Design of Dale Creek Dam

4K Engineering

Designed by:

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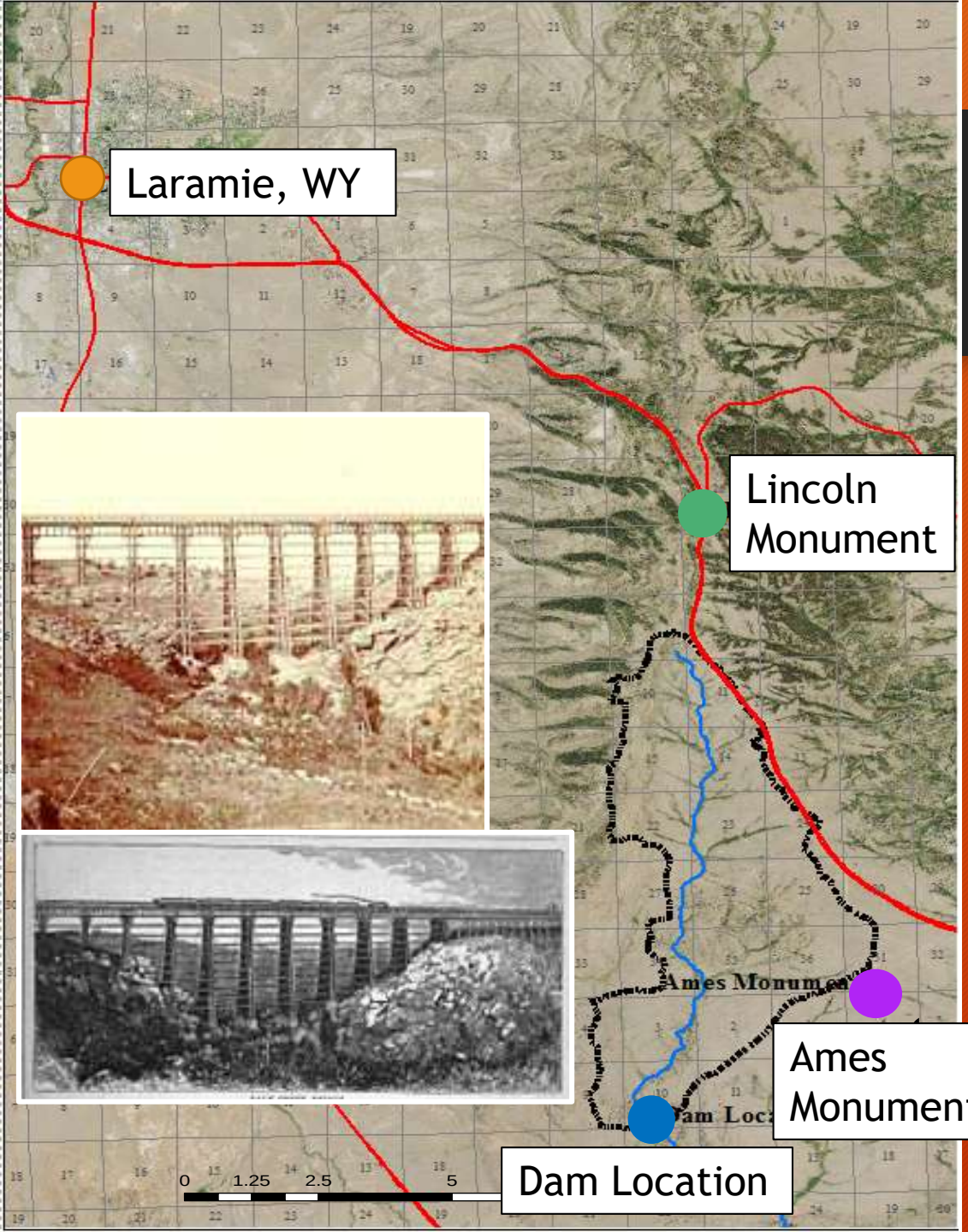
Outline

- Location
- Purpose and Site Description
- Hydrology
- Dam Design
- Spillway Design
- Inlet/Outlet Design
- Soils Analysis
- Slope Stability
- Cost Estimate
- Construction Considerations
- Environmental Considerations

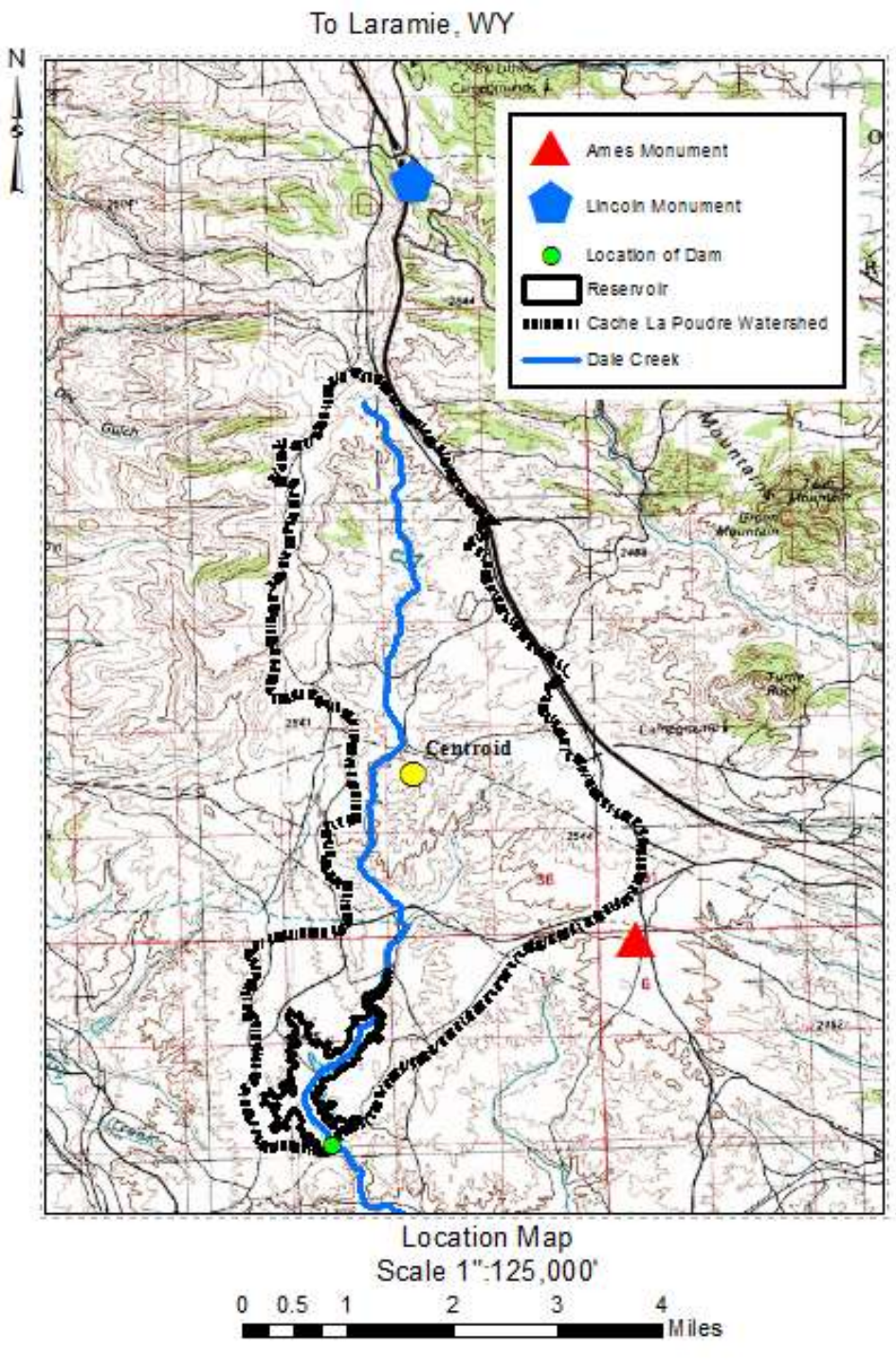
Location

- 41°06’14”N, 105°27’17”W
- S 10/15, T13N, R72W, 6 P.M.
- Albany County, Wyoming
- 16 miles southeast of Laramie
- 9.4 miles south of the Lincoln Monument
- 3.5 miles southwest of the Ames Monument
- Cache La Poudre Watershed
- Dale Creek

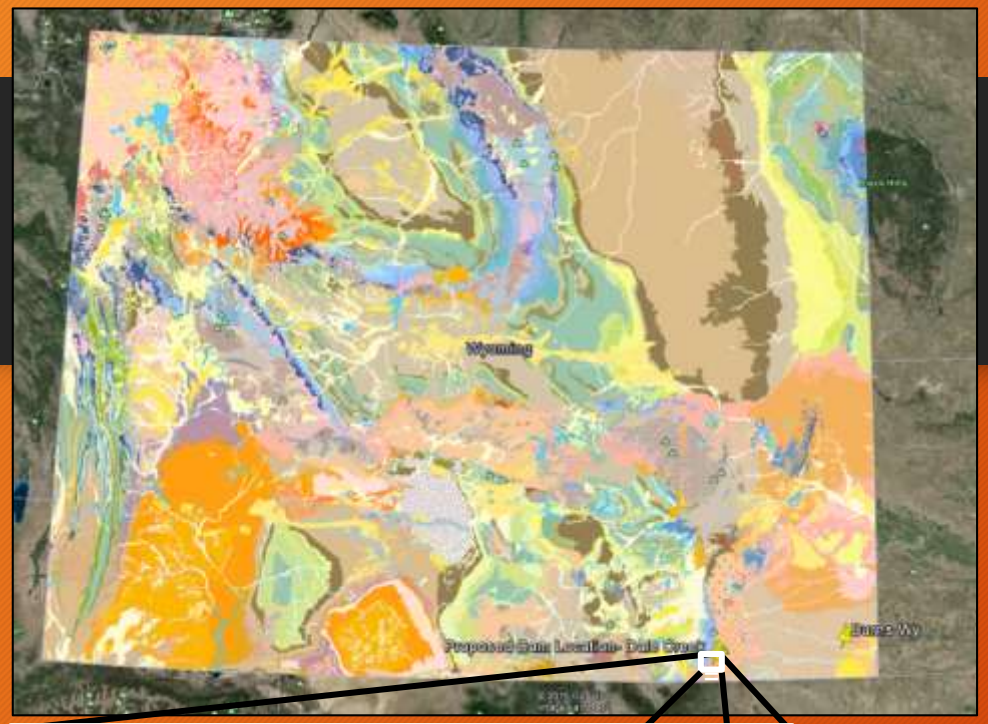


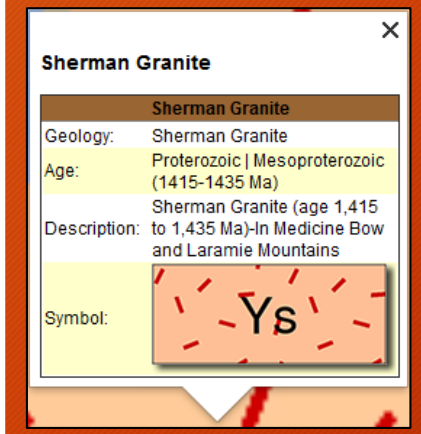
Purpose and Site Description

- Provide new water and storage of excess Cheyenne water for the municipality of Burns, Wy.
- Existing pipeline feeding Lake Owen Granite Springs Reservoirs primary water supply
- Appropriate size watershed to capture water and provide storage



