

WEDA 2011 ANNUAL MEETING

STRUCTURAL & HYDRAULIC ANALYSIS OF LOWER COLUMBIA RIVER PILE DIKES (LCR STUDY)

Presented by:

Carl Kassebaum, PE (AECOM)

Hans Moritz, PE (USACE – Portland District)



What Are the Presentation Goals?



AECOM

PRESENTATION GOALS

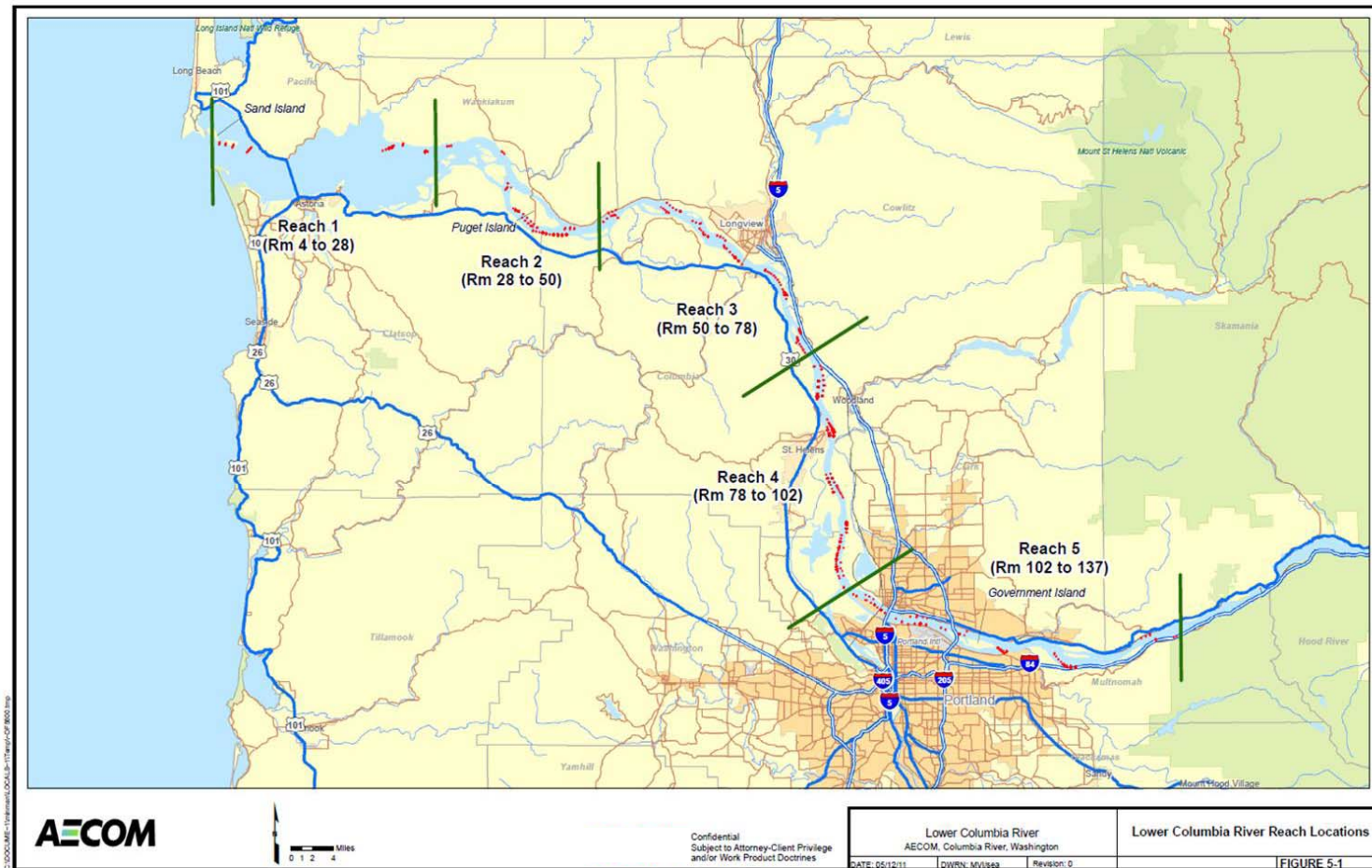
- Introduce and summarize the LCR Study
 - Comprehensive study of the LCR pile dikes (ARRA Funded)
 - Identify study purposes
- Highlight major results and findings
 - Pile dikes are critical component of the LCR navigation system
 - Navigation channel would be unstable without existing pile dikes
 - Pile dikes in substantial disrepair; repairs needed to maintain functions
 - Pile dikes have created and are currently protecting shallow water habitat used by juvenile salmonids
- Highlight potential opportunities
 - Juvenile salmonid habitat mitigation using pile dikes



