2005 Tri-Service Infrastructure Systems Conference & Exhibition

St. Louis, MO
"Re-Energizing Engineering Excellence"

2-4 August 2005

Agenda

Panel*:* The Future of Engineering and Construction

- LTG Carl A. Strock, Commander, USACE
- Dr. James Wright, Chief Engineer, NAVFAC

Panel*:* USACE Engineering and Construction

- Dr. Michael J. O'Connor, Director, R&D

Panel*:* Navy General Session

- Mr. Steve Geusic, Engineering Criteria & Programs NAVFAC Atlantic

Introduction to Multi-Disciplinary Tracks, by Mr. Gregory W. Hughes
Engineering Circular: Engineering Reliability Guidance for Existing USACE Civil Works Infrastructure, by Mr. David M. Schaaf, PE, LRD Regional Technical Specialist, Navigation Engineering Louisville District
MILCON S&A Account Study, by Mr. J. Joseph Tyler, PE, Chief, Programs Integration Division, Directorate of Military Programs HQUSACE
Financial Justification on Bentley Enterprise License Agreement (ELA)

Track 1

- The Chicago Shoreline Storm Damage Reduction Project, by Andrew Benziger
- Protecting the NJ Coast Using Large Stone Seawalls, by Cameron Chasten
- Cascade: An Integrated Coastal Regional Model for Decision Support and Engineering Design, by Nicholas C. Kraus and Kenneth J. Connell
- Modeling Sediment Transport Along the Upper Texas Coast, by David B. King Jr., Jeffery P. Waters and William R. Curtis
- Sediment Compatibility for Beach Nourishment in North Carolina, by Gregory L. Williams
- Evaluating Beachfill Project Performance in the USACE Philadelphia District, by Monica Chasten and Harry Friebel
- US Army Corps of Engineers' National Coastal Mapping Program, by Jennifer Wozencraft
- Flood Damage Reduction Project Using Structural and Non-Structural Measures, by Stacey Underwood
- Shore Protection Project Performance Improvement Initiative (S3P2I), by Susan Durden
- Hurricane Isabel Post-Storm Assessment, by Jane Jablonski
- US Army Corps of Engineers Response to the Hurricanes of 2004, by Rick McMillen and Daniel R. Haubner
- Increased Bed Erosion Due to Increased Bed Erosion Due to Ice, by Decker B. Hains, John I. Remus, and Leonard J. Zabilansky
- Mississippi Valley Division, by James D. Gutshall
- Impacts to Ice Regime Resulting from Removal of Milltown Dam, Clark Fork River, Montana, by Andrew M. Tuthill and Kathleen D. White, and Lynn A. Daniels
- Carroll Island Micromodel Study: River Miles 273.0-263.0, by Jasen Brown
- Monitoring the Effects of Sedimentation from Mount St. Helens, by Alan Donner, Patrick O'Brien and David Biedenharn
  Watershed Approach to Stream Stability and Benefits Related to the Reduction of Nutrients, by John B. Smith
- A Lake Tap for Water Temperature Control Tower Construction at Cougar Dam, Oregon, by Stephen Schlenker, Nathan Higa and Brad Bird
- San Francisco Bay Mercury TMDL – Implications for Constructed Wetlands, by Herbert Fredrickson, Elly Best and Dave Soballe
- Abandoned Mine Lands: Eastern and Western Perspectives, by Kate White and Kim Mulhern
  Translating the Hydrologic Tower of Babel, byDan Crawford
- Demonstrating Innovative River Restoration Technologies: Truckee River, Nevada, by Chris Dunn
- System-Wide Water Resource Management – Tools of the Trade

Track 2

- Ecological and Engineering Considerations for Dam Decommissioning, Retrofits, and Reoperations, by Jock Conyngham
- Hydraulic Design of tidegates and other Water Control structures for Ecosystem Restoration projects on the Columbia River estuary, by Patrick S. O'Brien
- Surface Bypass & Removable Spillway Weirs, by Lynn Reese
- Impacts of using a spillway for juvenile fish passage on typical design criteria, by Bob Buchholz
- Howard Hanson Dam: Hydraulic Design of Juvenile Fish Passage Facility in Reservoir with Wide Pool Fluctuation, by Dennis Mekkers and Daniel M. Katz
- Current Research in Fate Current Research in Fate & Transport of Chemical and Biological Contaminants in Water Distribution Systems, by Vincent F. Hock
- Regional Modeling Requirements, by Maged Hussein
- Tools for Wetlands Permit Evaluation: Modeling Groundwater and Surface Water Interaction, by Cary Talbot
- Ecosystem Restoration for Fish and Wildlife Habitat on the UMRS, by Jon Hendrickson
- Missouri River Shallow Water Habitat Creation, by Dan Pridal
- Aquatic Habitat Restoration in the Lower Missouri River, by Chance Bitner
- Transition to an Oracle Based Data System (Corps Water Management System, CWMS), by Joel Asunskis
- RiverGages.com: The Mississippi Valley Division Water Control Website, by Rich Engstrom
- HEC-ResSim 3.0: Enhancements and New Capabilities, by Fauwaz Hanbali
- Hurricane Season 2004 – Not to Be Forgotten, by Jacob Davis
- Re-Evaluation of a Flood Control Project, by Ferris W. Chamberlin
- Helmand Valley Water Management Plan, by Jason Needham
- A New Approach to Water Management Decision Making, by James D. Barton
- Developing Reservoir Operational Plans to Manage Erosion and Sedimentation during Construction – Willamette Temperature
- Control, Cougar Reservoir 2002-2005, by Patrick S. O'Brien
- Improved Water Supply Forecasts for the Kootenay Basin, by Randal T. Wortman
- ResSIM Model Development for Columbia River System, by Arun Mylvahanan
- Prescriptive Reservoir Modeling and the ROPE, by Jason Needham
- Missouri River Basin Water Management, by Larry Murphy

Track 3

- Corps Involvement in FEMA's Map Modernization Program, by Kate White, John Hunter and Mark Flick
- Innovative Approximate Study Method for FEMA Map Moderniation Program , by John Hunter
- Flood Fighting Structures Demonstration and Evaluation Program (FFSD), by Fred Pinkard
- Integrating Climate Dynamics Into Water Resources Planning and Management, by Kate White
- Hydrologic and Hydraulic Contributions to Risk and Uncertainty Propagation Studies, by Robert Moyer
- Uncertainty Analysis: Parameter Estimation, by Jackie P. Hallberg
- Geomorphology Study of the Middle Mississippi River, by Eddie Brauer
- Bank Erosion and Morphology of the Kaskaskia River, by Michael T. Rodgers
- Degradation of the Kansas City Reach of the Missouri River, by Alan Tool
- Sediment Impact Assessment Model (SIAM), by David S. Biedenharn and Meg Jonas
- Mississippi River Sedimentation Study, by Basil Arthur
- Sediment Model of Rivers, by Charlie Berger
- East Grand Forks, MN and Grand Forks, ND Local Flood Damage Reduction Project, by Michael Lesher
- Hydrologic and Hydraulic Analyses, by Thomas R. Brown
- Hydrologic and Hydraulic Modeling of the Mccook and Thornton Tunnel and Reservoir Plans, by David Kiel
- Ala Wai Canal Project, by Lynnette F. Schaper
- Missouri River Geospatial Decision Support Framework, by Bryan Baker and Martha Bullock
- Systemic Analysis of the Mississippi & Illinois Rivers Upper Mississippi River Comprehensive Plan, by Dennis L. Stephens

Section 227: National Shoreline Erosion Control Demonstration and Development Program Annual Workshop

- Workshop Objectives
- Section 227: Oil Piers, Ventura County, CA, by Heather Schlosser
- An Evaluation of Performance Measures for Prefabricated Submerged Concrete Breakwaters: Section 227 Cape May Point, New Jersey Demonstration Project, by Donald K Stauble, J.B. Smith and Randall A. Wise
- Bluff Stabilization along Lake Michigan, using Active and Passive Dewatering Techniques, by Rennie Kaunda, Eileen Glynn, Ron Chase, Alan Kehew, Amanda Brotz and Jim Selegean
- Storm Damage at Cape Lookout
- Branchbox Breakwater Design at Pickleweed Trail, Martinez, CA
- Section 227: Miami, FL
- Section 227: Sheldon Marsh Nature Preserve
- Section 227: Seabrook, New Hampshire
- Jefferson County, TX – Low Volume Beach Fill
- Sacred Falls, Oahsacred Falls, Oahu Section 227 Demonstration Project

Track 4

- Fern Ridge LakFern Ridge Lake Hydrologic Aspects of Operation during Failure, by Bruce J Duffe
- A Dam Safety Study Involving Cascading Dam Failures, by Gordon Lance
- Spillway Adequacy Analysis of Rough River Lake Louisville District, by Richard Pruitt
- Water Management in Iraq: Capability and Marsh Restoration, by Fauwaz Hanbali
- Iraq Ministry of Water Resources Capacity Building, by Michael J. Bishop, John W. Hunter, Jeffrey D. Jorgeson, Matthew M. McPherson, Edwin A. Theriot, Jerry W. Webb, Kathleen D. White, and Steven C. Wilhelms

- HEC Support of the CMEP Program, by Mark Jensen
- Geospatial Integration of Hydrology & Hydraulics Tools for Multi-Purpose, Multi-Agency Decision Support, by Timothy Pangburn, Joel Schlagel, Martha Bullock, Michael Smith, and Bryan Baker
- GIS & Surveying to Support FEMA Map Modernization and Example Bridge Report, by Mark Flick
- High Resolution Bathymetry and Fly-Through Visualization, by Paul Clouse
- Using GIS and HEC-RAS for Flood Emergency Plans, by Stephen Stello
- High Resolution Visualizations of Multibeam Data of the Lower Mississippi River, by Tom Tobin and Heath Jones
- System Wide Water Resources Program Unifying Technologies Geospatial Applications, by Andrew J. Bruzewicz
- Raystown Plate Locations
- Hydrologic Engineering Center: HEC–HMS Version 3.0 New Features, by Jeff Harris
- SEEP2D & GMS: Simple Tools for Solving a Variety of Seepage Problems, by Clarissa Hansen, Fred Tracy, Eileen Glynn, Cary Talbot and Earl Edris
- Sediment and Water Quality in HEC-RAS, by Mark Jensen
- Advances to the GSSHA Model, by Aaron Byrd and Cary Talbot
- Watershed Analysis Tool: HEC-WAT Program, by Chris Dunn
- Little Calumet River UnsteadLittle Calumet River Unsteady Flow Model Conversion UNET to HEC-RAS, by Rick D. Ackerson
  Kansas River Basin Model, by Edward Parker
- Design Guidance for Breakup Ice Control Structures, by Andrew M. Tuthill
- Computational Hydraulic Model of the Lower Monumental Dam Forebay, by Richard Stockstill, Charlie Berger, John Hite, Alex Carrillo, and Jane Vaughan
- Use of Regularization as a Method for Watershed Model Calibration, by Brian Skahill
- Demonstration Program Urban Flooding and Channel Restoration in Arid and Semi-Arid Regions (UFDP), by Joan Pope, Jack Davis, Ed Sing, John Warwick, Meg Jonas

Track 5

- Walla Walla District Northwestern Division, by Robert Berger
- Best Practices for Conduits through Embankment Dams, by Chuck R. Cooper
- Design, Construction Design, Construction and Seepage at Prado Dam, by Douglas E. Chitwood
- 2-D Liquefaction Evaluation with Q4Mesh, by David C. Serafini
- Unlined Spillway Erosion Risk Assessment, by Johannes Wibowo, Don Yule, Evelyn Villanueva and Darrel Temple
- Seismic Remediation of the Clemson Upper and Lower Diversion Dams; Evaluation, Conceptual Design and Design, by Lee Wooten and Ben Foreman
- Seismic Remediation of the Clemson Upper and Lower Diversion Dams; Deep Soil Mix Construction, by Lee Wooten and Ben Foreman
- Historical Changes in the State of the Art of Seismic Engineering and Effects of those changes on the Seismic Response Studies of Large Embankment Dams, by Sam Stacy
- Iwakuni Runway Relocation Project, by Vincent R. Donnally
- Internal Erosion & Piping at Fern Ridge Dam, by Jeremy Britton
- Rough River Dam Safety Assurance Project, by Timothy M. O'Leary
- Seepage Collection & Control Systems: The Devil is in the Details , by John W. France
- Dewey Dam Seismic Assessment, by Greg Yankey
- Seismic Stability Evaluation for Ute Dam, New Mexico, by John W. France
- An Overview of Criteria Used by Various Organizations for Assessment and Seismic Remediation of Earth Dams, by Jeffrey S. Dingrando
- A Review of Corps of Engineers Levee Seepage Practices and Proposed Future Changes, by George Sills
- Ground-Penetrating Radar Applications for the Assessment of Pavements, by Lulu Edwards and Don R. Alexander
- Peru Road Upgrade Project, by Michael P. Wielputz
- Slope Stability Evaluation of the Baldhill Dam Right Abutment, by Neil T. Schwanz
- Design and Construction of Anchored Bulkheads with Synthetic Sheet Piles Seabrook, New Hampshire, by Siamac Vaghar and Francis Fung
- Characterization of Soft Claya Case Study at Craney Island, by Aaron L. Zdinak
- Dispersive ClayDispersive Clays – Experience andHistory of the NRCS (Formerly SCS), by Danny McCook
- Post-Tensioning Institute, by Michael McCray
- Demonstration Program Urban Flooding and Channel Restoration in Arid and Semi-Arid Regions (UFDP), by Joan Pope, Jack Davis, Ed Sing, John Warwick, Meg Jonas

Track 6

- State of the Art in Grouting: Dams on Solution Susceptible or Fractured Rock Foundations, by Arthur H. Walz
- Specialty Drilling, Testing, and Grouting Techniques for Remediation of Embankment Dams, by Douglas M. Heenan
- Composite Cut-Offs for Dams, by Dr. Donald A. Bruce and Trent L. Dreese
- State of the Art in Grout Mixes, by James A. Davies
- State of the Art in Computer Monitoring and Analysis of Grouting, by Trent L. Dreese and David B. Wilson
- Quantitatively Engineered Grout Curtains, by David B. Wilson and Trent L. Dreese
- Grout Curtains at Arkabutla Dam: Outlet Monolith Joints and Cracks using Chemical Grout, Arkabutla Lake, MS, by Dale A. Goss
- Chicago Underflow Plan – CUP: McCook Reservoir Test Grout Program, by Joseph A. Kissane
- Clearwater Dam: Sinkhole Repair Foundation Investigation and Grouting Project, by Mark Harris
- Update on the Investigation of the Effects of Boring Sample Size (3" vs 5") on Measured Cohesion in Soft Clays, by Richard Pinner and Chad M. Rachel
- Soil-Bentonite Cutoff Wall Through Free-Product at Indiana Harbor CDF, by Joe Schulenberg and John Breslin
- Soil-Bentonite Cutoff Wall Through Dense Alluvium with Boulders into Bedrock, McCook Reservoir, by William A. Rochford
- Small Project, Big Stability Problem the Block Church Road Experience, by Jonathan E. Kolber
- Determination of Foundation Rock Properties Beneath Folsom Dam, by Michael K. Sharp, José L. Llopis and Enrique E. Matheu
  Waterbury Dam Mitigation, by Bethany Bearmore
- Armor Stone Durability in the Great Lakes Environment, by Joseph A. Kissane
- Mill Creek - An Urban Flood Control Challenge, by Monica B. Greenwell
- Next Stop, The Twilight Zone, by Troy S. O'Neal
- Limitations in the Back Analysis of Shear Strength from Failures, by Rick Deschamps and Greg Yankey
- Reconstruction of Deteriorated Concrete Lock Walls After Blasting and Other Demolition Removal Techniques, by Stephen G. O'Connor

- Flood Fighting Structures Demonstration and Evaluation Program (FFSD), by George Sills
- Innovative Design Concepts Incorporated into a Landfill Closure and Reuse Design Portsmouth Naval Shipyard, Kittery, Maine, by Dave Ray and Kevin Pavlik
- Laboratory Testing of Flood Fighting Structures, by Johannes L. Wibowo, Donald L. Ward and Perry A. Taylor
- Bluff Stabilization Along Lake Michigan, Using Active and Passive Dewatering Techniques, Allegan Co. Michigan, by Rennie Kaunda, Eileen Glynn, Ron Chase, Alan Kehew and Jim Selegean

Track 7

- Case History: Multiple Axial Statnamic Tests on a Drilled Shaft Embedded in Shale, by Paul J. Axtell, J. Erik Loehr, Daniel L. Jones
- The Sliding Failure of Austin Dam Pennsylvania - Revisited, by Brian H. Greene
- M3 –Modeling, Monitoring and Managing: A Comprehensive Approach to Controlling Ground Movements for Protection of Existing Structures and Facilities, by Francis D. Leathers and Michael P. Walker
- Time-Dependent Reliability Modeling for Use in Major Rehabilitation of Embankment Dams and Foundation, by Robert C. Patev
- Lateral Pile Load Test Results Within a Soft Cohesive Foundation, by Richard J. Varuso
- Engineering Geology Challenge Engineering Geology Challenges During Design and Construction of the Marmet Lock Project, by Ron Adams and Mike Nield
- Mill Creek Deep Tunnel Geologic Conditions and Potential Impacts on Design/Construction, by Kenneth E. Henn III
- McAlpine Lock Replacement Instrumentation: Design, Construction, Monitoring, and Interpretation, by Troy S. O'Neal
- Geosynthetics and Construction of the Second Powerhouse Corner Collector Surface Flow Bypass Project, Bonneville Lock and Dam Project, Oregon and Washington, by Art Fong
- McAlpine Lock Replacement Project Foundation Characteristics and Excavation, by Kenneth E. Henn III
- Structural and Geotechnical Issues Impacting The Dalles Spillwall Construction and Bay 1 Erosion Repair, by Jeffrey M. Ament
  Rock Anchor Design and Construction: The Dalles Dam Spillwalls, by Kristie M. Hartfeil
- The Future of the Discrete Element Method in Infrastructure Analysis, by Raju Kala, Johannes L. Wibowo and John F. Peters
- Sensitive Infrastructure Sites - Sonic Drilling Offers Quality Control and Non-Destructive Advantages to Geotechnical Construction Drilling, by John P. Davis

Track 8

- Evaluation of The Use of LithiuEvaluation of The Use of Lithium Compounds in Controlling ASR in Concrete Pavement, by Mike Kelly
- Roller Compacted Concrete for McAlpine Lock Replacement, by David E. Kiefer
- Soil-Cement for Stream Bank Stabilization, by Wayne Adaska
- Using Cement to Reclaim Asphalt Pavements, by David R. Luhr
- Valley Park 100-Yr Flood Protection Project: Use of 'Engineered Fill' in the Item IV-B Levee Core, by Patrick J. Conroy
- Bluestone Dam: AAR –A Case Study, by Greg Yankey
- USDA Forest Service: Unpaved Road Stabilization with Chlorides, by Michael R. Mitchell
- Use of Ultra-Fine Amorphous Colloidal Silica to Produce a High-Density, High-Strength Grout, by Brian H. Green
- Modular Gabion Systems, by George Ragazzo
- Addressing Cold Regions Issues in Pavement Engineering, by Edel R. Cortez and Lynette Barna
- Geology of New York Harbor: Geological and Geophysical Methods of Characterizing the Stratigraphy for Dredging Contracts, by Ben Baker, Kristen Van Horn and Marty Goff
- Rubblization of Airfield Concrete Pavements, by Eileen M. Vélez-Vega
- US Army Airfield Pavement Assessment Program, by Haley Parsons, Lulu Edwards, Eileen Velez-Vega and Chad Gartrell
- Critical State for Probabilistic Analysis of Levee Underseepage, by Douglas Crum,
- Curing Practices for Modern Concrete Production, by Toy Poole
- AAR at Carters Dam: Different Approaches, by James Sanders
- Concrete Damage at Carters Dam, by Toy Poole
  Damaging Interactions Among Concrete Materials, by Toy Poole
- Economic Effects on Construction of Uncertainty in Test Methods, by Toy Poole
- Trends in Concrete Materials Specifications, by Toy Poole
- Spall and Intermediate-Sized Repairs for PCC Pavements, by Reed Freeman and Travis Mann
- Acceptance Criteria Acceptance Criteria for Unbonded Aggregate Road Surfacing Materials, by Reed Freeman, Toy Poole, Joe Tom and Dale Goss
- Effective Partnering to Overcome an Interruption In the Supply of Portland Cement During Construction at Marmet Lock and Dam, by Billy D. Neeley, Toy S. Poole and Anthony A. Bombich

Track 10

- Marmet Lock &Dam: Automated Instrumentation Assessment, Summer/Fall 2004, by Jeff Rakes and Ron Adams
  Success Dam Seismic Remediation

Track 9

- Fern Ridge Dam, Oregon: Seepage and Piping Concerns (Internal Erosion)

Track 11

- Canton Dam Spillway Stability: Is a Test Anchor Program Necessary?, by Randy Mead
- Dynamic Testing and Numerical Correlation Studies for Folsom Dam, by Ziyad Duron, Enrique E. Matheu, Vincent P. Chiarito, Michael K. Sharp and Rick L. Poeppelman

Status of Portfolio Risk Assessment, by Eric Halpin
- Mississinewa Dam Foundation Rehabilitation, by Jeff Schaefer
- Wolf Creek Dam Seepage Major Rehabilitation Evaluation, by Michael F. Zoccola
- Bluestone Dam DSA Anchor Challenges, by Michael McCray
- Clearwater Dam Major Rehab Project, by Bobby Van Cleave
- Design, Construction and Seepage at Prado Dam, by Douglas E. Chitwood
- Seven Oaks Dam: Outlet Tunnel Invert Damage, by Robert Kwan
- An Overview of An Overview of the Dam Safety ProgramManagement Tools (DSPMT), by Tommy Schmidt

Track 12

- Greenup L&D Miter Gate Repair and Instrumentation, by Joseph Padula, Bruce Barker and Doug Kish
- Marmet Locks and Dam Lock Replacement Project, by Jeffrey S. Maynard,
- Status of HSS Inspections in The Portland District, by Travis Adams
- Kansas City District: Perry Lake Project Gate Repair, by Marvin Parks
- Mel Price – Auxiliary Lock Downstream Miter Gate Repair, by Thomas J. Quigley, Brian K. Kleber and Thomas R. Ruf
- J.T. Myers Lock Improvements Project Infrastructure Conference, by David Schaaf and Greg Werncke
- J.T. Myers Dam Major Rehab, by David Schaaf, Greg Werncke and Randy James
- Greenup L&D, by Rodney Cremeans
- McAlpine Lock Replacement Project, by Kathy Feger
- Roller Compacted Concrete Placement at McAlpine Lock, by Larry Dalton
- Kentucky Lock Addition Downstream Middle Wall Monolith Design, by Scott A. Wheeler
- London Locks and Dam Major Rehabilitation Project, by David P. Sullivan
- Replacing Existing Lock 4: Innovative Designs for Charleroi Lock, by Lisa R. Pierce, Dave A. Stensby and Steve R. Stoltz
- Olmsted L&D, Dam In-the-wet Construction, by Byron McClellan, Dale Berner and Kenneth Burg
- Olmsted Floating Approach Walls, by Terry Sullivan
- John Day Navigation Lock Monolith Repair, by Matthew D. Hanson
- Inner Harbor Navigation Canal (IHNC) Lock Replacement, by Mark Gonski
- Comite River Diversion Project, by Christopher Dunn
- Waterline Support Failure: A Case Study, by Angela DeSoto Duncan
- Public Appeal of Major Civil Projects: The Good, the Bad and the Ugly, by Kevin Holden and Kirk Sunderman
- Chickamauga Lock and Dam Lock Addition Cofferdam Height Optimization Study, by Leon A. Schieber
- Des Moines Riverwalk, by Thomas D. Heinold

Track 13

- Folsom Dam Evaluation of Stilling Basin Performance for Uplift Loading for Historic Flows and Modification of Folsom Dam
- Stilling Basin for Hydrodynamic Loading, by Rick L. Poeppelman, Yunjing (Vicky) Zhang, and Peter J. Hradilek
- Seismic Stress Analysis of Folsom Dam, by Enrique E. Matheu
- Barge Impact Analysis for Rigid Lock Walls ETL 1110-2-563, by John D. Clarkson and Robert C. Patev
- Belleville Locks & Dam Barge Accident on 6 Jan 05, by John Clarkson
- Portugues Dam Project Update, by Alberto Gonzalez, Jim Mangold and Dave Dollar
- Portugues Dam: RCC Materials Investigation, by Jim Hinds
- Nonlinear Incremental Thermal Stress Strain Analysis Portugues Dam, by David Dollar, Ahmed Nisar, Paul Jacob and Charles Logie
- Seismic Isolation of Mission-Critical Infrastructure to Resist Earthquake Ground Shaking or Explosion Effects, by Harold O. Sprague, Andrew Whitaker and Michael Constantino
- Obermeyer Gated Spillway S381, by Michael Rannie
- Design of High Pressure Vertical Steel Gates Chicago Land Underflow Plan McCook Reservoir, by Henry W. Stewart, Hassan Tondravi, Lue Tekola,
- Development of Design Criteria for the Rio Puerto Nuevo Contract 2D/2E Channel Walls, by Janna Tanner, David Shiver, and Daniel Russell
- Indianapolis NortIndianapolis North Phase 3A Warfleigh Section
- Design of Concrete Lined Tunnels in Rock CUP McCook Reservoir Distribution Tunnels Contract, by David Force

Track 14

- GSA Progressive Collapse Design Guidelines Applied to Concrete Moment-Resisting Frame Buildings, by David N. Bilow and Mahmoud E. Kamara,
- UFC 4-023-02 Retrofit of Existing Buildings to Resist Explosive Effects, by Jim Caulder
- Summit Bridge Fatigue Study, by Jim Chu
- Quality Assurance for Seismic Resisting Systems, by John Connor
- Seismic Requirements for Arch, Mech, and Elec. Components, by John Connor
- SBEDS - (Single degree of freedom Blast Effects Design Spreadsheets), by Dale Nebuda,
- Design of Buildings to Resist Progressive Collapse UFC 4-023-03, by Bernie Deneke,
- Fatigue and Fracture Assessment, by Jesse Stuart
- Unified Facilities Criteria: Seismic Design for Buildings, by Jack Hayes
- Evaluation and Repair Of Blast Damaged Reinforced Concrete Beams, by MAJ John L. Hudson
- Building an In-house Bridge Inspection Program
- United Facilities CriteriUnited Facilities Criteria Masonry Design for Buildings, by Tom Wright
- USACE Homeland Security Portal, by Michael Pace
- Databse Tools for Civil Works Projects

- Standard Procedure for Fatigue Evaluation of Bridges, by Phil Sauser
- Consolidation of Structural Criteria for Military Construction, by Steven Sweeney
- Cathodic Protectionfor the South Power Plant Reinforcing Steel, Diego Garcia, BIOT, by Thomas Tehada and Miki Funahashi

Track 15

- Engineering Analysis of Airfield Lighting System Lightning Protection, by Dr. Vladimir A. Rakov and Dr. Martin A. Uman
- Dr. Martin A. Uman
- Charleston AFB Airfield Lighting Vault
- UNIFIED FACILITIES CRITERIA (UFC) UFC 3-530-01 Design: Interior, Exterior Lighting and Controls, by Nancy Clanton and Richard Cofer
- Electronic Keycard Access Locks, by Fred A Crum
- Unified Facilities Criteria (UFC) 3-560-02, Electrical Safety, by John Peltz and Eddie Davis
- Electronic Security SystemElectronic Security Systems Process Overview
- Lightning Protection Standards
- Electrical Military Workshop
- Information Technology Systems Criteria, by Fred Skroban and John Peltz
- Electrical Military Workshop
- Electrical Infrastructure in Iraq- Restore Iraqi Electricity, by Joseph Swiniarski

Track 16

- BACnet® Technology Update, by Dave Schwenk
- The Infrastructur Conference 2005, by Steven M. Carter Sr. and Mitch Duke
- Design Consideration for the Prvention of Mold, by K. Quinn Hart
- COMMISSIONING, by Jim Snyder
- New Building Commissioning , by Gary Bauer
- Ventilation and IAQ TheNew ASHRAE Std 62.1, by Davor Novosel
- Basic Design Considerations for Geothermal Heat Pump Systems, by Gary Phetteplace
- Packaged Central Plants
- Effective Use Of Evaporative Cooling For Industrial And Institutional/Office Facilities, by Leon E. Shapiro
- Seismic Protection For Mechanical Equipment
- Non Hazardous Chemical Treatments for Heating and Cooling Systems, by Vincent F. Hock and Susan A. Drozdz
- Trane Government Systems & Services
- LONWORKS Technology Update, by Dave Schwenk
- Implementation of Lon-Based Specifications by Will White and Chris Newman

Track 17

- Utility System Security and Fort Future, by Vicki Van Blaricum, Tom Bozada, Tim Perkins, and Vince Hock
- Festus/Crystal City Levee and Pump Station
- Chicago Underflow Plan McCook Reservoir (CUP) Construction of Distribution Tunnel and Pumps Installation
- Technological Advances in Lock Control Systems, by Andy Schimpf and Mike Maher
- Corps of Engineers in Iraq Rebuilding Electrical Infrastructure, by Hugh Lowe
- Red River of the North at East Grand Forks, MN & Grand Forks, ND: Flood Control Project – Armada of Pump Stations Protect Both Cities, by Timothy Paulus
- Lessons Learned for Axial/Mixed Flow Propeller Pumps, by Mark A. Robertson
- Creek Automated Gate Considerations, by Mark A. Robertson
- HydroAMP: Hydropower Asset Management, by Lori Rux
- Acoustic Leak Detection for Water Distribution Systems, by Sean Morefield, Vincent F. Hock and John Carlyle
- Remote Operation System, Kaskaskia Dam Design, Certification, & Accreditation, by Shane M. Nieukirk
- Lock Gate Replacement System, by Shaun A. Sipe and Will Smith

Track 20

- “Re-Energizing Medical Facility Excellence”, by COL Rick Bond
- Rebuilding and Renovating The Pentagon , by Brian T. Dziekonski,
- Resident Management System
- Design-Build and Army Military Construction, by Mark Grammer
- Defense Acquisition Workforce Improvements Act - Update, by Mark Grammer
- Construction Management @ Risk: Incentive Price Revision – Successive Targets, by Christine Hendzlik
- Construction Reserve Matrix, by Christine Hendzlik
- Award contingent on several factors..., by Christine Hendzlik
- 52.216-17 Incentive Price Revision--Successive Targets (Oct 1997) - Alt I (Apr 1984), by Christine Hendzlik
- Preconstruction Services, by Christine Hendzlik
- Proposal Evaluation Factors, by Christine Hendzlik
- MILCON Transformation in Support of Army Transformation, by Claude Matsui
- Construction Practices in Russia, by Lance T. Lawton

- Partnering as a Best Practice, by Ray Dupont
- USACE Tsunami Reconstruction for USAID, by Andy Constantaras

Track 21

- Dredging Worldwide, by Don Carmen
- SpecsIntact Editor, by Steven Freitas
- SpecsIntact Explorer, by Steven Freitas
- American River Watershed Project, by Steven Freitas
- Unified Facilities Guide Specifications (UFGS) Conversion To MasterFormat 2004, by Carl Kersten
- Unified Facilities Guide Specifications (UFGS) Status and Direction , by Jim Quinn

Workshops

- Design of Buildings to Resist Progressive Collapse UFC 4-023-03, by Bernie Deneke
- Security Engineering and at Unified Facility Criteria (UFC), by Bernie Deneke, Richard Cofer, John Lynch and Rudy Perkey
- Packaged Central Plants, by Trey Austin

NATIONAL DEFENSE INDUSTRIAL ASSOCIATION

NDIA

STRENGTH THROUGH INDUSTRY & TECHNOLOGY

2005 Tri-Service Infrastructure Systems Conference & Exhibition

"Re-Energizing Engineering Excellence"

ON-SITE AGENDA

The America's Center
St. Louis Convention Center
St. Louis, MO
August 2-4, 2005
Event # 5150

ISC

Tri-Service Infrastructure Systems Conference & Exposition 2005

2005 Tri-Service Infrastructure Systems Conference & Exhibition

AGENDA

Monday, August 1, 2005

8:00 AM-9:00 PM	Exhibit Move-In
12 Noon-5:00 PM	Registration

Tuesday, August 2, 2005

7:00 AM-8:00 AM	Registration and Continental Breakfast
8:00 AM-8:15 AM Ferrara Theatre	Welcome and Introduction
8:15 AM-9:00 AM Ferrara Theatre	The Future of Engineering and Construction Panel Moderator: *Mr. Don Basham, Chief, Engineering & Construction, USACE* Panelists: *LTG Carl A. Strock, Commander, USACE* *Dr. James Wright, Chief Engineer NAVFAC*
9:00 AM-9:45 AM Ferrara Theater	Keynote Address The Lord of the Things: The Future of Infrastructure Technologies *Mr. Paul Doherty, AIA, Managing Director,* *General Land Corporation*
9:45 AM-10:15 AM	Break
10:15 AM-11:15 AM Ferrara Theatre	USACE Engineering and Construction Panel Moderator: *Mr. Don Basham, Chief, Engineering & Construction, USACE* Panelists: *MG Donald T. Riley, Director, Civil Works, USACE* *BG Bo M. Temple, Director, Military Programs, USACE* *Dr. Michael J. O'Connor, Director, R&D*
10:15 AM-11:15 AM Room 225	Navy General Session
11:00 AM - 7:00 PM	Exhibits Open
11:15 AM-1:00 PM	Lunch in Exhibit Hall (on your own)
11:15 AM-1:00 PM Washington G	Women's Career Lunch Session (Bring your lunch from Exhibit Hall) Moderator: *Ms. Demi Syriopoulou, HQ USACE* Opening Remarks: *LTG Carl A. Strock, Commander, USACE* Presentations & Discussion: *Dwight Beranek, Kristine Allaman, Donald Basham, HQ USACE*
1:00 PM-1:55 PM Ferrara Theatre	Introduction to Multi-Disciplinary Tracks

Tuesday, August 2, 2005

2:00 PM-2:50 PM — 1st Round of Multi-Disciplinary Concurrent Sessions (Continued)

Track 1: Acquisition Strategies for Civil Works
Room 230
Walt Norko

Track 2: Risk and Reliability Engineering
Room 231
Anjana Chudgar
David Schaaf

Track 3: Portfolio Risk Assessment
Room 232
Eric Halpin

Track 4: Hydrology, Hydraulics and Coastal Engineering Support for USACE
Room 240
Jerry Webb
Darryl Davis

Track 5: Civil Works R&D Forum
Room 241
Joan Pope

Track 6: Civil Works Security Engineering
Room 242
Joe Hartman
Bryan Cisar

Track 7: Building Information Model Applications
Room 226
Brian Huston
Daniel Hawk

Track 8: Design Build for Military Projects
Room 220
Mark Grammer

Track 9: Army Transformation/Global Posture Initiative/ Force Modernization
Room 221
Al Young
Claude Matsui

Track 10: Force Protection - Army Access Control Points
Room 222
John Trout

Track 11: Cost Engineering Forum on Government Estimates vs. Actual Costs
Room 227
Ray Lynn *Jack Shelton* *Kim Callan*
Miguel Jumilla *Ami Ghosh* *Joe Bonaparte*

Track 12: Engineering & Construction Information Technology
Room 228
MK Miles

Track 13: Sustainable Design
Room 223
Harry Goradia

Track 14: ACASS/CCASS/CPARS
Room 224
Ed Marceau
Marilyn Nedell

Track 15: Whole Building Design Guide
Room 229
Earle Kennett

Tuesday, August 2, 2005

2:50 PM-3:30 PM	Break in Exhibit Hall
3:30 PM-4:20 PM	2nd Round of Multi-Disciplinary Sessions
4:30 PM-5:20 PM	3rd Round of Multi-Disciplinary Sessions
5:30 PM-7:00 PM	Ice Breaker Reception in Exhibit Hall

Wednesday, August 3, 2005

7:00 AM-8:00 AM	Registration and Continental Breakfast
8:00 AM-9:30 AM	Concurrent Sessions (Please Refer to Concurrent Session Schedule on the Following Pages)
9:00 AM	Exhibit Hall Opens
9:30 AM-10:30 AM	Break in Exhibit Hall
10:30 AM-12:00 Noon	Concurrent Sessions (Please Refer to Concurrent Session Schedule on the Following Pages)
12:00 Noon-1:30 PM	Lunch in Exhibit Hall
1:30 PM-3:00 PM	Concurrent Sessions (Please Refer to Concurrent Session Schedule on the Following Pages)
3:00 PM-4:00 PM	Break in Exhibit Hall
4:00 PM-5:30 PM	Concurrent Sessions
5:00 PM	Exhibit Hall Closes

Thursday, August 4, 2005

7:00 AM-8:00 AM	Registration and Continental Breakfast
8:00 AM-9:30 AM	Concurrent Sessions (Please Refer to Concurrent Session Schedule on Following Pages)
9:30 AM-10:30 AM	Break in Exhibit Hall (Last Chance to view Exhibits)
10:30 AM-12:00 Noon	Concurrent Sessions (Please Refer to Concurrent Session Schedule on Following Pages)
12:00 Noon-1:30 PM	Lunch (On your own)
12:00 Noon-6:00 PM	Exhibits Move-Out
1:30 PM-3:00 PM	Concurrent Sessions (Please Refer to Concurrent Session Schedule on Following Pages)
3:00 PM-3:30 PM	Break
3:30 PM-5:00 PM	Concurrent Sessions (Please Refer to Concurrent Session Schedule on following pages)

Wednesday, August 3, 2005 Concurrent Sessions

HH&C Track

	8:00 AM	8:30 AM	9:00 AM	9:30 AM	10:30 AM	11:00 AM	11:30 AM
Room 220	**TRACK 1 Coastal Structures** Session 1A	Protecting the NJ Coast using large stone seawalls — *Cameron Chasten*	Chicago shoreline storm damage reduction project — *Andrew Bezinger*	Risk and reliability in coastal structure design — *Jeffrey Melby*	**TRACK 1 Coastal Regional Manangement** Session 1B	Cascade: An integrated regional model for decision support — *Nicholas Kraus*	Upper Texas coast sediment transport modeling & sediment budgets — *David King*	Sediment compatibility for beach nourishment in North Carolina — *Gregory Williams*
Room 221	**TRACK 2 Ecological Engineering & Design** Session 2A	Ecological and engineering considerations for dam decommissioning, retrofits and operations — *Jock Conyngham*	Hydraulic design of tidegates and other water control structures for ecosystem restoration on the Columbia Estuary — *Patrick O'Brien*	Innovative Integration of engineering and biological tools aids hydraulic structure design for restoring T&E fish — *Andrew Goodwin*	**TRACK 2 Ecological Engineering & Design** Session 2B	Innovative hydraulic structure design at Lower Granite Dam: design that saves water and salmon — *Lynn Reese*	Impacts of using a spillway for juvenile fish passage on typical design criteria — *Robert Buchholz*	Hydraulic design of juvenile fish passage facility for reservoir with wide range of pool elevation - Hanson Dam — *Dennis Mekkers*
Room 222	**TRACK 3 Modeling** Session 3A	Corps involvement in the FEMA map modernization program — *Kete White*	Innovative approximate study method for FEMA map modernization program — *John Hunter*	Flood fight structures demonstration evaluation program — *Fred Pinkard*	**TRACK 3 Modeling** Session 3B	Integrating climate dynamics into water resources planning and management — *Kate White*	Risk and uncertainty in flood damage reduction studies — *Rob Moyer*	Uncertainty analysis and stochastic simulation — *Jacke Hallberg*
Room 223	**TRACK 4 H&H Aspects of Dam Safety** Session4A	Hydrologic aspects of operating in failure mode: Fern Lake — *Bruce Duffe*	Dam safety study with cascading failures — *Gordon Lance*	Rough river spillway capacity — *Richard Pruitt*	**TRACK 4 International/ Military H&H** Session 4B	Capability restoration and historic marsh restoration — *Fauwaz Hanbali*	USACE capacity building effort for Iraq MoWR — *Steven Wilhelms*	USACE support of CMEP in 2004 — *Mark Jensen*

Break in Exhibit Hall

12 Noon — **Lunch in Exhibit Hall**

	1:30 PM	2:00 PM	2:30 PM	3:00 PM	4:00 PM	4:30 PM	5:00 PM
Room 220	**TRACK 1 Coastal Sediments** Session 1C	Evaluating beachfill project performance in the NAP — *Monica Chasten*	USACE's regional coastal mapping program — *Jennifer Wozencraft*	US Naval Academy flood damage reduction project using structural and non-structural measures — *Stacey Underwood*	**TRACK 1 Shore Protection Projects** Session 1D	Hurricane Isabel effects on communities — *Jane Jablonski*	Repair of the shore protection projects adversly affected by the hurricanes of 2004 — *Rick McMillen*	Shore protection project performance assessmet — *Sharon Haggett*
Room 221	**TRACK 2 Modeling Ecological Restoration/Systems Assessment** Session 2C	Regional modeling requirements for ecosystem restoration — *Maged Hussein*	Tools for wetlands permit evaluation: Modeling groundwater and surface water distribution systems — *Cary Talbot*	Current research in fate and transport of chemical and biological contaminants in water distribution systems — *Mark Ginsberg*	**TRACK 2 Ecosystem Habitat Restoration** Session 2D	Aquatic habitat restoration in the lower Missouri River — *Chance Bittner*	Missouri River restoration: shallow water habitat creation — *Daniel Pridal*	Ecosystem restoration for fish and wildlife habitat on the upper Mississippi River — *Jon Hendrickson*
Room 222	**TRACK 3 River Morphology** Session 3C	Geomorphology study of the Mississippi river — *Edward Braurer*	Bank erosion and morphology of the Kaskaskia river — *Michael Rodgers*	Sediment movement at Kansas City from water years 1920 to 2004 — *Alan Tool*	**TRACK 3 Modeling River Sedimentation** Session 3D	Sediment impact assessment model (SIAM) — *David Biedenharn*	Sediment modeling of MS River, Cairo to Gulf — *Basil Arthur*	Sediment modeling of rivers — *Charlie Berger*
Room 223	**TRACK 4 GIS and Surveying** Session 4C	GIS tools available now to support HHC — *Timothy Pangburn*	High resolution bathymetry and fly-through visualization — *Paul Clouse*	GIS & surverying to support national FEMA — *Mark Flick*	**TRACK 4 GIS and Surveying** Session 4D	Update flood emergency plans with GIS and HEC-RAS — *Stephen Stello*	High resolution visualizations of multibeam data: lower Mississippi River — *Thomas Tobin*	GIS in SWWRP — *Andrew Bruzewicz*

Break in Exhibit Hall

Wednesday, August 3, 2005 Concurrent Sessions

Geotechnical Track

	8:00 AM	8:30 AM	9:00 AM	9:30 AM	10:30 AM	11:00 AM	11:30 AM
Room 226	**TRACK 5** Session 5A	Levee lowering for the Lewis & Clark bi-centennial celebration ***Robert Berger***	Conduits through embankment dams - best practices for design, construction, problem id and evaluation, inspection, maintenance, renovation & repair ***Dave Pezza***	Design, construction and seepage at Prado Dam, CA ***Douglas Chitwood***	**TRACK 5** Session 5B	2-D liquefaction evaluation with q4MESH ***David Serafini***	Unlined spillway erosion risk assessment ***Johannes Wibowo***	Seismic remediation of the Clemson upper and lower diversion dams: evaluation, conceptal design and design (P1) ***Ben Foreman***
Room 227	**TRACK 6** Session 6A	USACE dams on solution susceptible or highly fractured rock foundations ***Art Walz***	Special drilling and grouting techniques for remedial work in embankment dams ***Doug Heenan***	Composite grouting & cutoff wall solutions ***Donald Bruce***	**TRACK 6** Session 6B	State of the art in grout mixes ***James Davies***	State of the art in computer monitoring, control, and analysis of grouting ***Trent Dreese***	Quantitatively engineered grout courtains ***David Wilson***
Room 228	**TRACK 7** Session 7A	Case history: multiple axial statnamic test on a drilled shaft embedded in shale ***Paul Axtell***	Austin Dam, Pennsylvania: the sliding failure of a concrete gravity dam revisited ***Brian Greene***	M^3 (Modeling, Monitoring and Manufacturing) - a comprehensive approach to controlling ground movements for protecting existing structures and facilities ***Michael Walker***	**TRACK 7** Session 7B	Controlled modulus columns: A ground improvement technique ***Martin Taube***	Time-dependent reliability models for use in major rehabilitation of embankment dams and foundations ***Robert Patev***	Engineering geology design challenges at the Soo Lock replacement project ***Mike Nield***
Room 229	**TRACK 8** Session 8A	Evaluation of the use of lithium nitrate in controlling alkali-silica reactivity in an existing concrete pavement ***Mike Kelly***	Use of self-consolidating concrete in the installation of bulhead slots - Lessons learned in the use of this innovative concrete material ***Darrell Morey***	Roller compacted concrete for McAlpine lock walls ***David Kiefer***	**TRACK 8** Session 8B	Soil-cement for stream bank stabilization ***Wayne Adaska***	Using cement to reclaim asphalt pavements ***David Luhr***	Valley park 100-year flood protection project: use of "engineered fill" in item 4b levee core ***Patrick Conroy***

Break in Exhibit Hall

12 Noon — **Lunch in Exhibit Hall**

	1:30 PM	2:00 PM	2:30 PM	3:00 PM	4:00 PM	4:30 PM	5:00 PM
Room 226	**TRACK 5** Session 5C	Seismic remediation of the Clemson upper and lower diversion dams: deep soil mix construction ***Ben Foreman***	Historical changes in the state-of-the-art of seismic engineering & effects of those changes on the seismic response studies of large embankement dams ***Samuel Stacy***	New Iwakuni runway ***Vincent Donnally***	**TRACK 5** Session 5D	Internal erosion and piping at Fern Ridge dam: Problems and solutions ***Jeremy Britton, Ph.D.***	Rough river dam safety assurance project ***Timothy O'Leary***	Seepage collection and control systems: The devil is in the details ***John France***
Room 227	**TRACK 6** Session 6C	Grout courtains at Arkabutla Dam outlet monolith joints using chemical grout to seal joints, Arkabutla, MS ***Dale Goss***	Results from a large-scale grout test program, Chicago underflow plan (CUP) McCook Reservoir ***Joseph Kissane***	Clearwater Dam - foundation drilling and grouting for repair of sinkholes ***Mark Harris***	**TRACK 6** Session 6D	Update on the investigation of the effects of boring sample size (3' vs 5") on measured cohesion in soft clays ***Richard Pinner***	Soil-bentonite cutoff wall through free-product at Indiana Harbor CDF ***Joseph Schulenberg***	Soil-bentonite cutoff wall through dense alluvium with boulders into bedrock, McCook Reservoir ***William Rochford***
Room 228	**TRACK 7** Session 7C	Engineering geology during design and construction of the Marmet lock project ***Michael Nield***	Mill Creek deep tunnel - Geological affects on proposed structures and construction techniques ***Tres Henn***	Earth pressure loads behind the new McAlpine Lock replacement project ***Troy O'Neal***	**TRACK 7** Session 7D	Geosynthetics and construction of the Bonneville lock and dam second powerhouse corner collector surface flow bypass project ***Art Fong***	McAlpine lock replacement - foundation characteristics and excavation ***Kenneth Henn***	
Room 229	**TRACK 8** Session 8C	What to do if your dam is expanding: a case study ***Greg Yankey***	Unpaved road stabilization with chlorides ***Michael Mitchell***	Use of ultra-fine amorphous colloidal silica to produce a high-density, high-strength rock-matching grout for instrumentation grouting ***Brian Green***	**TRACK 8** Session 8D	Innovative techniques in the Gabion system ***George Ragazzo***	Addressing cold regions issues in pavement engineering ***Lynette Barna***	Geology of New York Harbor - geological and geophysical methods of characterizing the stratigraphy for dredging contracts ***Ben Baker***

Break in Exhibit Hall

Wednesday, August 3, 2005 Concurrent Sessions

Structural Engineering Track

	8:00 AM	8:30 AM	9:00 AM	9:30 AM	10:30 AM	11:00 AM	11:30 AM
Room 240	**TRACK 12** Civil Works Structural	Recent changes to Corps guidance on steel hydraulic structures	Crack repairs and instrumentation of Greenup L&D miter gate	Recent hydraulic steel structures findings in the Portland district	**TRACK 12** Civil Works Structural	Perry Lake gate repair	Mel Price auxiliary lock gate repair	Mel Price auxiliary lock gate repair (Continued)
	Session 12A	*Joe Padula*	*Doug Kish*	*Travis Adams*	**Session 12B**	*Marvin Parks*	*Andrew Schimpf*	*Andrew Schimpf*
Room 241	**TRACK 13** Civil Works Structural	Folsom Dam evaluation of stilling basin performance for uplift loading for historic flows	Rehabilitation of Folsom Dam stilling basin	Seismic stability evaluation of Folson Dam	**TRACK 13** Civil Works Structural	Seismic stress analysis of Folsom Dam	Barge impact guidance for rigid lock walls, ETL 110-2-563 and probalistic barge impact analysis	Belleville barge accident
	Session 13A	*Rick Poeppelman*	*Rick Poeppelman*	*Enrique Matheu*	**Session 13B**	*Enrique Matheu*	*John Clarkson*	*John Clarkson*
Room 242	**TRACK 14** Bridges/ Buildings	The USACE bridge management system	Standard procedures for fatigue evaluation of bridges	Fatigue and fracture assessment of Jesse Stuart Highway Bridge	**TRACK 14** Bridges/ Buildings	Building an in-house bridge inspection program	Fatigue analysis of Summit bridge	Consolidation of Structural criteria for military construction
	Session 14A	*Phil Sauser*	*Phil Sauser*	*John Jaeger*	**Session 14B**	*Jennifer Laning*	*Jim Chu*	*Steve Sweeney*

Break in Exhibit Hall

12 Noon — **Lunch in Exhibit Hall**

	1:30 PM	2:00 PM	2:30 PM	3:00 PM	4:00 PM	4:30 PM	5:00 PM
Room 240	**TRACK 12** Civil Works Structural	Overview of John T. Myers locks improvements project	John T. Myers rehabilitation study	Ohio River Greenup Lock extension	**TRACK 12** Civil Works Structural	McAlpine lock replacement project, project summary and status of construction	Results of Roller Compacted concrete placement at the McAlpine lock replacement project	Tennessee Valley authority Kentucky lock addition downstream middle wall monoliths
	Session 12C	*Greg Werncke*	*Greg Werncke*	*Rodney Cremeans*	**Session 12D**	*Kathleen Feger*	*Larry Dalton*	*Scott Wheeler*
Room 241	**TRACK 13** Civil Works Structural	Portugues Dam, Ponce, Puerto Rico project update	Portugues Dam, Ponce, Puerto Rico, RCC design and testing program	Portugues Dam, Ponce, Puerto Rico, Thermal analysis of hydration and subsequent cooling of RCC	**TRACK 13** Civil Works Structural	Miter gate anchorage design	Obermeyer gated spillway project - S381	McCook Reservoir design of high pressure steel gates
	Session 13C	*Jim Mangold*	*Jim Hinds*	*Ahmed Nisar*	**Session 13D**	*Andy Harkness*	*Michael Rannie*	*Luelseged Tekola*
Room 242	**TRACK 14** Brigdes/ Buildings	Unified facilities criteria seismic design for buildings	Seismic requirements for architectural, mechanical and electrical components	Quality assurance for seismic resisting systems	**TRACK 14** Bridges/ Buildings	Unified facilities criteria masonry structural design for buildings	Cathodic protection of building reinforcing steel (in Diego Garcia)	USACE Homeland security web portal
	Session 14C	*Jack Hayes*	*John Connor*	*John Connor*	**Session 14D**	*Tom Wright*	*Thomas Tehada*	*Mike Pace*

Break in Exhibit Hall

Wednesday, August 3, 2005 Concurrent Sessions

Dam Safety Track & Construction Track

	8:00 AM	8:30 AM	9:00 AM	9:30 AM	10:30 AM	11:00 AM	11:30 AM
Room 224	**TRACK 10 Dam Safety**	Tuttle Creek warning and alert systems	Lessons from the dam failure warning system exercise - Tuttle Creek	Tuttle Creek ground modification treatability program	**TRACK 10 Dam Safety**	Dam safety analysis of Cannelton Dam	John Martin Dam, CO - Dam safety structural upgrades	Vesuvius Lake Dam rehabilitation
	Session 10A	***Bill Empson***	***Bill Empson***	***Bill Empson***	**Session 10B**	***Terry Sullivan***	***George Diewald***	***Susan Peterson***
Room 225	**TRACK 11 Dam Safety**	Canton lake spillway stabilization project: IS a test anchor program NECESSARY?	Dynamic testing and numerical correlation studies for Folsom dam	Status of portfolio risk assessment	**TRACK 11 Dam Safety**	Mississinewa Dam remediation	Wolf creek seepage history	Blue dam major rehabilitation
	Session 11A	***Randy Mead***	***Ziyad Duron***	***Eric Halpin***	**Session 11B**	***Jeff Schaefer***	***Michael Zoccola***	***Michael McCray***
Room 230	**TRACK 19 Construction**	RMS Update	RMS Update (Continued)	Updated CQM for Contractors Course	**TRACK 19 Construction**	Lessons learned on major construction projects	Update on safety issues - Safety manual 385-1-1	Update on safety issues - safety manual 385-1-1 (continued)
	Session 19A	***Haskell Barker***	***Haskell Barker***	***Walt Norko***	**Session 19B**	***Jim Cox***	***Charles Ray Waits***	***Charles Ray Waits***
Room 231	**TRACK 20 Construction**	Construction methods in Russia	Construction methods in Russia (Continued)	Renovating the Pentagon using Design/Build delivery	**TRACK 20 Construction**	Completion of the Olmsted approach walls	Completion of the Olmsted approach walls (Continued)	Construction management at risk
	Session 20A	***Lance Lawton***	***Lance Lawton***	***Brian Dziekonski***	**Session 20B**	***Dale Miller***	***Dale Miller***	***Christopher Prinslow***

Break in Exhibit Hall

12 Noon **Lunch in Exhibit Hall**

	1:30 PM	2:00 PM	2:30 PM	3:00 PM	4:00 PM	4:30 PM	5:00 PM
Room 224	**TRACK 10 Dam Safety**	Project specific risk analysis - Success Dam	Dam safety lessons learned, Winter storm 2005, Muskingum & Scioto Basins	Dam security and Dams Government Coordinating Council	**TRACK 10 Dam Safety**	Prompton Dam hydrologic deficiency and spillway modification	"Well, that's water over the dam" - Rough River spillway adequacy design	Roller-compacted concrete for dam spillways and overtopping protection
	Session 10C	***Ronn Ross***	***Charles Barry***	***Roy Braden***	**Session 10D**	***Troy Cosgrove***	***Richard Pruitt***	***Fares Abdo***
Room 225	**TRACK 11 Dam Safety**	Clearwater Dam major rehabilitation	Success dam seismic dam safety modification	Problems on the Santa Ana River - Prado Dam	**TRACK 11 Dam Safety**	Problems on the Santa Ana River - Seven Oaks Dam	Dam safety program management tools	
	Session 11C	***Bobby Van Cleave***	***Norbert Suter***	***Douglas Chitwood***	**Session 11D**	***Robert Kwan***	***Tommy Schmidt***	
Room 230	**TRACK 19 Construction**	3D Modeling and impact on constructability	3D Modeling and impact on constructability (Continued)	Construction in Iraq & Afganistan	**TRACK 19 Construction**	Air Force streamlining Design/Build	Air Force streamlining Design/Build (Continued)	Sustainable design requirements & construction implementation
	Session 19C	***Gary Cough***	***Gary Cough***	***Walt Norko***	**Session 19D**	***Joel Hoffman***	***Joel Hoffman***	***Harry Goradia***
Room 231	**TRACK 20 Construction**	Tsunami reconstruction	Tsunami reconstruction (Continued)	Military construction transformation in support of Army transformation	**TRACK 20 Construction**	MEDCOM Construction Issues	MEDCOM Construction Issues (Continued)	*TBA*
	Session 20C	***Andy Constantaras***	***Andy Constantaras***	***Sally Parsons***	**Session 20D**	***Rick Bond***	***Rick Bond***	

Break in Exhibit Hall

Wednesday, August 3, 2005 Concurrent Sessions

Electrical & Mechanical Engineering Track

	8:00 AM	8:30 AM	9:00 AM	9:30 AM	10:30 AM	11:00 AM	11:30 AM
Room A	**TRACK 15** Military Electrical	Tri-Service Electrical Criteria Overview -	Tri-Service Electrical Criteria Overview - (Continued)	Tri-Service Electrical Criteria Overview -(Continued)	**TRACK 15** Military Electrical	Interior/Exterior and security lighting criteria	Information technology systems criteria	Information technology systems criteria (Continued)
	Session 15A	*Tri-Service Panel*	*Tri-Service Panel*	*Tri-Service Panel*	**Session 15B**	*Tri-Service Panel*	*Tri-Service Panel*	*Tri-Service Panel*
Room B	**TRACK 16** Military Mechanical	Building Commissioning	HVAC Commissioning	Ventilation and indoor air quality	**TRACK 16** Military Mechanical	Ventilation and indoor air quality (Continued)	Refrigerant implications for HVAC specifications, selection, and o&m - now and future	Refrigerant implications for HVAC specifications, selection, and o&m - now and future (Continued)
	Session 16A	*Dale Herron*	*Dale Herron*	*Davor Novosel*	**Session 16B**	*Davor Novosel*	*Mike Thompson*	*Mike Thompson*
Room D	**TRACK 17** Military Mechanical / Electrical	Sustainable design update			**TRACK 17** Military Mechanical / Electrical	Utility systems security and fort future	Acoustic leak detection for utilities distribution systems	Acoustic leak detection for utilities distribution systems (Continued)
	Session 17A	*Harry Goradia*			**Session 17B**	*Vicki L. Van Blaricum*	*Sean Morefield*	*Sean Morefield*
Room E	**TRACK 18** Civil Mechanical	Emsworth Dam vertical lift gate hoist replacement	Hydraulic drive for Braddock Dam	John Day navigation lock upstream lift gate wire rope failure	**TRACK 18** Civil Mechanical	Overhead bulkhead at Olmstead Lock	Replacement of gate # 5 intermediate gear and pinion at RC Byrd Lock and Dam	Mechanical design issues during construction of McAlpine Lock
	Session 18A	*John Nites*	*Janine Krempa*	*Ronald Wridge*	**Session 18B**	*Rick Schultz*	*Brenden McKinley*	*Richard Nichols*

Break in Exhibit Hall

12 Noon **Lunch in Exhibit Hall**

	2:00 PM	2:30 PM	3:00 PM	3:30 PM	4:00 PM	4:30 PM	5:00 PM
Room A	**TRACK 15** Military Electrical	Mass notification system	Mass notification system (Continued)	Electronic card access locks	**TRACK 15** Military Electrical	Lightning protection standards	Lightning and surge protection	Lightning and surge protection (Continued)
	Session 15C	*Tri-Service Panel*	*Tri-Service Panel*	*Fred Crum*	**Session 15D**	*Richard Bouchard*	*Tri-Service Panel*	*Tri-Service Panel*
Room B	**TRACK 16** Military Mechanical	Basic design considerations for geothermal heat pump systems	Basic design considerations for geothermal heat pump systems (Continued)	Pentagon renovation	**TRACK 16** Military Electrical	Effective use of evaporative cooling for industrial and institutional/office facilities	Efective use of evaporative cooling for industrial and institutional/office facilities (Continued)	Non-hazardous chemical treatments for heating and cooling systems
	Session 16C	*Gary Phetteplace*	*Gary Phetteplace*	*Mitch Duke*	**Session 16D**	*Leon Shapiro*	*Leon Shapiro*	*Vincent Hock*
Room D	**TRACK 17** Civil Mechanical / Electrical	Hydropower asset management partnership (hydroAMP)	New gas fueled/diesel fueled turbine powered electrical generating station in Iraq	The construction of distribution tunnels and pump installation for the metropolitan Chicago sewer systems	**TRACK 17** Civil Mechanical / Electrical	The Festus/Crystal City levee and pump station project	Remote operations for Kaskaskia Dam	Technological advances in lock control systems
	Session 17C	*Lori Rux*	*Lester Lowe*	*Ernesto Go*	**Session 17D**	*Stephen Farkas*	*Shane Nieukirk*	*Andy Schimpf*
Room E	**TRACK 18** Civil Mechanical	New coating products for civil works structures	New guide specification for procurement of turbine oils	Synchronous condensing with large Kaplan turbine - A case study	**TRACK 18** Civil Mechanical	Acquifer storage and recovery (ASR) system	Wastewater infrastructure improvements in Appalachia	Storm water pumps
	Session 18C	*Al Beitelman*	*John Micetic*	*Brian Moentenich*	**Session 18D**	*Gerald Deloach*	*James Sadler*	*Thomas Jamieson*

Break in Exhibit Hall

Thursday, August 4, 2005 Concurrent Sessions

HH&C Track

	8:00 AM	8:30 AM	9:00 AM	9:30 AM	10:30 AM	11:00 AM	11:30 AM
Room 220	**TRACK 1 Sedimentation & New Concepts** Session 1E	Ice jams, contaminated sediment and structures Clark Fork River, MT — *Andrew Tuthill*	Increased bed erosion due to ice — *John Hains*	Monitoring the Mississippi River using GPS coordinated video — *James Gutshall*	**TRACK 1 Sedimentation, Case Examples** Session 1F	Watershed approach to stream stability the reduction of nutrients — *John B. Smith*	Monitoring the effects of sedimentation from Mount St. Helen — *Alan Donner*	Navigation and environmental interests in alleviating repetitive dredging — *Jason Brown*
Room 221	**TRACK 2 Water Management** Session 2E	Enhancements and new capabilities of HEC-ResSim 3.0 — *Fauwaz Hanbali*	Transition to Oracle based data system — *Joel Asunskis*	Accessing real time Mississippi Valley water level data — *Rich Engstrom*	**TRACK 2 Water Management** Session 2F	Hurricane Season 2004 — *Susan Sylvester*	Reevaluation of a project's flood control benefits — *Ferris Chamberlin*	Helmand Valley water management plan — *Jason Needham*
Room 222	**TRACK 3 Case Studies** Session 2E	Red River of the north flood protection project — *Michael Lesher*	Southeast Arkansas flood control & water supply feasibility study — *Thomas Brown*	McCook and Thorton tunnel and reservoir modeling — *David Kiel*	**TRACK 3 Case Studies** Session 3F	Ala Wai Canal Project, Honolulu, Oahu, Hawaii — *Lynnette Schapers*	Missouri River geospatial decision support framework — *Brian Baker*	Systemic analysis of the Mississippi & Illinois Rivers — *Dennis Stephens*
Room 223	**TRACK 4 Modeling** Session 4E	Hydrologic models supported by ERDC — *Robert Wallace*	HEC-HMS Version 3.0 new features — *Jeff Harris*	SEEP2D & GMS: Simple tools for solving a variety of seepage problems — *Clarissa Hansen*	**TRACK 4 Modeling** Session 4F	Water quality and sediment transport in HEC-RAS — *Mark Jensen*	Advances to the GSSHA program — *Aaron Byrd*	Software integration for watershed studies HEC-WAT — *Chris Dunn*

Break in Exhibit Hall

12 Noon — **Lunch**

	1:30 PM	2:00 PM	2:30 PM	3:00 PM	3:30 PM	4:00 PM	4:30 PM
Room 220	**TRACK 1 Water Quality Management** Session 1G	San Francisco Bay Mercury TMDL-Implications for constructed wetlands — *Herb Fredrickson*	Abandoned mine land: Eastern and Western perspectives — *Kate White*	A lake tap for temperature control tower construction at Cougar Dam — *Steve Schlenker*	**TRACK 1 Watershed Management** Session 1H	Demonstrating innovative river restoration technologies: Truckee River, NV — *Chris Dunn*	Comprehensive watershed restoration in the Buffalo district — *Anthony Friona*	Translating the hydrologic tower of Babel — *Dan Crawford*
Room 221	**TRACK 2 Water Management** Session 2G	Developing reservoir operation plans to manage erosion — *Patrick O'Brien*	New approaches to water management decision making — *James Barton*	Improved water supply forecasts for Kooteny basin using principal components regression — *Randal Wortman*	**TRACK 2 Water Management** Session 2H	Prescriptive reservoir modeling and ROPE study — *Jason Needham*	Missouri River mainstem operations — *Larry Murphy*	Res-Sim model for the Columbia River — *Arun Mylvahanan*
Room 222	**TRACK 3 Section 227** Session 3G	Section 227 Workshop/ Program Review — *William Curtis*	Section 227 Workshop/ Program Review (Continued) — *William Curtis*	Section 227 Workshop/ Program Review (Continued) — *William Curtis*	**TRACK 3 Section 227** Session 3H	Section 227 Workshop/ Program Review — *William Curtis*	Section 227 Workshop/ Program Review (Continued) — *William Curtis*	Section 227 Workshop/ Program Review (Continued) — *William Curtis*
Room 223	**TRACK 4 Modeling** Session 4G	Little Calumet River unsteady flow model conversion — *Rick Ackerson*	Kansas City River basin model — *Edward Parker*	Design guidance for breakup ice control — *Andrew Tuthill*	**TRACK 4 Modeling** Session 4H	Forebay flow simulations using Navier-Stokes code — *Charlie Berger*	Use of regularizatino as a method for watershed model calibration — *Brian Skahill*	Demonstration program in the arid southwest — *Margaret Jonas*

Break

Thursday, August 4, 2005 Concurrent Sessions

Geotechnical Track

	8:00 AM	8:30 AM	9:00 AM	9:30 AM	10:30 AM	11:00 AM	11:30 AM
Room 226	**TRACK 5**	Dynamic deformation analyses Dewey Dam Huntintong District Corps of Engineers	Seismic stability evaluation for Ute Dam, NM	An overview of criteria used by various organizations for assessments and seismic remediation of earth dams	**TRACK 5**	USACE seepage berm design criteria and district practices	Ground penetrating radar applications for the assessment of airfield pavements	Challenges of the Fernando Belaunde Terry road upgrade Campanillia to Pizana - Peru road project
	Session 5E	***Greg Yankey***	***John France***	***Sean Carter***	**Session 5F**	***George Sills***	***Lulu Edwards***	***Michael Wielputz***
Room 227	**TRACK 6**	Small geotechnical project, big stability problem - The Block Church Road experience	Geophysical investigation of foundation conditions beneath Folsom Dam	Bioengineering slope stabilization techniques coupled with traditional engineering applications - The result a stable slope	**TRACK 6**	Shoreline armor stone quality issues	Mill Creek - An urban flood control challenge	Next stop, The Twilight Zone
	Session 6E	***Jonathan Kolber***	***Jose Llopis***	***Bethany Bearmore***	**Session 6F**	***Joseph Kissane***	***Monica Greenwell***	***Troy O'Neal***
Room 228	**TRACK 7**	The geotechnical and structural issues impacting the Dalles spillway construction	The Dalles spillway engineering and design	The future of the discrete element method in infrastructure analysis	**TRACK 7**	Evaluating the portable falling weight deflectometer as a low-cost technique for posting seasonal load restrictions on low volume payments	Soil structure interaction effects in the seismic evaluation of success dam control tower	Olmsted locks and Dam project geotechnical/construction issues
	Session 7E	***Kristie Hartfeil***	***Kristie Hartfeil***	***Raju Kala***	**Session 7F**	***Maureen Kestler***	***Michael Sharp***	***Jeff Schaefer***
Room 229	**TRACK 8**	Rubblization of airfield concrete pavement	US Army airfield pavement assessment program	Critical state for probabilistic analysis of levee underseepage	**TRACK 8**	Curing practices for modern concrete construction	AAR at Carters Dam, a different approach	Concrete damage at Carters Dam, GA
	Session 8E	***Eileen Velez-Vega***	***Haley Parsons***	***Douglas Crum***	**Session 8F**	***Toy Poole***	***James Sanders***	***Toy Poole***

Break in Exhibit Hall

12 Noon — **Lunch**

	1:30 PM	2:00 PM	2:30 PM	3:00 PM	3:30 PM	4:00 PM	4:30 PM
Room 226	**TRACK 5**	Slope stability evaluation of the Baldhill Dam right abutment	Lateral pile load test results within a soft cohesive foundation	Design and construction of anchored bulheads for river diversion, Seabrook, NH	**TRACK 5**	Characterization of soft marine clays - A case study at Craney Island	50 years of NRSC experience with engineering problems caused by dispersive clays	Changes in the post-tensioning institutes new (4th Ed. 2004) "Recommendations for prestressed rock and soil anchors"
	Session 5G	***Neil Schwanz***	***Richard Varuso***	***Siamac Vaghar***	**Session 5H**	***Aaron Zdinak***	***Danny McCook***	***Michael McCray***
Room 227	**TRACK 6**	Perils in back analysis failures	Reconstruction of deteriorated lock walls concrete after blasting and other demolition removal techniques	Flood fighting structures demonstrations and evaluation program	**TRACK 6**	Innovative design concepts incorporated into a landfill closure and reuse design	Laboratory testing of flood fighting structures	Bluff stabilization along Lake Michigan using active and passive dewatering techniques
	Session 6G	***Greg Yankey***	***Steve O'Connor***	***George Sills***	**Session 6H**	***Dave Ray***	***Johannes Wibowo***	***Eileen Glynn***
Room 228	**TRACK 7**	Geotechnical instrumentation and foundation re-evaluation of John Day lock and Dam, Columbia River, Oregon-Washington	A study of the long term performance of seepage cutoff barriers in dams	Design, construction, and performance of seepage barriers for Guanella Dam, near Empire, CO	**TRACK 7**	Sensitive infrastructure sites and structures - Sonic drilling offers quality control and non-destructive advantages to geotechnical construction drilling	Subgrade failure criteria according to soil type and moisture condition	The automated stability monitoring of the Mississippi River levees using the range scan system
	Session 7G	***David Scofield***	***John Rice***	***John France***	**Session 7H**	***John Davis***	***Edel Cortez***	***Robert Jolissian***
Room 229	**TRACK 8**	Damaging interactions among concrete materials	Economic effects on construction of uncertainty in test methods	Major issues in materials specifications	**TRACK 8**	Spall and intermediate-sized repairs for PCC pavements	Acceptance criteria for unbonded aggregate road surfacing materials	Effective partnering to overcome an interruption in the supply of Portland cement during construction of Marmet lock and Dam
	Session 8G	***Toy Poole***	***Toy Poole***	***Toy Poole***	**Session 8H**	***Reed Freeman***	***Reed Freeman***	***Billy Neeley***

Break

Thursday, August 4, 2005 Concurrent Sessions

Geotechnical, Specifications, Electrical & Mechanical Engineering & Construction Tracks

	8:00 AM	8:30 AM	9:00 AM	9:30 AM	10:30 AM	11:00 AM	11:30 AM
Room 225	**TRACK 9 Geotechnical**	Seepage Committee Meeting	Seepage Committee Meeting (Continued)	Seepage Committee Meeting (Continued)			
	Session 9E	***GROUP DISCUSSION***	***GROUP DISCUSSION***	***GROUP DISCUSSION***	**TRACK 9 Geotechnical**	GMCoP Forum	GMCoP Forum (Continued)	GMCoP Forum (Continued)
					Session 9F	***GROUP DISCUSSION***	***GROUP DISCUSSION***	***GROUP DISCUSSION***
Room 232	**TRACK 21 Specifications**	SpecsIntact-Demonstration of the SI explorer, publishing to PDF and Word	SpecsIntact - Demonstration of the SI editor, UMRL and reference wizard	UFGS status and direction			
	Session 21E	***Patricia Robinson***	***Patricia Robinson***	***Jim Quinn***	**TRACK 21 Specifications**	UFGS transitin to Master-Format 2004	Project specifications for the upper tier Folsom outlet works modifications	UFGS dredging
					Session 21F	***Carl Kersten***	***Steve Freitas***	***Don Carmen***
Room A	**TRACK 15 Military Electrical**	Electronic Security	Electronic Security (Continued)	AIRFIELD lightning protection & grounding and lighting			
	Session 15E	***Tri-Service Panel***	***Tri-Service Panel***	***Tri-Service Panel***	**TRACK 15 Military Electrical**	Electrical safety and arc flash UFC	Electrical safety and arc flash UFC (Continued)	Electrical infrastructure in Iraq - Restore Iraqi electricity
					Session 15F	***Tri-Service Panel***	***Tri-Service Panel***	***Joseph Swiniarski***
Room B	**TRACK 16 Military Mechanical**	Lon works technology update	BACnet Technology Update	Implementation of Lon-based specifications			
	Session 16E	***David Schwenk***	***David Schwenk***	***Will White***	**TRACK 16 Military Mechanical**	Prefabricated Chiller Plants	Seismic for ME systems	Design considerations for the prevention of mold
					Session 16F	***Trey Austin***	***Greg Stutts***	***Quinn Hart***
Room D	**TRACK 17 Civil Mechanical**	Lessons learned on flood water pump stations	Armada of pump stations, Grand Forks and East Grand Forks	Various screen equipment selection guide			
	Session 17E	***Mark Robertson***	***Timothy Paulus***	***Sara Benier***	**TRACK 17 Civil Mechanical**	Lock gate replacement system	Lock gate replacement system (Continued)	Automated closure gate design for Duck creek flood control
					Session 17F	***Will Smith***	***Will Smith***	***Mark Robertson***
Room 230	**TRACK 19 Construction**	NAVFAC Construction scheduling	NAVFAC Construction scheduling (Continued)	ACASS/CASS - CPARS			
	Session 19E	***Glenn Saito***	***Glenn Saito***	***Ed Marceau***	**TRACK 19 Construction**	Self-consolidating concrete	Self-consolidating concrete (Continued)	
					Session 19F	***Beatrix Kerhoff***	***Beatrix Kerhoff***	
Room 231	**TRACK 20 Construction**	Update on DAWIA and Facilities Engineering	Update on DAWIA and Facilities Engineering (Continued)	Partnering as a best practice			
	Session 20E	***Mark Grammer***	***Mark Grammer***	***Ray DuPont***	**TRACK 20 Construction**	S&A Update	Construction Issues Open Forum (Q&A)	Construction Issues Open Forum (Q&A) (Continued)
					Session 20F	***Harry Jones***	***Don Basham***	***Don Basham***

Break in Exhibit Hall

12 Noon — **Lunch**

	1:30 PM	2:00 PM	2:30 PM	3:00 PM	3:30 PM	4:00 PM	4:30 PM
Room 225	**TRACK 9 Geotechnical**	Seismic Manual	Seismic Manual (Continued)	Seismic Manual (Continued)			
	Session 9G	***GROUP DISCUSSION***	***GROUP DISCUSSION***	***GROUP DISCUSSION***			

Thursday, August 4, 2005 Concurrent Sessions

Dam Safety Track & Structural Engineering Track

	8:00 AM	8:30 AM	9:00 AM	9:30 AM	10:30 AM	11:00 AM	11:30 AM
Room 224	**TRACK 10** Dam Safety	Seepage and stability, final evaluation for reservoir pool raising project, Terminus Dam, Kaweah River, CA	Initial filling plan, Terminus dam spillway enlargement, Terminus Dam, Kaweah River, CA	Hydrologic aspects of operating in a "failure mode" - Fern Ridge Lake, OR			
	Session 10E	*Michael Ramsbotham*	*Michael Ramsbotham*	*Bruce Duffe*			
Room 240	**TRACK 12** Civil Works Structural	London lock and dam, West Virginia major rehabilitation project	Replacing existing lock 4-Innovative designs for Charleroi lock	Use of non-linear incremental structural analysis in the design of the Charleroi lock			
	Session 12E	*David Sullivan*	*Steveb Stoltz*	*Randy James*			
Room 241	**TRACK 13** Civil Works Structural	Chicago shoreline project	Structural assessment of Bluestone Dam	Duck Creek, OH local flood protection projection phase III Culvert damage			
	Session 13E	*Jan Plachta*	*Robert Reed*	*Jeremy Nichols*			
Room 242	**TRACK 14** Bridges/ Buildings	Urban search & rescue program overview	Evaluation and repair of blast damaged reinforced concrete beams	Single degree of freedom blast effects spreadsheets			
	Session 14E	*Tom Niedernhofer*	*John Hudson*	*Dale Nebuda*			
				Break in Exhibit Hall			
Room 224	**TRACK 10** Dam Safety				A dam safety study involving cascading dam failures		The relationship of seismic velocity to the erodibility index
	Session 10F				*Gordon Lance*		*Joseph Topi*
Room 240	**TRACK 12** Civil Works Structural				Olmsted dam in-the-wet construction methods	Completion of the Olmstead approach walls	John Day lock monolith repair
	Session 12F				*Lynn Raque*	*Terry Sullivan*	*Mathew Hanson*
Room 241	**TRACK 13** Civil Works Structural				Development of design criteria for the Rio Puerto Nuevo contract 2D/2E channel wall	Design of concrete lined tunnels in rock	Indianapolis north phase IIIA project
	Session 13F				*Jana Tanner*	*David Force*	*Gene Hoard*
Room 242	**TRACK 14** Bridges/ Buildings				UFC 4-023-02 Structural design to resist explosive effects for existing buildings	Progressive collapse UFC requirements	U.S. general services admnistrative progressive collapse design guidelines applied to concrete moment-resisting frame buildings
	Session 14F				*Jim Caulder*	*Brian Crowder*	*David Billow*

12 Noon — **Lunch**

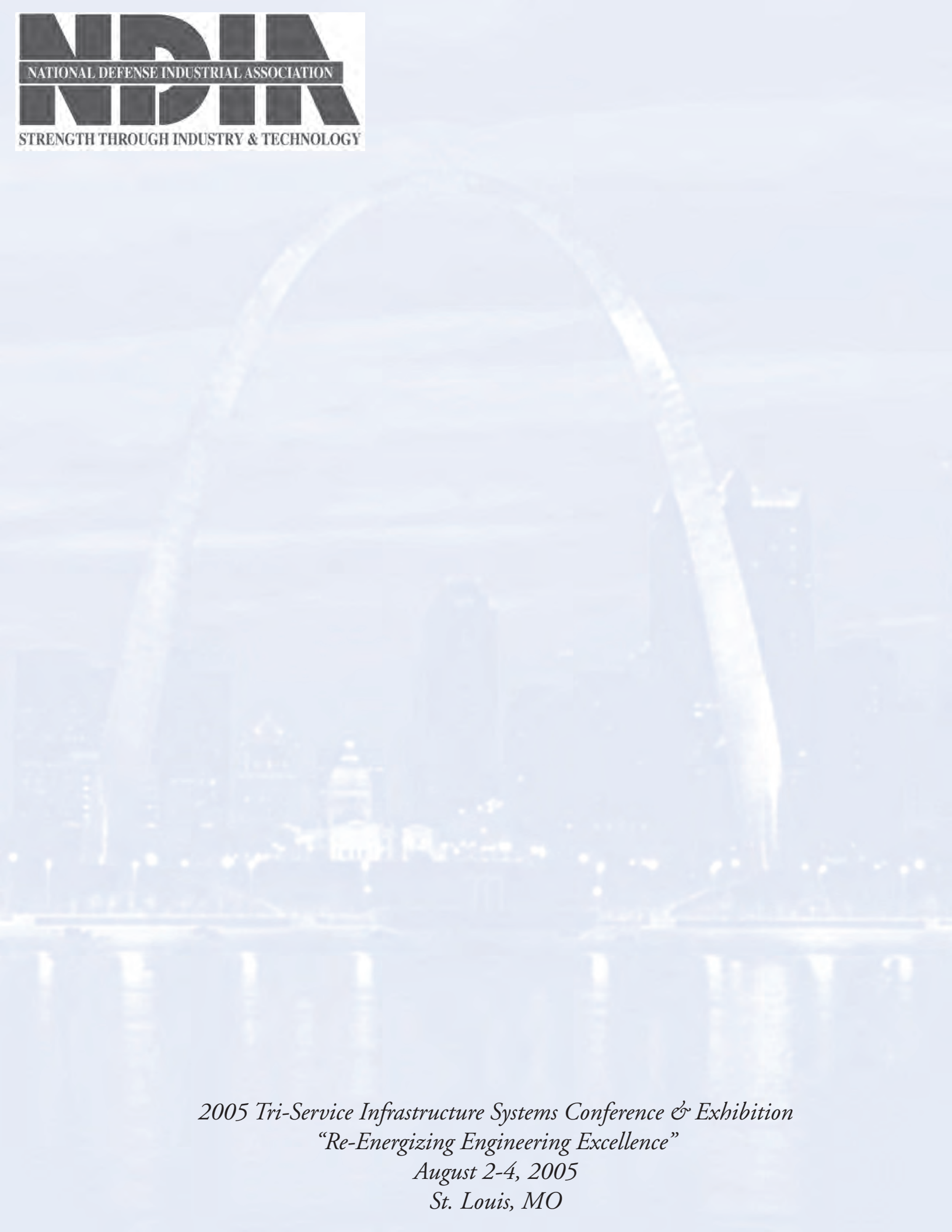
	1:30 PM	2:00 PM	2:30 PM	3:00 PM	3:30 PM	4:00 PM	4:30 PM
Room 224	**TRACK 10** Dam Safety	Dam safety instrumentation data management utilizing WinIDP to aid data collection and evaluation	Automated instrumentation assessments at Marmet lock & Dam	Potential failure mode analysis of Eau Galle Dam			
	Session 10G	*Travis Tutka*	*Ronald Rakes*	*David Rydeen*			
Room 240	**TRACK 12** Civil Works Structural	Inner Harbor navigation canal and lock structure	Design features and challenges of the Comite River diversion project	Waterline support failure on the Harvey canal: A case study			
	Session 12G	*Mark Gonski*	*Christopher Dunn*	*Angela DeSoto Duncan*			
				Break			
Room 224	**TRACK 10** Dam Safety				Dam safety officers panel - The Good	Dam safety officers panel - The Bad	Dam safety officers panel - The Ugly
	Session 10H				*Bruce Murray*	*Bruce Murray*	*Bruce Murray*
Room 240	**TRACK 12** Civil Works Structural				Public appeal of major civil projects- The good, the bad and the ugly	Des Moines Riverwalk	Chickamauga lock and Dam height optimization study using Monte Carlo simulation
	Session 12H				*Kevin Holden*	*Thomas Heinold*	*Leon Schieber*

Thursday, August 4, 2005 Concurrent Workshops

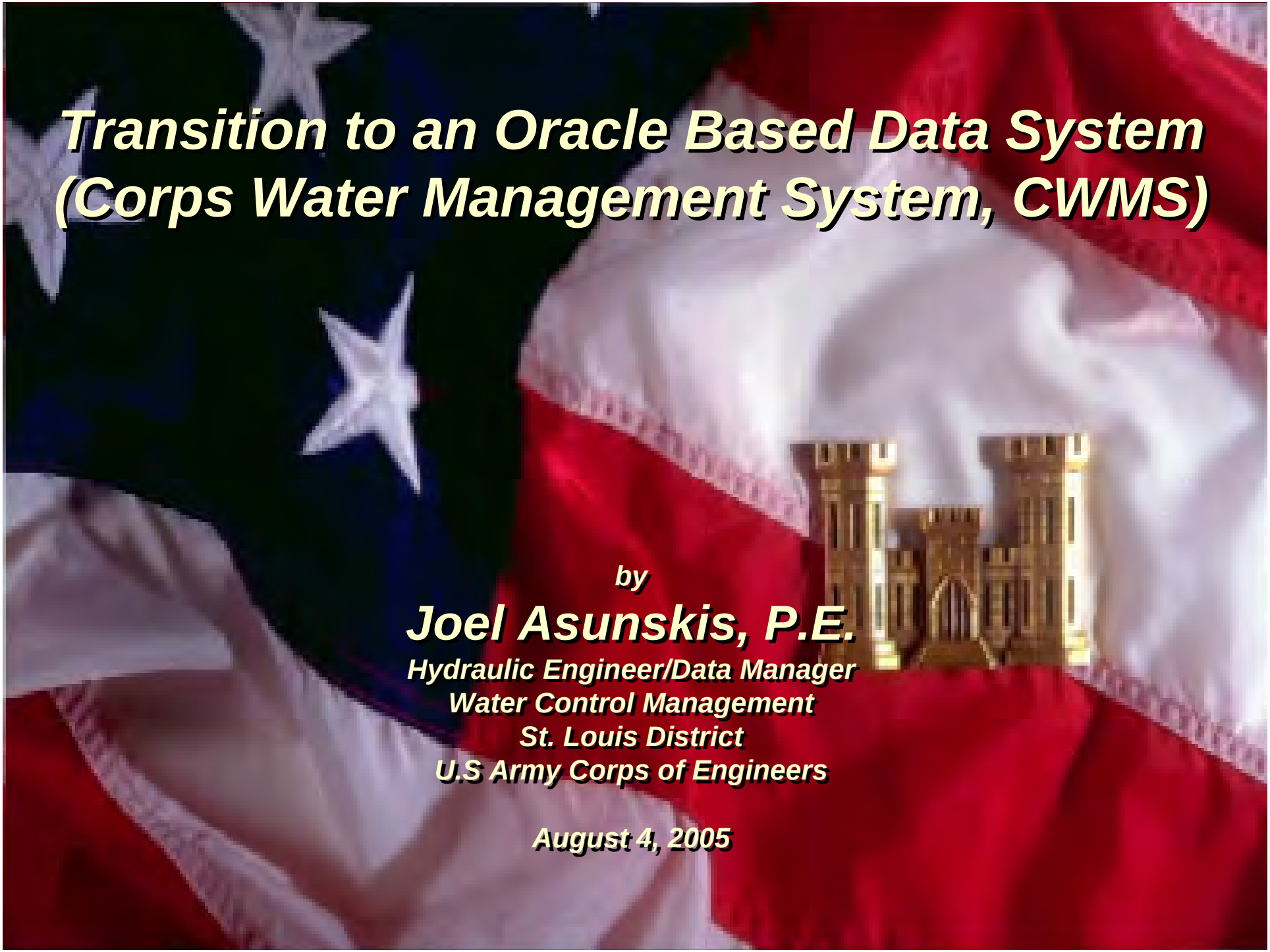
	1:30 PM	2:00 PM	2:30 PM	3:00 PM	3:30 PM	4:00 PM	4:30 PM
Room 241	**Workshop 1** DoD Security Engineering	Security planning & minimum standards	Security planning & minimum standards (Continued)	Security planning & minimum standards (Continued)	Security design manuals	Security design manuals (Continued)	Security design manuals (Continued)
	Session 1A	*Curt Betts*	*Curt Betts*	*Curt Betts*	**Session 1B**	*Bernie Deneke*	*Bernie Deneke*	*Bernie Deneke*
Room 231	**Workshop 2** Electrical Workshop	National Electrical Code 2005 Changes	National Electrical Code 2005 Changes (Continued)	National Electrical Code 2005 Changes (Continued)	National Electrical Code 2005 Changes (Continued)	National Electrical Code 2005 Changes (Continued)	National Electrical Code 2005 Changes (Continued)
	Session 2A	*Mark McNamara*	*Mark McNamara*	*Mark McNamara*	**Session 2B**	*Mark McNamara*	*Mark McNamara*	*Mark McNamara*
Room 242	**Workshop 3** Mechanical Engineering	Design and application of packaged central cooling plants	Design and application of packaged central cooling plants (Continued)	Design and application of packaged central cooling plants (Continued)	Improving dehumidification in HVAC systems	Improving dehumidification in HVAC systems (Continued)	Improving dehumidification in HVAC systems (Continued)
	Session 3A	*The Trane Company*	*The Trane Company*	*The Trane Company*	**Session 3B**	*The Trane Company*	*The Trane Company*	*The Trane Company*
Room 230	**Workshop 4** Construction	Construction Community of Practice Forum	Construction Community of Practice Forum (Continued)	Construction Community of Practice Forum (Continued)			
	Session 4A	*Walt Norko*	*Walt Norko*	*Walt Norko*			
Room 232	**Workshop 5** Specifications	Open Meeting of Corps Specifications Steering Committee	Open Meeting of Corps Specifications Steering Committee (Continued)	Open Meeting of Corps Specifications Steering Committee (Continued)	Open Meeting of Corps Specifications Steering Committee (Continued)	Open Meeting of Corps Specifications Steering Committee (Continued)	Open Meeting of Corps Specifications Steering Committee (Continued)
	Session 5A	*Robert Iseli, et al.*	*Robert Iseli, et al.*	*Robert Iseli, et al.*	**Session 5B**	*Robert Iseli, et al.*	*Robert Iseli, et al.*	*Robert Iseli, et al.*

Break

NOTES



2005 Tri-Service Infrastructure Systems Conference & Exhibition
"Re-Energizing Engineering Excellence"
August 2-4, 2005
St. Louis, MO



Transition to an Oracle Based Data System (Corps Water Management System, CWMS)

by

Joel Asunskis, P.E.

Hydraulic Engineer/Data Manager
Water Control Management
St. Louis District
U.S Army Corps of Engineers

August 4, 2005

US Army Corps of Engineers

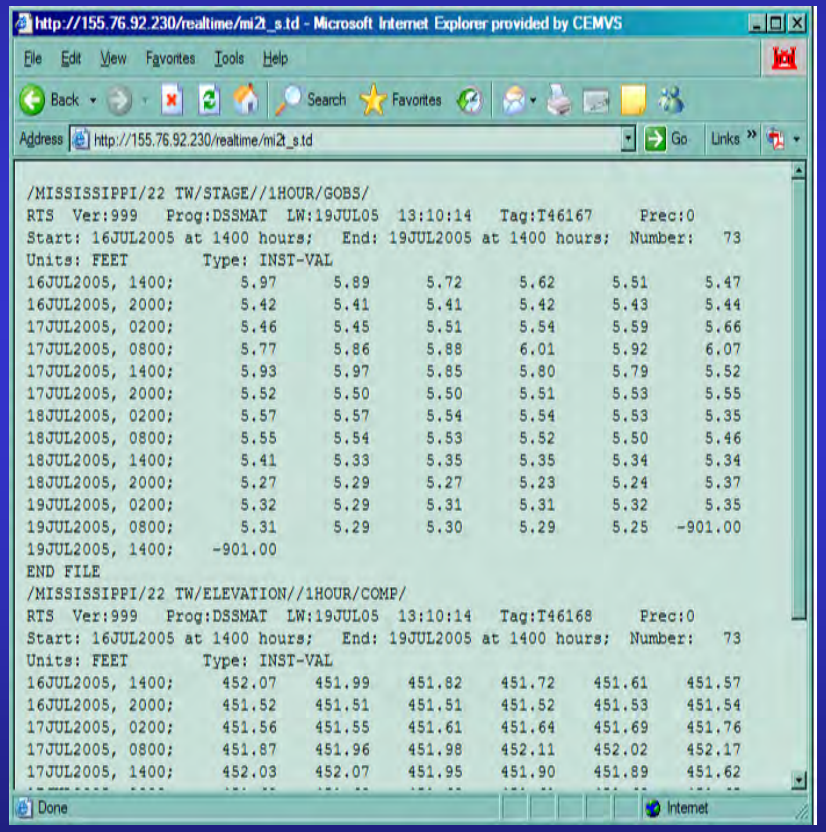
Legacy Data System

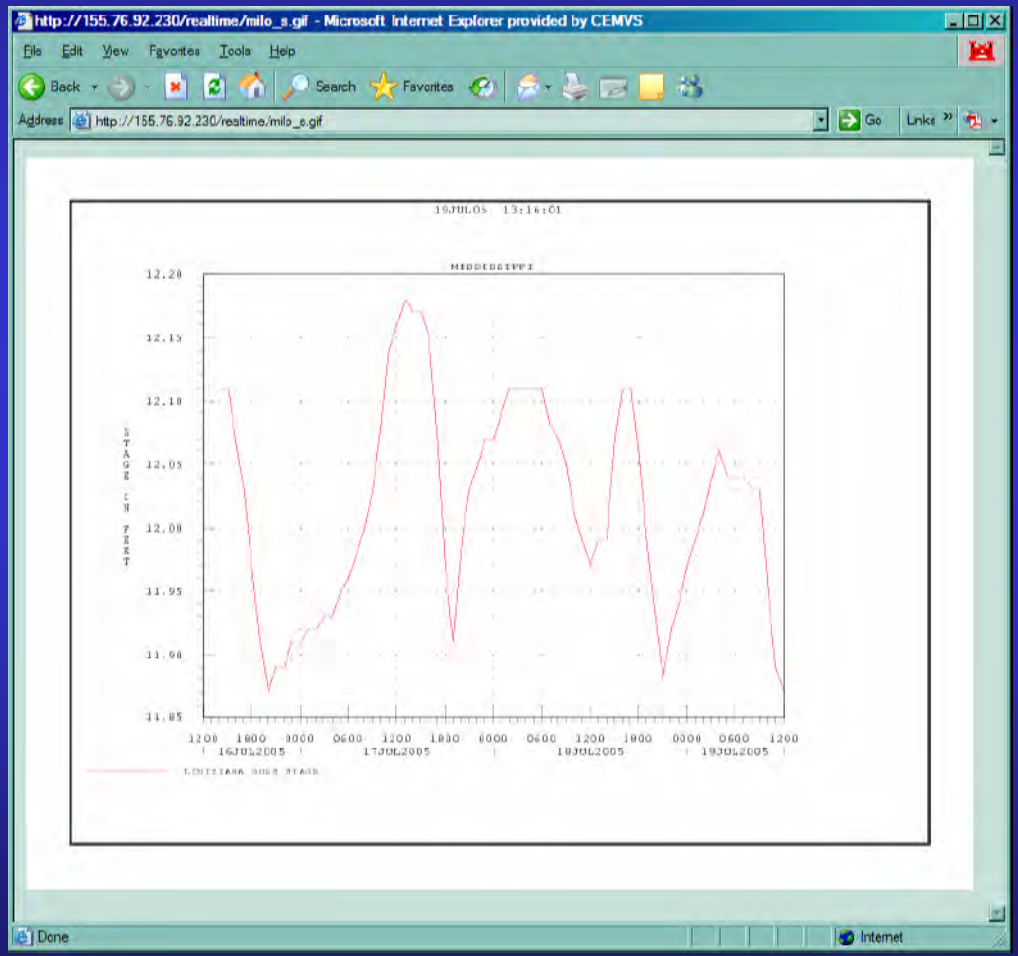
HEC – DSS

- A database system which enables efficient storage and retrieval of time series data developed to meet the needs for water resource projects and studies.

US Army Corps of Engineers

Legacy System Web Dissemination





US Army Corps of Engineers

Reservoir Operation Records

Command Prompt - pcrep

CARLYLE LAKE

COMPILED THE MORNING OF 18JUL05 OFFICE: 618-594-2484,618-274-2008

PRECIPITATION

COWDEN	0.00	FILLMORE	CARLYLE	0.00	QPF DAY 1
EFFINGHAM		KIMMUNDY	LAKE OFFICE		QPF DAY 2
RAMSEY		PATOKA			BASIN AVG. 0.00

UPSTREAM GAGES

STATION	0600 HRS STAGE/FLOW	1200 HRS STAGE/FLOW	1800 HRS STAGE/FLOW	2400 HRS STAGE/FLOW	24 HOUR CHNG/AVG	LAGGED FLOW
VANDALIA	2.88	3.20	3.42	3.39	0.54	L=12
	175	228	267	261	233	174
HICKORY CR	3.39	3.38	3.38	3.37	-0.02	L=12
	1	1	1	1	1	2
HURRICANE CR	3.21	3.18	3.15	3.11	-0.10	L=12
	11	10	9	8	10	12
EAST FORK CR	2.38	2.40	2.38	2.37	0.01	L=12
	4	4	4	4	4	3
SUM OF FLOWS	191	243	281	274	248	
6 HR DIFF		52	38	-7		

RESERVOIR

	ELEV/STOR	ELEV/STOR	ELEV/STOR	ELEV/STOR	CHANGE	%UTIL
CARLYLE LAKE	444.40	444.42	444.38	444.35	-0.03	Cons.
	134300	134520	134060	133700	-360	93.23
CHANGE =		220	-460	-360		Flood
						0.00

GATE INSTRUCTIONS

TIME	1	2	3	4	OUTFLOW
0000	0.00	0.20	0.00	0.00	170
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INFLOW

DAY	BY GAGES	TREND	BY STOR.	CONCENSUS
12	158	-7	485	300
13	190	32	125	130
14	199	9	935	200
15	211	12	145	150
16	199	-12	15	150
17	191	-8	5	130

--------->AVERAGE OUTFLOW= 170

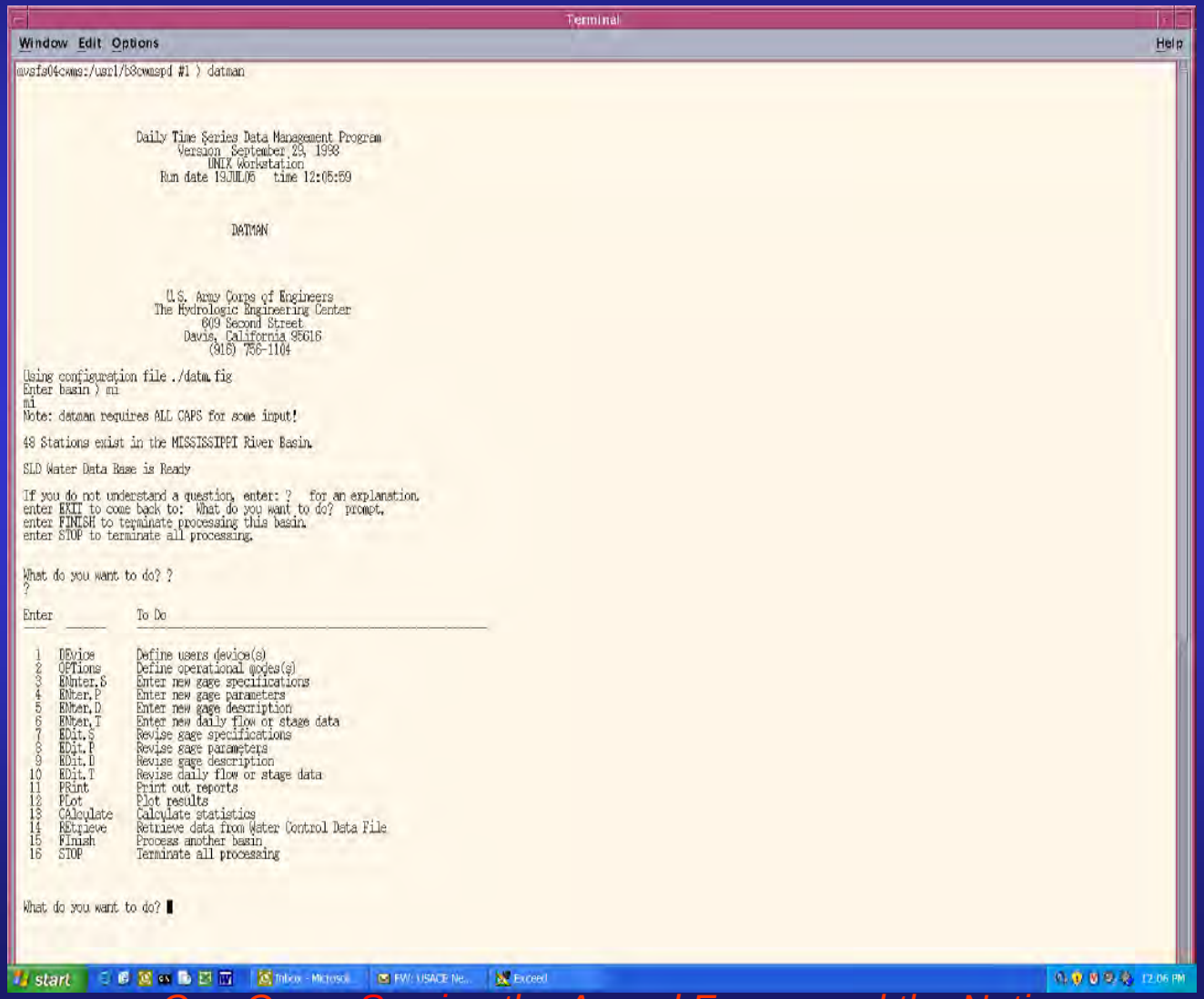
DOWNSTREAM GAGES

	STAGE/FLOW	STAGE/FLOW	STAGE/FLOW	STAGE/FLOW	CHANGE/AVG.
CARLYLE	6.27	6.26	6.25	6.26	0.00
	172	170	167	170	170
SHOAL CR.	2.14	1.98	1.87	1.82	-0.47
	127	98	79	71	94
VENEDY STATION	3.50	3.58	3.55	3.43	0.19
	485	504	497	469	489

F1-Print F2-Save F3-Build <esc>-Exit

US Army Corps of Engineers

Historical Records

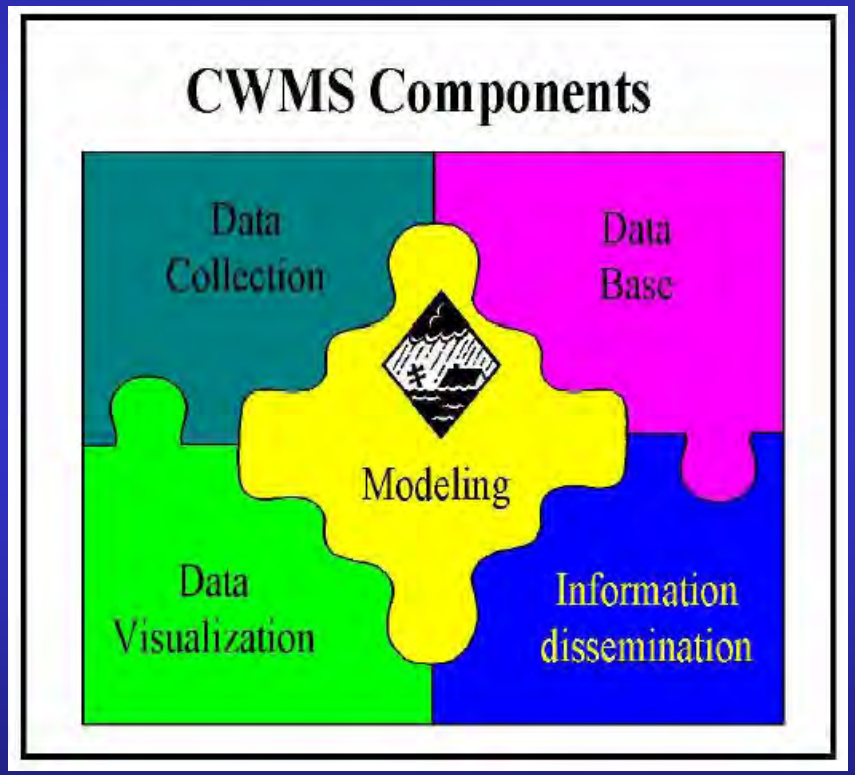


US Army Corps of Engineers

Corps Water Management System (CWMS)

Scope and Goal

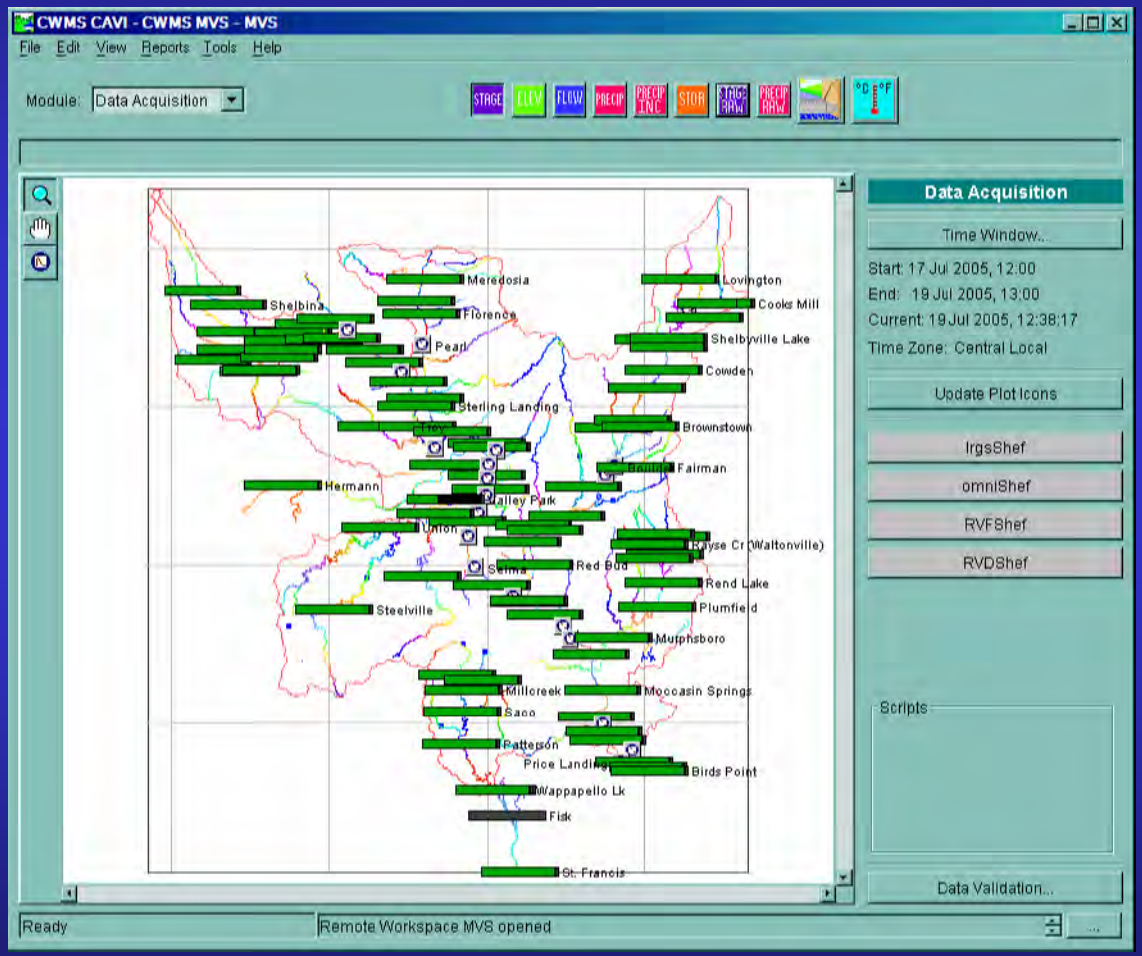
- USACE corporate AIS for water control decision support. Real-time 24/7 dedicated system.
- Provides management of hydromet data and forecasting models through a single interface.
- Modernized Technology
  - Oracle Database
  - Client-server architecture for network implementation



US Army Corps of Engineers

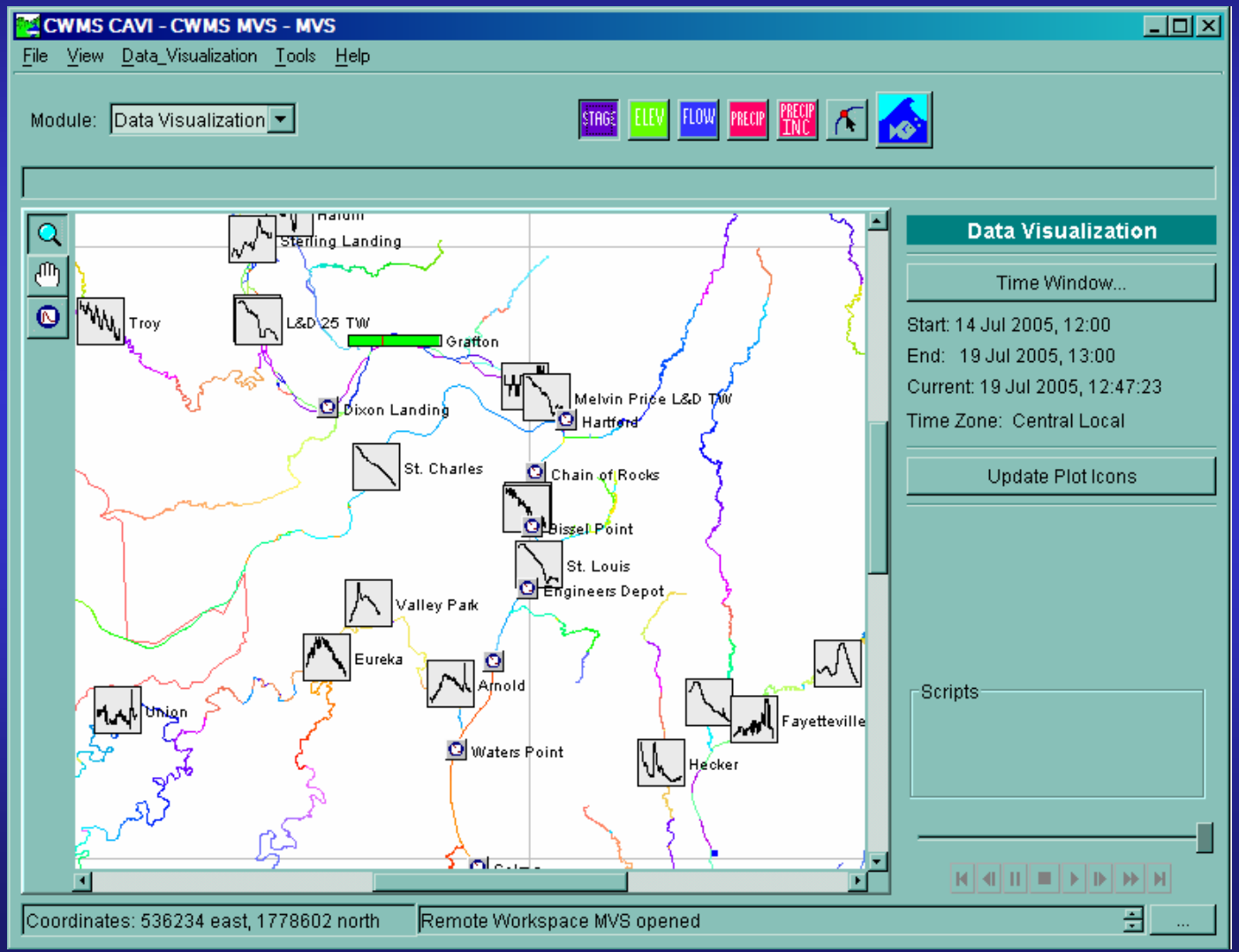
Data Acquisition

- Socket Connections
- File Transfer
- Goes (DCP) Format
- SHEF Format
- Data Validation
- Derive Parameters
- Data Status

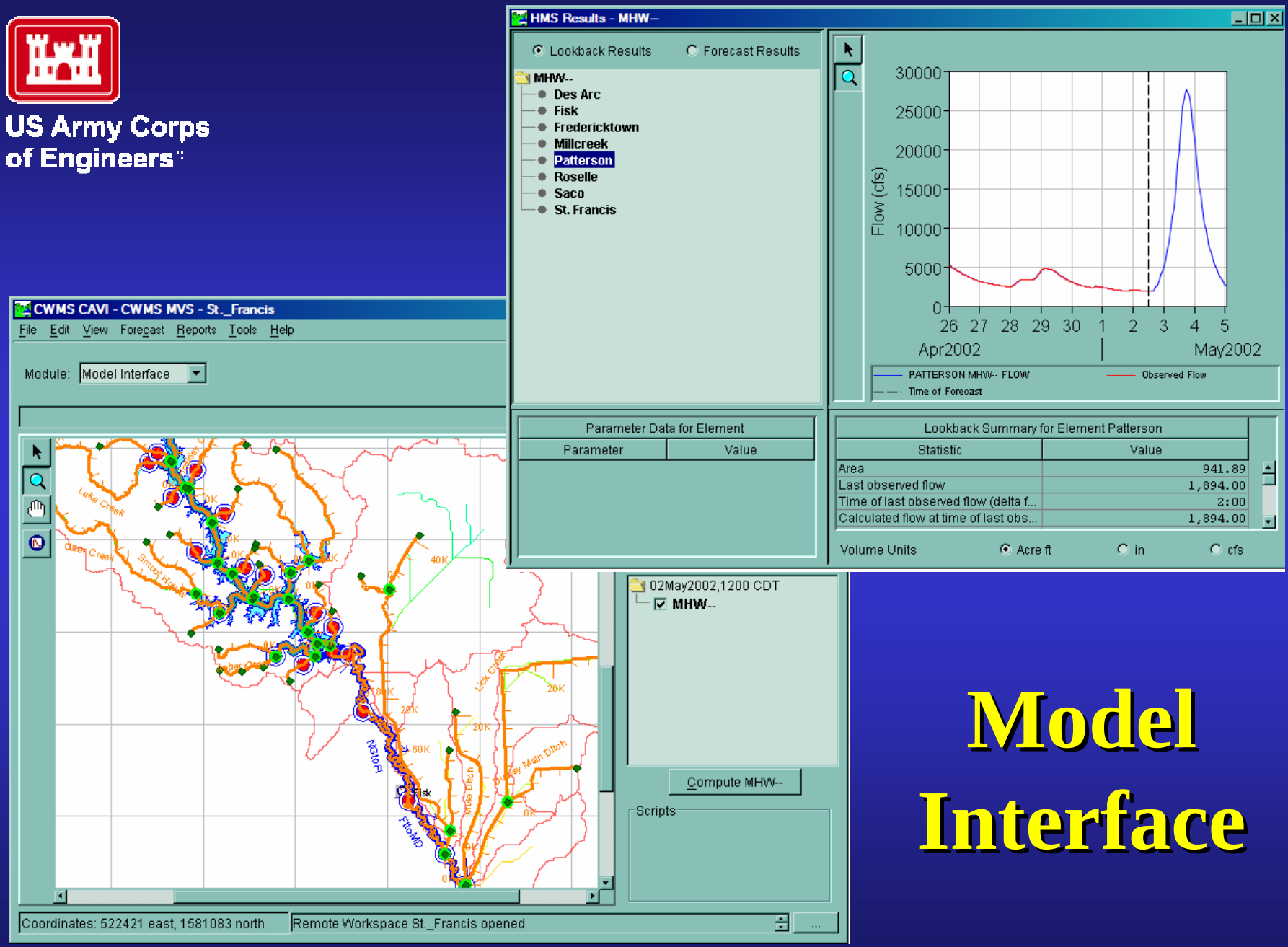


US Army Corps of Engineers

Data Visualization



US Army Corps of Engineers



Model Interface

One Corps Serving the Armed Forces and the Nation

Legacy System Diagram

US Army Corps of Engineers

Command Prompt Apps

PCREP

LRGS/Decodes

DAYREP DB (Reservoir DB)

Raw_dom.dss

DssMath Datcheck

Hourly Transformed Working DSS DB

DRGS – Raw Data

Static Web Server Internal/External

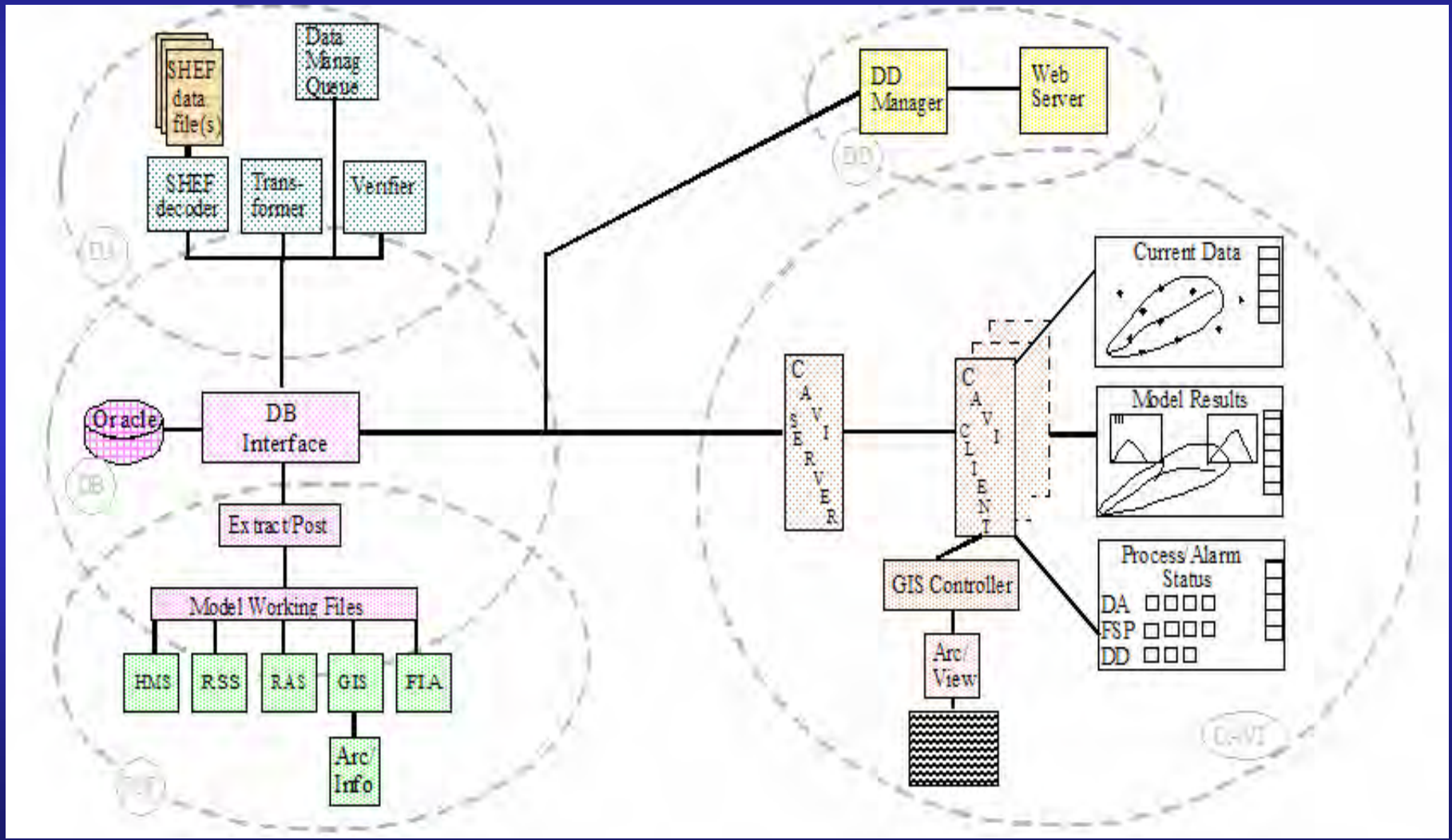
DATMAN DB (POR DB)

Web Application Window (Internet Explorer)

DATMAN

US Army Corps of Engineers

CWMS System Diagram

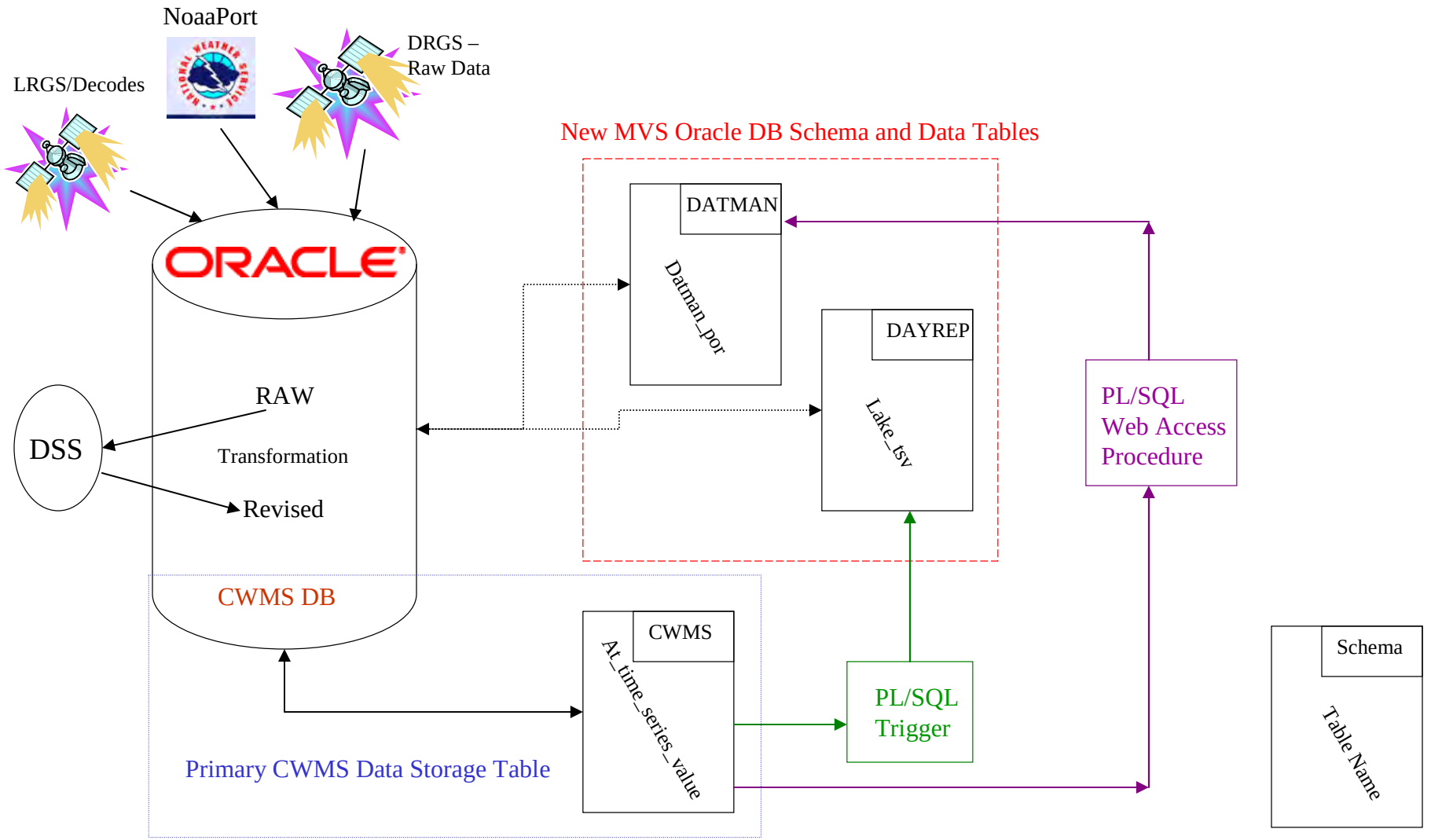


U.S. Army Corps of Engineers

St. Louis District Added Components

DATMAN -Gage Data Period of Record Database/Statistical Analysis Module

DAYREP -Reservoir Control and Associated Gage Data

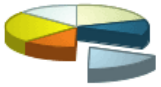


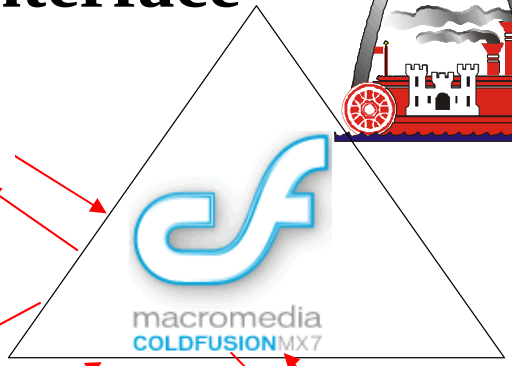
SLD CWMS Web Service Interface

U.S. Army Corps of Engineers

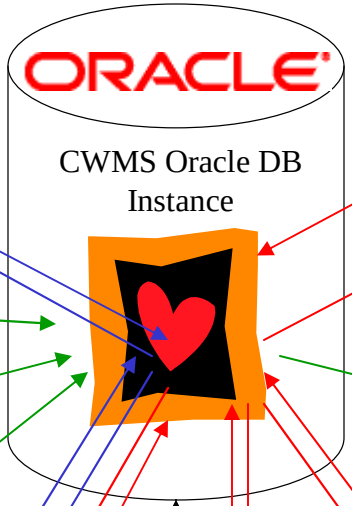
CWMS CAVI

Corda PopChart Server





CWMS DBI



CWMS Oracle DB Instance

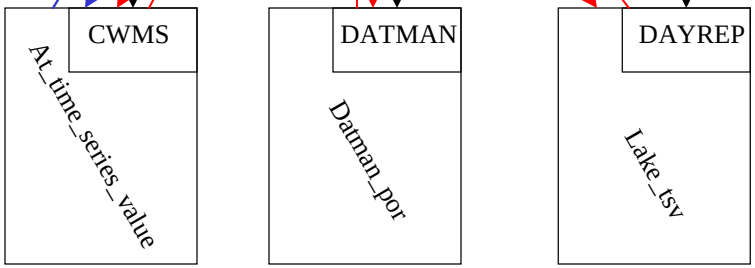
Query Stored Procedures

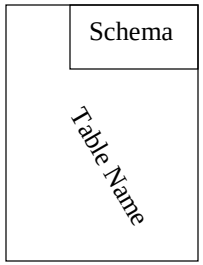
DRGS – Raw Data

Web Application Window (Internet Explorer) – Internal Only

NOAAPort

LRGS/Decodes

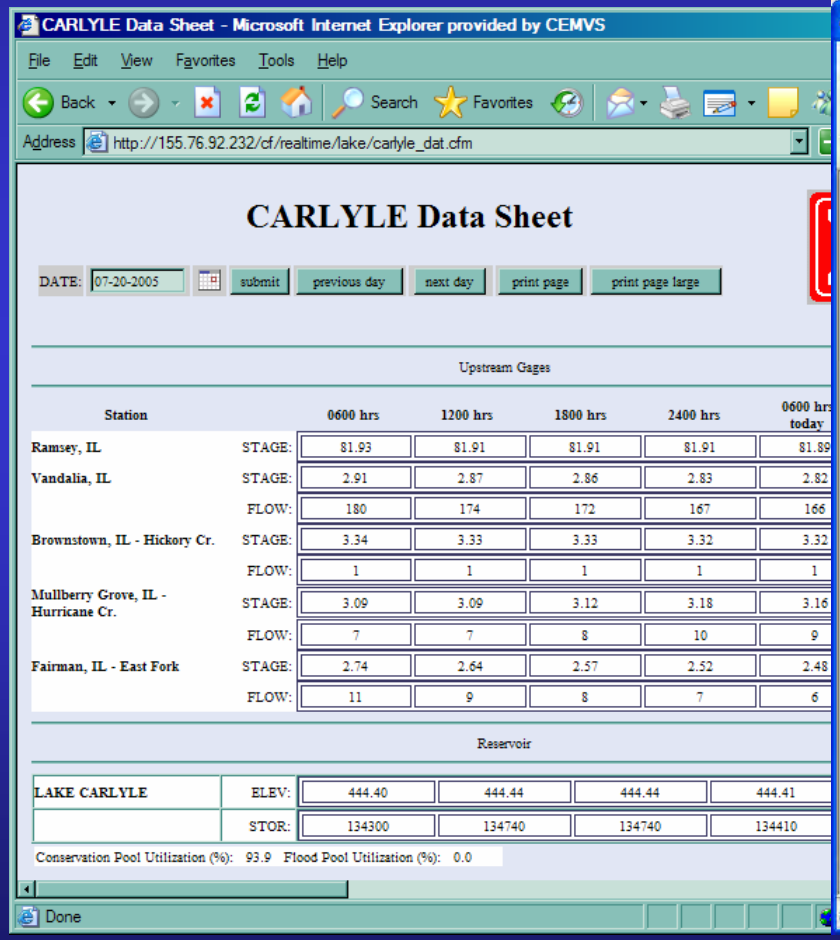


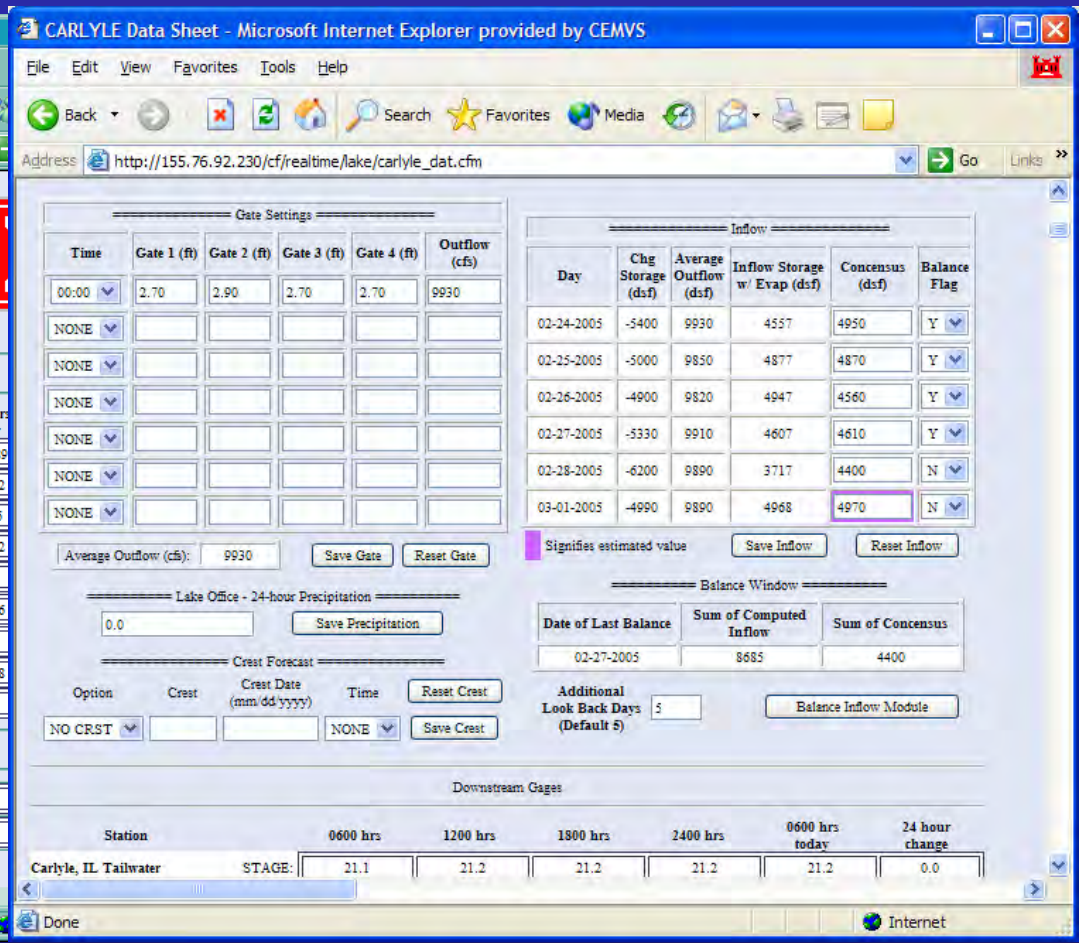


Oracle Database Time Series Schema/Table Structure

US Army Corps of Engineers

Lake Reports (PCREP)





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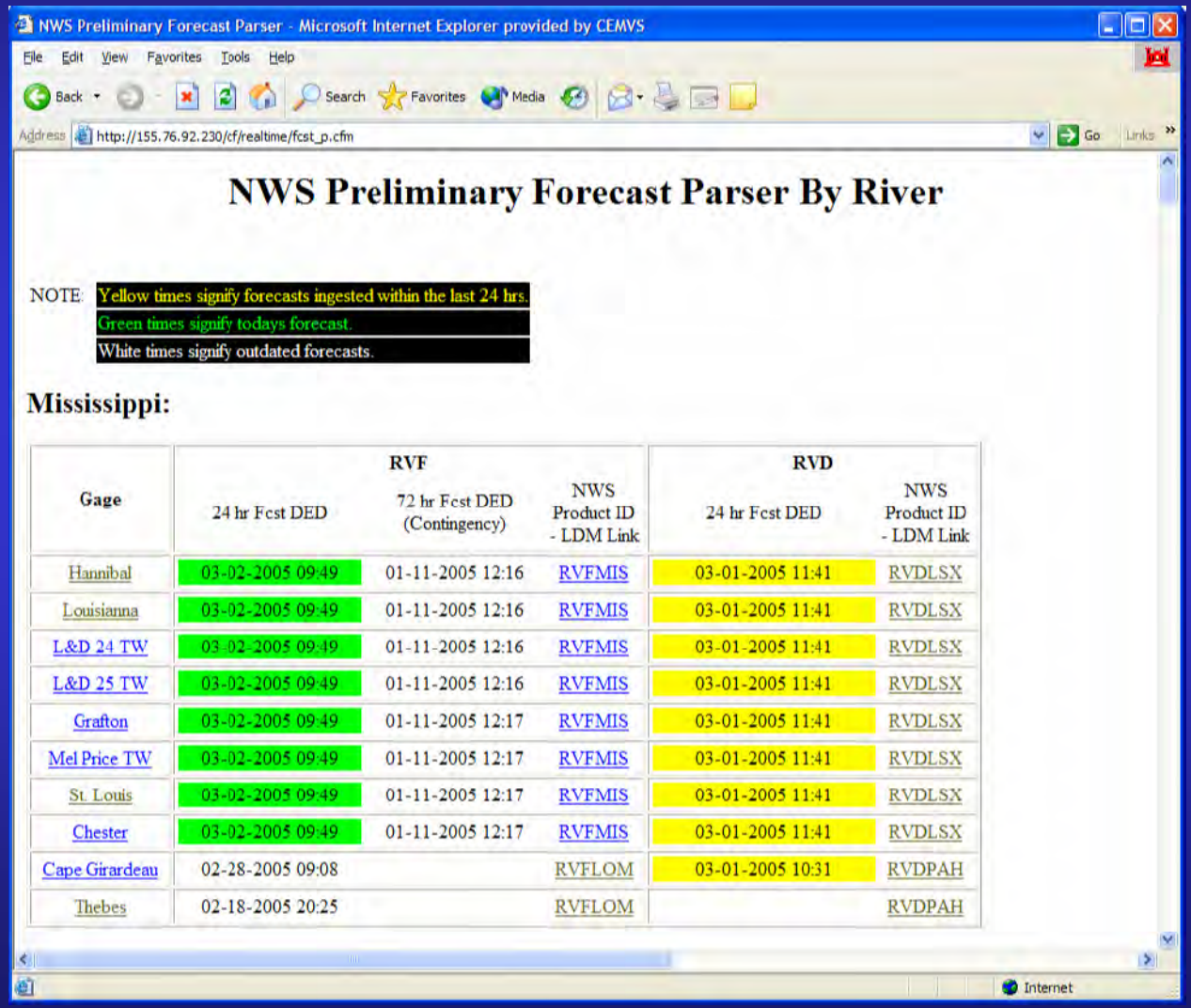
Forecast Parser



NWS Preliminary Forecast Parser By River

NOTE: Yellow times signify forecasts ingested within the last 24 hrs.
Green times signify todays forecast.
White times signify outdated forecasts.

Mississippi:

Gage	RVF			RVD	
	24 hr Fcst DED	72 hr Fcst DED (Contingency)	NWS Product ID - LDM Link	24 hr Fcst DED	NWS Product ID - LDM Link
Hannibal	03-02-2005 09:49	01-11-2005 12:16	RVFMIS	03-01-2005 11:41	RVDLSX
Louisianna	03-02-2005 09:49	01-11-2005 12:16	RVFMIS	03-01-2005 11:41	RVDLSX
L&D 24 TW	03-02-2005 09:49	01-11-2005 12:16	RVFMIS	03-01-2005 11:41	RVDLSX
L&D 25 TW	03-02-2005 09:49	01-11-2005 12:16	RVFMIS	03-01-2005 11:41	RVDLSX
Grafton	03-02-2005 09:49	01-11-2005 12:17	RVFMIS	03-01-2005 11:41	RVDLSX
Mel Price TW	03-02-2005 09:49	01-11-2005 12:17	RVFMIS	03-01-2005 11:41	RVDLSX
St. Louis	03-02-2005 09:49	01-11-2005 12:17	RVFMIS	03-01-2005 11:41	RVDLSX
Chester	03-02-2005 09:49	01-11-2005 12:17	RVFMIS	03-01-2005 11:41	RVDLSX
Cape Girardeau	02-28-2005 09:08		RVFLOM	03-01-2005 10:31	RVDPAH
Thebes	02-18-2005 20:25		RVFLOM		RVDPAH

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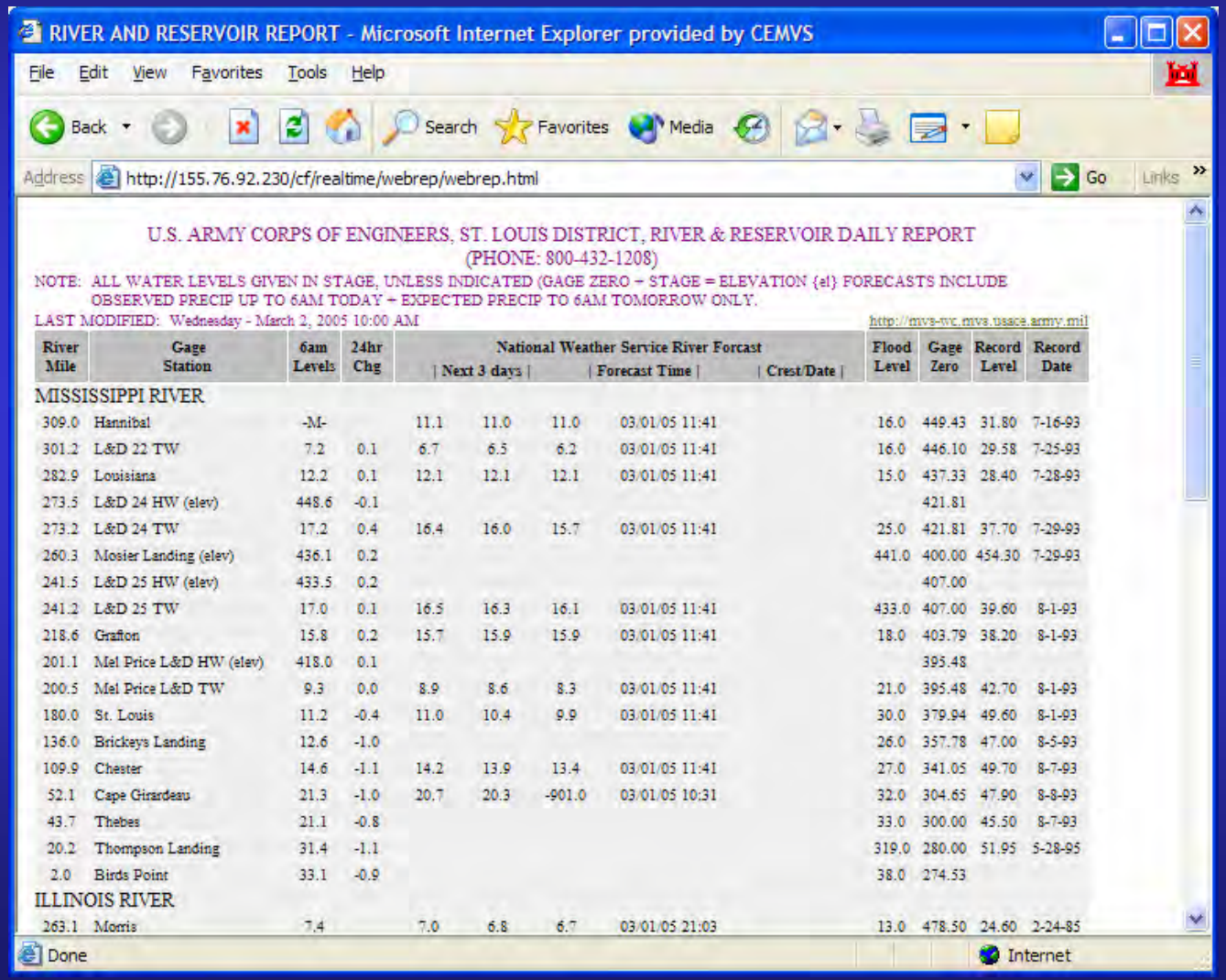
Webrep Bulletin


RIVER AND RESERVOIR REPORT - Microsoft Internet Explorer provided by CEMVS

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Address http://155.76.92.230/cf/realtime/webrep/webrep.html Go Links

U.S. ARMY CORPS OF ENGINEERS, ST. LOUIS DISTRICT, RIVER & RESERVOIR DAILY REPORT
(PHONE: 800-432-1208)

NOTE: ALL WATER LEVELS GIVEN IN STAGE, UNLESS INDICATED (GAGE ZERO = STAGE = ELEVATION (el) FORECASTS INCLUDE OBSERVED PRECIP UP TO 6AM TODAY + EXPECTED PRECIP TO 6AM TOMORROW ONLY.

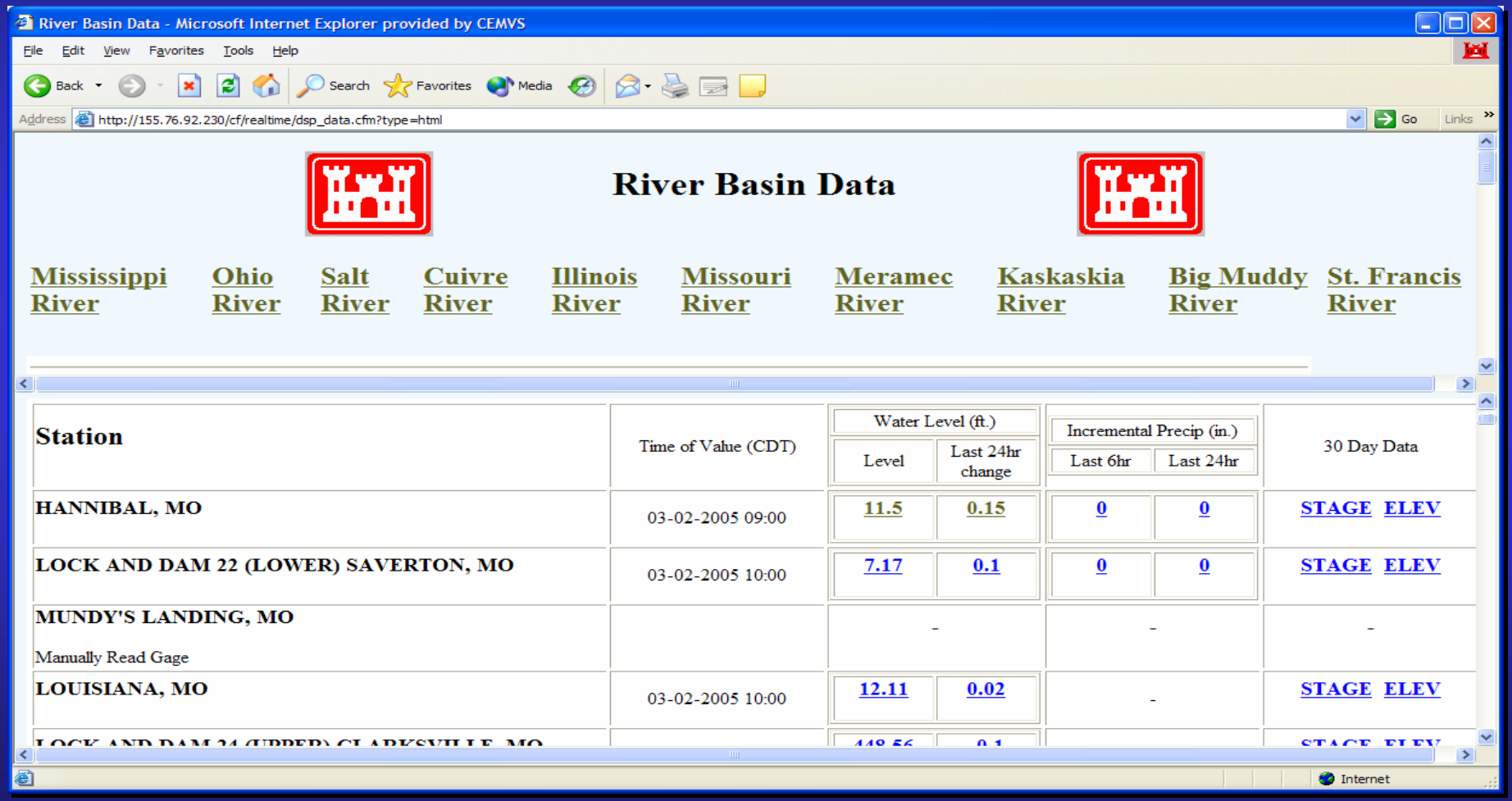
LAST MODIFIED: Wednesday - March 2, 2005 10:00 AM http://mvs-wc.mvs.usace.army.mil

River Mile	Gage Station	6am Levels	24hr Chg	National Weather Service River Forcast					Flood Level	Gage Zero	Record Level	Record Date
				Next 3 days			Forecast Time	Crest/Date				
MISSISSIPPI RIVER												
309.0	Hannibal	-M-		11.1	11.0	11.0	03/01/05 11:41		16.0	449.43	31.80	7-16-93
301.2	L&D 22 TW	7.2	0.1	6.7	6.5	6.2	03/01/05 11:41		16.0	446.10	29.58	7-25-93
282.9	Louisiana	12.2	0.1	12.1	12.1	12.1	03/01/05 11:41		15.0	437.33	28.40	7-28-93
273.5	L&D 24 HW (elev)	448.6	-0.1							421.81		
273.2	L&D 24 TW	17.2	0.4	16.4	16.0	15.7	03/01/05 11:41		25.0	421.81	37.70	7-29-93
260.3	Mosier Landing (elev)	436.1	0.2						441.0	400.00	454.30	7-29-93
241.5	L&D 25 HW (elev)	433.5	0.2							407.00		
241.2	L&D 25 TW	17.0	0.1	16.5	16.3	16.1	03/01/05 11:41		433.0	407.00	39.60	8-1-93
218.6	Grafton	15.8	0.2	15.7	15.9	15.9	03/01/05 11:41		18.0	403.79	38.20	8-1-93
201.1	Mel Price L&D HW (elev)	418.0	0.1							395.48		
200.5	Mel Price L&D TW	9.3	0.0	8.9	8.6	8.3	03/01/05 11:41		21.0	395.48	42.70	8-1-93
180.0	St. Louis	11.2	-0.4	11.0	10.4	9.9	03/01/05 11:41		30.0	379.94	49.60	8-1-93
136.0	Brickeys Landing	12.6	-1.0						26.0	357.78	47.00	8-5-93
109.9	Chester	14.6	-1.1	14.2	13.9	13.4	03/01/05 11:41		27.0	341.05	49.70	8-7-93
52.1	Cape Girardeau	21.3	-1.0	20.7	20.3	-901.0	03/01/05 10:31		32.0	304.65	47.90	8-8-93
43.7	Thebes	21.1	-0.8						33.0	300.00	45.50	8-7-93
20.2	Thompson Landing	31.4	-1.1						319.0	280.00	51.95	5-28-95
2.0	Birds Point	33.1	-0.9						38.0	274.53		
ILLINOIS RIVER												
263.1	Morris	7.4		7.0	6.8	6.7	03/01/05 21:03		13.0	478.50	24.60	2-24-85

Done Internet

US Army Corps of Engineers

Real-time Oracle Data Reports



Station	Time of Value (CDT)	Water Level (ft.)		Incremental Precip (in.)		30 Day Data
		Level	Last 24hr change	Last 6hr	Last 24hr	
HANNIBAL, MO	03-02-2005 09:00	11.5	0.15	0	0	STAGE ELEV
LOCK AND DAM 22 (LOWER) SAVERTON, MO	03-02-2005 10:00	7.17	0.1	0	0	STAGE ELEV
MUNDY'S LANDING, MO Manually Read Gage		-		-		-
LOUISIANA, MO	03-02-2005 10:00	12.11	0.02	-		STAGE ELEV

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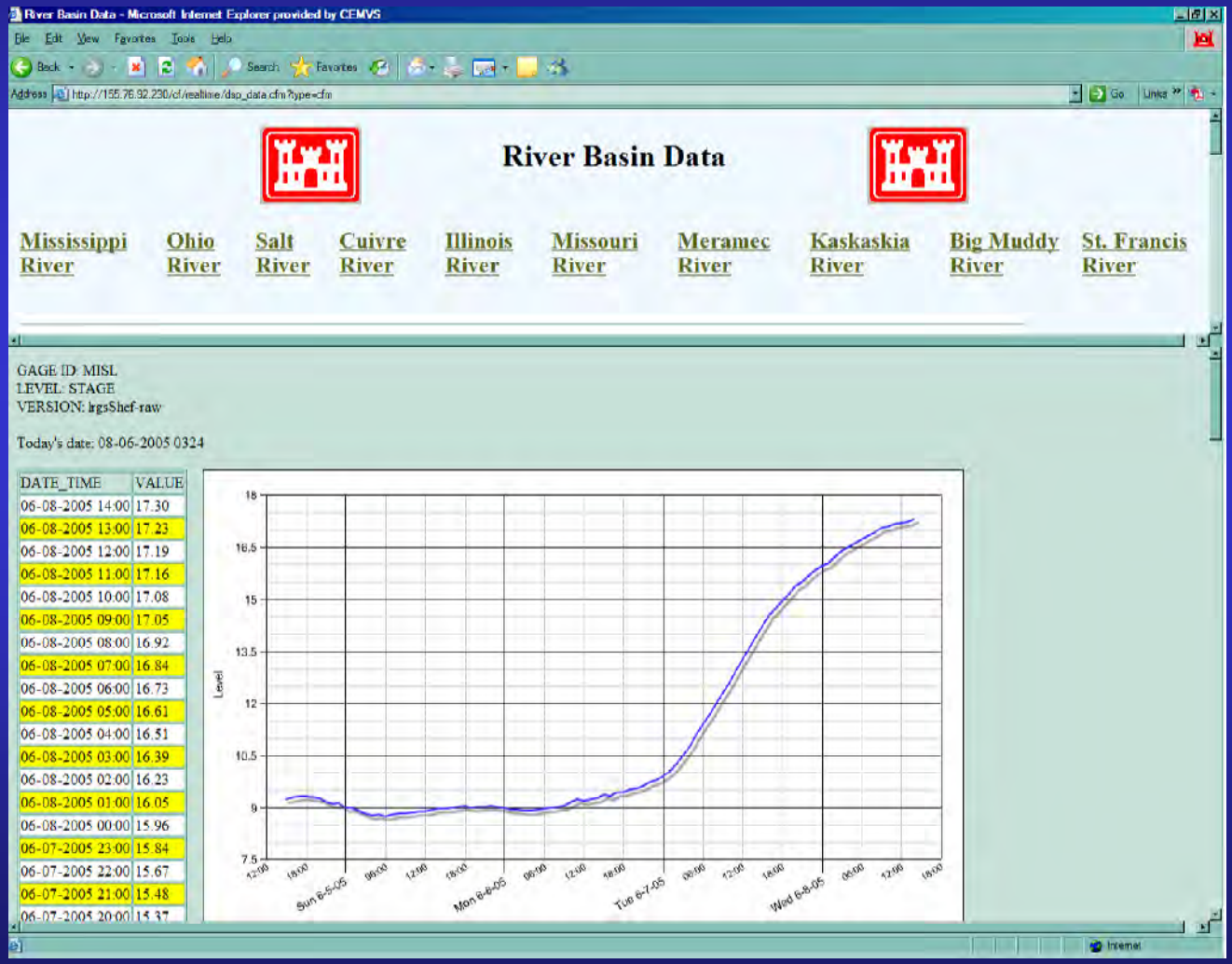
Real-time Oracle Data Reports



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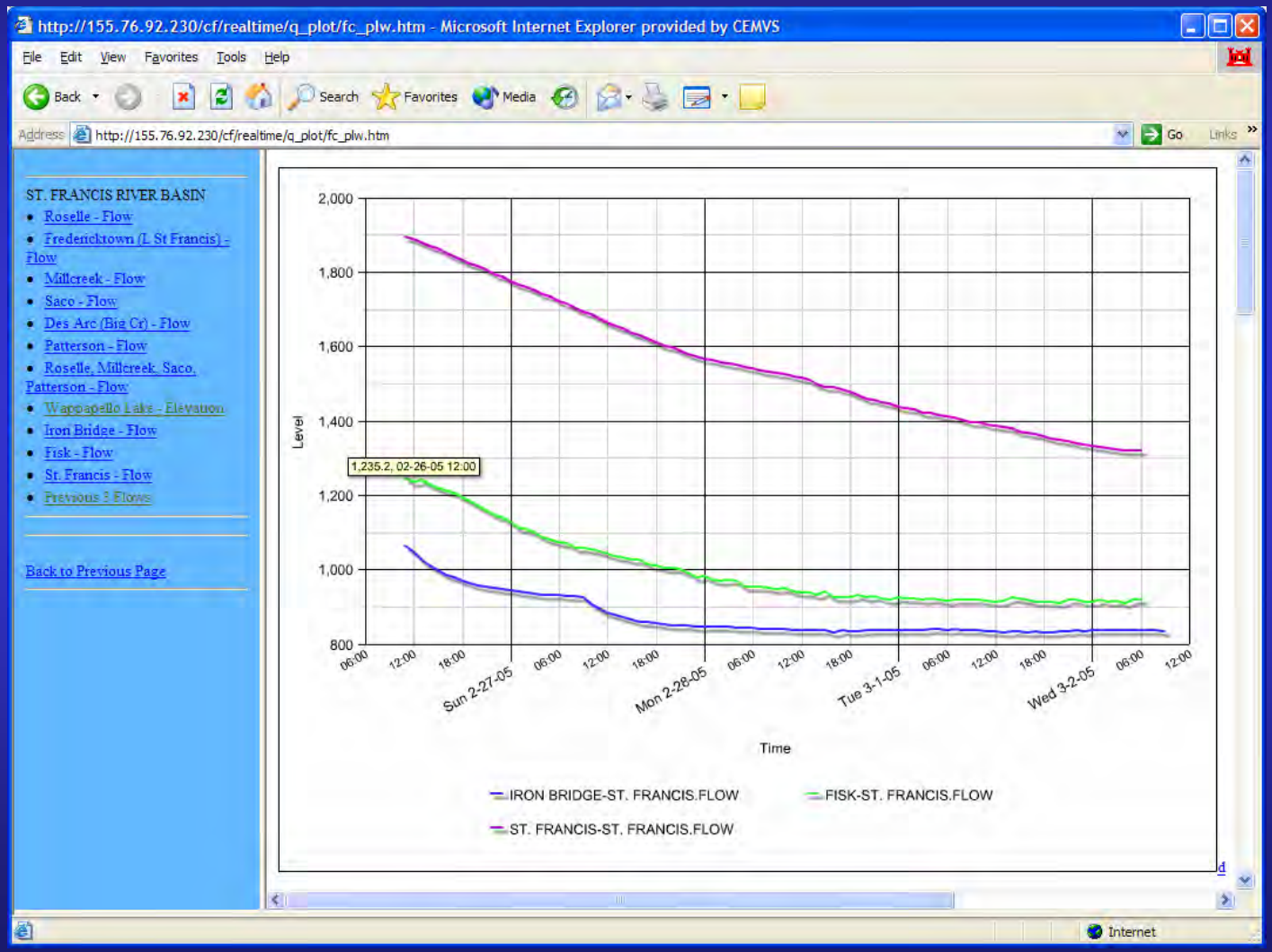
Plot Macros



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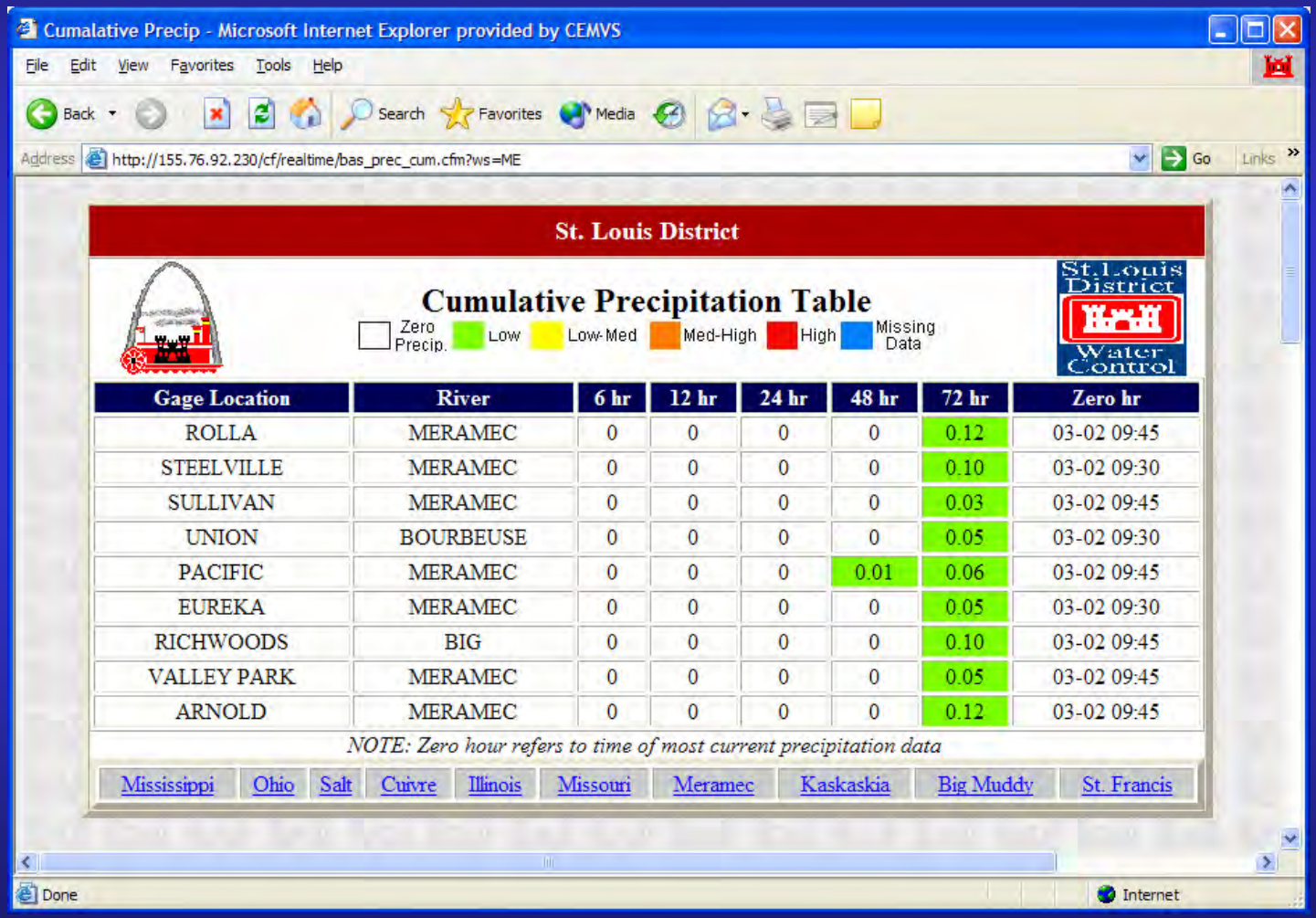
Precipitation Tables



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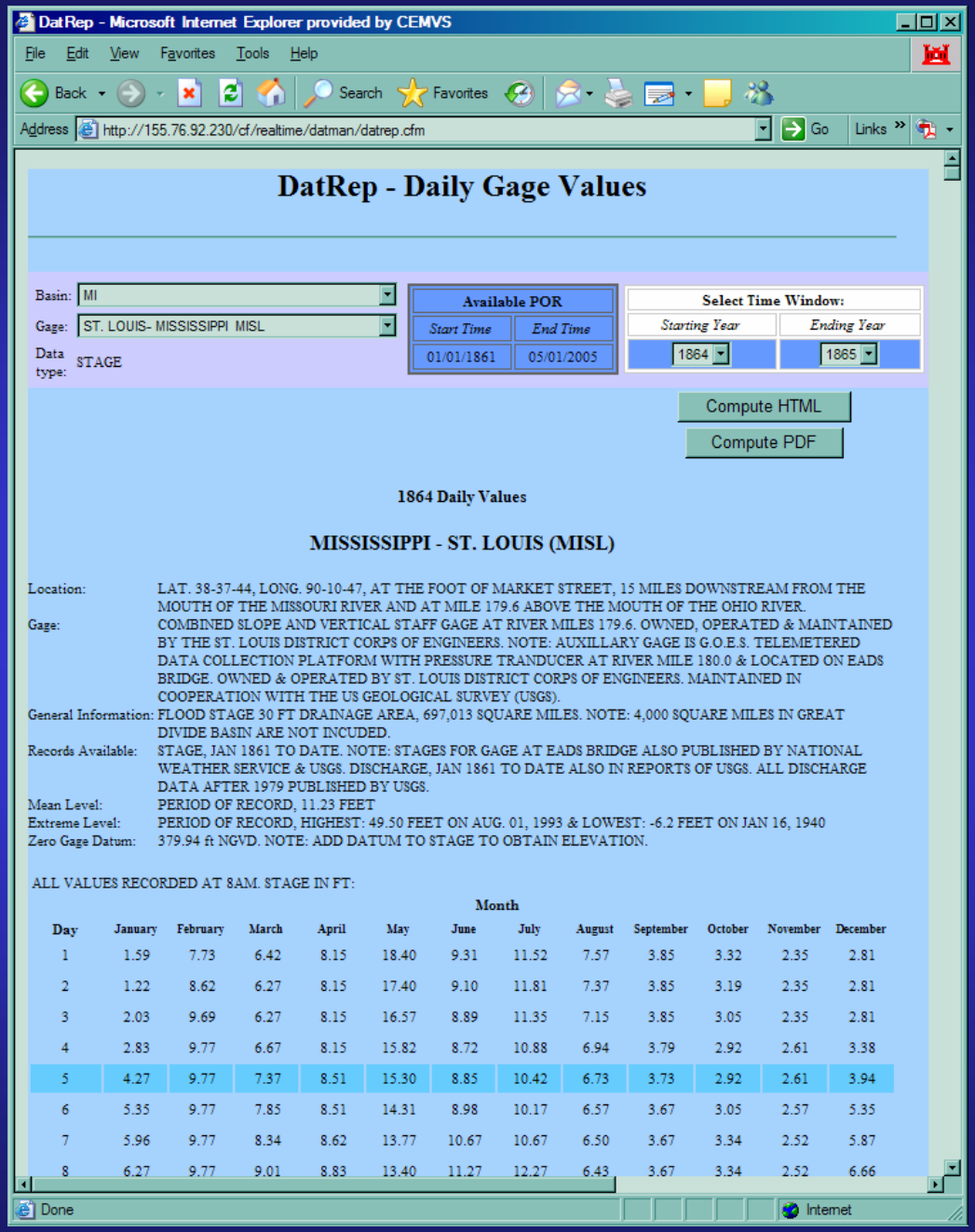
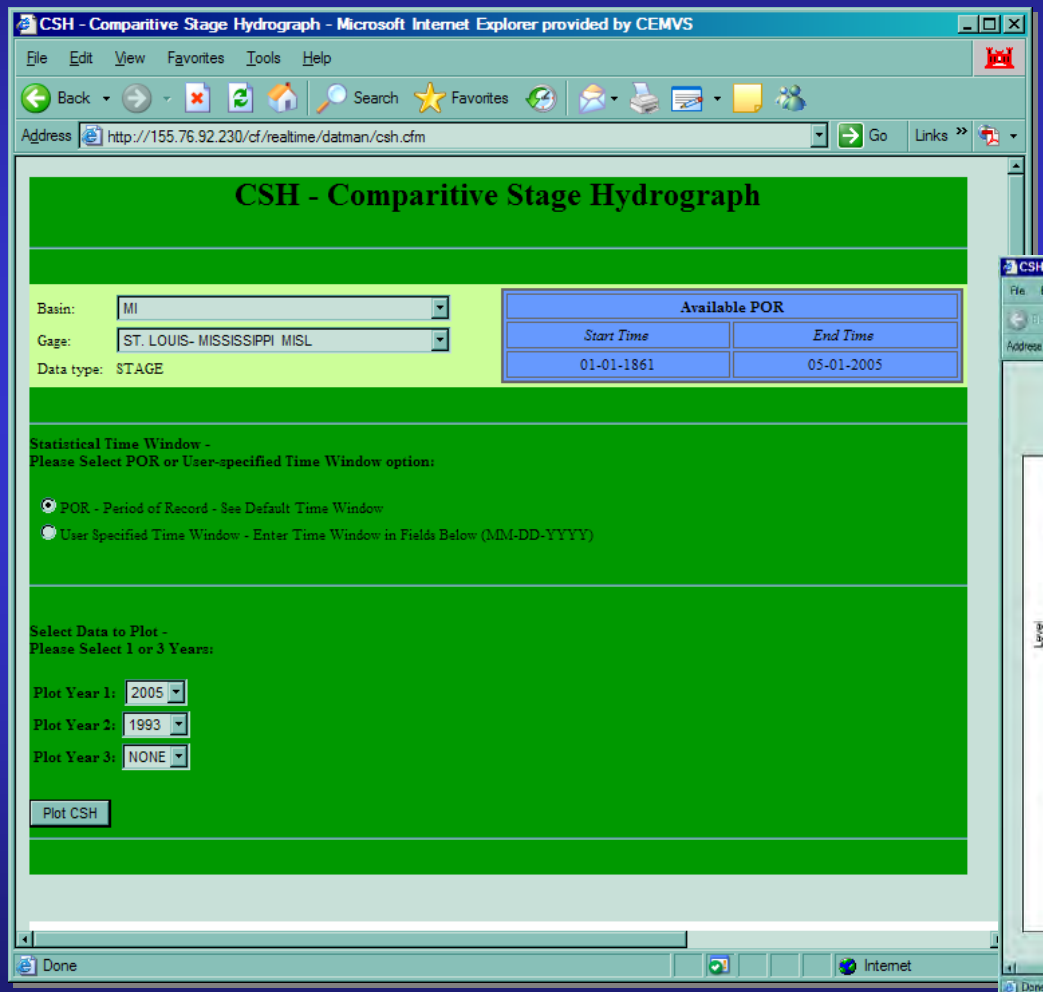
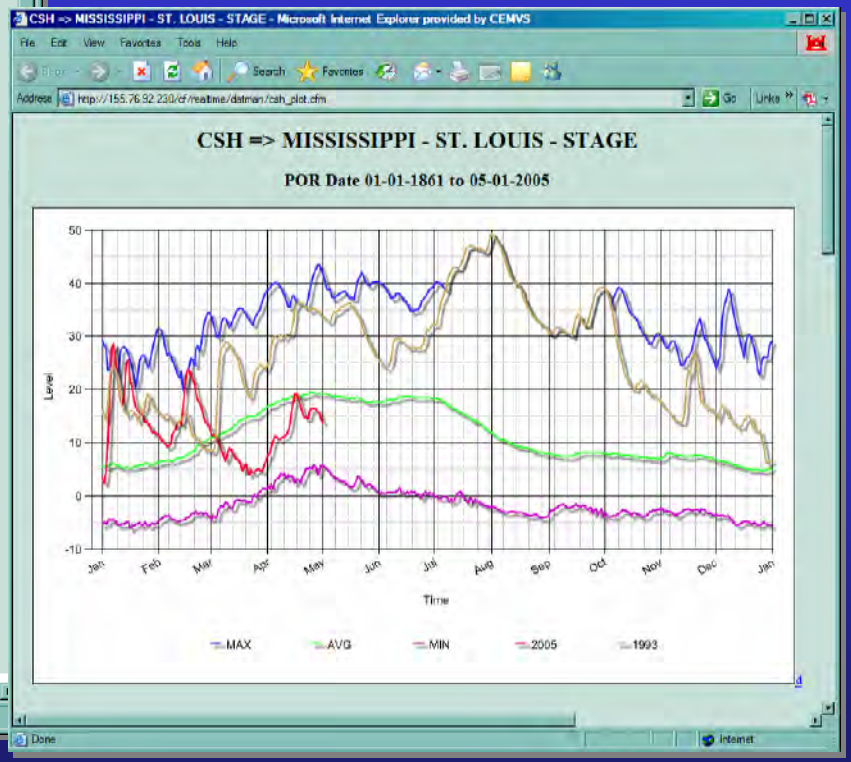
Historic Data Management DatRep



US Army Corps of Engineers

Historic Data Management
Comparative Stage Hydrograph





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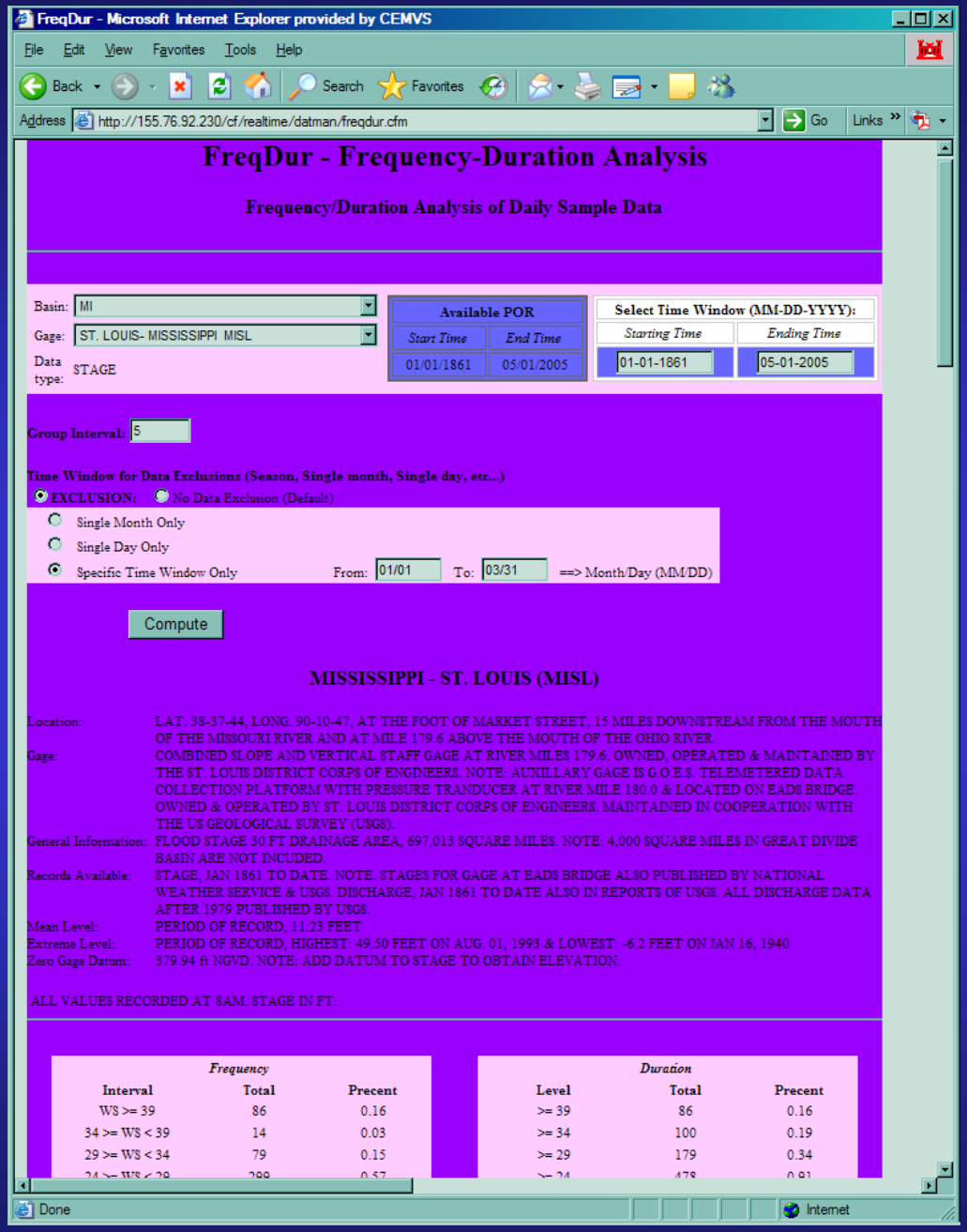
Historic Data Management
FreqDur



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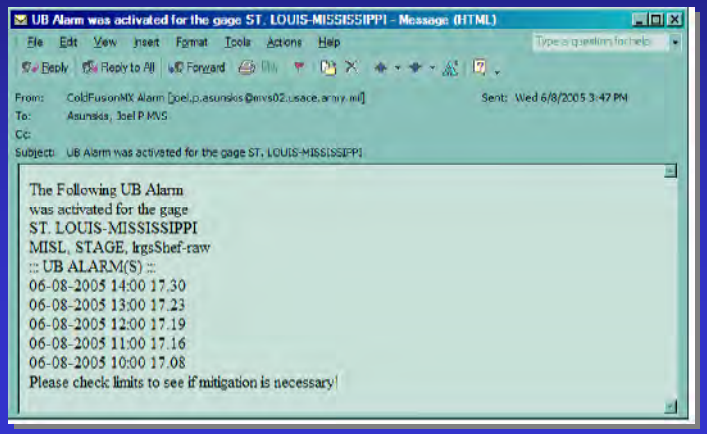
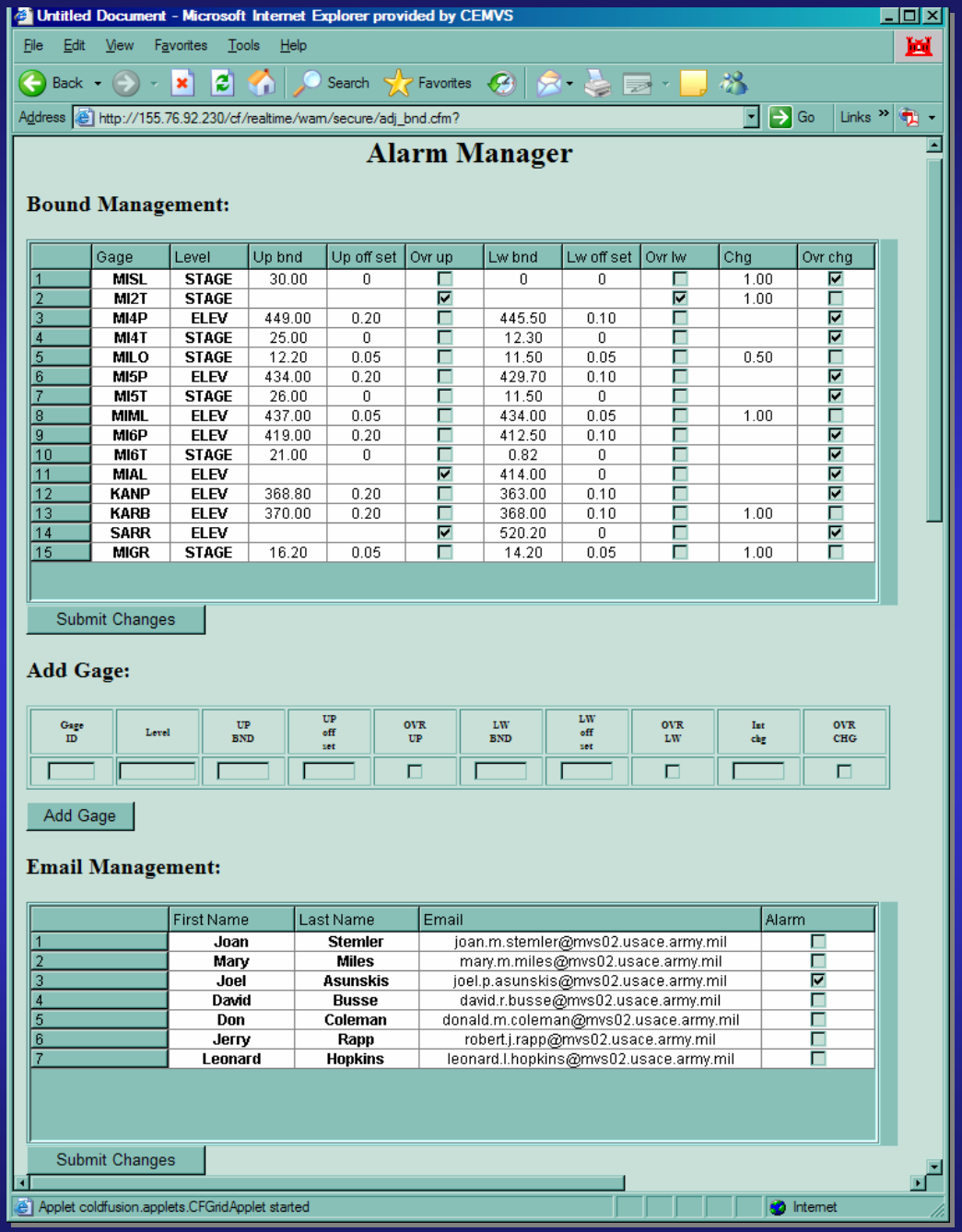
Alarm Manager (Blackberry)



Level 1 Encoded Message



Bound Management:

	Gage	Level	Up bnd	Up off set	Ovr up	Lw bnd	Lw off set	Ovr lw	Chg	Ovr chg
1	MISL	STAGE	30.00	0	☐	0	0	☐	1.00	☑
2	MI2T	STAGE			☑			☑	1.00	☐
3	MI4P	ELEV	449.00	0.20	☐	445.50	0.10	☐		☑
4	MI4T	STAGE	25.00	0	☐	12.30	0	☐		☑
5	MILO	STAGE	12.20	0.05	☐	11.50	0.05	☐	0.50	☐
6	MI5P	ELEV	434.00	0.20	☐	429.70	0.10	☐		☑
7	MI5T	STAGE	26.00	0	☐	11.50	0	☐		☑
8	MIML	ELEV	437.00	0.05	☐	434.00	0.05	☐	1.00	☐
9	MI6P	ELEV	419.00	0.20	☐	412.50	0.10	☐		☑
10	MI6T	STAGE	21.00	0	☐	0.82	0	☐		☑
11	MIAL	ELEV			☑	414.00	0	☐		☑
12	KANP	ELEV	368.80	0.20	☐	363.00	0.10	☐		☑
13	KARB	ELEV	370.00	0.20	☐	368.00	0.10	☐	1.00	☐
14	SARR	ELEV			☑	520.20	0	☐		☑
15	MIGR	STAGE	16.20	0.05	☐	14.20	0.05	☐	1.00	☐

Submit Changes

Add Gage:

Gage ID	Level	UP BND	UP off set	OVR UP	LW BND	LW off set	OVR LW	Ist chg	OVR CHG
				☐			☐		☐

Add Gage

Email Management:

	First Name	Last Name	Email	Alarm
1	Joan	Stemler	joan.m.stemler@mvs02.usace.army.mil	☐
2	Mary	Miles	mary.m.miles@mvs02.usace.army.mil	☐
3	Joel	Asunskis	joel.p.asunskis@mvs02.usace.army.mil	☑
4	David	Busse	david.r.busse@mvs02.usace.army.mil	☐
5	Don	Coleman	donald.m.coleman@mvs02.usace.army.mil	☐
6	Jerry	Rapp	robert.j.rapp@mvs02.usace.army.mil	☐
7	Leonard	Hopkins	leonard.l.hopkins@mvs02.usace.army.mil	☐

Submit Changes

US Army Corps of Engineers

Contact Information

- **Joel Asunskis, P.E.**
  - **314 – 331 – 8338**
  - **joel.p.asunskis@mvs02.usace.army.mil**
  - **U.S. Army Corps of Engineers**
    - **St. Louis District**

US Army Corps
of Engineers
Northwestern Division

A New Approach to Water Management Decision Making

Presented by

James D. Barton

Chief, Columbia Basin Water Management Division

US Army Corps
of Engineers
Northwestern Division

PRESENTATION OUTLINE

- Overview of Columbia River Basin and Water Management
- Regional Water Management Planning
- Regional Water Control Data System
- Regional Interagency Water Management Forum
- Summary and Questions

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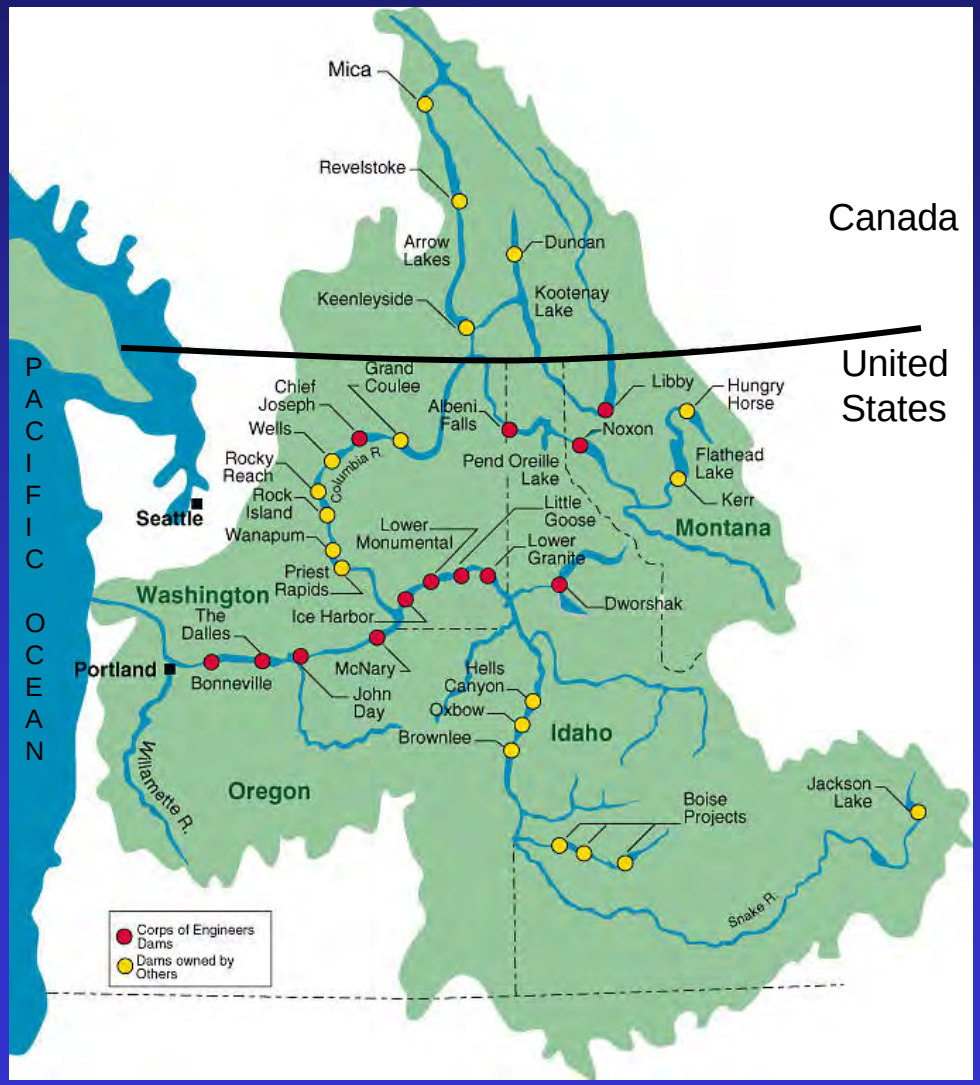
Northwestern Division

COLUMBIA RIVER BASIN



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COLUMBIA BASIN STATISTICS

- Approximately 259,000 square mile drainage area at the mouth
- Projects control only about 25% of the basin area
- Average annual runoff at The Dalles is approximately 156 MAF
- Storage capacity in the Columbia Basin is 40 MAF total
- 60 major dams, over 100 smaller dams

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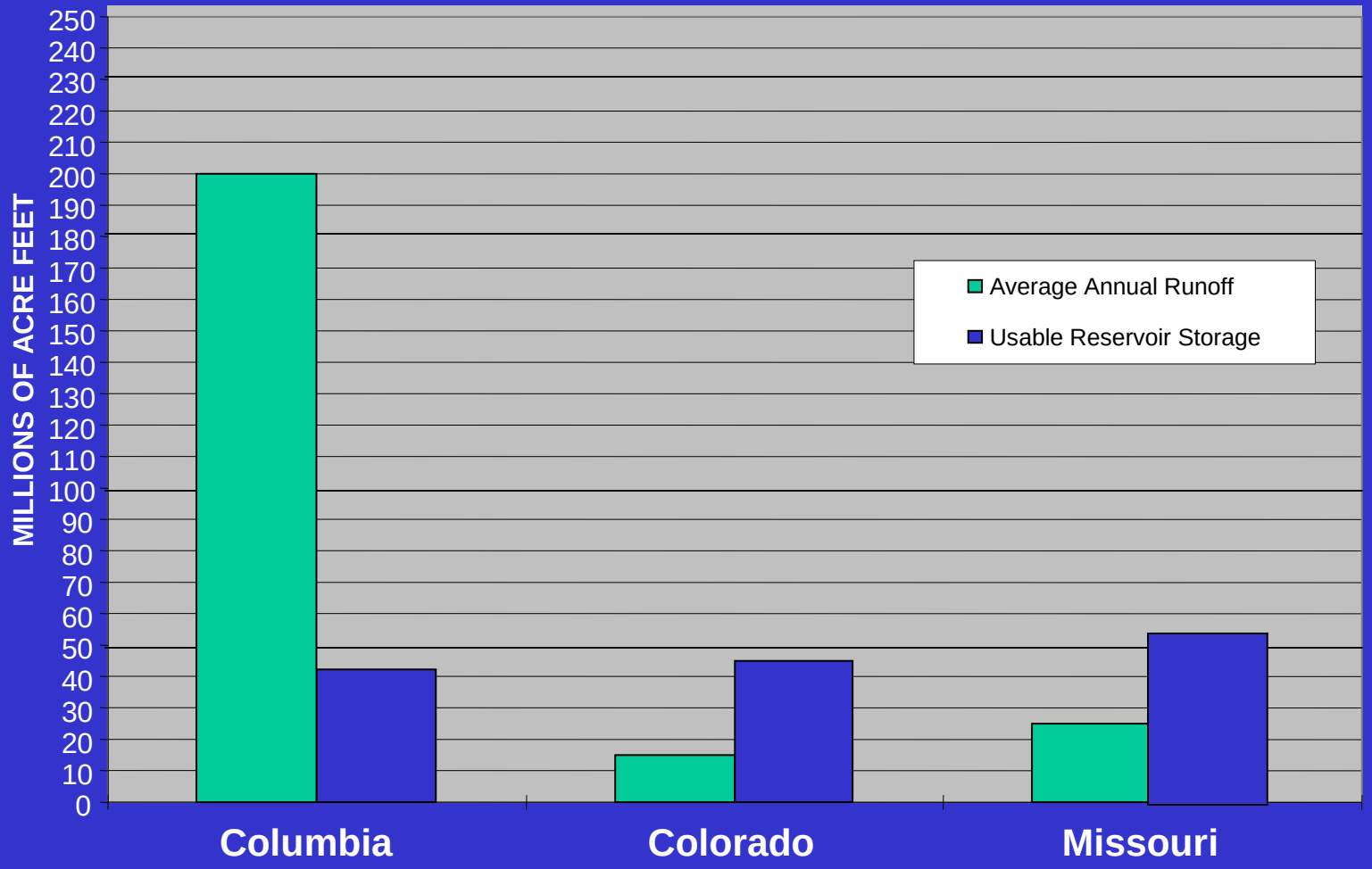
AVERAGE ANNUAL RUNOFF AND USABLE RESERVOIR STORAGE MAJOR WESTERN RIVER BASINS



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Major Columbia River Purposes and Benefits

HYDROPOWER: serves up to 80% of electricity in NW ; approximately $2-3 billion in annual revenues.