Purpose and Site Description

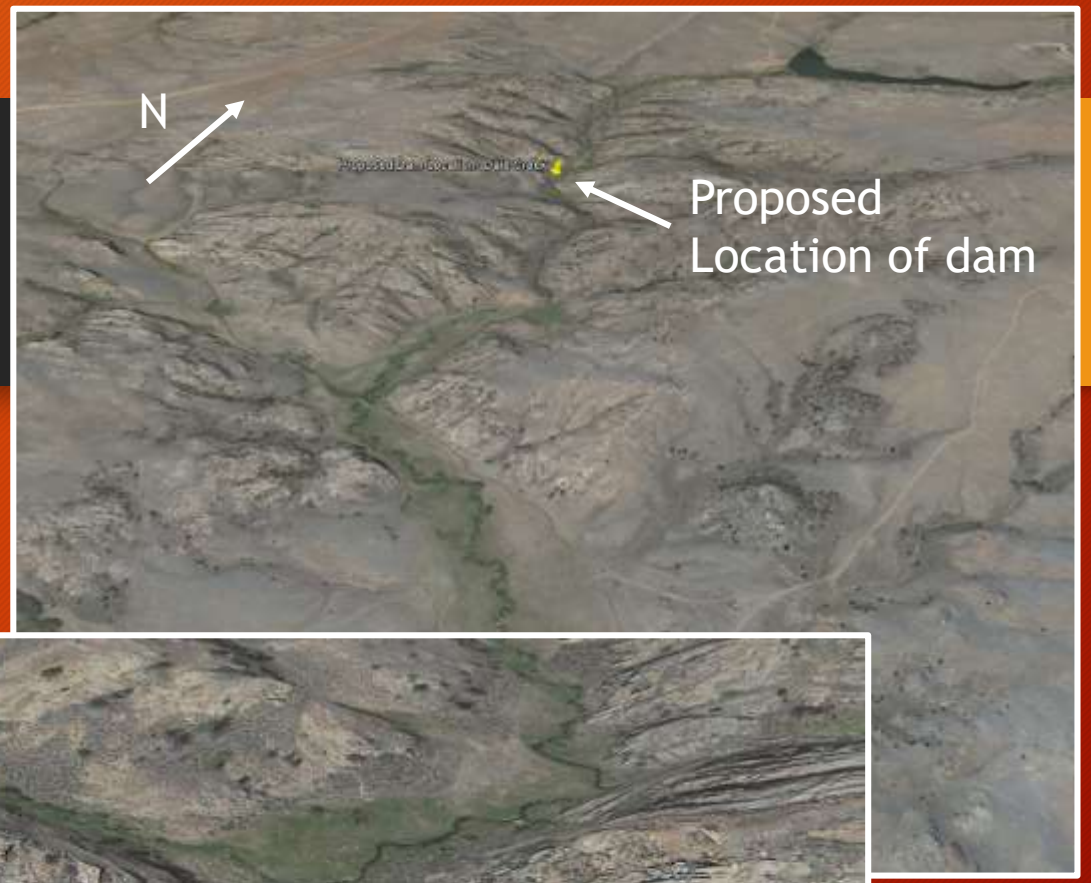


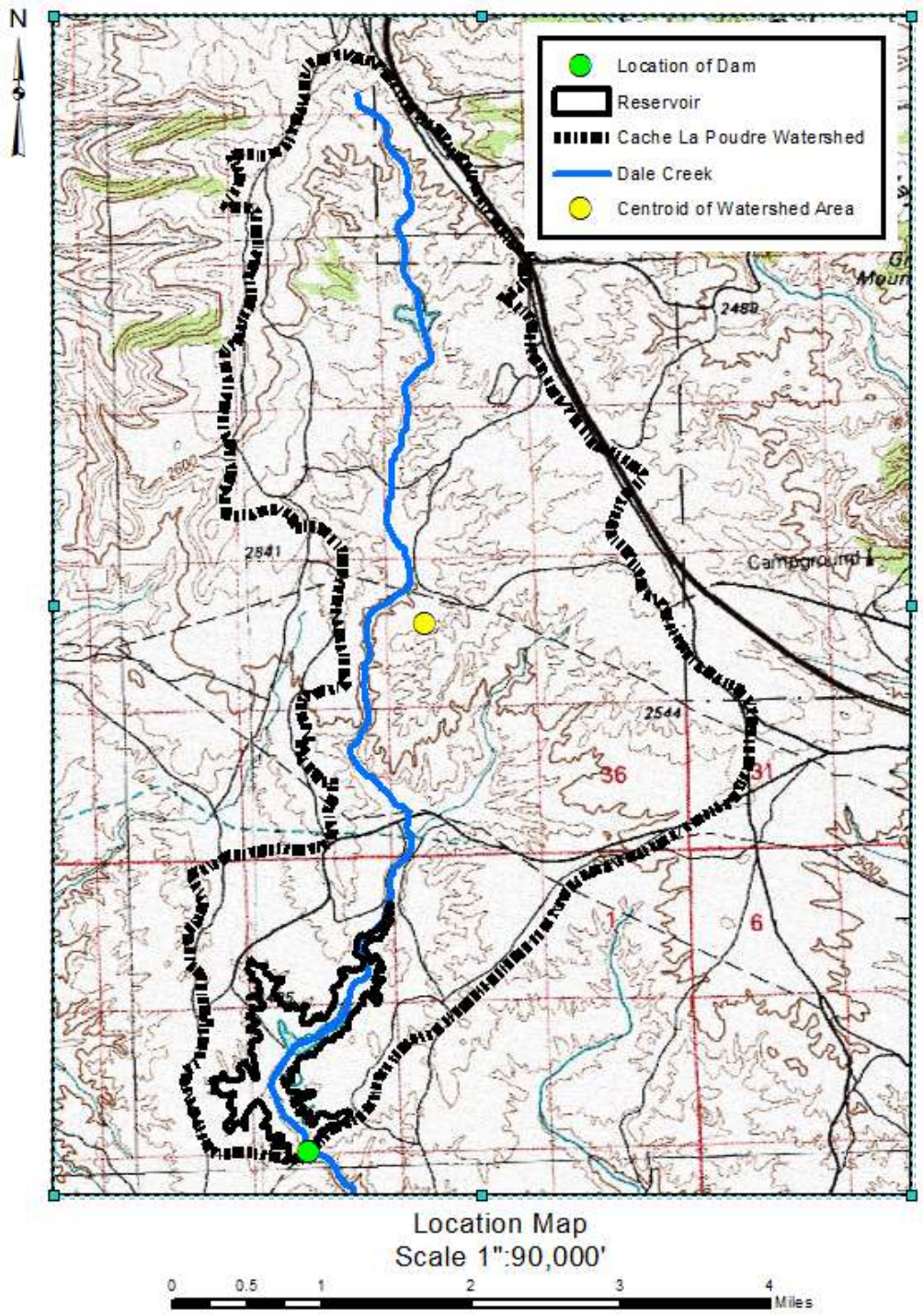


- Geologic Formations
  - Fractured Granite Bedrock Formations
    - abutments
  - Proterozoic/Mesoproterozoic era
    - 1415-1435 Ma
- Potential Reservoir Losses
  - Fractured bedrock
    - Water loss to groundwater
    - Evaporation losses
    - Sediment carryover from contributory streams

Purpose and Site Description

- Nature of Land (downstream of location)
  - Flat/spread out
  - Quick dispersion of water
- "High Hazard" Classification
  - Farmsteads 1.5 and 2.5 miles downstream
  - UP Railroad 2.5 miles downstream



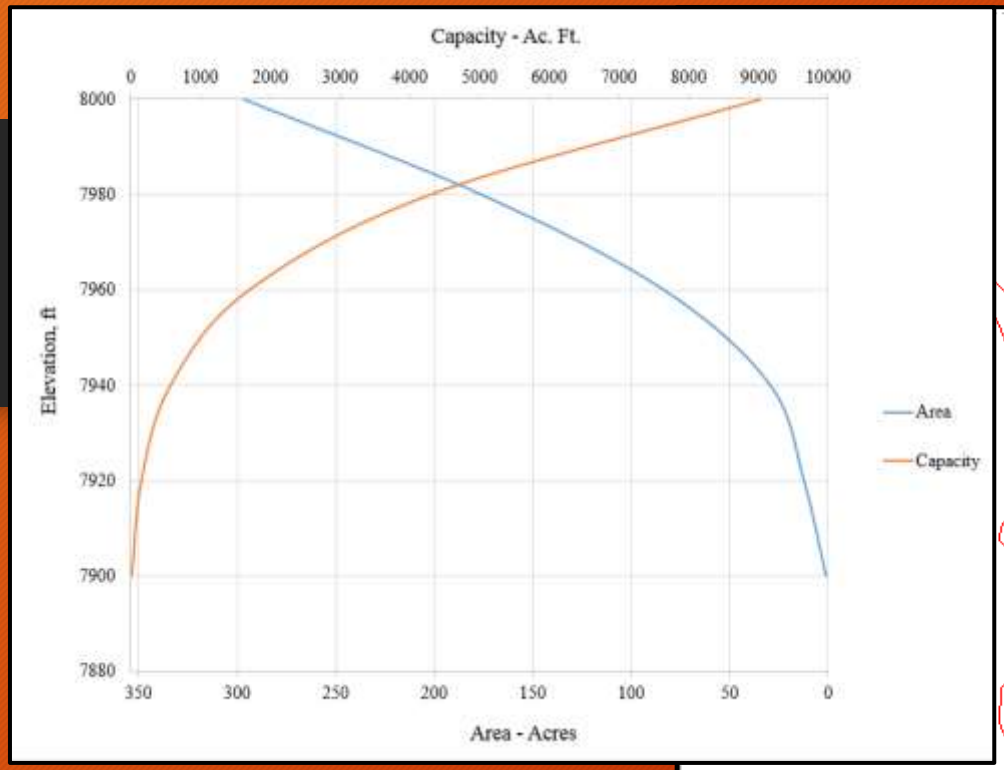


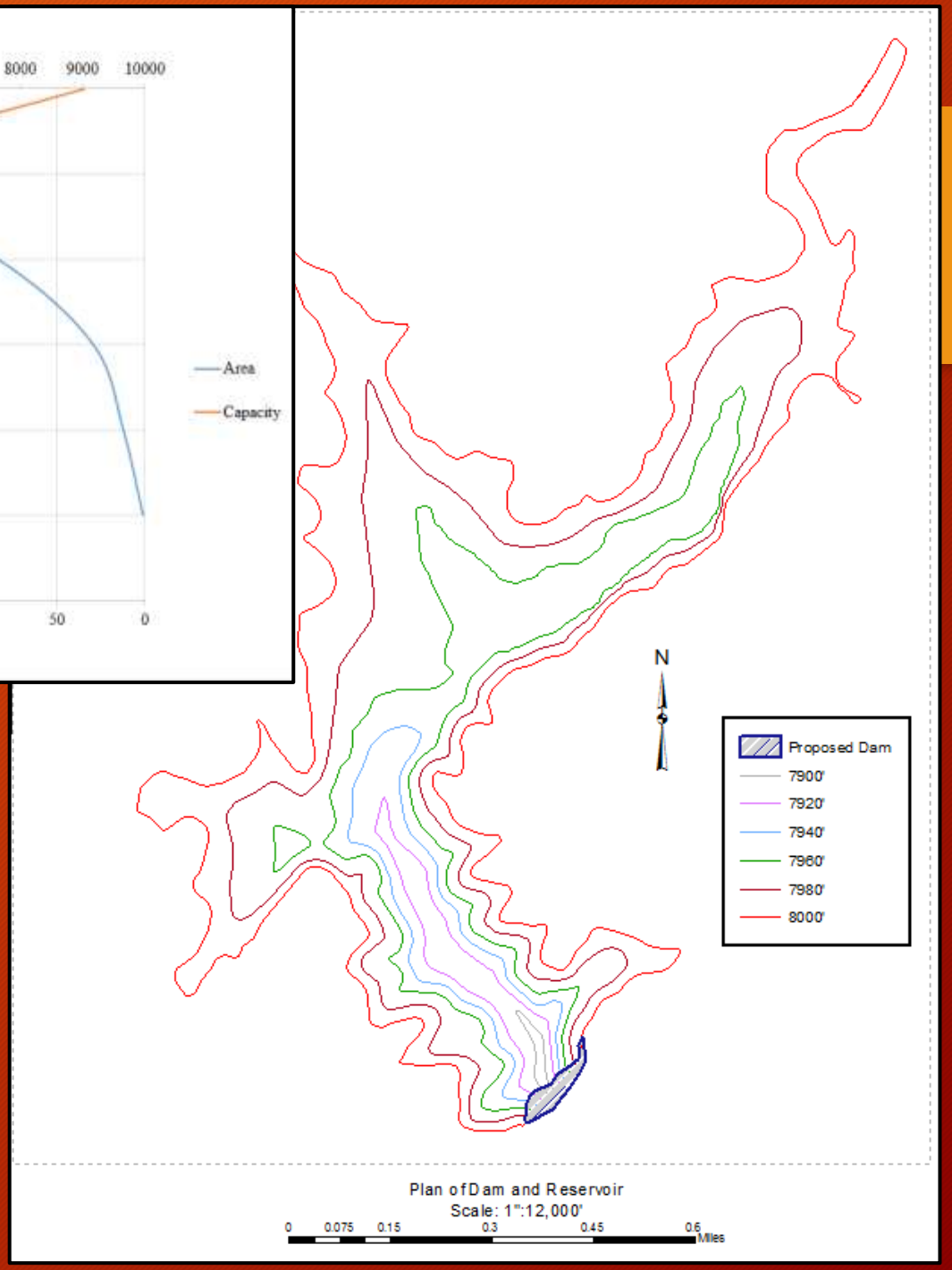
Hydrology

- Characteristics of Watershed
  - Area: 14.5 mi^2
  - Length of Longest Water (Dale Creek) : 8.42 mi
  - Distance along water to Centroid: 4.33 mi
  - Average Slope: 72.21 ft/mi
  - Kn= 0.13
  - Abstraction= 0.1 in/hr

