

Chemical Grouting of Leaking Joints in the Weber Coulee Siphon



Westin Joy, P.E.
Bureau of Reclamation



2017 Fall Convention | November 15-17 | New Orleans, LA

Outline

- Project Description
- Construction
- Repairs during construction
- Water Leakage & Site Visit
- Logistical Challenges
- Chemical Grout Repairs



2017 Fall Convention | November 15-17 | New Orleans, LA

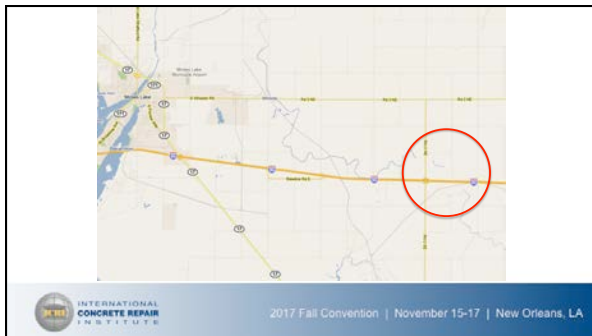
Columbia Basin Project

- Over 2,600 Miles of canals, laterals, and pipelines
- 2,500 miles of drains
- Irrigates 671,000 acres of land
- Produces \$1.4 Billion in produce annually



2017 Fall Convention | November 15-17 | New Orleans, LA

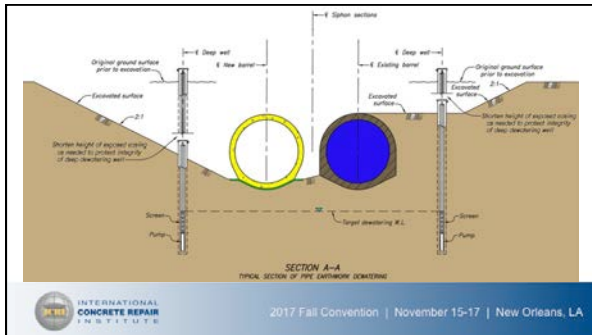




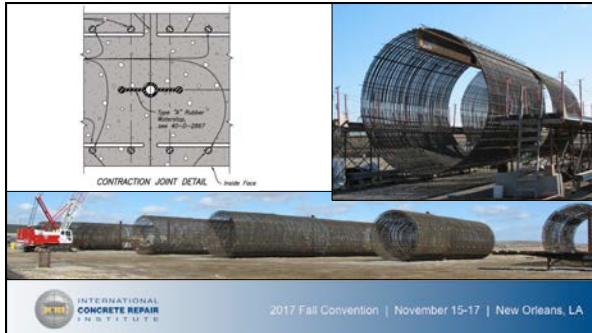


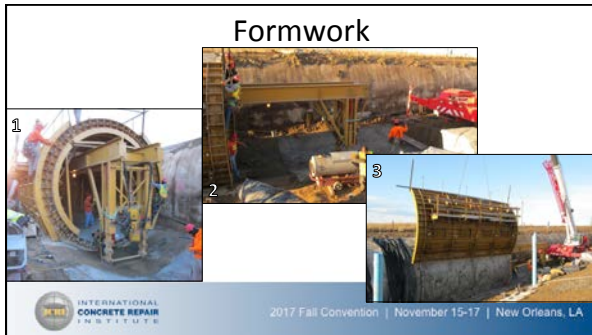


















Minor Repairs



Major Repairs





Major Repairs - CFRP



Joint Testing

- Leaks > 2 gallons in 10 minutes = FAIL
- 50% of joints failed water test and required repair





2017 Fall Convention | November 15-17 | New Orleans, LA

Joint Repairs During Construction

Acrylic latex concrete bonding agent mixed at 1:3 ratio with water

Hydrophilic polyurethane mixed at 1:1 to 2:1 ratio with water and injected into the joint

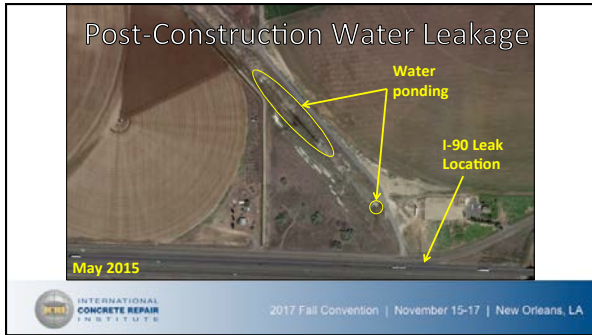


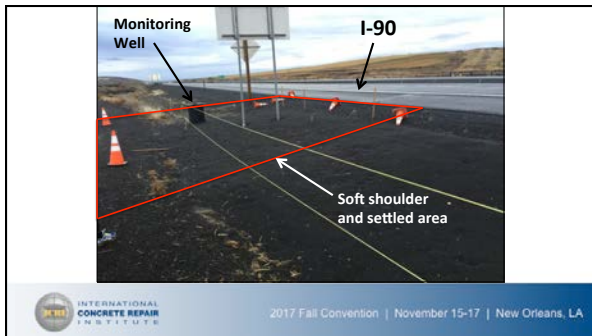
2017 Fall Convention | November 15-17 | New Orleans, LA

