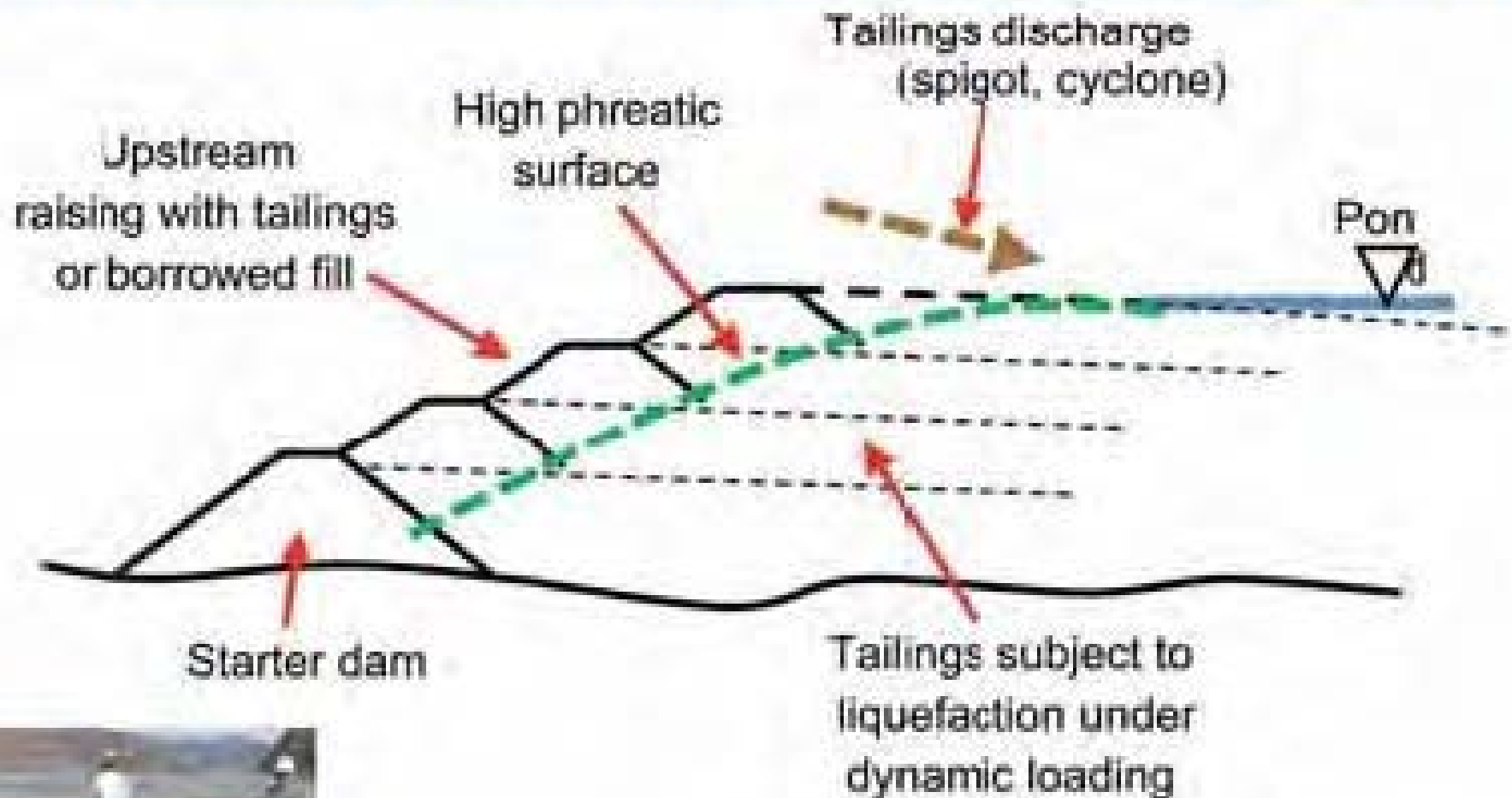








# COARSE SANDS FOR SLURRY DEPOSITION BY THE UPSTREAM METHOD (WITH, WITHOUT CYCLONES)



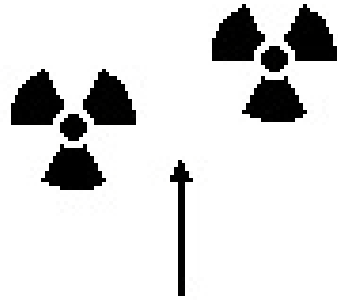




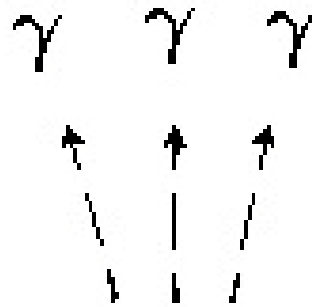


# Uranium Mill Tailings Hazards

radon-exhalation



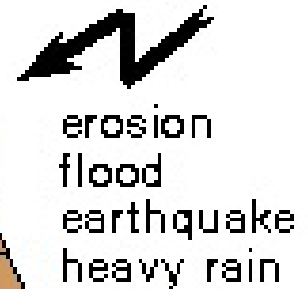
gamma-radiation



dust blowing  
(radium, arsenic,...)



dam failure



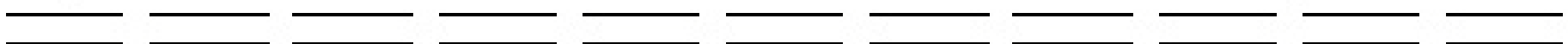
tailings

seepage  
(uranium, arsenic,...)

(uranium, arsenic,...)