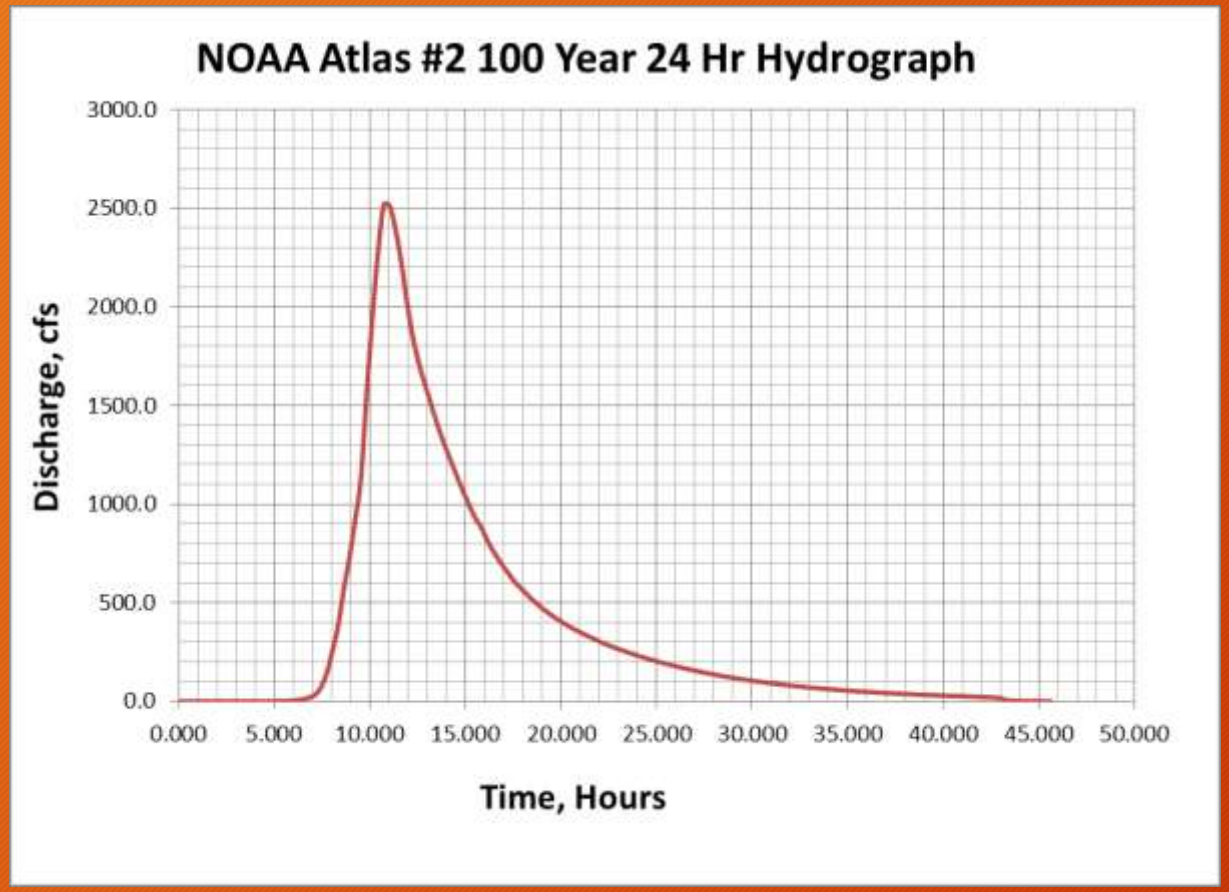
Hydrology

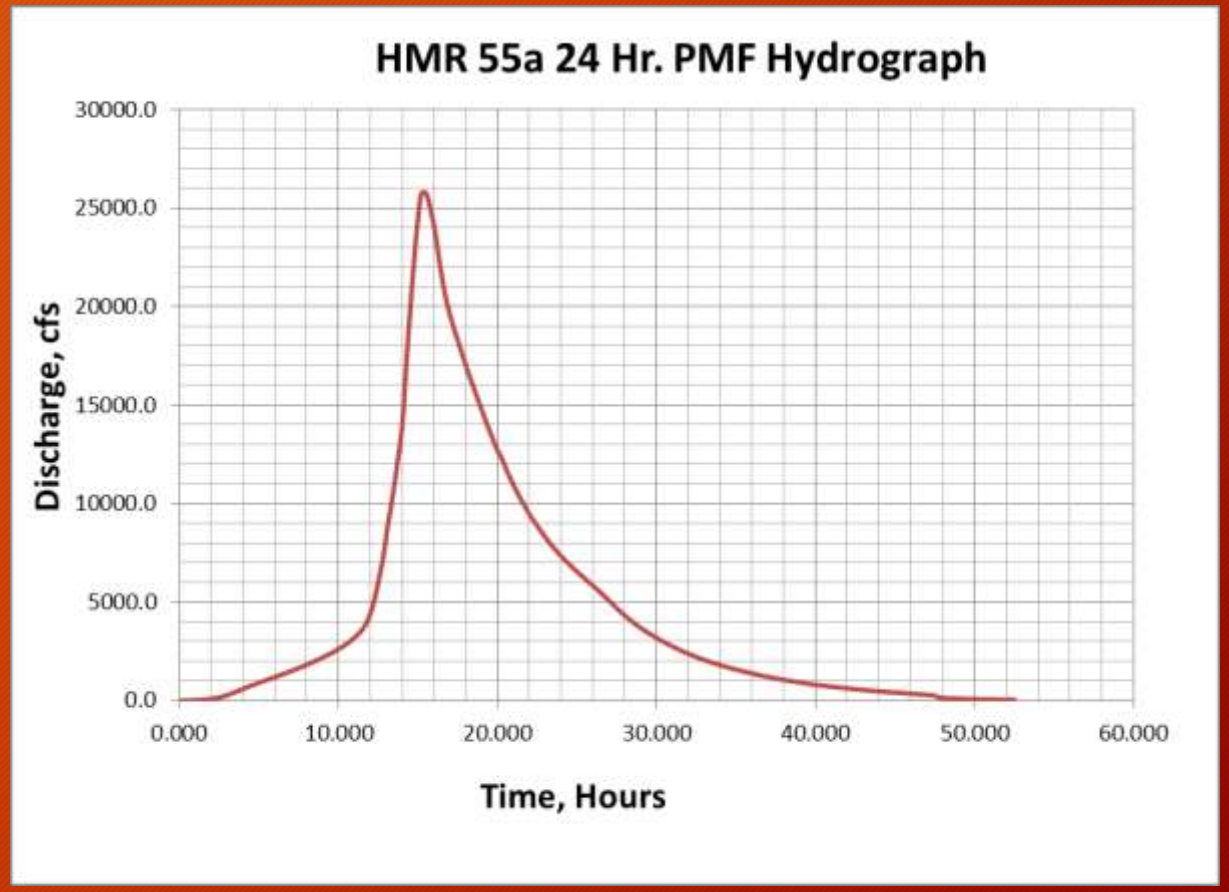
- Reservoir characteristics
  - Storage Capacity: 6360 acre-ft
    - Crest of Dam Elevation: 8000 ft
    - NHWL = 7990 ft
    - Freeboard = 10 ft
    - Min. Water Surface Elevation: 7924 ft
    - Max. Height of Dam above streambed: 109 ft

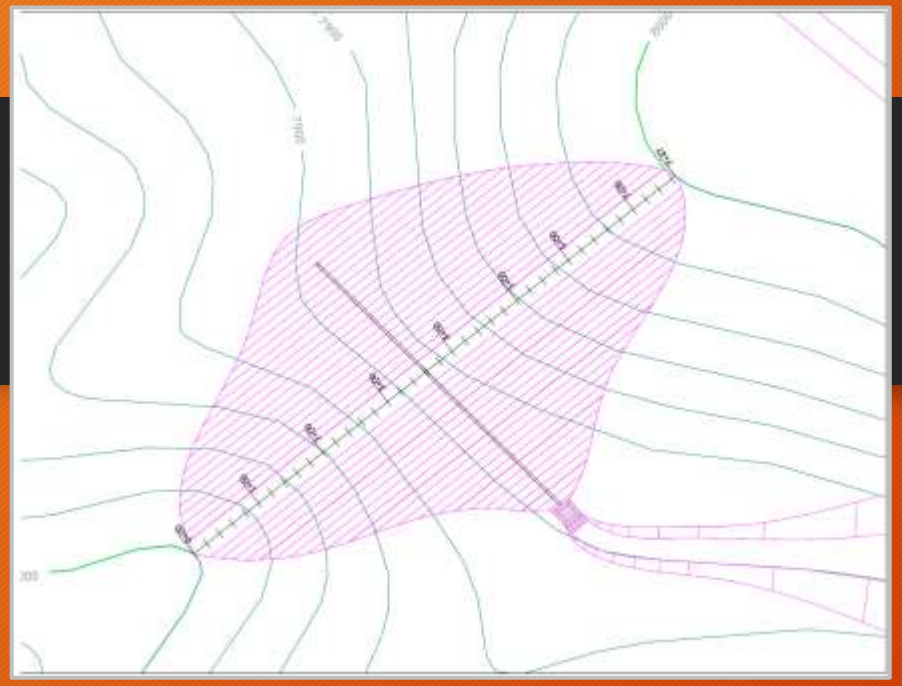




Hydrology

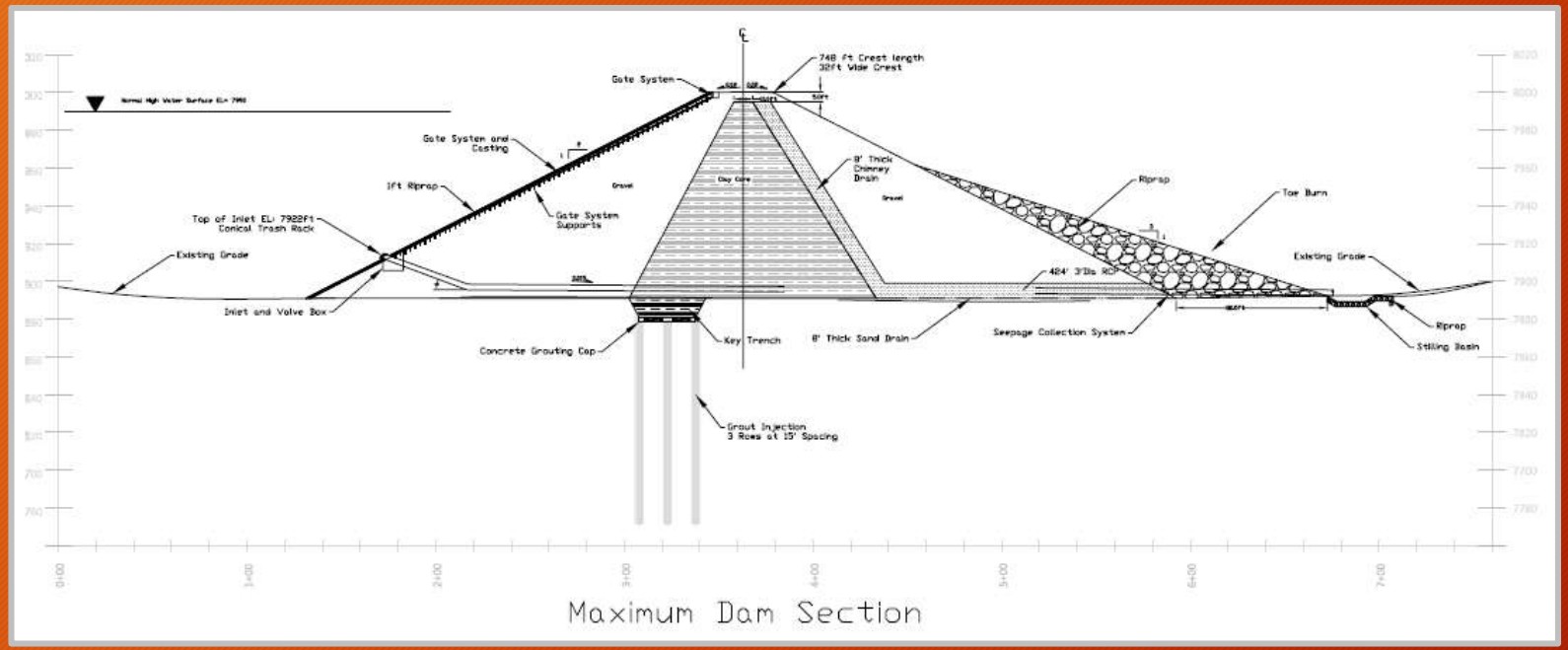

NOAA Atlas #2 100 Year 24 Hr Hydrograph
Discharge, cfs
3000.0
2500.0
2000.0
1500.0
1000.0
500.0
0.0
0.000
5.000
10.000
15.000
20.000
25.000
30.000
35.000
40.000
45.000
50.000
Time, Hours


HMR 55a 24 Hr. PMF Hydrograph
Discharge, cfs
30000.0
25000.0
20000.0
15000.0
10000.0
5000.0
0.0
0.000
10.000
20.000
30.000
40.000
50.000
60.000
Time, Hours

