Structural and Geotechnical Issues Impacting The Dalles Spillwall Construction and Bay 1 Erosion Repair

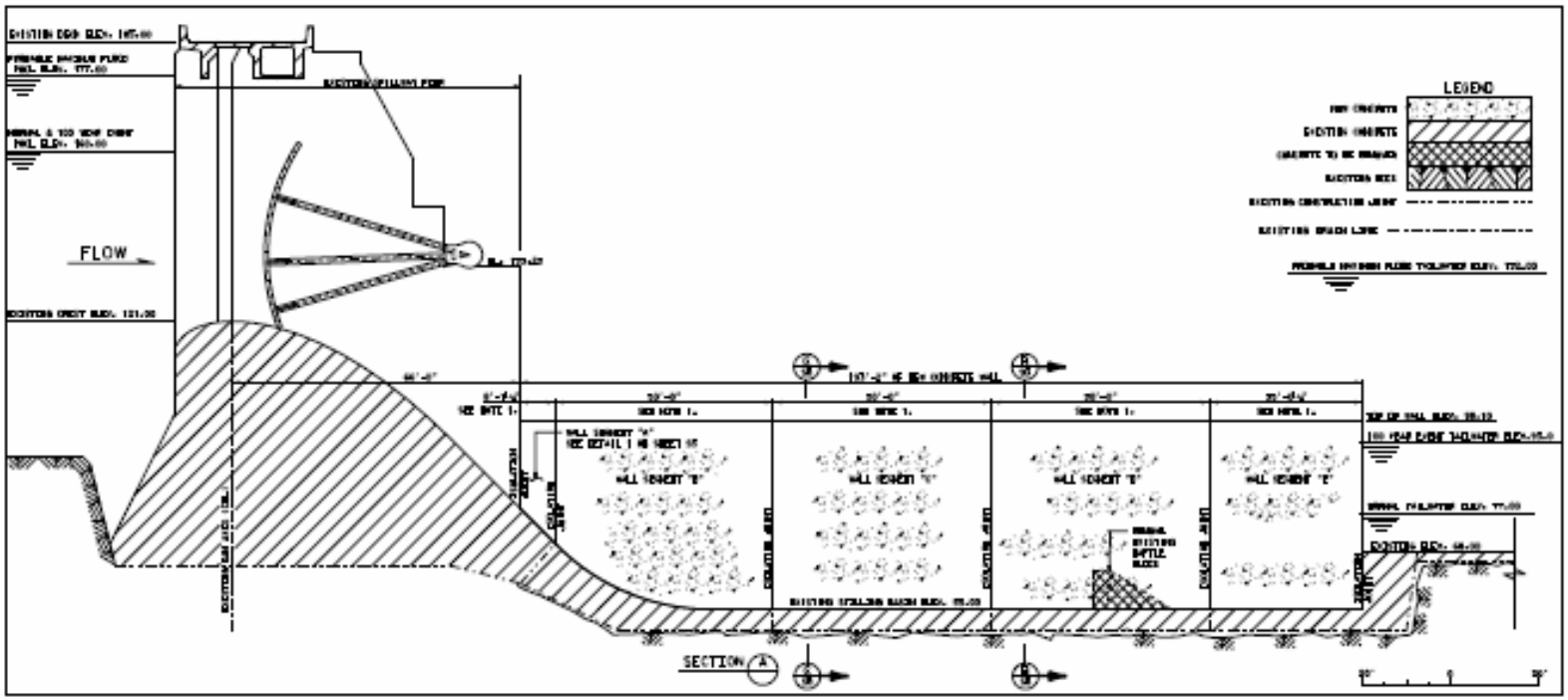
Jeffrey M. Ament, PE
U.S. Army Corps of Engineers,
Portland District
(503) 808-4950
Jeffrey.M.Ament@usace.army.mil

Reason for the Spillwall

- Juvenile Fish Passage through spillway
- Predator habitat to the South
- Spill only in northern bays
- Lateral flow and retention time not acceptable
- Need to separate spilling bays from non-spilling bays with a training wall

Spillwall Requirements

- Wall width: must match existing 10’ Pier width
- Wall height: 43’
- Wall length: 193’