LCR Study Description



LCR STUDY AREA



REASONS FOR LCR STUDY

- Comprehensive structural and functional condition pile dike assessment addressing
 - Channel stabilization
 - Reducing dredging requirements
 - Bank protection
 - Dredged disposal sites protection
- Federal Columbia River Power System National Marine Fisheries Service Biological Opinion (BiOp) Reasonable and Prudent Alternative (RPA) #38 which states

To increase access to productive habitat and to reduce avian predation, the Action Agencies will develop and implement a piling and pile dike removal program.



TYPES OF PILE DIKES IN THE LCR



Spur Pile Dike



Training Pile Dike

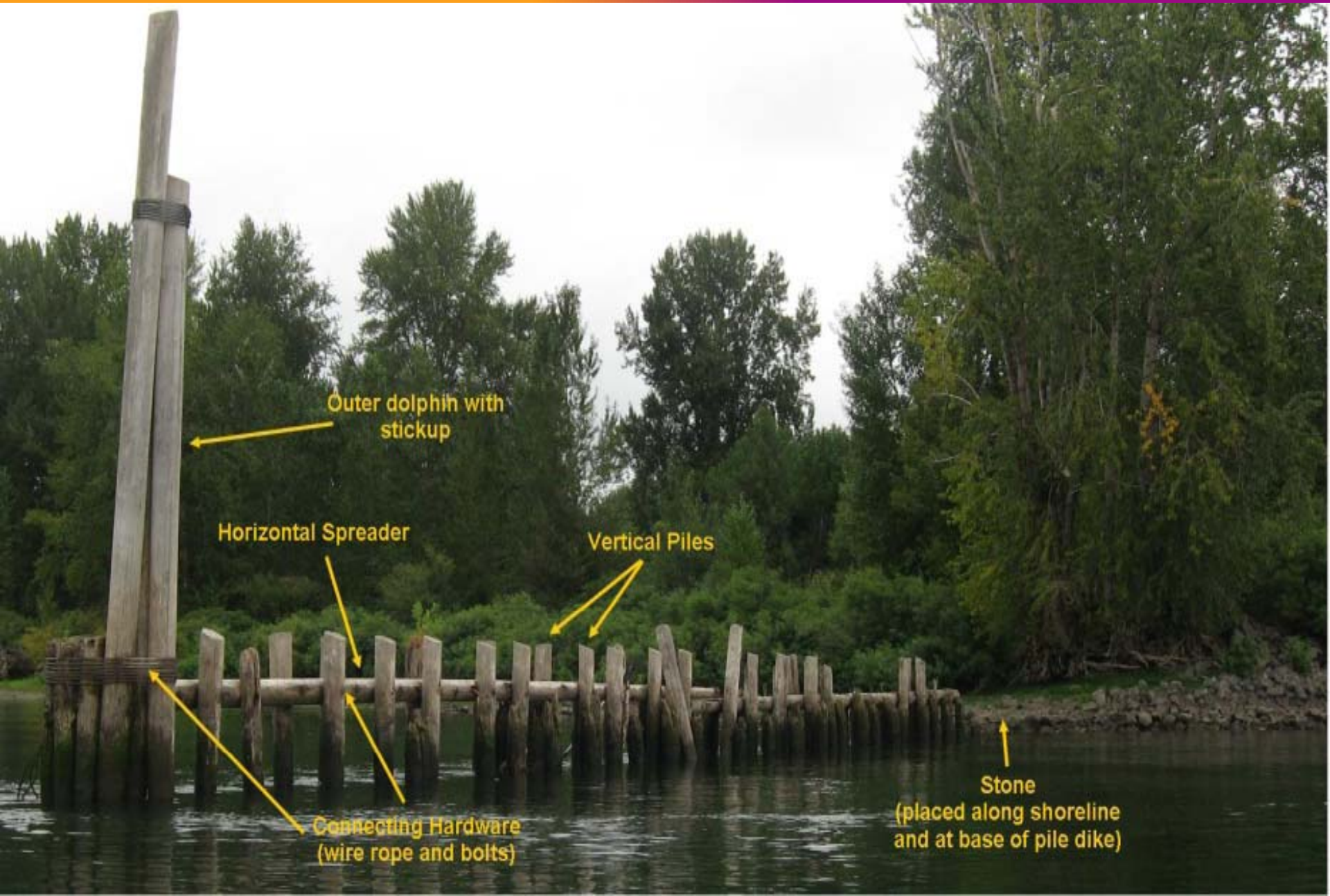


Transverse Pile Dike

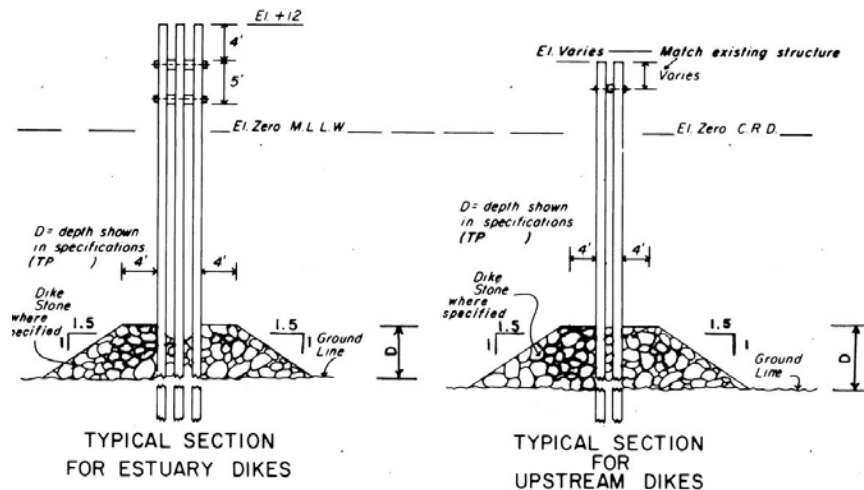
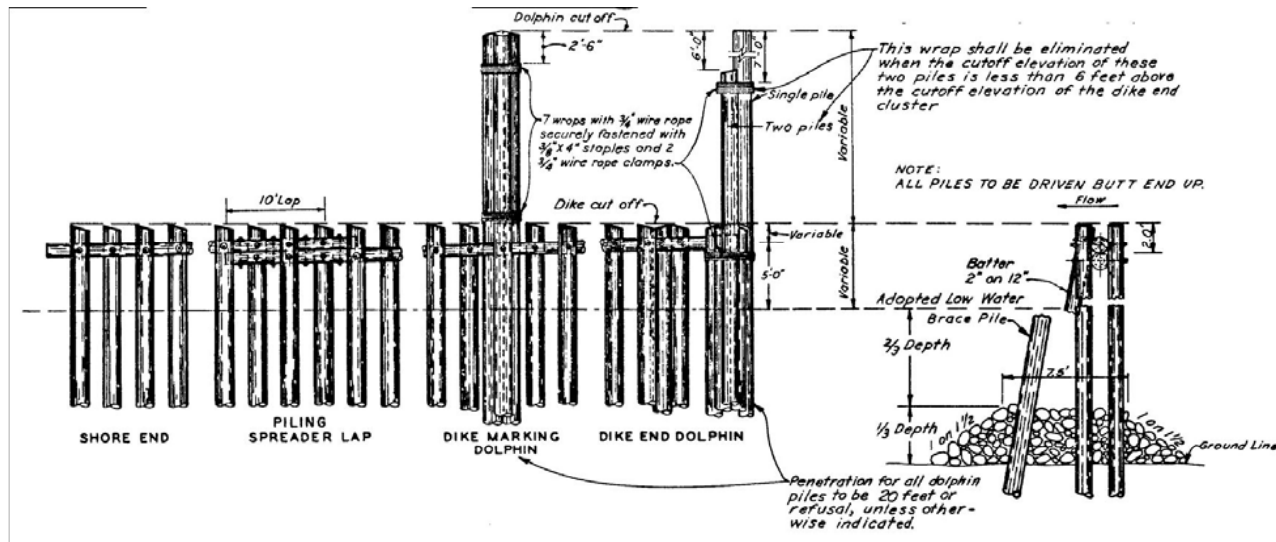