FLOOD CONTROL: provides 40 Maf of storage; over $6 billion in cumulative damages prevented.

NAVIGATION: millions of tons of commerce; 465 mi waterways (106 mi @40'; 359 mi @ 14'); 8 locks; multi-billion dollar annual economic benefits

RECREATION: fishing, swimming, camping, water skiing, rafting, boating, sightseeing.

WATER SUPPLY/IRRIGATION: water for millions of acres of agriculture, as well as M&I water

FISH and WILDLIFE: habitat for significant populations of fish and wildlife

Endangered Species Act Operation

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CONFLICTING REGIONAL PERSPECTIVES

- Action Agencies
  - Corps, Reclamation, BPA: Project operators, power marketers. Responsible for system operation
- Federal Fishery Agencies
  - NOAA: Salmon and Steelhead BiOps, anadromous fish responsibilities
  - USFW: Sturgeon BiOp, resident fish responsibilities, also a salmon manager

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CONFLICTING REGIONAL PERSPECTIVES (cont.)

- States
  - MT, ID: Upstream, interests to keep water.
  - OR, WA: Flow Advocates
- Thirteen Tribes
  - Participants: Advocate more flow, more spill - natural river
- Canada
  - Operates for power and flood control and mutually beneficial operations

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Regional Water Management Planning

- Interagency regional forums established for collaboration
- Annual, spring, and fall water management plans developed to guide system operation
- Document plans for compliance with Endangered Species Act (ESA) and other requirements

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Regional Water Management Planning

- Annual fish passage plans developed to guide fish passage
- Provide detailed operating plans for fish passage at specific projects
- More information: www.nwd-wc.usace.army.mil/tmt/

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Regional Water Control Data System

- Regional Water Control Data System (WCDS) and database implemented to improve interagency effectiveness and efficiency (~$500,00 annual savings)
- System provides “one door” to real-time & historic data in a consistent format for use by decision makers throughout the region

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Regional Water Control Data System (cont.)

- Data collected and stored for approximately 1,000 locations
- Processing approximately 25,000 data values per hour
- Regional website established for readily exchanging key information
- More information: www.nwd-wc.usace.army.mil/report.htm

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Regional Interagency Water Management Forum

- Interagency regional forum established for better collaboration
- Forum utilizes data from regional database/system and water management plans to formulate real time operation
- Forum has various teams focused on technical, policy, and strategic aspects

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Regional Water Management Forum

Regional Interagency Forum

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CORPS

USFWS

NOAA (CHAIR)

BLM

BIA

USFS

USBR

FEDERAL EXECUTIVES

NPPC

BPA

STATES

TRIBES

EPA

IMPLEMENTATION TEAM (IT)

Independent Scientific Advisory Board

SYSTEM CONFIGURATION TEAM (SCT)

WATER QUALITY TEAM (WQT)

TECHNICAL MANAGEMENT TEAM (TMT)

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SUMMARY

- Endangered Species Act, Clean Water Act, and others require strong regional interagency collaboration for compliance
- Tighter controls on operations at individual dams for ESA and other requirements limit flexibility to meet all the multiple purposes
- Use of interagency regional approach is only workable solution in this environment
- Regional WCDS provides easy access to all data in a consistent format for decision-makers

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FUTURE CHALLENGES

- Conflicts between upstream & downstream interests, resident & non-resident fish, etc.
- Tighter controls and accounting for operations at individual dams
- Less flexibility to meet all the multi-purposes
- More competition for limited water resources
- Budget limitations

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QUESTIONS?

US Army Corps of Engineers
Northwestern Division

Contact Information

- Jim Barton, Corps of Engineers
- (503) 808-3930
- Email: james.d.barton@nwd01.usace.army.mil

US Army Corps
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Aquatic Habitat Restoration in the Lower Missouri River

Chance Bitner, Hydraulic Engineer
Kansas City District Corps of Engineers

August, 2005

US Army Corps
of Engineers

Introduction

- History of Missouri River
- Missouri River Mitigation
- 2000 Biological Opinion (2003 amendment)
- Construction Types / what we have tried
- Short-term Observations
- Future Directions

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History and Changes to the Missouri River

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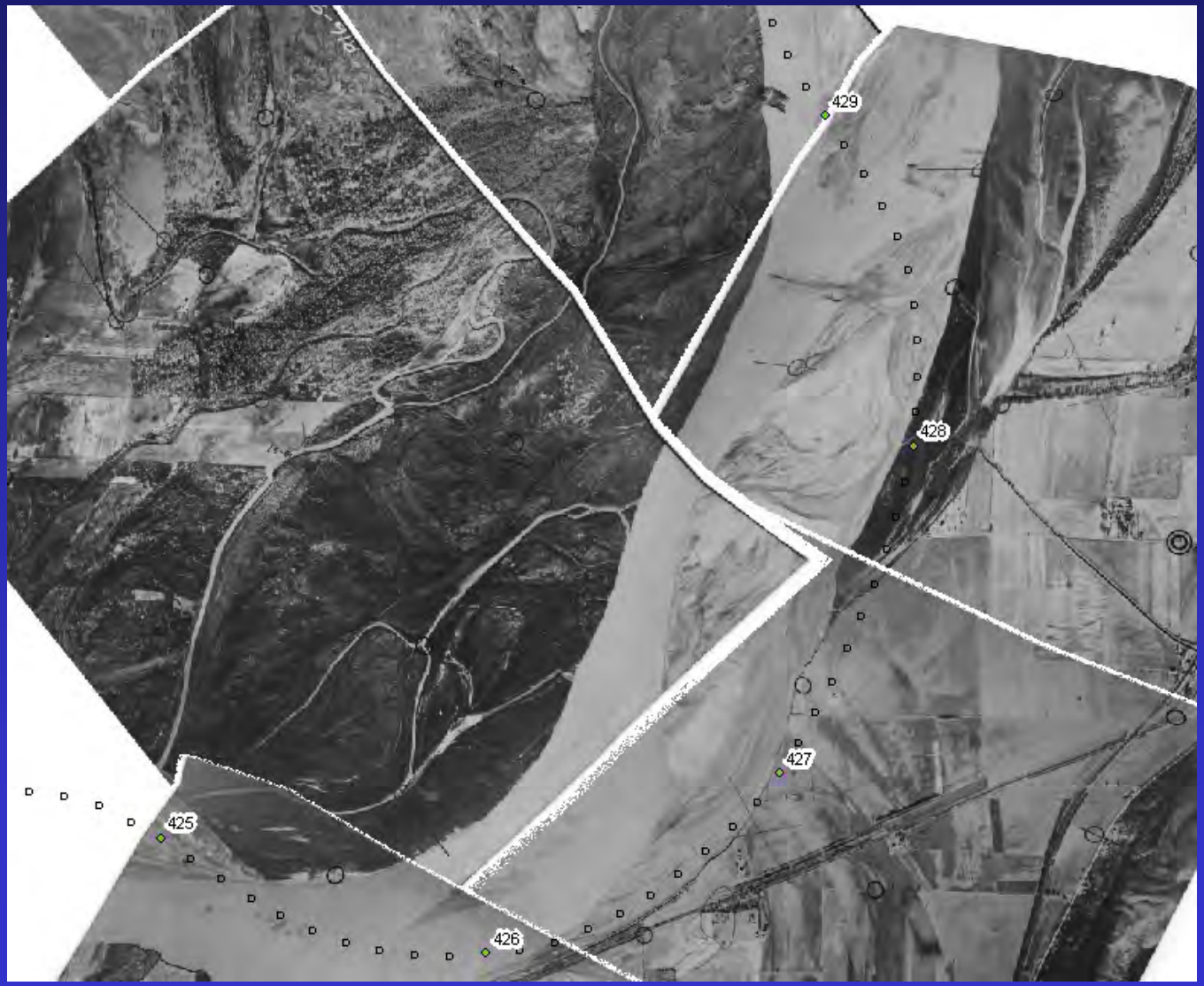
Benedictine Bottoms, 1928



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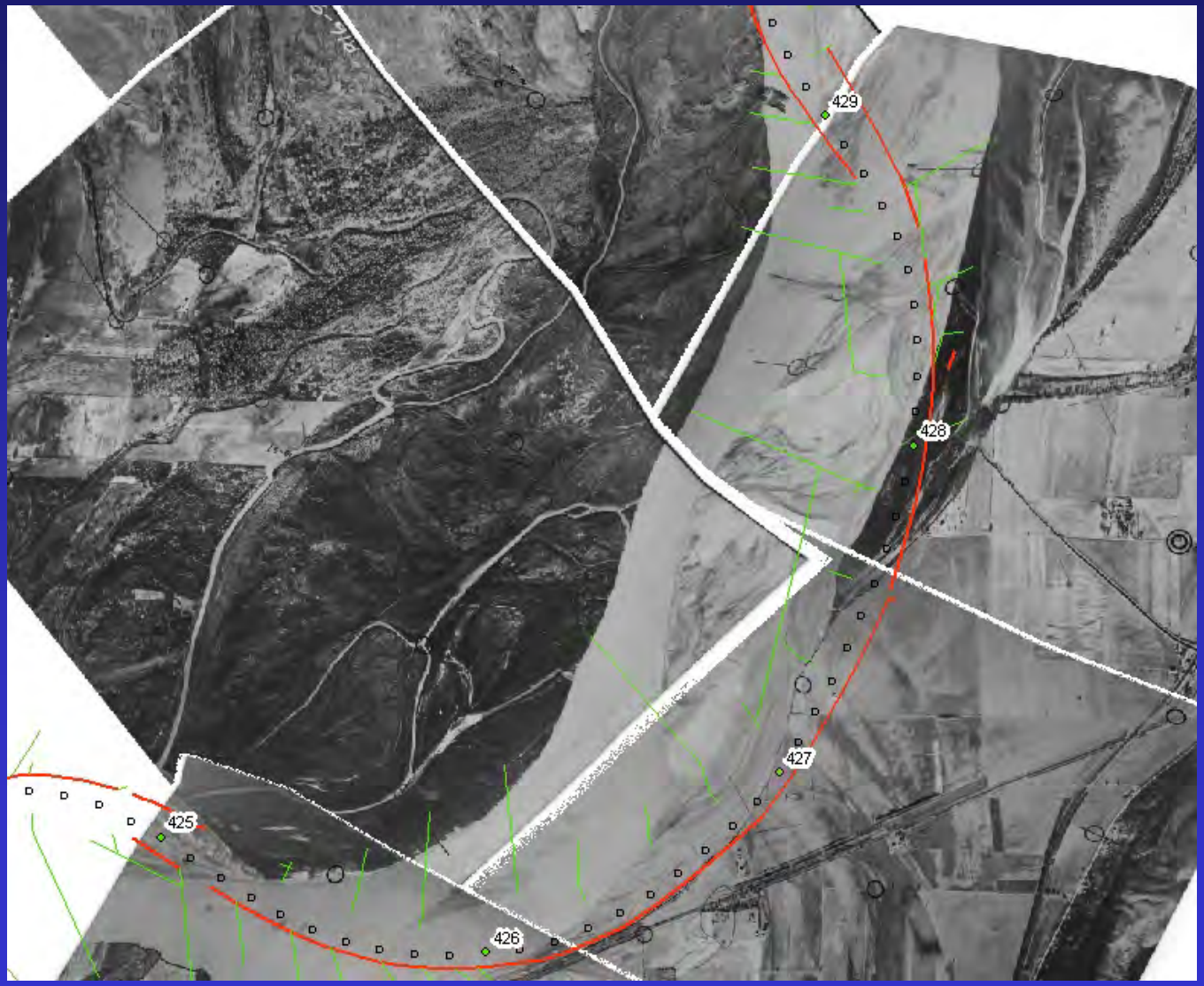
Benedictine Bottoms, 1928



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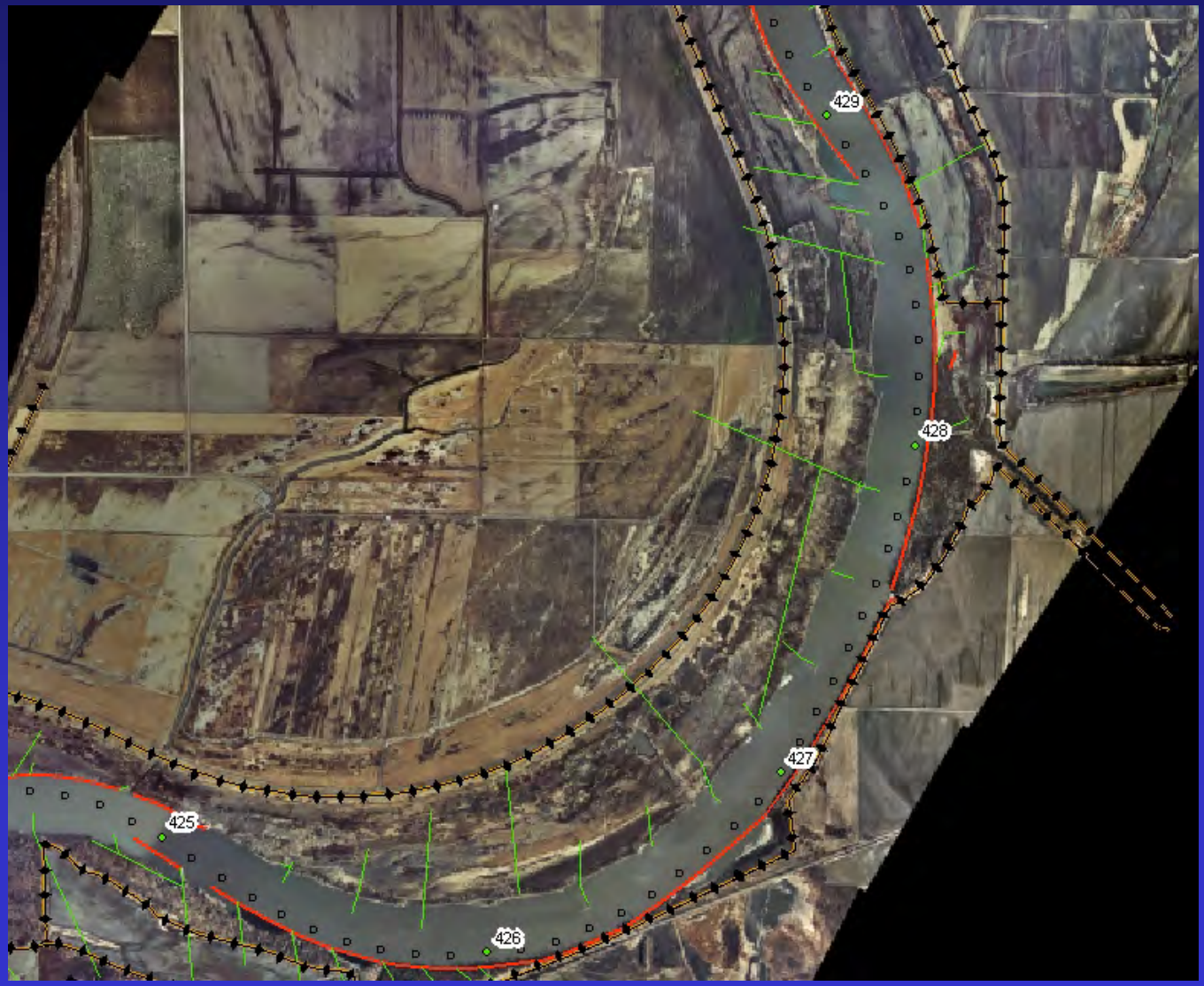
Benedictine Bottoms, 2000



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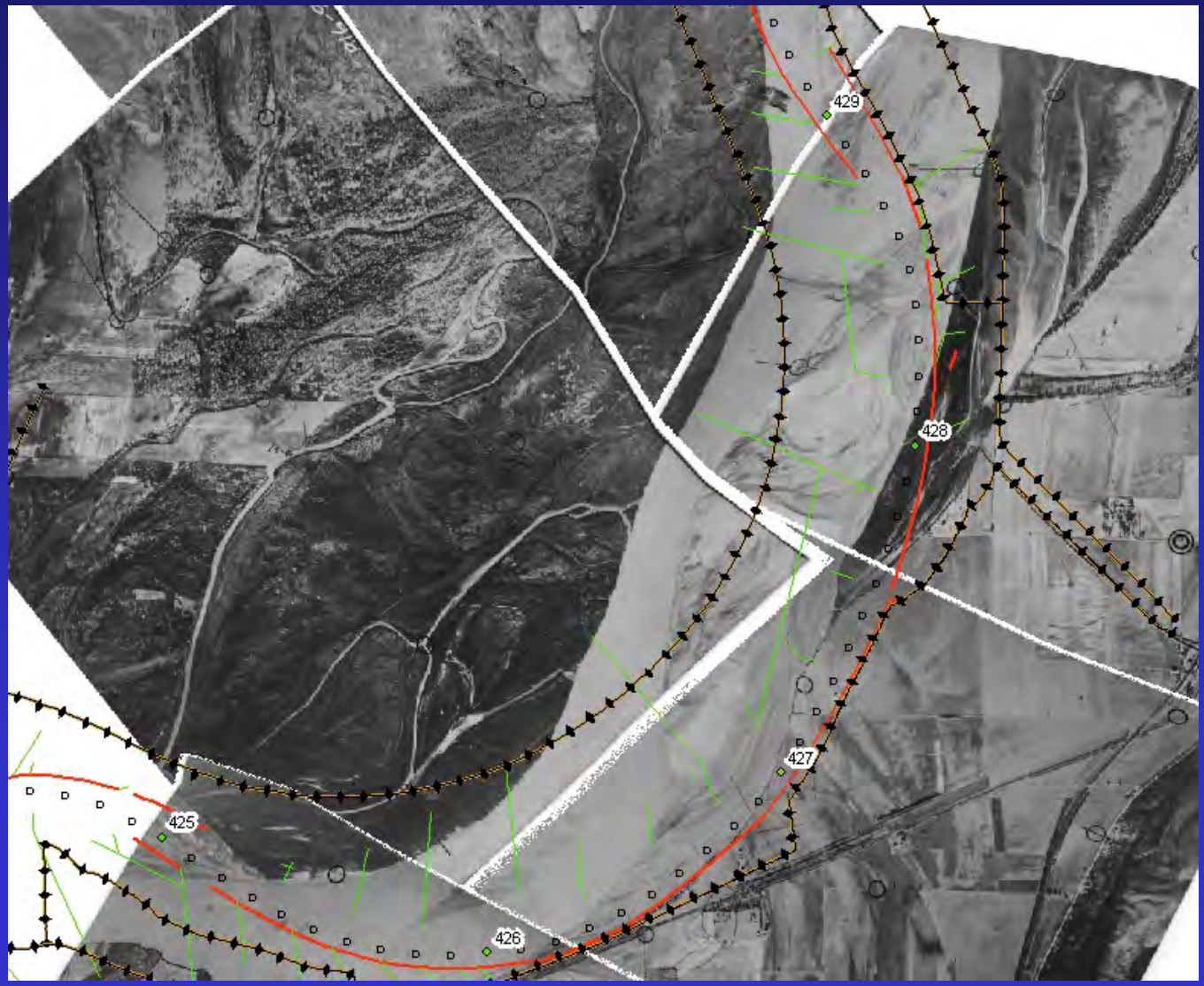

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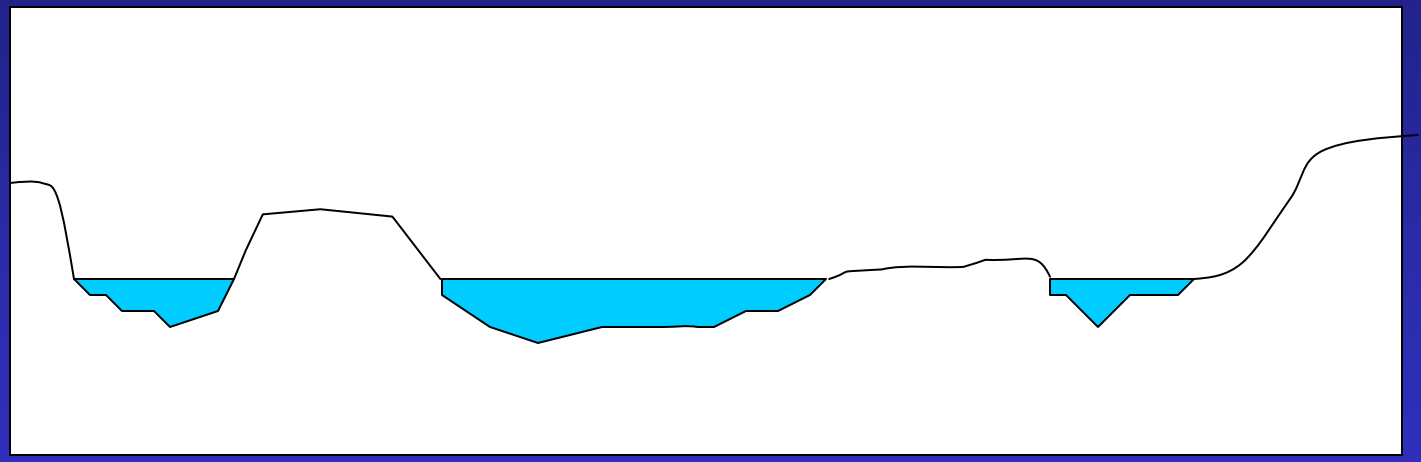

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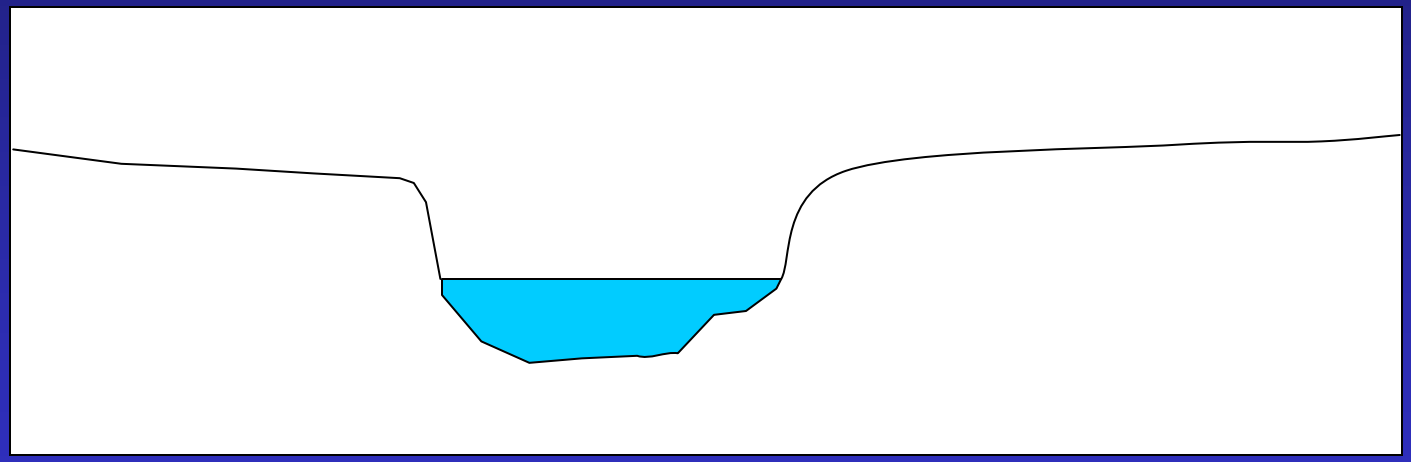

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Missouri River Mitigation

- Mitigate for Habitats lost due to Construction and O&M of BSNP
- Early Aquatic Work in KCD
  - Grand Pass Chute (1991)
  - Dike and Revetment Notching Program
    - (initiated in the 1970's), approx 2000 notches, various elevations and sizes)
  - Rootless dikes, approx 160 constructed before 1991

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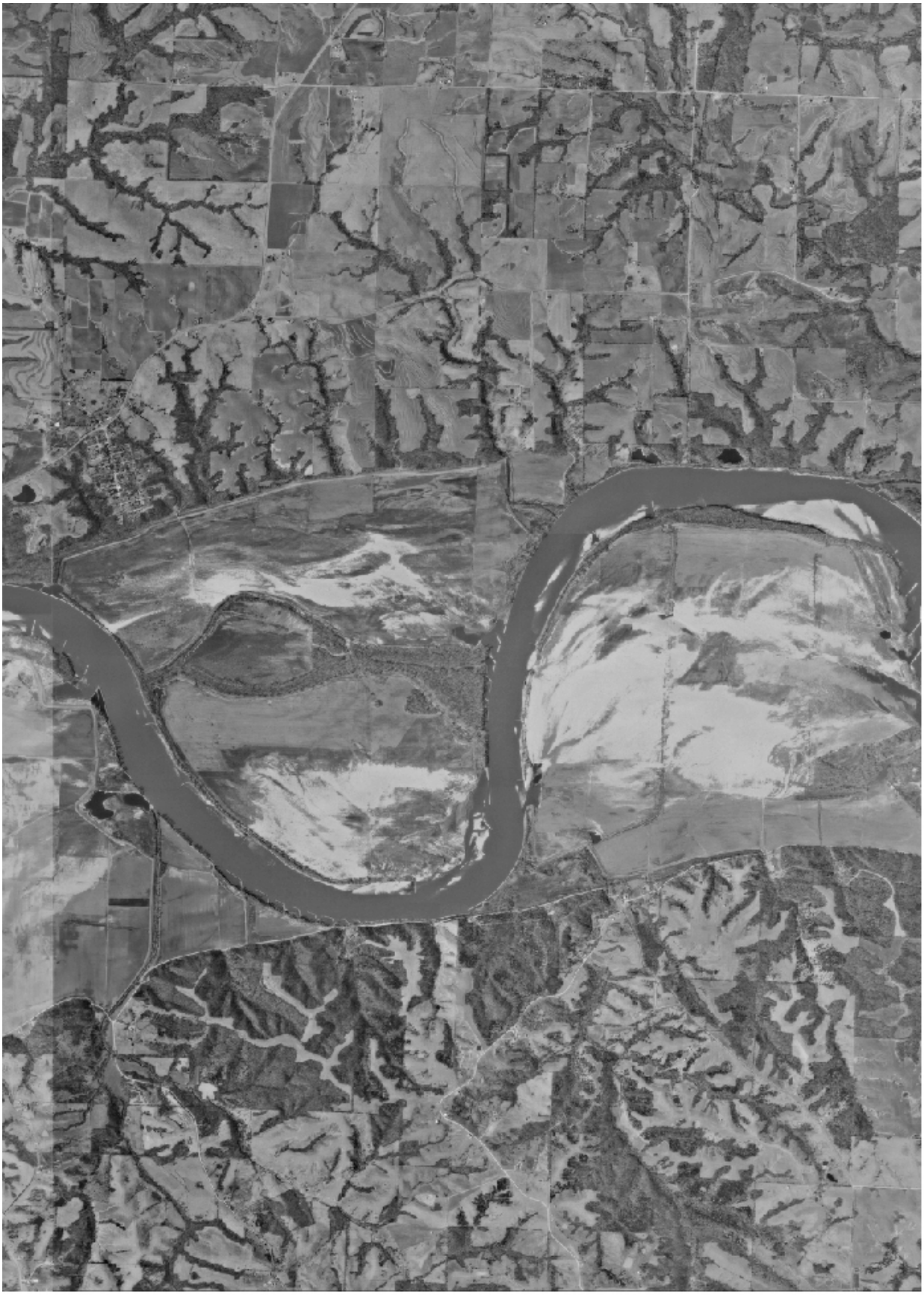
Flooding

- 1993, 1995, and 1997 floods
- Lisbon Chute
- Jameson
- Plowboy Bend
- Numerous Scour Holes

Jameson Island, Feb 1995

Jameson Island, Feb 2000



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2000 Biological Opinion

- Mitigate for impacts to the Pallid Sturgeon and the significant loss of Shallow Water Habitat
  - Velocities less than 2.5-ft/s, depths less than 5-ft.

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Toolbox

- Modification of Navigation Structures
- Construct New Structures
- Chute Construction (island restoration)
- River Widening
- Placement of Rootballs or other cover
- Flooding

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Dike Notching

21 Apr 2004
COE in-house Crew

21 Apr 2004 Series of Notches
Completed in April 2004.

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Revetment Notching

21 Apr 2004 Revetment Notch Examples.

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Bank Notching

10 JUL 2004: Bank Notch Examples.

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Pilot Channeling

Monkey Mtn Pilot Channel A.
21 APR 2004, Stage: -1.5-ft CRP

Monkey Mtn Pilot Channel B.
29 APR 2004, Stage: -1.5-ft CRP

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Chute Construction

April 2004

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of Engineers

KCD Summary Since 2000

- 833 Dike Notches
- 183 Revetment Notches
- 85 Bank Notches
- 14 Pilot Channels, 12,100-ft length
- 9 short chute projects, 6,670-ft length
- 3 Major Chutes, 4.6 - miles total length
- In-Construction: 60 notches, 1.7 mile chute

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Challenges and Limitations

- Other Congressionally Authorized Projects
- Spoil Placement
- Debris
- Public Perception
- Number of Structures in the Missouri River
- Tracking and Documenting Changes
- Drought
- Definition of SWH
- Land acquisition

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Short-Term Observations

- Bank Notches
- Pilot Channels
- Short Chutes

RM 181: Overton South: 28 April 2005: Stage = +1 CRP

RM 457: Worthwine: 26 JULY 2005: Stage = -1 CRP

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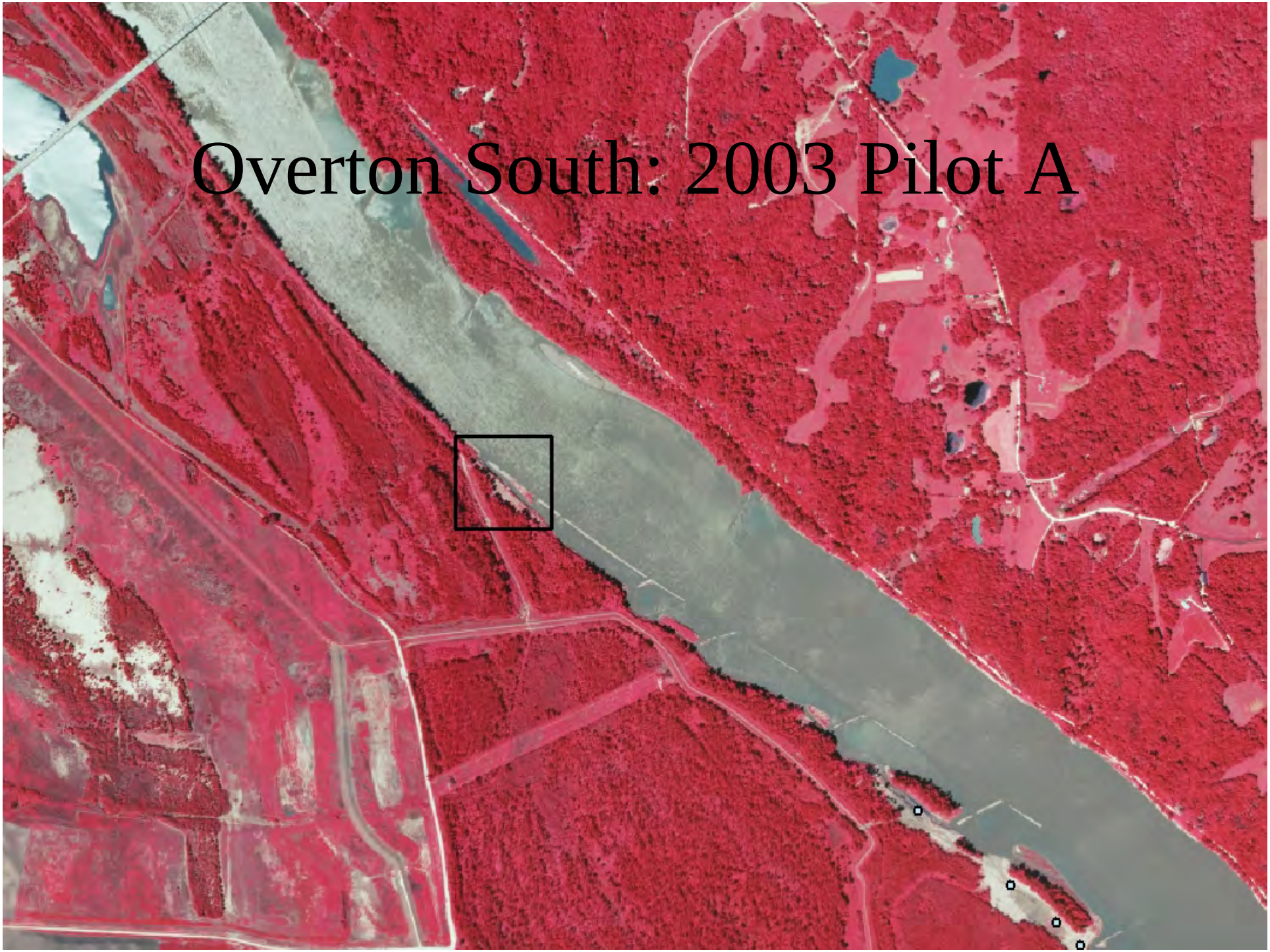
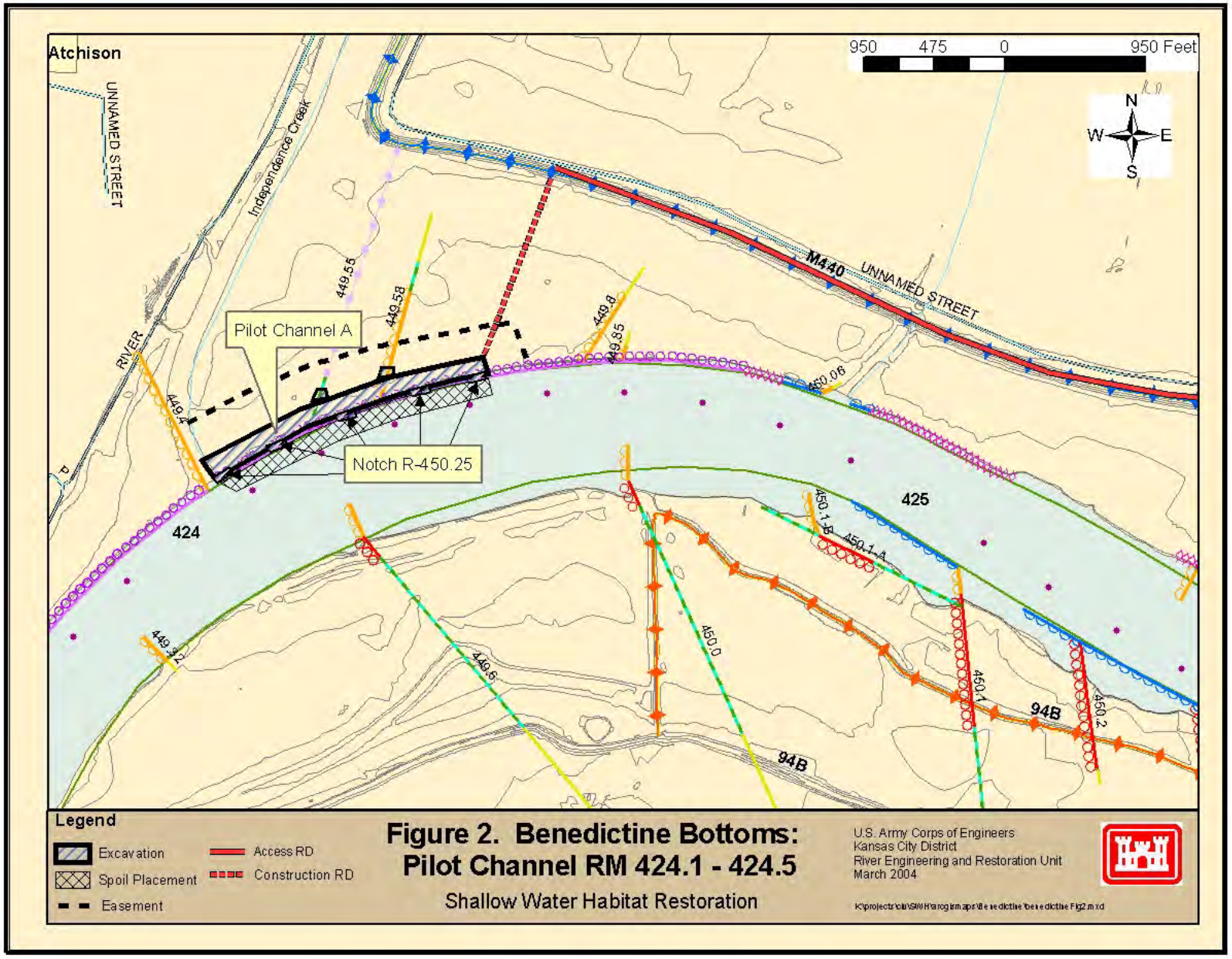
RM 198: Franklin Island: 28 APR 2005: Stage +1 CRP

Baltimore Bend: 26 APR 2005: Stage 0 CRP


Overton South: 2003 Pilot A

22 Apr 2004, stage at –2 CRP
Overton Bottoms South
SWH Work

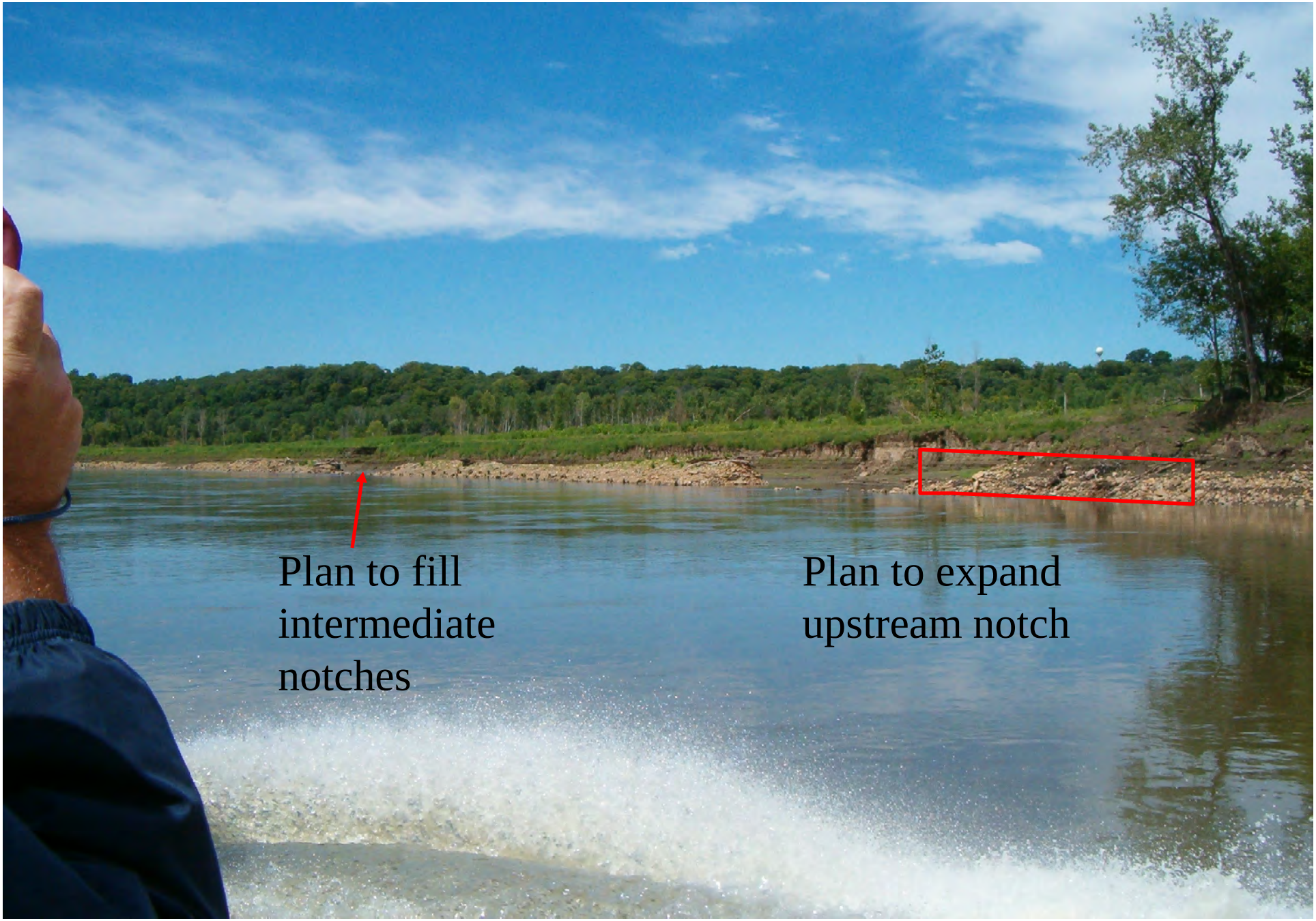
Overton South Pilot A: 02 SEP 2004: Stage +6 CRP


Atchison
UNNAMED STREET
Independence Creek
RIVER
950 475 0 950 Feet
N
W E
S
M440
UNNAMED STREET
Pilot Channel A
Notch R-450.25
449.55
449.58
449.8
449.85
450.06
449.4
425
424
450.1-B
450.1-A
449.92
449.6
450.0
450.1
450.2
94B
94B
Legend
Excavation
Spoil Placement
Easement
Access RD
Construction RD
Figure 2. Benedictine Bottoms:
Pilot Channel RM 424.1 - 424.5
Shallow Water Habitat Restoration
U.S. Army Corps of Engineers
Kansas City District
River Engineering and Restoration Unit
March 2004

Benedictine Pilot Channel: 17 DEC 2004, Stage ~-6.5-ft CRP
Looking upstream from exit.

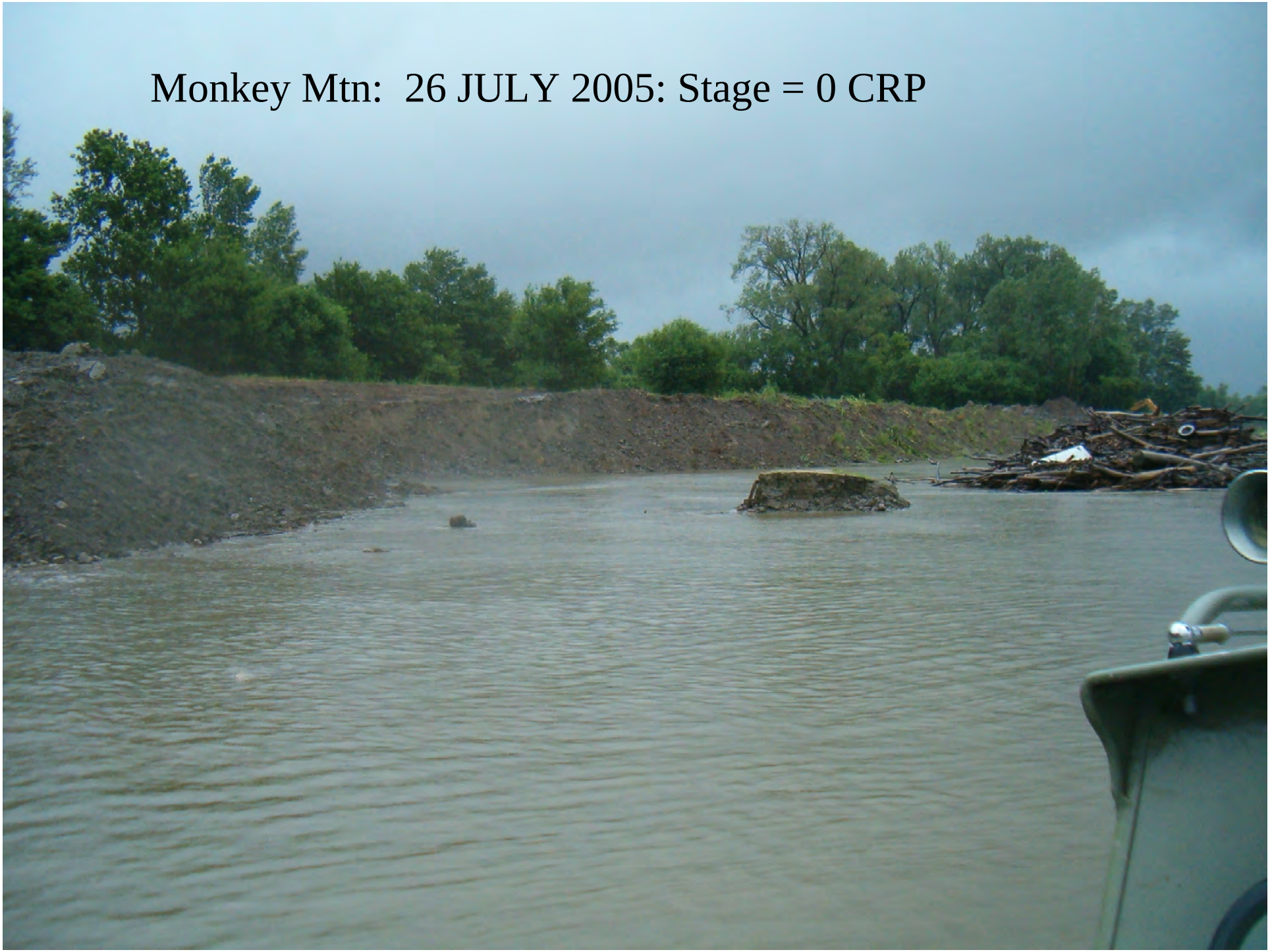
Benedictine Pilot Channel A: 11 MAY 2005, Stage ~ -1-ft CRP
View of channel looking downstream from entrance

Benedictine Pilot Channel A: 24 AUG 2004, Stage ~-2-ft CRP



Monkey Mountain Pilot Channel A: 22 SEP 2004, Stage ~ -1-ft CRP

Monkey Mtn: 12 JULY 2005: Stage = -1 CRP


Monkey Mtn: 26 JULY 2005: Stage = 0 CRP

Monkey Mtn: 12 JULY 2005: Stage = -1 CRP

Monkey Mtn: 19 JULY 2005: Stage = -1 CRP

Worthwine Island Pilot Channel: 17 DEC 2004, Stage ~ -6-ft CRP.
Looking upstream from the downstream end.

Worthwine Island Pilot Channel: 26 JUL 2005, Stage ~ 0-ft CRP.
Looking downstream from the midpoint.

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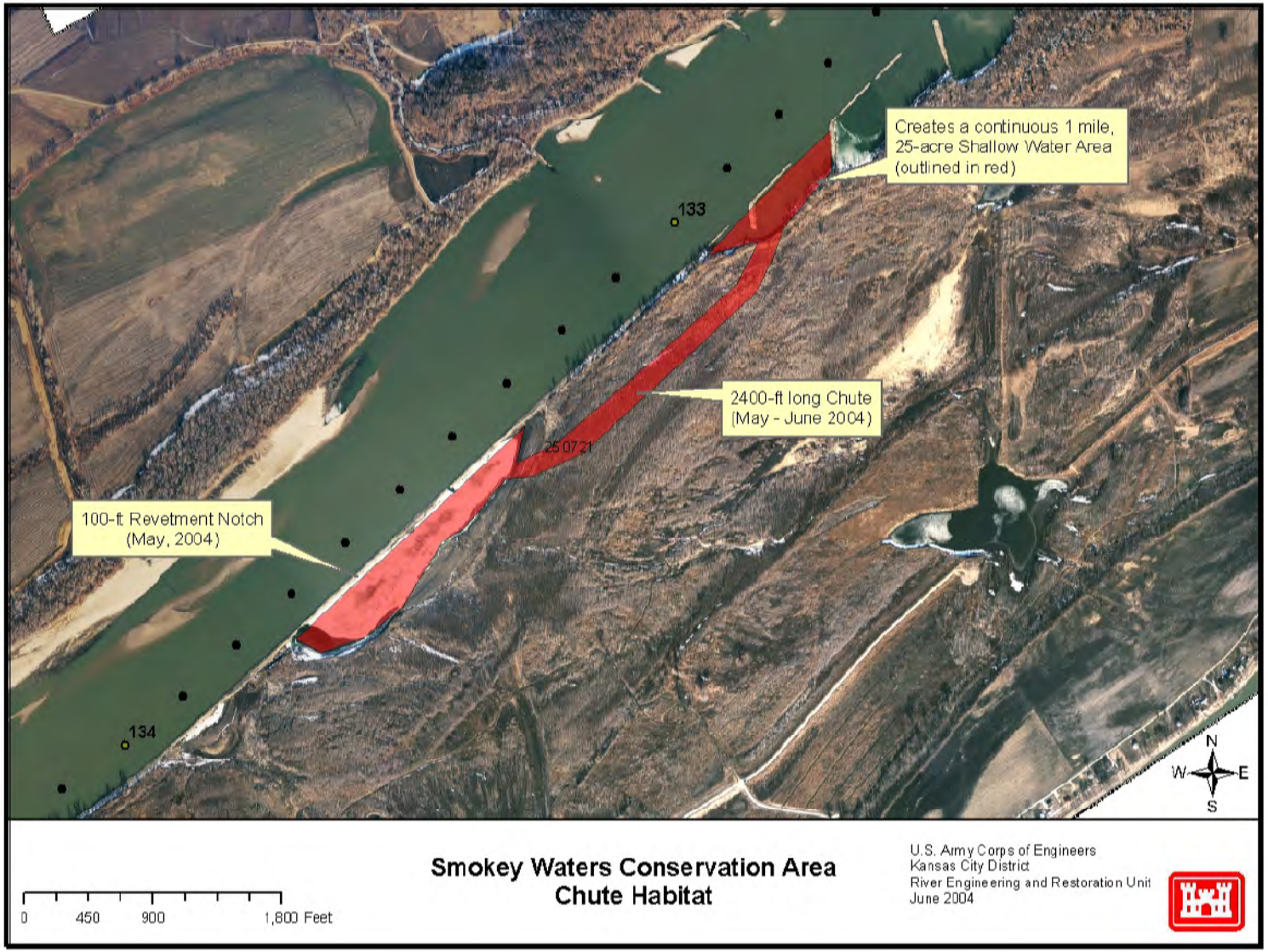

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Smokey Waters Chute, 21 OCT 2004, Stage ~ -5-ft CRP
Looking Downstream from the upstream end

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Smokey Waters Chute, 21 OCT 2004, Stage ~ -5-ft CRP
Looking Upstream at the chute from a created gravel bar

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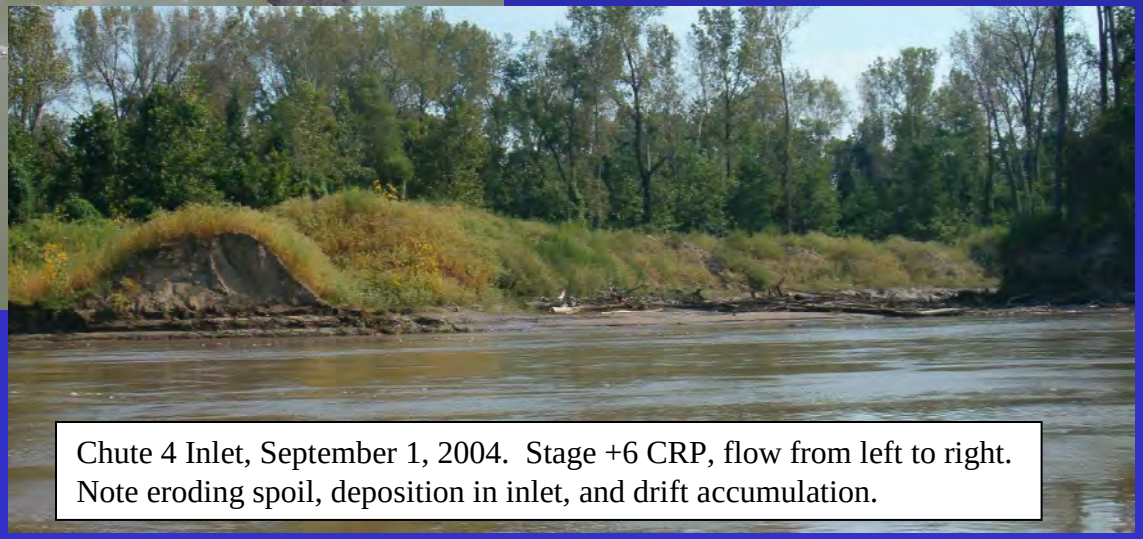
22 Apr 2004, stage at –2 CRP



Chute 4 Inlet, September 1, 2004. Stage +6 CRP, flow from left to right. Note eroding spoil, deposition in inlet, and drift accumulation.

Overton South Chute
River Mile 182

Overton Bottoms South,
22 Apr 2004, stage at –2 CRP

Overton South Chute 2: 02 SEP 2006: Stage +6 CRP
Invert EL +0 CRP

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Comparison

- Cost / Benefit? Must Rely on Biological Monitoring
- Relative Construction Cost
  - Dike/Revetment Notches, Bank Notches, New Structures, Pilot Channels, Chutes

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Future Directions

- Dike notch program (until we run out of dikes)
- Multiple iterations of bank notch program
- Continue chute construction
- Aggressive pilot channel construction behind revetments
- Other in-stream habitat changes (if found successful by monitoring)
- Creek and Tributary mouth modifications
- Wait for flooding...

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Thanks to our Partners

- Missouri Department of Conservation
- Missouri Department of Natural Resources
- US Fish and Wildlife Service, Big Muddy Refuge
- Kansas Department of Wildlife and Parks
- Iowa Department of Natural Resources
- Nebraska Game and Parks Commission

US Army COE
Portland District

Impacts of using a spillway for juvenile fish passage on typical design criteria.

By

Bob Buchholz

Portland District

The Dalles Lock and Dam

US Army COE
Portland District

US Army COE
Portland District

The Dalles Lock and Dam

Completed 1957

Run of River w/Navigation Lock

Powerhouse has 22 units

1800 MW capacity

PH Discharge Capacity 375,000 cfs

Spillway Pertinent Data

US Army COE
Portland District

- 23-50’ wide Spillway bays
- SDF – 2.29 million CFS
- Crest: 121 ft msl
- Operating Range: 155-160 ft msl
- Stilling Basin Invert: El 55
- Exit Channel (shelf): El 68
- Normal TW range: 77-82 ft msl

Fish Passage History of Spillway

US Army COE
Portland District

- Spill for fish passage began in 1996.
- Listed species: Salmonids, Steelhead.
- Since 1999 40% of total river flow spilled for juvenile fish passage.
- Poor juvenile survival through spillway.

Pertinent Spillway Features

US Army COE
Portland District

- **Excavated out of Basalt.**
- **Minimized excavation resulting in short stilling basin and shallow exit channel.**
- **Concrete apron added downstream of end sill to act as a warning.**
- **Deep, narrow canyon & shallow island area downstream of spillway.**

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Portland District

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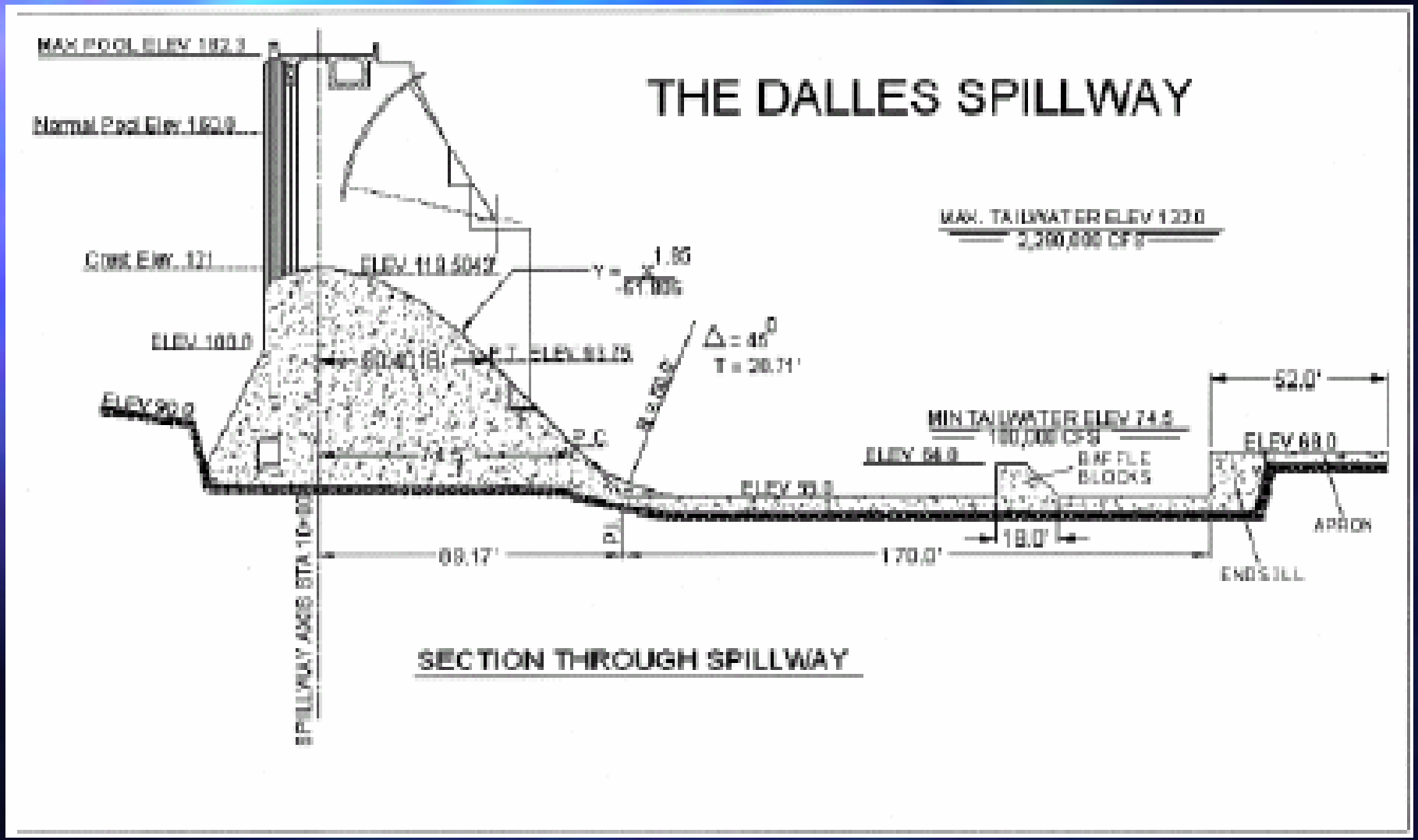
Portland District



Design Solution - Spillwall

US Army COE
Portland District

- Aids in Egress of Juveniles
- Eliminates flow entrainment
- Increases direct survival of juveniles
- Concentrates spill in northern 6 bays.

Consequences of Spillwall

US Army COE
Portland District

- Higher Unit Q without an increase in tailwater.
- Impact stilling basin efficiency.
- Higher velocities exiting stilling basin.

Mitigation of Consequences

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Portland District

- Extensive physical and numerical model studies and literature search.
- Evaluated exit velocity from stilling basin and established threshold criteria.
- Established monitoring program.

Dalles Spillway w/Spillwall

US Army COE
Portland District

Operational Limitations & Monitoring Plan

US Army COE
Portland District

- Depth of flow on apron at or above critical depth.
- Developed q and TW relationship.
- Monitor exposure time where above relationship exceeded (Excel file used by PH Operators)
- Perform hydro-surveys and dive surveys as appropriate.

TW-Velocity-q/bay Relationship

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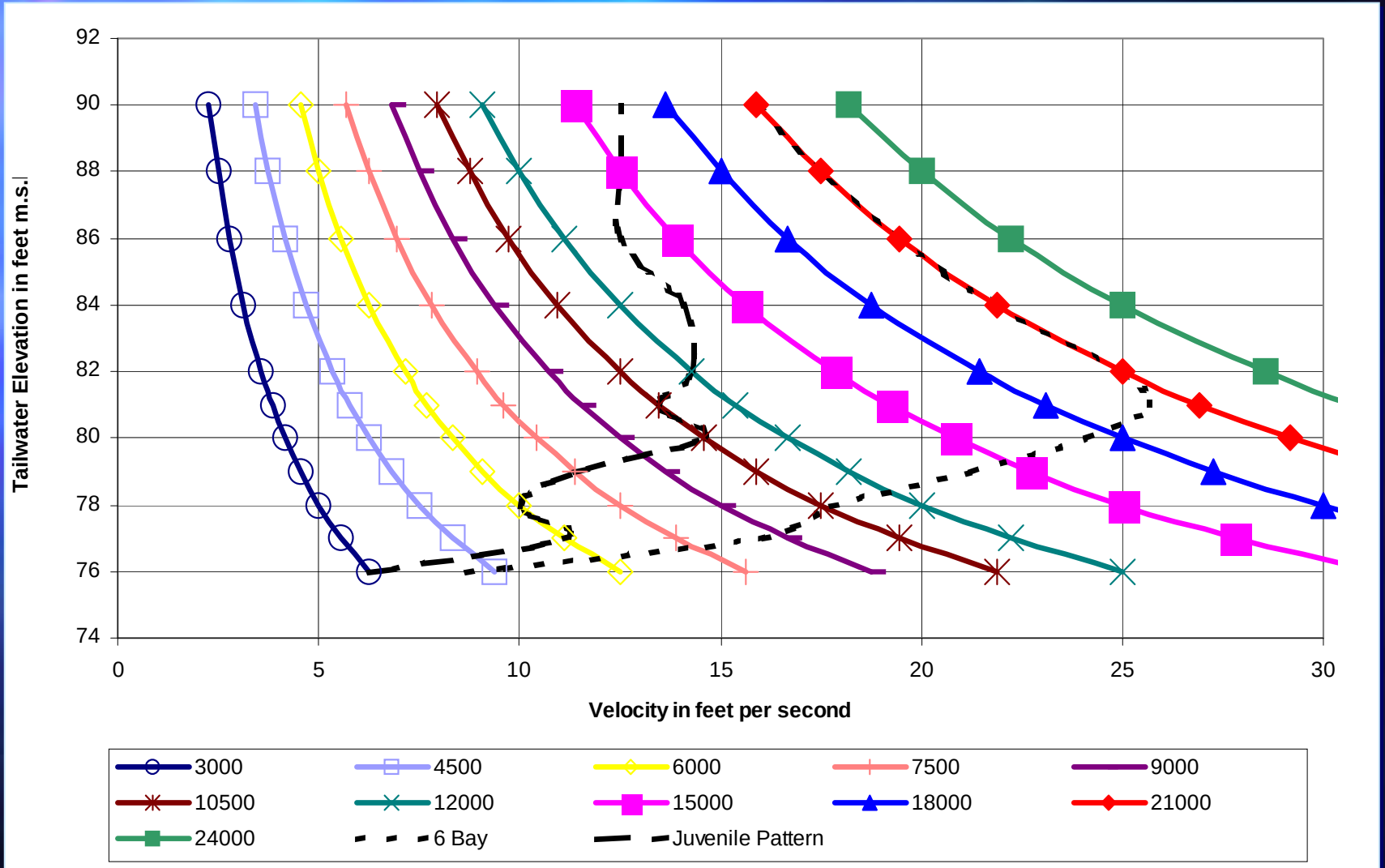
Portland District



TW vs q/bay Relationship

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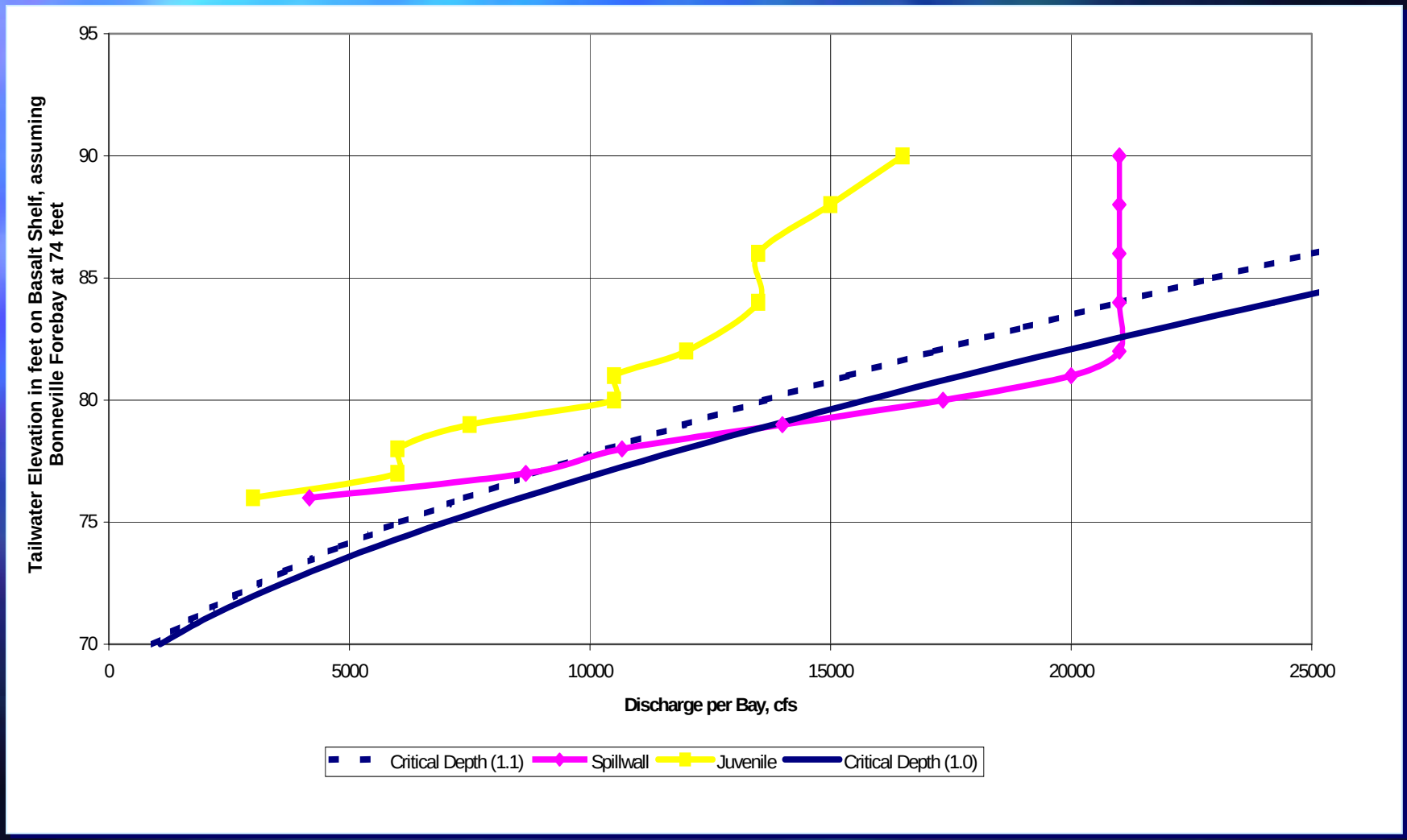
Portland District

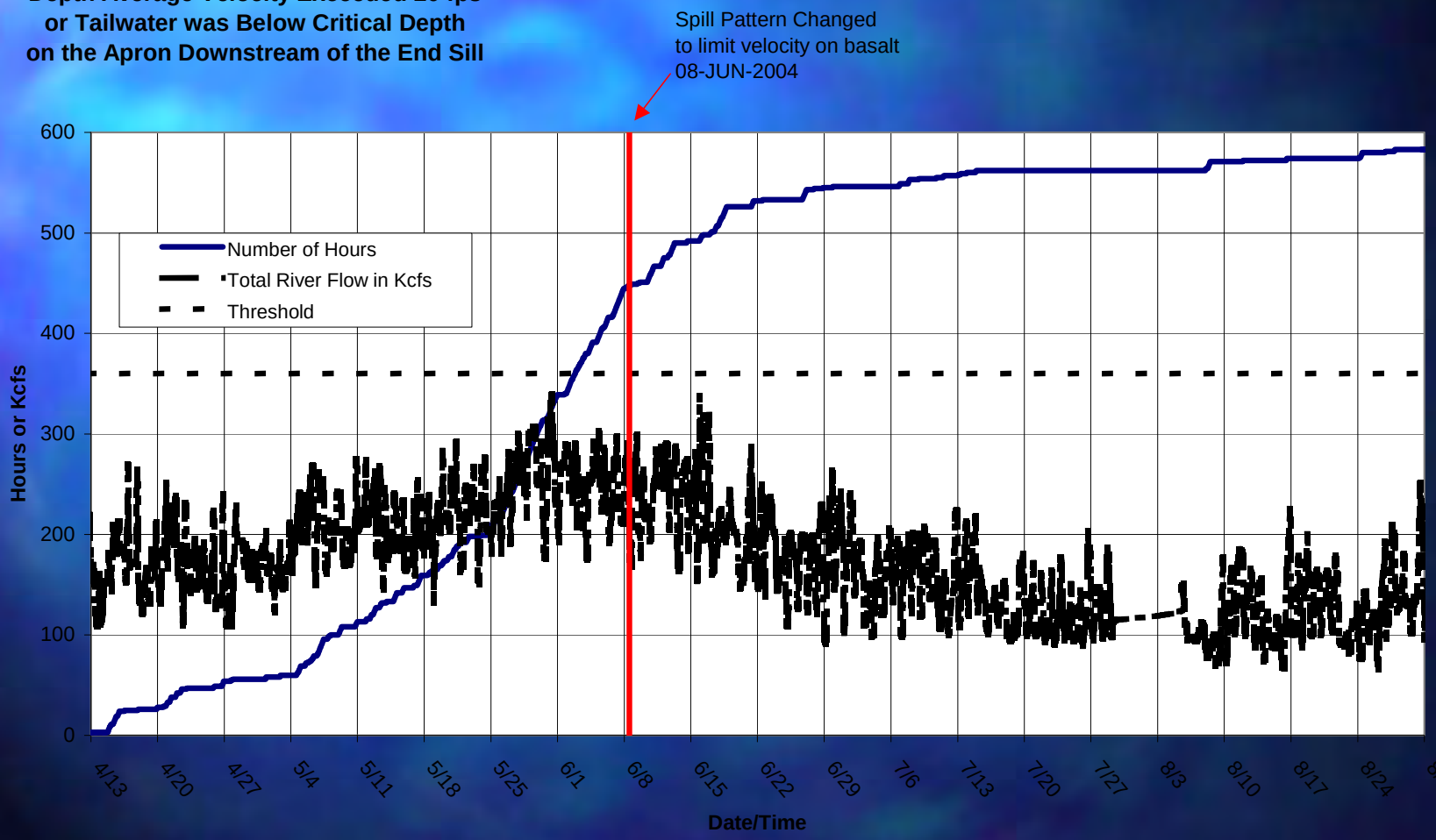


Spillway Monitoring Spreadsheet

US Army COE
Portland District

The Dalles Spillway
Cumulative Hours Where
Depth Average Velocity Exceeded 20 fps
or Tailwater was Below Critical Depth
on the Apron Downstream of the End Sill

Cumulative Number of Hours = 585
as of date / time: 8/31/04 23:00



Dalles Spillway Bathymetry 4/03

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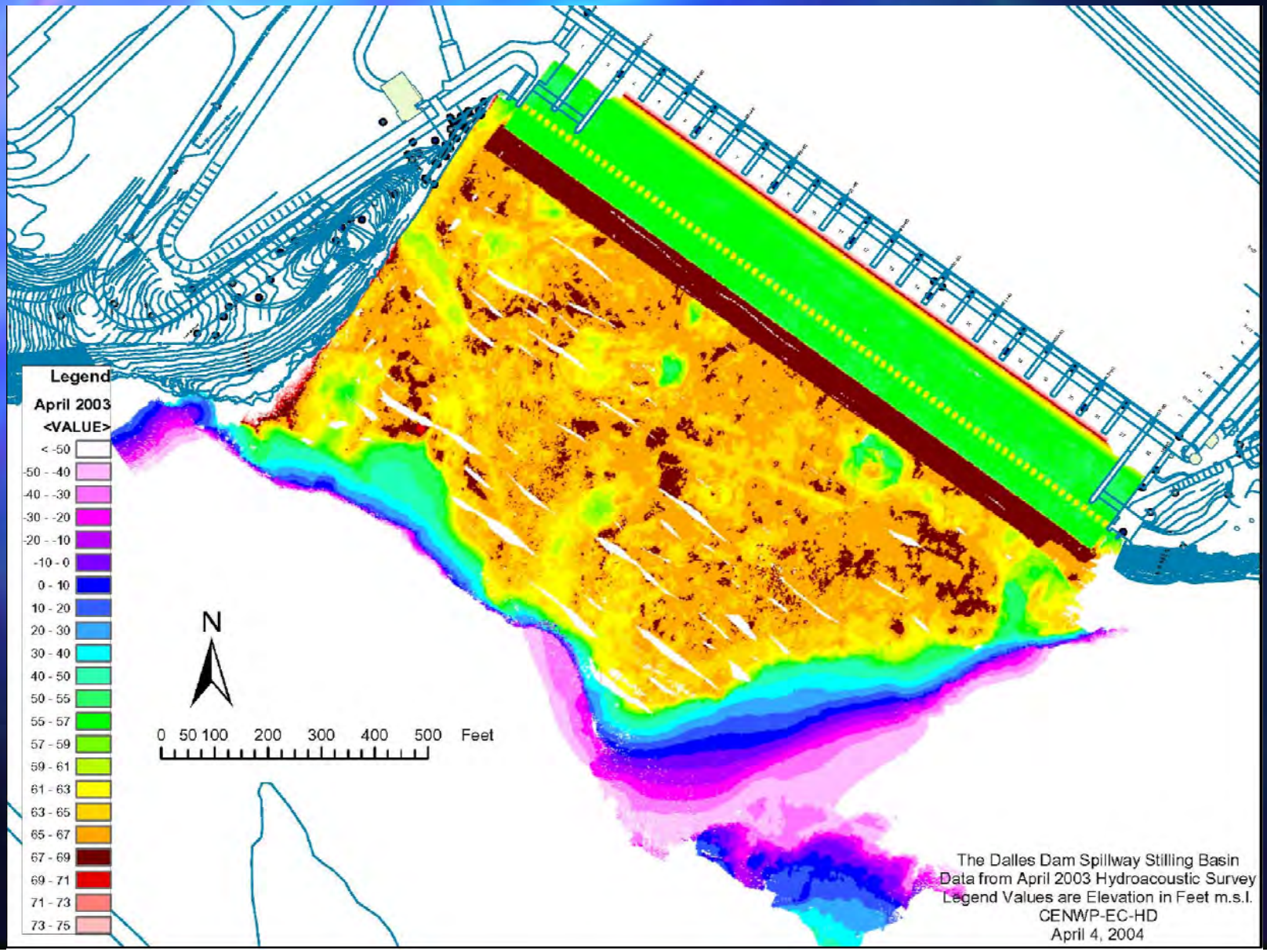
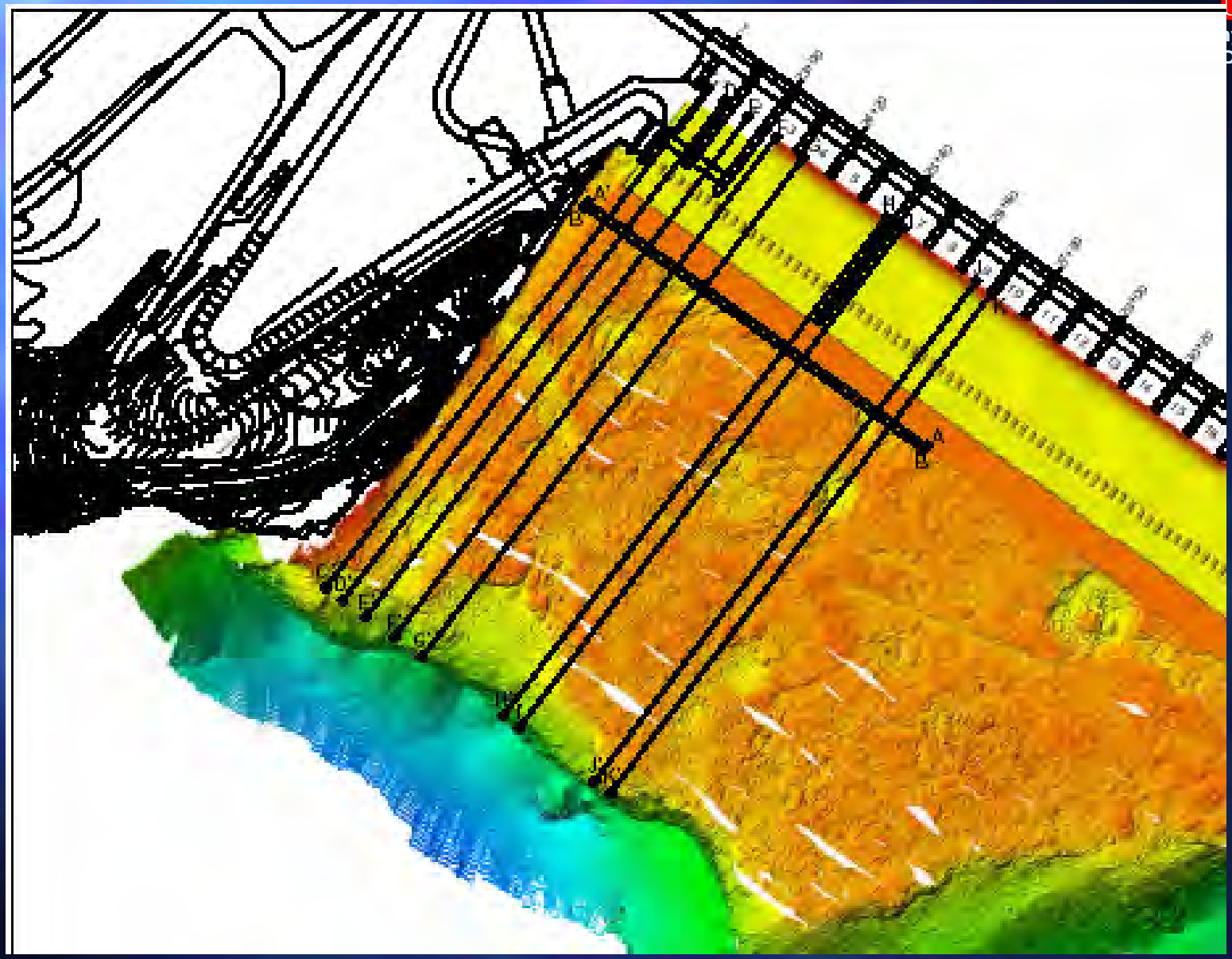
Portland District



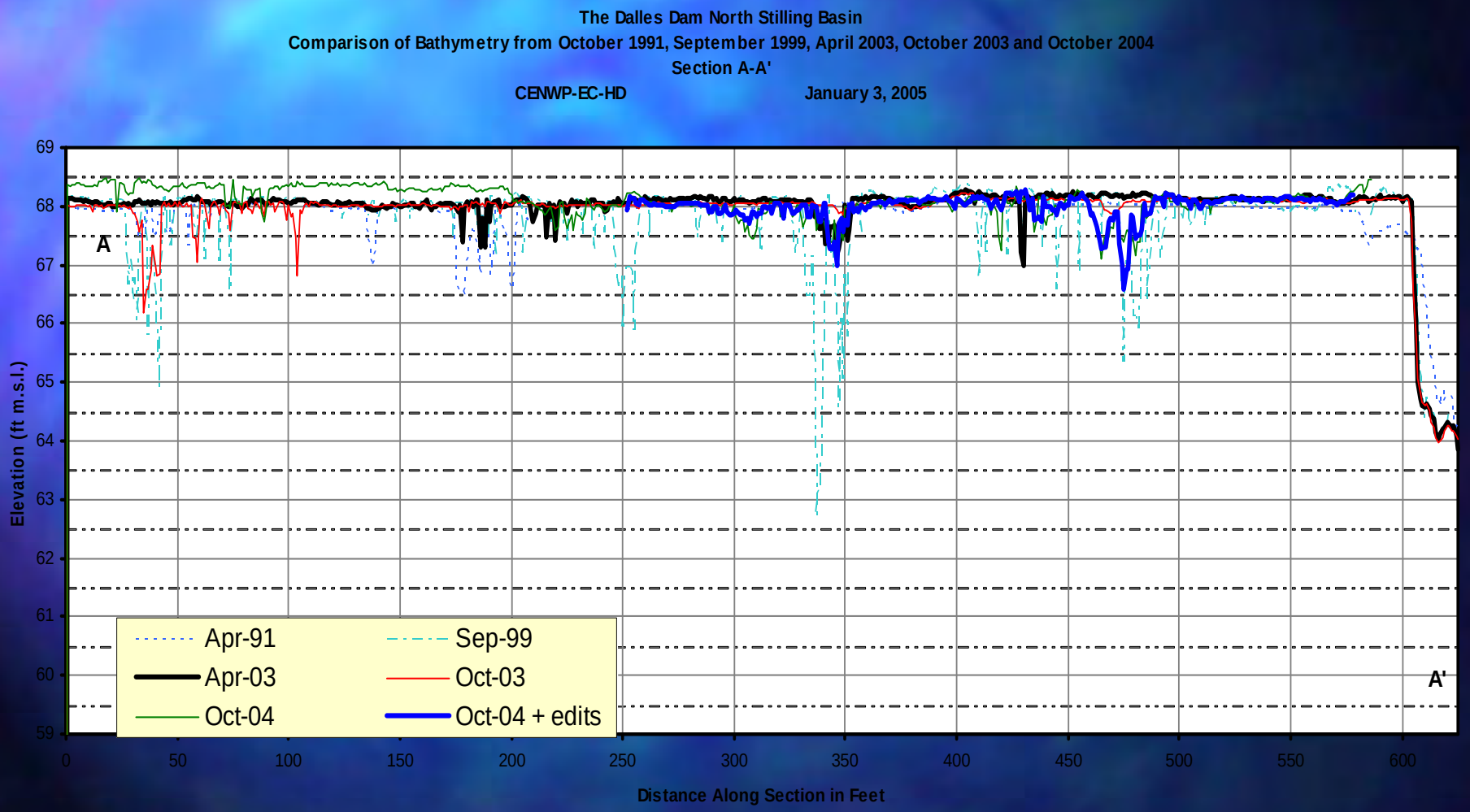
Monitoring Ranges



y COE
District

Range A-A’

US Army COE
Portland District



Range B-B’

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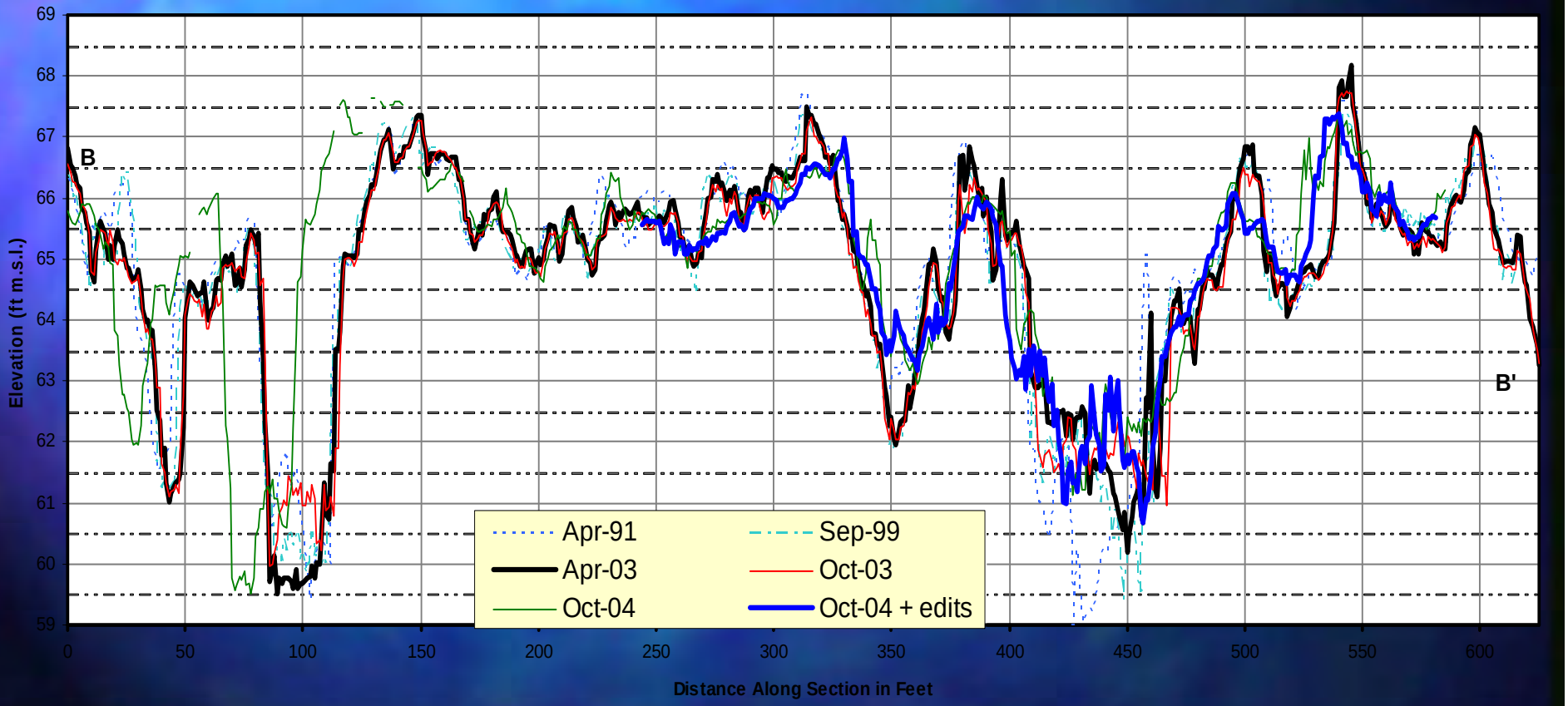
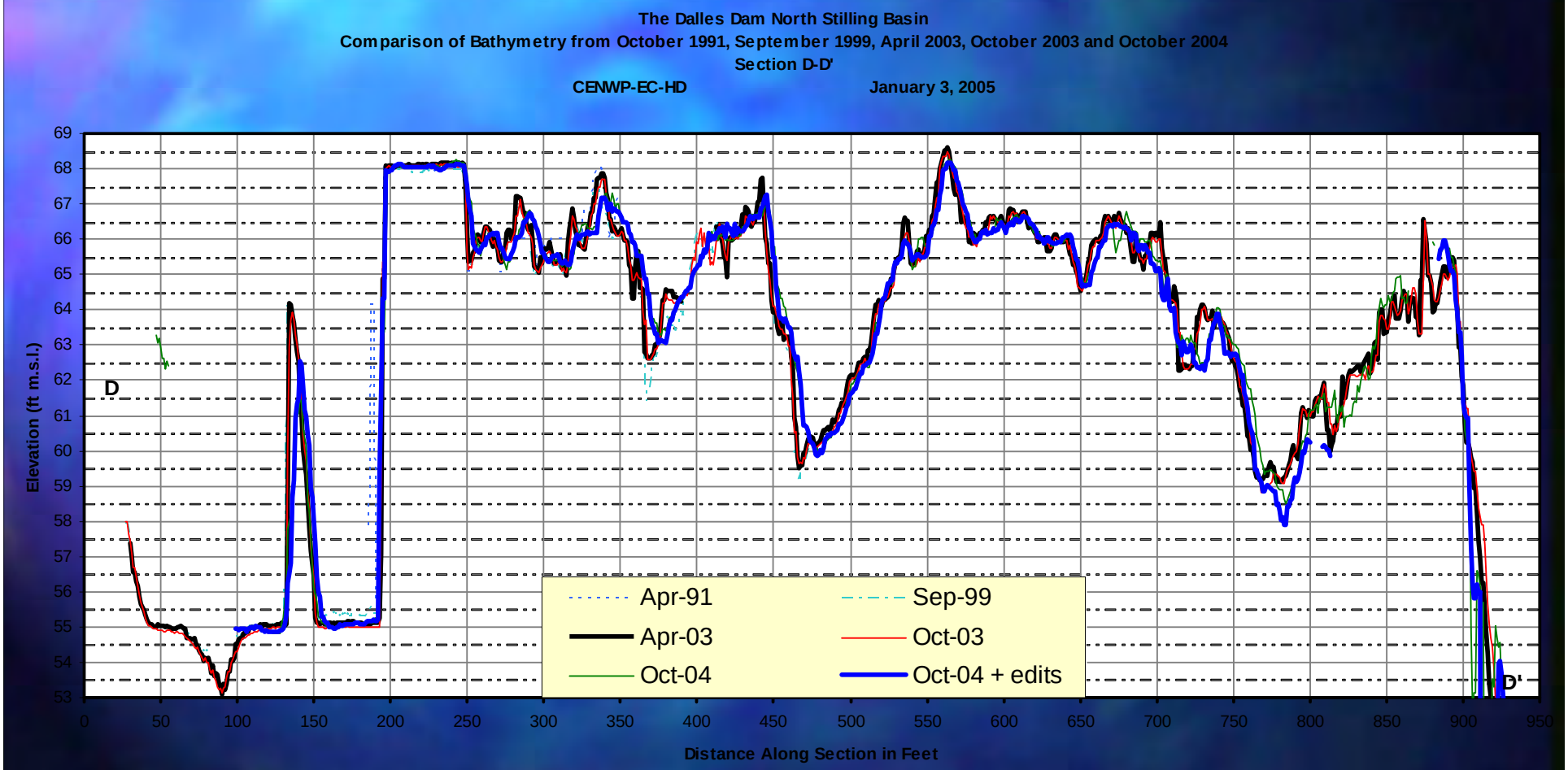
Portland District

The Dalles Dam North Stilling Basin
Comparison of Bathymetry from October 1991, September 1999, April 2003, October 2003 and October 2004
Section B-B'
CENWP-EC-HD January 3, 2005



Range D-D’

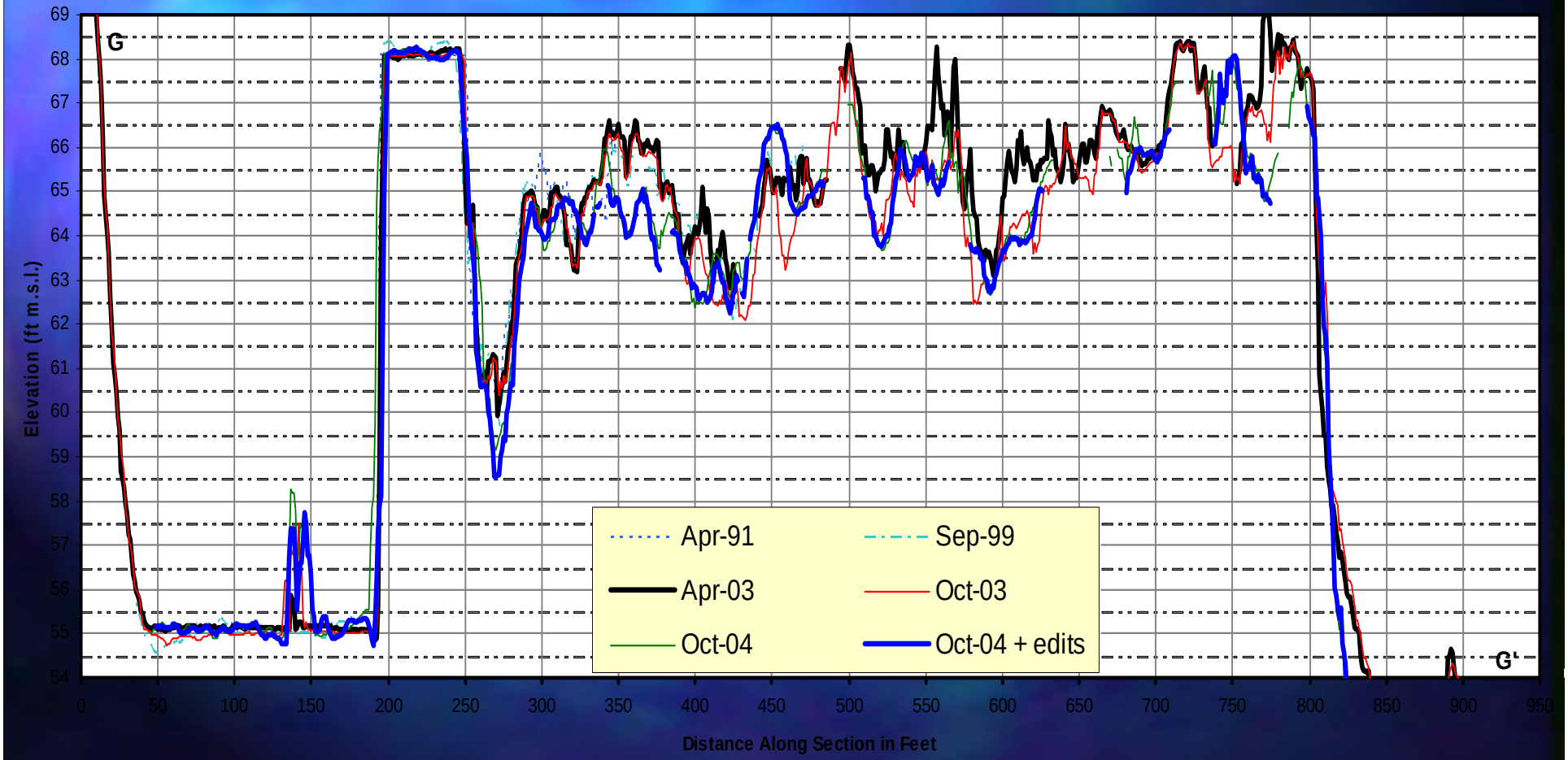
US Army COE
Portland District



Range G-G'

US Army COE
Portland District

The Dalles Dam North Stilling Basin
Comparison of Bathymetry from October 1991, September 1999, April 2003, October 2003 and October 2004
Section G-G'
CENWP-EC-HD January 3, 2005



2004 Experience

US Army COE
Portland District

- Operation limits reached in early June
  - Modified spill pattern to above 1.1 Dc.
  - Conducted limited hydro-survey.
  - Conducted mid-season dive survey.
  - No damage noted – continued operation.
- End of Season Survey
  - Limited results due to survey error.
  - Detailed diver mapping of apron undercutting.
  - Results went into 2005 monitoring plan.

Results of 2004 dive survey.

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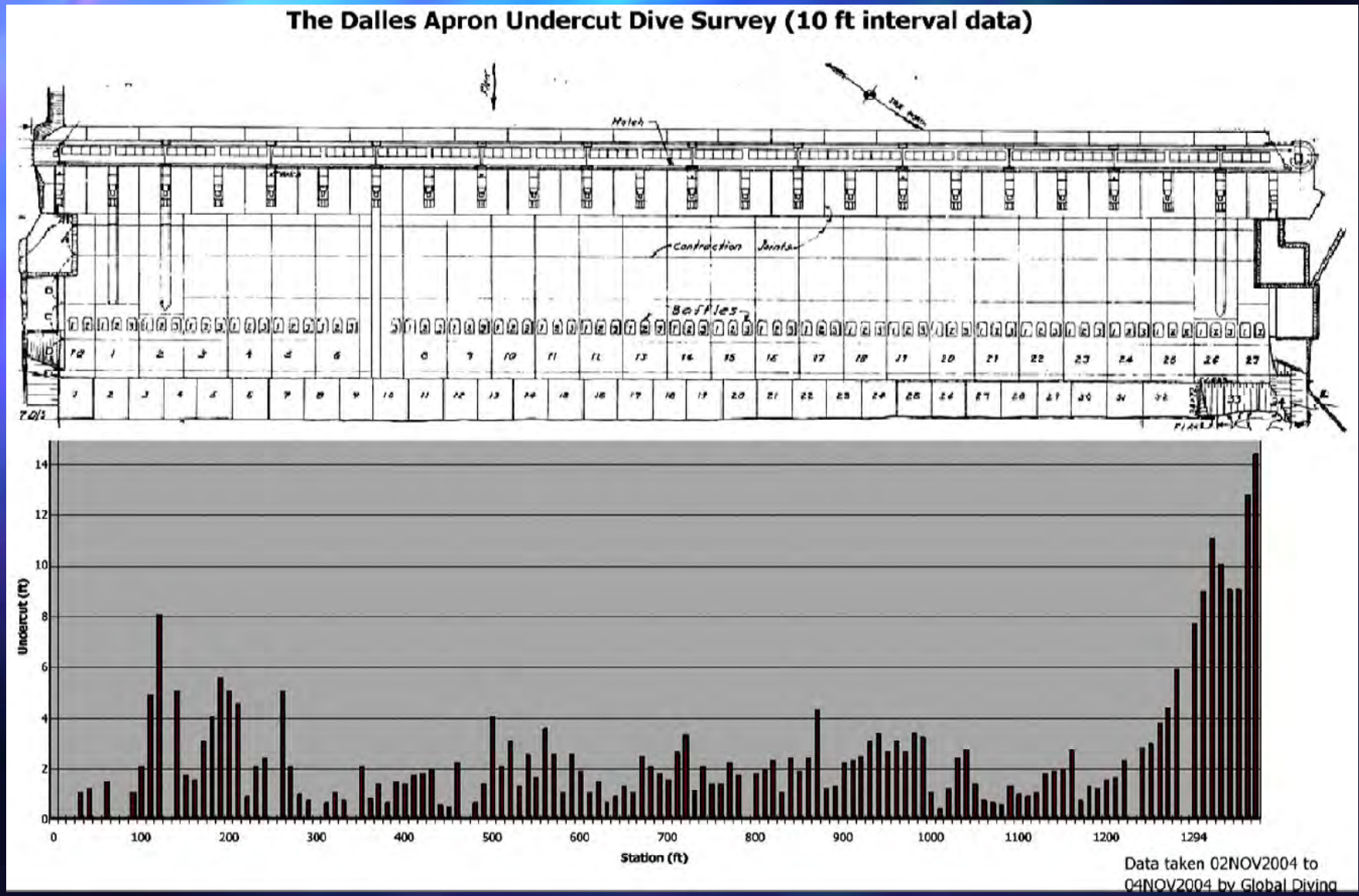

Conclusions

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Portland District

- Spillwall increased juvenile survival.
- A detailed monitoring plan can mitigate for operations outside of design criteria.
- Monitoring is annual event so we know what is going on in spillway better than through dam safety program.
- Met needs of biologists to spill for listed species but ensured project not compromised.

Re-Evaluation of a Flood Control Project

Presentation for the

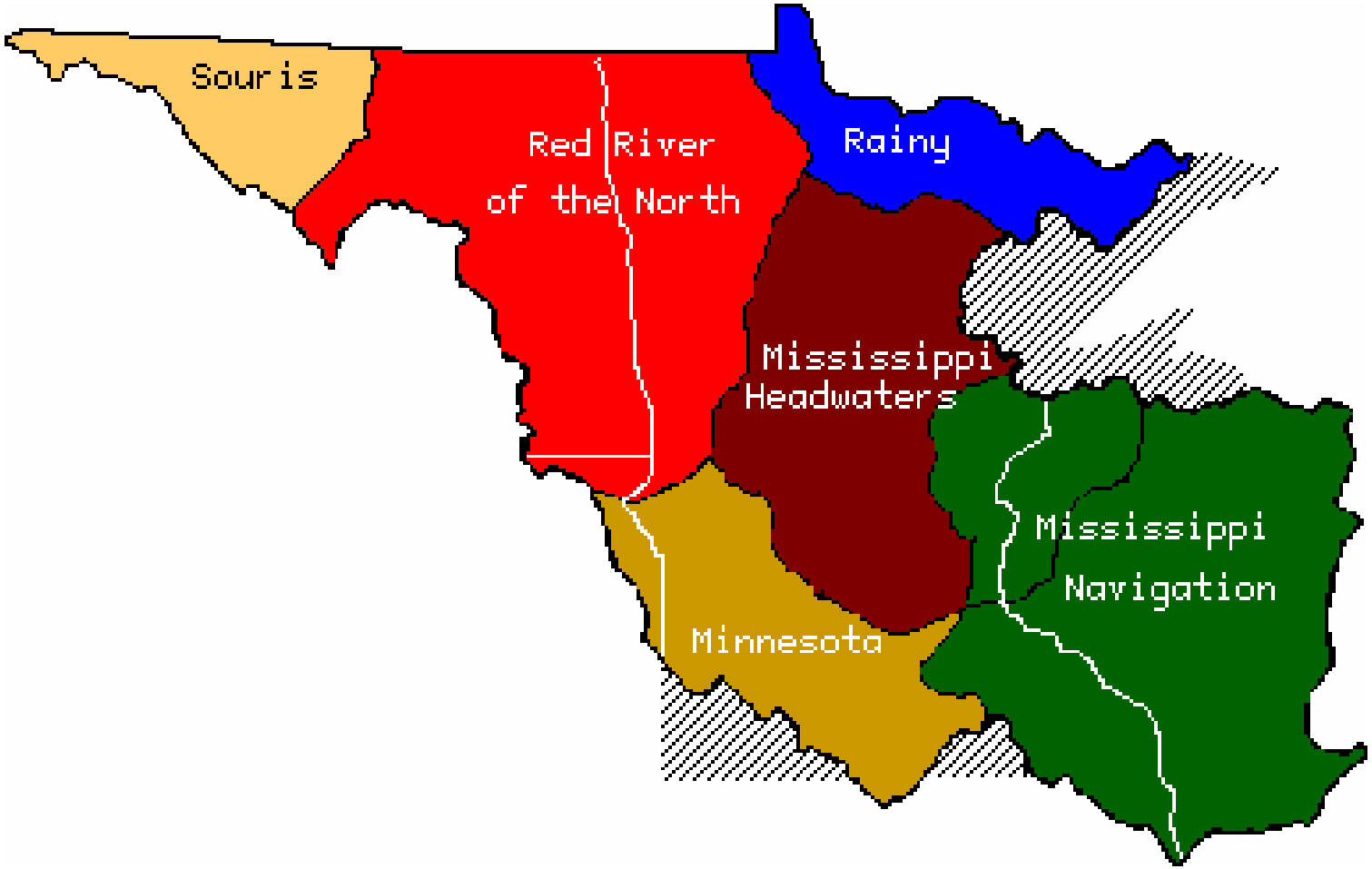
Tri-Service Conference

By

Ferris W. Chamberlin, P.E.

August 2005

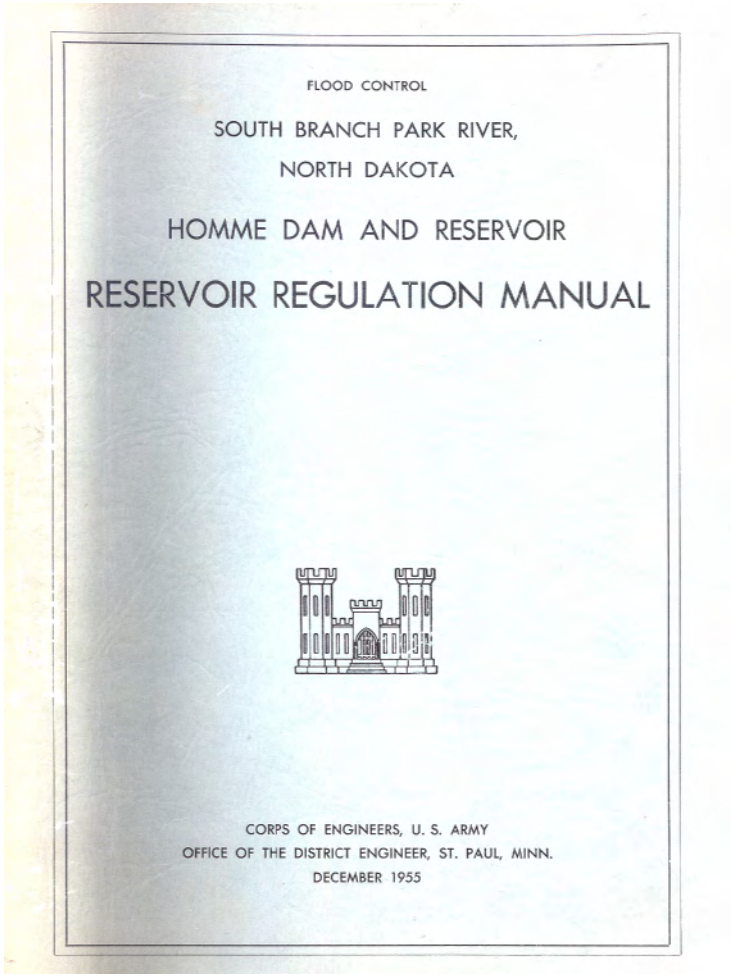
St. Paul District



Eau Galle Reservoir

Cross Lake Dam

Water Control Manuals

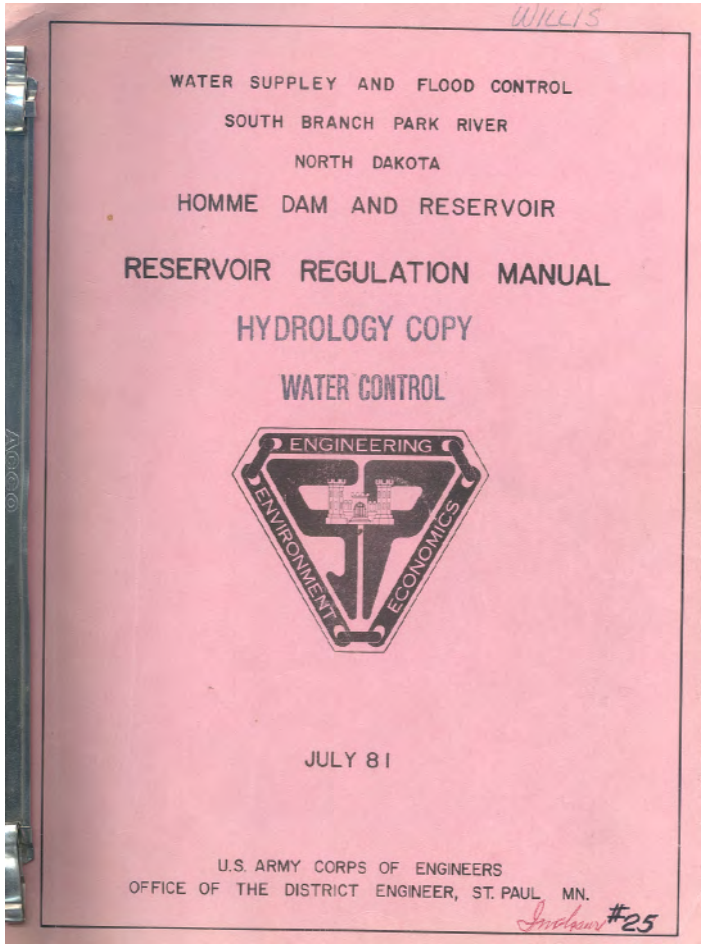

FLOOD CONTROL

SOUTH BRANCH PARK RIVER,
NORTH DAKOTA

HOMME DAM AND RESERVOIR

RESERVOIR REGULATION MANUAL

CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER, ST. PAUL, MINN.
DECEMBER 1955


WILLIS

WATER SUPPLEY AND FLOOD CONTROL
SOUTH BRANCH PARK RIVER
NORTH DAKOTA
HOMME DAM AND RESERVOIR
RESERVOIR REGULATION MANUAL
HYDROLOGY COPY
WATER CONTROL
ENGINEERING
ENVIRONMENT
ECONOMICS
JULY 81
U.S. ARMY CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER, ST. PAUL MN.
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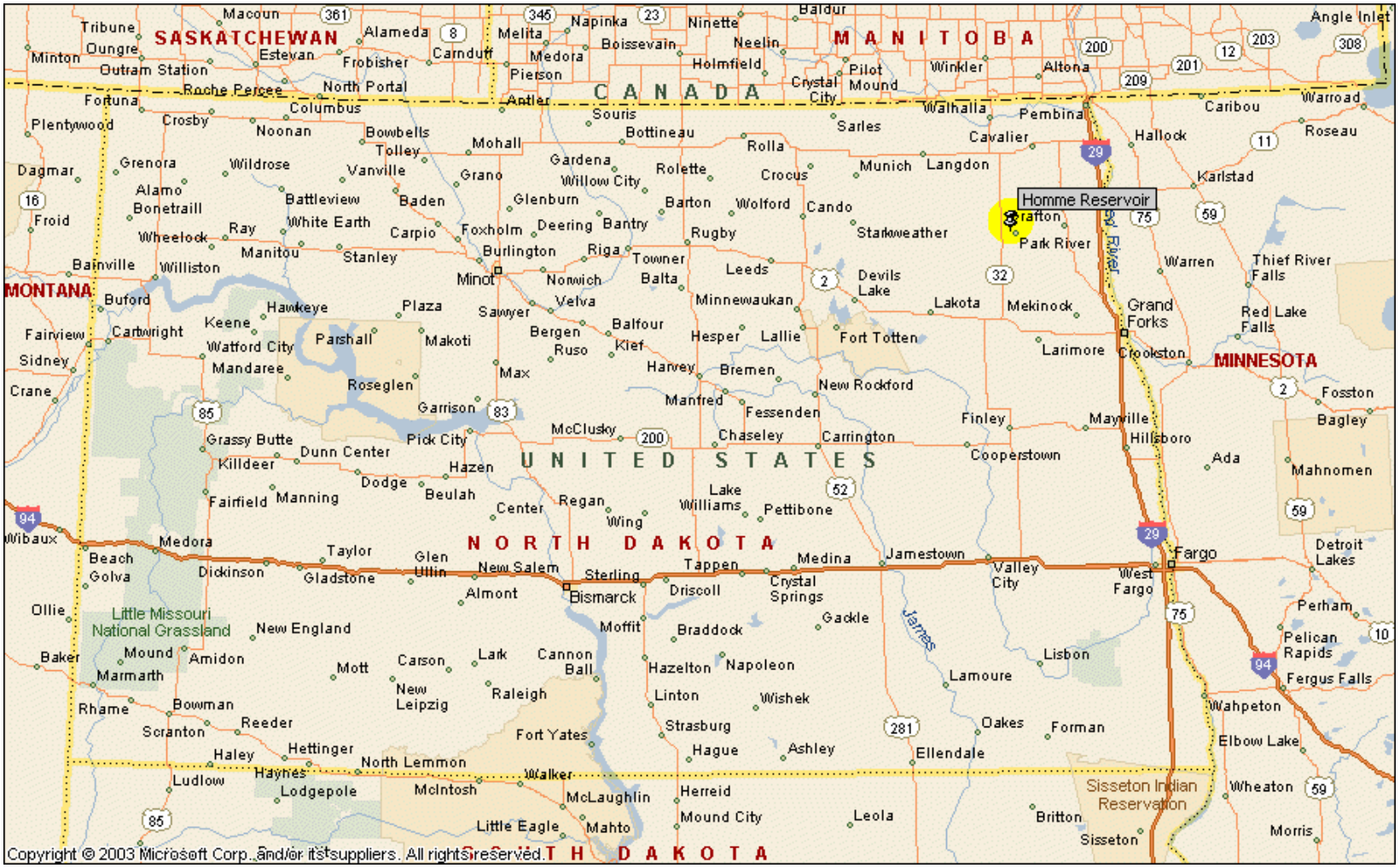
Mississippi Valley Division
Mississippi River Commission

North Dakota


Homme Reservoir
SASKATCHEWAN
MANITOBA
CANADA
MONTANA
MINNESOTA
UNITED STATES
NORTH DAKOTA
SOUTH DAKOTA
Little Missouri National Grassland
Sisseton Indian Reservation
Minot
Bismarck
Jamestown
Fargo
Grand Forks
Devils Lake
Williston
Dickinson
Valley City
West Fargo
Wahpeton
Lisbon
Oakes
Ellendale
Fort Yates
Sisseton
Britton
Watford City
Killdeer
Hazen
Beulah
Garrison
Riverdale
Park River
Crookston
Thief River Falls
Red Lake Falls
Bagley
Mahnomen
Detroit Lakes
Pelican Rapids
Fergus Falls
Elbow Lake
Wheaton
Morris
Cooperstown
Carrington
Harvey
Rugby
Devils Lake
Lakota
Mekinock
Larimore
Finley
Mayville
Hillsboro
Ada
Fosston
Perham
Warren
Karlstad
Roseau
Warroad
Angle Inlet
Pembina
Cavalier
Hallock
Langdon
Munich
Starkweather
Crosby
Stanley
Parshall
Makoti
Roseglen
Max
Velva
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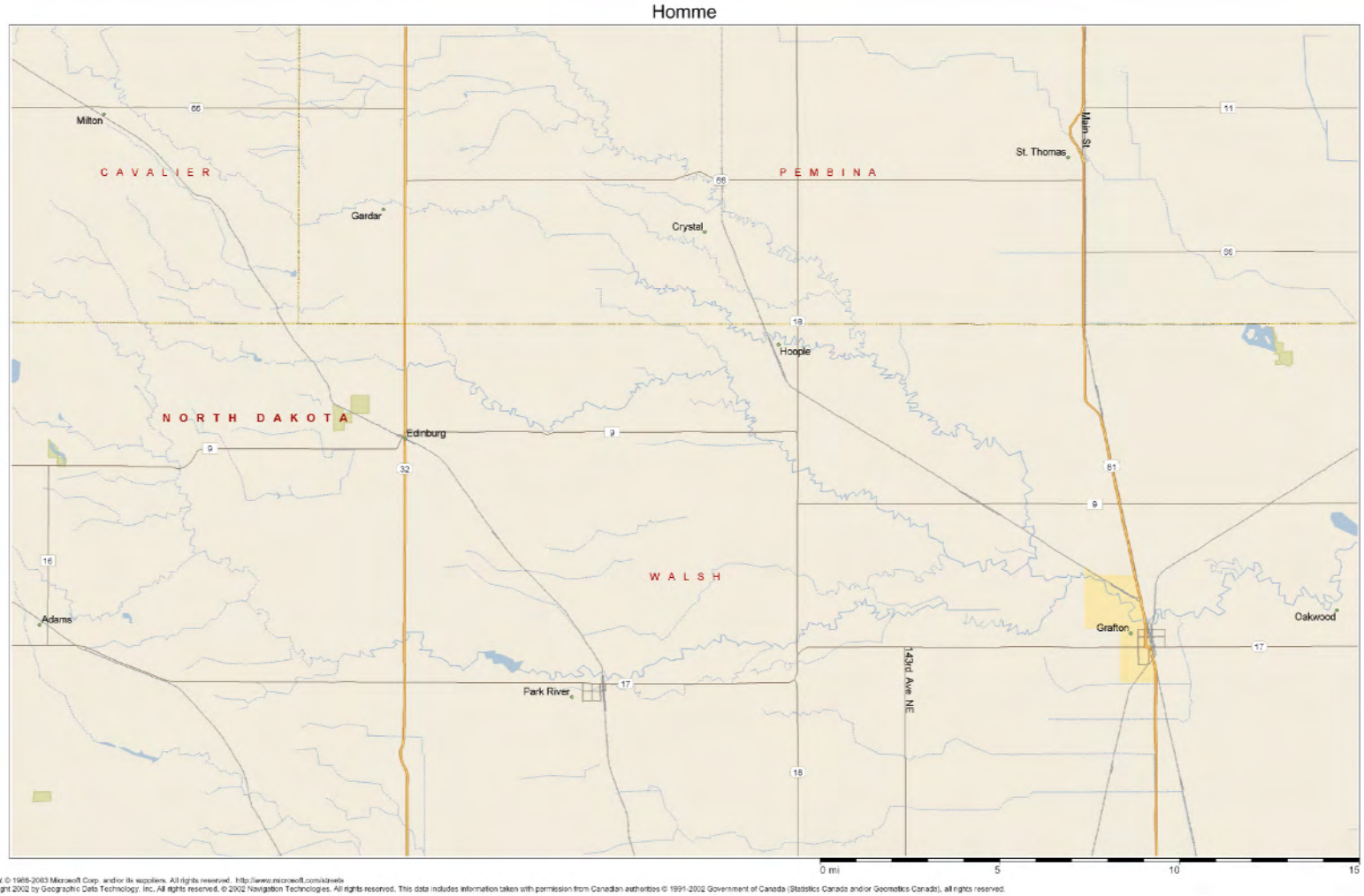
Plaza
Hawkeye
Keene
Cartwright
Fairview
Sidney
Crane
Buford
Bainville
Froid
Dagmar
Scranton
Bowman
Rhame
Haley
Hettinger
Reeder
Ludlow
Haynes
Lodgepole
North Lemmon
McIntosh
McLaughlin
Little Eagle
Mahto
Mound City
Herreid
Walker
Strasburg
Hague
Ashley
Linton
Wishek
Napoleon
Hazelton
Braddock
Moffit
Gackle
Crystal Springs
Driscoll
Tappen
Medina
Sterling
New Salem
Ullin
Glen Ullin
Gladstone
Taylor
Medora
Beach
Golva
Wibaux
Ollie
Baker
Marmarth
Mound
Amidon
New England
Almont
Center
Regan
Wing
Pettibone
Lake Williams
Fessenden
New Rockford
Manfred
Bremen
Chaseley
McClusky
Pick City
Dunn Center
Grassy Butte
Manning
Fairfield
Dodge
Mandaree
Watford City
Ray
Wheelock
Alamo
Bonetraill
Froid
Carpio
White Earth
Battleview
Baden
Vanville
Wildrose
Grenora
Plentywood
Fortuna
Roche Percee
Outram
Oungre
Tribune
Minton
Estevan
Frobisher
Alameda
Carnduff
Melita
Napinka
Boissevain
Ninette
Neelin
Holmfield
Pierson
Medora
Antler
Souris
Columbus
North Portal
Noonan
Crosby
Bowbells
Tolley
Mohall
Grano
Gardena
Willow City
Rolette
Crocus
Bottineau
Rolla
Sarles
Walhalla
Pembina
Caribou
Glenburn
Barton
Wolford
Cando
Deering
Foxholm
Burlington
Riga
Towner
Balta
Leeds
Minnewaukan
Balfour
Bergen
Ruso
Kief
Hesper
Lallie
Fort Totten
Harvey
Bremen
Manfred
Fessenden
Chaseley
Carrington
Cooperstown
Finley
Maywille
Hillsboro
Ada
Mahnomen
Fosston
Bagley
Warren
Thief River Falls
Red Lake Falls
Karlstad
Roseau
Warroad
Angle Inlet
Pembina
Cavalier
Hallock
Langdon
Munich
Starkweather
Park River
Grafton
Homme Reservoir
Devils Lake
Lakota
Mekinock
Grand Forks
Crookston
Larimore
Fort Totten
Lallie
Hesper
Kief
Ruso
Bergen
Balfour
Minnewaukan
Velva
Sawyer
Plaza
Hawkeye
Keene
Cartwright
Fairview
Sidney
Crane
Buford
Bainville
Froid
Dagmar
Scranton
Bowman
Rhame
Haley
Hettinger
Reeder
Ludlow
Haynes
Lodgepole
North Lemmon
McIntosh
McLaughlin
Little Eagle
Mahto
Mound City
Herreid
Walker
Strasburg
Hague
Ashley
Linton
Wishek
Napoleon
Hazelton
Braddock
Moffit
Gackle
Crystal Springs
Driscoll
Tappen
Medina
Sterling
New Salem
Ullin
Glen Ullin
Gladstone
Taylor
Medora
Beach
Golva
Wibaux
Ollie
Baker
Marmarth
Mound
Amidon
New England
Almont
Center
Regan
Wing
Pettibone
Lake Williams
Fessenden
New Rockford
Manfred
Bremen
Chaseley
McClusky
Pick City
Dunn Center
Grassy Butte
Manning
Fairfield
Dodge
Killdeer
Hazen
Beulah
Garrison
Riverdale
Park River
Crookston
Thief River Falls
Red Lake Falls
Bagley
Mahnomen
Detroit Lakes
Pelican Rapids
Fergus Falls
Elbow Lake
Wheaton
Morris
Cooperstown
Carrington
Harvey
Rugby
Devils Lake
Lakota
Mekinock
Larimore
Finley
Mayville
Hillsboro
Ada
Fosston
Perham
Warren

Tools of the Trade

Northeast North Dakota



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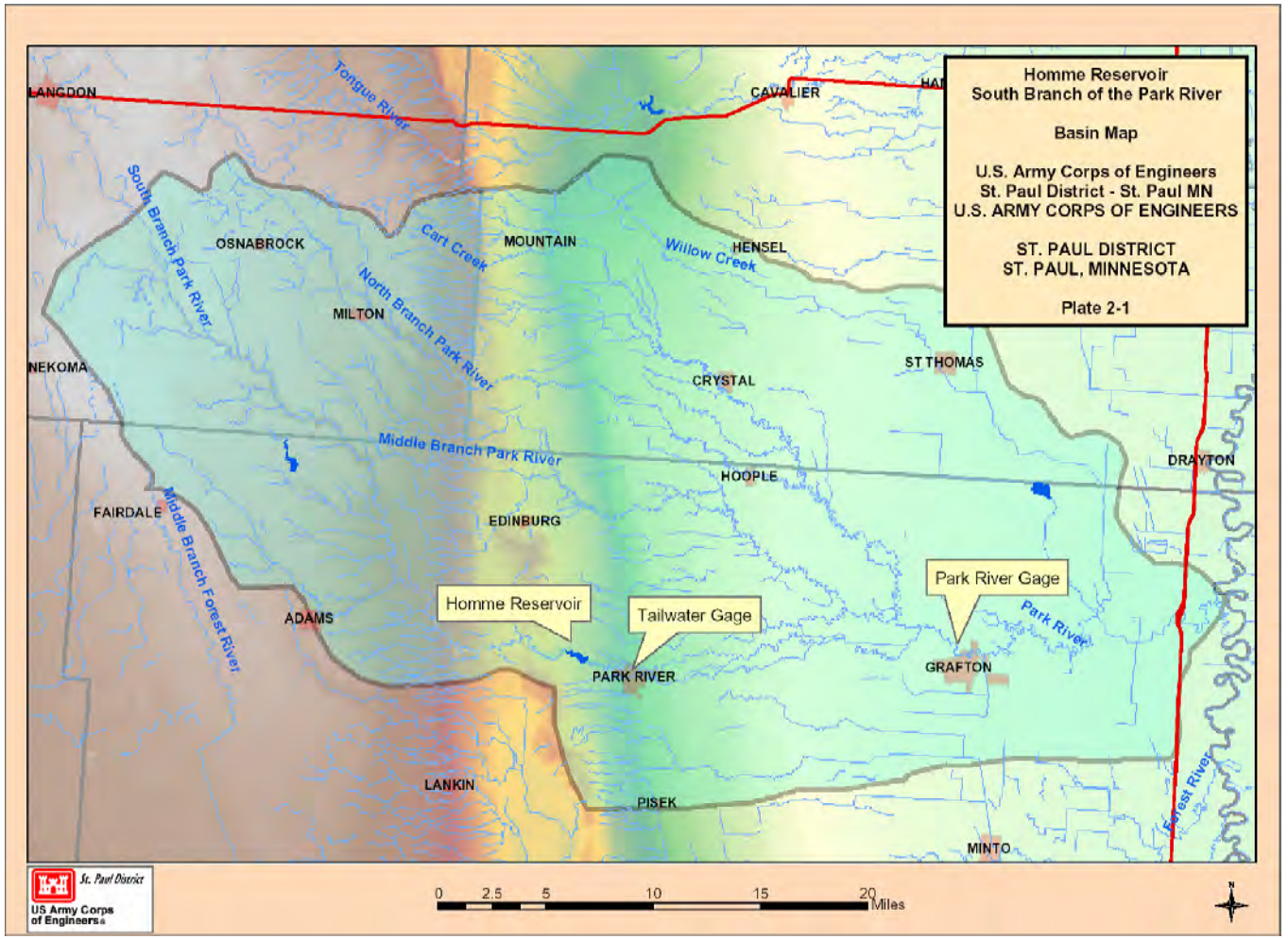
The Dust Bowl

Homme Reservoir

Park River Basin



Average Monthly Rainfall

	Jan	Feb	Mar	Apr
Grafton	0.60	0.44	0.89	1.52
Park River	0.61	0.46	0.92	1.66

Spring Runoff

3.0 inches 2001	0.1 inches 2000
2.5 inches 1999	3.0 inches 1998
8.0 inches 1997	2.5 inches 1996
3.4 inches 1995	1.4 inches 1994
0.2 inches 1993	1.1 inches 1992

Flood of 1997

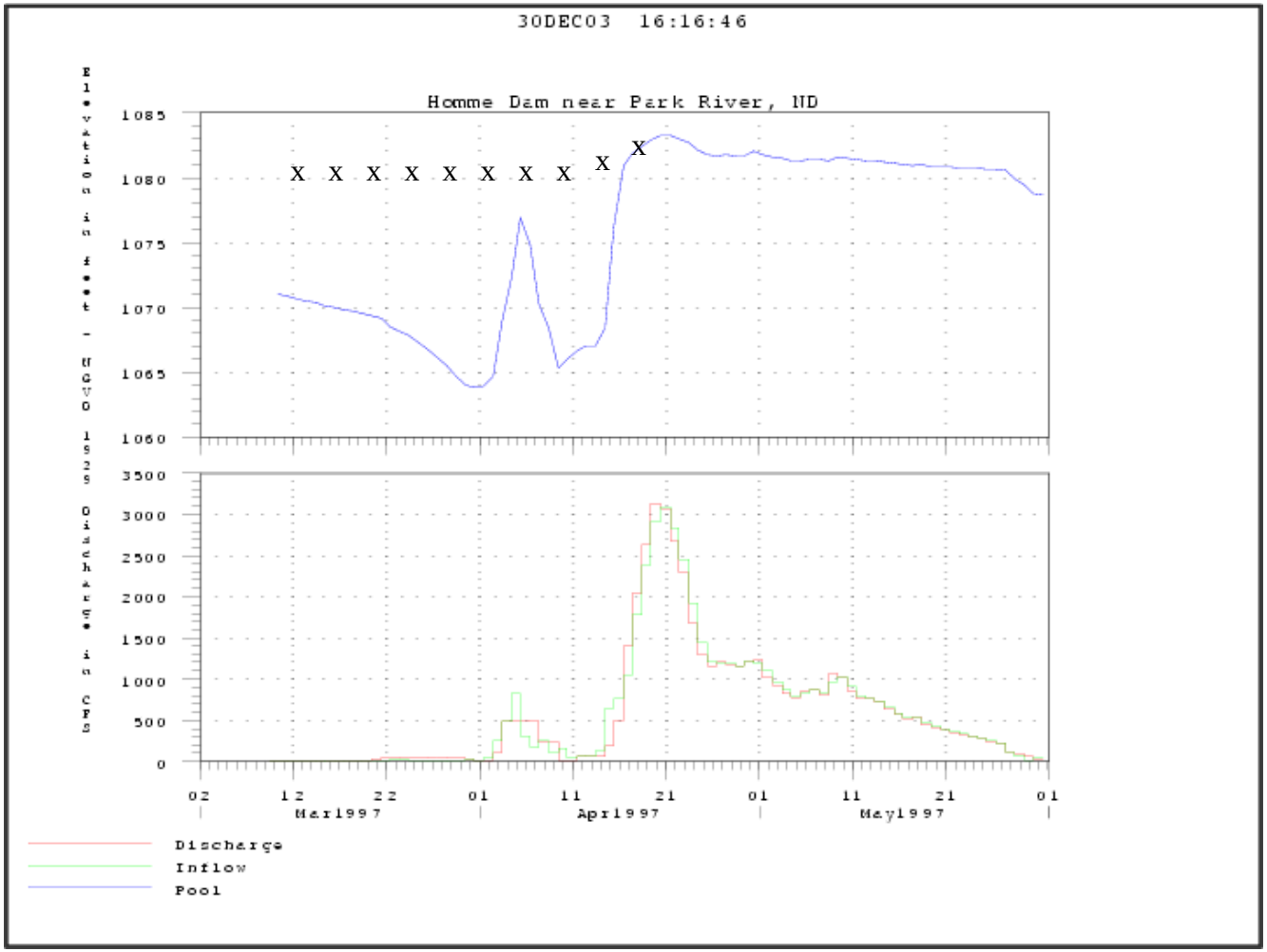
Runoff: 8 inches **Drawdown: 1064.0 feet**

The Pool Rose Accordingly:

Date	Pool	Inflow
13 Apr	1066.97	54
14 Apr	1068.37	126
15 Apr	1076.25	641
16 Apr	1080.90	763 (over spillway)
17 Apr	1081.87	1042

Peak Inflow was 3,093 cfs on 21 April.

1997 Flood


30DEC03 16:16:46
Homme Dam near Park River, ND
Elevation in feet - NGVD
1085
1080
1075
1070
1065
1060
Discharge in CFS
3500
3000
2500
2000
1500
1000
500
0
02
12
22
01
11
21
01
11
21
01
Mar1997
Apr1997
May1997
Discharge
Inflow
Pool

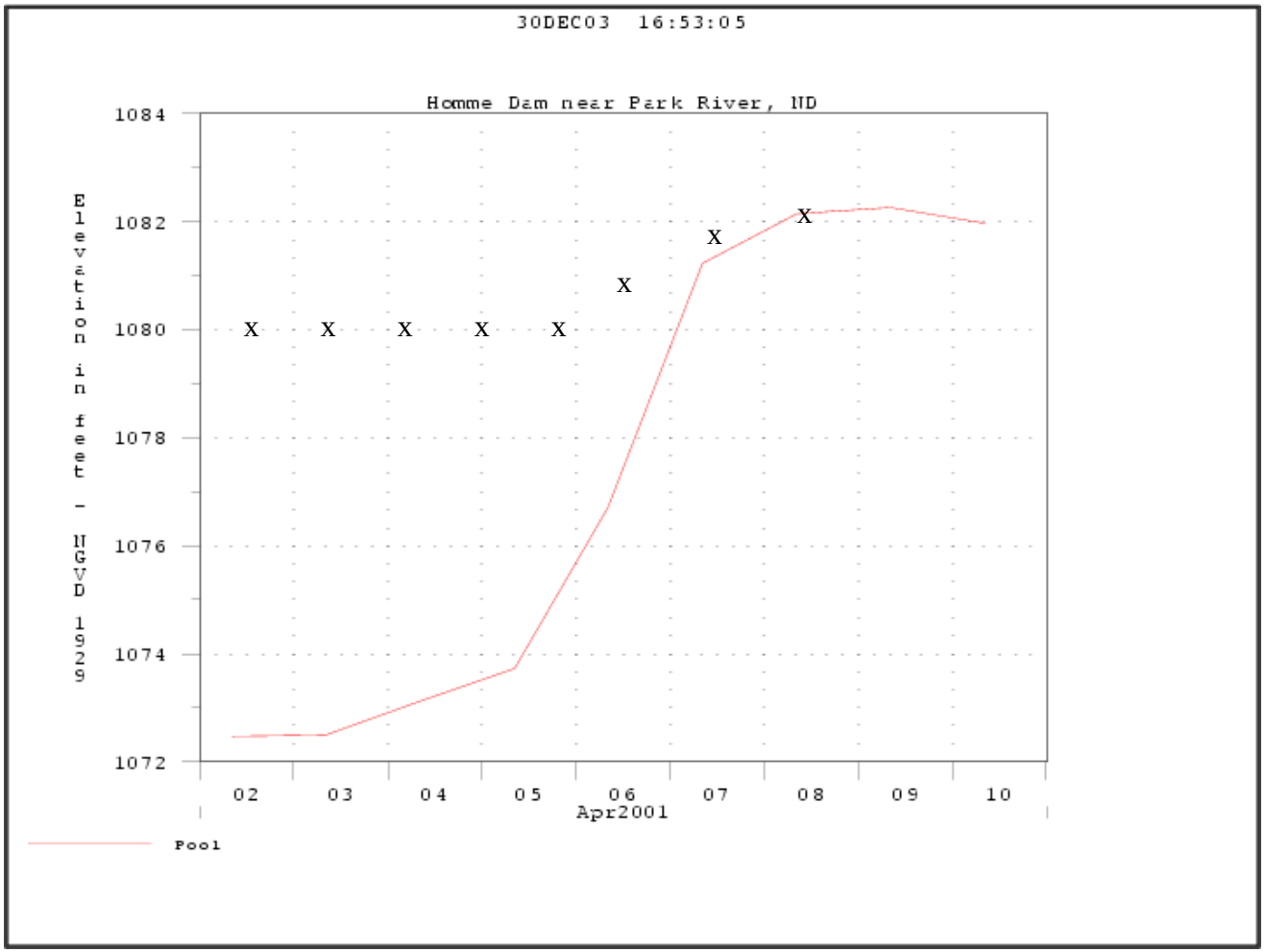
Flood of 2001

Runoff: 3.0 inches **Drawdown: 1072.0 ft**

The Pool Rose Accordingly:

Date	Pool	Inflow
4 Apr	1073.11	82
5 Apr	1073.72	92
6 Apr	1076.71	331
7 Apr	1081.22	1060 (over spillway)
8 Apr	1082.15	1420
9 Apr	1082.26	1,540 (peak inflow)

2001 Flood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Homme Dam near Park River, ND
Elevation in feet - NGVD 1929
1084
1082
1080
1078
1076
1074
1072
02
03
04
05
06
07
08
09
10
Apr2001
Pool

Spring of 1993

Runoff: 0.24 inches Drawdown: 1065.3 ft

The Pool Rose Accordingly:

Date	Pool	Inflow
6 Apr	1075.01	185 (peak inflow)
7 Apr	1077.08	172
8 Apr	1078.60	130
9 Apr	1079.78	119
10 Apr	1080.23	109 (storage gone)

Peak outflow was 104 cfs on 10 April.

Conclusions of Analysis

Over an Inch of Runoff

1. **Flood storage is gone days before the peak inflow arrives.**
2. **Drawdown has no impact on peak pool or peak discharge.**

Under an Inch of Runoff

1. **Maximum outflow is within channel capacity with or without drawdown.**

What Were The Designers Up To?

- Water Supply was primary goal.
- The Tools of the time were adequate for the flood control design; however, it would appear little time was spent on the flood control analysis.
- There was a war going on.
- How sharp are we now?
  - We've been drawing the reservoir down every winter since 1950.

Ecological and Engineering Considerations for Dam Decommissioning, Retrofits, and Reoperations

2005 Tri-Service Infrastructure Conference

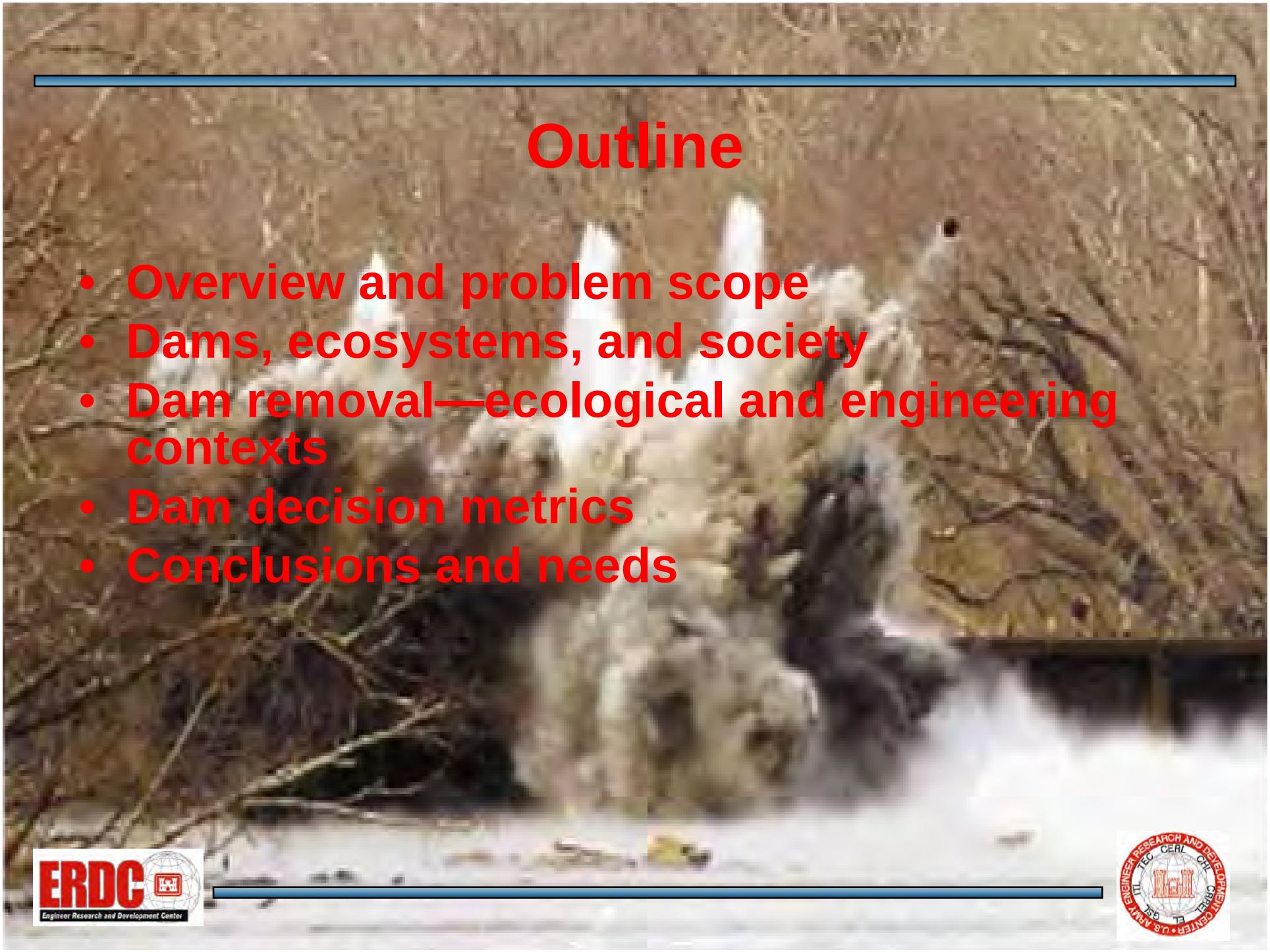
Jock Conyngham

US Army Corps of Engineers

Engineer Research and Development Center

Environmental Laboratory

Jock.N.Conyngham@erdc.usace.army.mil

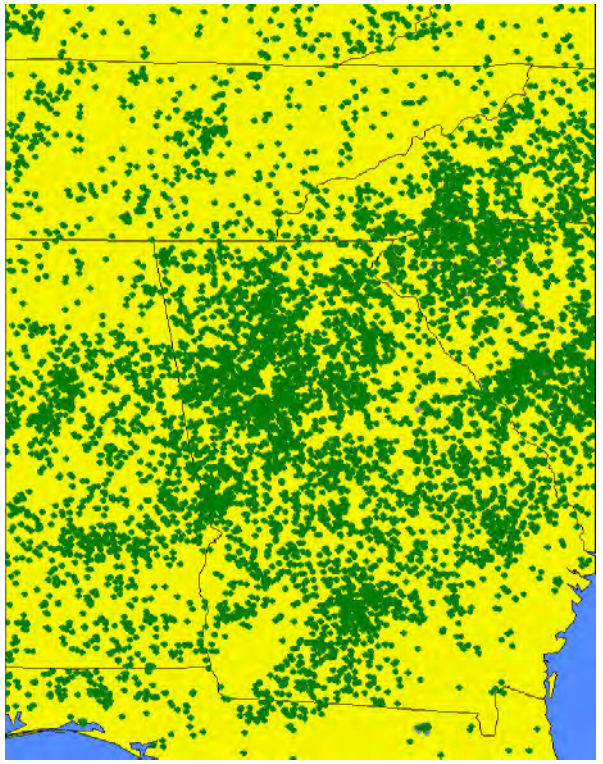


Outline

- Overview and problem scope
- Dams, ecosystems, and society
- Dam removal—ecological and engineering contexts
- Dam decision metrics
- Conclusions and needs

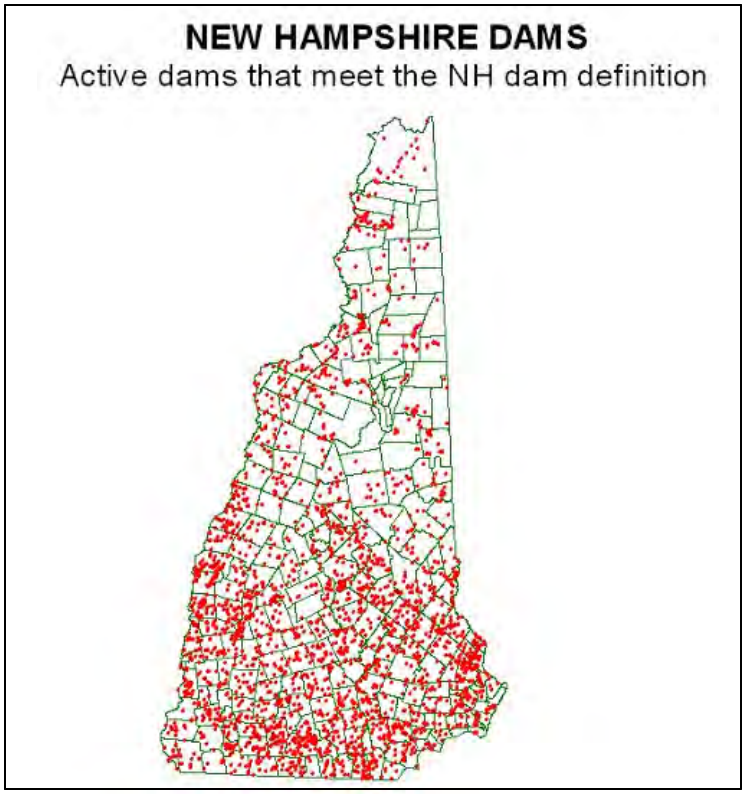
Overview and problem scope

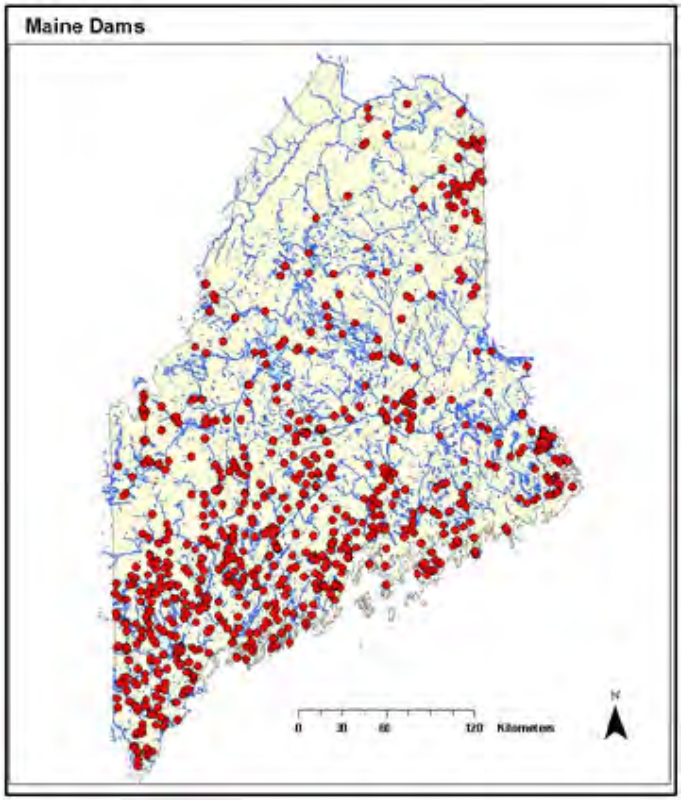
- ~77,000 large dams in the US, ~2.5 million total (National Academy of Sciences)
- Impounded water 5x volume of flowing water
- Sediments are leading cause of impairment in US. 6-12% of these are contaminated to Tier 1 or 2.
- Structural and economic obsolescence have condemned many smaller dams; that is less true of large structures, but 85% of large dams will have reached their design lifespan by 2020
- Dams and their removal are emotionally charged subjects in which science and reasoned discourse have played minor roles.



Overview and problem scope

- Unobstructed river reaches have been reduced 91% in the North Atlantic region





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Benefits and costs of dams

Benefits

- Water quality and delivery for domestic, agricultural, and industrial uses
- Hydropower
- Navigation, including canals
- Control of flooding and ice regime
- Control of invasive populations
- Flatwater recreation
- Waste or sediment disposal and trapping
- Archeological and aesthetic values

Costs

- Ecosystem impacts
- Water quality impacts
- Recreation dependent on unregulated hydrography and ecological integrity
- Impacts on T&E populations
- Legal and financial liability
- Safety
- Maintenance requirements for structure, headpond, associated erosion
- Archaeological and aesthetic impacts

St. Francis Dam failure, CA, 1928

Chase Brook Bridge collapse caused by private dam failure, NY, 1996.

Teton Dam failure, ID, 1976

Rockfish Creek dam failure, NC, 2003

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Dams and ecosystems

- Altered sediment, hydrologic, woody debris, and ice regimes
- Habitat fragmentation
- Nutrient cycling and flow impacts
- Water quality and thermal regimes
- Major impacts on T&E, anadromous, catadromous, and adfluvial populations
- Mix of lentic and lotic habitats alters predation regimes and other life history processes
- Dams encourage floodplain development and discourage spatial and temporal dynamism

Nutrient flows and cycling

- The Columbia River system once received about 200,000 tons of nutrients annually from salmon runs.
- ~60% of the carbon structuring the bodies of juvenile salmon and other species is marine in origin in anadromous rivers.
- As much as 18% of nutrients supporting riparian vegetation in salmon rivers is ocean-derived.
- Salmonid fry double their growth rate post-spawning in rivers with active runs, as opposed to control rivers.
- Hydrologic flux and woody debris budget changes
- Reservoirs can act beneficially as nutrient sinks in agricultural watersheds.

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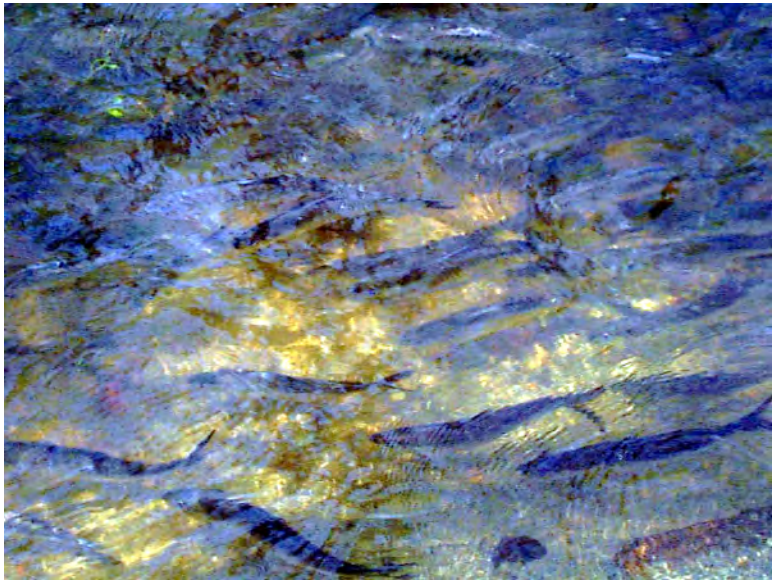
Cited reasons for removals

- Environmental--43%
- Safety--30%
- Economics--18%
- Failure--6%
- Unauthorized structure--4%
- Recreation—2%



(American Rivers et al., 1999)

Public safety and desire to save costs of repair usually drive removal, not restoration goals (Born et al., 1998)

Dam decision metrics

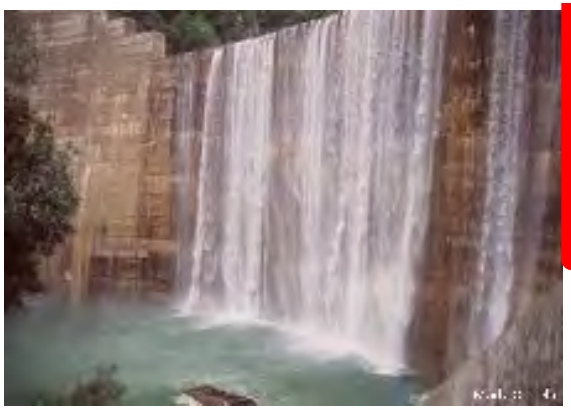
- Physical
  - Hydrology and hydraulics
  - Sediment budget, storage, and properties
  - Channel and valley morphology
  - Headpond capacity
- Chemical
  - WQ and temperature
  - Sediment contamination
- Ecosystemic/ecological
  - Aquatic and riparian ecosystems' processes and functions
  - Recovery of T&E populations
  - Keystone population and community needs
- Economic values
  - Site, reach, and system values w/dam and w/o dam(s)
  - Regional economies
  - Flood risk
  - Relevant infrastructure
- Social and legal
  - Ownership
  - Tribal rights
  - Safety and liability
  - Aesthetics and cultural

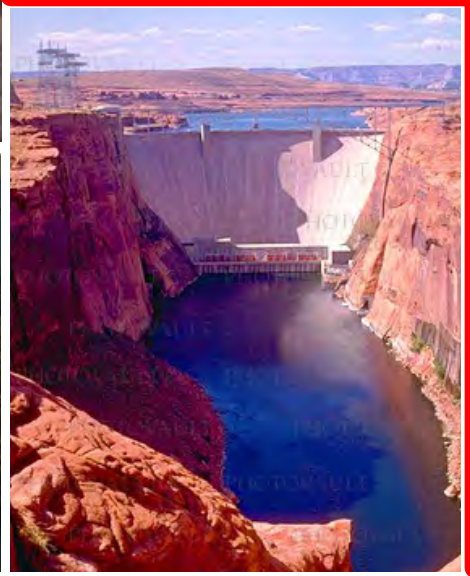
Perceptions and social values

- What would it look like? Change is threatening.
- Professionals don't value public opinion.
- Impoundment recreation will be missed.
- Many appreciate the impoundment's aesthetics.
- Fish and wildlife values will be lost.
- It's safer without the dam.
- Fish and wildlife values will improve.
- Maintenance and liability costs need to be eliminated.
- Removal is cheaper.

(From Born et al., 1998)

Scope and scale





ANALYSES LEVEL

Big Dam - High Impact - High Controversy → Big Analyses

Elwha, Glines Canyon and Snake River Dams

Small Dam - High Impact - No Controversy → Big Analyses

Cuddebackville Dam

Big Dam - Low Impact - Some Controversy → Moderate Analyses

Edwards Dam

Small Dam - Low Impact - No Controversy → Small Analyses

Naugatuck River Dams

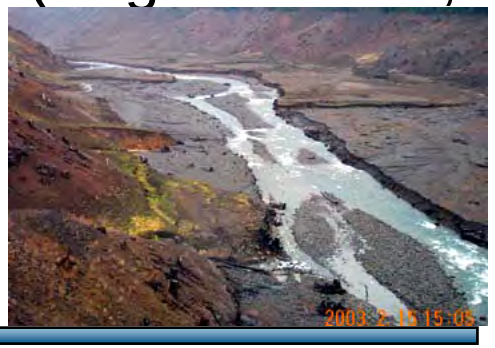
Small Dam - No Impact - No Controversy → Minimal Analyses

Pizzini Dam

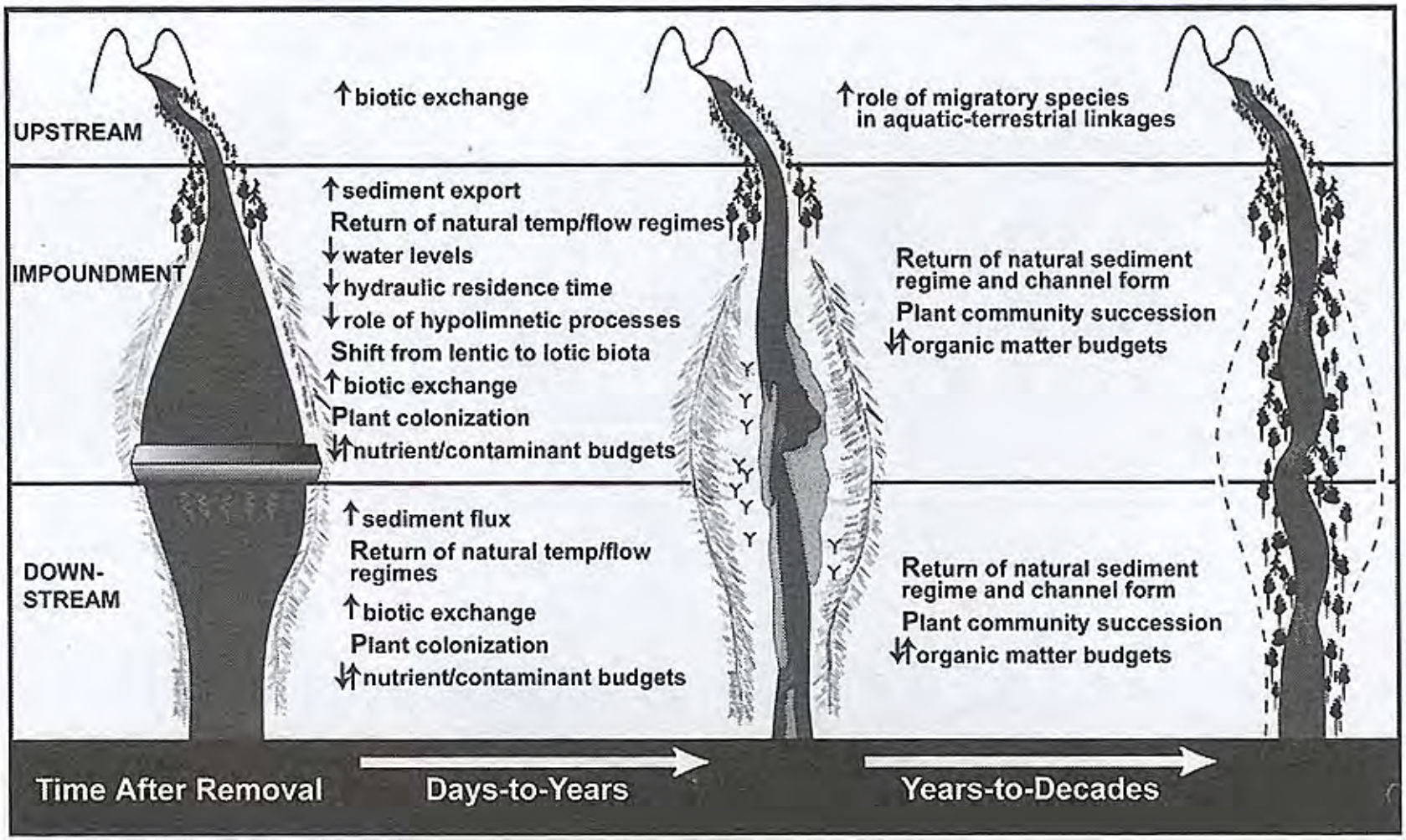
“Blow and go”

Dam removal and ecosystems

- New hydrology and hydraulics on sites and reaches that have adjusted, to some degree, to original alteration.
- Sediment pulse (often relatively short lived; “dispersion dominates advection”)
- Morphology and layering of deposition lens influences passive routing and magnitude, duration, and timing of suspended sediment impacts
- Risk of invasive plant communities on exposed substrate
- Risk of invasive aquatic populations (fragmentation, unfortunately, can be beneficial)
- Impacts on T&E populations
- Altered redox boundary



Realistic Expectations for Ecological Response



From Hart, D.D, T.E Johnson, K.L. Bushaw-Newton, R.J. Horwitz, A.T. Bednarek, D.F. Charles, D.A. Kreeger, and D.J. Velinsky (2002) "Dam removal: Challenges and opportunities for ecological research and river restoration." BioScience, Vol. 52, No. 8, p. 669-681.

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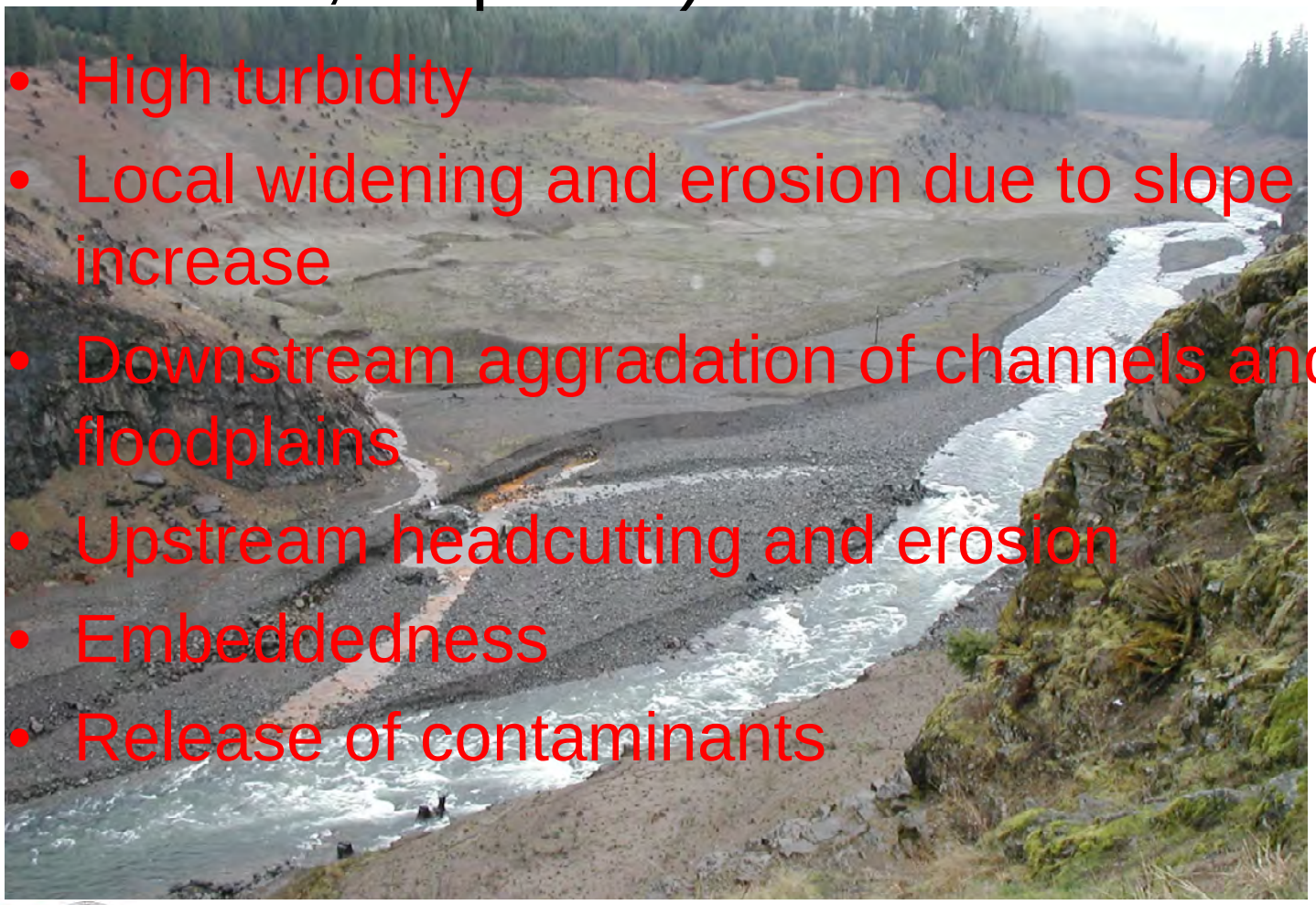
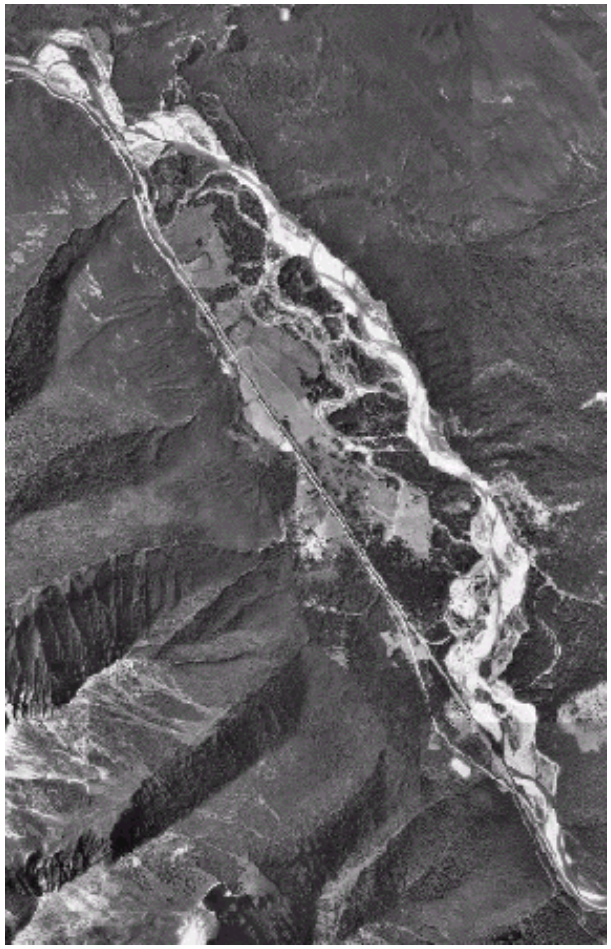
Sediment transport and fate ("It's the sediment, stupid…")



- High turbidity
- Local widening and erosion due to slope increase
- Downstream aggradation of channels and floodplains
- Upstream headcutting and erosion
- Embeddedness
- Release of contaminants

Embeddedness and the channel margin

- Embeddedness reduces redd success, entombs larvae, limits overwintering, alters chemical and thermal regimes by limiting interaction with hyporrheic zone, but methods are not standardized (http://el.erdc.usace.army.mil/publications.cfm?Topic=technote&Code=emrrp) EMRRP-SR-36.