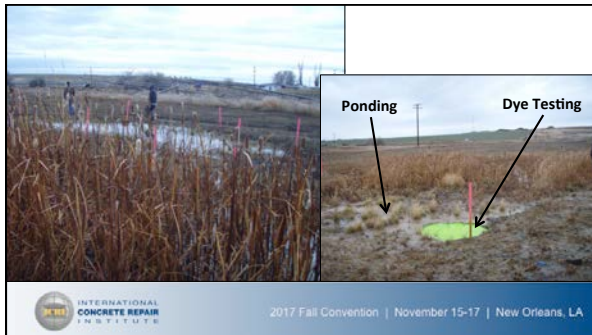
WEKO-Seals Installed



2017 Fall Convention | November 15-17 | New Orleans, LA



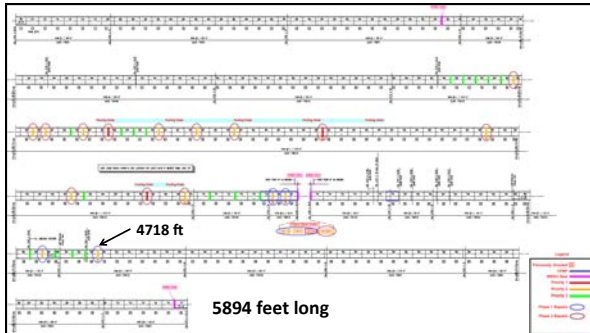












Logistical Challenges

- Access to siphon entrance
- Siphon length & repair locations
 - Siphon 5894 ft long
 - Furthest repair **4718 ft**
- Considered confined space
 - Good air flow but long distances
 - Personnel transport
- Electrical power
- Joint tester wouldn't fit past WEKO-Seal (tight tolerances)
- Weather




INTERNATIONAL CONCRETE REPAIR INSTITUTE
2017 Fall Convention | November 15-17 | New Orleans, LA





Weather Was a Factor

- Multiple days of freezing rain
 - 2-1/2 days of delay overall
- Periodic drifted snow removal
- Removal of ice buildup at entrance



INTERNATIONAL CONCRETE REPAIR INSTITUTE

2017 Fall Convention | November 15-17 | New Orleans, LA

Chemical Grout Repairs

INTERNATIONAL CONCRETE REPAIR INSTITUTE

2017 Fall Convention | November 15-17 | New Orleans, LA

Grout Holes

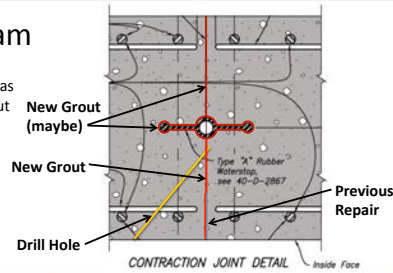
- Offset from joint
- 45 degree angle
- 1-ft spacing (to start)
- Cleaned with oil-free compressed air
- Plastic bang-in ports with zerk fittings
- Water injected first
 - Clean out
 - Water for reaction



2017 Fall Convention | November 15-17 | New Orleans, LA

Grout Diagram

- Previous repair acted as bulkhead to keep grout in joint
- Not all joints were previously grouted
- Hoping to filling voids around embedded waterstop



2017 Fall Convention | November 15-17 | New Orleans, LA

Chemical Grouts

- Hydrophilic polyurethane
 - Require water to propagate the chemical reaction
 - Flexible foam
 - Shrinks when dehydrated (water is half, or more, of the volume)
- Hydrophobic polyurethane
 - Require little or no water, typically use a catalyst
 - Can be two component
 - Little to no shrinkage upon drying
- Acrylic based resins
- Epoxy resins
 - Structural applications



2017 Fall Convention | November 15-17 | New Orleans, LA

Grouting

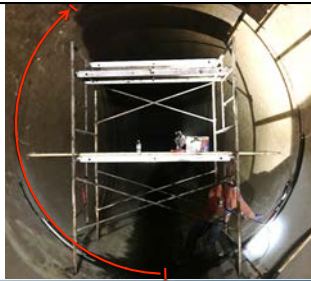
- Flexible Hydrophobic Polyurethane
 - Two products, similar characteristics
 - Mixed with 5% catalyst
 - Final cure time in 4-5 min @ 50°F
- Grouting sequence
 1. Invert to haunch
 2. Haunch to spring line
 3. Spring line to shoulder
 4. Shoulder to crown



2017 Fall Convention | November 15-17 | New Orleans, LA

Grouting

- Grout takes
 - Average of ~2.5 gallons per joint
 - Highest take - 4 gallons
 - Lowest take - 0.5 gallons
- Grout Travel
 - Average of 3-4 feet
 - Some travel of 23 feet (half the circumference)
 - A few noticeable "voids" under invert (could be unbonded interface between rat slab and siphon barrel)



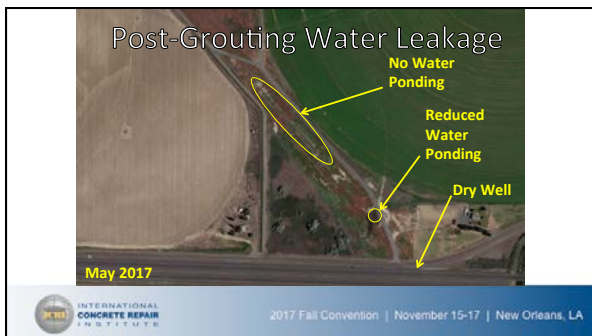
2017 Fall Convention | November 15-17 | New Orleans, LA

Before and After



2017 Fall Convention | November 15-17 | New Orleans, LA





Acknowledgements

- Bureau of Reclamation Personnel
 - Denver Technical Services Center
 - Ephrata Field Office
 - Yakima Field Office
- East Columbia Irrigation District Personnel
- ICRI

INTERNATIONAL CONCRETE REPAIR INSTITUTE 2017 Fall Convention | November 15-17 | New Orleans, LA

Thank you!
Questions?



Westin Joy, P.E.
Bureau of Reclamation
wjoy@usbr.gov
303-445-2382



INTERNATIONAL
CONCRETE REPAIR
INSTITUTE

2017 Fall Convention | November 15-17 | New Orleans, LA