groundwater



NORTH

SOUTH

Bentonite Amended Slope

FTB Pond

Pump to FTB Pond  
and/or WWTP

Flotation Tailings

Buttress

*During Operations*

LTVSMC Tailings

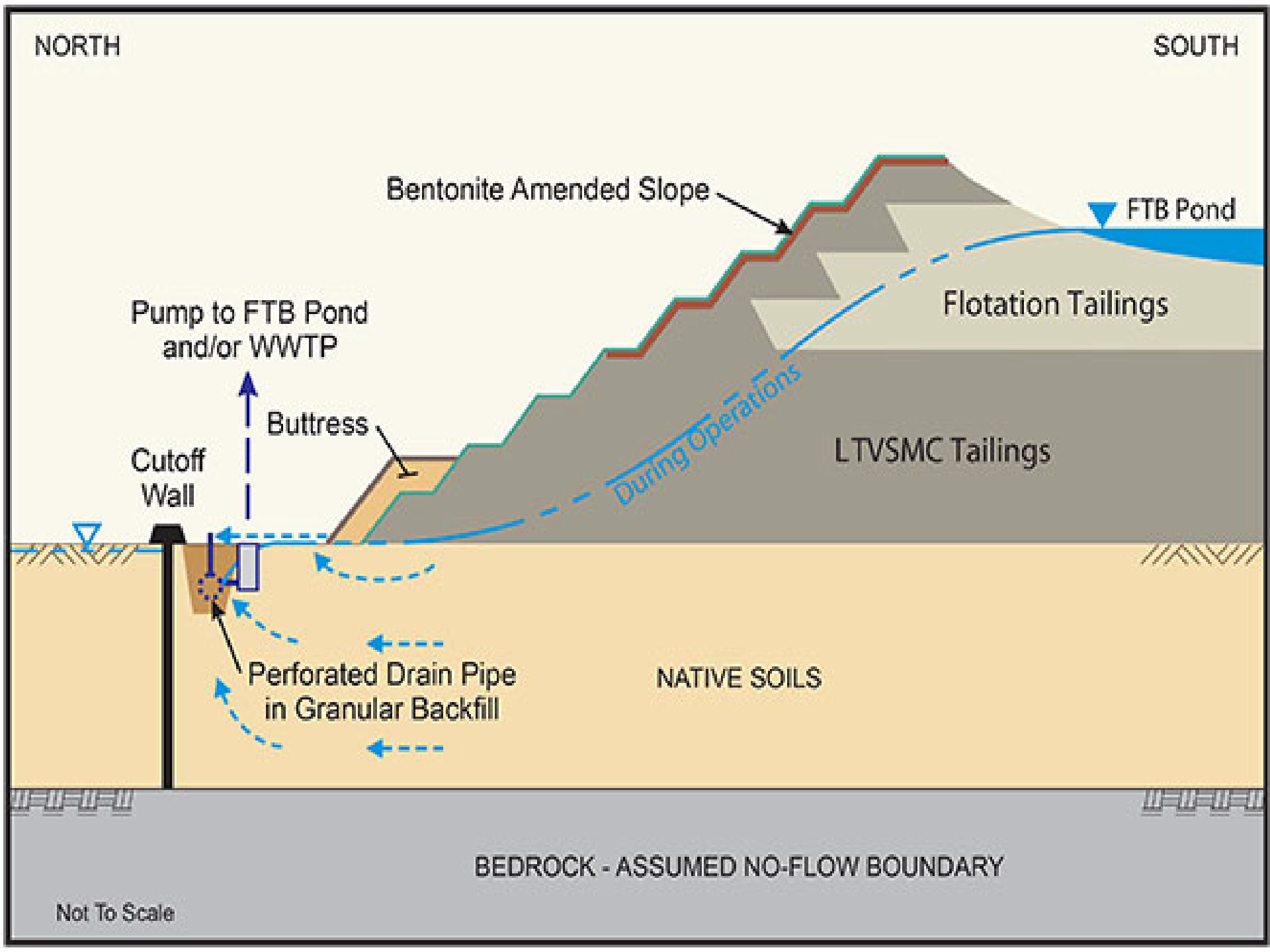
Cutoff Wall

Perforated Drain Pipe  
in Granular Backfill

NATIVE SOILS

BEDROCK - ASSUMED NO-FLOW BOUNDARY

Not To Scale





# Evolução da Segurança de Barragens

Principais eventos:

- Código de Hamurabi – 1772 A.C. (282 Leis)
- ICOLD – Lessons from Dam Incidents
- US Army Corps of Engineers – Inspeção de barragens nos EUA
- Brasil – Lei Federal de Segurança de Barragens
- Brasil – Decreto 8572 – Parágrafo Único, de 13/11/2015