Pile Field

PILE DIKE DESIGN ELEMENTS



PILE DIKE DESIGN ELEMENTS



PILE DIKE DESIGN ELEMENTS

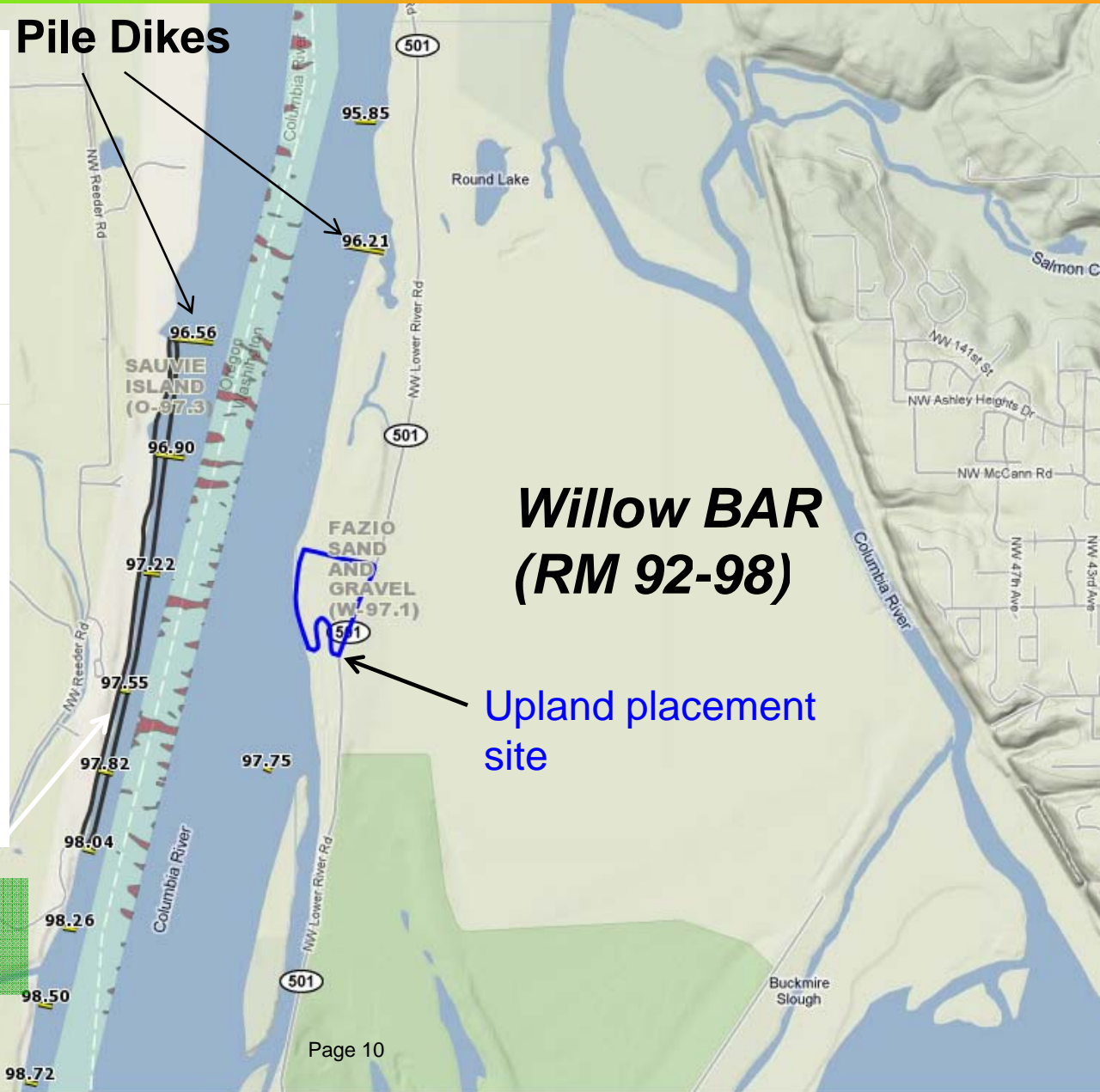
Construction of pile dikes at Willow Bar has stabilized the Columbia River within this reach, reducing dredging within the navigation channel by 100,000s cy/yr.