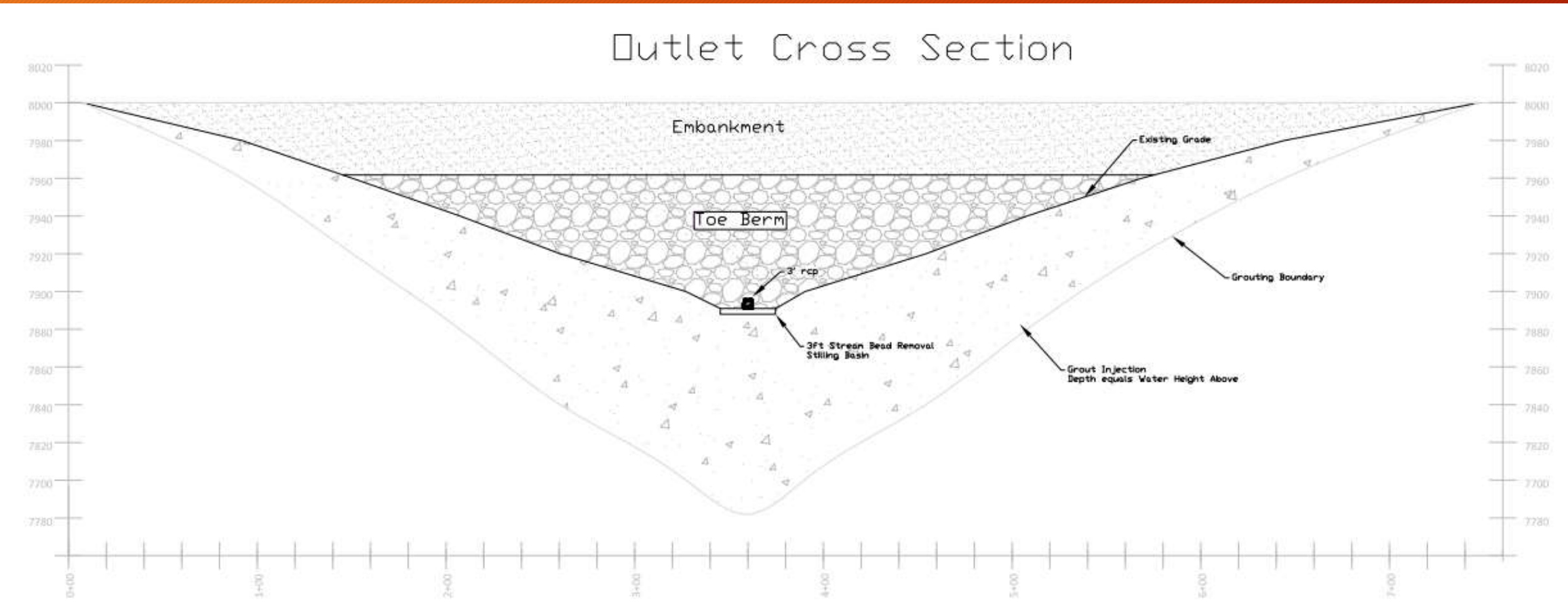


Dam Design

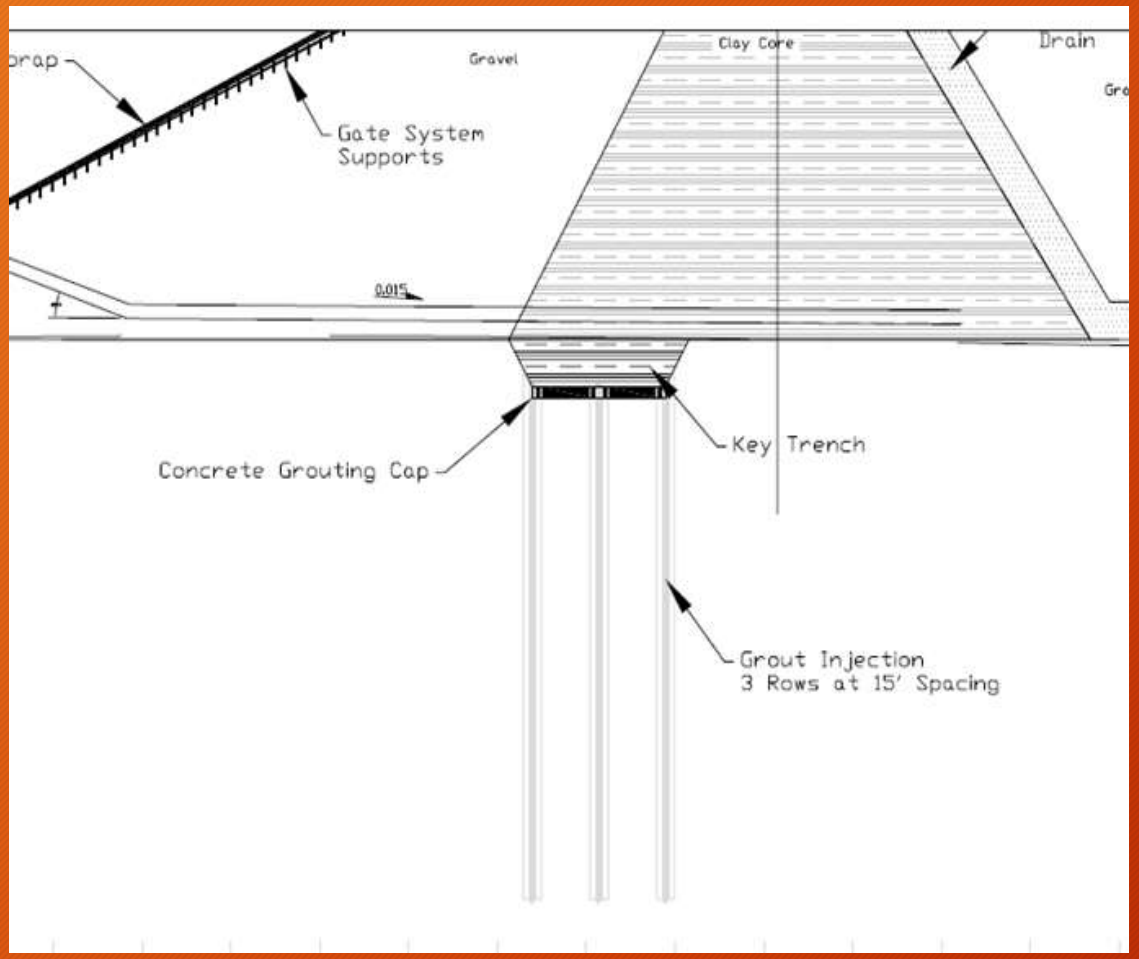
- Top Elevation= 8000’
- Crest Height: 109 ft
- Width of Widest Section: 541.3 ft
- Crest Length: 747.6 ft
- Dam Top Width: 32 ft
- Slope Design
  - Embankment slopes 2:1
  - Core slopes 1:1.6
    - Table 6-6, Design of Small Dams
    - Minimum Core



Dam Design


Outlet Cross Section
Embankment
Existing Grade
Toe Berm
3' rcp
Grouting Boundary
3ft Stream Bead Removal
Stilling Basin
Grout Injection
Depth equals Water Height Above
8020
8000
7980
7960
7940
7920
7900
7880
7860
7840
7820
7700
7780
0+00
1+00
2+00
3+00
4+00
5+00
6+00
7+00

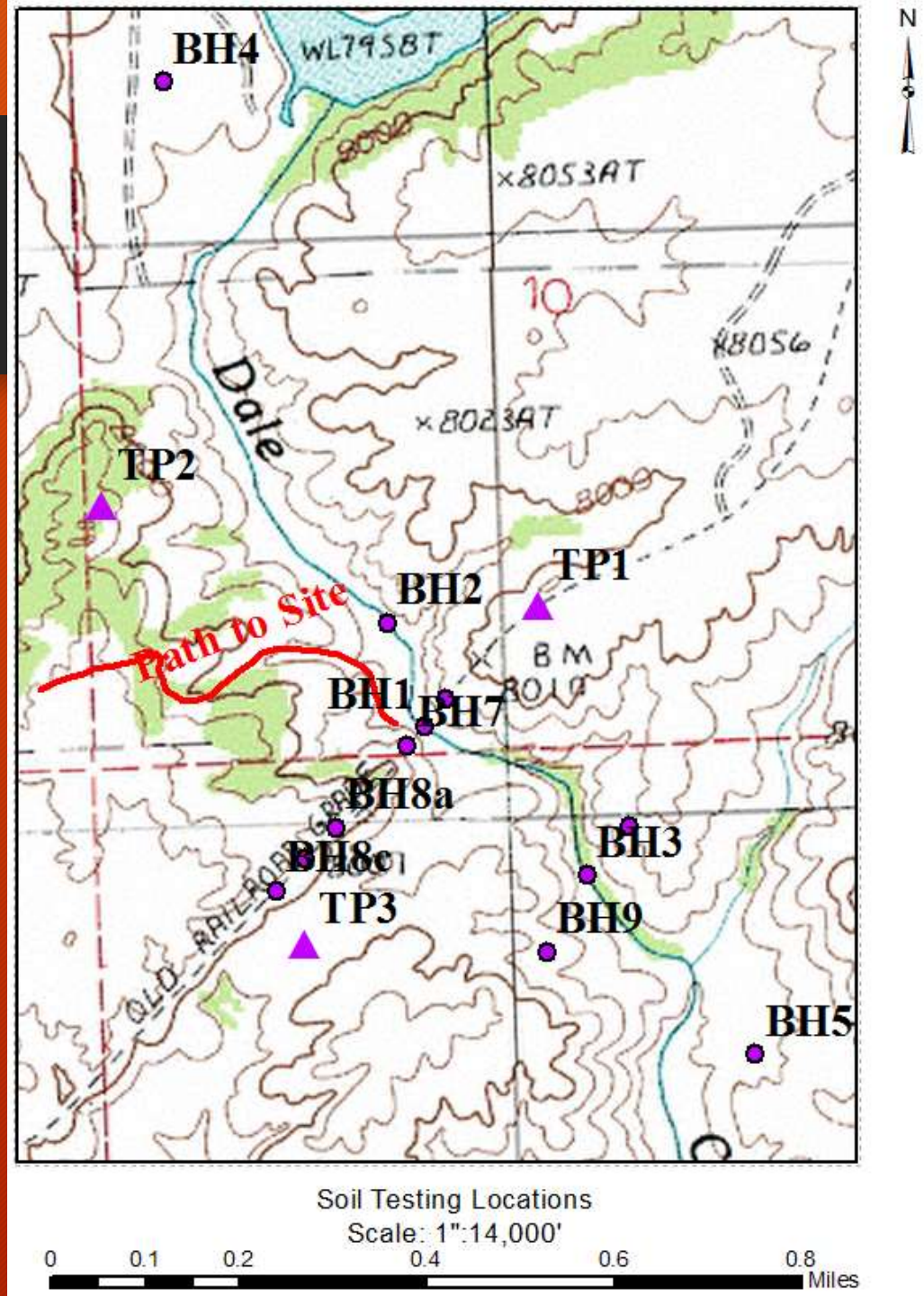
Dam Design



- Grouting
  - 3 rows grout holes
  - 15’ spacing
  - Contractor specifications

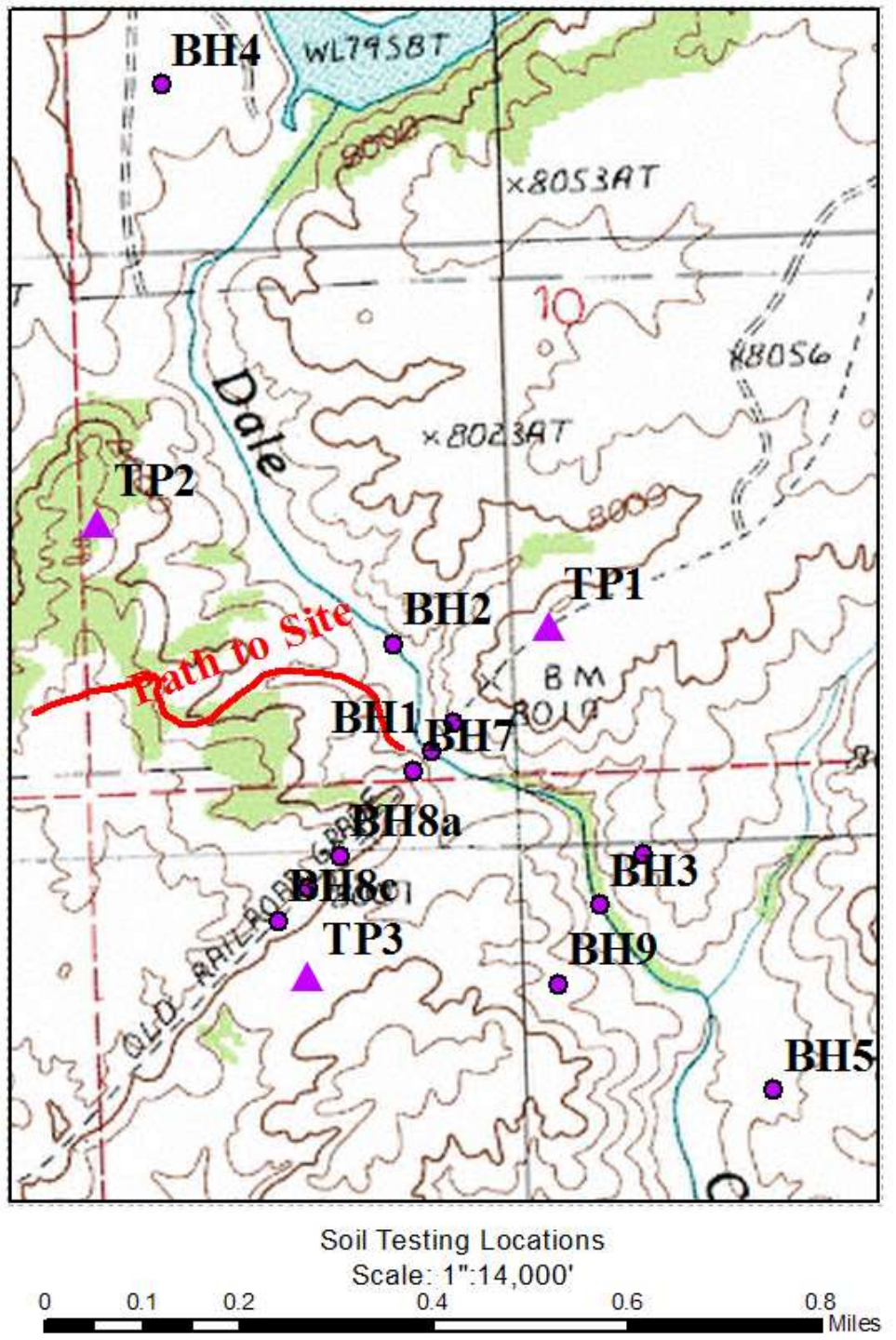
Dam Design

- Core
  - Sandy Silty CL from TP3
- Embankment
  - Poorly graded gravel
  - From aux. spillway cut, TP1
- Chimney and Blanket Drains
  - Well graded sand
  - Wash -#200 material from BH5
- Road Gravel/Top of Embankment
  - Well graded gravel
  - Crushed from TP1, aux. spillway cut
- Riprap/Toe Berm,
  - From TP1, aux. spillway cut