Factors influencing impacts

- Sediment types and particle size distribution
- Volume and morphology of deposition
- Nutrient and contaminant concentrations
- Load-local and background
- Timing
- Duration
- Source sites
- Fate—local and system-wide
- Existing exotics

Case study analyses of physical responses

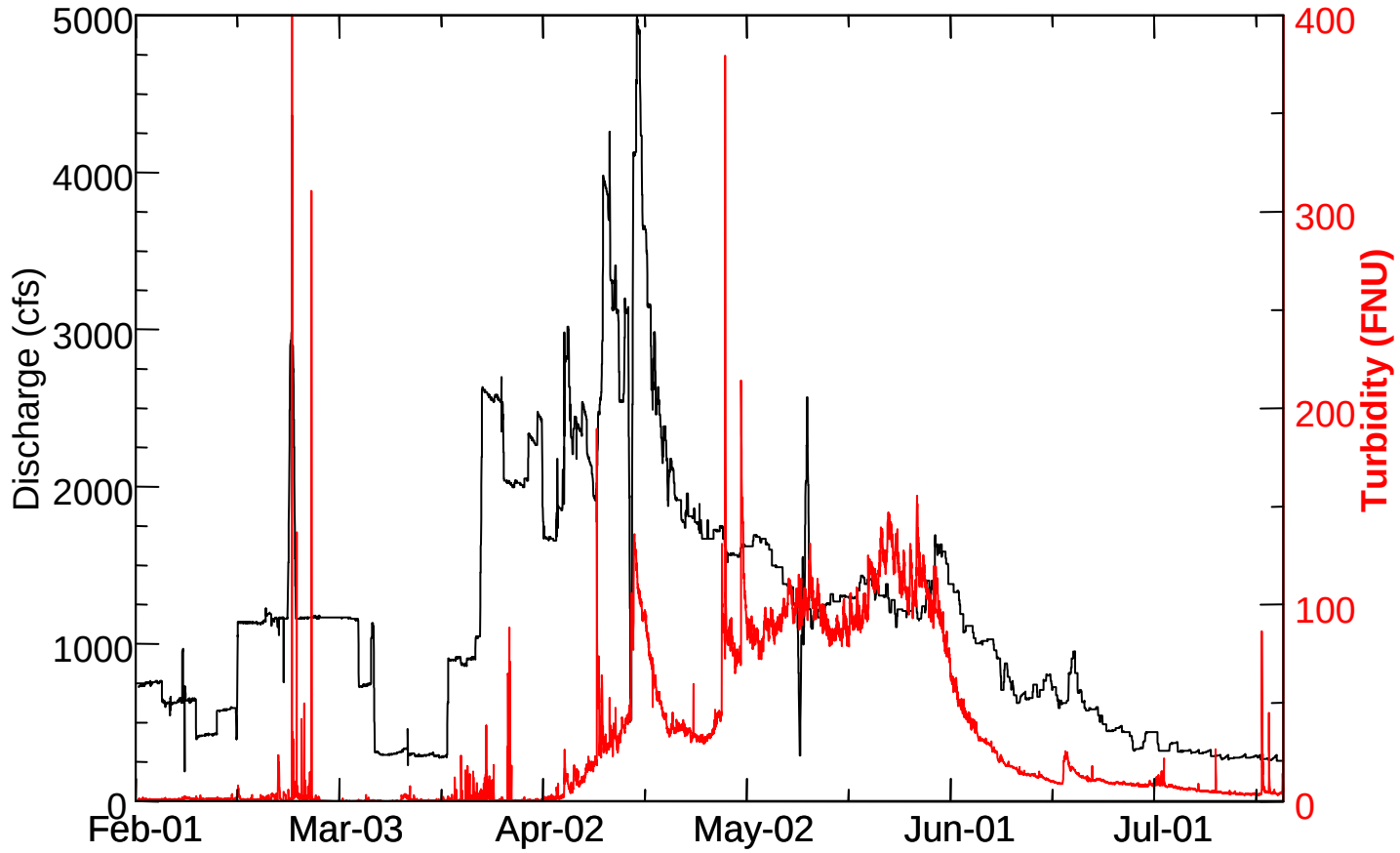
Doyle et al.'s studies:

- Sand-bed, high-transport channels
- Impoundment filled with sediment
- Channel evolution accomplished by **erosion and channel widening**, almost at any size flow

Pizzuto et al.'s study:

- Gravel systems
- Impoundment not filled with sediment
- Channel evolution accomplished by **deposition** of new floodplains and **channel narrowing** during floods

Cougar Dam Drawdown Impacts on South Fork MacKenzie River (provisional data)

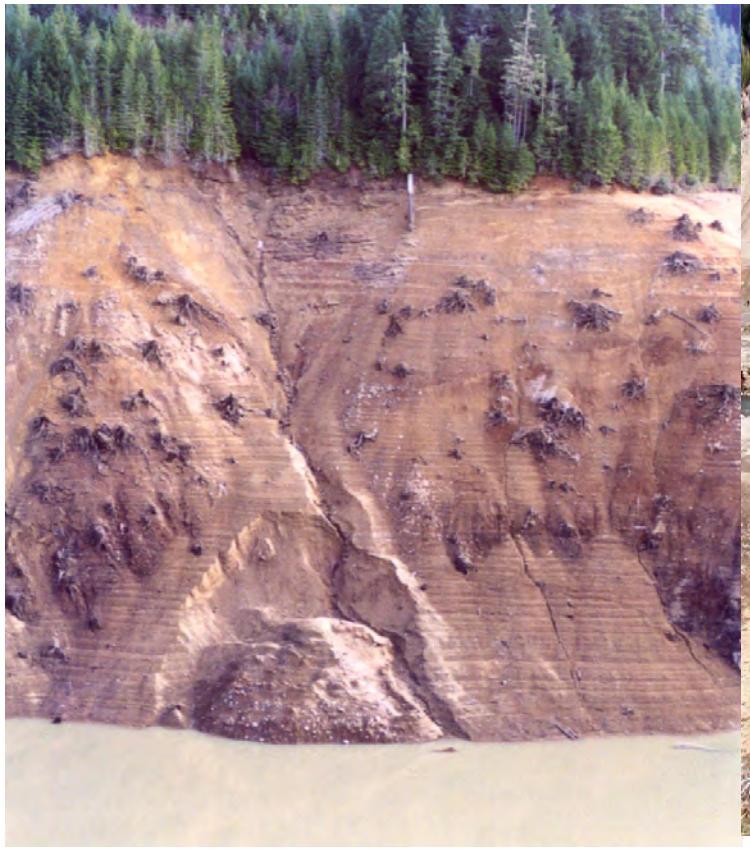


Sources of Cougar Modelling Inaccuracies

- Initial submergence of dried lakebed deposits **
- Mass wasting and slope failures caused by rapidly changing pool levels
- Active erosion of predominantly clay banks
- Lateral migration and downcutting of main inflow tributaries. **

** cause higher levels of turbidity

Sediment Sources in Cougar Drawdown



Analytical techniques

- Sediment Budgets
- Geomorphic Assessment
- Transport Analyses
- Coupled Modeling
  - HEC 6T ->HEC-RAS
  - GSTAR-1D
  - DREAM
  - CONCEPTS

  Don't get invested in one.

Why don’t the 1-D models work?

- Unpredictable hydrology
- Vertical layering and longitudinal sorting
- Non-alluvial mechanisms of transport initiation
- Erosion widths unknown
- Most models don’t handle silts and clays well
- Models don’t include many geomorphic phenomena, e.g. sinuosity, secondary hydraulics, and channel position

Simple (and draft) sediment decision metrics

- The reservoir storage capacity (at normal pool elevation) relative to the mean annual volume of river flow.
- The purposes for which the dam was constructed and operational modes (e.g., normally full, frequently drawn down, or normally empty).
- The reservoir sediment volume relative to the mean annual capacity of the river to transport sediment of relevant size range and distribution of deposition sites.
- Maximum width of reservoir relative to the active channel width of the upstream river channel in an alluvial reach.
- Concentrations of contaminants present relative to background levels.

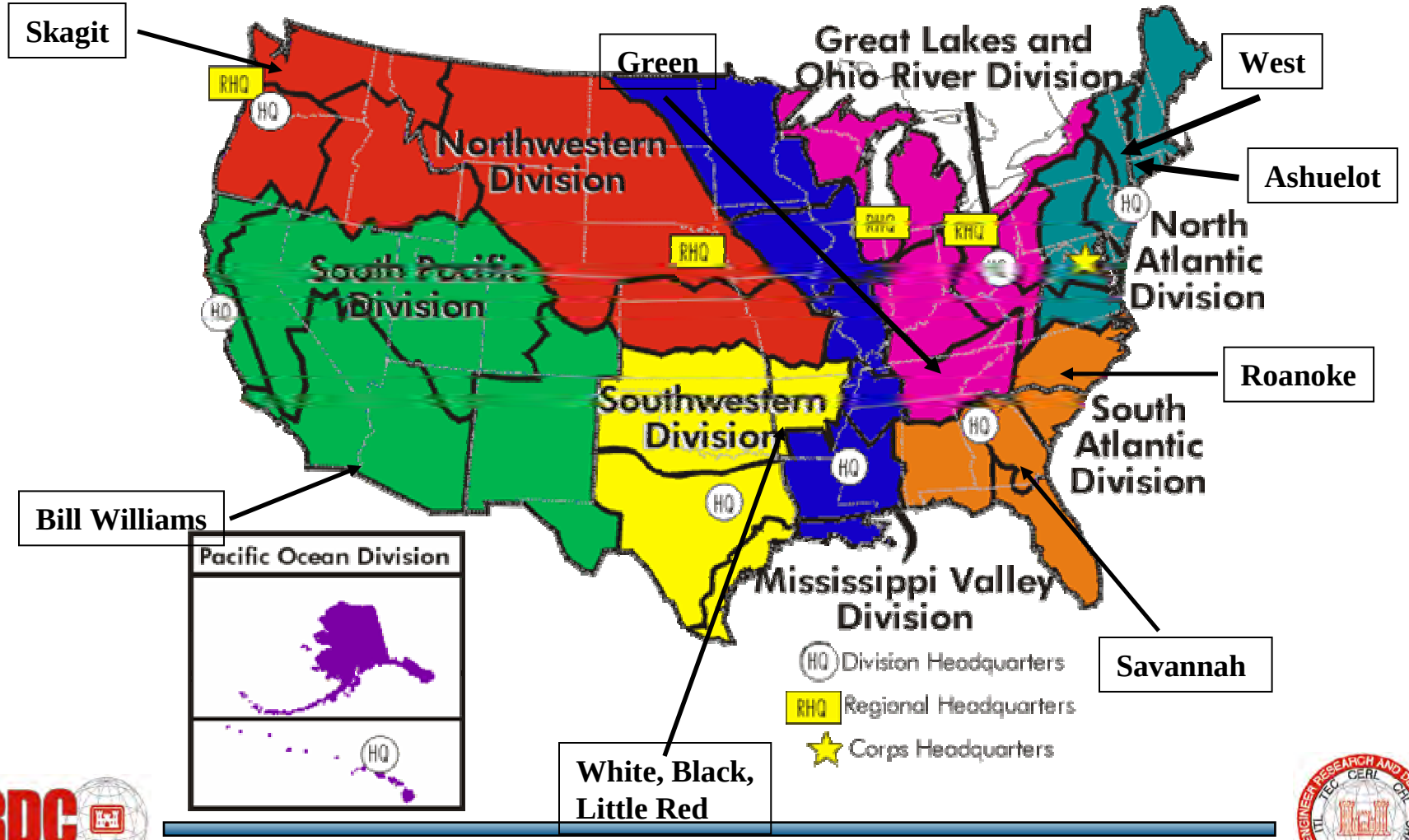
(with Randle and Greimann, BOR)

Sediment management options

- No action
- Bypass
- Mechanical removal
- Stabilization (temporary or permanent)
- Controlled release (spatial or temporal increments)
- River erosion
- Combination—remove fines, passively route coarse

Sustainable Rivers Project

Current Sites



**At this time, 12 rivers participating in SRP.*

State-of-practice

- "To manage sediment, you need two out of three: time, money, water." (Greimann)
- No standards
- Size matters. Volume counts.
- Qualitative
- Limited monitoring and adaptation
- Rapid rate of learning from lab and paired sample studies, field scale drawdowns, initial cohort of removals
- Need for some rapid assessment and decision support tools

Research needs

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Conclusions 1

- Dam removal is a requisite tool for managing aging structures and restoring both aquatic and riparian populations.
- Develop more knowledge on the effects of dams and drawdowns to learn about dam removals.
- Analytic and communications requirements are demanding but scale-, goal-, and system-dependent.

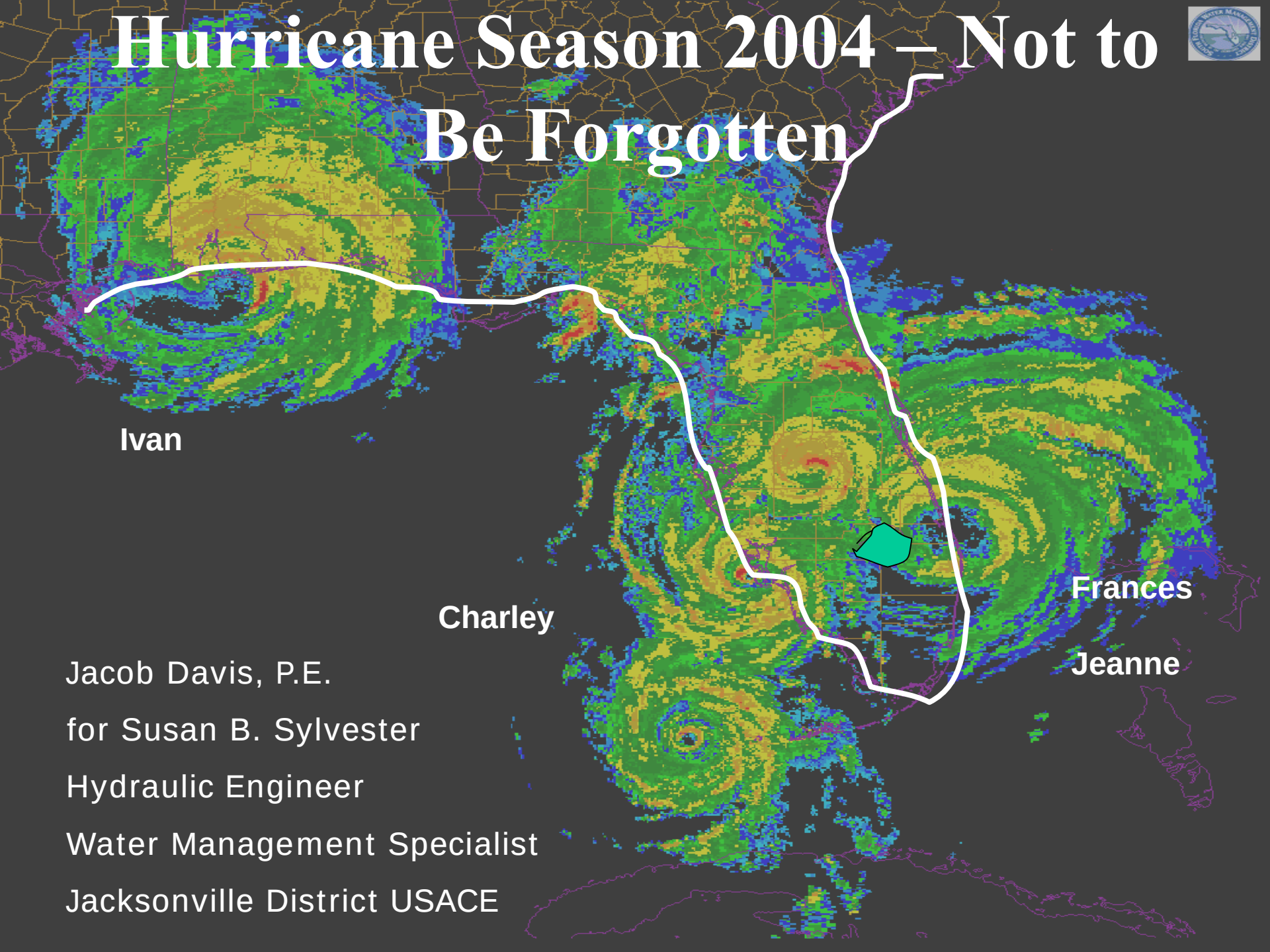
Conclusions 2

- Projects can be difficult and expensive; prioritization and effective planning and implementation are sorely needed.
- Many costs, benefits, perceptions, and both physical and ecological processes don't readily quantify.
- Better models and case study documentation are needed, particularly for ecosystem responses. Physical, transport, and ecological models need linkage and dynamic capacity for temporal and spatial scaling.

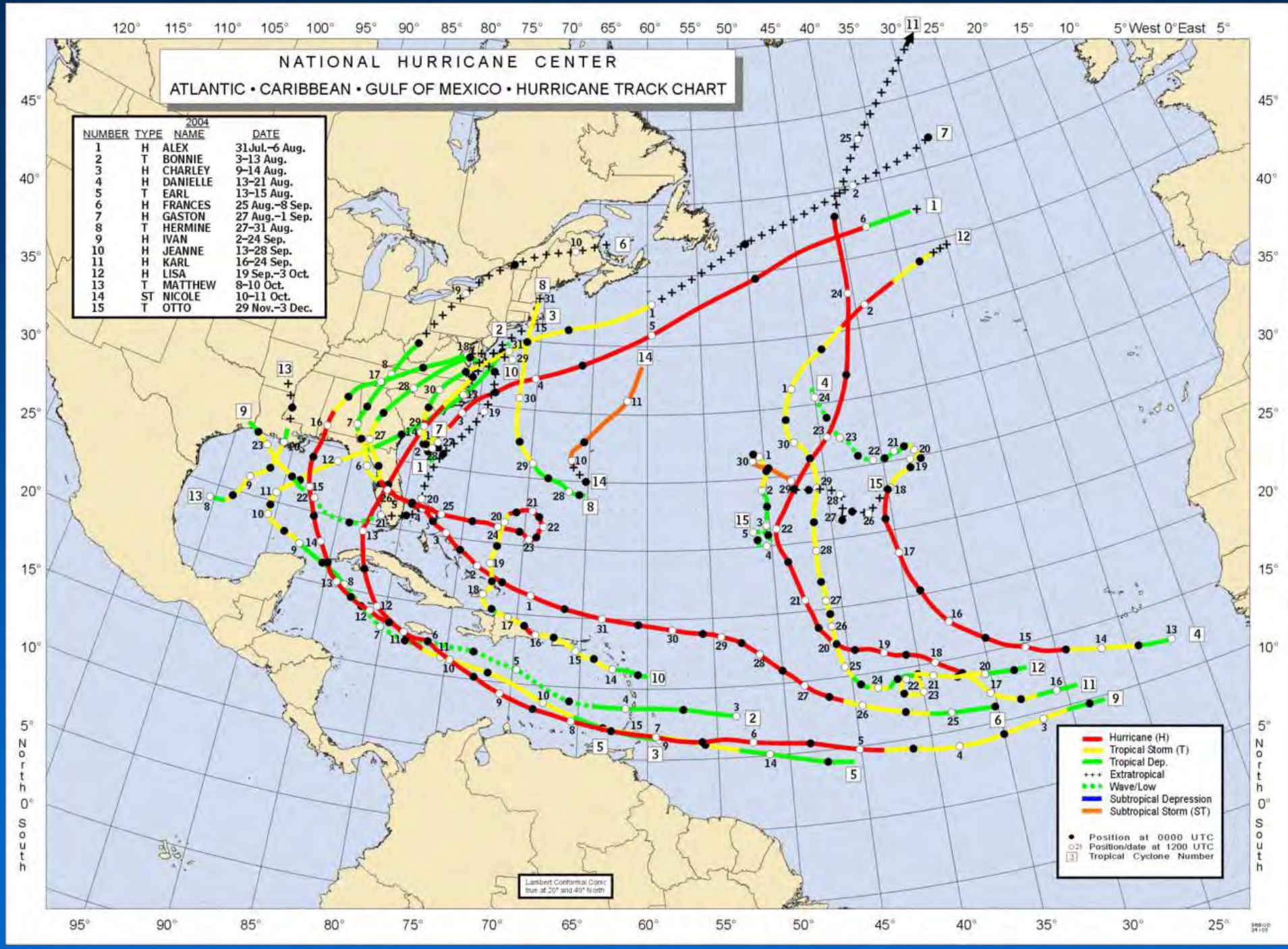
Conclusions 3

- Develop techniques for controlled sediment release for headpond and deposition zones for downstream reaches.
- Specify acceptable risks and dynamism to reduce hardening where possible and reallocate resources to sediment management, physical restoration, exotics management, and revegetation.
- For existing dams, route sediment as part of ongoing O&M.
- Improve sediment and debris routing and organism passage design in new structures.

Hurricane Season 2004 – Not to Be Forgotten

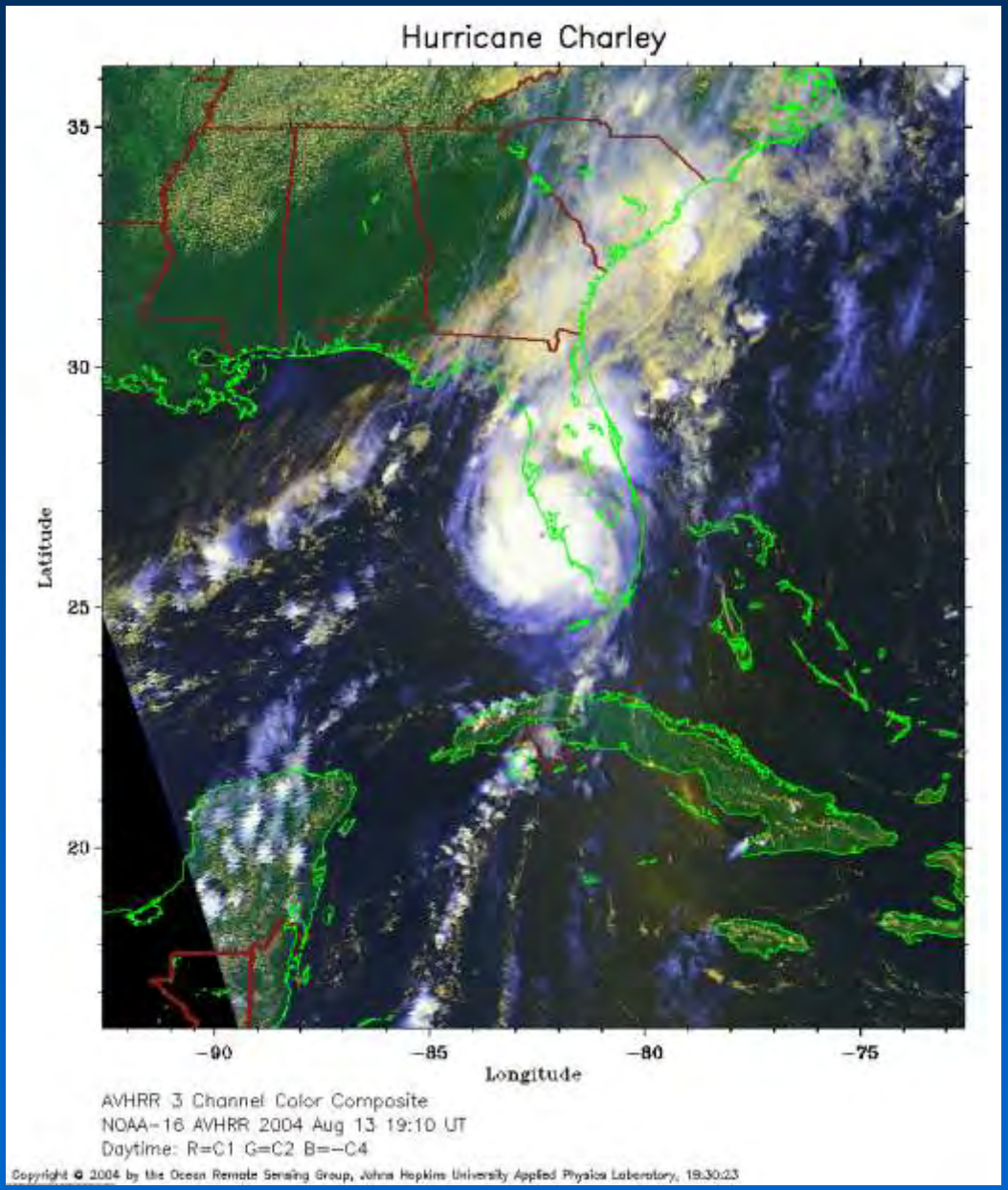


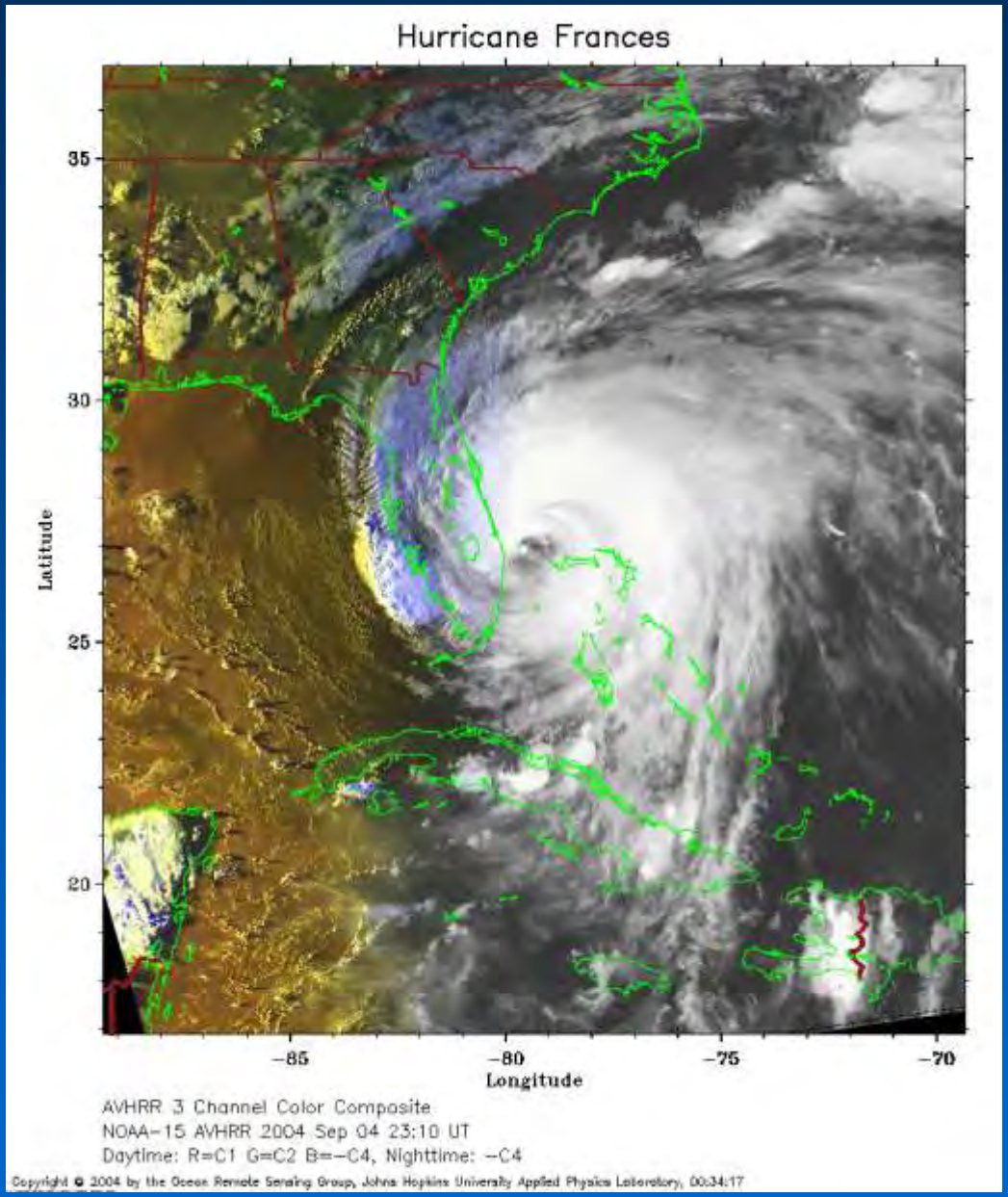
Jacob Davis, P.E.
for Susan B. Sylvester
Hydraulic Engineer
Water Management Specialist
Jacksonville District USACE

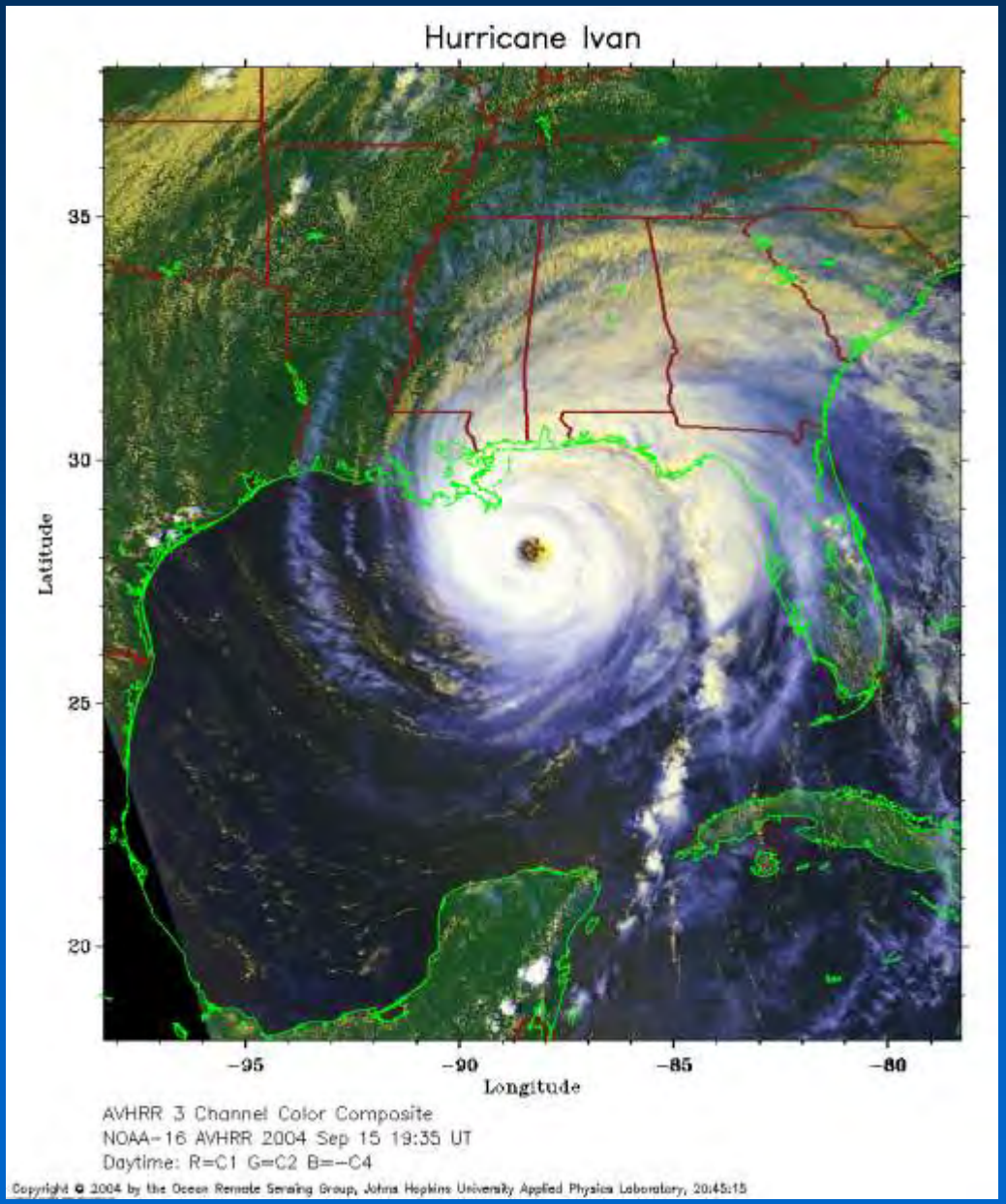

NATIONAL HURRICANE CENTER
ATLANTIC • CARIBBEAN • GULF OF MEXICO • HURRICANE TRACK CHART
2004
NUMBER TYPE NAME DATE
1 H ALEX 31Jul.–6 Aug.
2 T BONNIE 3–13 Aug.
3 H CHARLEY 9–14 Aug.
4 H DANIELLE 13–21 Aug.
5 T EARL 13–15 Aug.
6 H FRANCES 25 Aug.–8 Sep.
7 H GASTON 27 Aug.–1 Sep.
8 T HERMINE 27–31 Aug.
9 H IVAN 2–24 Sep.
10 H JEANNE 13–28 Sep.
11 H KARL 16–24 Sep.
12 H LISA 19 Sep.–3 Oct.
13 T MATTHEW 8–10 Oct.
14 ST NICOLE 10–11 Oct.
15 T OTTO 29 Nov.–3 Dec.
Hurricane (H)
Tropical Storm (T)
Tropical Dep.
Extratropical
Wave/Low
Subtropical Depression
Subtropical Storm (ST)
Position at 0000 UTC
Position/date at 1200 UTC
Tropical Cyclone Number
Lambert Conformal Conic
true at 20° and 40° North
120° 115° 110° 105° 100° 95° 90° 85° 80° 75° 70° 65° 60° 55° 50° 45° 40° 35° 30° 25° 20° 15° 10° 5° West 0° East 5°
95° 90° 85° 80° 75° 70° 65° 60° 55° 50° 45° 40° 35° 30° 25°
45° 40° 35° 30° 25° 20° 15° 10° 5° North 0° South

The 2004 Atlantic Hurricane Season

Alex	
TS Bonnie	
Charley	13 August
Danielle	
TS Earl	
Frances	4 September
TS Gaston	
TS Hermine	
Ivan	Return 14 September
Jeanne	Jeanne 25 September
Karl	
Lisa	
TS Matthew	
Sub-TS Nicole	


Hurricane Charley
35
30
25
20
Latitude
−90
−85
−80
−75
Longitude
AVHRR 3 Channel Color Composite
NOAA-16 AVHRR 2004 Aug 13 19:10 UT
Daytime: R=C1 G=C2 B=−C4
Copyright © 2004 by the Ocean Remote Sensing Group, Johns Hopkins University Applied Physics Laboratory, 19:30:23


Hurricane Frances
35
30
25
20
Latitude
−85
−80
−75
−70
Longitude
AVHRR 3 Channel Color Composite
NOAA−15 AVHRR 2004 Sep 04 23:10 UT
Daytime: R=C1 G=C2 B=−C4, Nighttime: −C4
Copyright © 2004 by the Ocean Remote Sensing Group, Johns Hopkins University Applied Physics Laboratory, 00:34:17


Hurricane Ivan
35
30
25
20
Latitude
−95
−90
−85
−80
Longitude
AVHRR 3 Channel Color Composite
NOAA-16 AVHRR 2004 Sep 15 19:35 UT
Daytime: R=C1 G=C2 B=−C4
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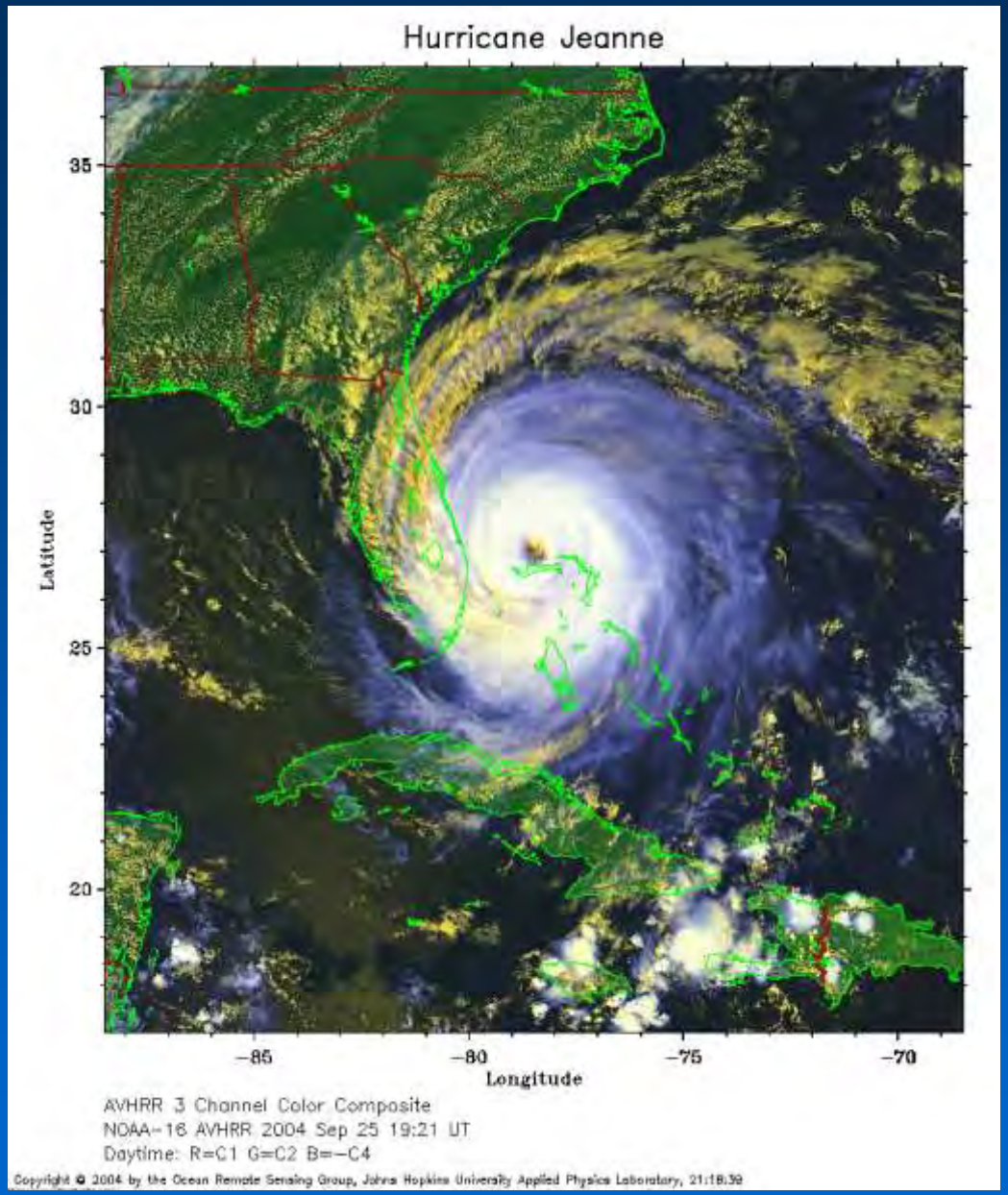
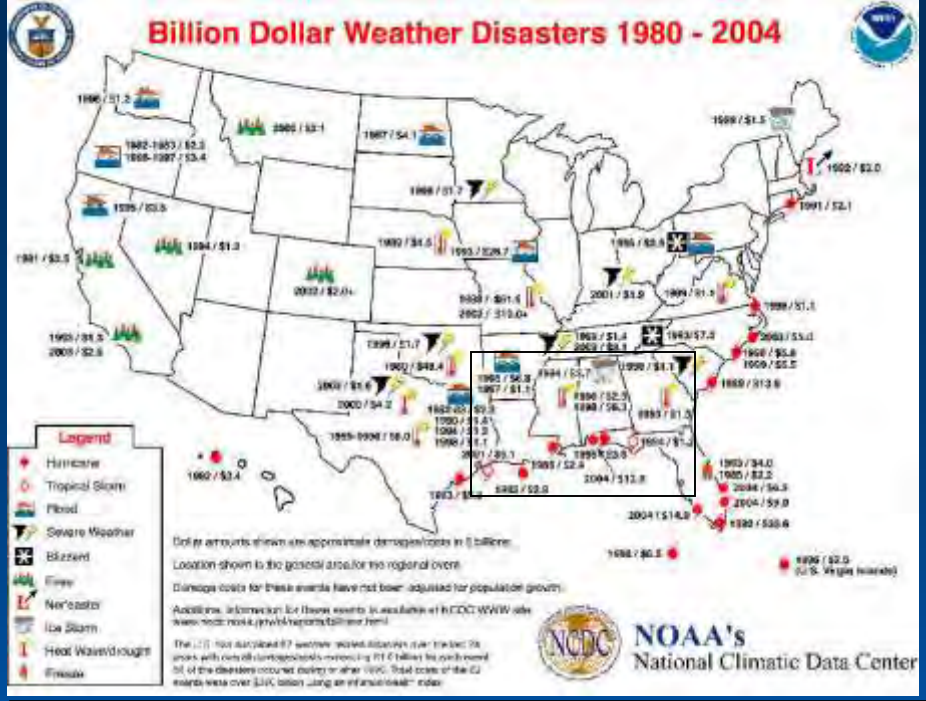
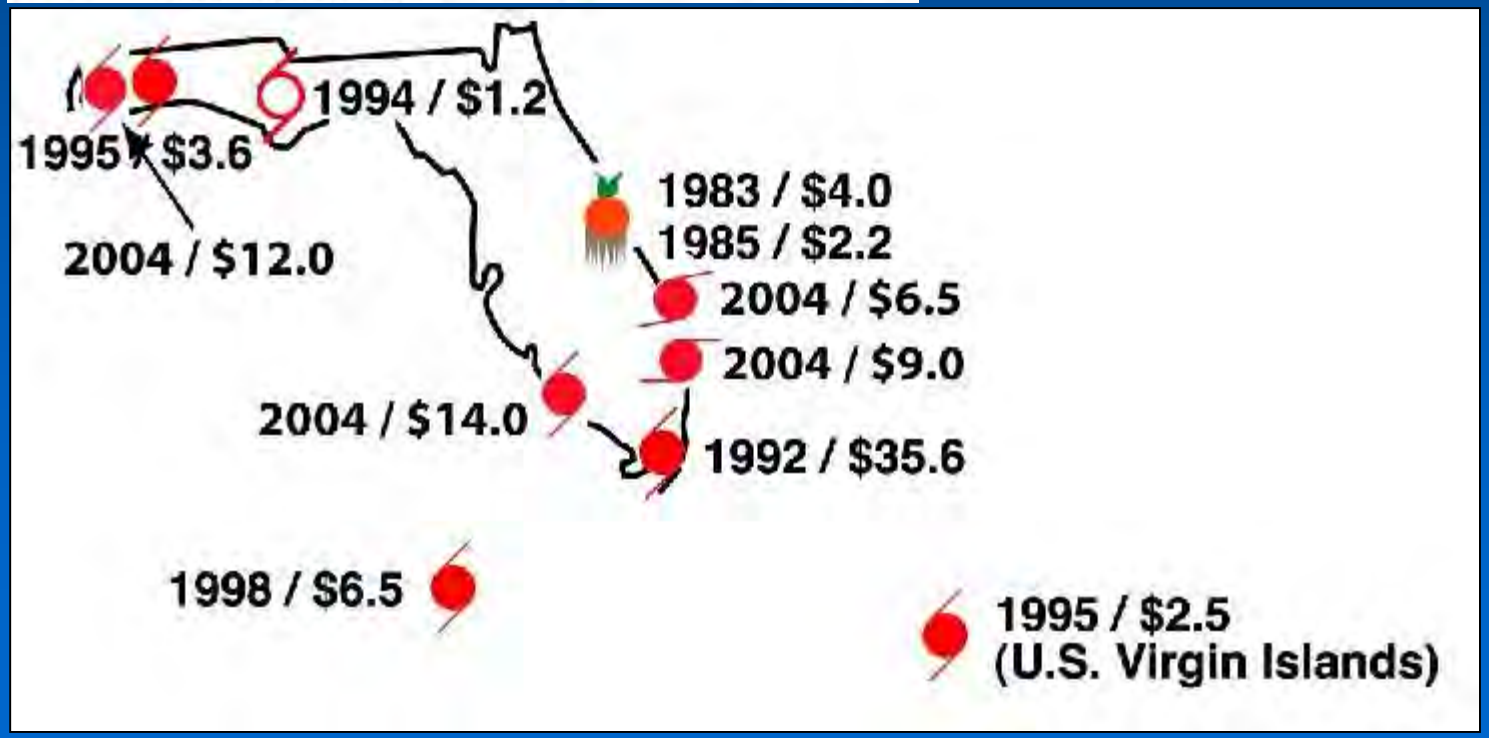

Hurricane Jeanne
35
30
25
20
Latitude
−85
−80
−75
−70
Longitude
AVHRR 3 Channel Color Composite
NOAA−16 AVHRR 2004 Sep 25 19:21 UT
Daytime: R=C1 G=C2 B=−C4
Copyright © 2004 by the Ocean Remote Sensing Group, Johns Hopkins University Applied Physics Laboratory, 21:18:39



4 hit Florida within ~6 weeks, 3 were major hurricanes;

117 lives lost, 1 in 5 homes damaged or destroyed,

Est. property damage ~$42B



http://www.ncdc.noaa.gov/img/climate/research/2004/sep/frances-landfall-pg.gif

Atlantic Hurricane Season (Jun 1 – Nov 30)

	Average[1]	NOAA 2004 Initial Forecast	2004 Actual	NOAA 2005 Initial Forecast	CSU (Dr. Gray) Initial '05 Forecast[4]
Tropical Storms	**10**	**12-15**	**15**	**12-15**	**13**
Hurricanes	**6**	**6-8**	**9[2]**	**7-9**	**7**
Major Hurricanes (winds > 111 mph)	**2**	**2-4**	**6[3]**	**3-5**	**3**

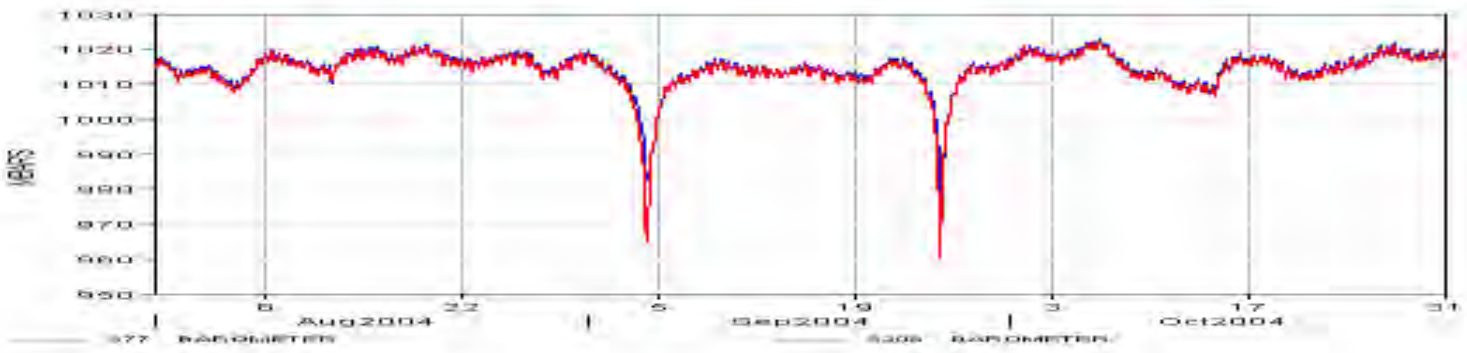
(1) 8 of past 10 seasons were above average
(2) 4 hit Florida within ~6 weeks, 3 were major hurricanes;
(117 lives lost, 1 in 5 homes damaged or destroyed, est. property damage ~$42B (msnbc.nsn.com/id/7872376)
(3) Alex, Charley, Frances, Ivan, Jeanne, Karl
(4) to be updated 31May – likely to be increased due to lack of strong El Nino & northern Atlantic Ocean temperatures ~3°F > normal.

South Florida Water System

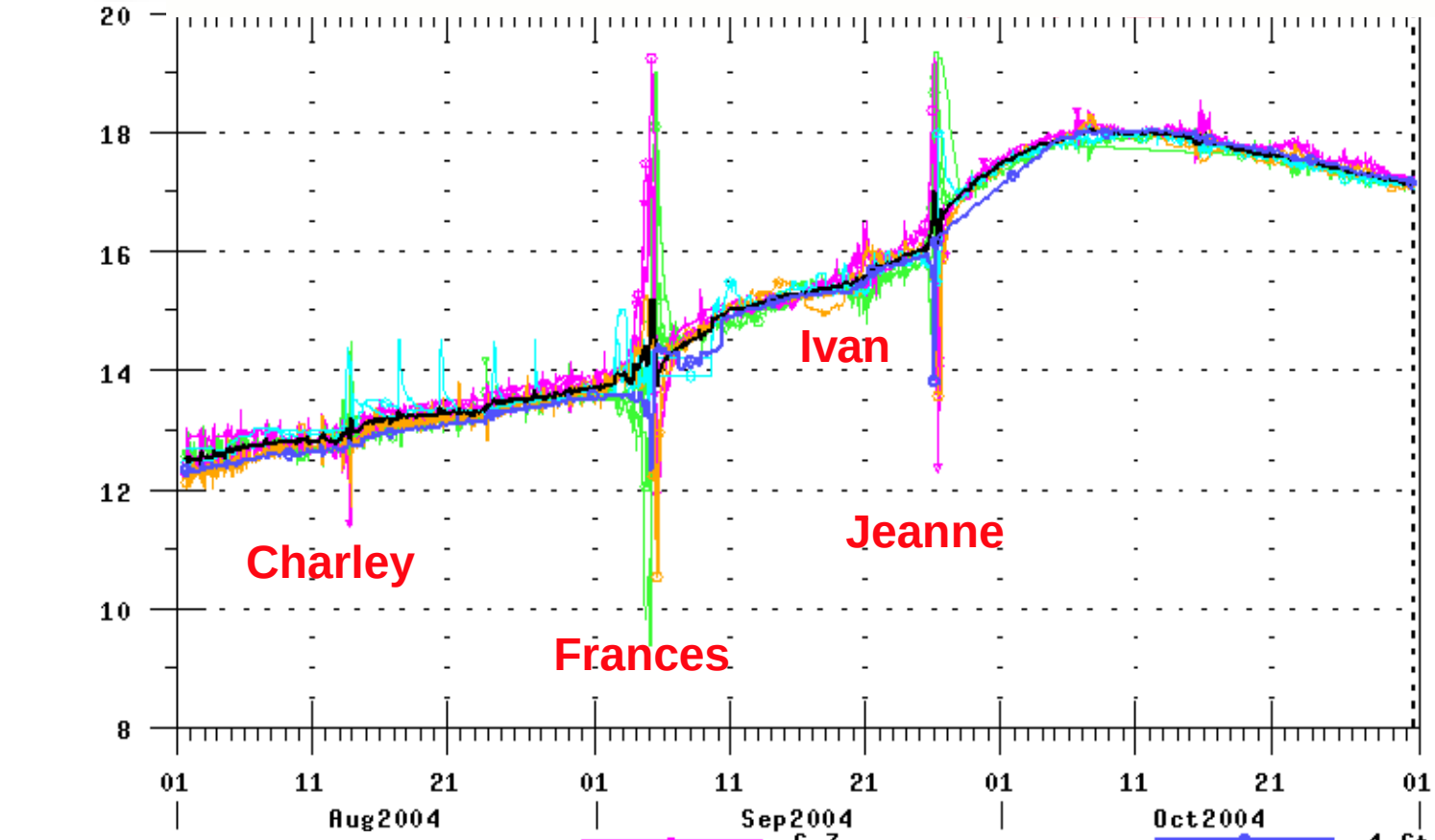
- 18,000 Square Miles
- Highly managed system
- 6.5 Million people
- Multi-Billion Dollar economy focused on tourism, agriculture, and commercial activities

1

- 2nd Largest FW Lake in US
- 143 Miles Earthen Dike (HHD)
- 5 Spillway Outlets
- 5 Spillway Inlets
- 17 Primary Culverts
- 12 Secondary Culverts
- 9 Locks
- 9 Pump Stations



Lake Elevation



Surge Animation

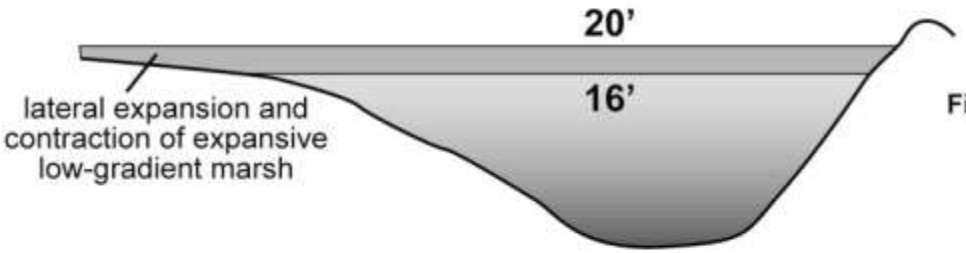
Courtesy COMET Program

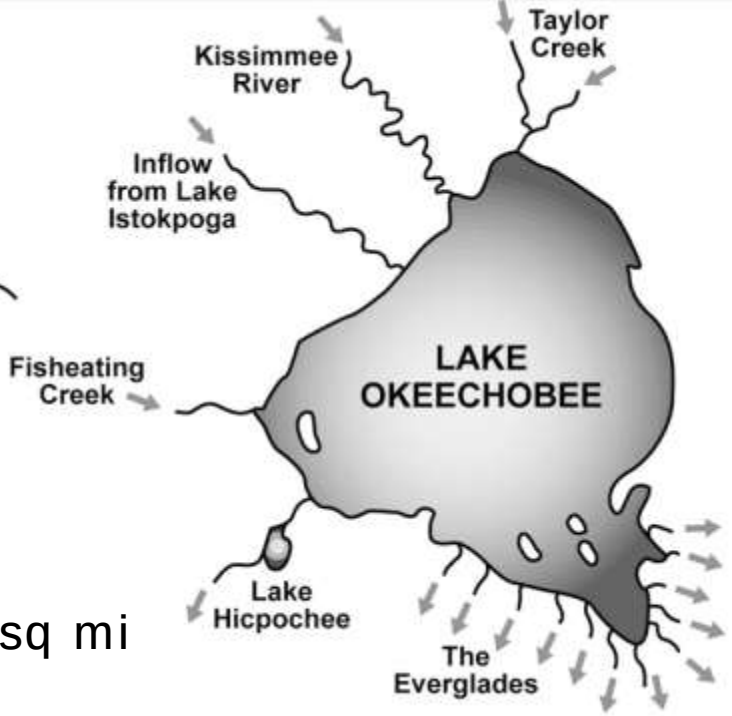
11/30/2004

11/30/2004

11/30/2004

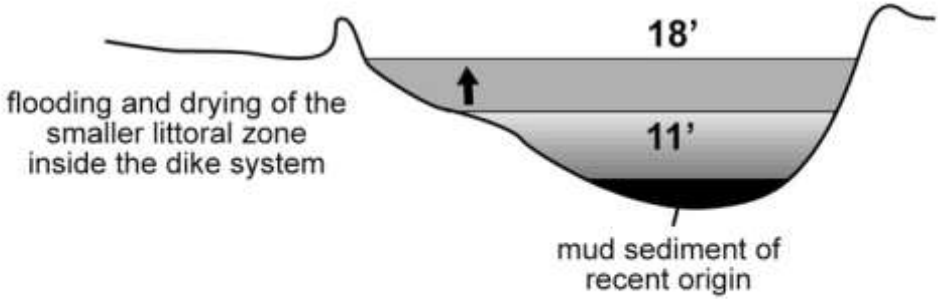
PAST

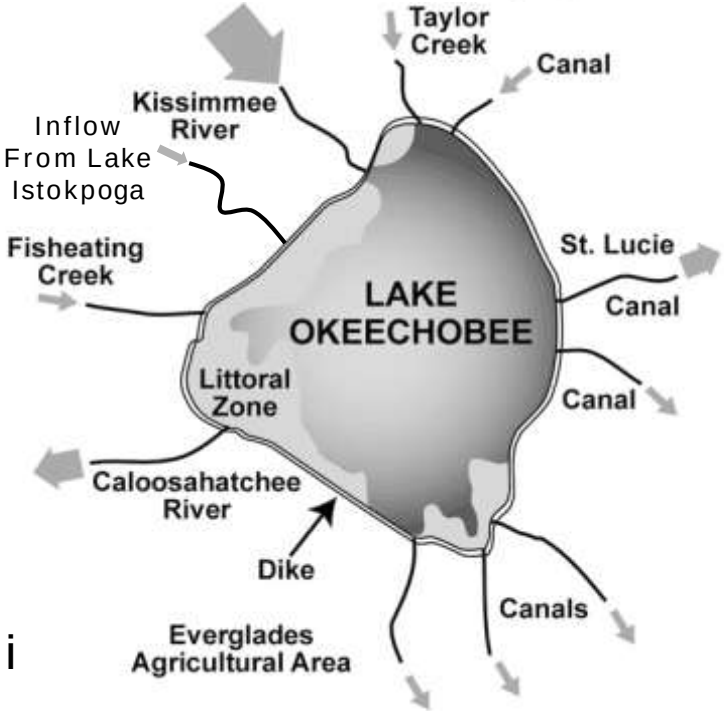




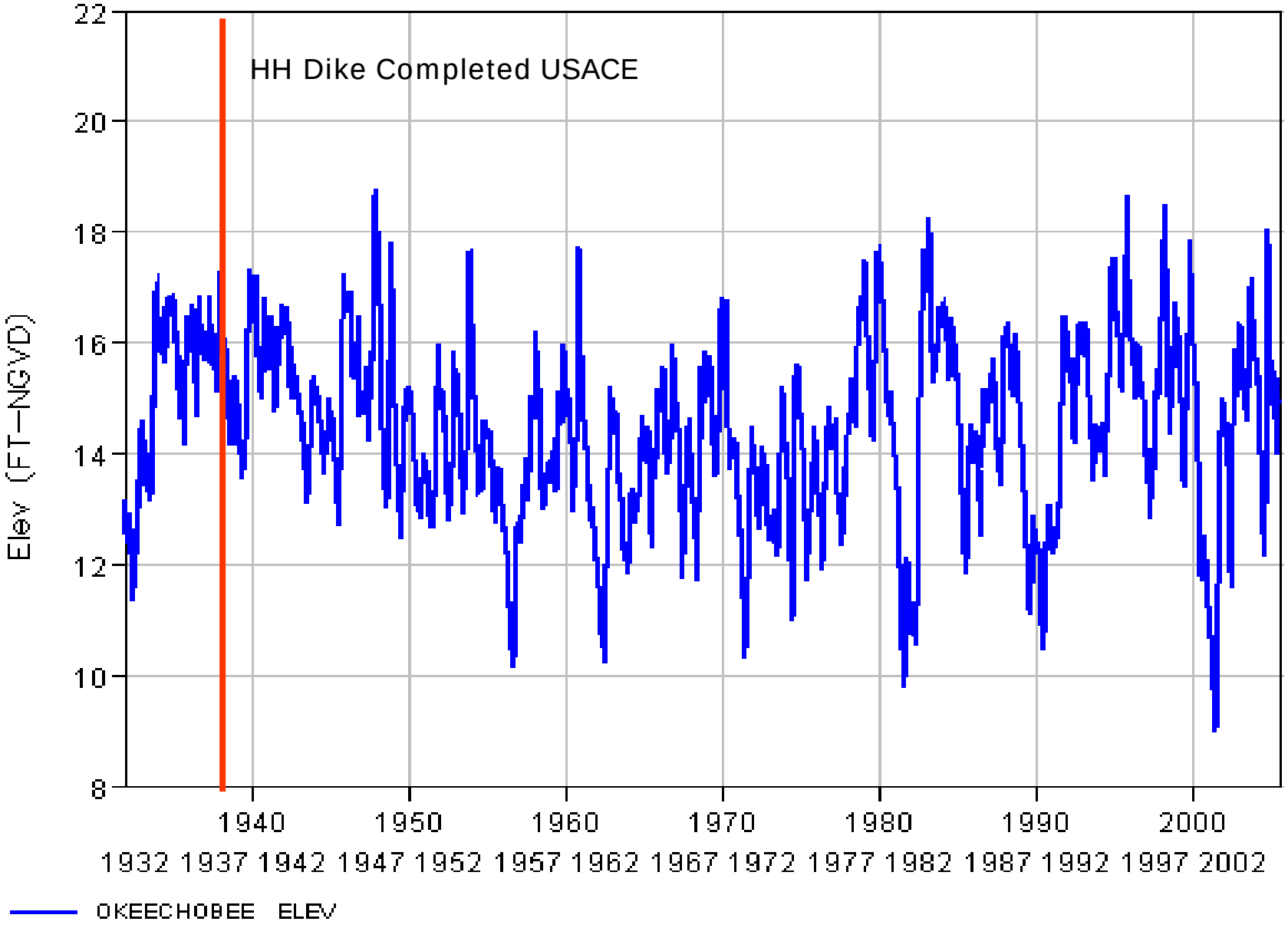
~1200 sq mi

PRESENT



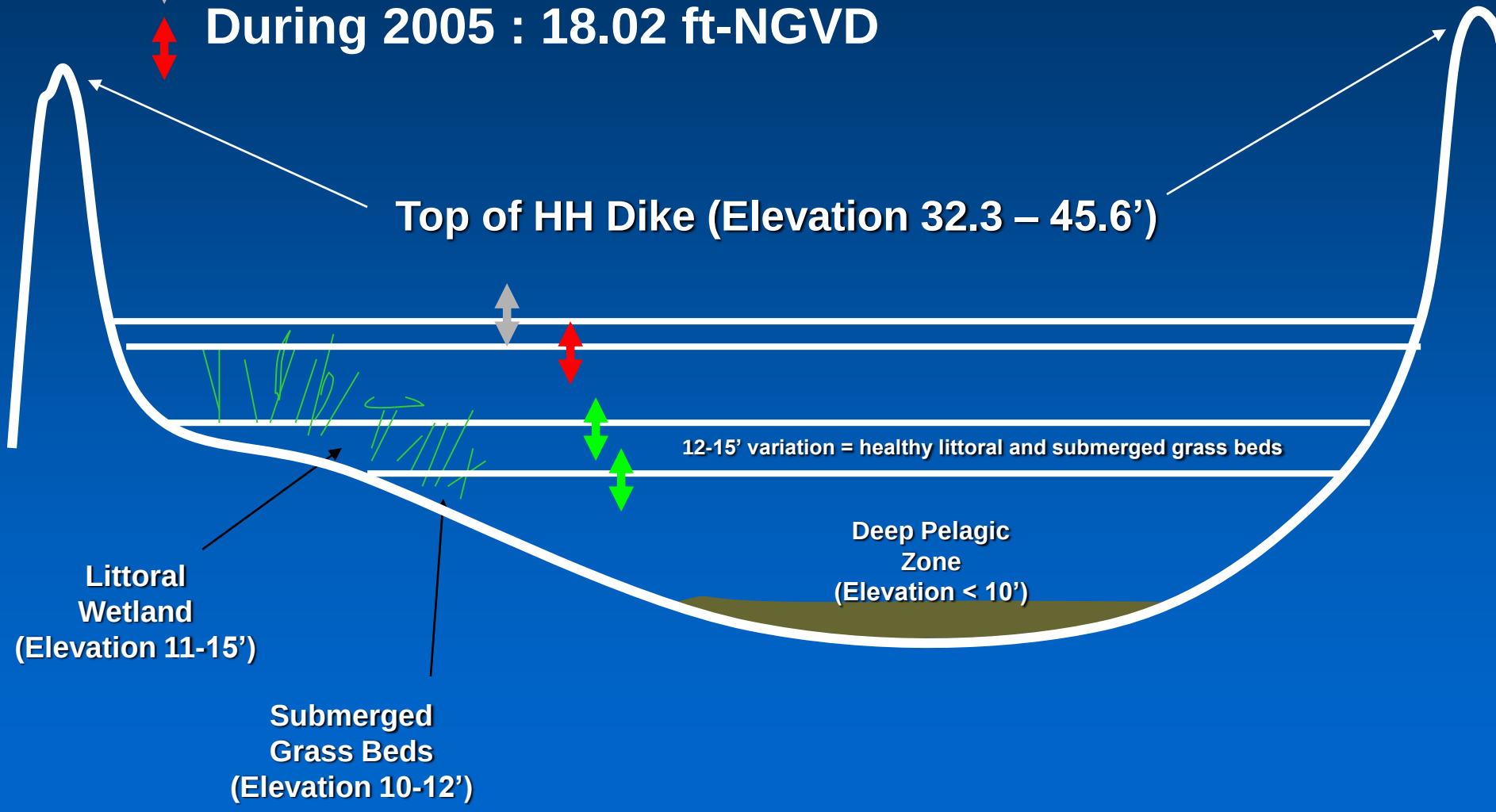


730 sq mi

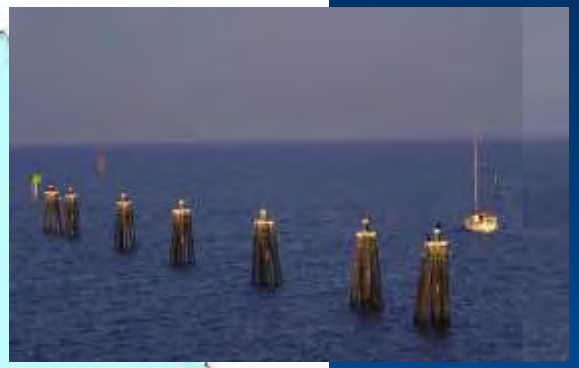

HH Dike Completed USACE
Elev (FT-NGVD)
22
20
18
16
14
12
10
8
1940
1950
1960
1970
1980
1990
2000
1932 1937 1942 1947 1952 1957 1962 1967 1972 1977 1982 1987 1992 1997 2002
OKEECHOBEE ELEV

Ranges of water levels

- For Ecological sustainability: 12.5 to 15.0 ft-NGVD
- For HH Dike Stability: < 18.5 ft-NGVD
- During 2005 : 18.02 ft-NGVD



Not to Scale



N

0 10 20

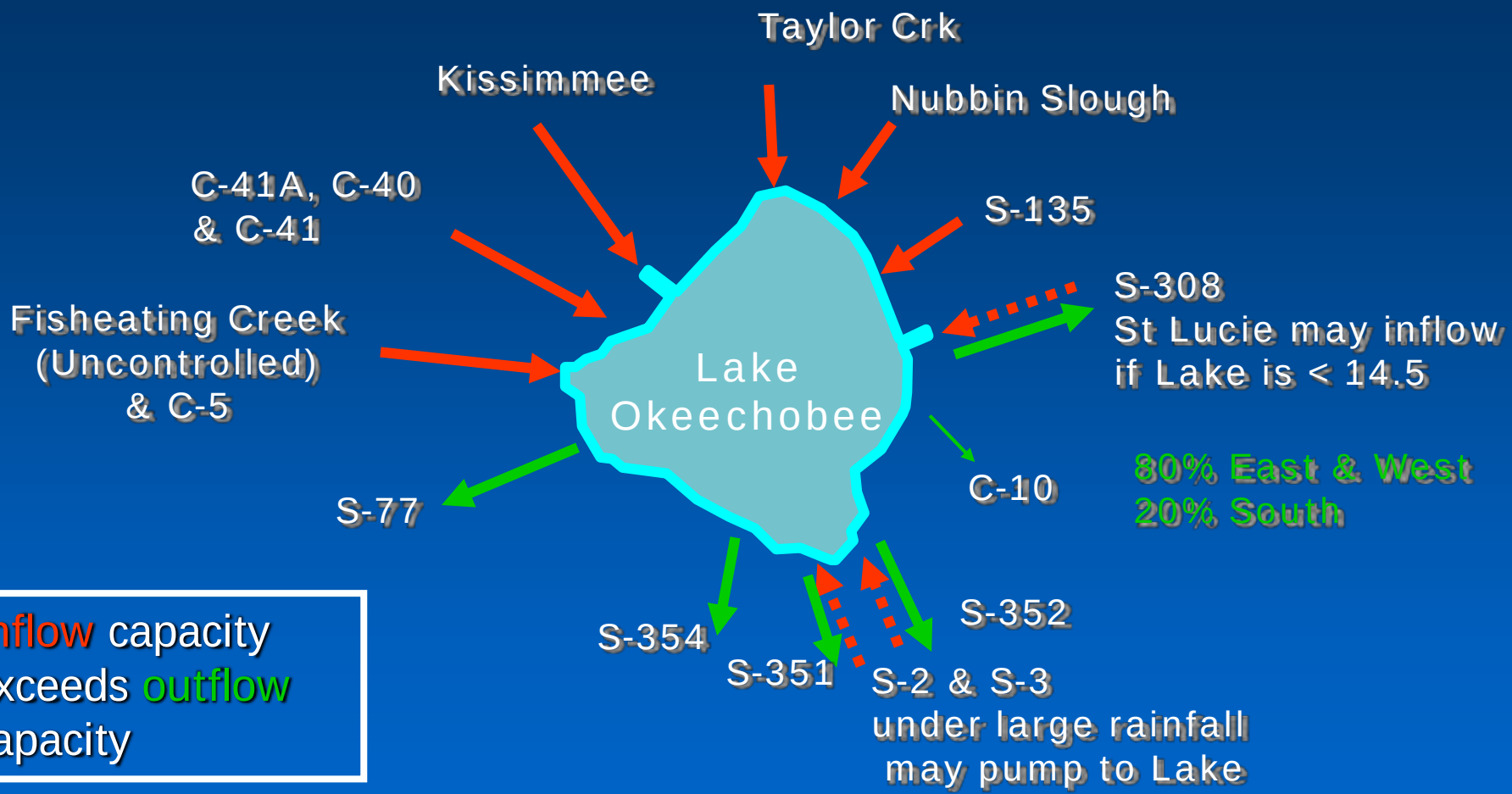
Kilometers

Pelagic Zone
(no plants)

Littoral Zone
(emergent, submerged, and floating plants)

Near Shore Zone
(submerged plant beds, *Chara*, bulrush)

Inflows & Outflows



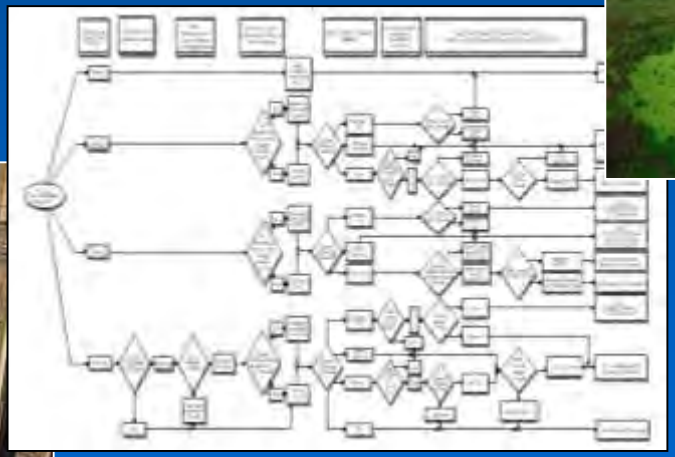
Inflow capacity exceeds outflow capacity

Lake Okeechobee's drainage basin covers more than 4,600 square miles

Revised Lake Okeechobee Operating Schedule

Lake Okeechobee Water Supply / Environmental Regulation Schedule (WSE)

Incorporates tributary hydrologic conditions and climate forecasts for operational decisions



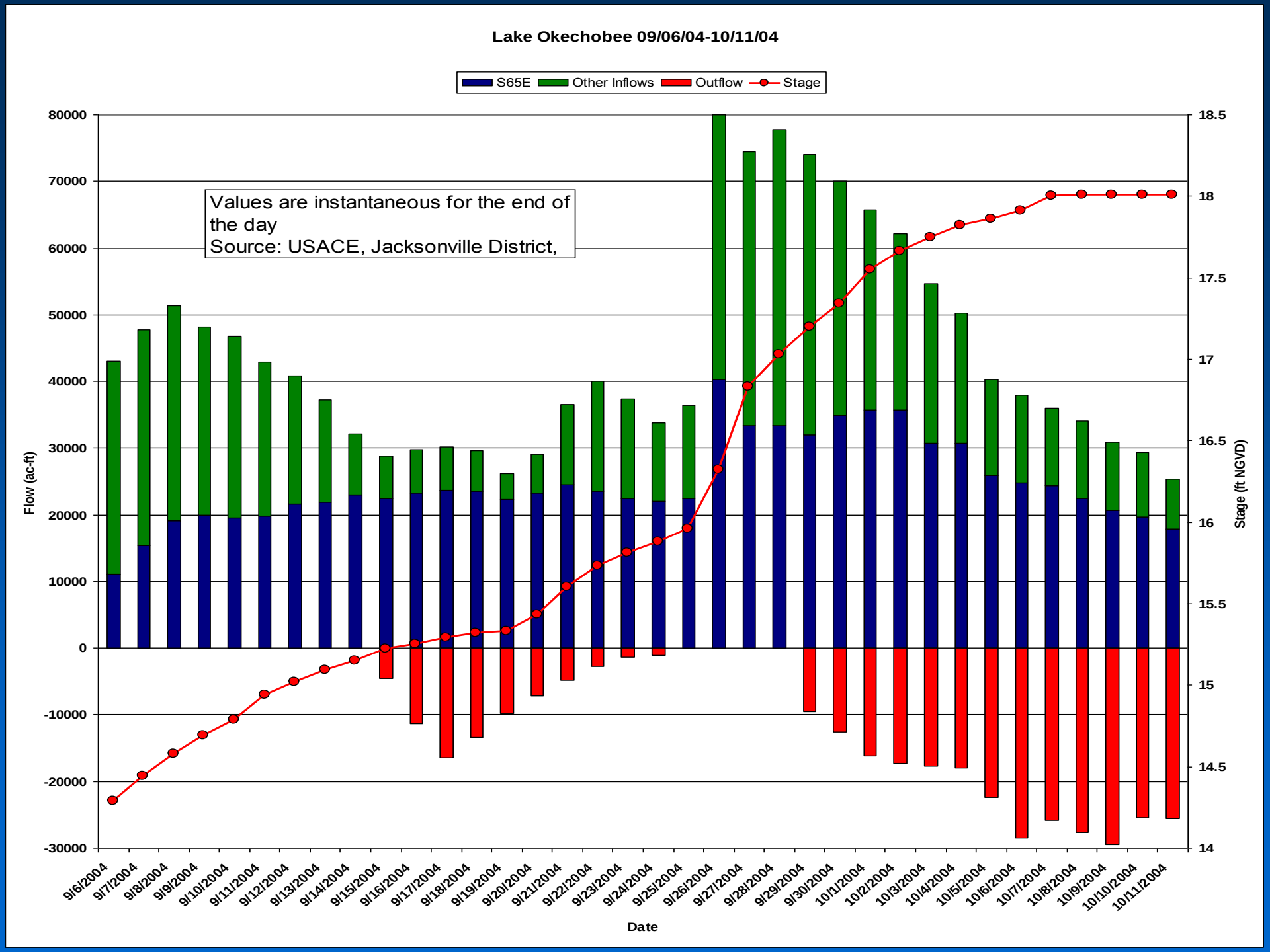
Utilizes pulse releases to mimic natural rainfall and runoff

Looking west across the Port Mayaca showing immensity of Lake O relative to the outlet size.

Port Mayaca S-308 Lock and Spillway (5600 cfs) 15July2005:1430

Gates at 7.0 ft, 4320, plus Lock open full (1300 cfs)

15JUL05 1430^{o} 7.0 641 ^{3} 7.0 641 ^{3} 7.0 641 ^{3} 7.0 641 ^{3} 56 1756^{3} 4320^{3}


Lake Okechobee 09/06/04-10/11/04
S65E
Other Inflows
Outflow
Stage
Values are instantaneous for the end of the day
Source: USACE, Jacksonville District,
Flow (ac-ft)
Stage (ft NGVD)
Date
80000
70000
60000
50000
40000
30000
20000
10000
0
-10000
-20000
-30000
18.5
18
17.5
17
16.5
16
15.5
15
14.5
14
9/6/2004
9/7/2004
9/8/2004
9/9/2004
9/10/2004
9/11/2004
9/12/2004
9/13/2004
9/14/2004
9/15/2004
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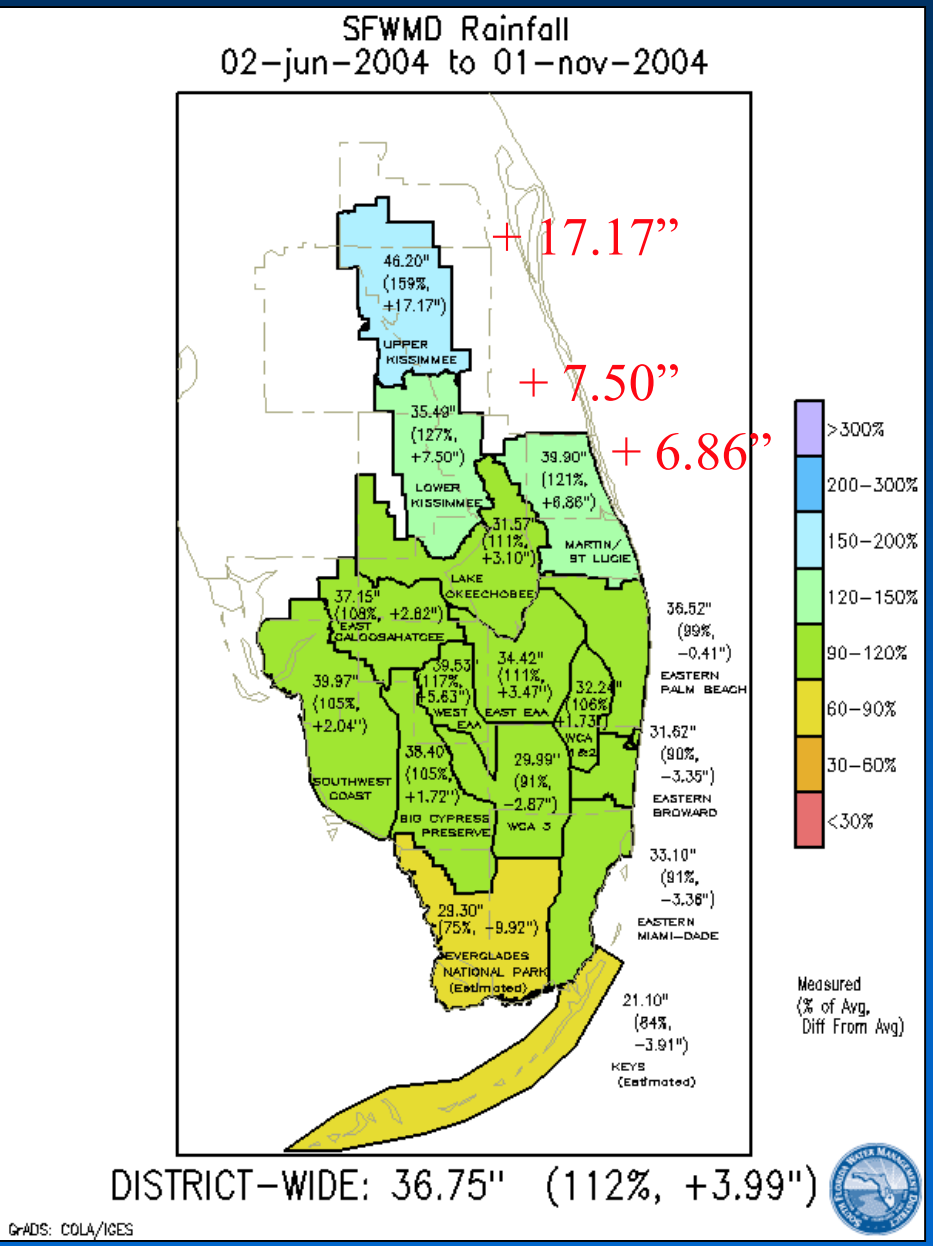
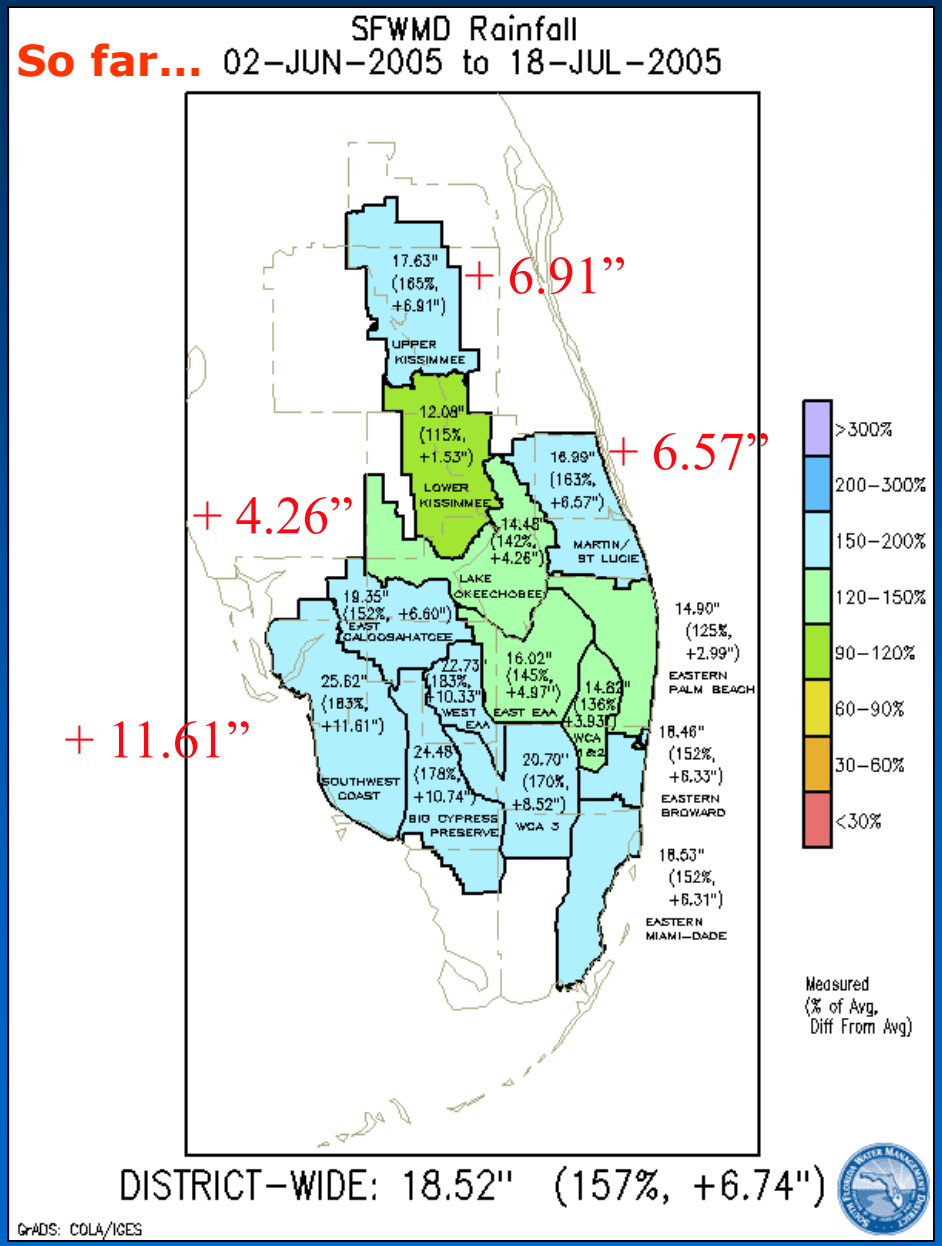
10/11/2004

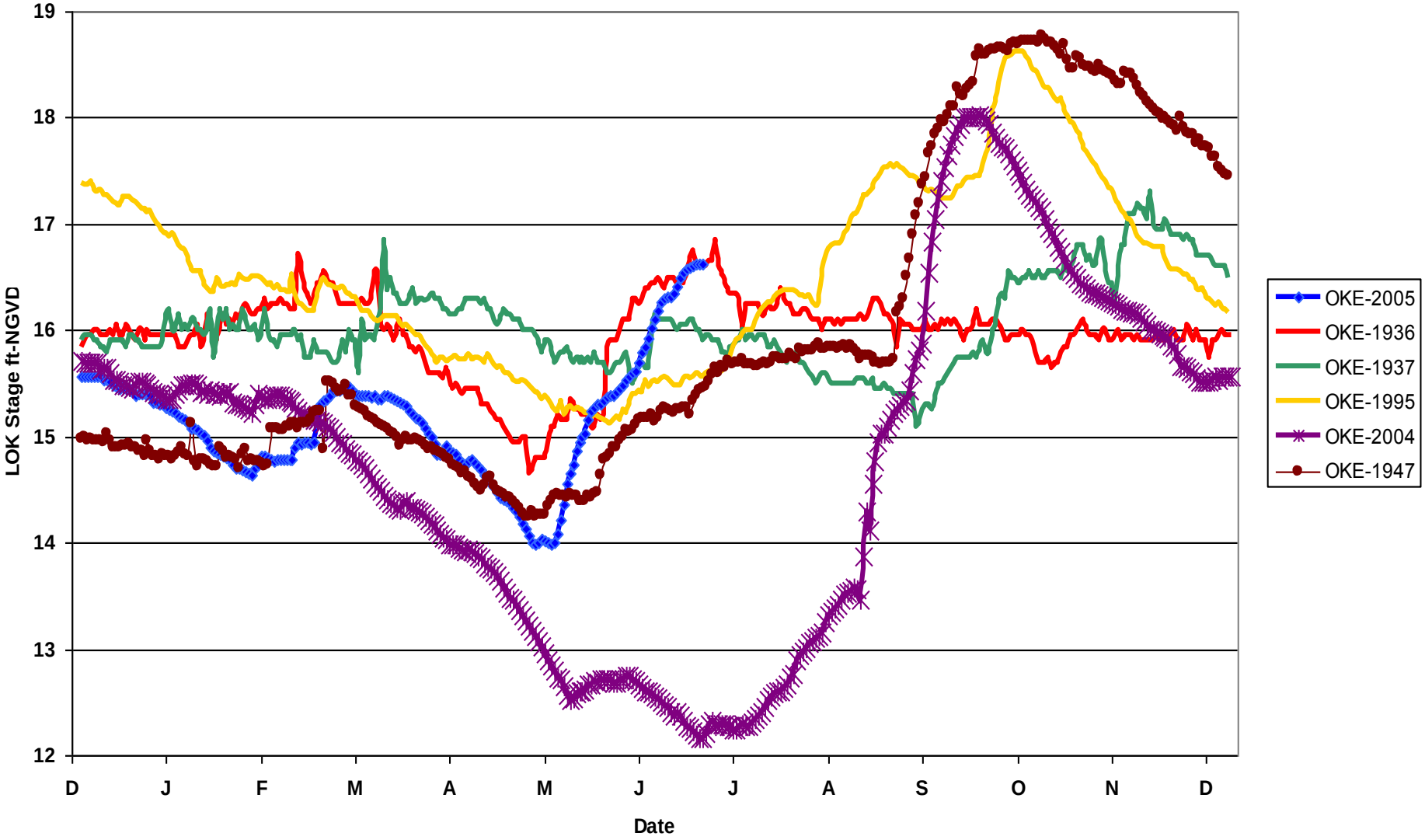
Wet Season 2004

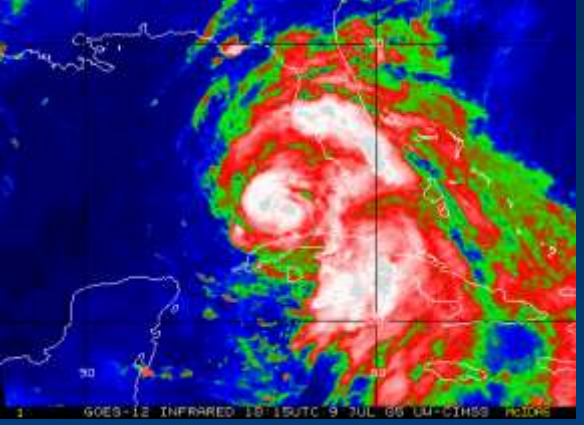


Wet Season 2005



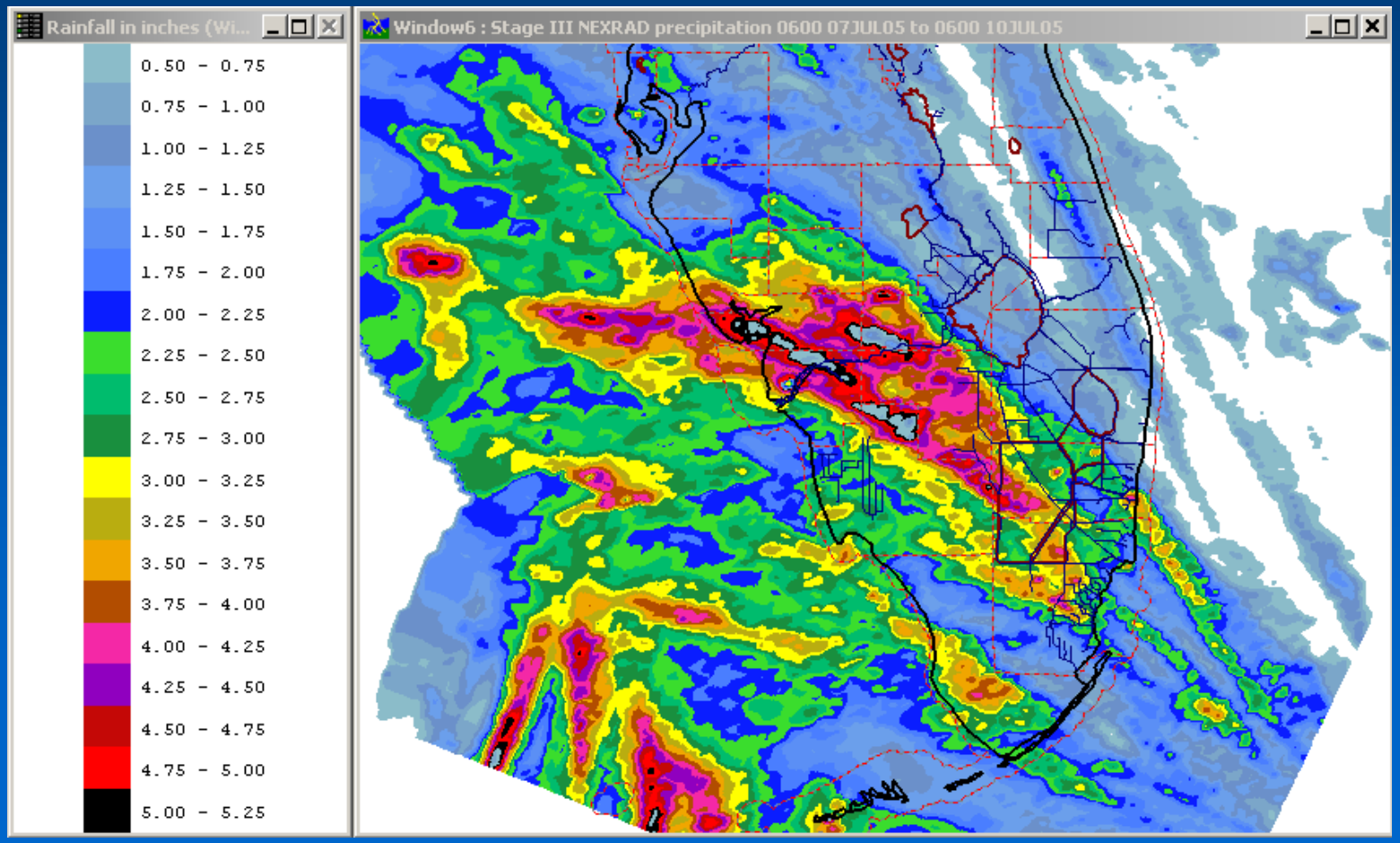
Lake Okeechobee Water Levels for Various Historical Years





Hurricane Dennis

9 July 2005



Looking north toward Stuart Inlet. Plume of discharge is impressive and alarming.

Questions?

http://fcit.usf.edu/florida/photos/envirmnt/sunset/sunset02.htm

RiverGages.com

The Mississippi Valley Division Water Control Website

2005 Tri-Services Infrastructure Conference
Rich Engstrom P.E.
Rock Island District
Mississippi Valley Division
U.S. Army Corps of Engineers
richard.t.engstrom@usace.army.mil

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U.S. Army Corps of Engineers

RiverGages.com

- Began Development in 2002
- Started with a clean slate
- Evolved into a unique web site
- Ten reasons why RiverGages is like no other Water Control web site in the Corps

US Army Corps of Engineers®

U.S. Army Corps of Engineers

Reason #1: RiverGages provides water level information for all six Water Control Centers in MVD.

- Same look and feel
- Similar data
- Navigate across district boundaries
- Provides the “big picture” of the Mississippi Valley

USAED-St Paul Water Control Center Public Web Server - Microsoft Internet Explorer

File Edit View Favorites Tools Help

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Address http://www.mvp-wc.usace.army.mil/ Go Links

US Army Corps of Engineers, St Paul District
Water Control Center

Real Time Data
MBMS Modeling
NWS Products
Agency Links
Flood Information
River Ice Network
Anonymous FTP
Resources
Mailing Lists
Water Quality
Staff Services
Intranet

Locks & Dams
Reservoirs
Bulletins

Send Mail

Privacy and Security Notice & Disclaimer
Webmaster-POC: Richard Pomeleau, P.E.

Search here

Local intranet

Start Conne... Launc... Inbox ... mvrsu... RiverG... Micros... USAE... 8:58 AM

http://water.mvr.usace.army.mil/index_1.html - Microsoft Internet Explorer

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US ARMY CORPS OF ENGINEERS
ROCK ISLAND DISTRICT

WATER MANAGEMENT CENTER

- Current Water Levels
- Precipitation Tables
- Water Level Archives
- Reservoir Forecasts
- National Weather Service Information
- Related Web Sites
- Comments

NWS forecasts (Dubuque - Keokuk) NWS forecasts (Canton - Chester)

Click Map for Current, Historical, and Forecast data

| Purpose | Privacy and Security Notice | Disclaimers

Local intranet

Start Connect... Launchb... Inbox - ... mvrsuni... RiverGag... Microsoft... http://... 7:12 AM

St. Louis District - Water Control - Microsoft Internet Explorer

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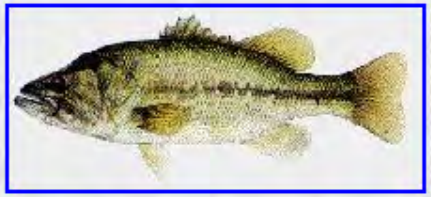
US Army Corps of Engineers

ST. LOUIS DISTRICT

Water Control

Water Management information available on this server includes:



Fish Spawn Information

Environmental Pool Management

- River and Reservoir Reports - Corps of Engineers 6:00 A.M. Daily Readings, National Weather Service 3-Day River Forecasts
- River Gage Data, Current Conditions - Plots, Tables, Descriptions
- Lock & Dam Gate Report - Table of L&D Gate Settings, Pool, and Tailwater Levels
- Gage Preciptation - 6 Hour Incremental Precipitation Table With Color Code
- Gage Preciptation Totals - 6, 12, 24, 36, & 72 Hour Cumulative Precipitation Table With Color Code
- Historic Records - Period of Record Levels and Discharges of the Mississippi River and Tributaries in the St. Louis District
- Weather Information - Various Weather Web Sites
- Water Control Management District Boundaries - District Map With Detailed Gage Locations

Done Local intranet

Start Connecte... Launchba... Inbox - M... mvrsunim... RiverGag... Microsoft... St. Louis... 7:13 AM

Water Control Home Page - Microsoft Internet Explorer

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Address http://www.mvm.usace.army.mil/hydraulics/ Go Links

Welcome to the US Army Corps of Engineers

Memphis District Water Control Home Page

Internet
Home
Current River Stages
Radar
St. Louis Water Control
NWS Products
Historic Gage Readings
Pointers
Gage Information
Project Reports

- Current Gage Readings
- Historic Gage Readings
- Gage Related Information, SHEF Messages and Hydrographs
- Radar
- River Forecast
- Project Reports
- St. Louis Water Control
- Mississippi Valley Division Water Control
- Search
- NWS Products
- Pointers to Other Web Servers
- About these Web Pages

POC for this page:
Water Data Information email:
WDataInfo@mvm02.usace.army.mil
CEMVM-ED-H, (901) 544-3391

The POC for this website:

Webmaster
Memphis, TN

This page last updated: 07/14/05 ***DISCLAIMER***: Historic Data and Reports are generally the information published annually in the *"Stages and Discharges of the Mississippi River and Tributaries in the Memphis District"* pamphlet. The data is for general information purposes ONLY and SHALL NOT be used in technical applications such as, but not limited to, studies or designs. All critical data should be obtained from and verified by the United States Army Corps of Engineers, Memphis District, Engineering Division, Hydrology and Hydraulics Branch, Water Analysis and Management Section, 167 North Main Street, Memphis, TN 38103. The United States of America assumes no liability for the completeness or accuracy of the data contained herein and any use of such data inconsistent with this disclaimer shall be solely at the risk of the user.

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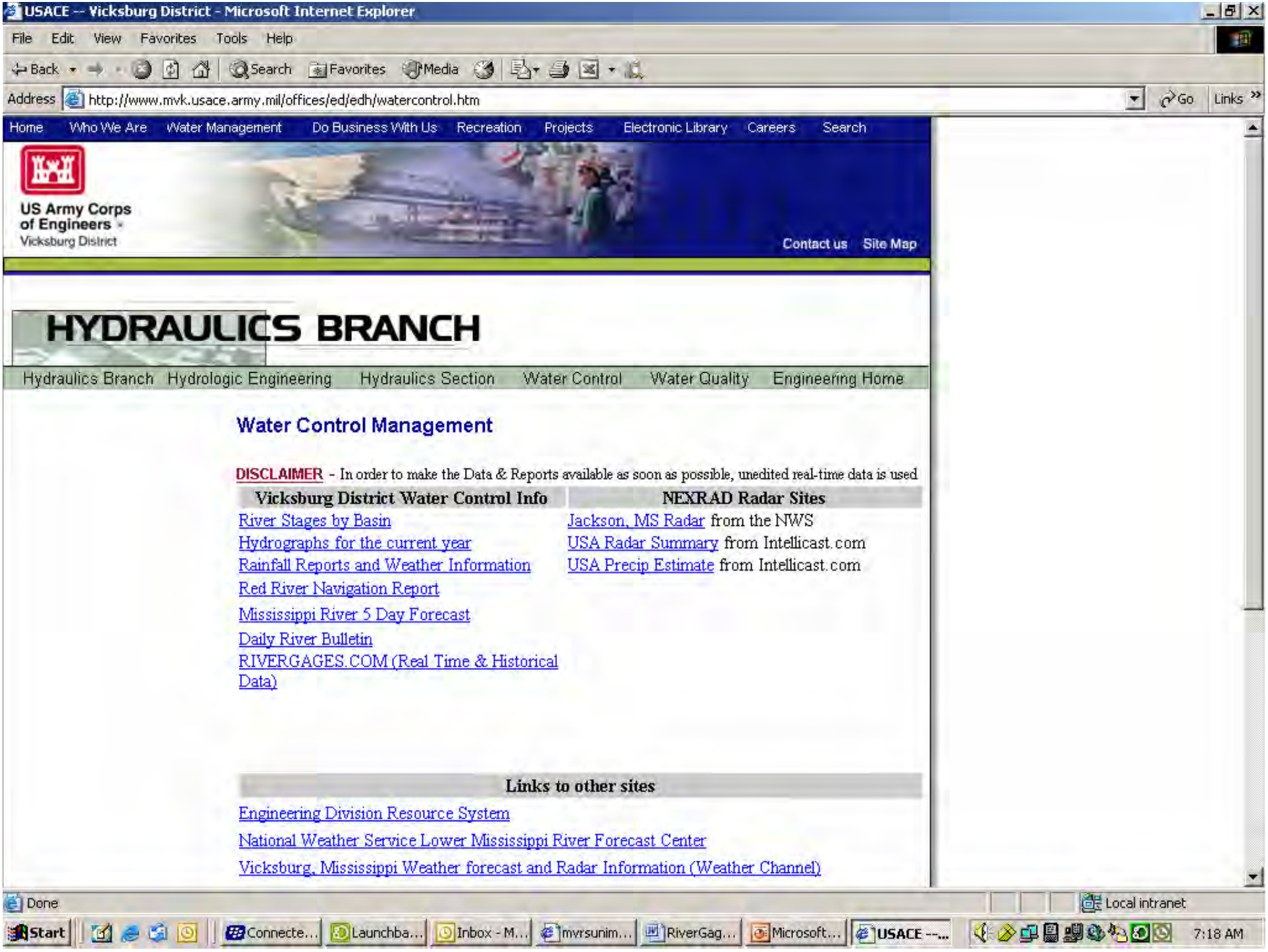
USACE -- Vicksburg District - Microsoft Internet Explorer
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Address http://www.mvk.usace.army.mil/offices/ed/edh/watercontrol.htm
Go Links
Home Who We Are Water Management Do Business With Us Recreation Projects Electronic Library Careers Search
US Army Corps of Engineers
Vicksburg District
Contact us Site Map
HYDRAULICS BRANCH
Hydraulics Branch Hydrologic Engineering Hydraulics Section Water Control Water Quality Engineering Home
Water Control Management
DISCLAIMER - In order to make the Data & Reports available as soon as possible, unedited real-time data is used
Vicksburg District Water Control Info
River Stages by Basin
Hydrographs for the current year
Rainfall Reports and Weather Information
Red River Navigation Report
Mississippi River 5 Day Forecast
Daily River Bulletin
RIVERGAGES.COM (Real Time & Historical Data)
NEXRAD Radar Sites
Jackson, MS Radar from the NWS
USA Radar Summary from Intellicast.com
USA Precip Estimate from Intellicast.com
Links to other sites
Engineering Division Resource System
National Weather Service Lower Mississippi River Forecast Center
Vicksburg, Mississippi Weather forecast and Radar Information (Weather Channel)
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RiverGag...
Microsoft...
USACE --...
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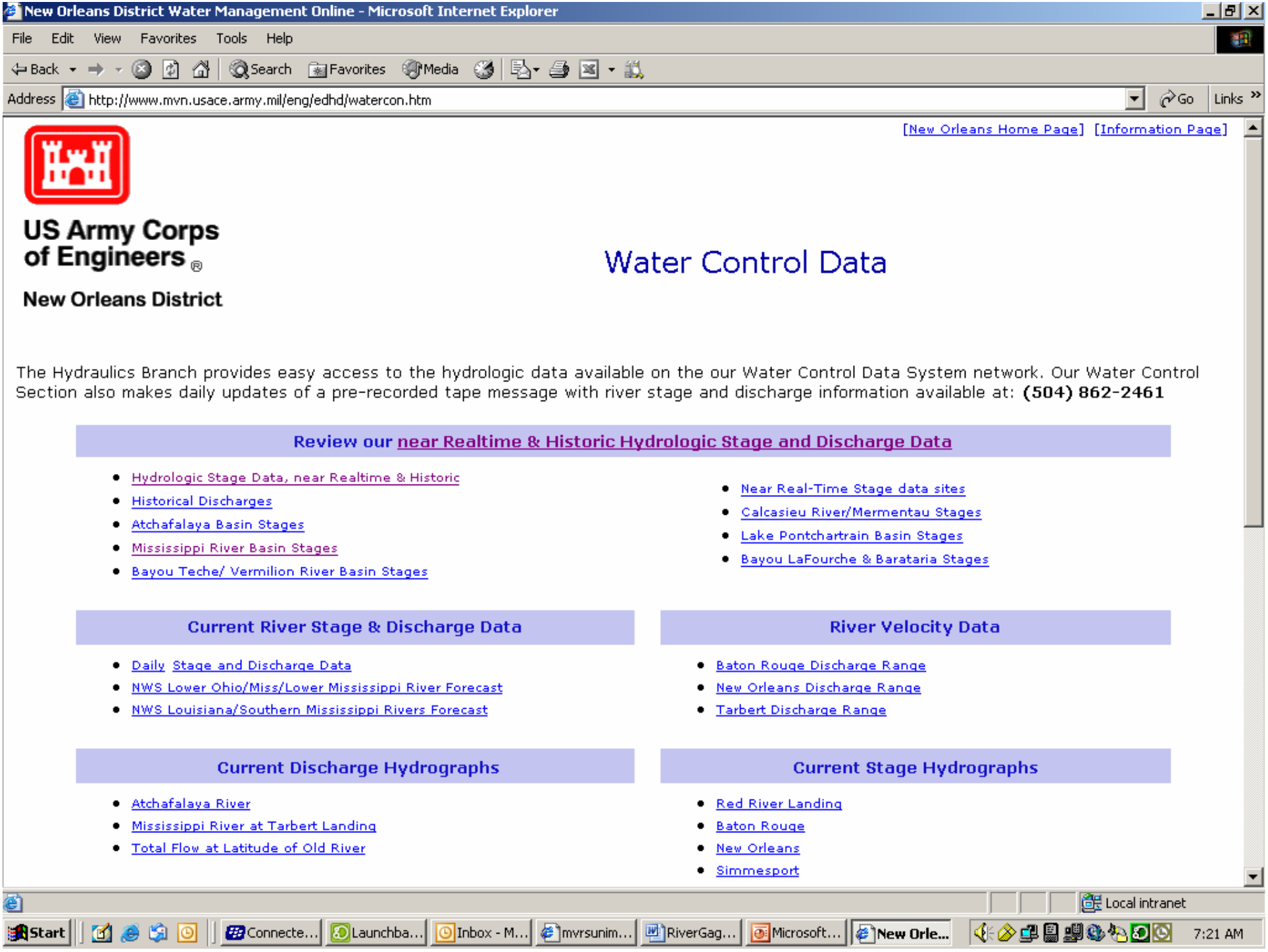
New Orleans District Water Management Online - Microsoft Internet Explorer
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Address http://www.mvn.usace.army.mil/eng/edhd/watercon.htm
Go Links
[New Orleans Home Page] [Information Page]
US Army Corps of Engineers ®
New Orleans District
Water Control Data
The Hydraulics Branch provides easy access to the hydrologic data available on the our Water Control Data System network. Our Water Control Section also makes daily updates of a pre-recorded tape message with river stage and discharge information available at: (504) 862-2461
Review our near Realtime & Historic Hydrologic Stage and Discharge Data
Hydrologic Stage Data, near Realtime & Historic
Historical Discharges
Atchafalaya Basin Stages
Mississippi River Basin Stages
Bayou Teche/ Vermilion River Basin Stages
Near Real-Time Stage data sites
Calcasieu River/Mermentau Stages
Lake Pontchartrain Basin Stages
Bayou LaFourche & Barataria Stages
Current River Stage & Discharge Data
Daily Stage and Discharge Data
NWS Lower Ohio/Miss/Lower Mississippi River Forecast
NWS Louisiana/Southern Mississippi Rivers Forecast
River Velocity Data
Baton Rouge Discharge Range
New Orleans Discharge Range
Tarbert Discharge Range
Current Discharge Hydrographs
Atchafalaya River
Mississippi River at Tarbert Landing
Total Flow at Latitude of Old River
Current Stage Hydrographs
Red River Landing
Baton Rouge
New Orleans
Simmesport
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mvrsunim...
RiverGag...
Microsoft...
New Orle...
7:21 AM

Rivergages.com: Providing River Gage Data for the Rivers, Streams, and Tributaries Along the Mi - Microsoft Internet Explorer

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Address http://www2.mvr.usace.army.mil/WaterControl/new/layout.cfm Go Links

RIVERGAGES.COM

Water Levels of Rivers and Lakes Within the Mississippi Valley Division

US Army Corps of Engineers

Home Search This Site Related Websites Data Mining Glossary Reports Who We Are Contact Us

Water Levels By:

Choose An Option

National Weather Service Products

NOTICE: All data contained herein is preliminary in nature and therefore subject to change. The data is for general information purposes ONLY and SHALL NOT be used in technical applications such as, but not limited to, studies or designs. All critical data should be obtained from and verified by the United States Army Corps of Engineers. The United States Government assumes no liability for the completeness or accuracy of the data contained herein and any use of such data inconsistent with this disclaimer shall be solely at the risk of the user.

Done Local intranet

Start Connec... Launch... Inbox -... mvrsun... RiverG... Microso... Riverg... 7:26 AM

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U.S. Army Corps of Engineers

Reason #2: RiverGages designed by a Configuration Control Board.

- One member from each district and division
- Comprised of Water Control personnel
- Designed through consensus by emphasizing our similarities; not our differences
- Grassroots design; NOT a top down design

US Army Corps of Engineers®

U.S. Army Corps of Engineers

Reason #3: RiverGages.com has a simple URL name.

- Inspired by GoARMY.com
- Purchased URL name for $33/yr
- Easy to remember
- Easy to give out over the phone to customers
- Previous WC URLs were very cryptic

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Cryptic WC URLs

Previous URLs used by MVD Water Control Web Sites

- **St. Paul → www.mvp-wc.usace.army.mil**
- **Rock Island → water.mvr.usace.army.mil**
- **St. Louis → mvs-wc.mvs.usace.army.mil**
- **Memphis → www.mvm.usace.army.mil/hydraulics**
- **Vicksburg → www.mvk.usace.army.mil/offices/ed /edh/watercontrol.htm**
- **New Orleans → www.mvn.usace.army.mil/eng/edhd /watercon.htm**

US Army Corps of Engineers®

U.S. Army Corps of Engineers

Reason #4: RiverGages provides "real time" information.

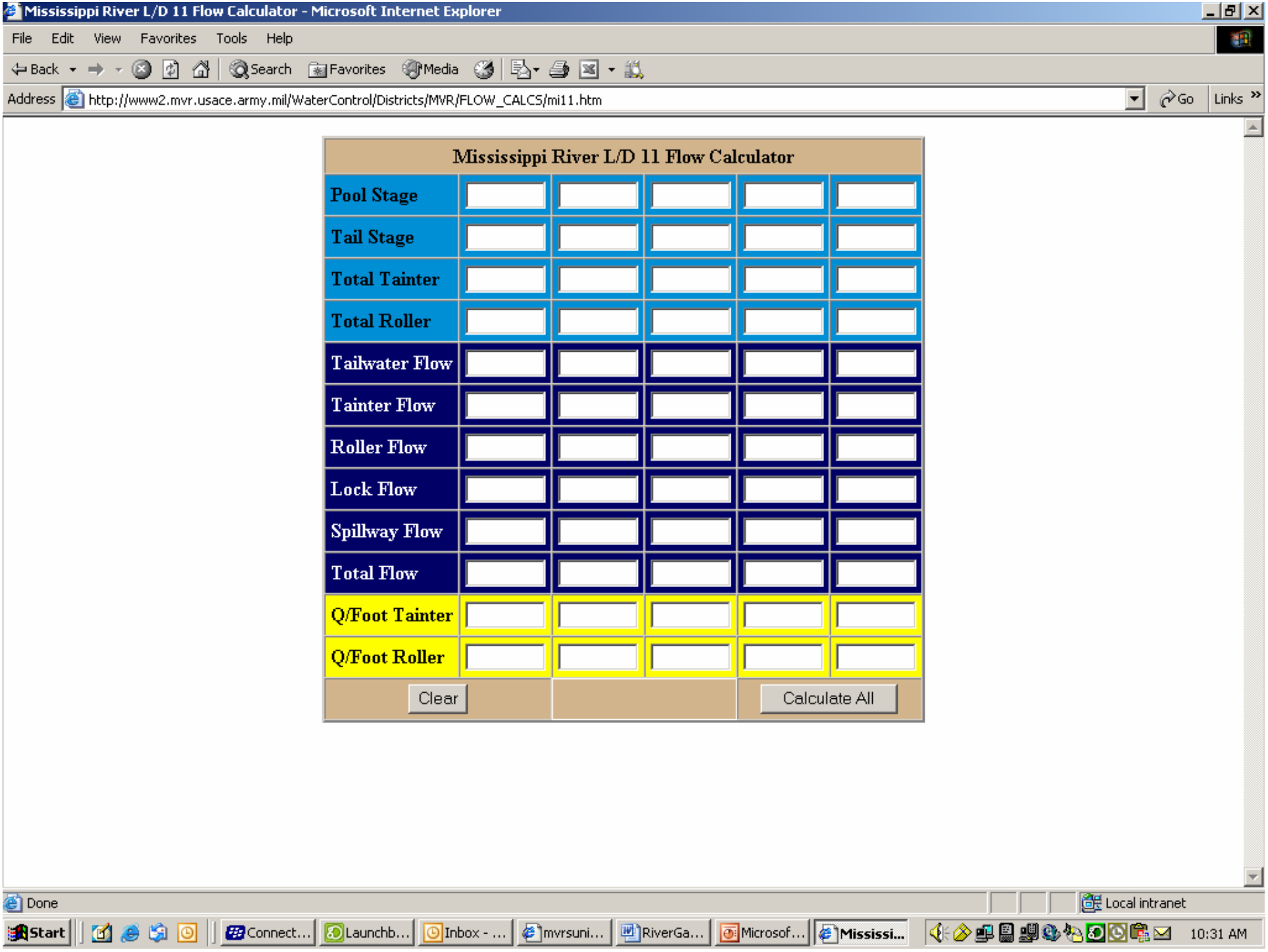
- Database queried for each click of the mouse
- DCP Data posted to database within minutes of a DCP transmission
- Ensures timeliness

US Army Corps of Engineers®

U.S. Army Corps of Engineers

Reason #5: RiverGages realizes one size doesn't fit all and provides the capability to insert "Value Added" content.

- Customize "Station Information" pages with district specific content
- Allows each district to present unique information to their customers
- Allows each district to use RiverGages as an "Electronic Filing Cabinet" for WC information


Mississippi River L/D 11 Flow Calculator - Microsoft Internet Explorer
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Address http://www2.mvr.usace.army.mil/WaterControl/Districts/MVR/FLOW_CALCS/mi11.htm
Go Links
Mississippi River L/D 11 Flow Calculator
Pool Stage
Tail Stage
Total Tainter
Total Roller
Tailwater Flow
Tainter Flow
Roller Flow
Lock Flow
Spillway Flow
Total Flow
Q/Foot Tainter
Q/Foot Roller
Clear
Calculate All
Done
Local intranet
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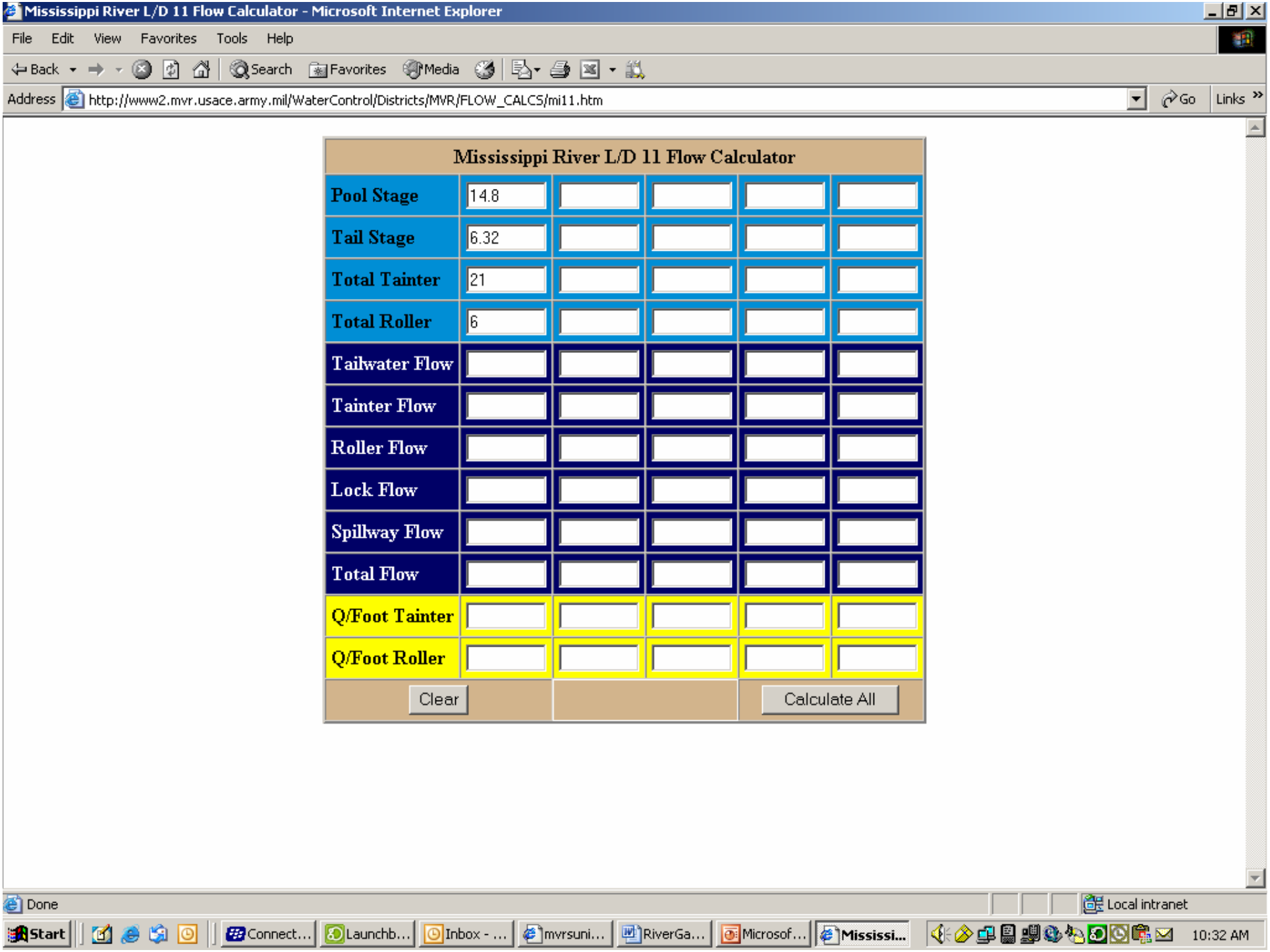
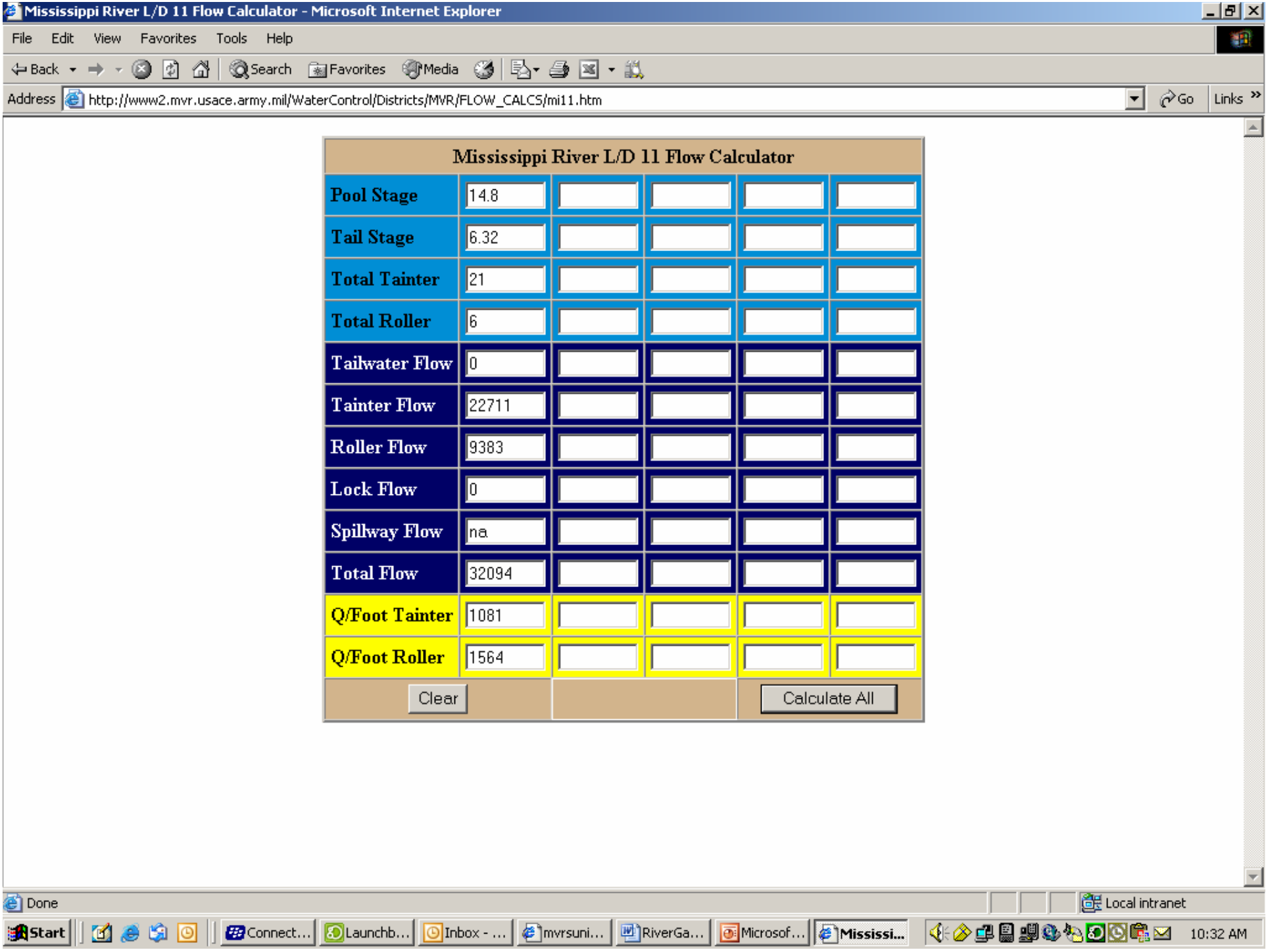
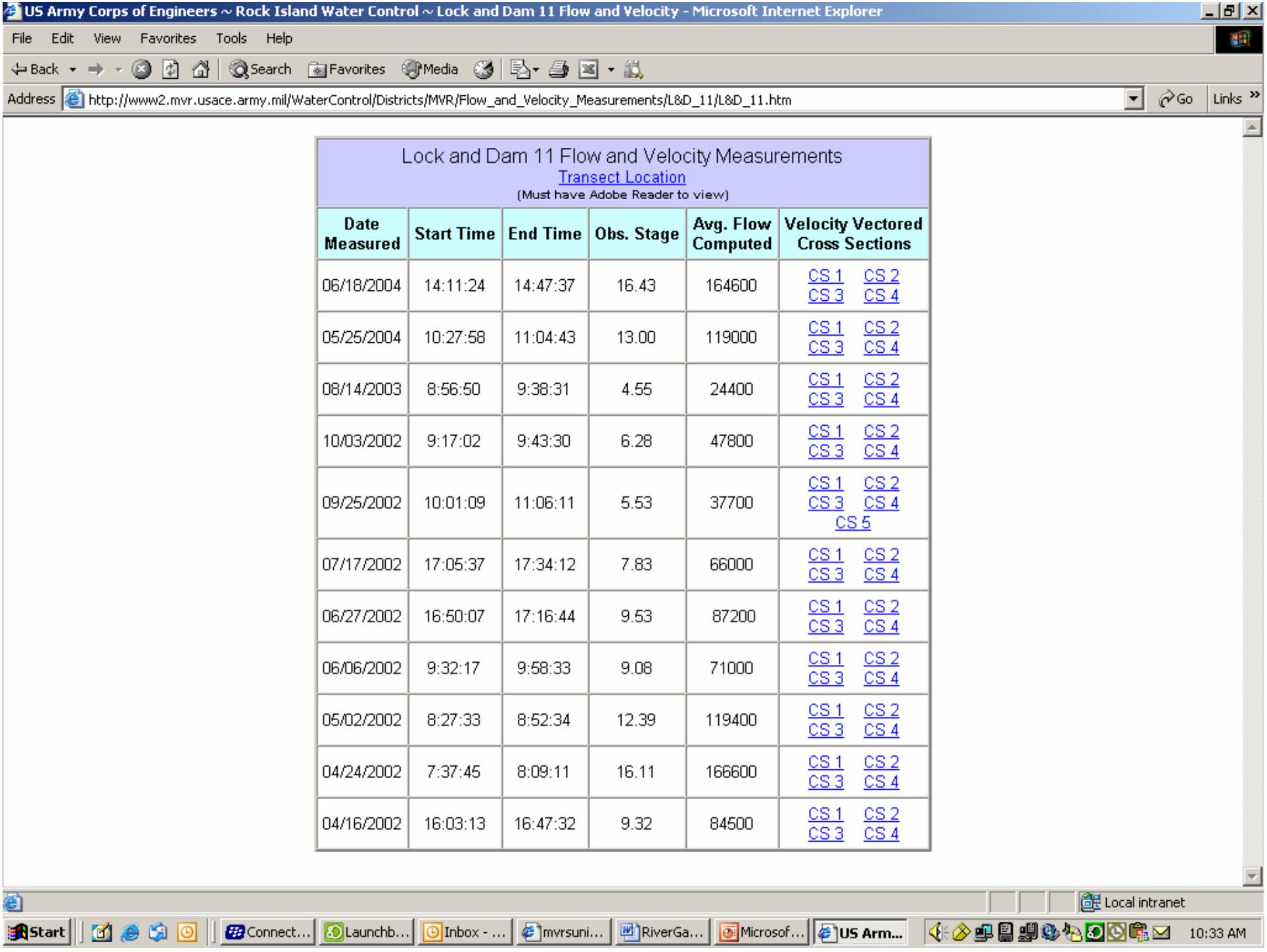
Mississi...
10:31 AM


Mississippi River L/D 11 Flow Calculator - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://www2.mvr.usace.army.mil/WaterControl/Districts/MVR/FLOW_CALCS/mi11.htm
Go Links
Mississippi River L/D 11 Flow Calculator
Pool Stage 14.8
Tail Stage 6.32
Total Tainter 21
Total Roller 6
Tailwater Flow
Tainter Flow
Roller Flow
Lock Flow
Spillway Flow
Total Flow
Q/Foot Tainter
Q/Foot Roller
Clear
Calculate All
Done
Local intranet
Start
Connect...
Launchb...
Inbox - ...
mvrsuni...
RiverGa...
Microsof...
Mississi...
10:32 AM


Mississippi River L/D 11 Flow Calculator - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://www2.mvr.usace.army.mil/WaterControl/Districts/MVR/FLOW_CALCS/mi11.htm
Go Links
Mississippi River L/D 11 Flow Calculator
Pool Stage 14.8
Tail Stage 6.32
Total Tainter 21
Total Roller 6
Tailwater Flow 0
Tainter Flow 22711
Roller Flow 9383
Lock Flow 0
Spillway Flow na
Total Flow 32094
Q/Foot Tainter 1081
Q/Foot Roller 1564
Clear
Calculate All
Done
Local intranet
Start
Connect...
Launchb...
Inbox - ...
mvrsuni...
RiverGa...
Microsof...
Mississi...
10:32 AM



Lock and Dam 11 Flow and Velocity Measurements

Transect Location

(Must have Adobe Reader to view)

Date Measured	Start Time	End Time	Obs. Stage	Avg. Flow Computed	Velocity Vectored Cross Sections
06/18/2004	14:11:24	14:47:37	16.43	164600	CS 1 CS 2 CS 3 CS 4
05/25/2004	10:27:58	11:04:43	13.00	119000	CS 1 CS 2 CS 3 CS 4
08/14/2003	8:56:50	9:38:31	4.55	24400	CS 1 CS 2 CS 3 CS 4
10/03/2002	9:17:02	9:43:30	6.28	47800	CS 1 CS 2 CS 3 CS 4
09/25/2002	10:01:09	11:06:11	5.53	37700	CS 1 CS 2 CS 3 CS 4 CS 5
07/17/2002	17:05:37	17:34:12	7.83	66000	CS 1 CS 2 CS 3 CS 4
06/27/2002	16:50:07	17:16:44	9.53	87200	CS 1 CS 2 CS 3 CS 4
06/06/2002	9:32:17	9:58:33	9.08	71000	CS 1 CS 2 CS 3 CS 4
05/02/2002	8:27:33	8:52:34	12.39	119400	CS 1 CS 2 CS 3 CS 4
04/24/2002	7:37:45	8:09:11	16.11	166600	CS 1 CS 2 CS 3 CS 4
04/16/2002	16:03:13	16:47:32	9.32	84500	CS 1 CS 2 CS 3 CS 4

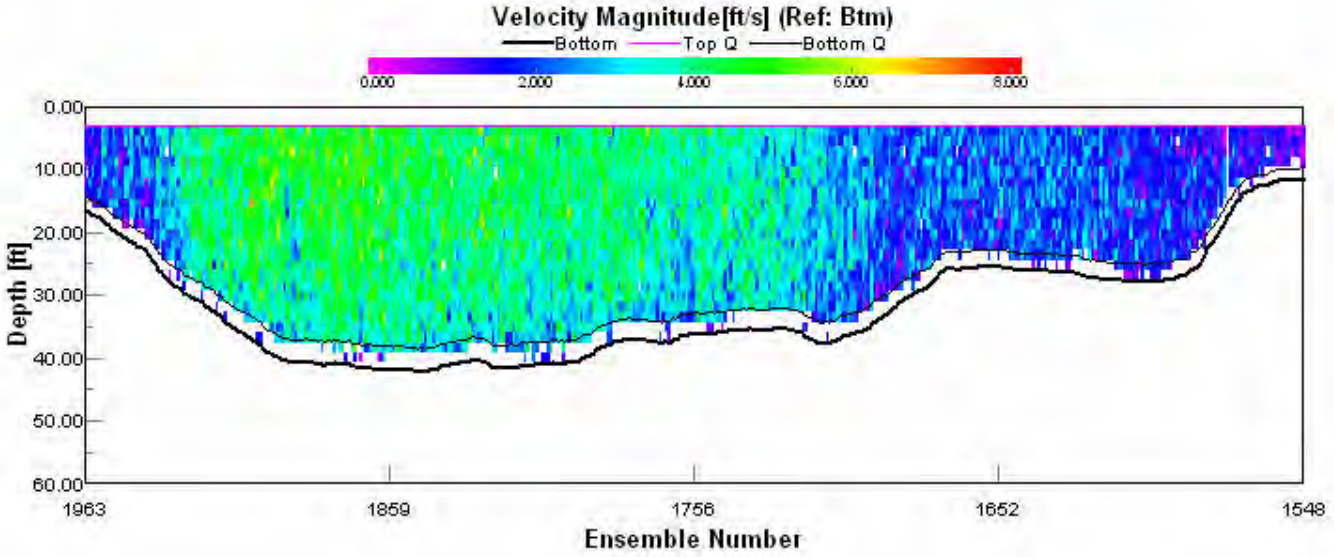
L&D 11 Velocity 06/18/04-4 - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites Media

Address http://www2.mvr.usace.army.mil/WaterControl/Districts/MVR/Flow_and_Velocity_Measurements/L&D_11/L&D11_Velocity061804-4.htm

Go Links



Return to L&D 11

Done

Local intranet

Start Connect... Launchb... Inbox - ... mvrsuni... RiverGa... Microsof... L&D 11 ... 10:34 AM

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Reason #6: RiverGages has its own data acquisition system.

- Does NOT rely on Districts to send it data
- Uses RiverGages-WIBS (Wallops Island Backup System) to collect DCP data
- Uses DECODES-HUB to decode DCP data "On the Fly"

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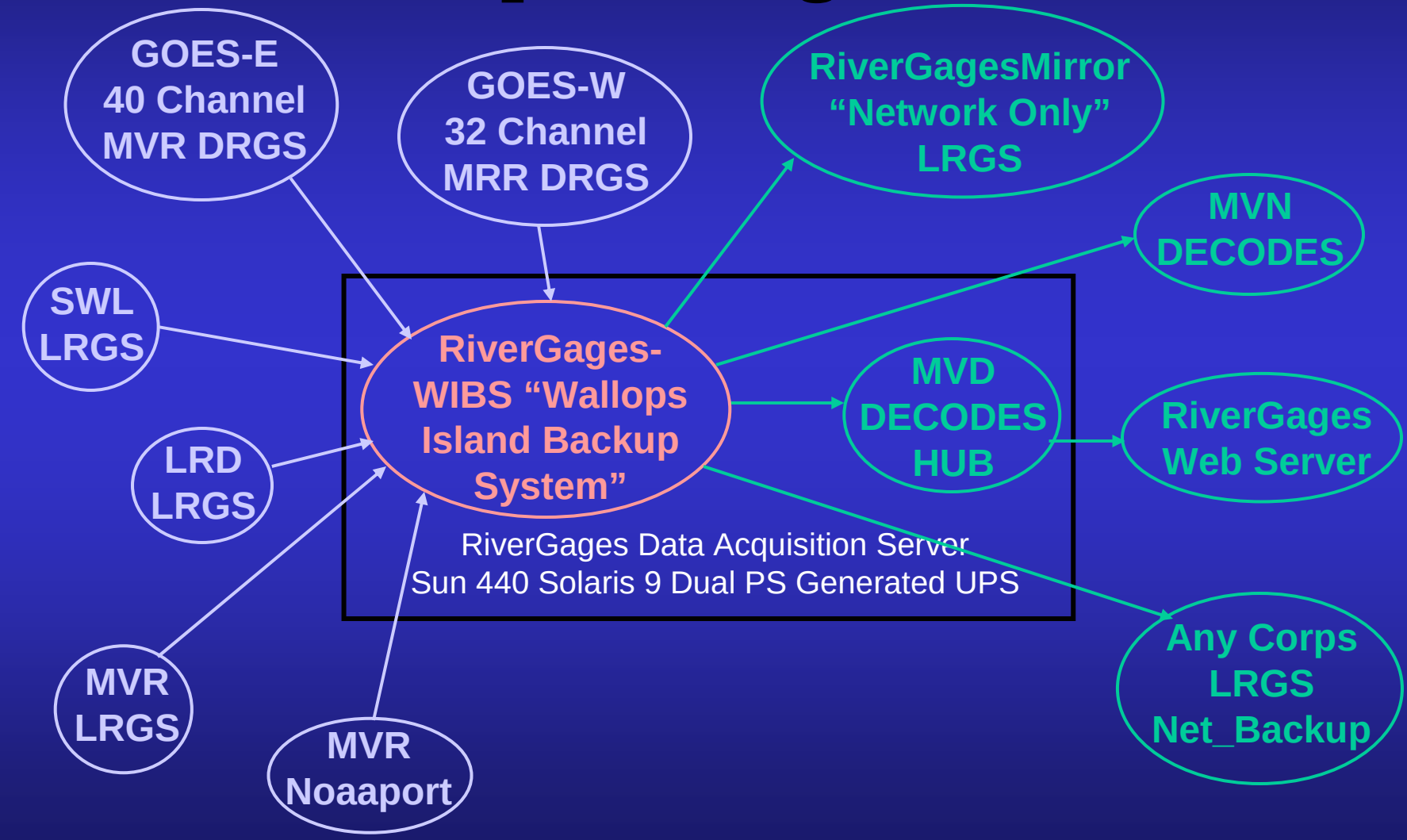

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Reason #7: RiverGages is a functional COOP for Water Control operations

- Since RiverGages has its own data acquisition system, it is not dependant on any office being operational.
- Since RiverGages contains "Value Added" information it can be used to regulate projects.
- Recently "tested" by MVK.

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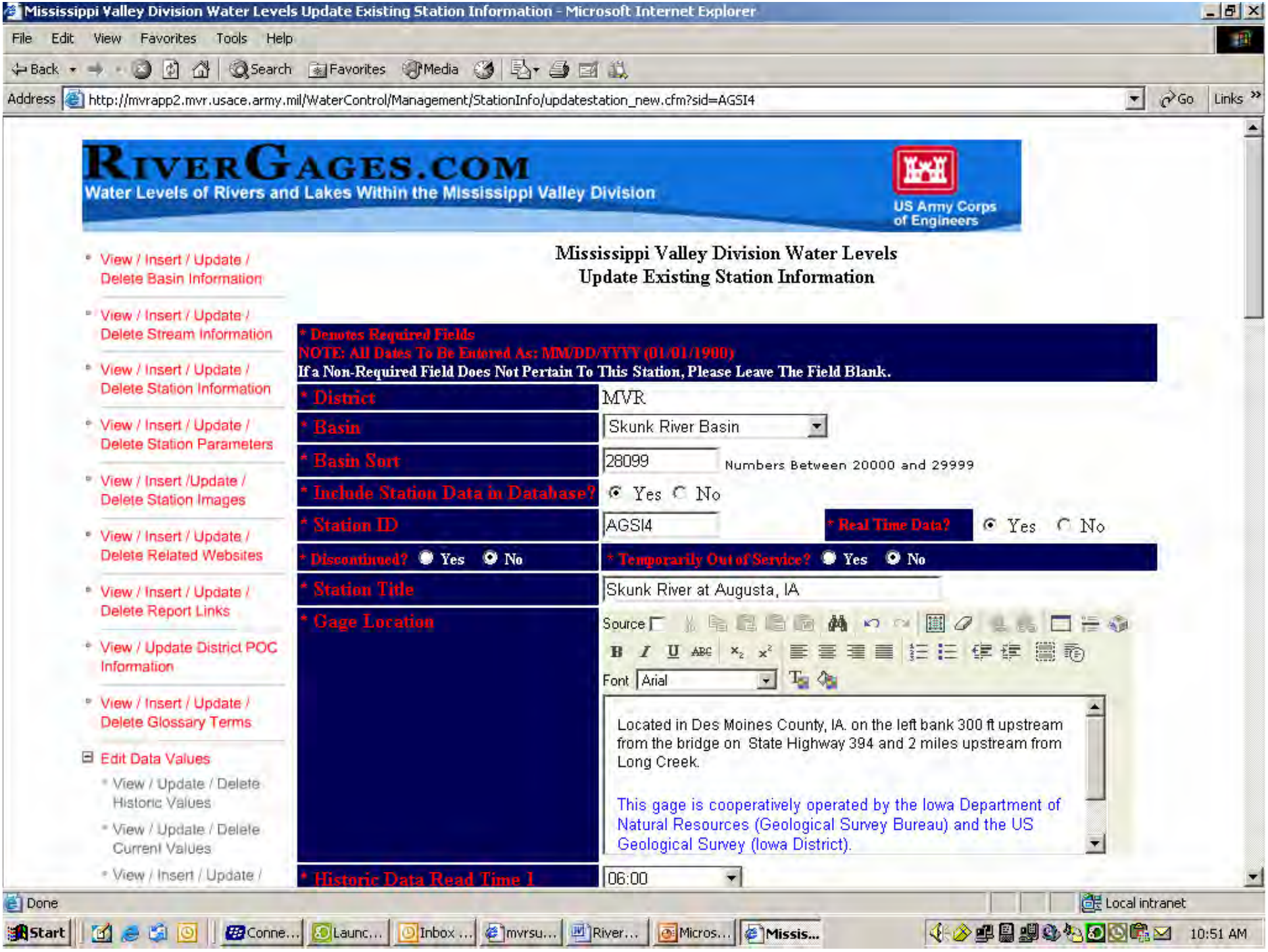
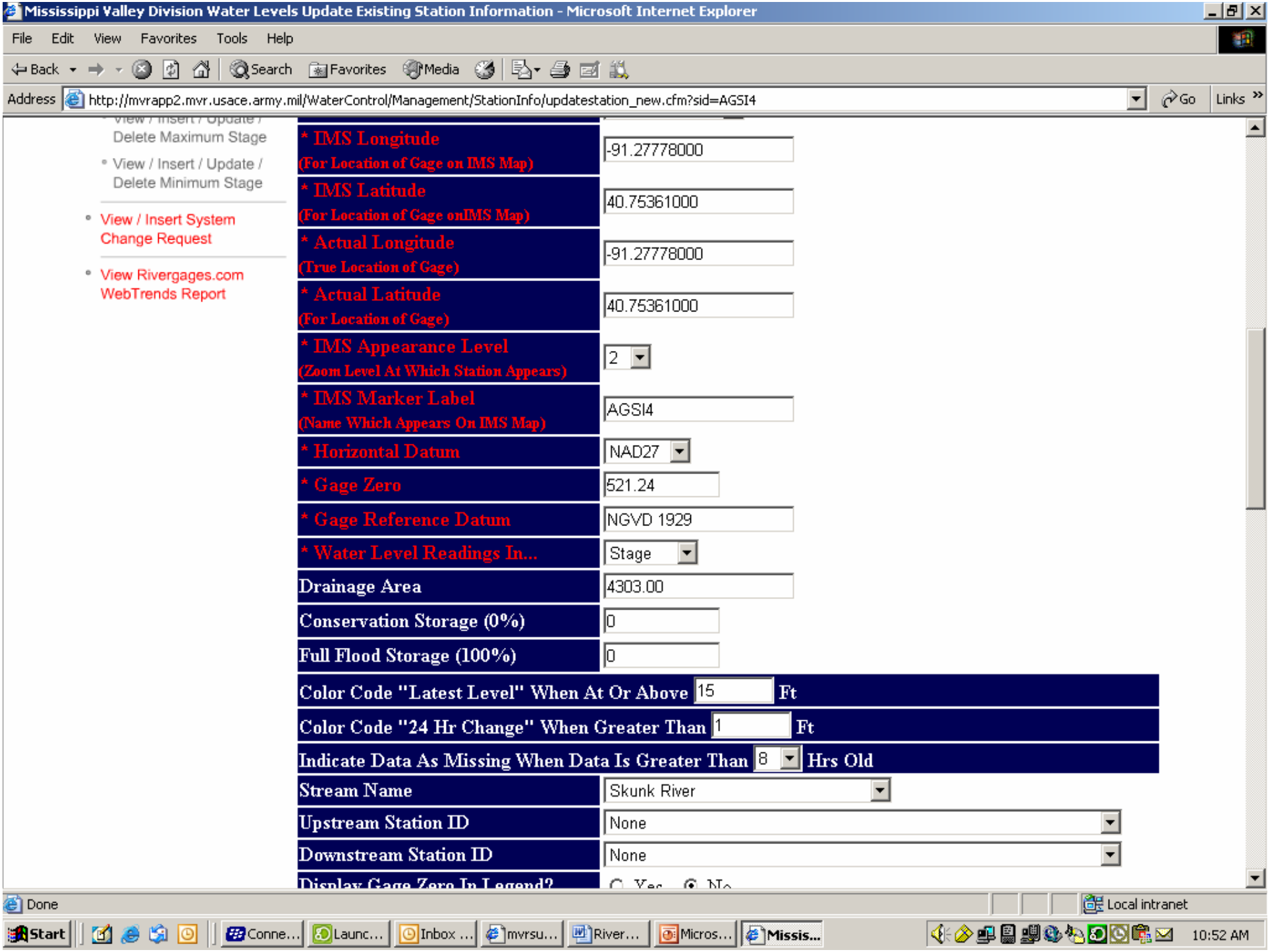
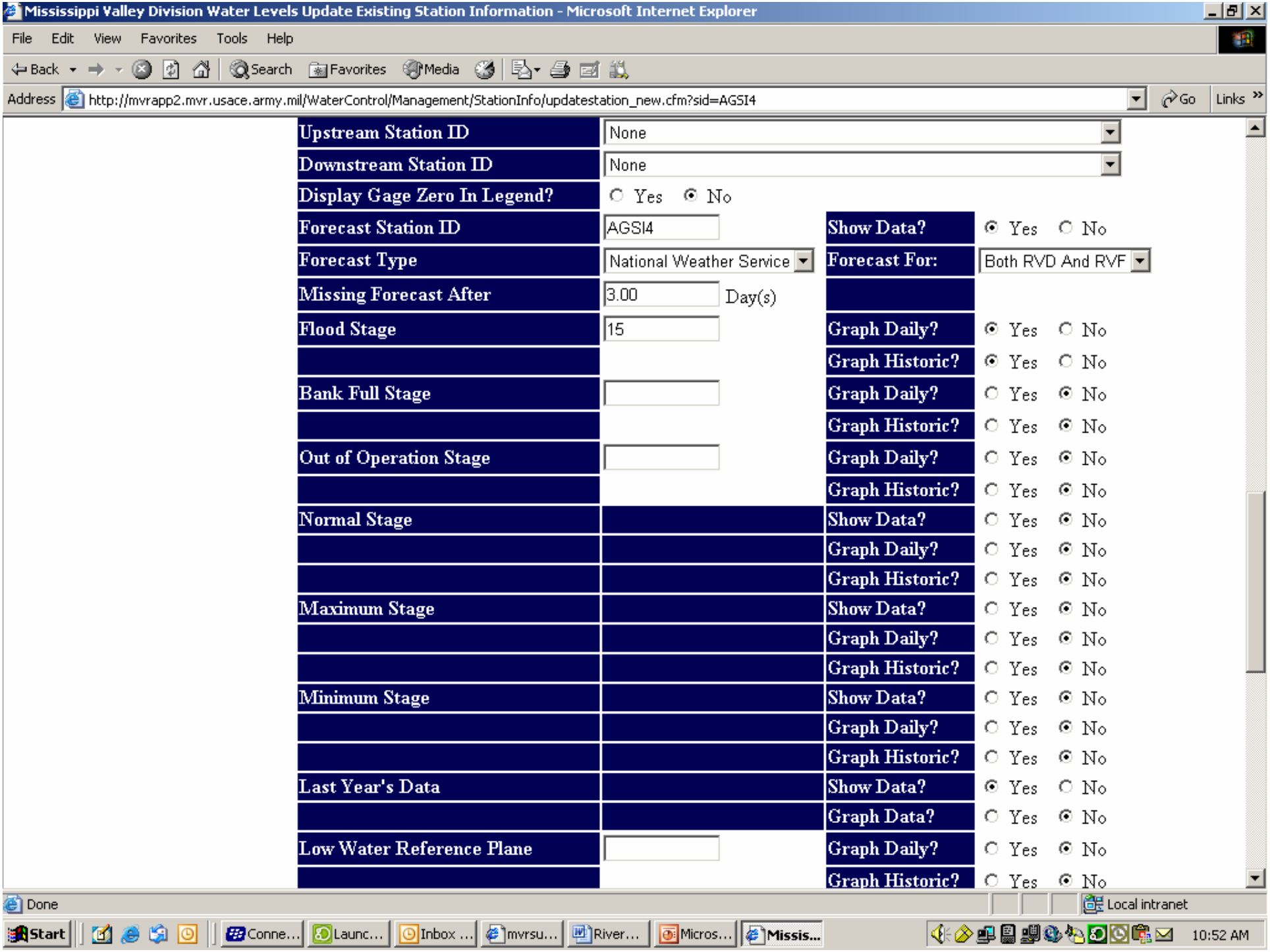
Reason #8: RiverGages content is managed via a simple web-based management tool

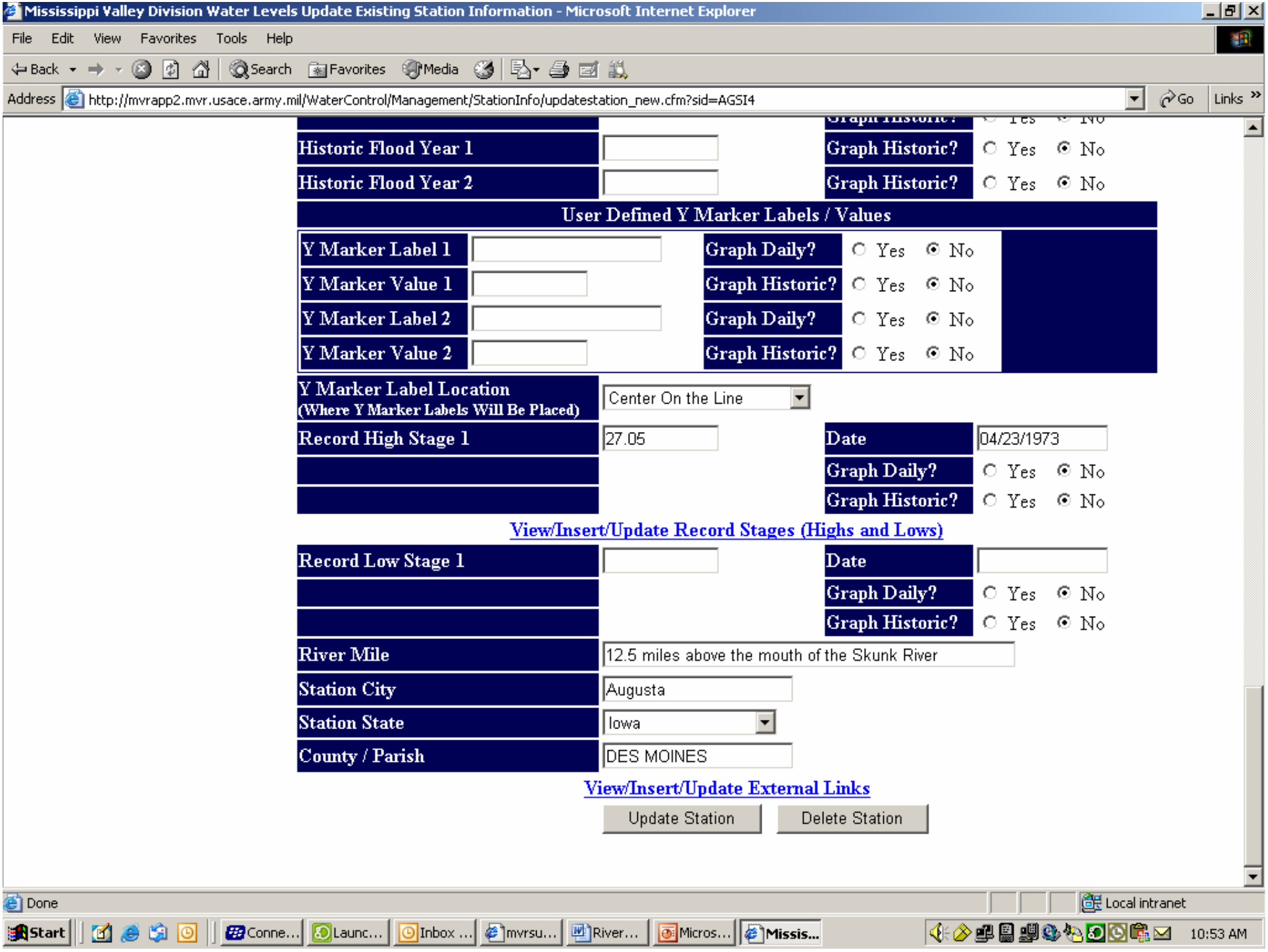
- Easy to use
- Each district manages its own content
- No longer need a “Computer Guru” to manage a web site.

Mississippi Valley Division Water Levels Station Information - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://mvrapp2.mvr.usace.army.mil/WaterControl/Management/StationInfo/viewstation_new.cfm?
Go Links
RIVERGAGES.COM
Water Levels of Rivers and Lakes Within the Mississippi Valley Division
US Army Corps of Engineers
View / Insert / Update / Delete Basin Information
View / Insert / Update / Delete Stream Information
View / Insert / Update / Delete Station Information
View / Insert / Update / Delete Station Parameters
View / Insert /Update / Delete Station Images
View / Insert / Update / Delete Related Websites
View / Insert / Update / Delete Report Links
View / Update District POC Information
View / Insert / Update / Delete Glossary Terms
Edit Data Values
View / Update / Delete Historic Values
View / Update / Delete Current Values
View / Insert / Update /
Mississippi Valley Division Water Levels
Station Information
Insert New Station
Update Y-Markers
Station ID
Station Title
Gage Zero
Flood Stage
Record Stage
River Mile
AESI4
South Skunk River below Squaw Creek near Ames, IA
857.10
20
25.57
222.6 miles above the mouth of the Skunk River
AFTW3
Rock River at Afton, WI
742.36
9
13.05
173 miles above the mouth of the Rock River
AGNI4
East Fork Des Moines River near Algona, IA
1098.74
14
374.4 miles above the mouth of the Des Moines River
AGSI4
Skunk River at Augusta, IA
521.24
15
27.05
12.5 miles above the mouth of the Skunk River
AKWI4
South River near Ackworth, IA
769.97
26
32.85
14 miles above the mouth of the South River
ALGI2
Fox River at Algonquin, IL
729.48
3
4.5
81.6 miles above the mouth of the Fox River
ALOI4
Cedar River at
824.14
12
21.86
187.9 miles above
Done
Local intranet
Start
Conne...
Launc...
Inbox ...
mvrsu...
River...
Micros...
Missis...
10:51 AM


Mississippi Valley Division Water Levels Update Existing Station Information - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://mvrapp2.mvr.usace.army.mil/WaterControl/Management/StationInfo/updatestation_new.cfm?sid=AGSI4
Go Links
RIVERGAGES.COM
Water Levels of Rivers and Lakes Within the Mississippi Valley Division
US Army Corps of Engineers
View / Insert / Update / Delete Basin Information
View / Insert / Update / Delete Stream Information
View / Insert / Update / Delete Station Information
View / Insert / Update / Delete Station Parameters
View / Insert /Update / Delete Station Images
View / Insert / Update / Delete Related Websites
View / Insert / Update / Delete Report Links
View / Update District POC Information
View / Insert / Update / Delete Glossary Terms
Edit Data Values
View / Update / Delete Historic Values
View / Update / Delete Current Values
View / Insert / Update /
Mississippi Valley Division Water Levels
Update Existing Station Information
* Denotes Required Fields
NOTE: All Dates To Be Entered As: MM/DD/YYYY (01/01/1900)
If a Non-Required Field Does Not Pertain To This Station, Please Leave The Field Blank.
* District
MVR
* Basin
Skunk River Basin
* Basin Sort
28099
Numbers Between 20000 and 29999
* Include Station Data in Database?
Yes No
* Station ID
AGSI4
* Real Time Data?
Yes No
* Discontinued?
Yes No
* Temporarily Out of Service?
Yes No
* Station Title
Skunk River at Augusta, IA
* Gage Location
Source
Font Arial
Located in Des Moines County, IA. on the left bank 300 ft upstream from the bridge on State Highway 394 and 2 miles upstream from Long Creek.
This gage is cooperatively operated by the Iowa Department of Natural Resources (Geological Survey Bureau) and the US Geological Survey (Iowa District).
* Historic Data Read Time 1
06:00
Done
Local intranet
Start
Conne...
Launc...
Inbox ...
mvrsu...
River...
Micros...
Missis...
10:51 AM


Mississippi Valley Division Water Levels Update Existing Station Information - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://mvrapp2.mvr.usace.army.mil/WaterControl/Management/StationInfo/updatestation_new.cfm?sid=AGSI4
Go Links
View / Insert / Update / Delete Maximum Stage
View / Insert / Update / Delete Minimum Stage
View / Insert System Change Request
View Rivergages.com WebTrends Report
* IMS Longitude (For Location of Gage on IMS Map) -91.27778000
* IMS Latitude (For Location of Gage onIMS Map) 40.75361000
* Actual Longitude (True Location of Gage) -91.27778000
* Actual Latitude (For Location of Gage) 40.75361000
* IMS Appearance Level (Zoom Level At Which Station Appears) 2
* IMS Marker Label (Name Which Appears On IMS Map) AGSI4
* Horizontal Datum NAD27
* Gage Zero 521.24
* Gage Reference Datum NGVD 1929
* Water Level Readings In... Stage
Drainage Area 4303.00
Conservation Storage (0%) 0
Full Flood Storage (100%) 0
Color Code "Latest Level" When At Or Above 15 Ft
Color Code "24 Hr Change" When Greater Than 1 Ft
Indicate Data As Missing When Data Is Greater Than 8 Hrs Old
Stream Name Skunk River
Upstream Station ID None
Downstream Station ID None
Display Gage Zero In Legend? Yes No
Done
Local intranet
Start
Conne... Launc... Inbox ... mvrsu... River... Micros... Missis...
10:52 AM


Mississippi Valley Division Water Levels Update Existing Station Information - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://mvrapp2.mvr.usace.army.mil/WaterControl/Management/StationInfo/updatestation_new.cfm?sid=AGSI4
Go Links
Upstream Station ID None
Downstream Station ID None
Display Gage Zero In Legend? Yes No
Forecast Station ID AGSI4
Show Data? Yes No
Forecast Type National Weather Service
Forecast For: Both RVD And RVF
Missing Forecast After 3.00 Day(s)
Flood Stage 15
Graph Daily? Yes No
Graph Historic? Yes No
Bank Full Stage
Graph Daily? Yes No
Graph Historic? Yes No
Out of Operation Stage
Graph Daily? Yes No
Graph Historic? Yes No
Normal Stage
Show Data? Yes No
Graph Daily? Yes No
Graph Historic? Yes No
Maximum Stage
Show Data? Yes No
Graph Daily? Yes No
Graph Historic? Yes No
Minimum Stage
Show Data? Yes No
Graph Daily? Yes No
Graph Historic? Yes No
Last Year's Data
Show Data? Yes No
Graph Data? Yes No
Low Water Reference Plane
Graph Daily? Yes No
Graph Historic? Yes No
Done
Local intranet
Start
Conne...
Launc...
Inbox ...
mvrsu...
River...
Micros...
Missis...
10:52 AM


Mississippi Valley Division Water Levels Update Existing Station Information - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://mvrapp2.mvr.usace.army.mil/WaterControl/Management/StationInfo/updatestation_new.cfm?sid=AGSI4
Go Links
Historic Flood Year 1
Graph Historic? Yes No
Historic Flood Year 2
Graph Historic? Yes No
User Defined Y Marker Labels / Values
Y Marker Label 1
Graph Daily? Yes No
Y Marker Value 1
Graph Historic? Yes No
Y Marker Label 2
Graph Daily? Yes No
Y Marker Value 2
Graph Historic? Yes No
Y Marker Label Location
(Where Y Marker Labels Will Be Placed)
Center On the Line
Record High Stage 1
27.05
Date
04/23/1973
Graph Daily? Yes No
Graph Historic? Yes No
View/Insert/Update Record Stages (Highs and Lows)
Record Low Stage 1
Date
Graph Daily? Yes No
Graph Historic? Yes No
River Mile
12.5 miles above the mouth of the Skunk River
Station City
Augusta
Station State
Iowa
County / Parish
DES MOINES
View/Insert/Update External Links
Update Station
Delete Station
Done
Local intranet
Start
Conne...
Launc...
Inbox ...
mvrsu...
River...
Micros...
Missis...
10:53 AM

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Reason #9: RiverGages has a twin site: RiverGagesMirror.com

- RiverGagesMirror is totally independent of the RiverGages site
- RiverGages is hosted in Rock Island, IL
- RiverGagesMirror is hosted in Vicksburg, MS
- RiverGagesMirror is 95% complete, will be 100% operation by the end of FY

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Reason #10: RiverGages is now mobile with RiverGagesMobile.com (RGMob.com)

- Water level information anytime you are away from a computer
- Designed RGMob.com for any web-enabled device to access RiverGages information (i.e. cell phone, blackberry, pda, etc.)

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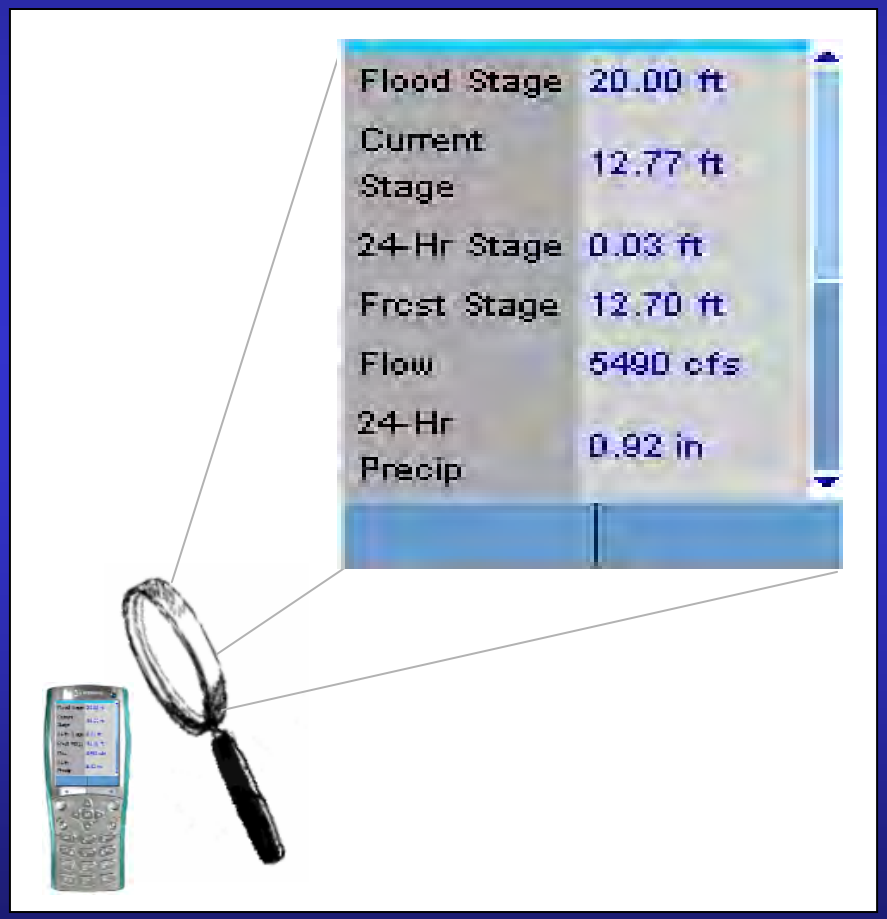

One Corps Serving the Armed Forces and the Nation

US Army Corps of Engineers®

U.S. Army Corps of Engineers

Thanks

- When you need water level information for the Mississippi River Valley just think RiverGages.com.

Now for a quick RiverGages tour…

Rivergages.com: Providing River Gage Data for the Rivers, Streams, and Tributaries Along the Mi - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites Media

Address http://www2.mvr.usace.army.mil/WaterControl/new/layout.cfm Go Links

RIVERGAGES.COM

Water Levels of Rivers and Lakes Within the Mississippi Valley Division

US Army Corps of Engineers

Home Search This Site Related Websites Data Mining Glossary Reports Who We Are Contact Us

Water Levels By:

Choose An Option

National Weather Service Products

NOTICE: All data contained herein is preliminary in nature and therefore subject to change. The data is for general information purposes ONLY and SHALL NOT be used in technical applications such as, but not limited to, studies or designs. All critical data should be obtained from and verified by the United States Army Corps of Engineers. The United States Government assumes no liability for the completeness or accuracy of the data contained herein and any use of such data inconsistent with this disclaimer shall be solely at the risk of the user.

Local intranet

Start Co... La... In... lo... Ex... Mi... xt... Ch... Ro... Mi... Ri... 10:09 AM

Rivergages.com: Providing River Gage Data for the Rivers, Streams, and Tributaries Along the Mi - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites Media

Address http://www2.mvr.usace.army.mil/WaterControl/new/layout.cfm Go Links

RIVERGAGES.COM

Water Levels of Rivers and Lakes Within the Mississippi Valley Division

US Army Corps of Engineers

Home Search This Site Related Websites Data Mining Glossary Reports Who We Are Contact Us

Water Levels By: Rock Island District

Rock Island District Basins Choose A Basin

National Weather Service Products

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Done Local intranet

Start 10:10 AM

Rivergages.com: Providing River Gage Data for the Rivers, Streams, and Tributaries Along the Mi - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites Media

Address http://www2.mvr.usace.army.mil/WaterControl/new/layout.cfm Go Links

RIVERGAGES.COM

Water Levels of Rivers and Lakes Within the Mississippi Valley Division

US Army Corps of Engineers

Home Search This Site Related Websites Data Mining Glossary Reports Who We Are Contact Us

Water Levels By: Rock Island District

Rock Island District Basins Des Moines River Basin

- Choose A Basin
- All 20 Basins Below
- Cedar River Basin
- Des Moines River Basin
- Des Plaines River Basin
- Fox River Basin
- Illinois River Basin
- Iowa River Basin
- Kankakee River Basin
- LaMoine River Basin
- Mackinaw River Basin

National Weather Service Products

NOTICE: All data contained herein is preliminary in nature and therefore subject to change. The data is for general information purposes ONLY and SHALL NOT be used in technical applications such as, but not limited to, studies or designs. All critical data should be obtained from and verified by the United States Army Corps of Engineers. The United States Government assumes no liability for the completeness or accuracy of the data contained herein and any use of such data inconsistent with this disclaimer shall be solely at the risk of the user.

