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

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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