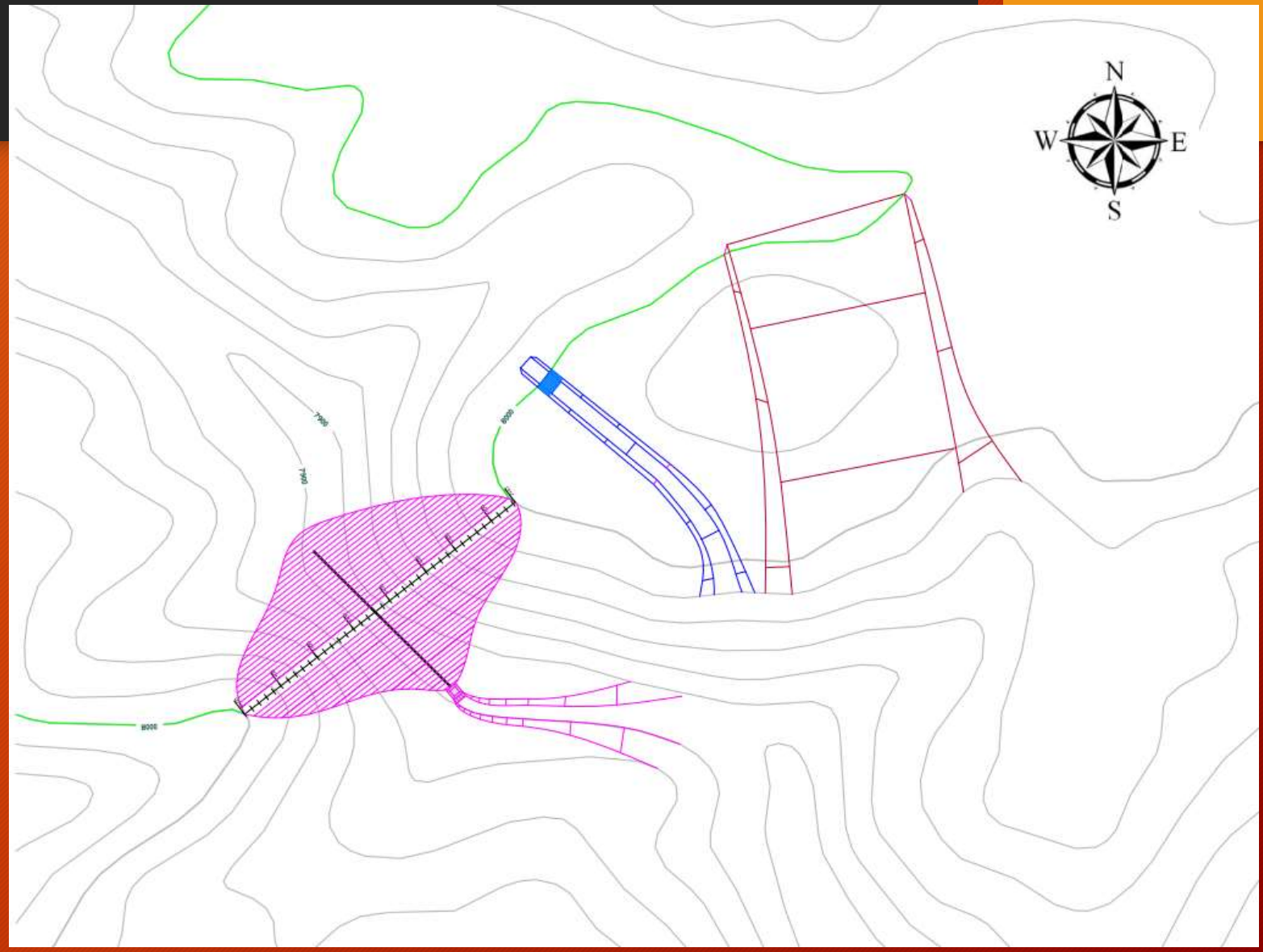
Dam Design

- Core
  - 96-98% of relative compaction
  - +2% of optimum moisture (for ductility)
- Embankment
  - 88-93% of relative density
- Chimney and Blanket Drains
  - 85-90% of relative density

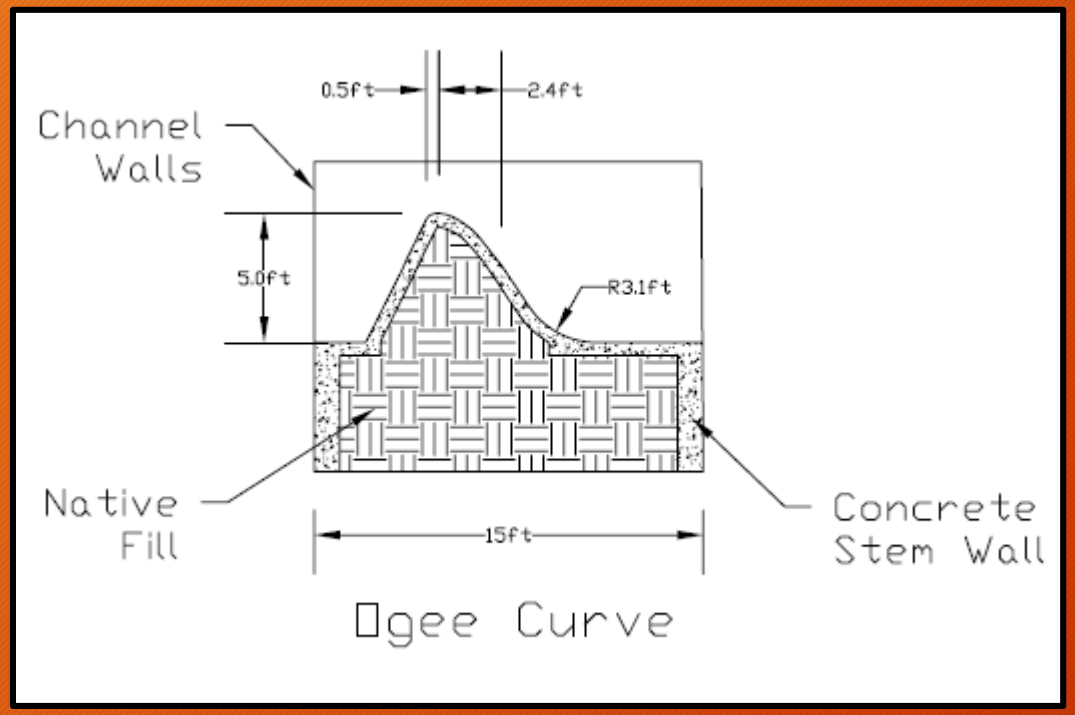


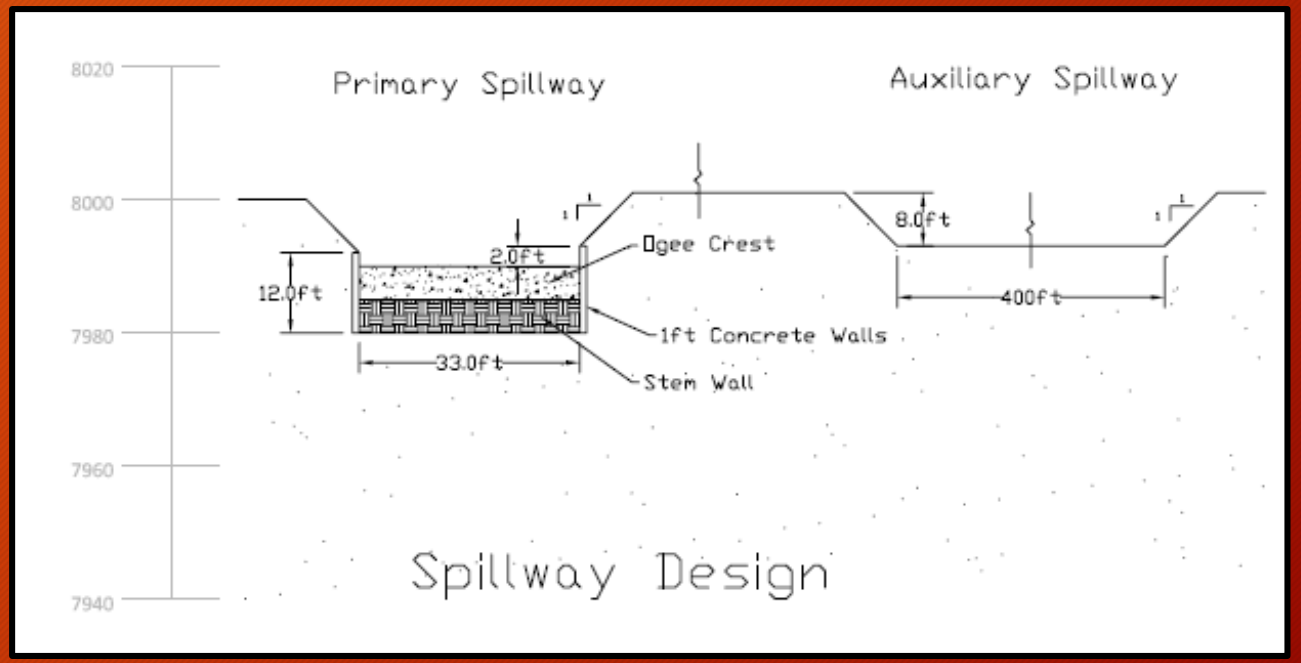
Spillway Design

- Primary Spillway:
  - Channel length - 680 ft
  - Width – 33 ft
- Auxiliary Spillway
  - Channel length- 750 ft
  - Width – 400 ft



Spillway Design





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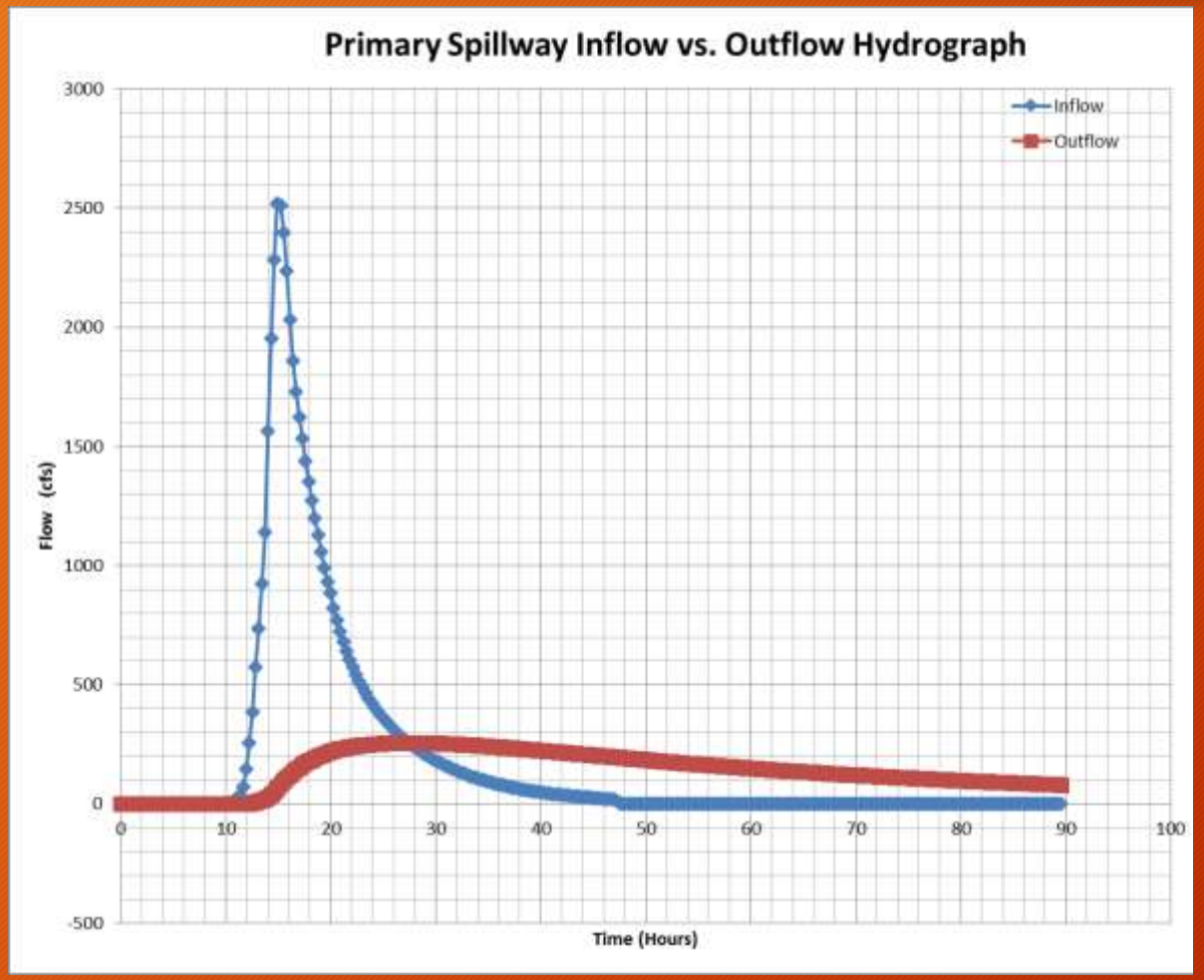


