



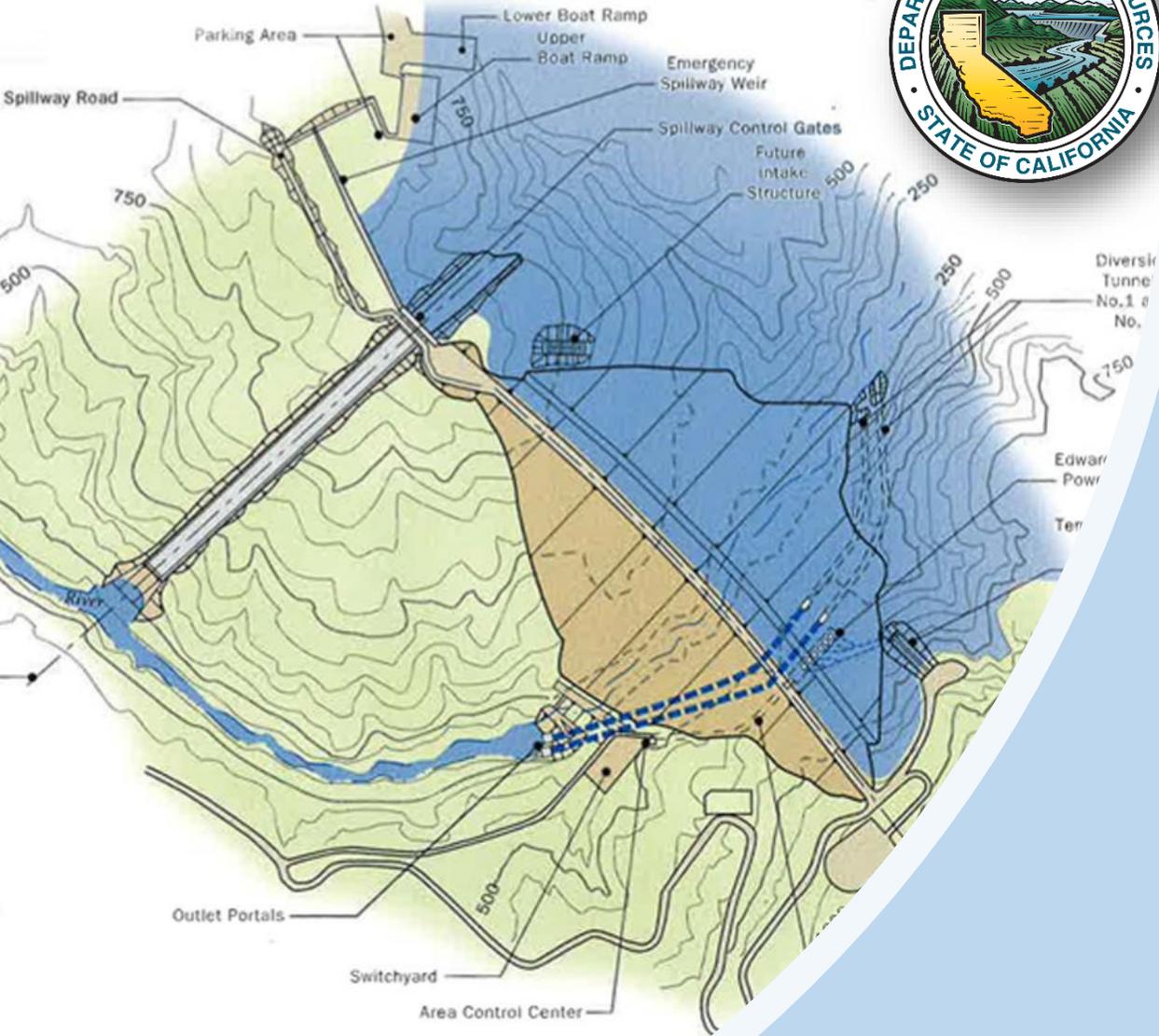
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
OROVILLE DAM SAFETY
COMPREHENSIVE NEEDS ASSESSMENT

Early Implementation Project:

**Installation of
New Piezometers
in Oroville Dam**

Reference TM No. ODSCNA-2019-01

Oroville Dam Safety – Ad Hoc Committee Meeting No. 5
August 9, 2019





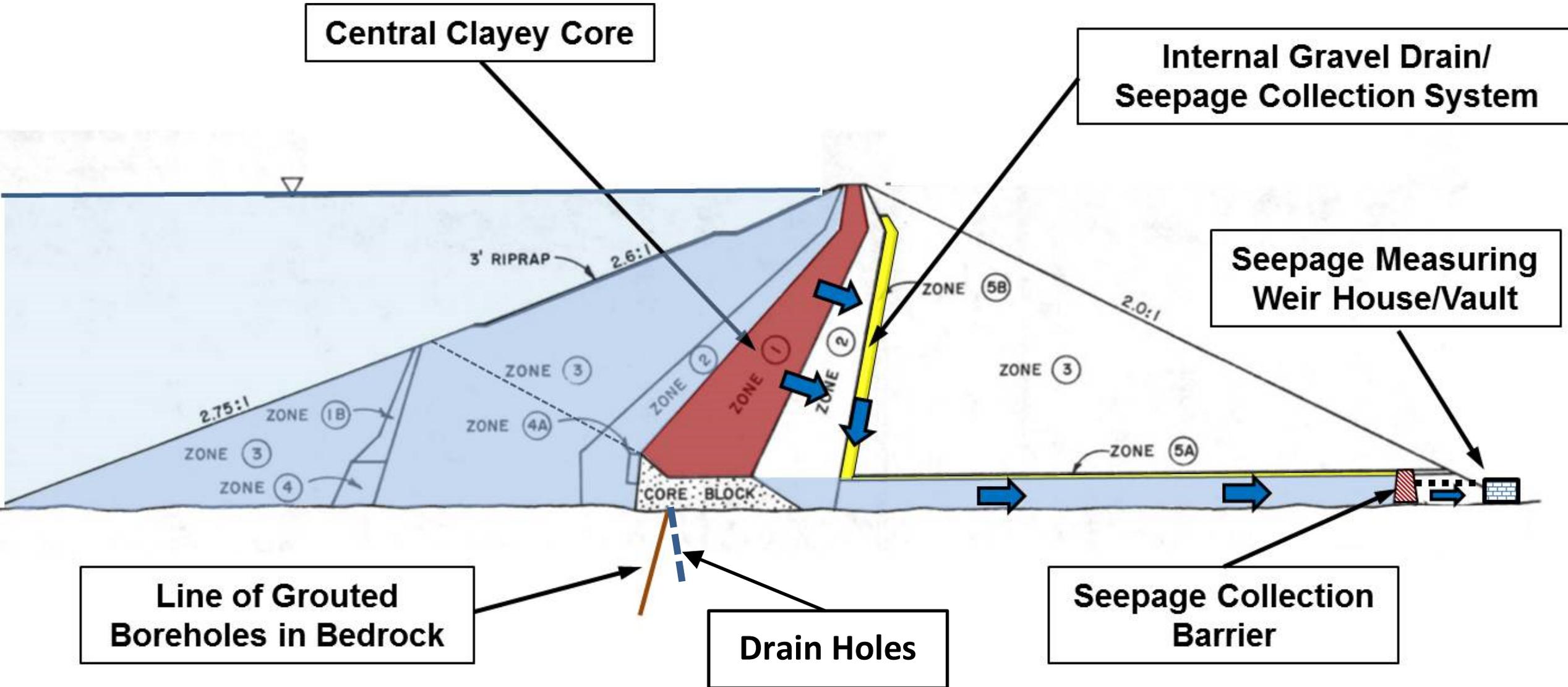
Early Implementation Project: Installation of New Piezometers in Oroville Dam

Presentation Outline

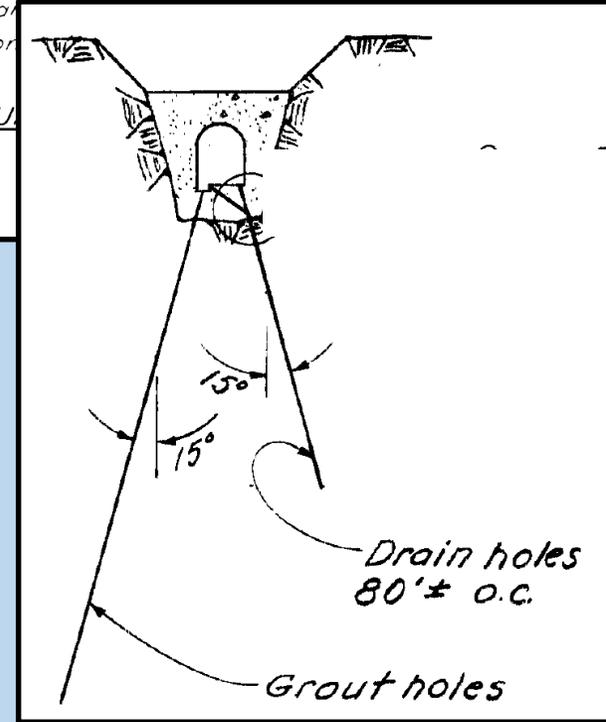
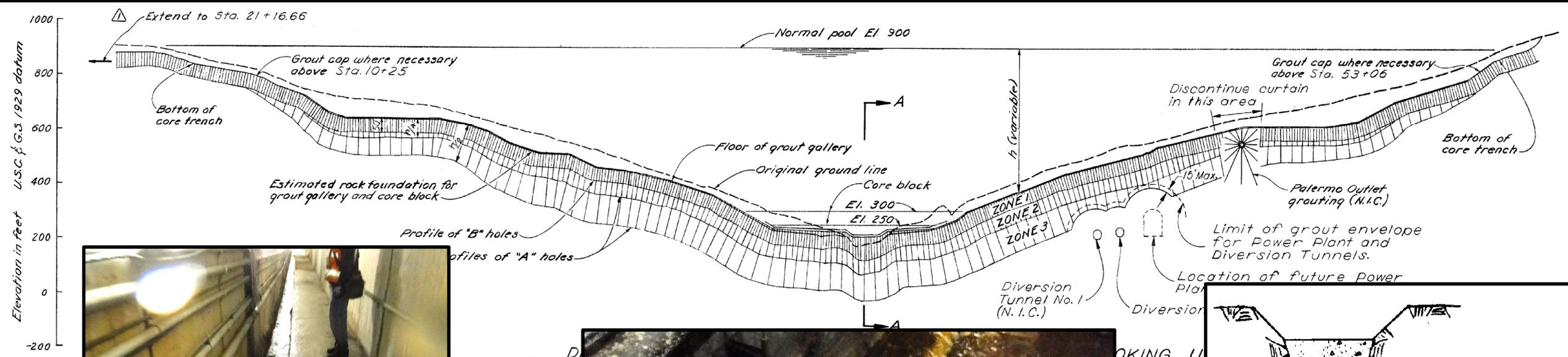
- **Review of Seepage Control and Monitoring Systems**
- **Review of Past Seepage/Drainage Measurements**
- **Planned Installation of 11 New Piezometers**
 - ✓ **Phase 1: 6 piezometers at D/S Toe**
 - ✓ **Phase 2: 5 piezometers in Core Block/ Grout Galleries**