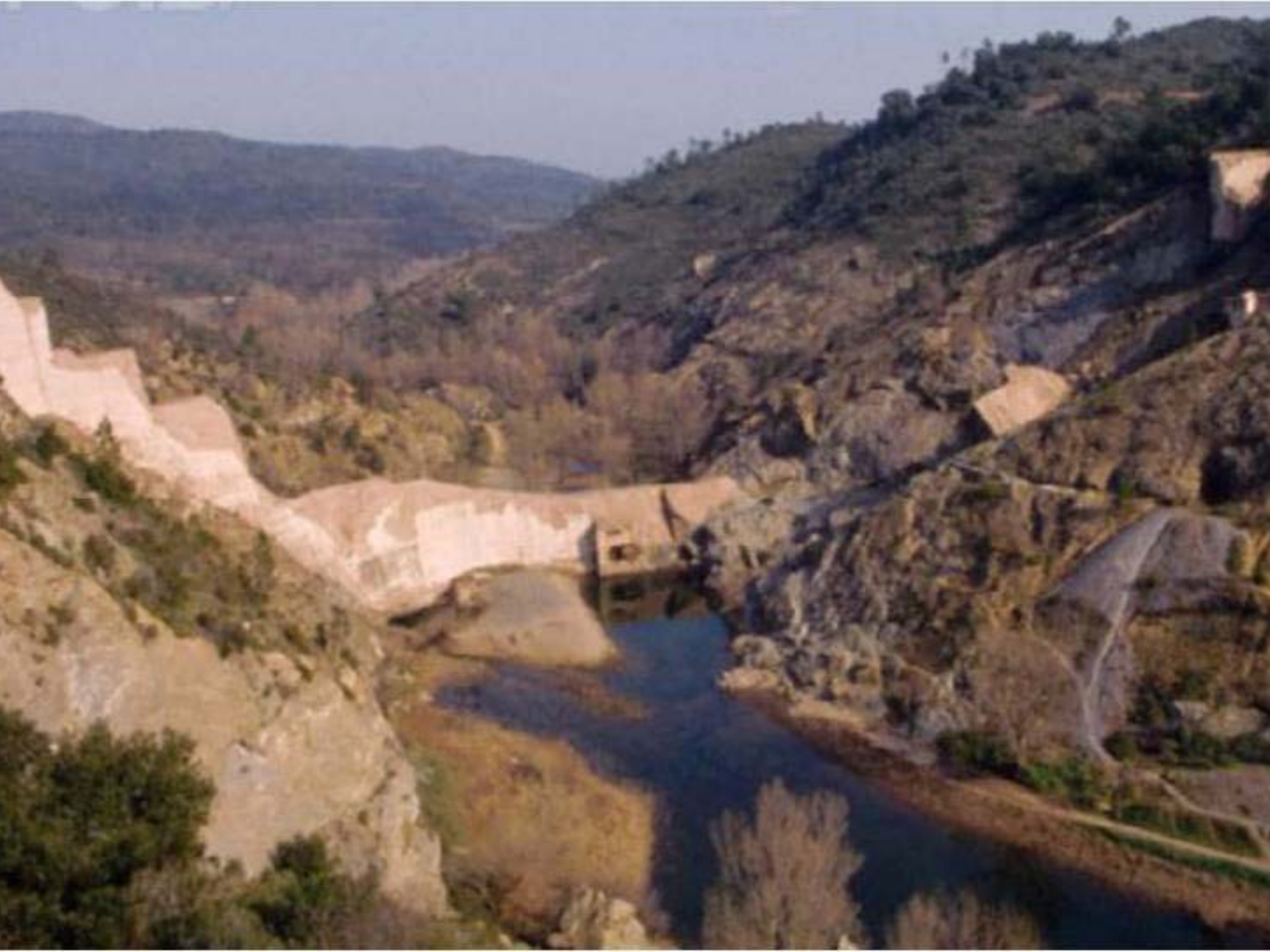


# Contrastes Extremos

- Código de Hamurabi – 1771 A.C.  
Lei de Talião
- Decreto 8572: “... Considera-se também como natural o desastre decorrente do rompimento ou colapso de barragens que ocasione movimento de massa, como danos a unidades residenciais.”  
Brasília, 13 de novembro de 2015.  
Dilma Rousseff