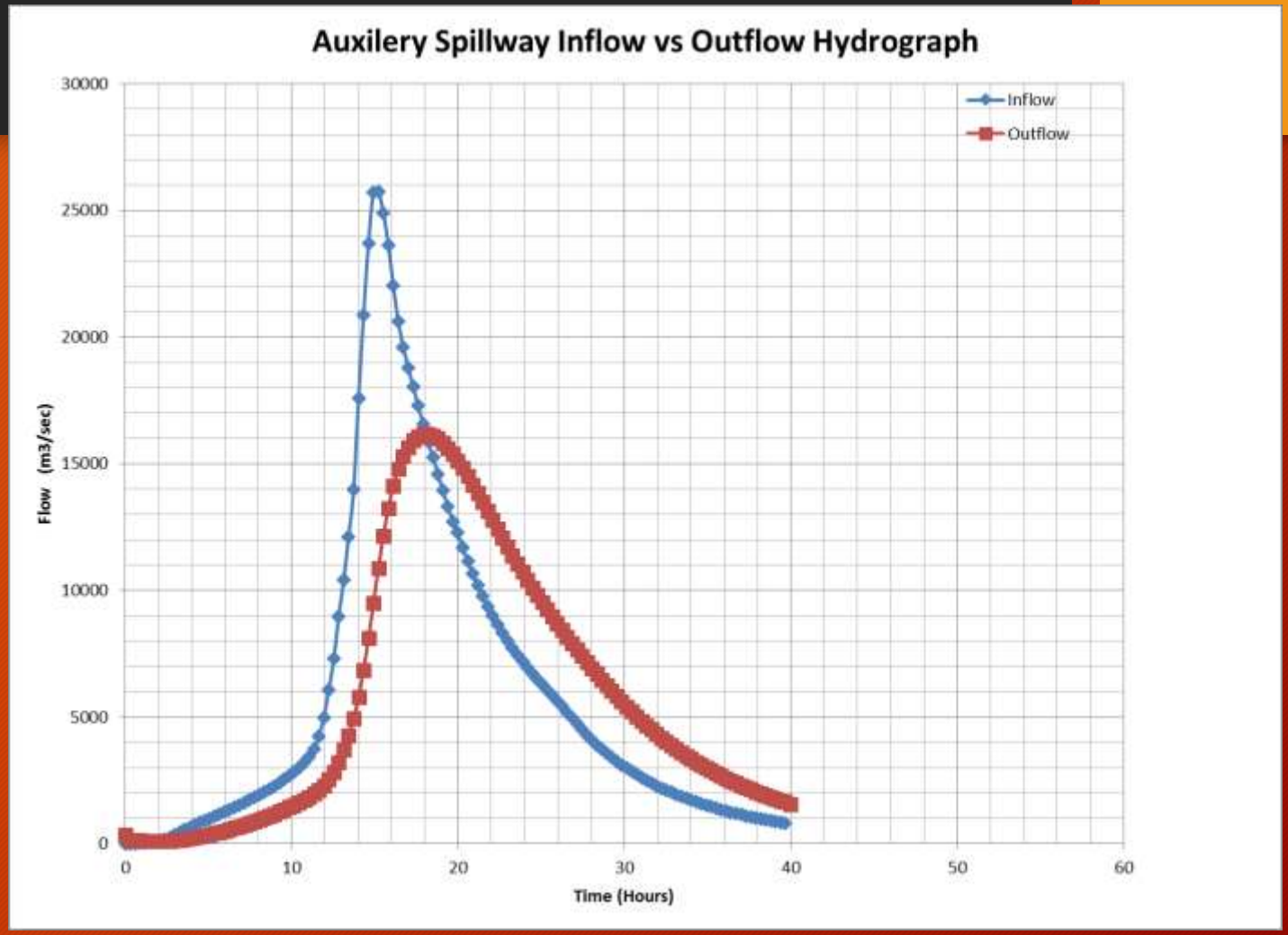
Primary Spillway

- Crest width: 33 ft
- Peak inflow: 2500 cfs
- Peak outflow: 250 cfs
- Maximum head: 1.9 ft

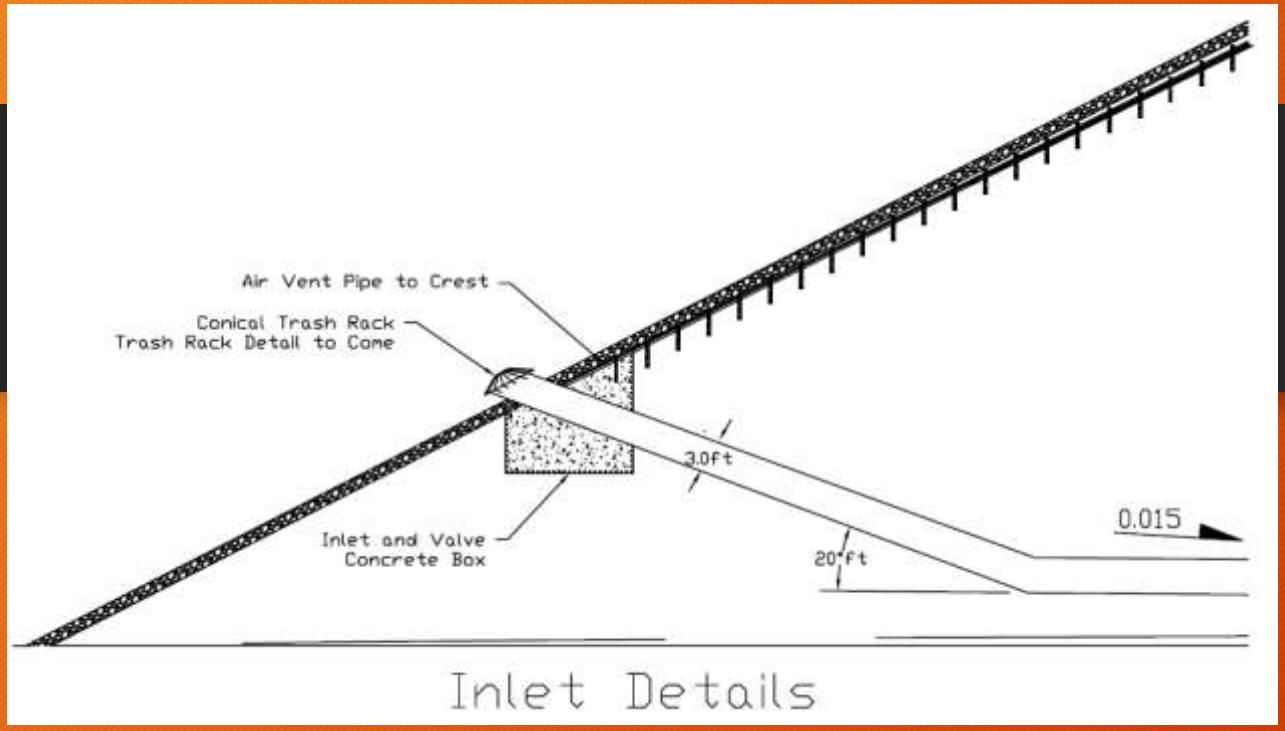
Spillway Design

Auxiliary Spillway

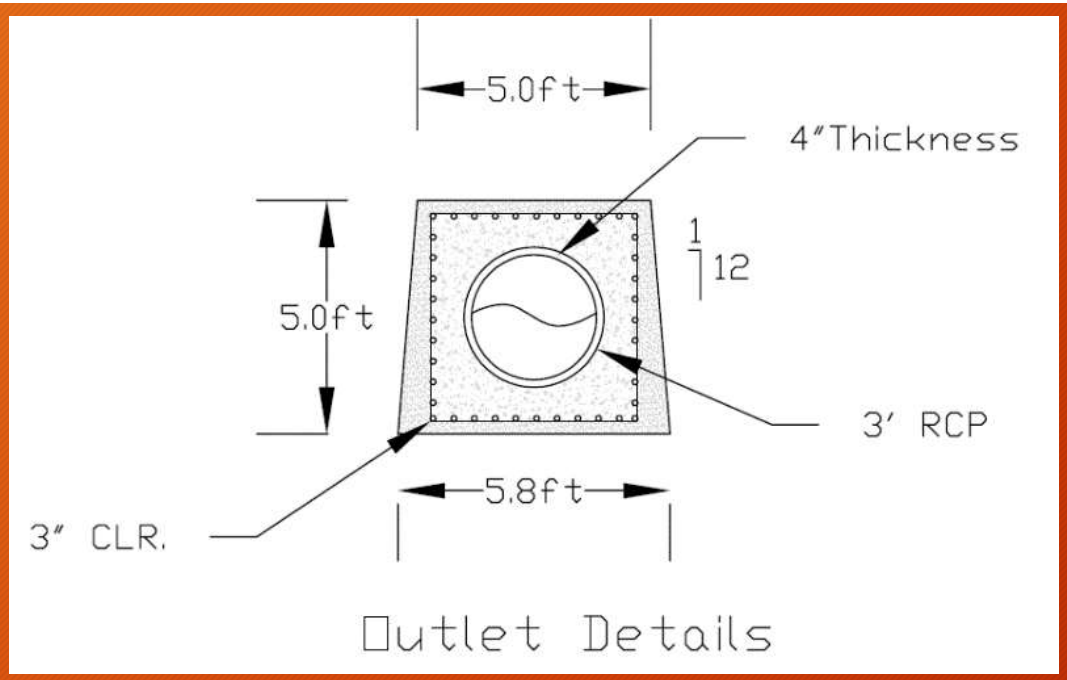
- Crest Width: 400 ft
- Peak Inflow: 25,000 cfs
- Peak Outflow: 16,000 cfs
- Maximum Head: 5.5 ft