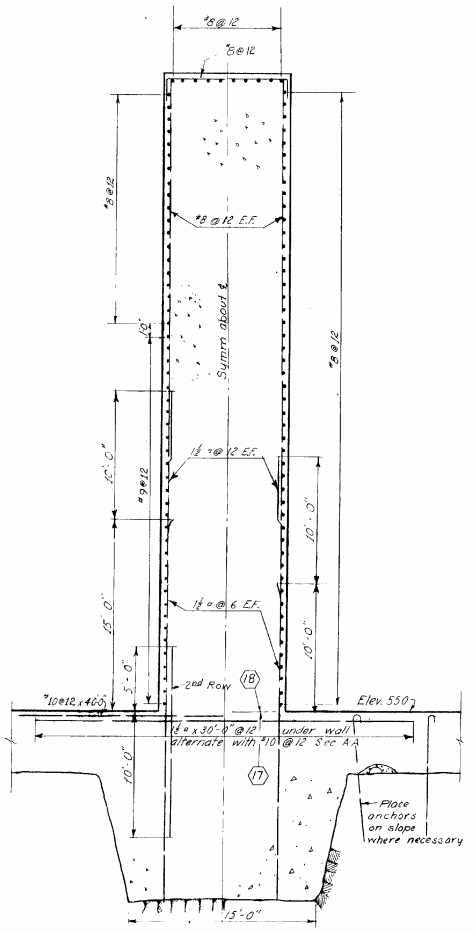


Structural Design

- Load
  - Design load occurred at a River flow of 1050 kcfs and assumed spill on only one side
    - Overturn Moment – 1083.6 ft-kips/ft of wall
    - Shear – 62.1 kips/ft of wall

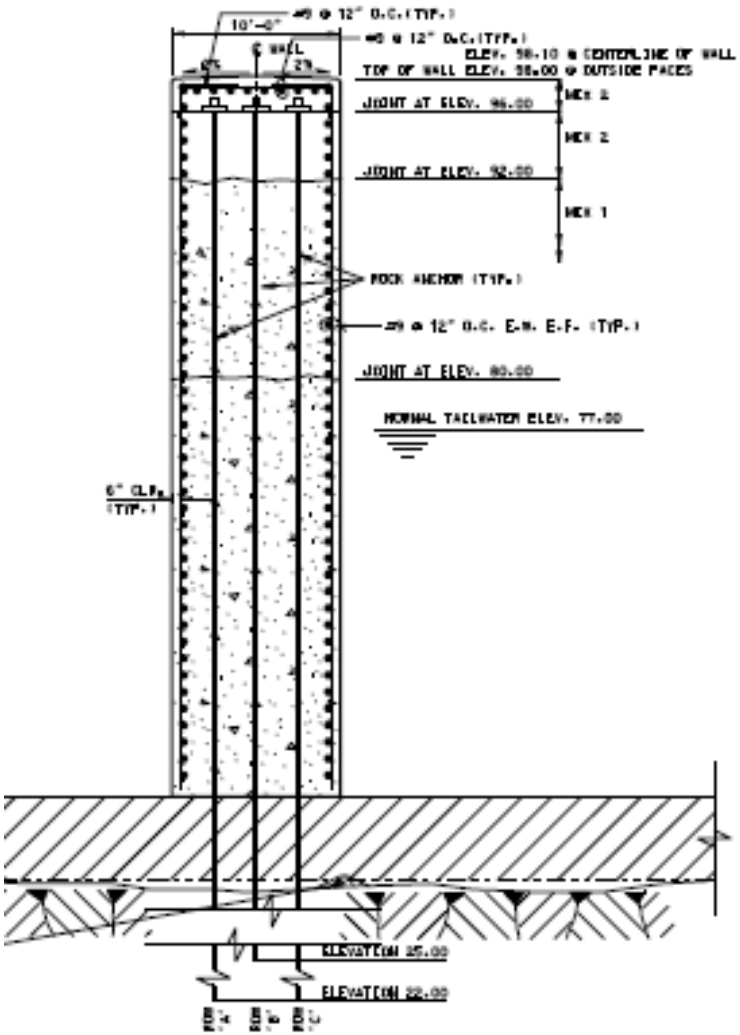
Typical Existing Wall

- Foundation below stilling basin slab
- Design would be very difficult to add to the existing structure



Construction Method

- Construct Wall first
  - Tremie placed concrete
- Construct Foundation last
  - Post-tension wall to rock using rock bolts
- Requires 3 rock bolts evenly spaced across the width (2.5’ o.c.) every 3’ o.c. the entire length
- Each rock bolt post-tensioned to 545 kips



Construction

- In-Water Work Period
  - Minimal Fish in the River System
  - November 1, 2003 – February 28, 2004