Local intranet

Start Co... La... In... Io... Ex... Mi... xt... Ch... Ro... Mi... Ri... 10:11 AM

Rivergages.com: Providing River Gage Data for the Rivers, Streams, and Tributaries Along the Mi - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://www2.mvr.usace.army.mil/WaterControl/new/layout.cfm
Go Links
RIVERGAGES.COM
Water Levels of Rivers and Lakes Within the Mississippi Valley Division
US Army Corps of Engineers
Home Search This Site Related Websites Data Mining Glossary Reports Who We Are Contact Us
Water Levels By:
Rock Island District
Rock Island District Basins
Des Moines River Basin
National Weather Service Products
Des Moines River Basin
View Real-Time Stations In This Basin
View All Stations In This Basin
View All Values In Stage
View All Values In Elevation
STATION
* Currently Forecasted Station
FLOOD STAGE
LATEST LEVEL
24 Hr CHANGE
24 Hr PRECIP
West Fork Des Moines River near Windom, MN
as of 05/13/2005 09:00
17
15.63
+0.62
0.57
West Fork Des Moines River at Jackson, MN
as of 05/13/2005 09:00
12
8.18
+1.13
1.68
* West Fork Des Moines River near Estherville, IA
as of 05/13/2005 09:00
7
9.42
+2.56
0.64
* West Fork Des Moines River near Emmetsburg, IA
as of 05/13/2005 09:00
10
8.73
+1.43
0.17
Pilot Creek near Rolfe, IA
as of 05/13/2005 09:00
8.19
+1.80
0.25
* West Des Moines River at Humboldt, IA
as of 05/13/2005 09:00
8
7.80
+0.38
0.63
* East Fork Des Moines River near Algona, IA
as of 05/13/2005 09:00
14
16.59
+0.69
0.05
East Fork Des Moines River at Dakota City, IA
as of 05/13/2005 09:00
20
15.13
+0.68
0.39
Local intranet
Start
Discon...
Launc...
Inbox ...
login_...
Exceed
Micros...
LDM L...
River...
9:54 AM

Rivergages.com: Providing River Gage Data for the Rivers, Streams, and Tributaries Along the Mi - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://www2.mvr.usace.army.mil/WaterControl/new/layout.cfm
Go Links
* Des Moines River at Fort Dodge, IA as of 05/13/2005 09:00 | 10 | 8.29 | +0.76 |
Boone River near Goldfield, IA as of 05/13/2005 09:00 | | 17.46 | +0.78 | 0.66
* Boone River near Webster City, IA as of 05/13/2005 09:00 | 10 | 6.87 | +0.61 | 1.27
* Des Moines River near Stratford, IA as of 05/13/2005 09:00 | 14 | 14.65 | +1.00 | 0.52
Big Creek Lake near Polk City, IA as of 05/13/2005 09:00 | | 920.79 | +0.75 | 1.80
Big Creek Ponding Area near Polk City, IA as of 05/13/2005 09:00 | | 837.34 | +4.10 | 1.90
* Saylorville Reservoir as of 05/13/2005 09:00 | | 838.83 | +1.70 | 1.82
* Des Moines River downstream of Saylorville Reservoir as of 05/13/2005 09:00 | | 11.15 | +0.08 |
Beaver Creek near Woodward, IA as of 05/13/2005 09:00 | 19 | 18.23 | +4.89 | 1.62
* Beaver Creek near Grimes, IA as of 05/13/2005 09:00 | 12 | 9.28 | +3.37 | 2.29
* Des Moines River at 2nd Ave Des Moines, IA as of 05/13/2005 09:00 | 23 | 18.90 | +0.88 | 1.21
* Des Moines River at SE 6th St. Des Moines,IA as of 05/13/2005 09:00 | 24 | 24.49 | +3.95 | 1.97
Fourmile Creek at Des Moines, IA as of 05/13/2005 09:00 | 12 | 13.02 | +6.15 | 1.71
* North River near Norwalk, IA as of 05/13/2005 09:00 | 18 | 19.36 | +2.11 | 2.06
* Middle River near Indianola, IA as of 05/13/2005 09:00 | 19 | 21.79 | +11.27 | 2.03
South River near Ackworth, IA
Local intranet
Start Discon... Launc... Inbox ... login_... Exceed Micros... LDM L... River... 9:55 AM

Rivergages.com: Providing River Gage Data for the Rivers, Streams, and Tributaries Along the Mi - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://www2.mvr.usace.army.mil/WaterControl/new/layout.cfm
Go Links
Fourmile Creek at Des Moines, IA as of 05/13/2005 09:00 12 13.02 +6.15 1.71
* North River near Norwalk, IA as of 05/13/2005 09:00 18 19.36 +2.11 2.06
* Middle River near Indianola, IA as of 05/13/2005 09:00 19 21.79 +11.27 2.03
South River near Ackworth, IA as of 05/13/2005 09:00 26 16.89 +9.29 1.42
Des Moines River near Runnells, IA as of 05/13/2005 09:00 75 57.81 +3.44 1.75
White Breast Creek near Dallas, IA as of 05/13/2005 09:00 22 11.39 +4.89 0.79
* Lake Redrock as of 05/13/2005 09:00 744.03 +1.54
* Des Moines River downstream of Lake Redrock as of 05/13/2005 09:00 92.50 +0.82
English Creek near Knoxville, IA as of 05/13/2005 09:00 17 15.05 +4.71 0.81
Des Moines River near Tracy, IA as of 05/13/2005 09:00 14 8.82 +1.00 0.82
* Cedar Creek near Bussey, IA as of 05/13/2005 09:00 18 7.57 +2.03 0.66
Des Moines River near Eddyville, IA as of 05/13/2005 09:00 57.15 +1.39 0.83
* Des Moines River at Ottumwa, IA as of 05/13/2005 09:00 10 6.83 +1.29 0.58
* Des Moines River at Keosauqua, IA as of 05/13/2005 09:00 22 15.01 +2.11 0.12
* Des Moines River at St. Francisville, MO as of 05/13/2005 09:00 18 12.47 +2.50 1.18
Local intranet
Start
Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive...
9:56 AM

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Address http://www2.mvr.usace.army.mil/WaterControl/new/layout.cfm
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East Fork Des Moines River at Dakota City, IA as of 05/13/2005 09:00 20 15.13 +0.68 0.39
Lizard Creek near Fort Dodge, IA as of 05/13/2005 09:00 9 8.00 +1.27 0.72
* Des Moines River at Fort Dodge, IA as of 05/13/2005 09:00 10 8.29 +0.76
Boone River near Goldfield, IA as of 05/13/2005 09:00 17.46 +0.78 0.66
* Boone River near Webster City, IA as of 05/13/2005 09:00 10 6.87 +0.61 1.27
* Des Moines River near Stratford, IA as of 05/13/2005 09:00 14 14.65 +1.00 0.52
Big Creek Lake near Polk City, IA as of 05/13/2005 09:00 920.79 +0.75 1.80
Big Creek Ponding Area near Polk City, IA as of 05/13/2005 09:00 837.34 +4.10 1.90
* Saylorville Reservoir as of 05/13/2005 09:00 838.83 +1.70 1.82
* Des Moines River downstream of Saylorville Reservoir as of 05/13/2005 09:00 11.15 +0.08
Beaver Creek near Woodward, IA as of 05/13/2005 09:00 19 18.23 +4.89 1.62
* Beaver Creek near Grimes, IA as of 05/13/2005 09:00 12 9.28 +3.37 2.29
* Des Moines River at 2nd Ave Des Moines, IA as of 05/13/2005 09:00 23 18.90 +0.88 1.21
* Des Moines River at SE 6th St. Des Moines,IA as of 05/13/2005 09:00 24 24.49 +3.95 1.97
Fourmile Creek at Des Moines, IA as of 05/13/2005 09:00 12 13.02 +6.15 1.71
* North River near Norwalk, IA 18 19.36 +2.11 2.06
Local intranet
Start Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive... 9:59 AM

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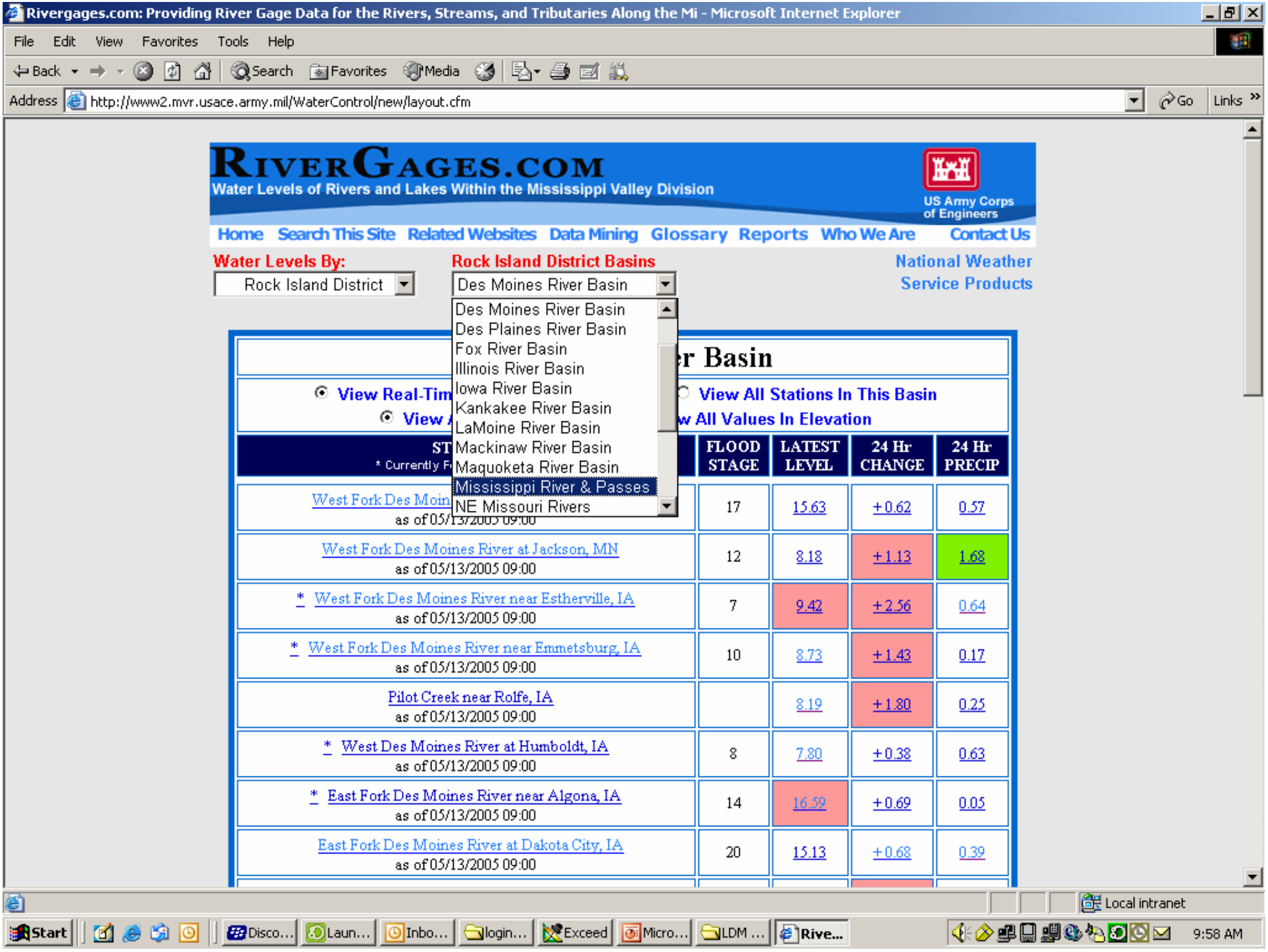
STATION
* Currently Forecasted Station
FLOOD STAGE
LATEST LEVEL
24 Hr CHANGE
24 Hr PRECIP
West Fork Des Moines River near Windom, MN
as of 05/13/2005 09:00
17
15.63
+0.62
0.57
West Fork Des Moines River at Jackson, MN
as of 05/13/2005 09:00
12
8.18
+1.13
1.68
* West Fork Des Moines River near Estherville, IA
as of 05/13/2005 09:00
7
9.42
+2.56
0.64
* West Fork Des Moines River near Emmetsburg, IA
as of 05/13/2005 09:00
10
8.73
+1.43
0.17
Pilot Creek near Rolfe, IA
as of 05/13/2005 09:00
8.19
+1.80
0.25
* West Des Moines River at Humboldt, IA
as of 05/13/2005 09:00
8
7.80
+0.38
0.63
* East Fork Des Moines River near Algona, IA
as of 05/13/2005 09:00
14
16.59
+0.69
0.05
East Fork Des Moines River at Dakota City, IA
as of 05/13/2005 09:00
20
15.13
+0.68
0.39
Done
Local intranet
Start
Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive...
10:00 AM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Iowa River Basin
Kankakee River Basin
LaMoine River Basin
Mackinaw River Basin
Maquoketa River Basin
Mississippi River & Passes
NE Missouri Rivers
National Weather Service Products
r Basin
View Real-Tim
View All Stations In This Basin
View A
w All Values In Elevation
ST
* Currently F
FLOOD STAGE
LATEST LEVEL
24 Hr CHANGE
24 Hr PRECIP
West Fork Des Moin
as of 05/13/2005 09:00
17
15.63
+0.62
0.57
West Fork Des Moines River at Jackson, MN
as of 05/13/2005 09:00
12
8.18
+1.13
1.68
* West Fork Des Moines River near Estherville, IA
as of 05/13/2005 09:00
7
9.42
+2.56
0.64
* West Fork Des Moines River near Emmetsburg, IA
as of 05/13/2005 09:00
10
8.73
+1.43
0.17
Pilot Creek near Rolfe, IA
as of 05/13/2005 09:00
8.19
+1.80
0.25
* West Des Moines River at Humboldt, IA
as of 05/13/2005 09:00
8
7.80
+0.38
0.63
* East Fork Des Moines River near Algona, IA
as of 05/13/2005 09:00
14
16.59
+0.69
0.05
East Fork Des Moines River at Dakota City, IA
as of 05/13/2005 09:00
20
15.13
+0.68
0.39
Local intranet
Start
Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive...
9:58 AM

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View All Values In Elevation
STATION
* Currently Forecasted Station
FLOOD STAGE
LATEST LEVEL
24 Hr CHANGE
24 Hr PRECIP
Continue Upstream
* Mississippi River at Guttenburg, IA
as of 05/13/2005 09:00
15
6.77
+0.05
0.16
Grant River near Burton,WI
as of 05/13/2005 09:00
18
4.88
-0.17
0.24
Mississippi River at Lock and Dam 11 (POOL)
as of 05/13/2005 08:00
15.18
+0.50
* Mississippi River at Lock and Dam 11 (Dubuque,IA)
as of 05/13/2005 08:00
16
6.41
+0.41
* Mississippi River at Lock and Dam 11 (Auxiliary Gage)
as of 05/13/2005 08:00
16
6.40
+0.42
* Mississippi River at Lock and Dam 11 (MET Station)
as of 05/13/2005 09:00
16
0.23
* Mississippi River at Dubuque,IA
as of 05/13/2005 09:00
17
9.07
+0.30
0.32
Galena River at Bucombe,WI
15
2.88
+0.01
0.10
Done
Local intranet
Start
Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive...
10:02 AM

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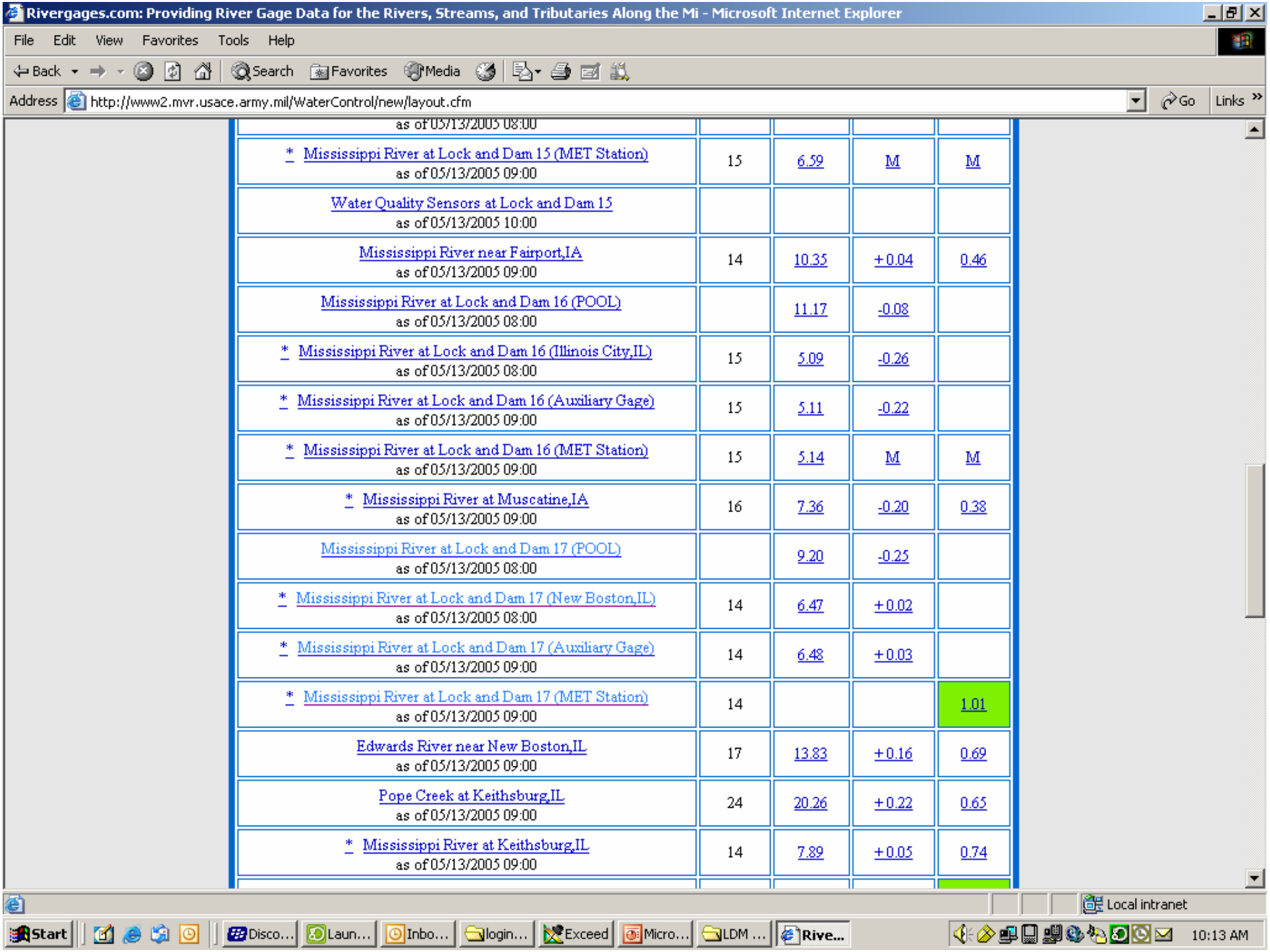
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://www2.mvr.usace.army.mil/WaterControl/new/layout.cfm
Go Links
as of 05/13/2005 08:00 11.88 +0.28
* Mississippi River at Lock and Dam 12 (Bellevue,IA) as of 05/13/2005 08:00 17 6.63 +0.12
* Mississippi River at Lock and Dam 12 (Auxiliary Gage) as of 05/13/2005 09:00 17 6.62 +0.10
Mississippi River at Lock and Dam 12 (MET Station) as of 05/13/2005 09:00 17 0.77
Mississippi River at Lock and Dam 13 (POOL) as of 05/13/2005 08:00 14.07 -0.19
* Mississippi River at Lock and Dam 13 (Fulton,IL) as of 05/13/2005 08:00 16 6.13 -0.03
* Mississippi River at Lock and Dam 13 (Auxiliary Gage) as of 05/13/2005 09:00 16 6.13 -0.02
* Mississippi River at Lock and Dam 13 (MET Station) as of 05/13/2005 09:00 16 0.41
Mississippi River (Beaver Slough) at Clinton,IA as of 05/13/2005 08:00 11.60 -0.07
* Mississppi River at Camanche,IA as of 05/13/2005 09:00 17 10.06 -0.06
Mississippi River at Lock and Dam 14 (POOL) as of 05/13/2005 08:00 14.53 -0.23
* Mississippi River at Lock and Dam 14 (LeClaire,IA) as of 05/13/2005 08:00 11 5.18 -0.10
* Mississippi River at Lock and Dam 14 (Auxiliary Gage) as of 05/13/2005 09:00 11 5.23 -0.03
* Mississippi River at Lock and Dam 14 (MET Station) as of 05/13/2005 09:00 11 0.40
Crow Creek at Bettendorf, IA as of 05/13/2005 06:00 9 3.95 +0.21
Mississippi River at Lock and Dam 15 (POOL) as of 05/13/2005 08:00 18.39 -0.19
Local intranet
Start Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive... 10:11 AM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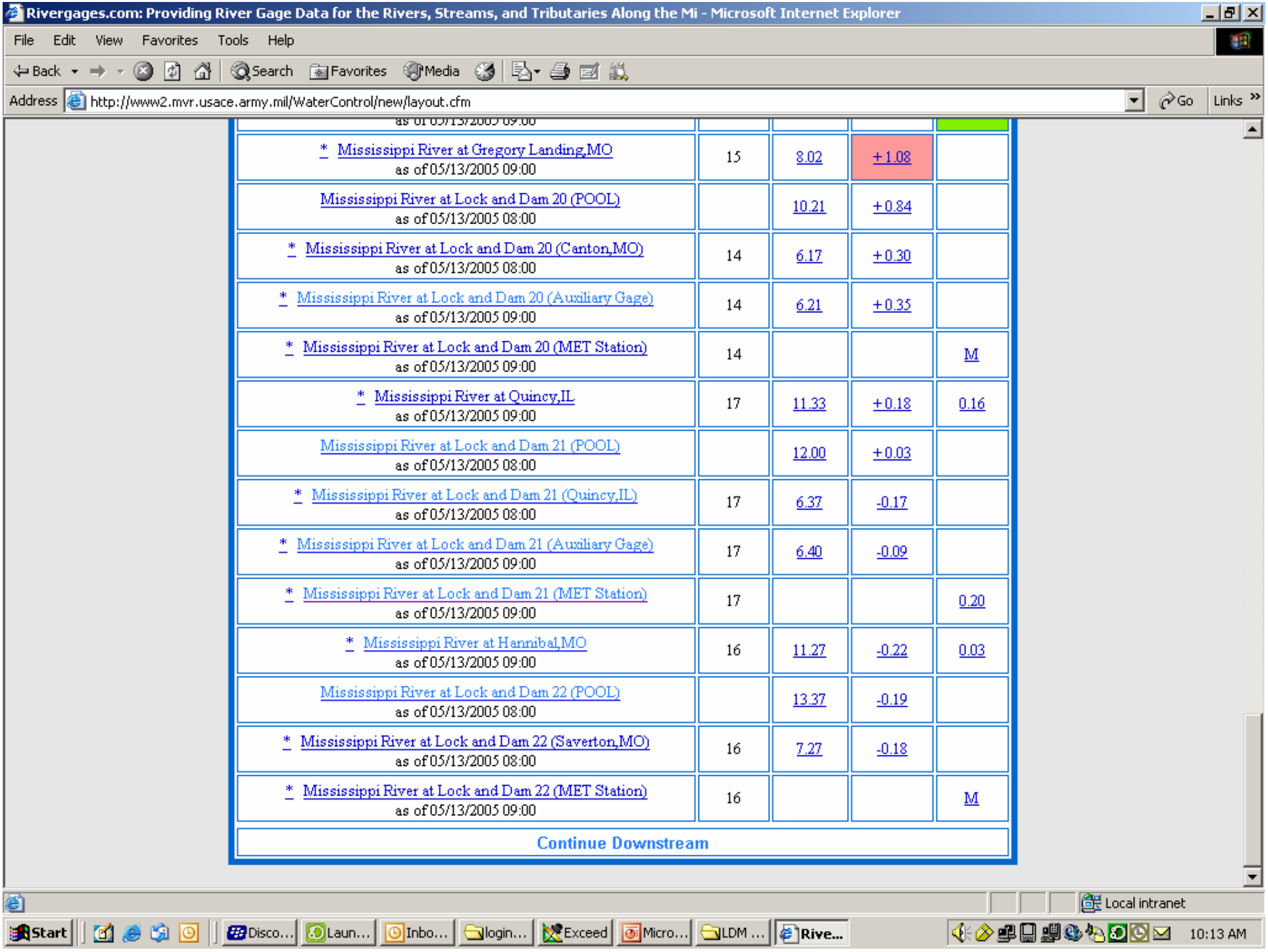
Address http://www2.mvr.usace.army.mil/WaterControl/new/layout.cfm
Go Links
as of 05/13/2005 08:00
* Mississippi River at Lock and Dam 15 (MET Station) as of 05/13/2005 09:00 15 6.59 M M
Water Quality Sensors at Lock and Dam 15 as of 05/13/2005 10:00
Mississippi River near Fairport,IA as of 05/13/2005 09:00 14 10.35 +0.04 0.46
Mississippi River at Lock and Dam 16 (POOL) as of 05/13/2005 08:00 11.17 -0.08
* Mississippi River at Lock and Dam 16 (Illinois City,IL) as of 05/13/2005 08:00 15 5.09 -0.26
* Mississippi River at Lock and Dam 16 (Auxiliary Gage) as of 05/13/2005 09:00 15 5.11 -0.22
* Mississippi River at Lock and Dam 16 (MET Station) as of 05/13/2005 09:00 15 5.14 M M
* Mississippi River at Muscatine,IA as of 05/13/2005 09:00 16 7.36 -0.20 0.38
Mississippi River at Lock and Dam 17 (POOL) as of 05/13/2005 08:00 9.20 -0.25
* Mississippi River at Lock and Dam 17 (New Boston,IL) as of 05/13/2005 08:00 14 6.47 +0.02
* Mississippi River at Lock and Dam 17 (Auxiliary Gage) as of 05/13/2005 09:00 14 6.48 +0.03
* Mississippi River at Lock and Dam 17 (MET Station) as of 05/13/2005 09:00 14 1.01
Edwards River near New Boston,IL as of 05/13/2005 09:00 17 13.83 +0.16 0.69
Pope Creek at Keithsburg,IL as of 05/13/2005 09:00 24 20.26 +0.22 0.65
* Mississippi River at Keithsburg,IL as of 05/13/2005 09:00 14 7.89 +0.05 0.74
Local intranet
Start
Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive...
10:13 AM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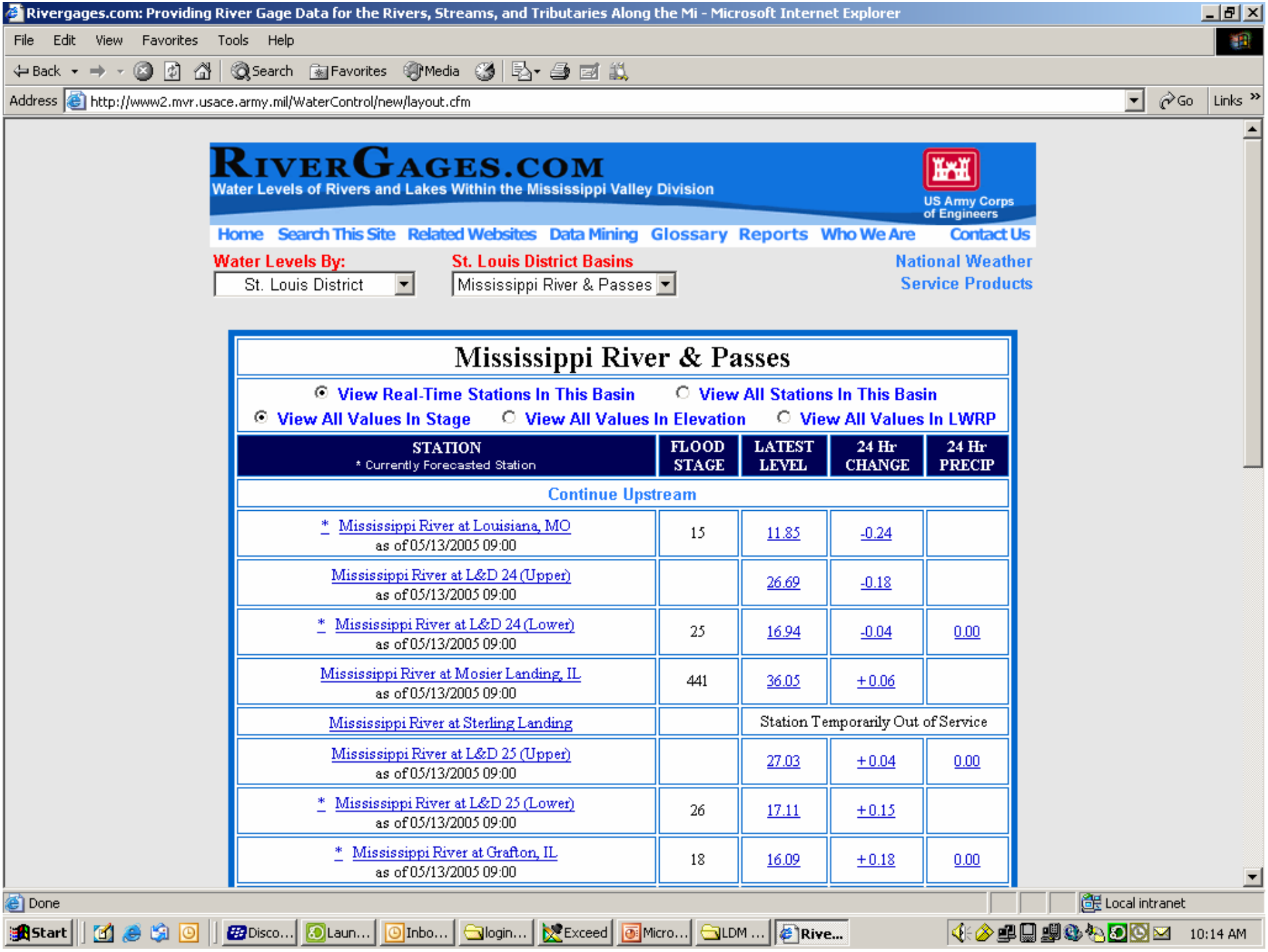
Address http://www2.mvr.usace.army.mil/WaterControl/new/layout.cfm
Go Links
* Mississippi River at Gregory Landing,MO as of 05/13/2005 09:00 | 15 | 8.02 | +1.08
Mississippi River at Lock and Dam 20 (POOL) as of 05/13/2005 08:00 | 10.21 | +0.84
* Mississippi River at Lock and Dam 20 (Canton,MO) as of 05/13/2005 08:00 | 14 | 6.17 | +0.30
* Mississippi River at Lock and Dam 20 (Auxiliary Gage) as of 05/13/2005 09:00 | 14 | 6.21 | +0.35
* Mississippi River at Lock and Dam 20 (MET Station) as of 05/13/2005 09:00 | 14 | M
* Mississippi River at Quincy,IL as of 05/13/2005 09:00 | 17 | 11.33 | +0.18 | 0.16
Mississippi River at Lock and Dam 21 (POOL) as of 05/13/2005 08:00 | 12.00 | +0.03
* Mississippi River at Lock and Dam 21 (Quincy,IL) as of 05/13/2005 08:00 | 17 | 6.37 | -0.17
* Mississippi River at Lock and Dam 21 (Auxiliary Gage) as of 05/13/2005 09:00 | 17 | 6.40 | -0.09
* Mississippi River at Lock and Dam 21 (MET Station) as of 05/13/2005 09:00 | 17 | 0.20
* Mississippi River at Hannibal,MO as of 05/13/2005 09:00 | 16 | 11.27 | -0.22 | 0.03
Mississippi River at Lock and Dam 22 (POOL) as of 05/13/2005 08:00 | 13.37 | -0.19
* Mississippi River at Lock and Dam 22 (Saverton,MO) as of 05/13/2005 08:00 | 16 | 7.27 | -0.18
* Mississippi River at Lock and Dam 22 (MET Station) as of 05/13/2005 09:00 | 16 | M
Continue Downstream
Local intranet
Start Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive... 10:13 AM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STATION
* Currently Forecasted Station
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LATEST LEVEL
24 Hr CHANGE
24 Hr PRECIP
Continue Upstream
* Mississippi River at Louisiana, MO
as of 05/13/2005 09:00
15
11.85
-0.24
Mississippi River at L&D 24 (Upper)
as of 05/13/2005 09:00
26.69
-0.18
* Mississippi River at L&D 24 (Lower)
as of 05/13/2005 09:00
25
16.94
-0.04
0.00
Mississippi River at Mosier Landing, IL
as of 05/13/2005 09:00
441
36.05
+0.06
Mississippi River at Sterling Landing
Station Temporarily Out of Service
Mississippi River at L&D 25 (Upper)
as of 05/13/2005 09:00
27.03
+0.04
0.00
* Mississippi River at L&D 25 (Lower)
as of 05/13/2005 09:00
26
17.11
+0.15
* Mississippi River at Grafton, IL
as of 05/13/2005 09:00
18
16.09
+0.18
0.00
Done
Local intranet
Start
Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive...
10:14 AM

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STATION
* Currently Forecasted Station
FLOOD STAGE
LATEST LEVEL
24 Hr CHANGE
24 Hr PRECIP
Continue Upstream
* Mississippi River at Guttenburg, IA
as of 05/13/2005 09:00
15
6.77
+0.05
0.16
Grant River near Burton,WI
as of 05/13/2005 09:00
18
4.88
-0.17
0.24
Mississippi River at Lock and Dam 11 (POOL)
as of 05/13/2005 08:00
15.18
+0.50
* Mississippi River at Lock and Dam 11 (Dubuque,IA)
as of 05/13/2005 08:00
16
6.41
+0.41
* Mississippi River at Lock and Dam 11 (Auxiliary Gage)
as of 05/13/2005 09:00
16
6.40
+0.30
* Mississippi River at Lock and Dam 11 (MET Station)
as of 05/13/2005 09:00
16
0.23
* Mississippi River at Dubuque,IA
as of 05/13/2005 09:00
17
9.07
+0.30
0.32
Galena River at Bucombe,WI
15
2.88
+0.01
0.10
Done
Local intranet
Start
Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive...
10:15 AM

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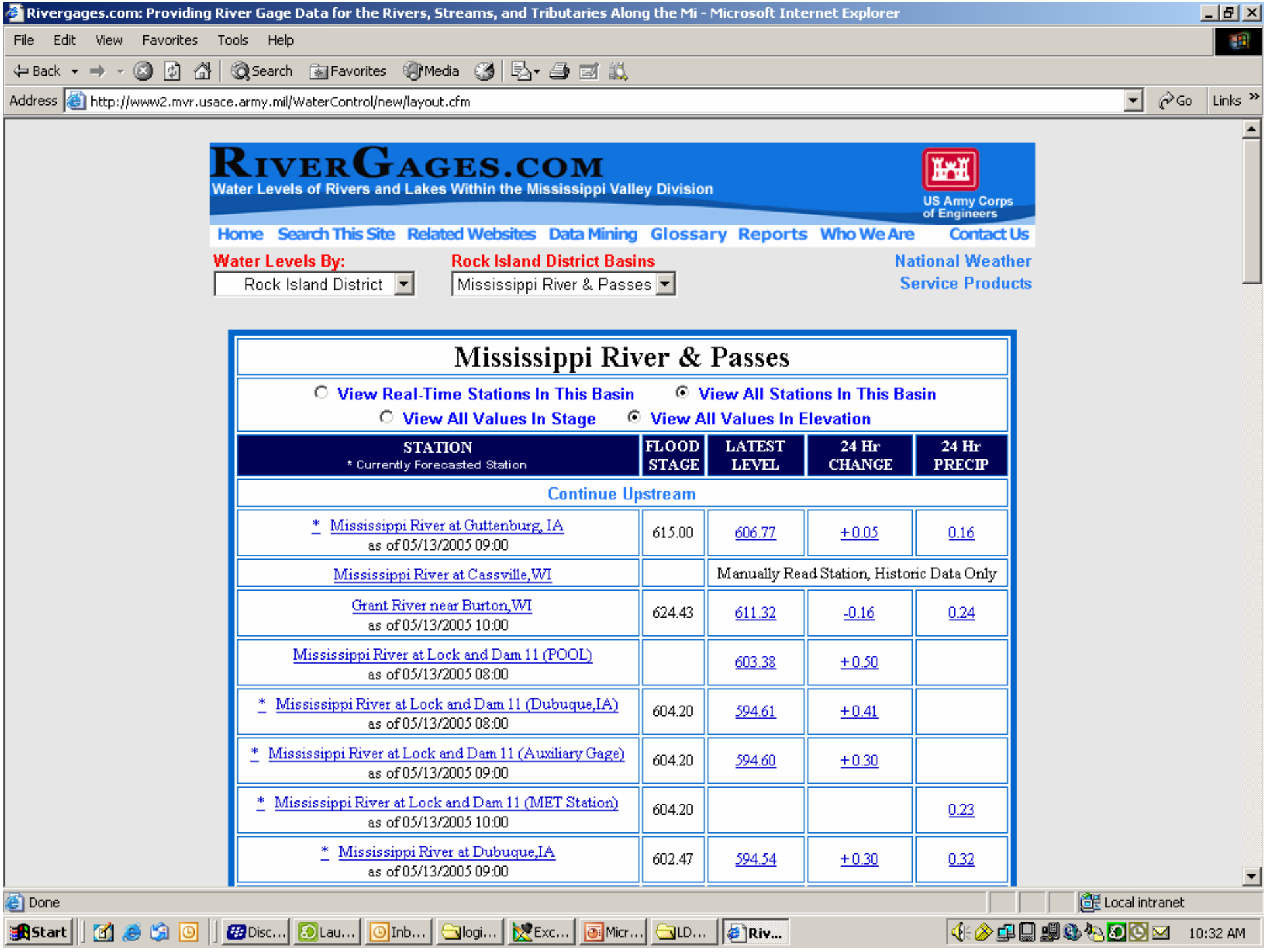
View All Values In Elevation
STATION
* Currently Forecasted Station
FLOOD STAGE
LATEST LEVEL
24 Hr CHANGE
24 Hr PRECIP
Continue Upstream
* Mississippi River at Guttenburg, IA
as of 05/13/2005 09:00
615.00
606.77
+0.05
0.16
Grant River near Burton,WI
as of 05/13/2005 09:00
624.43
611.31
-0.17
0.24
Mississippi River at Lock and Dam 11 (POOL)
as of 05/13/2005 08:00
603.38
+0.50
* Mississippi River at Lock and Dam 11 (Dubuque,IA)
as of 05/13/2005 08:00
604.20
594.61
+0.41
* Mississippi River at Lock and Dam 11 (Auxiliary Gage)
as of 05/13/2005 09:00
604.20
594.60
+0.30
* Mississippi River at Lock and Dam 11 (MET Station)
as of 05/13/2005 10:00
604.20
0.23
* Mississippi River at Dubuque,IA
as of 05/13/2005 09:00
602.47
594.54
+0.30
0.32
Galena River at Bucombe,WI
697.31
685.19
+0.01
0.10
Done
Local intranet
Start
10:31 AM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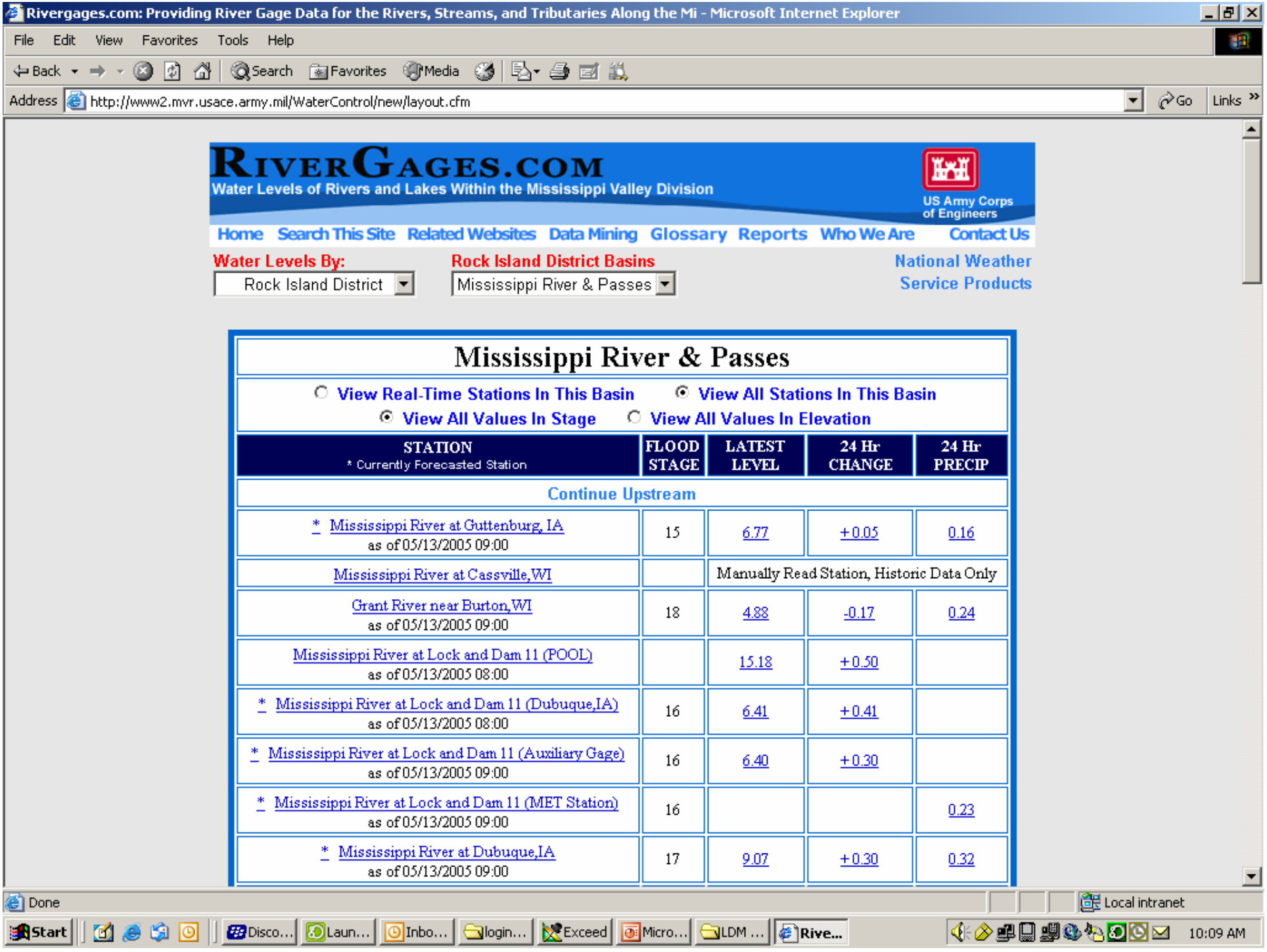
View All Values In Stage
View All Values In Elevation
STATION
* Currently Forecasted Station
FLOOD STAGE
LATEST LEVEL
24 Hr CHANGE
24 Hr PRECIP
Continue Upstream
* Mississippi River at Guttenburg, IA
as of 05/13/2005 09:00
615.00
606.77
+0.05
0.16
Mississippi River at Cassville,WI
Manually Read Station, Historic Data Only
Grant River near Burton,WI
as of 05/13/2005 10:00
624.43
611.32
-0.16
0.24
Mississippi River at Lock and Dam 11 (POOL)
as of 05/13/2005 08:00
603.38
+0.50
* Mississippi River at Lock and Dam 11 (Dubuque,IA)
as of 05/13/2005 08:00
604.20
594.61
+0.41
* Mississippi River at Lock and Dam 11 (Auxiliary Gage)
as of 05/13/2005 09:00
604.20
594.60
+0.30
* Mississippi River at Lock and Dam 11 (MET Station)
as of 05/13/2005 10:00
604.20
0.23
* Mississippi River at Dubuque,IA
as of 05/13/2005 09:00
602.47
594.54
+0.30
0.32
Done
Local intranet
Start
10:32 AM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STATION
* Currently Forecasted Station
FLOOD STAGE
LATEST LEVEL
24 Hr CHANGE
24 Hr PRECIP
Continue Upstream
* Mississippi River at Guttenburg, IA
as of 05/13/2005 09:00
15
6.77
+0.05
0.16
Mississippi River at Cassville,WI
Manually Read Station, Historic Data Only
Grant River near Burton,WI
as of 05/13/2005 09:00
18
4.88
-0.17
0.24
Mississippi River at Lock and Dam 11 (POOL)
as of 05/13/2005 08:00
15.18
+0.50
* Mississippi River at Lock and Dam 11 (Dubuque,IA)
as of 05/13/2005 08:00
16
6.41
+0.41
* Mississippi River at Lock and Dam 11 (Auxiliary Gage)
as of 05/13/2005 09:00
16
6.40
+0.30
* Mississippi River at Lock and Dam 11 (MET Station)
as of 05/13/2005 09:00
16
0.23
* Mississippi River at Dubuque,IA
as of 05/13/2005 09:00
17
9.07
+0.30
0.32
Done
Local intranet
Start
Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive...
10:09 AM

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View All Stations In This Basin
View All Values In Stage
View All Values In Elevation
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* Currently Forecasted Station
FLOOD STAGE
LATEST LEVEL
24 Hr CHANGE
24 Hr PRECIP
Continue Upstream
* Mississippi River at Guttenburg, IA
as of 05/13/2005 09:00
15
6.77
+0.05
0.16
Grant River near Burton,WI
as of 05/13/2005 09:00
18
4.88
-0.17
0.24
Mississippi River at Lock and Dam 11 (POOL)
as of 05/13/2005 08:00
15.18
+0.50
* Mississippi River at Lock and Dam 11 (Dubuque,IA)
as of 05/13/2005 08:00
16
6.41
+0.41
* Mississippi River at Lock and Dam 11 (Auxiliary Gage)
as of 05/13/2005 09:00
16
6.40
+0.30
* Mississippi River at Lock and Dam 11 (MET Station)
as of 05/13/2005 09:00
16
0.23
* Mississippi River at Dubuque,IA
as of 05/13/2005 09:00
17
9.07
+0.30
0.32
Galena River at Bucombe,WI
15
2.88
+0.01
0.10
Done
Local intranet
Start
Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive...
10:10 AM

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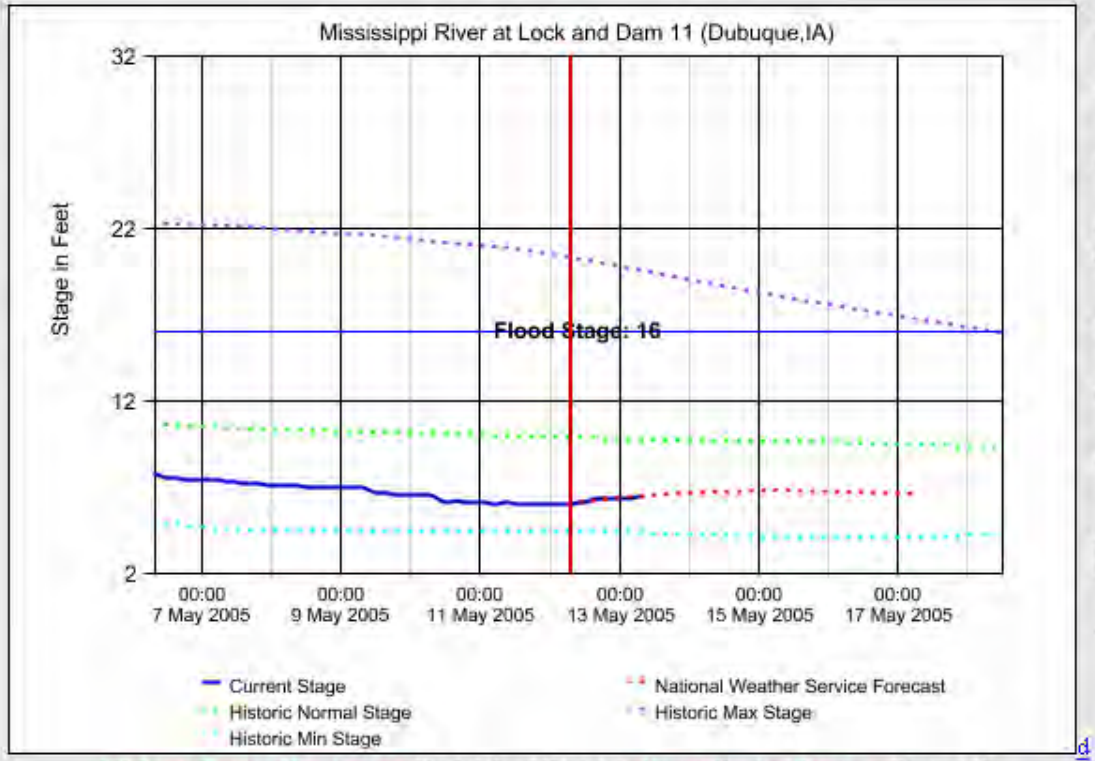

Flood Stage
On Off

Record High Stage
On Off

L&D12 Flat Pool
On Off

Lock Closed Stage (APPROXIMATE)
On Off

Normal Values
On Off

Max Values
On Off

Min Values
On Off

Historic Year
None

View Graph

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Done Local intranet

Start Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive... 10:03 AM

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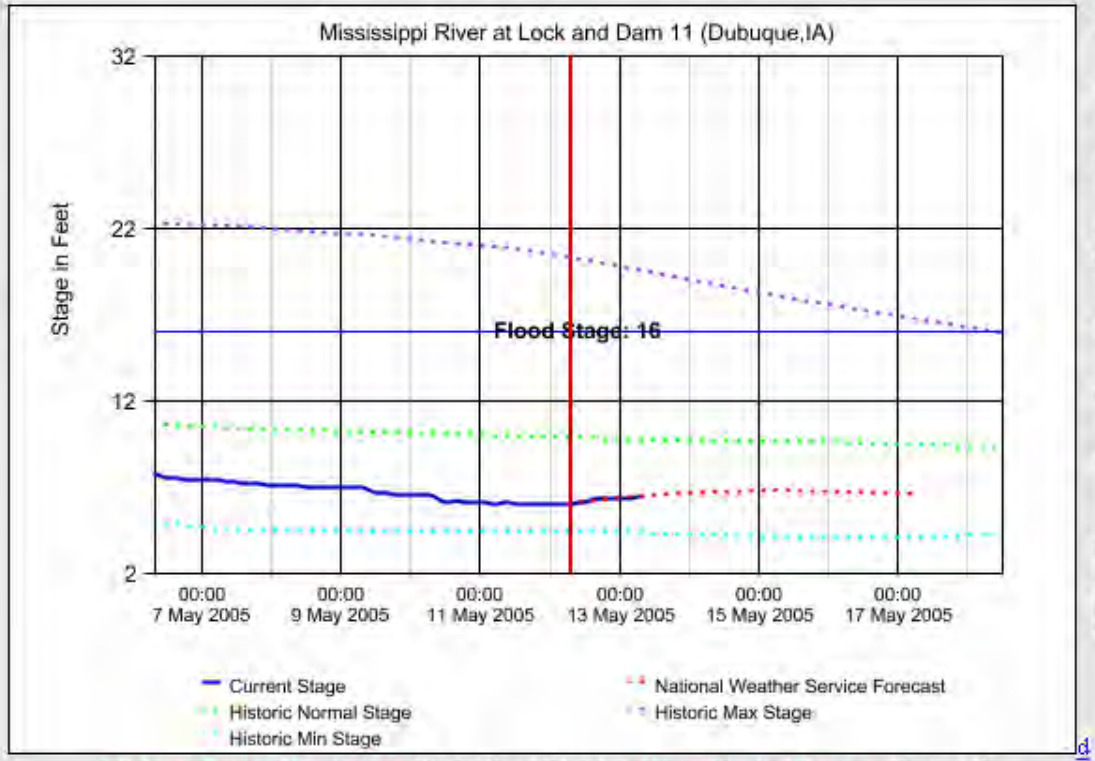
Address http://www2.mvr.usace.army.mil/WaterControl/shefgraph-forecast2.cfm?sid=MI11&fid=DLDI4&dt=S&d=7 Go Links



Flood Stage
On Off

Record High Stage
On Off

L&D12 Flat Pool
On Off

Lock Closed Stage (APPROXIMATE)
On Off

Normal Values
On Off

Max Values
On Off

Min Values
On Off

Historic Year
None

View Graph

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Local intranet

Start Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive... 10:03 AM

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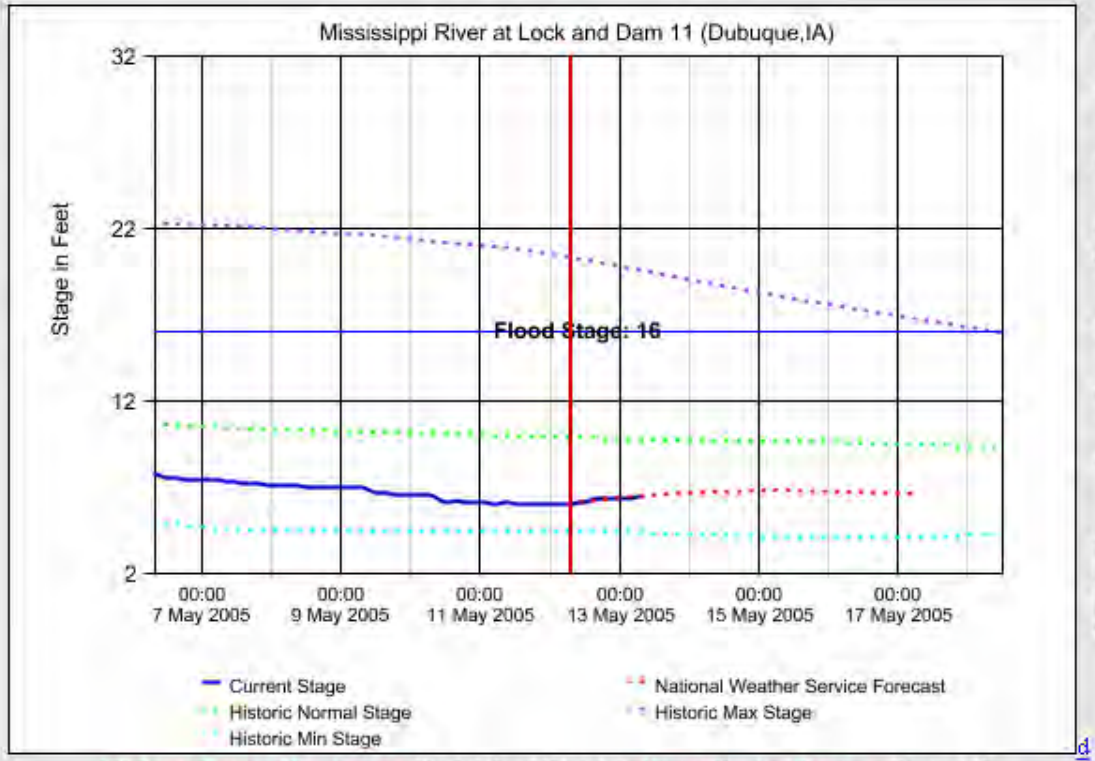
Address http://www2.mvr.usace.army.mil/WaterControl/shefgraph-forecast2.cfm?sid=MI11&fid=DLDI4&dt=S&d=7 Go Links



Flood Stage
On Off

Record High Stage
On Off

L&D12 Flat Pool
On Off

Lock Closed Stage (APPROXIMATE)
On Off

Normal Values
On Off

Max Values
On Off

Min Values
On Off

Historic Year
None

View Graph

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Start Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive... 10:04 AM

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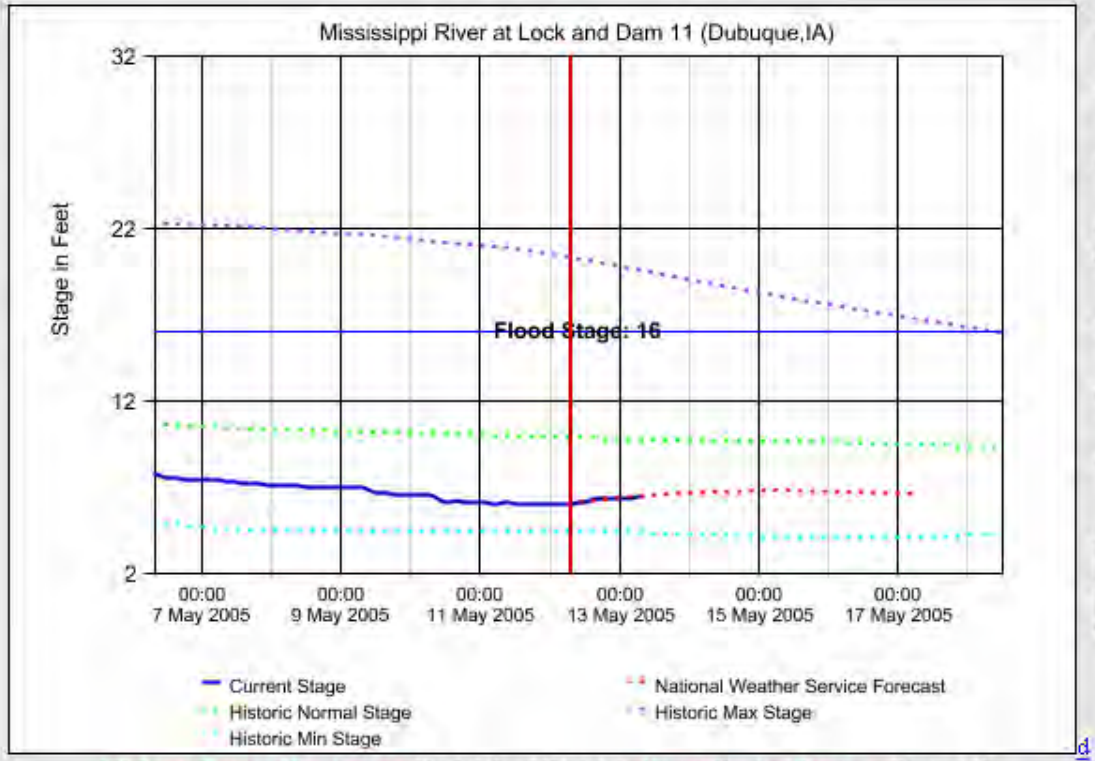
Address http://www2.mvr.usace.army.mil/WaterControl/shefgraph-forecast2.cfm?sid=MI11&fid=DLDI4&dt=S&d=7 Go Links



Flood Stage
On Off
Record High Stage
On Off
L&D12 Flat Pool
On Off
Lock Closed Stage (APPROXIMATE)
On Off
Normal Values
On Off
Max Values
On Off
Min Values
On Off
Historic Year
None
View Graph

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Start Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive... 10:05 AM

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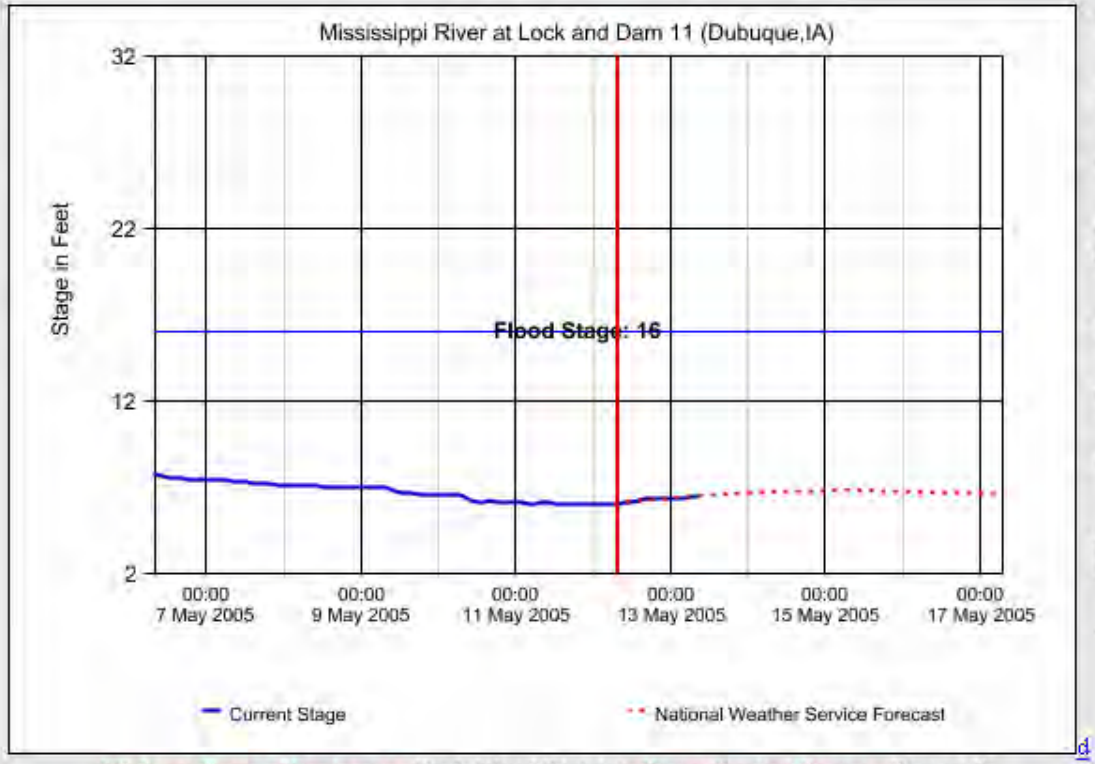

Flood Stage
On Off
Record High Stage
On Off
L&D12 Flat Pool
On Off
Lock Closed Stage (APPROXIMATE)
On Off
Normal Values
On Off
Max Values
On Off
Min Values
On Off
Historic Year
None
View Graph

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Start Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive... 10:05 AM

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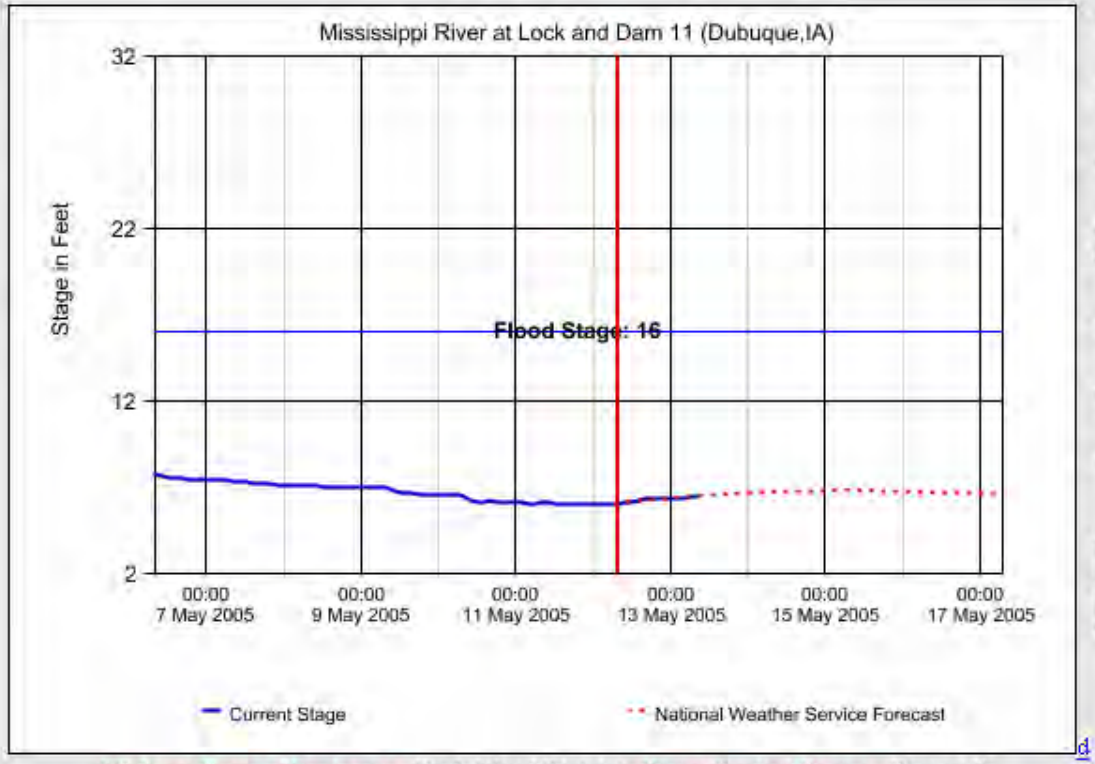
Address http://www2.mvr.usace.army.mil/WaterControl/shefgraph-forecast2.cfm?sid=MI11&fid=DLDI4&d=7&dt=S Go Links



Flood Stage
On Off

Record High Stage
On Off

L&D12 Flat Pool
On Off

Lock Closed Stage (APPROXIMATE)
On Off

Normal Values
On Off

Max Values
On Off

Min Values
On Off

Historic Year
None

View Graph

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Start Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive... 10:18 AM

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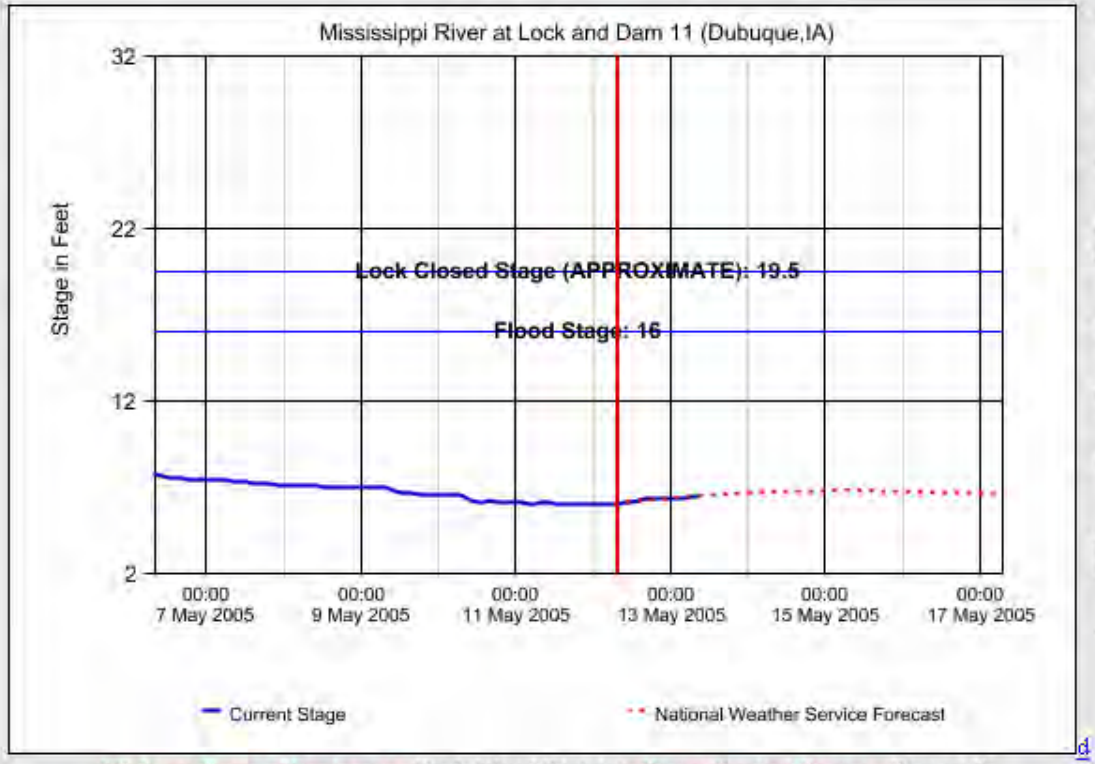

Flood Stage
On Off
Record High Stage
On Off
L&D12 Flat Pool
On Off
Lock Closed Stage (APPROXIMATE)
On Off
Normal Values
On Off
Max Values
On Off
Min Values
On Off
Historic Year
None
View Graph

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Start Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive... 10:18 AM

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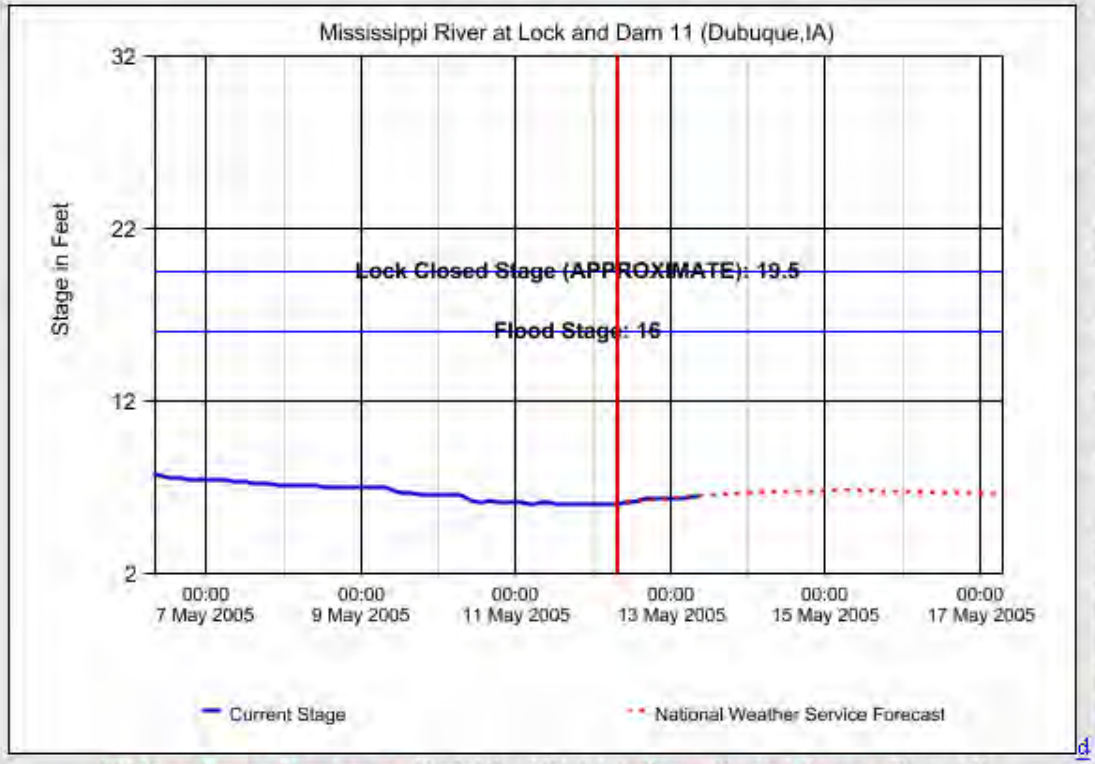

Flood Stage
On Off

Record High Stage
On Off

L&D12 Flat Pool
On Off

Lock Closed Stage (APPROXIMATE)
On Off

Normal Values
On Off

Max Values
On Off

Min Values
On Off

Historic Year
None
None 2005 2004 2003 2002 2001 2000 1999 1998 1997 1996
Graph

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Start Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive... 10:19 AM

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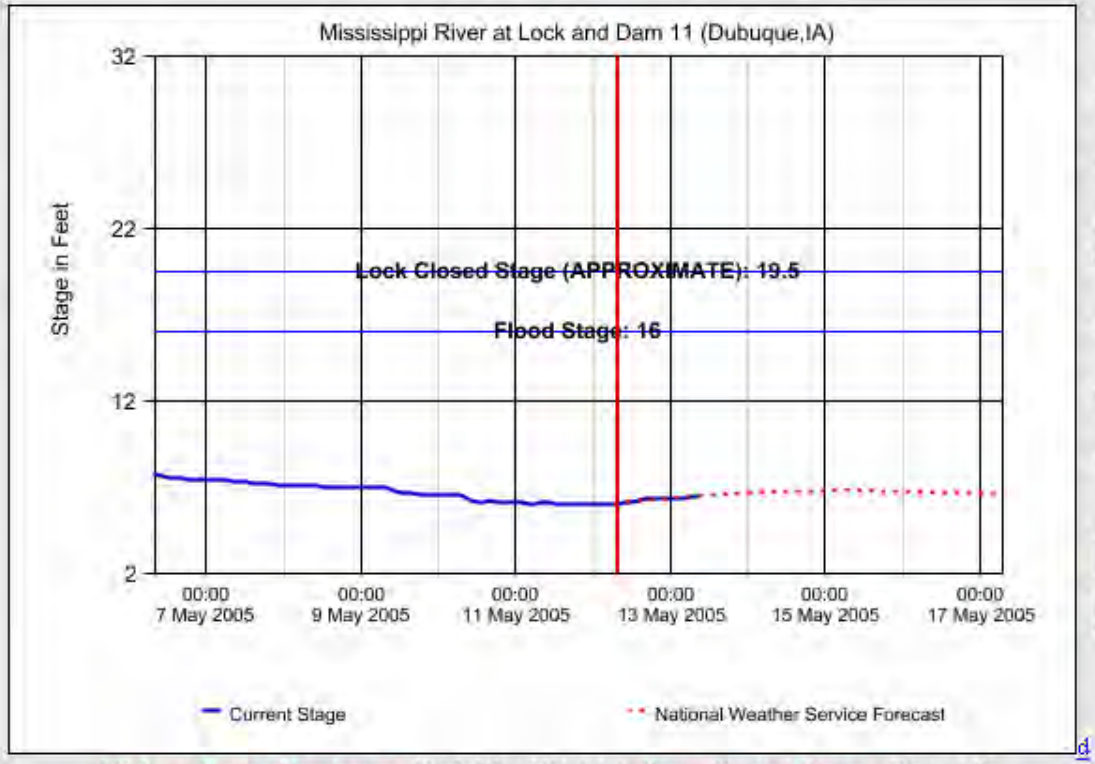

Flood Stage
On Off

Record High Stage
On Off

L&D12 Flat Pool
On Off

Lock Closed Stage (APPROXIMATE)
On Off

Normal Values
On Off

Max Values
On Off

Min Values
On Off

Historic Year
2001

View Graph

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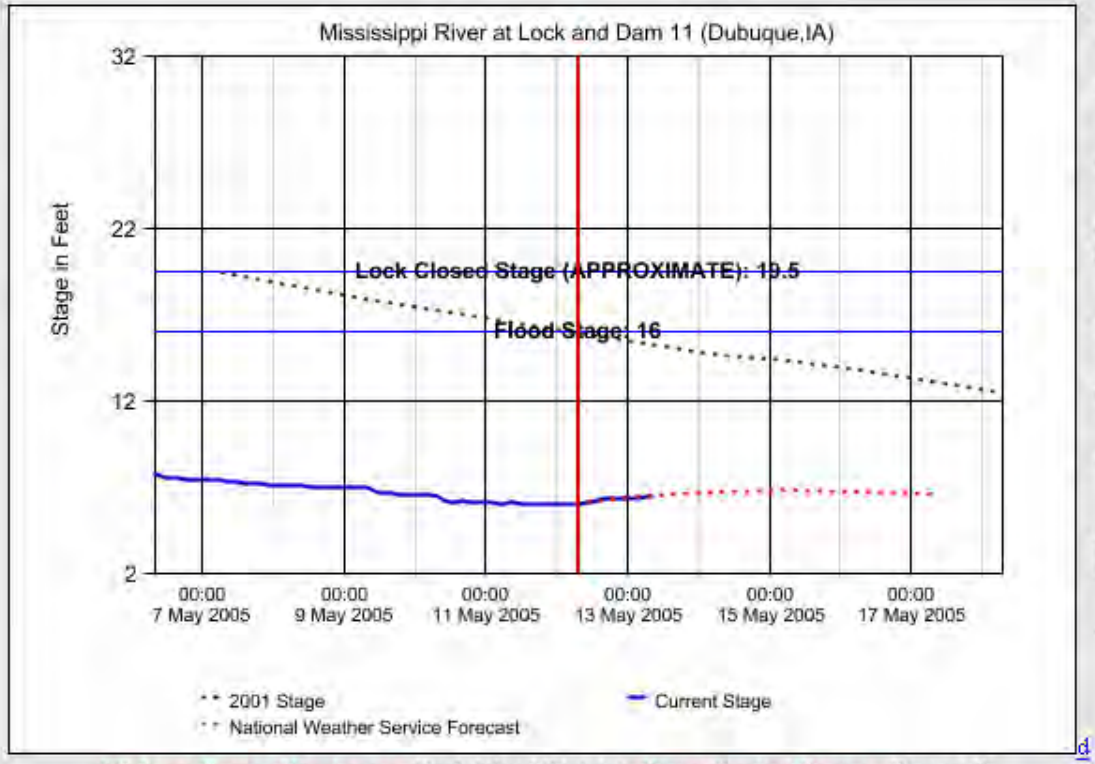

Flood Stage
On Off

Record High Stage
On Off

L&D12 Flat Pool
On Off

Lock Closed Stage (APPROXIMATE)
On Off

Normal Values
On Off

Max Values
On Off

Min Values
On Off

Historic Year
2001

View Graph

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* Currently Forecasted Station
FLOOD STAGE
LATEST LEVEL
24 Hr CHANGE
24 Hr PRECIP
Continue Upstream
* Mississippi River at Guttenburg, IA
as of 05/13/2005 09:00
15
6.77
+0.05
0.16
Grant River near Burton,WI
as of 05/13/2005 09:00
18
4.88
-0.17
0.24
Mississippi River at Lock and Dam 11 (POOL)
as of 05/13/2005 08:00
15.18
+0.50
* Mississippi River at Lock and Dam 11 (Dubuque,IA)
as of 05/13/2005 08:00
16
6.41
+0.41
* Mississippi River at Lock and Dam 11 (Auxiliary Gage)
as of 05/13/2005 09:00
16
6.40
+0.30
* Mississippi River at Lock and Dam 11 (MET Station)
as of 05/13/2005 09:00
16
0.23
* Mississippi River at Dubuque,IA
as of 05/13/2005 09:00
17
9.07
+0.30
0.32
Galena River at Bucombe,WI
15
2.88
+0.01
0.10
Local intranet
Start
Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive...
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Dynamic Map Static Map

Mississippi River at Lock and Dam 11 (Dubuque,IA)

Gage Zero : 588.20 Ft. MSL 1912

Flood Stage:16 Ft.

Record High Stage:25.69 Ft.(04/26/1965)

River Mile : 583 miles above the mouth of the Ohio River

Drainage Area : 81600.00 Mi^2

Location of Gage : Pool No. 11 extends from Dubuque northwesterly 32.1 river miles to Guttenburg, IA. Lock and Dam 11 is located at 11 Lime Street, at the foot of the bluff below Eagle Point Park. It is 2.7 river miles upstream of the Highway 151 bridge.

This gage is operated by the US Army Corps of Engineers (Rock Island District).

Latest Data
05/13/2005 08:00

Latest Stage	6.41 Ft.
24 Hr. Change	+0.41 Ft.
Tomorrow's Forecast (Issued 05/12/2005 11:57)	6.60 Ft. Plot Forecast
Last Year's Stage	6.11 Ft.
Today's Historic Normal Stage	9.68 Ft.

Daily Historic Data
(06:00 Reading)

From JAN 1 2005

To DEC 31 2005

Stage

Done

Local intranet

Start Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive... 10:22 AM

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Latest Data
05/13/2005 08:00

Latest Stage	6.41 Ft.
24 Hr. Change	+0.41 Ft.
Tomorrow's Forecast (Issued 05/12/2005 11:57)	6.60 Ft. Plot Forecast
Last Year's Stage	6.11 Ft.
Today's Historic Normal Stage	9.68 Ft.
Today's Historic Max Stage	19.40 Ft.
Today's Historic Min Stage	4.20 Ft.
Latest Pool Level	15.18 Ft.
24 Hr. Change	+0.30 Ft.
Last Year's Pool Level	14.74 Ft.
Latest Flow	49,733 CFS

7 Days | Stage

Plot | Tabulate

Daily Historic Data
(06:00 Reading)

From JAN 1 2005

To DEC 31 2005

Stage

Plot | Tabulate | Tabulate (Yearly Formatted)

View All Images

Additional Links:

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Vessels in POOL 11
Flow and Velocity Measurements
Historic Flood Profiles (Pool 11)

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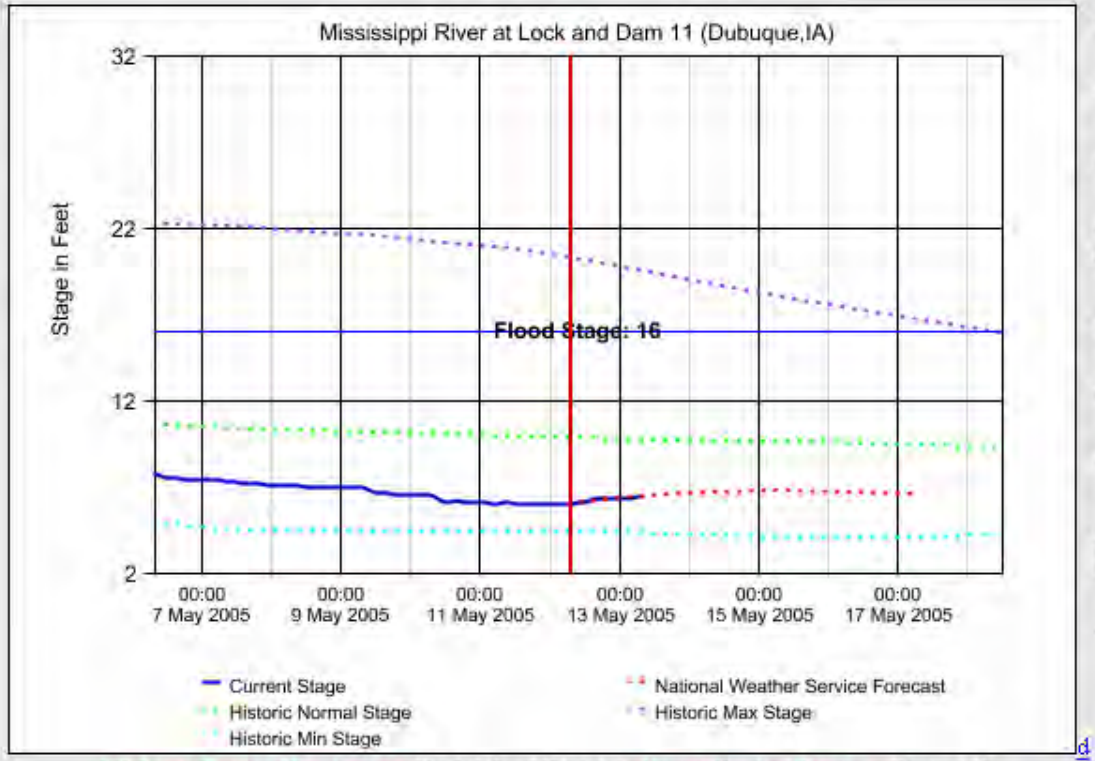
Address http://www2.mvr.usace.army.mil/WaterControl/shefgraph-forecast2.cfm?sid=MI11&fid=DLDI4&d=7&dt=S Go Links



Flood Stage
On Off

Record High Stage
On Off

L&D12 Flat Pool
On Off

Lock Closed Stage (APPROXIMATE)
On Off

Normal Values
On Off

Max Values
On Off

Min Values
On Off

Historic Year
None

View Graph

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Done Local intranet

Start Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive... 10:24 AM

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Address http://www2.mvr.usace.army.mil/WaterControl/stationinfo2.cfm?sid=MI11&fid=DLDI4&dt=S Go Links

This gage is operated by the US Army Corps of Engineers (Rock Island District).

Latest Data
05/13/2005 08:00

Latest Stage	6.41 Ft.
24 Hr. Change	+0.41 Ft.
Tomorrow's Forecast (Issued 05/12/2005 11:57)	6.60 Ft. Plot Forecast
Last Year's Stage	6.11 Ft.
Today's Historic Normal Stage	9.68 Ft.
Today's Historic Max Stage	19.40 Ft.
Today's Historic Min Stage	4.20 Ft.
Latest Pool Level	15.18 Ft.
24 Hr. Change	+0.30 Ft.
Last Year's Pool Level	14.74 Ft.
Latest Flow	49,733 CFS

7 Days | Stage

Plot | Tabulate

Daily Historic Data
(06:00 Reading)

From JAN 1 2005

To DEC 31 2005

Stage

Plot | Tabulate | Tabulate (Yearly Formatted)

View All Images

Additional Links:

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Flow Calculator for L&D 11
Vessels in POOL 11
Flow and Velocity Measurements
Historic Flood Profiles (Pool 11)

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Local intranet

Start Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive... 10:24 AM

Rivergages.com - Station Information ForMississippi River at Lock and Dam 11 (Dubuque,IA) - Microsoft Internet Explorer

File Edit View Favorites Tools Help

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Address http://www2.mvr.usace.army.mil/WaterControl/stationinfo2.cfm?sid=MI11&fid=DLDI4&dt=S

Go Links

This gage is operated by the US Army Corps of Engineers (Rock Island District).

Latest Data
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Latest Stage	6.41 Ft.
24 Hr. Change	+0.41 Ft.
Tomorrow's Forecast (Issued 05/12/2005 11:57)	6.60 Ft. Plot Forecast
Last Year's Stage	6.11 Ft.
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Today's Historic Max Stage	19.40 Ft.
Today's Historic Min Stage	4.20 Ft.
Latest Pool Level	15.18 Ft.
24 Hr. Change	+0.30 Ft.
Last Year's Pool Level	14.74 Ft.
Latest Flow	49,733 CFS

31 Days (1 Day, 3 Days, 7 Days, 14 Days, 31 Days, Year To Date, Current Year)

Stage

Tabulate

Daily Historic Data
(06:00 Reading)

From JAN 1 2005

To DEC 31 2005

Stage

Plot Tabulate Tabulate (Yearly Formatted)

View All Images

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View Record Stage High / Lows

Flow Calculator for L&D 11

Vessels in POOL 11

Flow and Velocity Measurements

Historic Flood Profiles (Pool 11)

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Latest Data
05/13/2005 08:00

Latest Stage	6.41 Ft.
24 Hr. Change	+0.41 Ft.
Tomorrow's Forecast (Issued 05/12/2005 11:57)	6.60 Ft. Plot Forecast
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Latest Pool Level	15.18 Ft.
24 Hr. Change	+0.30 Ft.
Last Year's Pool Level	14.74 Ft.
Latest Flow	49,733 CFS

31 Days | Stage

Plot | Tabulate

Daily Historic Data
(06:00 Reading)

From JAN 1 2005

To DEC 31 2005

Stage

Plot | Tabulate | Tabulate (Yearly Formatted)

View All Images

Additional Links:

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Flow Calculator for L&D 11

Vessels in POOL 11

Flow and Velocity Measurements

Historic Flood Profiles (Pool 11)

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Start | Disco... | Laun... | Inbo... | login... | Exceed | Micro... | LDM ... | Rive... | 10:26 AM

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Address http://www2.mvr.usace.army.mil/WaterControl/shefgraph-wotem2.cfm?sid=MI11&d=31&dt=S

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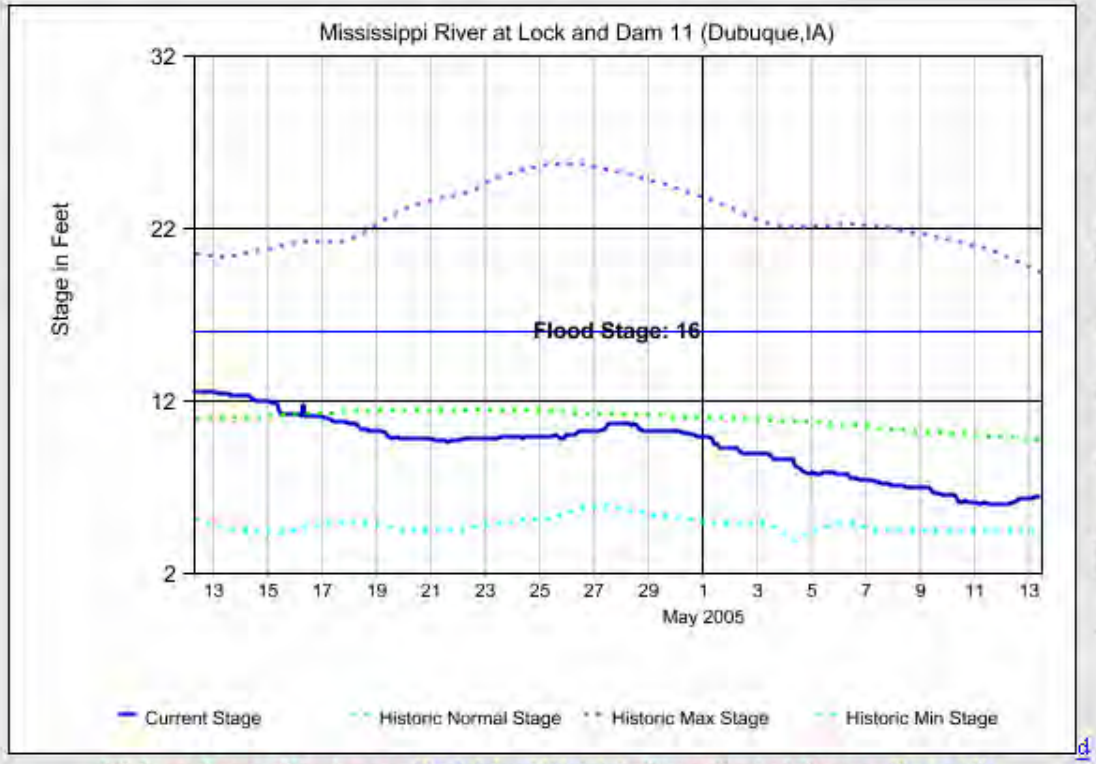


Flood Stage
On Off

Record High Stage
On Off

L&D12 Flat Pool
On Off

Lock Closed Stage (APPROXIMATE)
On Off

Normal Values
On Off

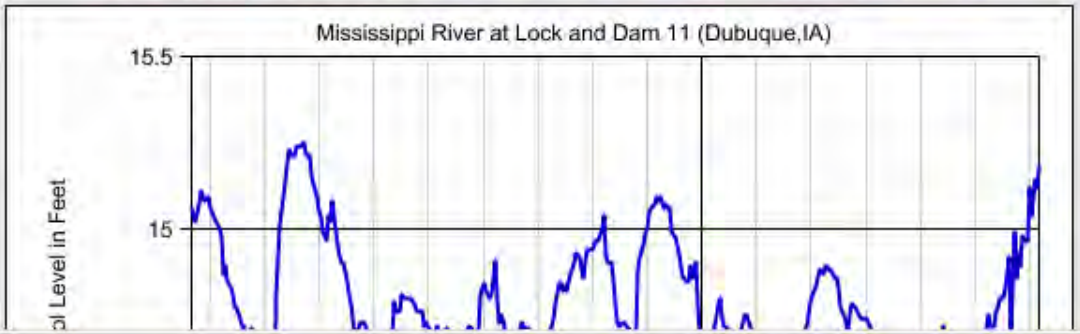
Max Values
On Off

Min Values
On Off

Historic Year
None

View Graph

US Army Corps of Engineers - Rock Island District - Water Control Center - Contact Us



Done

Local intranet

Start Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive... 10:27 AM

Rivergages.com - Current Hydrograph ForMississippi River at Lock and Dam 11 (Dubuque,IA) - Microsoft Internet Explorer

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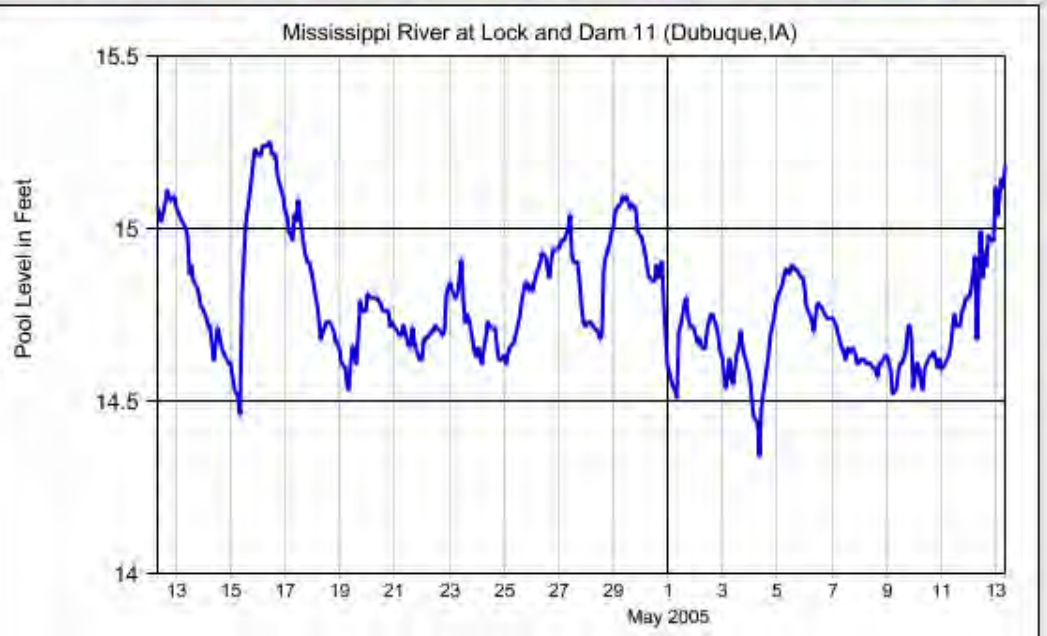
Address http://www2.mvr.usace.army.mil/WaterControl/shefgraph-wotem2.cfm?sid=MI11&d=31&dt=S

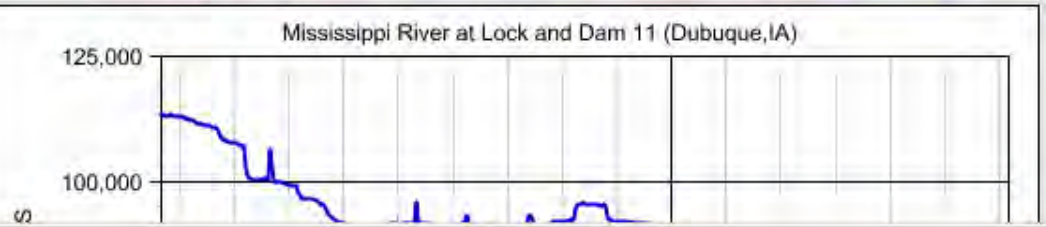
Go Links

Current Stage Historic Normal Stage Historic Max Stage Historic Min Stage

US Army Corps of Engineers - Rock Island District - Water Control Center - Contact Us



US Army Corps of Engineers - Rock Island District - Water Control Center - Contact Us



Done Local intranet

Start Disco... Laun... Inbo... login... Exceed Micro... LDM ... Rive... 10:27 AM

Rivergages.com - Current Hydrograph ForMississippi River at Lock and Dam 11 (Dubuque,IA) - Microsoft Internet Explorer

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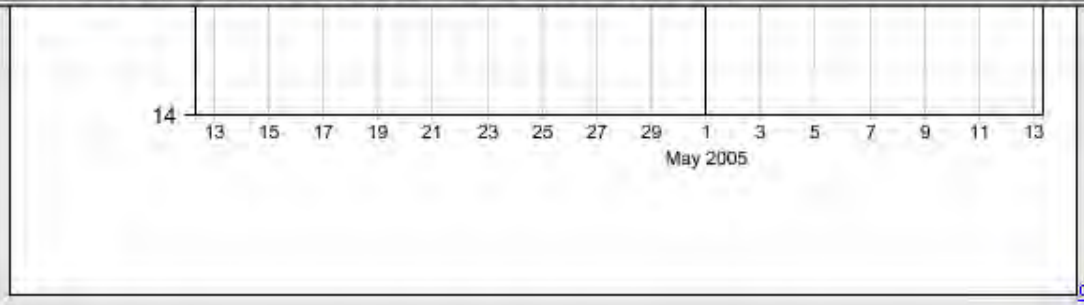
Address http://www2.mvr.usace.army.mil/WaterControl/shefgraph-wotem2.cfm?sid=MI11&d=31&dt=S

Go Links



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US Army Corps of Engineers - Rock Island District - Water Control Center - Contact Us

Done

Local intranet

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Rivergages.com - Station Information ForMississippi River at Lock and Dam 11 (Dubuque,IA) - Microsoft Internet Explorer

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Address http://www2.mvr.usace.army.mil/WaterControl/stationinfo2.cfm?sid=MI11&fid=DLDI4&dt=E Go Links

Latest Data
05/13/2005 08:00

Latest Elevation	594.61 Ft.
24 Hr. Change	+0.41 Ft.
Tomorrow's Forecast (Issued 05/13/2005 10:42)	594.80 Ft. Plot Forecast
Last Year's Elevation	594.31 Ft.
Today's Historic Normal Elevation	597.88 Ft.
Today's Historic Max Elevation	607.60 Ft.
Today's Historic Min Elevation	592.40 Ft.
Latest Pool Level	603.38 Ft.
24 Hr. Change	+0.50 Ft.
Last Year's Pool Level	602.94 Ft.
Latest Flow	49,733 CFS

31 Days | Stage

Plot | Tabulate

Daily Historic Data
(06:00 Reading)

From JAN 1 2005

To DEC 31 2005

Elevation

Plot | Tabulate | Tabulate (Yearly Formatted)

View All Images

Additional Links:

View Record Stage High / Lows

Flow Calculator for L&D 11

Vessels in POOL 11

Flow and Velocity Measurements

Historic Flood Profiles (Pool 11)

US Army Corps of Engineers - Rock Island District - Water Control Center - Contact Us

Local intranet

Start Disc... Lau... Inb... logi... Exc... Micr... LD... Riv... 10:48 AM

Rivergages.com - SHEF Data ForMississippi River at Lock and Dam 11 (Dubuque,IA) - Microsoft Internet Explorer

File Edit View Favorites Tools Help

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Address http://www2.mvr.usace.army.mil/WaterControl/shefdata2.cfm?sid=MI11&d=31&dt=5 Go Links

RIVERGAGES.COM

Water Levels of Rivers and Lakes Within the Mississippi Valley Division

US Army Corps of Engineers

Mississippi River at Lock and Dam 11 (Dubuque,IA)

Stream Name: Mississippi River
Gage Zero: 588.20 Ft. MSL 1912
Flood Stage:16 Ft.
Record High Stage:25.69 Ft.

Longitude: -90.64639000
Latitude: 42.53861000
River Mile: 583 miles above the mouth of the Ohio River
Record High Stage Date: 04/26/1965

Location of Gage: Pool No. 11 extends from Dubuque northwesterly 32.1 river miles to Guttenburg, IA. Lock and Dam 11 is located at 11 Lime Street, at the foot of the bluff below Eagle Point Park. It is 2.7 river miles upstream of the Highway 151 bridge.

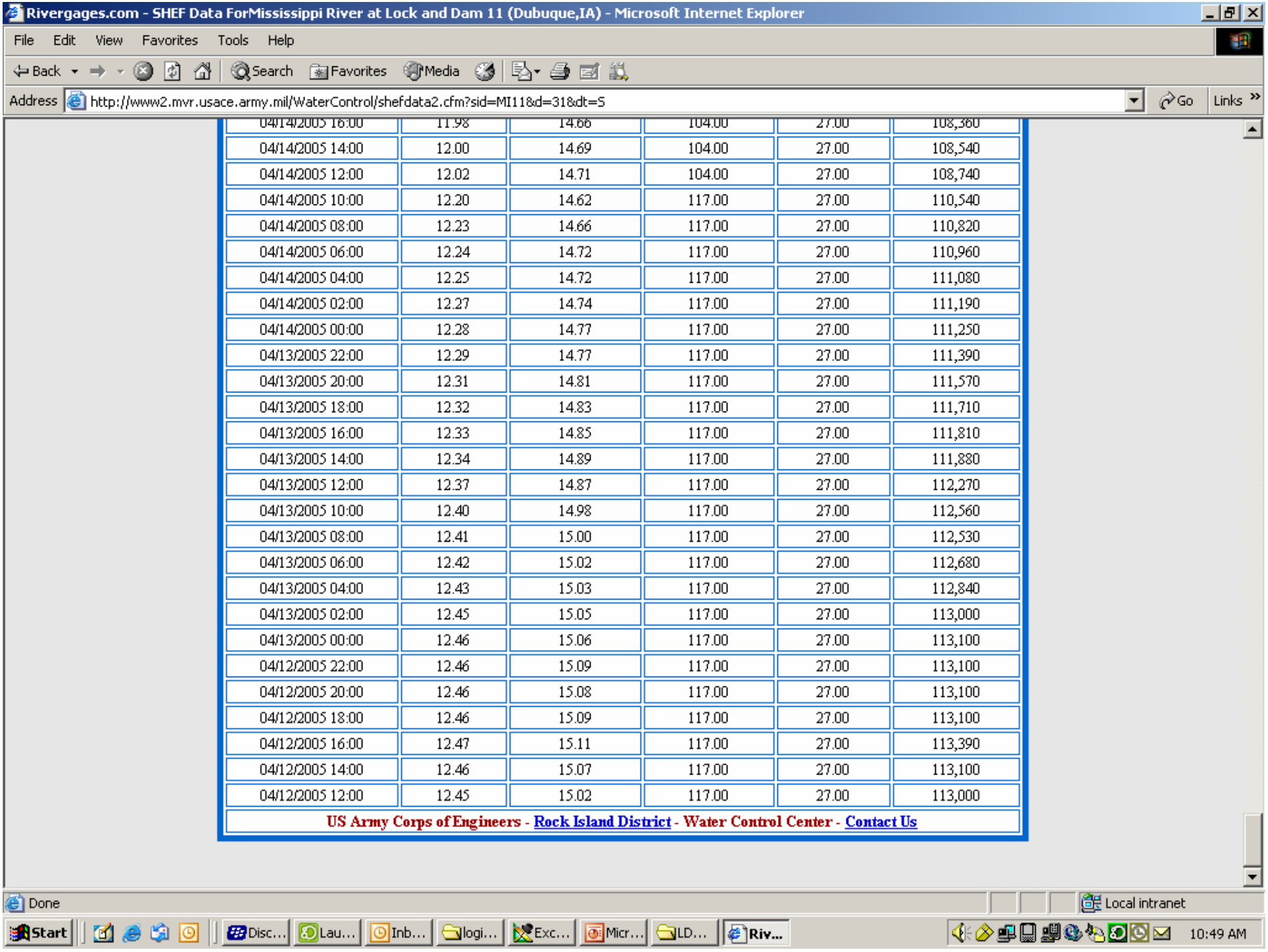
This gage is operated by the US Army Corps of Engineers (Rock Island District).

Download Data

Date / Time	Stage (Ft)	Pool Level (Ft)	Tainter (Ft)	Roller (Ft)	Flow (CFS)
05/13/2005 08:00	6.41	15.18	31.00	9.00	49,733
05/13/2005 06:00	6.36	15.12	31.00	9.00	49,720
05/13/2005 04:00	6.35	15.14	31.00	9.00	49,808
05/13/2005 02:00	6.31	15.04	31.00	9.00	49,650
05/13/2005 00:00	6.30	15.12	31.00	9.00	49,909
05/12/2005 22:00	6.30	14.97	31.00	9.00	49,483
05/12/2005 20:00	6.28	14.96	31.00	9.00	49,517
05/12/2005 18:00	6.26	14.98	31.00	9.00	49,637
05/12/2005 16:00	6.29	14.89	31.00	9.00	49,285

Done Local intranet

Start Disc... Lau... Inb... logi... Exc... Micr... LD... Riv... 10:48 AM



04/14/2005 16:00	11.98	14.66	104.00	27.00	108,360
04/14/2005 14:00	12.00	14.69	104.00	27.00	108,540
04/14/2005 12:00	12.02	14.71	104.00	27.00	108,740
04/14/2005 10:00	12.20	14.62	117.00	27.00	110,540
04/14/2005 08:00	12.23	14.66	117.00	27.00	110,820
04/14/2005 06:00	12.24	14.72	117.00	27.00	110,960
04/14/2005 04:00	12.25	14.72	117.00	27.00	111,080
04/14/2005 02:00	12.27	14.74	117.00	27.00	111,190
04/14/2005 00:00	12.28	14.77	117.00	27.00	111,250
04/13/2005 22:00	12.29	14.77	117.00	27.00	111,390
04/13/2005 20:00	12.31	14.81	117.00	27.00	111,570
04/13/2005 18:00	12.32	14.83	117.00	27.00	111,710
04/13/2005 16:00	12.33	14.85	117.00	27.00	111,810
04/13/2005 14:00	12.34	14.89	117.00	27.00	111,880
04/13/2005 12:00	12.37	14.87	117.00	27.00	112,270
04/13/2005 10:00	12.40	14.98	117.00	27.00	112,560
04/13/2005 08:00	12.41	15.00	117.00	27.00	112,530
04/13/2005 06:00	12.42	15.02	117.00	27.00	112,680
04/13/2005 04:00	12.43	15.03	117.00	27.00	112,840
04/13/2005 02:00	12.45	15.05	117.00	27.00	113,000
04/13/2005 00:00	12.46	15.06	117.00	27.00	113,100
04/12/2005 22:00	12.46	15.09	117.00	27.00	113,100
04/12/2005 20:00	12.46	15.08	117.00	27.00	113,100
04/12/2005 18:00	12.46	15.09	117.00	27.00	113,100
04/12/2005 16:00	12.47	15.11	117.00	27.00	113,390
04/12/2005 14:00	12.46	15.07	117.00	27.00	113,100
04/12/2005 12:00	12.45	15.02	117.00	27.00	113,000

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Rivergages.com - SHEF Data ForMississippi River at Lock and Dam 11 (Dubuque,IA) - Microsoft Internet Explorer

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Address http://www2.mvr.usace.army.mil/WaterControl/shefdata2.cfm?sid=MI11&d=31&dt=5 Go Links

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Water Levels of Rivers and Lakes Within the Mississippi Valley Division

US Army Corps of Engineers

Mississippi River at Lock and Dam 11 (Dubuque,IA)

Stream Name: Mississippi River
Gage Zero: 588.20 Ft. MSL 1912
Flood Stage:16 Ft.
Record High Stage:25.69 Ft.

Longitude: -90.64639000
Latitude: 42.53861000
River Mile: 583 miles above the mouth of the Ohio River
Record High Stage Date: 04/26/1965

Location of Gage: Pool No. 11 extends from Dubuque northwesterly 32.1 river miles to Guttenburg, IA. Lock and Dam 11 is located at 11 Lime Street, at the foot of the bluff below Eagle Point Park. It is 2.7 river miles upstream of the Highway 151 bridge.

This gage is operated by the US Army Corps of Engineers (Rock Island District).

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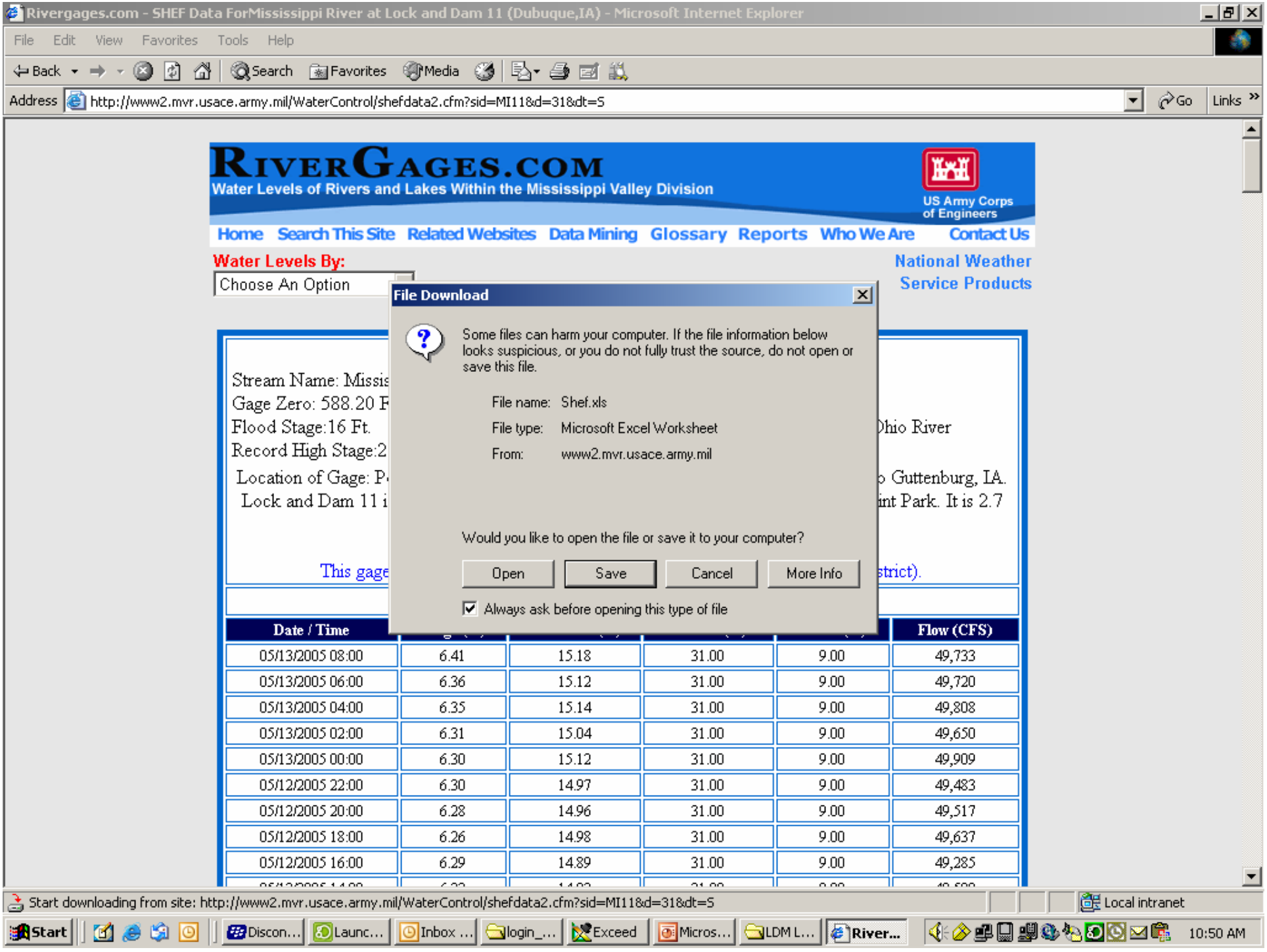
Date / Time	Stage (Ft)	Pool Level (Ft)	Tainter (Ft)	Roller (Ft)	Flow (CFS)
05/13/2005 08:00	6.41	15.18	31.00	9.00	49,733
05/13/2005 06:00	6.36	15.12	31.00	9.00	49,720
05/13/2005 04:00	6.35	15.14	31.00	9.00	49,808
05/13/2005 02:00	6.31	15.04	31.00	9.00	49,650
05/13/2005 00:00	6.30	15.12	31.00	9.00	49,909
05/12/2005 22:00	6.30	14.97	31.00	9.00	49,483
05/12/2005 20:00	6.28	14.96	31.00	9.00	49,517
05/12/2005 18:00	6.26	14.98	31.00	9.00	49,637
05/12/2005 16:00	6.29	14.89	31.00	9.00	49,285

Done Local intranet

Start Disc... Lau... Inb... logi... Exc... Micr... LD... Riv... 10:48 AM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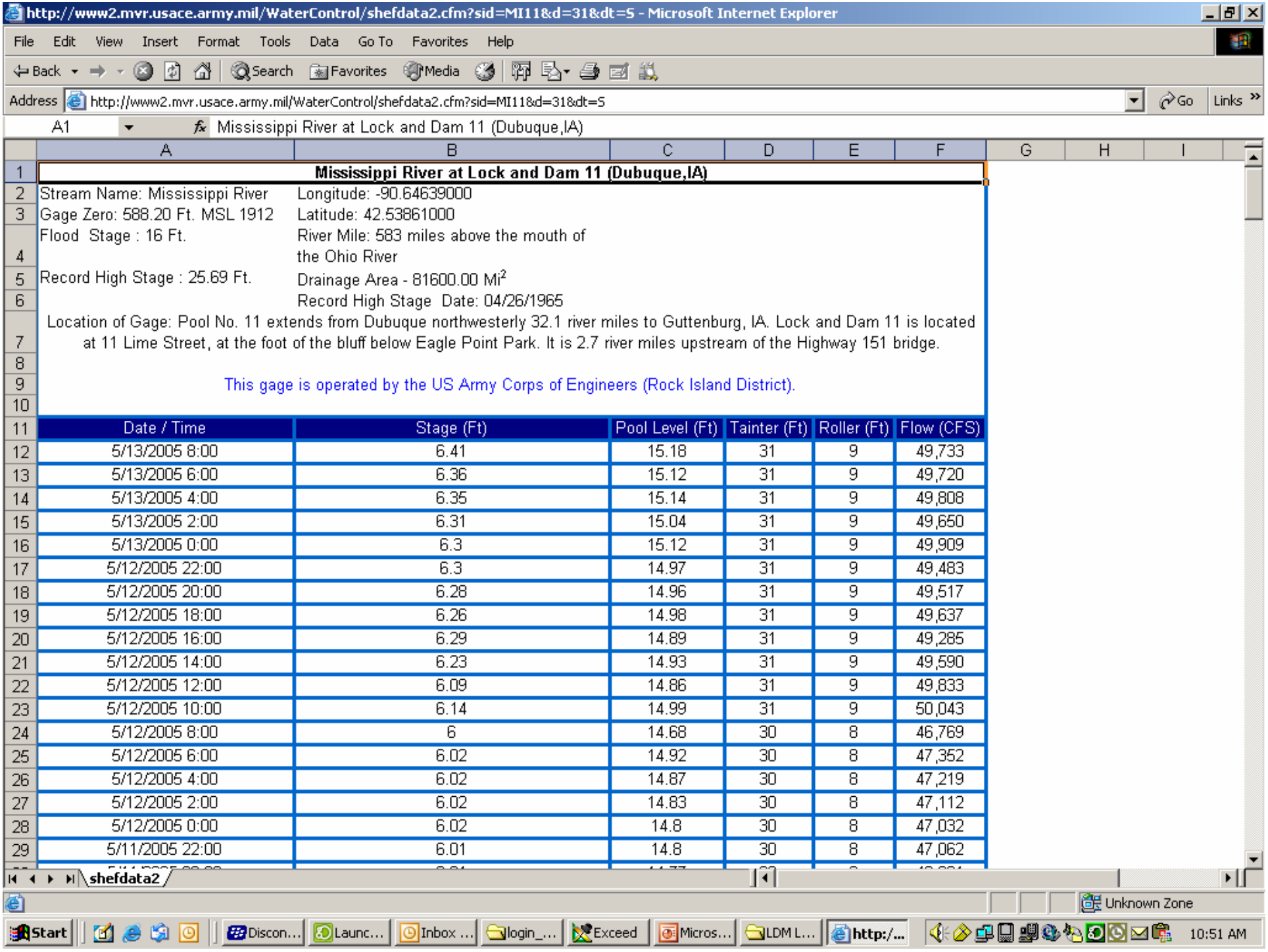
File name: Shef.xls
File type: Microsoft Excel Worksheet
From: www2.mvr.usace.army.mil
Would you like to open the file or save it to your computer?
Open Save Cancel More Info
Always ask before opening this type of file
Stream Name: Missis
Gage Zero: 588.20 F
Flood Stage:16 Ft.
Record High Stage:2
Location of Gage: P
Lock and Dam 11 i
Ohio River
o Guttenburg, IA.
int Park. It is 2.7
This gage
strict).
Date / Time
Flow (CFS)
05/13/2005 08:00 6.41 15.18 31.00 9.00 49,733
05/13/2005 06:00 6.36 15.12 31.00 9.00 49,720
05/13/2005 04:00 6.35 15.14 31.00 9.00 49,808
05/13/2005 02:00 6.31 15.04 31.00 9.00 49,650
05/13/2005 00:00 6.30 15.12 31.00 9.00 49,909
05/12/2005 22:00 6.30 14.97 31.00 9.00 49,483
05/12/2005 20:00 6.28 14.96 31.00 9.00 49,517
05/12/2005 18:00 6.26 14.98 31.00 9.00 49,637
05/12/2005 16:00 6.29 14.89 31.00 9.00 49,285
Start downloading from site: http://www2.mvr.usace.army.mil/WaterControl/shefdata2.cfm?sid=MI11&d=31&dt=5
Local intranet
Start Discon... Launc... Inbox ... login_... Exceed Micros... LDM L... River... 10:50 AM



Date / Time	Stage (Ft)	Pool Level (Ft)	Tainter (Ft)	Roller (Ft)	Flow (CFS)
5/13/2005 8:00	6.41	15.18	31	9	49,733
5/13/2005 6:00	6.36	15.12	31	9	49,720
5/13/2005 4:00	6.35	15.14	31	9	49,808
5/13/2005 2:00	6.31	15.04	31	9	49,650
5/13/2005 0:00	6.3	15.12	31	9	49,909
5/12/2005 22:00	6.3	14.97	31	9	49,483
5/12/2005 20:00	6.28	14.96	31	9	49,517
5/12/2005 18:00	6.26	14.98	31	9	49,637
5/12/2005 16:00	6.29	14.89	31	9	49,285
5/12/2005 14:00	6.23	14.93	31	9	49,590
5/12/2005 12:00	6.09	14.86	31	9	49,833
5/12/2005 10:00	6.14	14.99	31	9	50,043
5/12/2005 8:00	6	14.68	30	8	46,769
5/12/2005 6:00	6.02	14.92	30	8	47,352
5/12/2005 4:00	6.02	14.87	30	8	47,219
5/12/2005 2:00	6.02	14.83	30	8	47,112
5/12/2005 0:00	6.02	14.8	30	8	47,032
5/11/2005 22:00	6.01	14.8	30	8	47,062

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Go Links

This gage is operated by the US Army Corps of Engineers (Rock Island District).

Latest Data
05/13/2005 08:00

Latest Stage	6.41 Ft.
24 Hr. Change	+0.41 Ft.
Tomorrow's Forecast (Issued 05/13/2005 10:42)	6.60 Ft. Plot Forecast
Last Year's Stage	6.11 Ft.
Today's Historic Normal Stage	9.68 Ft.
Today's Historic Max Stage	19.40 Ft.
Today's Historic Min Stage	4.20 Ft.
Latest Pool Level	15.18 Ft.
24 Hr. Change	+0.30 Ft.
Last Year's Pool Level	14.74 Ft.
Latest Flow	49,733 CFS

7 Days | Stage

Plot | Tabulate

Daily Historic Data
(06:00 Reading)

From JAN 1 2005

To DEC 31 2005

Stage

Plot | Tabulate | Tabulate (Yearly Formatted)

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Flow Calculator for L&D 11

Vessels in POOL 11

Flow and Velocity Measurements

Historic Flood Profiles (Pool 11)

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Done

Local intranet

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Address http://www2.mvr.usace.army.mil/WaterControl/stationinfo2.cfm?sid=MI11&fid=DLDI4&dt=S

Go Links

This gage is operated by the US Army Corps of Engineers (Rock Island District).

Latest Data
05/13/2005 08:00

Latest Stage	6.41 Ft.
24 Hr. Change	+0.41 Ft.
Tomorrow's Forecast (Issued 05/13/2005 10:42)	6.60 Ft. Plot Forecast
Last Year's Stage	6.11 Ft.
Today's Historic Normal Stage	9.68 Ft.
Today's Historic Max Stage	19.40 Ft.
Today's Historic Min Stage	4.20 Ft.
Latest Pool Level	15.18 Ft.
24 Hr. Change	+0.50 Ft.
Last Year's Pool Level	14.74 Ft.
Latest Flow	49,733 CFS

7 Days | Stage

Plot | Tabulate

Daily Historic Data
(06:00 Reading)

From JAN 1 2005

To DEC 31

Stage

2005 2004 2003 2002 2001 2000 1999 1998 1997 1996 1995

Plot | Tabulate

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Additional Links:

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Flow Calculator for L&D 11

Vessels in POOL 11

Flow and Velocity Measurements

Historic Flood Profiles (Pool 11)

US Army Corps of Engineers - Rock Island District - Water Control Center - Contact Us

Done

Local intranet

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Go Links

This gage is operated by the US Army Corps of Engineers (Rock Island District).

Latest Data
05/13/2005 08:00

Latest Stage	6.41 Ft.
24 Hr. Change	+0.41 Ft.
Tomorrow's Forecast (Issued 05/13/2005 10:42)	6.60 Ft. Plot Forecast
Last Year's Stage	6.11 Ft.
Today's Historic Normal Stage	9.68 Ft.
Today's Historic Max Stage	19.40 Ft.
Today's Historic Min Stage	4.20 Ft.
Latest Pool Level	15.18 Ft.
24 Hr. Change	+0.30 Ft.
Last Year's Pool Level	14.74 Ft.
Latest Flow	49,733 CFS

7 Days | Stage

Plot | Tabulate

Daily Historic Data
(06:00 Reading)

From JAN 1 2001

To DEC 31 2005

Stage

Plot | Tabulate | Tabulate (Yearly Formatted)

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Additional Links:

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Flow Calculator for L&D 11

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Flow and Velocity Measurements

Historic Flood Profiles (Pool 11)

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Address http://www2.mvr.usace.army.mil/WaterControl/stationinfo2.cfm?sid=MI11&fid=DLDI4&dt=S

Go Links

This gage is operated by the US Army Corps of Engineers (Rock Island District).

Latest Data
05/13/2005 08:00

Latest Stage	6.41 Ft.
24 Hr. Change	+0.41 Ft.
Tomorrow's Forecast (Issued 05/13/2005 10:42)	6.60 Ft. Plot Forecast
Last Year's Stage	6.11 Ft.
Today's Historic Normal Stage	9.68 Ft.
Today's Historic Max Stage	19.40 Ft.
Today's Historic Min Stage	4.20 Ft.
Latest Pool Level	15.18 Ft.
24 Hr. Change	+0.30 Ft.
Last Year's Pool Level	14.74 Ft.
Latest Flow	49,733 CFS

7 Days | Stage

Plot | Tabulate

Daily Historic Data
(06:00 Reading)

From JAN 1 2001

To DEC 31 2005

Stage

Plot | Tabulate

2005
2004
2003
2002
2001
2000
1999
1998
1997
1996
1995

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Start | Disc... | Laun... | Inbo... | login... | Exceed | Micr... | LDM ... | Rive... | 11:06 AM

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This gage is operated by the US Army Corps of Engineers (Rock Island District).

Latest Data
05/13/2005 08:00

Latest Stage	6.41 Ft.
24 Hr. Change	+0.41 Ft.
Tomorrow's Forecast (Issued 05/13/2005 10:42)	6.60 Ft. Plot Forecast
Last Year's Stage	6.11 Ft.
Today's Historic Normal Stage	9.68 Ft.
Today's Historic Max Stage	19.40 Ft.
Today's Historic Min Stage	4.20 Ft.
Latest Pool Level	15.18 Ft.
24 Hr. Change	+0.30 Ft.
Last Year's Pool Level	14.74 Ft.
Latest Flow	49,733 CFS

7 Days | Stage

Plot | Tabulate

Daily Historic Data
(06:00 Reading)

From JAN 1 2001

To DEC 31 2001

Stage

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Flow and Velocity Measurements

Historic Flood Profiles (Pool 11)

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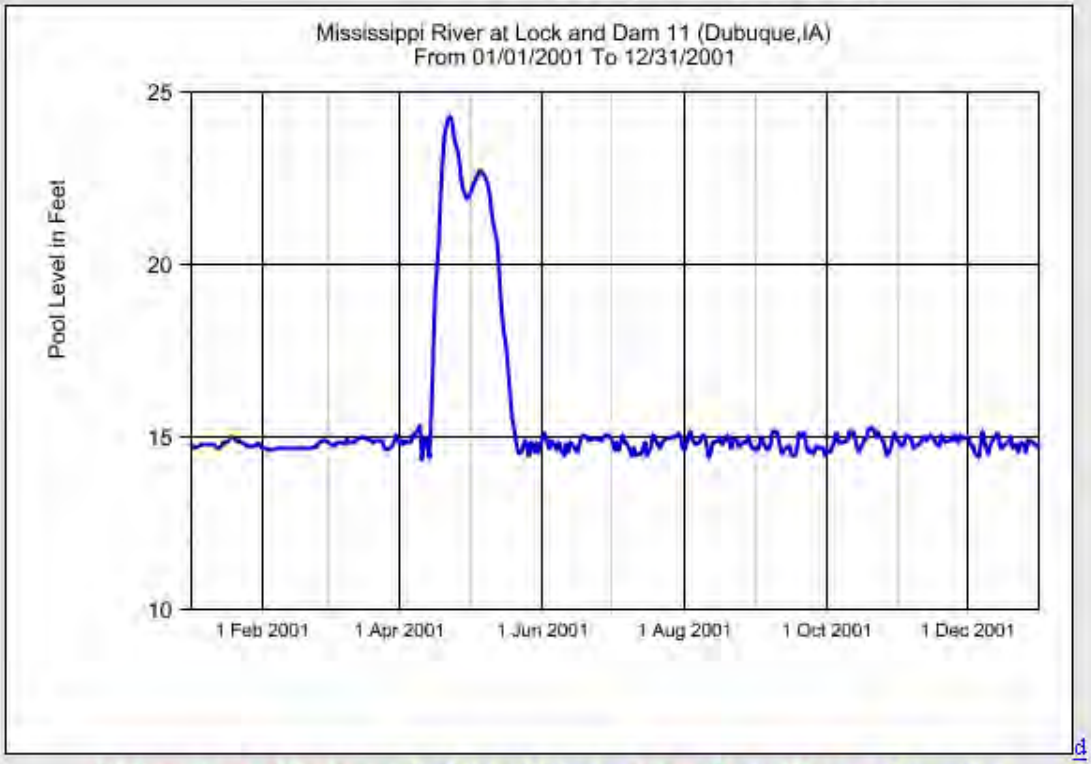
Address http://www2.mvr.usace.army.mil/WaterControl/shefgraph-historic.cfm?sid=MI11
Go

Mississippi River at Lock and Dam 11 (Dubuque,IA)

(Data Represents 06:00 Values)



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Address http://www2.mvr.usace.army.mil/WaterControl/stationinfo2.cfm?sid=MI11&fid=DLDI4&dt=S

Go Links

This gage is operated by the US Army Corps of Engineers (Rock Island District).

Latest Data
05/13/2005 08:00

Latest Stage	6.41 Ft.
24 Hr. Change	+0.41 Ft.
Tomorrow's Forecast (Issued 05/13/2005 10:42)	6.60 Ft. Plot Forecast
Last Year's Stage	6.11 Ft.
Today's Historic Normal Stage	9.68 Ft.
Today's Historic Max Stage	19.40 Ft.
Today's Historic Min Stage	4.20 Ft.
Latest Pool Level	15.18 Ft.
24 Hr. Change	+0.30 Ft.
Last Year's Pool Level	14.74 Ft.
Latest Flow	49,733 CFS

7 Days | Stage

Plot | Tabulate

Daily Historic Data
(06:00 Reading)

From JAN 1 2001

To DEC 31 2001

Stage

Plot | Tabulate | Tabulate (Yearly Formatted)

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Flow Calculator for L&D 11

Vessels in POOL 11

Flow and Velocity Measurements

Historic Flood Profiles (Pool 11)

US Army Corps of Engineers - Rock Island District - Water Control Center - Contact Us

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Rivergages.com - Historic Data Table For Mississippi River at Lock and Dam 11 (Dubuque,IA) - Microsoft Internet Explorer

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Address http://www2.mvr.usace.army.mil/WaterControl/shefgraph-historic.cfm?sid=MI11 Go Links

Historic Data For Mississippi River at Lock and Dam 11 (Dubuque,IA)

Stream Name: Mississippi River
Gage Zero: 588.20 Ft. MSL 1912
Flood Stage: 16
Record High Stage : 25.69

Longitude: -90.64639000
Latitude: 42.53861000
River Mile: 583 miles above the mouth of the Ohio River
Drainage Area - 81600.00 Mi^2
Record High Stage Date: 04/26/1965

Location of Gage: Pool No. 11 extends from Dubuque northwesterly 32.1 river miles to Guttenburg, IA. Lock and Dam 11 is located at 11 Lime Street, at the foot of the bluff below Eagle Point Park. It is 2.7 river miles upstream of the Highway 151 bridge.

This gage is operated by the US Army Corps of Engineers (Rock Island District).

Download Data

Data Represents 06:00 Values

Date / Time	Stage (Ft)	Pool Level (Ft)	Flow (CFS)
12/31/2001 06:00	5.64	14.72	22,561
12/30/2001 06:00	5.62	14.74	24,828
12/29/2001 06:00	5.43	14.79	28,657
12/28/2001 06:00	5.32	14.89	25,768
12/27/2001 06:00	5.20	14.81	24,981
12/26/2001 06:00	5.08	14.91	27,060
12/25/2001 06:00	4.88	14.55	29,638
12/24/2001 06:00	5.09	14.85	36,050
12/23/2001 06:00	5.39	14.76	36,616
12/22/2001 06:00	5.20	14.59	39,182
12/21/2001 06:00	5.27	14.76	43,816
12/20/2001 06:00	5.11	14.69	46,451
12/19/2001 06:00	4.98	14.98	47,833
12/18/2001 06:00	5.13	14.81	45,808
12/17/2001 06:00	5.39	14.85	42,113

Done Local intranet

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Rivergages.com - Station Information ForMississippi River at Lock and Dam 11 (Dubuque,IA) - Microsoft Internet Explorer

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Address http://www2.mvr.usace.army.mil/WaterControl/stationinfo2.cfm?sid=MI11&fid=DLDI4&dt=S

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7 Days | Stage

Plot | Tabulate

Daily Historic Data
(06:00 Reading)

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Stage

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Yearly Formatted Historic Values For MI11 - Microsoft Internet Explorer
File Edit View Favorites Tools Help
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Address http://www2.mvr.usace.army.mil/WaterControl/yearly_tables2.cfm?sid=MI11&from1=01/01/2001&to1=12/31/2001&dt=S
Go Links

Mississippi River at Lock and Dam 11 (Dubuque,IA)

Gage Zero - 588.20 Ft. MSL 1912

Flood Stage - 16 Ft.

Record High Stage - 25.69 Ft. (04/26/1965)

River Mile - 583 miles above the mouth of the Ohio River

Location of Gage - Pool No. 11 extends from Dubuque northwesterly 32.1 river miles to Guttenburg, IA. Lock and Dam 11 is located at 11 Lime Street, at the foot of the bluff below Eagle Point Park. It is 2.7 river miles upstream of the Highway 151 bridge.

This gage is operated by the US Army Corps of Engineers (Rock Island District).

Stage (Ft) Year - 2001

Day	JAN	FEB	MAR	APR	MAY	JUN	JLY	AUG	SEP	OCT	NOV	DEC
1	5.66	5.44	5.45	8.75	22.04	11.72	10.17	6.84	4.69	4.90	5.18	5.97
2	5.62	5.43	5.36	9.31	21.78	11.66	9.77	6.90	4.75	4.58	4.85	6.95
3	5.62	5.50	5.22	10.05	21.48	11.60	8.89	7.39	5.38	4.41	4.92	7.10
4	5.62	5.70	5.29	11.11	21.05	11.33	7.88	6.88	5.87	4.47	4.95	6.75
5	5.65	5.59	5.23	11.31	20.73	10.85	7.65	6.28	6.03	4.94	4.94	6.87
6	5.56	5.59	5.20	12.88	20.13	10.62	6.82	4.98	5.86	5.37	4.98	7.09
7	5.43	5.59	5.36	14.06	19.40	10.41	6.21	4.54	5.78	5.53	5.00	7.44
8	5.44	5.54	5.42	15.30	18.57	10.17	6.26	4.63	5.66	5.50	5.03	7.40
9	5.51	5.57	5.43	16.91	17.87	10.10	5.90	4.78	5.42	5.11	5.18	6.75
10	5.57	5.56	5.42	18.57	17.17	9.84	5.60	4.87	5.00	4.92	5.18	5.66
11	5.63	5.56	5.57	20.20	16.49	9.89	5.08	4.88	4.53	5.13	5.18	5.66
12	5.76	5.55	5.70	21.49	15.86	10.51	5.15	4.75	4.50	5.33	5.18	5.96
13	5.82	5.54	5.86	22.60	15.19	11.66	5.72	4.95	4.55	5.22	4.94	6.17
14	5.90	5.45	5.83	23.22	14.57	11.92	5.75	5.09	5.21	5.28	5.05	6.10
15	5.86	5.23	5.83	23.72	14.26	12.50	5.95	5.02	5.32	5.47	5.14	5.75
16	5.84	5.21	5.80	23.60	13.72	12.67	5.98	4.99	5.31	5.60	5.07	5.71
17	5.67	5.21	6.27	23.48	13.00	12.69	6.26	5.39	5.01	5.75	5.10	5.39
18	5.49	5.21	6.64	22.94	12.39	12.77	6.09	5.28	5.13	5.56	5.26	5.13
19	5.40	5.46	6.41	22.72	12.19	12.87	5.80	5.22	5.09	5.31	5.22	4.98
20	5.17	5.66	6.14	22.34	11.88	13.11	5.71	5.14	5.13	5.06	5.43	5.11
21	5.15	5.62	5.94	21.92	11.48	13.21	5.74	5.13	5.38	4.91	5.65	5.27
22	5.13	5.61	6.01	21.56	11.36	13.37	5.74	5.11	5.48	4.63	5.83	5.20
23	5.18	5.60	6.20	21.34	10.98	13.38	5.80	5.31	5.20	4.82	6.18	5.39
24	5.58	5.59	6.16	21.34	11.24	13.31	5.84	4.84	4.82	4.90	6.49	5.09

Opening page http://www2.mvr.usace.army.mil/WaterControl/yearly_tables2.cfm?sid=MI11&from1=01/01/2001&to1=12/31/2001&dt=S...
Local intranet
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Go Links

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Latest Flow	49,733 CFS

7 Days | Stage

Plot | Tabulate

Daily Historic Data
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From JAN 1 2001

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US Army Corps of Engineers

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National Weather Service Products

Images For Mississippi River at Lock and Dam 11 (Dubuque,IA)

Poolside Close

Poolside Overview

Tailside Close

Done

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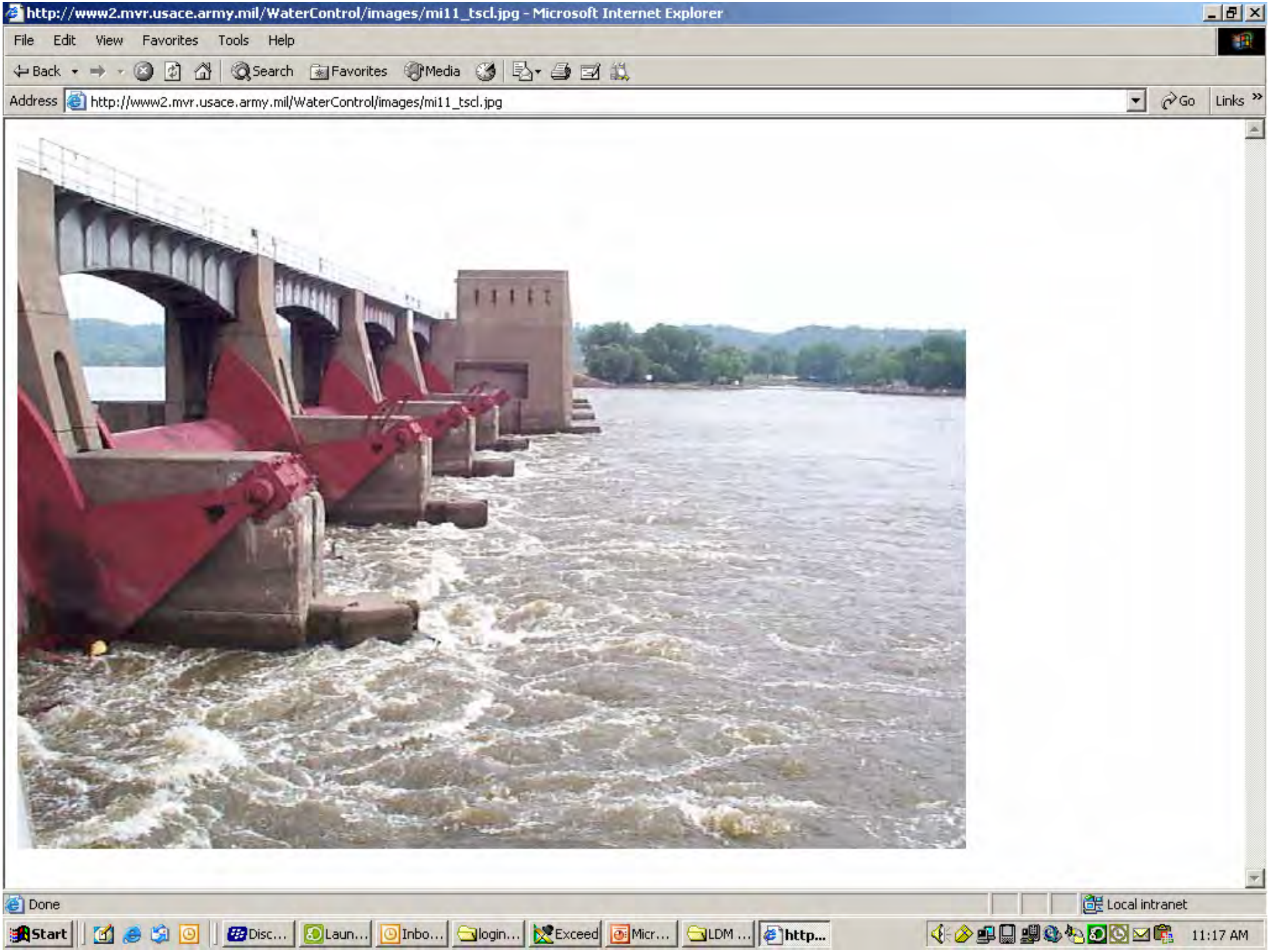
http://www2.mvr.usace.army.mil/WaterControl/images/mi11_tscl.jpg - Microsoft Internet Explorer
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Images For Mississippi River at Lock and Dam 11 (Dubuque,IA)

Poolside Close

Poolside Overview

Tailside Close

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7 Days | Stage

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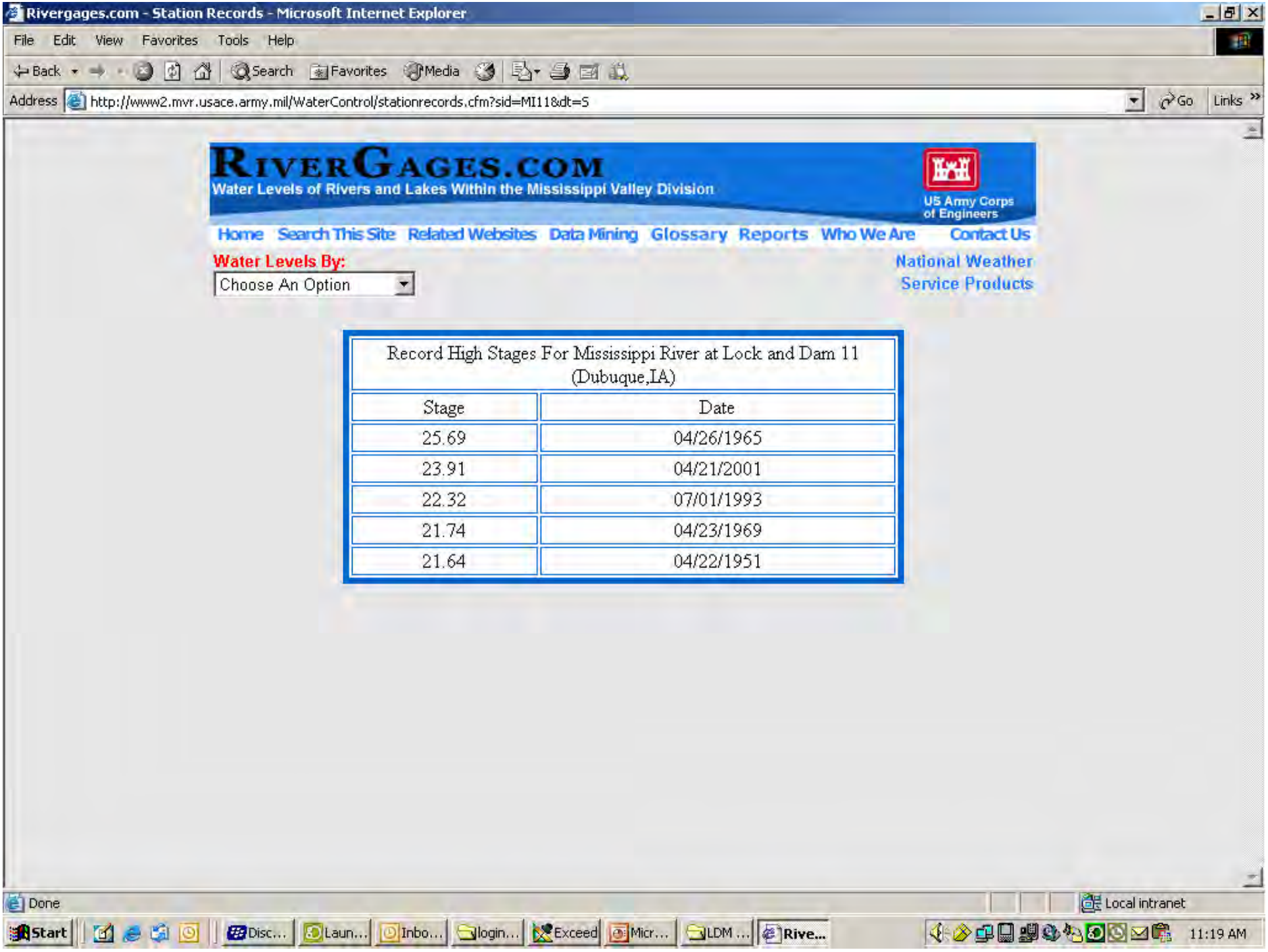
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National Weather Service Products
Record High Stages For Mississippi River at Lock and Dam 11 (Dubuque,IA)
Stage Date
25.69 04/26/1965
23.91 04/21/2001
22.32 07/01/1993
21.74 04/23/1969
21.64 04/22/1951
Done
Local intranet
Start
Disc... Laun... Inbo... login... Exceed Micr... LDM ... Rive...
11:19 AM

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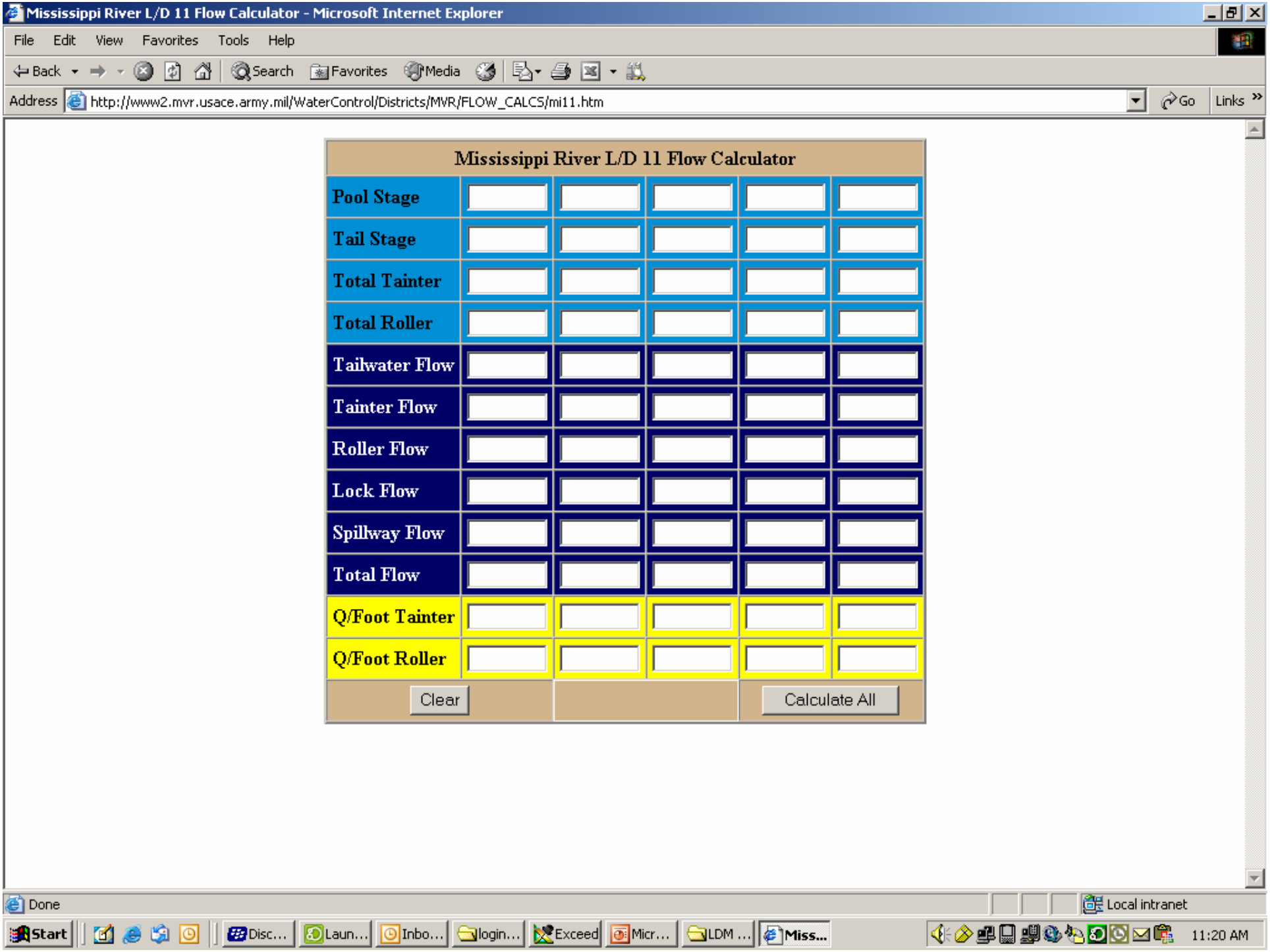
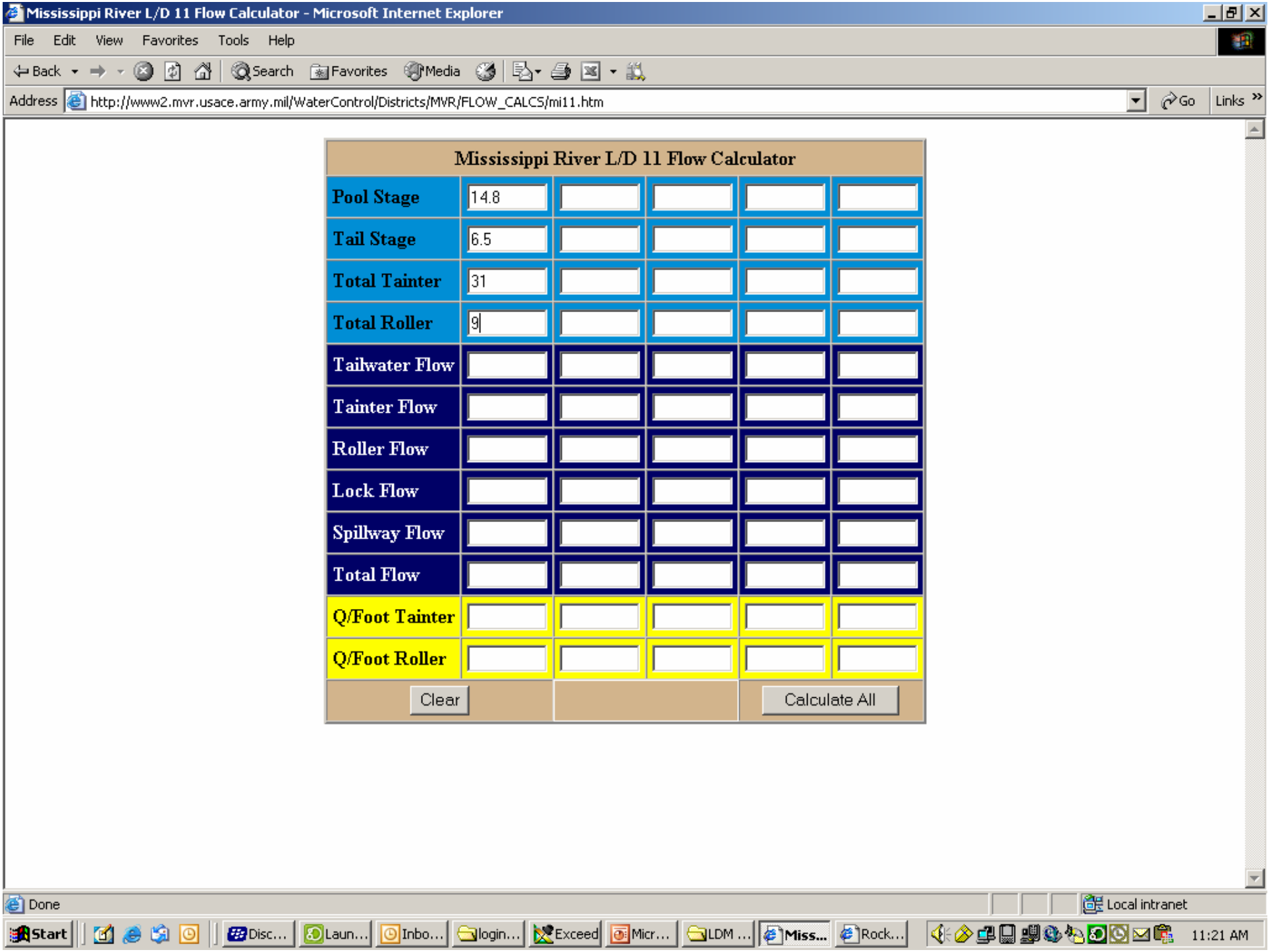
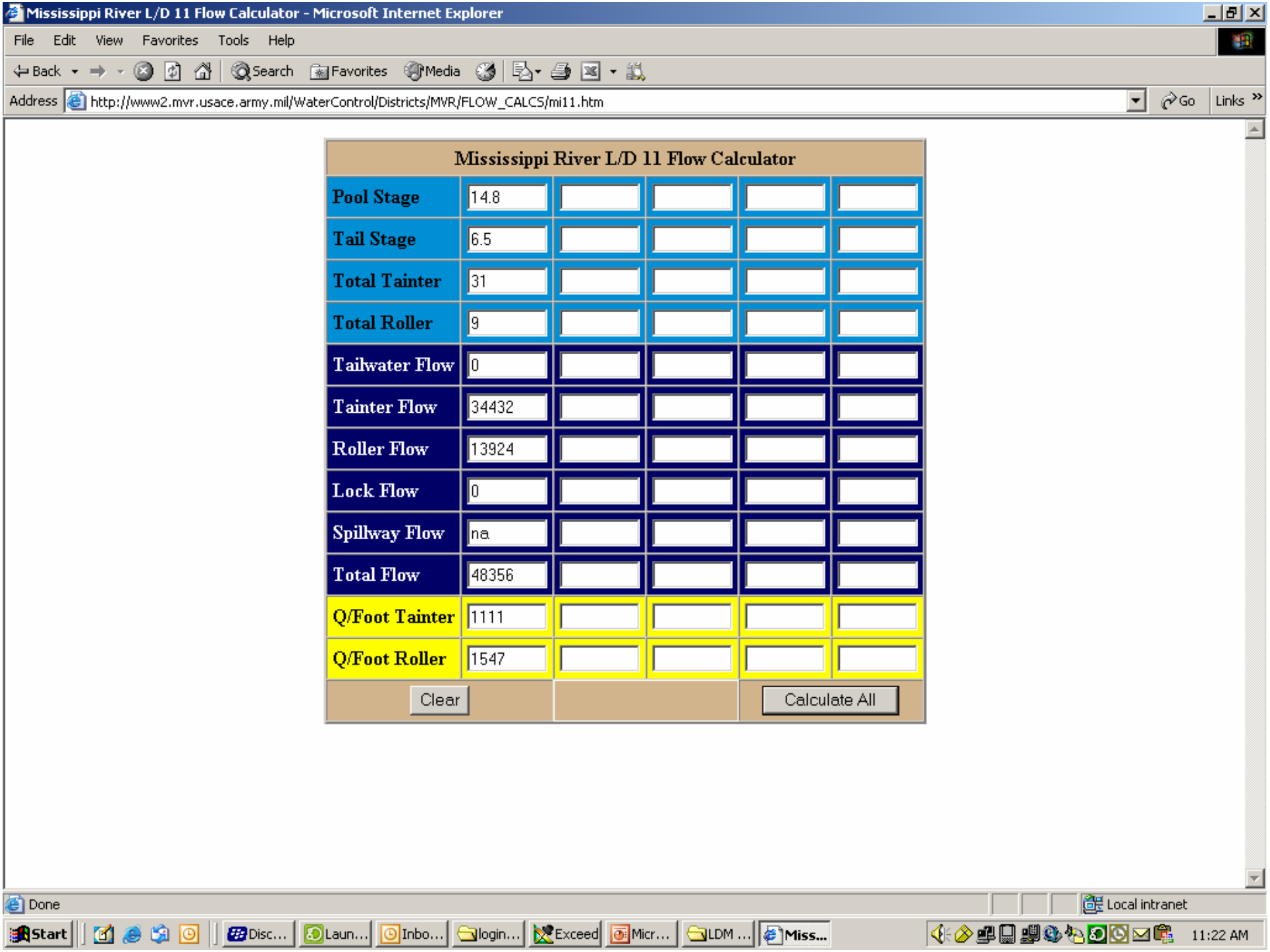

Mississippi River L/D 11 Flow Calculator - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://www2.mvr.usace.army.mil/WaterControl/Districts/MVR/FLOW_CALCS/mi11.htm
Go Links
Mississippi River L/D 11 Flow Calculator
Pool Stage
Tail Stage
Total Tainter
Total Roller
Tailwater Flow
Tainter Flow
Roller Flow
Lock Flow
Spillway Flow
Total Flow
Q/Foot Tainter
Q/Foot Roller
Clear
Calculate All
Done
Local intranet
Start
11:20 AM


Mississippi River L/D 11 Flow Calculator - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://www2.mvr.usace.army.mil/WaterControl/Districts/MVR/FLOW_CALCS/mi11.htm
Go Links
Mississippi River L/D 11 Flow Calculator
Pool Stage 14.8
Tail Stage 6.5
Total Tainter 31
Total Roller 9
Tailwater Flow
Tainter Flow
Roller Flow
Lock Flow
Spillway Flow
Total Flow
Q/Foot Tainter
Q/Foot Roller
Clear
Calculate All
Done
Local intranet
Start
11:21 AM


Mississippi River L/D 11 Flow Calculator - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://www2.mvr.usace.army.mil/WaterControl/Districts/MVR/FLOW_CALCS/mi11.htm
Go Links
Mississippi River L/D 11 Flow Calculator
Pool Stage 14.8
Tail Stage 6.5
Total Tainter 31
Total Roller 9
Tailwater Flow 0
Tainter Flow 34432
Roller Flow 13924
Lock Flow 0
Spillway Flow na
Total Flow 48356
Q/Foot Tainter 1111
Q/Foot Roller 1547
Clear
Calculate All
Done
Local intranet
Start
11:22 AM

Rivergages.com - Station Information ForMississippi River at Lock and Dam 11 (Dubuque,IA) - Microsoft Internet Explorer

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7 Days | Stage

Plot | Tabulate

Daily Historic Data
(06:00 Reading)

From JAN 1 2001

To DEC 31 2001

Stage

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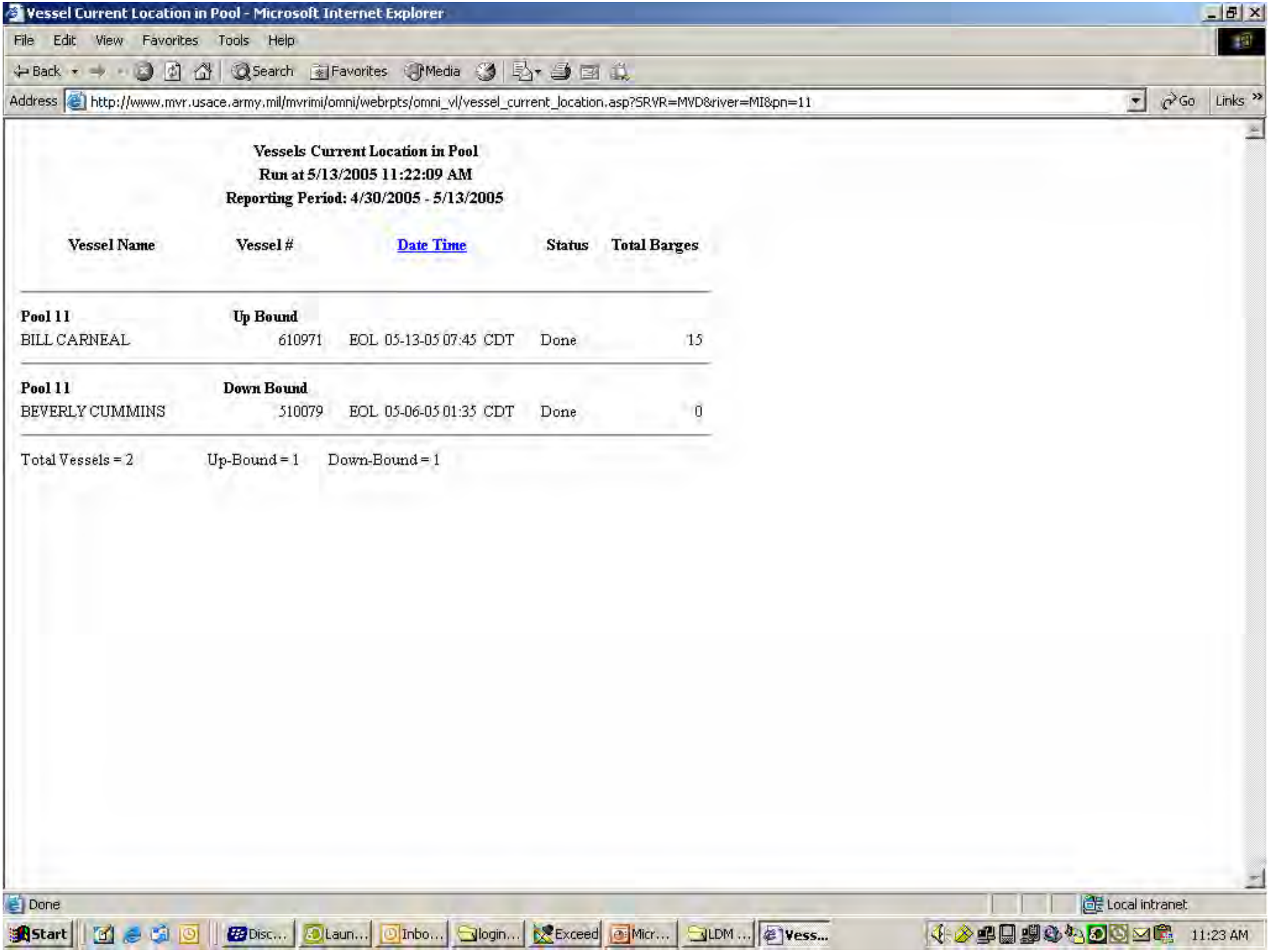
Vessel Current Location in Pool - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://www.mvr.usace.army.mil/mvrimi/omni/webrpts/omni_vl/vessel_current_location.asp?SRVR=MVD&river=MI&pn=11
Go Links
Vessels Current Location in Pool
Run at 5/13/2005 11:22:09 AM
Reporting Period: 4/30/2005 - 5/13/2005
Vessel Name Vessel # Date Time Status Total Barges
Pool 11 Up Bound
BILL CARNEAL 610971 EOL 05-13-05 07:45 CDT Done 15
Pool 11 Down Bound
BEVERLY CUMMINS 510079 EOL 05-06-05 01:35 CDT Done 0
Total Vessels = 2 Up-Bound = 1 Down-Bound = 1
Done
Local intranet
Start
Disc... Laun... Inbo... login... Exceed Micr... LDM ... Vess...
11:23 AM

Rivergages.com - Station Information ForMississippi River at Lock and Dam 11 (Dubuque,IA) - Microsoft Internet Explorer

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7 Days | Stage

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To DEC 31 2001

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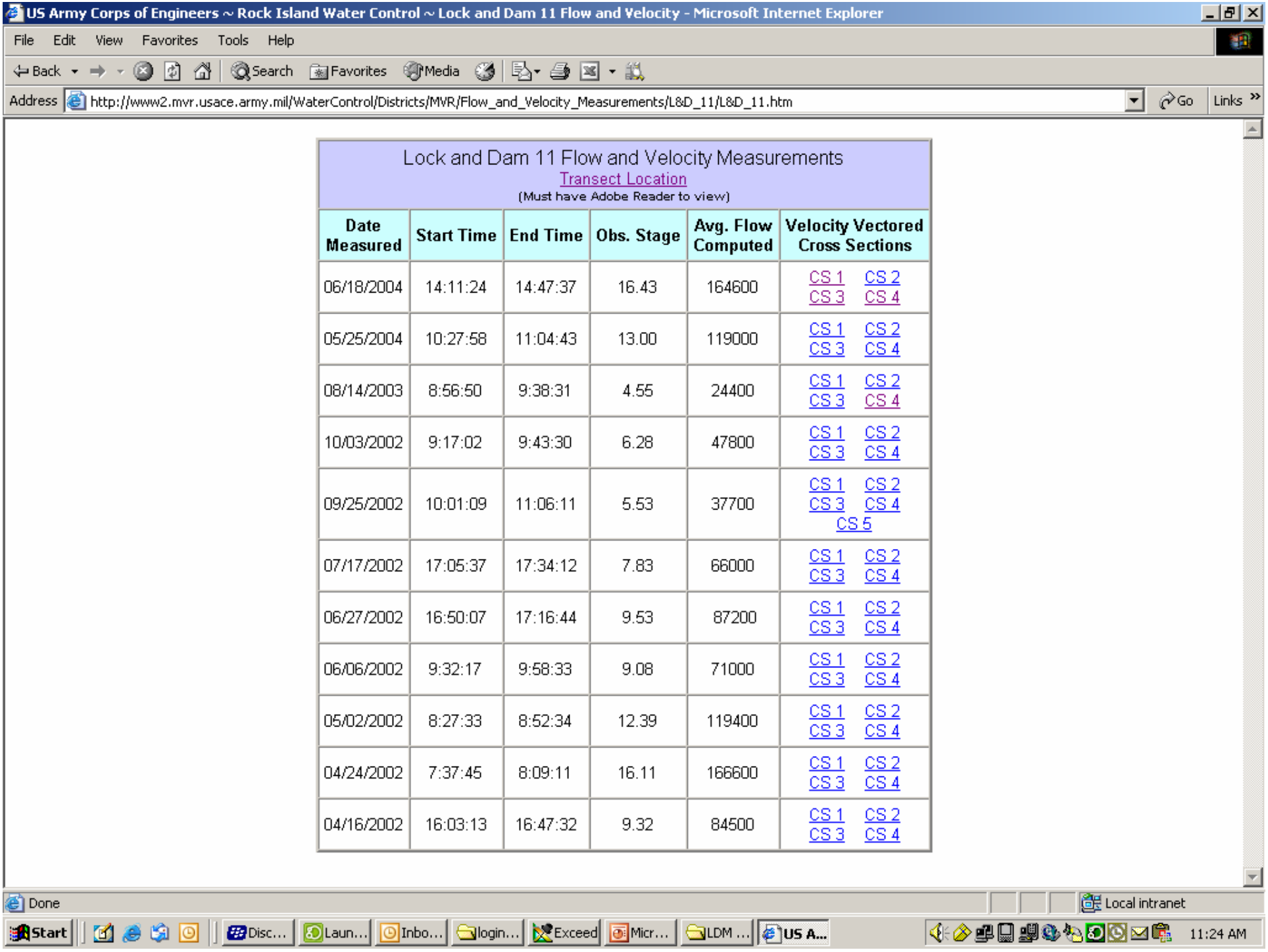
Local intranet

Start Disc... Laun... Inbo... login... Exceed Micr... LDM ... Rive... 11:23 AM



Lock and Dam 11 Flow and Velocity Measurements

Transect Location

(Must have Adobe Reader to view)

Date Measured	Start Time	End Time	Obs. Stage	Avg. Flow Computed	Velocity Vectored Cross Sections
06/18/2004	14:11:24	14:47:37	16.43	164600	CS 1 CS 2 CS 3 CS 4
05/25/2004	10:27:58	11:04:43	13.00	119000	CS 1 CS 2 CS 3 CS 4
08/14/2003	8:56:50	9:38:31	4.55	24400	CS 1 CS 2 CS 3 CS 4
10/03/2002	9:17:02	9:43:30	6.28	47800	CS 1 CS 2 CS 3 CS 4
09/25/2002	10:01:09	11:06:11	5.53	37700	CS 1 CS 2 CS 3 CS 4 CS 5
07/17/2002	17:05:37	17:34:12	7.83	66000	CS 1 CS 2 CS 3 CS 4
06/27/2002	16:50:07	17:16:44	9.53	87200	CS 1 CS 2 CS 3 CS 4
06/06/2002	9:32:17	9:58:33	9.08	71000	CS 1 CS 2 CS 3 CS 4
05/02/2002	8:27:33	8:52:34	12.39	119400	CS 1 CS 2 CS 3 CS 4
04/24/2002	7:37:45	8:09:11	16.11	166600	CS 1 CS 2 CS 3 CS 4
04/16/2002	16:03:13	16:47:32	9.32	84500	CS 1 CS 2 CS 3 CS 4

L&D 11 Velocity 06/18/04-1 - Microsoft Internet Explorer

File Edit View Favorites Tools Help

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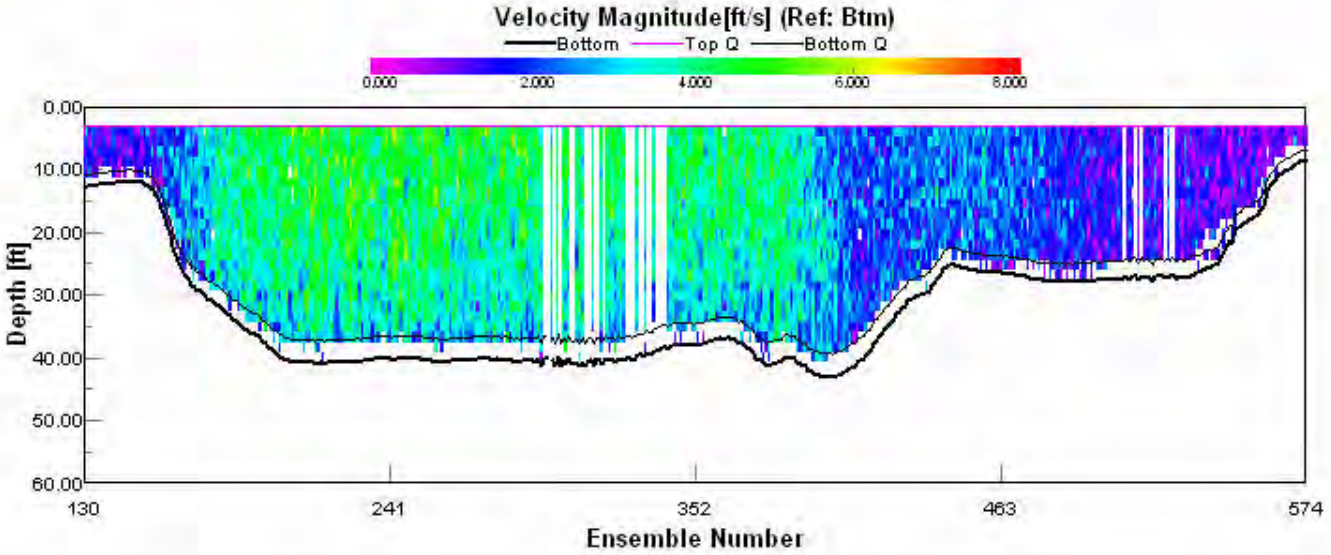
Address http://www2.mvr.usace.army.mil/WaterControl/Districts/MVR/Flow_and_Velocity_Measurements/L&D_11/L&D11_Velocity061804-1.htm

Go Links

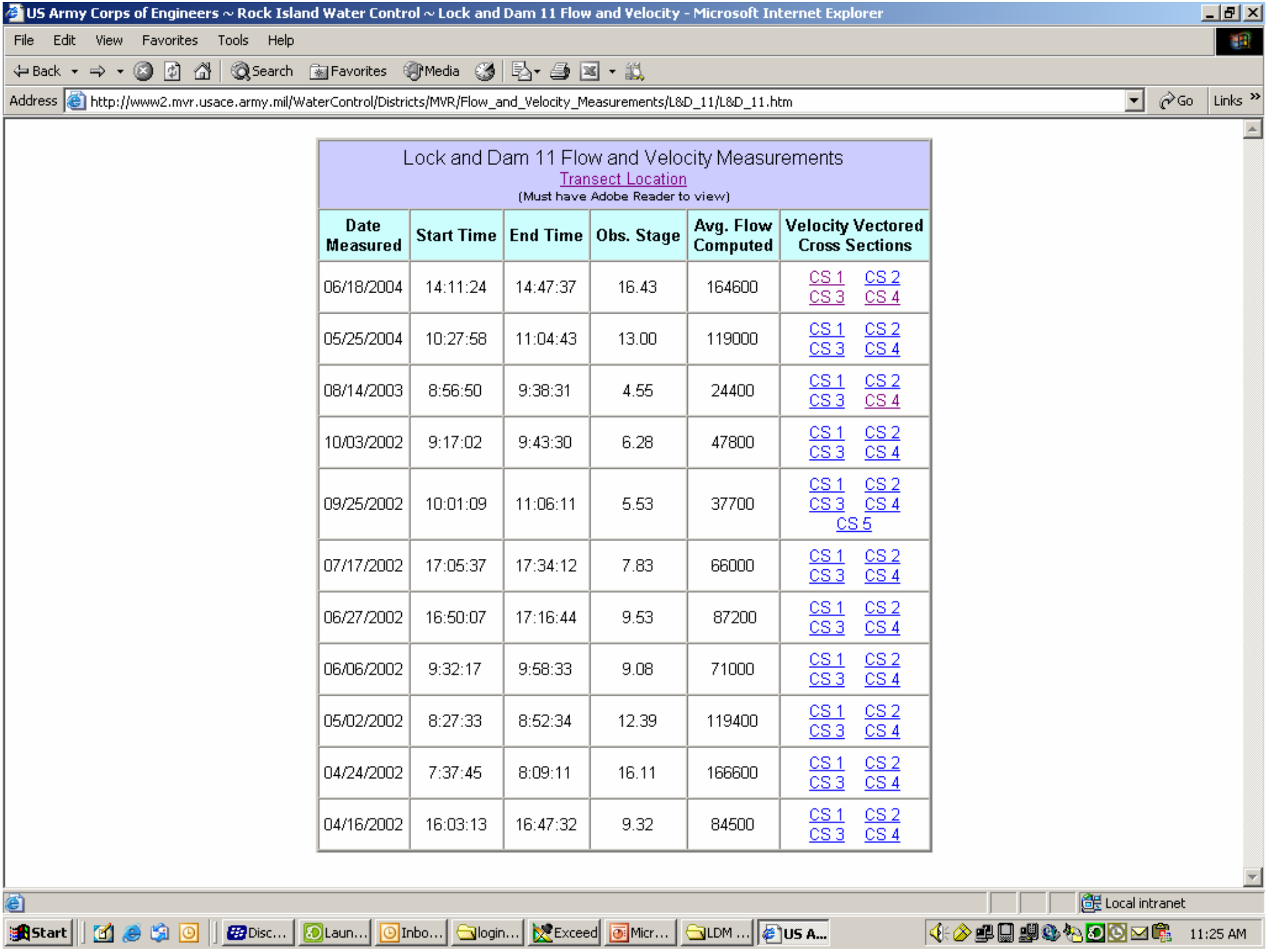


Return to L&D 11

Done

Local intranet

Start Disc... Laun... Inbo... login... Exceed Micr... LDM ... L&D ... 11:24 AM



Lock and Dam 11 Flow and Velocity Measurements

Transect Location

(Must have Adobe Reader to view)

Date Measured	Start Time	End Time	Obs. Stage	Avg. Flow Computed	Velocity Vectored Cross Sections
06/18/2004	14:11:24	14:47:37	16.43	164600	CS 1 CS 2 CS 3 CS 4
05/25/2004	10:27:58	11:04:43	13.00	119000	CS 1 CS 2 CS 3 CS 4
08/14/2003	8:56:50	9:38:31	4.55	24400	CS 1 CS 2 CS 3 CS 4
10/03/2002	9:17:02	9:43:30	6.28	47800	CS 1 CS 2 CS 3 CS 4
09/25/2002	10:01:09	11:06:11	5.53	37700	CS 1 CS 2 CS 3 CS 4 CS 5
07/17/2002	17:05:37	17:34:12	7.83	66000	CS 1 CS 2 CS 3 CS 4
06/27/2002	16:50:07	17:16:44	9.53	87200	CS 1 CS 2 CS 3 CS 4
06/06/2002	9:32:17	9:58:33	9.08	71000	CS 1 CS 2 CS 3 CS 4
05/02/2002	8:27:33	8:52:34	12.39	119400	CS 1 CS 2 CS 3 CS 4
04/24/2002	7:37:45	8:09:11	16.11	166600	CS 1 CS 2 CS 3 CS 4
04/16/2002	16:03:13	16:47:32	9.32	84500	CS 1 CS 2 CS 3 CS 4

L&D 11 Velocity 08/14/03-1 - Microsoft Internet Explorer

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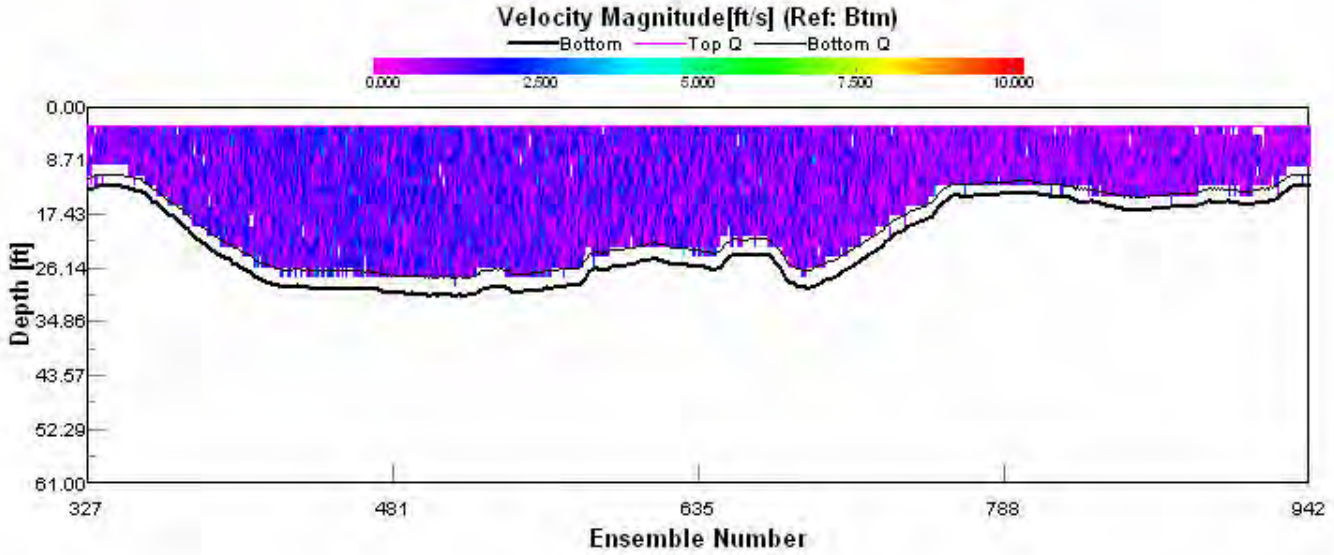
Address http://www2.mvr.usace.army.mil/WaterControl/Districts/MVR/Flow_and_Velocity_Measurements/L&D_11/L&D11_Velocity081403-1.htm

Go Links

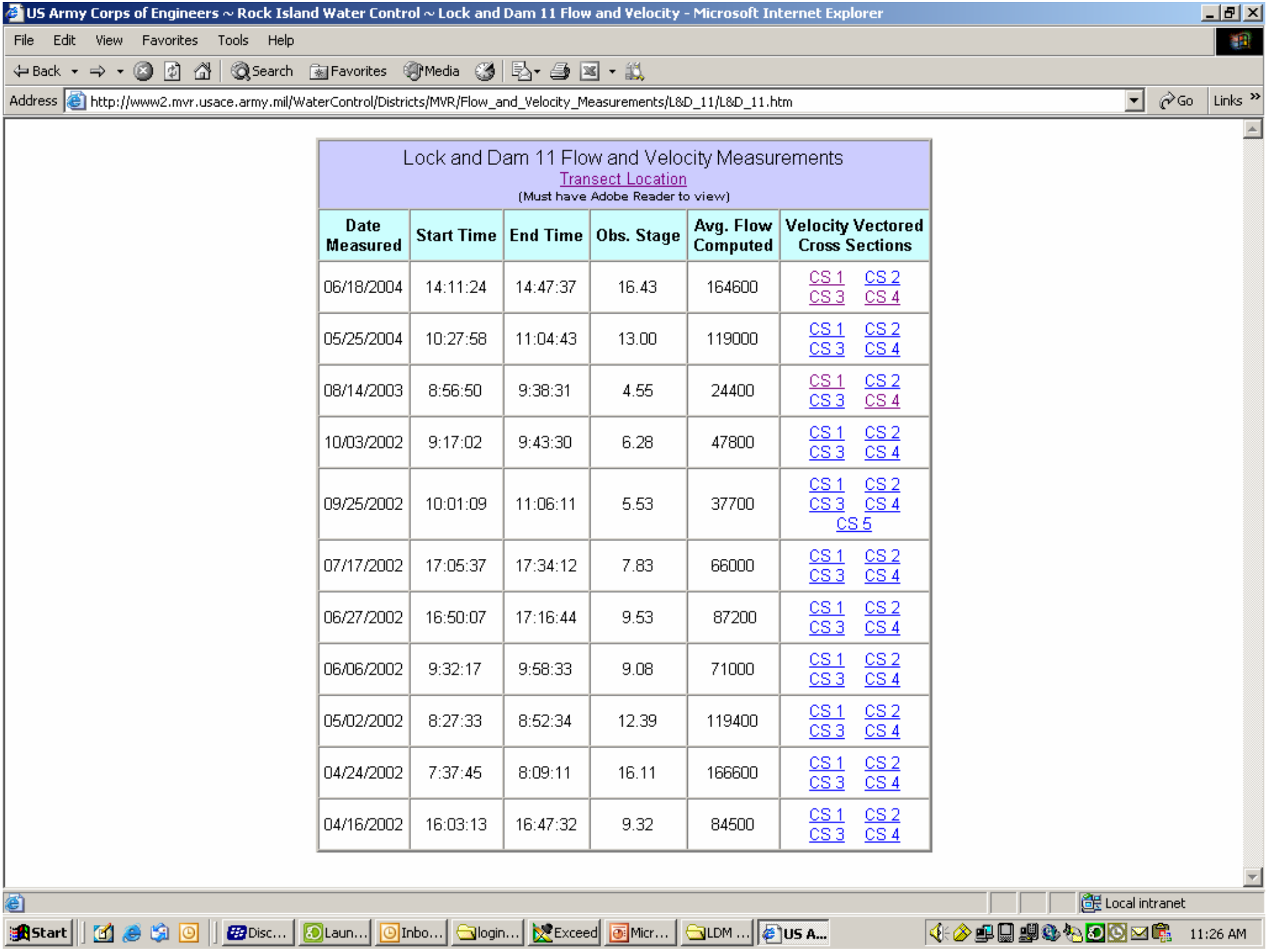


Return to L&D 11

Done

Local intranet

Start Disc... Laun... Inbo... login... Exceed Micr... LDM ... L&D ... 11:25 AM



Lock and Dam 11 Flow and Velocity Measurements

Transect Location

(Must have Adobe Reader to view)

Date Measured	Start Time	End Time	Obs. Stage	Avg. Flow Computed	Velocity Vectored Cross Sections
06/18/2004	14:11:24	14:47:37	16.43	164600	CS 1 CS 2 CS 3 CS 4
05/25/2004	10:27:58	11:04:43	13.00	119000	CS 1 CS 2 CS 3 CS 4
08/14/2003	8:56:50	9:38:31	4.55	24400	CS 1 CS 2 CS 3 CS 4
10/03/2002	9:17:02	9:43:30	6.28	47800	CS 1 CS 2 CS 3 CS 4
09/25/2002	10:01:09	11:06:11	5.53	37700	CS 1 CS 2 CS 3 CS 4 CS 5
07/17/2002	17:05:37	17:34:12	7.83	66000	CS 1 CS 2 CS 3 CS 4
06/27/2002	16:50:07	17:16:44	9.53	87200	CS 1 CS 2 CS 3 CS 4
06/06/2002	9:32:17	9:58:33	9.08	71000	CS 1 CS 2 CS 3 CS 4
05/02/2002	8:27:33	8:52:34	12.39	119400	CS 1 CS 2 CS 3 CS 4
04/24/2002	7:37:45	8:09:11	16.11	166600	CS 1 CS 2 CS 3 CS 4
04/16/2002	16:03:13	16:47:32	9.32	84500	CS 1 CS 2 CS 3 CS 4

Rivergages.com - Station Information ForMississippi River at Lock and Dam 11 (Dubuque,IA) - Microsoft Internet Explorer

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Address http://www2.mvr.usace.army.mil/WaterControl/stationinfo2.cfm?sid=MI11&fid=DLDI4&dt=S

Go Links

This gage is operated by the US Army Corps of Engineers (Rock Island District).