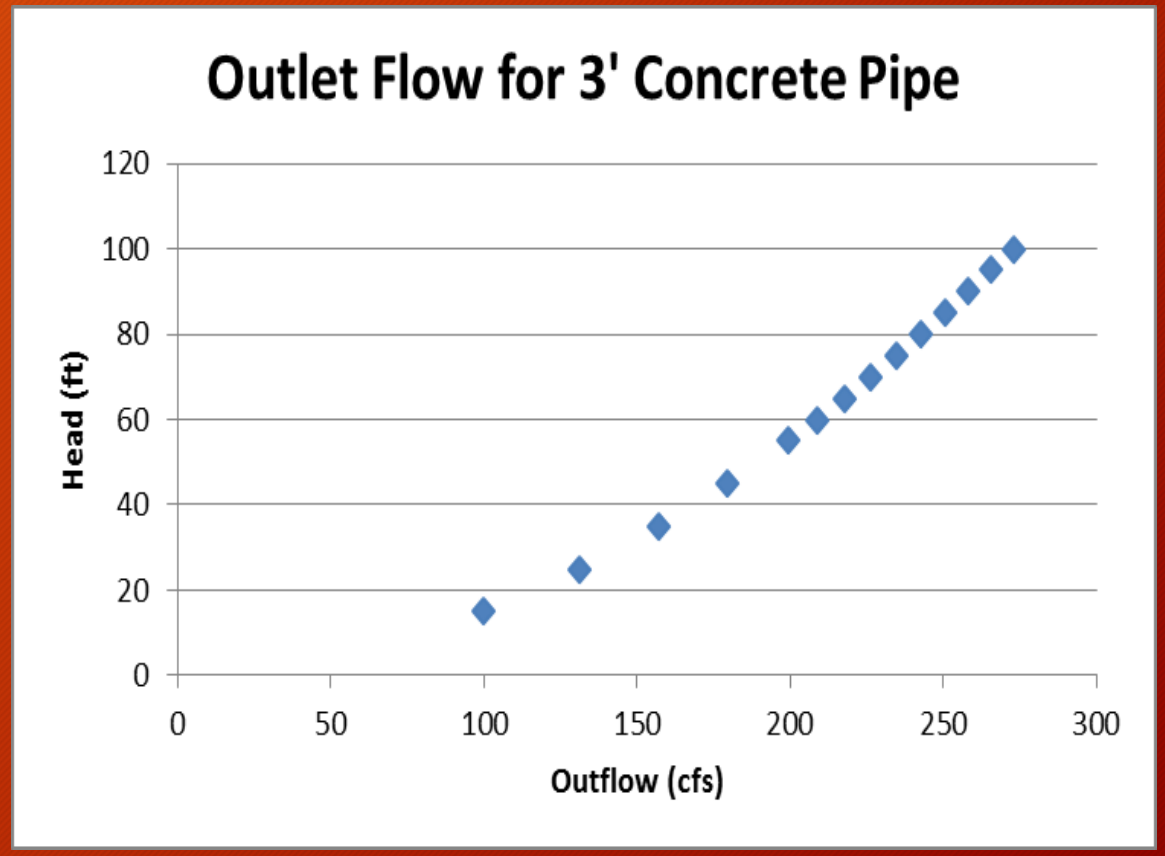
Inlet/Outlet Design



Inlet Details

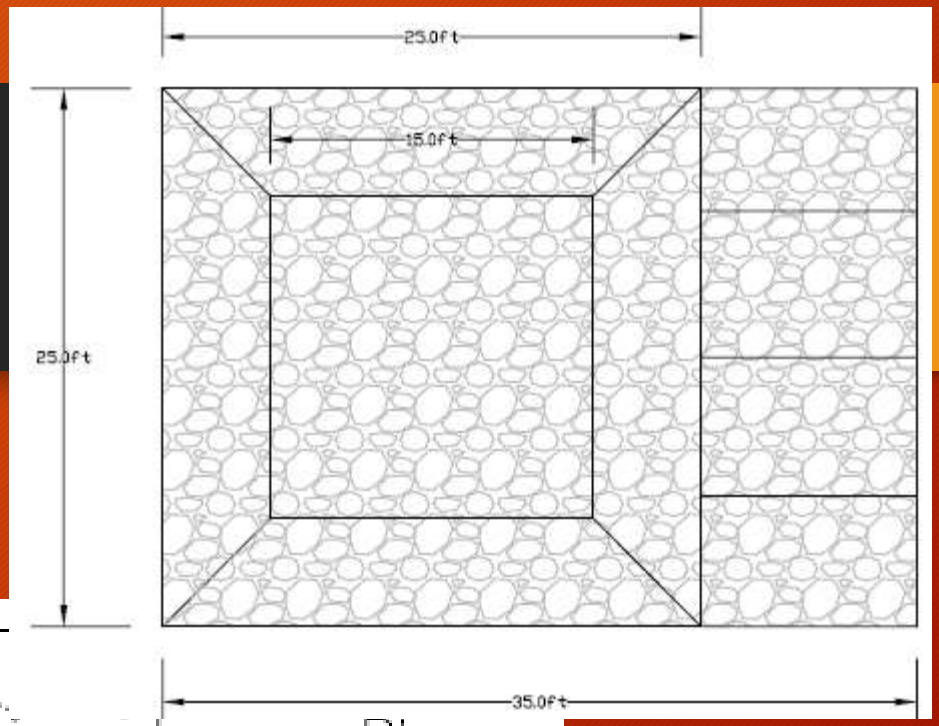


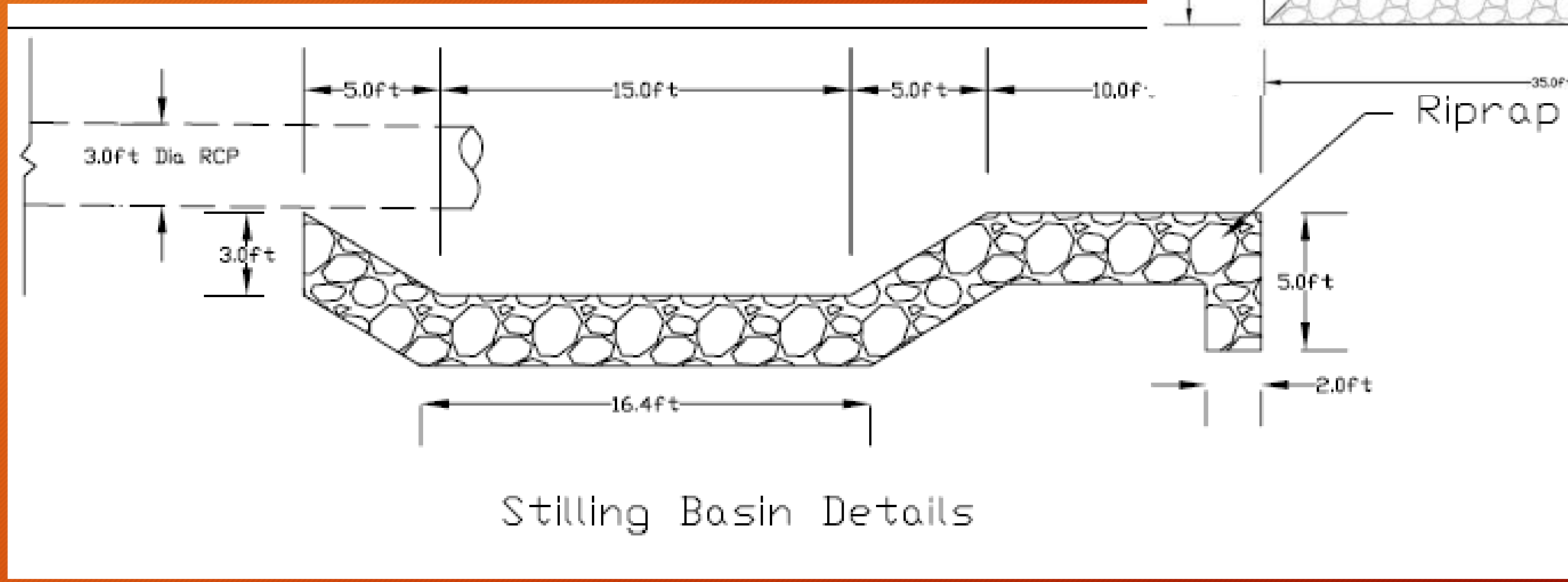
Outlet Details



Inlet/Outlet Design

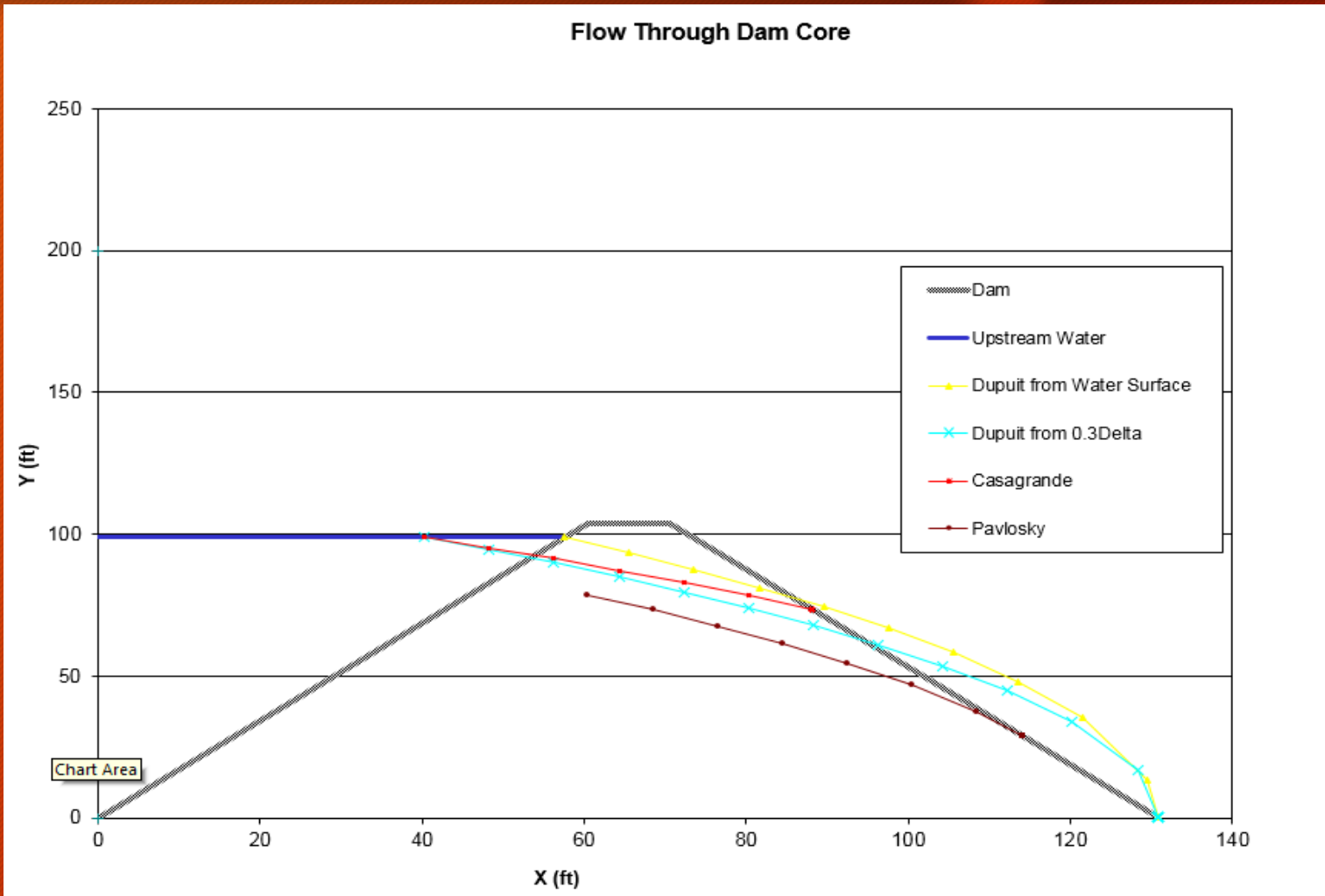
Stilling Basin Design





Soils Analysis

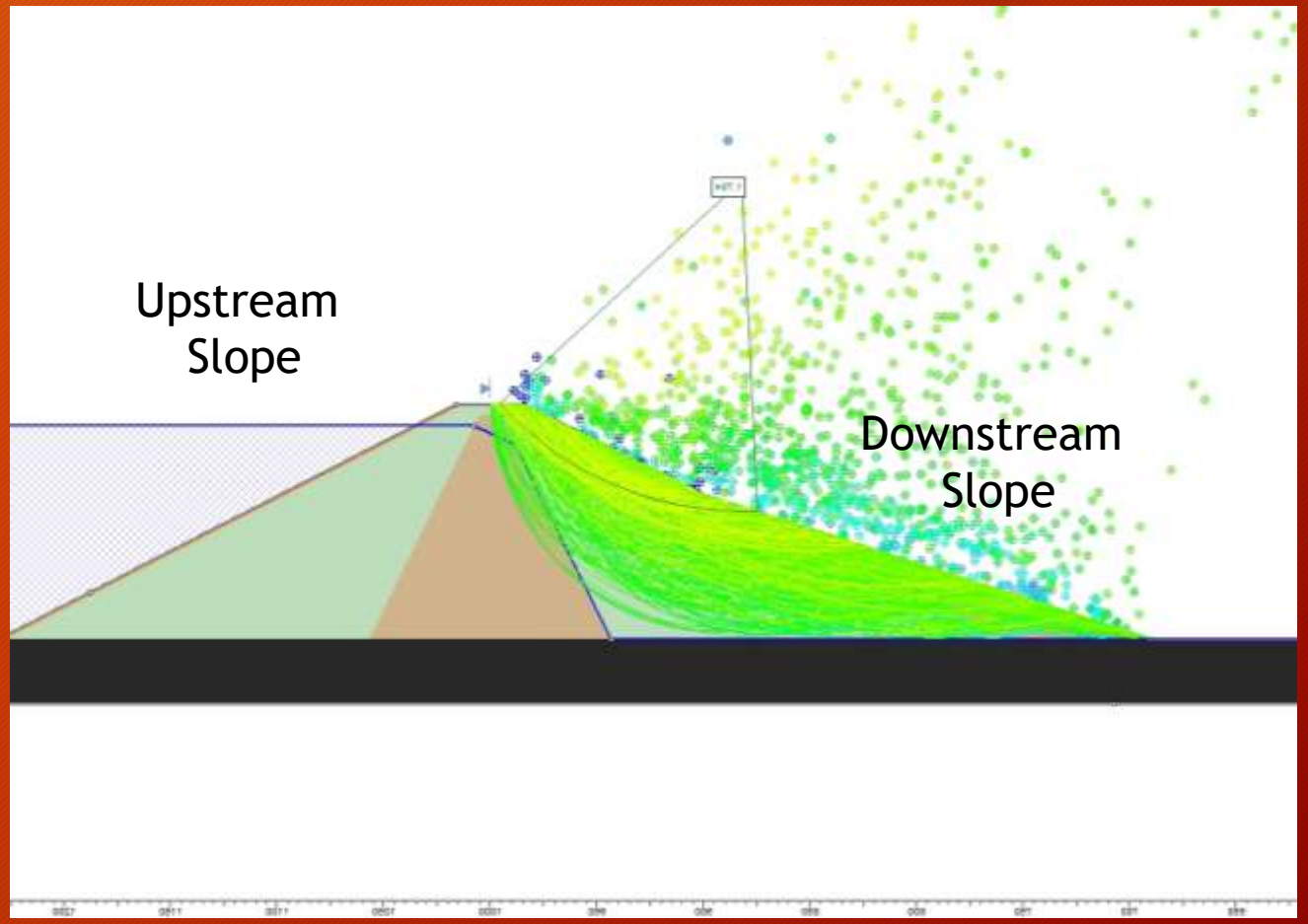
- Seepage:
  - Estimated seepage flow
    - 0.04 ft^3/min
    - 0.3 gal/min