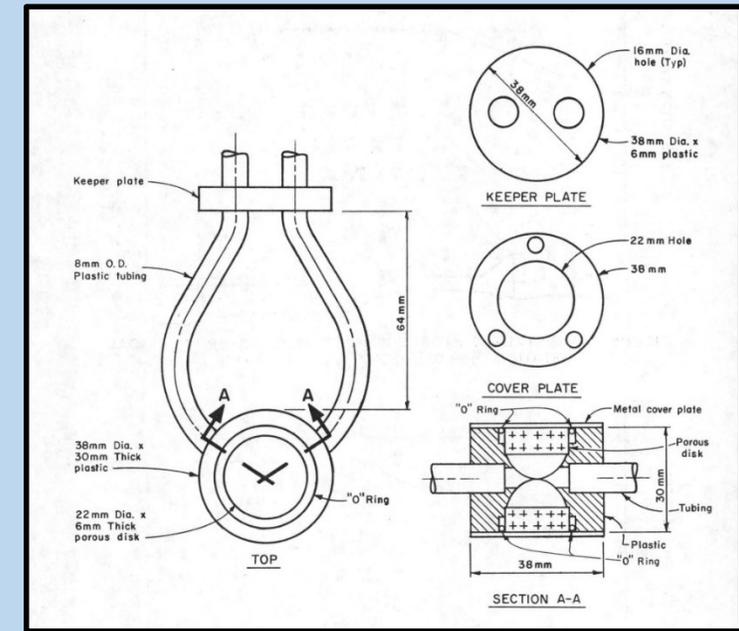
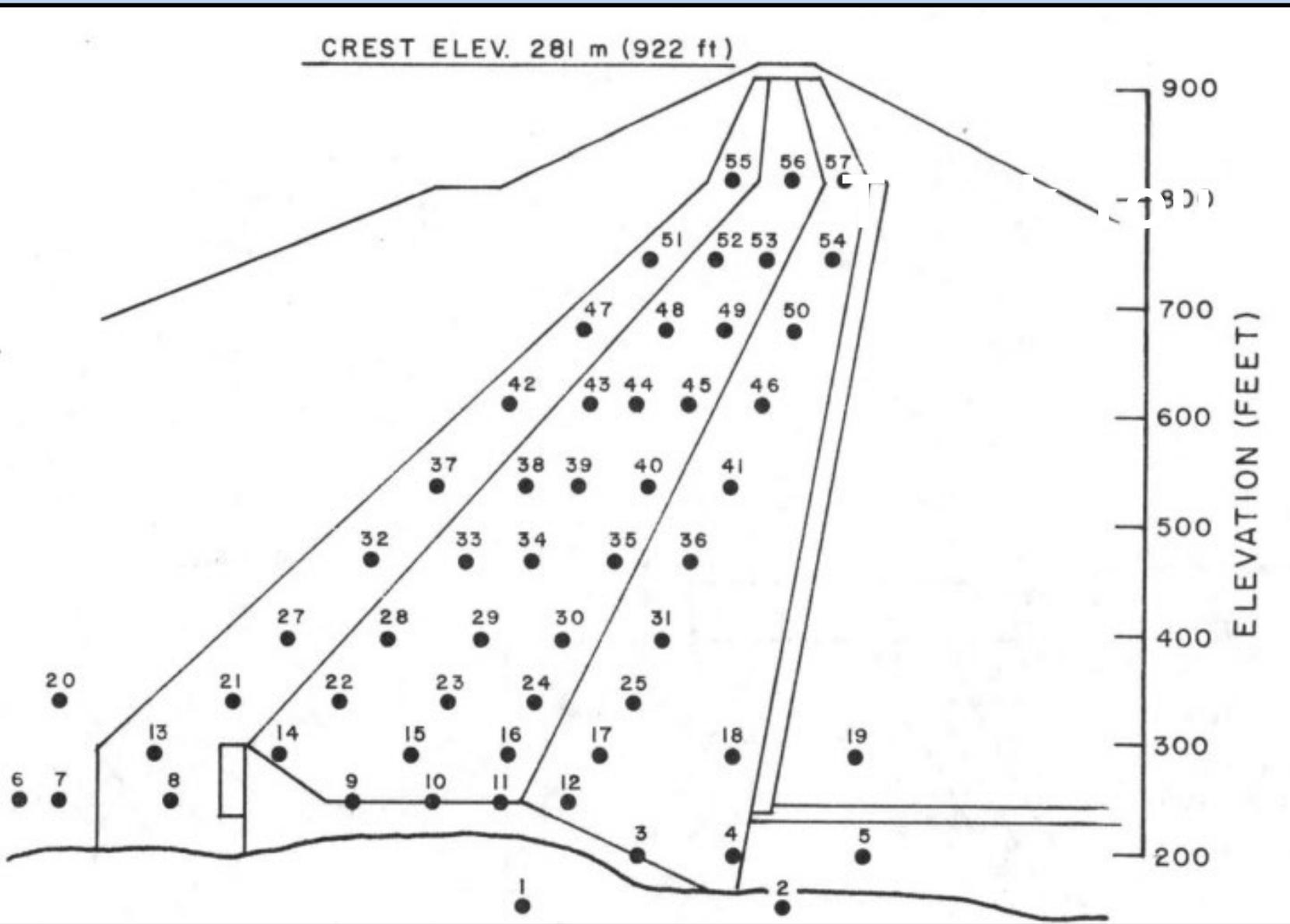
Seepage Control and Monitoring Design



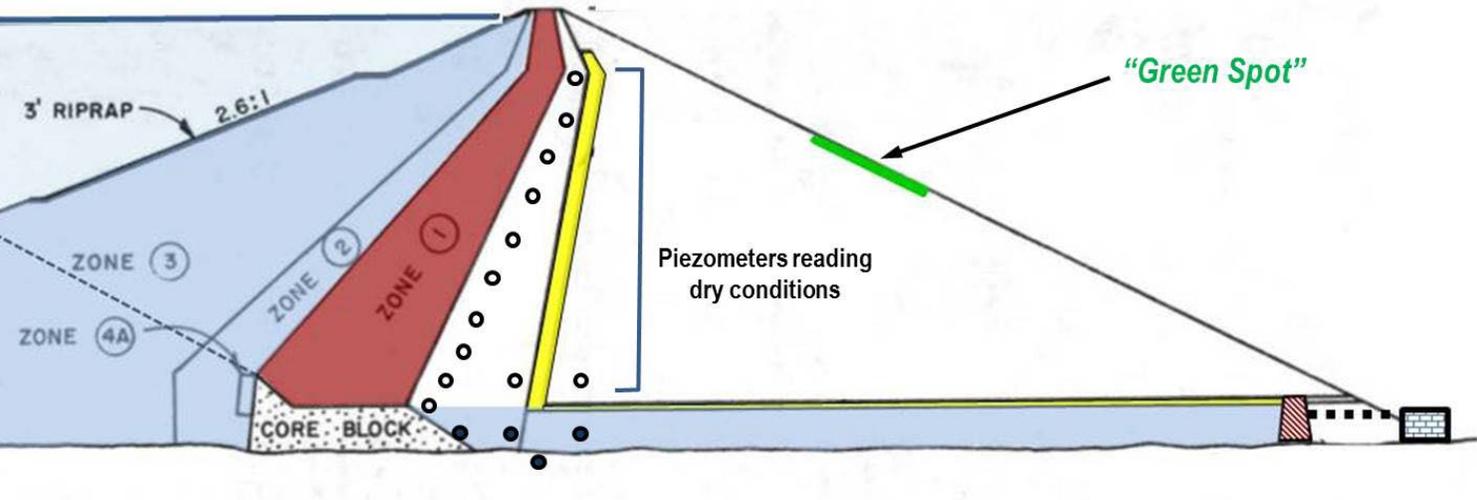
Oroville Dam Grout Gallery and Drains



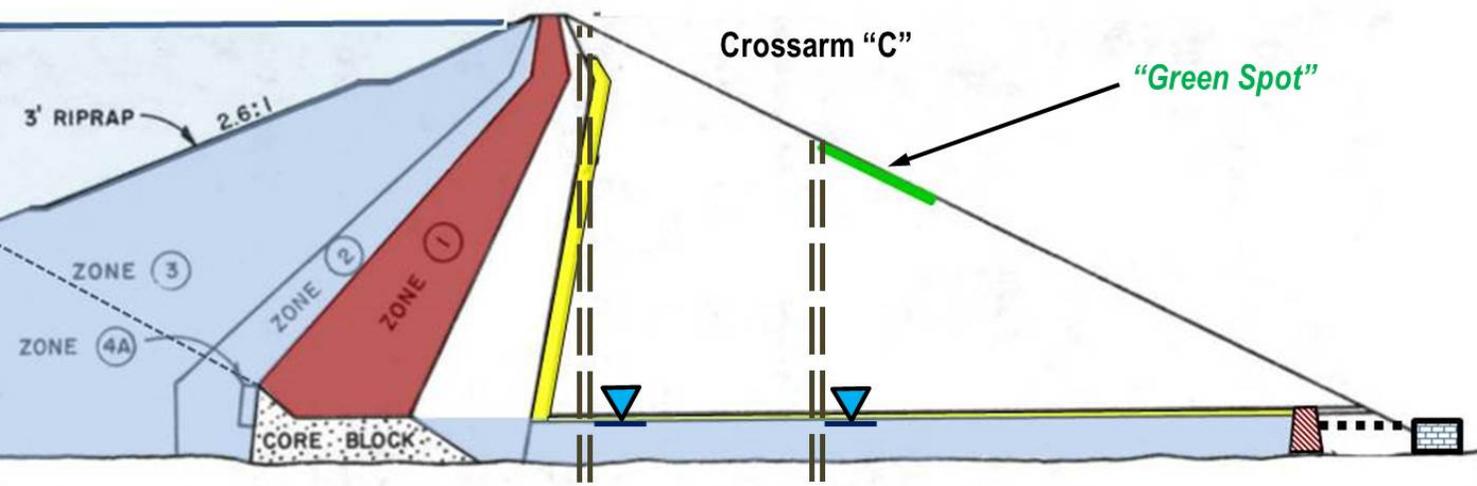
Twin-tube Hydraulic Piezometers Installed in Oroville Dam



- Downstream Piezometer indicating Dry Conditions
- Downstream Piezometer indicating Low Seepage Pool Water Level