The realized effect for USACE pile dikes at other LCR locations is similar:

- 1) Stabilized river thalweg
- 2) Stabilized river bank
- 3) Accreted river bank & riparian areas
- 4) Improved retention of dredged material placed along bankline)

Dredged material placement site

Pile Dikes



SHORT HISTORY AND FUTURE OF LCR PILE DIKES

- Early Implementation and Experimentation (1890's – 1930's)
 - Dominant goal was to stabilize the navigation channel and reduce dredging
 - St. Helen's Bar – First pile dike installation
 - Period of trial and error
 - River thalweg partially controlled
- Consolidation Period (1930's – 1969)
 - All pile dikes constructed (last constructed in 1969)
 - Maintenance program initiated
 - River thalweg stabilized
- Maintain/Operate Period (1970 – Present)
 - Pile dikes are aging; most now beyond 50-year design life
 - Numerous pile dikes with advanced degradation
 - ESA listings (13 separate fish species)
- Future LCR Navigation System Management
 - Maintain/upgrade existing pile dikes and navigation channel
 - Reduce dredging
 - Enhance and protect juvenile salmonid habitat



LCR STUDY

PILE DIKE INSPECTIONS

SEPTEMBER 2010

October 28, 2011



AECOM

LCR STUDY - PILE DIKE INSPECTIONS

- Site Inspections (September 2010)
 - 233 pile dikes
- Focus of inspections
 - Structural condition
 - Functional effectiveness
 - Sediment management (reduce river cross-section/reduce dredging)
 - Bank protection
 - Dredged material disposal site protection
 - Redirect flow
 - Habitat
- LCR pile dike condition assessment form



PILE DIKE 61.28 (SEPTEMBER 2010)



Pile DiKE 56.64

For this dike the following structural ratings were given:

Structural

- Outer Dolphin (OD) = Present (+1), Fair Condition (0)
- Pile Braces = Absent (0), Not Present (0)
- Spreader = Present (+1), Good (+1)
- Wood Rot = Minor (+1)
- Hardware = All Intact (+1)
- Overall Damage = < 10% damage (+1);
- Stone blanket = Absent (-1)

PILE DIKE 105.04 (SEPTEMBER 2010)



Pile Dike 105.04

For this dike the following structural ratings were given:

Structural

- Outer Dolphin (OD) = Absent (-1), Not Present (0)
- Pile Braces = Absent (0), Not Present (0)
- Spreader = Absent (-1), Not Present (0)
- Wood Rot = Major (-1)
- Hardware = >30% missing (-1)
- Overall Damage = > 30% damage (-1);
- Stone blanket = Absent (-1)

PILE DIKE 105.04 (SEPTEMBER 2010)



Pile Dike 61.28

For this dike the following structural ratings were given:

Structural

- Outer Dolphin (OD) = Present (+1), Fair Condition (0)
- Pile Braces = Present (+1), 50%-90% (0)
- Spreader = Present (+1), Fair Condition (0)
- Wood Rot = Minor (+1)
- Hardware = >30% missing (-1)
- Overall Damage = 10%-30% damage (0); assigned as result of 125 ft hole
- Stone blanket = Present (+1)