Underwater (Tremie) Placed Concrete

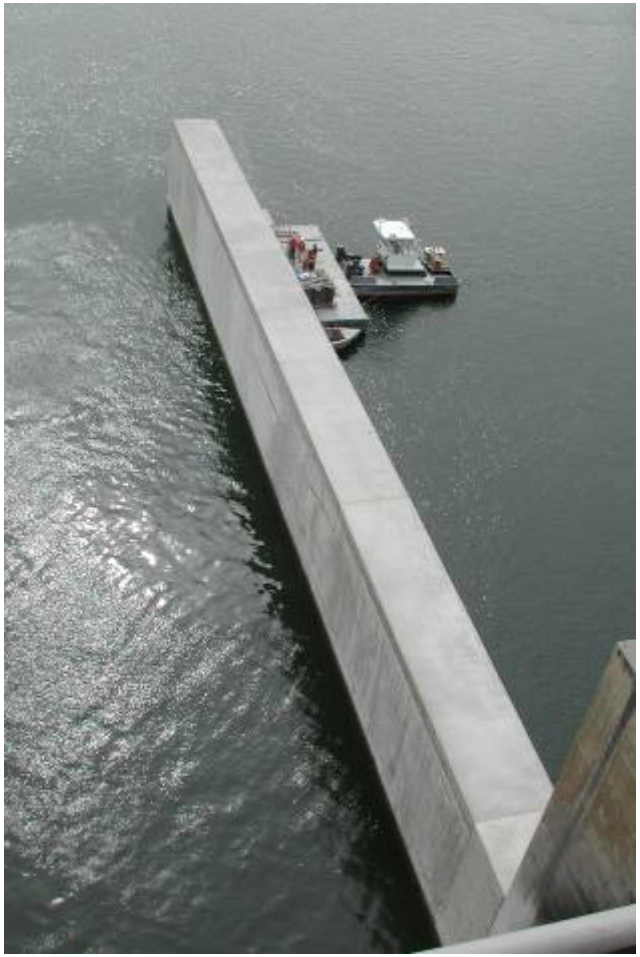
Rock Bolt Ducts

- Spiral wound steel ducts, used in prestressed concrete industry, specified as option for contractor
- Difficult to hold alignment during concrete placements
- Lesson learned: not a good choice for drilling through