Latest Data
05/13/2005 08:00

Latest Stage	6.41 Ft.
24 Hr. Change	+0.41 Ft.
Tomorrow's Forecast (Issued 05/13/2005 10:42)	6.60 Ft. Plot Forecast
Last Year's Stage	6.11 Ft.
Today's Historic Normal Stage	9.68 Ft.
Today's Historic Max Stage	19.40 Ft.
Today's Historic Min Stage	4.20 Ft.
Latest Pool Level	15.18 Ft.
24 Hr. Change	+0.30 Ft.
Last Year's Pool Level	14.74 Ft.
Latest Flow	49,733 CFS

7 Days | Stage

Plot | Tabulate

Daily Historic Data
(06:00 Reading)

From JAN 1 2001

To DEC 31 2001

Stage

Plot | Tabulate | Tabulate (Yearly Formatted)

View All Images

Additional Links:

View Record Stage High / Lows

Flow Calculator for L&D 11

Vessels in POOL 11

Flow and Velocity Measurements

Historic Flood Profiles (Pool 11)

US Army Corps of Engineers - Rock Island District - Water Control Center - Contact Us

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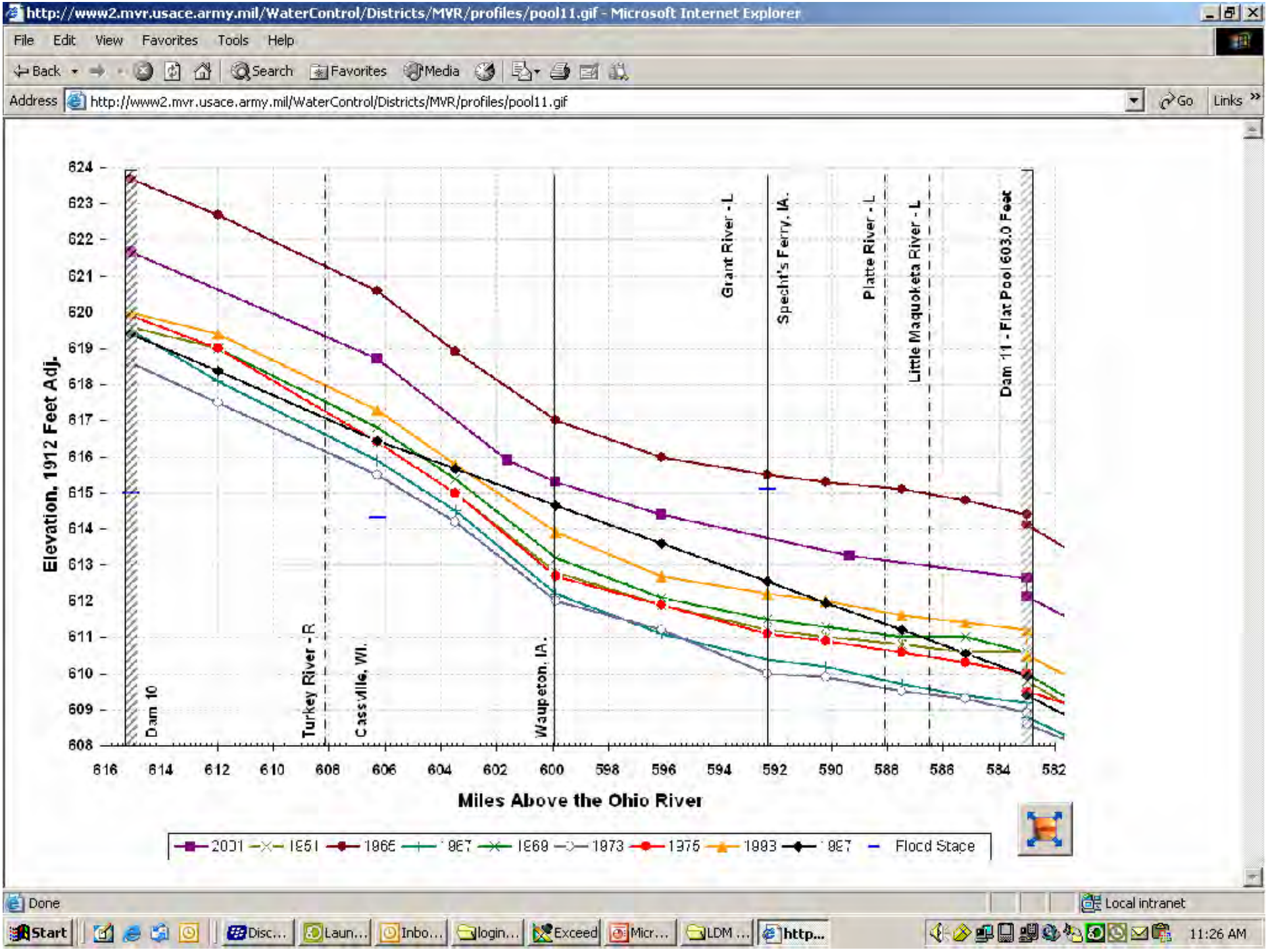
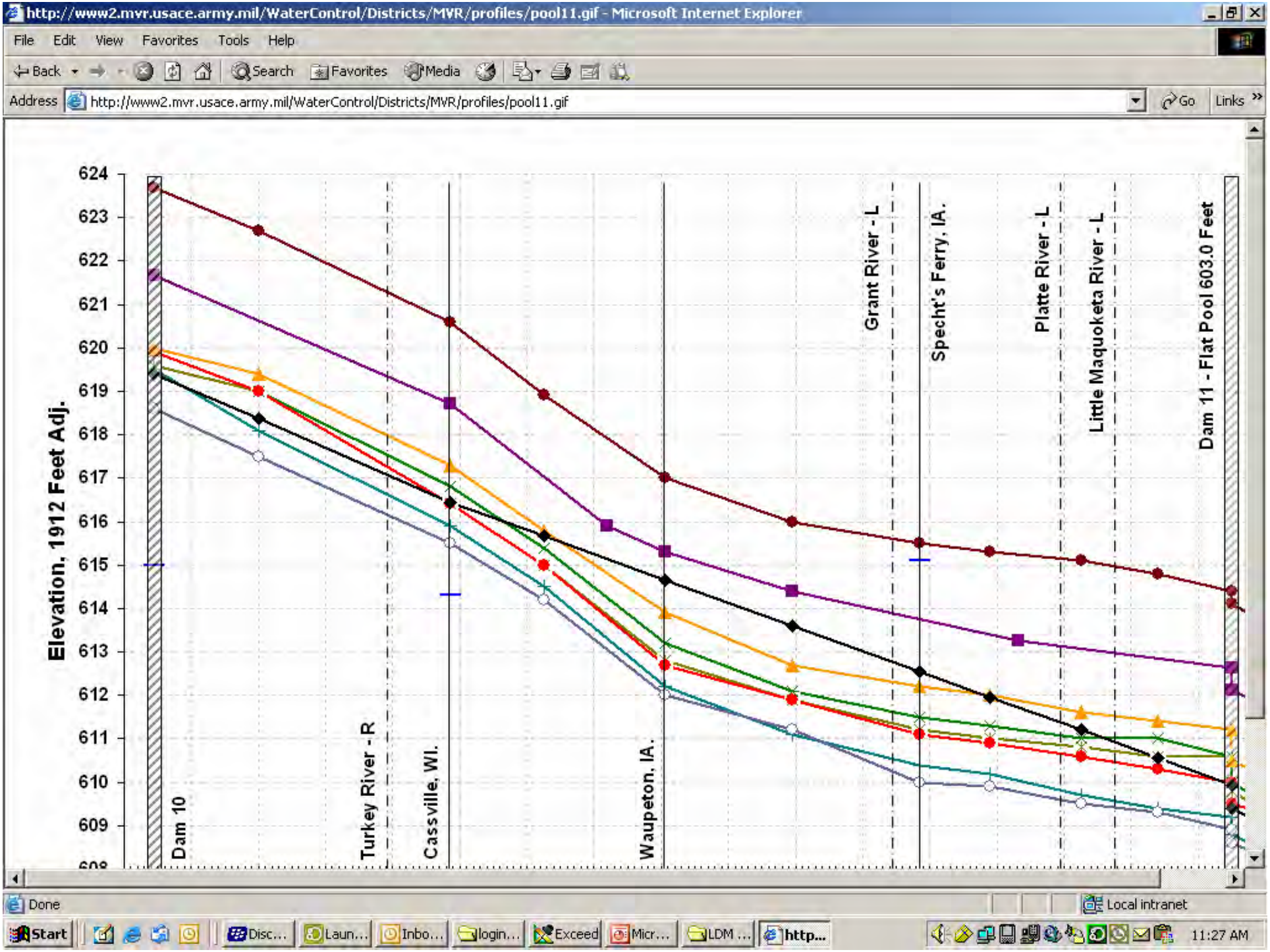

http://www2.mvr.usace.army.mil/WaterControl/Districts/MVR/profiles/pool11.gif - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://www2.mvr.usace.army.mil/WaterControl/Districts/MVR/profiles/pool11.gif
Go Links
Elevation, 1912 Feet Adj.
624
623
622
621
620
619
618
617
616
615
614
613
612
611
610
609
608
Dam 10
Turkey River - R
Cassville, WI.
Wauperon, IA.
Grant River - L
Specht's Ferry, IA.
Platte River - L
Little Maquoketa River - L
Dam 11 - Flat Pool 603.0 Feet
616 614 612 610 608 606 604 602 600 598 596 594 592 590 588 586 584 582
Miles Above the Ohio River
2001 1951 1965 1967 1969 1973 1975 1993 1987 Flood Stage
Done
Local intranet
Start
Disc... Laun... Inbo... login... Exceed Micr... LDM ... http...
11:26 AM


http://www2.mvr.usace.army.mil/WaterControl/Districts/MVR/profiles/pool11.gif - Microsoft Internet Explorer
File Edit View Favorites Tools Help
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Address http://www2.mvr.usace.army.mil/WaterControl/Districts/MVR/profiles/pool11.gif
Go Links
Elevation, 1912 Feet Adj.
624
623
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Dam 10
Turkey River - R
Cassville, WI.
Waupeton, IA.
Grant River - L
Specht's Ferry, IA.
Platte River - L
Little Maquoketa River - L
Dam 11 - Flat Pool 603.0 Feet
Done
Local intranet
Start
Disc...
Laun...
Inbo...
login...
Exceed
Micr...
LDM ...
http...
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Rivergages.com - Station Information ForMississippi River at Lock and Dam 11 (Dubuque,IA) - Microsoft Internet Explorer

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Address http://www2.mvr.usace.army.mil/WaterControl/stationinfo2.cfm?sid=MI11&fid=DLDI4&dt=S

Go Links

This gage is operated by the US Army Corps of Engineers (Rock Island District).

Latest Data
05/13/2005 08:00

Latest Stage	6.41 Ft.
24 Hr. Change	+0.41 Ft.
Tomorrow's Forecast (Issued 05/13/2005 10:42)	6.60 Ft. Plot Forecast
Last Year's Stage	6.11 Ft.
Today's Historic Normal Stage	9.68 Ft.
Today's Historic Max Stage	19.40 Ft.
Today's Historic Min Stage	4.20 Ft.
Latest Pool Level	15.18 Ft.
24 Hr. Change	+0.30 Ft.
Last Year's Pool Level	14.74 Ft.
Latest Flow	49,733 CFS

7 Days — Plot

Stage — Tabulate

Daily Historic Data
(06:00 Reading)

From JAN 1 2001

To DEC 31 2001

Stage

Plot Tabulate Tabulate (Yearly Formatted)

View All Images

Additional Links:

View Record Stage High / Lows
Flow Calculator for L&D 11
Vessels in POOL 11
Flow and Velocity Measurements
Historic Flood Profiles (Pool 11)

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Rivergages.com: Providing River Gage Data for the Rivers, Streams, and Tributaries Along the Mi - Microsoft Internet Explorer
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View All Stations In This Basin
View All Values In Stage
View All Values In Elevation
STATION
* Currently Forecasted Station
FLOOD STAGE
LATEST LEVEL
24 Hr CHANGE
24 Hr PRECIP
Continue Upstream
* Mississippi River at Guttenburg, IA
as of 05/13/2005 10:00
15
6.77
+0.05
0.16
Grant River near Burton,WI
as of 05/13/2005 10:00
18
4.89
-0.16
0.24
Mississippi River at Lock and Dam 11 (POOL)
as of 05/13/2005 08:00
15.18
+0.50
* Mississippi River at Lock and Dam 11 (Dubuque,IA)
as of 05/13/2005 08:00
16
6.41
+0.41
* Mississippi River at Lock and Dam 11 (Auxiliary Gage)
as of 05/13/2005 10:00
16
6.48
+0.34
* Mississippi River at Lock and Dam 11 (MET Station)
as of 05/13/2005 10:00
16
0.23
* Mississippi River at Dubuque,IA
as of 05/13/2005 10:00
17
9.15
+0.31
0.32
Galena River at Bucombe,WI
15
2.88
+0.01
0.10
Local intranet
Start
11:28 AM

Rivergages.com - Current Hydrograph ForMississippi River at Lock and Dam 11 (Dubuque,IA) - Microsoft Internet Explorer

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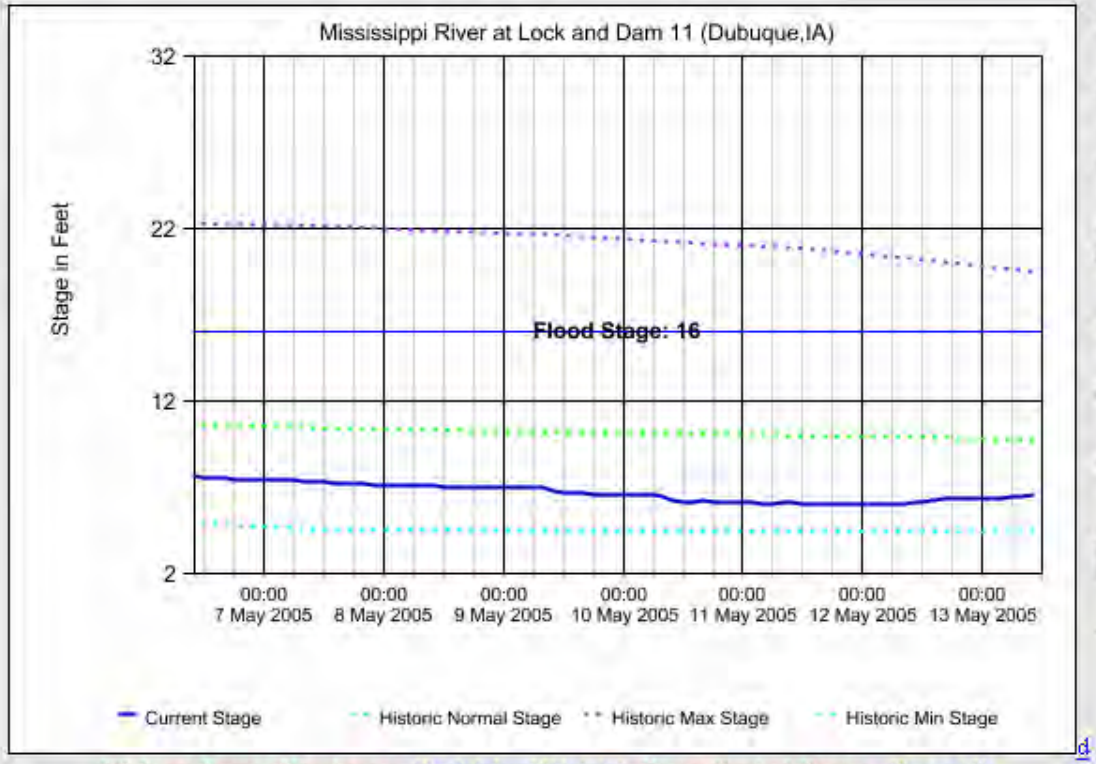
Address http://www2.mvr.usace.army.mil/WaterControl/shefgraph-wotem2.cfm?sid=MI11&dt=S&d=7 Go Links



Flood Stage
On Off

Record High Stage
On Off

L&D12 Flat Pool
On Off

Lock Closed Stage (APPROXIMATE)
On Off

Normal Values
On Off

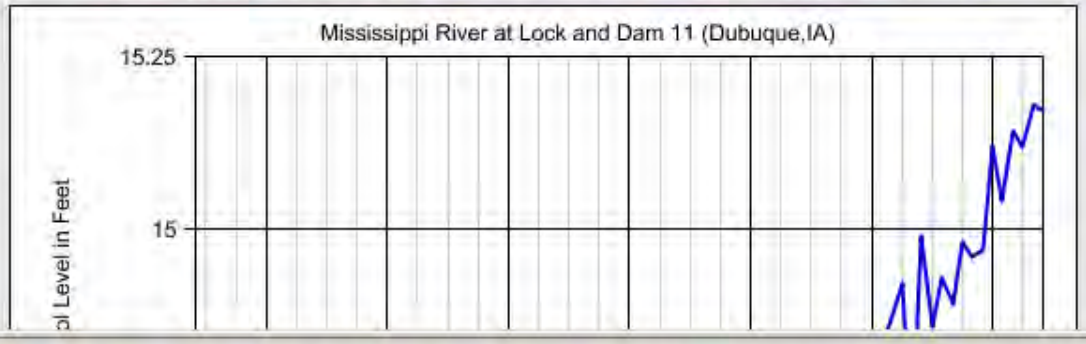
Max Values
On Off

Min Values
On Off

Historic Year
None

View Graph

US Army Corps of Engineers - Rock Island District - Water Control Center - Contact Us



Done Local intranet

Start Disc... Laun... Inbo... login... Exceed Micr... LDM ... Rive... 11:39 AM

Rivergages.com: Providing River Gage Data for the Rivers, Streams, and Tributaries Along the Mi - Microsoft Internet Explorer
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View All Stations In This Basin
View All Values In Stage
View All Values In Elevation
STATION
* Currently Forecasted Station
FLOOD STAGE
LATEST LEVEL
24 Hr CHANGE
24 Hr PRECIP
Continue Upstream
* Mississippi River at Guttenburg, IA
as of 05/13/2005 10:00
15
6.77
+0.05
0.16
Grant River near Burton,WI
as of 05/13/2005 10:00
18
4.89
-0.16
0.24
Mississippi River at Lock and Dam 11 (POOL)
as of 05/13/2005 08:00
15.18
+0.50
* Mississippi River at Lock and Dam 11 (Dubuque,IA)
as of 05/13/2005 08:00
16
6.41
+0.41
* Mississippi River at Lock and Dam 11 (Auxiliary Gage)
as of 05/13/2005 10:00
16
6.48
+0.34
* Mississippi River at Lock and Dam 11 (MET Station)
as of 05/13/2005 10:00
16
0.23
* Mississippi River at Dubuque,IA
as of 05/13/2005 10:00
17
9.15
+0.31
0.32
Galena River at Bucombe,WI
15
2.88
+0.01
0.10
Local intranet
Start
11:39 AM

Rivergages.com - SHEF Data ForMississippi River at Lock and Dam 11 (Dubuque,IA) - Microsoft Internet Explorer

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Address http://www2.mvr.usace.army.mil/WaterControl/shefdata2.cfm?sid=MI11&dt=S

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Water Levels of Rivers and Lakes Within the Mississippi Valley Division

US Army Corps of Engineers

Mississippi River at Lock and Dam 11 (Dubuque,IA)

Stream Name: Mississippi River
Gage Zero: 588.20 Ft. MSL 1912
Flood Stage:16 Ft.
Record High Stage:25.69 Ft.

Longitude: -90.64639000
Latitude: 42.53861000
River Mile: 583 miles above the mouth of the Ohio River
Record High Stage Date: 04/26/1965

Location of Gage: Pool No. 11 extends from Dubuque northwesterly 32.1 river miles to Guttenburg, IA. Lock and Dam 11 is located at 11 Lime Street, at the foot of the bluff below Eagle Point Park. It is 2.7 river miles upstream of the Highway 151 bridge.

This gage is operated by the US Army Corps of Engineers (Rock Island District).

Download Data

Date / Time	Stage (Ft)	Pool Level (Ft)	Tainter (Ft)	Roller (Ft)	Flow (CFS)
05/13/2005 10:00	6.51	15.17	34.00	9.00	53,152
05/13/2005 08:00	6.41	15.18	31.00	9.00	49,733
05/13/2005 06:00	6.36	15.12	31.00	9.00	49,720
05/13/2005 04:00	6.35	15.14	31.00	9.00	49,808
05/13/2005 02:00	6.31	15.04	31.00	9.00	49,650
05/13/2005 00:00	6.30	15.12	31.00	9.00	49,909
05/12/2005 22:00	6.30	14.97	31.00	9.00	49,483
05/12/2005 20:00	6.28	14.96	31.00	9.00	49,517
05/12/2005 18:00	6.26	14.98	31.00	9.00	49,637

Done Local intranet

Start Disc... Laun... Inbo... login... Exceed Micr... LDM ... Rive... 11:40 AM

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STATION
* Currently Forecasted Station
FLOOD STAGE
LATEST LEVEL
24 Hr CHANGE
24 Hr PRECIP
Continue Upstream
* Mississippi River at Guttenburg, IA
as of 05/13/2005 10:00
15
6.77
+0.05
0.16
Grant River near Burton,WI
as of 05/13/2005 10:00
18
4.89
-0.16
0.24
Mississippi River at Lock and Dam 11 (POOL)
as of 05/13/2005 08:00
15.18
+0.50
* Mississippi River at Lock and Dam 11 (Dubuque,IA)
as of 05/13/2005 08:00
16
6.41
+0.41
* Mississippi River at Lock and Dam 11 (Auxiliary Gage)
as of 05/13/2005 10:00
16
6.48
+0.34
* Mississippi River at Lock and Dam 11 (MET Station)
as of 05/13/2005 10:00
16
0.23
* Mississippi River at Dubuque,IA
as of 05/13/2005 10:00
17
9.15
+0.31
0.32
Galena River at Bucombe,WI
15
2.88
+0.01
0.10
Local intranet
Start
11:40 AM

Rivergages.com - Precipitation Total (In.) - Microsoft Internet Explorer
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Address http://www2.mvr.usace.army.mil/WaterControl/precipitation2.cfm?bid=18&did=6
Go Links

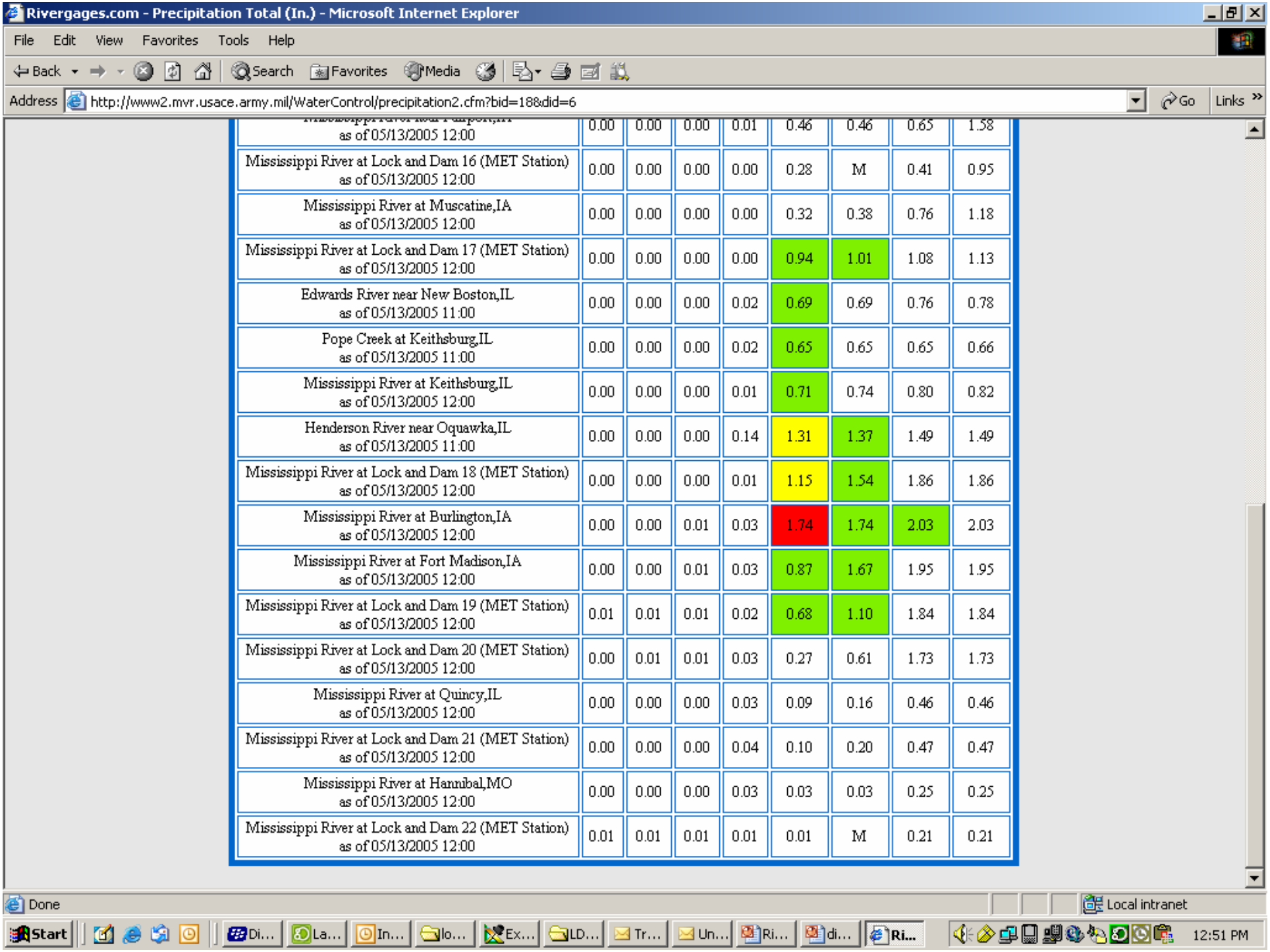
Precipitation Total (In.)

Mississippi River & Passes

Intensity Level: Low Medium High

STATION	1 Hr	2 Hrs	3 Hrs	6 Hrs	12 Hrs	24 Hrs	48 Hrs	72 Hrs
Mississippi River at Guttenburg, IA as of 05/13/2005 12:00	0.00	0.00	0.00	0.00	0.07	0.16	0.16	0.47
Grant River near Burton,WI as of 05/13/2005 12:00	0.00	0.00	0.00	0.02	0.09	0.24	0.26	0.81
Mississippi River at Lock and Dam 11 (MET Station) as of 05/13/2005 12:00	0.00	0.00	0.00	0.00	0.13	0.23	0.23	0.67
Mississippi River at Dubuque,IA as of 05/13/2005 12:00	0.00	0.00	0.00	0.04	0.23	0.32	0.32	0.92
Galena River at Bucombe,WI as of 05/13/2005 11:00	0.00	0.00	0.00	0.00	0.10	0.10	0.10	0.37
Mississippi River at Lock and Dam 12 (MET Station) as of 05/13/2005 12:00	0.00	0.00	0.00	0.00	0.61	0.77	0.83	1.19
Mississippi River at Lock and Dam 13 (MET Station) as of 05/13/2005 12:00	0.00	0.00	0.00	0.01	0.41	0.41	0.51	1.16
Mississippi River at Lock and Dam 14 (MET Station) as of 05/13/2005 12:00	0.00	0.00	0.00	0.00	0.40	0.40	0.48	2.00
Mississippi River at Lock and Dam 15 (MET Station) as of 05/13/2005 12:00	0.00	0.00	0.00	0.00	0.46	0.46	0.67	2.43
Mississippi River near Fairport,IA	0.00	0.00	0.00	0.01	0.46	0.46	0.65	1.58

Done
Local intranet
Start Di... La... In... lo... Ex... LD... Tr... Un... Ri... di... Ri... 12:50 PM



as of 05/13/2005 12:00	0.00	0.00	0.00	0.01	0.46	0.46	0.65	1.58
Mississippi River at Lock and Dam 16 (MET Station) as of 05/13/2005 12:00	0.00	0.00	0.00	0.00	0.28	M	0.41	0.95
Mississippi River at Muscatine,IA as of 05/13/2005 12:00	0.00	0.00	0.00	0.00	0.32	0.38	0.76	1.18
Mississippi River at Lock and Dam 17 (MET Station) as of 05/13/2005 12:00	0.00	0.00	0.00	0.00	0.94	1.01	1.08	1.13
Edwards River near New Boston,IL as of 05/13/2005 11:00	0.00	0.00	0.00	0.02	0.69	0.69	0.76	0.78
Pope Creek at Keithsburg,IL as of 05/13/2005 11:00	0.00	0.00	0.00	0.02	0.65	0.65	0.65	0.66
Mississippi River at Keithsburg,IL as of 05/13/2005 12:00	0.00	0.00	0.00	0.01	0.71	0.74	0.80	0.82
Henderson River near Oquawka,IL as of 05/13/2005 11:00	0.00	0.00	0.00	0.14	1.31	1.37	1.49	1.49
Mississippi River at Lock and Dam 18 (MET Station) as of 05/13/2005 12:00	0.00	0.00	0.00	0.01	1.15	1.54	1.86	1.86
Mississippi River at Burlington,IA as of 05/13/2005 12:00	0.00	0.00	0.01	0.03	1.74	1.74	2.03	2.03
Mississippi River at Fort Madison,IA as of 05/13/2005 12:00	0.00	0.00	0.01	0.03	0.87	1.67	1.95	1.95
Mississippi River at Lock and Dam 19 (MET Station) as of 05/13/2005 12:00	0.01	0.01	0.01	0.02	0.68	1.10	1.84	1.84
Mississippi River at Lock and Dam 20 (MET Station) as of 05/13/2005 12:00	0.00	0.01	0.01	0.03	0.27	0.61	1.73	1.73
Mississippi River at Quincy,IL as of 05/13/2005 12:00	0.00	0.00	0.00	0.03	0.09	0.16	0.46	0.46
Mississippi River at Lock and Dam 21 (MET Station) as of 05/13/2005 12:00	0.00	0.00	0.00	0.04	0.10	0.20	0.47	0.47
Mississippi River at Hannibal,MO as of 05/13/2005 12:00	0.00	0.00	0.00	0.03	0.03	0.03	0.25	0.25
Mississippi River at Lock and Dam 22 (MET Station) as of 05/13/2005 12:00	0.01	0.01	0.01	0.01	0.01	M	0.21	0.21

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Mississippi River & Passes
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Mississippi River & Passes
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View All Stations In This Basin
View All Values In Stage
View All Values In Elevation
STATION
* Currently Forecasted Station
FLOOD STAGE
LATEST LEVEL
24 Hr CHANGE
24 Hr PRECIP
Continue Upstream
* Mississippi River at Guttenburg, IA
as of 05/13/2005 10:00
15
6.77
+0.05
0.16
Grant River near Burton,WI
as of 05/13/2005 10:00
18
4.89
-0.16
0.24
Mississippi River at Lock and Dam 11 (POOL)
as of 05/13/2005 08:00
15.18
+0.50
* Mississippi River at Lock and Dam 11 (Dubuque,IA)
as of 05/13/2005 08:00
16
6.41
+0.41
* Mississippi River at Lock and Dam 11 (Auxiliary Gage)
as of 05/13/2005 10:00
16
6.48
+0.34
* Mississippi River at Lock and Dam 11 (MET Station)
as of 05/13/2005 10:00
16
0.23
* Mississippi River at Dubuque,IA
as of 05/13/2005 10:00
17
9.15
+0.31
0.32
Galena River at Bucombe,WI
15
2.88
+0.01
0.10
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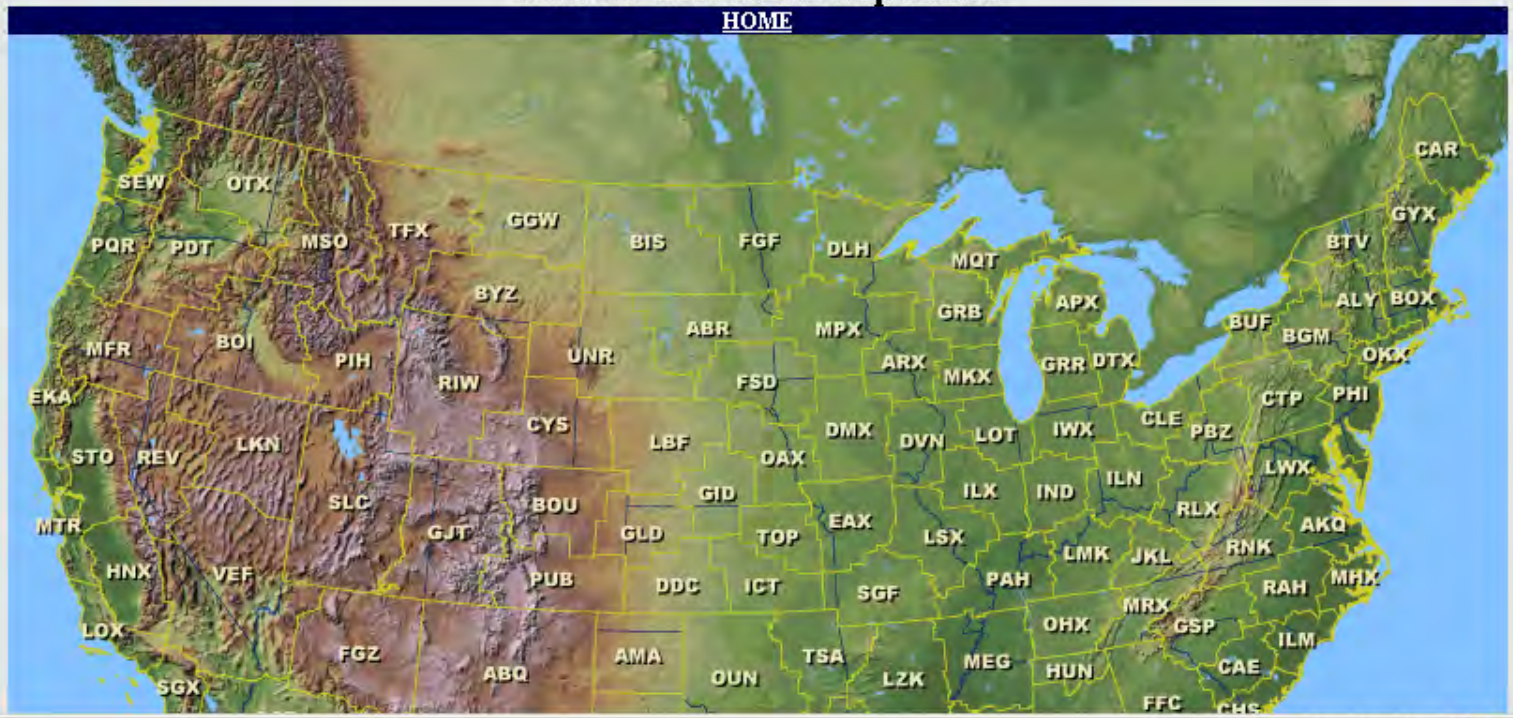
Click on WFO name for products



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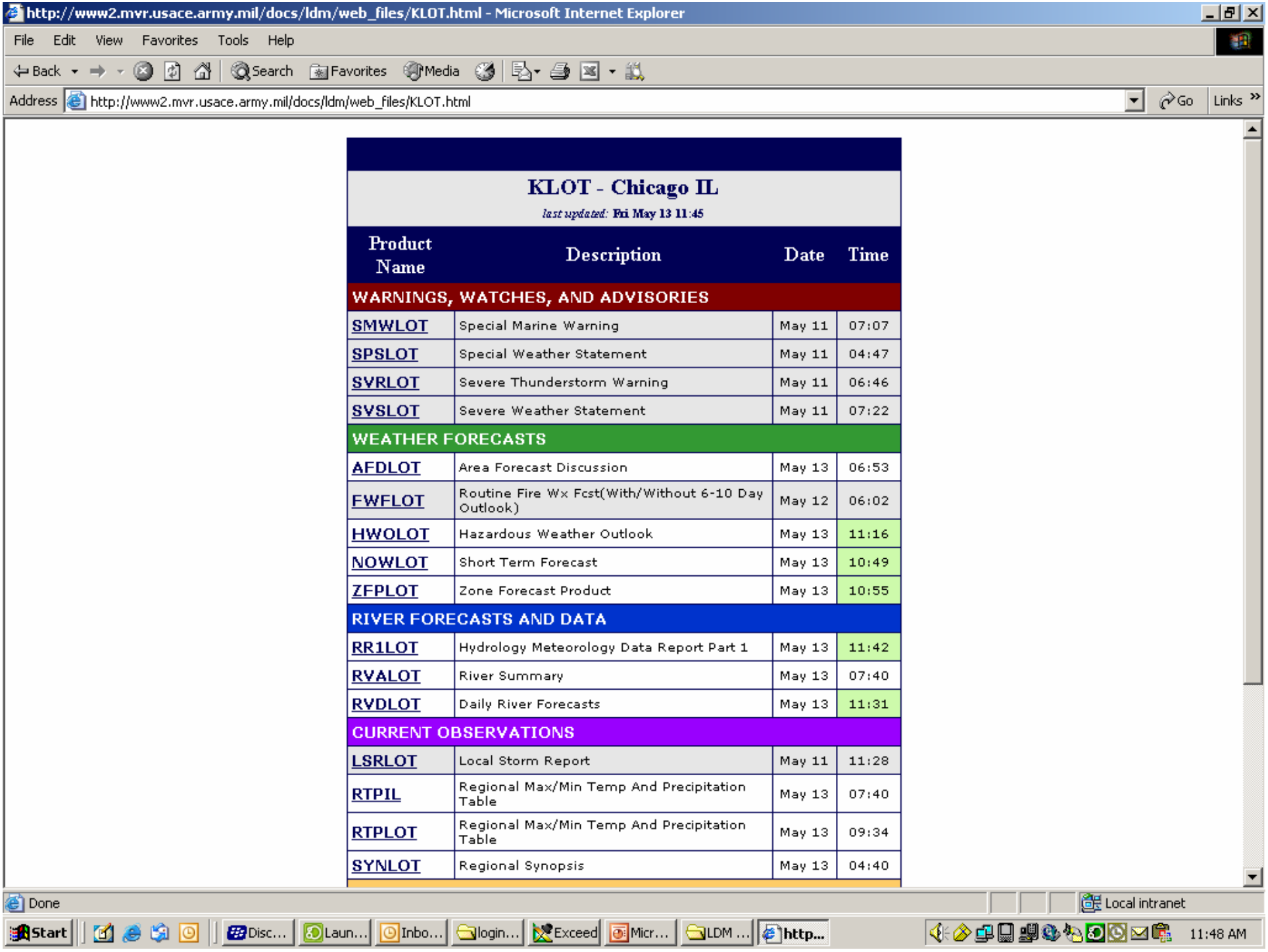
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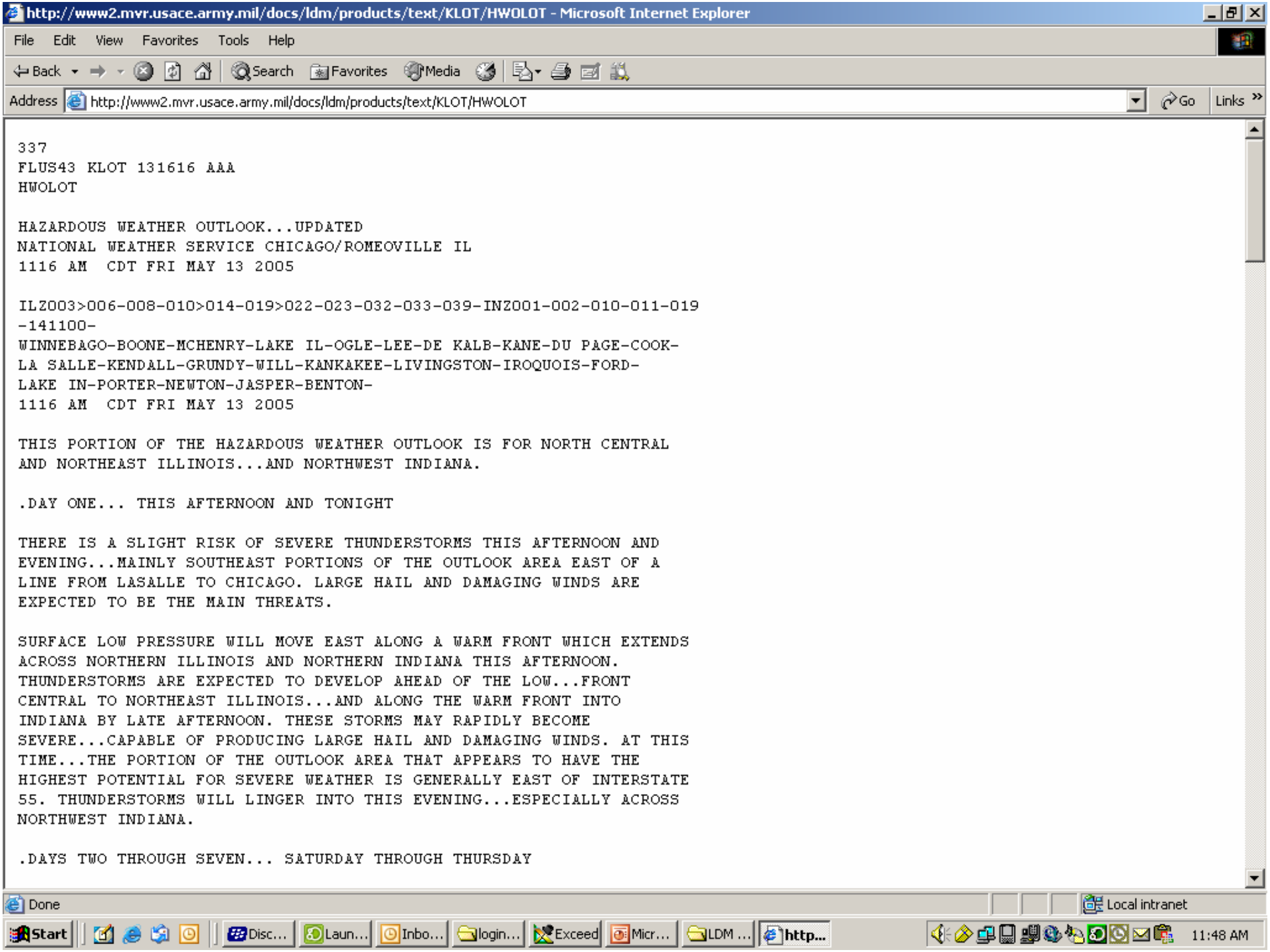
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337
FLUS43 KLOT 131616 AAA
HWOLOT
HAZARDOUS WEATHER OUTLOOK...UPDATED
NATIONAL WEATHER SERVICE CHICAGO/ROMEOVILLE IL
1116 AM CDT FRI MAY 13 2005
ILZ003>006-008-010>014-019>022-023-032-033-039-INZ001-002-010-011-019
-141100-
WINNEBAGO-BOONE-MCHENRY-LAKE IL-OGLE-LEE-DE KALB-KANE-DU PAGE-COOK-
LA SALLE-KENDALL-GRUNDY-WILL-KANKAKEE-LIVINGSTON-IROQUOIS-FORD-
LAKE IN-PORTER-NEWTON-JASPER-BENTON-
1116 AM CDT FRI MAY 13 2005
THIS PORTION OF THE HAZARDOUS WEATHER OUTLOOK IS FOR NORTH CENTRAL
AND NORTHEAST ILLINOIS...AND NORTHWEST INDIANA.
.DAY ONE... THIS AFTERNOON AND TONIGHT
THERE IS A SLIGHT RISK OF SEVERE THUNDERSTORMS THIS AFTERNOON AND
EVENING...MAINLY SOUTHEAST PORTIONS OF THE OUTLOOK AREA EAST OF A
LINE FROM LASALLE TO CHICAGO. LARGE HAIL AND DAMAGING WINDS ARE
EXPECTED TO BE THE MAIN THREATS.
SURFACE LOW PRESSURE WILL MOVE EAST ALONG A WARM FRONT WHICH EXTENDS
ACROSS NORTHERN ILLINOIS AND NORTHERN INDIANA THIS AFTERNOON.
THUNDERSTORMS ARE EXPECTED TO DEVELOP AHEAD OF THE LOW...FRONT
CENTRAL TO NORTHEAST ILLINOIS...AND ALONG THE WARM FRONT INTO
INDIANA BY LATE AFTERNOON. THESE STORMS MAY RAPIDLY BECOME
SEVERE...CAPABLE OF PRODUCING LARGE HAIL AND DAMAGING WINDS. AT THIS
TIME...THE PORTION OF THE OUTLOOK AREA THAT APPEARS TO HAVE THE
HIGHEST POTENTIAL FOR SEVERE WEATHER IS GENERALLY EAST OF INTERSTATE
55. THUNDERSTORMS WILL LINGER INTO THIS EVENING...ESPECIALLY ACROSS
NORTHWEST INDIANA.
.DAYS TWO THROUGH SEVEN... SATURDAY THROUGH THURSDAY
Done
Local intranet
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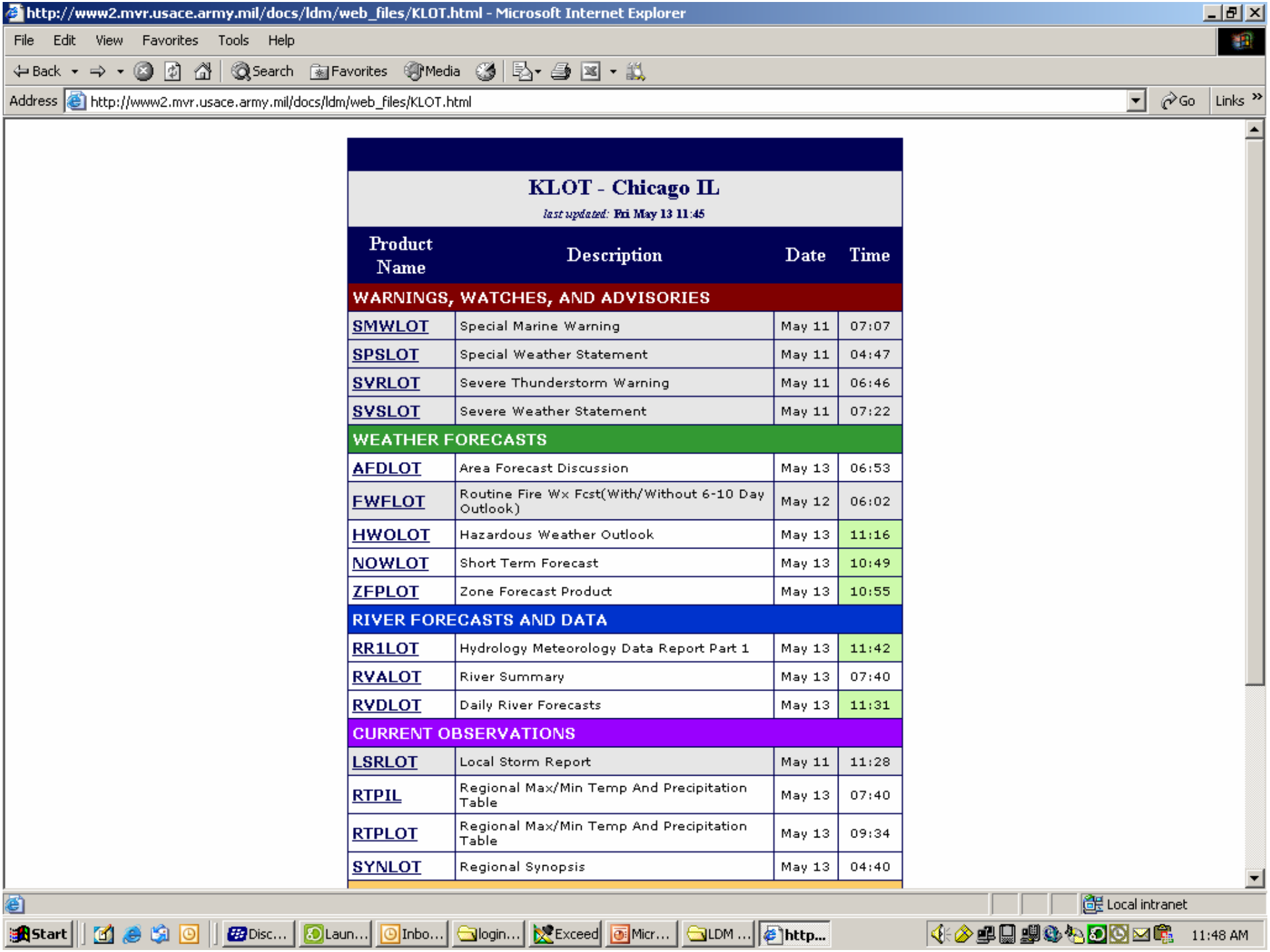
Disc...
Laun...
Inbo...
login...
Exceed
Micr...
LDM ...
http...
11:48 AM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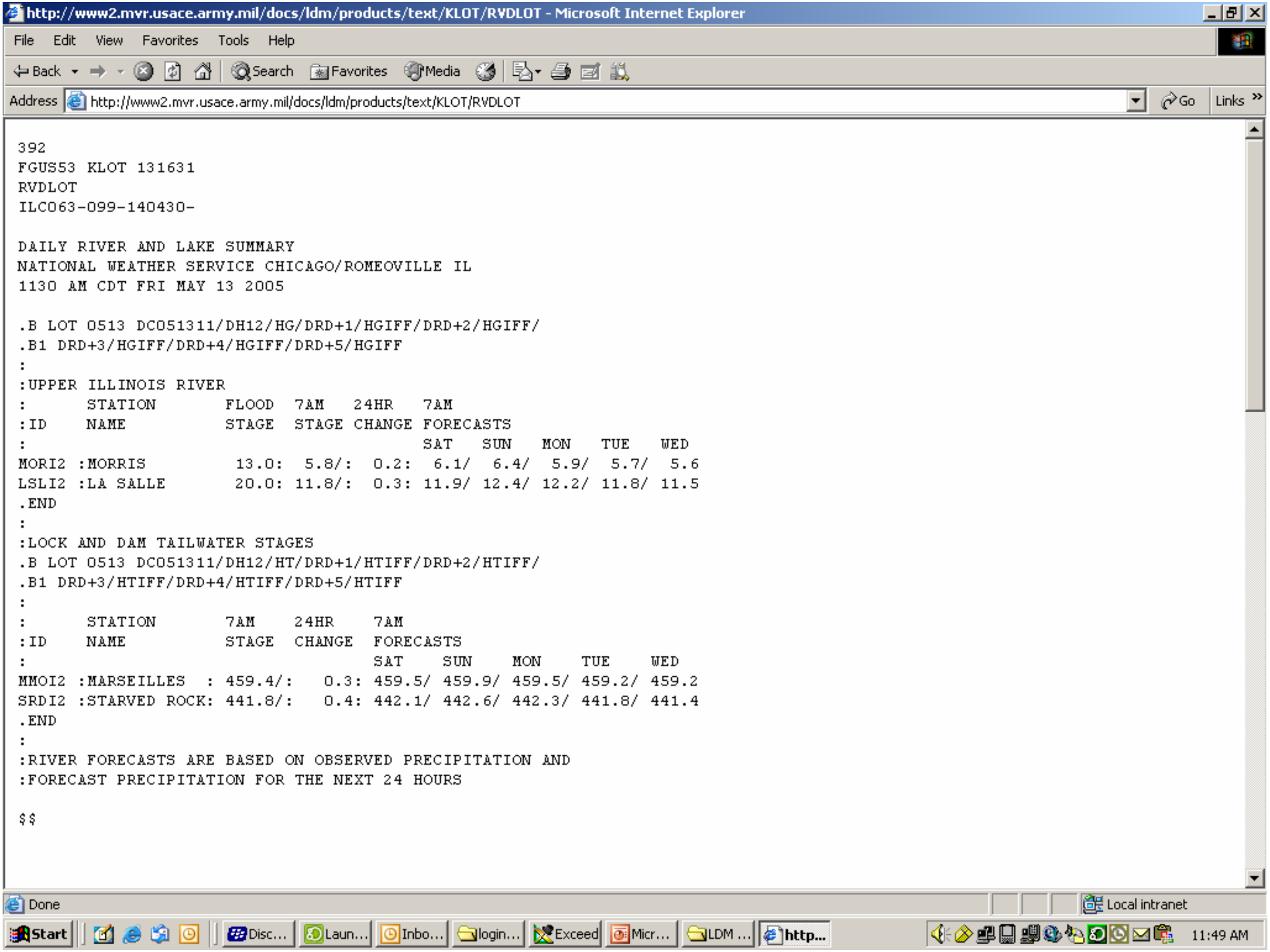
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392
FGUS53 KLOT 131631
RVDLOT
ILC063-099-140430-
DAILY RIVER AND LAKE SUMMARY
NATIONAL WEATHER SERVICE CHICAGO/ROMEOVILLE IL
1130 AM CDT FRI MAY 13 2005
.B LOT 0513 DC051311/DH12/HG/DRD+1/HGIFF/DRD+2/HGIFF/
.B1 DRD+3/HGIFF/DRD+4/HGIFF/DRD+5/HGIFF
:
:UPPER ILLINOIS RIVER
: STATION FLOOD 7AM 24HR 7AM
:ID NAME STAGE STAGE CHANGE FORECASTS
: SAT SUN MON TUE WED
MORI2 :MORRIS 13.0: 5.8/: 0.2: 6.1/ 6.4/ 5.9/ 5.7/ 5.6
LSLI2 :LA SALLE 20.0: 11.8/: 0.3: 11.9/ 12.4/ 12.2/ 11.8/ 11.5
.END
:
:LOCK AND DAM TAILWATER STAGES
.B LOT 0513 DC051311/DH12/HT/DRD+1/HTIFF/DRD+2/HTIFF/
.B1 DRD+3/HTIFF/DRD+4/HTIFF/DRD+5/HTIFF
:
: STATION 7AM 24HR 7AM
:ID NAME STAGE CHANGE FORECASTS
: SAT SUN MON TUE WED
MMOI2 :MARSEILLES : 459.4/: 0.3: 459.5/ 459.9/ 459.5/ 459.2/ 459.2
SRDI2 :STARVED ROCK: 441.8/: 0.4: 442.1/ 442.6/ 442.3/ 441.8/ 441.4
.END
:
:RIVER FORECASTS ARE BASED ON OBSERVED PRECIPITATION AND
:FORECAST PRECIPITATION FOR THE NEXT 24 HOURS
$$
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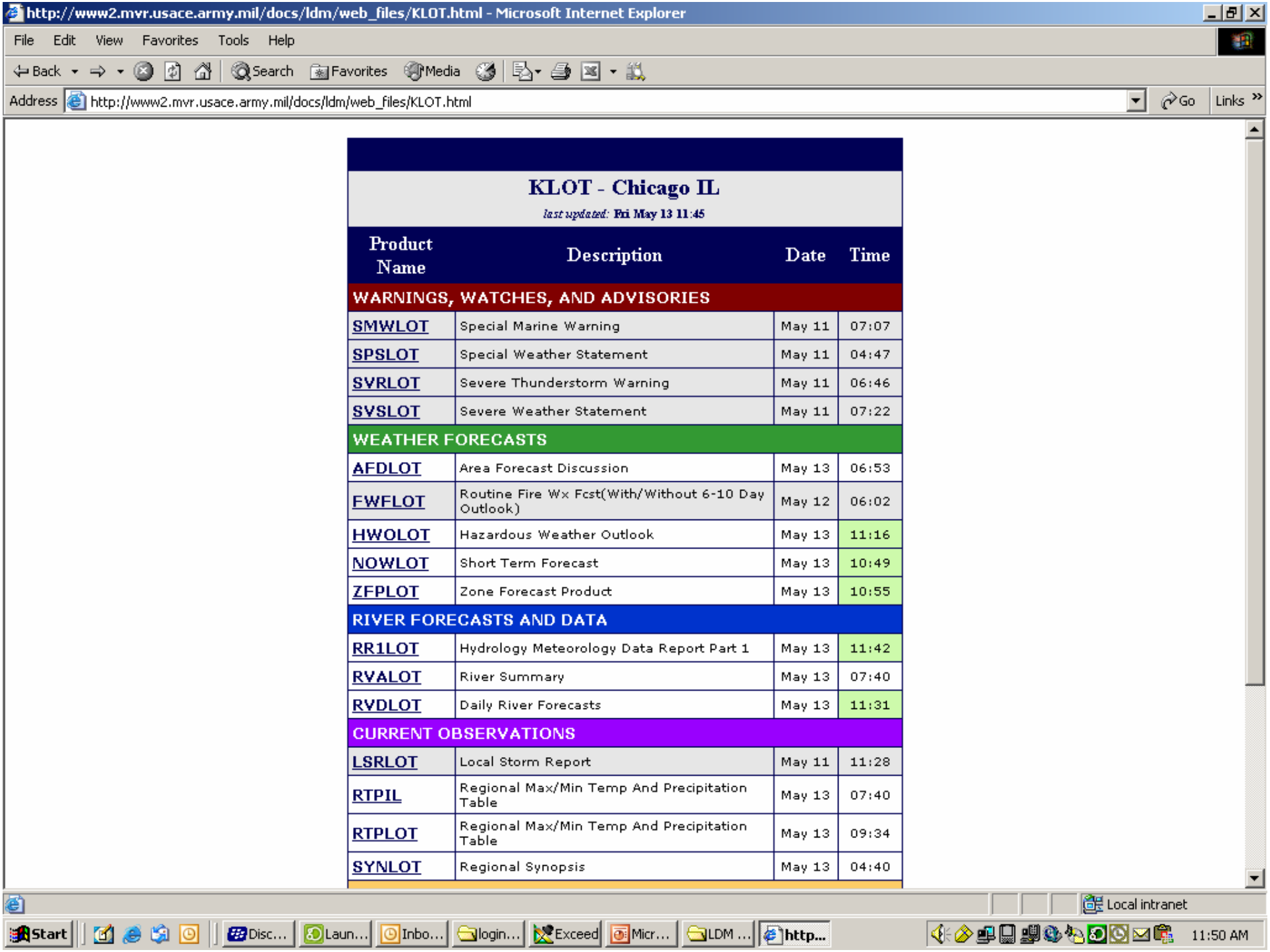
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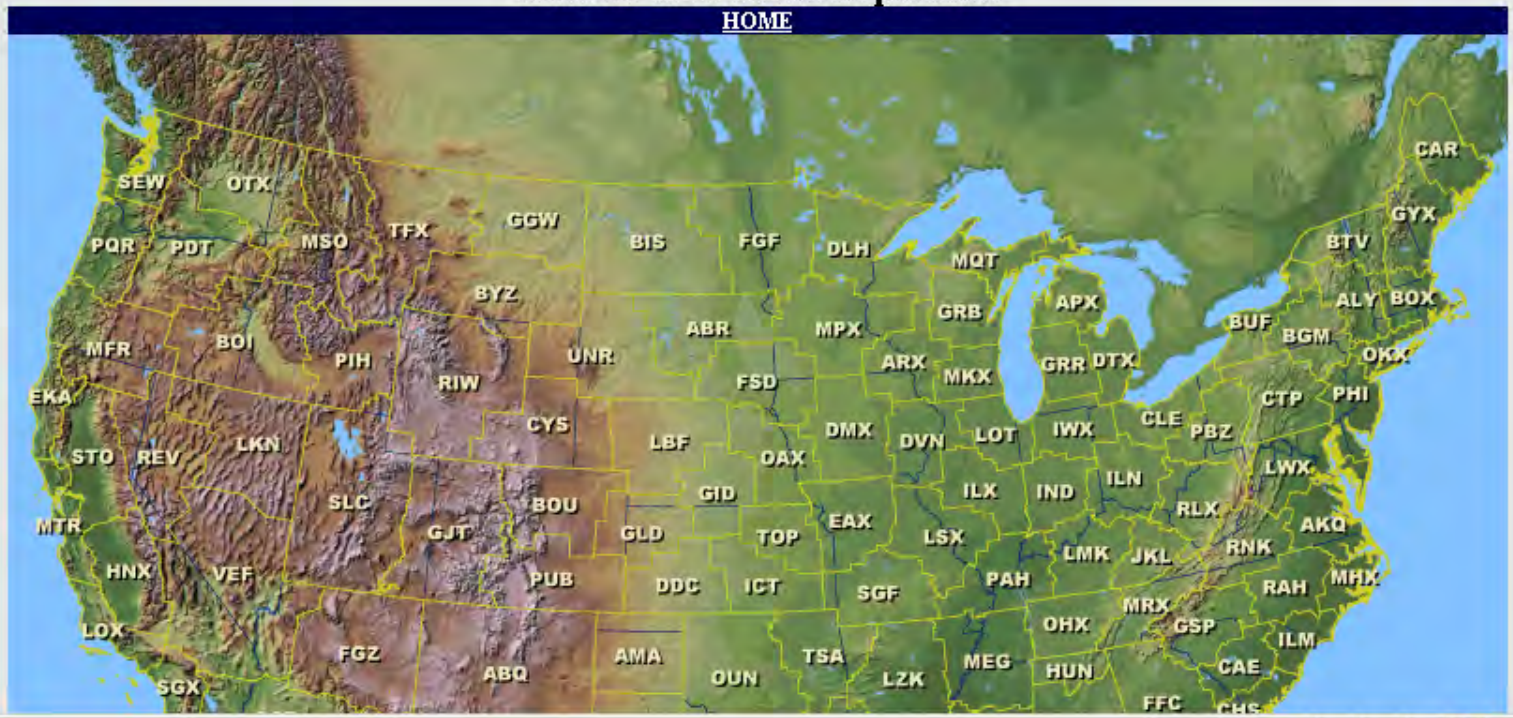
Click on WFO name for products



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LATEST LEVEL
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Continue Upstream
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HEC-ResSim 3.0

Enhancements and New Capabilities

Fauwaz Hanbali

August 4, 2005

USACE Hydrologic Engineering Center

HEC-ResSim Program

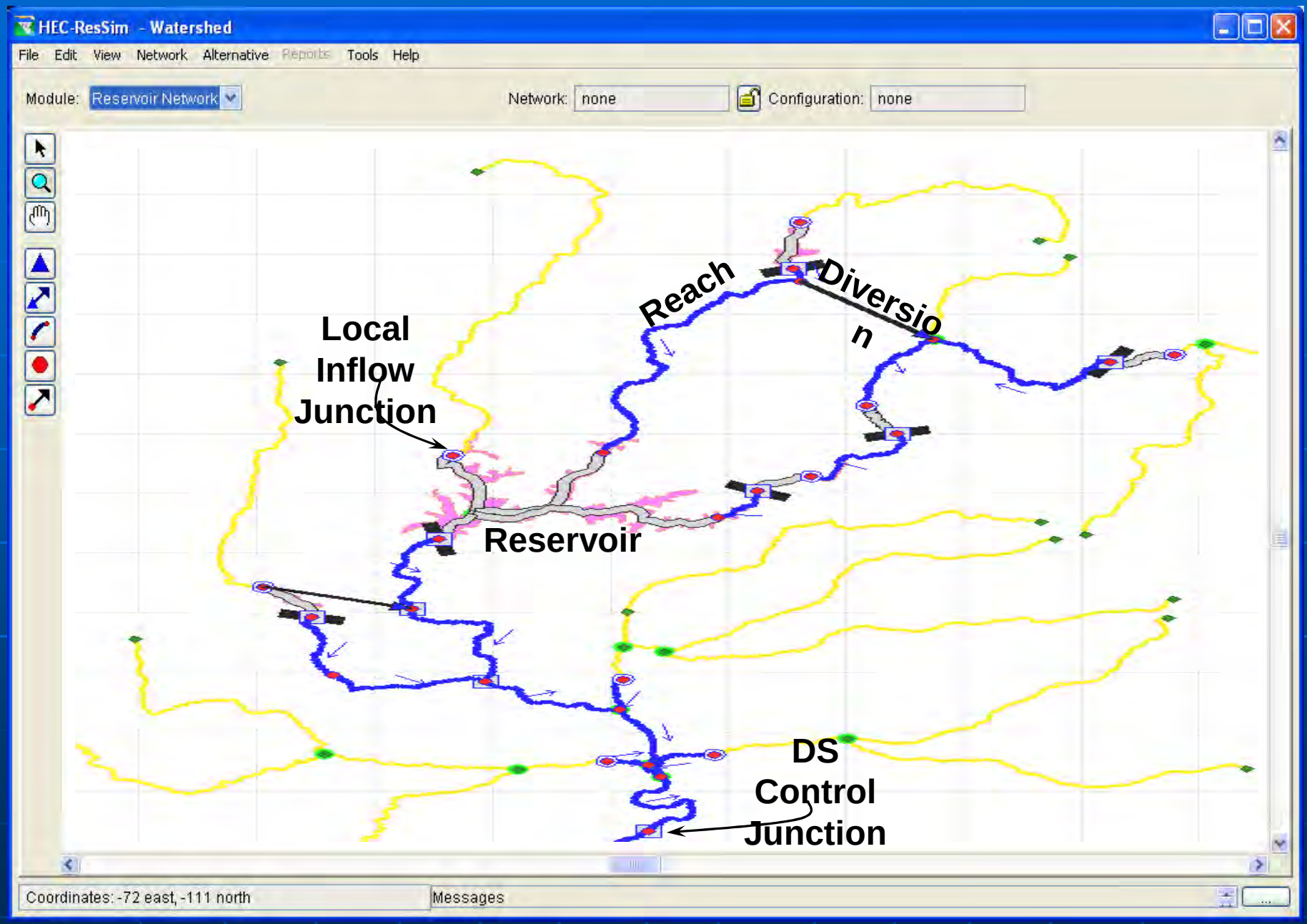
- HEC Next Generation Software
- Real-time and planning application for water control management systems
- V2.0 Public Release (October 2003)
- New Capabilities ~ upcoming V3.0

Standard Capabilities

- Networked Reservoir and Flow Routing
- Guide Curve and Zone-Based Reservoir Operation
- At-site Release Function Rules
- Downstream Control Function Rules
- Parallel and Tandem System Operation
- Incidental and Scheduled Hydropower
- Emergency Gate Operation
- Release Overrides

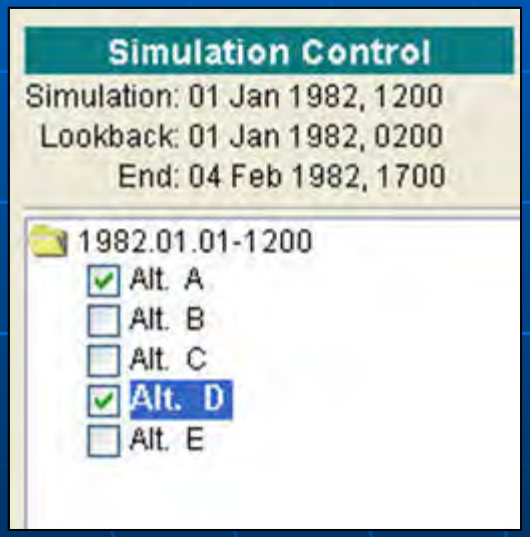
Network Elements

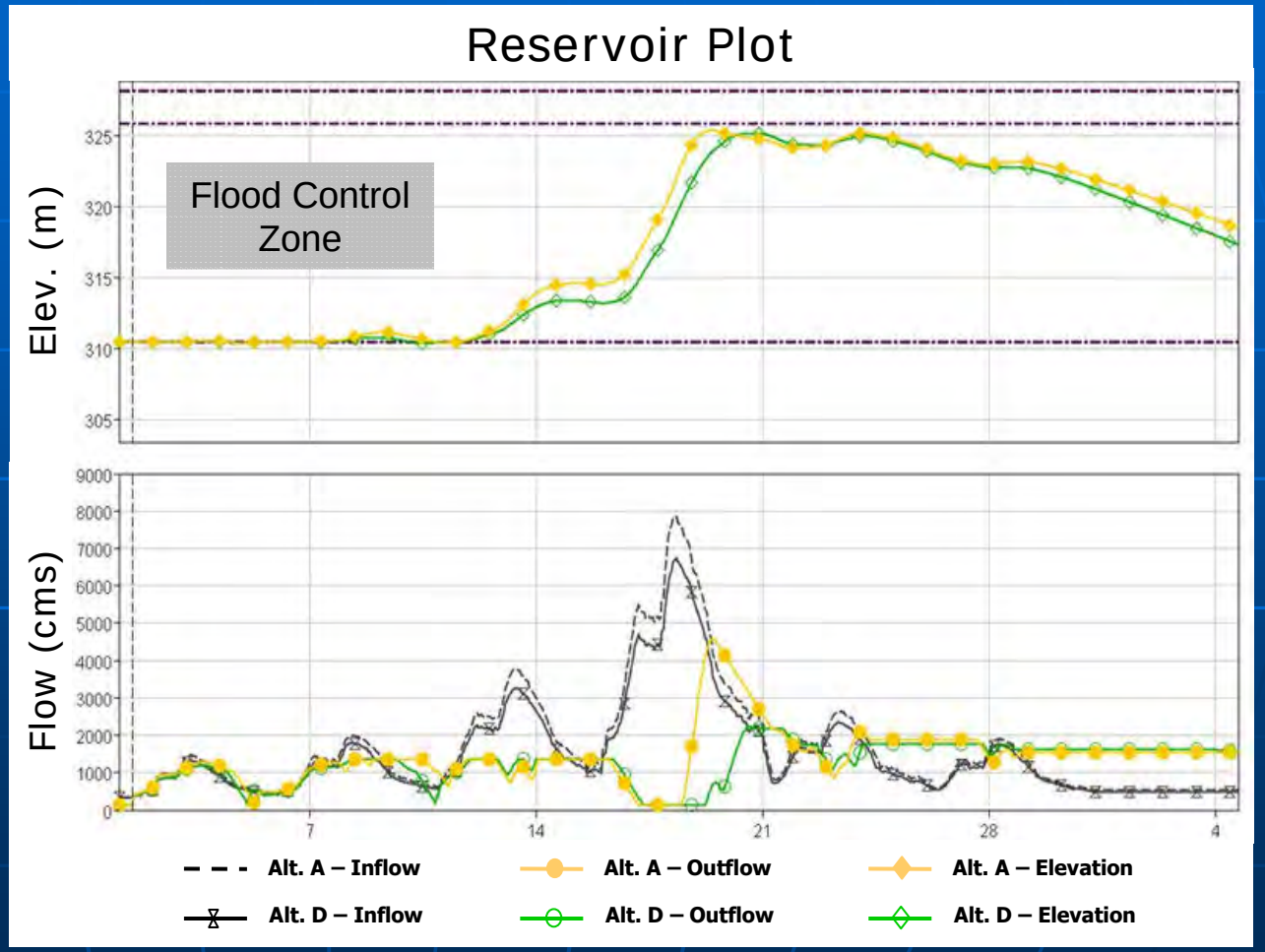
- Reservoirs – mass balance, release decision
- Reaches – flow routing, losses
- Diversions – withdrawals, routing, losses
- Junctions – control points and connections (link reservoirs, reaches, diversions, plus local inflows)


HEC-ResSim - Watershed
File Edit View Network Alternative Reports Tools Help
Module: Reservoir Network
Network: none
Configuration: none
Reach
Diversion
Local Inflow Junction
Reservoir
DS Control Junction
Coordinates: -72 east, -111 north
Messages

Simulation & Analysis

- Multiple Alternatives



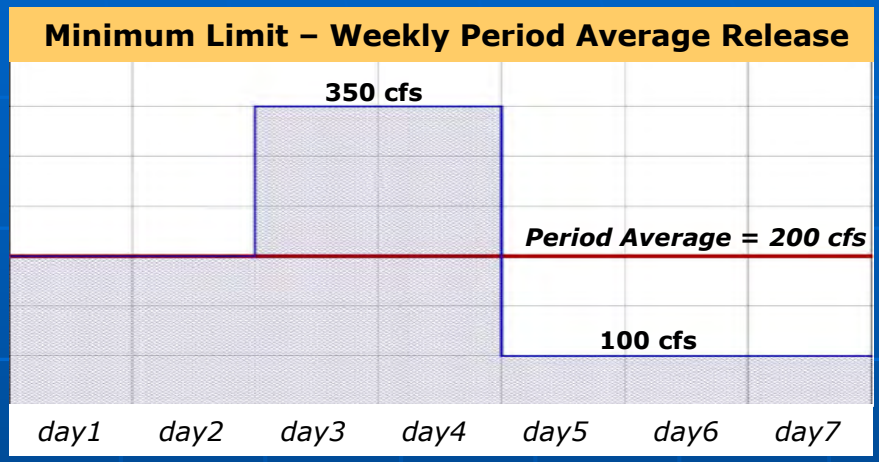


New Capabilities

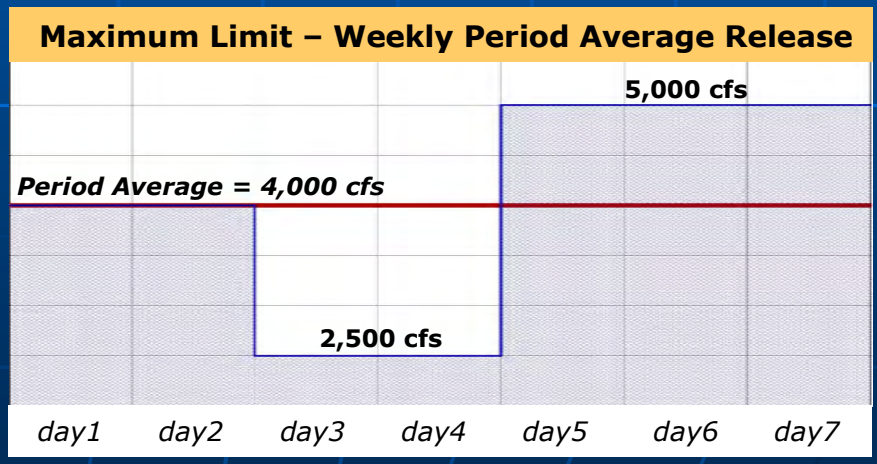
- Period average flow limit criteria
- If-then-else
- User-scripted State Variables
- User-scripted Rules
  - Report Builder
- Outlet Outages
- Release Allocations
- System Hydropower
- Pump-back Storage

Period Average Flow Limits

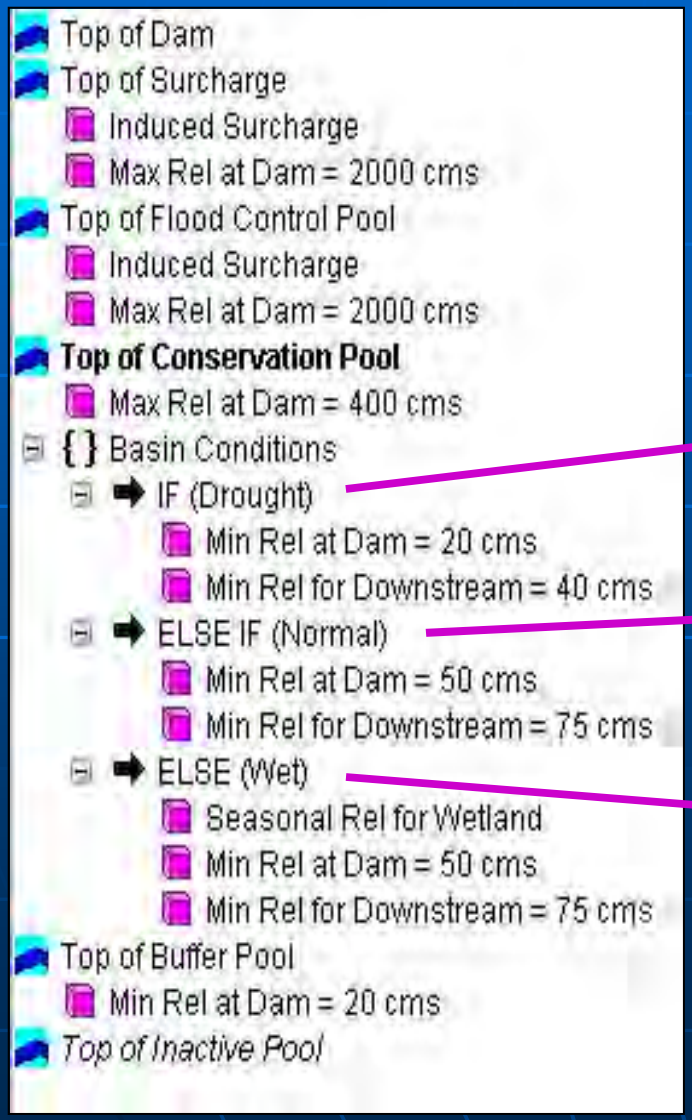
- New option for flow limit goals as daily or weekly period averages



- Fluctuating flows are allowed for intervals within period, but period average requirement is satisfied



IF-THEN-ELSE



- Operational constraints with conditional statements
- Compound conditions
- Nested if-then-else

current inflow < 85% of Average
Or current inflow < 50 cms

current inflow > 85% of Average
And current inflow < 120% of Average

current inflow > 120% of Average
And current Date > 20 Mar 2005
And current Date < 15 Apr 2005

State Variable

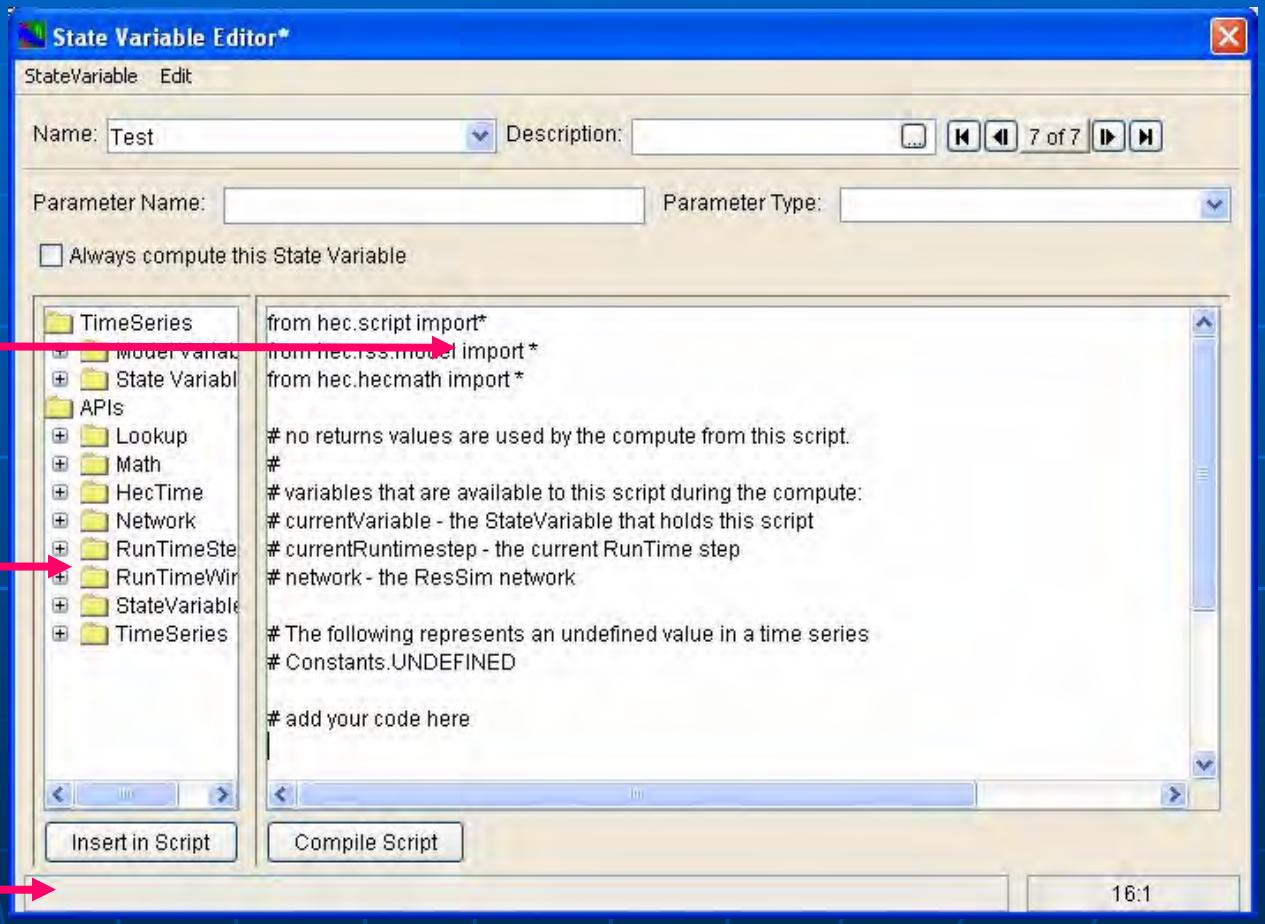
- User-defined variable whose value ResSim computes by executing a *user-created script* at every time step throughout the simulation period
- Computation of non-standard model variables, such as:
  - Basin wetness
  - Drought level
  - System storage
- Scripting in Jython using an editor with access to standard ResSim model variables and methods

State Variable Editor

Script Pane
(editor window)

Object Pane
(API window)

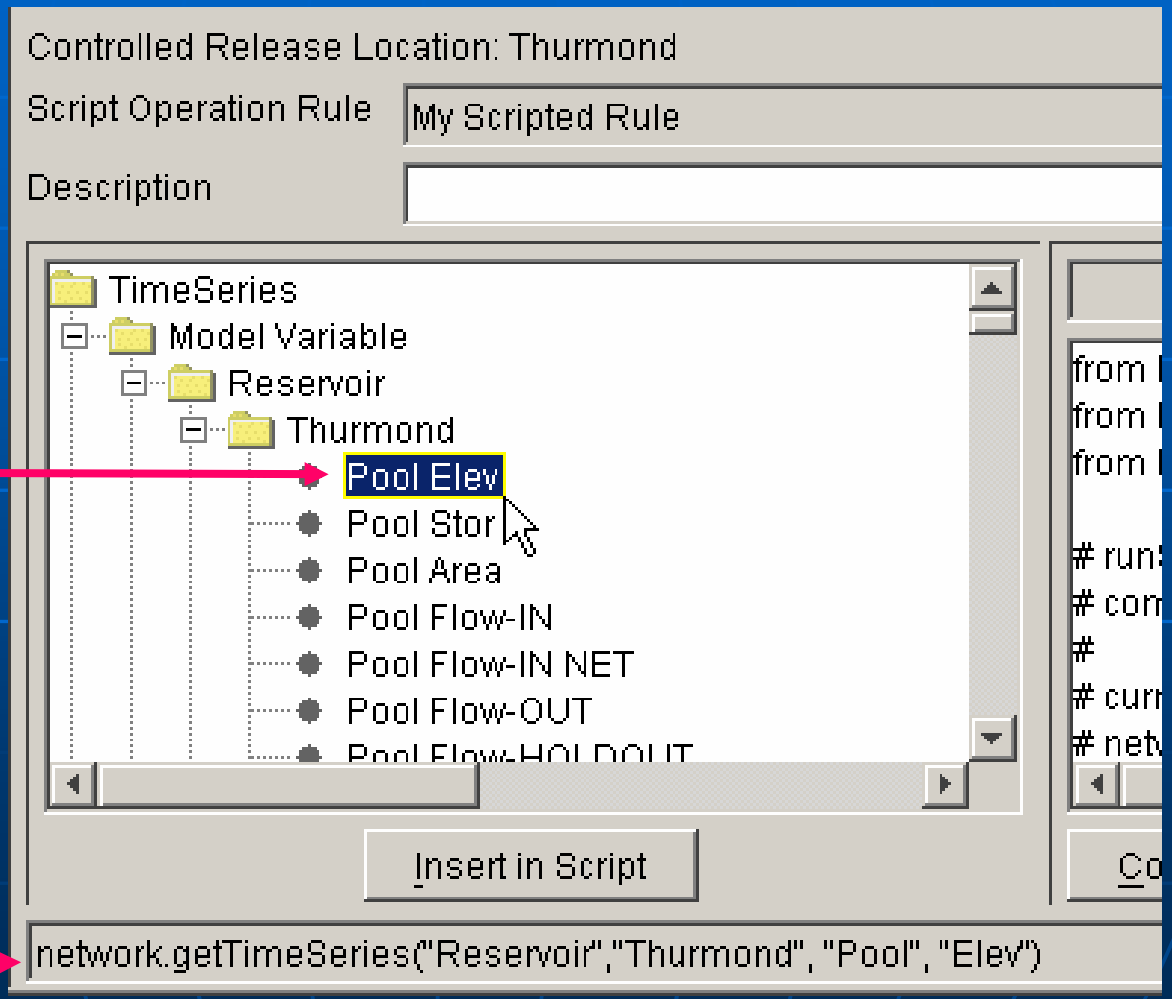
API preview bar



User-Scripted Rule

- A rule that can be added and prioritized in a certain operation set
- Defining complex criteria that depends on various parameters, conditions, and special calculations
- Scripting in Jython using an editor with access to standard objects for ResSim model variables and methods

Scripted Rule Editor



Object API Item

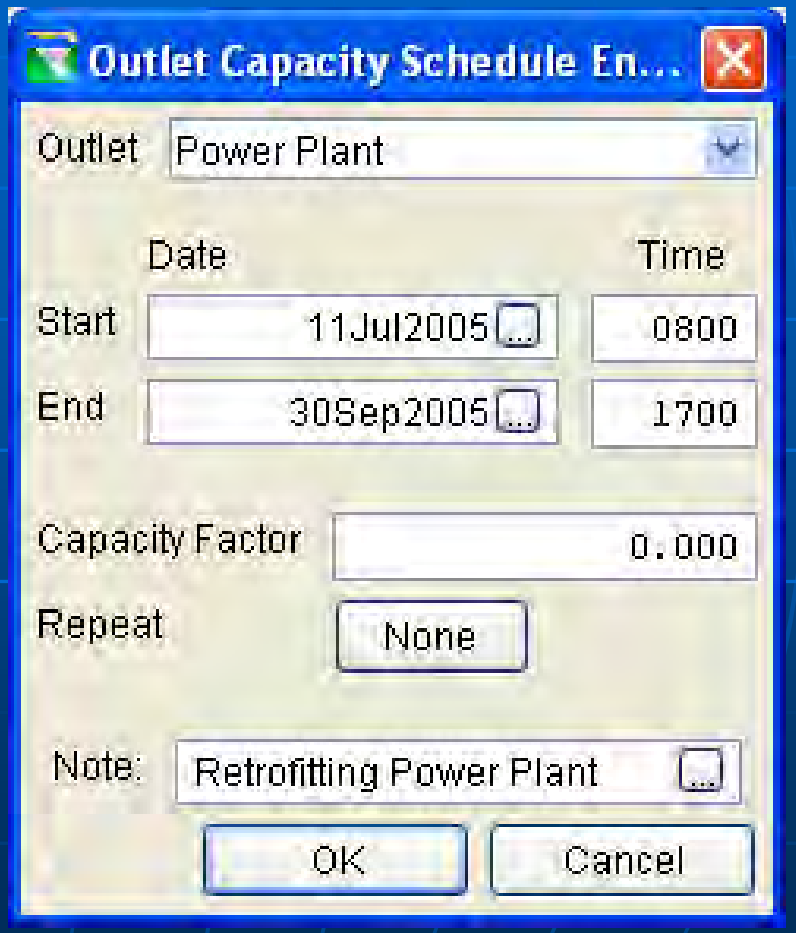
Object API text

Example Script

```
from hec.rss.model import OpRule
from hec.rss.model import OpValue

def runScript(currentRule, network, currentRunTimeStep):
    # create new Operation Value (OpValue) to return
    opValue = OpValue()

    # set the type and value of the OpValue
    inflowTS= network.getTimeSeries("Reservoir","Friant", "Pool", "Flow-IN")
    inflow= inflowTS.getCurrentValue(currentRunTimeStep)

    if inflow > 5000:
        opValue.init(OpRule.RULETYPE_SPEC, inflow)
    else:
        opValue.init(OpRule.RULETYPE_MAX, 5000)

    # return the OpValue
    return opValue
```

Outlet Outages

- Capacity Override factor (0.0-1.0)
- Maintenance or offline schedule
- Repeatable outage interval
  - None
  - Daily
  - Weekly
  - Monthly
  - Yearly

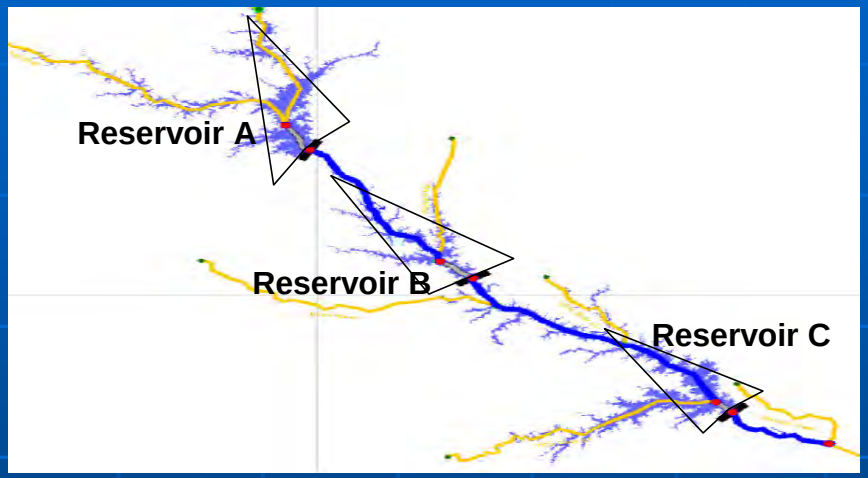


Release Allocations

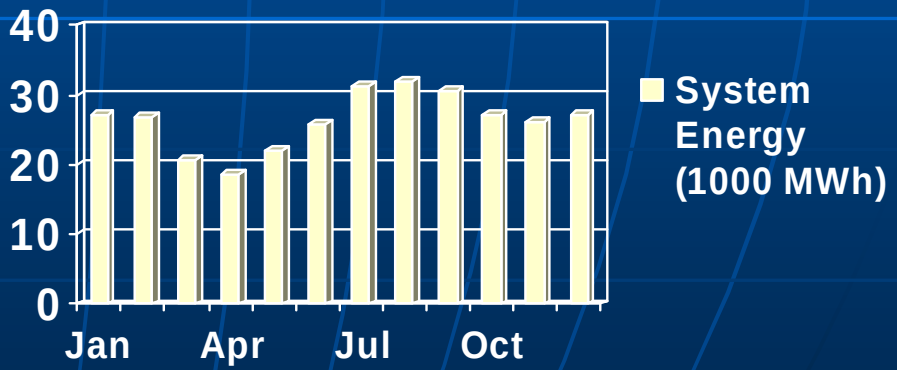
- Allocation options for releases across multiple outlets:
  - **Balanced** releases across multiple outlets (*weighted distribution of releases*)
  - **Sequential** operation of outlets (*prioritized sequence of release*)
  - **Stepped** percent of allocation as function of total release (*combination of balance and sequential allocation schemes*)

System Hydropower

- Storage and energy balance to achieve system-wide targets

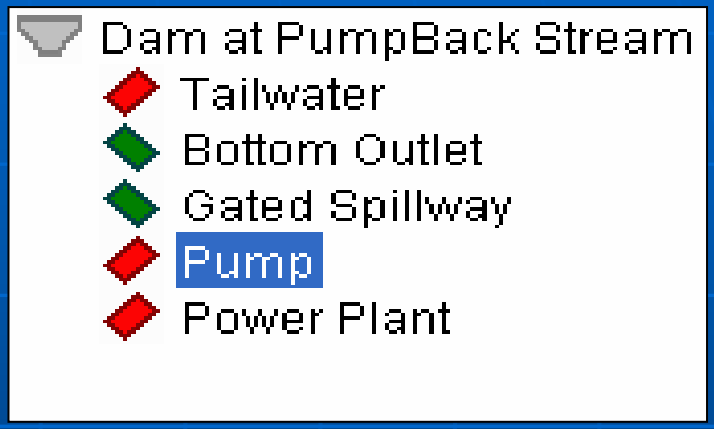


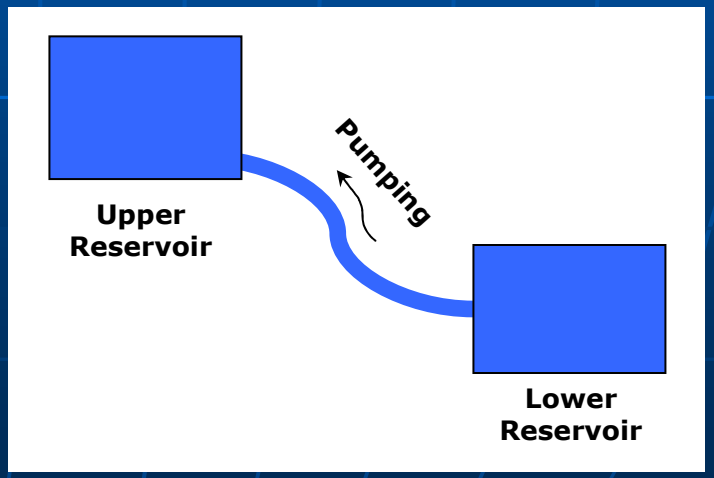
- System generation requirement for a group of reservoirs



Pump-back Storage

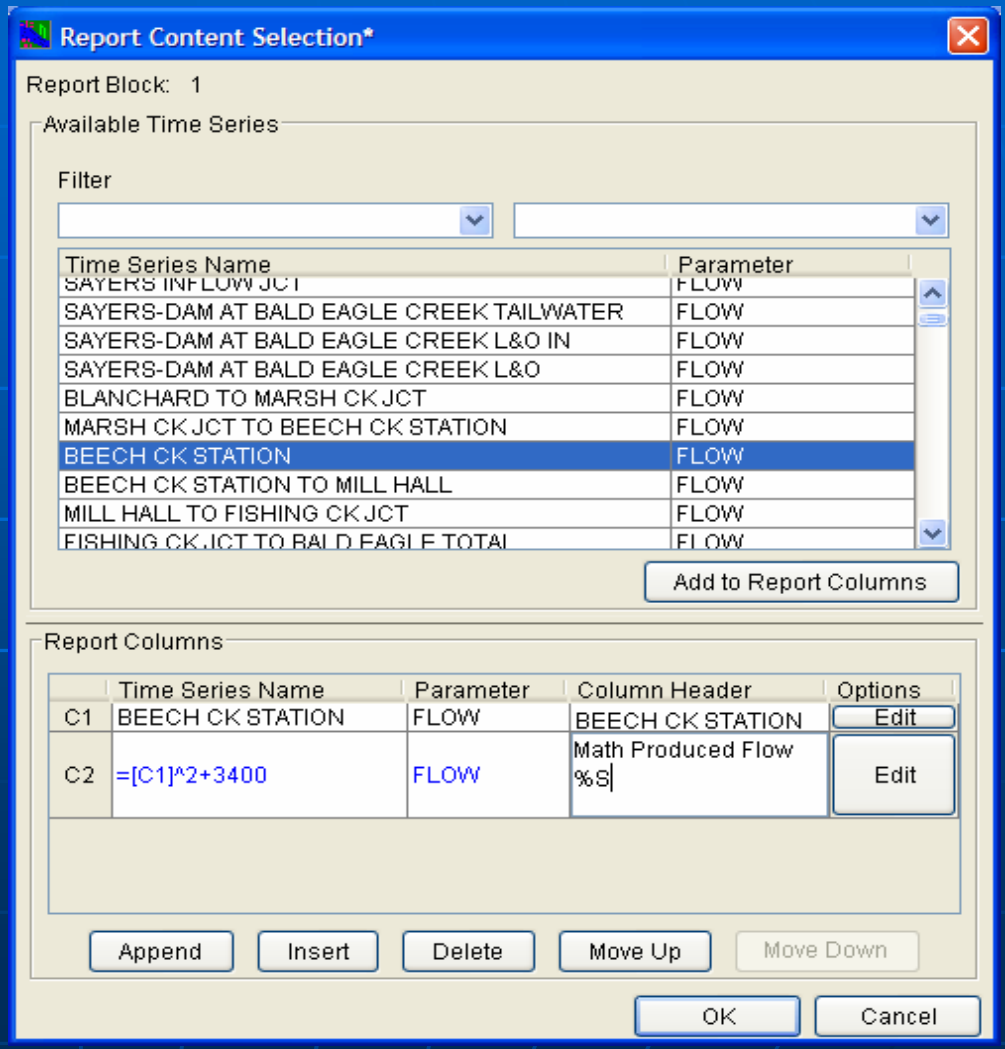
- Downstream source reservoir
- Pumping criteria defined at upper reservoir
  - Target fill level
  - Daily pumping schedule





Report Builder

- User-defined reports
- Time-series catalog & filter
- Column, row, & report block builder
- Column math operation & summary statistics



Recap of Enhancements

- Additional power and flexibility for defining reservoir operating criteria
- Extra control for outlet release allocations
- Expanded hydropower capabilities for system generation and pump-back operation
- User-defined Reports

Version 3.0 Public Release ~ Winter 2005

Contacts

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  Joan.D.Klipsh@usace.army.mil
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HEC Website http://www.hec.usace.army.mil

Ecosystem Restoration For Fish and Wildlife Habitat on the UMRS

Presentation for the

2005 Infrastructure Conference

By

JON HENDRICKSON

Hydraulic Engineer
Regional Technical Specialist
Water Quality and Environmental Restoration

02 –04 Aug 2005

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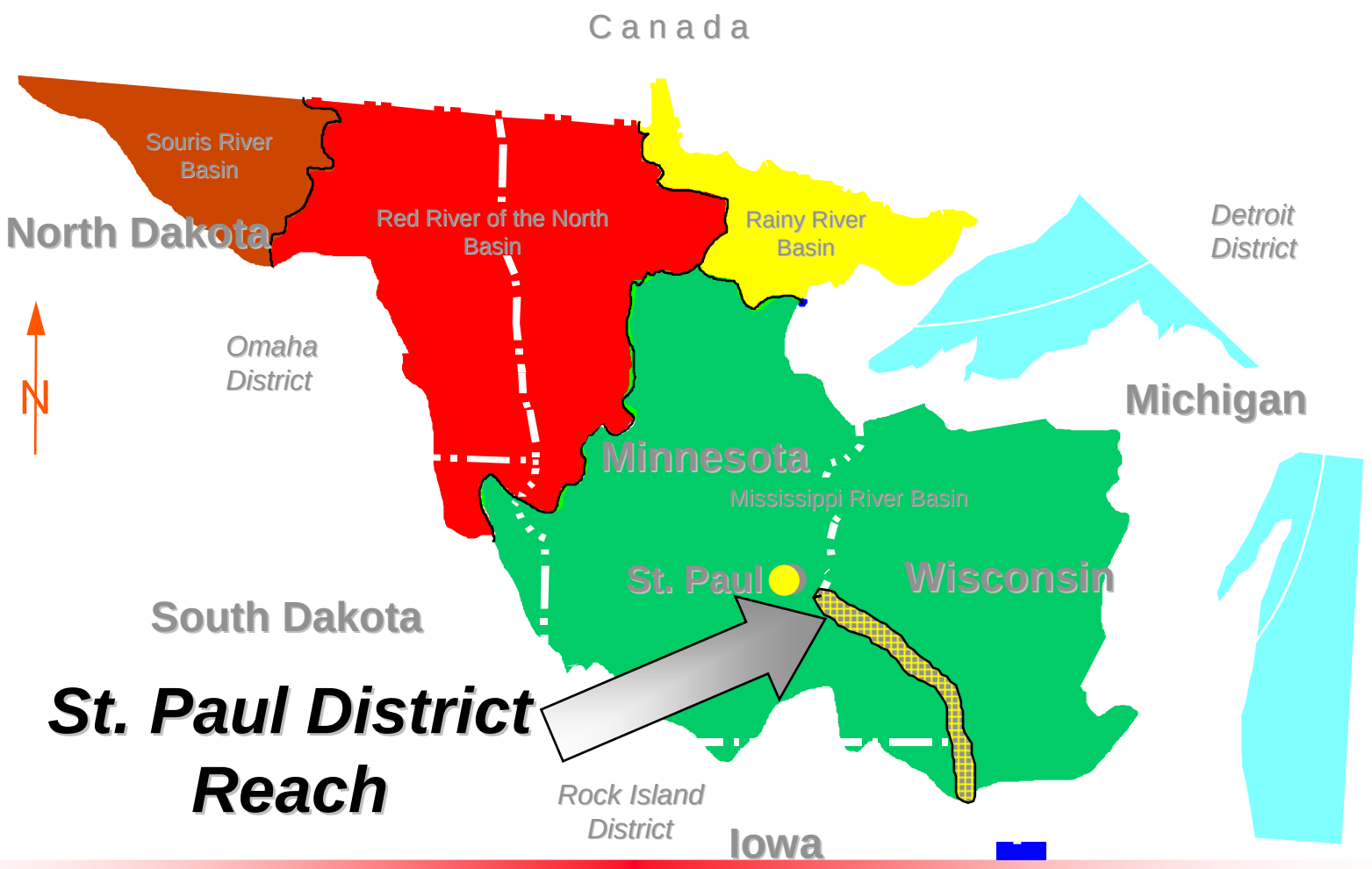
Mississippi River Commission

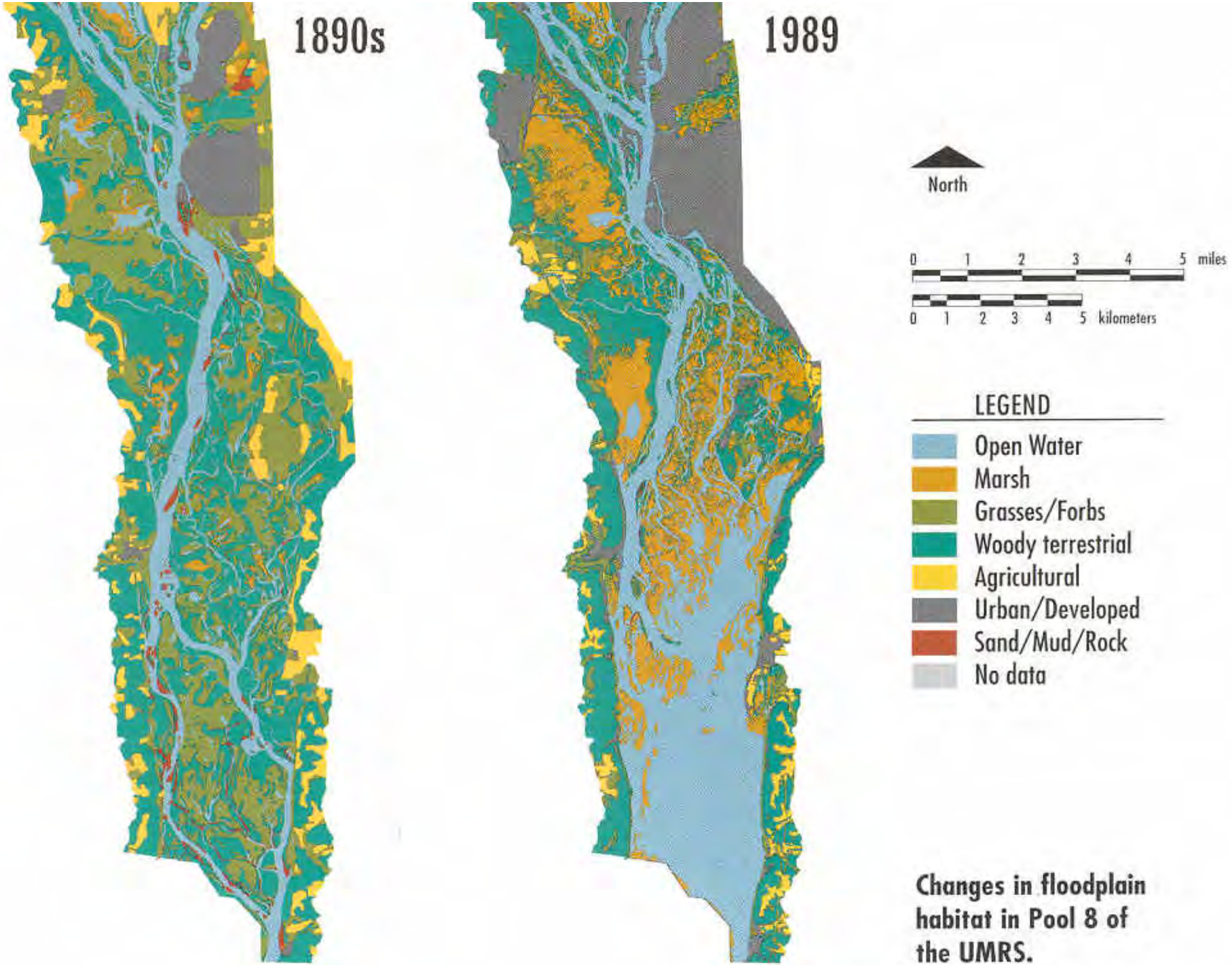
UPPER MISSISSIPPI RIVER
ENVIRONMENTAL MANAGEMENT PROGRAM



One Corps Serving the Armed Forces and the Nation

V018JS01

- ✓ **Multi-Agency Effort**
  - ✓ **USACE, USFWS, State DNRs, USGS, NGOs**
- ✓ **Multi-Discipline**
  - ✓ **Engineers, Biologists, Planners**
- ✓ **Multi-Use**
  - ✓ **Navigation, Recreation, Water Supply, Fish and Wildlife Habitat**



Changes in floodplain habitat in Pool 8 of the UMRS.

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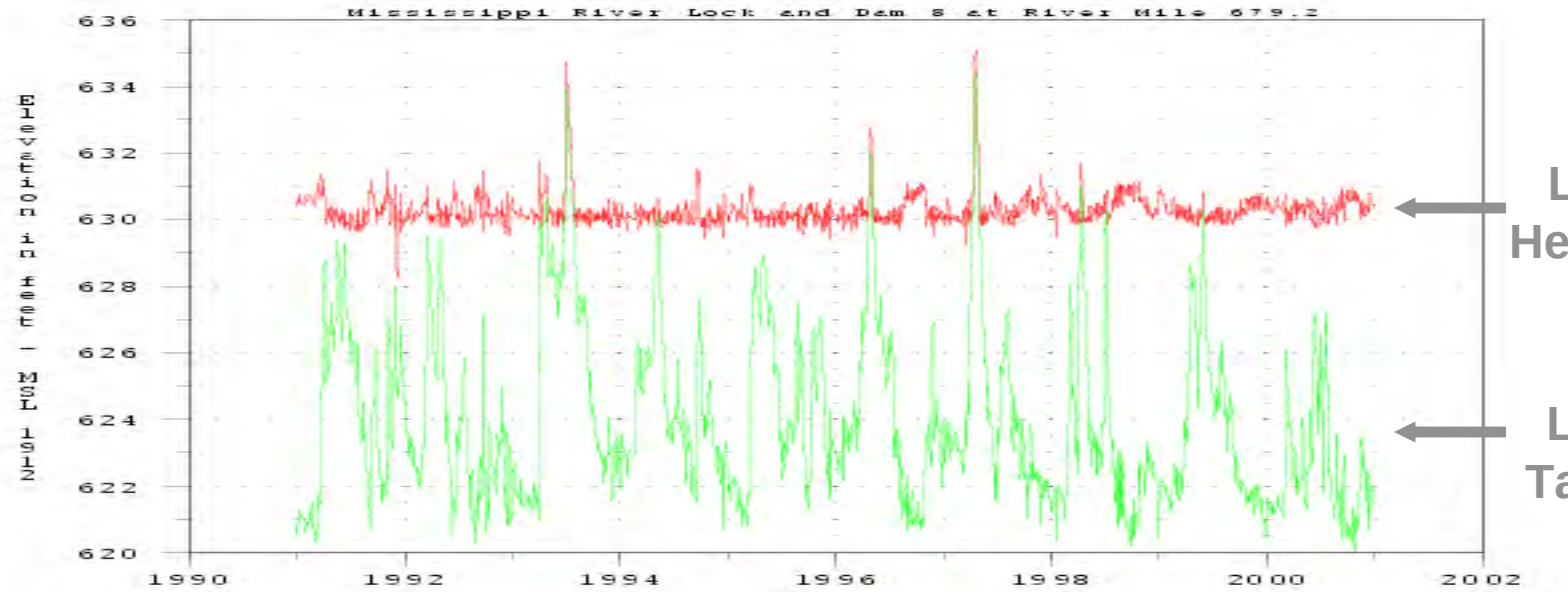
Water Levels Stabilized in Lower Reach of Pool



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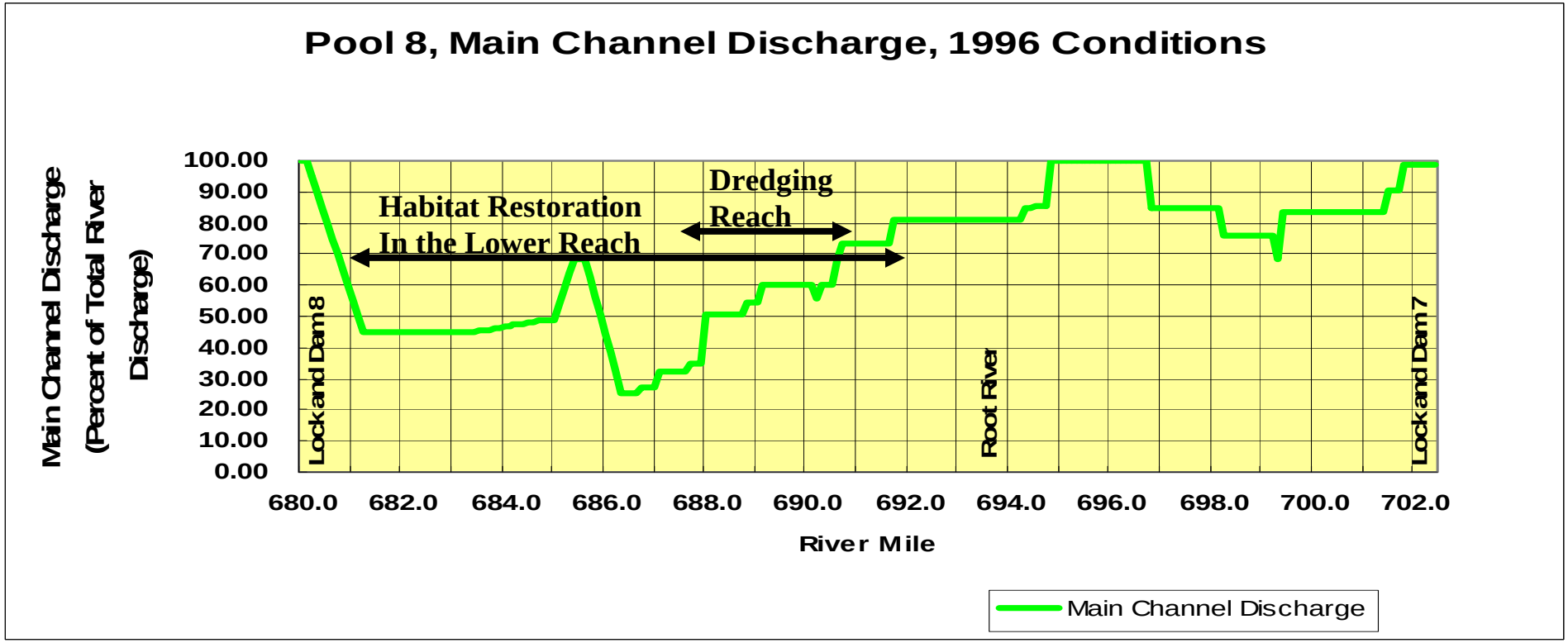
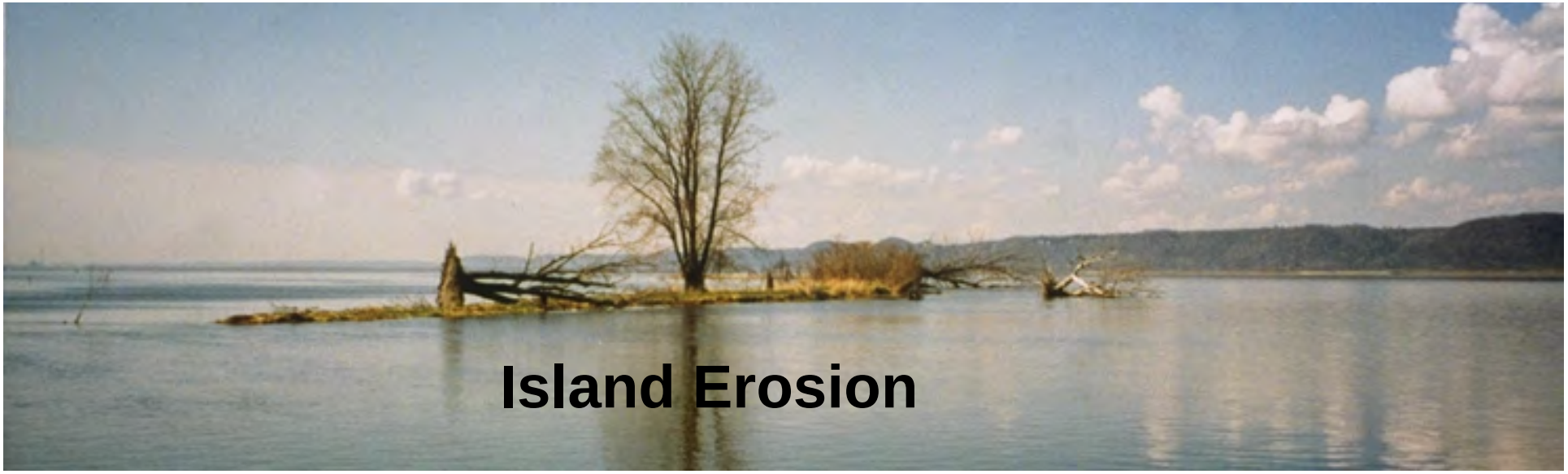
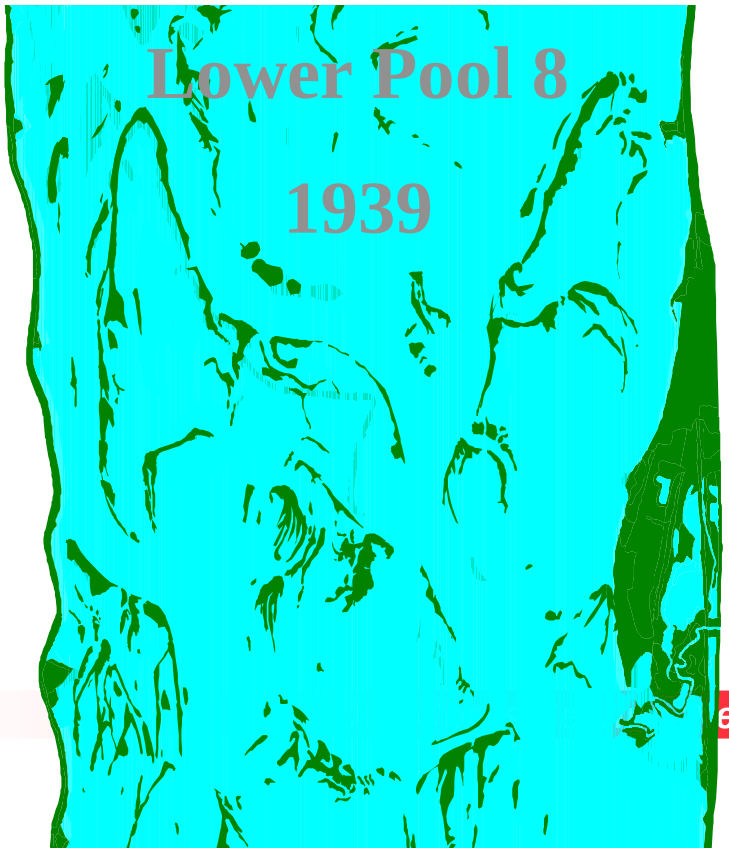
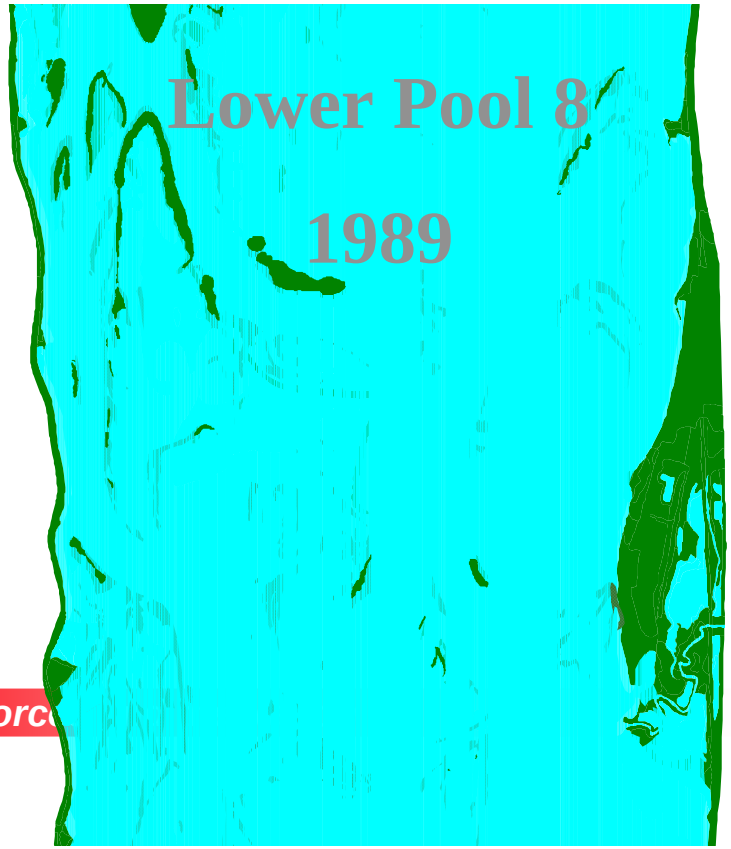
Increased Floodplain Discharge





Island Erosion





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Restoring the River

Navigation and Ecosystem Sustainability Program Initiated in 2005

Environmental Management Program

1986 To The Present

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Project Delivery Teams Need to Operate Smarter

- ✓ Document and Use Lessons Learned
- ✓ Do a better job linking objectives, design criteria, performance metrics, actions, modeling, and monitoring needs.
- ✓ Work with research community to develop
  - ✓ Biological Criteria, Scale of Restoration Guidelines
- ✓ Cross-Discipline Training:
  - ✓ Engineering, Geomorphology, Biology

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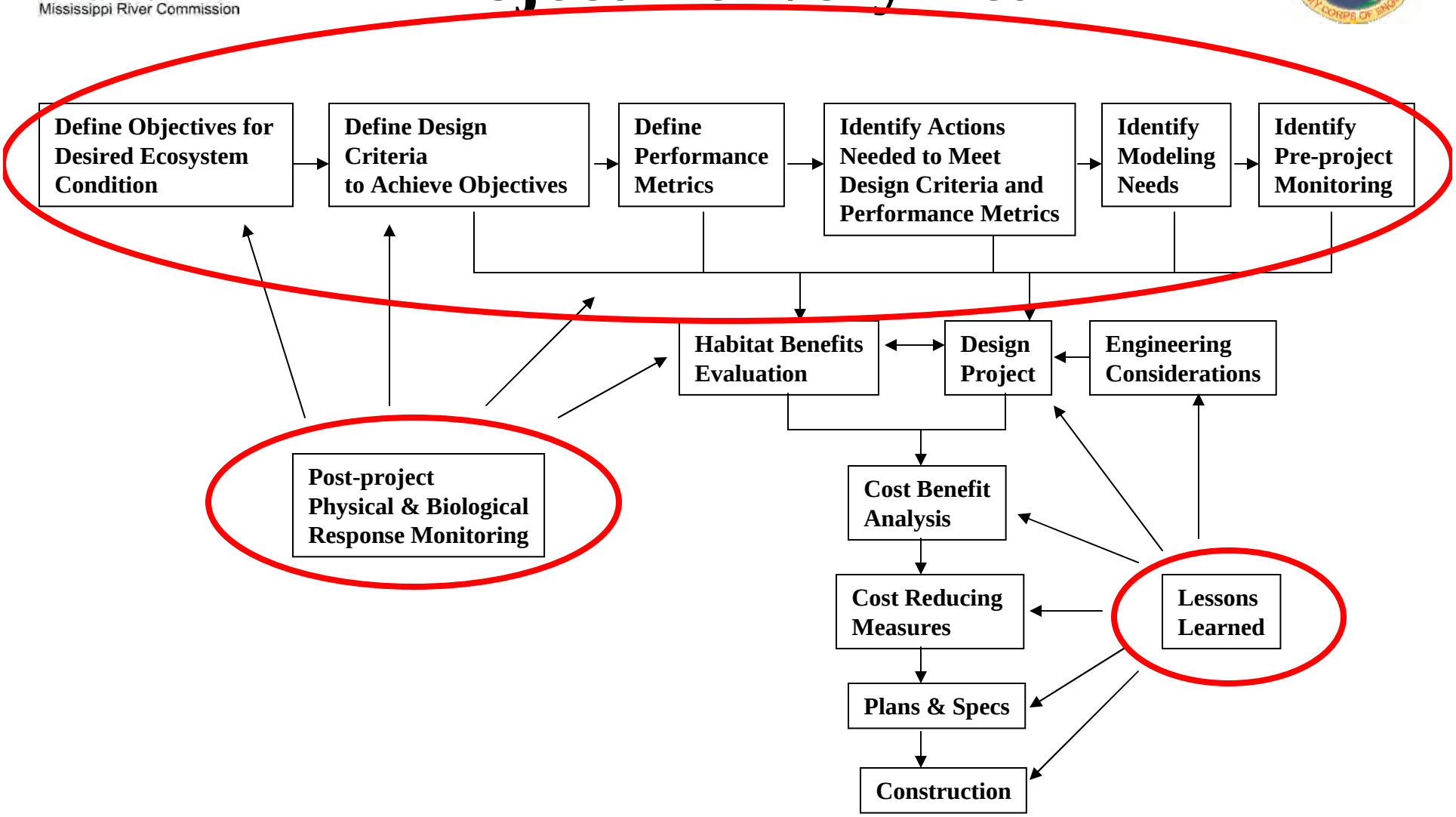
Project Delivery Team



Define Objectives

- ✓ **SMART (Specific, Measurable, Attainable, Relevant, Time Bound) Objectives**
  - ✓ **Example: Increase the area of aquatic vegetation in Weaver Bottoms by the year 2015 as follows:**
    - ✓ **Submersed Aquatic Plants – 300 acres**
    - ✓ **Emerged Aquatic Plants – 600 acres**
    - ✓ **Floating Leaf Aquatic Plants – 300 acres**
- ✓ **Defined by:**
  - ✓ **FWWG (Interagency Team of Biologists, Planners, Engineers)**
  - ✓ **Product Delivery Teams**

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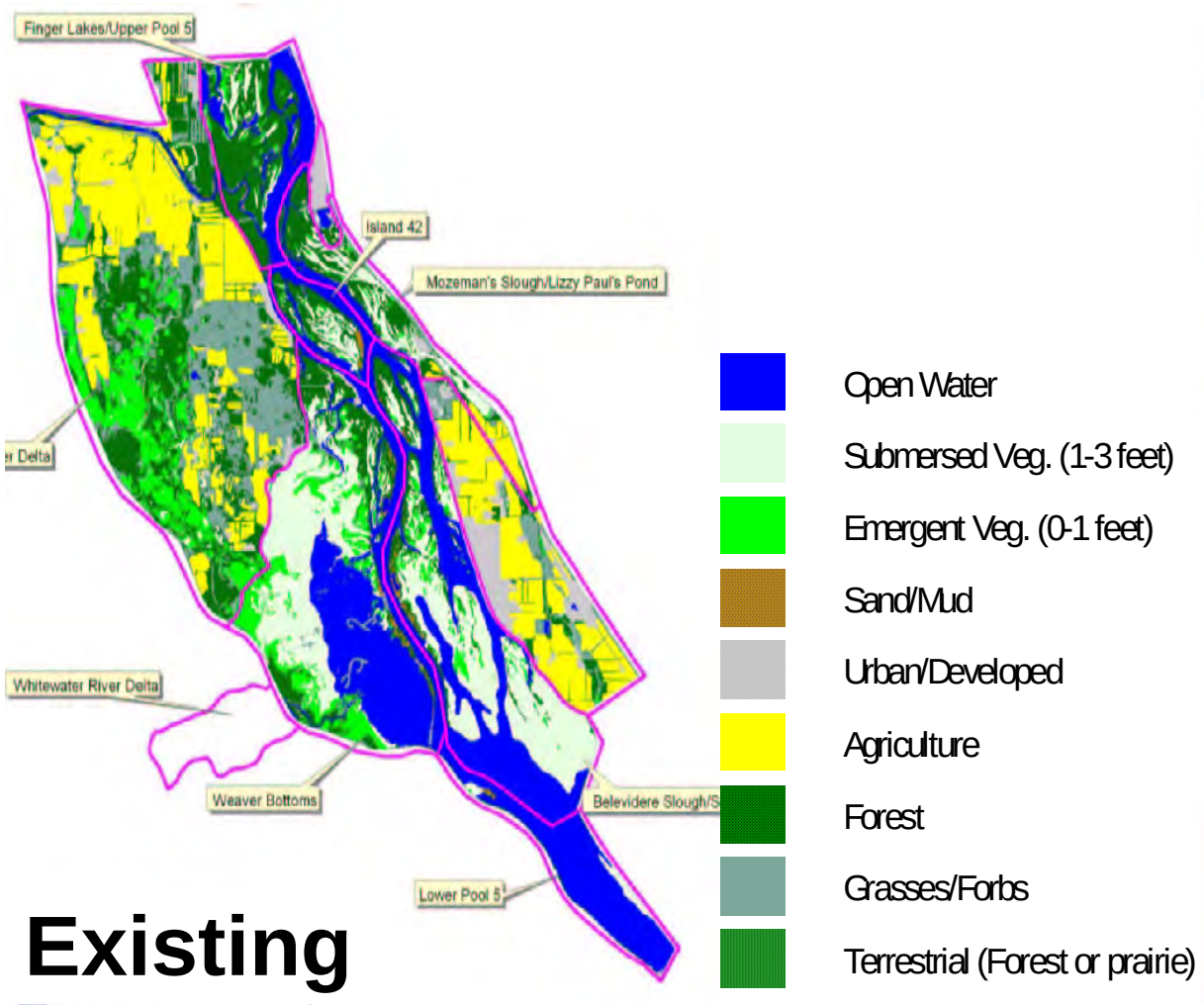
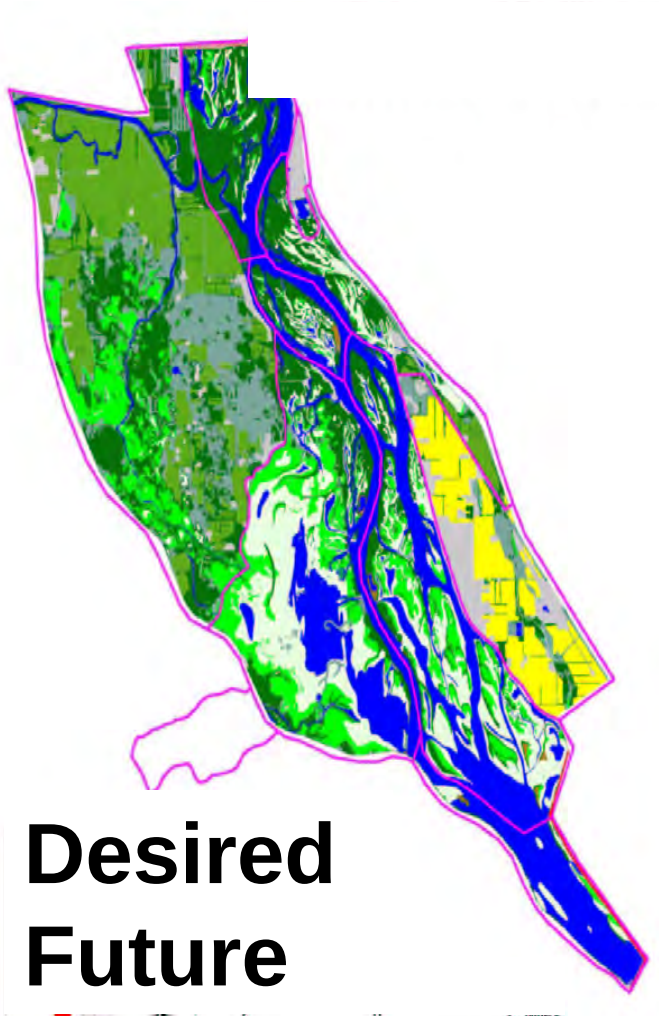
Environmental Pool Plans



Existing



Desired Future

Define Design Criteria

Example: Given the light extinction and substrate typical of backwater areas, aquatic plants grow in the following conditions

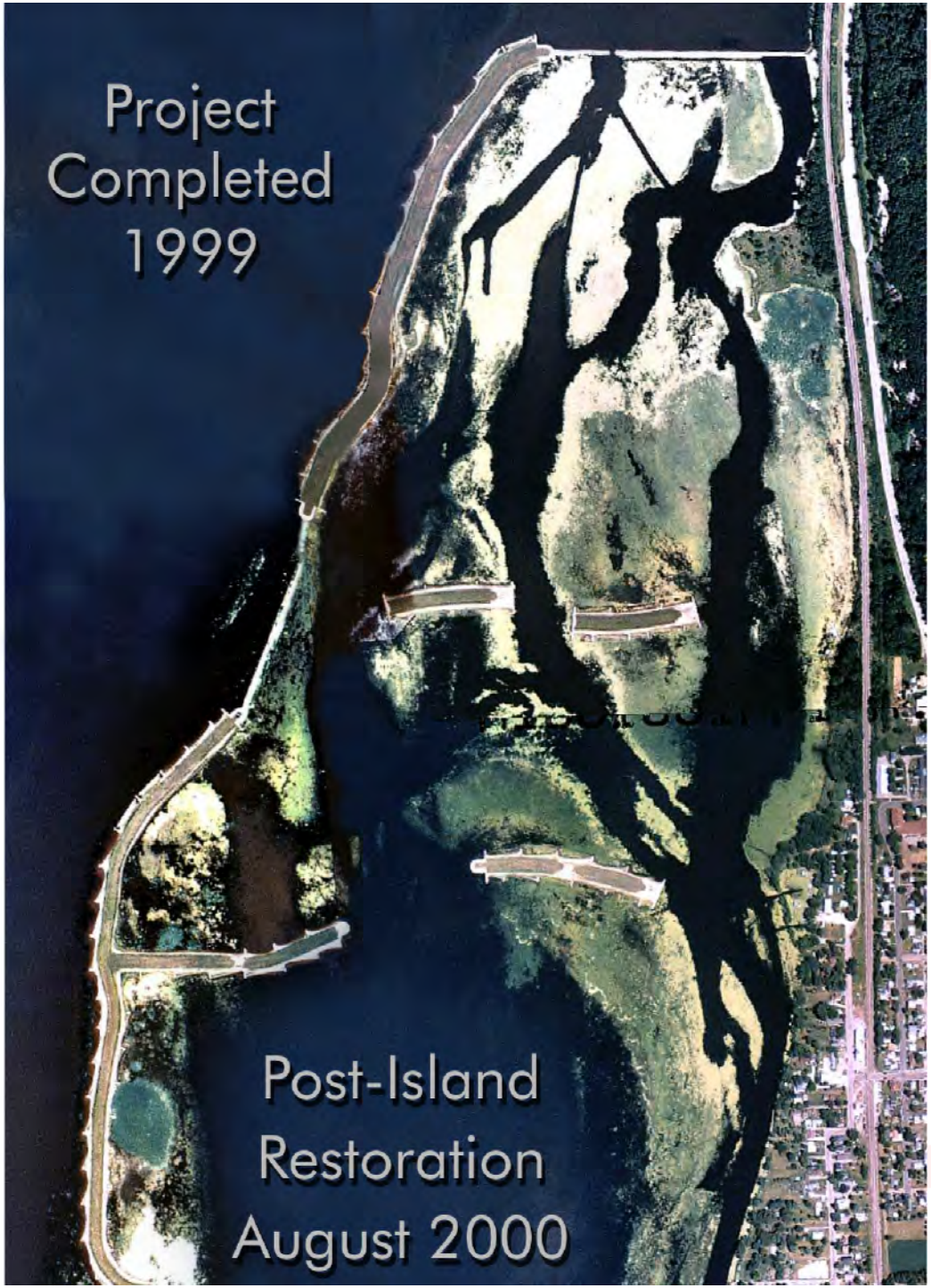
	Depth (feet)	Average Velocity (fps)	Wind Fetch (miles)	Performance Metric
Emergent Aquatics	0 - 2	< .1	< .75	Area Diversity Community Structure
Submersed Aquatics	1.3 – 5.2	< .5	< .75	
Floating Aquatics	.6 – 2.6	< .2	< .75	

ID Actions Needed to Meet Design Criteria and Metrics

- ✓ Water Level Management
- ✓ Islands
- ✓ Dredging
- ✓ Secondary Channel Restoration
- ✓ Shoreline Stabilization
- ✓ Training Structure Modifications
- ✓ Dredge Material Placement
- ✓ Forest Management
- ✓ Tributary Delta Restoration
- ✓ Fish Passage Structures

Historical
Islands
October
1961
BII-4BB-32

Pre-Island
Restoration
August 1994


Project
Completed
1999
Post-Island
Restoration
August 2000

ISLANDS

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Water Level Drawdowns

Water Level Drawdowns

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Secondary Channel Modification

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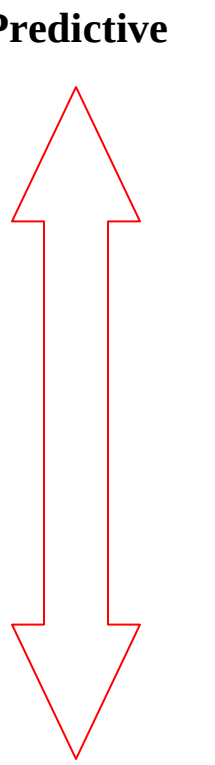
Backwater Dredging

Identify Modeling Needs

- ✓ **Hydrodynamic Models**
  - ✓ Steady/Unsteady Flow
- ✓ **Sediment Transport Models**
  - ✓ Multiple Grain Size
  - ✓ Sediment Budgets
- ✓ **Water Quality**
- ✓ **Geomorphology**
  - ✓ River Meandering, Island Formation
- ✓ **Ecological Response Models**
  - ✓ Aquatic and Terrestrial vegetation response
  - ✓ Biota



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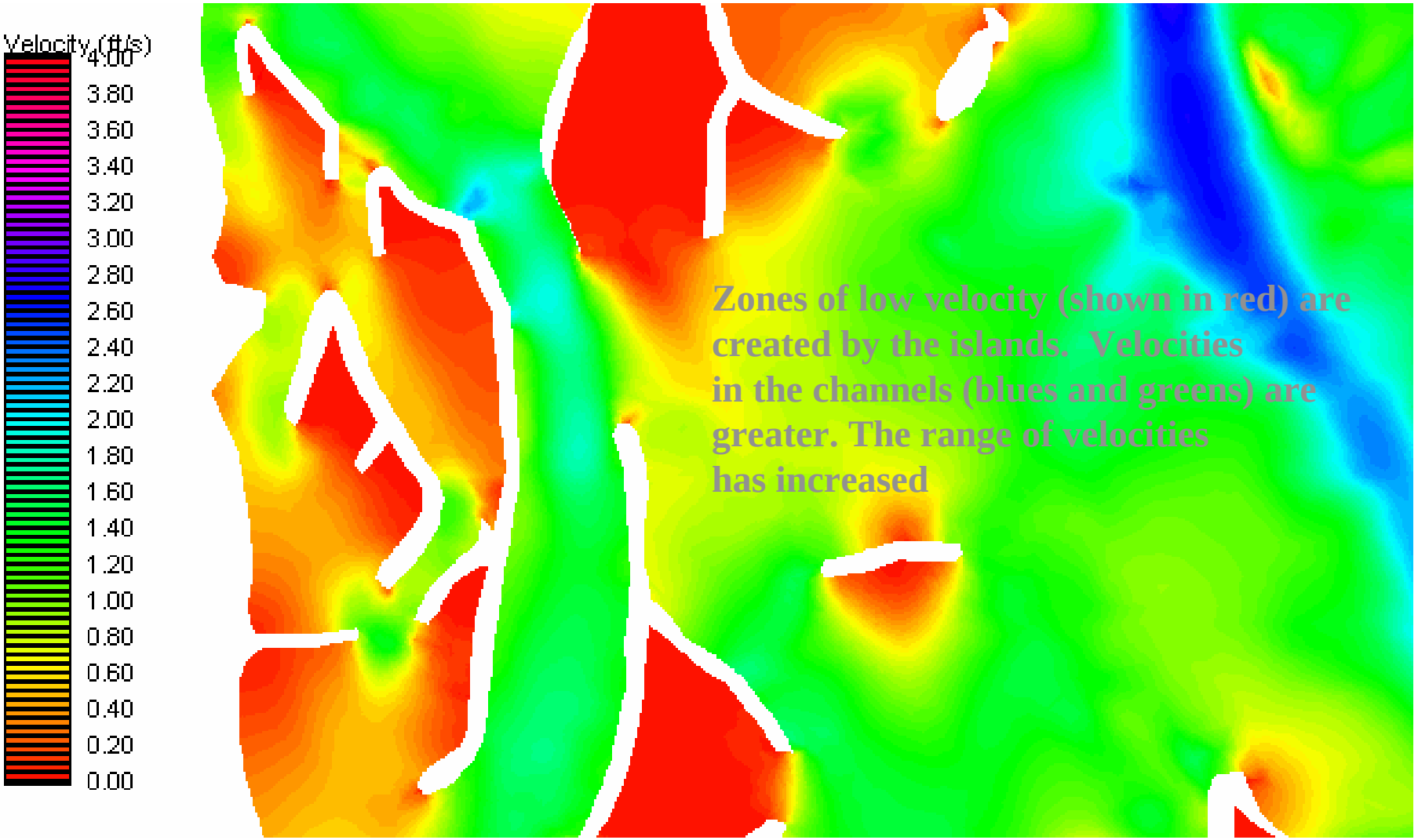
Hydrodynamic Diversity



Identify Pre-Project Monitoring Needs

- ✓ **With goals and objectives, design criteria, performance measures, and actions identified, can develop a pre-project monitoring plan to address critical unknowns**
  - ✓ **Ecosystem condition**
  - ✓ **Topography for plans and specs**
  - ✓ **Data needed for model calibration**

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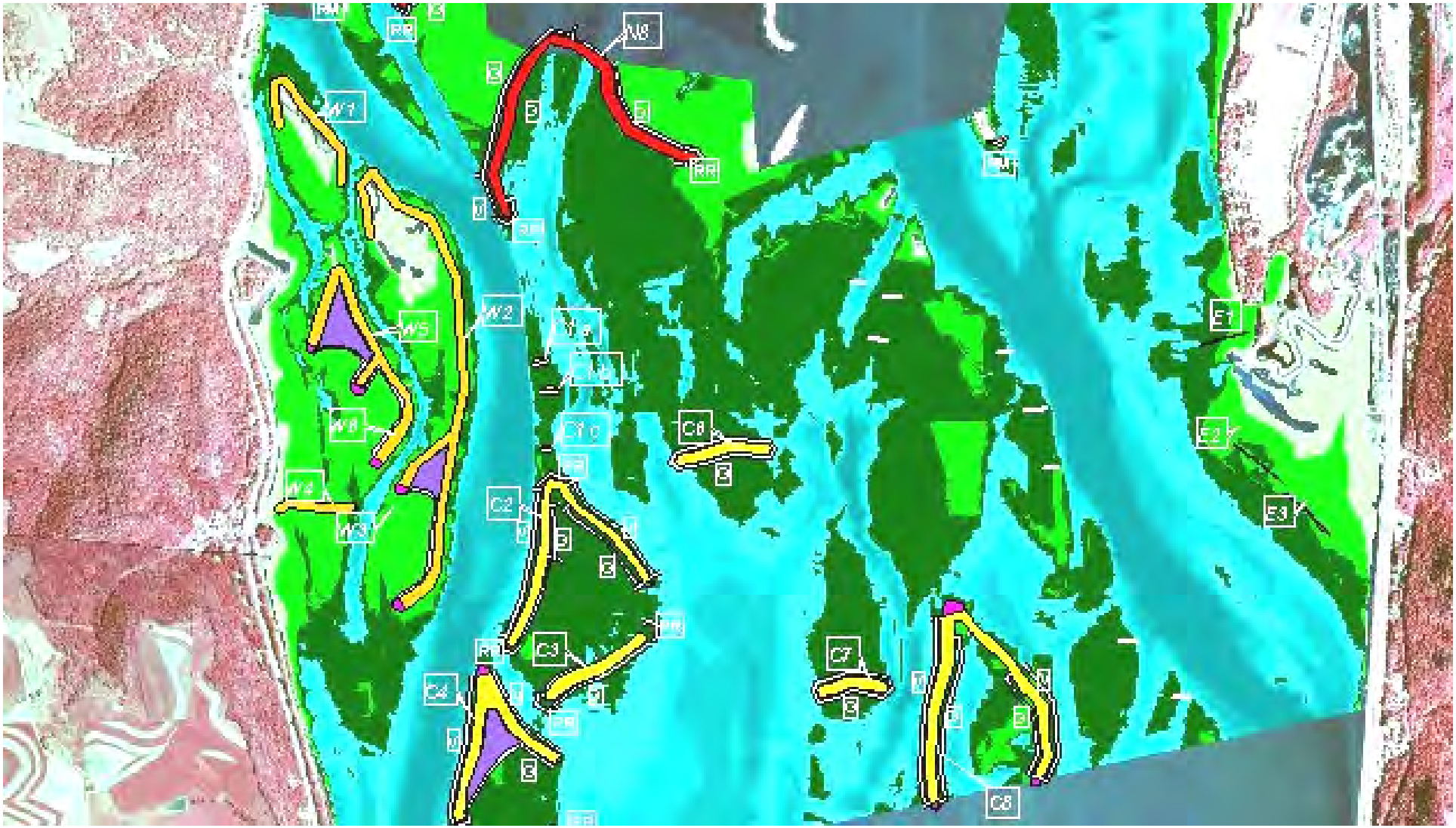
Pool 8, Phase 3 Layout



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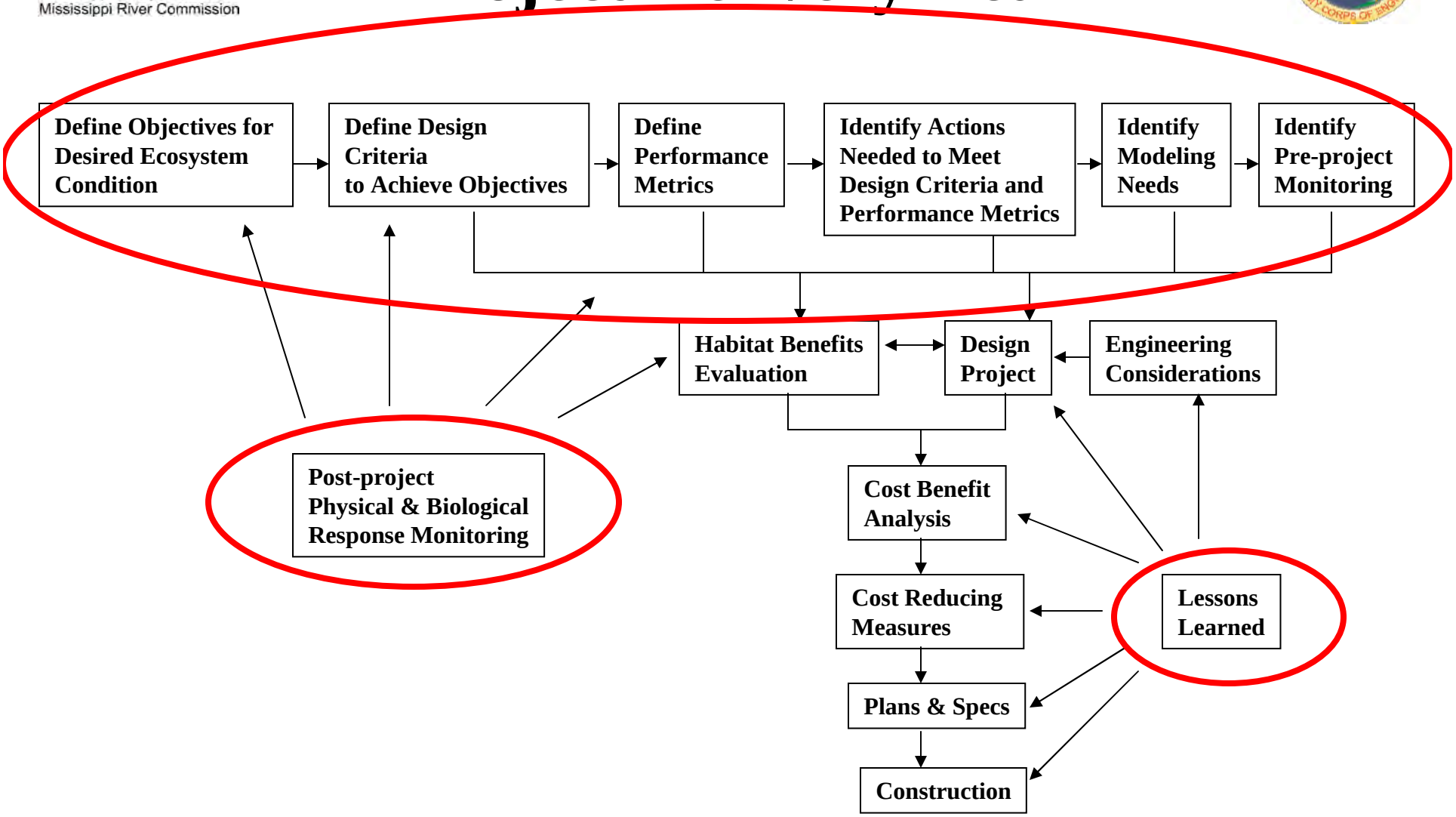
Project Delivery Team



EMP Project Design Handbook

Project Design Criteria Based on:

- ✓ Lessons Learned
- ✓ Habitat Design Criteria
  - ✓ Fish
  - ✓ Migrating Waterfowl (Fall)
  - ✓ Aquatic Vegetation
  - ✓ Terrestrial Vegetation
  - ✓ Loafing Habitat
  - ✓ Nesting
- ✓ Desired Physical Attributes
  - ✓ Water and Sediment
- ✓ Engineering Considerations
  - ✓ Shoreline stabilization, geotechnical, constructability, …

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Post-project Physical and Biological Monitoring

- ✓ Monitoring should lead to improved designs (adaptive management) and should quantify the effects at the project scale
- ✓ Our knowledge base should be increased
- ✓ Large scale effects of numerous small projects needs to be determined
- ✓ Limited by Budgets

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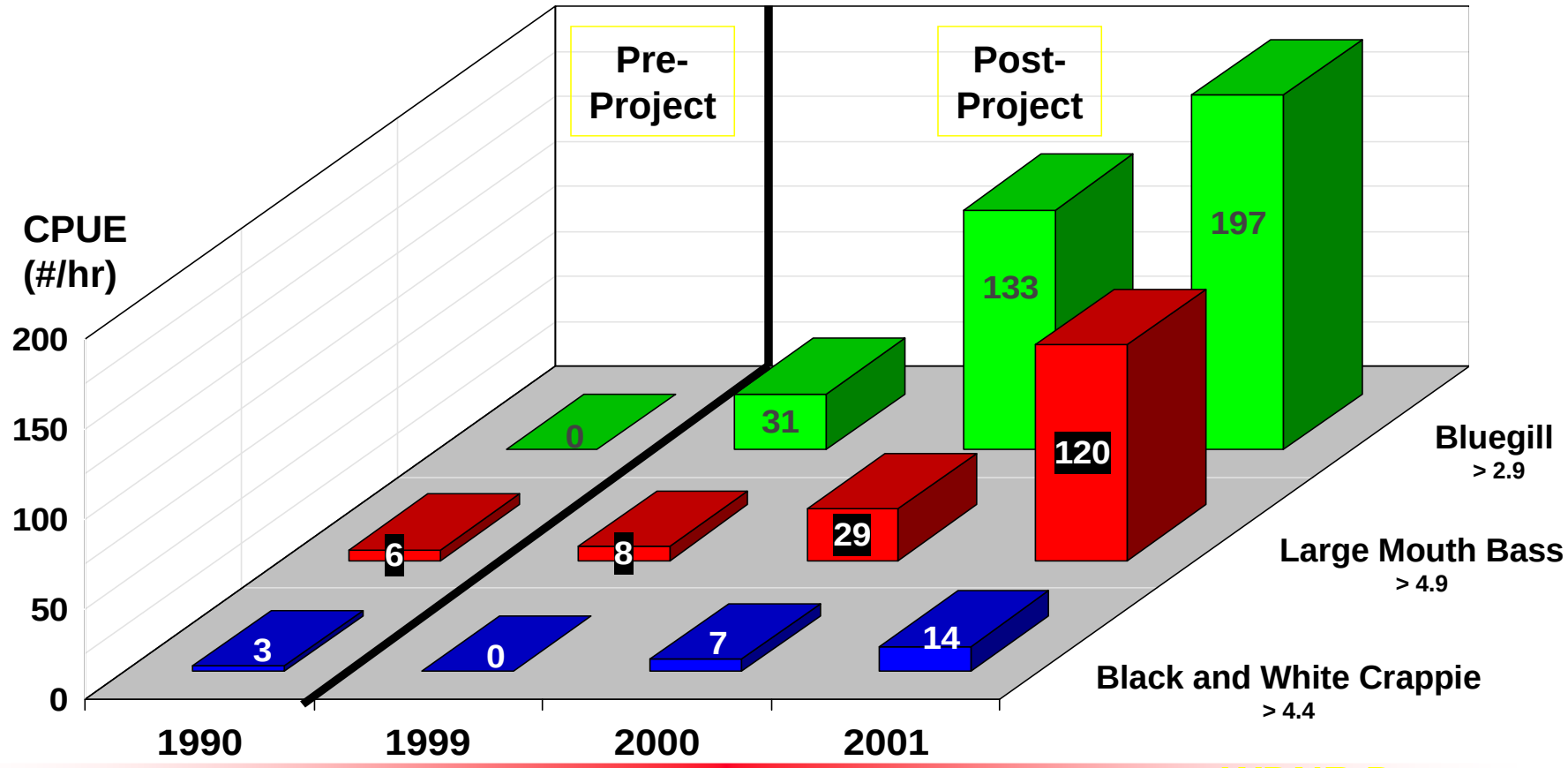
Pool 8 Islands Phase II

Pre- and Post-Project Fall Electro-fishing



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WDNR Data

The number of fish in the phase II island area has increased significantly.

Conclusion

- ✓ **Strengths**
  - ✓ **Cooperative Interagency Effort**
  - ✓ **Adaptive Engineering Based on Lessons Learned and Available Knowledge**
  - ✓ **Design Tools: Hydrodynamic Models, GIS, CADD**
- ✓ **Weaknesses**
  - ✓ **Ecosystem Response Monitoring has been Minimal**
  - ✓ **Ecosystem Response Models Are Poor**
    - ✓ **Individual Species Based Models**
    - ✓ **Matrix Scoring**
  - ✓ **Weak Relationship Between Research Community and PDTs**

Current Research in Fate & Transport of Chemical and Biological Contaminants in Water Distribution Systems

Session 2C
Modeling, Ecological Restoration / Systems Assessment

V. F. Hock - USA-ERDC-CERL
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ERDC
Engineer Research and Development Center

Team

- Product Development Team:
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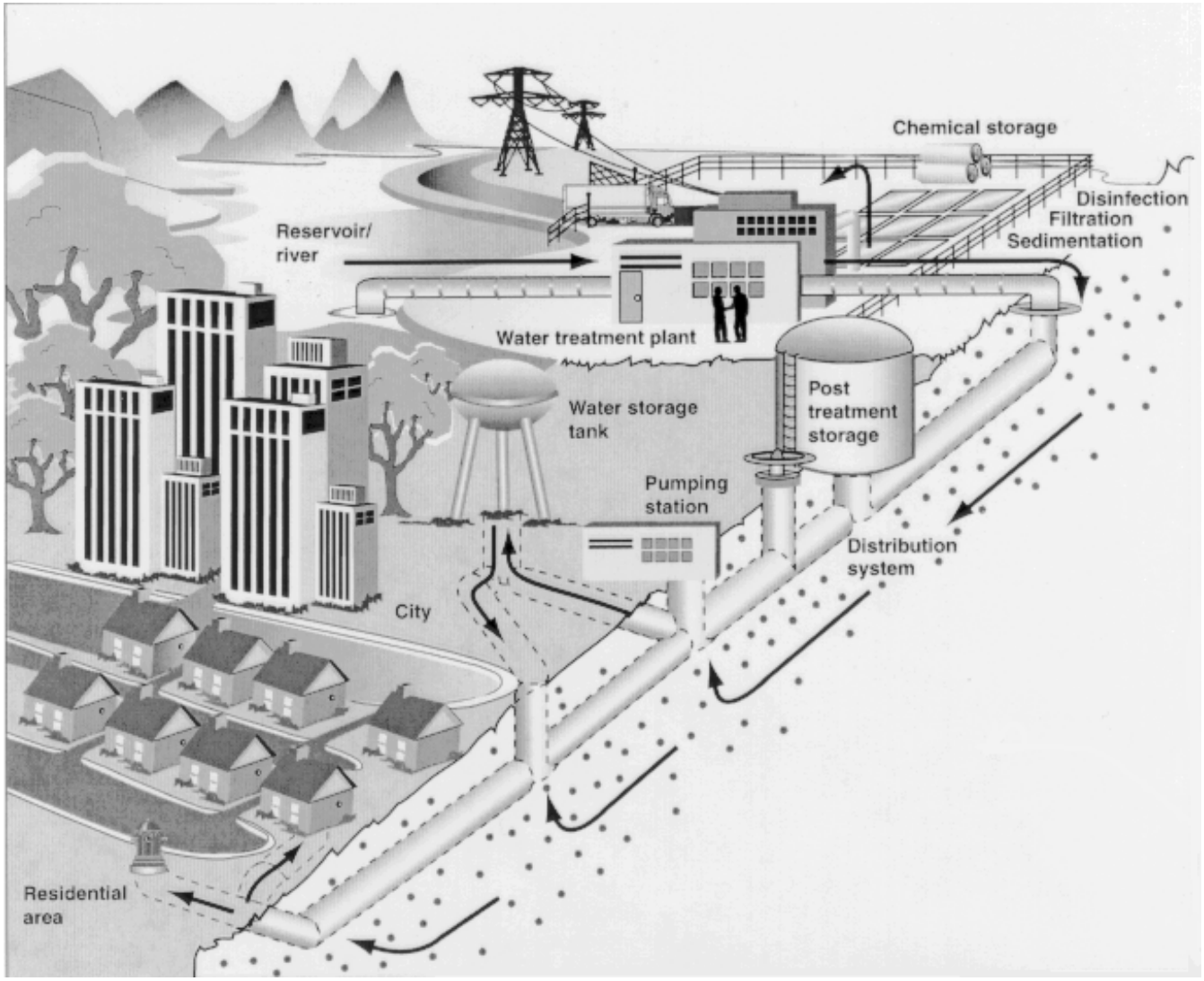
  - EPA: J. Herrmann, S. Clarke, K. Fox, R. Murray
  - ECBC: V. Rastogi, A. Turetsky, A. Pappas
  - Hach HST: M. Gibson, D. Kroll
  - AwwaRF: G. Welter, F. Blaha
- CRADA - ERDC-CERL, ECBC, Hach HST
- Other Partners:
  - Sensors (SBIR & commercial partners)
  - Water treatment (SBIR & commercial partners, CHPPM)
  - Decontamination methods (EPA, AwwaRF)
  - Control systems (Commercial Partners & ERDC, CHPPM)
  - Updated fate and transport physics for simulation (ERDC lead, UIUC, AwwaRF, EPA, ECBC, CHPPM)
  - Test bed facilities at ECBC for experimental verification against live CB agents (ECBC, ERDC, Hach HST, EPA.)

Threats and Vulnerabilities



- Threat to Water Potability
- Threat to Fire Suppression
- Lack of system redundancy
- Large area subtended by the system
- Treatment chemicals
- Lack of anti-tampering devices currently built-in
- Control systems (SCADA)

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The Threat – Current Estimates

- AwwaRF Project 1812
  - 279 Documented incidents from ~1960's to present
  - 19 deaths, 166 illnesses confirmed
- GAO Report GAO-03-29
  - 75% of experts (32/43) identify the water distribution system as being most vulnerable (as opposed to source waters or other system components, treatment chemicals, etc.).

The Threat – Current Estimates

- Recent Incidents
  1. February 2002 – Al Qaeda arrested with plans to attack U.S. embassy water in Rome with “cyanide”.
  2. December 2002 -- Al Qaeda operatives arrested with plans to attack water networks surrounding the Eiffel Tower neighborhoods, Paris
  3. April 2003 -- Jordan foils Iraqi plot to poison drinking water supplies from Zarqa feeding U.S. military bases along the Eastern desert.
  4. September 2003 -- FBI bulletin warns of Al Qaeda plans found in Afghanistan to poison U.S. food and water supplies.

Army Relevance

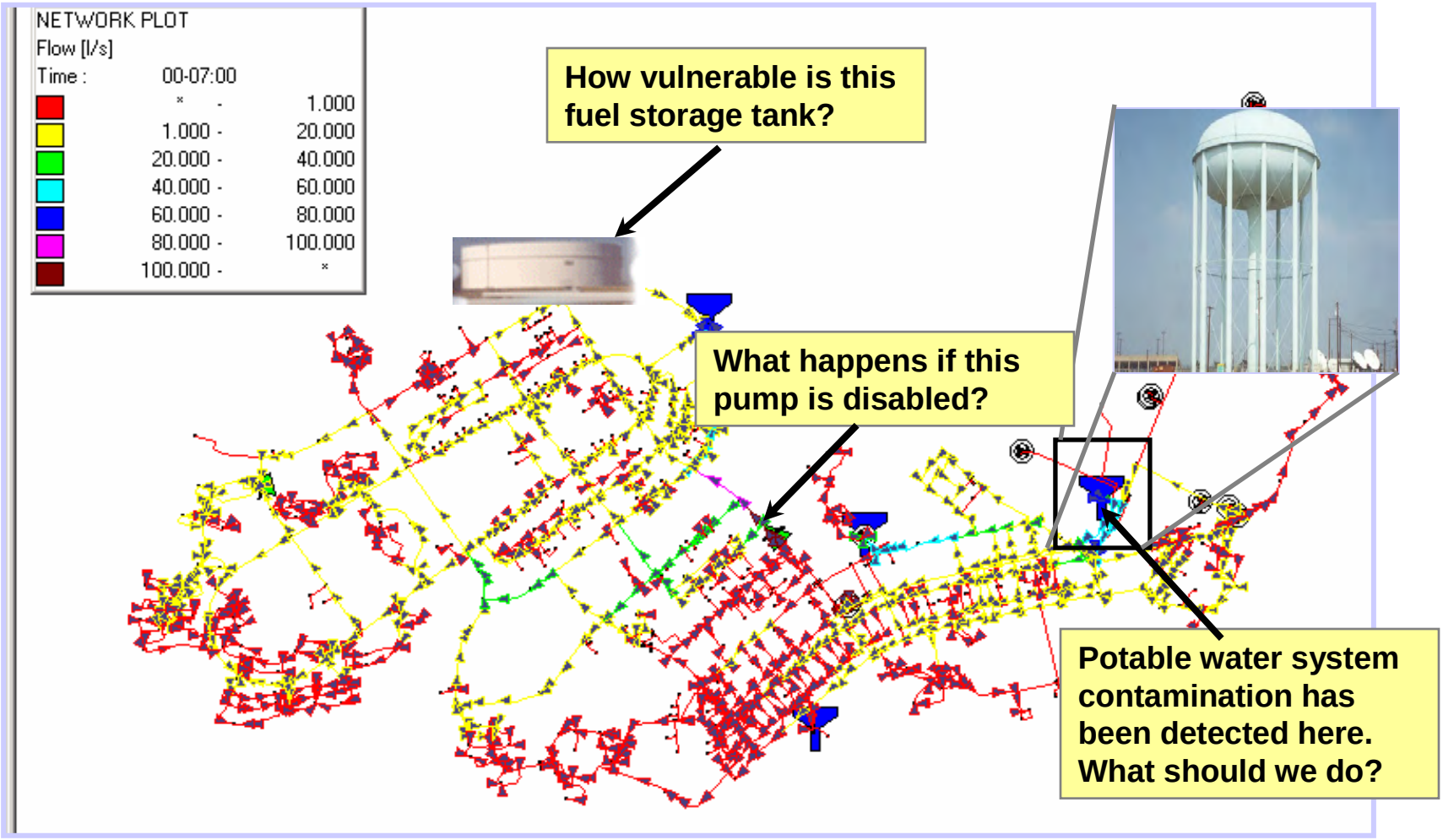
CINC's and services are required by DoDD 2000.12 and DoDI 2000.16 standard 26, to conduct a higher headquarters vulnerability assessment of their installations AT programs every three years.

Dynamic Simulation tools can be used to support the Joint AntiTerrorism Guide (JAT Guide)

Installation Management Agency (IMA) – Force protection officer supports requirements for mitigation of terrorist threats to utilities (Feb '04)

Force Protection

Utility systems are potential targets to terrorists.



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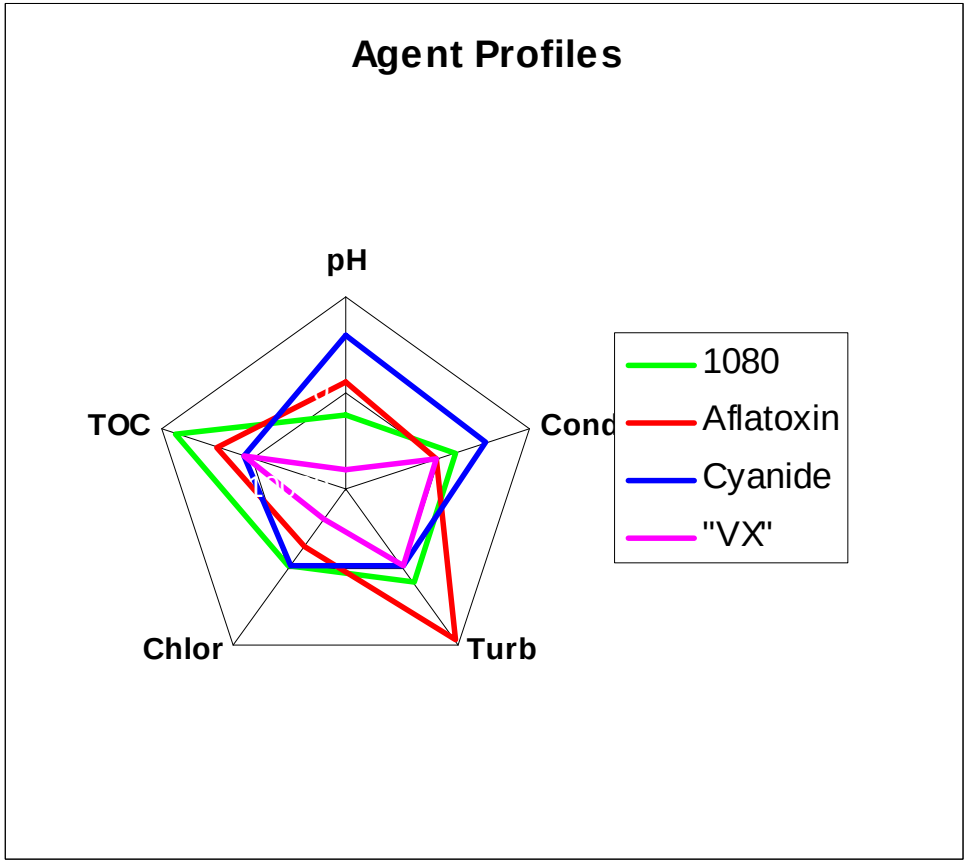
Problem

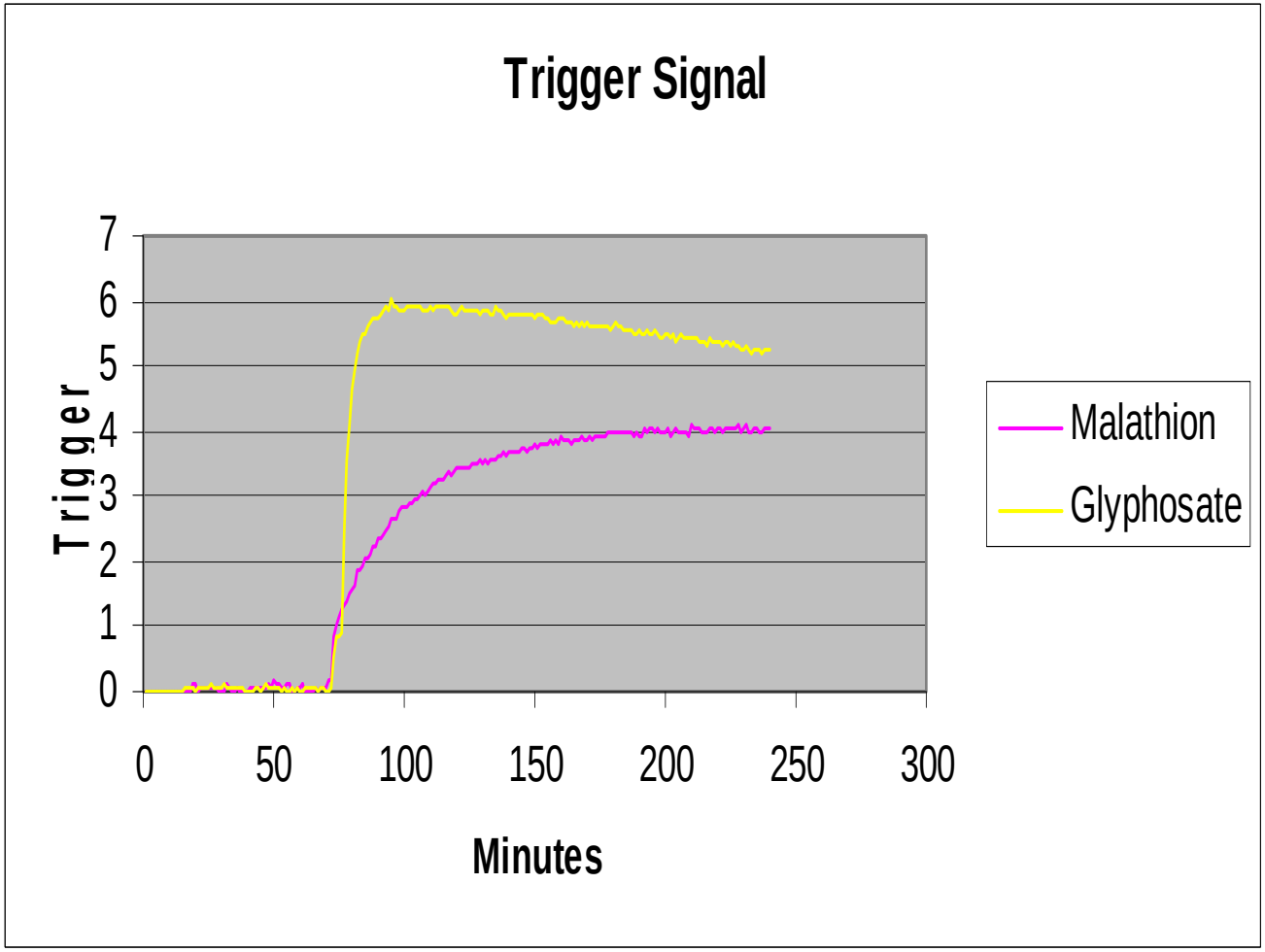
- Water Security has 4 primary components
  - Detection
    - No single sensor can determine the contaminant type and amount released into the system.
  - Modeling - better models of contaminant fate & transport are required to:
    - Preplan response to attack
    - Monitor the progress of an actual attack
  - Countermeasure - “Green” methods (that do not produce additional toxins) are required to
    - Water treatment
    - Pipe Decontamination - 5% of the attack can cause 95% of the cleanup cost
  - Emergency Response
    - Coordination of these resources

Approach: Detection

- Coordinate testing of Hach HST sensor capable of determining contaminant type from water quality data
- Hach sensor is equipped with a library of water quality responses to ~100 classes of agent.
- Contaminant is detected and identified by monitoring the water parameters: ORP, TOC, chlorine, pH, etc. as a generalized vector. Two test runs were conducted at ~70 minutes as the loop is dosed with…
  - Malathion
  - Glyphosate



Agents at 1 mg/L, LD50(2%) Trigger Strongly



Trigger Threshold= 1.0

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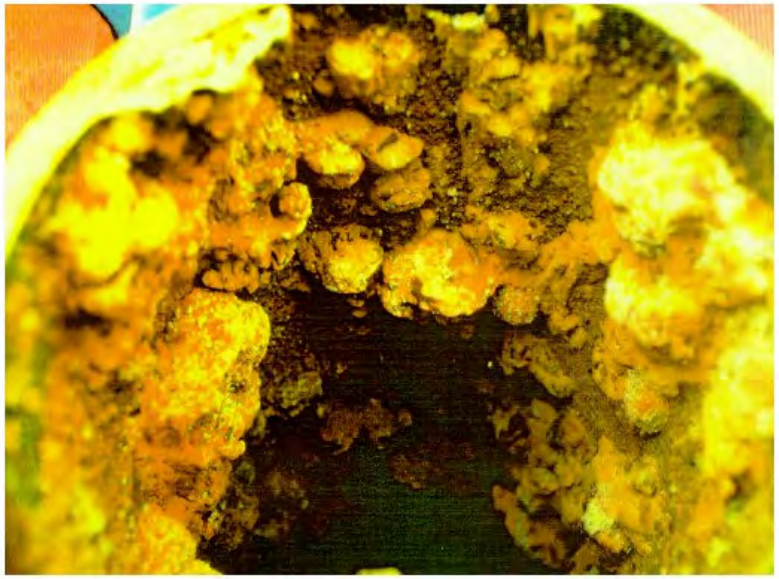
HACH Be Right™

S&T Knowledge Gap in the Physical and Chemical Models Embedded in Current Simulations

- Any interaction between the contaminant and the pipe wall will prolong the the CB attack
- Surface roughness from scale or corrosion slows transport and inhibits decontamination.
- Biofilm - Biological contaminants may settle in the biofilm and continue to release bio-toxins.



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Current R&D in Fate and Transport

- Current simulation is limited by inadequate chemical and physical models.
  - Needs interaction between the CB agent and the pipe wall
  - Interactions between CB agents and decontamination agents (ex. Chlorine) need improvement at low concentrations in the water distribution environment.
- Need to translate CBR protection requirements into water distribution requirements
- Updated physicochemical models will be used to improve existing simulations.

Current F&T Issues

- Reaction Rate:
  - Classically - Rate = $k[A]^m[B]^n$
  - Does this continue at low concentrations in the presence of corrosion products, chlorine, biofilm, etc.?
- Wall Interaction
  - DA yields $$\frac{u}{v*} = f\left(\frac{yv*}{\nu}, \frac{y}{e}, \frac{y}{L}\right)$$

    Where u= velocity, y = dist. From wall,

    e = roughness height, nu = viscosity,

    v* = friction velocity = $\sqrt{\tau_0 / \rho}$

    tau = shearing stress, rho = density
  - How common is adhesion to wall material, biofilm, scale, or corrosion products?
  - Hypothesis: Water/Biofilm/Sediment/Pipe equilibrium is related to:
    - octanol / water partition coefficient and molecular weight of the contaminant and the pipe material

Current Model in EPANet 2.0

$$\frac{\partial C_i}{\partial t} = -u_i \frac{\partial C_i}{\partial x} + r(C_i)$$

- Advective Transport Equation
  - with u = flow velocity, C_i is concentration, r is the ***pure loss*** term due to bulk interaction and wall interaction
  - The term ‘r’ was limited to pure loss because the simulation was built to track chlorine
  - Conversation with L. Rossman indicates version 3.0 will have more general modeling capabilities to take advantage of our research results.