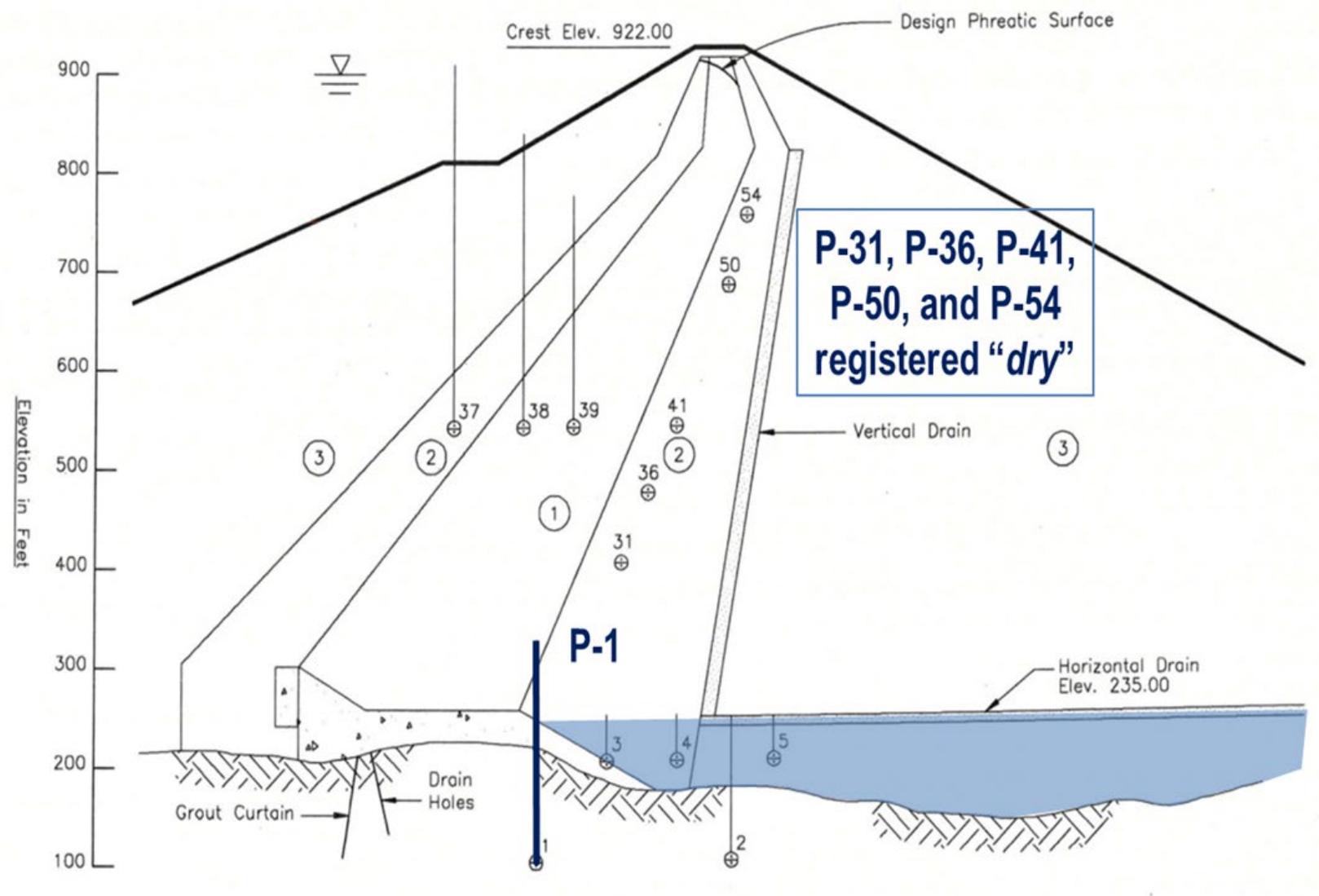


Crossarm "A"



▼ Water Level Measured Inside Cross Arm Settlement Device Casing

Pore Pressures Measured in Downstream Pervious Zones and Foundation



P-31, P-36, P-41,
P-50, and P-54
registered "dry"

SECTION AT STA. 53+05

Zone	Description
1	Core
2	Transition
3	Embankment

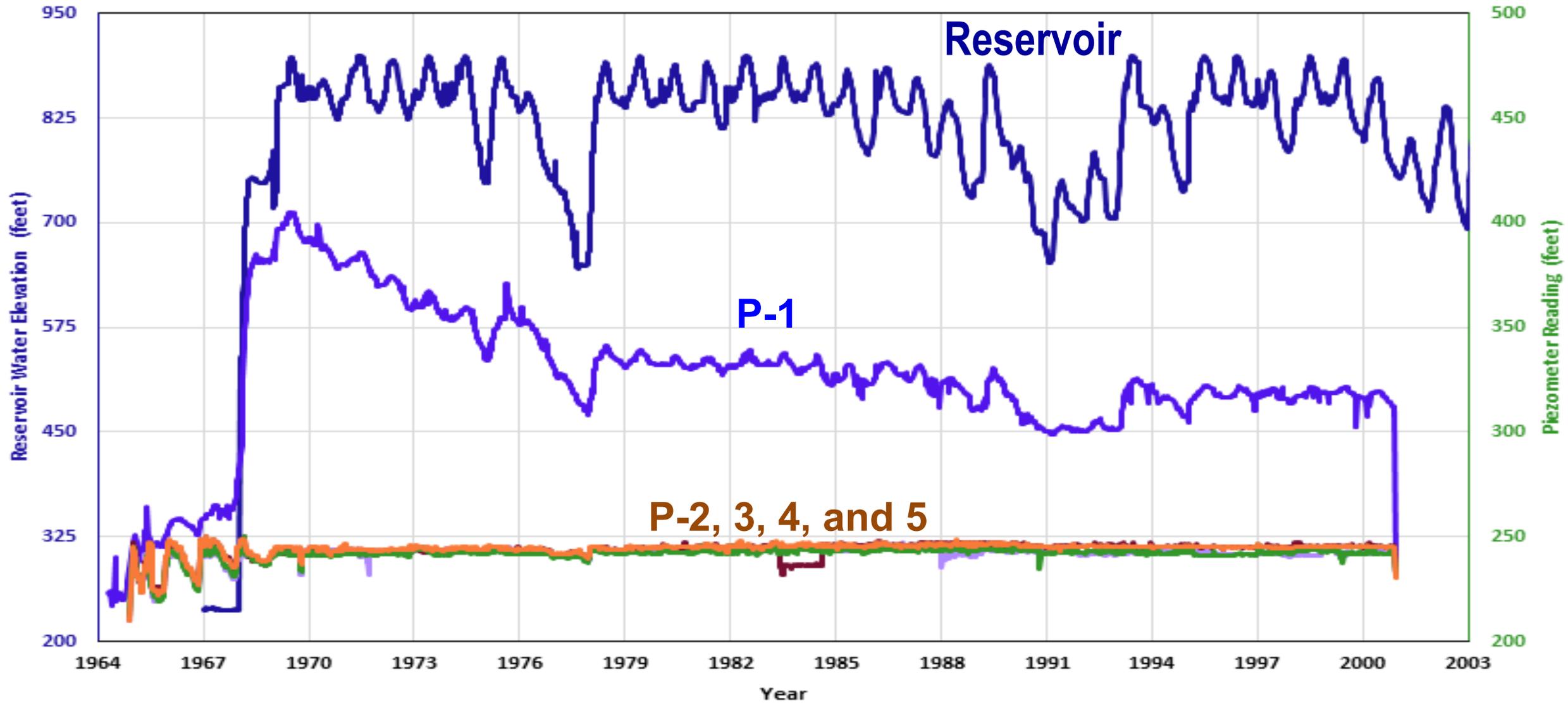
Legend:
⊕ Functional Piezometer - 1998

OROVILLE DAM
MAXIMUM PIEZOMETER PRESSURE READINGS

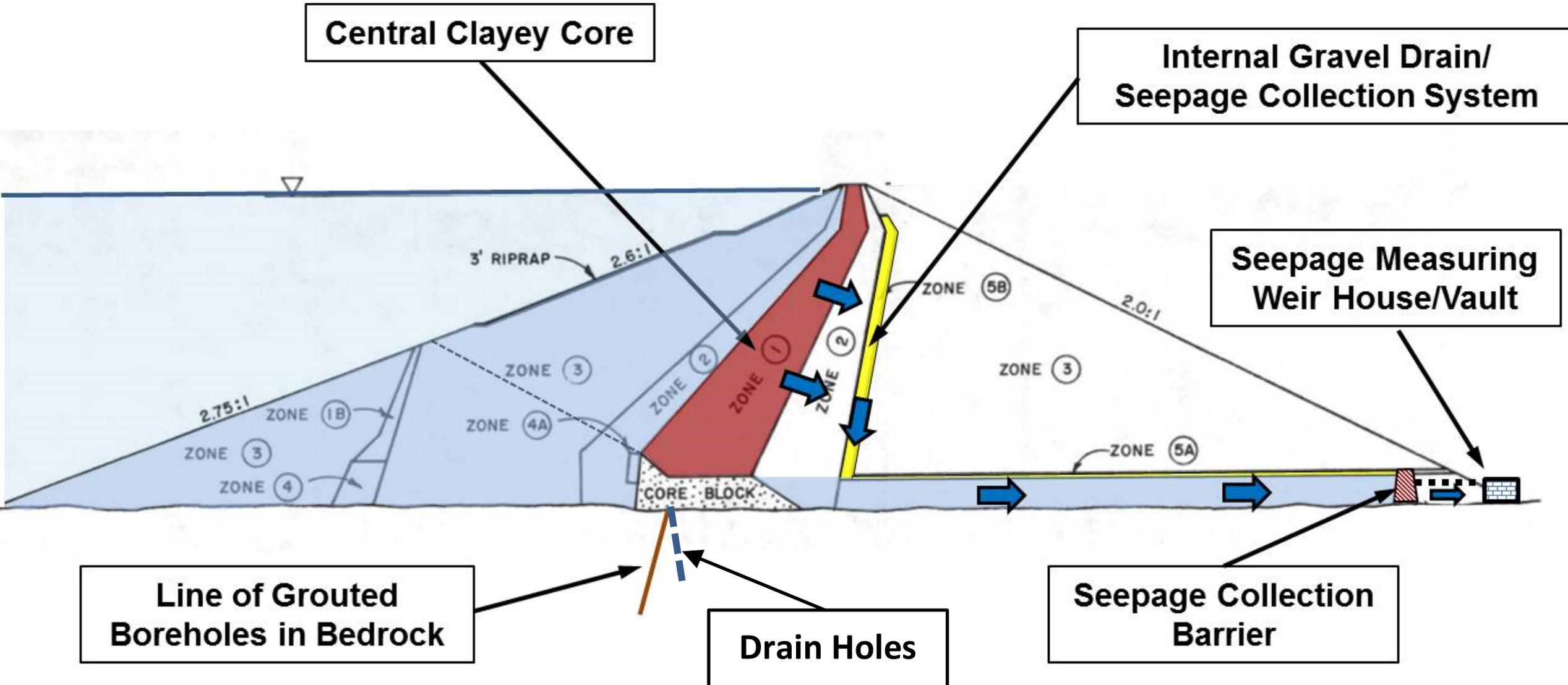
Pore Pressures Measured in Surviving Hydraulic Piezometers up to 2000

from Performance Report No. 10 (2000)