WATER  
FRONT  
ATLANTA













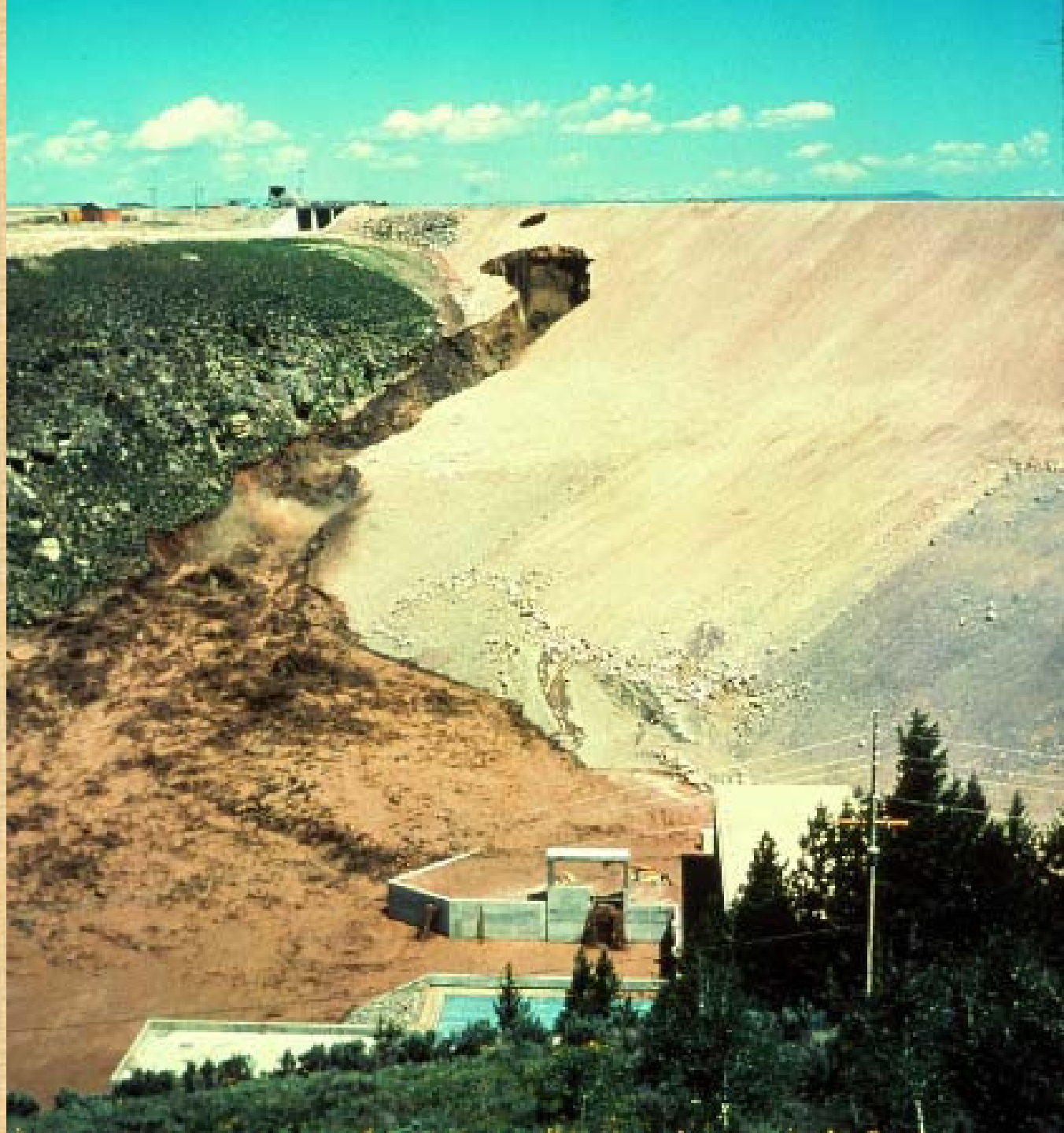


























BARRAGEM ROMPIDA — 29-3-60