6.2 In-house Testing

- Pipe types
  - PVC (15 April 2005)
  - Copper (29 April 2005)
  - Cement Lined Ductile Iron (Sealed and Unsealed) (25 May 2005)
- Agents - Low concentration
  - Prophos (VX simulant)
  - Ovalbumin (Ricin simulant) - Starts 30 May
- Static testing - Low concentration
  - Prophos @ 400, 200, 100 mg / L

In-House Simulant Static Testing

- VX Simulant Ethoprophos
  - MW = 242 (267.37)
  - H_{ow}= 140 (123)
- Ricin Simulant Ovalbumin
- Pipe: cPVC, Copper, Cement-Lined Ductile Iron (Sealed & Unsealed).
- Measure
  - Time constant & Asymptote
    - During exposure to simulant
    - Then on exposure to fresh water
- HPLC / MS, UV absorption
  - UIUC (A. Scheeline)

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ECBC Live Agent Static Testing

- Static Testing against live agents, (Starts 9 May 2005)
- Dynamic testing with live agents, in meso-scale loops at the ECBC/CERL Test Bed (Starts May 2005)
- Pipe types
  - PVC
  - Cement Lined Ductile Iron
  - CLDI with Sealer
- Agents - Low concentration
  - VX
  - Ricin

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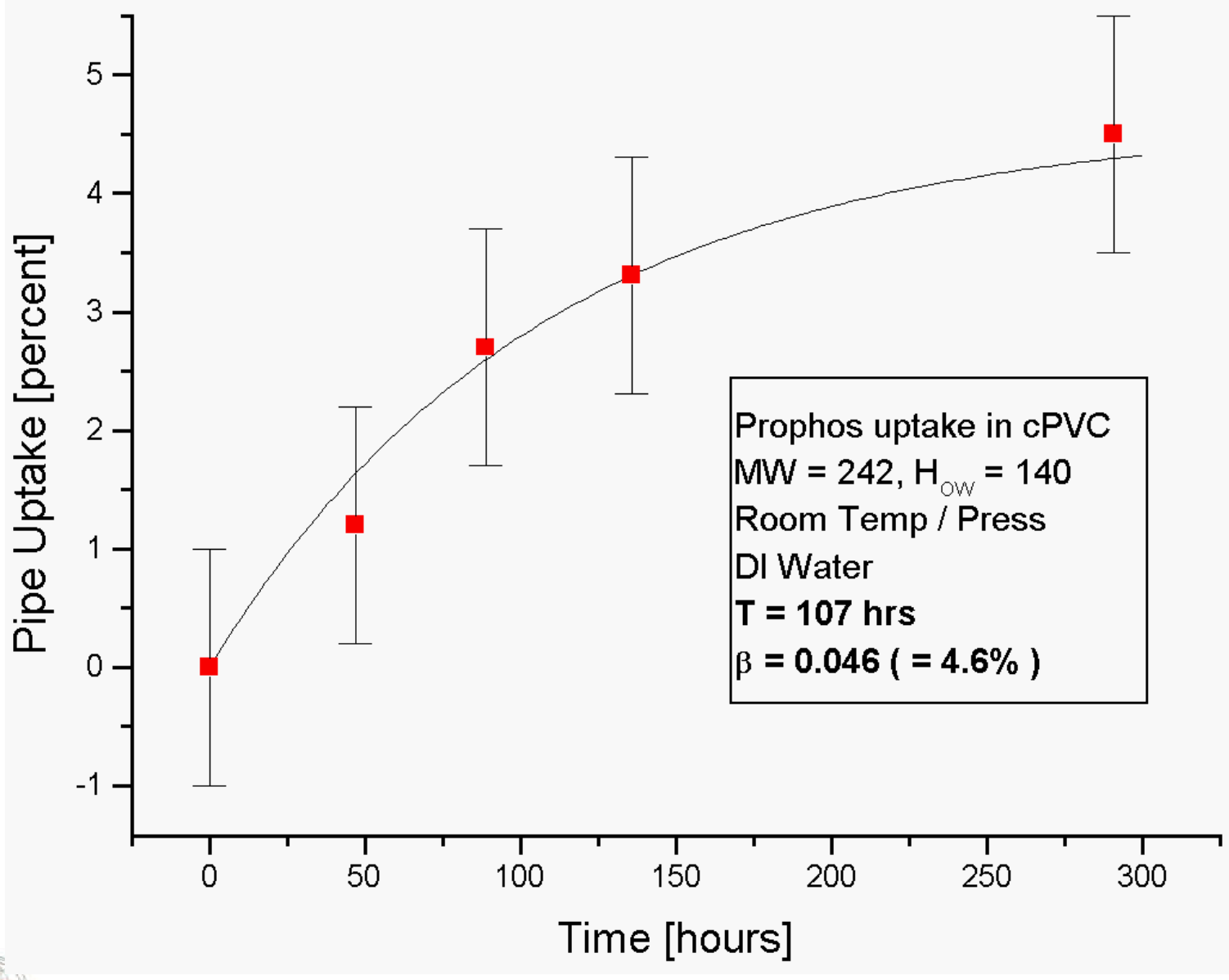
Current Results

$$C(t) = C_0^*\left(\beta\, e^{-t/T} + (1-\beta)\right)$$

- Where
  - C(t) is the concentration of agent in water
  - C_0* is the initial concentration at the pipe wall
  - Beta is the fraction deposited on the wall at equilibrium
  - Tau is a characteristic time constant.
  - Beta and Tau are the parameters of interest in simulators
- This implies the pipe uptake P(t) is…

$$\frac{P(t)}{C_0^*} = \beta\left(1 - e^{-t/T}\right)$$

ERDC Static Test - VX Simulant in cPVC



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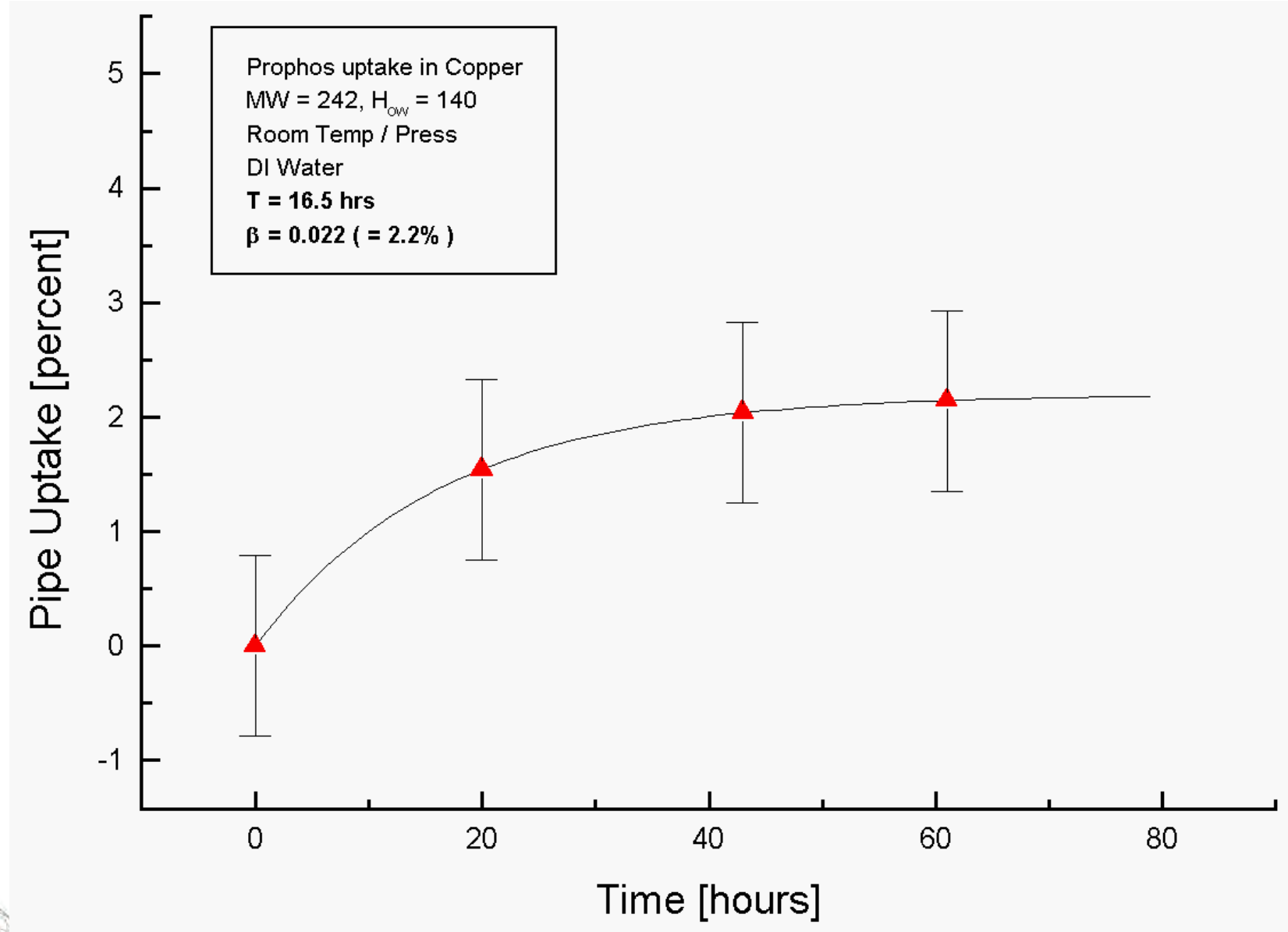
ERDC Static Test - VX Simulant in Copper



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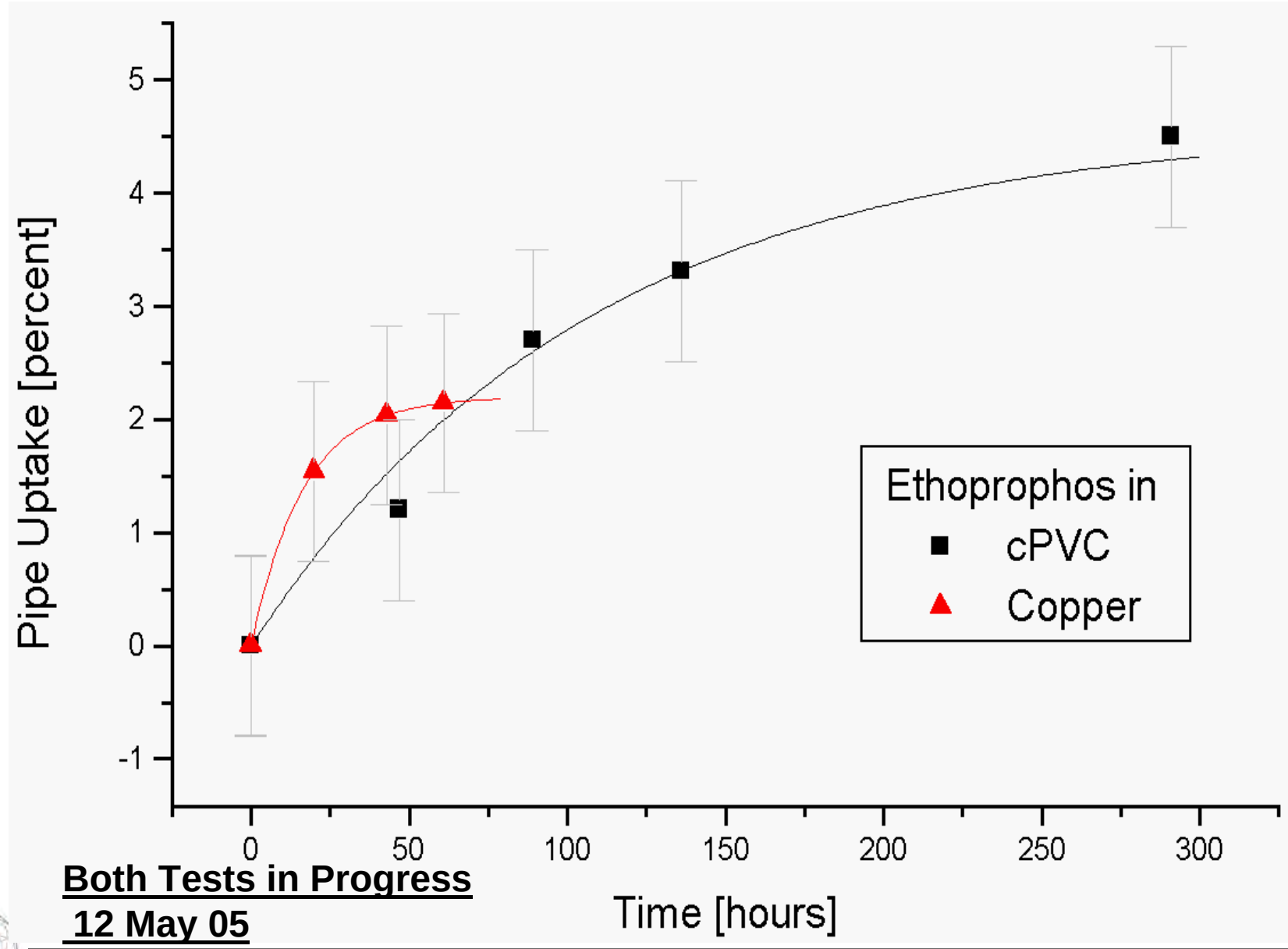
VX Simulant in Copper vs. cPVC



Both Tests in Progress
12 May 05

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ERDC Analysis of Static Testing

Uptake in 7 days, Time constant in hours

Agent	cPVC	Fe	Cu
Prophos	3.6%, 107	-	2.2%, 16.5
Bacillus	189%	21%	
MS2	30%	3%	
Inorganic As, Sr, Cs, Hg, Co, Tl	1%, ~1	1%	
Chlordane	14%, ~140	6%	
p-DCB	2%, ~73	1%	

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Chemical Agent Results

- Percentage uptake on new pipe wall is directly proportional to chemical agent concentration (at moderate or high levels)
  - Preliminary data for VX simulant on cPVC indicates uptake of ~ 5%
- Pipe wall interaction is independent of:
  - pH [7 - 8.9], temperature [4 - 25C]
- Pipe wall interaction is dependent on
  - Pipe type
  - Agent type

High Concentration Mini-Loop at ECBC

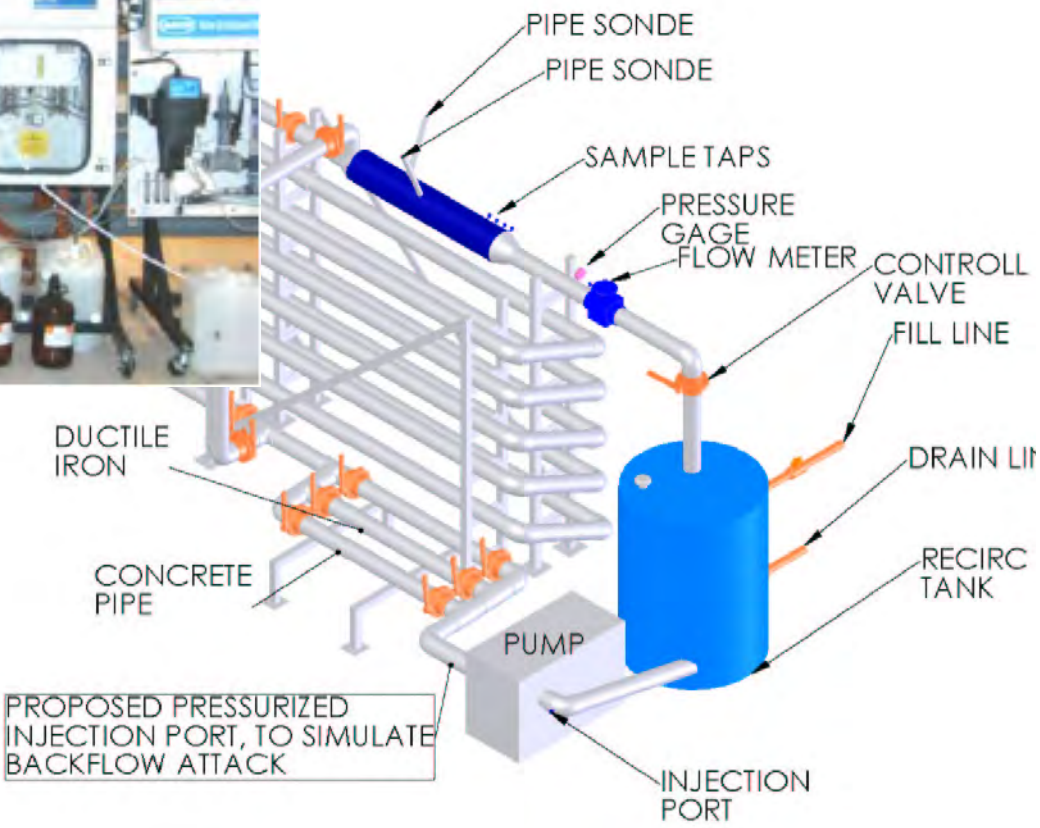

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Photo of Large Test Loop at ECBC

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Approach: Countermeasures

- Develop new “green” countermeasures that do not produce toxic by-products, including:
  - UV
  - E-Beam
  - Pulsed Corona Discharge

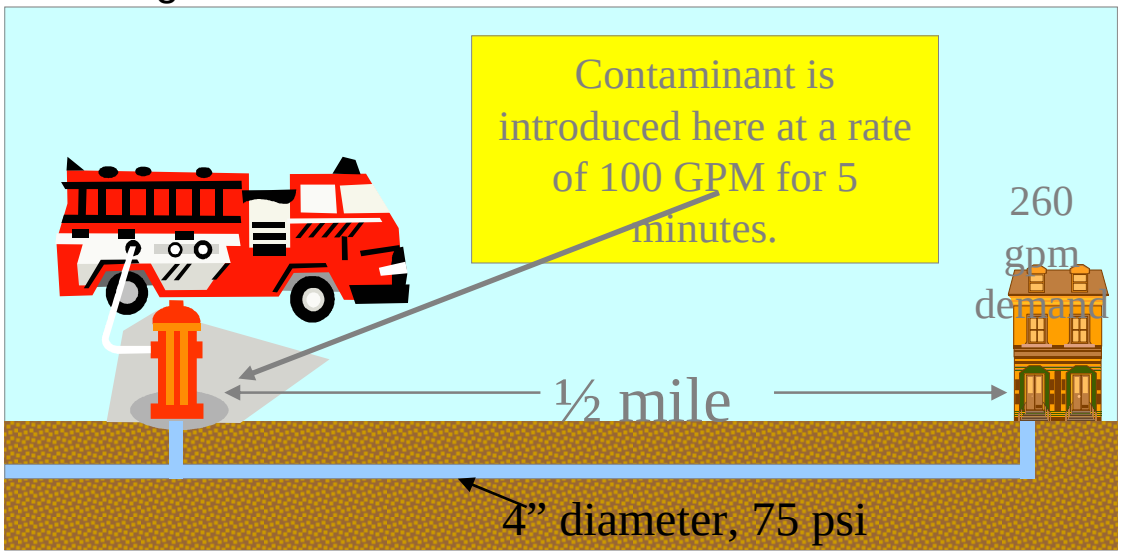
R&D Simulation of Fate & Transport of a CB Agent in a Water Distribution System

Scenario:

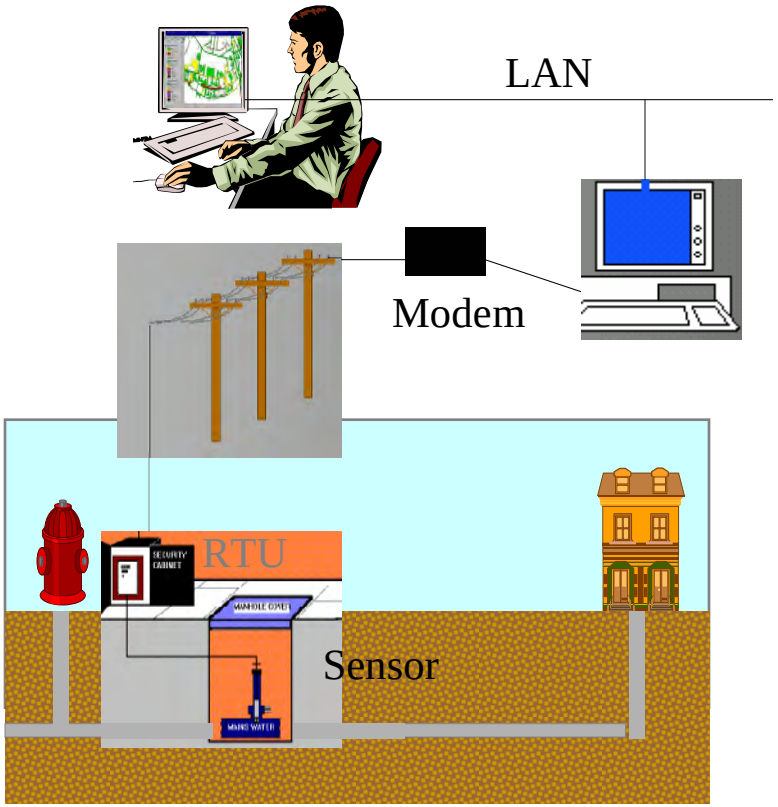
- DoD and municipal water systems are vulnerable to terrorist threats
- System-specific response to threats/ emergencies (such as chem/bio attack) is often unknown
- Limited methods for detecting chem/bio agents

Response:

- Sensor-enabled dynamic models coupled with countermeasures



How long before it reaches the building? What will its concentration be? When will the concentration return to zero?



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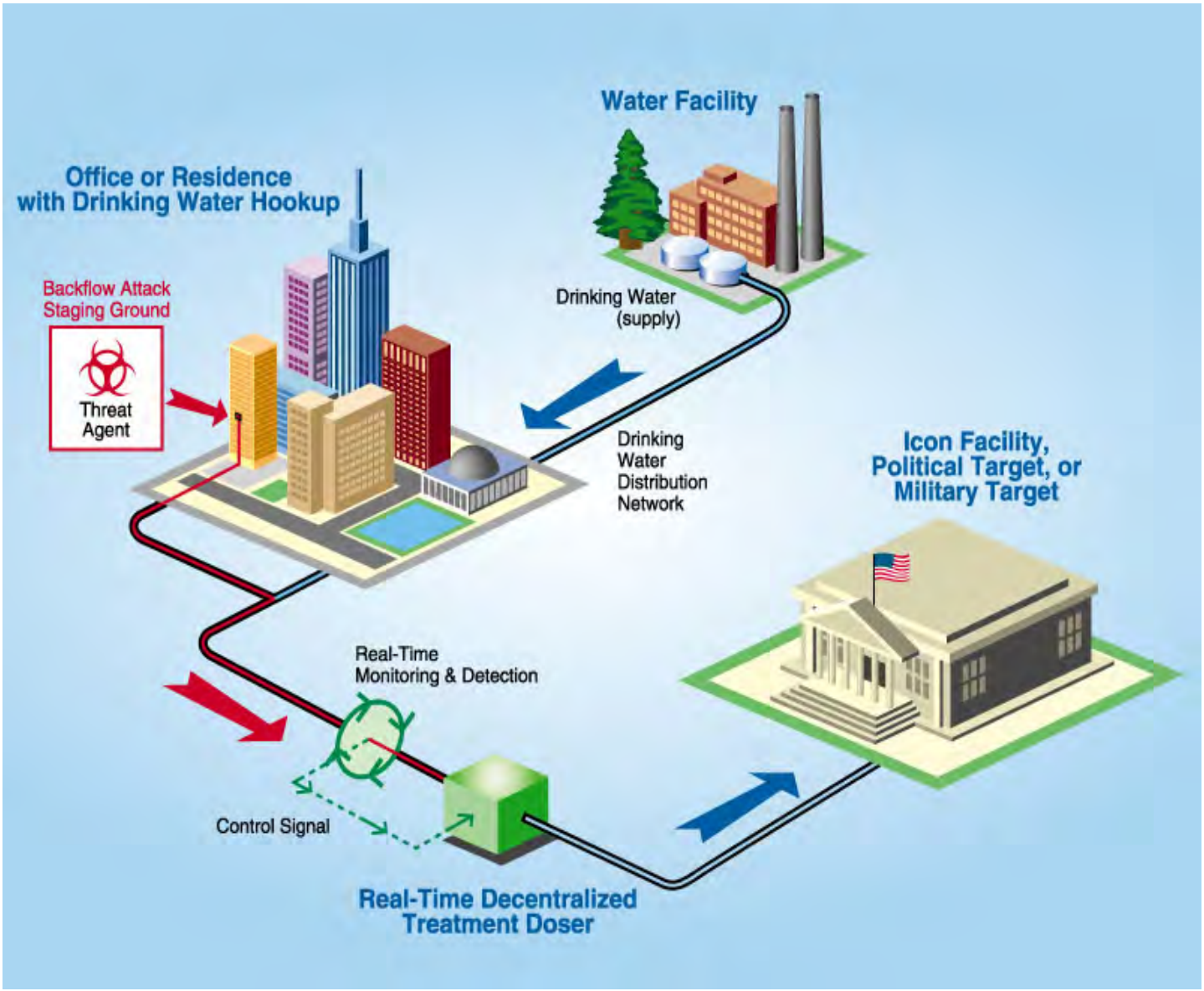
Integrated System Protection



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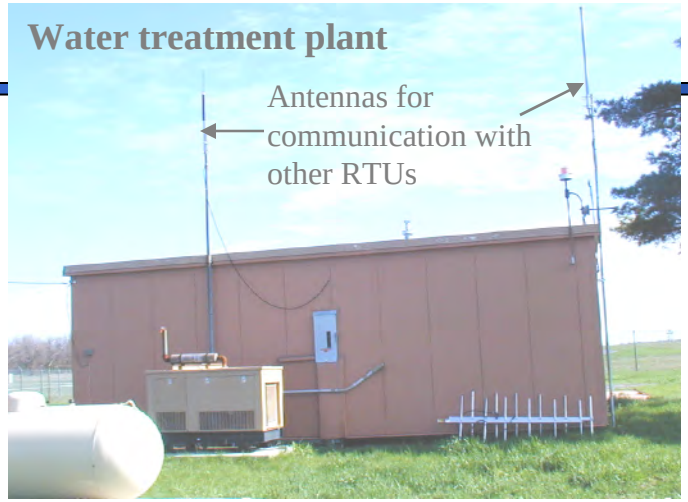
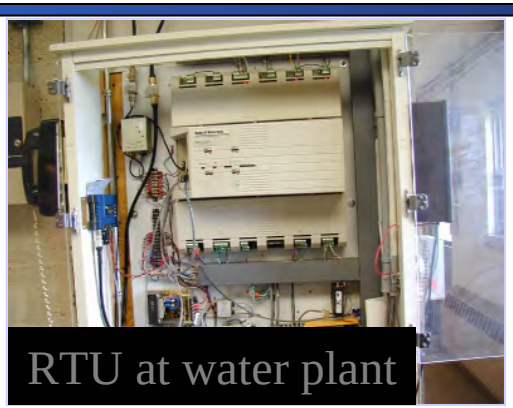
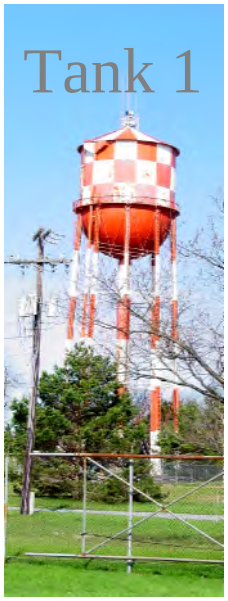



RTU at water plant

Ground storage reservoir

Tank 1 water level sensor at water plant



Flow meter at water plant

Well 3 RTU

FORT DRUM PILOT TEST

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Technology Transfer

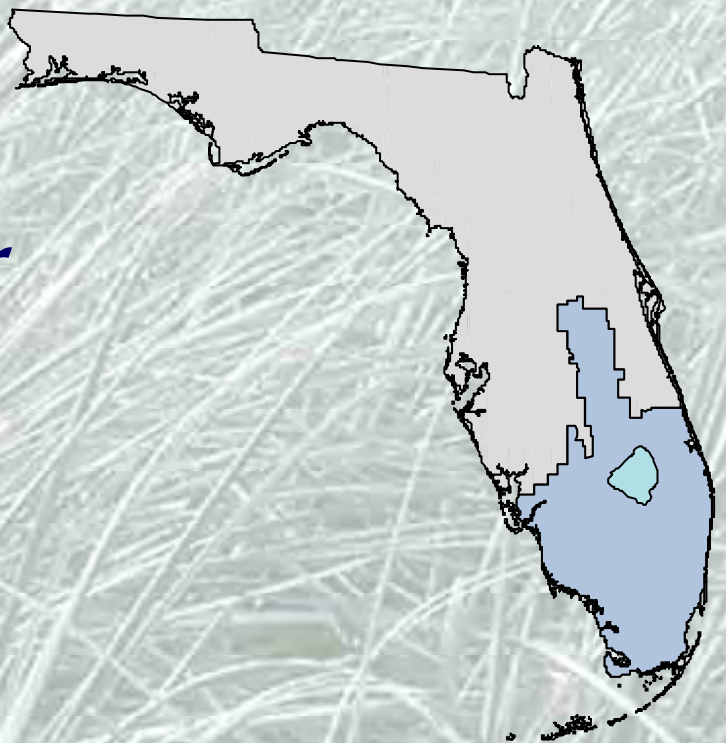
- Transfer rate constants for CB Agent F&T in various pipe types to enhance engineering simulation
- EPANet 3.0 updated by EPA office of Water Security (POC L. Rossman) Fall 05
- Updated EPANet 3.0 embedded in the Ft. Future Virtual Installation FY06.
- Additional plans
  - ACSM / IMA - Force Protection (P. Hoffman)
    - Vulnerability Assessment of Critical Facilities
  - DTRA - Nationwide network of sensors with integration with ASOCC or CATS.
  - CHPPM - Soldier health, sensors, and fate of agent.
  - Congressional line-item with Hach HST for field implementation of sensors

CENTRAL & SOUTHERN FLORIDA PROJECT
COMPREHENSIVE EVERGLADES RESTORATION PLAN

REGIONAL MODELING REQUIREMENTS

Presented By

Maged Hussein, Ph.D., P.E.
Interagency Modeling Center
US Army Corps of Engineers



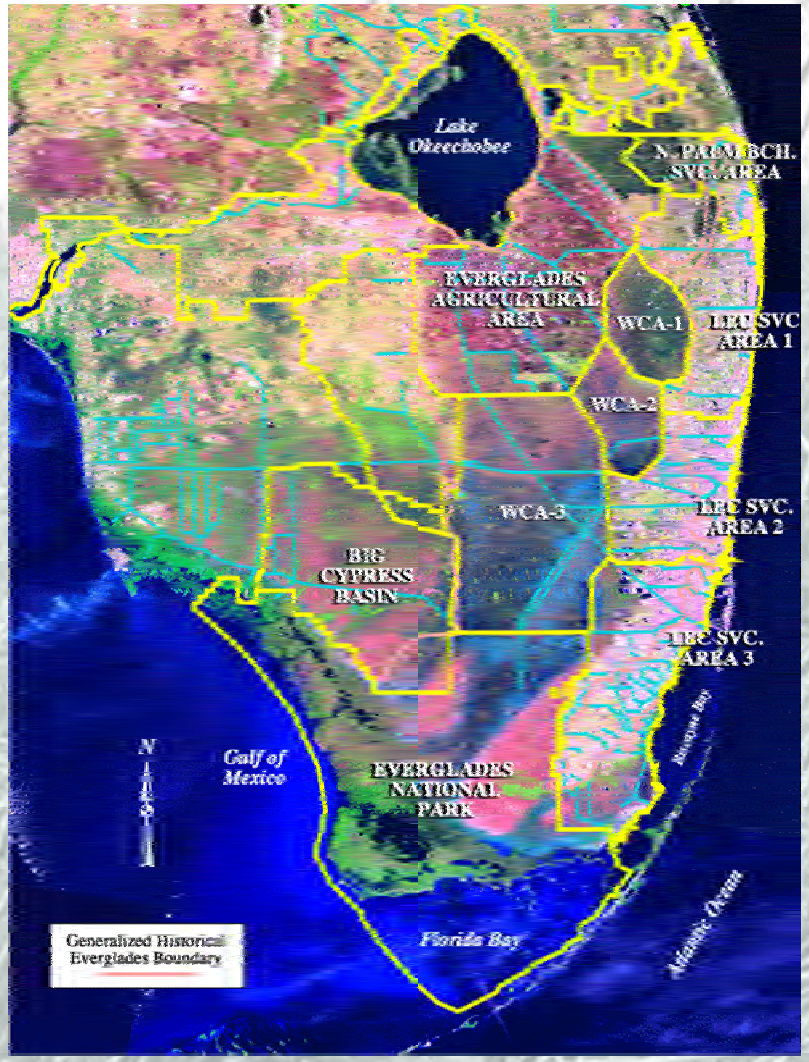
Some Definitions

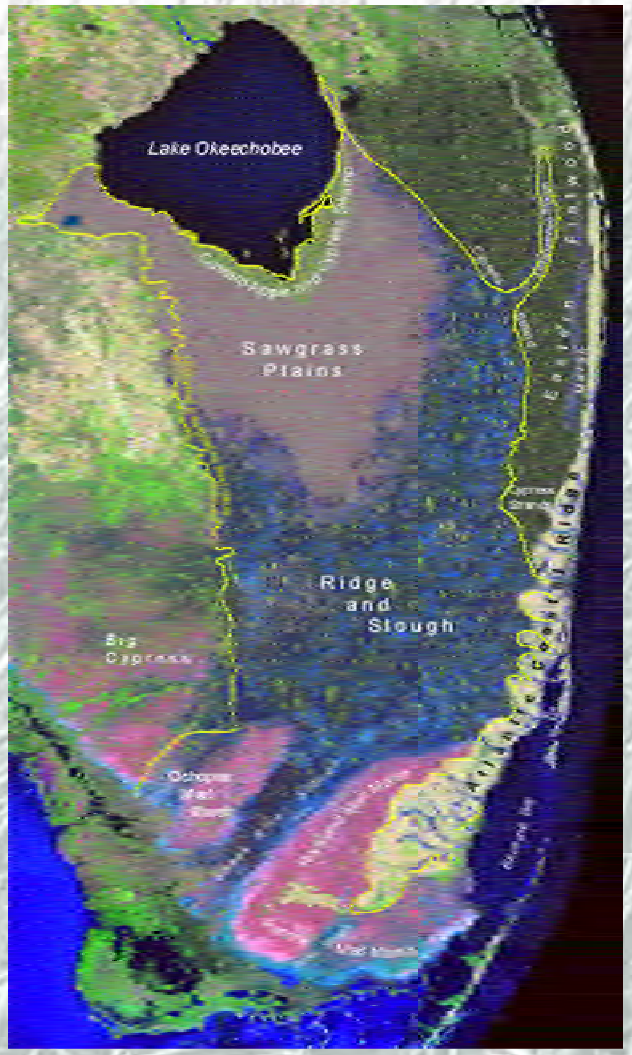
- **Model**
  - A mathematical representation of a device or process used for analysis and planning
- **Regional**
  - Cover the Everglades watershed
  - Include all of CERP components
- **Requirement**
  - Analyze the response of the natural and the managed systems to different components of CERP
  - Examine how the different 68 CERP projects will work together

Motives for Defining the Requirements

- **Modeling objectives:**
  - **Restoration of ecology to pre-drainage conditions (to the extent possible or to other healthy conditions) while maintaining water supply and flood protection**
- **Complex physics**
- **Very complex operation and management of water resources features**
- **The Gold Rush:**
  - **Proliferation modeling codes capable of a wide range of applications**
  - **The rush from CERCLA/RECRA to CERP**

CERP


Lake Okeechobee
N. PALM BCH. SVC. AREA
EVERGLADES AGRICULTURAL AREA
WCA-1
LEC SVC AREA 1
WCA-2
WCA-3
LEC SVC. AREA 2
BIG CYPRESS BASIN
LEC SVC. AREA 3
Gulf of Mexico
EVERGLADES NATIONAL PARK
Florida Bay
Atlantic Ocean
Generalized Historical Everglades Boundary


Lake Okeechobee
Sawgrass Plains
Ridge and Slough
Big Cypress

Team Composition

- Walter Wilcox (South Florida Water Management District)
- Shawn Komlos (US Fish and Wildlife Service)
- Cary White (US Army Corps of Engineers)
- George Shih (South Florida Water Management District)
- Arturo Torres (US Geological Survey)
- Paul Trimble (South Florida Water Management District)
- Chuck Downer (Everglades National Park)
- Maged Hussein (US Army Corps of Engineers), Chair

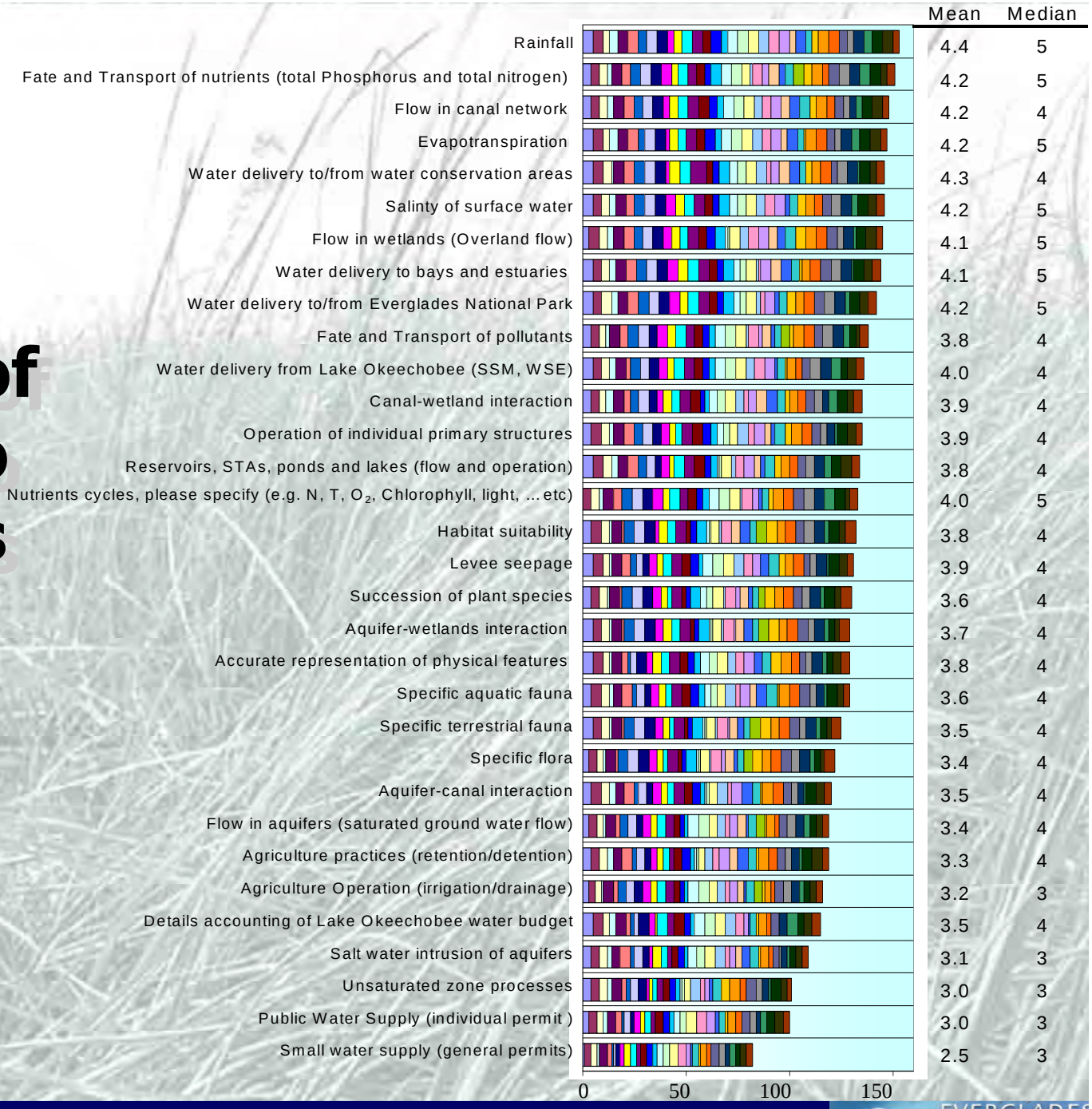
Model Customers

- Managers and decision makers at different agencies
- Ecologist studying the natural system
- REstoration COordination & VERification (RECOVER)
- Solicited Input from Potential Customers

Customer Input

- Use of the model in relation to resources of concern to customer: 4 questions
- Metrics and accuracy needed for evaluation of impact: 14 questions
- Processes of concerns: 3 questions

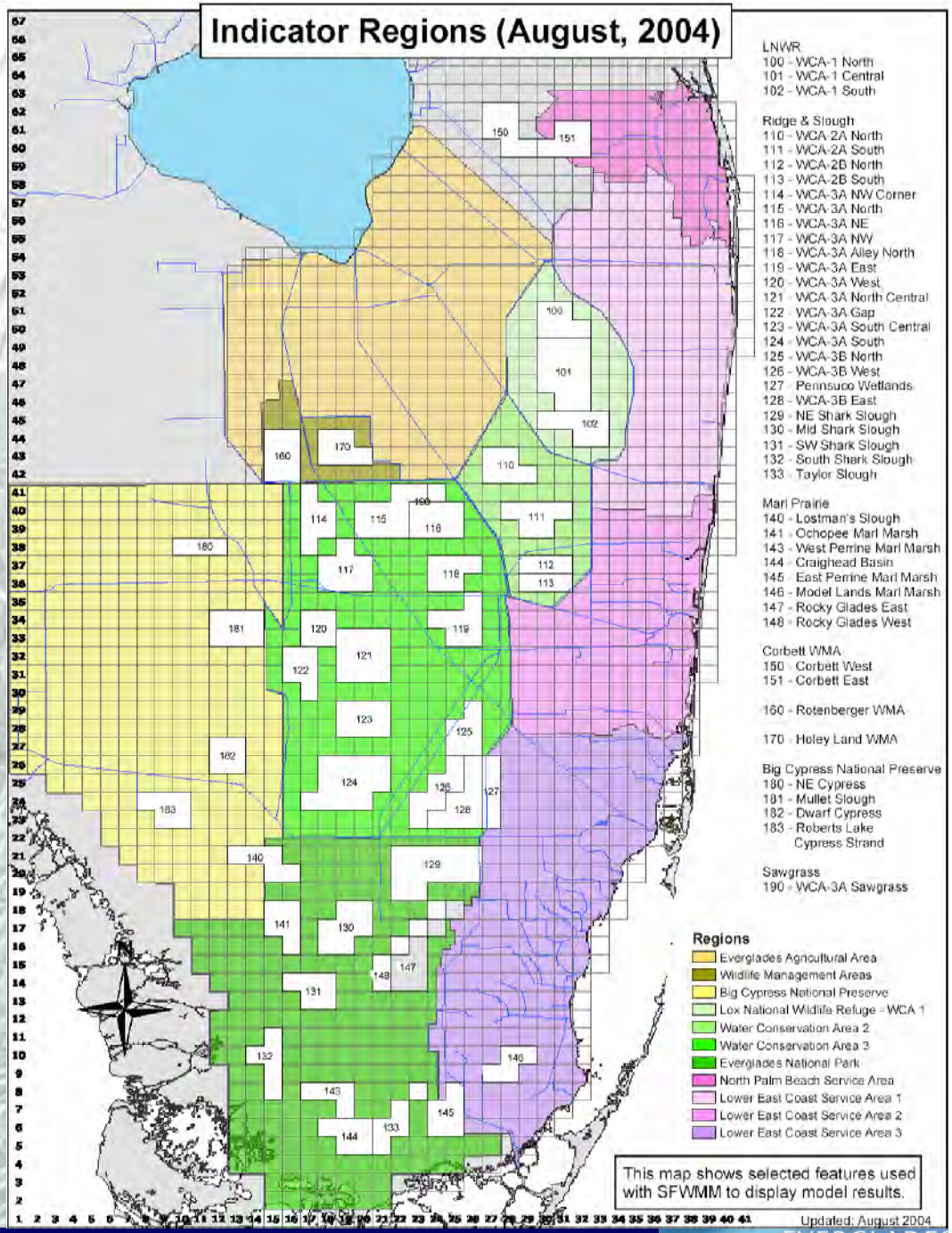
Processes of Interest to Customers



Performance Measures

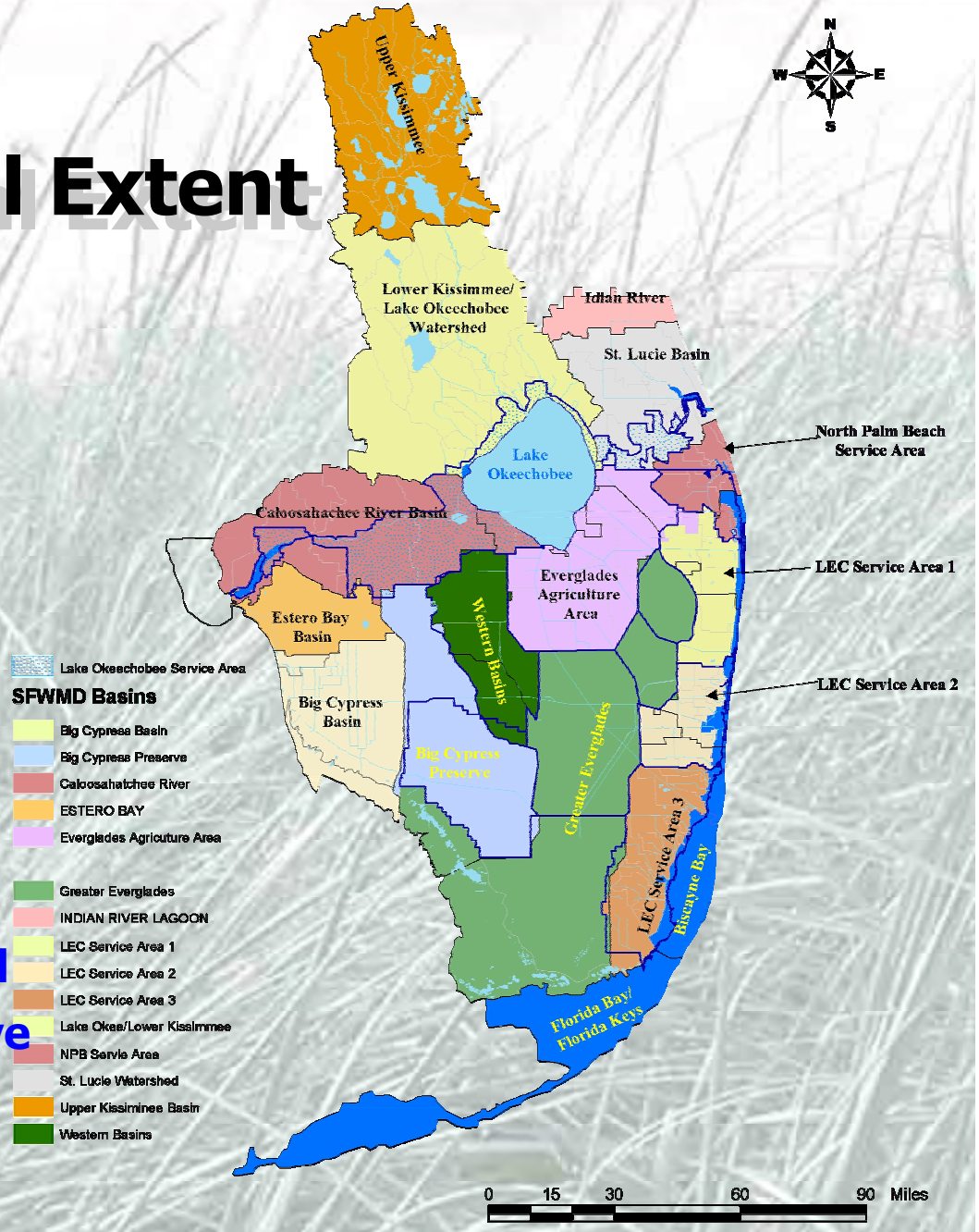
- RECOVER defined system-wide performance measures, 50+
- Model results of interest include; discharge in canals, overland flow depth and velocity, stage in surface and ground water, flow to tide, salinity, concentration of nutrients.
- Varying spatial and temporal scales

Indicator Regions



Spatial Extent

- **Highest priority**
  - Lower East Coast
  - Lake Okeechobee Service Area
  - Everglades Agriculture Area
  - Everglade Protection Area (the Park + Water Conservation Areas)
- **Important regions**
  - Upper East Coast
  - Lake Okeechobee Watershed
  - Big Cypress National Preserve
  - Lower West Coast



Temporal Extent

- Continuous or event simulations
- Period of record for continuous
  - 36 years of available data
  - Address water reserved for the natural system (reservations)
- Possibility of different models
  - Low fidelity models for multi-decadal simulations
  - High fidelity models for event simulations
  - Reconcile differences

Water Management Consideration

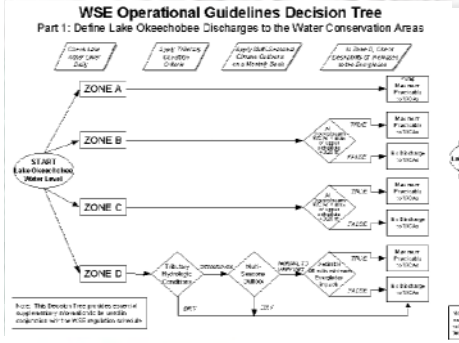
- **The most complex part of the modeling**
  - **>160 major drainage basins and**
  - **~1800 miles of canals and levees.**
  - **> 2000 water control structures (spillways, pumps, gated culverts, adjustable weirs, … etc.)**
- **Operation decisions are based on local, sub-regional, and regional considerations and are very subjective**
- **Receives the least attention from developers of modeling code**
  - **Physics receives more attention**
  - **H&H models are not equipped with optimization modules**
  - **Model developers with local knowledge as well as understanding of numerical techniques are rare**
  - **R&D are focused on general purpose models.**

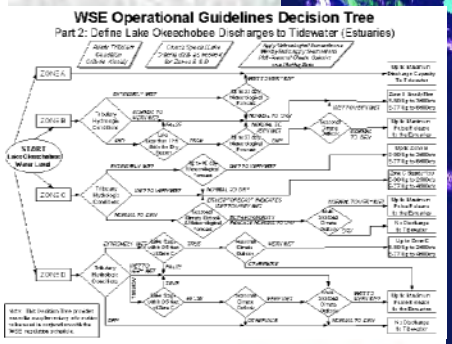
Water Management Consideration

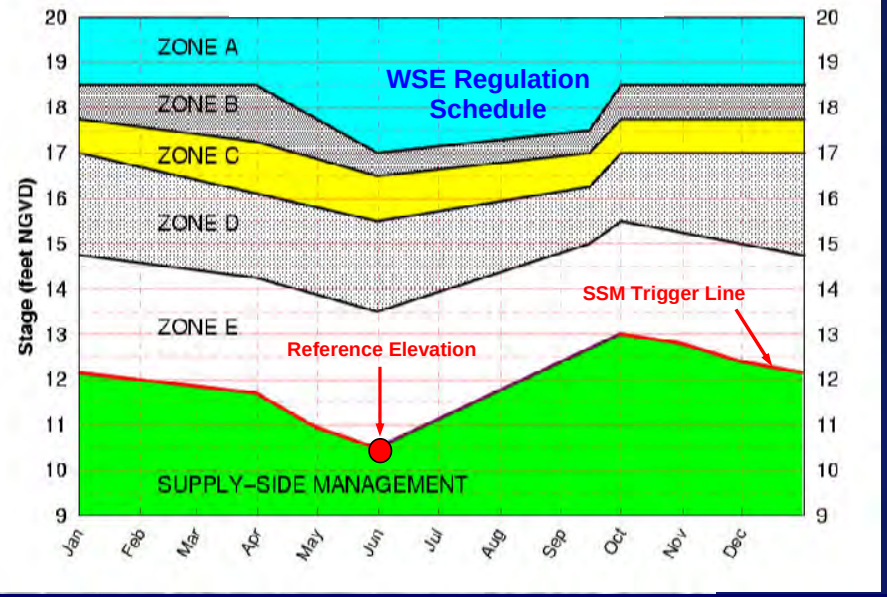
- **Hydraulic Structures**
  - Simple operation (head/tail control)
  - Complex operations (e.g. remote triggers, dual ops, storm drawdowns, etc.)
- **Regulation Schedules**
  - Lake Okeechobee
  - Water Conservation Areas
- **Storage Facilities**
- **Local Management Practices**
  - Golf Course
  - Urban detention or diversion components
  - Agriculture practices including detention and retention

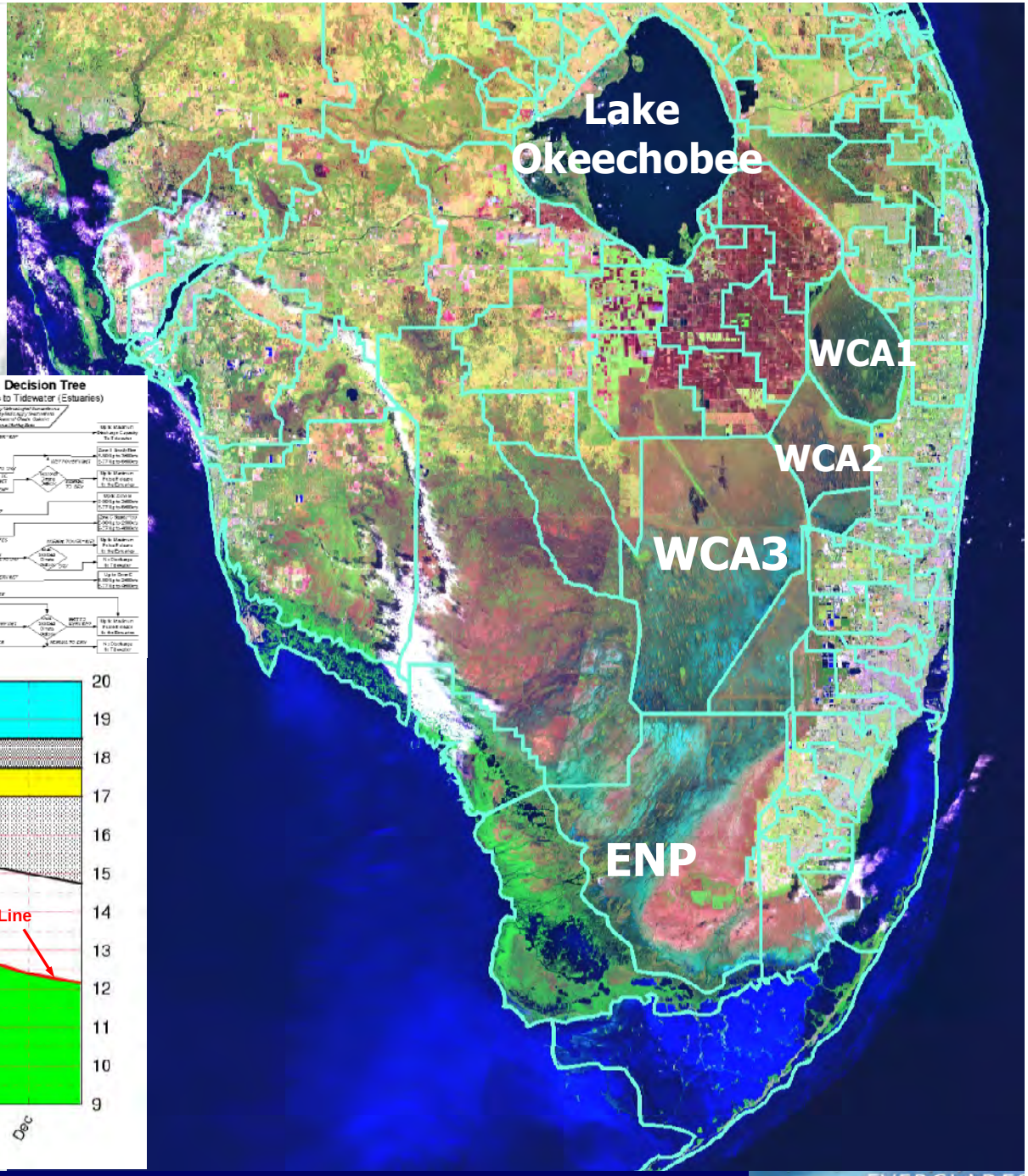
Confusion corner and S-9 Pump Station

Regional Storage









Other Consideration

- Distributed parameters models
- Rainfall and Evapotranspiration
- Coupled ground water/surface water models
  - Ground water flow
  - Overland flow in wetlands
  - Canal flow
  - Hydraulic structures
- Local scale processes
  - Agriculture and urban
- Coupling with water quality, salinity, and ecological models

Policy Considerations

- Distinguish between types of releases:
  - water supply releases,
  - releases to satisfy environmental restoration
  - releases to achieve flood protection
- Existing legal sources of water
- Natural system model:
  - establish interim goals
  - implementation of rainfall driven operations (
  - establishing targets for comparing alternatives based on performance measures.
- Level of service for flood protection (local or sub-regional models)

Recommended Approach for Model Selection

- **Two issues in model selection:**
  - Selecting of the modeling code
  - Definition of the conceptual site model (conceptual representation and modeling assumption)
- **Two phase approach:**
  - Screening of modeling codes based on general capabilities
  - Detailed examination of modeling assumptions, capabilities and ability to satisfy most of stakeholders expectations

	Critical Capability
A	Adaptability to recognize spatial and temporal variability of sound meteorological data
B	Ability to simulate overland flow, canal flow, hydraulic structure flow, and ground water flow
C	Ability to simulate interaction between hydrologic components in criteria B
D	Capability to simulate operational decision logic of hydraulic structures and storage areas (sluice gates, pumps, gated culverts, above-ground and in-ground reservoirs, ASRs, lakes, seepage management features, …etc.) based on one or more nearby and/or regional triggers' conditions and/or trends
E	Capacity to simulate management of a system of hydraulic structures, system of interconnected basins, and system of water control units such as regulation schedules, regional water shortage policies, regional water rationing policies, … etc. based on one or more nearby and/or regional triggers' conditions and/or trends
F	Potential to address operation and management related to drainage districts (298 districts), agriculture practices, demand of the natural system and urban regions and the cumulative impact of operations associated with each on the regional system
G	Ability to forecast and to extend expected trends, spatially and temporally, caused by CERP implemented structures and their operation rules for discrimination of alternatives according performance measures
H	Ability to provide detailed water budget accounting on basin and structure scale.
I	Functionality of an implementation using a verified, documented and peer reviewed code to provide boundary conditions to sub-regional models and generate output with reasonable runtime

No	Criterion Definition	Type	W
First Priority			
1	Accurate representation of rainfall and evapotranspiration	Hydrologic	16
2	Accurate simulation of flow/stage in wetlands, canals, and ground water	Hydrologic	16
3	Operations and Management of the Everglades Protection Area (ENP and WCAs), Lake Okeechobee, and Kissimmee River	Operation and Management	16
4	Accurate simulation of surface water – ground water interaction	Hydrologic	14
5	Accurate representation of hydraulic structures and their operation	Operation and Management	14
6	Ability to extract boundary conditions for subregional models	Functionality	12
7	Freshwater delivery to bays, estuaries, and other near shore regions	Hydrologic	12
8	Detailed accounting of regional and basins water budget including type of releases (environmental, water supply, flood protection, … etc.)	Hydrologic	11
9	Based on verified, documented, and peer reviewed modeling code	Functionality	10
10	Reasonable runtime (allows multiple years to be simulated)	Functionality	10
11	Ability to account for seepage below, around, and through levees and associated borrow canals	Hydrologic	10
12	Accurate representation reservoirs, STAs, ponds, lakes, and other storage facilities and their operations	Operation and Management	9

No	Criterion Definition	Type	W
Second Priority			
13	Account for salinity effects on flow (density effects on head)	Hydrologic	8
14	Accurate simulation of velocity field necessary for use in simulating transport of water quality and ecological constituents	Water Quality /Ecological	8
15	Simulation of agriculture operations and practices	Operation and Management	6
16	Simulation of urban regions water supply and flood protection needs	Operation and Management	6
Third Priority			
17	Accurate simulation of the unsaturated zone process	Hydrologic	4
18	Consistent with existing natural system model for target evaluation	Functionality	3
19	Cost of deployment for model users, customers, and stakeholders	Functionality	3
20	Ability to perform water quality simulations (fate and transport of nutrients and other constituents)	Water Quality /Ecological	2

Evaluation Criteria Definitions and Priority

Evaluation Criteria		*W*	*Definition of Rankings*				
N	***Description***		**0**	**1**	**1.1**	**1.2**	**1.3**
First Priority							
1	Rainfall/ET	16	Uniform rain and PET. Actual ET calibrated	Temporally varied rainfall and ET AET calibrated.	Spatially and temporally varied rainfall and PET utilizing multiple gauges, and a consistent methodology for actual ET based on land use, crop type, … etc.	INTENTIONALLY BLANK	Spatially and temporally varied rainfall. AET computed as part of integrated unsaturated zone solution.
2	Flow Simulation	16	Lumped parameter model (link-node)	Distributed but simplified (e.g. Horton's or Kadlec equation for overland, kinematic equation for canal or 2-D for ground water)	Diffusive flow in surface water and 2D flow in ground water	Dynamic wave in canals, diffusive wave in overland and quasi 3D in ground water	Dynamic wave is surface water, full 3D variably saturated flow in ground water
3	Operation & Management	16	Internal boundary with prescribed flows or simple if/then rules based on the structure book for each structure or other simple approach	INTENTIONALLY BLANK	INTENTIONALLY BLANK	Complex operation of multiple structures based on multiple criteria + Regulation Schedule + Rainfall Driven Operation + water shortage/rationing logic	As in 4 + optimization routine
4	Surface/Ground water interaction	14	No interaction	Loosely coupled (one system as a sink/source for the next)	Coupled through a simple time lag approach	2 out of 3 fully coupled (overland, canal, and ground water)	All 3 systems fully coupled
5	Hydraulic Structures	14	Not simulated	Simplified/passive hydraulic structure simulation capabilities, rating curves and/or no operation (Steady state or Quasi-dynamic routing)	Accurate simulation of hydraulic structures + simple/active operations (Quasi-dynamic routing)	Accurate simulation of hydraulic structures + multi-criteria decision logic based on combination of local and regional triggers	Accurate simulation of hydraulic structures + optimization of their operation (Dynamic routing through structures)
6	Subregional Models	12	Not possible to extract boundary conditions for subregional model	Possible to extract flow and stage/head boundary conditions for subregional models with some interpolation scheme (e.g. Telescopic Mesh Refinement)	INTENTIONALLY BLANK	INTENTIONALLY BLANK	Fully scalable and capable of being utilized in regional, subregional modeling, and site specific modeling
7	Water delivery to near shore regions	12	None	Near shore regions treated as boundary conditions. Tidal effects not taken into consideration	Near shore regions as boundary conditions. Tidal effect taken into consideration.	Density corrected heads in near shore and estuarine environment, which are included in the regional model.	Full density dependent flow in estuaries and near shore regions which are encompassed in the regional model
8	Water Budget	11	Overall water budget computed and balanced	As 1 + basin-wide water budget	As 2 + detailed water budget by layer and basin including service area-specific sinks/sources	As 3 + detailed water budget for each structure by the type of release (environmental, flood control, and water supply)	As 4 + flexibility to easily define/modify water budget zone boundaries
9	Code Maturity	10	New untested code.	Methodology peer reviewed and code verified against analytical solution by developer	Code verified against analytical and other numerical models by independent reviewers	Code extensively used throughout the modeling industry with documented applications	Code extensively used throughout the modeling industry with documented applications + extensive code verification by independent reviewers
10	Reasonable runtime	10	Prohibiting runtime. Model cannot be used for alternative evaluation (multi-decadal runs cannot be performed within a reasonable period of time).	Excessive runtime. Model can be used for alternative evaluation but with extensive resource allocation (only one multi-decadal runs can be performed within a reasonable period of time).	High runtime. Model can be used for alternative evaluation (at least two multi-decadal runs can be performed concurrently within a reasonable period of time).	Low runtime. Model can be used for alternative evaluation (more than three multi-decadal runs can be performed concurrently within a reasonable period of time).	Optimal runtime. Model can be used effectively for alternative comparison (up to 5 concurrent multi-decadal runs can be compared within a "very" reasonable period of time)
11	Levee Seepage	10	Not simulated	2-D groundwater flow equation on single ground water layer below levees. No seepage through levees	Quasi 3-D ground water flow below levees, seepage through levees	Full 3-D flow below and through levees	Full 3-D flow below and through levees with detailed discretization of the levee material and ability to represent seepage control measures

Conclusion

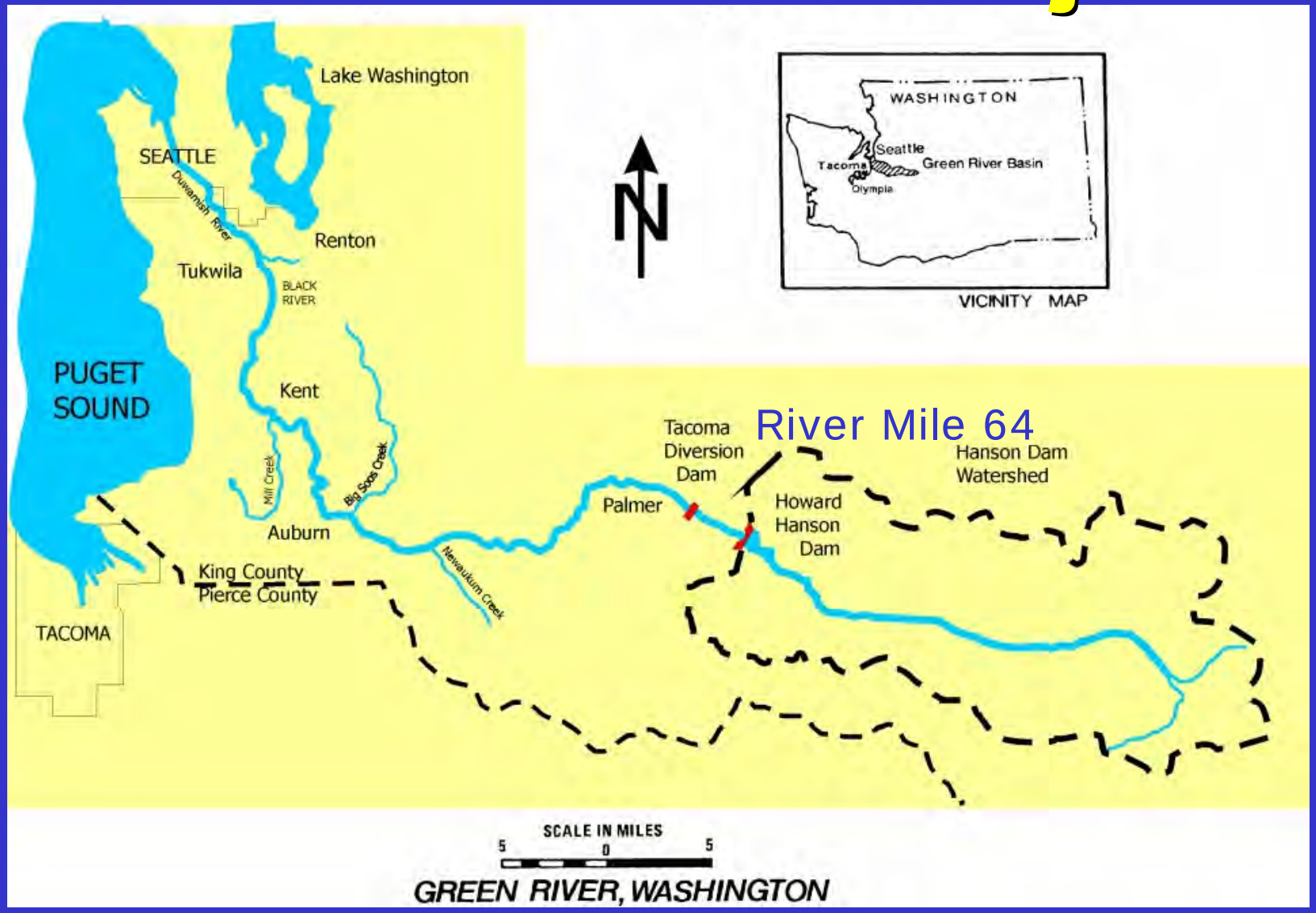
- Regional models are good decision support tool but should not be a substitute for engineering judgment
- Regional models requirements are considerably different from models utilized for H&H, RECRA/CERCLA, TMDL, or other local or sub-regional models
- At the regional scale water management plays a profound role
- Model developer should consider incorporating Operation Research components in their modeling codes
- Local scale processes should not be represented explicitly in regional models. Lumped representation is sufficient. Otherwise run time will be prohibitive

US Army Corps
of Engineers
Seattle District

Howard Hanson Dam:
Hydraulic Design of Juvenile Fish Passage Facility in Reservoir with Wide Pool Fluctuation

Dennis Mekkers, PE
Mobile District
and
Daniel M. Katz, PE,
Seattle District
US Army Corps of Engineers

Howard Hanson Project



US Army Corps
of Engineers
Seattle District

Howard Hanson Reservoir

- **Pool Fluctuation:** 100 ft
- **Reservoir Length:** 5 miles
- **Reservoir Depth:** can exceed 140 ft. at dam
- **Fish:** Coho, Chinook, Steelhead

Howard Hanson Dam

Concrete Spillway:
Capacity 107 Kcfs

Spillway Tainter Gates:
45 x 30 ft

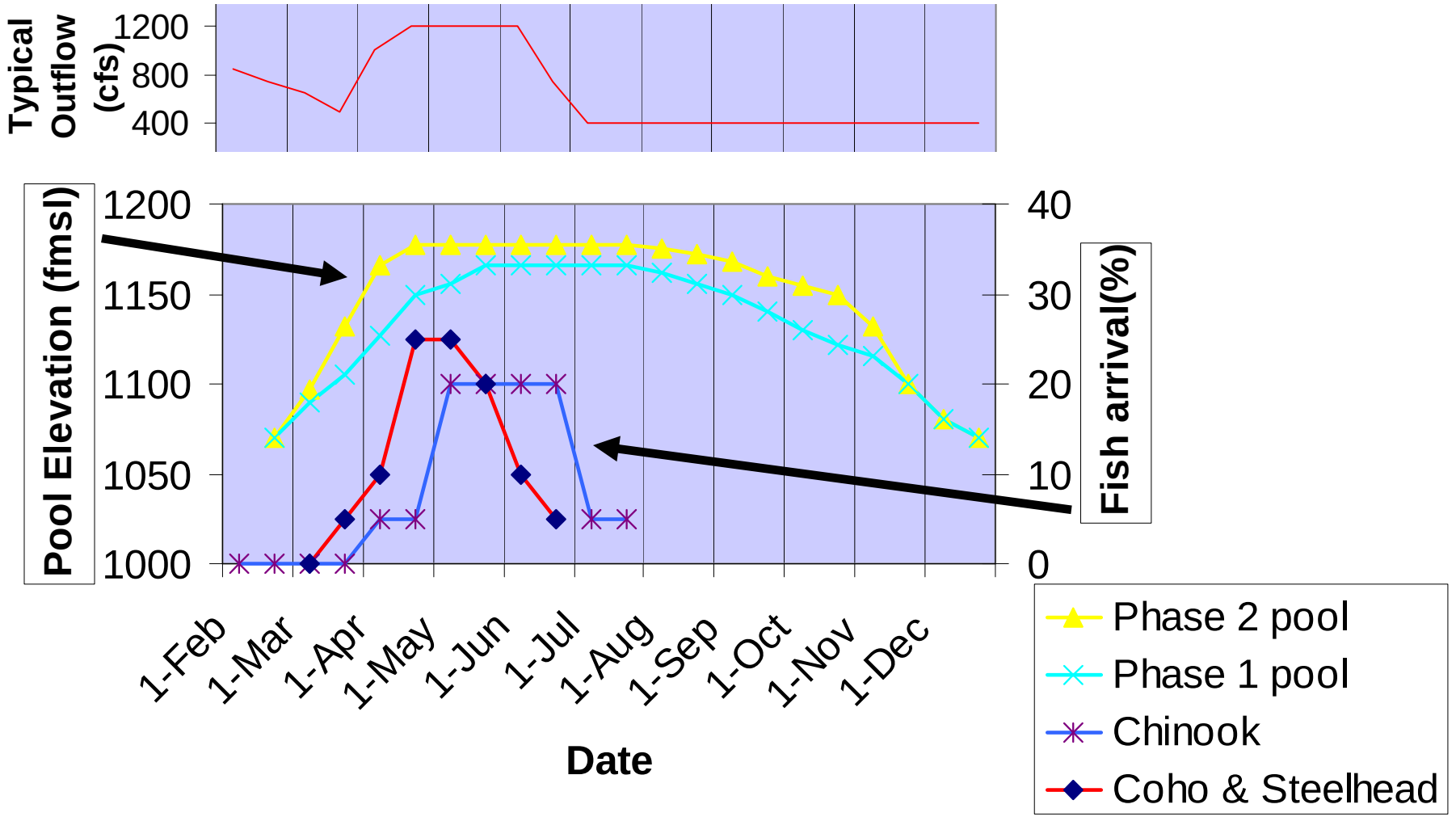
Length at Crest: 450 ft

Outlet Tunnel:

- 19 ft wide x 900 ft long
- 2 Tainter Gates, 10 x 12 ft
- Normal Capacity: 10 kcfs
- Auxiliary low-flow tunnel (0.5 kcfs)

Tailrace Features

Typical Project Operations & Timing

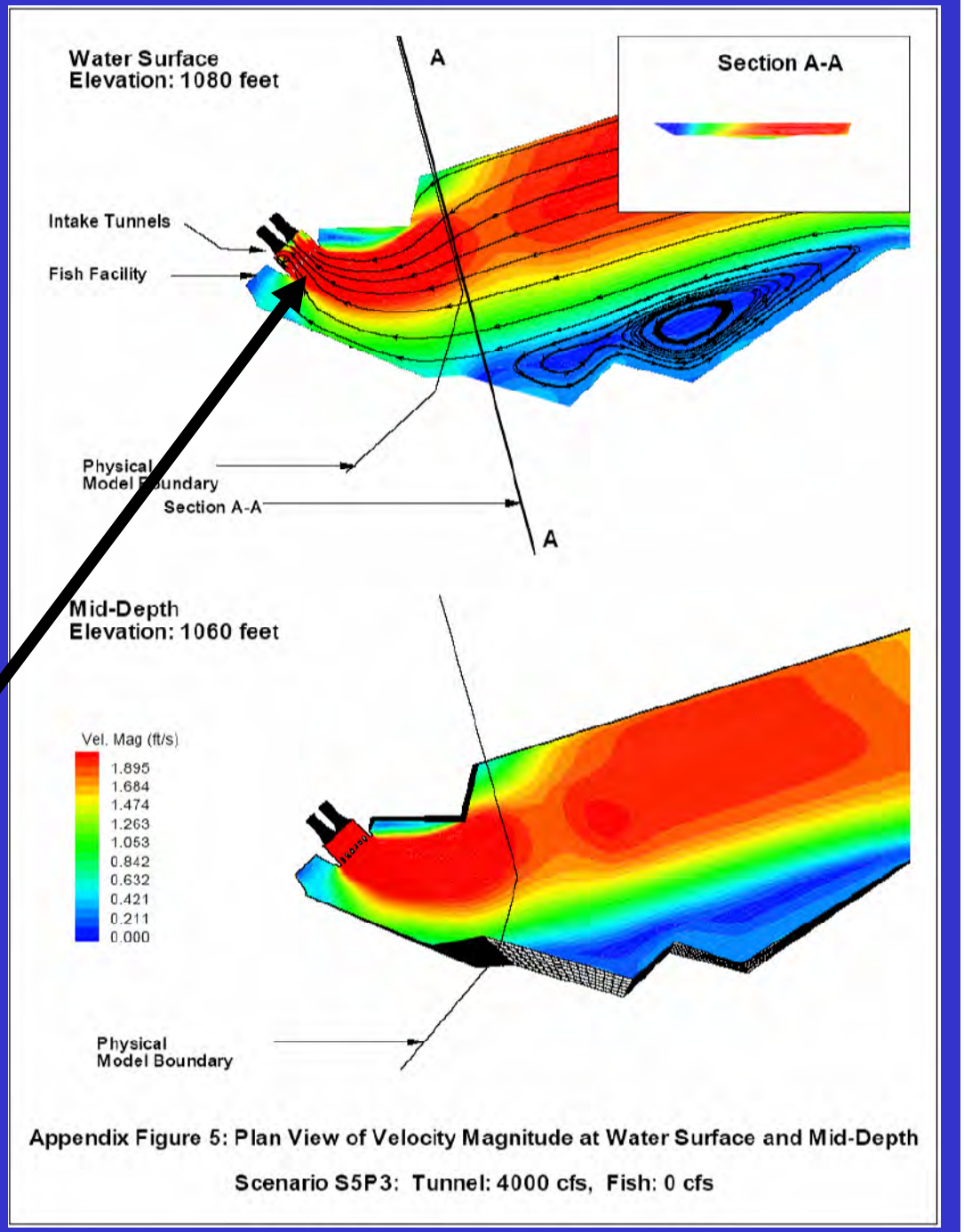


US Army Corps of Engineers
Seattle District

Howard Hanson Forebay

- **Without Fish Facility**
- **Existing Tunnel Only**
- **Low Pool**

- **Note Strong Surface Current at Low Pool**



Appendix Figure 5: Plan View of Velocity Magnitude at Water Surface and Mid-Depth

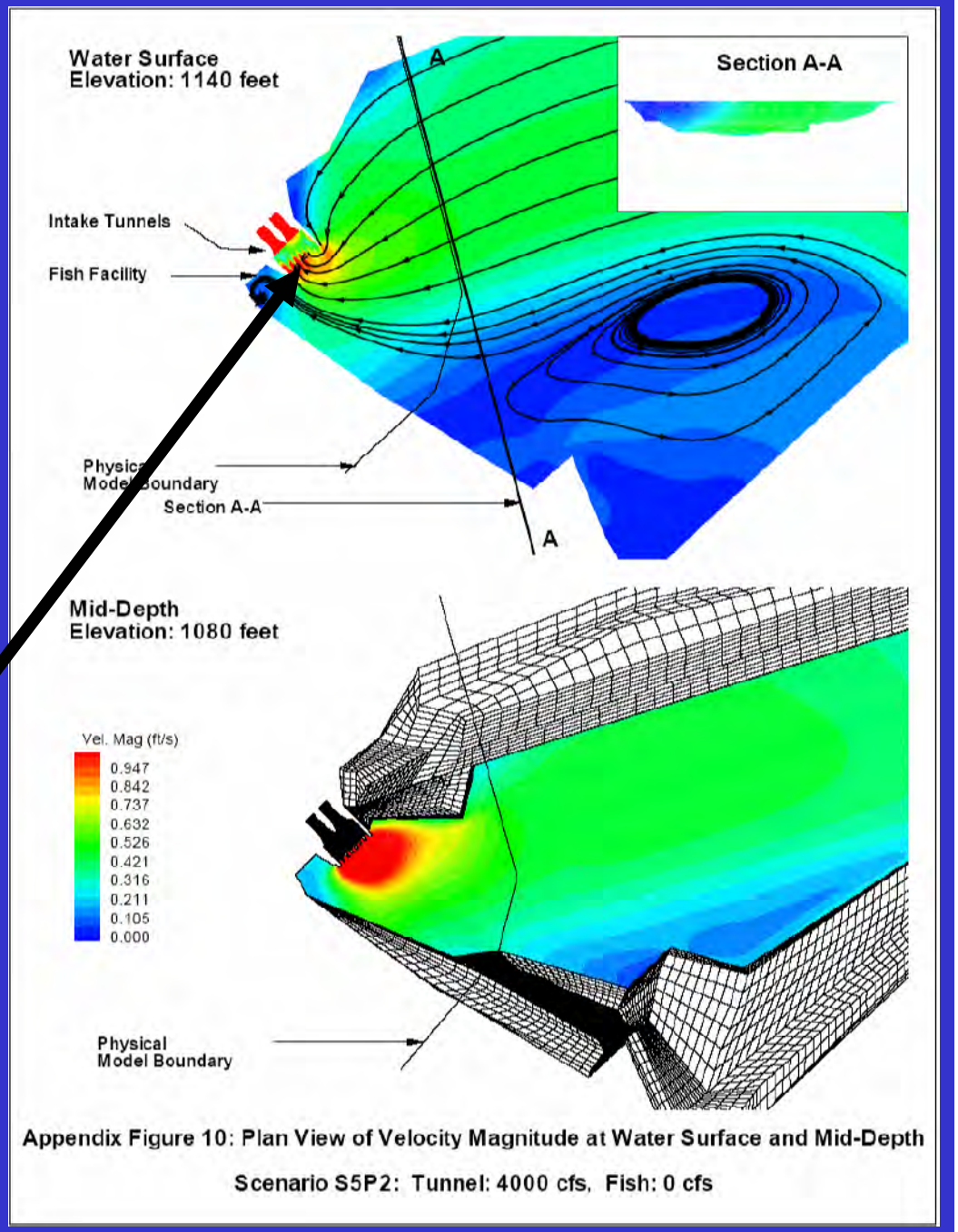
Scenario S5P3: Tunnel: 4000 cfs, Fish: 0 cfs

US Army Corps of Engineers
Seattle District

Howard Hanson Forebay

- **Without Fish Facility**
- **Existing Tunnel Only**
- **High Pool**

Note Weaker Surface Current at High Pool



Appendix Figure 10: Plan View of Velocity Magnitude at Water Surface and Mid-Depth

Scenario S5P2: Tunnel: 4000 cfs, Fish: 0 cfs

US Army Corps
of Engineers
Seattle District

Howard Hanson juvenile fish facility

Primary Project Goals

- Reduce juvenile passage delay
- Improve juvenile passage survival
- No impact on existing project function

Specific Design Goals

- Operating Range: 97 feet
- Facility Flow: 400 cfs to 1200 cfs
- Meet appropriate velocity, velocity gradient, energy dissipation, and screen criteria

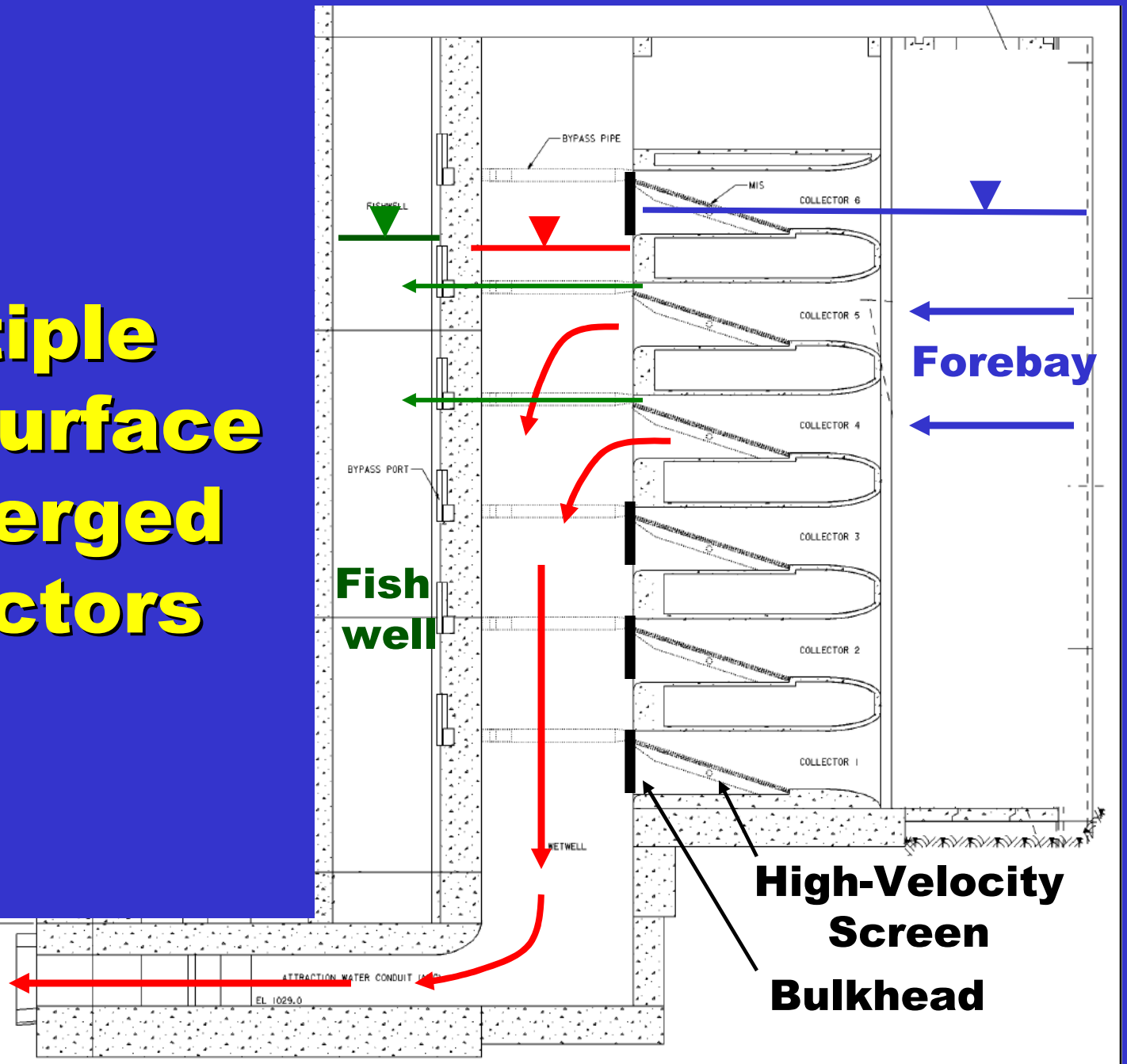
US Army Corps
of Engineers
Seattle District

What is the best design alternative?

Proposed Facility...

US Army Corps
of Engineers
Seattle District

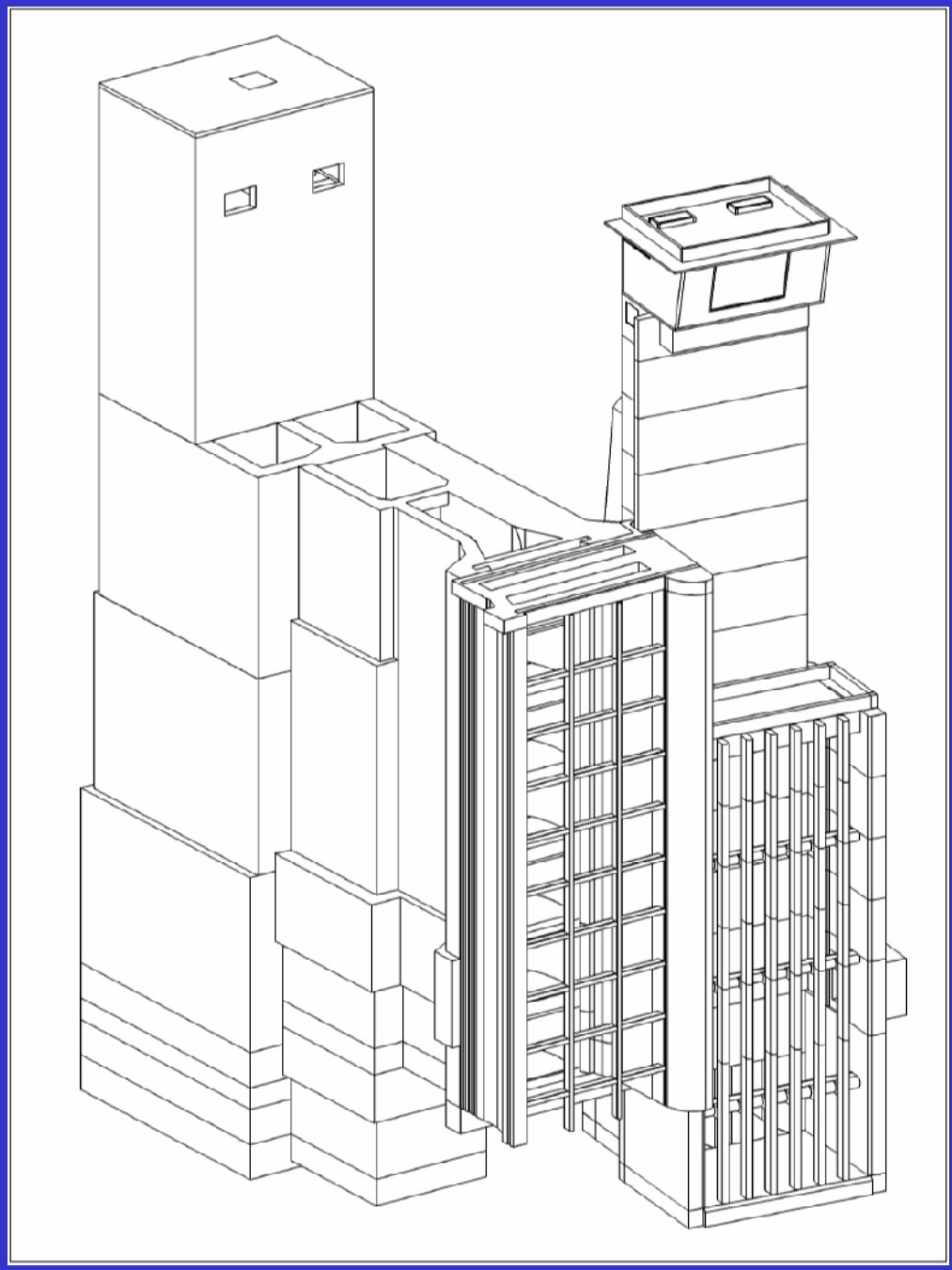
Multiple Near-Surface Submerged Collectors



US Army Corps
of Engineers
Seattle District

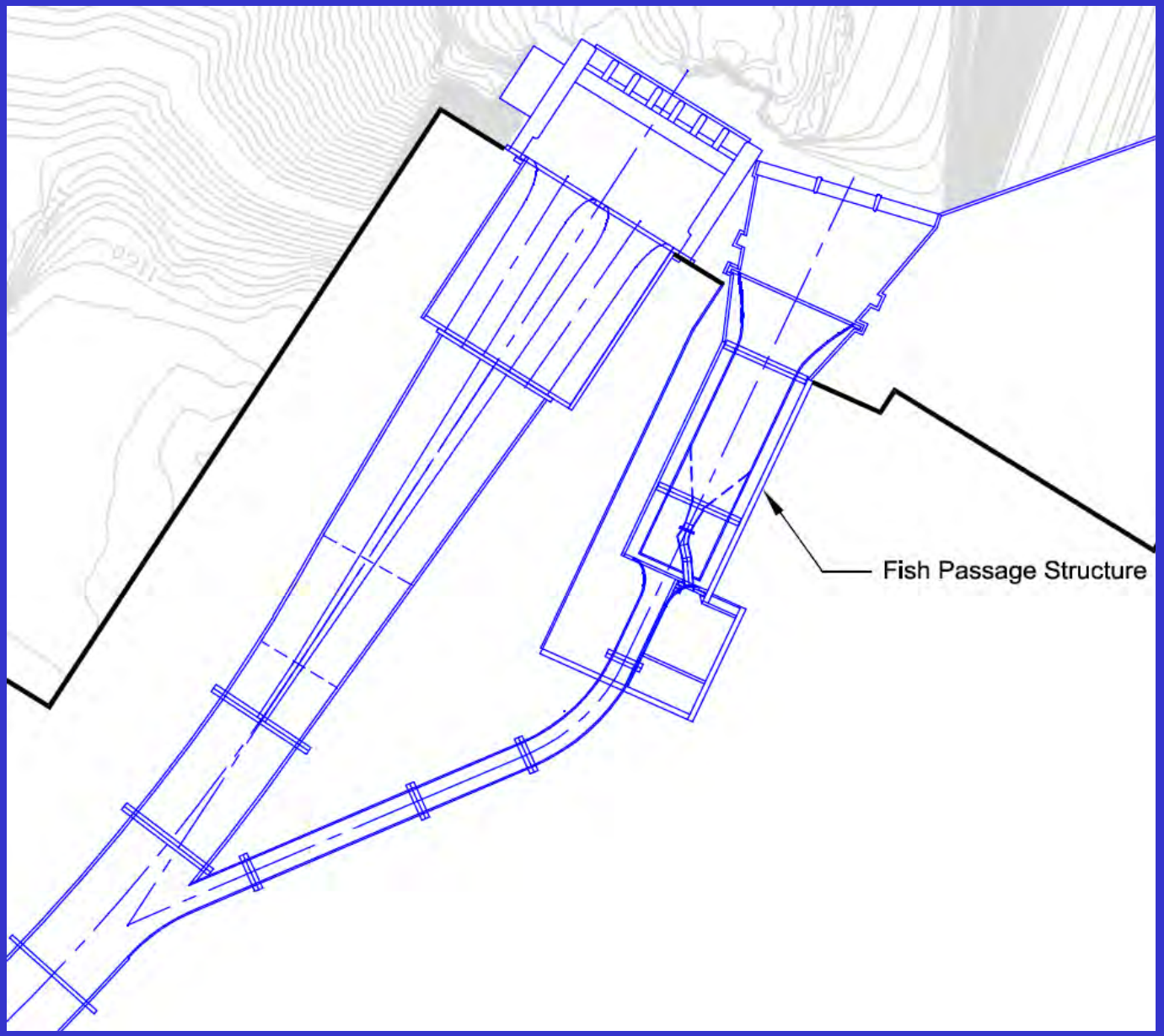
Goal:
No impact on existing function

Junction with adjacent flood-control tunnel...



US Army Corps
of Engineers
Seattle District

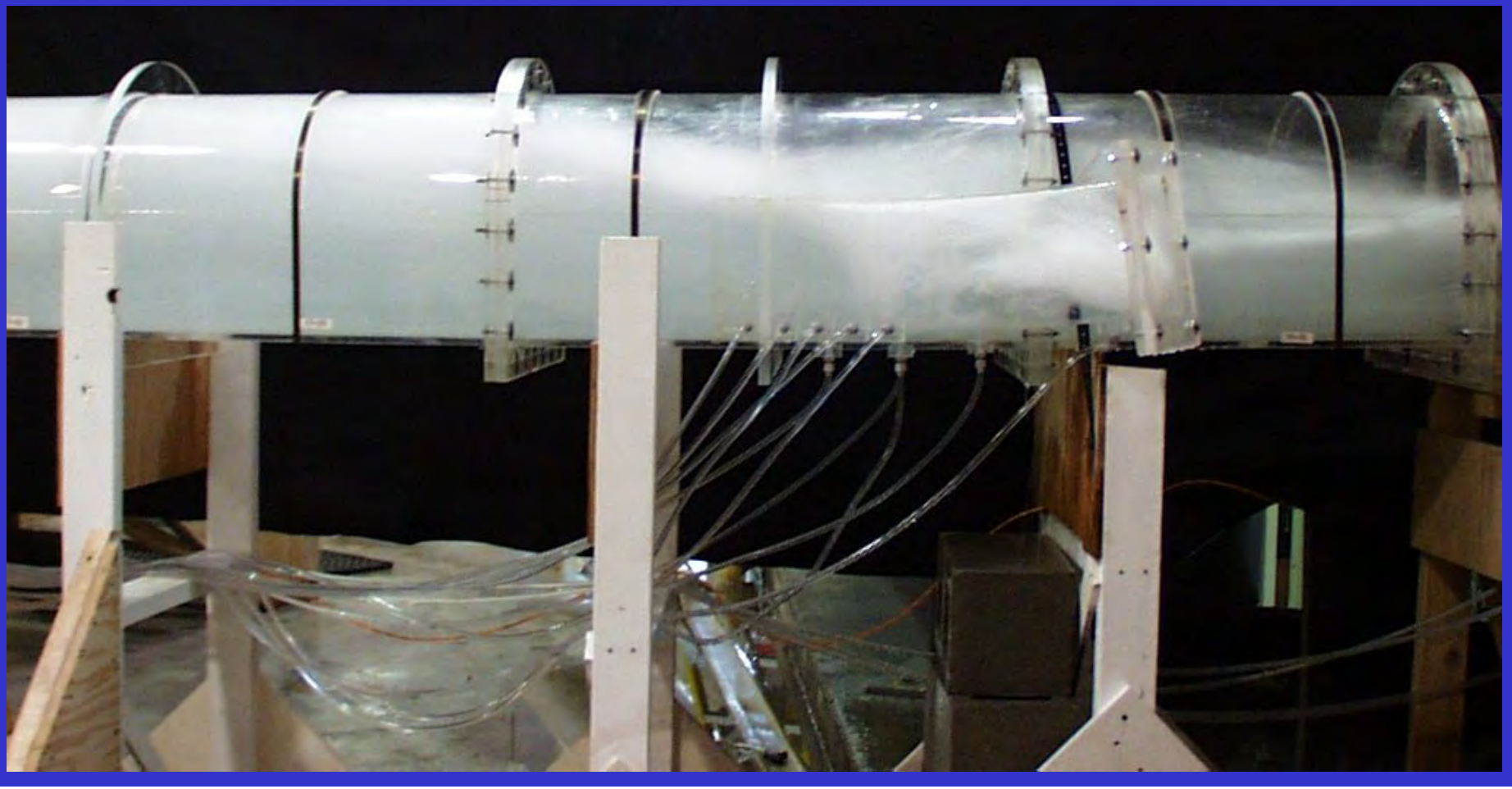
Plan View of tunnel junction



US Army Corps
of Engineers
Seattle District

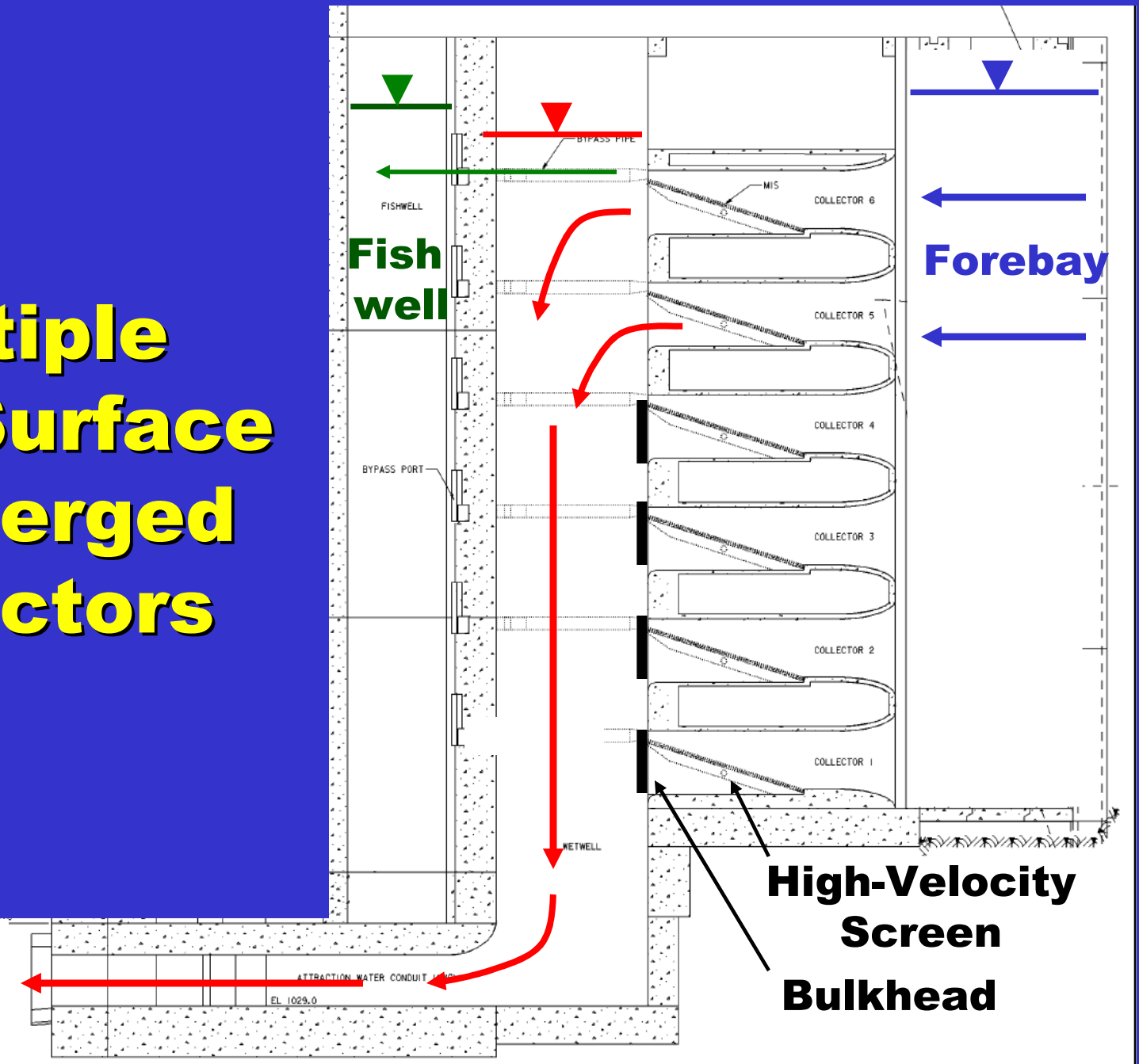
Tunnel Junction Concerns

- Highly Supercritical Flow
- Cavitation
- Stability of Water Surface
- Air movement



US Army Corps
of Engineers
Seattle District

Multiple Near-Surface Submerged Collectors



US Army Corps
of Engineers
Seattle District

Goal:

Reduce Delay…

Plan view of collector entrance

US Army Corps
of Engineers
Seattle District

Goal:
Reduce Delay

High Forebay with Juvenile Fish Facility

Low-level outlet closed

Note Strong Surface Current at High Pool

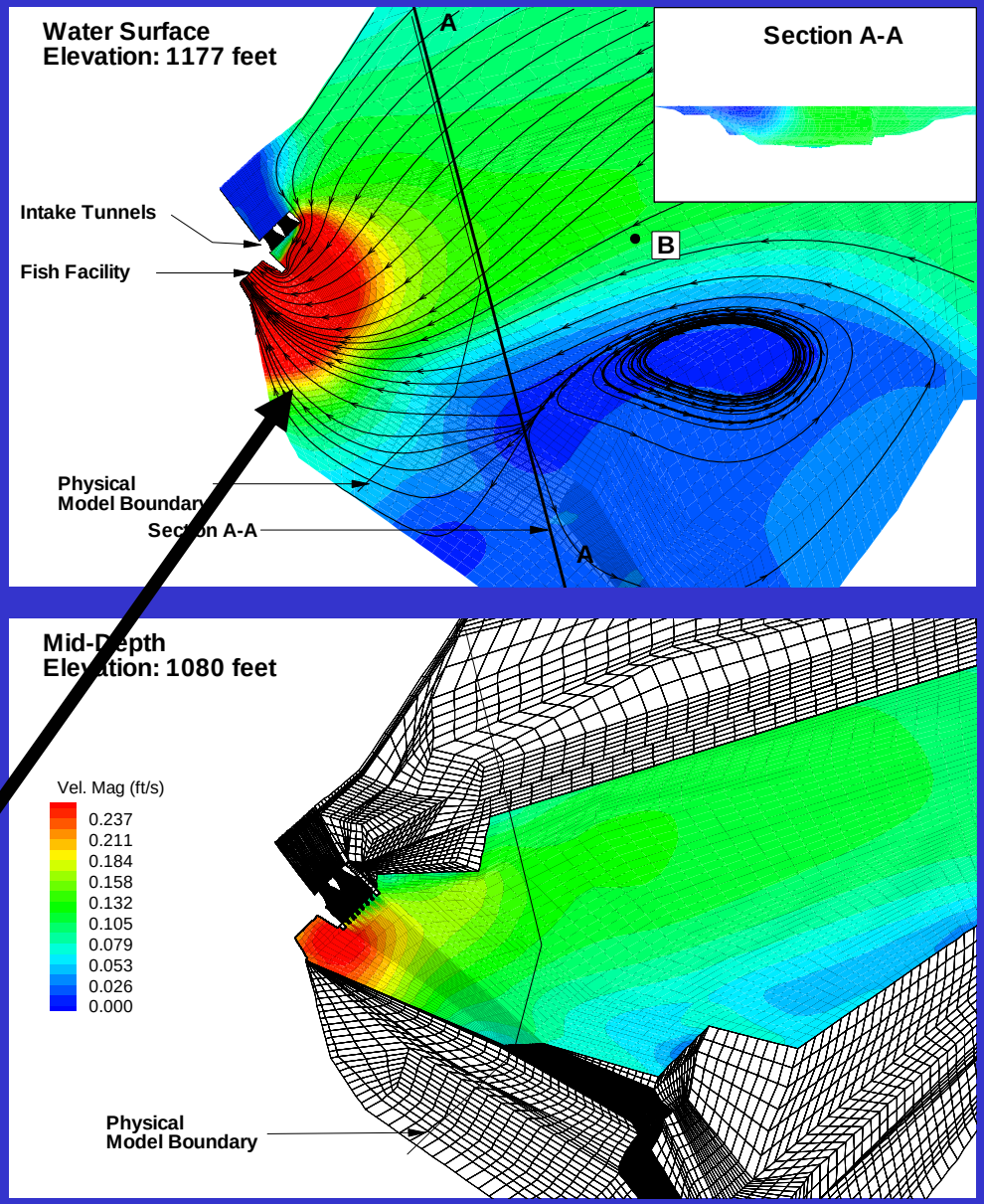


Figure 5: Plan View of Velocity Magnitude at Water Surface and Mid-Depth

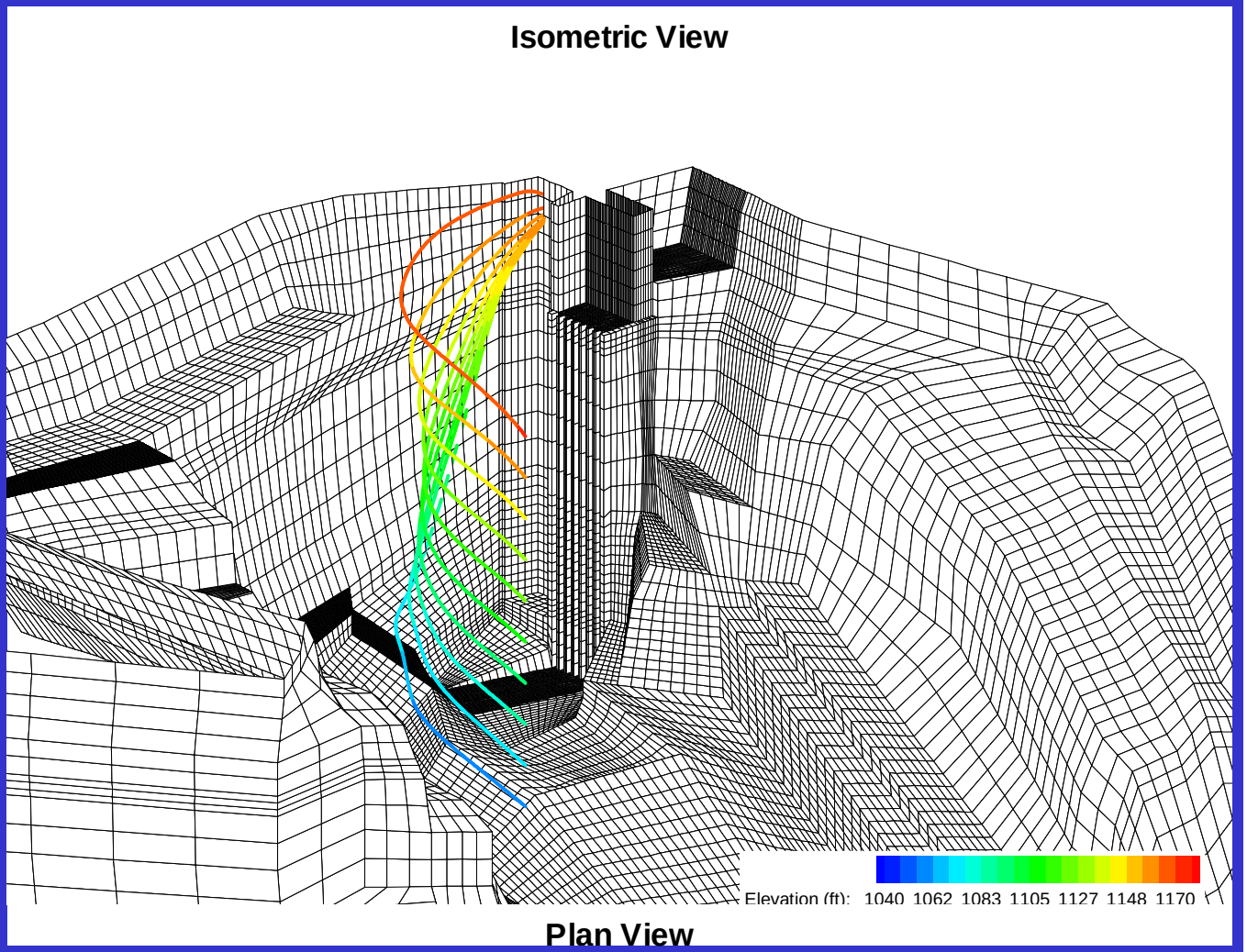
Scenario S4P1: Tunnel: 0 cfs, Fish: 1300 cfs

US Army Corps
of Engineers
Seattle District

Goal:
Reduce Delay

High Forebay with Juvenile Fish Facility

Low-level outlet closed



US Army Corps
of Engineers
Seattle District

Goals: Reduce Delay and Improve Survival

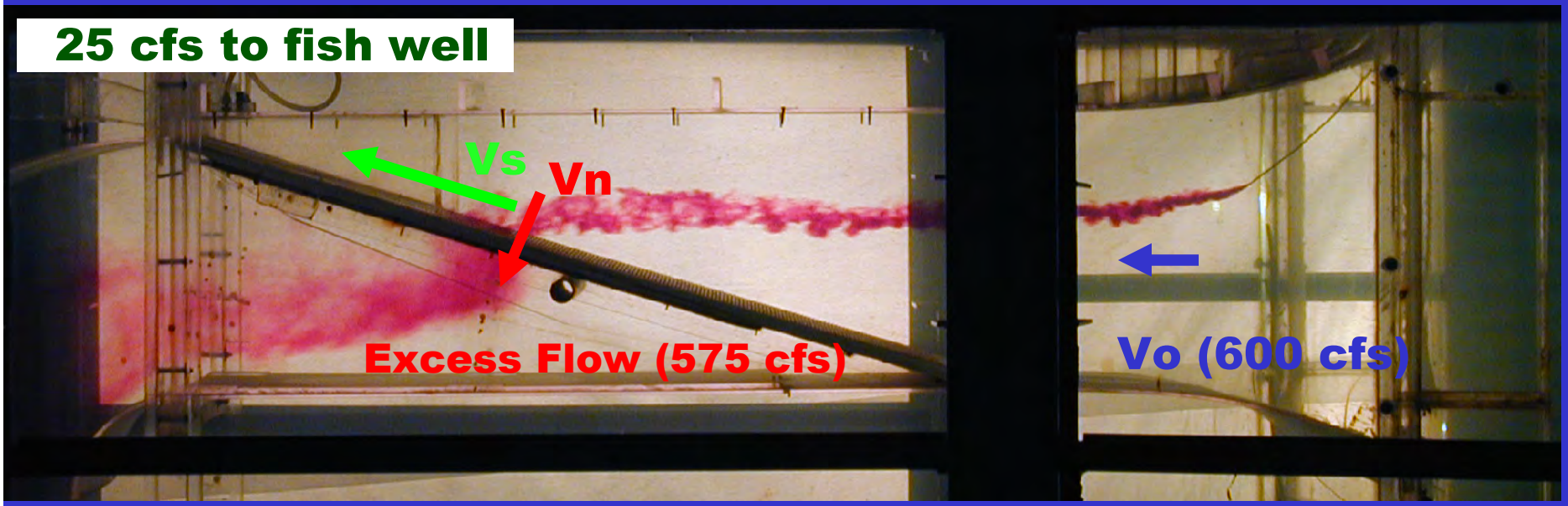
Side View of Fish Passage Facility

US Army Corps
of Engineers
Seattle District

Fish Screen in Normal Operation

Fish Capture Criteria
6 to 8 fps

25 cfs to fish well



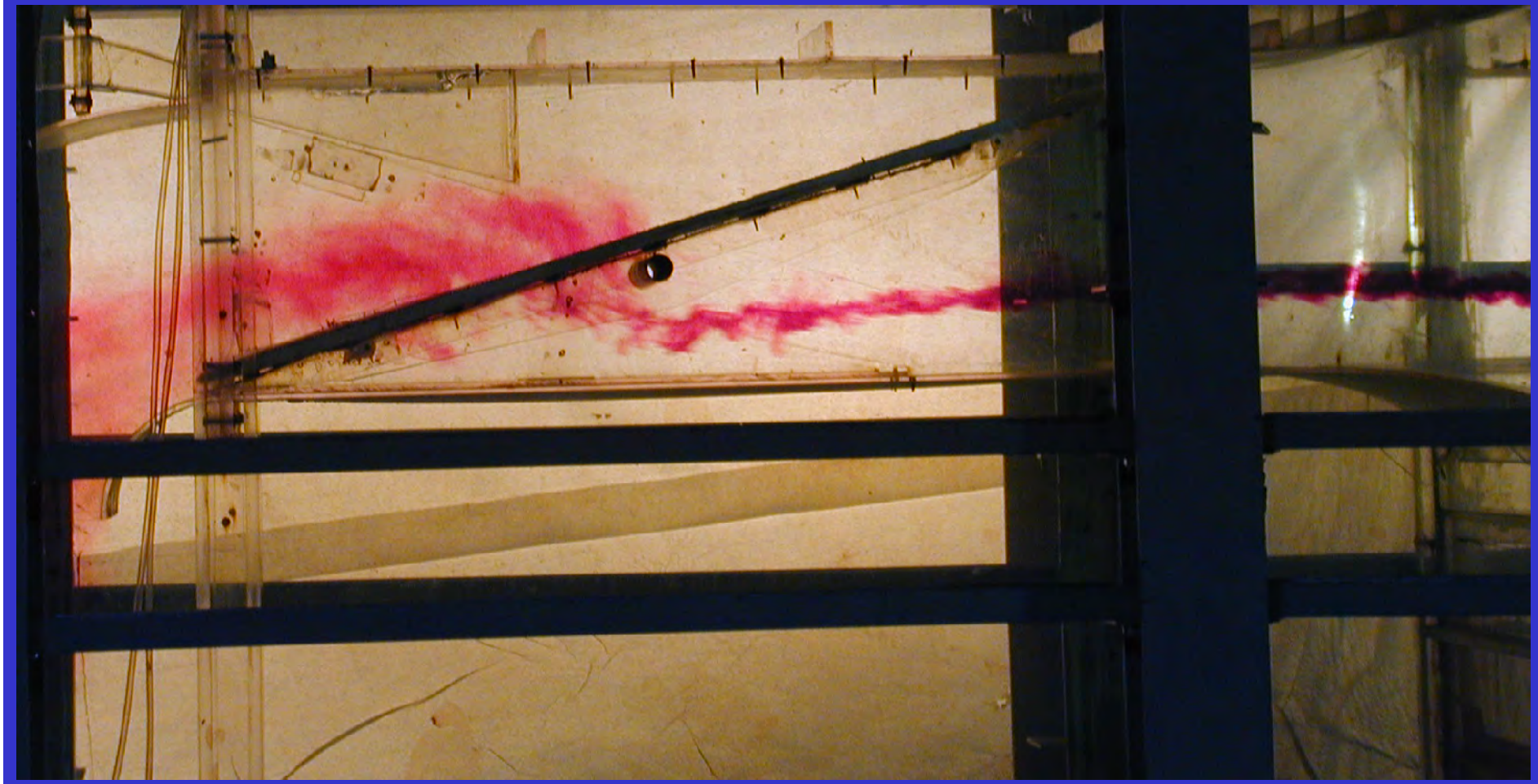
High Velocity Screen Criteria
- Vs / Vn > 2.2
- Vn / Vo < 0.45

Entrance Criteria
- Velocity Gradient < 0.3 fps / ft
- Design Vo = 6 fps @ 600 cfs

US Army Corps
of Engineers
Seattle District

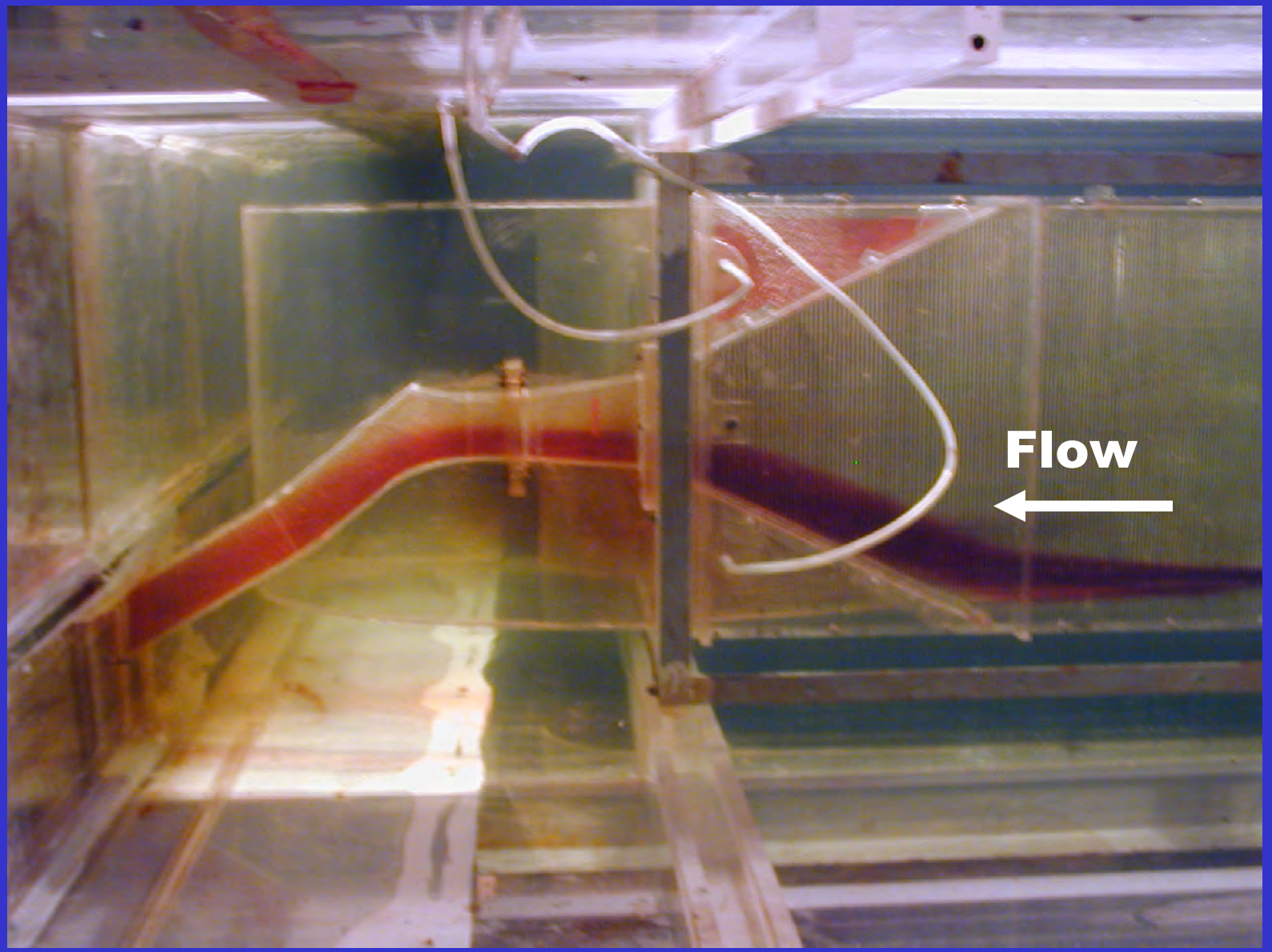
Debris

Fish Screen in Backflush Operation



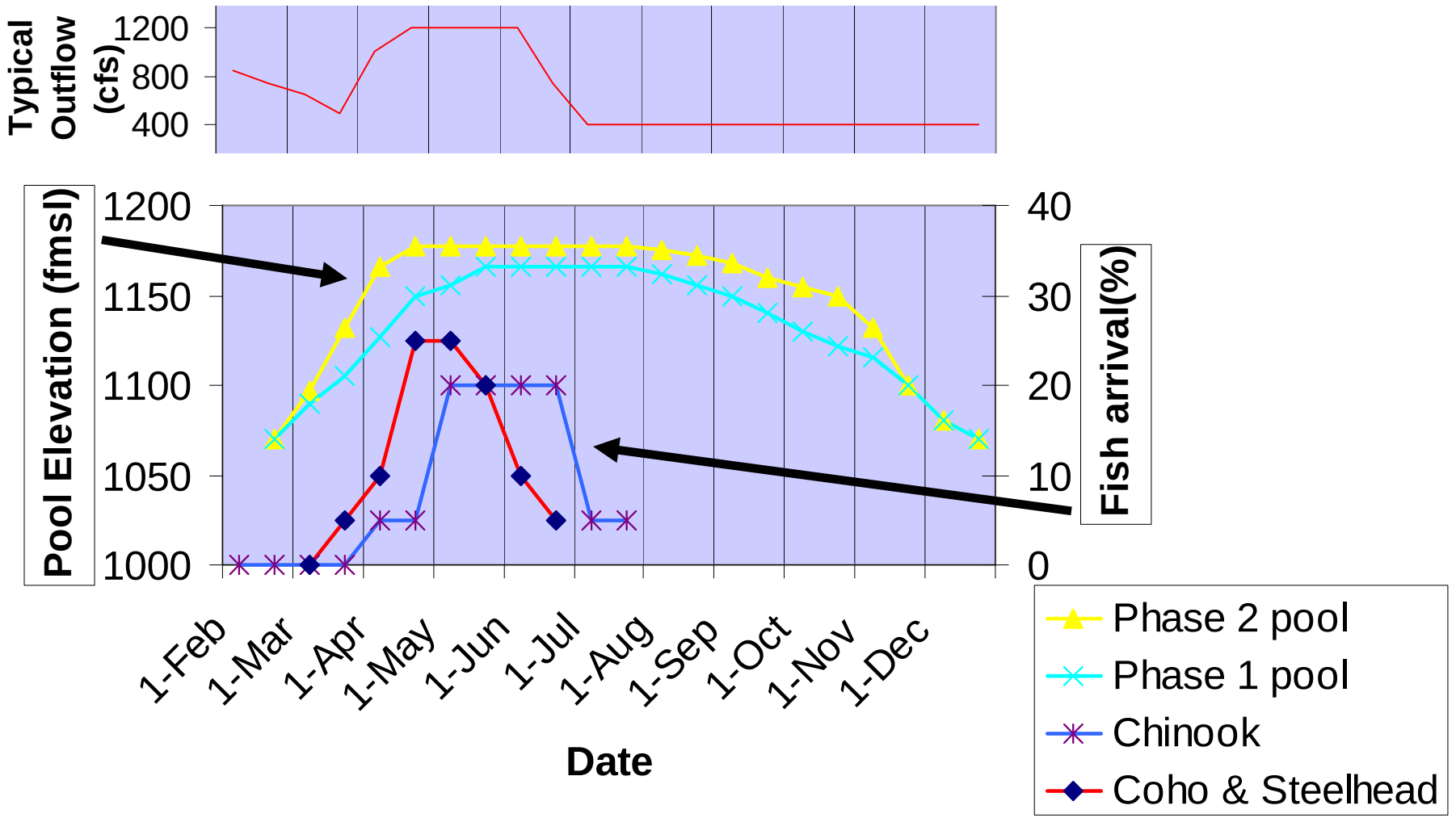
US Army Corps
of Engineers
Seattle District

Pathway to fish well along screen and screen enclosure (Plan View)



Velocity and energy dissipation in fish lock

A Remaining Concern.

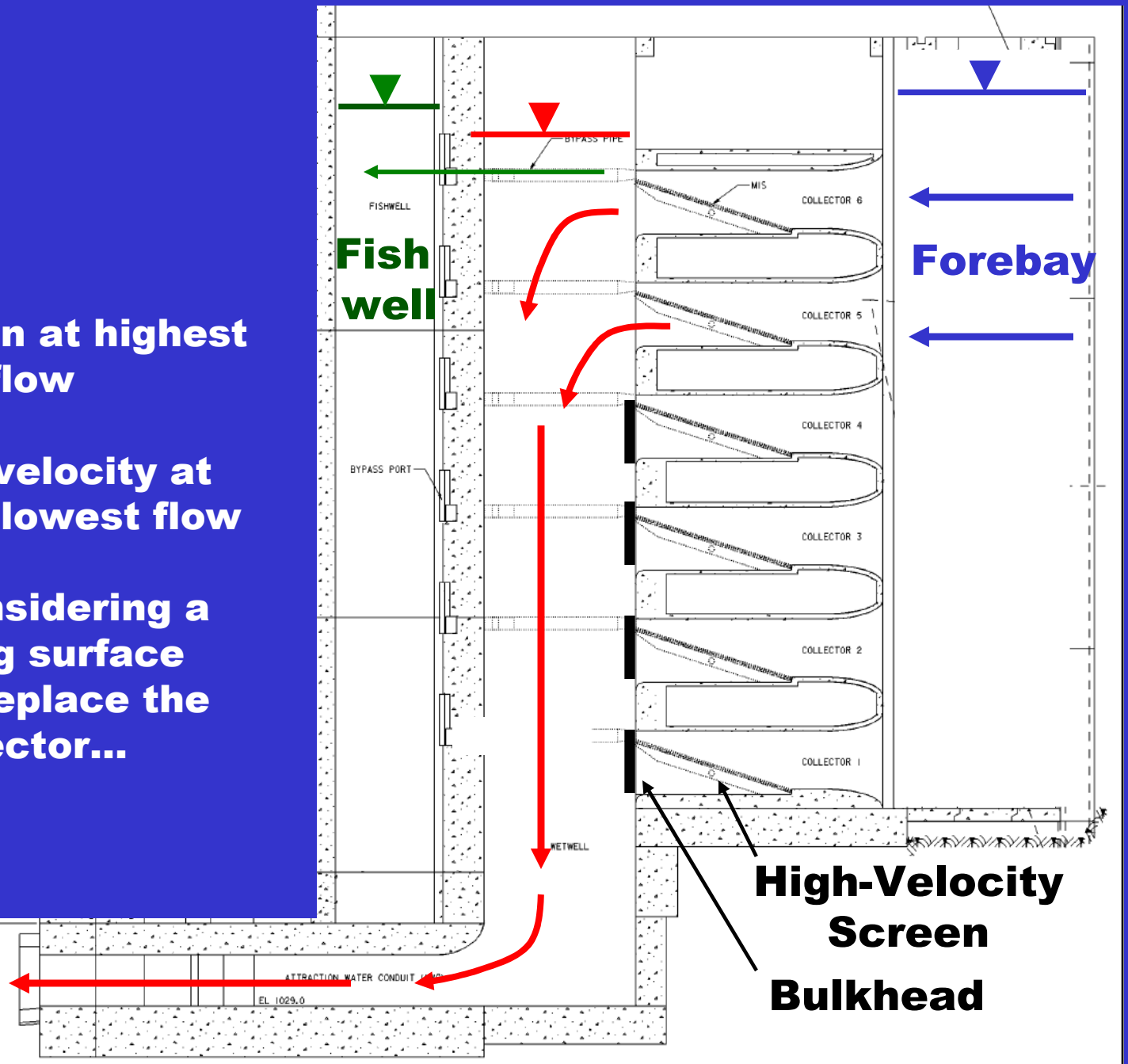


US Army Corps of Engineers
Seattle District

Fish attraction at highest pool, lowest flow

Fish capture velocity at highest pool, lowest flow

Presently considering a small, floating surface collector to replace the topmost collector…



US Army Corps
of Engineers
Seattle District

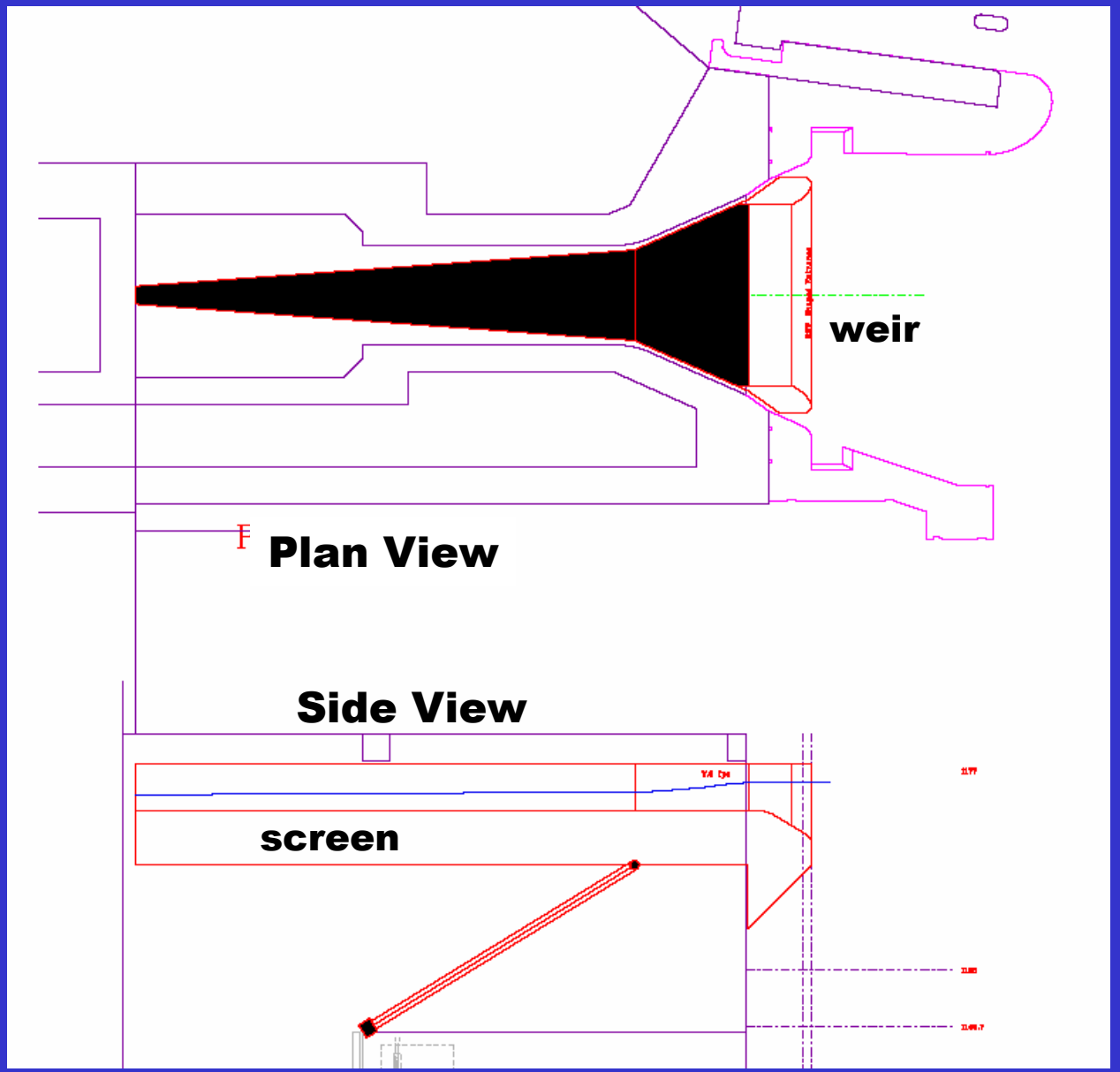
Questions?

Sample Surface Collector Design

US Army Corps
of Engineers
Seattle District

- **Issues:**

Operational complexity
Compatibility with existing design
Cost
Is it necessary?



Howard Hanson fish facility: hydraulic design considerations

US Army Corps of Engineers
Seattle District

- High head radial gate and vertical emergency gate
- Highly supercritical confluence
- Constant dv/dx intake
- Screen enclosure
- Fish-friendly bypass
- Wet well size
- Fish bypass system to pool below
- PHYSICAL MODELING
  - 1:? Scale forebay and stilling basin model
  - Sectional model (approach flow, wet-well, conduit intake, flood control tunnel)
  - Screen model
  - Physical/biological fish well model
- NUMERICAL MODELING
  - Forebay (to set BC's for sectional model)
  - 3-D fish well model (I did this on the side)
- Modeling of new conduit and junction with existing tunnel.
- Flow Control and AWC.

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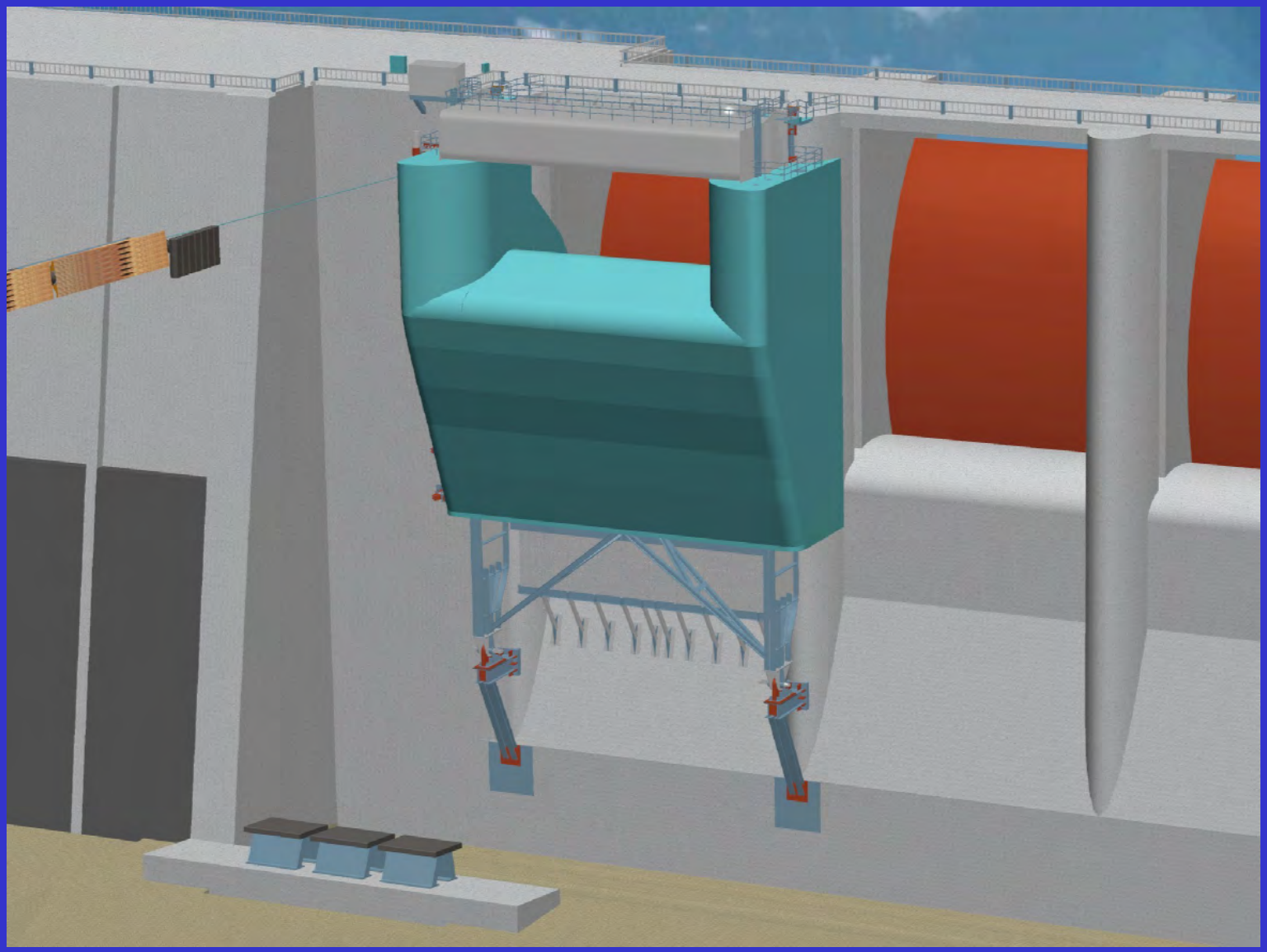
of Engineers
Seattle District

Removable Spillway Weir

Typical Snake River Project



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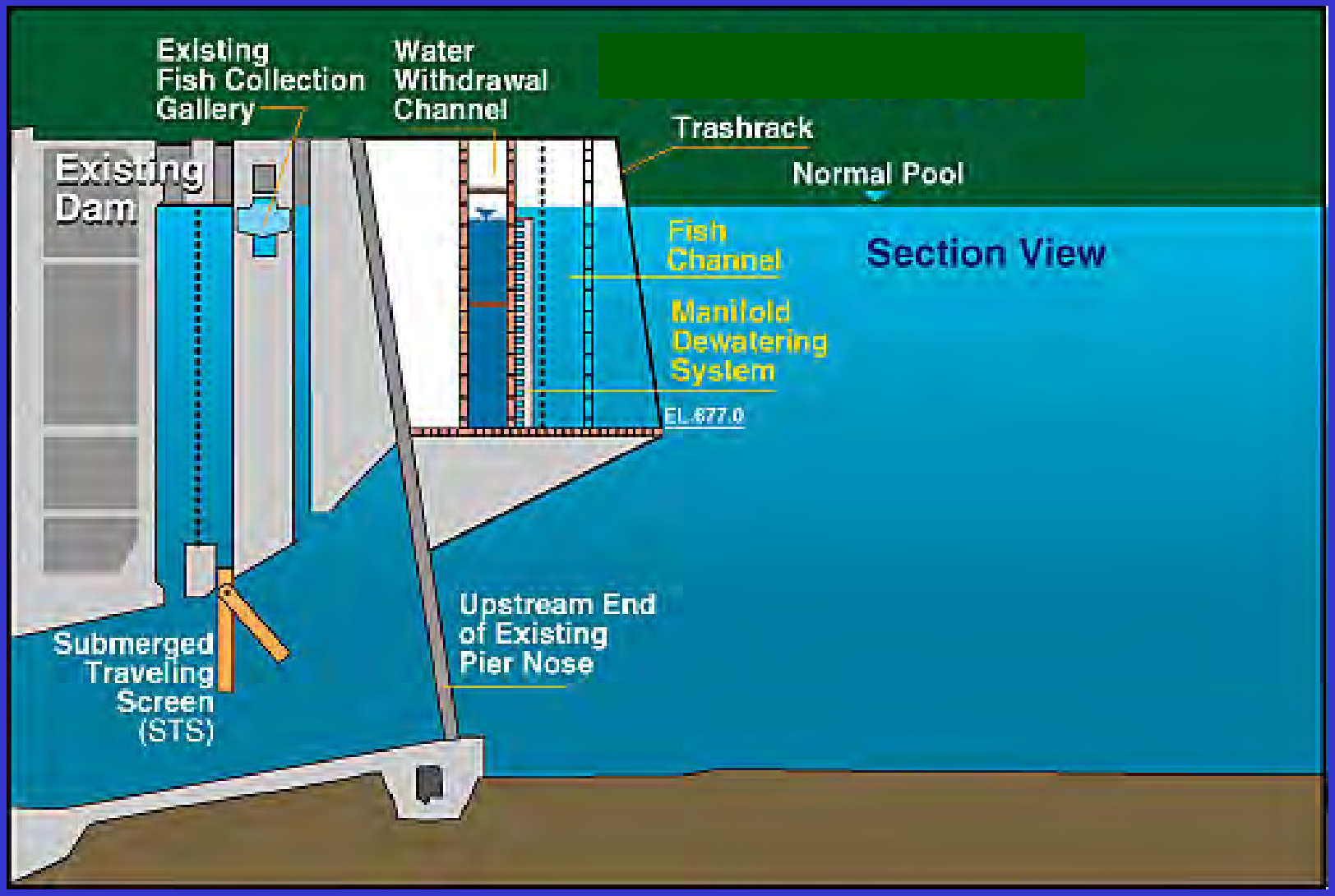
of Engineers
Seattle District

Powerhouse Passage
Typical Snake River Project



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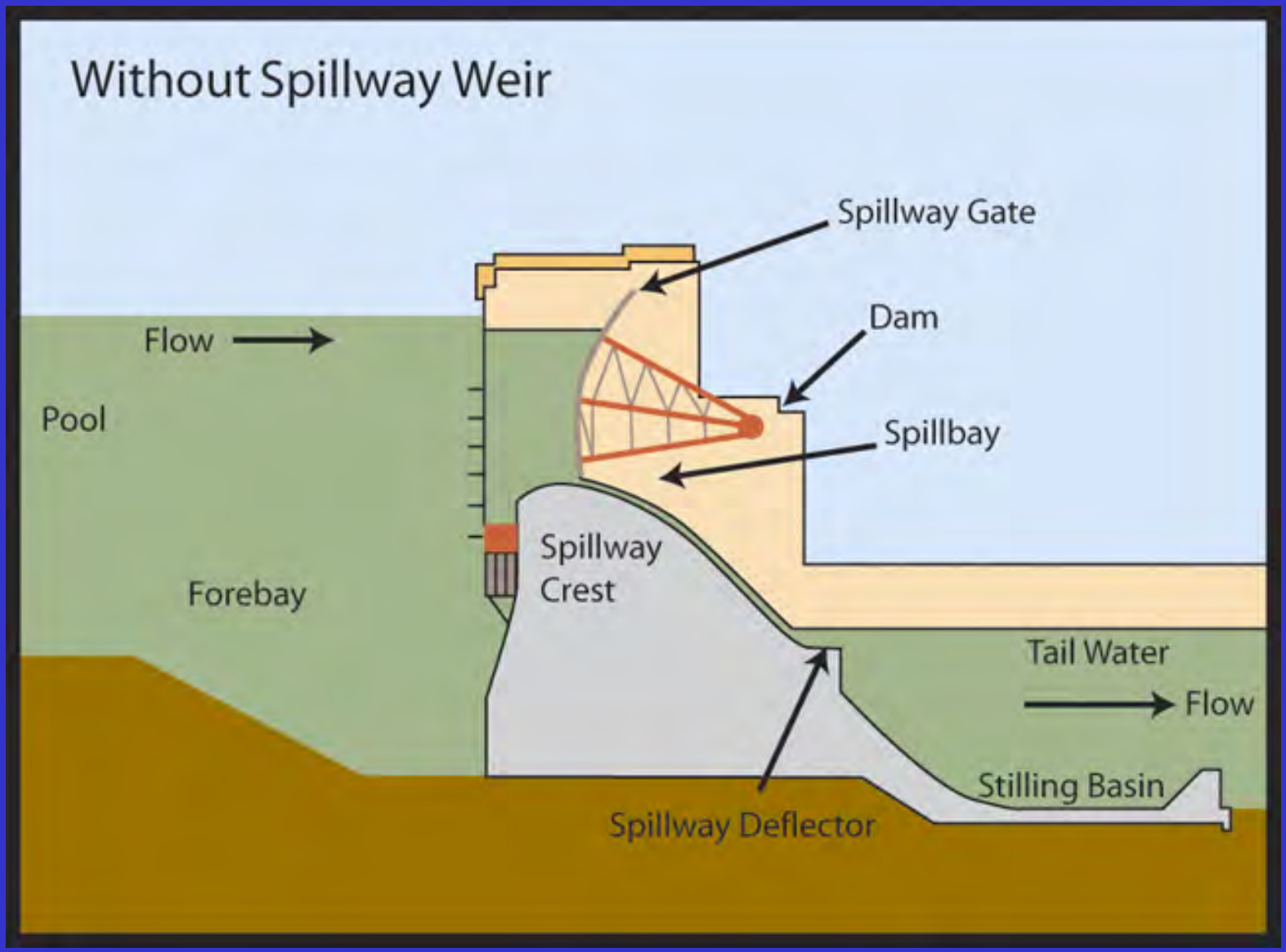
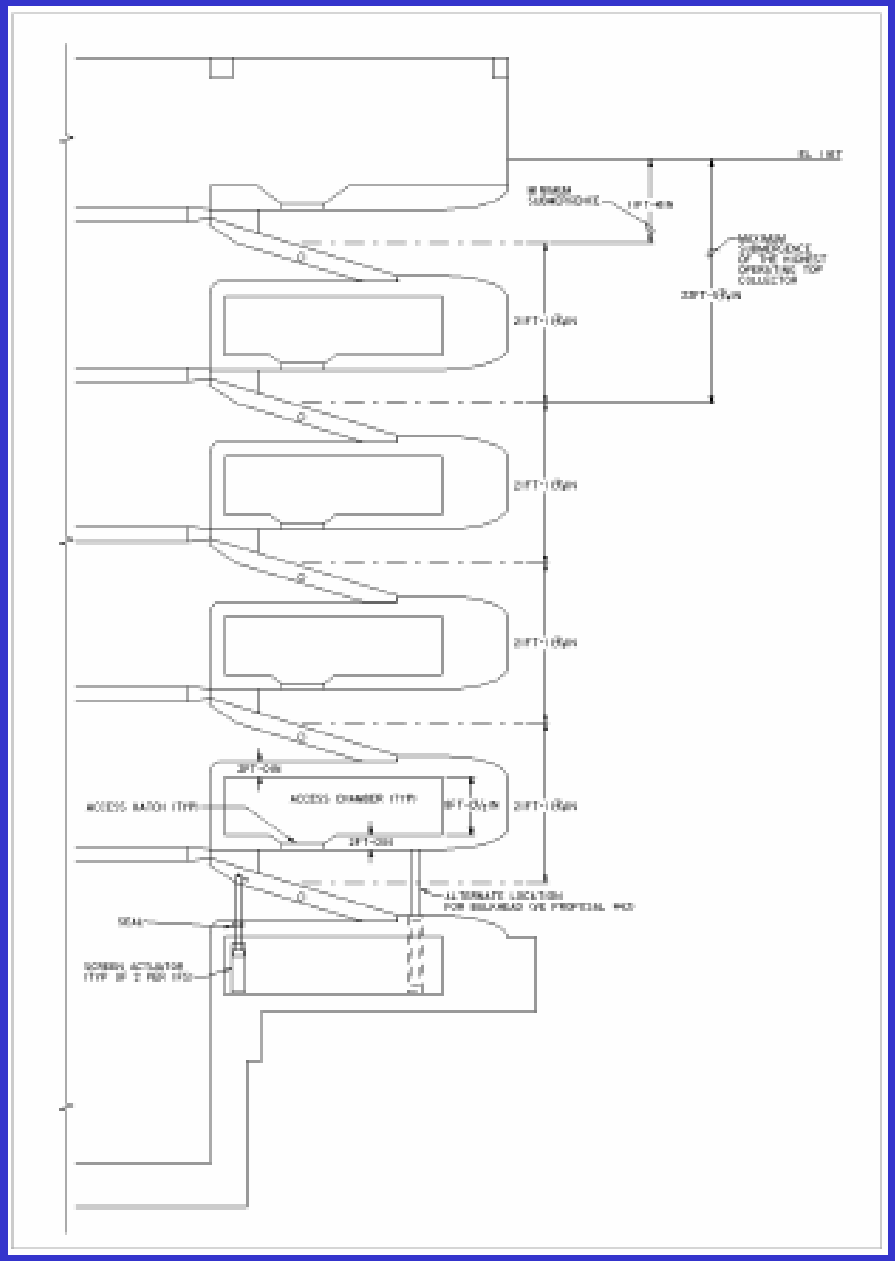
Seattle District

Spillway Passage
Typical Snake River Project





Howard Hanson

Juvenile Fish Facility

Current Design without Surface Collector

US Army Corps
of Engineers
Seattle District

Howard Hanson fish facility: hydraulic design features

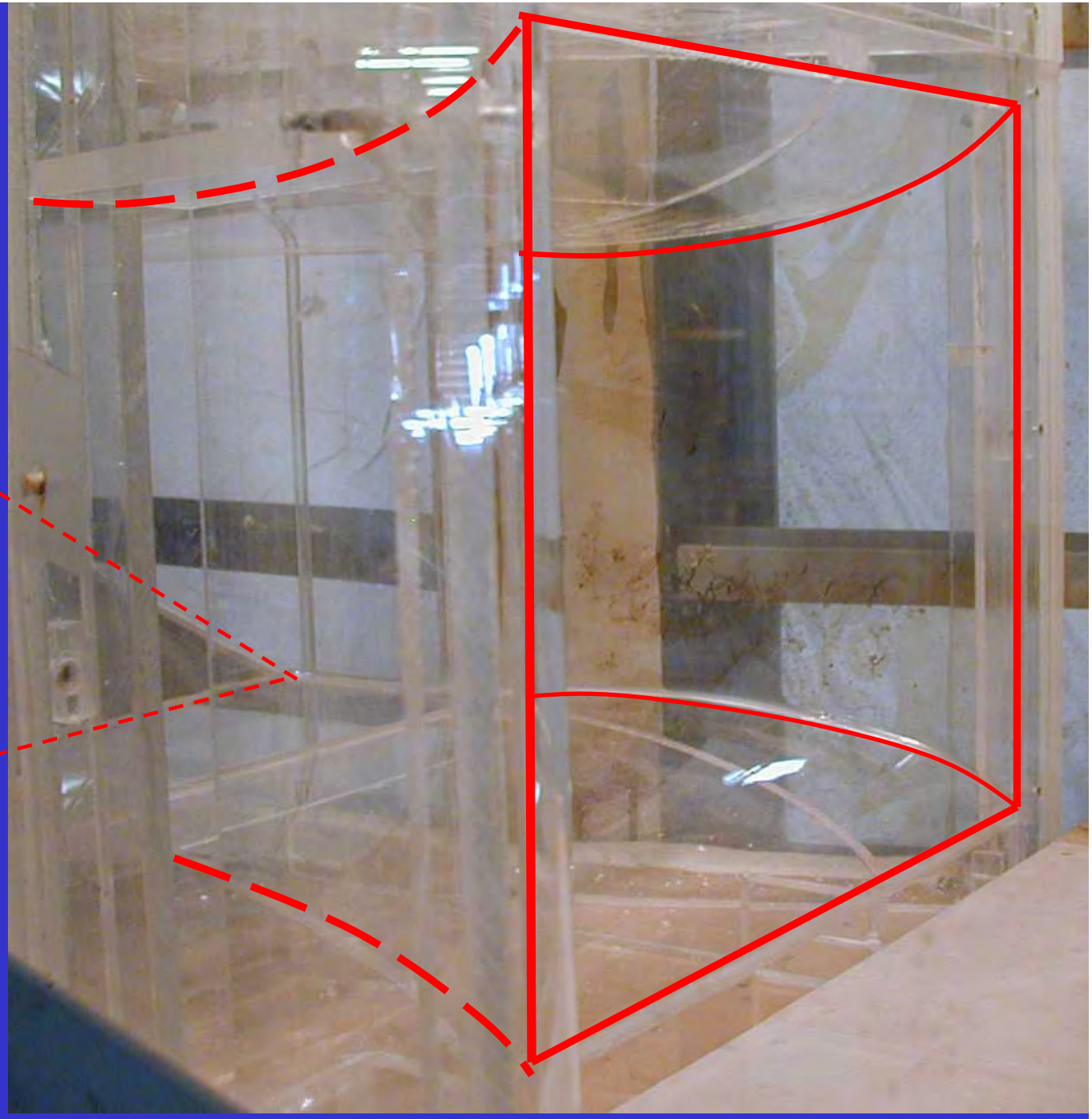
Fish Entrance Horn

Overhead Oblique View

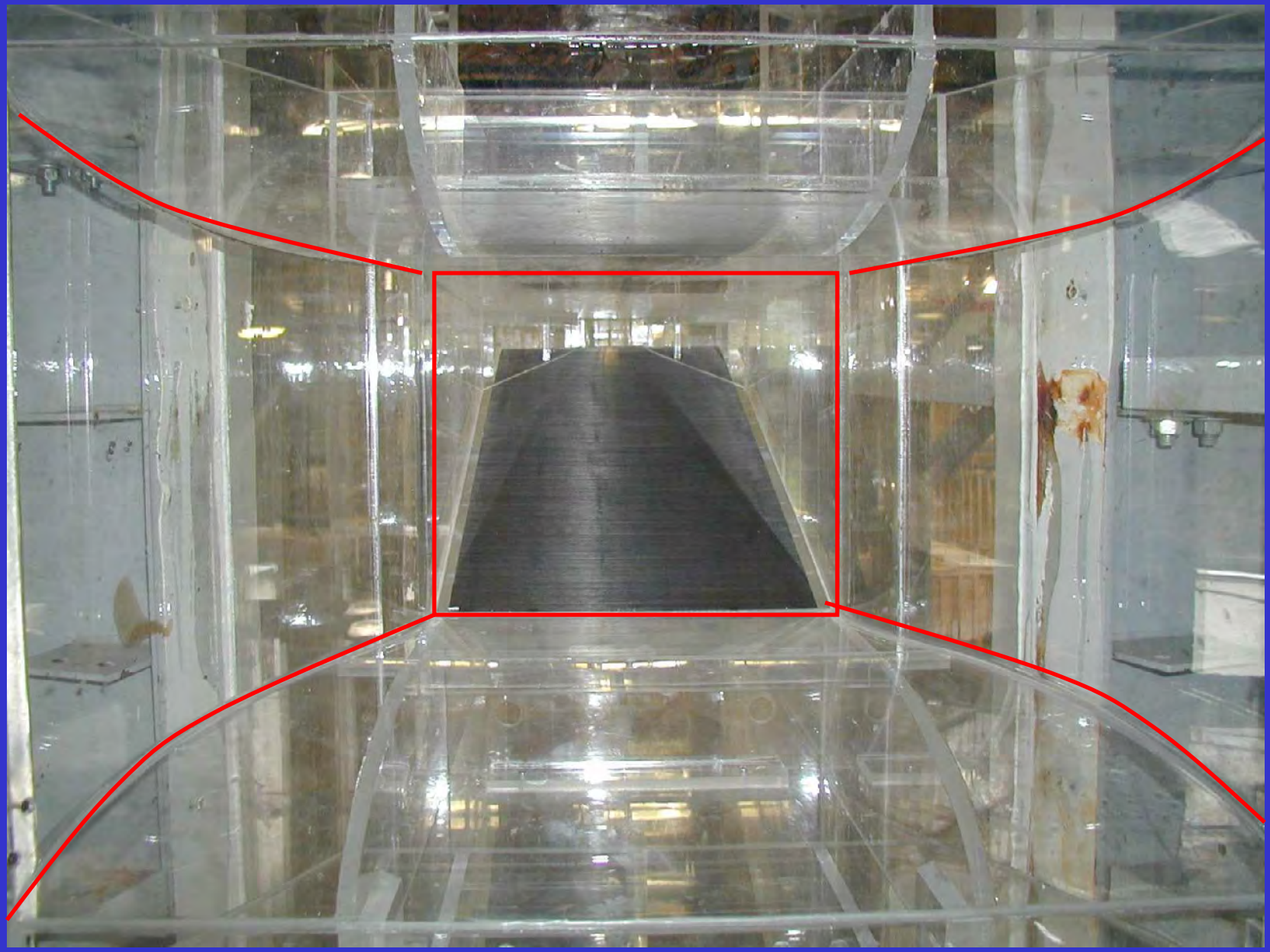
US Army Corps
of Engineers
Seattle District

Howard Hanson fish facility: hydraulic design features

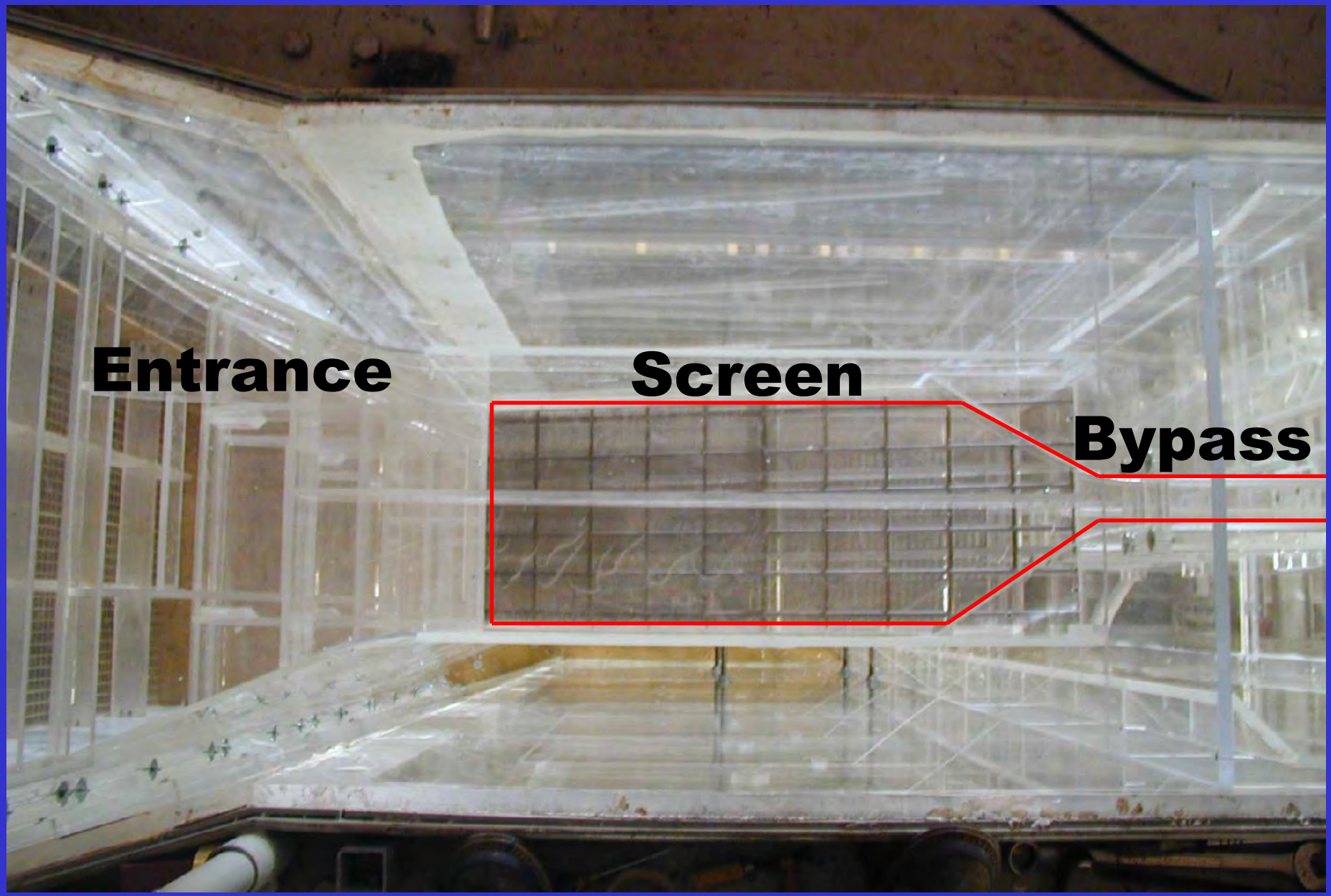
Entrance Horn



Conclusions.



Fish screen and screen enclosure



Overhead view of bypass conduit and wet well

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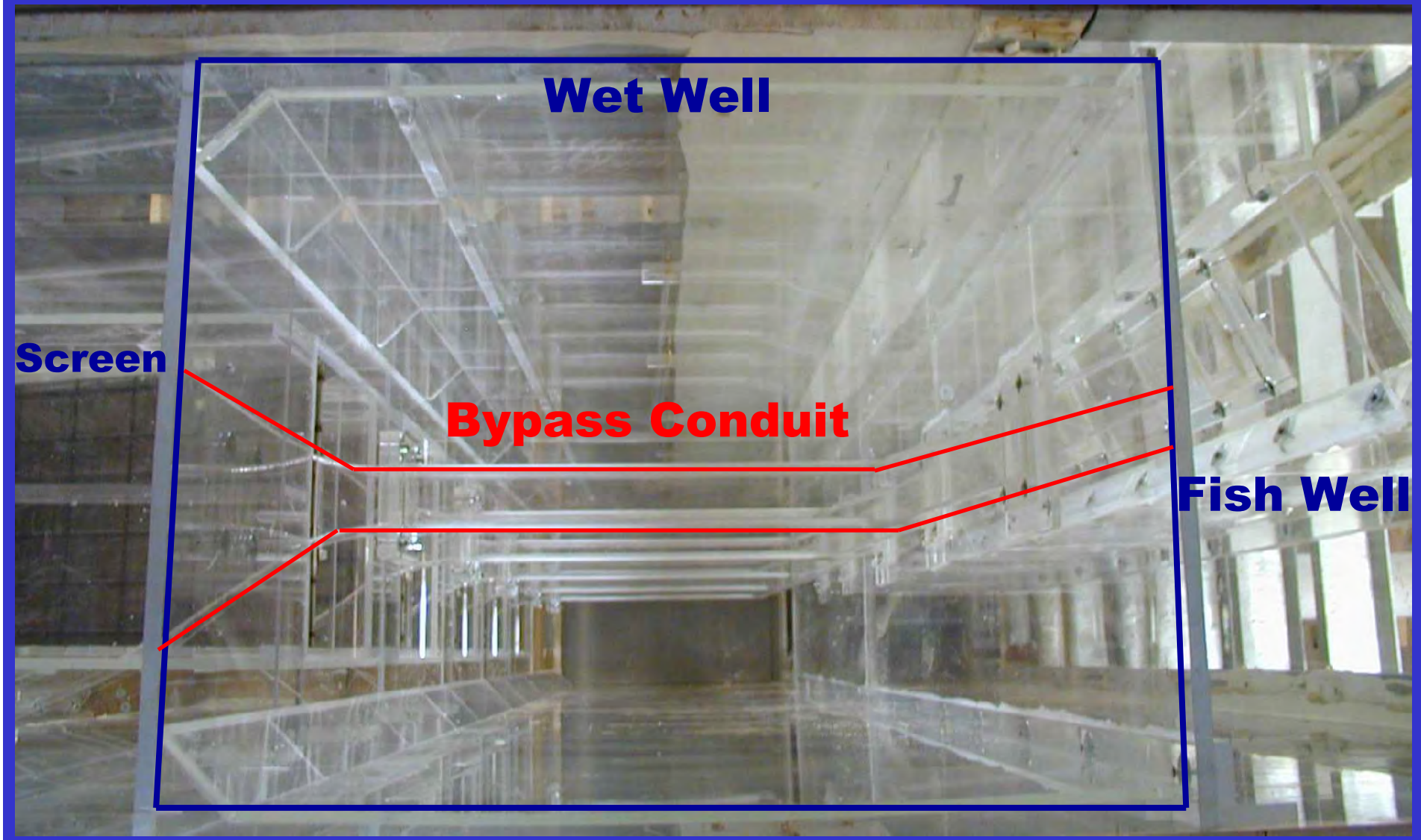
of Engineers
Seattle District



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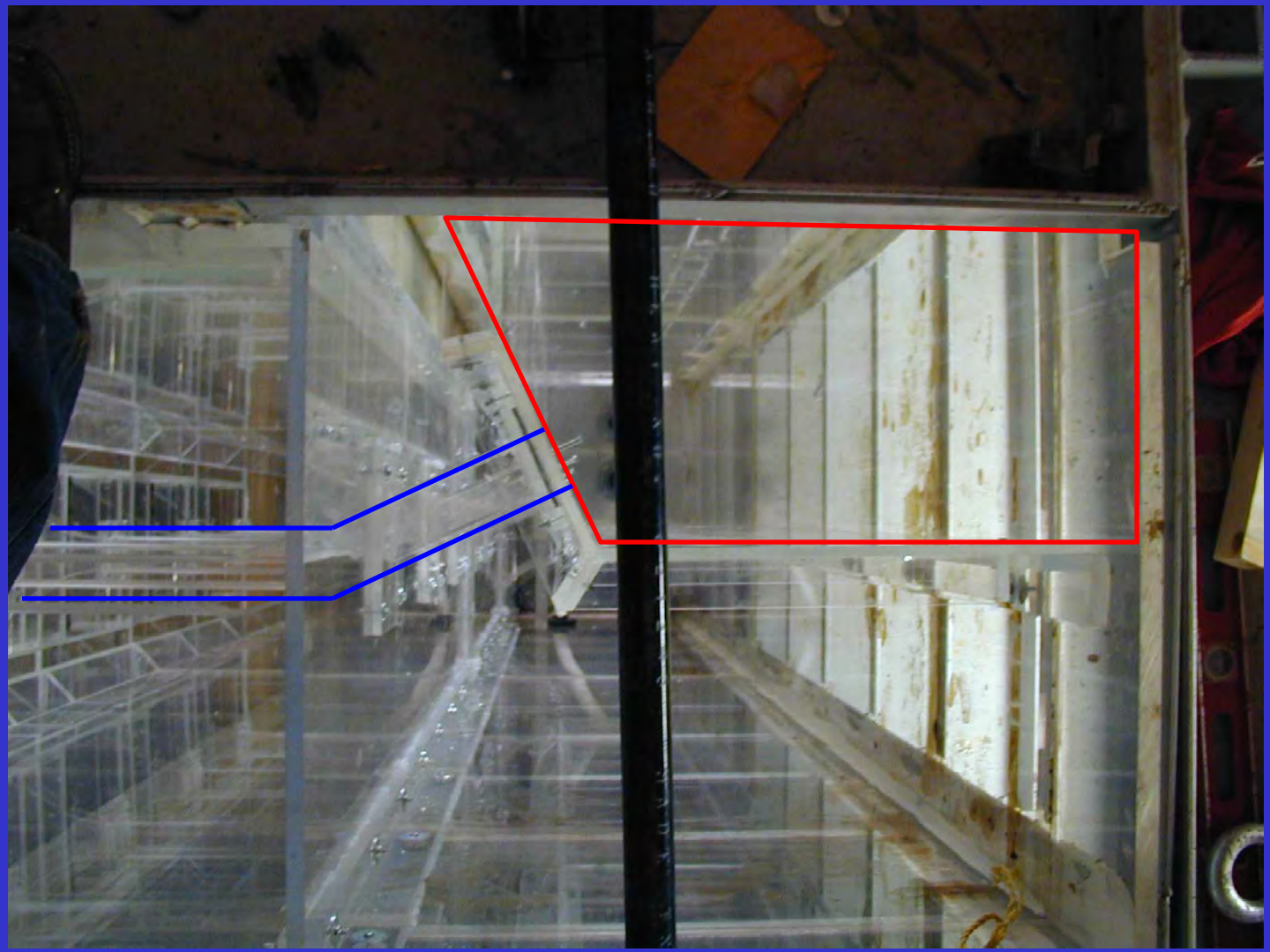
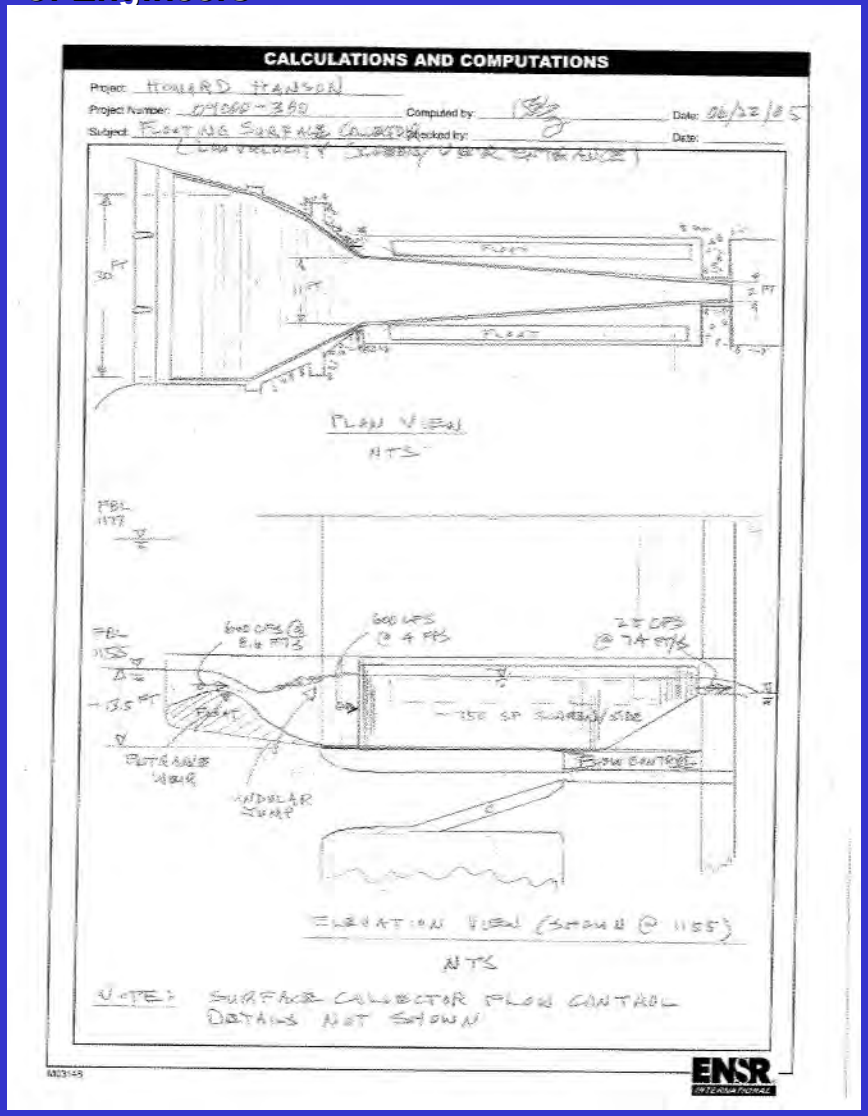
of Engineers
Seattle District

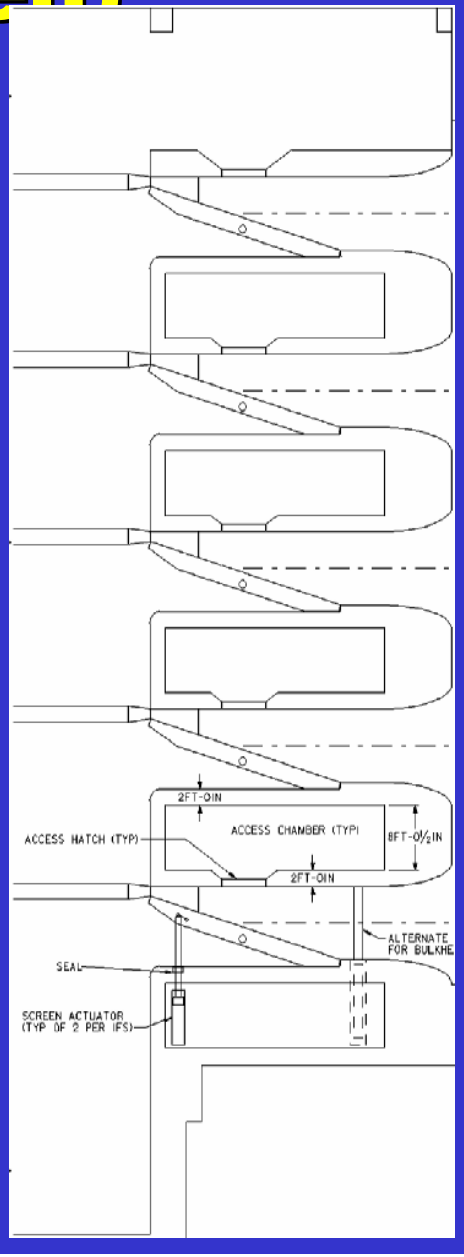
Plan View of Wet Well



US Army Corps of Engineers

Floating Surface Collector (Low Velocity Screen)



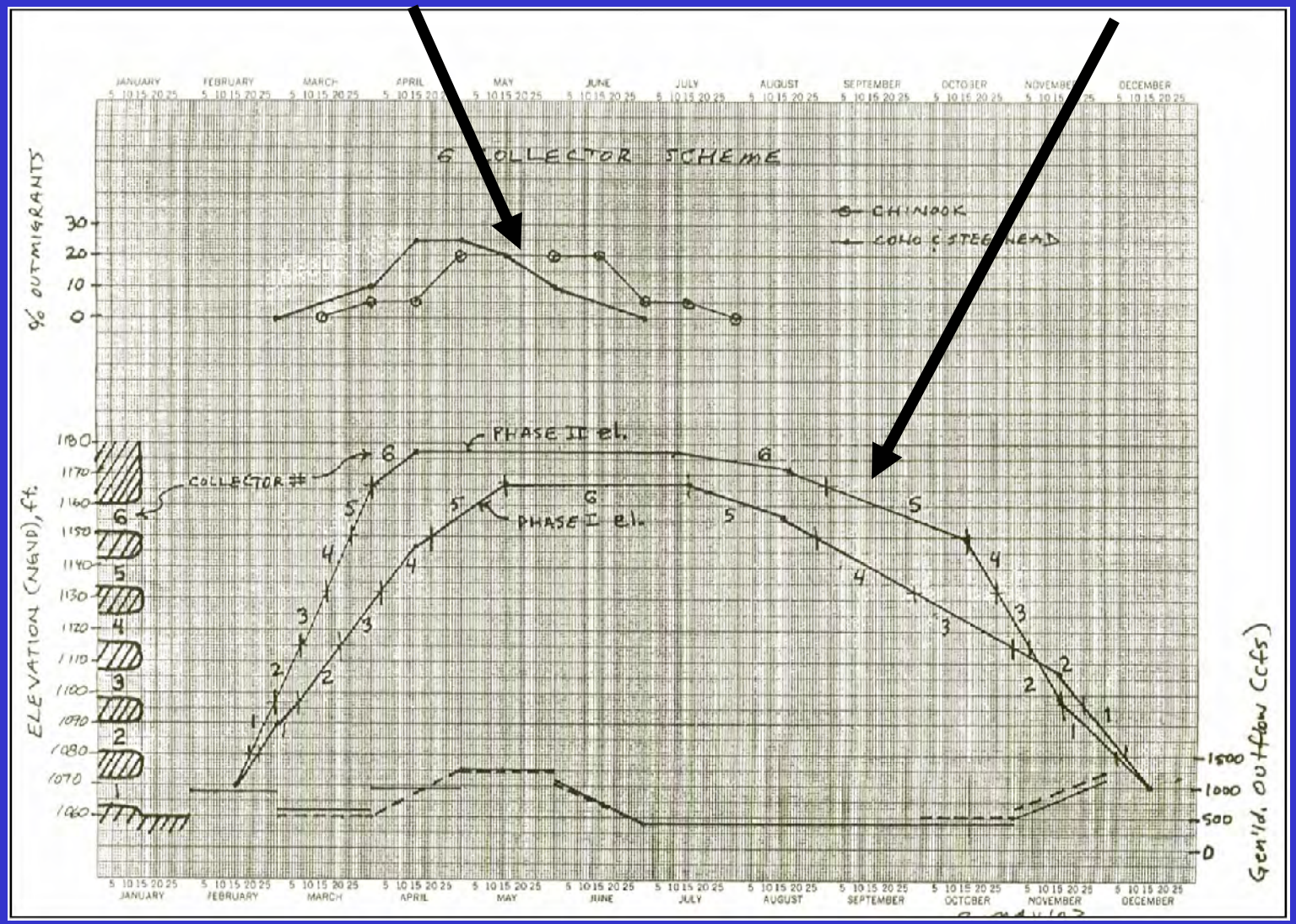


Howard Hanson site limitations

US Army Corps of Engineers
Seattle District

- **Expected fish timing**

•Wide pool fluctuation

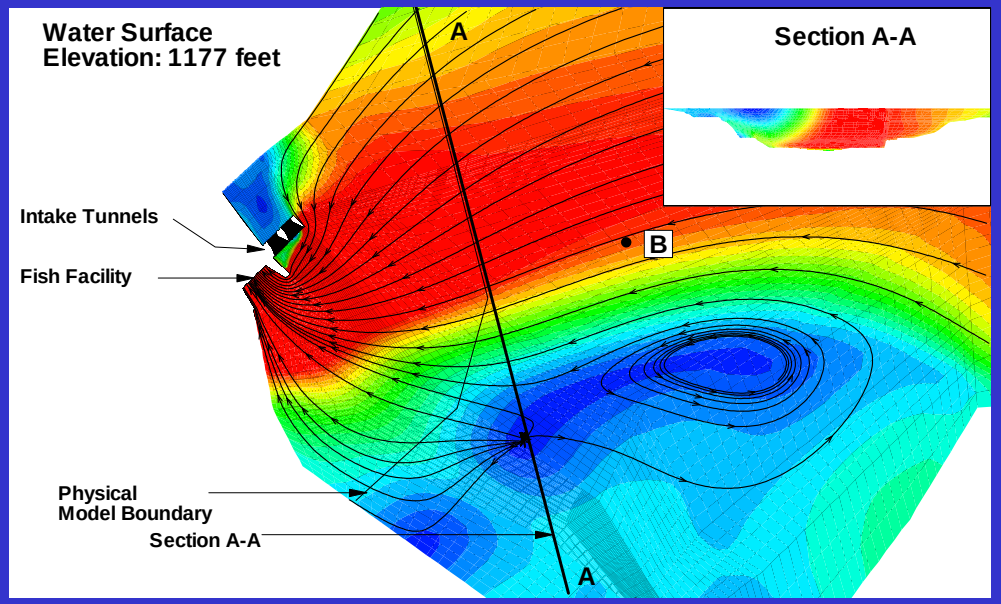


US Army Corps
of Engineers
Seattle District

Goal:
Reduce Delay

High Forebay with Juvenile Fish Facility

Low level outlet open



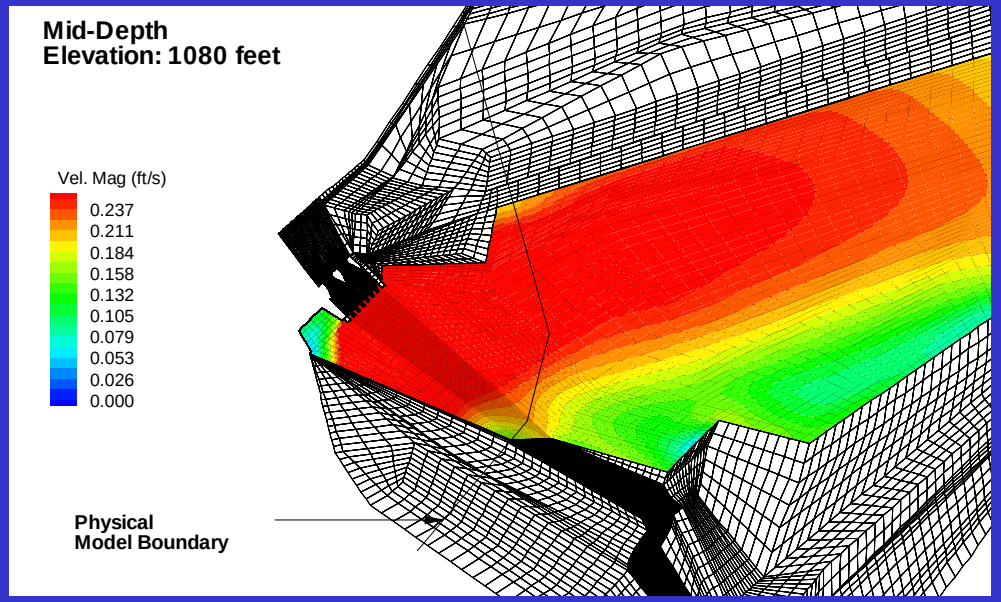


Figure 3: Plan View of Velocity Magnitude at Water Surface and Mid-Depth

Scenario S1P1: Tunnel: 2700 cfs, Fish: 1300 cfs

US Army Corps
of Engineers
Seattle District

Goal:
Reduce Delay

High Forebay

with Juvenile Fish Facility

Low Level Outlet Open

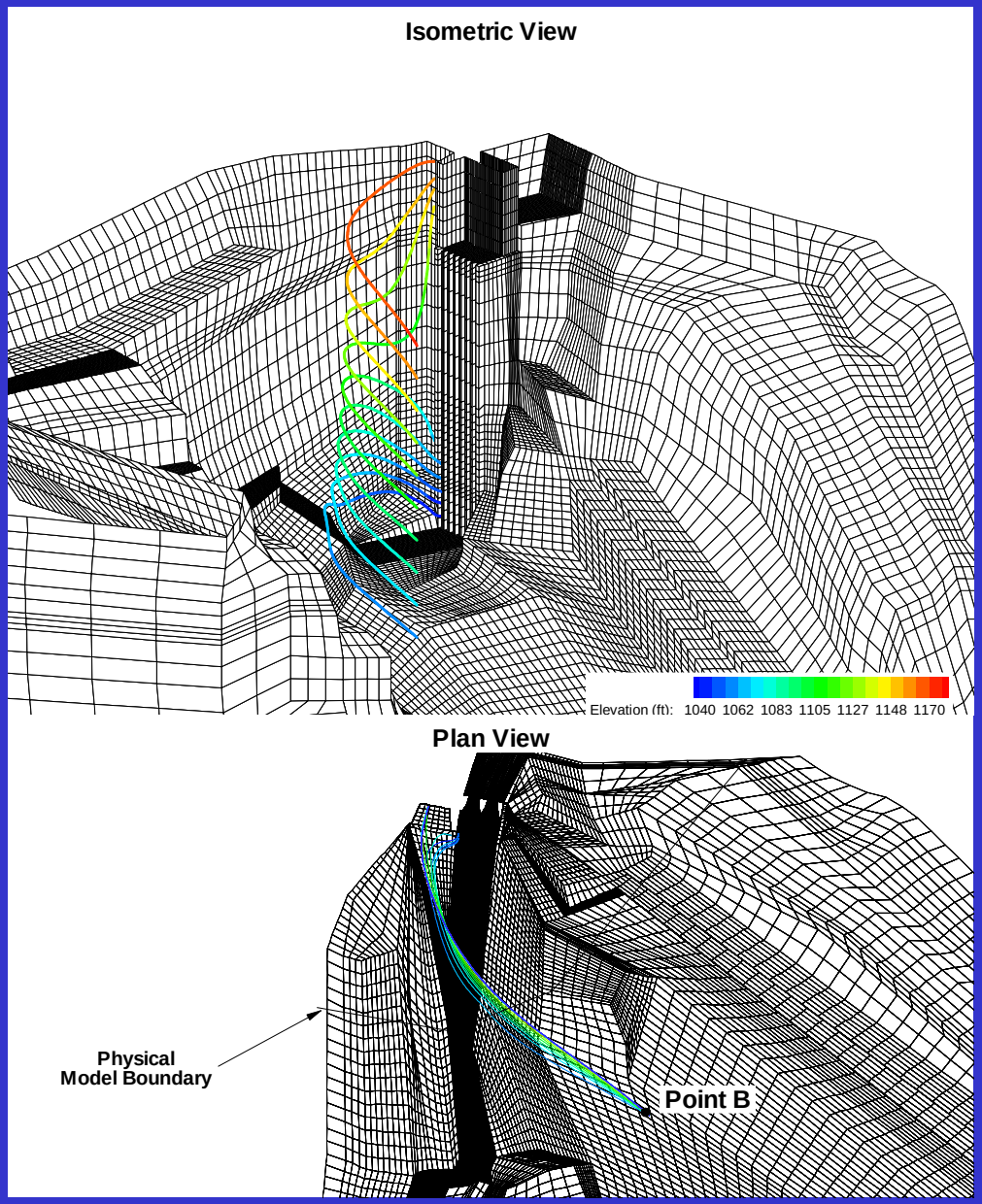


Figure 4: Flow Path From Point B to Tunnel and Fish Facility

Scenario S1P1: Tunnel: 2700 cfs, Fish: 1300 cfs

US Army Corps
of Engineers
Seattle District

Overview of Fisheries Design Criteria

- Operating Range: 97 feet
- Collector Design Flow: 200 - 600 cfs
- Facility Flow: 400 cfs to 1200 cfs
- Velocity gradient and screen criteria
- Bypass discharge: 25 cfs at all times
- Limitations on screen angle, flow depths in bypass conduit, energy dissipation in fish lock, maximum velocities, valve operations, pipe r/d ratios, etc.