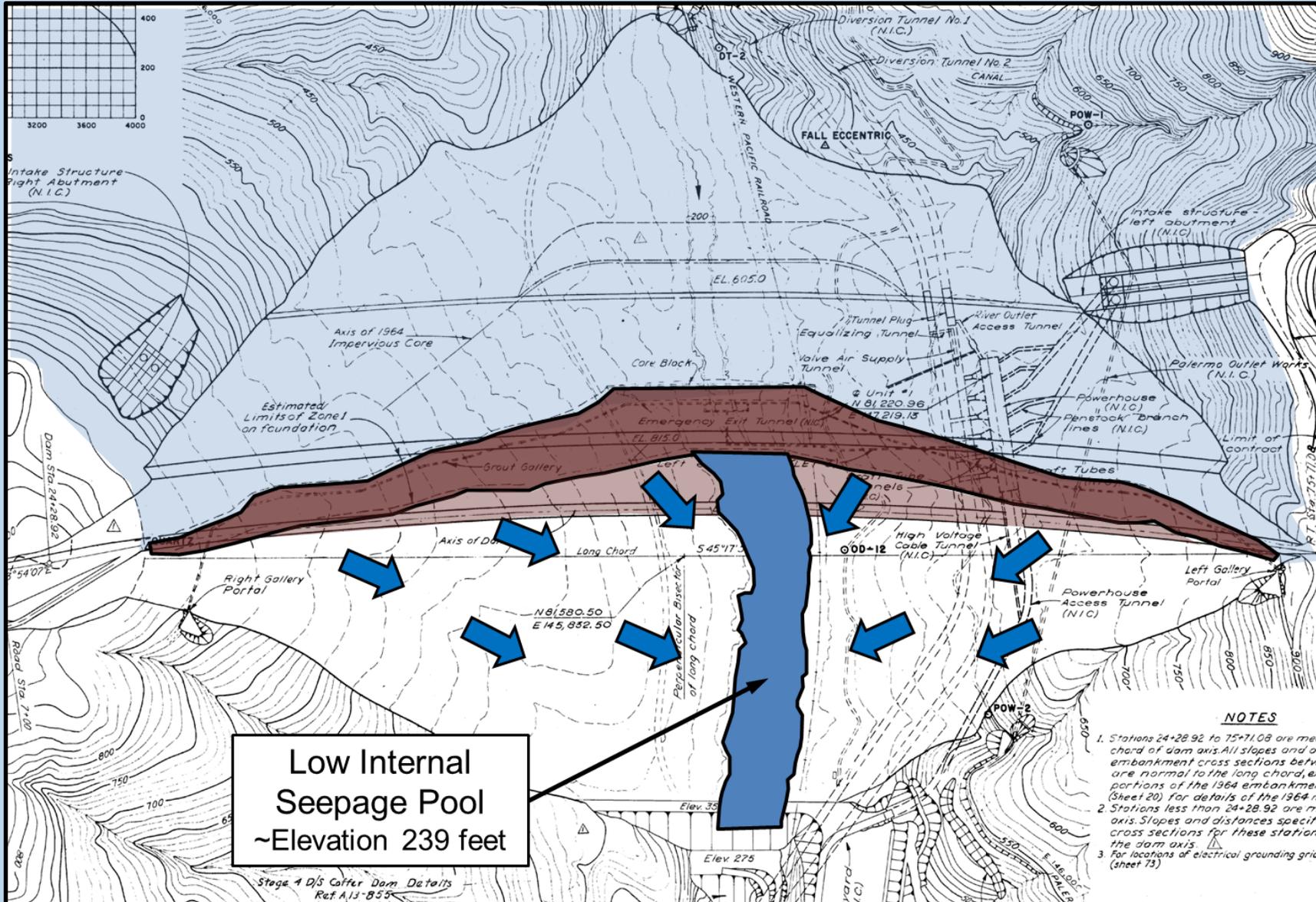
Pore Pressures Measured in Downstream Pervious Zone and Foundation Hydraulic Piezometers (1965 - 2000)



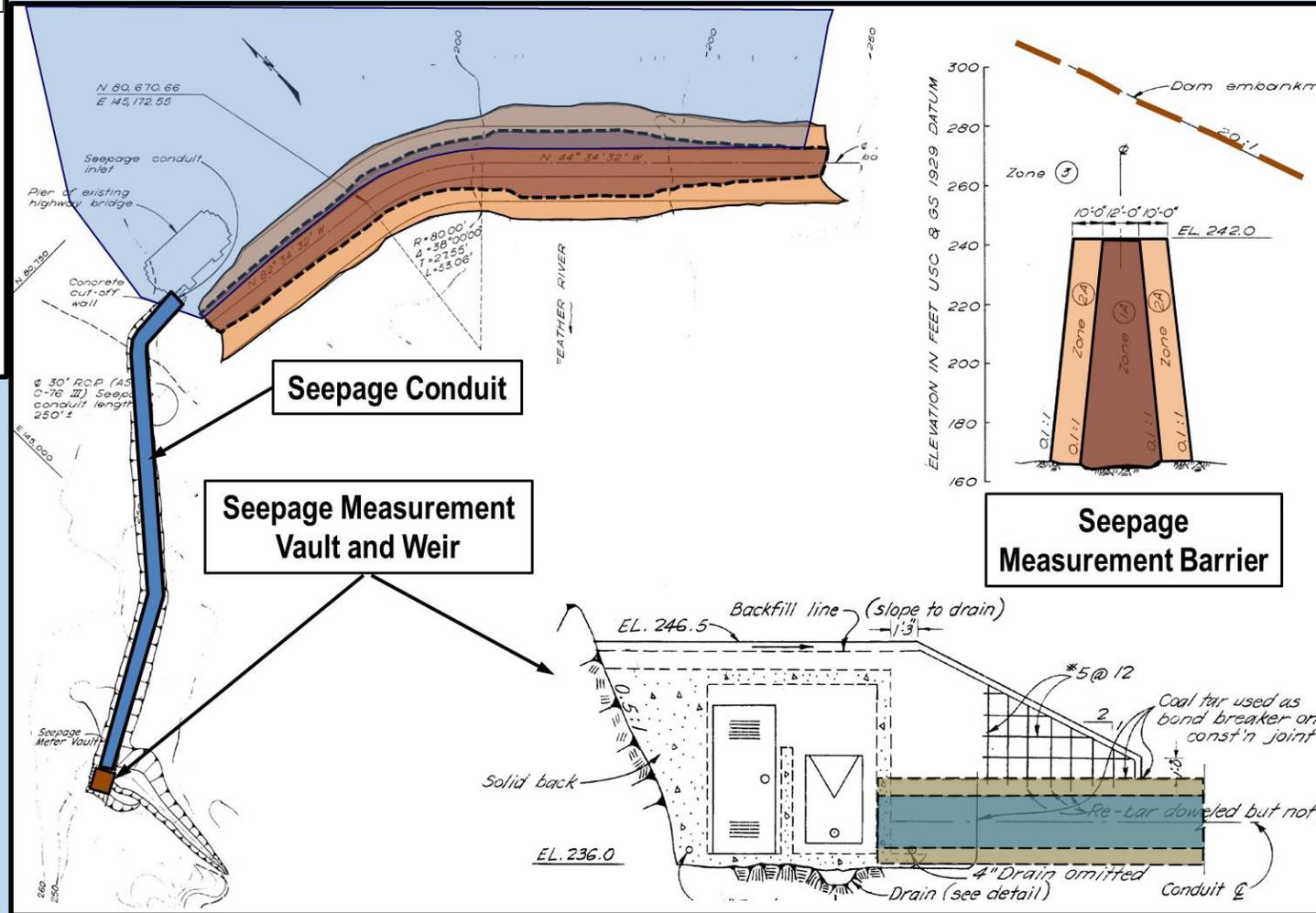
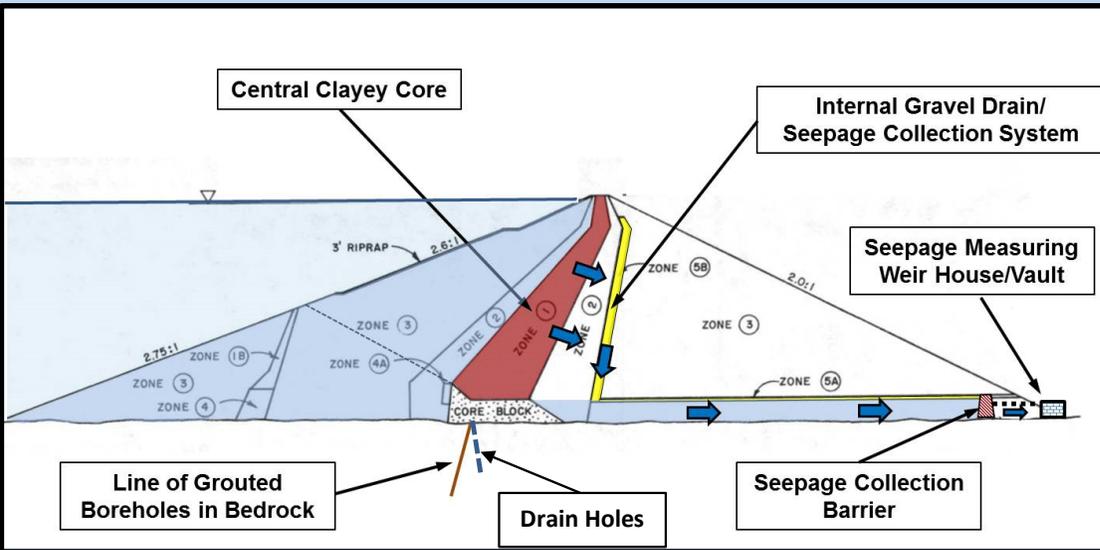
Seepage Control and Monitoring Design