Vertical

FINDINGS AND RECOMMENDATIONS



FINDINGS

- Pile dikes are vital to the proper continuing functioning of the LCR navigation system
- Majority (>70%) of pile dikes are currently achieving their original intended functions; the thalweg is protected and stable, and associated maintenance dredging has been minimized
- Without the pile dikes
 - Substantial bank erosion would occur
 - The navigation channel location (widths and depths) would become destabilized; the LCR thalweg would become destabilized
 - Cost and amount of dredging would increase substantially and ability to maintain the navigation channel would be jeopardized

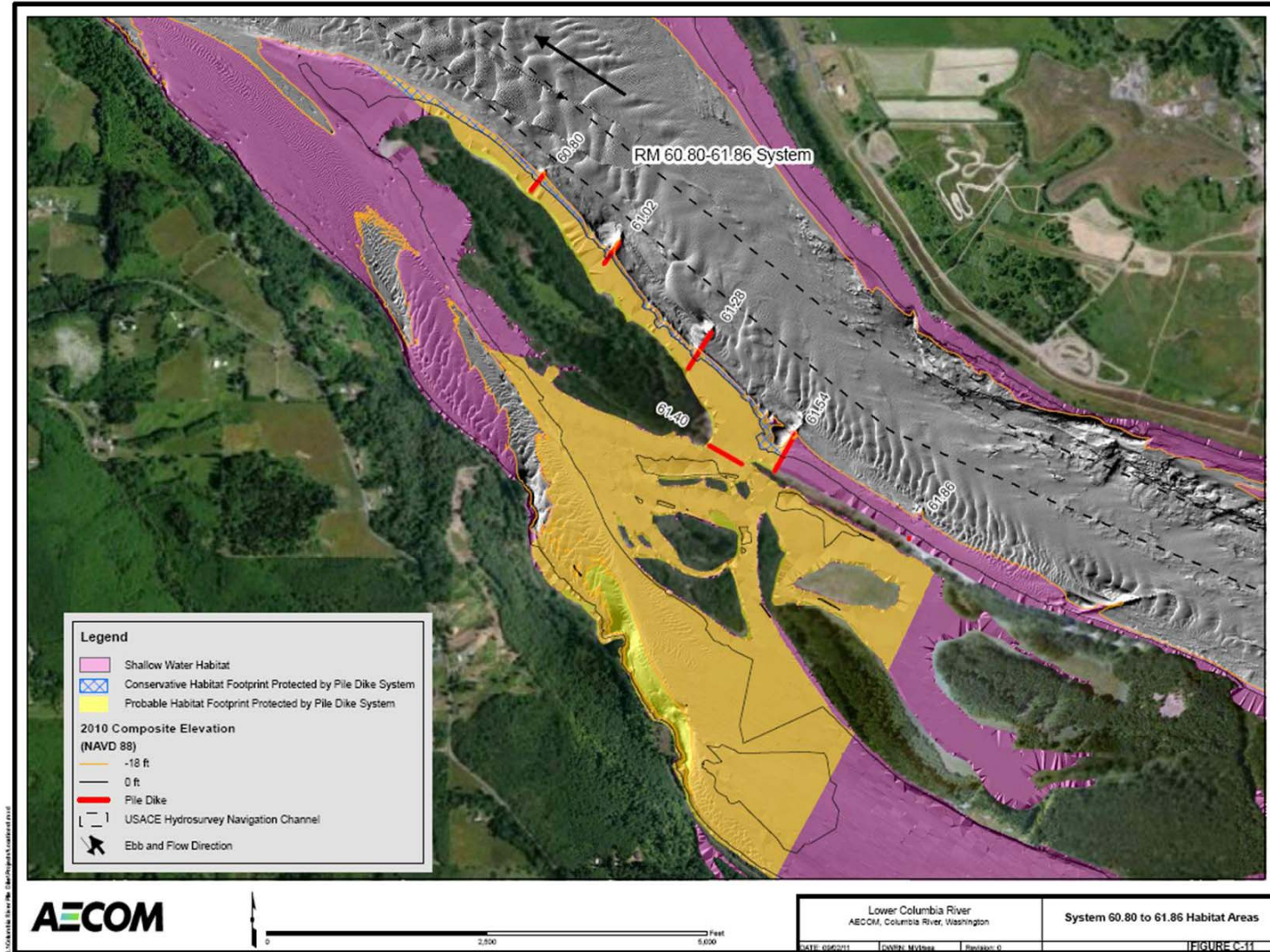


FINDINGS (CONTINUED)

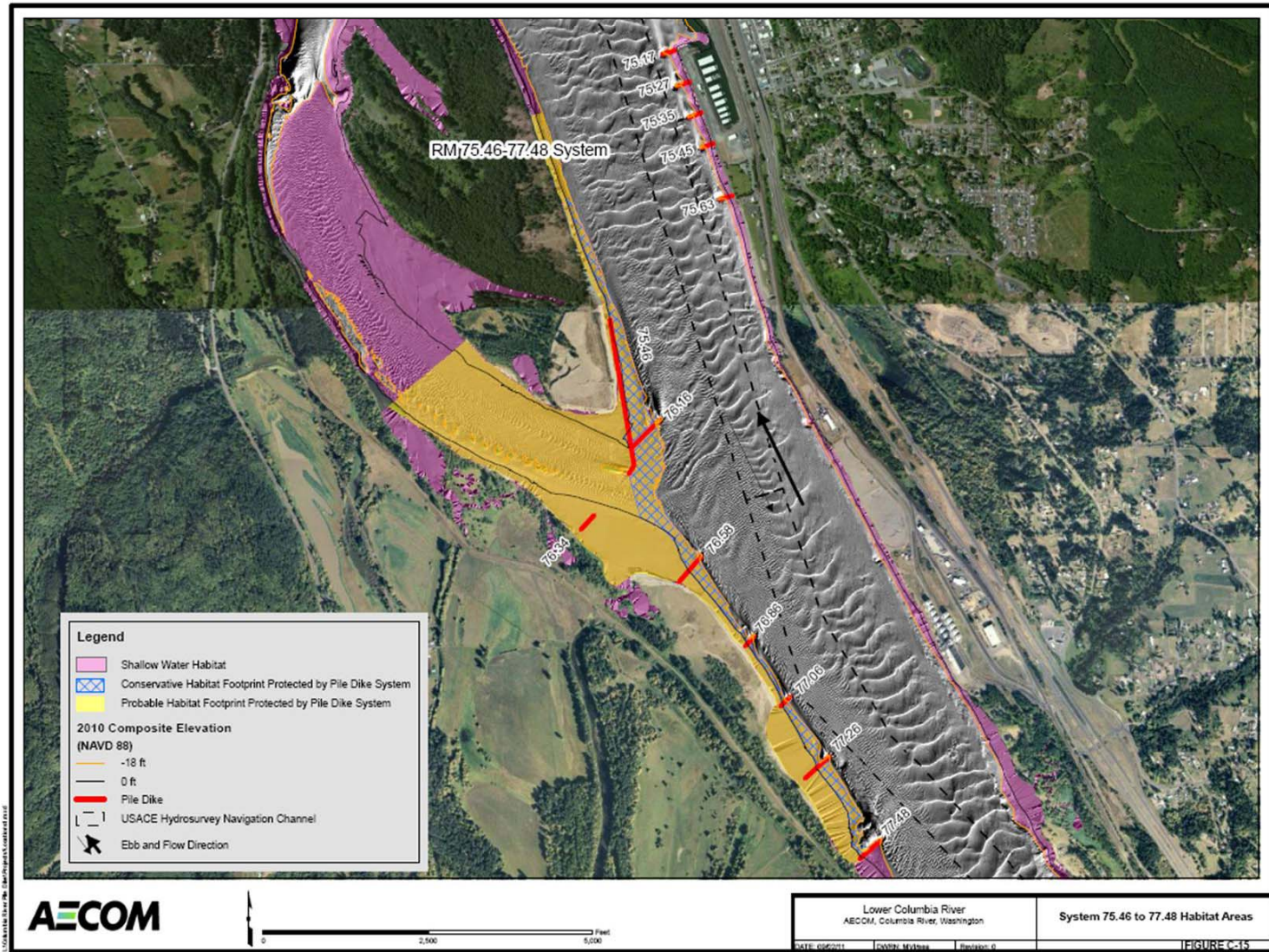
- Substantial near-term maintenance is needed
 - Recent deferred maintenance
 - Overall average age of pile dikes > 70 years; substantially greater than original 50-year design standard
- Approximately half of the pile dikes have created and/or are protecting shallow water juvenile salmonid habitat
 - Defined as depths shallower than 18 feet
- 6,100 acres of shallow water habitat currently being protected
- Near-term maintenance required to maintain existing conditions and protect existing shallow water habitat