U.S. Army Corps of Engineers
Northwestern Division

Missouri River Basin Water Management

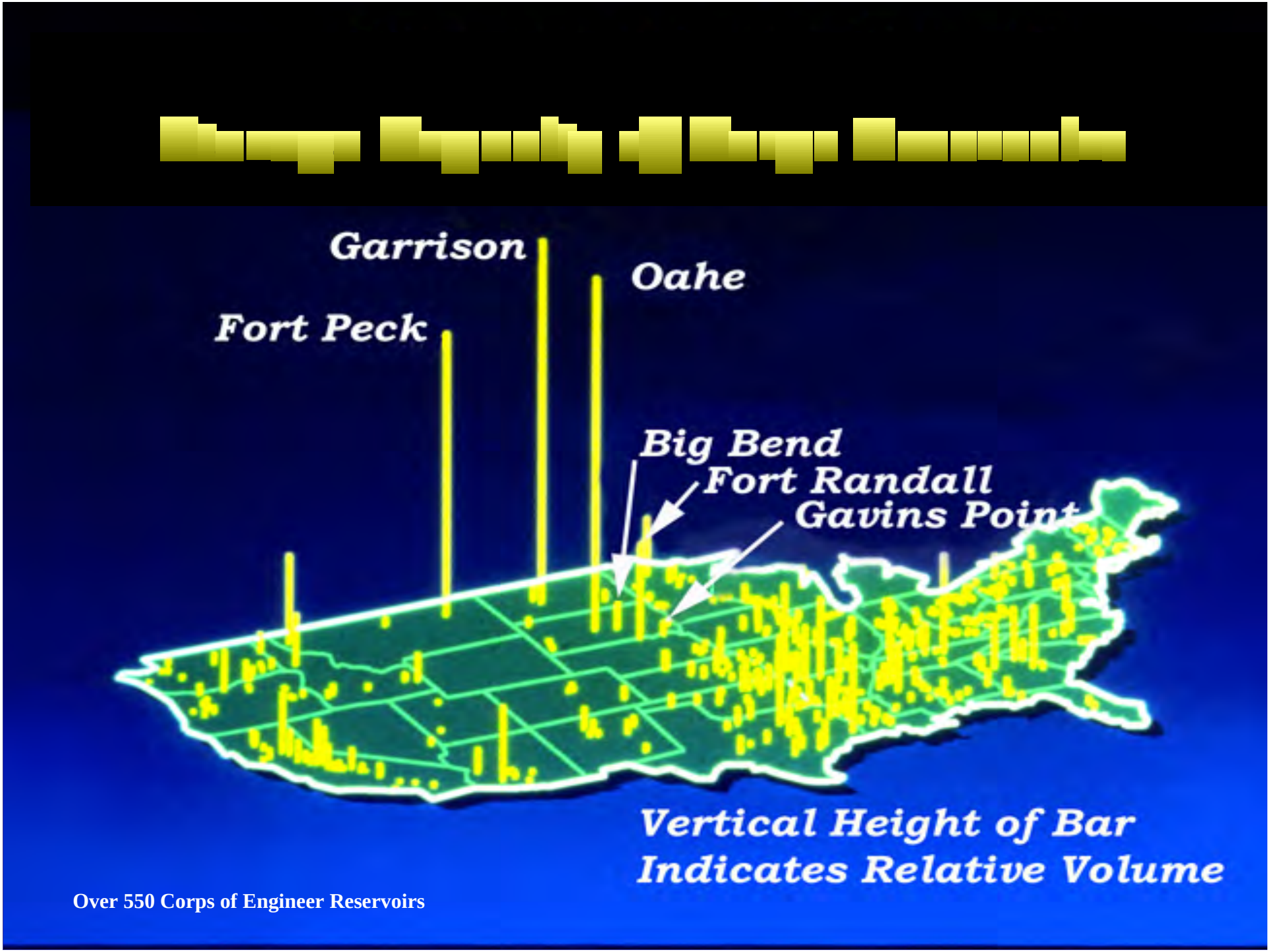
Infrastructure Conference

Missouri River Mainstem Reservoir System

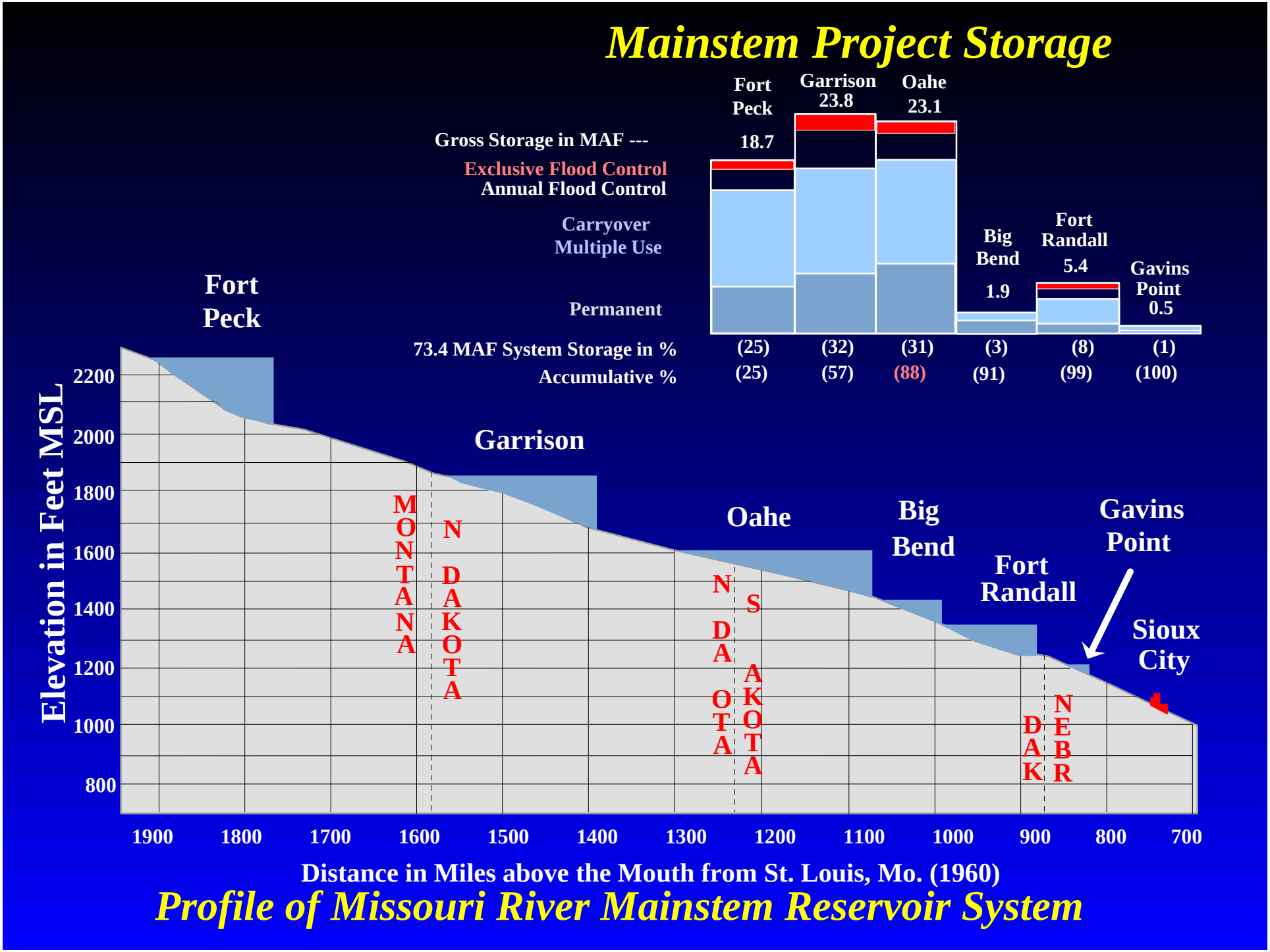
Congressionally Authorized
Project Purposes

Flood Control
Irrigation
Hydropower
Navigation
Recreation
Water Supply
Water Quality
Fish and Wildlife
(Including endangered species)

Bank Stabilization and Navigation Project
Sioux City, IA – St. Louis, MO

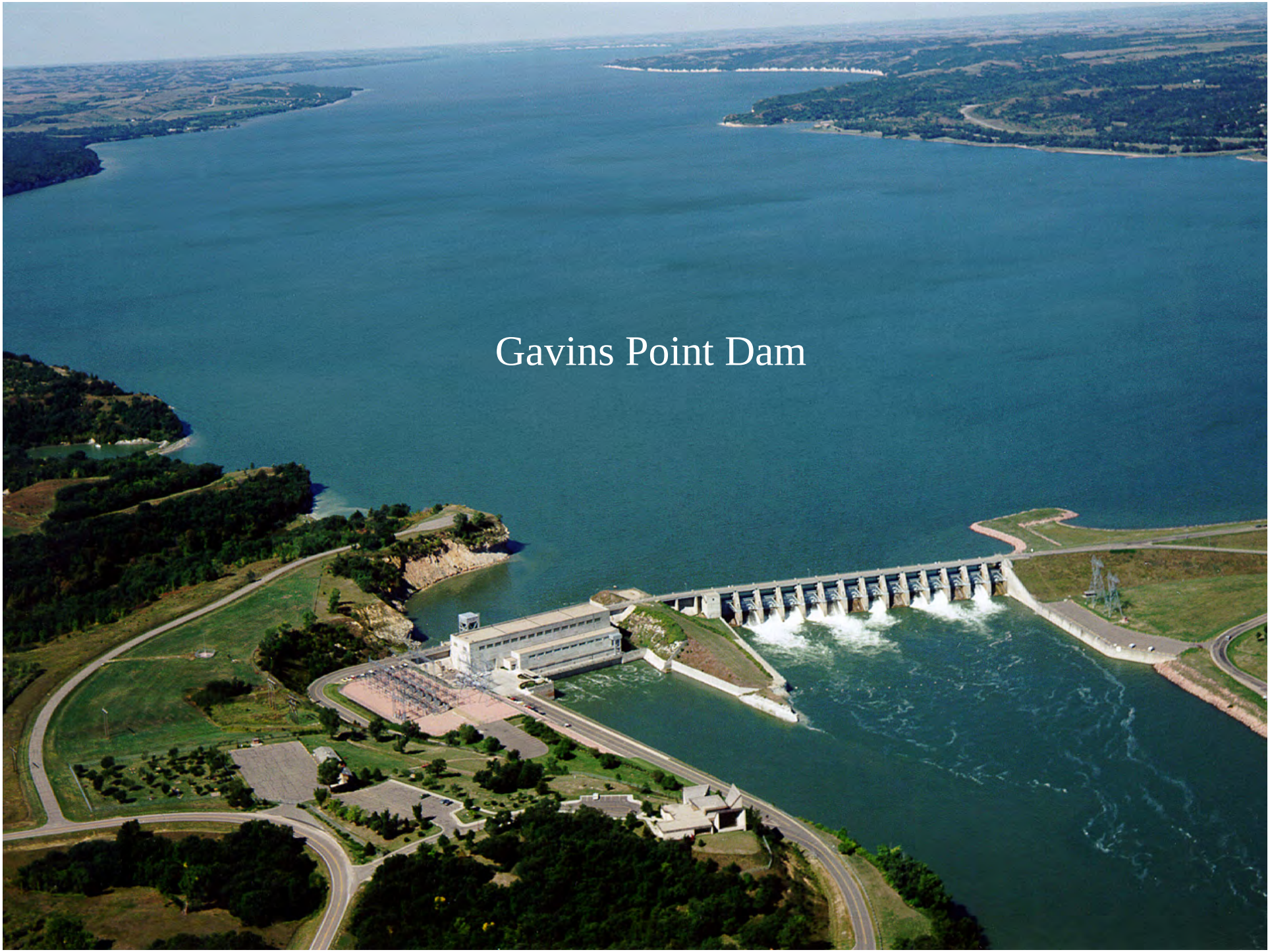

Garrison
Oahe
Fort Peck
Big Bend
Fort Randall
Gavins Point
Vertical Height of Bar
Indicates Relative Volume
Over 550 Corps of Engineer Reservoirs

Mainstem Project Storage



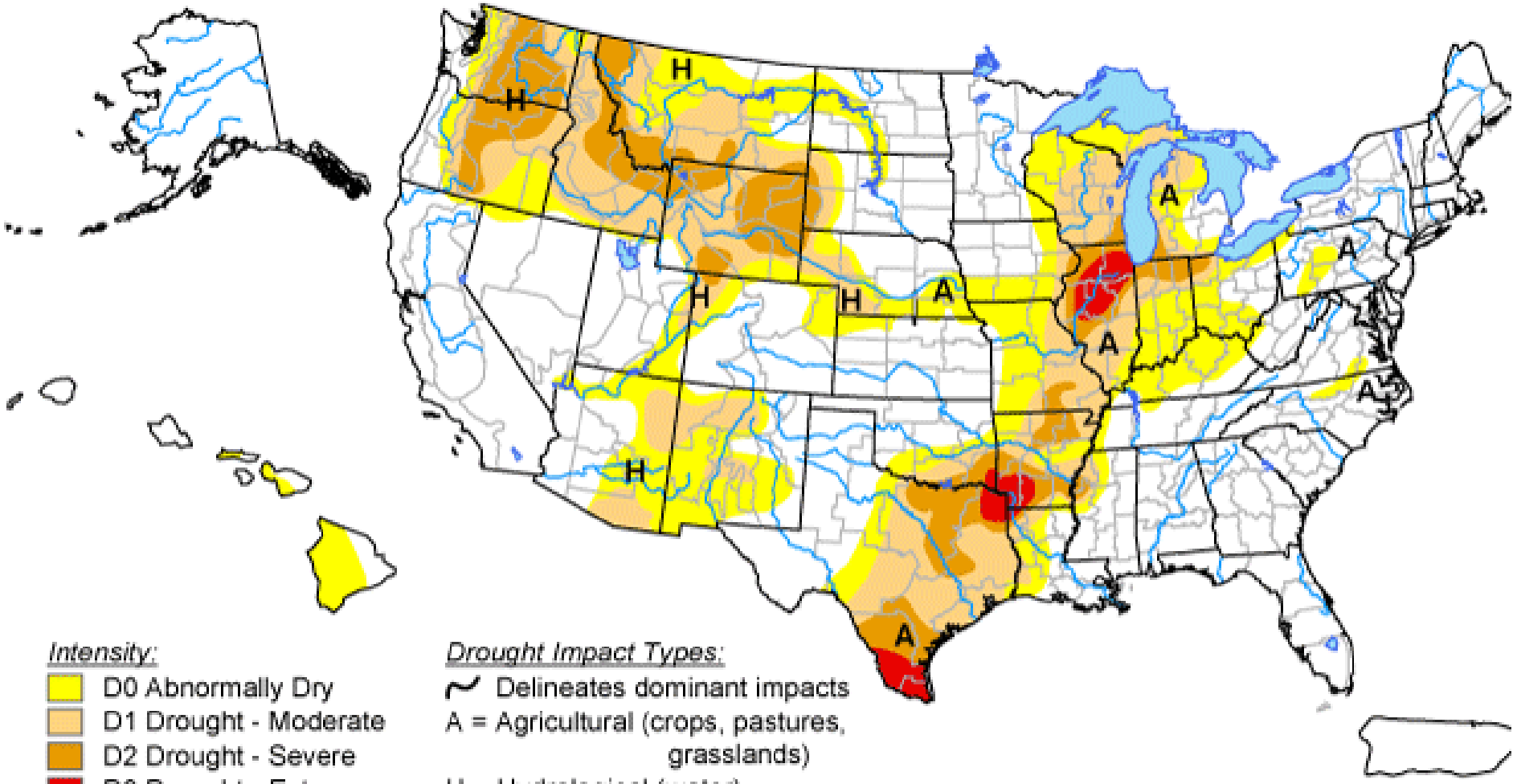
Profile of Missouri River Mainstem Reservoir System

Garrison Dam


Gavins Point Dam

U.S. Drought Monitor

July 12, 2005
Valid 8 a.m. EDT



Intensity:
- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

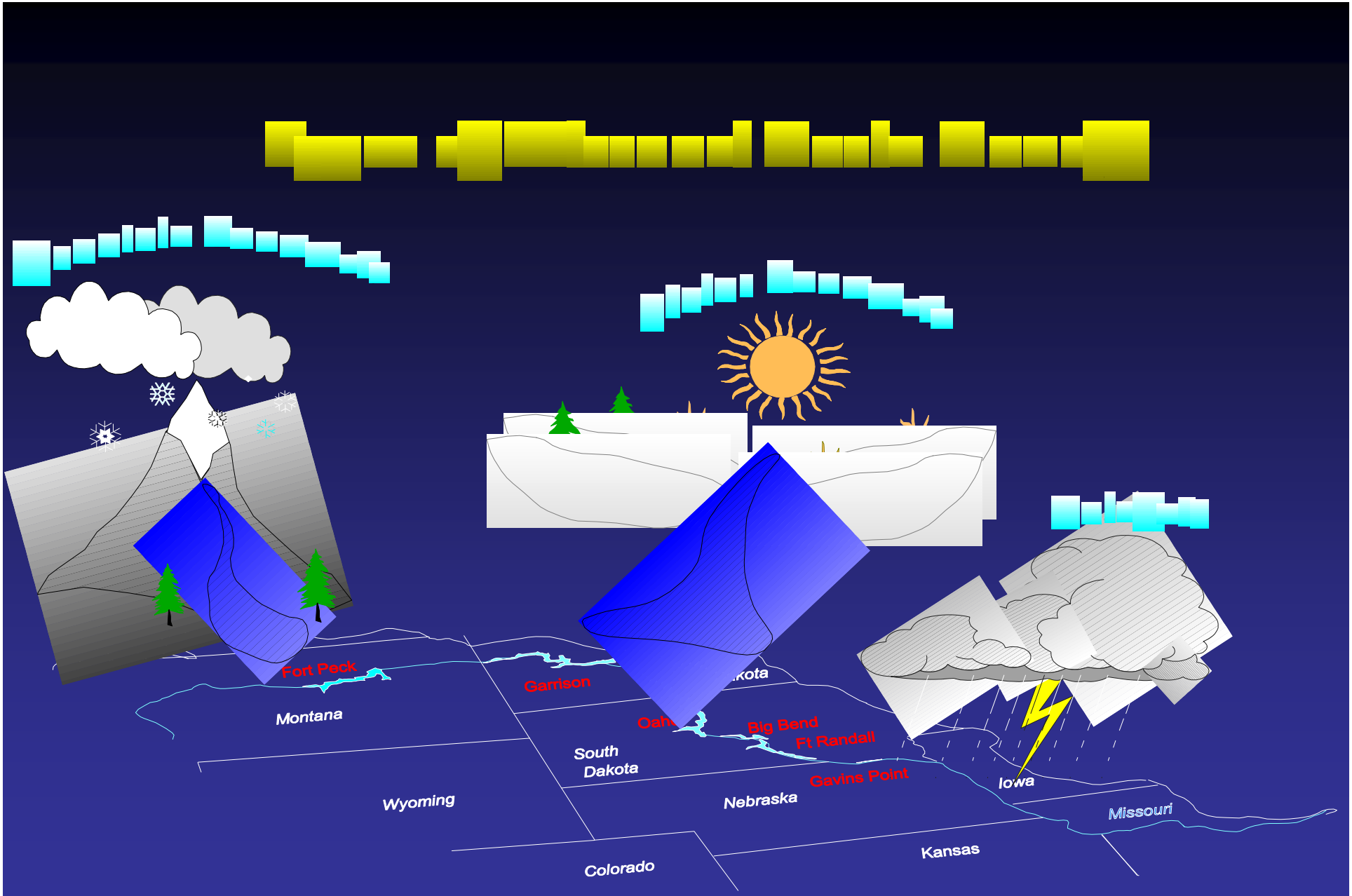
Drought Impact Types:
- ~ Delineates dominant impacts
- A = Agricultural (crops, pastures, grasslands)
- H = Hydrological (water)
- (No type = Both impacts)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

USDA National Drought Mitigation Center

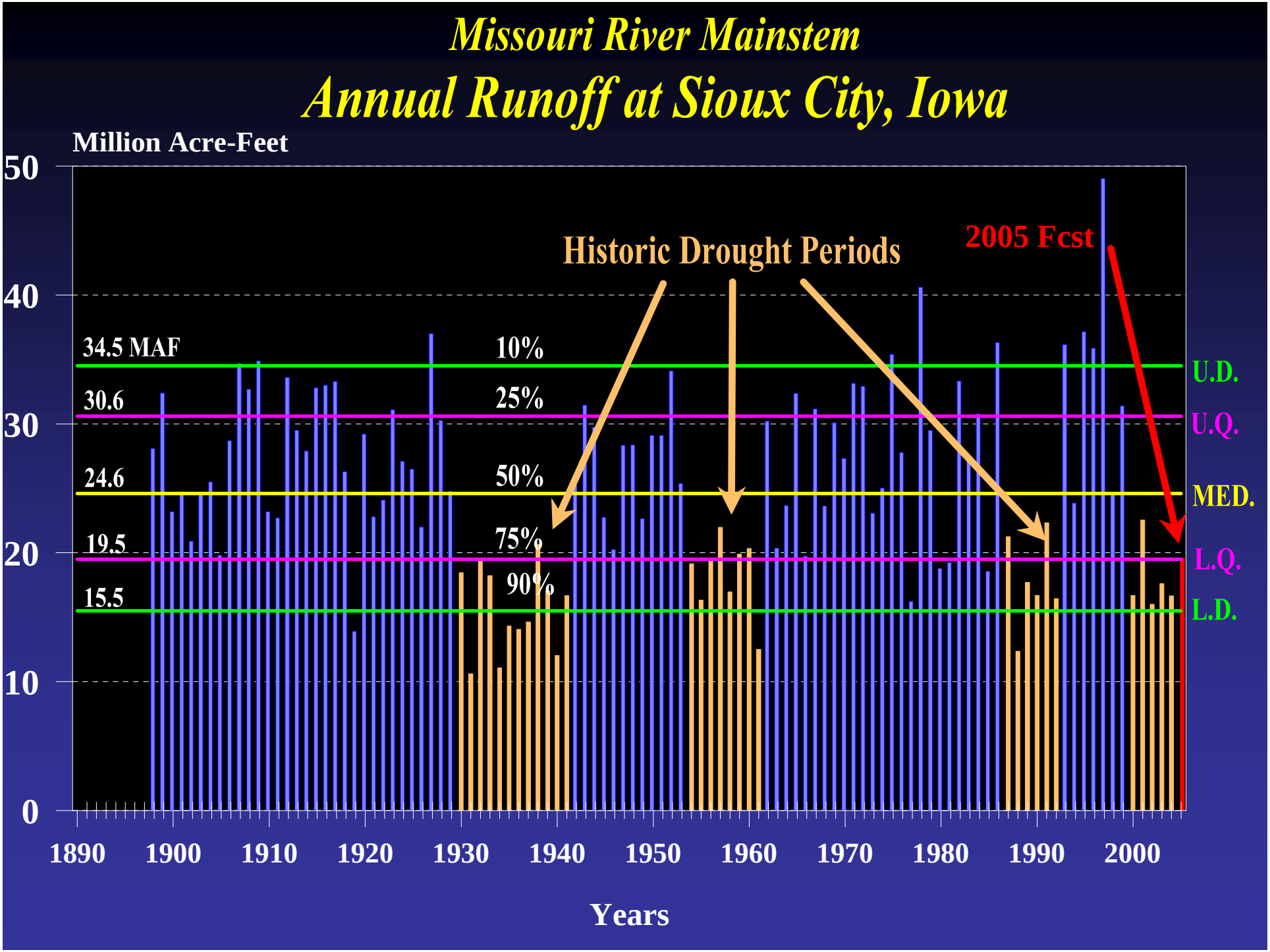
Released Thursday, July 14, 2005

Author: Richard Tinker, NOAA/NWS/NCEP/CPC

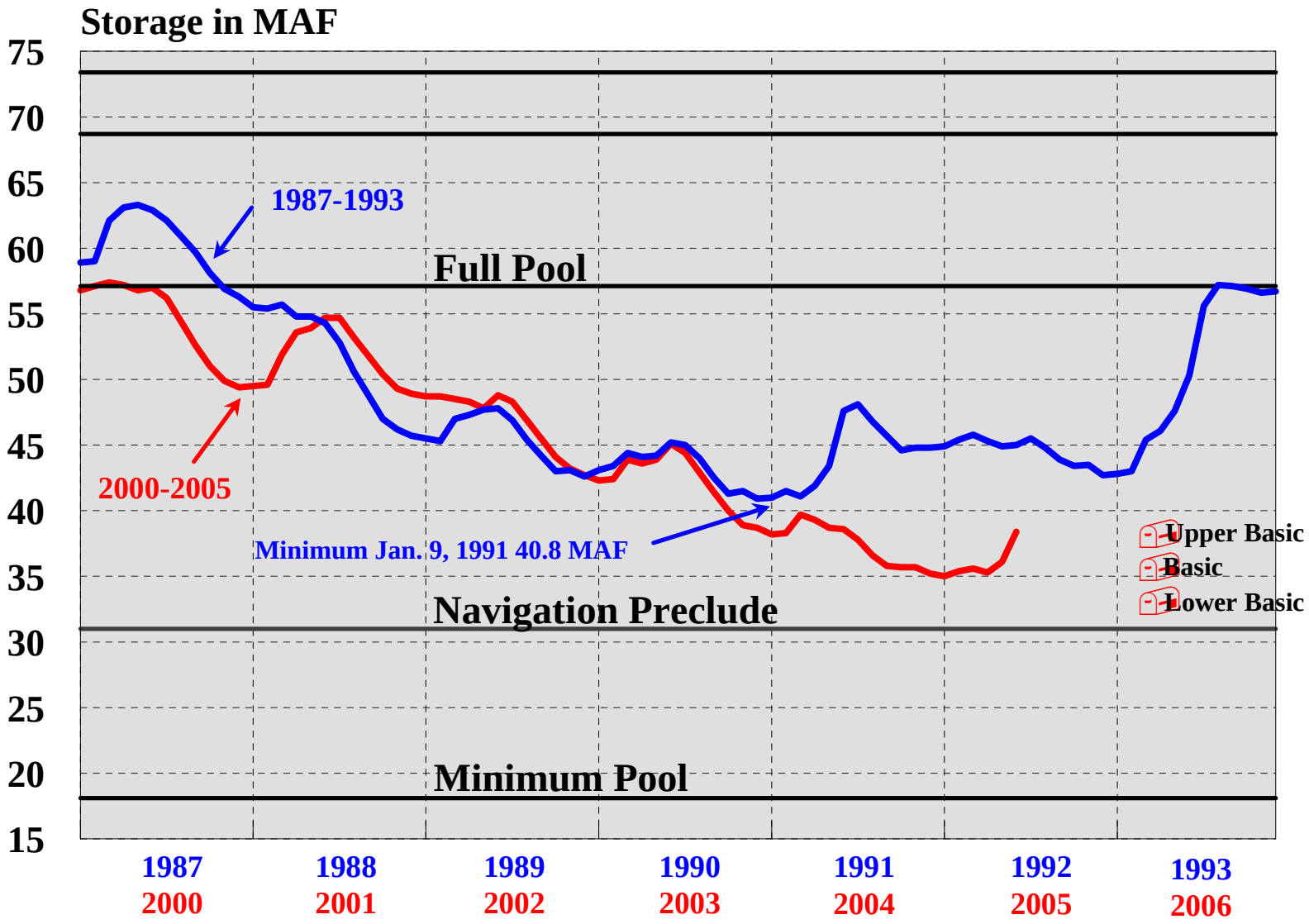


Mountain Snowpack + Plains Snowpack + 2005 Rainfall = 19.9 MAF

76% 73% = 74% No significant snow Above Normal 79% of Normal


Missouri River Mainstem
Annual Runoff at Sioux City, Iowa
Million Acre-Feet
50
40
30
20
10
0
34.5 MAF
30.6
24.6
19.5
15.5
10%
25%
50%
75%
90%
U.D.
U.Q.
MED.
L.Q.
L.D.
Historic Drought Periods
2005 Fcst
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
Years

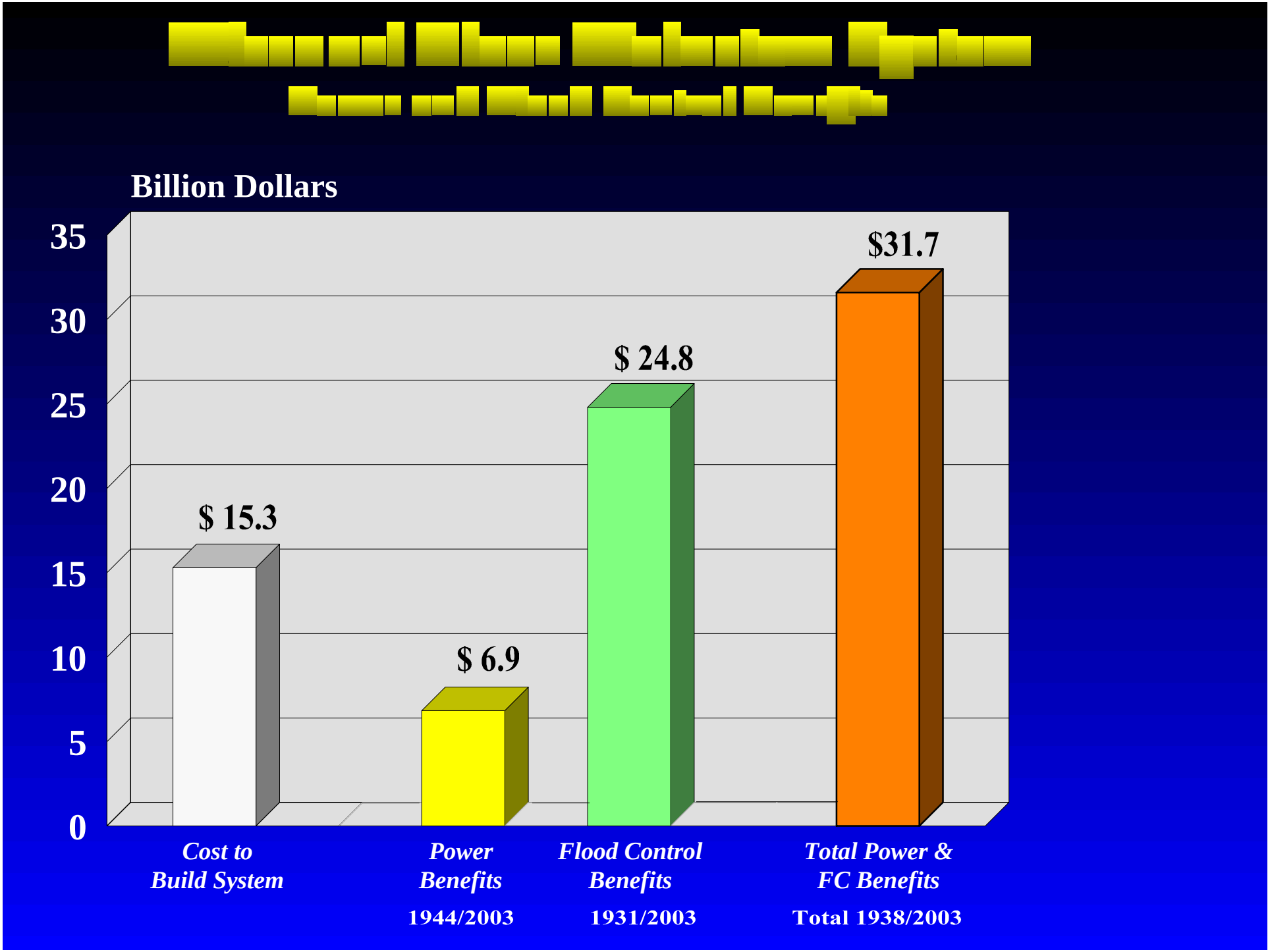
Missouri River Mainstem
System Storage 1987-1993 & 2000-2006



Interior Least Tern

Piping Plover

Pallid Sturgeon


Billion Dollars
35
30
25
20
15
10
5
0
$ 15.3
$ 6.9
$ 24.8
$31.7
Cost to Build System
Power Benefits 1944/2003
Flood Control Benefits 1931/2003
Total Power & FC Benefits Total 1938/2003

Missouri River Mainstem Master Manual

Update Study

MISSOURI RIVER:
MULTIPLE PURPOSES, MULTIPLE INTERESTS
IRRIGATION
RESERVOIR FISH
HISTORIC PROPERTIES
M&I WATER SUPPLY
Fort Peck
North Dakota
TERNS AND PLOVERS (Endangered & Threatened)
RECREATION
Garrison
Montana
HYDROPOWER
South Dakota
WETLAND HABITAT
Oahe
Big Bend
ENVIRONMENTAL JUSTICE
Wyoming
Fort Randall
TREATY AND TRUST
RIPARIAN HABITAT
Gavins Point
Iowa
WATER QUALITY
Nebraska
Navigation Channel
FLOOD CONTROL
Missouri
Colorado
Kansas
WATER RIGHTS
INTERESTS
ECONOMIC
ENVIRONMENTAL
TRIBAL
NAVIGATION (Missouri River & Mississippi River)
RIVERINE FISH (Endangered Pallid Sturgeon)

Master Manual & ESA Consultation History

- 1985 – Interior Least Tern Listed
- 1986 – Piping Plover Listed
- Nov 1989 – Master Manual Review initiated
  Why? MM 1960, updated 1975 and 1979
- 1990 – Pallid Sturgeon Listed & Final BiOp for terns and Plovers
- 1993 – Preliminary Draft EIS (Agency Review)
- 1994 – Draft EIS (DEIS) published (PA identified) & Draft BiOp on the PA completed

Master Manual & ESA Consultation History (Cont'd)

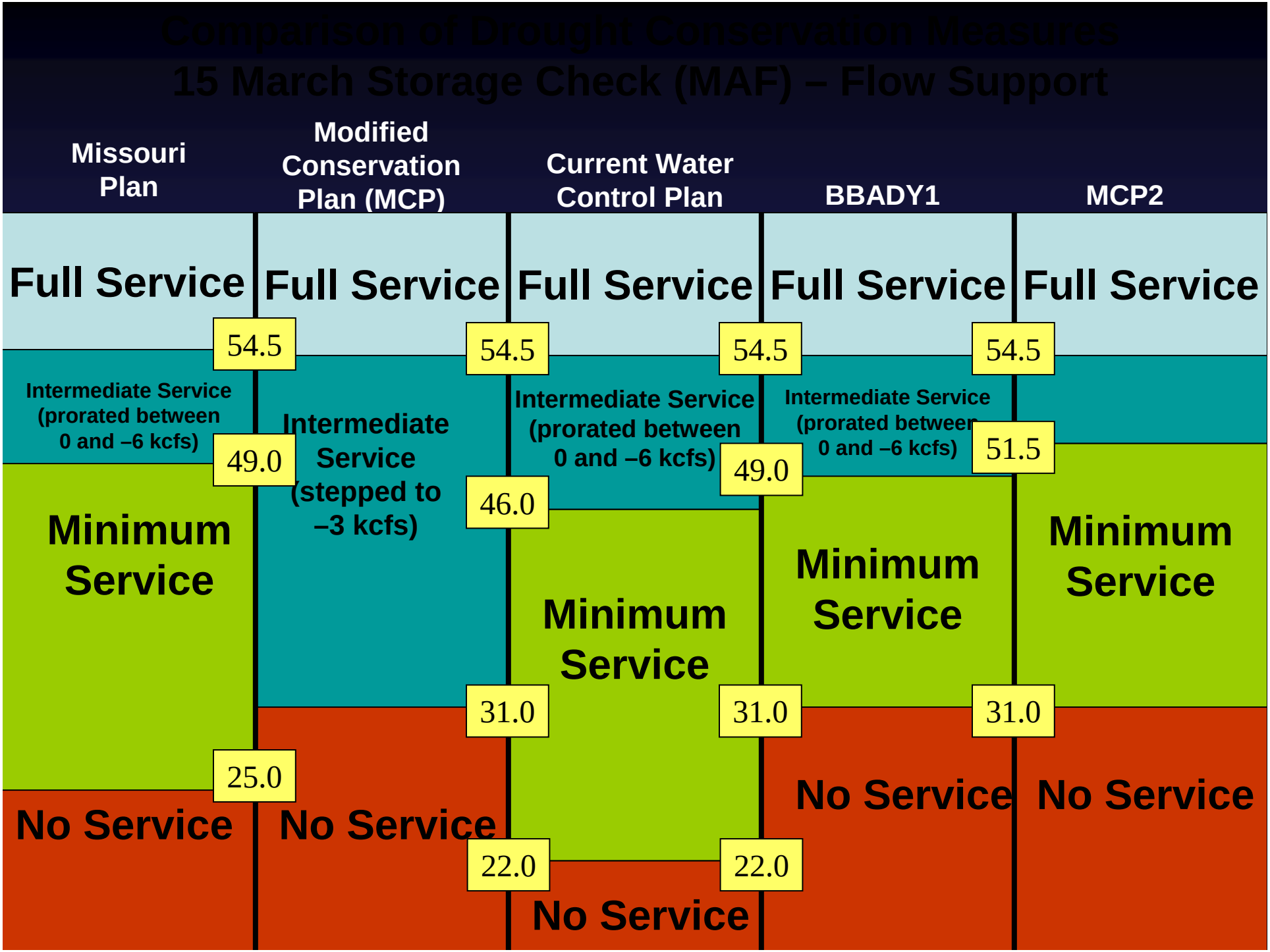
- 1998 – Preliminary Revised DEIS (8 alternatives)
- Feb 1999 – Formal Government-to-Government consultation initiated with Basin Tribes
- Nov 1999 – Basin submitted alternatives
- Apr 2000 – Formal consultation with Service on current water control plan initiated
- Nov 2000 – Final BiOp on current water control plan
- Aug 2001 – RDEIS published (No PA identified)
- Dec 2003 – Amendment to the Nov 2000 BiOp

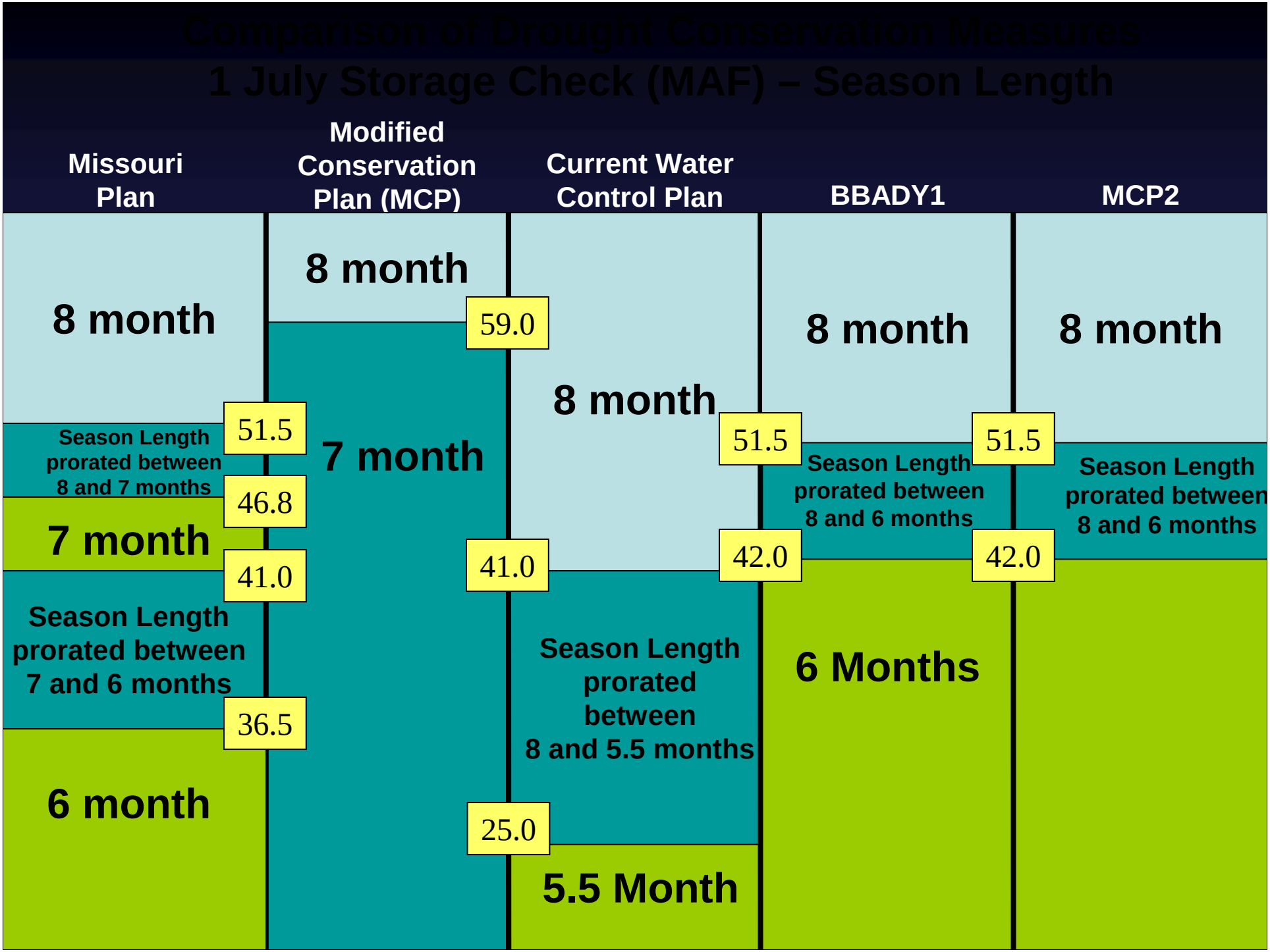
Master Manual & ESA Consultation History (Cont'd)

- February 2004 – FEIS, Draft Final AOP & Draft Master Manual Released for Public Review
- 5-19 March 2004 – Comment Period / Review of FEIS
- March 19, 2004 – Record of Decision, Master Manual and 2004 AOP completed
- August 2005 - Facilitated Spring Rise Process
- Fall 2005 – Draft and Final AOP reflect Spring Rise
- Winter 2005 – Master Manual Updated with Spring Rise

Master Manual

- In house Mainstem Model developed for long term planning LRS model modified for Master Manual Study.
- Daily Routing Model developed and used primarily for flood control, interior drainage and ESA determinations.
- 100 years of historic data (1898 to present) modeled on alternatives
- Interior drainage and other detailed models developed for critical or representative reaches.
- Value Functions developed for Economic Purposes based on dollars.
- Value Functions developed for Environmental Considerations based on special units or indices.
- Purposes modeled in a certain order.
- Mississippi River effects considered in alternatives.
- Model results presented to public and specific interests for comment.


Comparison of Drought Conservation Measures
15 March Storage Check (MAF) – Flow Support
Missouri Plan
Modified Conservation Plan (MCP)
Current Water Control Plan
BBADY1
MCP2
Full Service
Full Service
Full Service
Full Service
Full Service
54.5
54.5
54.5
54.5
Intermediate Service (prorated between 0 and –6 kcfs)
Intermediate Service (stepped to –3 kcfs)
Intermediate Service (prorated between 0 and –6 kcfs)
Intermediate Service (prorated between 0 and –6 kcfs)
49.0
46.0
49.0
51.5
Minimum Service
Minimum Service
Minimum Service
Minimum Service
31.0
31.0
31.0
25.0
No Service
No Service
No Service
No Service
22.0
22.0
No Service


Comparison of Drought Conservation Measures
1 July Storage Check (MAF) – Season Length
Missouri Plan
Modified Conservation Plan (MCP)
Current Water Control Plan
BBADY1
MCP2
8 month
8 month
8 month
8 month
8 month
59.0
51.5
51.5
51.5
Season Length prorated between 8 and 7 months
7 month
46.8
7 month
41.0
41.0
42.0
42.0
Season Length prorated between 8 and 6 months
Season Length prorated between 8 and 6 months
Season Length prorated between 7 and 6 months
36.5
Season Length prorated between 8 and 5.5 months
6 Months
6 month
25.0
5.5 Month

Missouri River Mainstem Master Manual

Missouri River Mainstem Master Manual

- Master Manual available in electronic format, text hyperlinked to plates and other pertinent information.
- All plates in electronic format.
- Manual format changed from USACE recommended format. More of a story format followed.
- Final manual requested by Courts to be completed by 1 April 2004.
- Final Product was Missouri River Mainstem Master Manual - cost $30 million 14 years.

Missouri River Mainstem Master Manual

Changes made in Master Manual

- Drought Conservation Measures were increased there by reducing service level and season length during drought.
- Intra System Unbalancing of Upper Three Reservoirs added as a formal feature for improved reservoir fishery.
- Non-navigation flow period minimums stated. Minimum flows for downstream flow support formally provided as a guideline for power plants, intakes etc.
- Adaptive Management process adopted.
- Fulfilled ESA along with Missouri River Recovery Plan.

Missouri River Mainstem Master Manual

Changes not made in Manual Update

- Spring Rise - Controversial flows during spring for pallid sturgeon spawning queue.
- Summer Low flows - Controversial flows during mid summer that would cause split navigation season for ESA items concerning pallid and bird nesting issues.
- The adaptive management formal process and framework is outside of the master manual update but discussed as an adopted method to providing guidance for future regulation.

Missouri River Mainstem Master Manual

Binding Resolution Discussion

This Master Manual and the selected water control plan are intended to be non-binding guidelines to be used by the Corps in regulating and operating the Mainstem System. In South Dakota v. Ubbelohde, 330 F. wd. 1014, the Eighth Circuit Court of Appeals held that the Corps' prior manual was a binding regulation. This was not the Corps' intent and accordingly, the Master Manual has been amended to clearly reflect the Corps' intent that it not be considered a binding regulation. This is consistent with Corps' regulations that allow for both updates for changes in normal regulations as well as for deviations to the approved water control plan. ***This information was written on the first page of the March 2004 Master Manual.***

Missouri River Mainstem Master Manual

Inconsistencies Discussion

In the event of any inconsistencies between the provisions of this Chapter VII and any other provisions of this Master Manual, this Chapter VII shall take precedence.

Missouri River Mainstem Master Manual

Flexibility Discussion

Several attorney's spent a considerable amount of time reviewing and making suggested changes to add additional flexibility to the master manual. The attorney's suggested changes such as "the Corps will make release increases to evacuate accumulated flood storage" and they suggested we change it to "the Corps may make release increases to evacuate accumulated flood storage". All this effort resulted in a manual that contains a lot of flexibility to deal with the wide range of conditions that the System must be regulated to meet.

Missouri River Mainstem Master Manual

Appendix Additions

Perhaps the most significant change to the manual format was in the area of the addition of appendices.

Appendix A – includes Historic Floods and Flood Control regulation examples. Plus we are going to add drought history and examples.
Appendix B – includes Recreation
Appendix C – includes Water Quality
Appendix D – includes Fish and Wildlife, including ESA
Appendix E – includes Water Supply and Irrigation

Missouri River Mainstem Master Manual

Appendix Additions

Appendix F – includes Hydropower
Appendix G – includes Navigation
Appendix H – includes Continuing Studies
Appendix I – Adaptive Management

This concept allows one to easily change significant portions of the manual. Items that can be expected to change over time but are not part of the water control plan can be put in an appendix and updated as required.

Missouri River Basin

Since 1954

Water Management Division

US Army
Corps of Engineers

Missouri River Basin

Since 1953

Water Management Division

Larry Murphy

402-697-2685

Corps of Engineers

Larry.L.Murphy@usace.army.mil

Columbia Basin Water Management
Northwestern Division

ResSIM Model Development for Columbia River System

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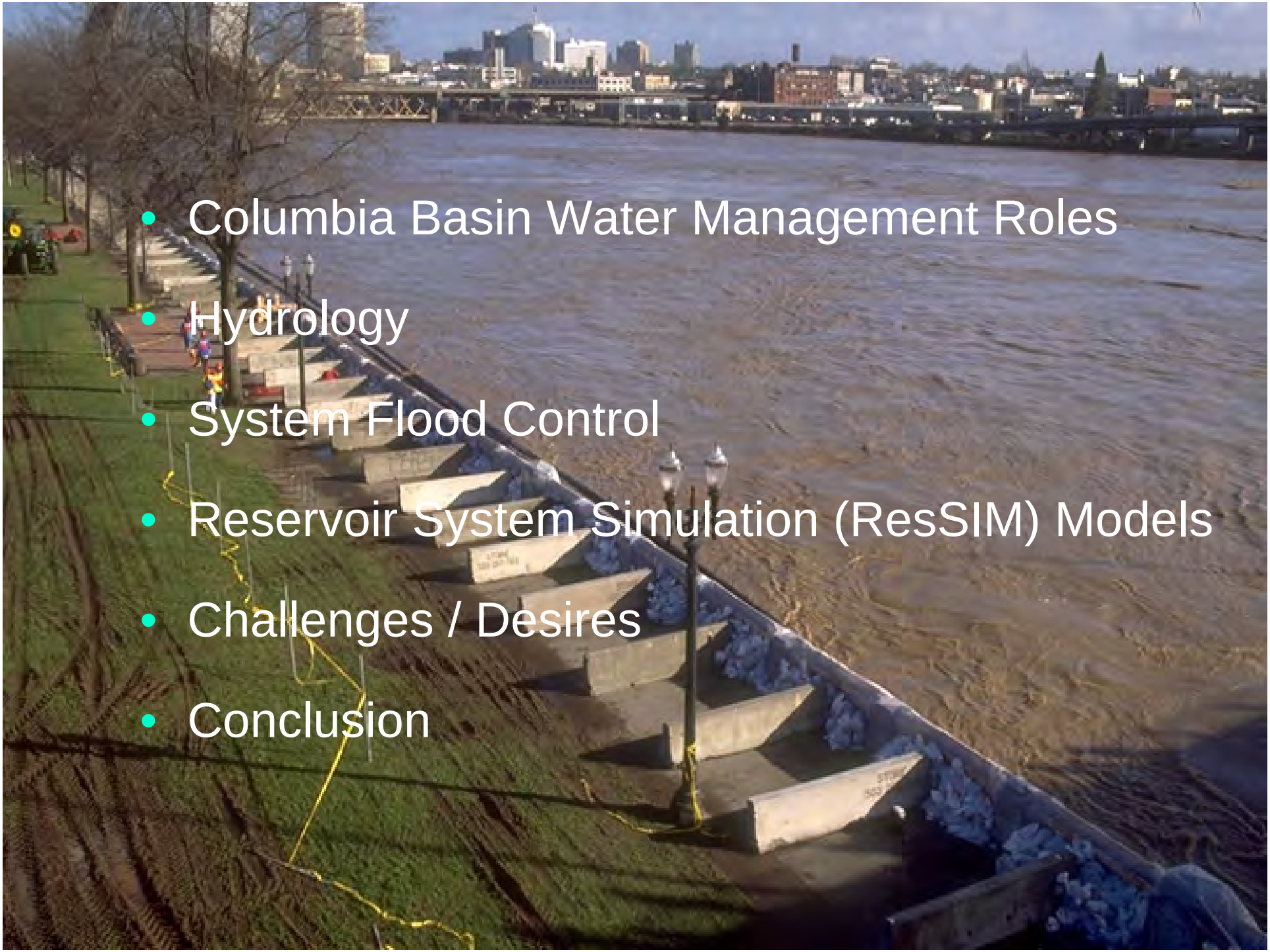
(503) 808-3961



- Columbia Basin Water Management Roles
- Hydrology
- System Flood Control
- Reservoir System Simulation (ResSIM) Models
- Challenges / Desires
- Conclusion

US Army Corps
of Engineers
Northwestern Division

Columbia Basin Water Management Division Roles

- Flood control studies, & Hydrologic investigations
- Real time operations
- Operational planning & Power system analyses (multi-purpose, Treaty ops.)

US Army Corps
of Engineers
Northwestern Division

Hydrology

- The 4th largest River in North America
- Entire Basin = 259,000 mi²
- Basin in Canada = 40,000 mi²
- Avg. Annual Runoff = 200 mil. acre-ft
- Storage Capacity = 39.5 mil. acre-ft
- Over 200 dams and projects
- Peak runoff in May – June period

US Army Corps
of Engineers
Northwestern Division

System Flood Control

- Columbia River is water rich. Only 20% of average annual runoff storage is available for flood control regulation.
- System flood control point is The Dalles (just below the dam) and is the focus of the coordinated system operation.
- Local flood control points are also considered.
- Design Flood is 1894 (1240 kcfs unregulated at The Dalles)
  - storage and levees provide the capability to regulate 800 kcfs

US Army Corps
of Engineers
Northwestern Division

Models Currently in use

- Synthetic Streamflow and Reservoir Regulation (SSARR) model for Un-regulated flow calculations for Columbia and Snake Rivers
- AutoReg (GUI for SSARR) for Planning and Flood Control studies
- National Weather Service River Forecast System (NWSRFS) for Real-time operations
- Hydro System Seasonal Regulation (HYSSR) for System Power Studies

US Army Corps of Engineers
Northwestern Division

ResSIM Models in Development

- Real Time Operational ResSIM Model
  - Similar to NWSRFS model
  - Able to use RFC's ESP flows
- Un-Reg ResSIM Model
  - Replacing SSARR Model for Un-regulation of Columbia and Snake Rivers
- Study ResSIM Model
  - Replacing AutoReg Model
  - Will be used for planning and flood control studies

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of Engineers
Northwestern Division

Developing a ResSIM model

- Create Watershed
  - Define the projects and computation points
- Create Reservoir Network
  - Enter Physical Data
  - Define Reservoir Operations, & Rules
  - Setup Alternative Editor – mapping time-series
- Create Simulation
  - Define time window and time step
- Calibration or Verification

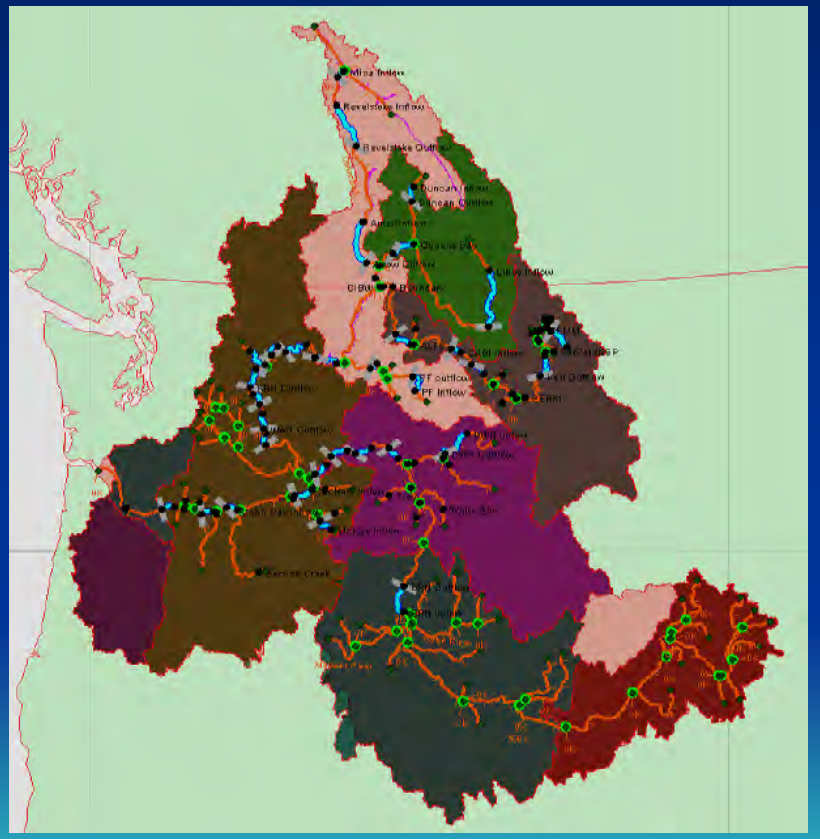
US Army Corps of Engineers
Northwestern Division

Real Time ResSIM

Watershed

Based on NWSRFS, & SSARR

- Streamflow forecast points, Rivers, Reservoirs, Flood Control points
- Same naming convention for consistency
- Can be utilized for other CWMS models



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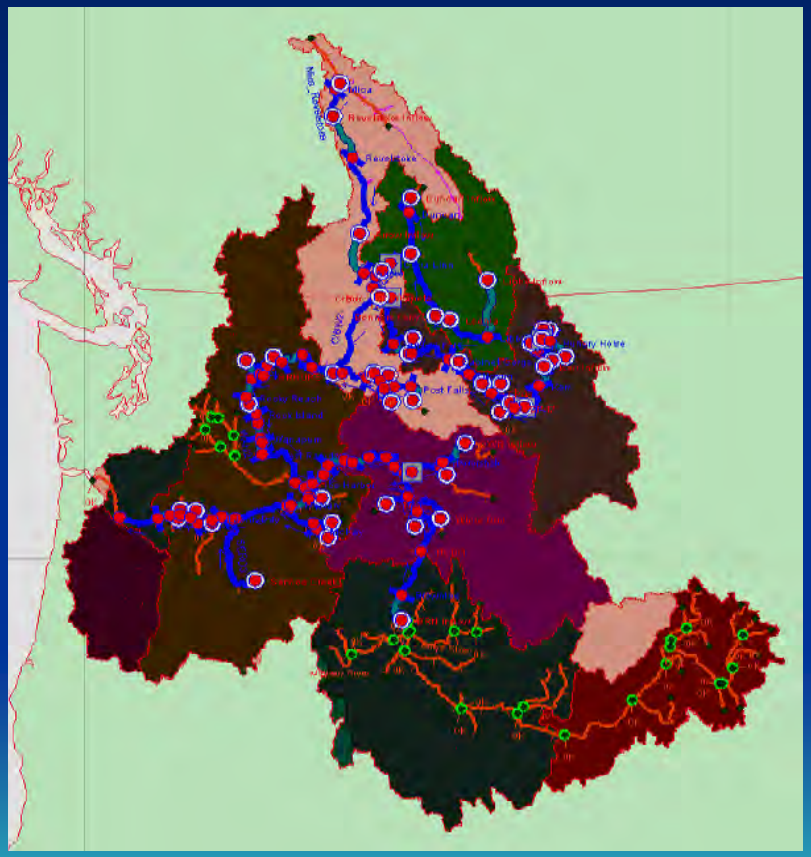
of Engineers
Northwestern Division

Real Time ResSIM

Reservoir Network

Physical data

- Reservoir data
  (Dam height, length)
- Rating curves
  (Elevation Vs storage, & outlet capacity)
- Reach routing parameters
  (SSARR, Lag-K)



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Real Time ResSIM

Reservoir Network

Operational data

- Flood control rule curves
  - Forecast based time-series in DSS format
- Min.& Max Flow @ D/S control point
- Project min.& max. flows
- Rate of changes (release, pool elevation)
- Other rules (if-then-else, state variables, script)

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Northwestern Division

Real Time ResSIM

Reservoir Network

Alternative Editor

- Mapping to all time-series data (in DSS)
  - ESP flow as inflow and local flow
  - Lookback data (initial conditions) from CROHMS database
  - Forecast Based Rule curves

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Northwestern Division

Real Time ResSIM

- Model Consists
  - 32 Reservoirs
  - 93 Channel reaches
  - 126 Computation points includes
    - Inflow and outflow
    - Stream junctions
    - Flood control points

- Future Work
  - Model calibration or verification
  - Incorporate more operational rules (Treaty operating rules, 3-way rating, Lake routing)
  - Improve pre-and post-processing and customer products
  - Operational by water year 2007

US Army Corps of Engineers
Northwestern Division

Dworshak Operation

Simulation Based on January 2005 ESP Forecast

US Army Corps of Engineers
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Hungry Horse Operation

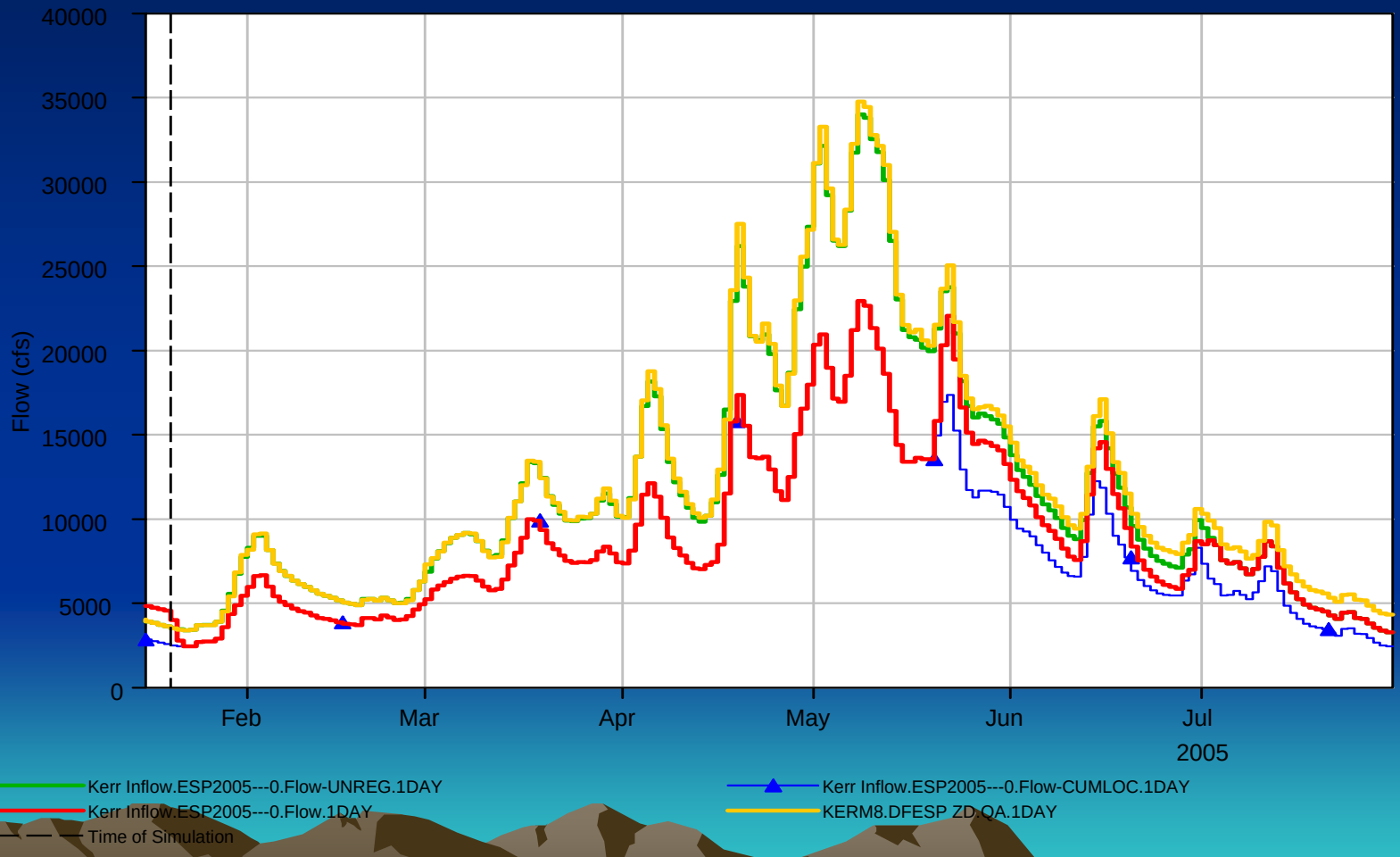
Simulation Based on January 2005 ESP Forecast

US Army Corps of Engineers
Northwestern Division

Hydrograph Verification

NWSRFS Vs ResSIM @ Flathead River

Simulation Based on January 2005 ESP Forecast



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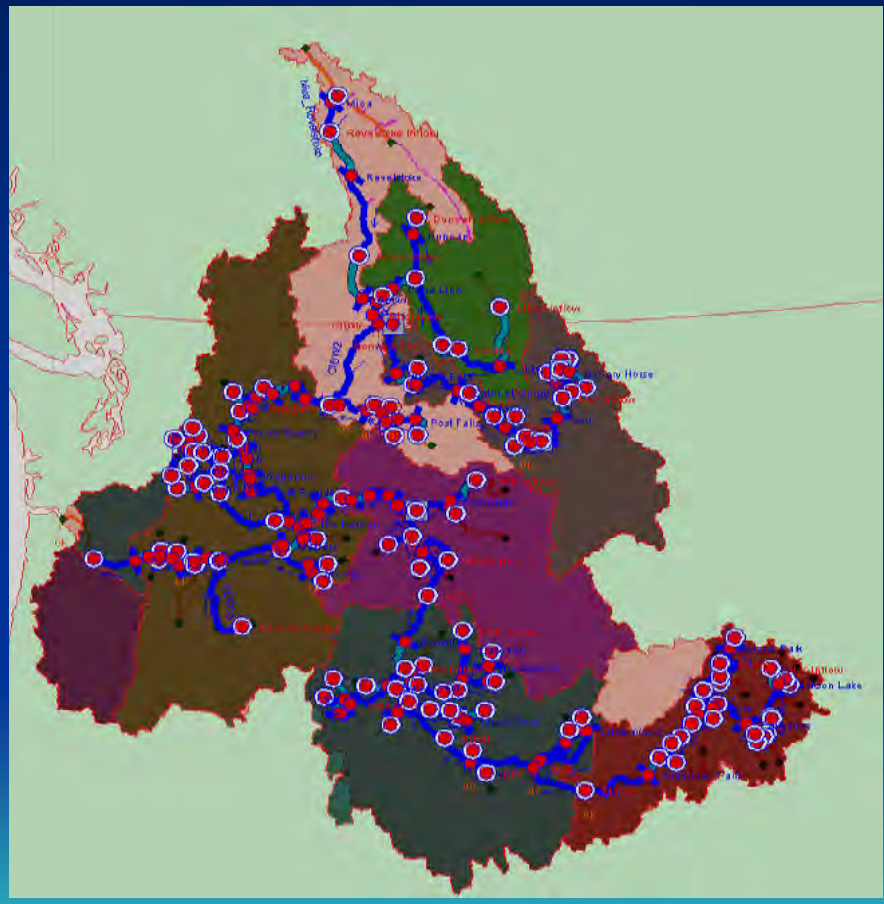
Northwestern Division

Un-Reg ResSIM Model
(Under Construction)

- Model Consists
  - 51 reservoirs
  - 165 channel reaches
  - 217 computation points

- Output product will be used for databases for flood control studies and public dissemination



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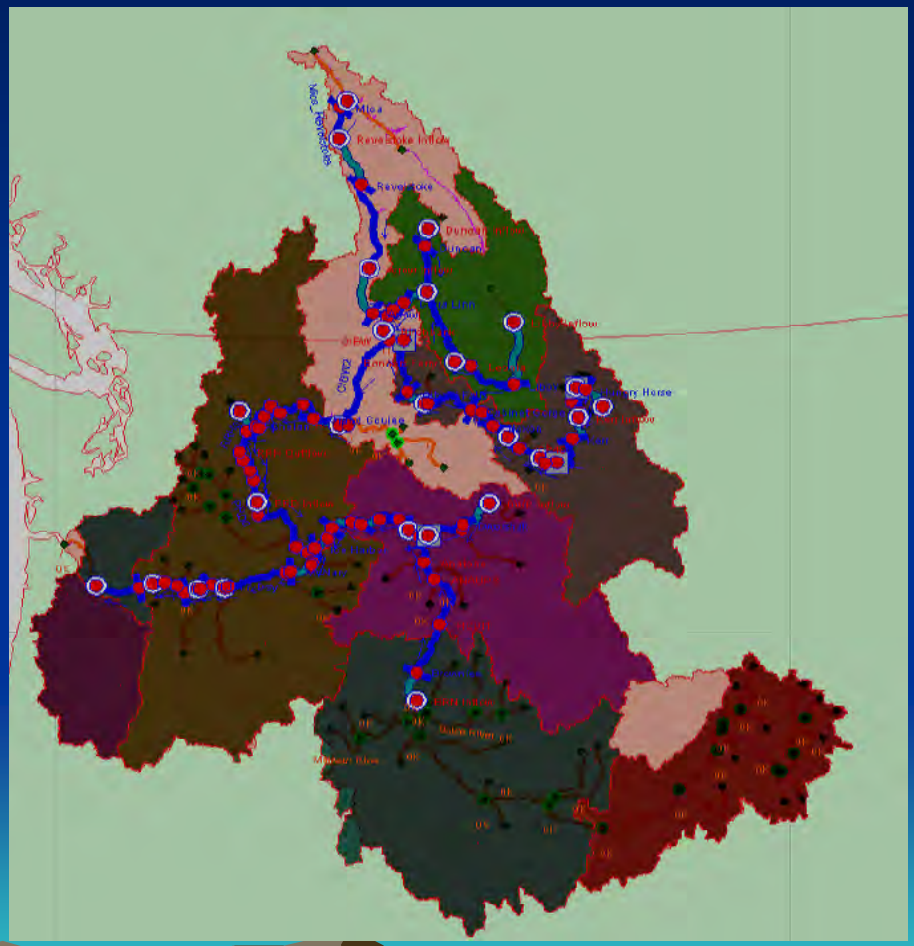
Northwestern Division

Study ResSIM Model (Under Construction)

- Model Consists
  - 23 reservoirs
  - 67 channel reaches
  - 91 computation points
- Model will be used for flood control studies



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Northwestern Division

Challenges/Desires

1. Would like to have tool in ResSIM to deal with 3-way discharge table associated with forebay and lake elevations
2. Would like to have tool in ResSIM to deal with 3-way rating table at a control point based on backwater from a lake
3. Would like to have lake routing
4. Need ability to compute local flow from observed project data
5. Need to improve Process time (script and rules can increase computation time)

US Army Corps
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Northwestern Division

CONCLUSION

- Columbia Basin Water Management Division will continue it's important role in the multi-purposes operation of the Columbia River System
- Collaboration with the HEC, by adding new tools to ResSIM will make the next generation Reservoir Regulation model for the Columbia River System.

Thank you !

Helmand Valley Water Management Plan

Presented By: Jason Needham, P.E. (HEC)

Project Team: HEC, AED, USAID

USACE, Hydrologic Engineering Center

Problem Statement

- Over 25 years of turmoil has lead to deficient water management in Afghanistan
  - Construction
  - Maintenance
  - Operations
  - Technical
    - Capacity
    - Equipment

Project Overview

- Purpose
  - Develop water management plans for Helmand Valley
  - Restore water management institutional capacity in Afghanistan
- Two phase process
- Funded and managed by US Agency for International Development (USAID)
  - Contracted with USACE Afghanistan Engineering District (AED) and USACE Hydrologic Engineering Center (HEC)

The Helmand Valley

- Drainage area
  - 160,000 km^2
  - 31% of country
- Helmand River
  - AY~14 Billion m^3
- Kajakai Reservoir

Kajakai Reservoir

- Max Capacity - 3.2 Billion m^3
- Water supply
  - Irrigation
  - Wetlands
  - Iran
- Hydropower
  - Existing - 33 MW
  - Design - 150 MW

Phase I

- Goals
  - Provide updated information on the capacity of the Helmand system to support water resource demands.
  - Evaluate immediate improvements to the system and provide information for long-term planning of water resources.
  - Begin capacity building process.

Phase I – Tasks

- Hydrologic Data
  - Data gathering and validation
    - 42 stream gages
    - 1950s through late 1970s
  - USGS – 1991 event
- Institutional capacity building
  - Ministry of Water and Energy Engineers (6)
  - Two week water management training in US
    - Site visits
      - Joint Operation Center (DWR, USGS, NWS, USACE)
      - Gage sites
      - Irrigation districts
      - Large reservoirs and hydropower facilities
      - Small reservoir and water diversion structures
      - Irrigation management information system
    - Introduction to water management software

Phase I – Water Management Tour

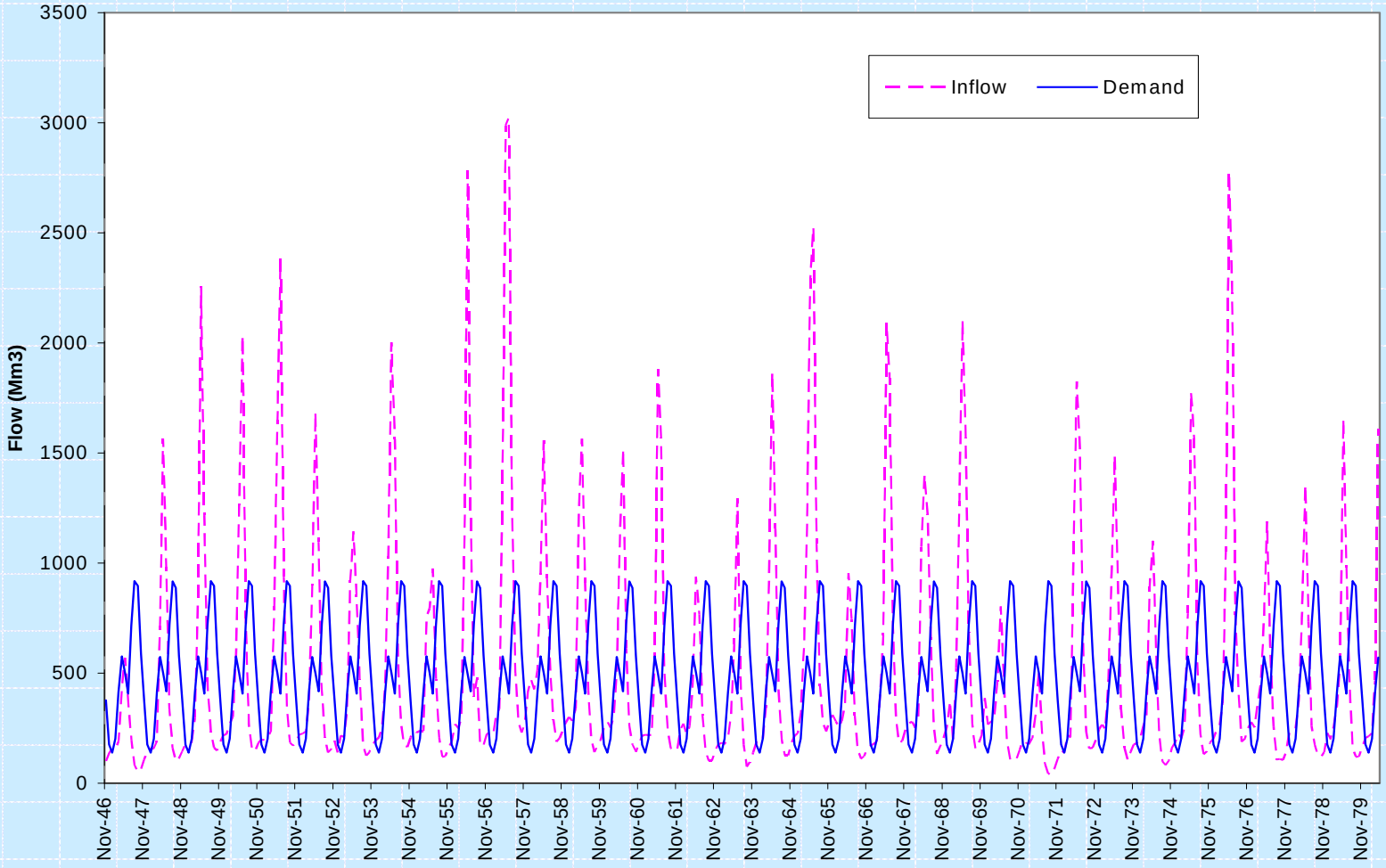
Phase I – Water Management Tour

Phase I – Tasks (Continued)

- Preliminary Water Budget Analysis
  - Update information on capacity of Kajakai Reservoir for irrigation supply and power generation
    - Simulation Model
      - Existing configuration
      - Existing power/gated spillway
      - Expanded power/gated spillway
      - Raised dam/expanded power/gated spillway
    - Use historic inflow record
    - Demands
      - Various levels of irrigation demand
      - Iran treaty requirements

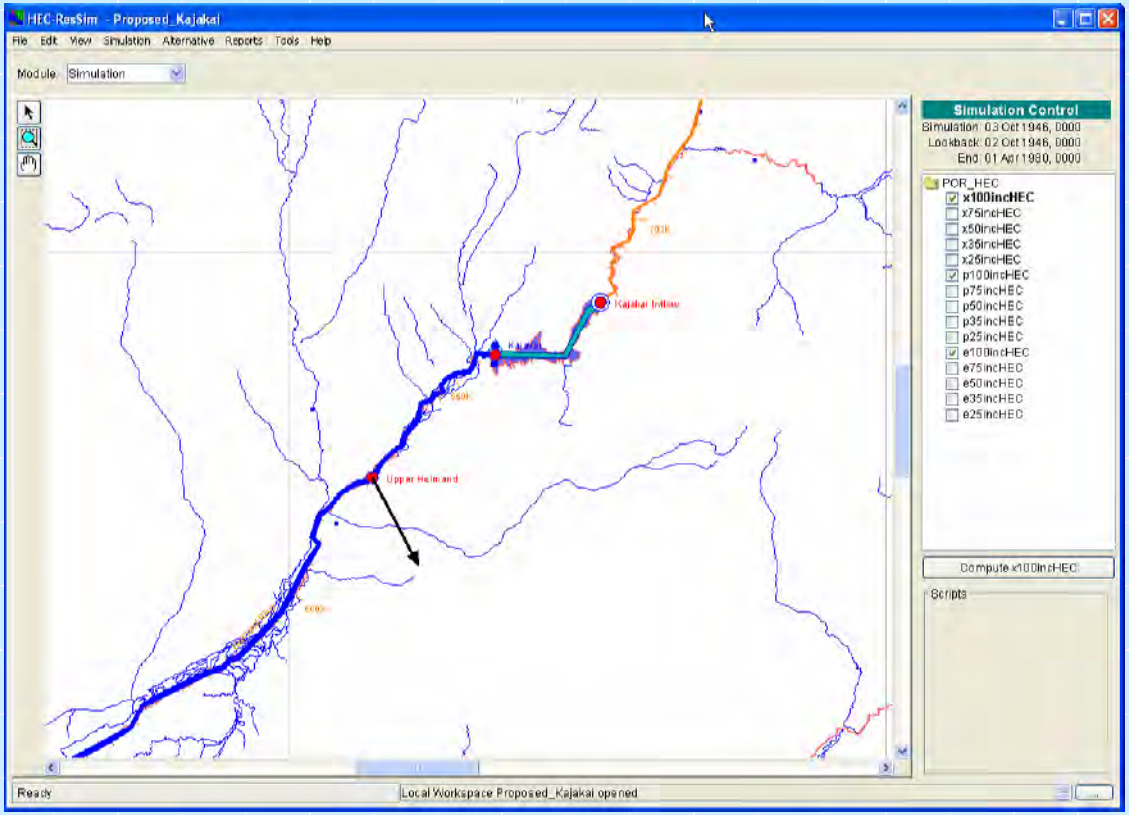
Phase I – Tasks

- Inflows vs. demand

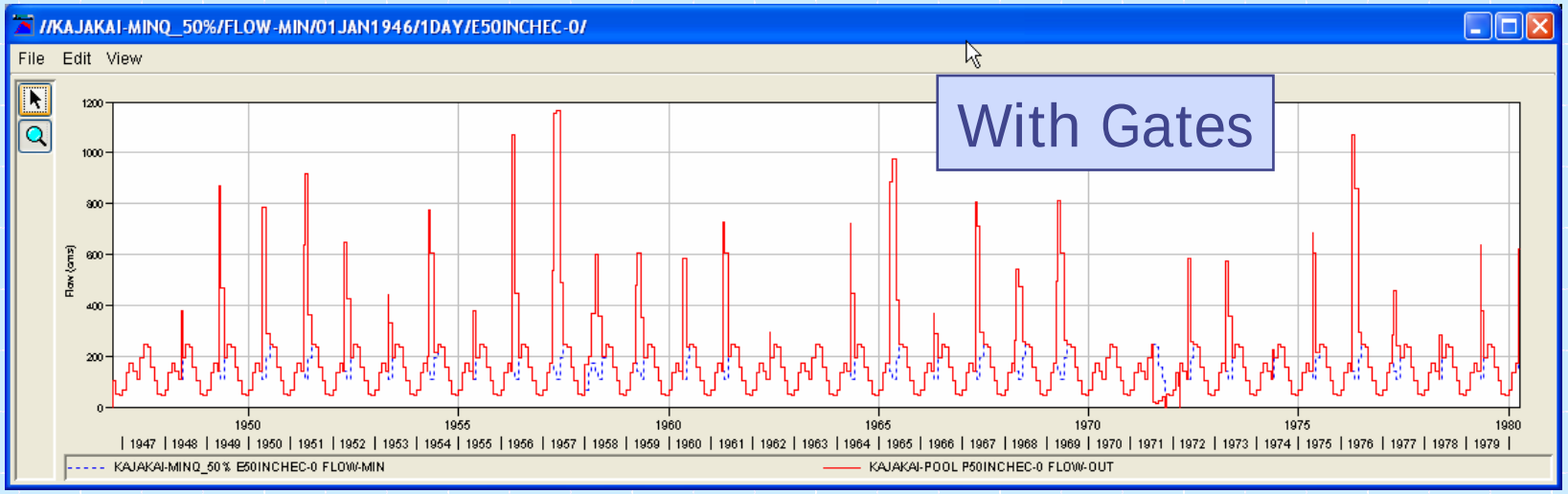


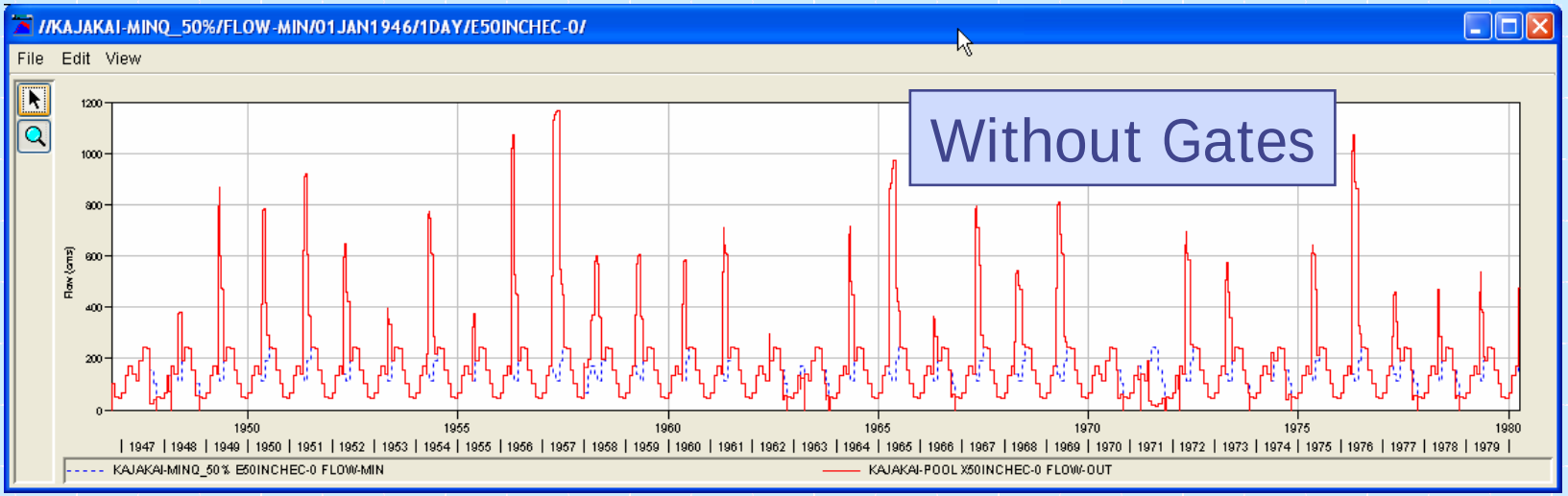
Simulation Model – HEC-ResSim

- Rule-based
- Multi-purpose system simulation
- Network structure – object structured.

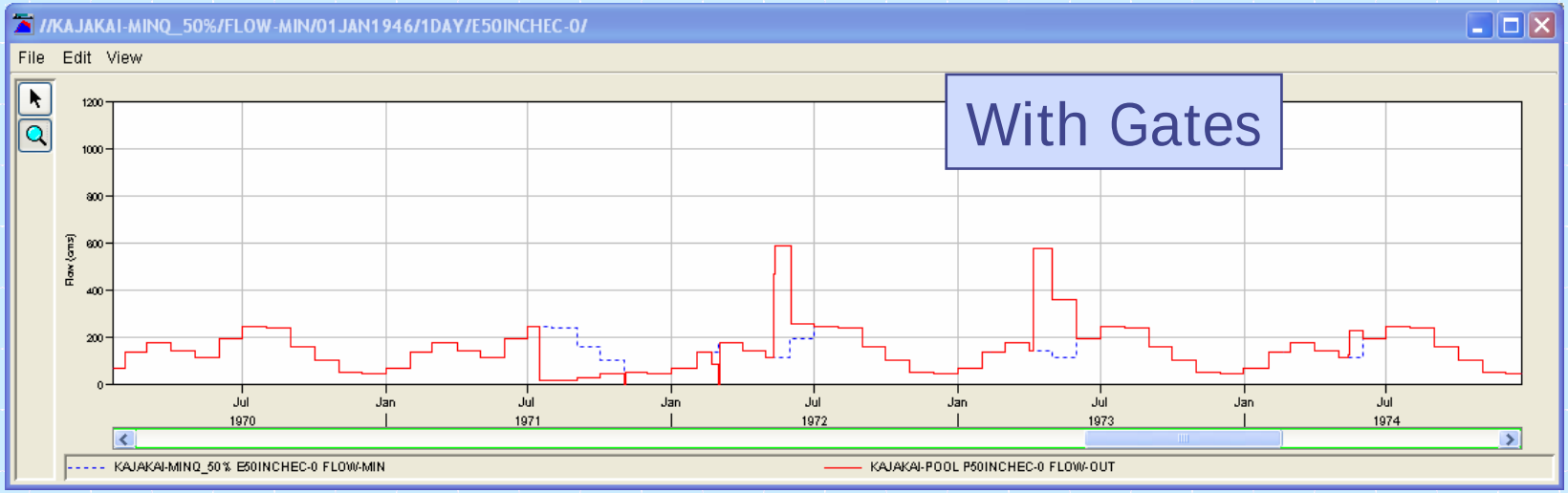


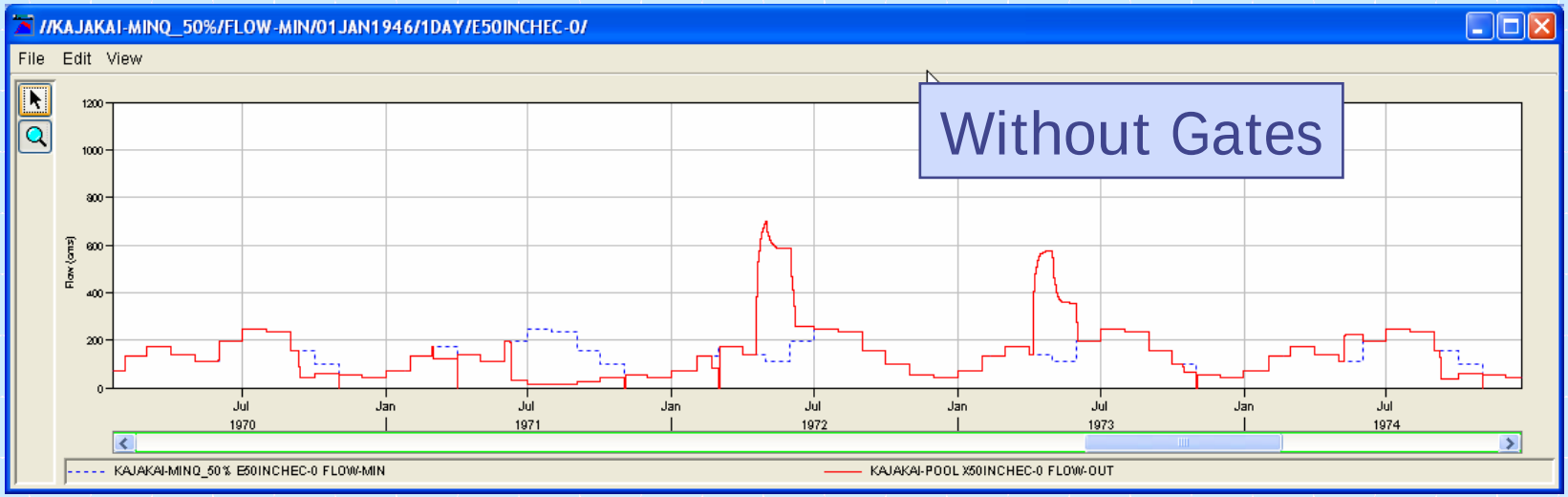
Water Supply Comparison – 50% Demand



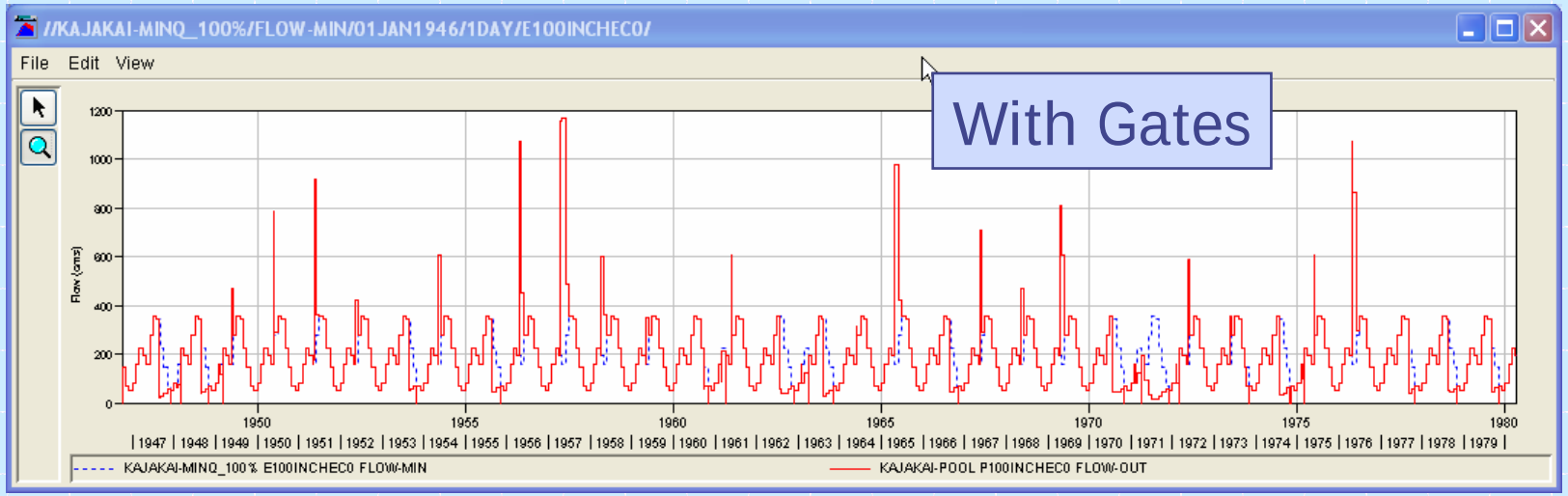


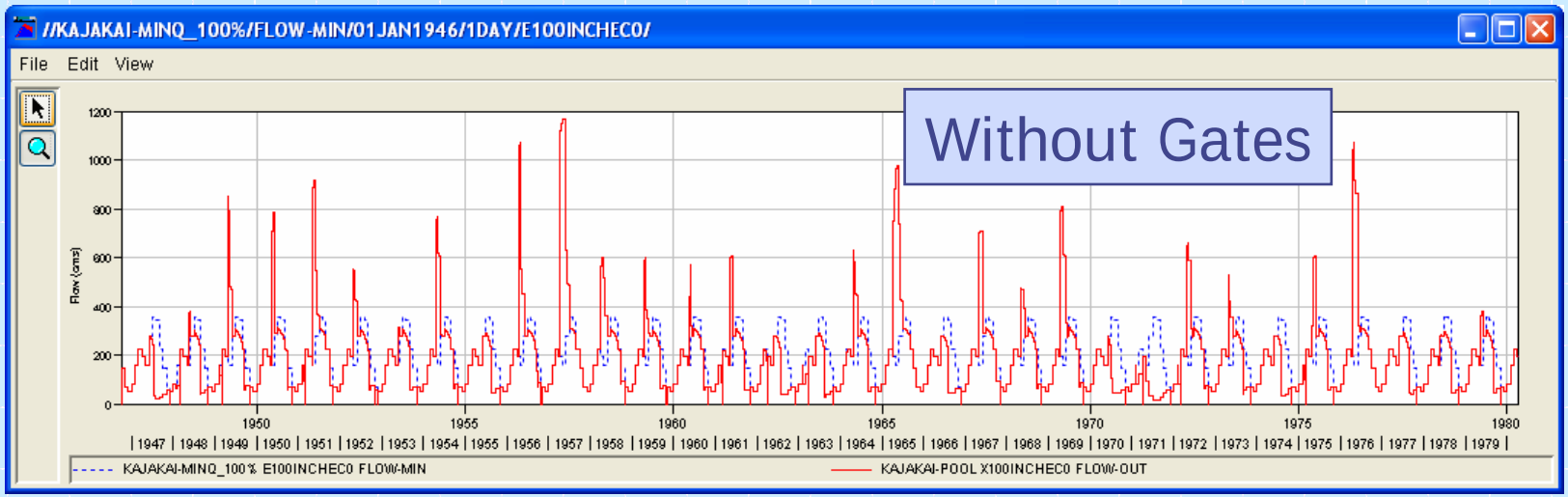
Water Supply Comparison – 50% Demand



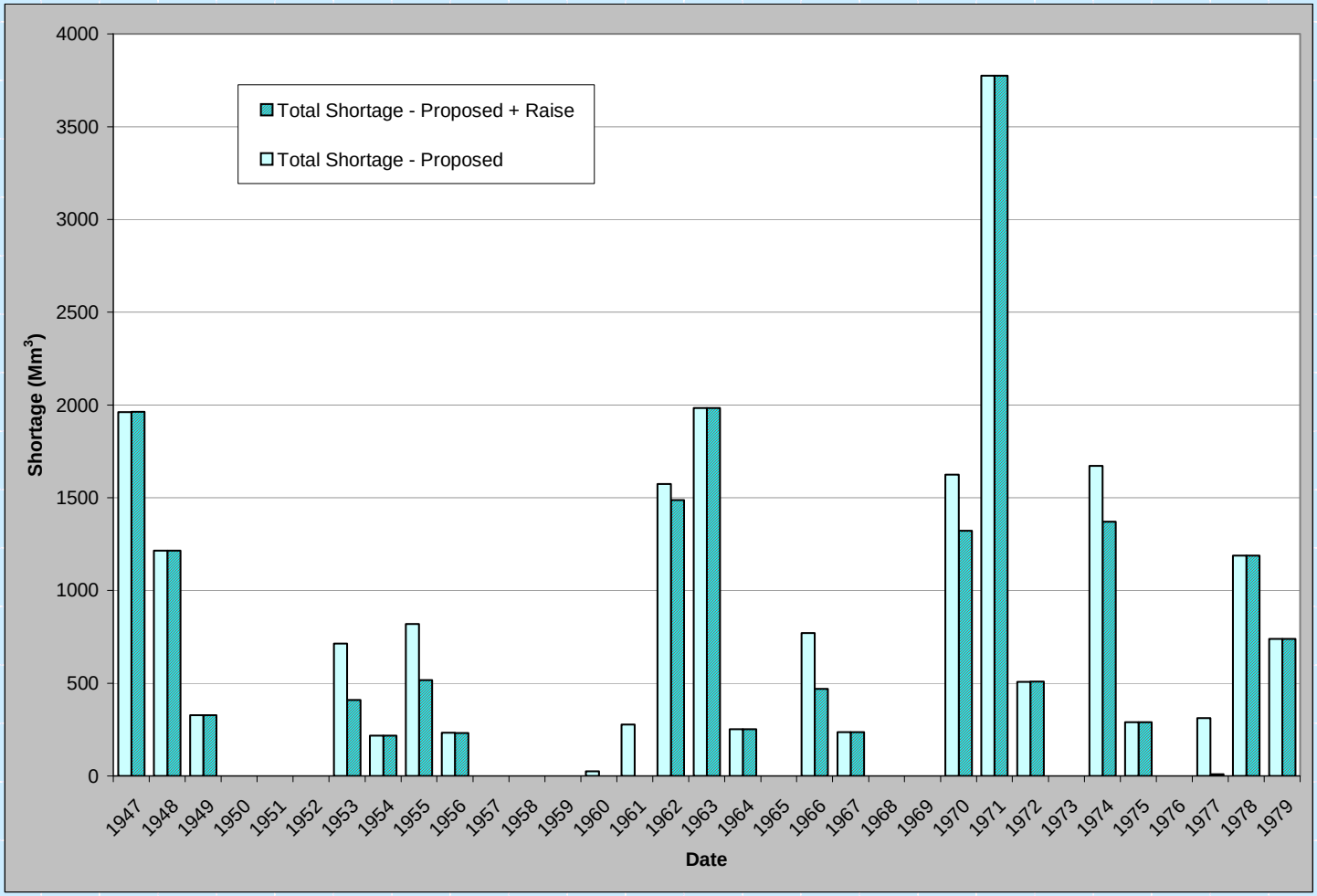


Water Supply Comparison – 100% Demand





Water Supply Comparison – Raised Dam



Phase I – Tasks (Continued)

- Preliminary Water Budget Analysis (cont.)
  - Preliminary rule curves
  - Time to fill estimate
  - Report
- Define Phase II

Phase II

- Comprehensive simulation model
  - Tributaries
  - Demands
  - Hydropower vs. irrigation trade-off
- Reservoir regulation manuals
- Training

Contact

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- Hydrologic Engineering Center
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- (530) 756-1104
- Jason.t.needham@usace.army.mil

Prescriptive Reservoir Modeling and the ROPE

Jason Needham, P.E.

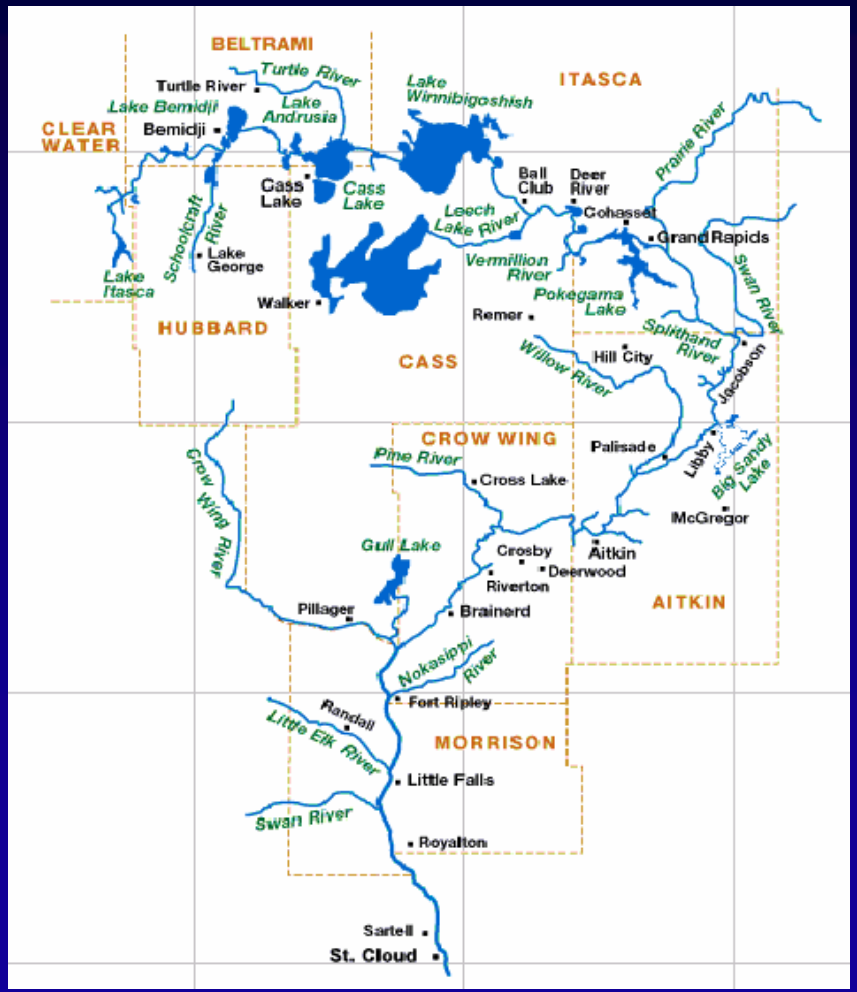
Hydrologic Engineering Center
Davis, CA

What is our goal?

- Assist MVP in Upper Miss ROPE Study
  - New operation policy for each reservoir and system
  - Shared-vision approach
  - Optimization and simulation
- Technology Transfer

Study Area

- Central Northern Minnesota
- 6 Primary Reservoirs
- Extends from Lake Bemidji to St. Paul



Reservoir System Modeling

The function of a reservoir system is to redistribute the natural occurrence of water in time and space.

- Reservoirs accumulate and release water to modify the distribution in time
  - **flood storage, water supply storage**
- Conveyance modifies the distribution in space
  - **rivers, reservoirs, canals, pipelines, diversions**

Redistribution of Water

- Redistribution is generally a series of decisions on how to operate **water control facilities**.
- Based on multiple objectives of system

Balancing Multiple Objectives

- Navigation
- Flood Control
- Hydropower
- Fish & Wildlife
- Irrigation
- Municipal Supply
- Recreation

Some of these objectives are <u>Complimentary</u>, and some are in <u>Conflict.</u>

Two Approaches to Analysis

- Simulation and Optimization modeling
  - A simulation model makes decisions that follow operating rules specified by the user
  - An optimization model makes decisions to maximize the benefits associated with meeting the objectives of a reservoir system. (Prescriptive)

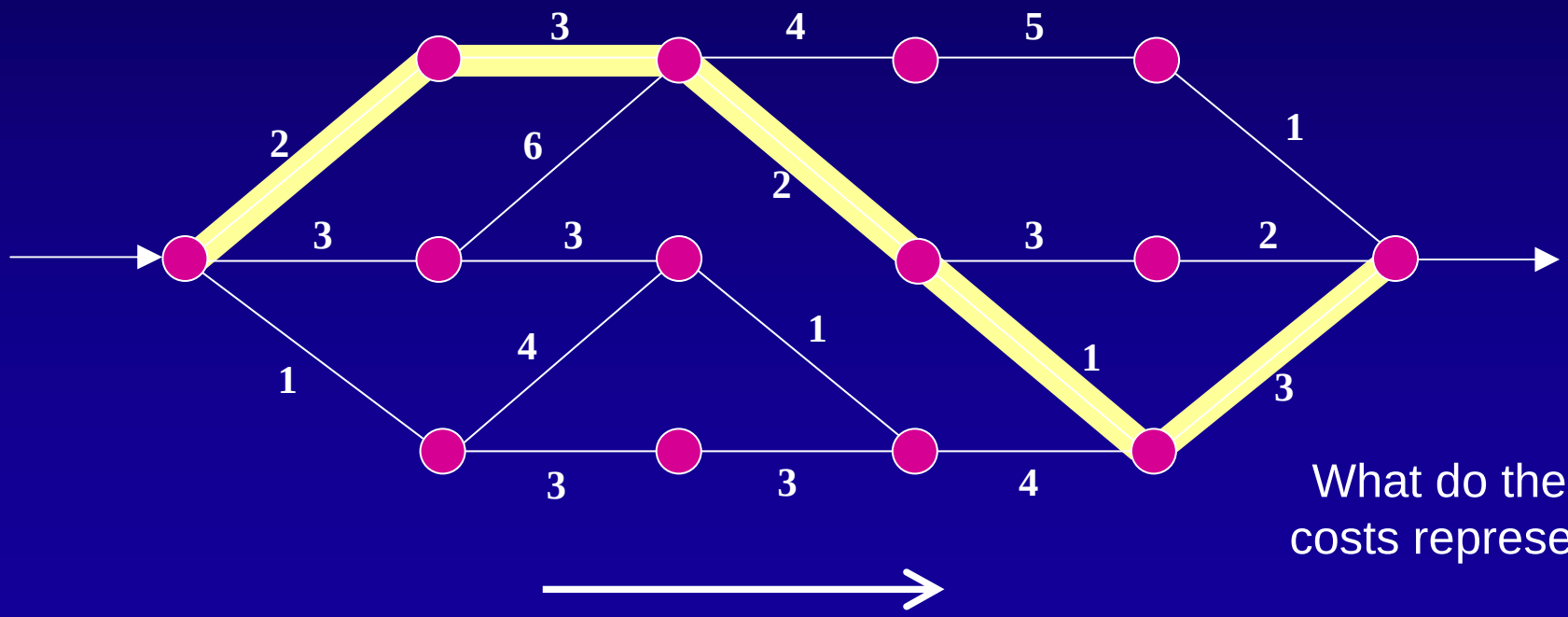
Task of a Simulation Model

- A simulation model answers “what if” questions
  - The model “operates” the water system for a historical period given a set of operating rules
  - Rules can be added, changed or removed in response to “what if” questions, and the model shows how the system would have operated with those changes
  - Many “what if” questions can be asked and answered to explore ideas and suggestions

Tasks of an Optimization Model

1) Identify the “optimal” solution

Example:



What do these costs represent?

Tasks of an Optimization Model

2) Evaluate and quantify the tradeoffs between various objectives
   - ie, how much does it cost one objective if the benefit to another objective is increased?
3) Seek operations (and operating rules) that achieve a reasonable balance between those objectives
   - simulation aids in this task

Use of Optimization AND Simulation

- Optimization and Simulation models play a complimentary role in developing operating rules.
  - Optimization models make decisions based on the benefit achieved for system objectives over time, but those decisions are difficult to make in real-time.
  - Operating rules that approach those optimal operations can be developed for use in real-time.
  - Simulation models demonstrate the outcome of proposed rules, and allow small adjustments to target the outcome achieved by the optimization.

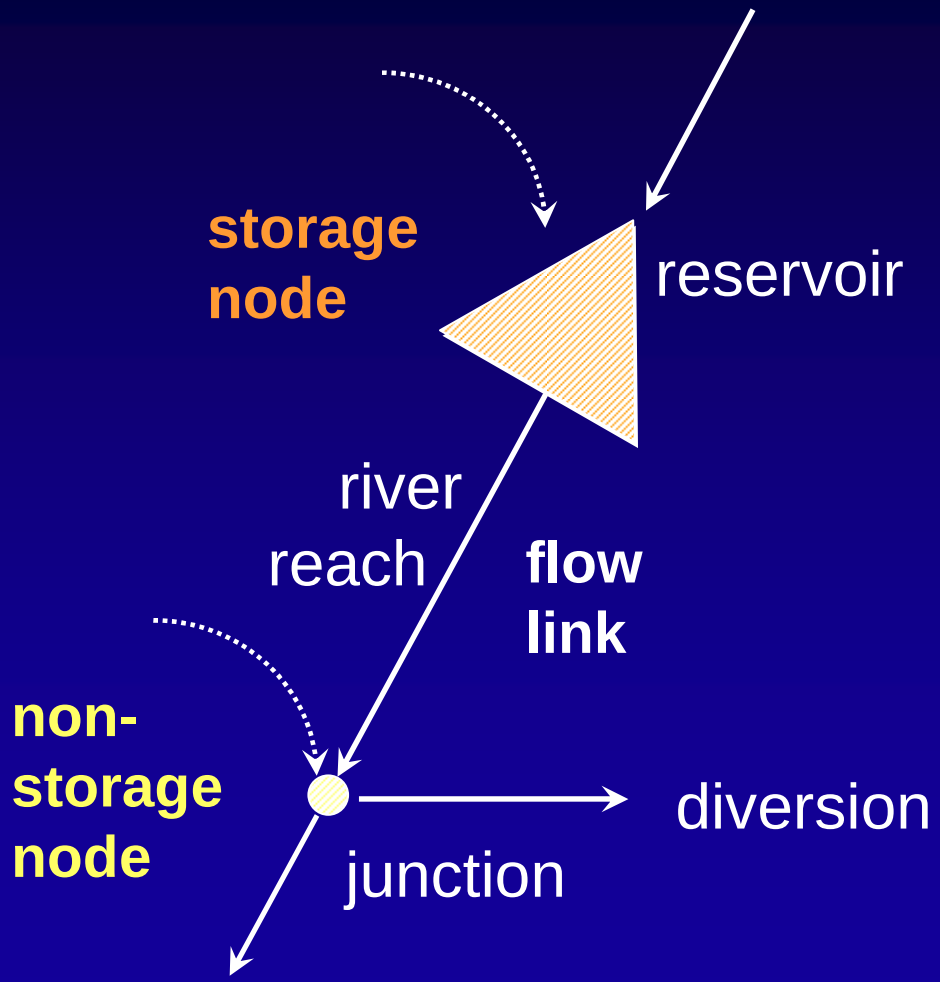
The Bottom Line -- Symbiosis

- Simulation provides a test of operating rules inferred from “optimal” operation
- Optimization provides a target to aim for with the simulation
- Optimization also quantifies the expense of one objective as a cost to other objectives (ie, a trade-off), which is then demonstrated with the simulation

Data Requirements

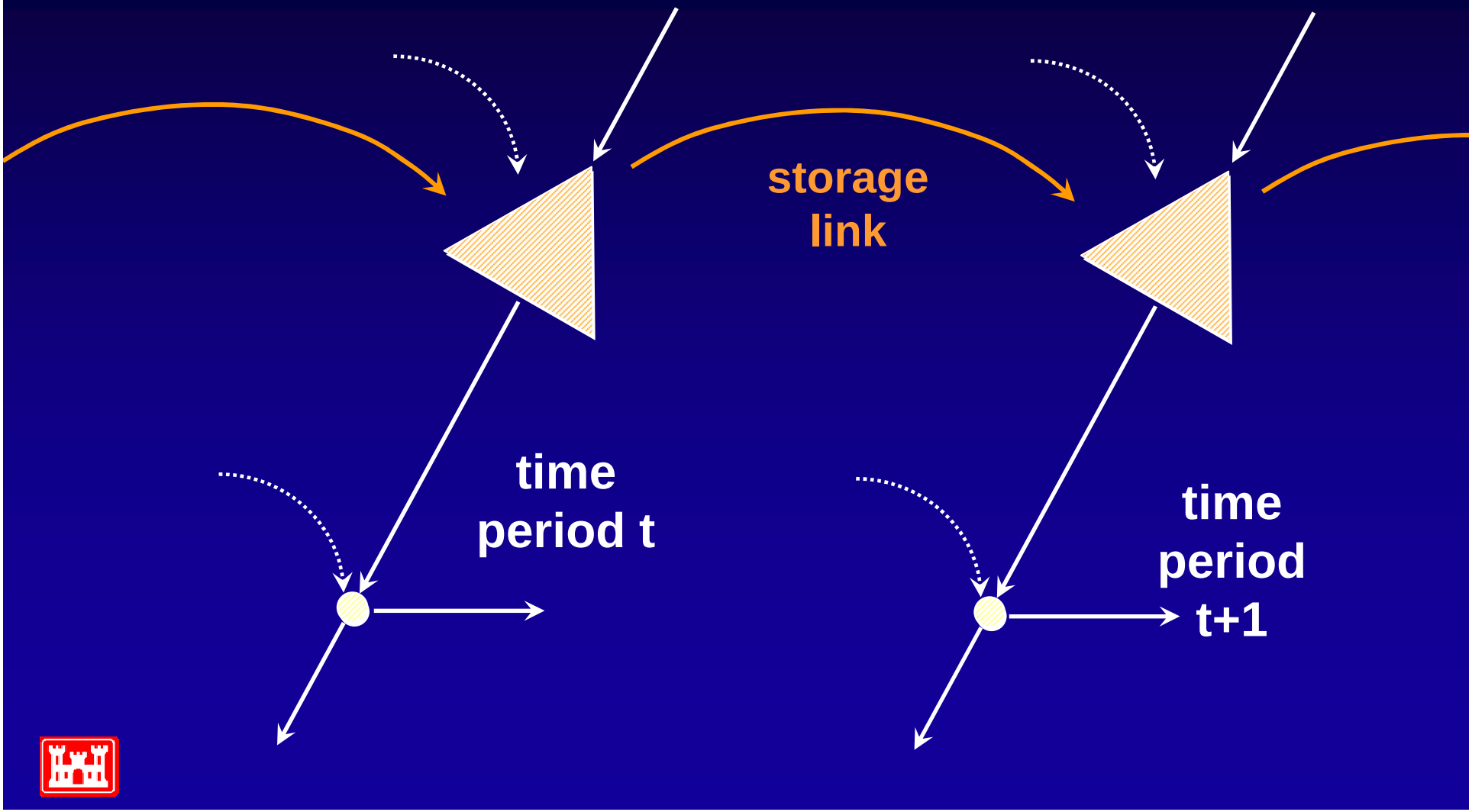
- Physical Reservoir Characteristics
  - storage and outlet capacities
  - elevation/capacity/surface area (if consider evaporation)
- Channel or Conveyance Characteristics
  - channel or conduit capacities
  - losses
- Streamflow Time-Series
  - reservoir inflow, incremental local flow, demand
- Unit penalties on streamflow and storage

Reservoir System as a Network

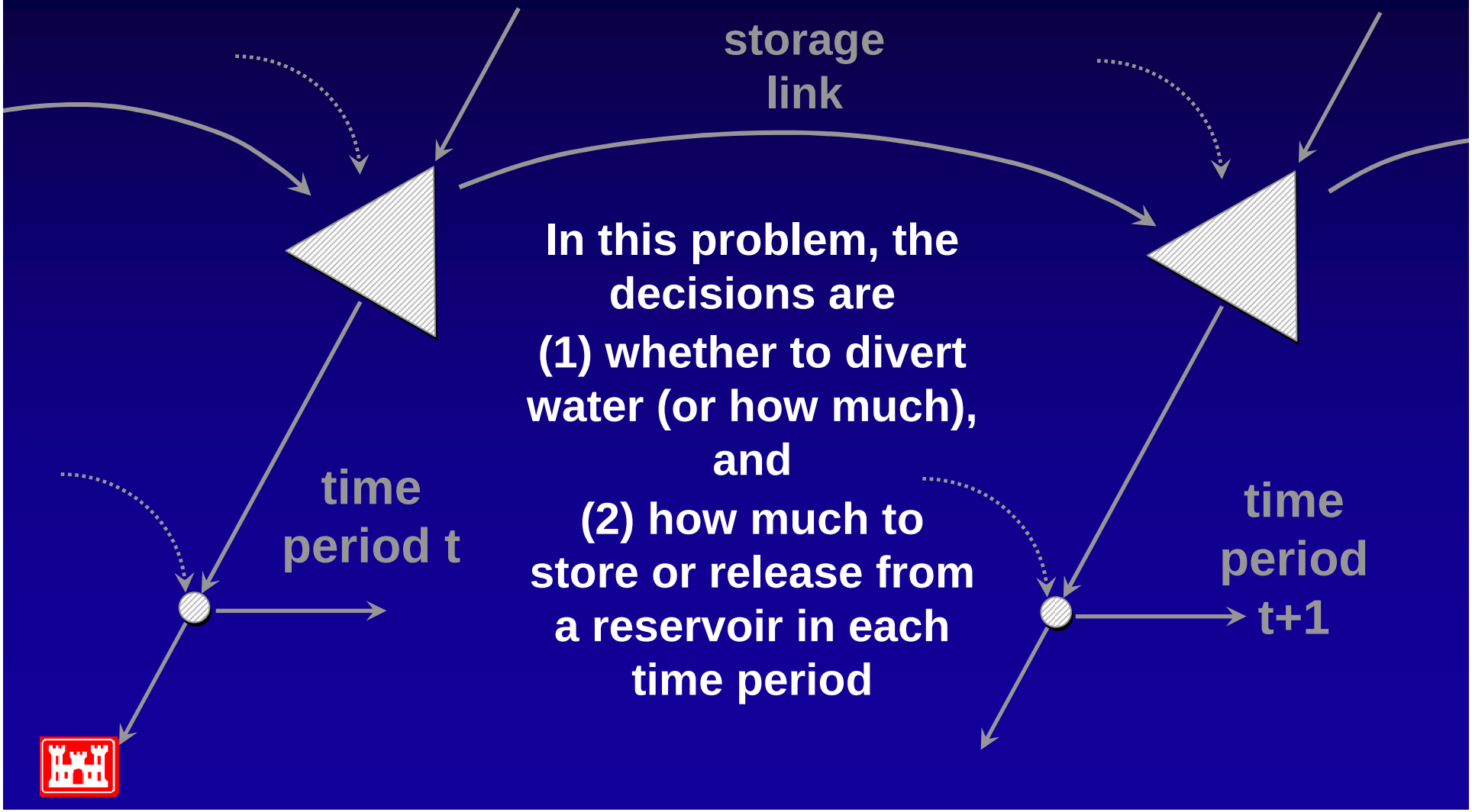


Use flow network to represent a WATER SYSTEM

Reservoir System as a Network



What are the decisions?



In this problem, the decisions are

(1) whether to divert water (or how much), and

(2) how much to store or release from a reservoir in each time period

Maximizing Objectives

We want to optimize the objectives of the water system, whatever those might be

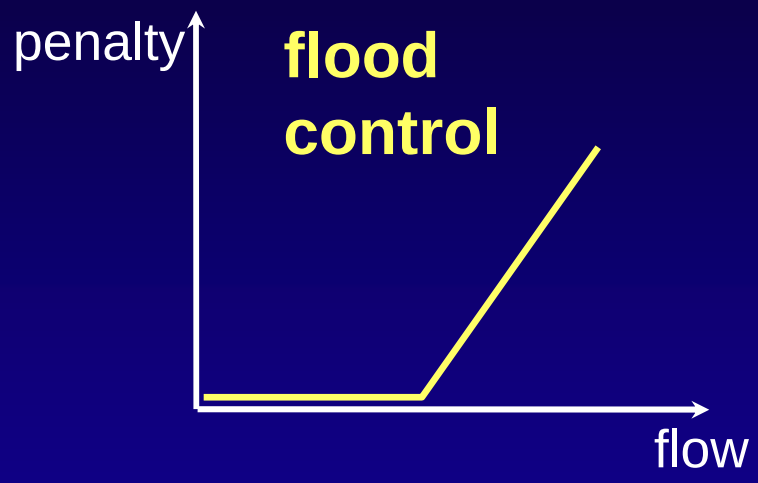
For example,

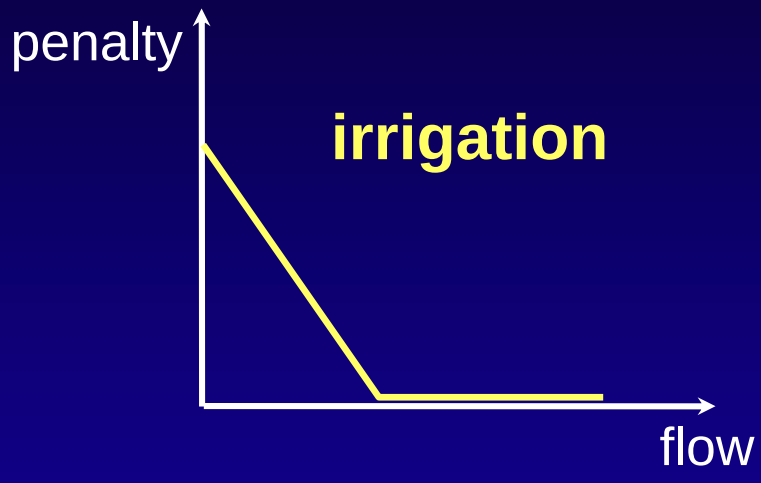
- for flood control, the objective is to minimize damage due to flooding
- for water supply, the objective is to maximize yield or minimize shortage to existing demand

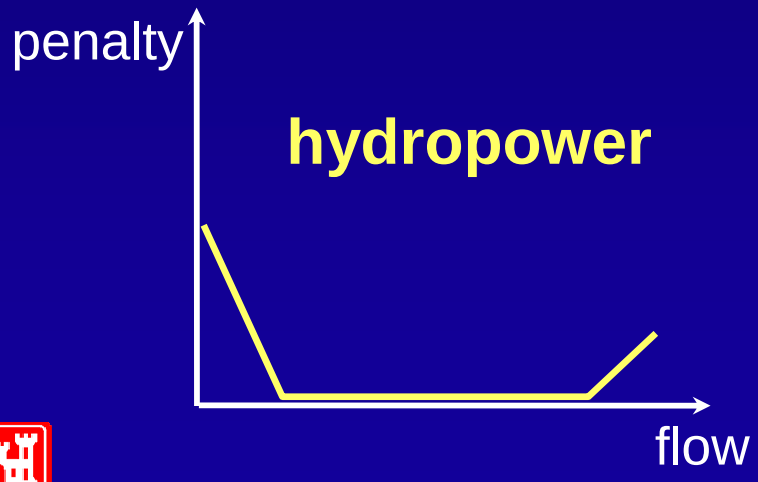
Articulating Objectives (Penalties)

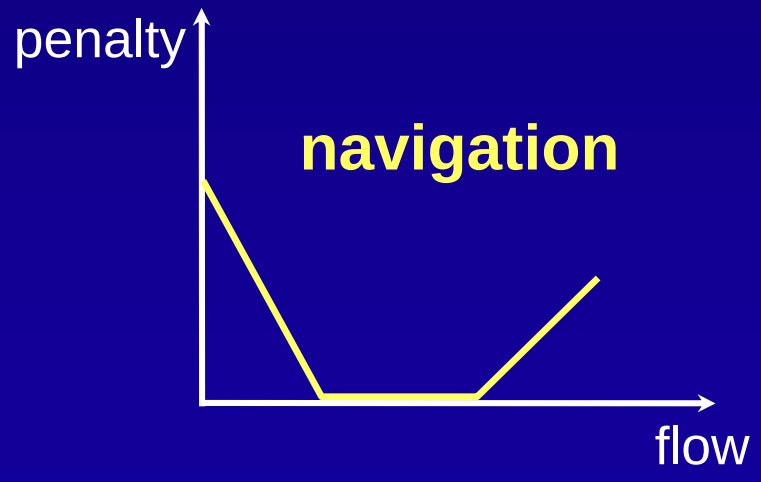
- We can articulate our values, priorities, and objectives using penalties or benefits
- Unit-penalties are applied for occurrences we consider detrimental, such as high flow or very high reservoir storage
- Negative unit-penalties are applied to positive occurrences, such as streamflow needed for navigation or irrigation

Examples of Penalty Curves

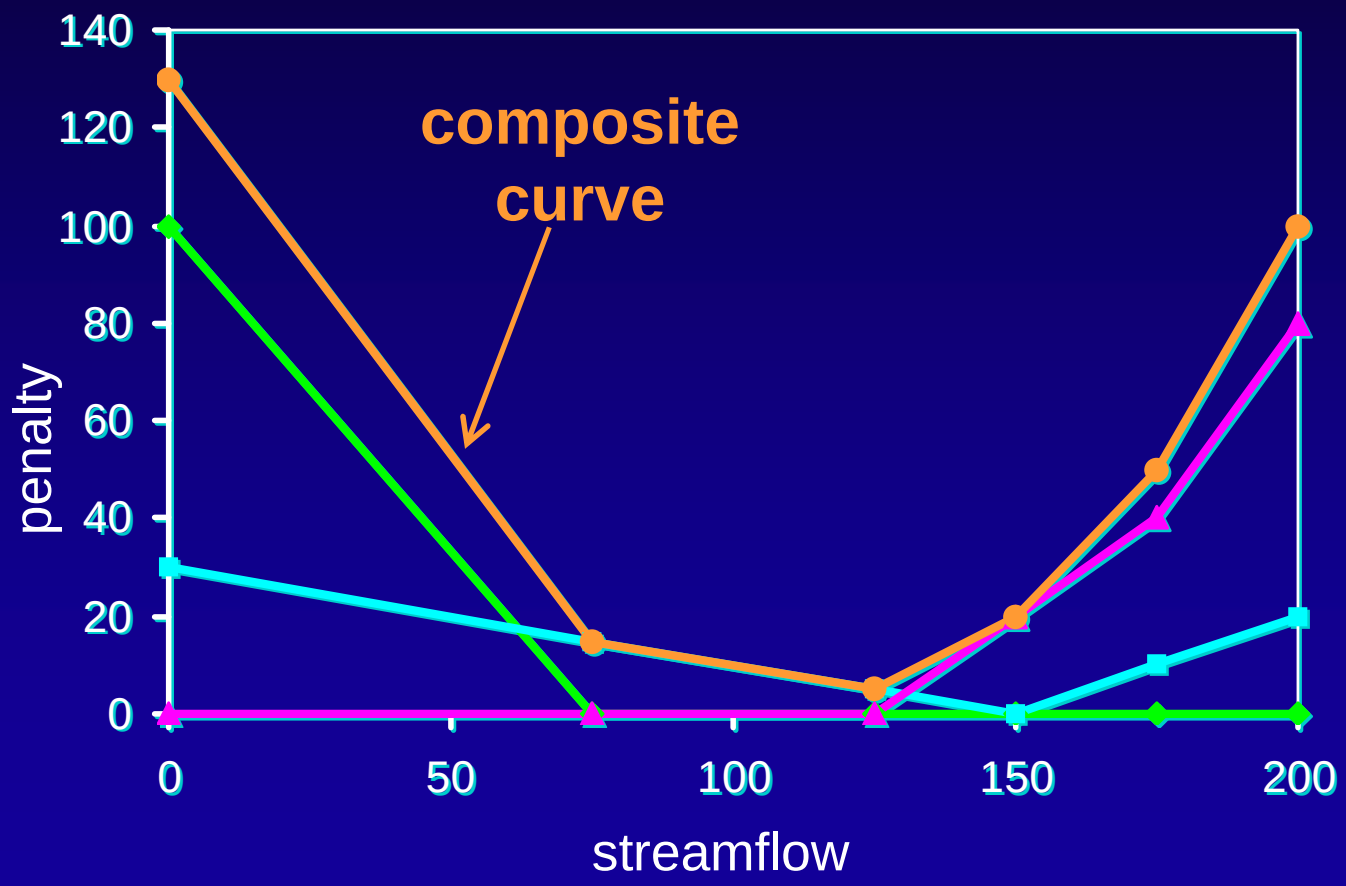








Combined Penalty Curves



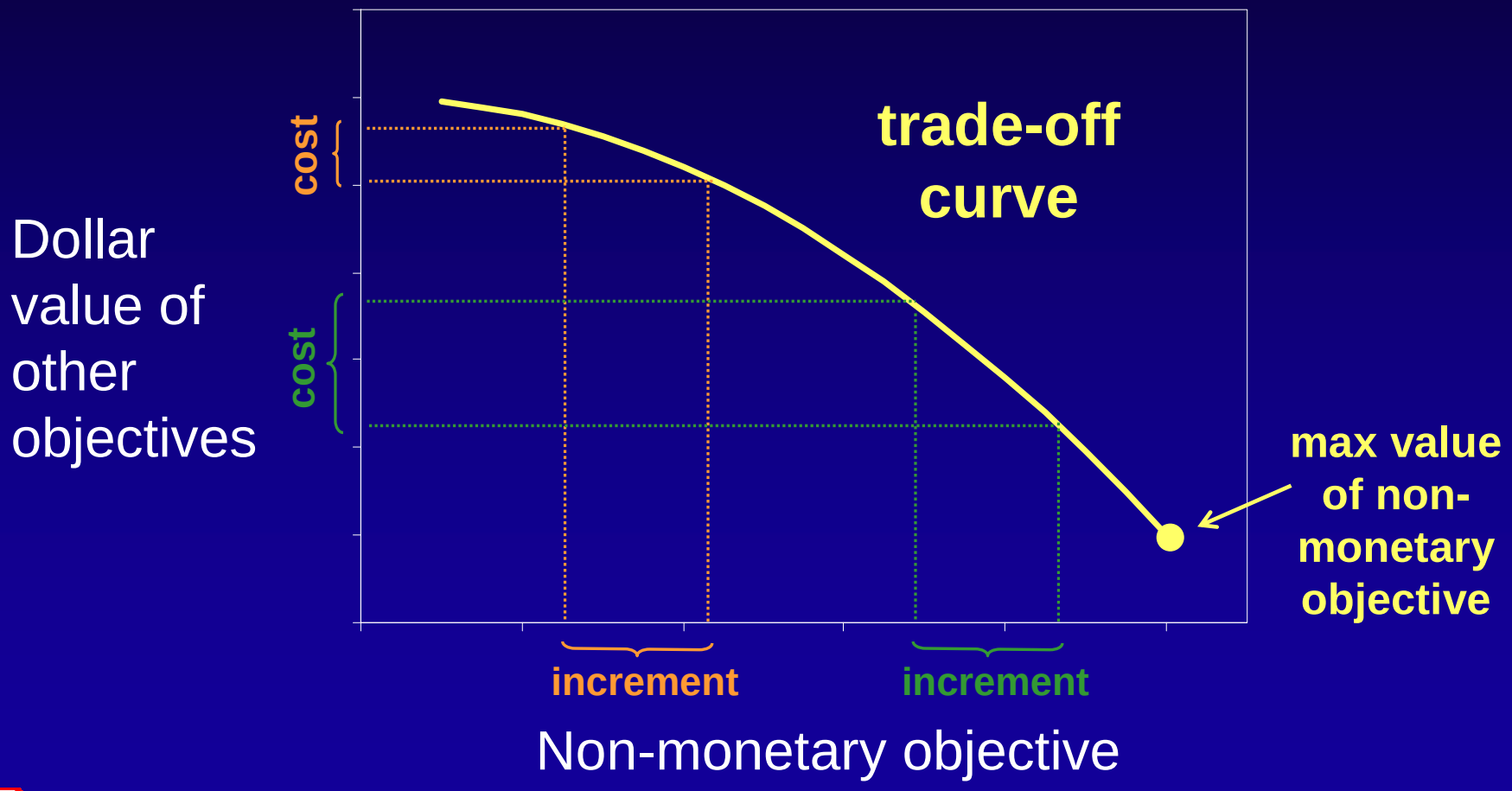
penalty is for a single location

penalty is applied in <u>each</u> time period

Articulating Objectives (Penalties)

- Values can be monetarily based
  - flood damage, price of water, hydropower
- Or, when value cannot be properly stated in dollars, non-monetary based
  - instream use, such as wildlife preservation
- We often set non-monetary penalties to encourage specific operations or an operating preference
  - **referred to as “persuasion penalties”**

Comparing Economic to Non-Monetary Objectives



Prioritizing Objectives?

- If one objective is more important than another, can give it a higher priority
  - in the optimization it would be satisfied first
- Can vary priorities to determine the system's sensitivity to these assumptions

Application

- Run model for each objective individually
  - ensure results are consistent with goals
  - provide upper bound on benefits
- Run model for all objectives
  - using composite penalty functions
  - using various weightings of the objectives
- Infer operating rules **(look for patterns in output)**
- Simulate operating rules to measure performance

then repeat…

Contact

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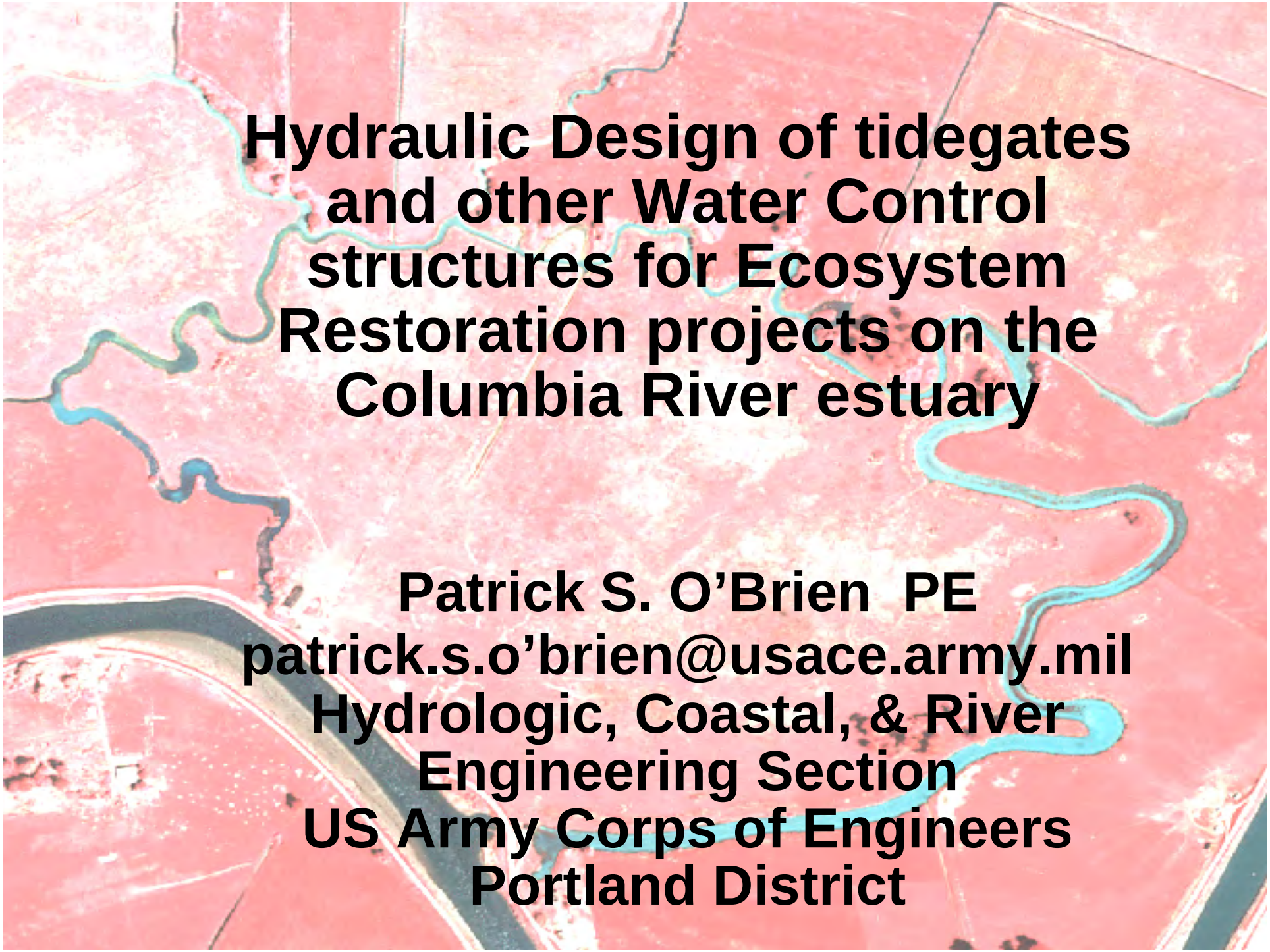
- US Army Corps of Engineers
- Hydrologic Engineering Center
- Davis, California
- (530) 756-1104
- Jason.t.needham@usace.army.mil



Hydraulic Design of tidegates and other Water Control structures for Ecosystem Restoration projects on the Columbia River estuary

Patrick S. O'Brien PE
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Hydrologic, Coastal, & River Engineering Section
US Army Corps of Engineers
Portland District

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Portland District

New Orleans, Louisiana

- Surrounded by Levees for flood protection from Mississippi River + Hurricanes
- Drainage network of canals
- Gravity drainage into canals
- Network of pumping stations drains canals into Lake Pontchartrain
- Significant tidal effect
- High Water Table

N
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Image © 2005 DigitalGlobe
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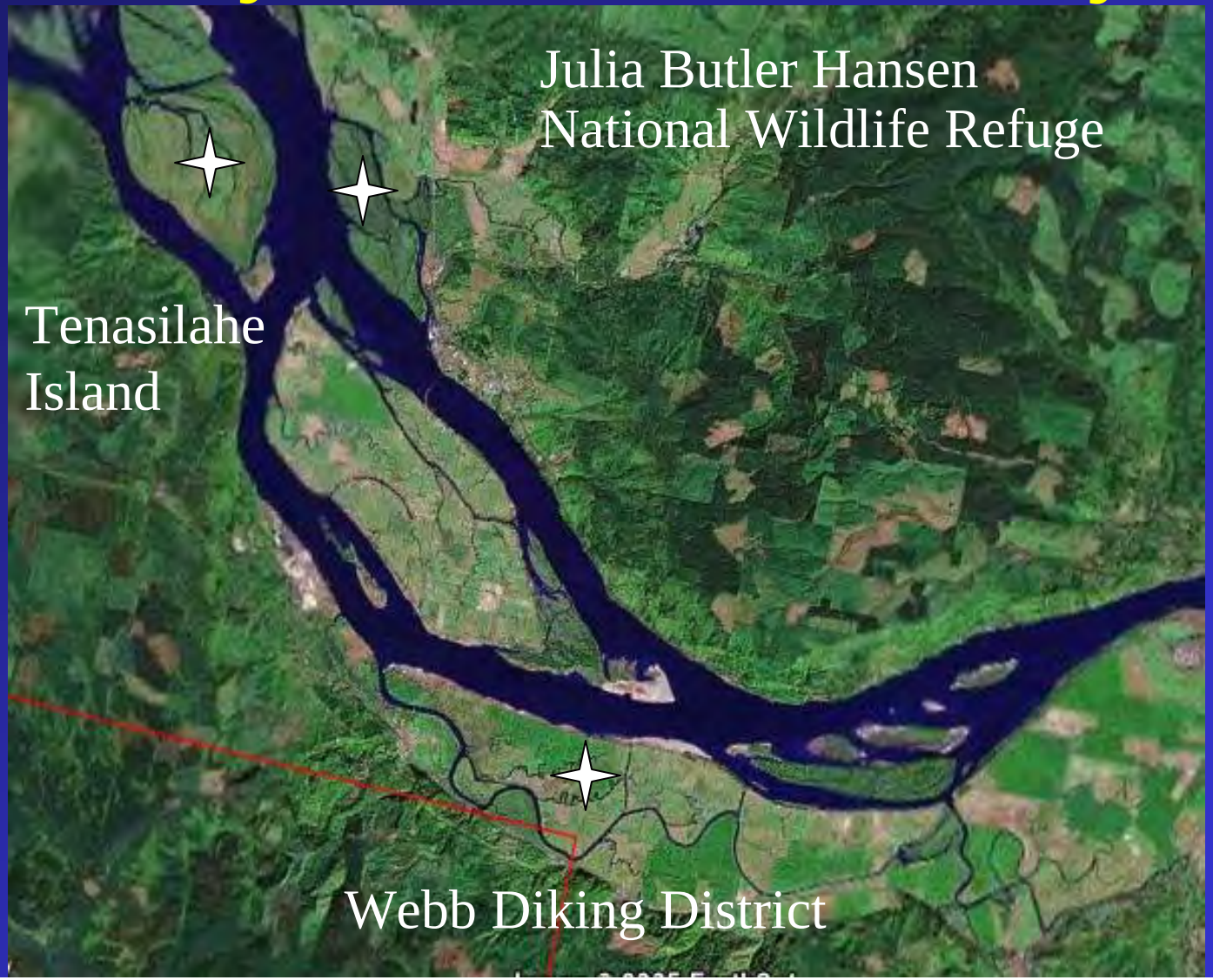
Ecosystem Restoration Projects in Col R Estuary



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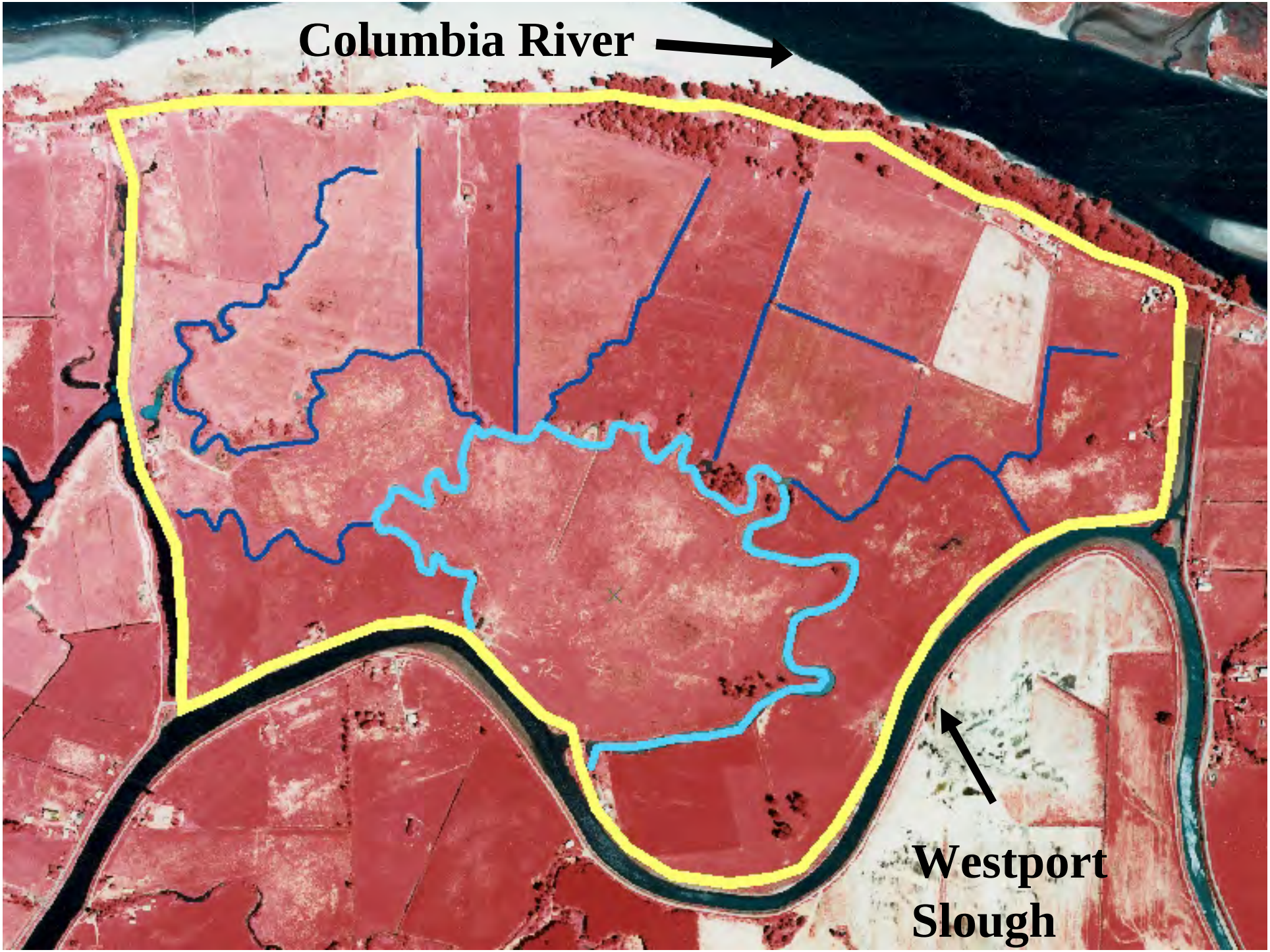
Webb Managed Wetland

- Located at CRM 46
- Wildlife mitigation project associated with Columbia River Channel Deepening
- Project sponsors – Lower Columbia River Ports
- Diking District area 733 acres
- Project consists of 74 acre managed wetland built on Port of Portland land
- 6 mo execution from design to P & S
- Small project with lots of complexities
- Must deliver quality product capable of withstanding close scrutiny by stakeholders


Columbia River
Westport
Slough

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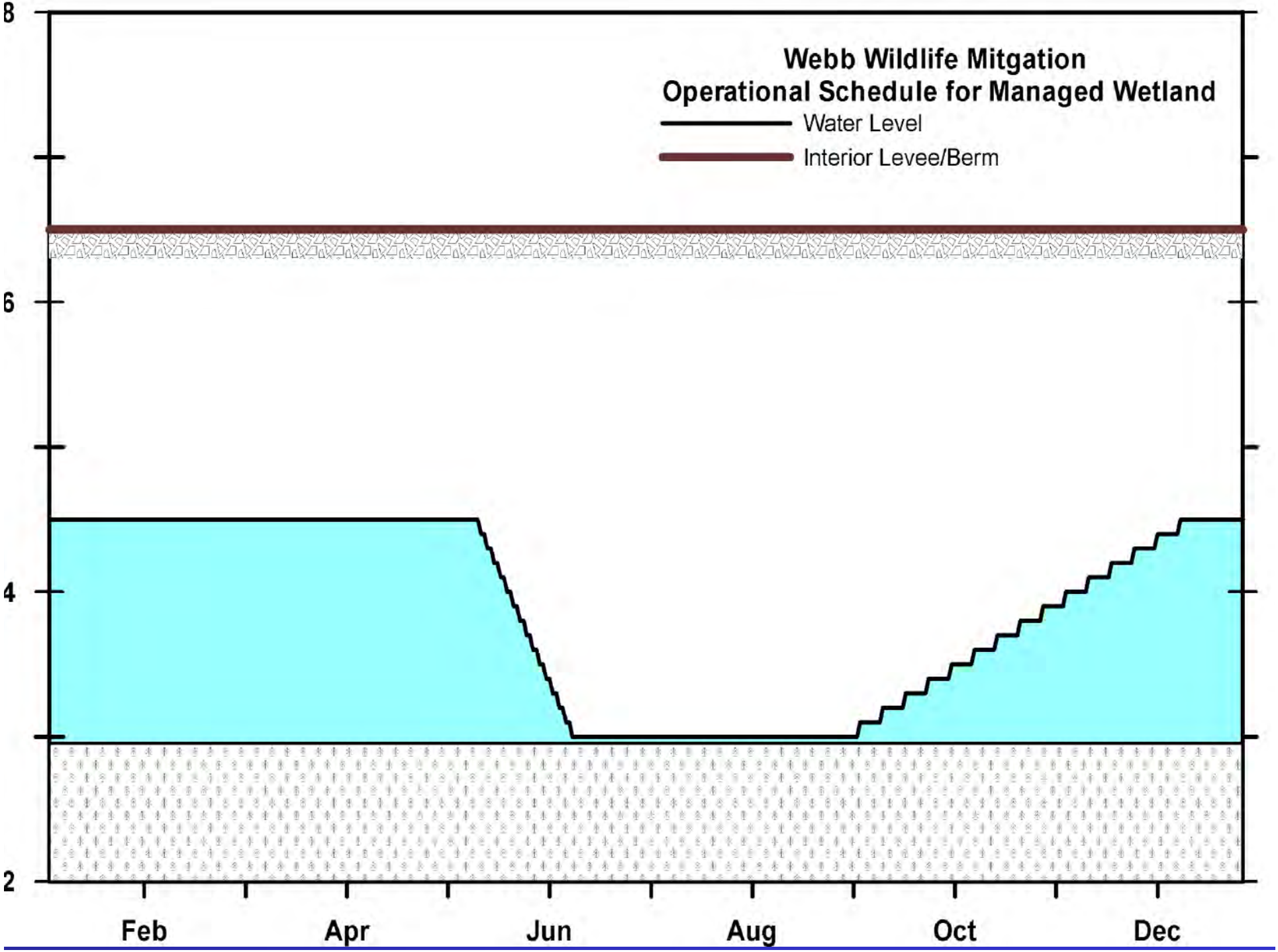
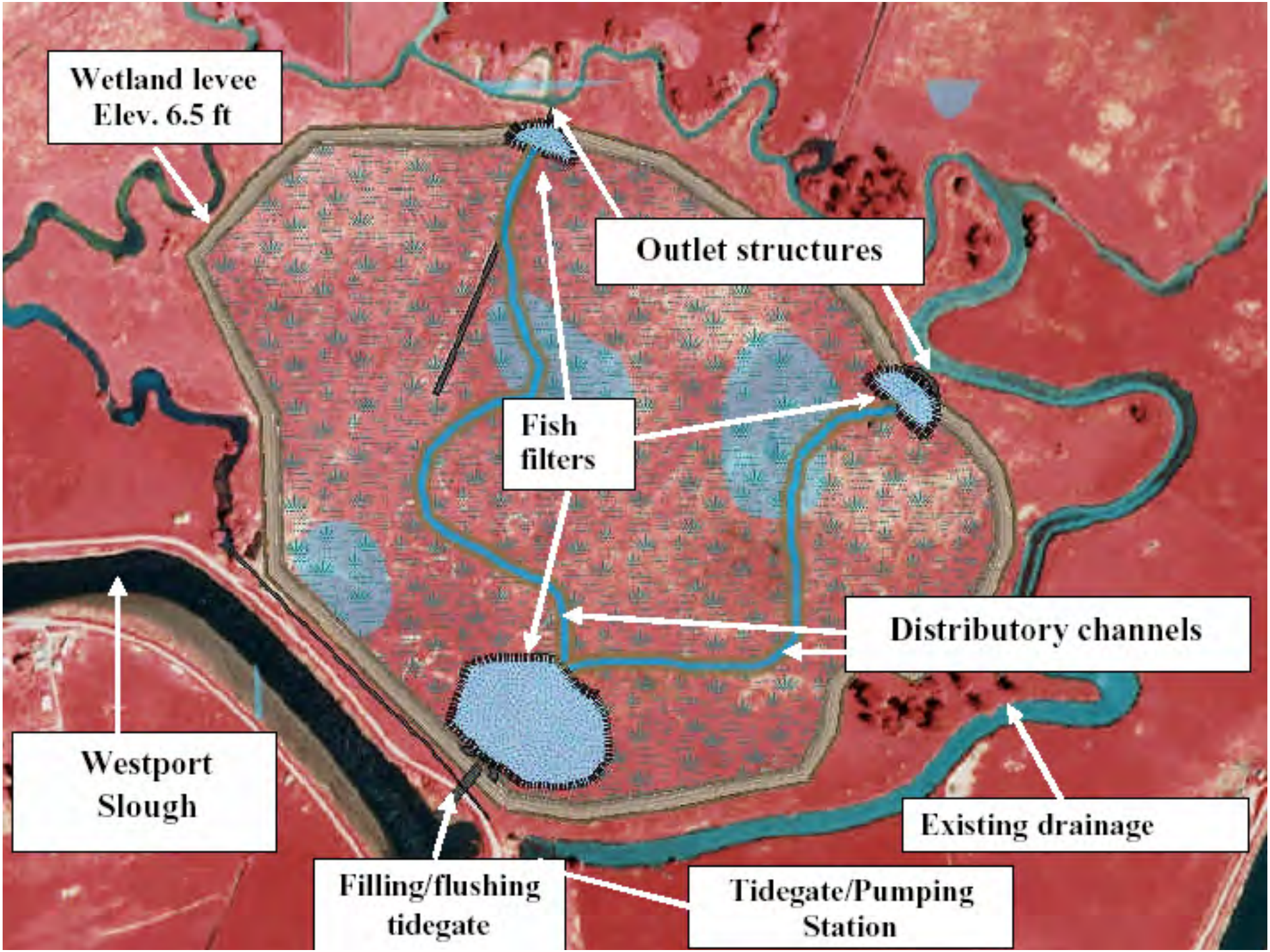
Portland District

Webb Managed Wetland

- Goals – passive management of water level between 3 and 4.5 feet
- Provide flushing water to main drainage slough
- Minimize standing water
- Opposed by landowners in the Diking district – lots of legal issues
- Concerns – Flood control, drainage, mosquitoes (west Nile virus), birds (avian flu)
- Public meeting Aug 10. Construction start ~ late Aug – early Sep pending signed MOA
- P & S complete, some remaining parts will be added as mods to the contract


Webb Wildlife Mitgation
Operational Schedule for Managed Wetland
Water Level
Interior Levee/Berm
8
6
4
2
Feb
Apr
Jun
Aug
Oct
Dec


Wetland levee
Elev. 6.5 ft
Outlet structures
Fish
filters
Distributory channels
Westport
Slough
Existing drainage
Filling/flushing
tidegate
Tidegate/Pumping
Station

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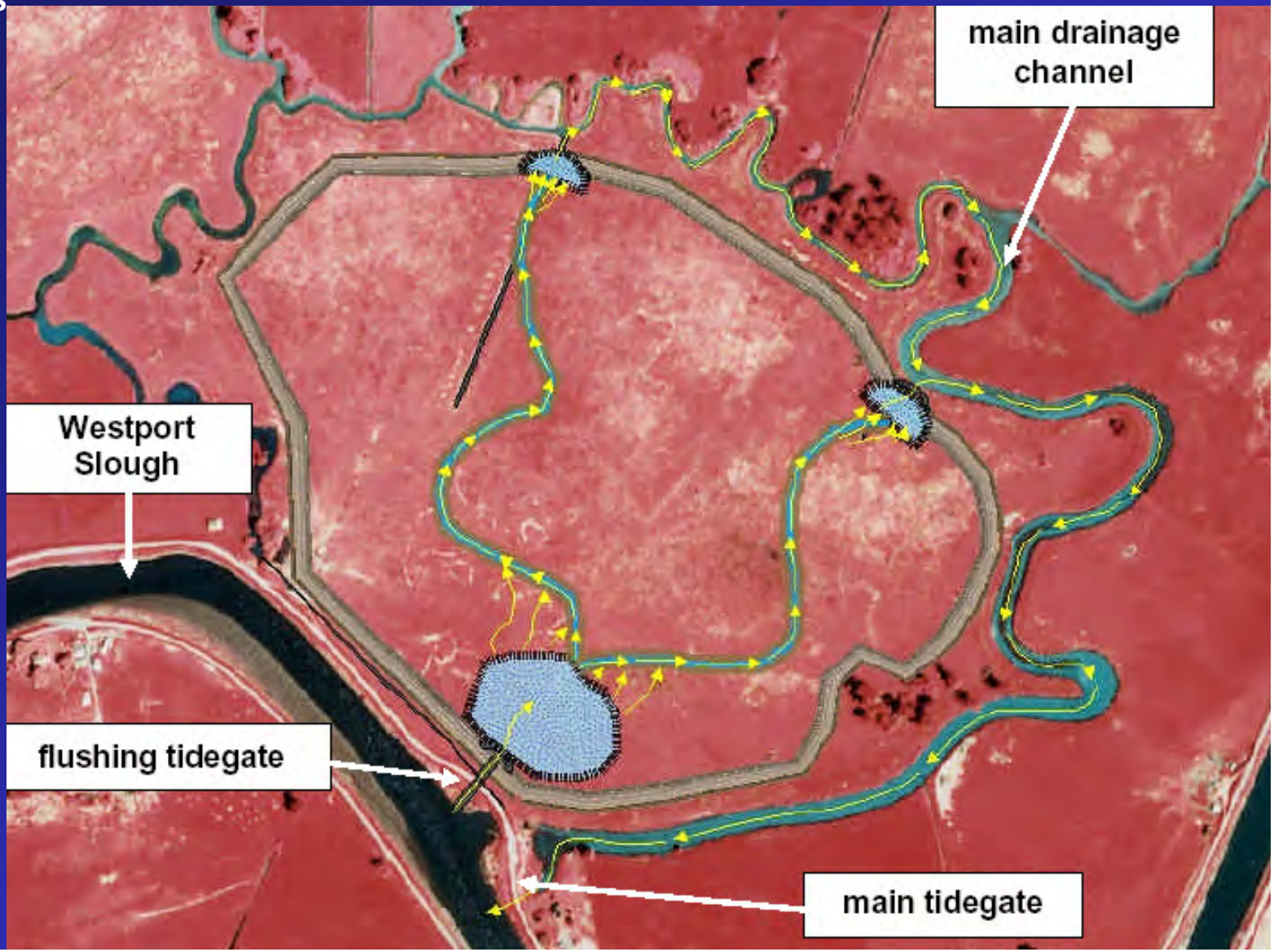
Summer low water operation



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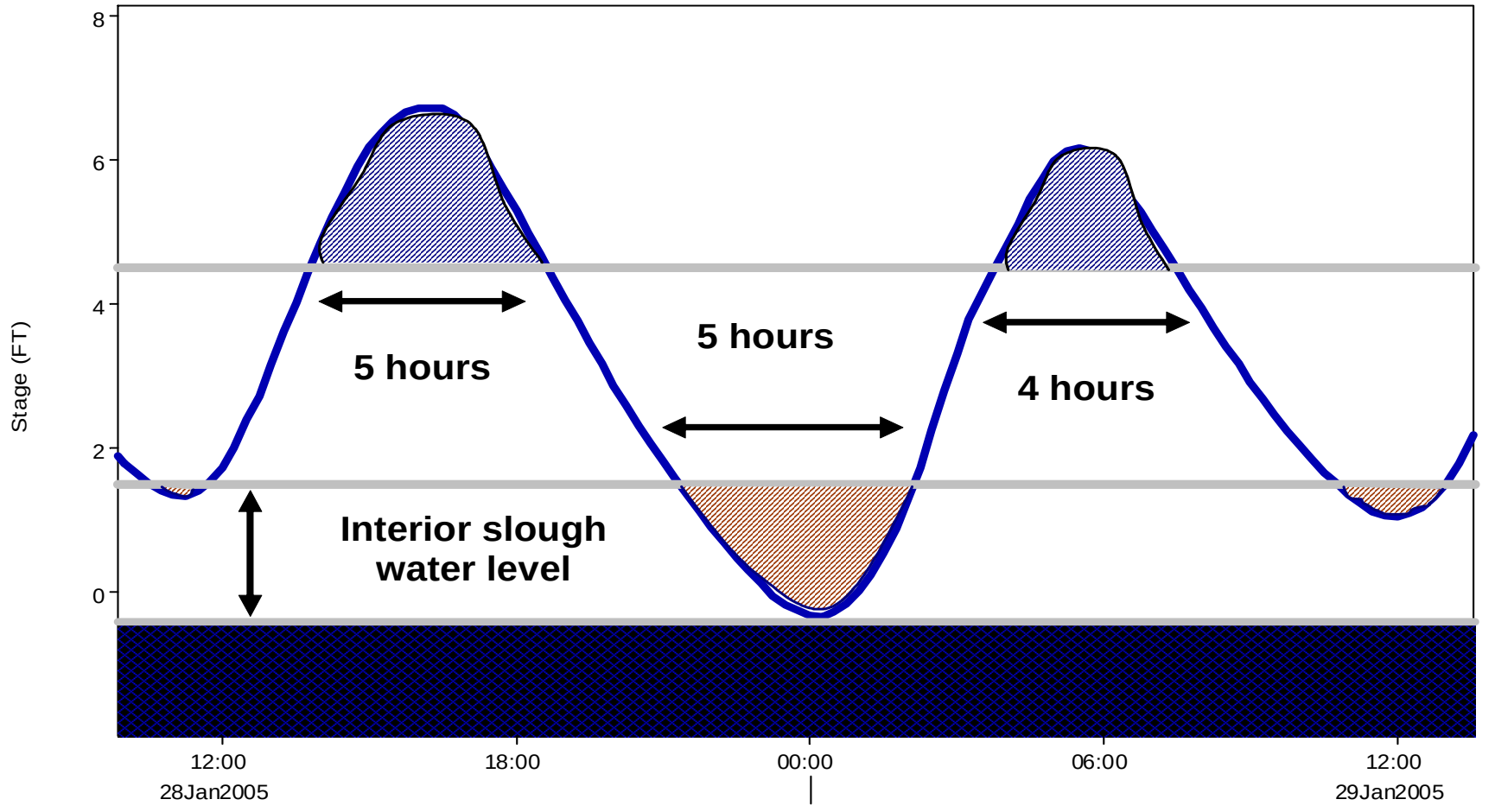
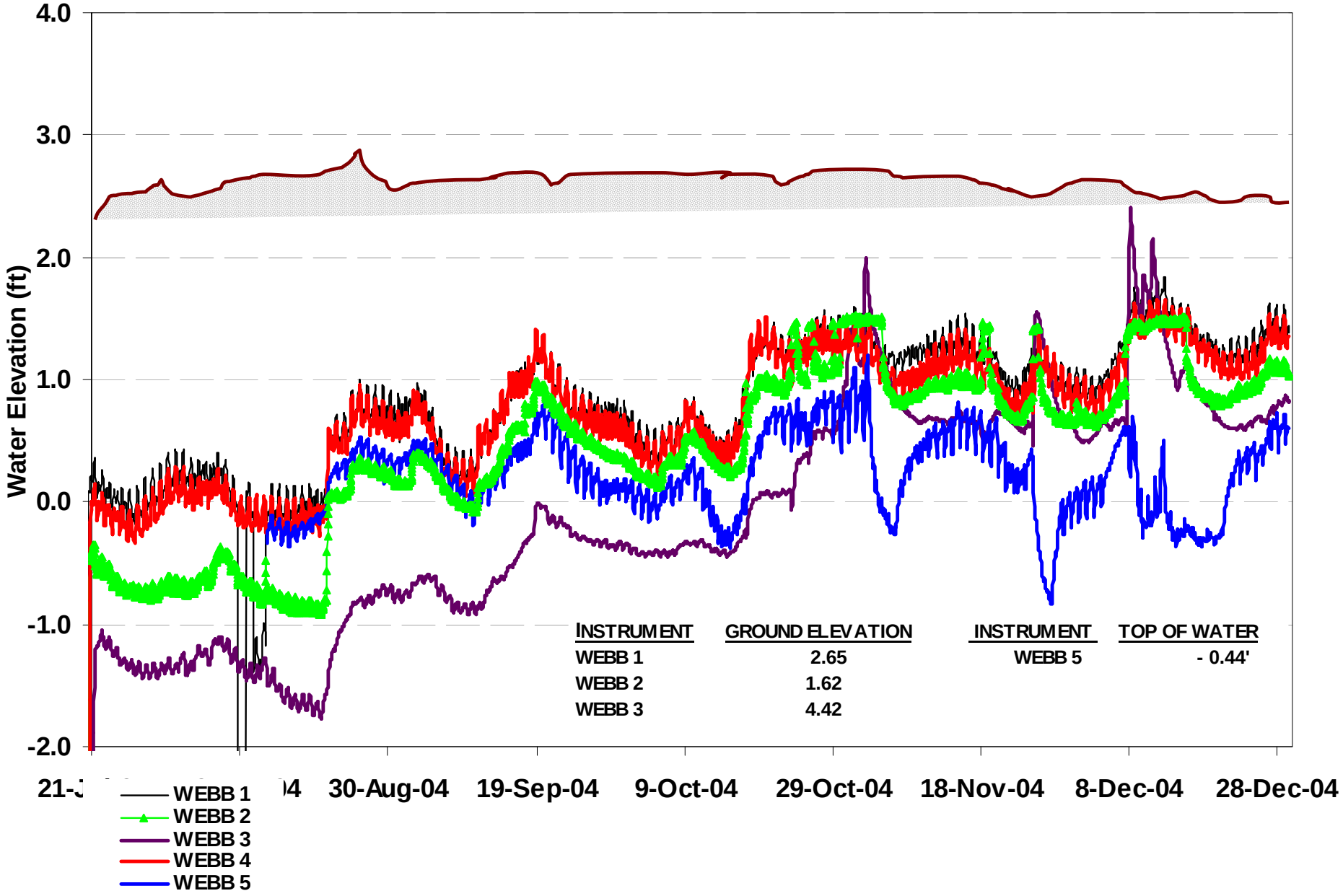
Hydrology & Climatology

- Interior drainage system
- High water table, responds rapidly to tidal cycle
- Gravity drainage into Westport Slough, 8 – 10 ft stage variation
- 48 cfs pump station, used to keep water table down and pasture land dry
- Drain tiles present

Drainage Cycle




4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
Water Elevation (ft)
30-Aug-04
19-Sep-04
9-Oct-04
29-Oct-04
18-Nov-04
8-Dec-04
28-Dec-04
WEBB 1
WEBB 2
WEBB 3
WEBB 4
WEBB 5
INSTRUMENT GROUND ELEVATION
WEBB 1 2.65
WEBB 2 1.62
WEBB 3 4.42
INSTRUMENT TOP OF WATER
WEBB 5 - 0.44'

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Hydrology & Climatology

- Design has to consider rainfall runoff
- Small area ~ considered rational method
- Peak flow important, but continuous flow hydrographs needed.
- Quick-easy-cheap way to develop with and without project hydrology
- MGSFlood – WA DOT free program used
- **http://www.wsdot.wa.gov/eesc/design/hydraulics/downloads.htm**

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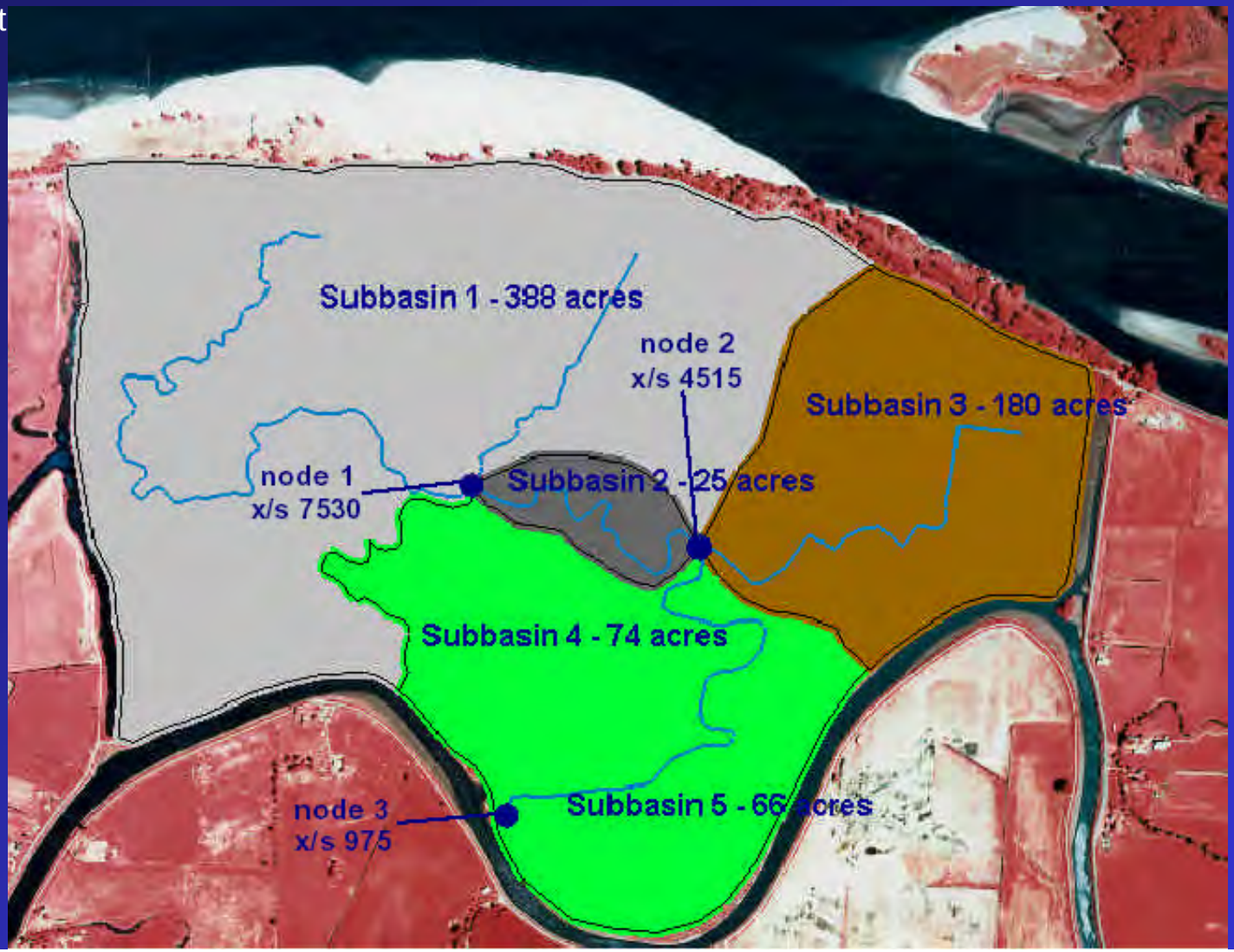
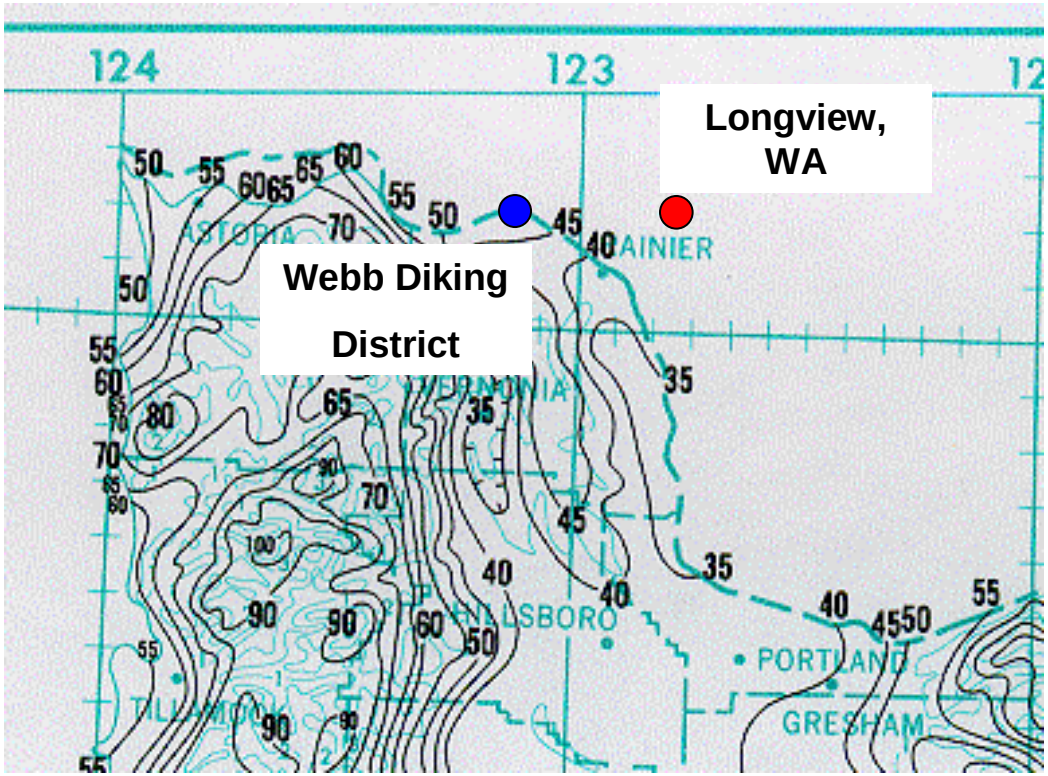
MGSFlood schematic with inflow points to HEC RAS



MGSFlood Rainfall data

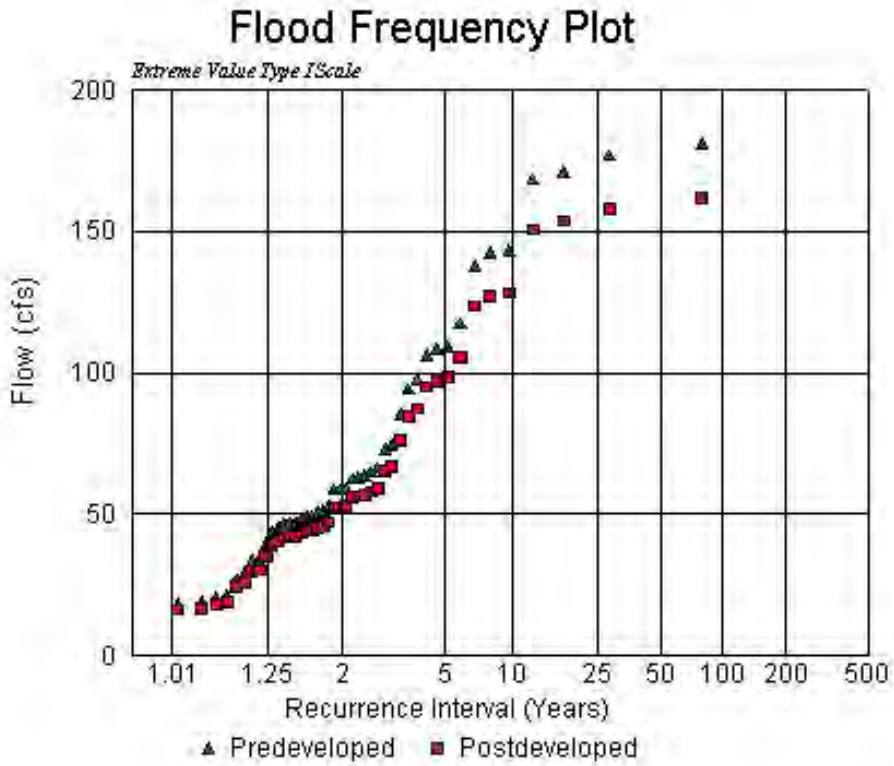


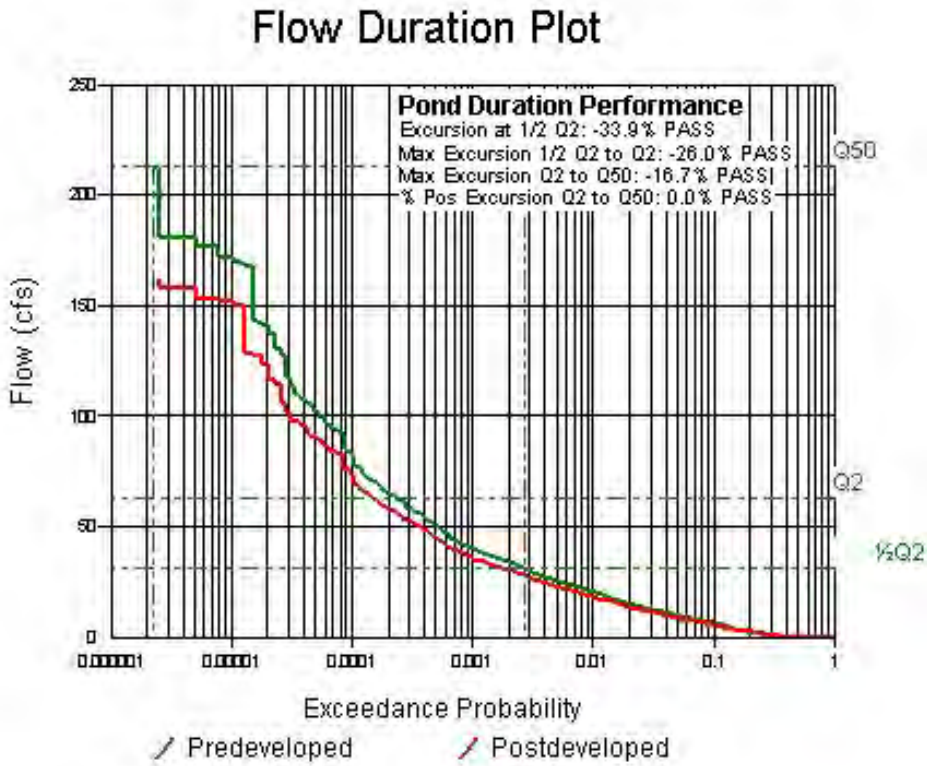
25 Year 24 hour Isopluvial Map – NOAA Atlas #2

- Project area – Webb
  25 yr – 24 hr = 5.25 inches
- Use Longview, WA gage
  44 yr POR 25 yr – 24 hr
  4.21 inches
- Precipitation Scale Factor
  5.25 / 4.1 1.247
- Continuous Flow Hydrographs developed with HSPF FORTRAN routine

MGS Flood Outputs

- Computed continuous flow for POR +





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Do we really need a Hydraulic Model ?