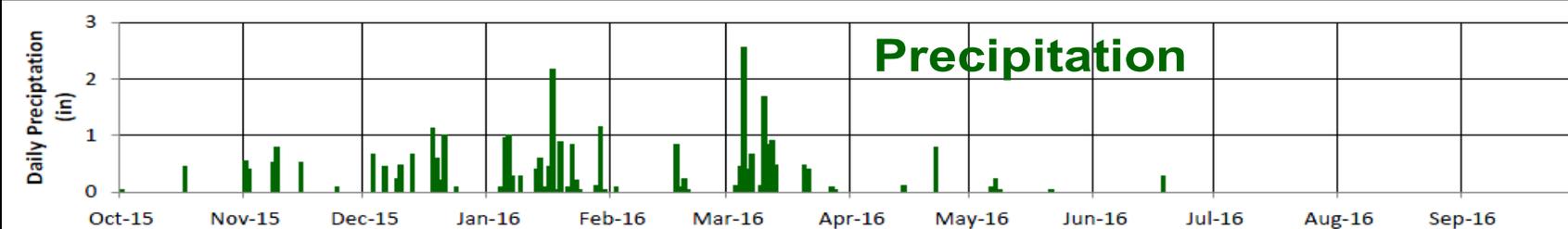
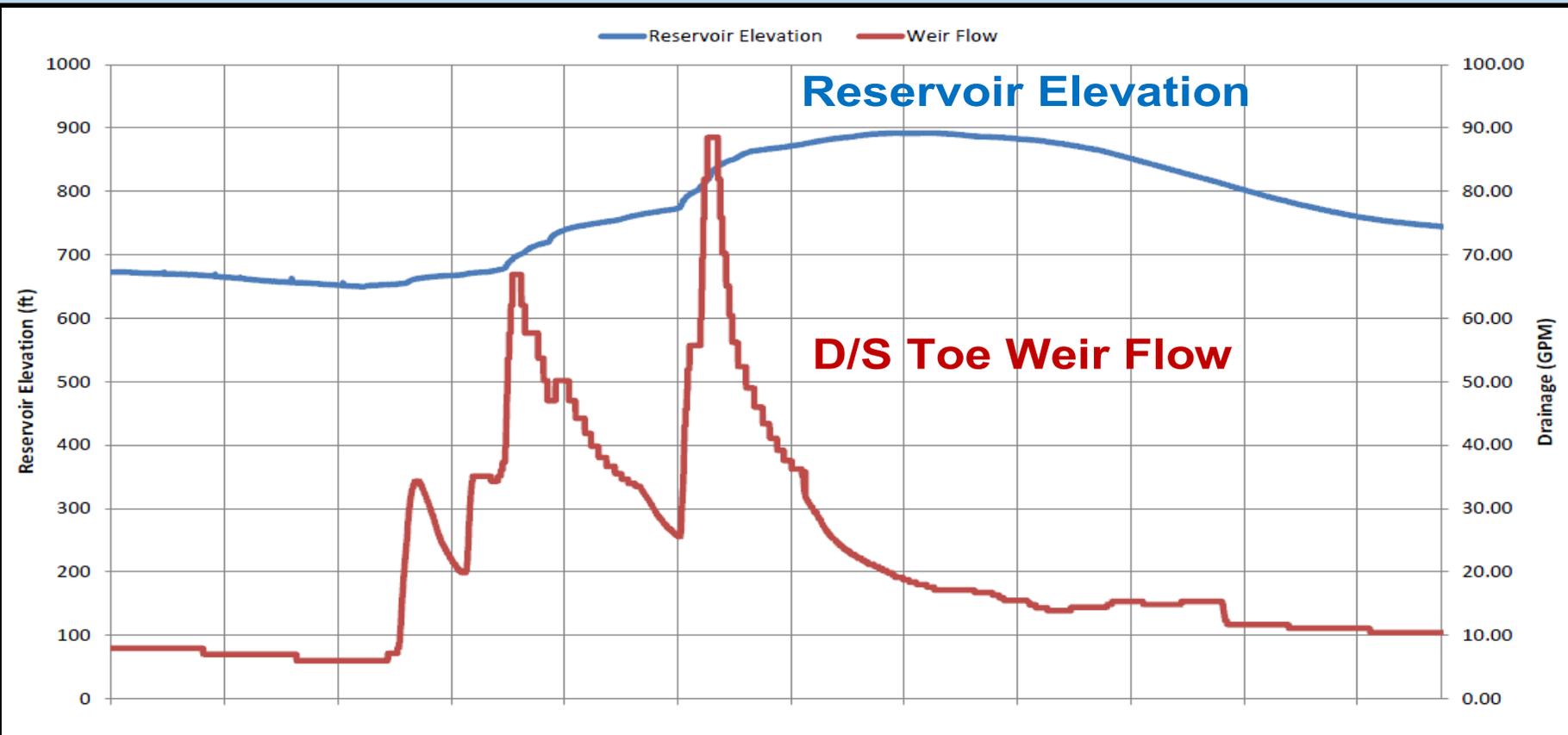
Seepage Control and Monitoring Design



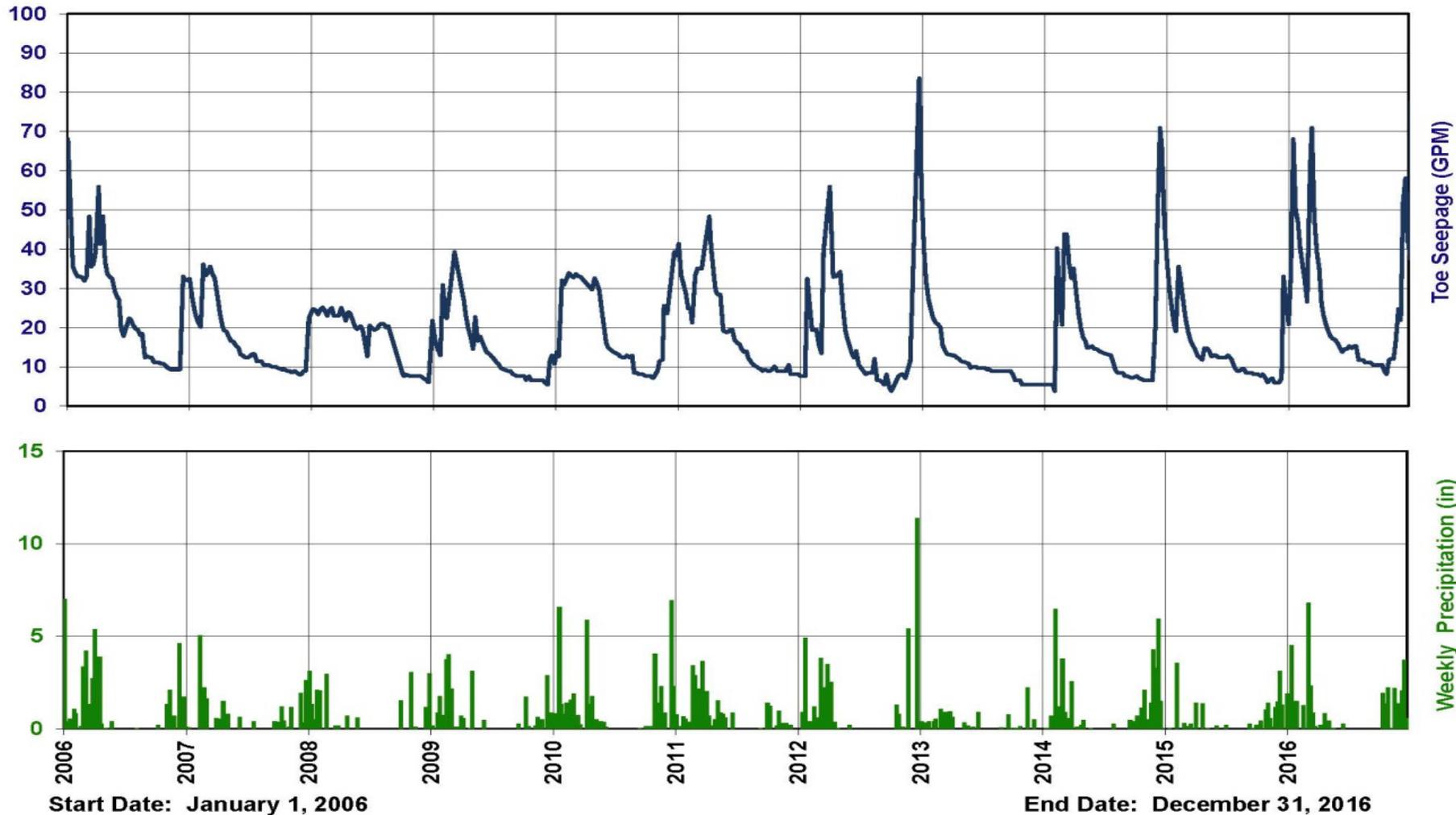
Seepage Collection Barrier, 30-inch Seepage Conduit, and Seepage Vault and Weir System at D/S Toe of Oroville Dam



Seepage Measured at D/S Toe Seepage Weirs (Oct. 2015 – Oct. 2016)



Seepage Measured at Downstream Toe of Oroville Dam

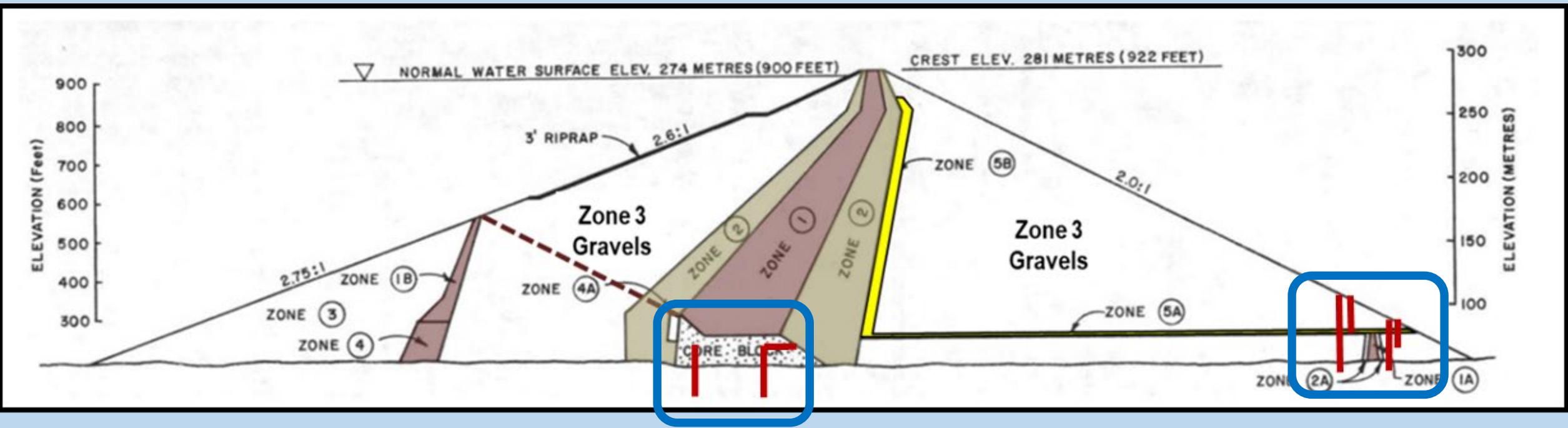


**Seepage During
Dry Seasons
~10 gpm**



Proposed 11 New Piezometers to be Installed in Oroville Dam

- ✓ Phase 1: 6 piezometers at D/S Toe
- ✓ Phase 2: 5 piezometers in Core Block/Grout Galleries



Proposed 11 New Piezometers to be Installed in Oroville Dam

✓ **Phase 1: 6 piezometers at D/S Toe**

Purpose:

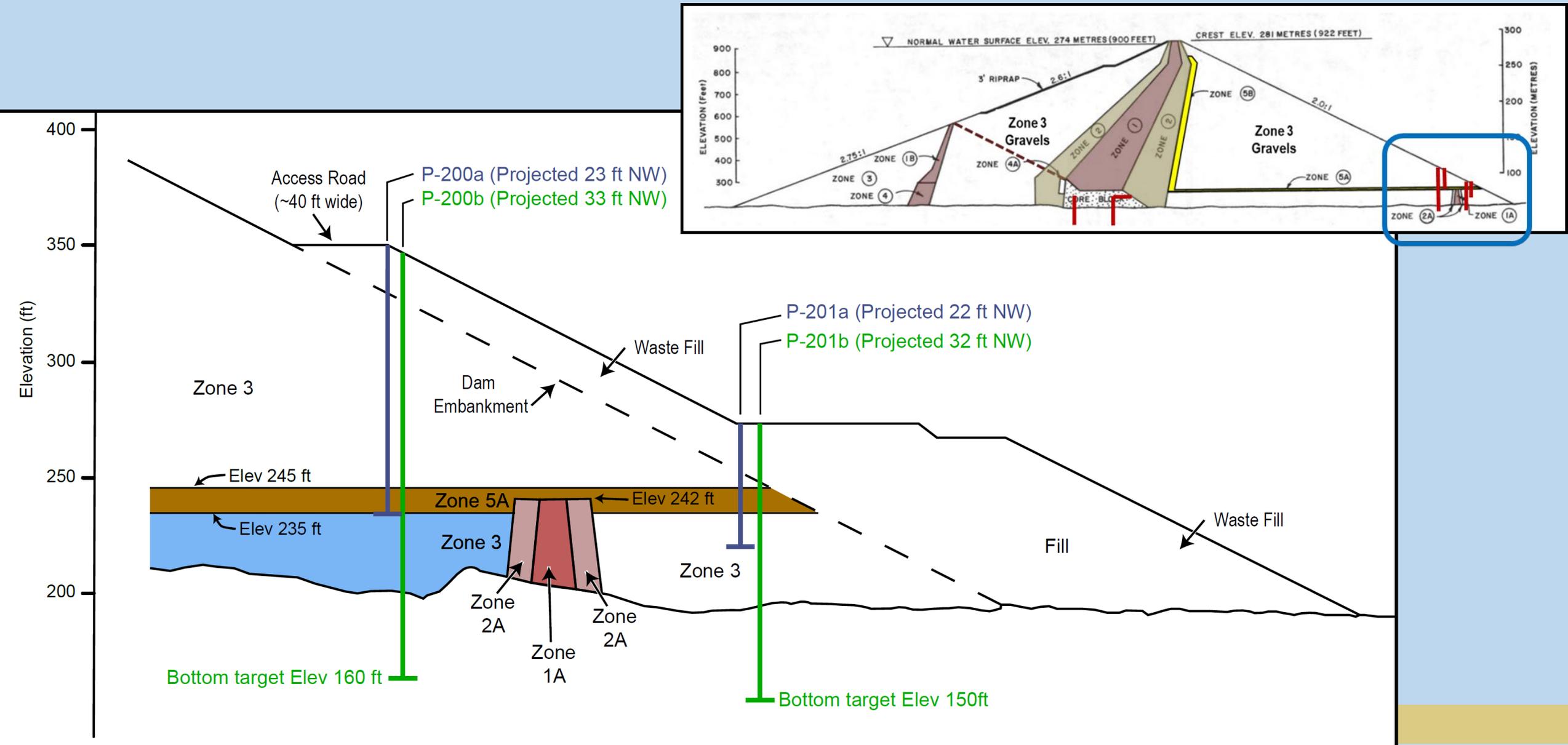
- Improve understanding of 3D seepage in foundation rock near Seepage Collection Barrier
- Determine whether some portions of the seepage are passing over or around the Seepage Collection Barrier without being measured

✓ **Phase 2: 5 piezometers in Core Block/Grout Galleries**

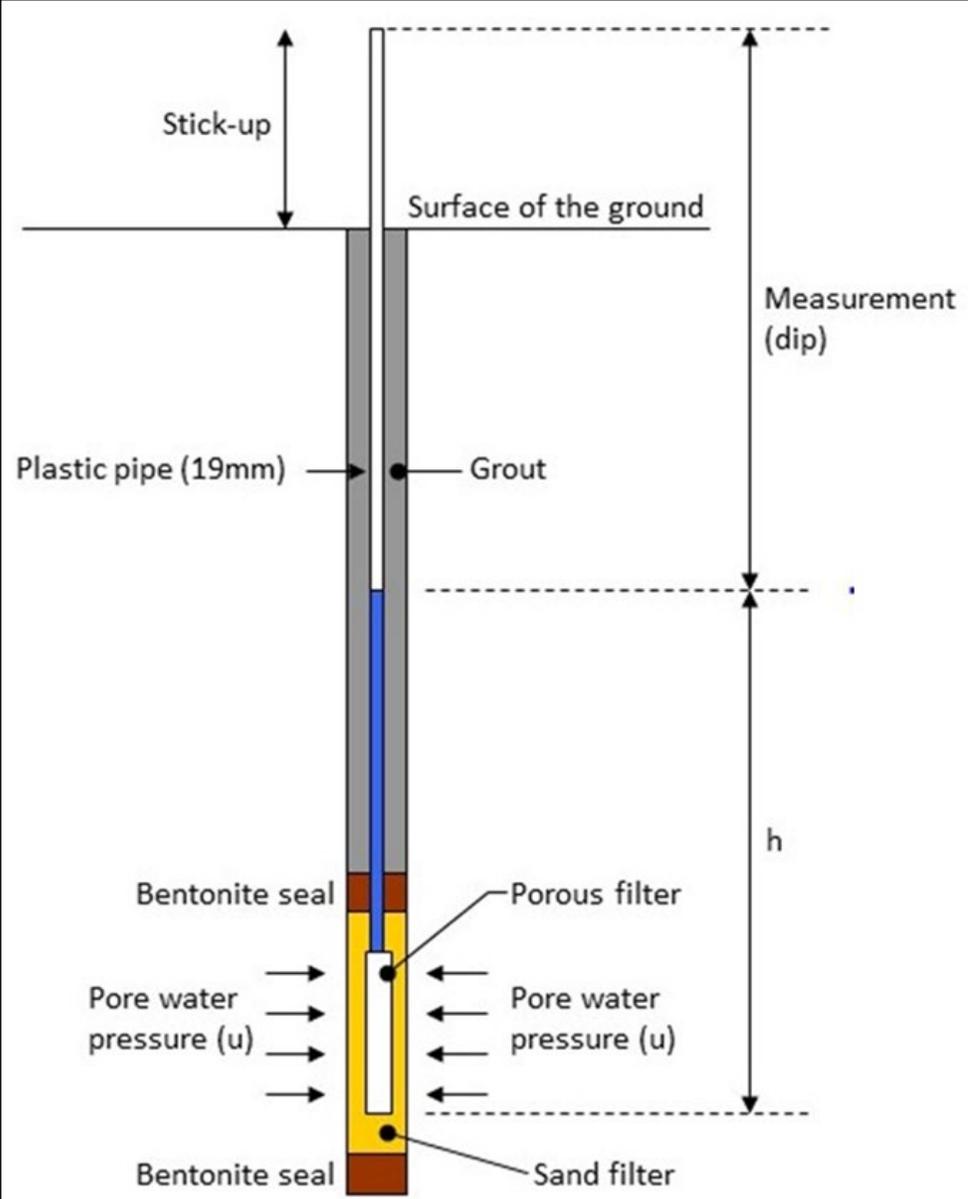
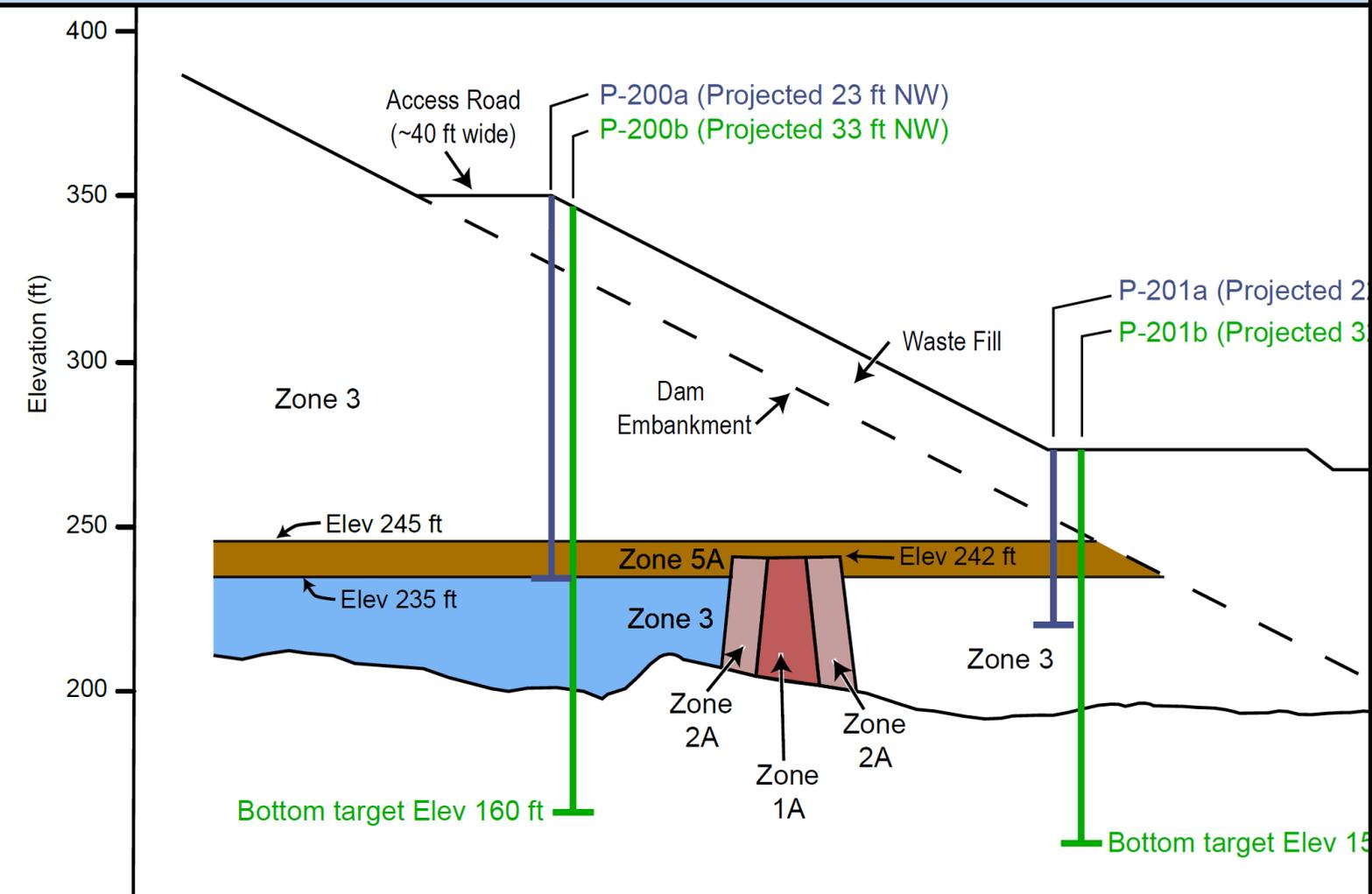
Purpose:

- 1 piezometer to replace previous piezometers measuring the upstream portion of the Seepage Collection Pool
- 4 piezometers in bedrock to confirm indications of reduced seepage through the foundation rock – trends observed in gallery drains