PROTECTED HABITAT (RM 60.80-61.86 SYSTEM)



PROTECTED HABITAT (RM 75.46-77.48 SYSTEM)



AVIAN AND FISH-RELATED PREDATION OF JUVENILE SALMONIDS

- 2008 BiOp RPA #38 – Pile dike removal program to beneficially impact juvenile salmonids
- Optional removal recommendation - 39 pile dikes (17%)
- Inconclusive evidence to show positive or negative habitat impact on juvenile salmonids
 - Treated piles – Very few, not a contaminant threat
 - Predator fish - Activity unobservable, inconclusive impact
 - Avian perching - Primarily cormorants observed, inconclusive impact
- Additional scientific research is needed to address pile dike impacts on juvenile salmonids by
 - Impeding access to adjacent habitat
 - Modification of migration patterns
 - Providing perching habitat for avian predators



LCR STUDY RECOMMENDATIONS

- Retain/Repair
 - 169 pile dikes
- Further Study/Analysis
 - 6 pile dikes
- Implement Habitat Improvement Study
 - 101 of the 169 pile dikes receiving retain/repair (dual recommendation)
 - 3 pile dikes (only recommendation)
- Monitor/Optional Removal
 - Monitor (only) - 16 pile dikes
 - Optional removal or monitor - 39 pile dikes
- Remove (detrimental to function or habitat)
 - No pile dikes identified



OPPORTUNITY



HABITAT ENHANCEMENT WITH PILE DIKES

- Pile dikes reduce downstream energy (flow velocities)
- Modify existing (install new pile dikes) in conjunction with potential habitat features such as:
 - Dredged material placement to create shallow water submerged habitat areas (e.g., bench or mound)
 - Large woody debris (LWD)
 - Marsh
 - Wetland mosaic



HABITAT ENHANCEMENT WITH PILE DIKES

Hopper dredge *Sugar Island* (GLDD) and cutter head dredge *Oregon* (Port of Portland) working in tandem during Columbia River channel improvement at ~ RM 102.

Sugar Island “feeds” sand/gravel dredged from the navigation channel to the dredge *Oregon*, where the sand/gravel is re-dredged and placed upland or along acceptable river bank areas.



HABITAT ENHANCEMENT WITH PILE DIKES



Bank line and upland placement of LCR sand dredged from the navigation channel by “teaming” dredges.



FUTURE: Leverage opportunities for creating additional shallow water habitat.

Develop & apply specific placement methods to achieve “best” terra-forming objectives for desirable habitat using LCR dredged material and existing pile dikes.

SUMMARY



SUMMARY

- Pile dikes are a vital component to the LCR navigation system; currently functioning largely as originally intended
- Pile dikes are in substantial disrepair; maintenance is required to maintain existing functions
- Pile dikes are important to juvenile salmonid habitat; greater than 6,100 acres of shallow water habitat currently being protected
- Inconclusive evidence to show positive or negative benefit to juvenile salmonids by removing pile dikes pursuant to RPA#38
- Significant opportunity to create/improve juvenile salmonid habitat with use of pile dikes