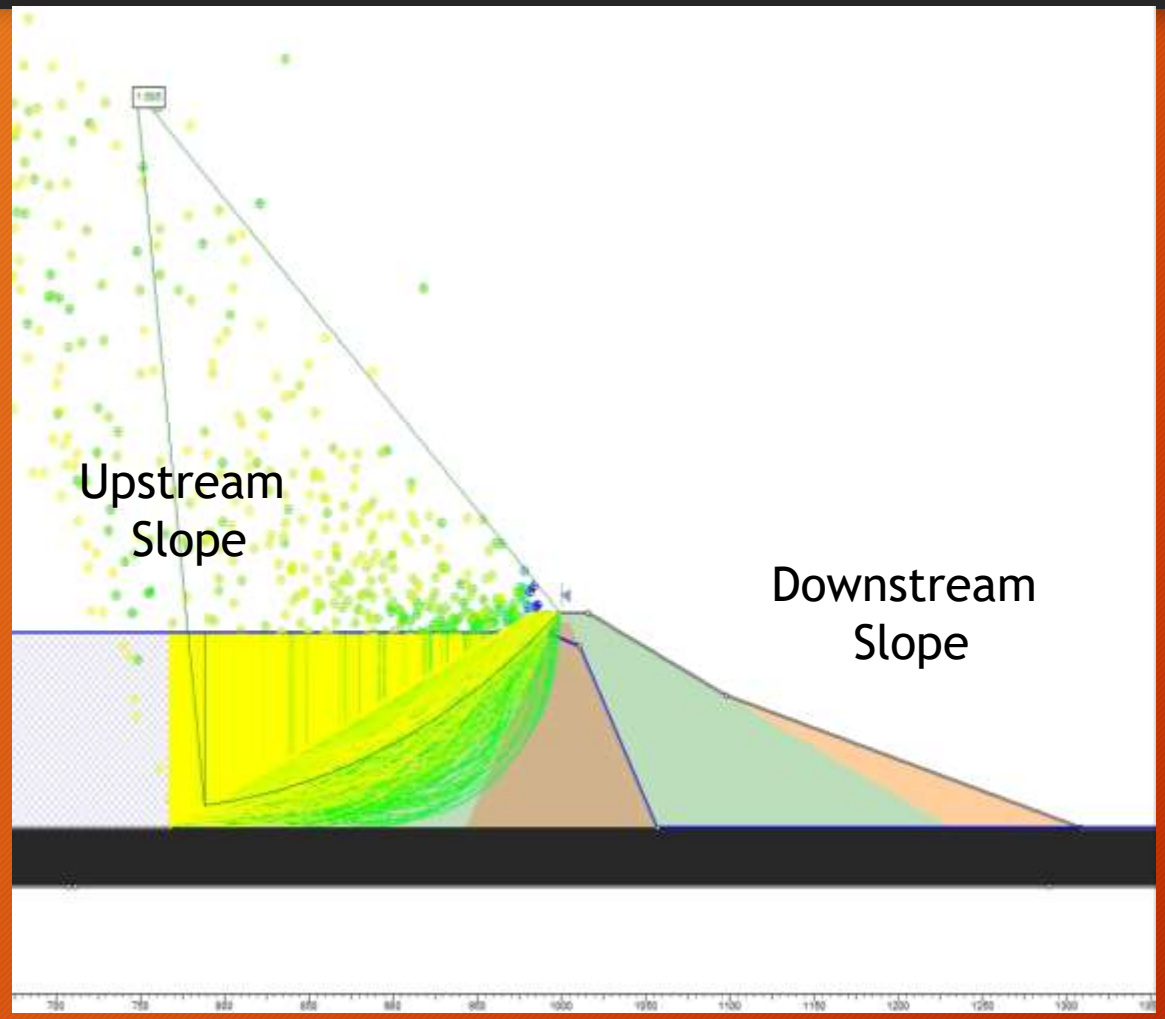
Slope Stability

Downstream

- Riprap toe berm added to downstream slope
  - Increases slope F.S.
- No seismic loading:
  - F.S.=1.71
- Pseudo-seismic loading of 0.07:
  - F.S.=1.45



Slope Stability

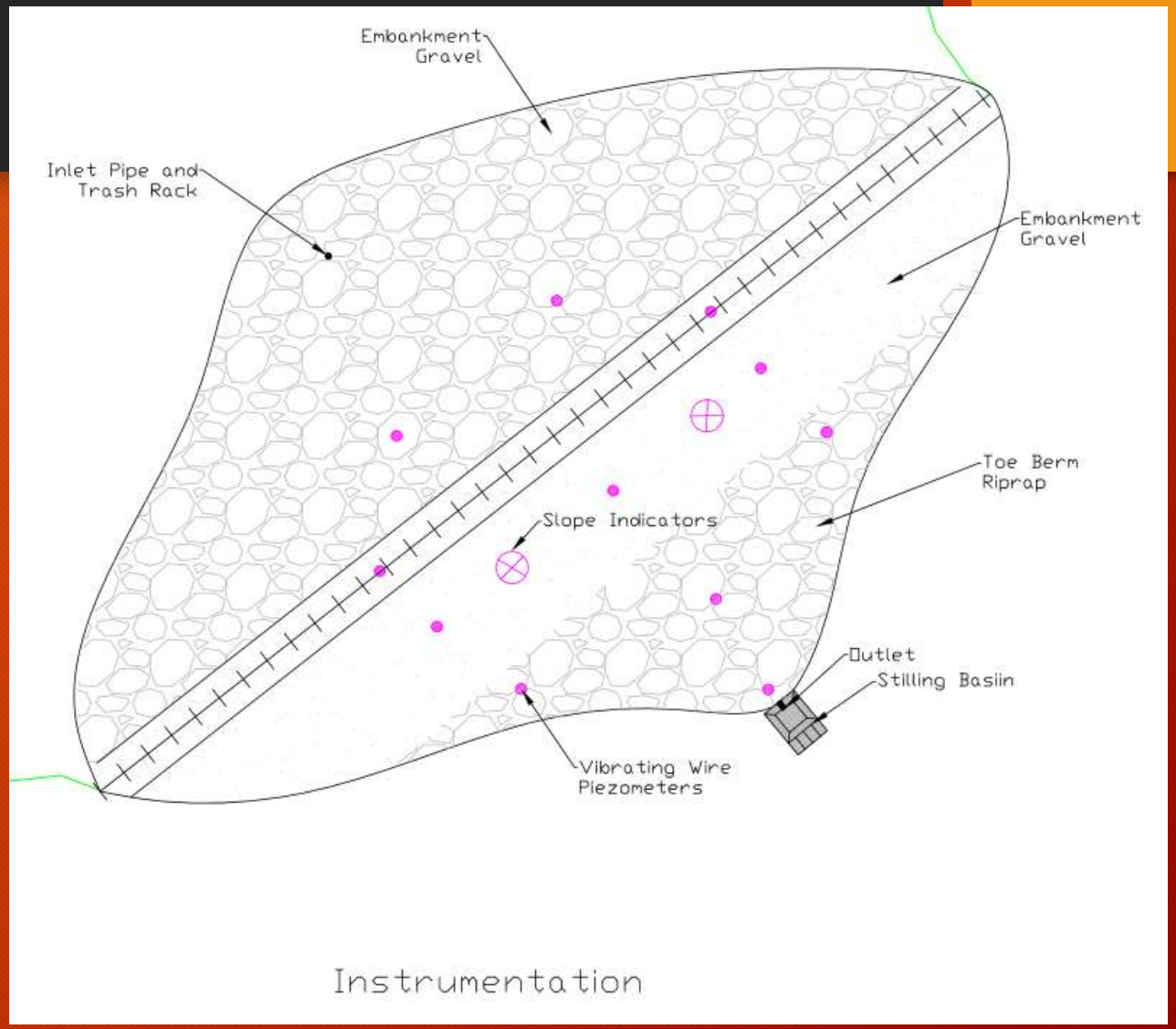


Upstream

- 1’ layer of riprap added to upstream slope
  - Slightly increases slope F.S.
  - Provides embankment protection from waves
- No seismic loading:
  - F.S.=1.59
- Pseudo-seismic loading of 0.07:
  - F.S.=1.22

Slope Stability

- Multiple Vibrating Wire Piezometers
  - Monitor pressures within the dam to compare with the values we determined in the design
- Slope Indicators
  - Monitor movement along the slope of the dam



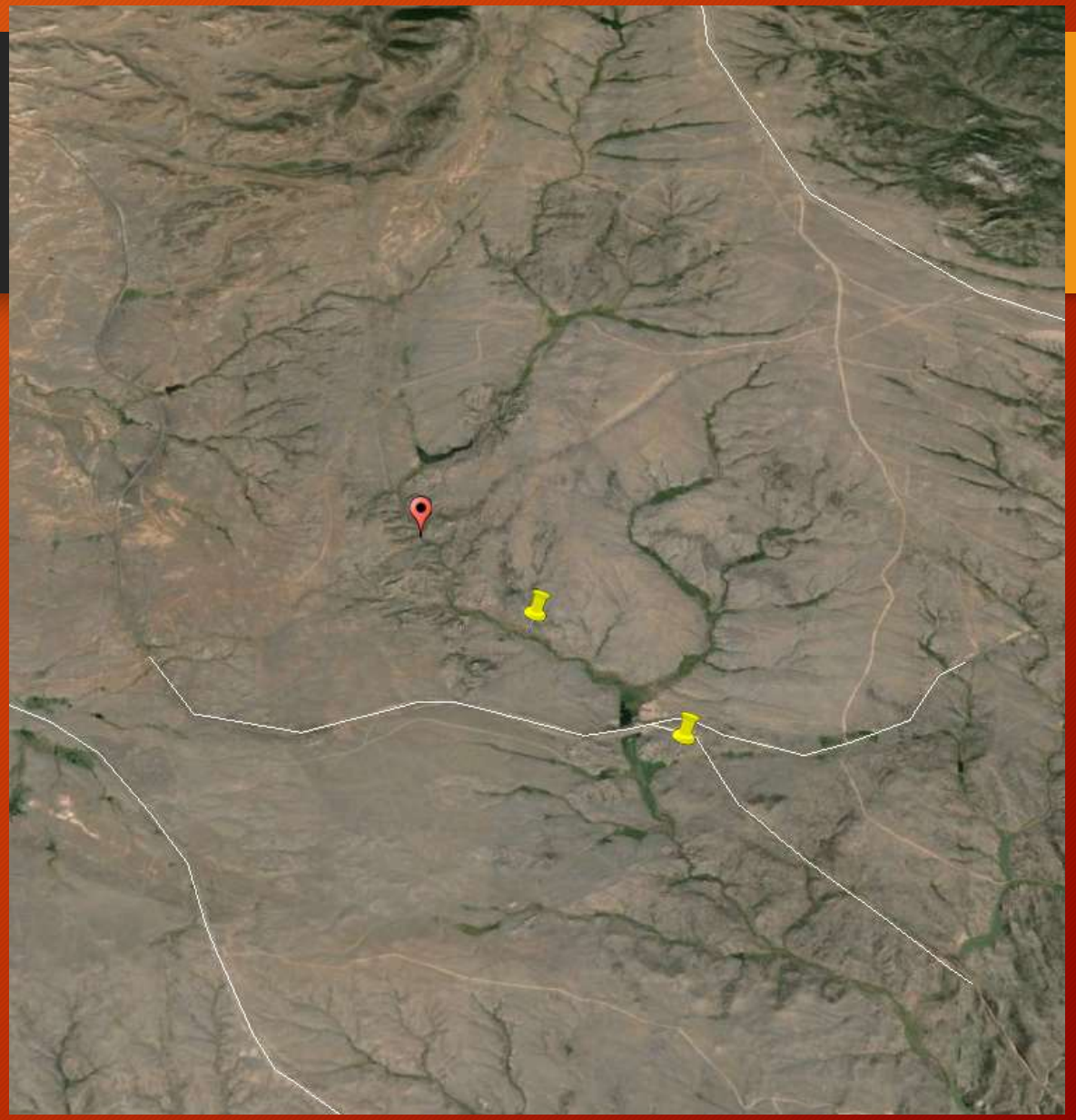
Cost Estimation

Reservoir Embankment and Related Costs	Quantity:	Units	Unit Cost	Total Cost of Item
General				
Mobilization	1	LUM SUM	1,000,000	1,000,000
Diversion of channel for construction	1	LUM SUM	100,000	100,000
Construction surveying	1	LUM SUM	150,000	150,000
Silt fencing	1	LUM SUM	2,000	2,000
Creation of staging areas	2	LUM SUM	15,000	30,000
Creating acess roads	1	LUM SUM	15,000	15,000
Modifying exsisting fencing (gates)	2	LUM SUM	1,000	2,000
Site Preparation				
Stripping and stockpiling of topsoil	1,000	CYD	3	3,000
Over-excavation to bedrock	1,000	CYD	4	4,000
Grouting, bedrock	1	LUM SUM	1,000,000	1,000,000
Excavation of key trench	9,000	CYD	4	36,000
Dam Embankment				
Dam fill, impervious	75,000	CYD	4	262,500
Dam fill, pervious	750,000	CYD	4	3,000,000
Fill, filter type (chimney and blanket drain)	40,000	CYD	4	160,000
Riprap, Toe berm	50,000	CYD	5	250,000
Riprap, upstream	4,500	CYD	5	22,500
Backfill of key trench	9,000	CYD	2	18,000
Primary Outlet Works				
RCP	50	LF	420	21,000
RCP 20 degree elbow	500	LUM SUM	1	500
Flow gate for RCP	2,000	LUM SUM	1	2,000
Connection from gate to hand crank	7	LF	190	1,330
Supports for crank connection	100	PER	64	6,400
Trash rack	2,000	LUM SUM	1	2,000
Stilling Basin, Outlet Works				
Riprap	100	CYD	5	500
Grout for riprap	10	CYD	150	1,500
Primary Spillway				
Concrete	38	CYD	200	7,600
Excavation	17,000	CYD	4	68,000
Riprap	1,500	CYD	5	7,500
Emergency Spillway				
Excavation of channel	225,000	CYD	4	900,000
Revegetation	3	ACRE	1,000	3,000
Roadways				
Crushed base across embankment and to access spillways	185	CYD	4	740
Reclaimation				
Seeding	3	ACRE	1,000	1,000,000
Replacment of topsoil	1,000	CYD	3	3,000

Total Cost of Materials	8,000,000
Estimated Total Construction Cost (Cost of Materialsx2.5)	20,000,000
Cost per Acre-ft	3,000

Construction Considerations

- Estimated time to completion
- Power Considerations
- Construction Hauls
- Construction Camp
- Local Considerations



Environmental Considerations

- Dale Creek = Ephemeral Stream
  - Fish not of major concern
  - Minimal impact to wildlife
- Silt fences
  - Perimeter control used to retain sediment in place where soil is being disturbed by construction processes
- Re-vegetation

Thank you from

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