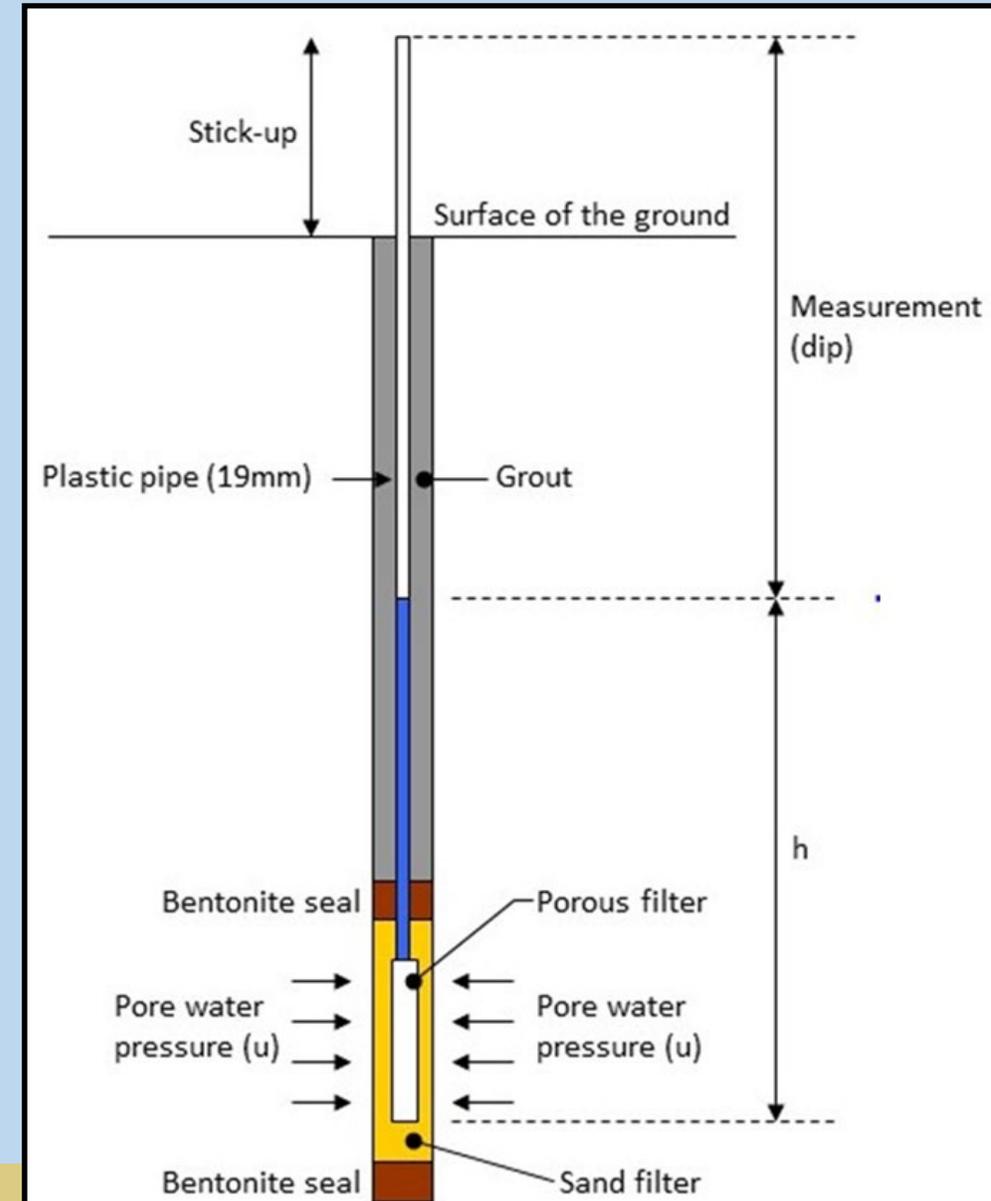
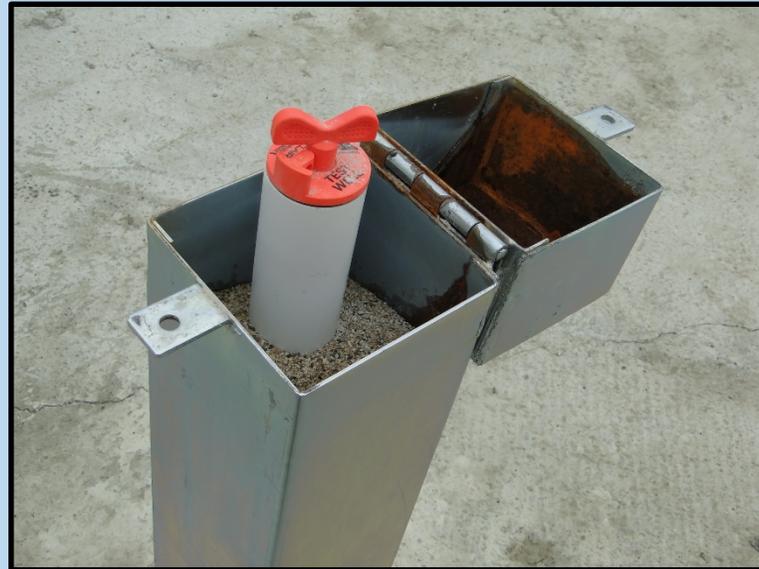
Proposed 6 New Piezometers Installed In Lower River Channel at Downstream Toe



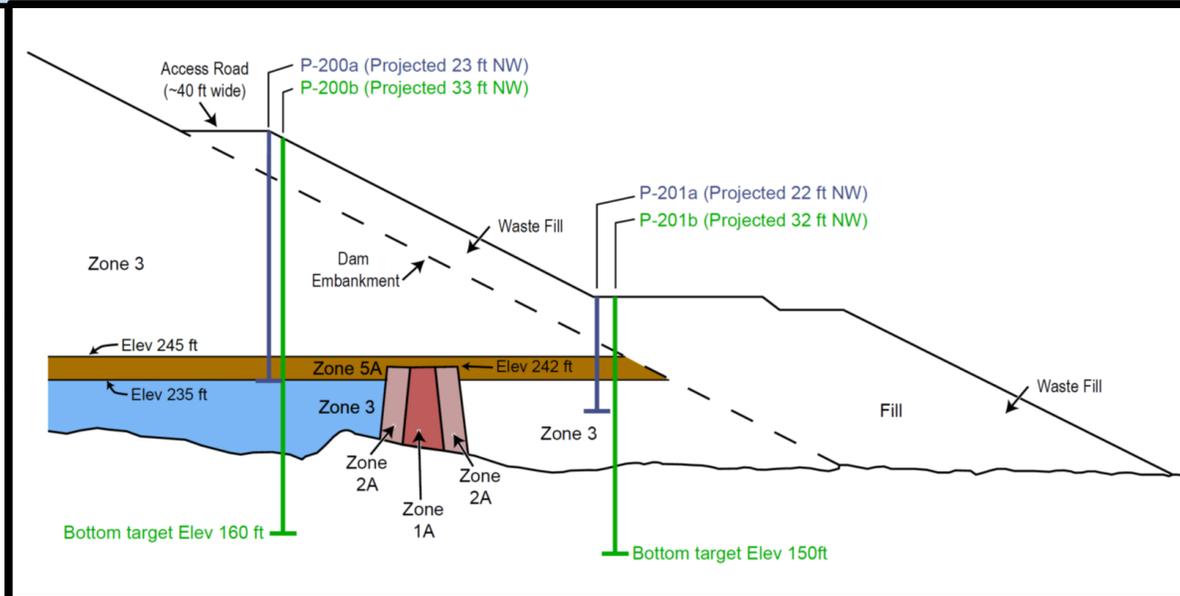
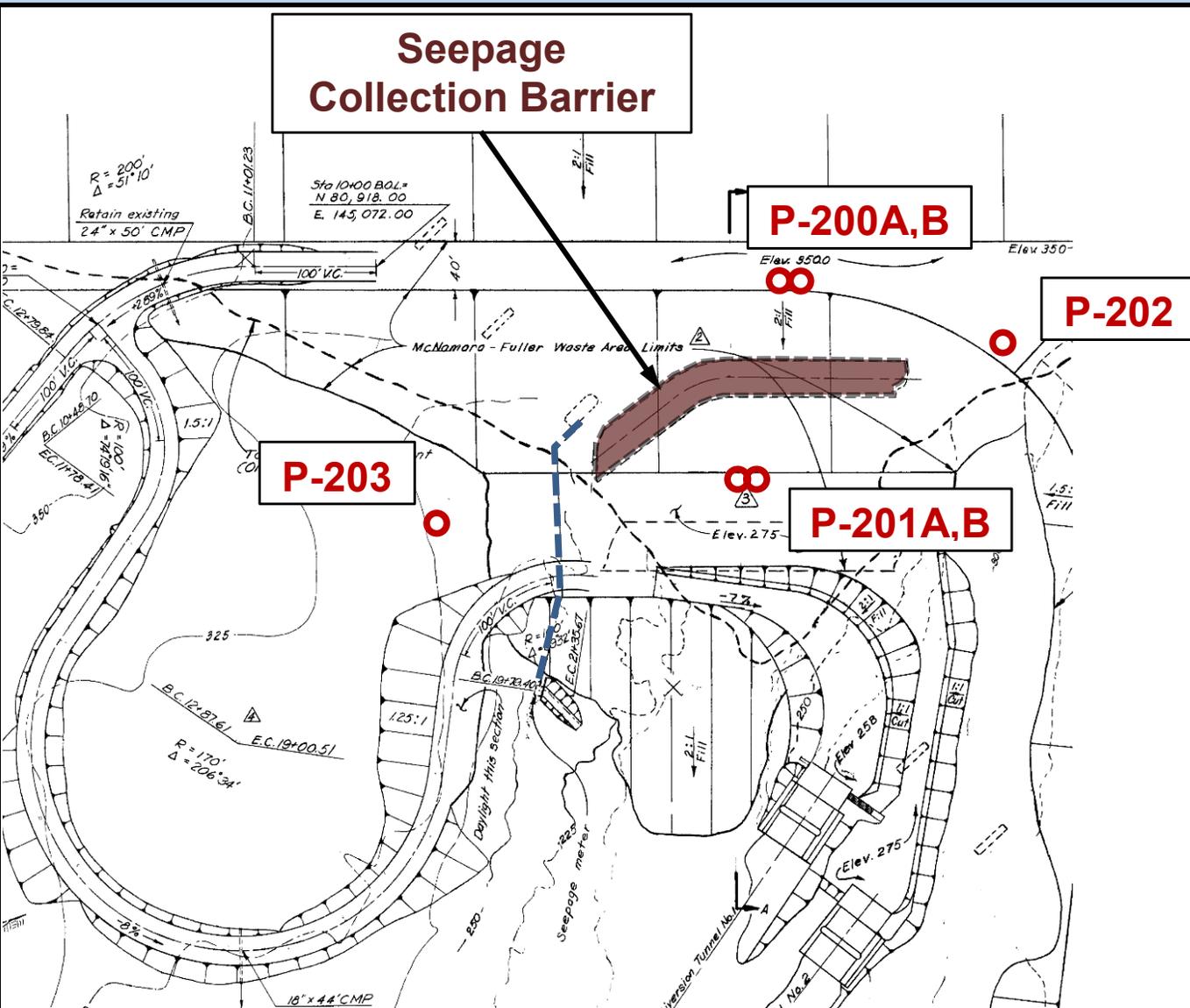
Proposed 6 New Piezometers Installed In Lower River Channel at Downstream Toe