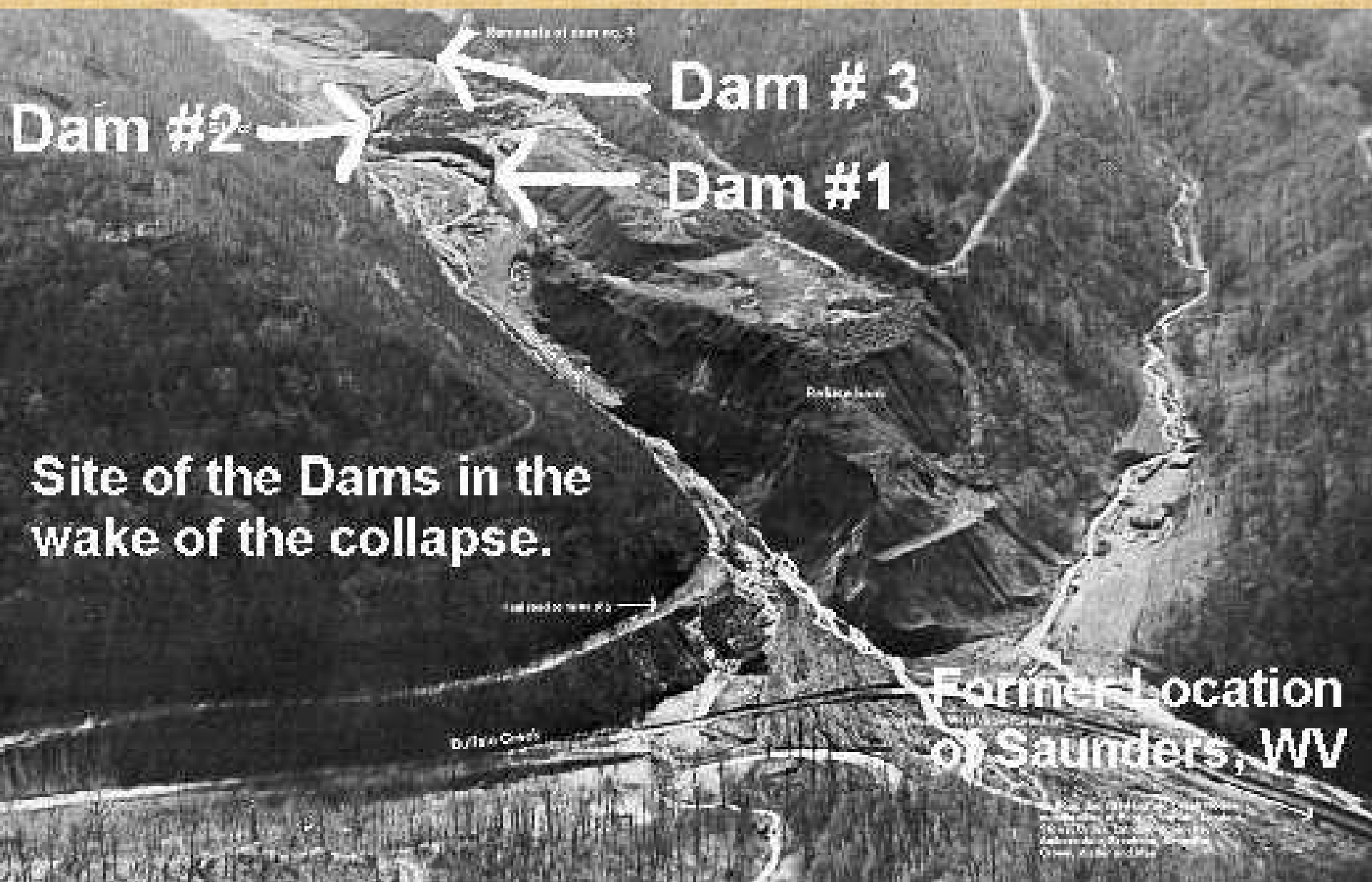












Remnants of dam no. 3

Dam # 3

Dam # 2

Dam # 1

Site of the Dams in the wake of the collapse.