Concrete Formwork

Cap Placement

Completed Spillwall



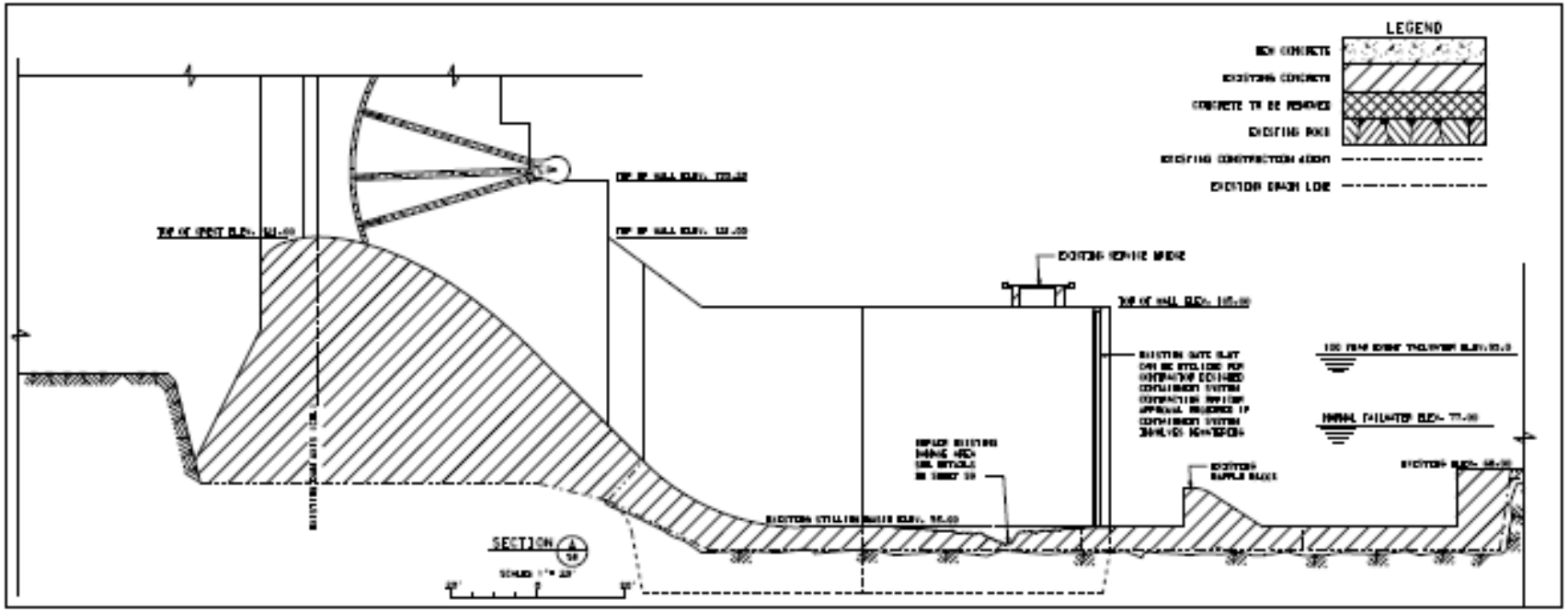
Spillwall in Action

New Spill Pattern

Bay 1 Erosion Hole Repair

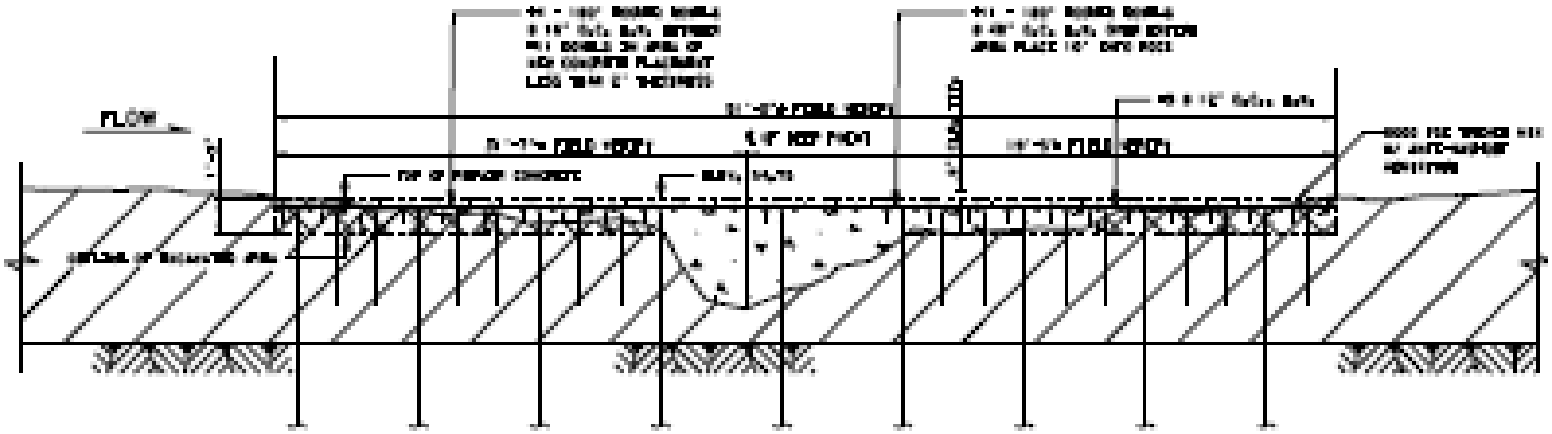
Bay 1 Stilling Basin Erosion Hole Repair

- 4’ Deep Hole in 5’ Stilling Basin Slab



Repair Design

- Excavate out concrete to 15” minimum depth
- Replace #11 dowels into rock
- Add #4 dowels into existing concrete
- Place #9 mat each way to help in load transfer



Contractor Chose to Dewater

- Very difficult to dewater
- Water coming in from:
  - Wall joints
  - Floor joints, Floor slab drains pressurized with tailwater
  - Contractor Temporary Bulkhead

Causes of Erosion

- Not likely ball milling from large objects
- Possible erosion from
  - Small particles
  - Hydraulic conditions around wall
  - Poor initial concrete placement

Dowels into Rock

- Holes drilled into rock giving water
- Grout socks used to enable placement of dowels – providing mechanical anchorage
- Dowels still gave water
- Average dowel tested – withstood ~10 kips before hook bent and test suspended, dowels declared acceptable

Dowels into Concrete

- Some holes penetrated slab and geysered
- Switched from cementious grout to epoxy grout to shorten embedment length
- Geysering holes capped with PVC pipe to divert water out of concrete placement area

Concrete Placement Plan

- Due to dewatering problems
  - Flood bay to within 1’-3’ of tailwater (to keep bulkhead from blowing off)
  - Build a 4”-high form around placement area to account for poor surface concrete
  - Tremie place concrete using antiwash-out admix using direct pump method directed by diver
  - Cure for 1 week underwater, then dewater and remove excess 4” over-placement

Bay 1 Dewatered after Concrete Placement

- Diver had difficulties seeing
- Possible Incompatibility between High Range Water Reducer Admix and Antiwash-out Admix reduced the slump
- 4’ high mound formed that now had to be removed
- Some leaks existed
- Some low spots existed

Excess Concrete Removal

- Contractor attempted using:
  - Jackhammers
  - Concrete Saws
  - Backhoe
- USACE authorized use of a Bobcat Planer

Additional Repairs Made

- Pressure inject grout into leaks – assumed to be from water around dowels washing out concrete during placement
- Patch low spots
- Taper all edges to minimize any negative hydraulic effects

Final Repair Completed

- Final Repair was to stilling basin elevation +/- 3”
- Spill occurred from April 14, 2004 to August 31, 2004
  - Diver inspected in November 2004 – no signs of erosion
- Spill occurred from April 10, 2005 to present
  - Diver inspected June 21, 2005 – no signs of erosion