Proposed 6 New Piezometers Installed In Lower River Channel at Downstream Toe



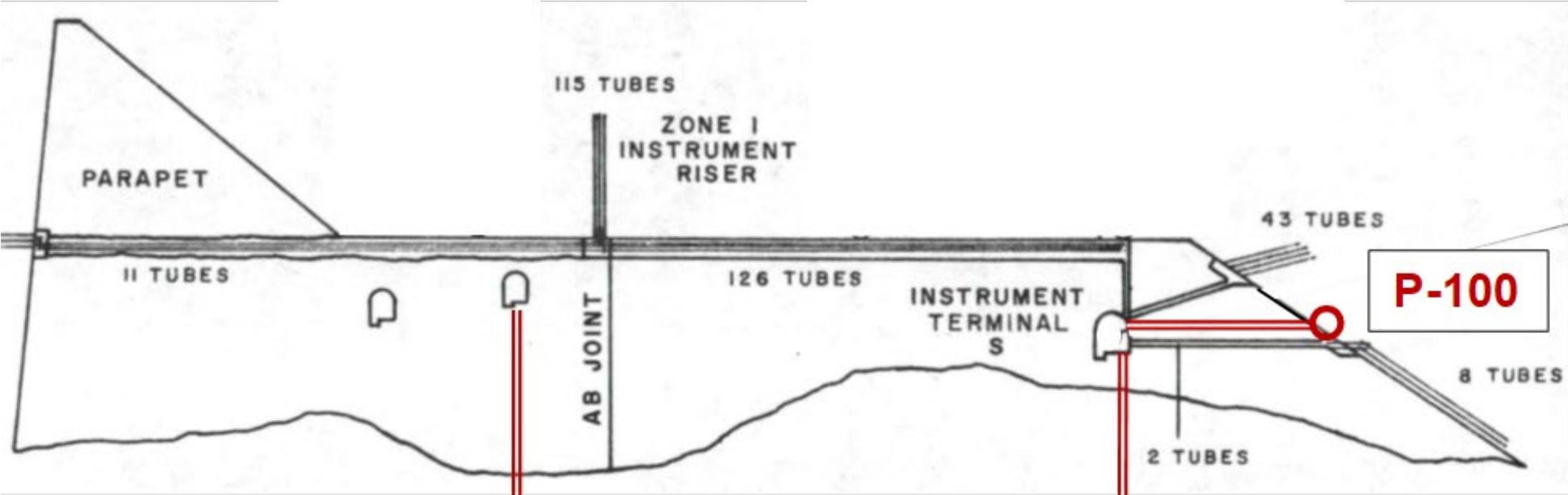
Proposed New Piezometers Installed at Downstream Toe



6 Piezometers Installed from Downstream Toe

- 2 Piezometers installed vertically down into Zone 3 and Zone 5 Pervious Zones – straddling Seepage Barrier
- 4 Piezometers drilled vertically down into foundation rock
 - 2 in center of river channel
 - 2 in lower left and right abutments

Proposed Replacement Piezometers Installed in Core Block



P-102

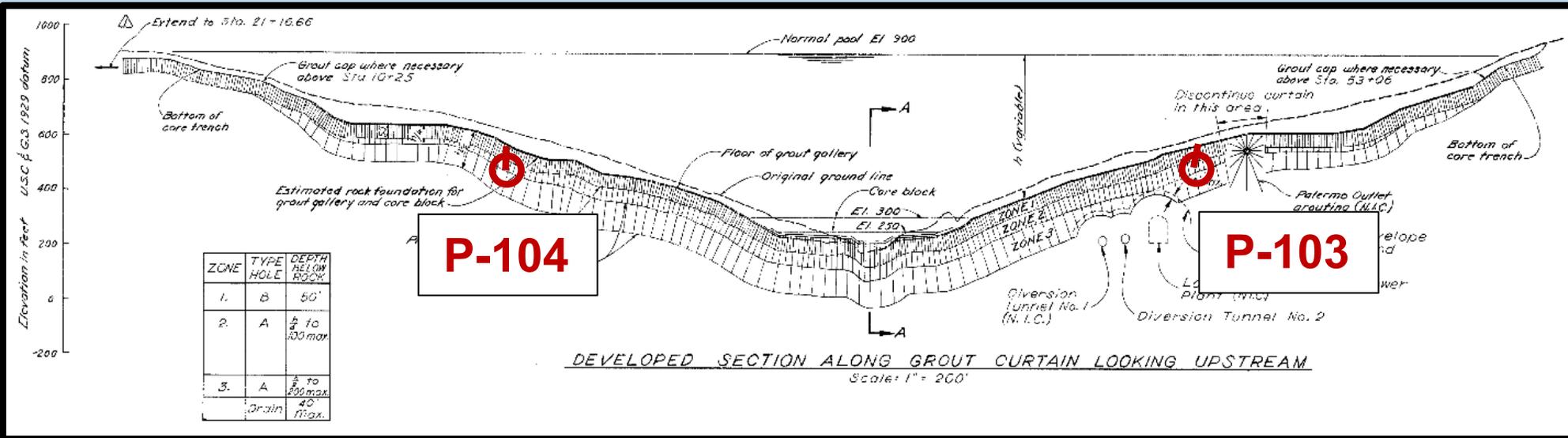


P-101

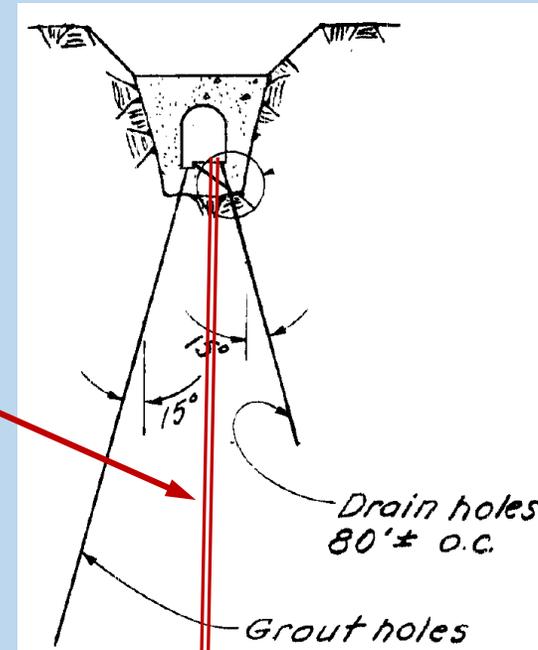


P-100

Proposed Replacement Piezometers Installed In Left and Right Abutment Grout Galleries

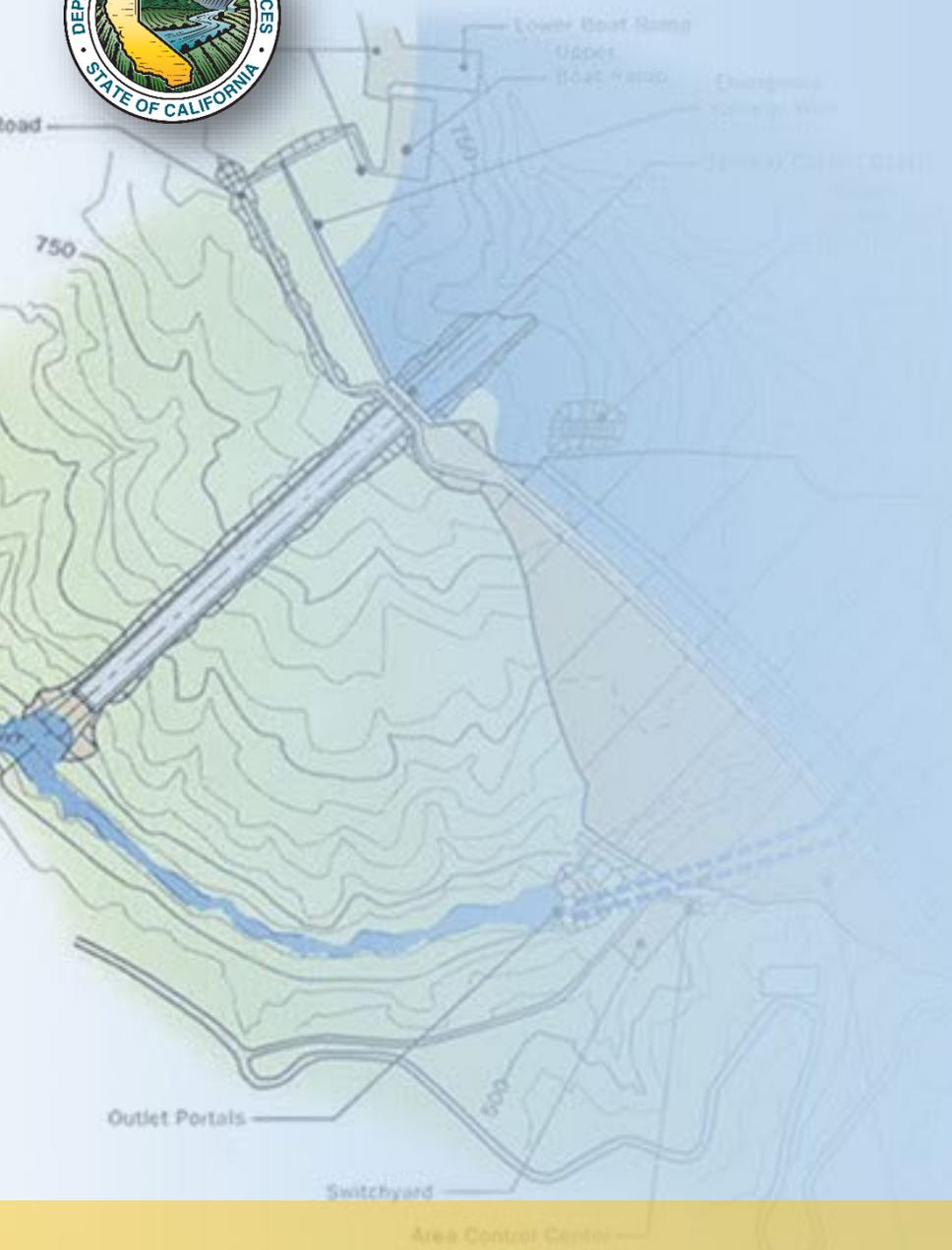


Vertical Boreholes Drilled from Abutment Grout Galleries for Piezometers P-103 and P-104



Replacement Piezometer	Location	Approx. Embankment Dam Station	Alignment	Approximate Gage/Surface Elevation (feet)	Approximate Tip Elevation (feet)	Approx. Depth/ Length (feet)
P-100 D/S Zone 2	Core Block D/S Zone 2	53+15 (33+15)*	Horiz.	232	232	40
P-101 Foundation	Core Block	53+15 (33+15)*	Vertical	227.6	150	77.6
P-102 Foundation	Core Block	53+11 (33+11)*	Vertical	236.7	150	86.7
P-103 Foundation	Left Grout Gallery	~63+00	Vertical	562	482	80
P-104 Foundation	Right Grout Gallery	~39+00	Vertical	562	482	80
P-200A D/S Zone 5A	D/S Toe U/S of Barrier	~53+00	Vertical	350	236 - 244	114
P-200B Foundation	D/S Toe U/S of Barrier	~53+00	Vertical	350	15-20 feet below TOR**	180
P-201A D/S Zone 3	D/S Toe D/S of Barrier	~52+50	Vertical	275	220 - 225	55
P-201B Foundation	D/S Toe D/S of Barrier	~52+50	Vertical	275	15-20 feet below TOR**	110
P-200 Left Abutment	D/S Toe	~54+00	Vertical	350	220 - 225	130
P-203 Right Abutment	D/S Toe	~51+00	Vertical	335	220 - 225	115

Summary of Locations and Depths for Planned Replacement Piezometers



Questions?