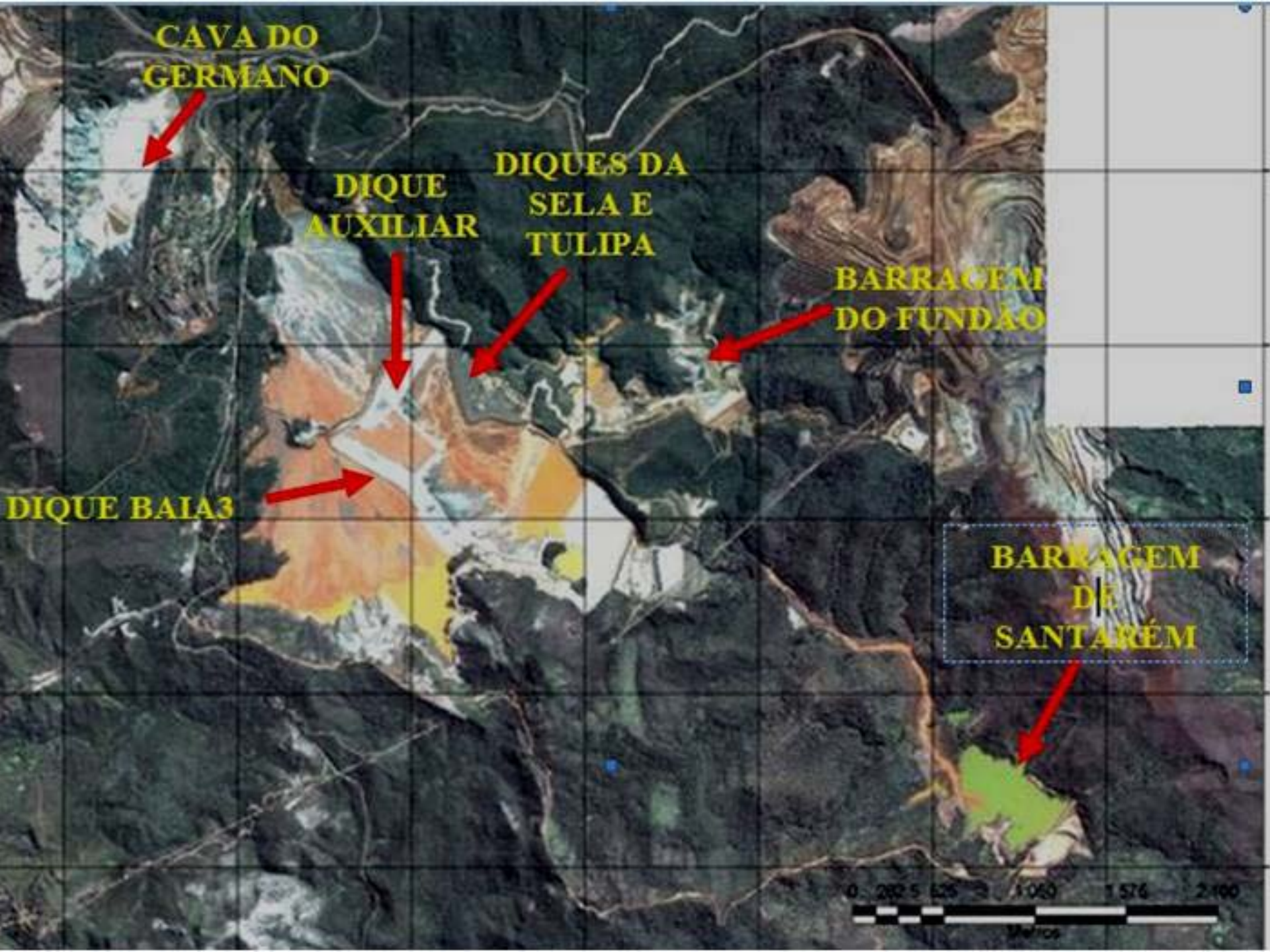
Remnants of dam no. 2

Remnants of dam no. 1

Former Location of Saunders, WV

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National Center for Groundwater Research and Technology  
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