- Test and evaluate performance of design over range of tidal and rainfall conditions
- Answer a battery of questions that come up
  - How long to fill wetland ?
  - How fast can we drain it ?
- Communication tool – helps you communicate the hydraulics and hydrology to
  - the other members of the design team
  - May provides data for of the parts of the design
  - Resource agencies for permitting
  - Public - through graphics, want to keep it simple, common sense

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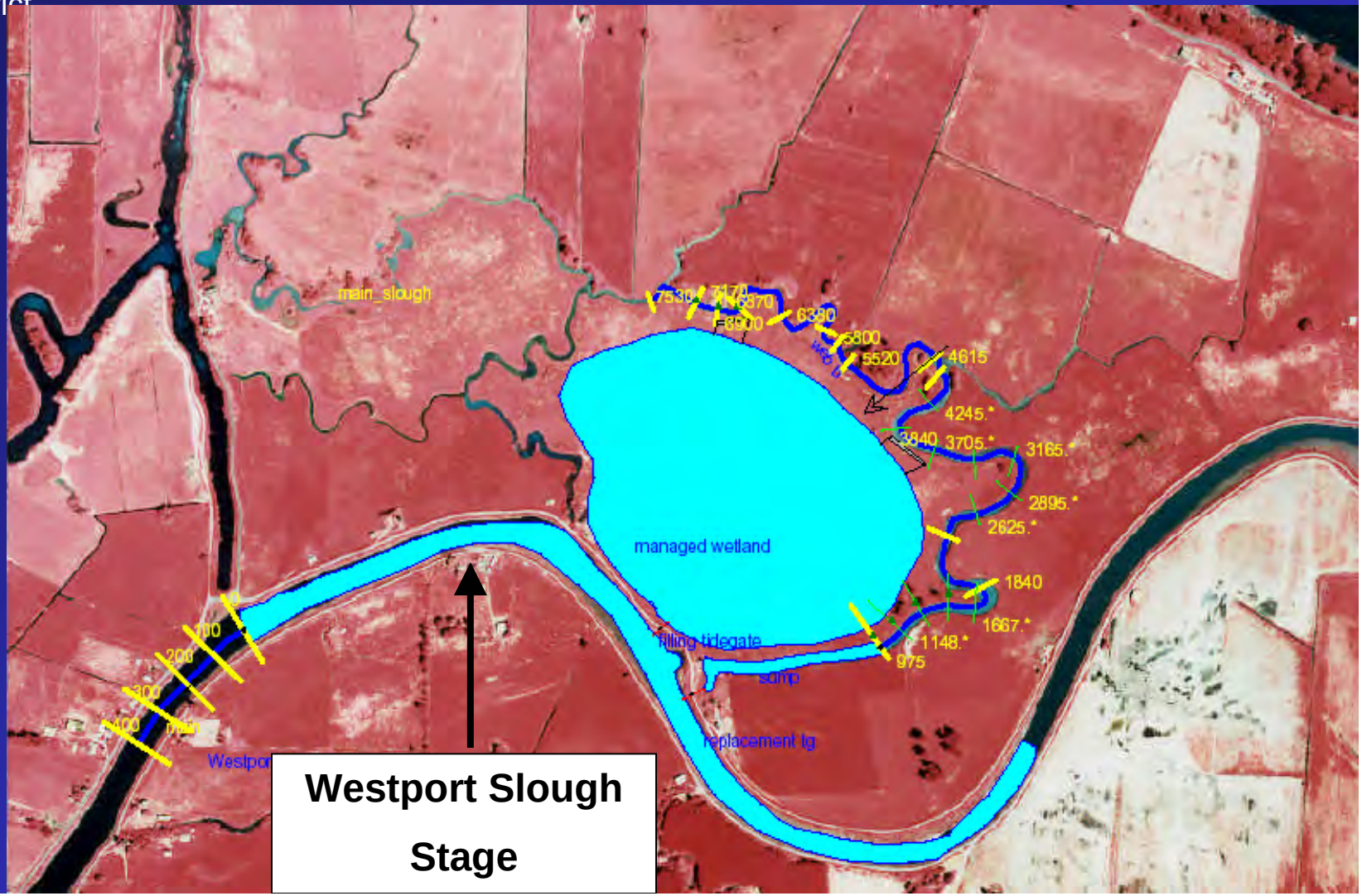
Webb HEC-RAS



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Data requirements

- Basic model setup relies on representation of design water control structures (tidegates) as culverts defined by flow direction
- Managed wetland – elevation – volume curve defines storage curve
- Existing and replacement tidegate, pump station

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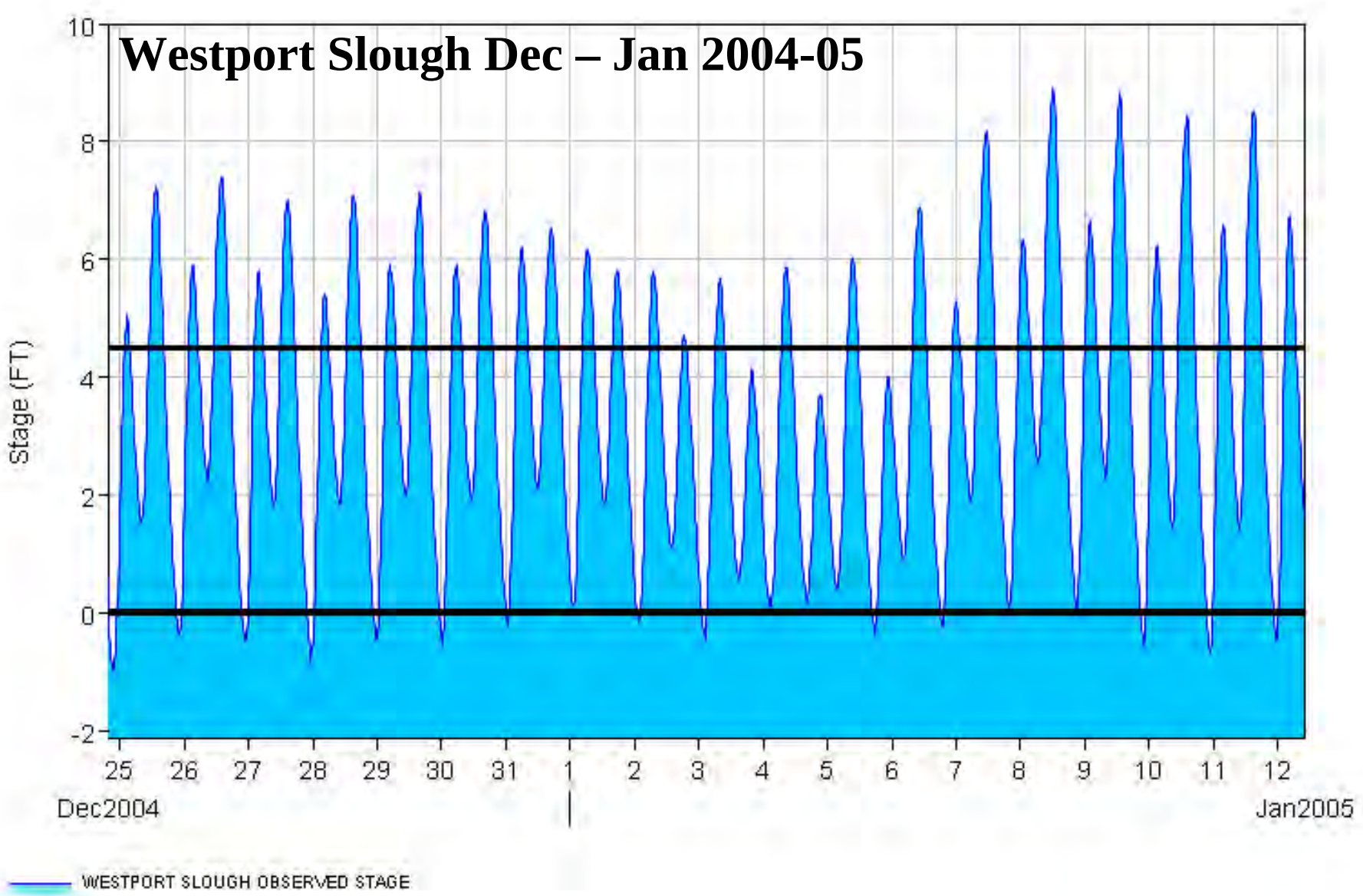
Data requirements

- Minimal survey data – cross sections of main drainage channel, spot elevations in 74 acre proposed managed wetland
- 1 day effort ~ 4 K
- Sutron gage at Westport slough (most important) ! 5 K


Westport Slough Dec – Jan 2004-05
Stage (FT)
10
8
6
4
2
0
-2
25
26
27
28
29
30
31
1
2
3
4
5
6
7
8
9
10
11
12
Dec2004
Jan2005
WESTPORT SLOUGH OBSERVED STAGE

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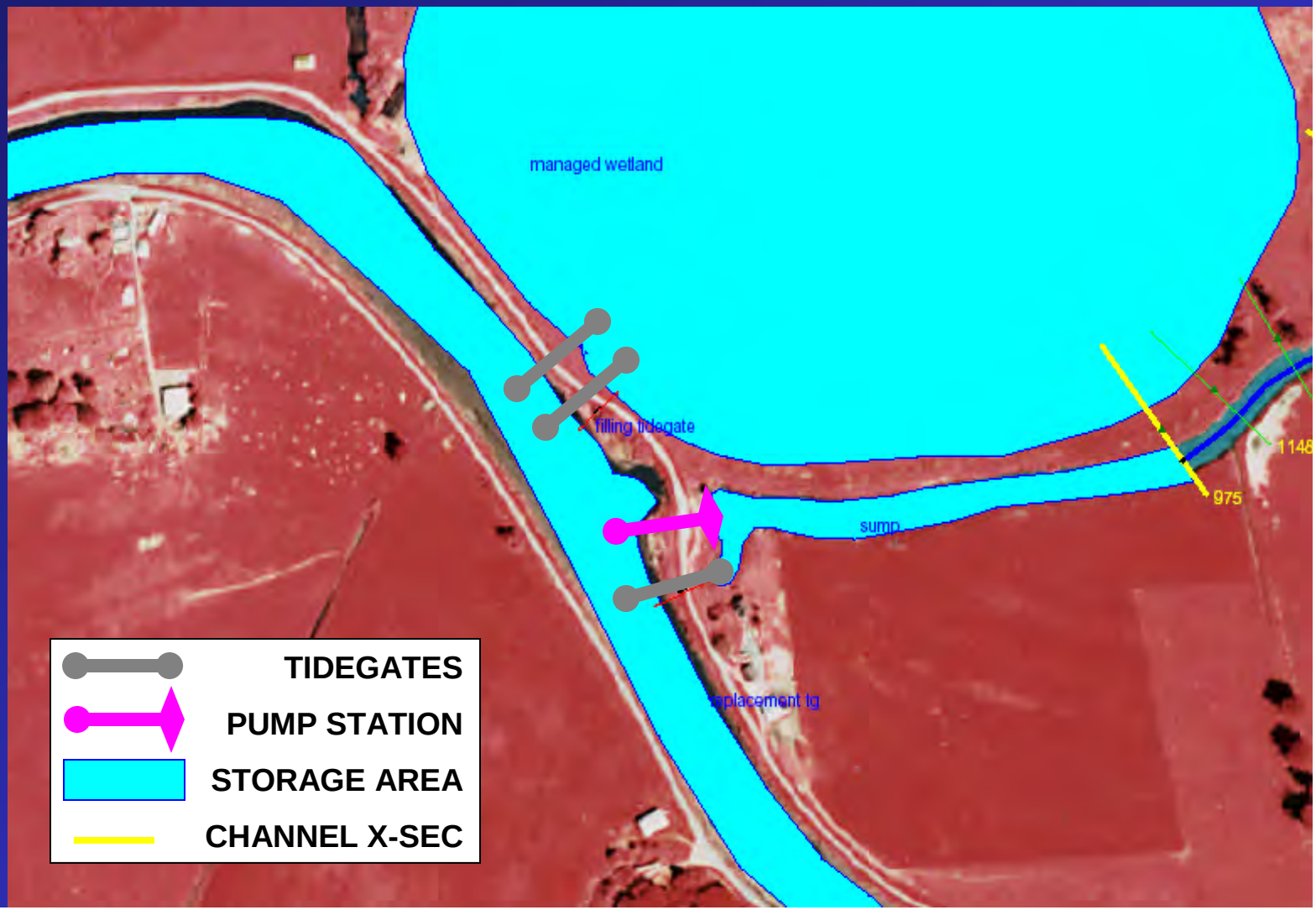
STORAGE AREA CONNECTIONS



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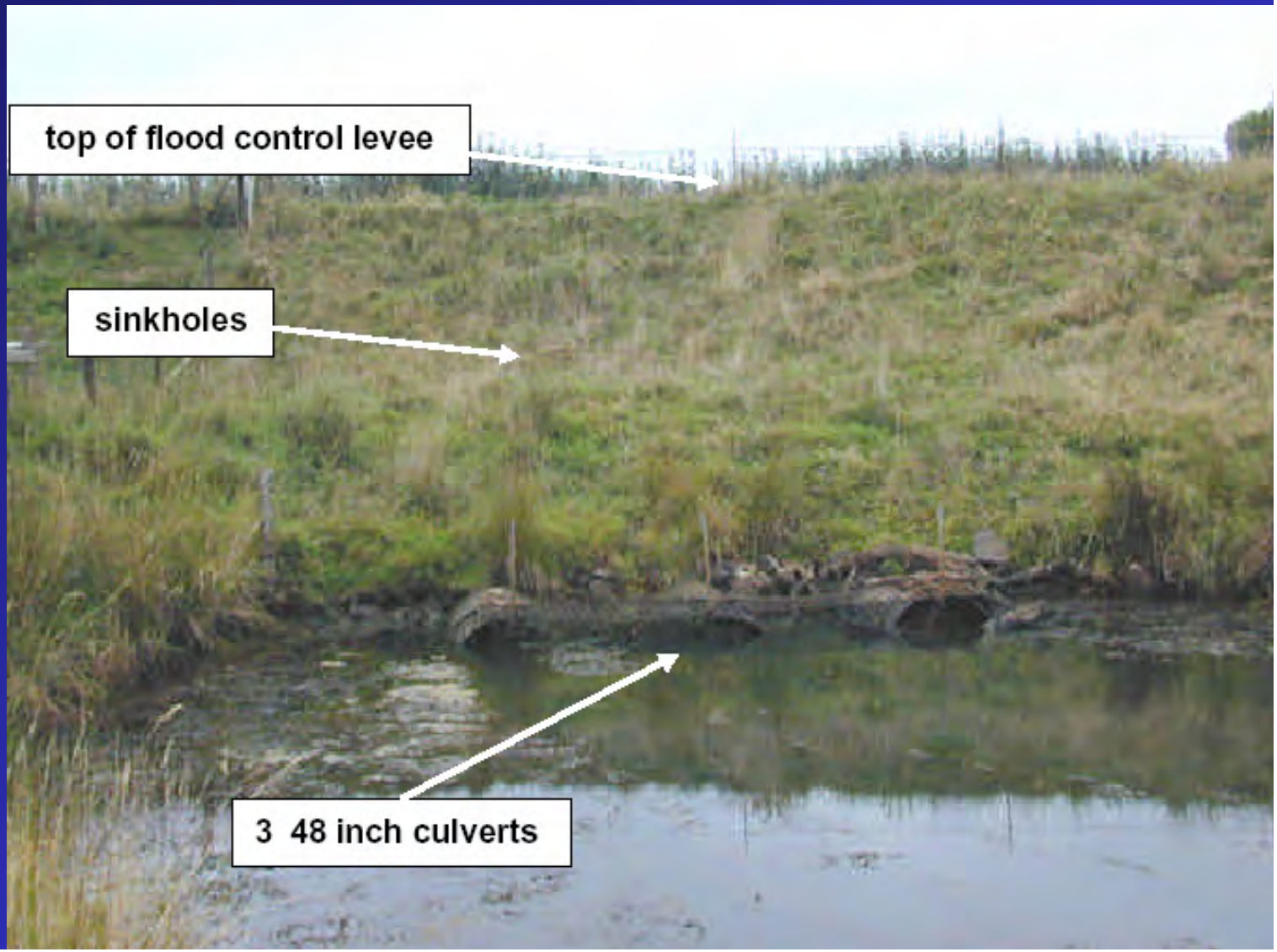
Replacement Tidegate



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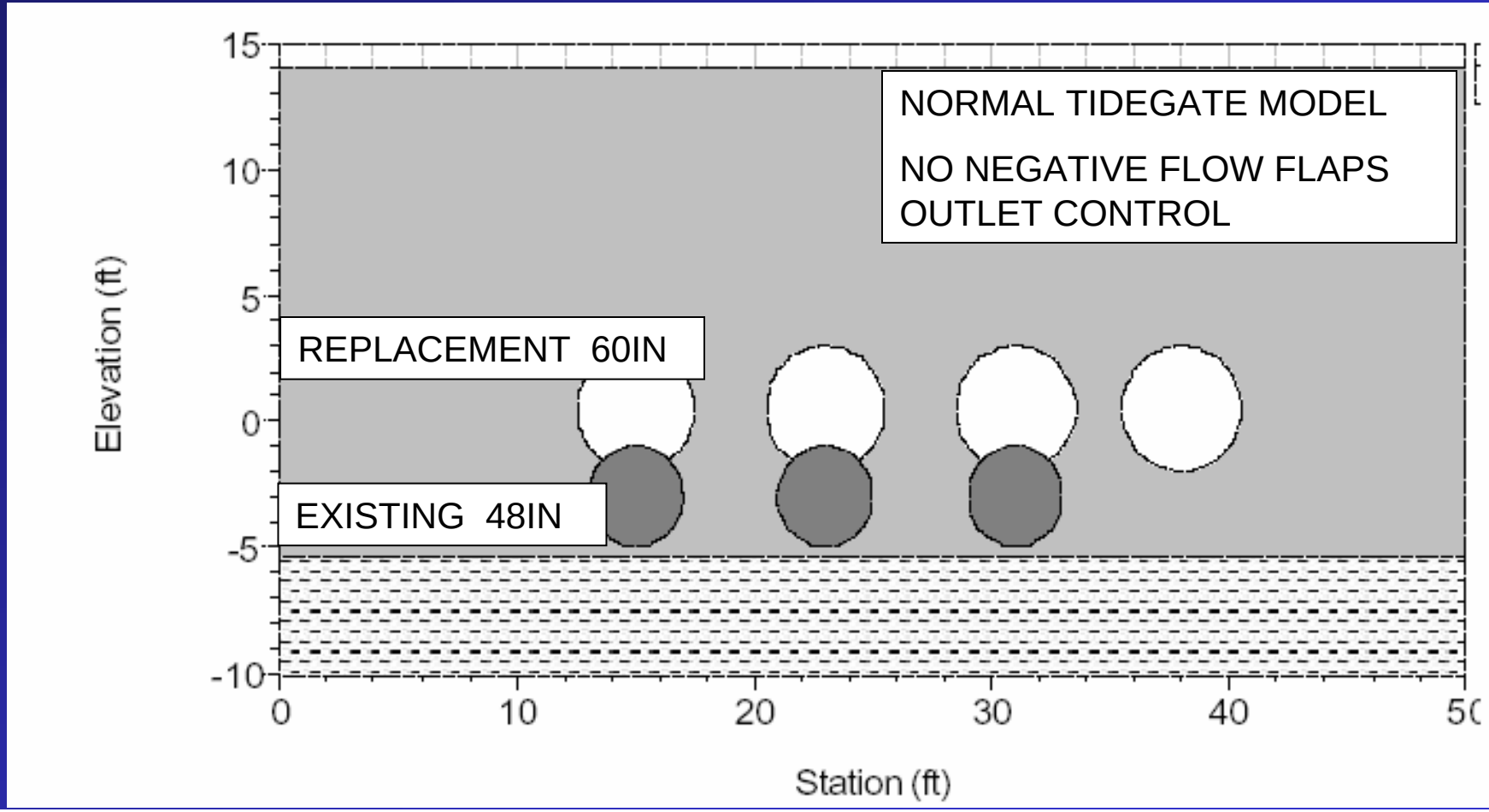
Replacement Tidegate
4 60in culverts/side opening tidegates



Coalbank Slough, Coos Bay

Five foot diameter aluminum tidegates designed by Nehalem Marine. Picture taken December 3, 2002 at 5:03 p.m. Coos Bay low tide -1.4 feet at 6:59 p.m. The side-hinged gate is 3 inches from being fully open. Water beginning to break over downstream control riffle. Shutter speed: 1 second.

Photo courtesy of Leo Kuntz, Nehalem Marine

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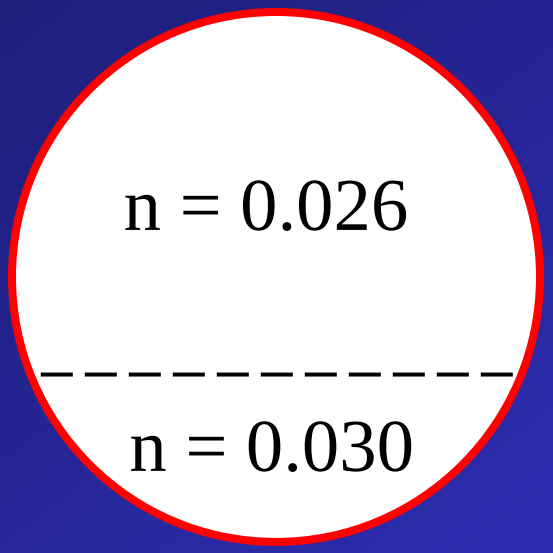
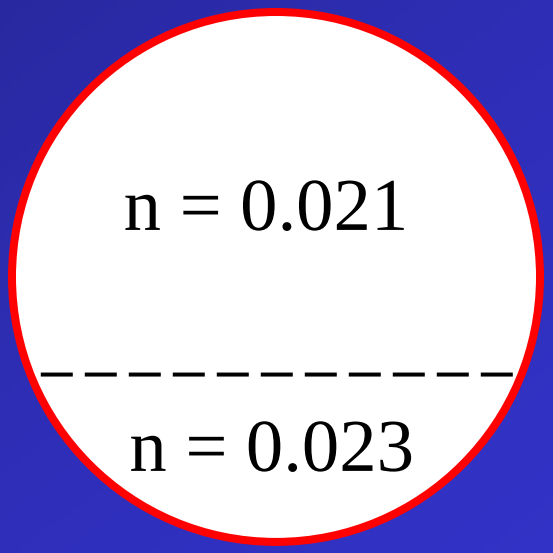
Tidegate Hydraulics

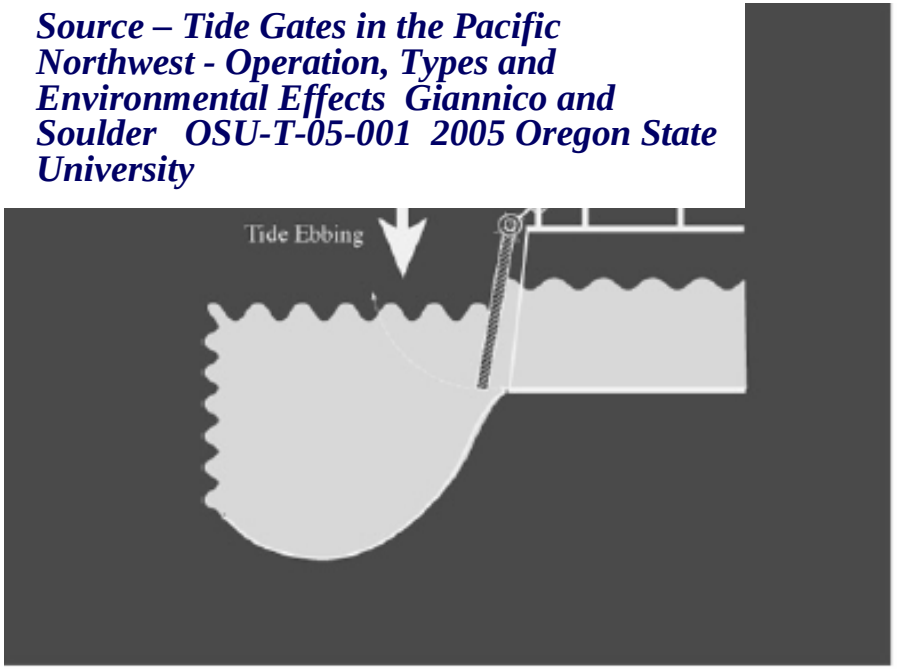
Top opening



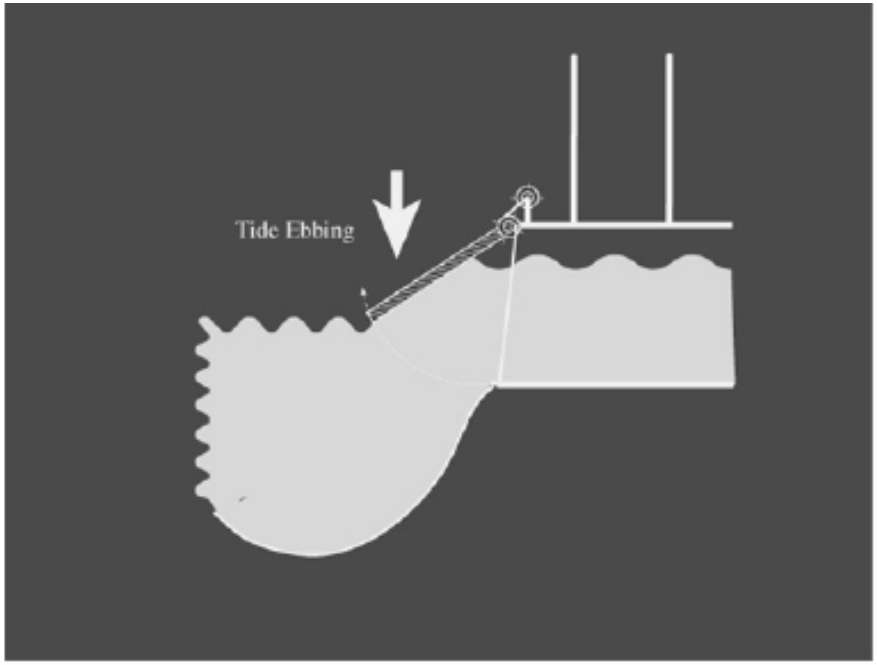
Side opening



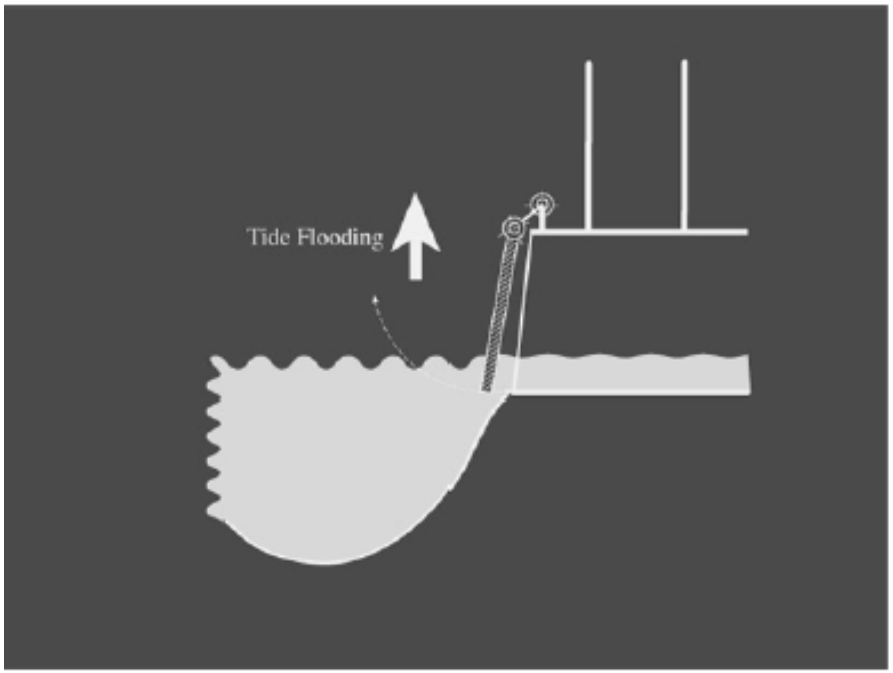
- ***Source – Tide Gates in the Pacific Northwest - Operation, Types and Environmental Effects Giannico and Soulder OSU-T-05-001 2005 Oregon State University***

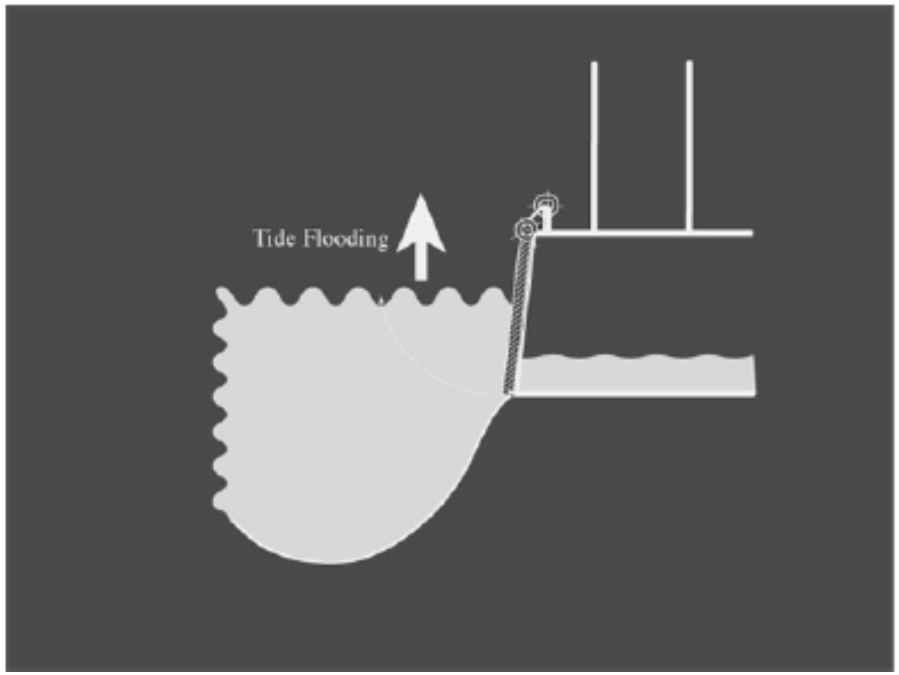


A



B





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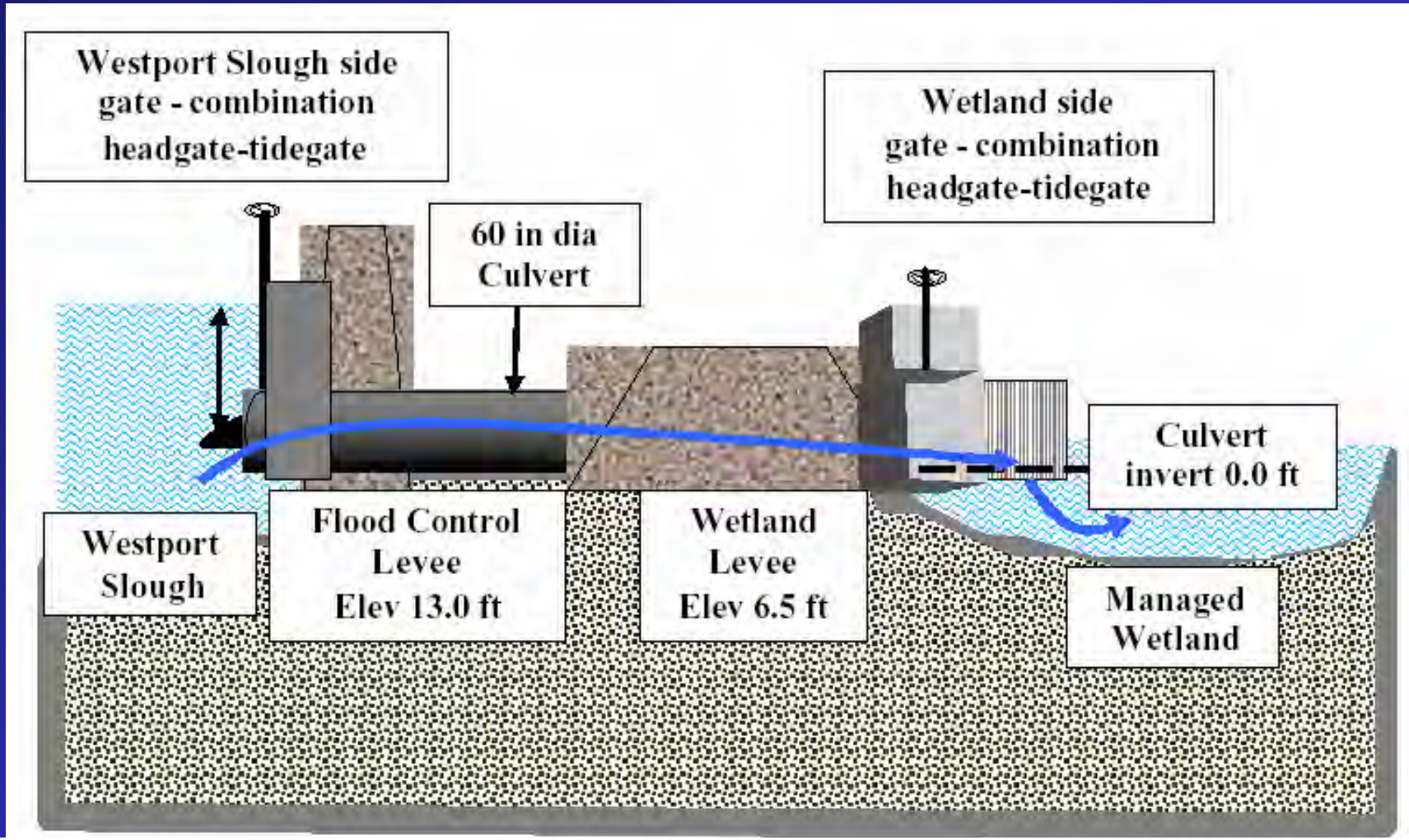
Filling/Flushing Tidegate



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Filling/Flushing Tidegate

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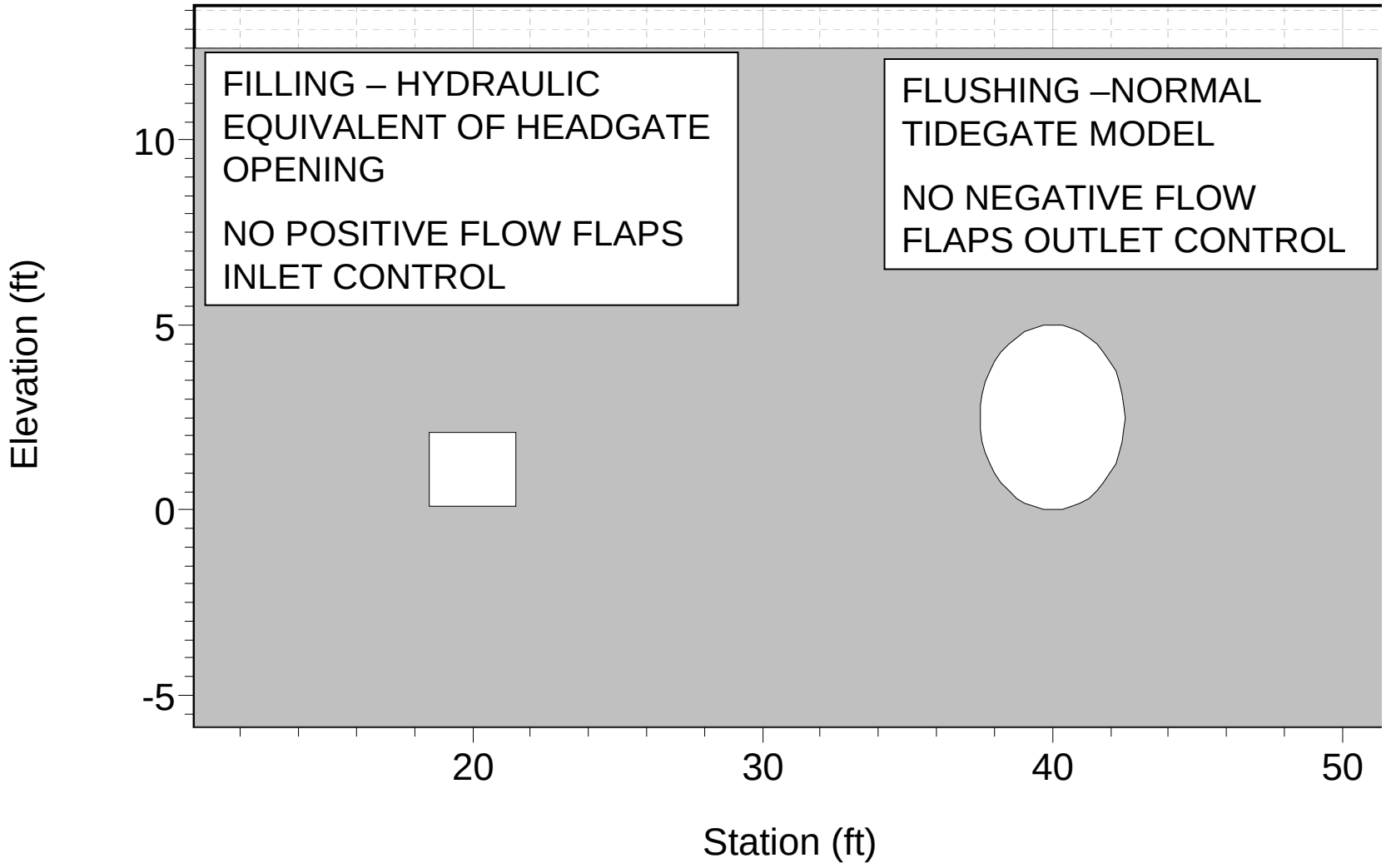
Filling – Flushing Tidegate



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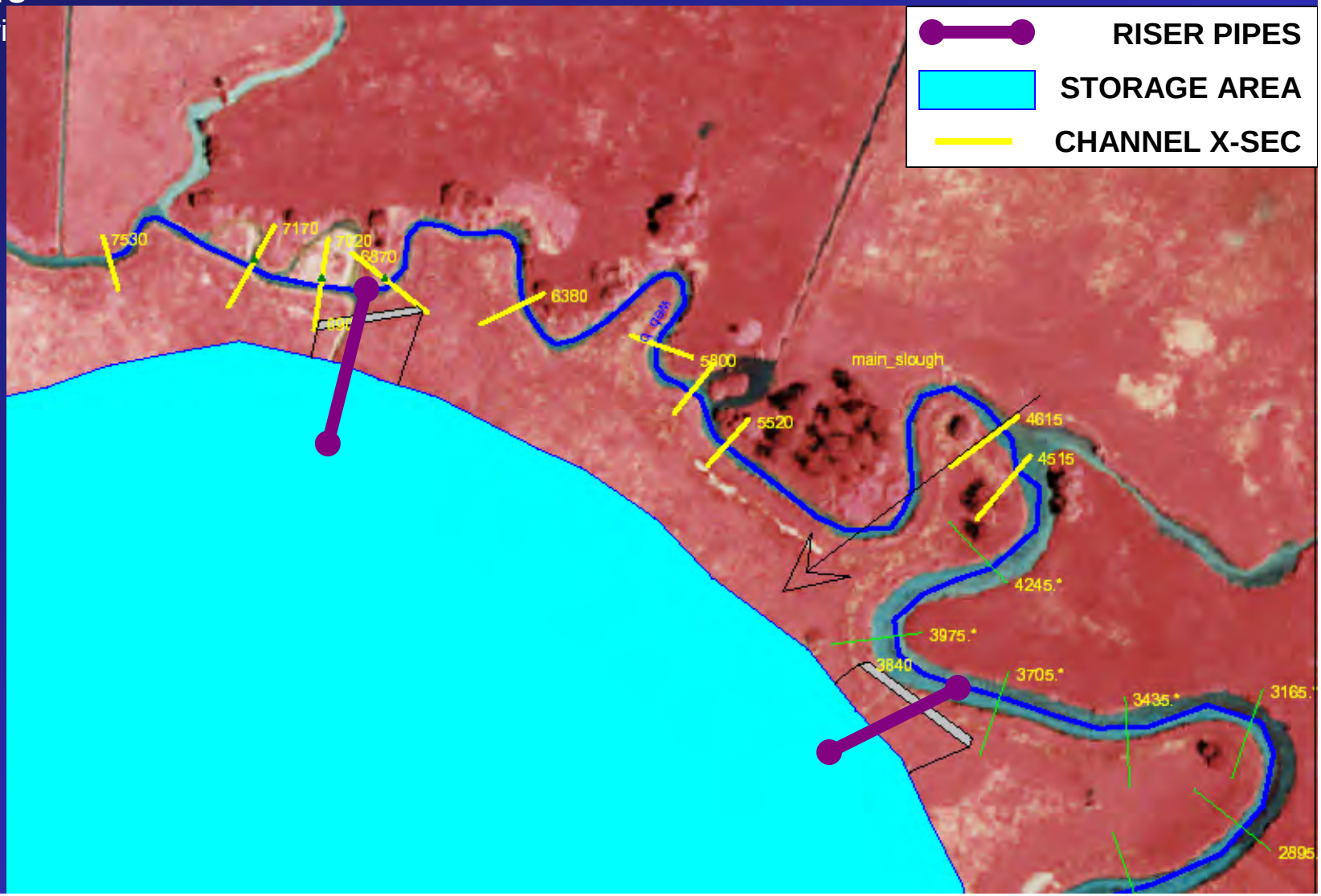
STORAGE AREA CONNECTIONS



Fish Filter – Riser Pipe – Slough Connection

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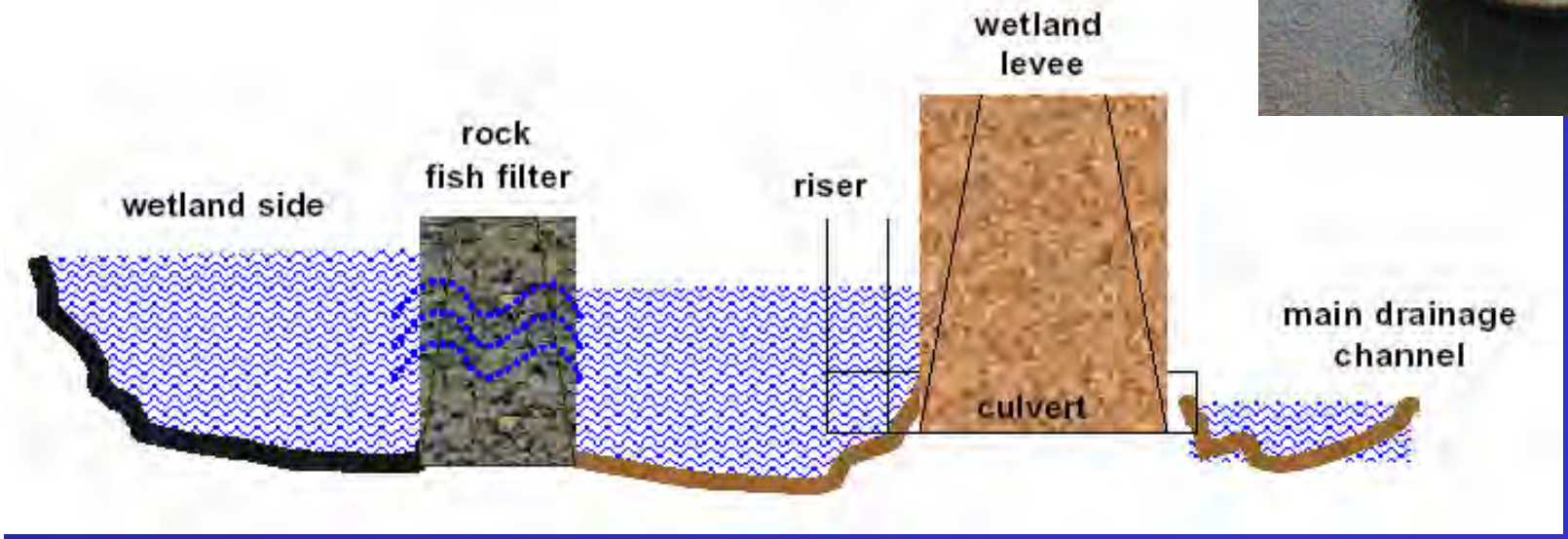

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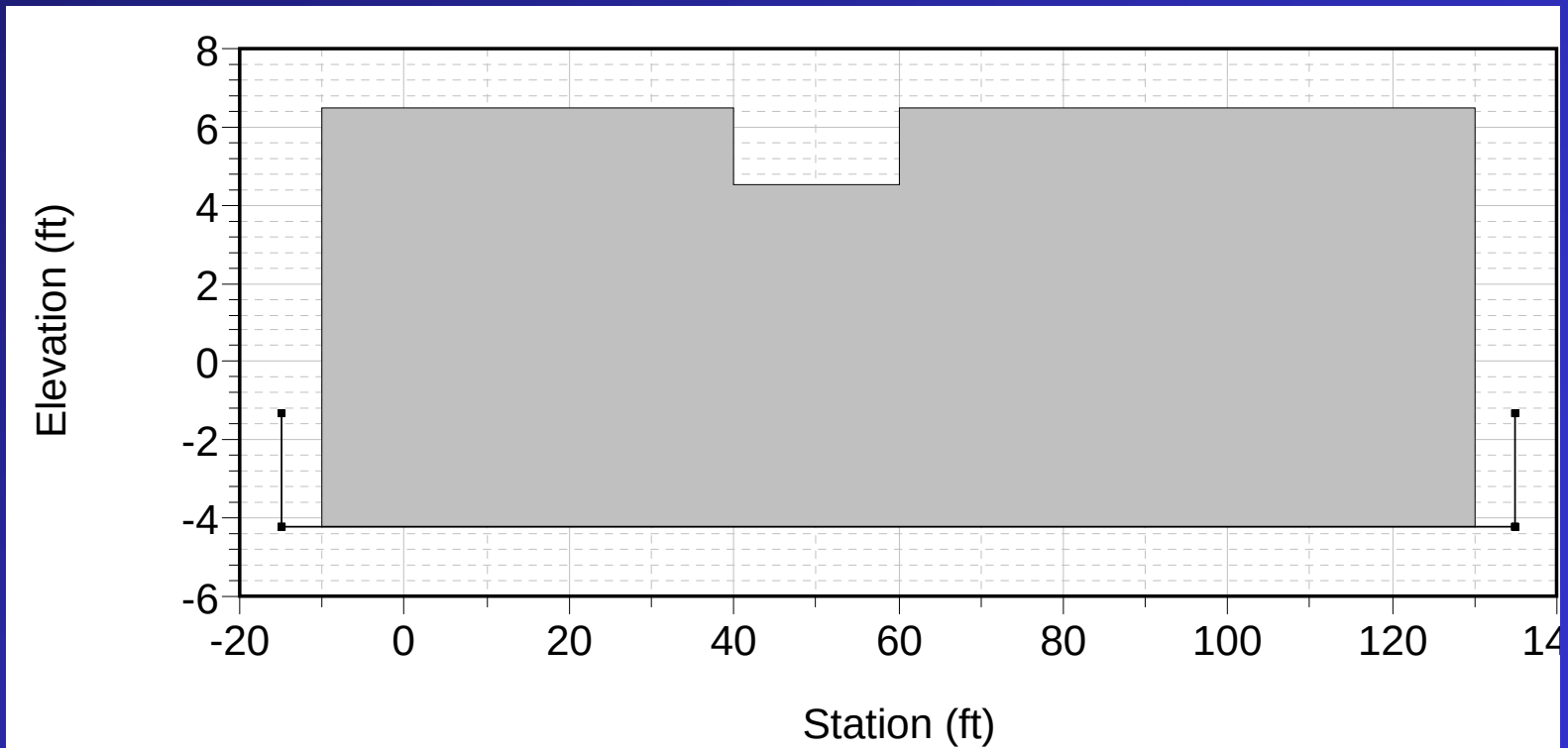
Fish Filter – Riser Pipe – Slough Connection

- Lateral Connection – Storage Area to River Reach
- Weir notch set to desired water level (4.5 feet)



Fish Filter Design

- Volume ~ 10 acre ft/day 10 acft/74 ac = 0.135 ft/day (1.62 in) variation of water level in pond
- Desired Flow Rate through filters ~ 25 cfs

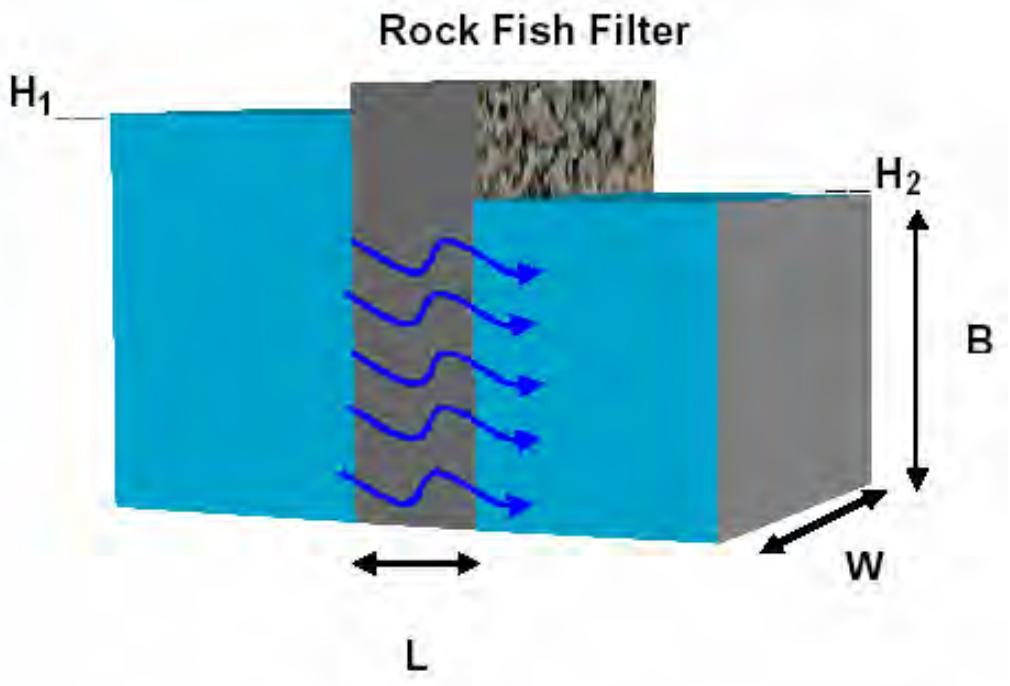
$$\frac{\textbf{10 ac ft}}{\textbf{5 hr}} = \textbf{24.2 cfs} \sim \textbf{25 cfs}$$

Darcy's Law Application to Fish Filter Design

- **Q = k x i x A**
- **H_1 = 5.5 ft**
- **H_2 = 4.5 ft**
- **Lavg = 18.5 ft**
- **$I = \frac{H_1 - H_2}{Lavg}$**

Assumed hydraulic conductivity of rock filter k

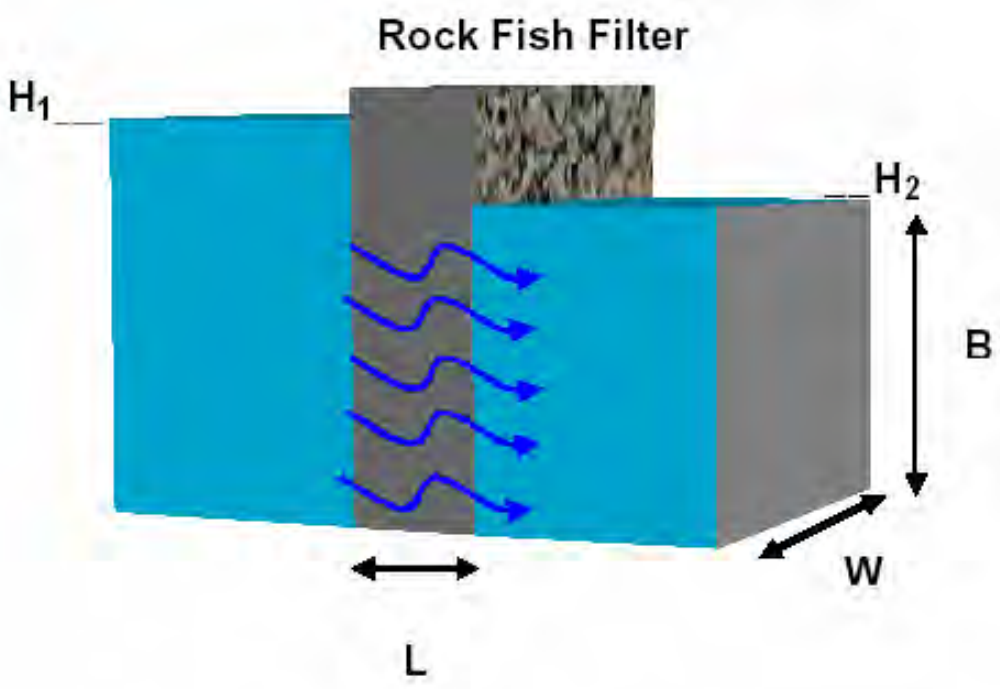
k = 2 in/sec (5 x 10^{-1} m/sec)



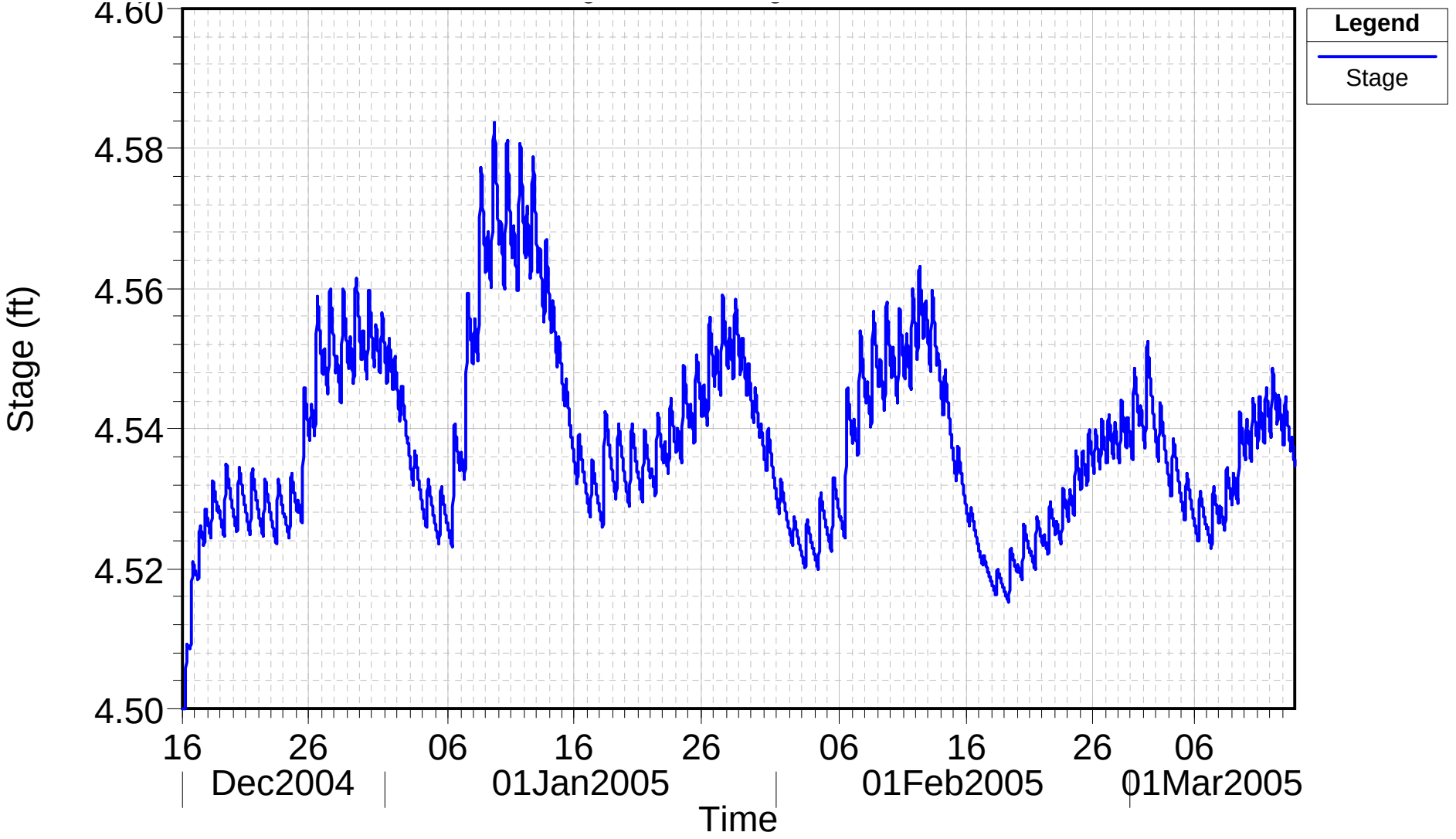
Darcy's Law Application to Fish Filter Design

- Cross sectional area needed to pass 25 cfs
  A = Q / k x i
- **B = 4.5 ft** Design water level in wetland = saturated thickness of filter ***B***
- Lineal feet of rock filter needed **L_{filter} = A/B**
- **Solve for footprint of filter using area of semi circle**

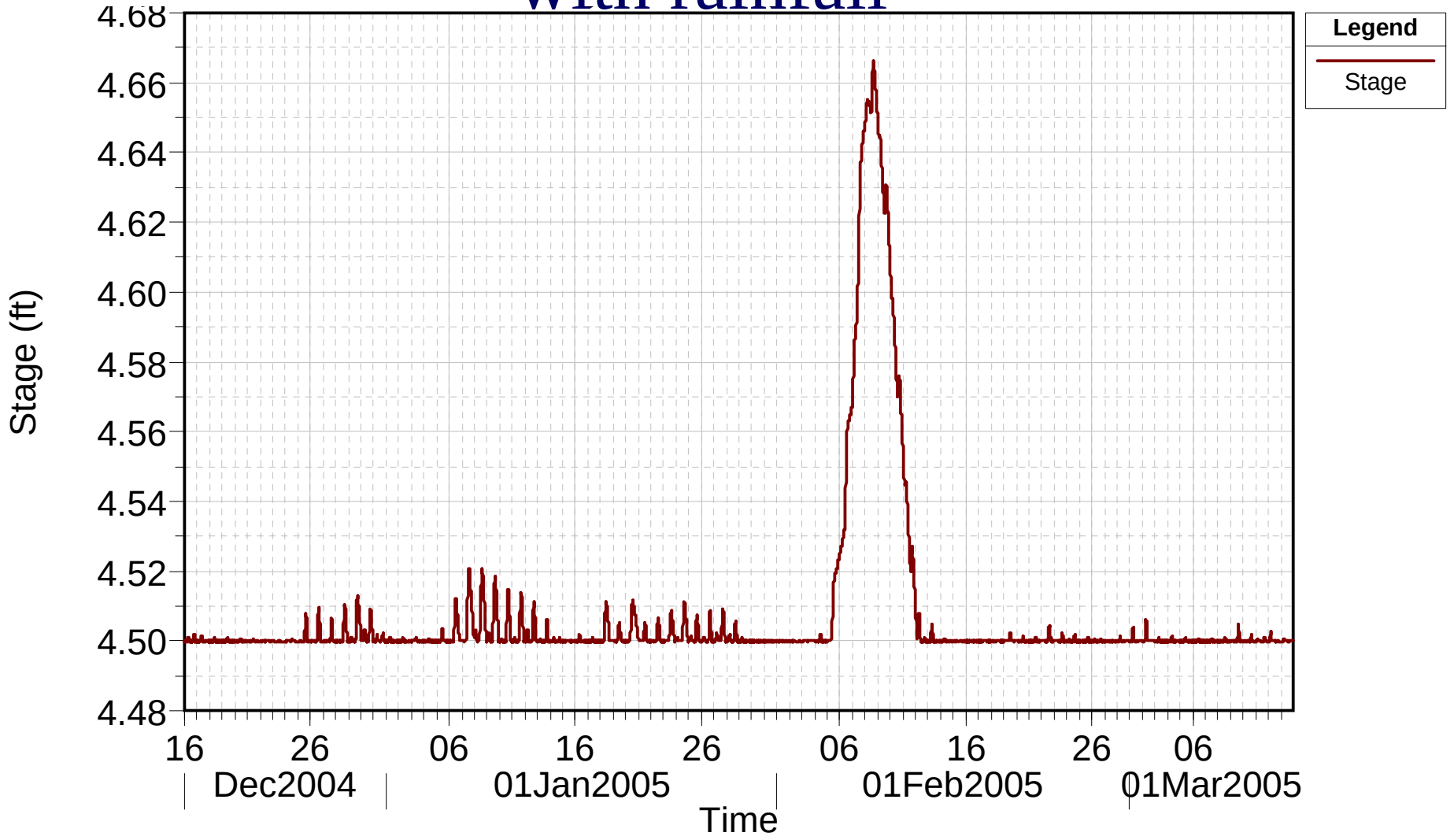
Inlet fish filter 1.3 ac Outlet fish filters 0.65 ac ea



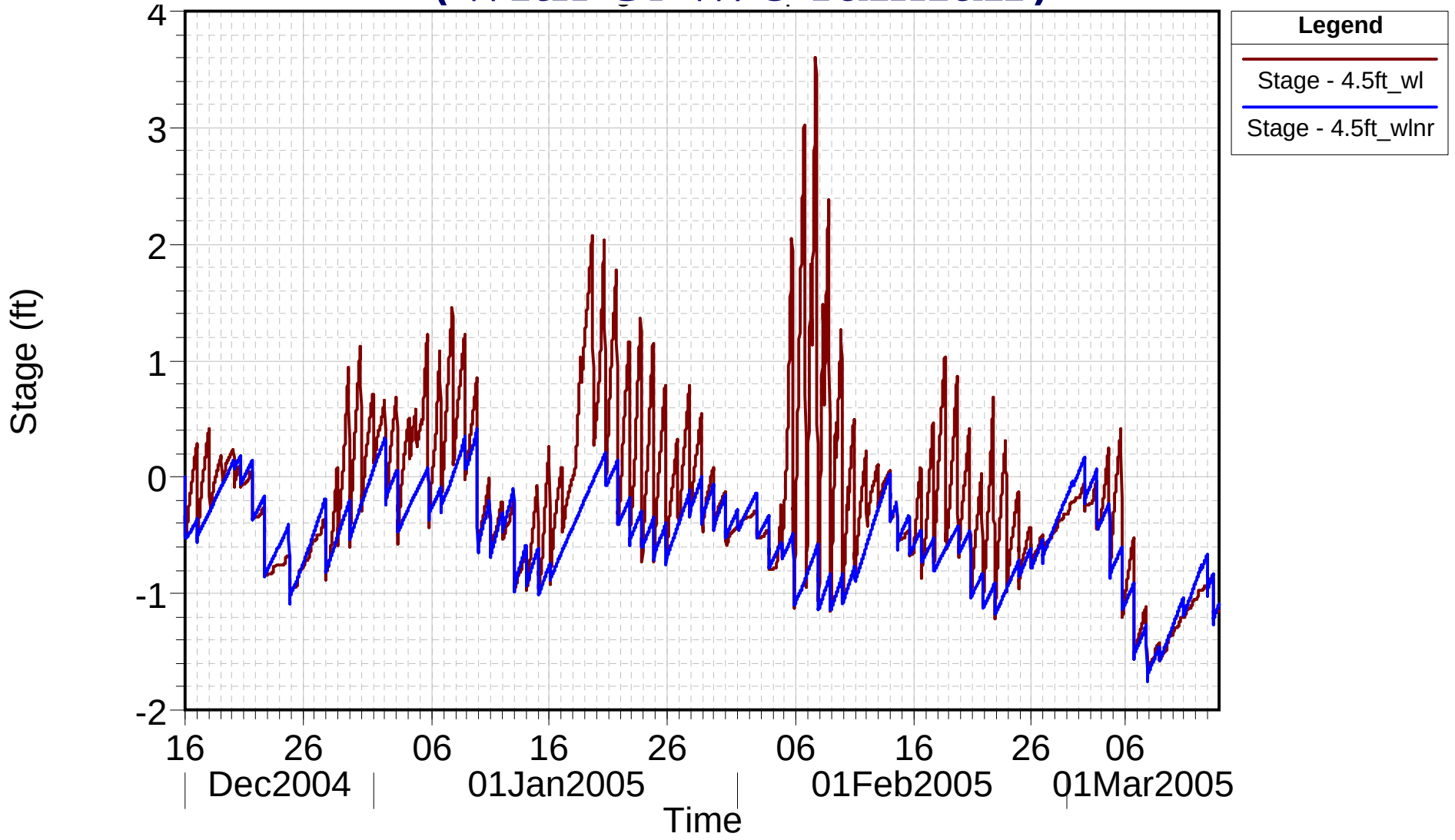
HEC RAS output
Managed Wetland Water Level – no rainfall



HEC RAS output
Managed Wetland Water Level – with rainfall



HEC RAS output
Main Drainage Channel Water Level
(with & w/o rainfall)



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Tidegate Hydraulic Studies and Information

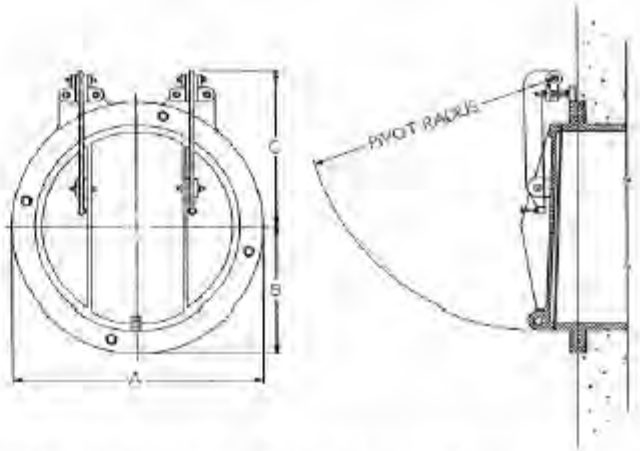
- University of Louisiana Lafayette

Laboratory Experimental Study for the Hydraulics and Structural Performance of Flap Gates

Sponsor: Louisiana Department of Natural Resources

Brief Description:

The objective of this laboratory experiment is to test the hydraulic and structural performance of flap gates, which is a widely used structure in coastal Louisiana. It is mainly used to control the progression of salinity within Louisiana's coastal wetlands. A quantitative measure of energy losses through flap gates is not precisely known. Published literature discussing such losses is quite scarce and fairly outdated.



The two figures shown in this page are typical examples of flap gates used in coastal Louisiana. The proposed study herein will investigate and quantify the head losses due to the gate's own weight, the friction of the gate's bearing, and the flow turbulence downstream of the gate. Chart, tables, and possibly equations describing and quantifying such losses will be documented and provided to Louisiana Department of Natural Resources (LDNR). This document will be valuable for performing detailed data analysis of field observations, and for calibrating numerical models.

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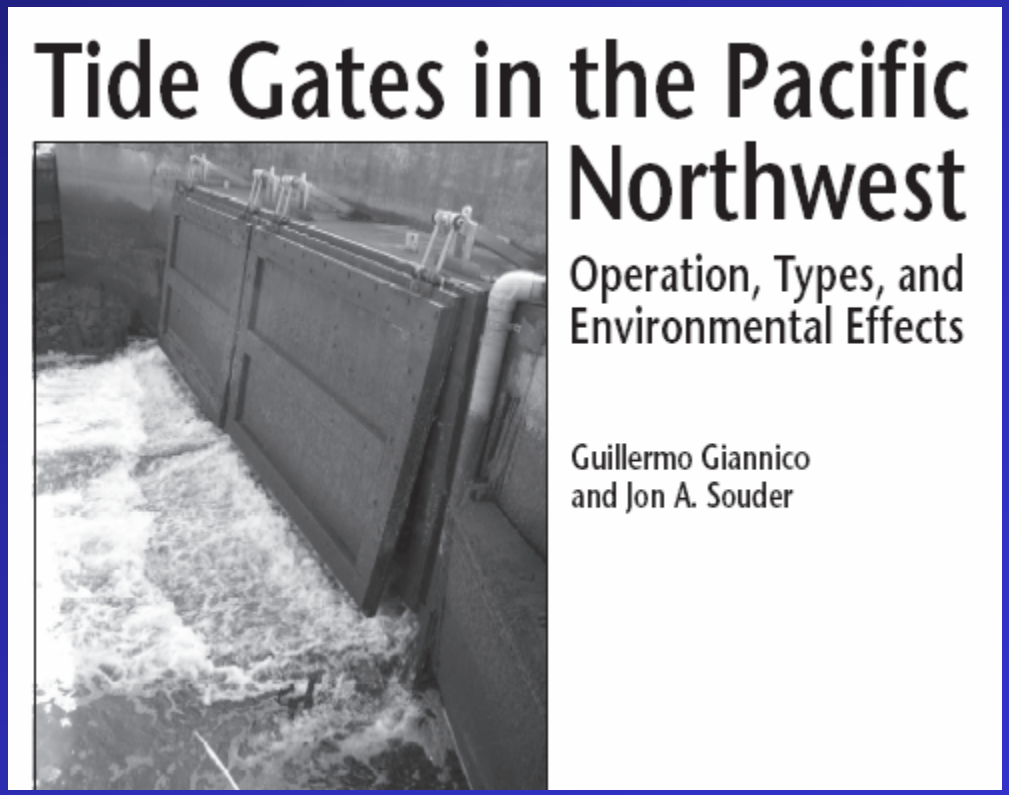
Tidegate Hydraulic Studies and Information

- Oregon State University- available on line



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Julia Butler Hansen NWR Biological Monitoring

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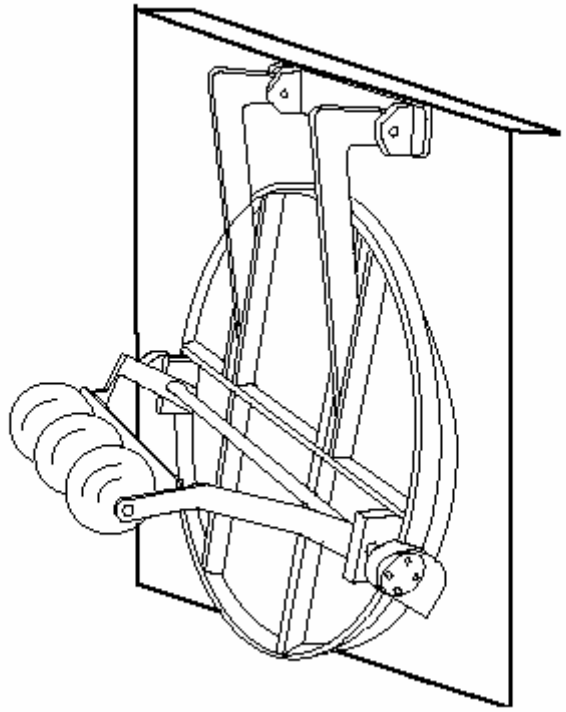
Portland District

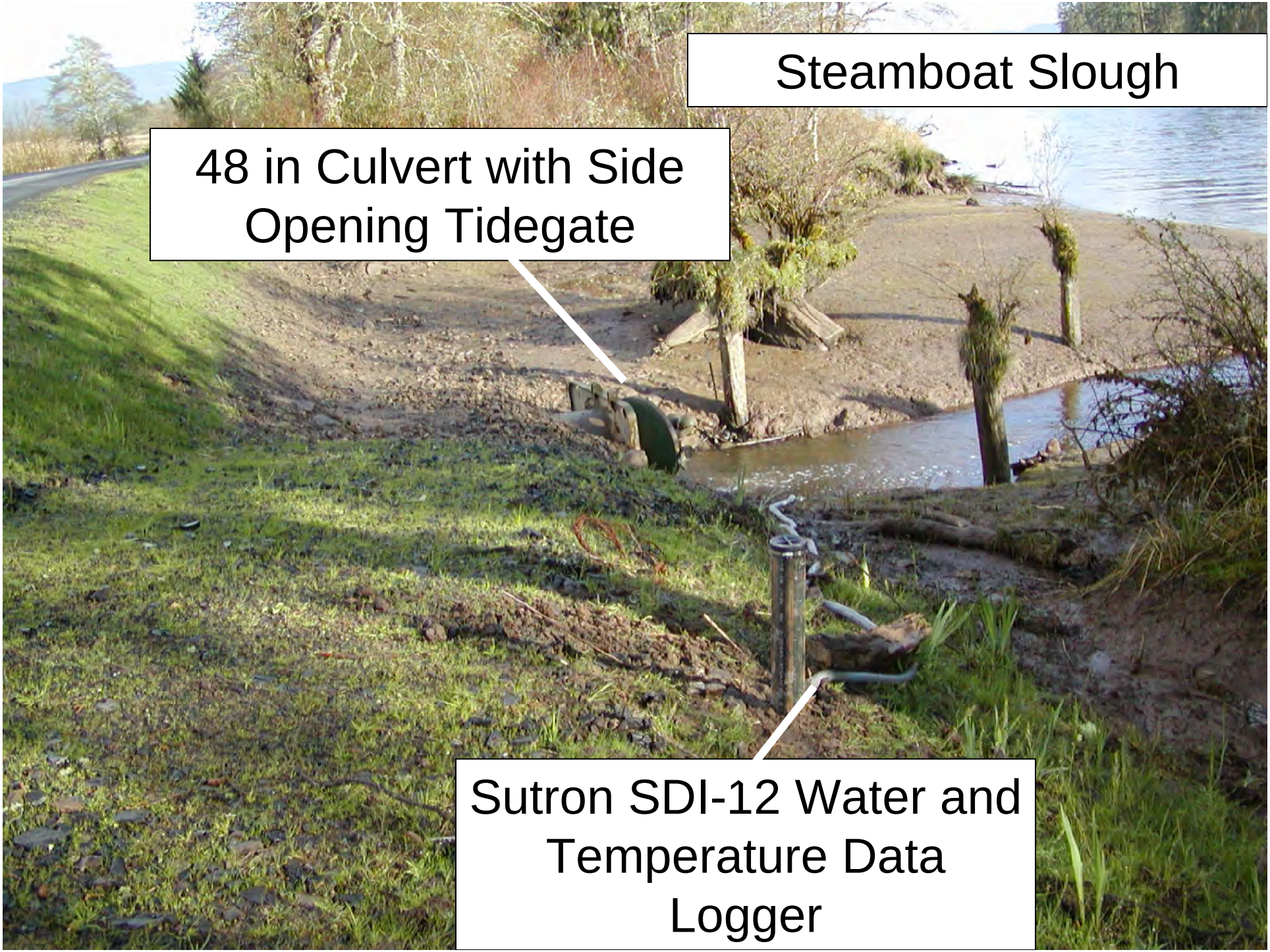
Modeling and Output Presentation for Environmental Compliance and Permitting

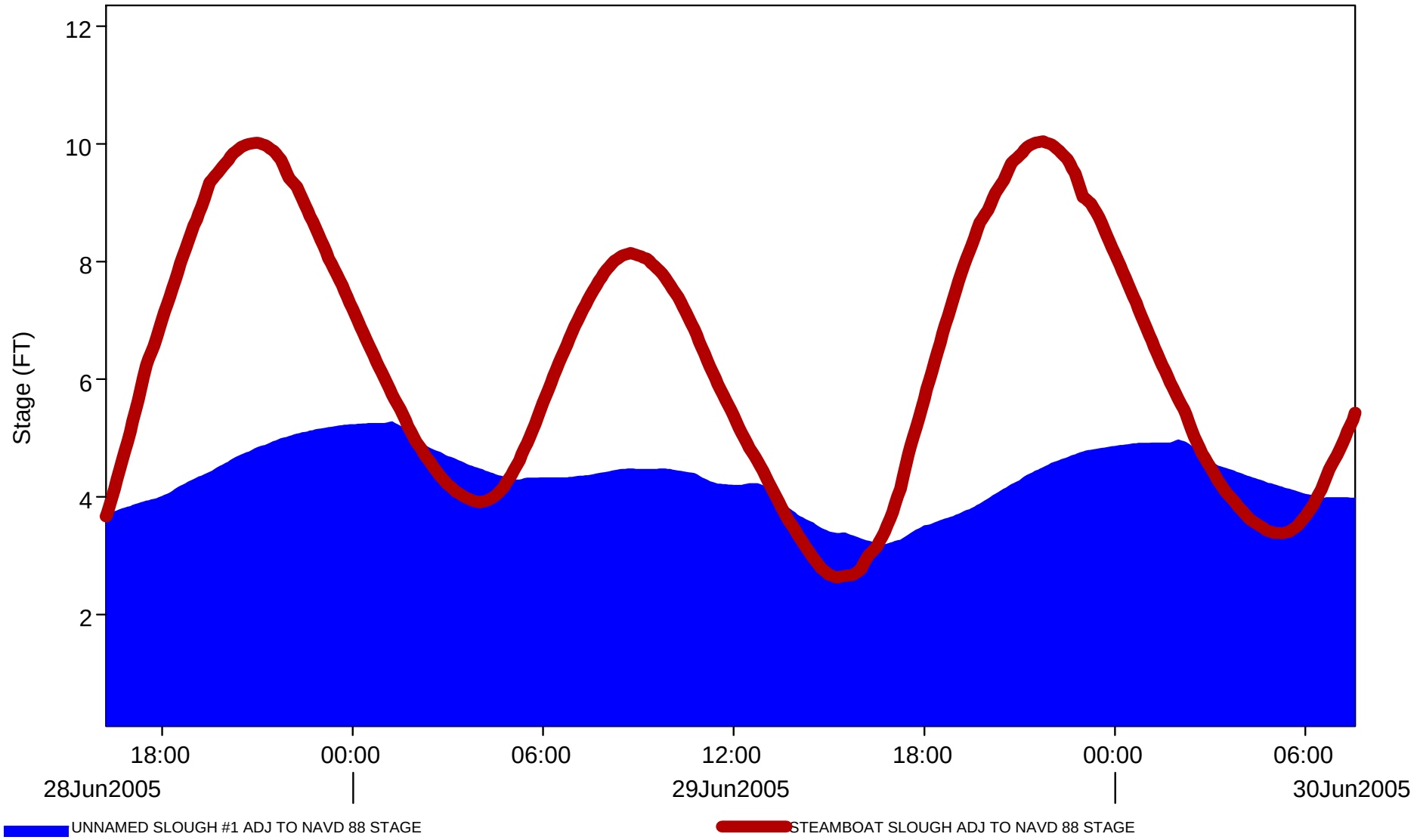
- Resource agencies want details of tidegate performance
- When are tidegates open ?
- How long – time windows ?
- Velocity data important – fish passage criteria…
- Develop presentation of data to answer questions
- Muted tidegate questions – how much backflow ?

“Muted” Tidegates

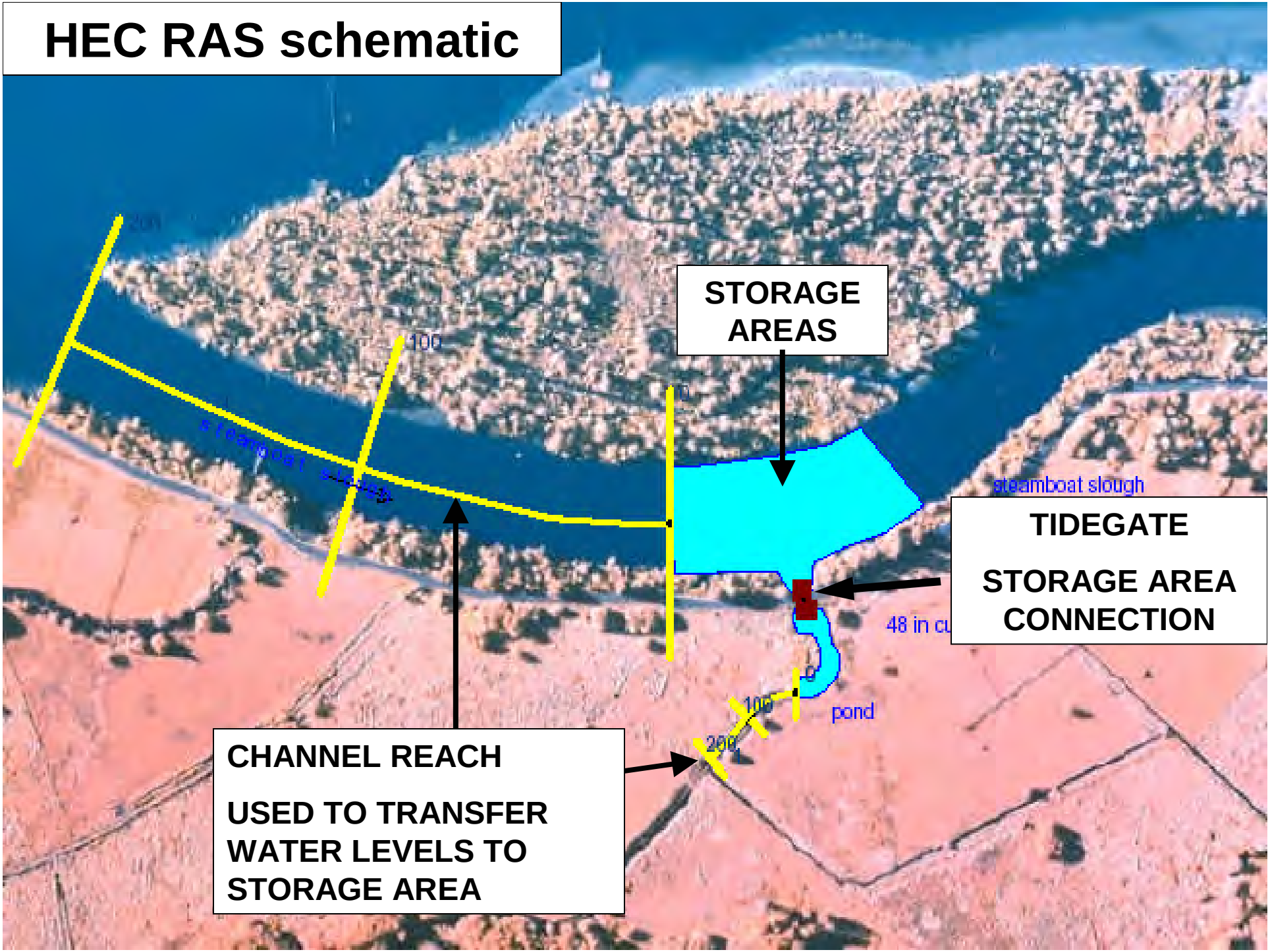
- The “mitigator”
- Invented by Leo Kuntz, NEHALEM MARINE
- JBHNWR model is side hinged
- Floats connected to cam which prevent the tidegate to completely close
- Allows some water to move upstream against past the tidegate




Steamboat Slough
48 in Culvert with Side Opening Tidegate
Sutron SDI-12 Water and Temperature Data Logger


12
10
8
6
4
2
Stage (FT)
18:00
00:00
06:00
12:00
18:00
00:00
06:00
28Jun2005
29Jun2005
30Jun2005
UNNAMED SLOUGH #1 ADJ TO NAVD 88 STAGE
STEAMBOAT SLOUGH ADJ TO NAVD 88 STAGE

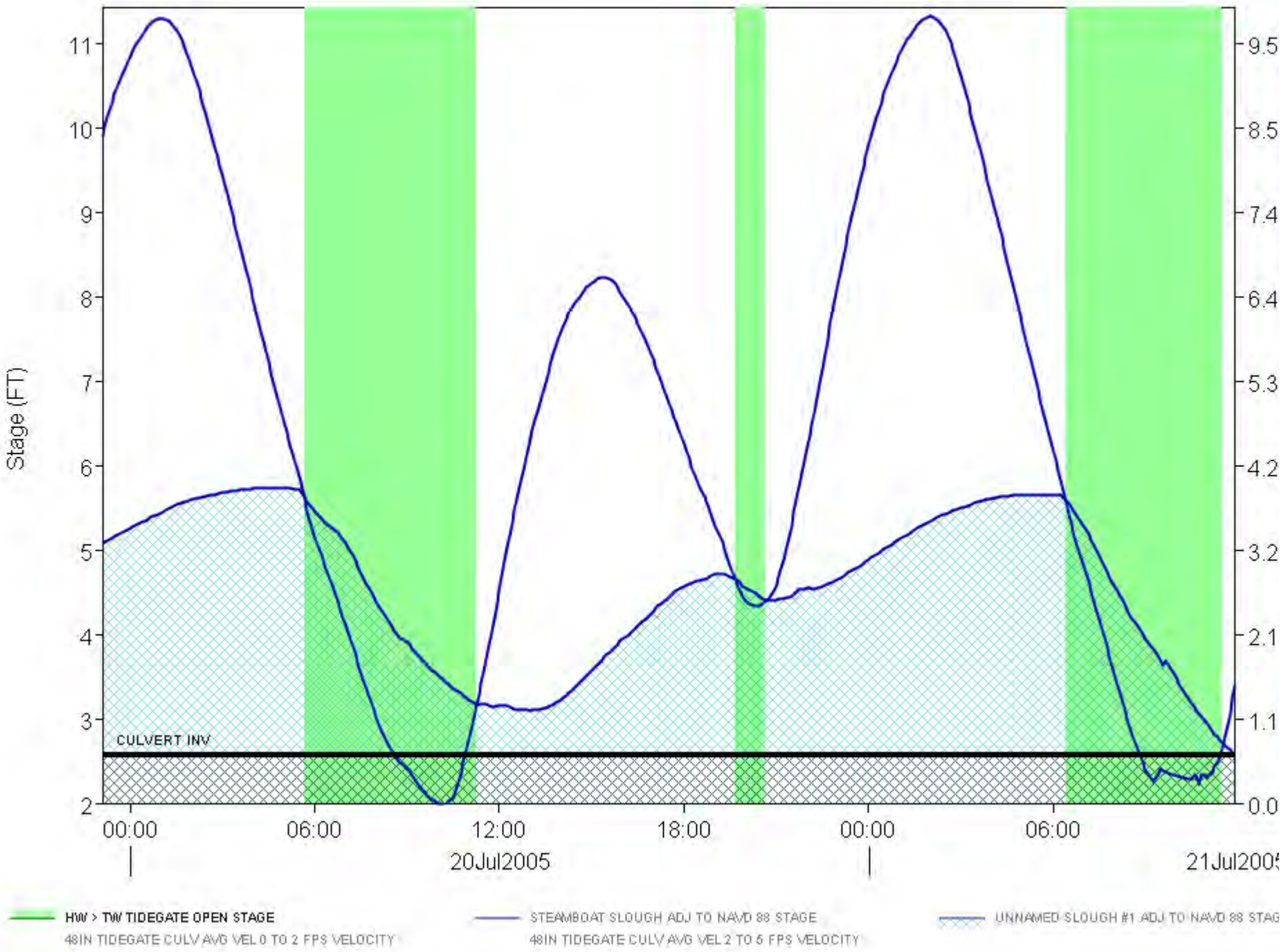
HEC RAS schematic

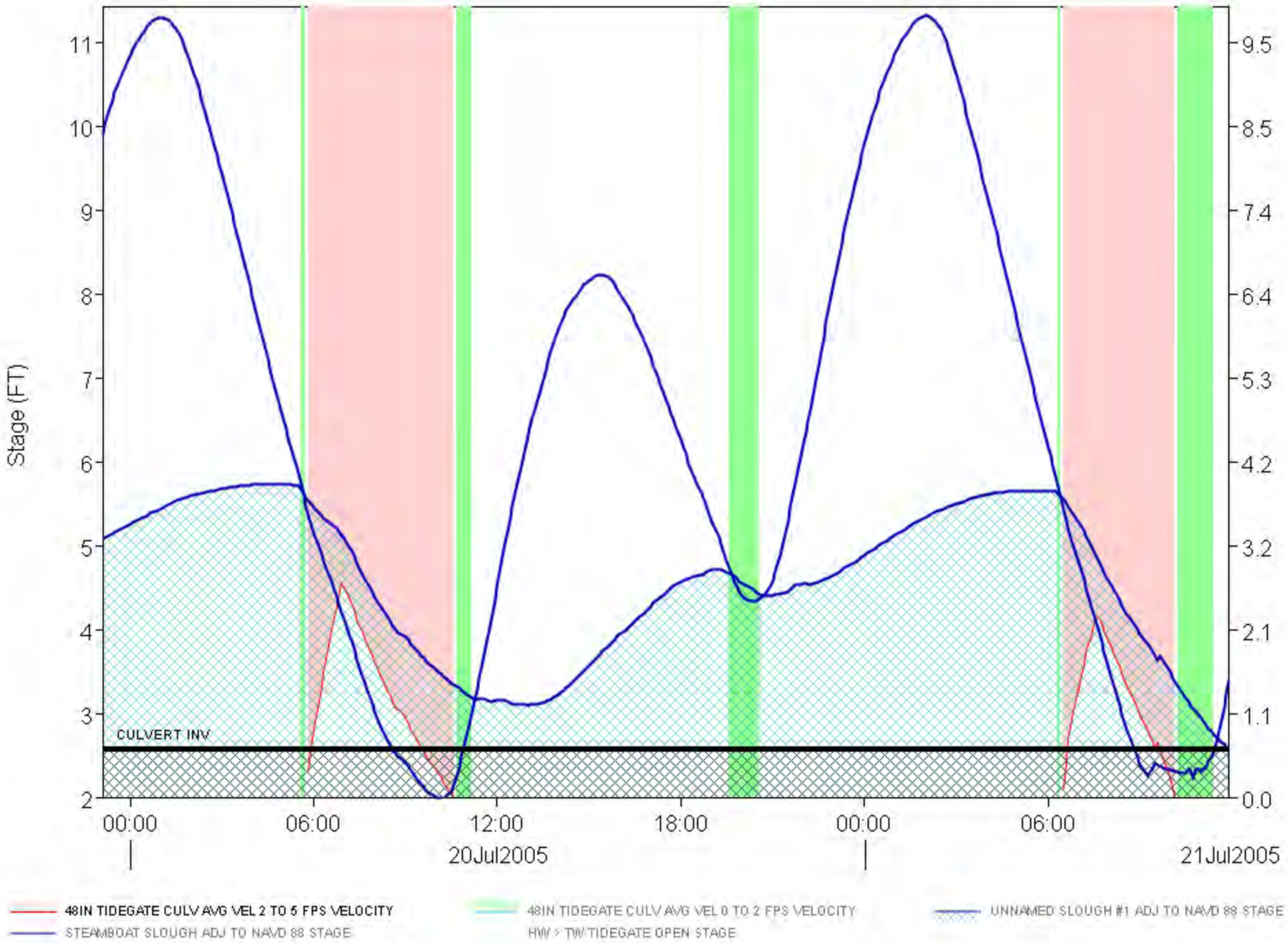


Average Water Velocities required at high flow in Oregon to ensure upstream passage of Salmon and Steelhead

Culvert Length	Adult Salmon and Steelhead	Juvenile Salmon and Steelhead
<60 ft (<18.3 m)	6 ft/sec (1.83 m/sec)	2 ft/sec (0.61 m/sec)
60–100 ft (18.3–30.5 m)	5 ft/sec (1.52 m/sec)	2 ft/sec (0.61 m/sec)
100–200 ft (30.5–61 m)	4 ft/sec (1.22 m/sec)	---
200–300 ft (61–91.5 m)	3 ft/sec (0.92 m/sec)	---
>300 ft (>91.5 m)	2 ft/sec (0.61 m/sec)	---

- ***Source – Tide Gates in the Pacific Northwest - Operation, Types and Environmental Effects Giannico and Soulder OSU-T-05-001 2005 Oregon State University***
  http://seagrant.oregonstate.edu


Stage (FT)
11
10
9
8
7
6
5
4
3
2
9.5
8.5
7.4
6.4
5.3
4.2
3.2
2.1
1.1
0.0
CULVERT INV
00:00
06:00
12:00
18:00
00:00
06:00
20Jul2005
21Jul200
HW > TW TIDEGATE OPEN STAGE
48IN TIDEGATE CULV AVG VEL 0 TO 2 FPS VELOCITY
STEAMBOAT SLOUGH ADJ TO NAVD 88 STAGE
48IN TIDEGATE CULV AVG VEL 2 TO 5 FPS VELOCITY
UNNAMED SLOUGH #1 ADJ TO NAVD 88 STAG


Stage (FT)
11
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5.3
4.2
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CULVERT INV
00:00
06:00
12:00
18:00
00:00
06:00
20Jul2005
21Jul2005
48IN TIDEGATE CULV AVG VEL 2 TO 5 FPS VELOCITY
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UNNAMED SLOUGH #1 ADJ TO NAVD 88 STAGE
STEAMBOAT SLOUGH ADJ TO NAVD 88 STAGE
HW > TW TIDEGATE OPEN STAGE

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Documents and Publications

- Webb H&H report
  https://www.nwp.usace.army.mil/issues/crcip/cms/docs/webb/webbhhreport.pdf
- MGSFlood software & manuals (WHAM)
  https://www.nwp.usace.army.mil/issues/crcip/cms/docs/webb/webbhhreport.pdf
- OSU Tidegate Report
  http://seagrant.oregonstate.edu/sgpubs/onlinepubs/t05001.pdf

Developing Reservoir Operational Plans to Manage Erosion and Sedimentation during Construction – Willamette Temperature Control, Cougar Reservoir 2002-2005

Patrick S. O'Brien, PE CENWP-EC-HY

patrick.s.o'brien@usace.army.mil

Dr. Terry M Sobecki ERDC-EL-MS

Dr. David M. Soballe ERDC-EL-MS

Dr. John Hains ERDC-EL-MS

Willamette Basin
(McKenzie, Santiam, Clackamas, Yamhill & Tualatin)
Columbia R.
Portland
Portland
Scoggins
Tualatin R.
Dilley
Farmington
Clackamas R.
N. Yamhill R.
Willamette R.
McMinnville
Aurora
Canby
Faraday
North Fork
S. Yamhill R.
Pudding R.
Molalla R.
Salem
Salem
Oak Grove
Timothy
Lackamute R.
Jefferson
Suver
North Santiam
Mehama
Big Cliff
Detroit
Albany
Waterloo
Marys R.
Corvallis
Philomath
Middle Santiam R.
South Santiam R.
Green Peter
Foster
Monroe
Willamette R.
Harrisburg
Fern Ridge
Blue River
Carmen-Smith
McKenzie R.
Vida
Leaburg
Eugene
Cougar
Fall Creek
Jasper
Dexter
North Fork
Goshen
Lookout Point
Dorena
Row R.
Coast Fk.
Hills Creek
Cottage Grove

Sediment Management Below Reservoirs

- Wash load may be a problem when there is too much
- Cougar
- Mount St Helens Sediment Retention Structure

Sediment Change 2003 to 2005

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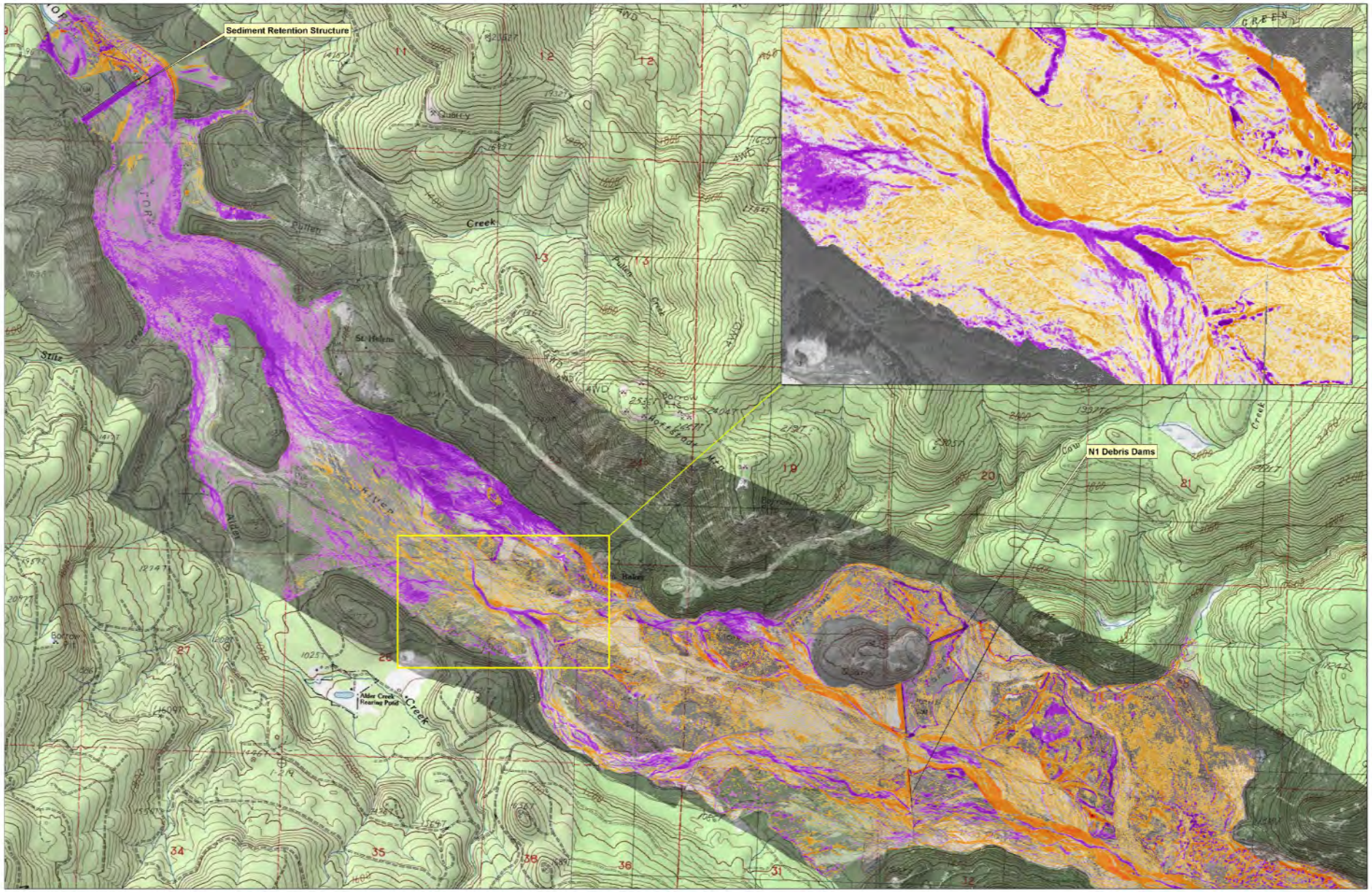


Need for Temperature Control

- Spring/Summer: High Pool, very cold deep water is drawn from bottom intakes of existing tower, causes downstream cold spikes reducing migration of Spring Chinook
- Fall/Winter: Low Pool, cold reservoir is used up, water becomes mixed, water warmer than pre dam, causes prespawn mortality, premature fry emergence.
- Selective withdrawal operations will restore a more natural temperature cycle.

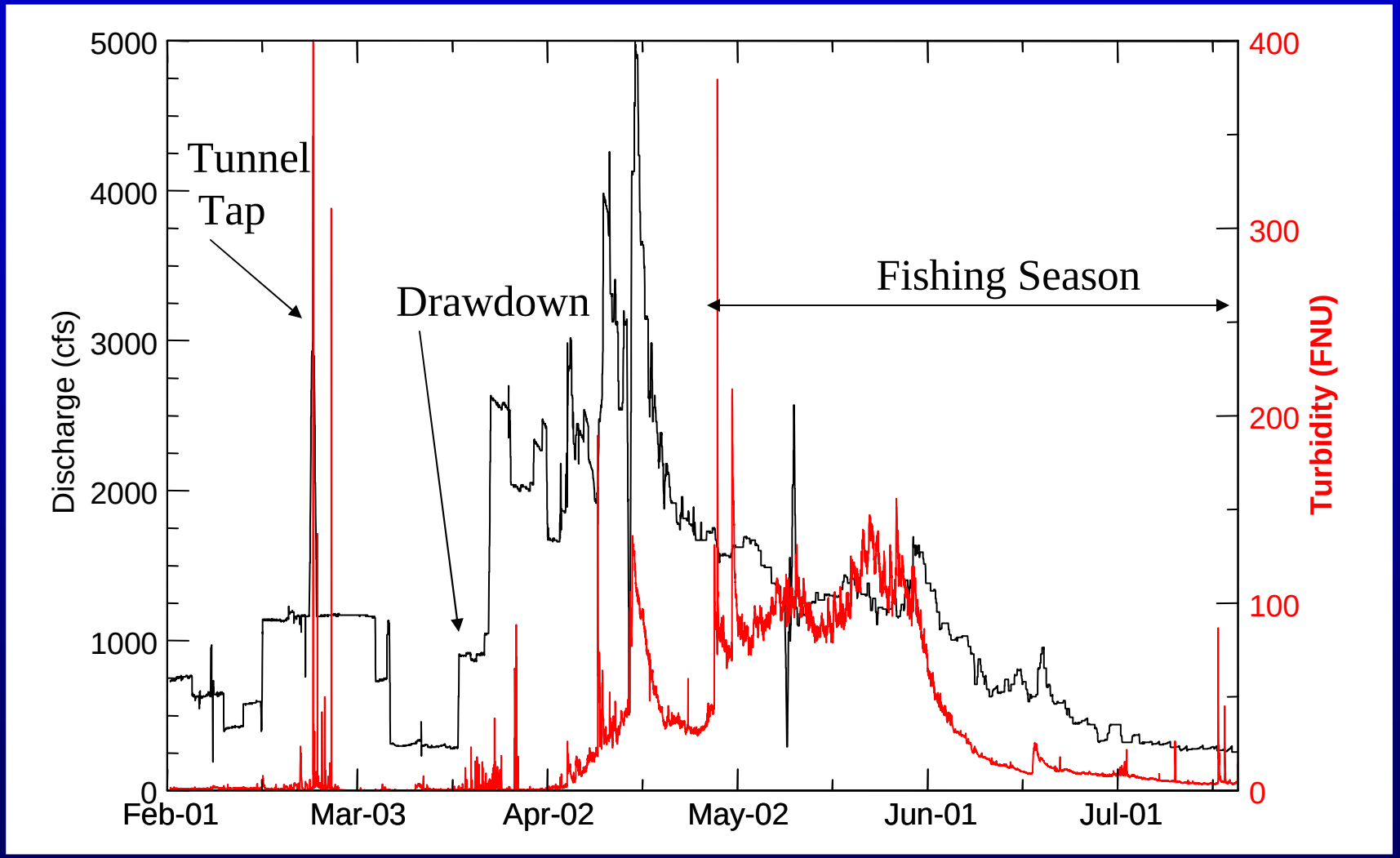
Old Tower - New Tower

Initial Drawdown to Construction Pool February – June 2002

- Concrete plug to Diversion tunnel opened on February 23
- Drawdown proceeded at 3 feet/day until May 26
- Reservoir turbidity increased during drawdown, causing high turbidity downstream of the dam
- Projected turbidity averaged 30 NTU, with spikes to 100 NTU
- Actual turbidity averaged 85-100 NTU, peaks of 130 – 225 NTU, spikes ~ 1000 NTU

Downstream Effect of Drawdown

(Data from S. Frk. McK. Riv.)



Turbid Water in Mckenzie R, Summer 2002

Downstream Impacts of Turbidity - Public Concerns

- Severe impact to fly fishing season
- Impacts to fishery, macro invertebrates, salmonid spawning gravels
- Concerns over volume of sediment released and amount deposited downstream
- Concerns over drinking water quality
- Concerns over the possibility of DDT contamination from Cougar sediment releases
- Comments solicited from public through public meeting process
- Corps regulations for implementing NEPA provide for publishing additional supplemental information documents on long-term or complex Environmental Impact Statements (EISs) to keep the public informed.

Willamette Temperature Control
McKenzie River Sub-Basin, Oregon

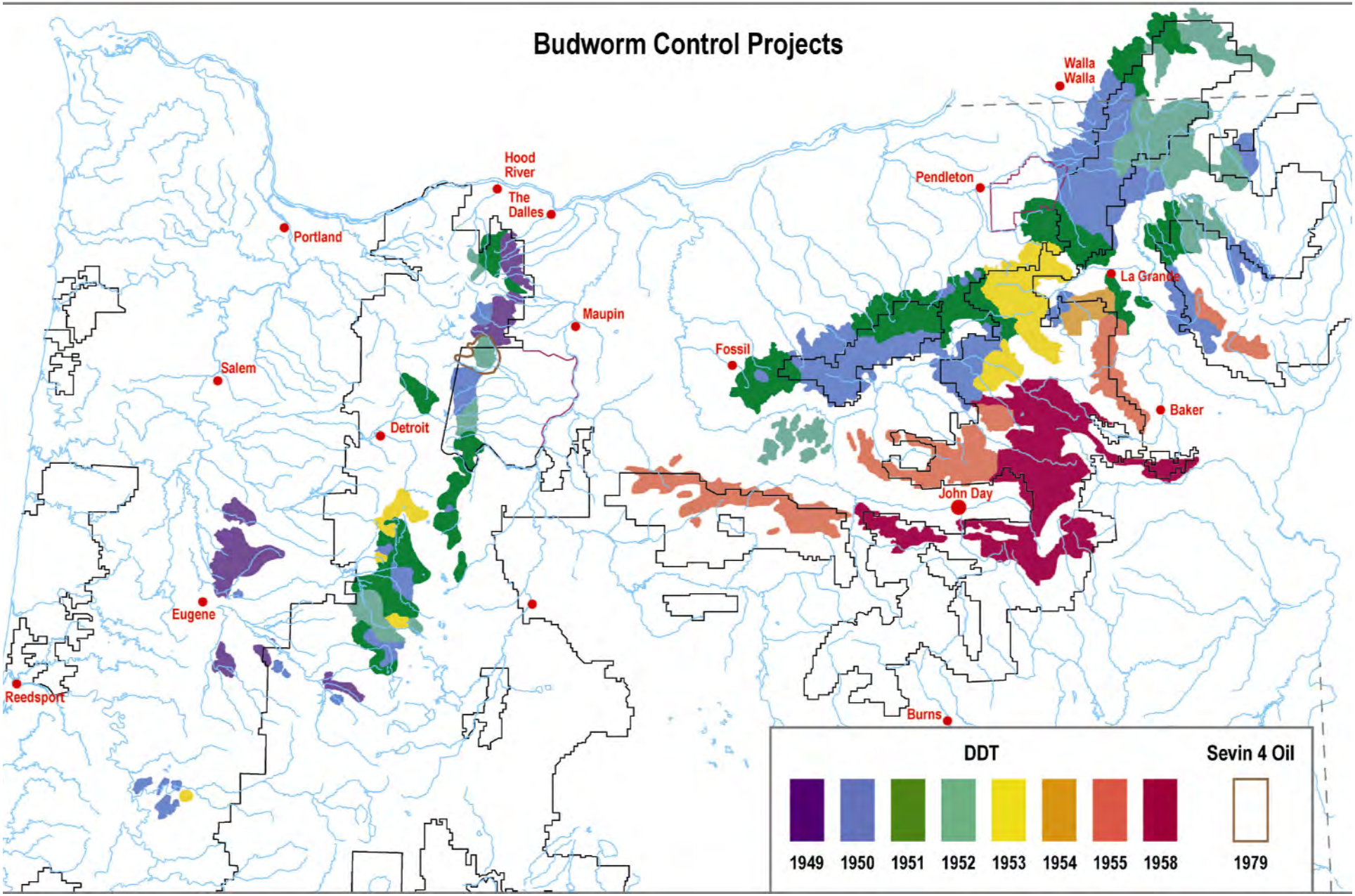
Cougar Dam and Reservoir

Draft Supplemental Information Report

US Army Corps
of Engineers ®
Portland District

January 2003

USFS Insecticide Spraying (1949-1962)



Reservoir Operation during Construction

Construction season - October 1 to April 1

Three options available to reduce turbidity

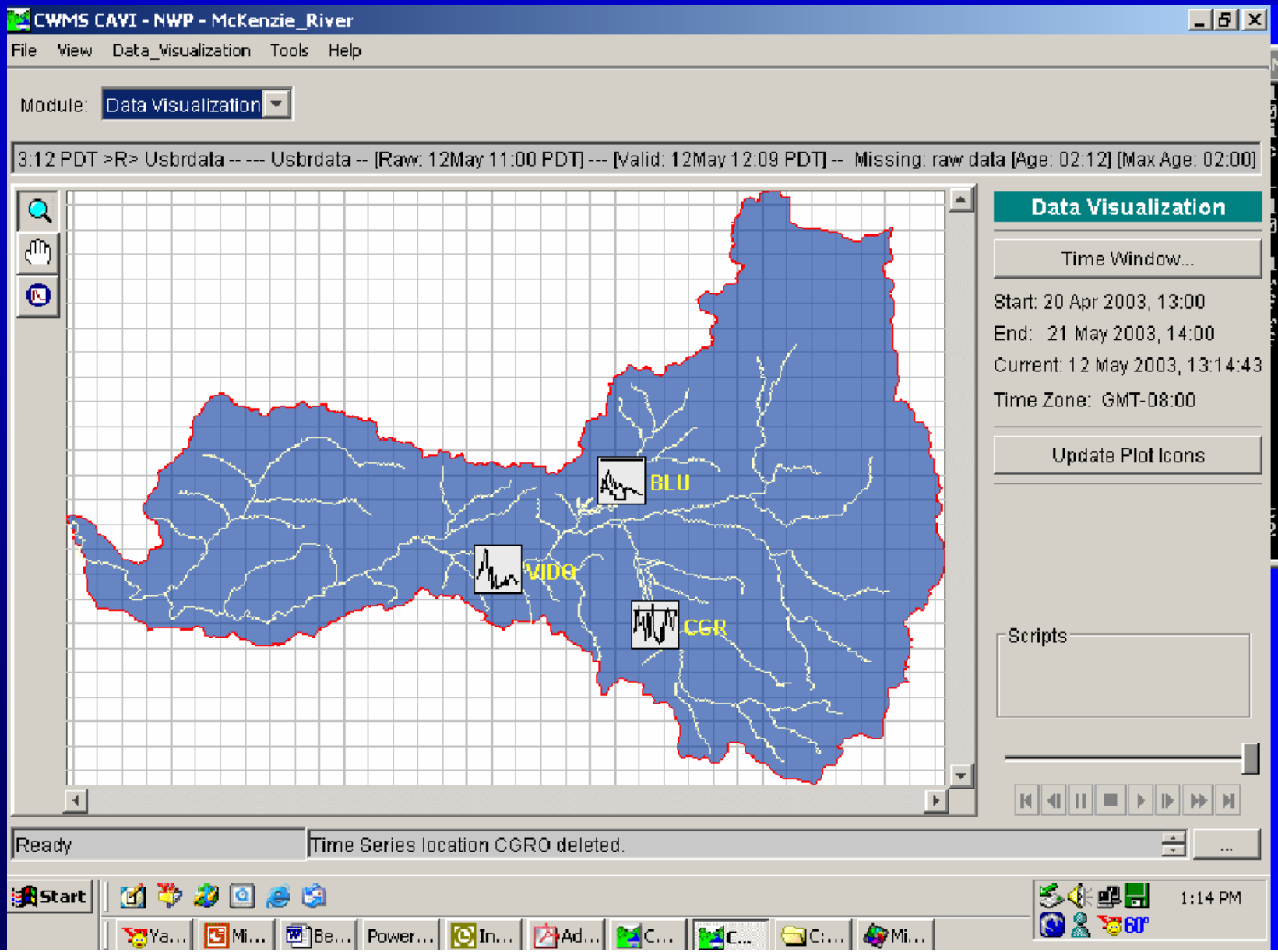
- **Increase drawdown rate (3 ft/day to 6 ft/day)**
- **Non-construction/winter flood control pool level – 1532 ft (high pool option) or hold pool at 1400 ft (low pool option)**
- **Target date to reach construction pool (high pool option) March 1 or April 1**

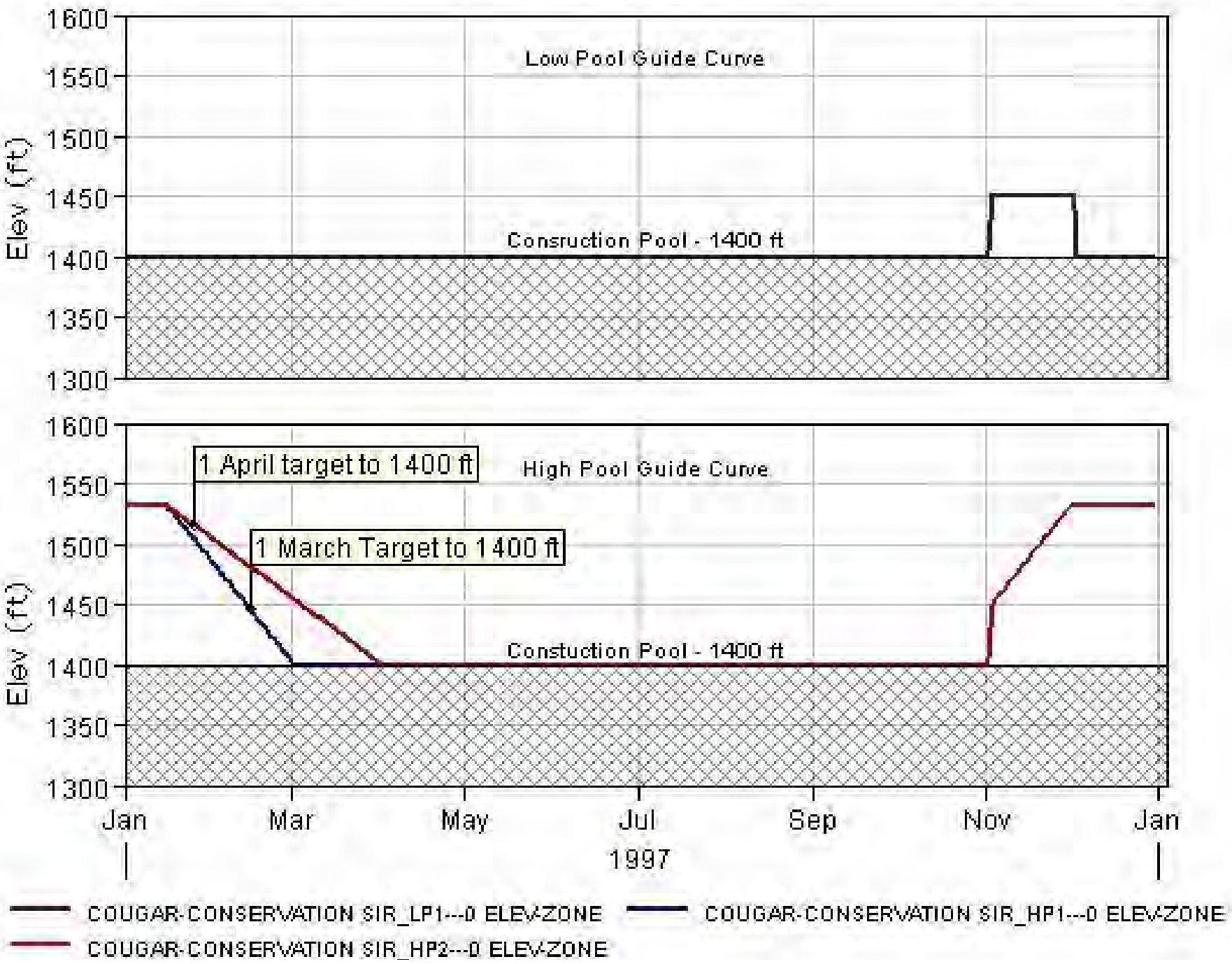
Development of Operational Plans

6 operational scenarios were created from combinations of the 3 options

- **4 high pool (HP) options / 2 low pool (LP) options**
- **HEC ResSim model developed for the McKenzie River system. Period of record inflows used (1935 to 1998) to determine reservoir elevations under 6 operational scenarios.**
- **ResSIM – elevation rate of change rule available**
- **Selected plan becomes part of adopted "Best Management Practices" in SIR**

Reservoir model – HEC ResSim

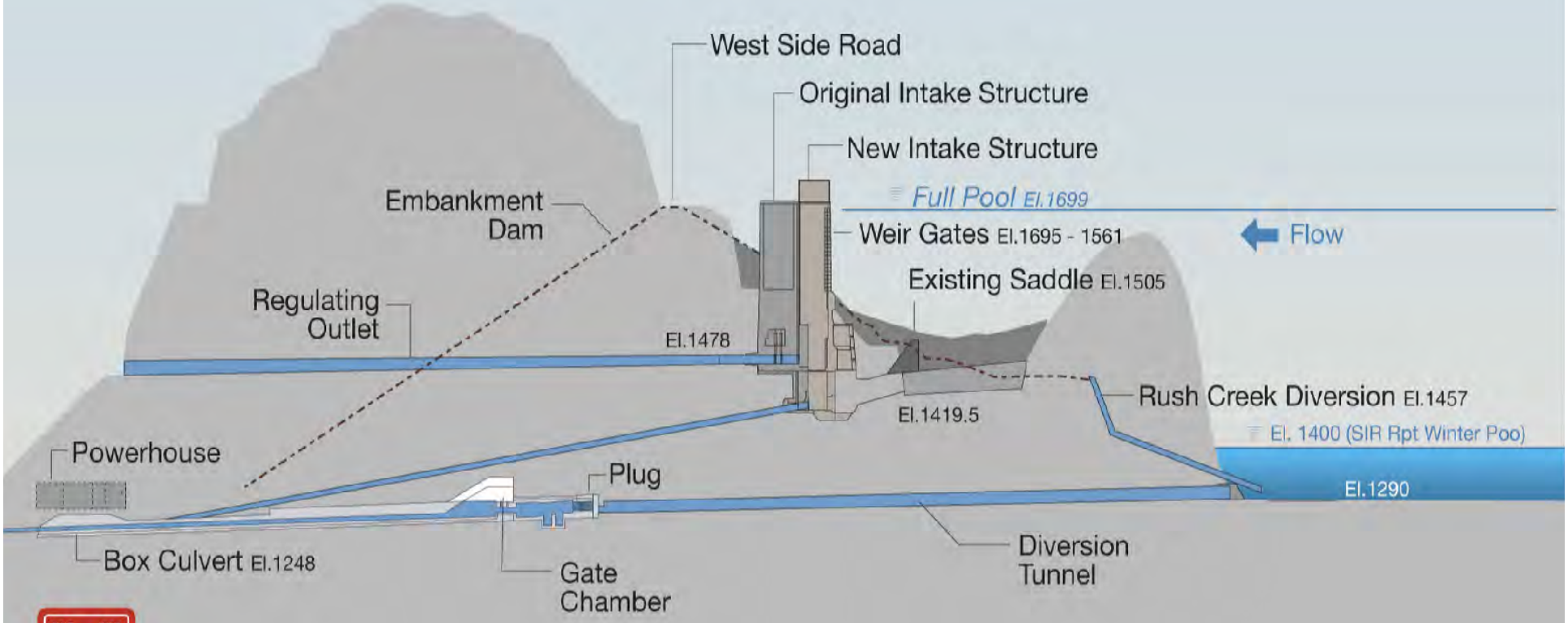



Low Pool Guide Curve
Consruction Pool - 1400 ft
High Pool Guide Curve
1 April target to 1400 ft
1 March Target to 1400 ft
Constuction Pool - 1400 ft
Elev (ft)
1600
1550
1500
1450
1400
1350
1300
Jan
Mar
May
Jul
Sep
Nov
Jan
1997
COUGAR-CONSERVATION SIR_LP1---0 ELEV-ZONE
COUGAR-CONSERVATION SIR_HP1---0 ELEV-ZONE
COUGAR-CONSERVATION SIR_HP2---0 ELEV-ZONE

Willamette River Temperature Control Project, Oregon

Cougar Dam Cross-Section

Low Pool Option



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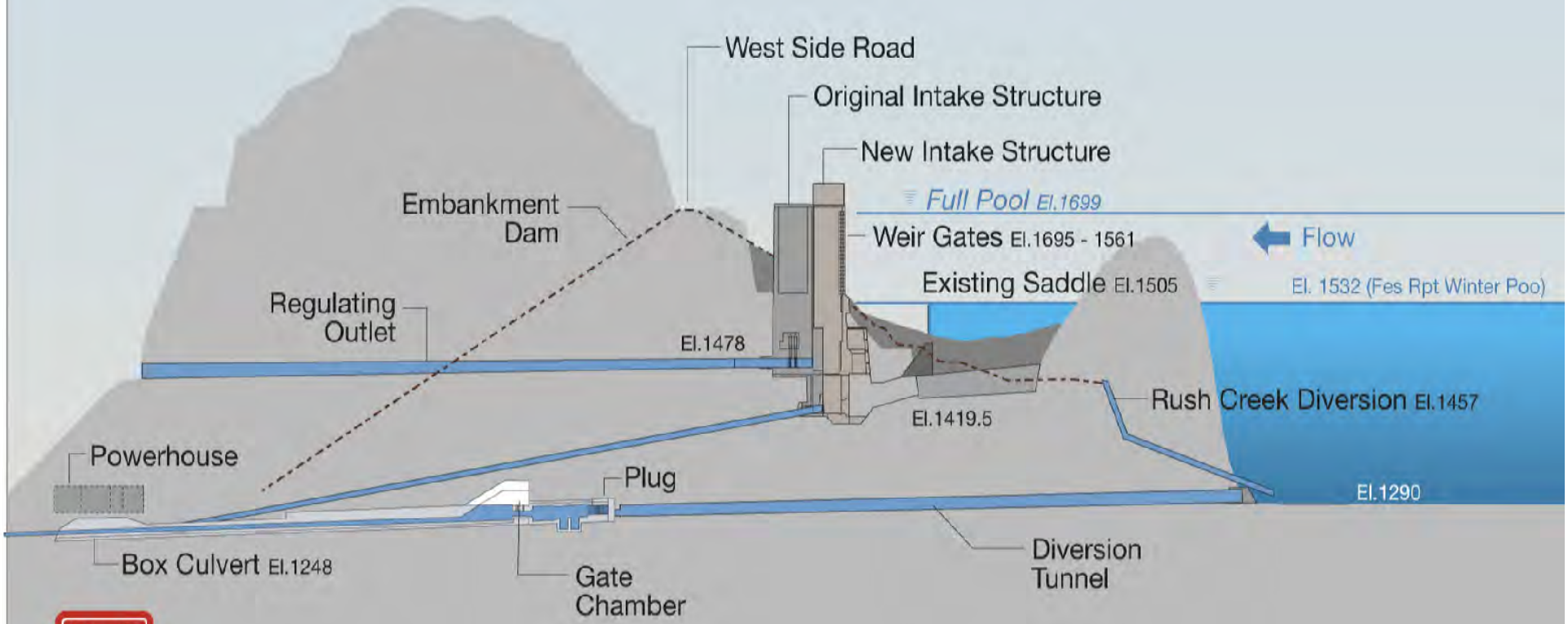
Willamette River Temperature Control Project, Oregon

Cougar Dam Cross-Section

High Pool Option



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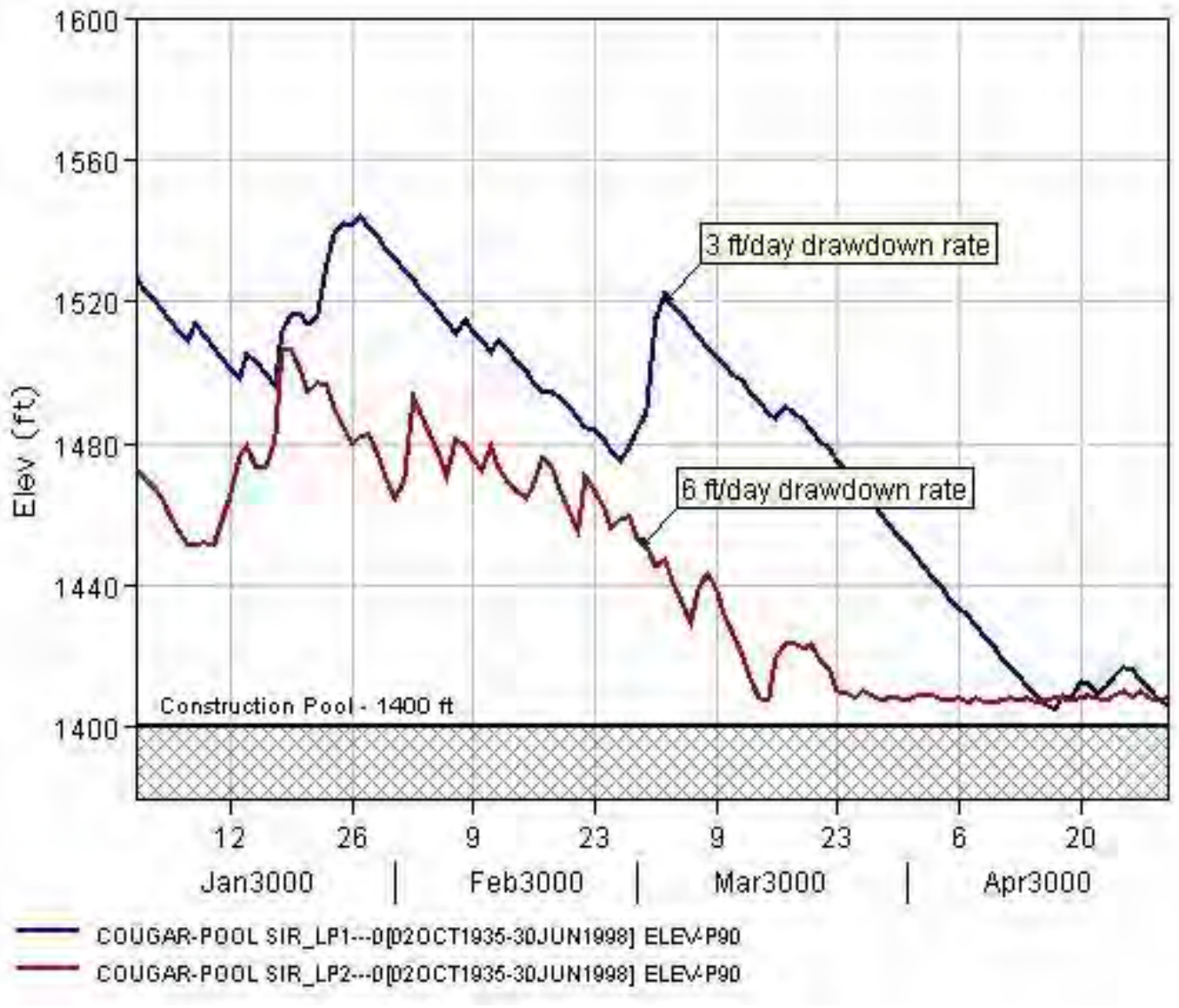
Alternative	Target date	Drawdown rate	Winter Pool Elev.
LP1	-	3 ft/day	1400 ft
*** LP2 ***	-	6 ft/day	1400 ft
HP1	March 1	3 ft/day	1532 ft
HP2	April 1	3 ft/day	1532 ft
HP3	March 1	6 ft/day	1532 ft
HP4	April 1	6 ft/day	1532 ft

March 1 target date - % chance non-exceedance

	10 %	25%	50%	75%	90%
HP1	1404	1405	1412	1443	1483
HP2	1454	1456	1457	1460	1488
HP3	1401	1403	1406	1412	1455
HP4	1454	1456	1459	1461	1472
LP1	1400	1401	1404	1435	1464
LP2	1396	1400	1403	1407	1447

90 % non-exceedance LP options

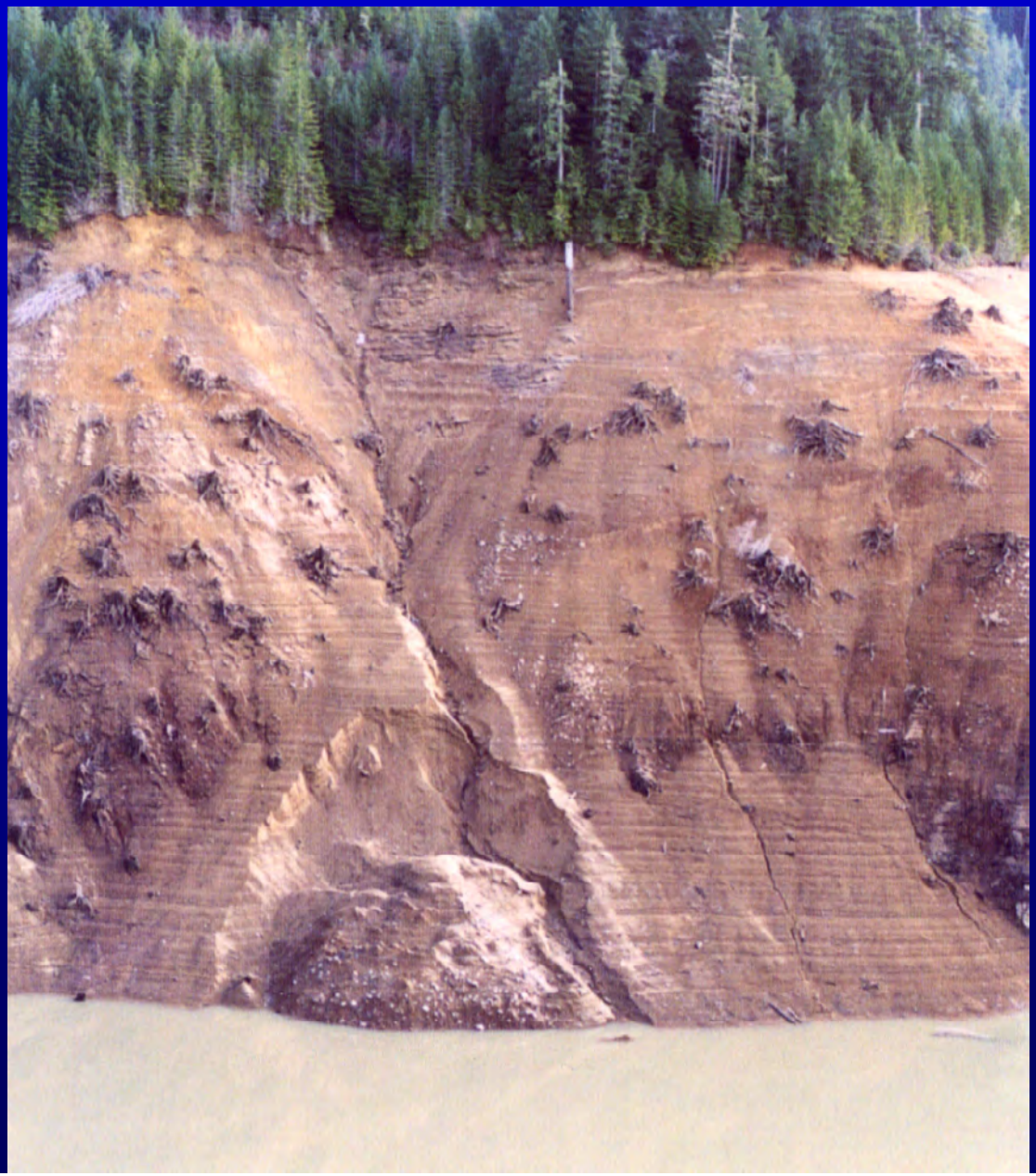


Erosional processes within Cougar

- Initial submergence of dried lakebed deposits **
- Mass wasting and slope failures caused by rapidly changing pool levels
- Active erosion of predominantly clay banks
- Lateral migration and downcutting of main inflow tributaries. **

** cause higher levels of turbidity

Slope failures



Active erosion of exposed clay banks

South Fork McKenzie R. Inflow to Cougar

January 29, 2003

January 30, 2003

January 31, 2003

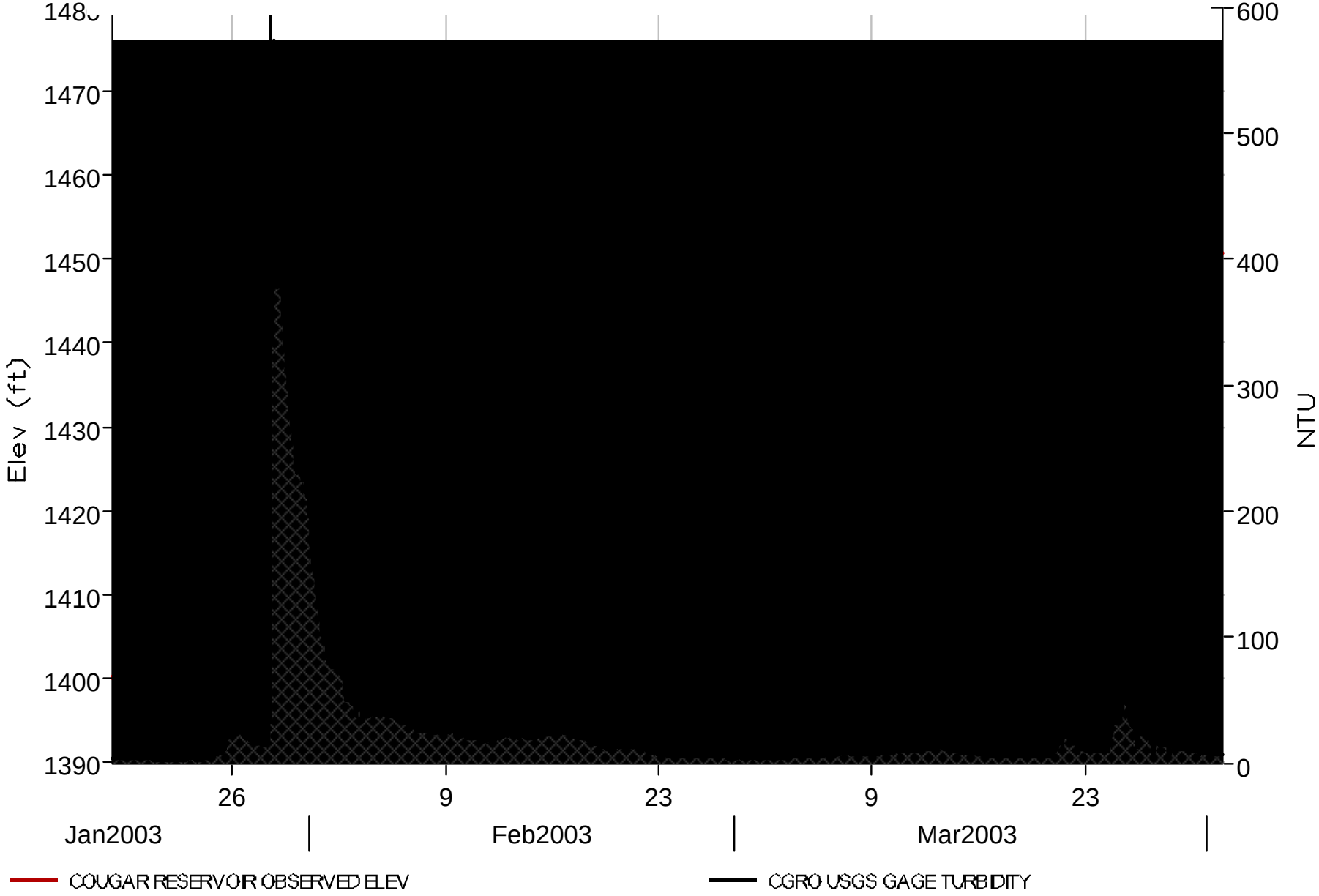
Rush Creek Drainage Failure

January 30, 2003

January 31, 2003

Pool maintained at 1450 feet to prevent further slope failures

Elevation vs. Turbidity – January – March, 2003



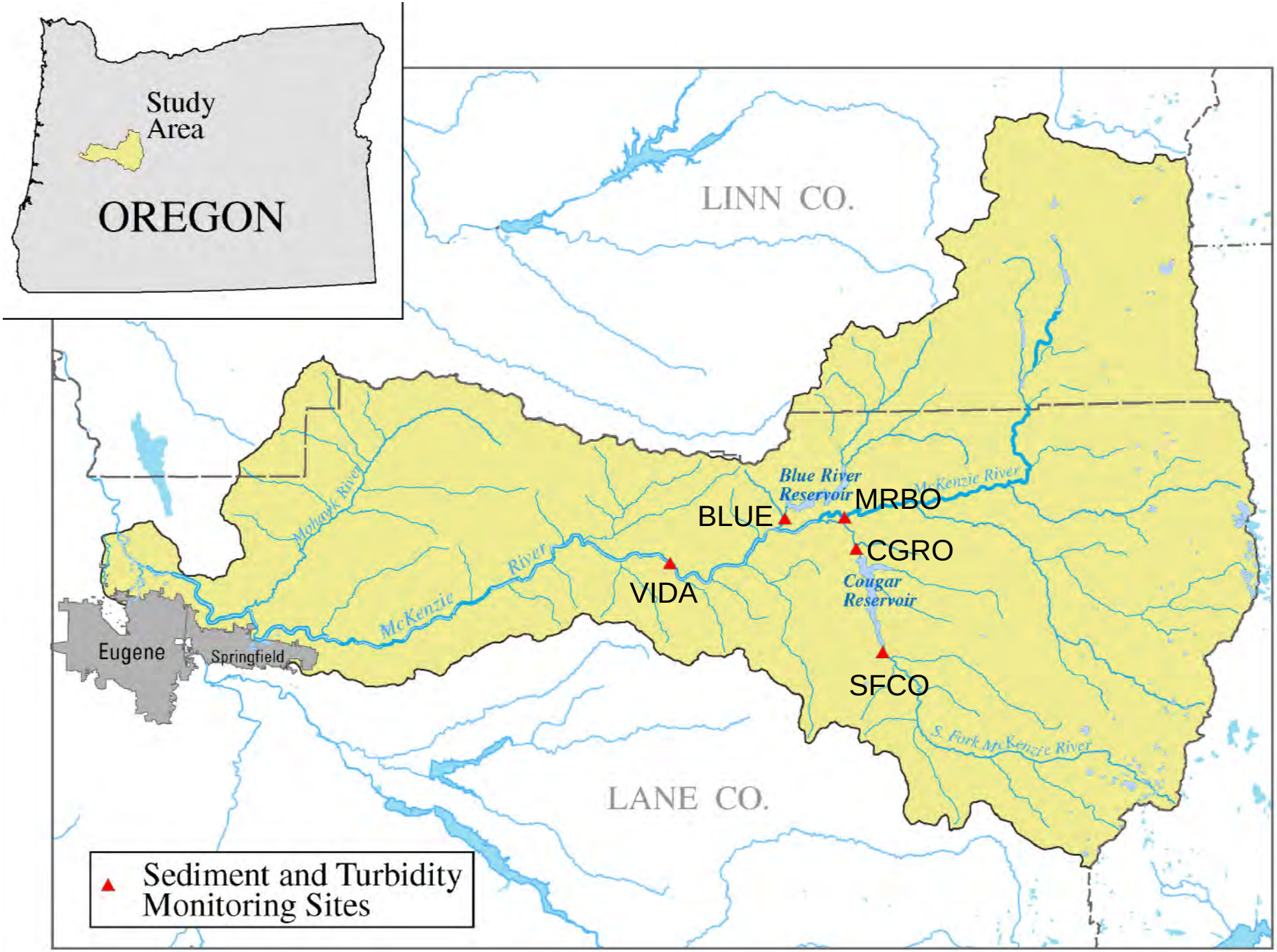
USGS Monitoring Study Objectives

- Measure deposition of fine materials into spawning gravels
- Deposition of DDT in fine materials
- Compare contributions from Cougar Reservoir construction with other areas
  - 2 reference sites
    - (S. Fork above Cougar, mainstem above S. Fork)
  - 2 sites below reservoirs
    - S. Fork below Cougar, Blue River below Blue River Res.
  - Downstream integrator site
    - McKenzie R at Vida below Cougar & Blue

USGS Sediment Trap Installation and Retrieval

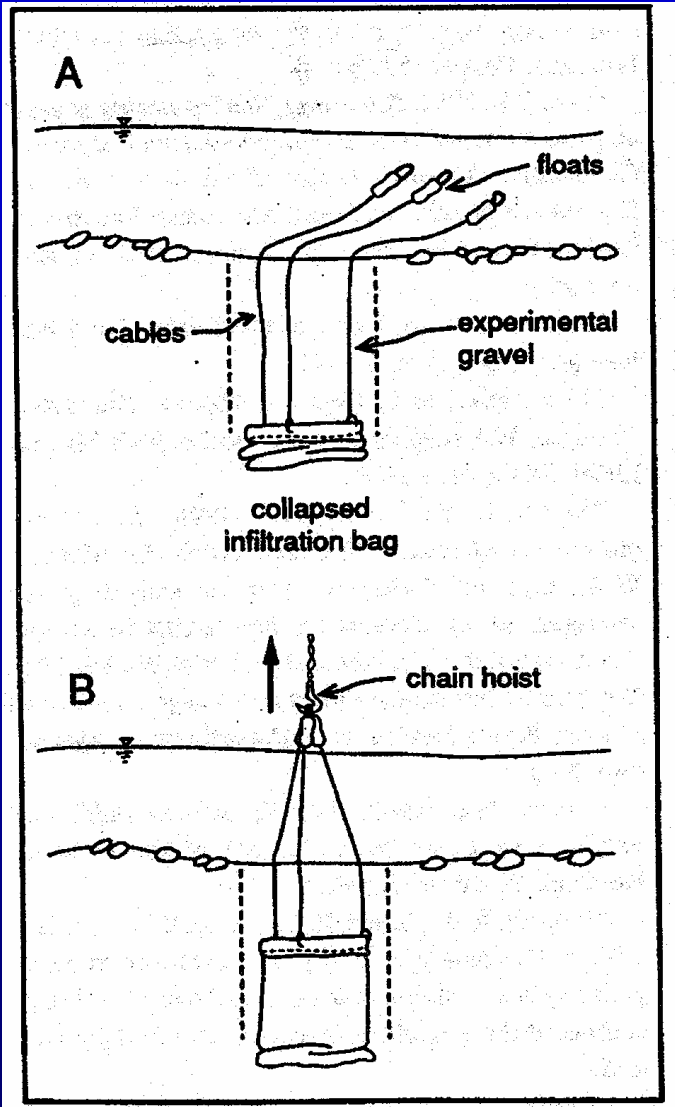
US Army Corps of Engineers
Portland District (J. Britton, P. O'Brien, T. Sherman)
WES (T. Sobiecki, J. Hains, D. Sobale, C. Schneider)
EWEB (K. Morgenstern)
ODFW (M. Wade)
OSU (G. Stewart, A. Jefferson)
NOAA Fisheries (L. Krasnow)

USFS (Gordon Grant)
USGS (H. Bragg, I. Wigger, E. Rupp, C. Palmer, J. O'Connor)


Study Area
OREGON
LINN CO.
LANE CO.
Blue River Reservoir
McKenzie River
BLUE
MRBO
CGRO
VIDA
Cougar Reservoir
SFCO
Mohawk River
McKenzie River
Eugene
Springfield
S. Fork McKenzie River
Sediment and Turbidity Monitoring Sites

Infiltration Bags

- Dimensions:
  - Width: 30 cm
  - Depth: 56 cm
  - Volume: 40 L
  - Teflon liner
- Buried ~40 cm below bed
- Used experimental (non-native) rock
  - Pre-clean rocks
  - Relatively uniform porosity
  - Direct comparisons between sites
- Deployed Aug. 03 – July 04
  - 5 sites, 3 traps each
  - Spawning areas with downwelling



(Lisle and Eads, 1990)

Figure 4—Installation (A) and recovery (B) of an infiltration bag.

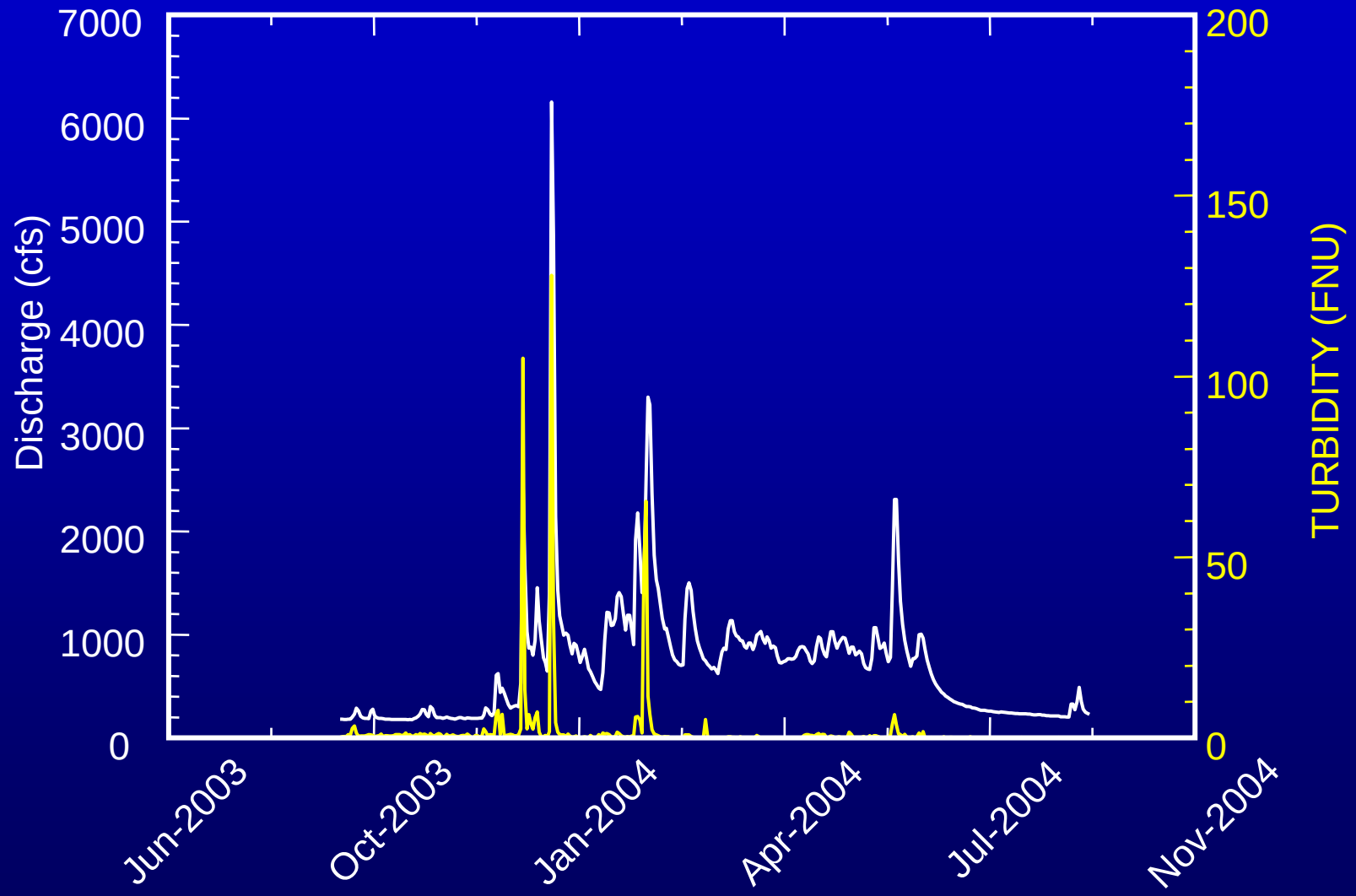
Installation– Dig the hole!

Use a form, & backfill

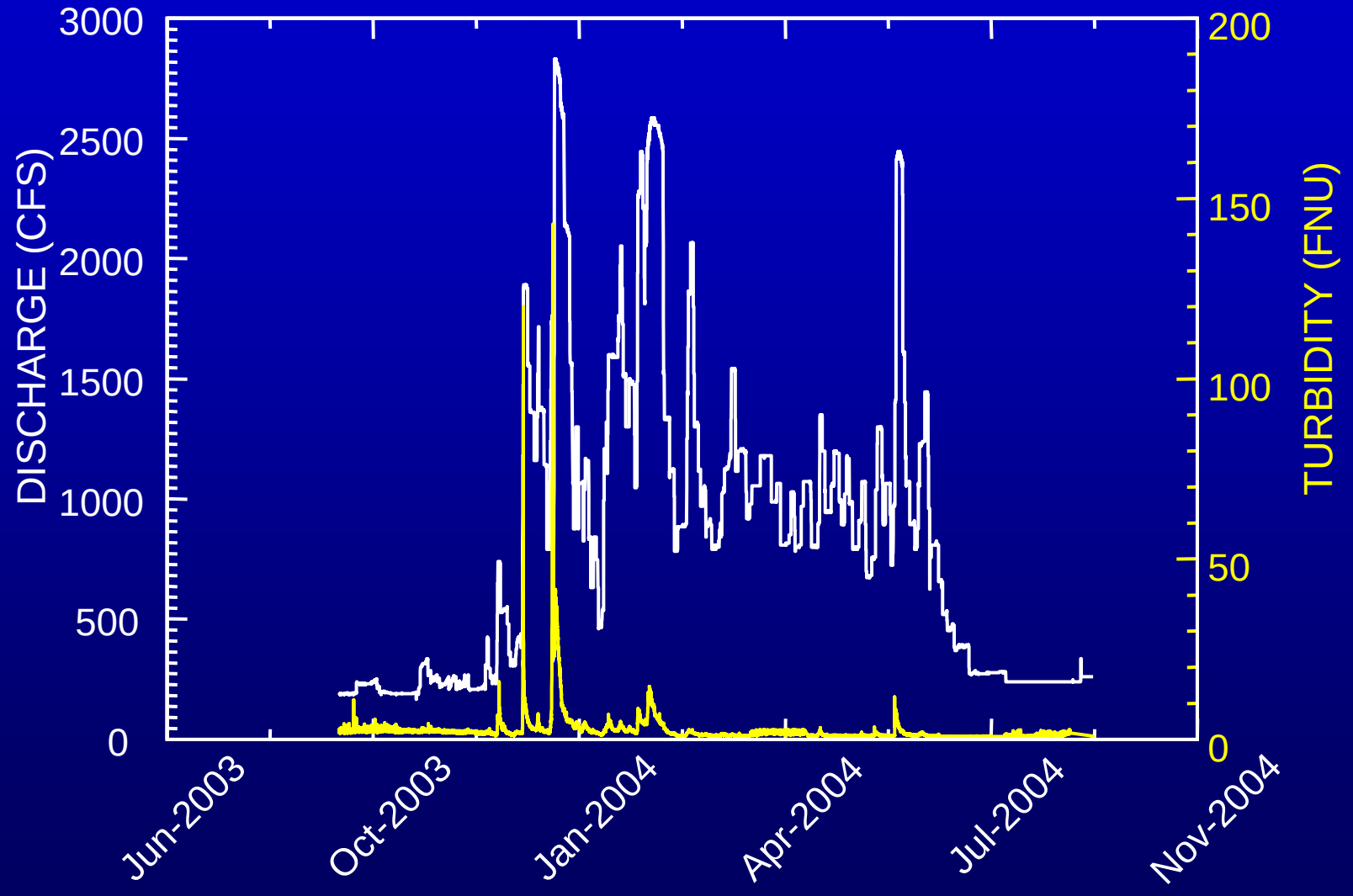
Collapse bag and install

Deployed infiltration bags

Winter Storms – Unregulated Sites

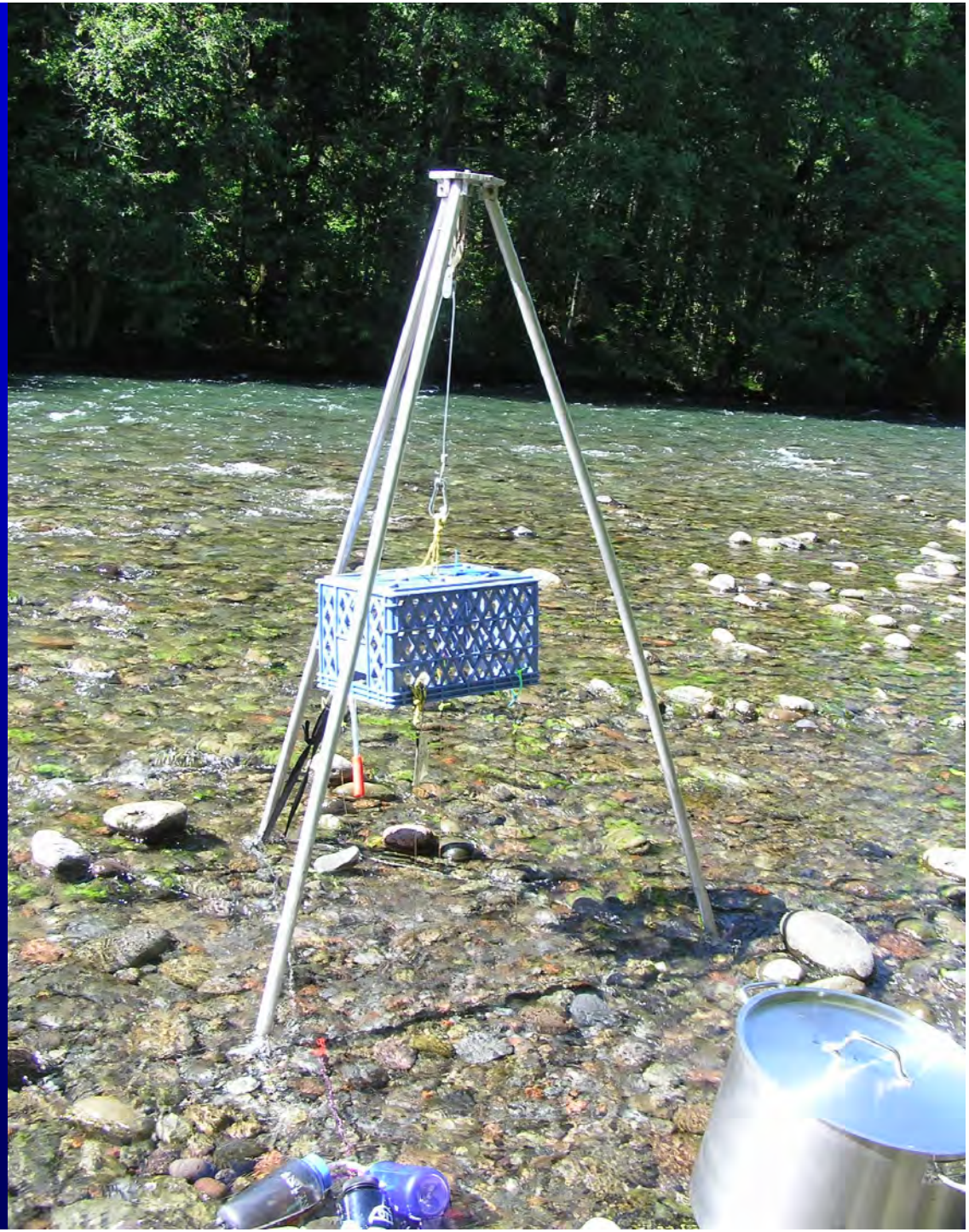


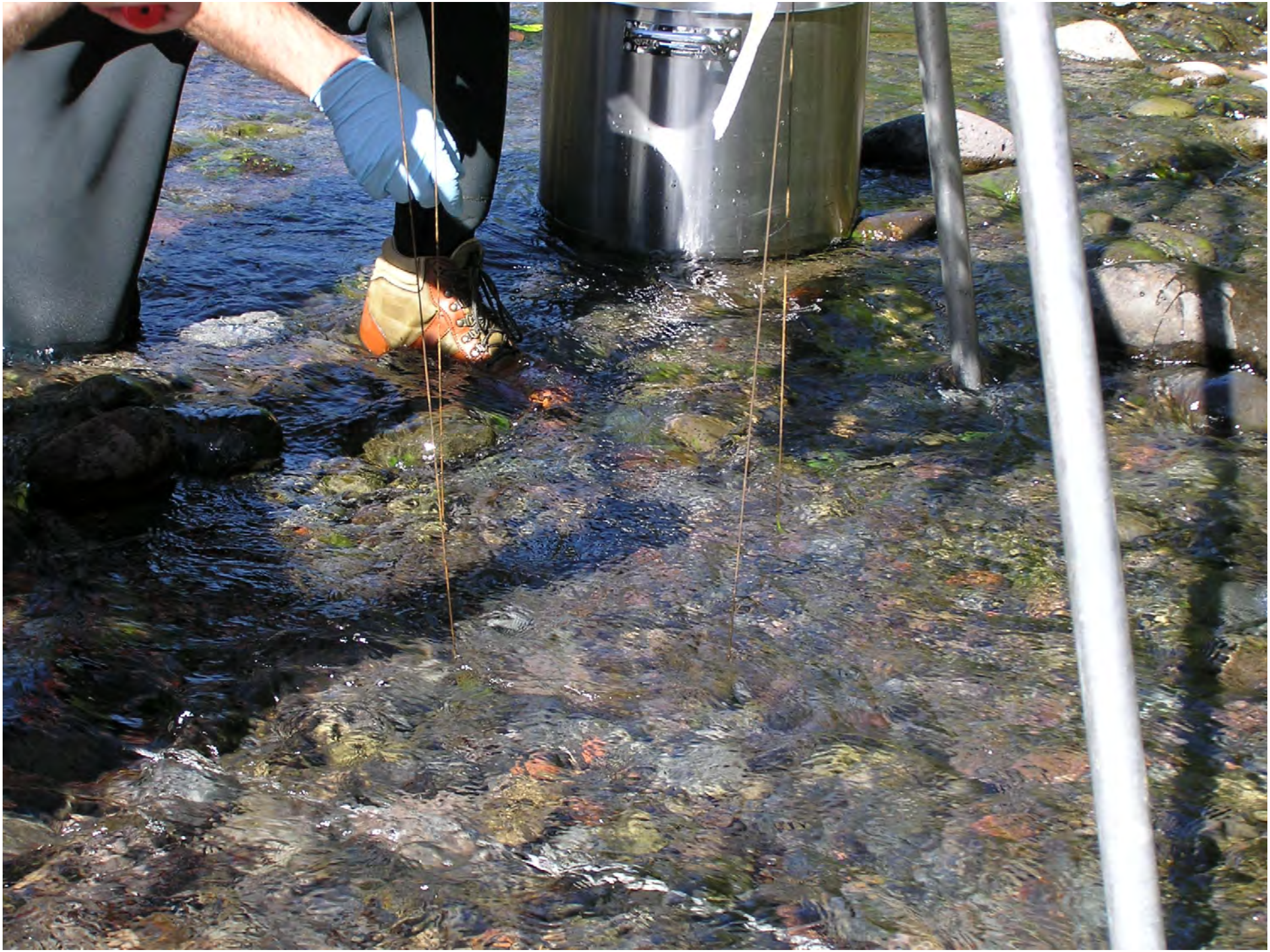
Winter Storms – Regulated Sites

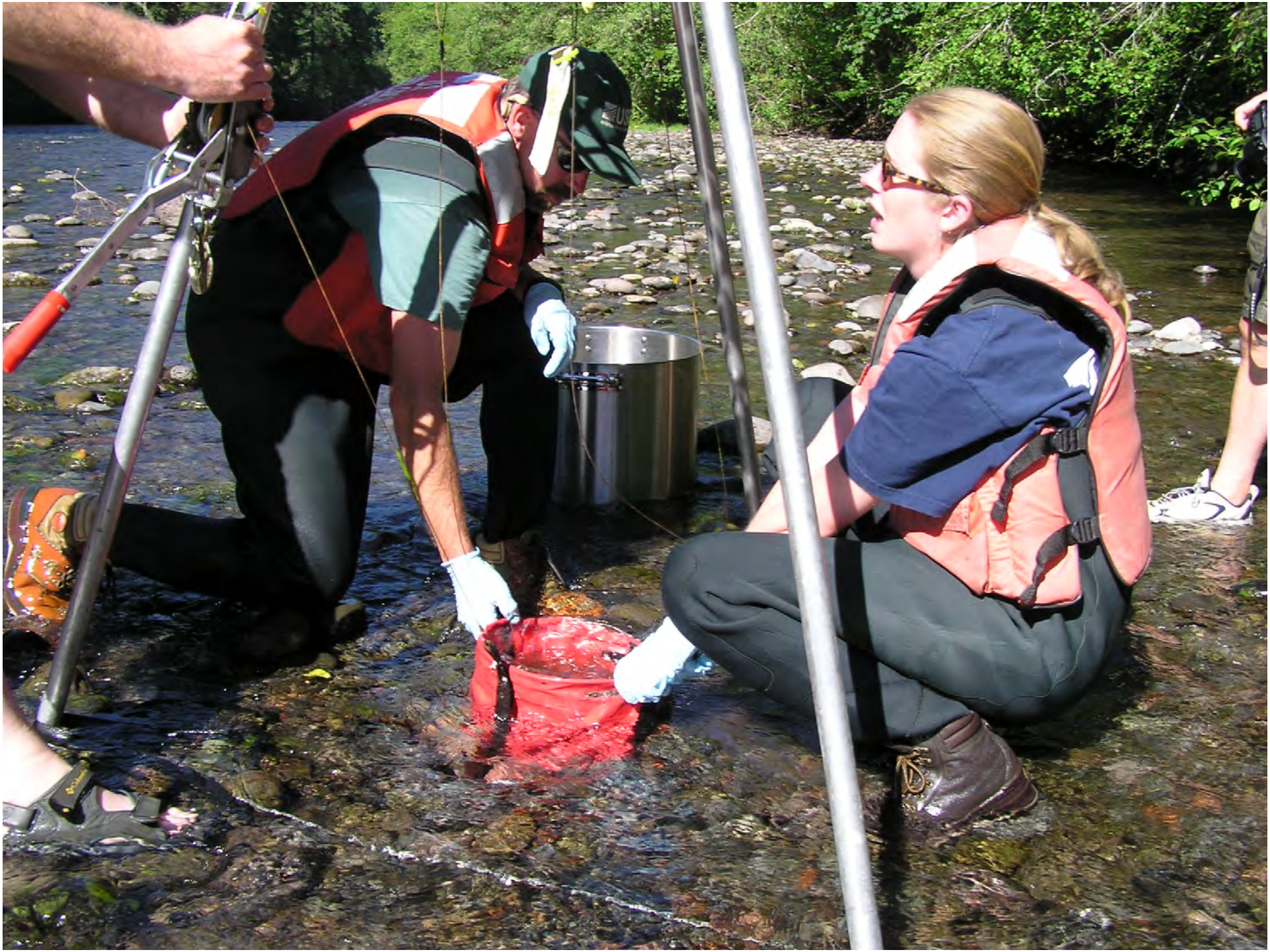


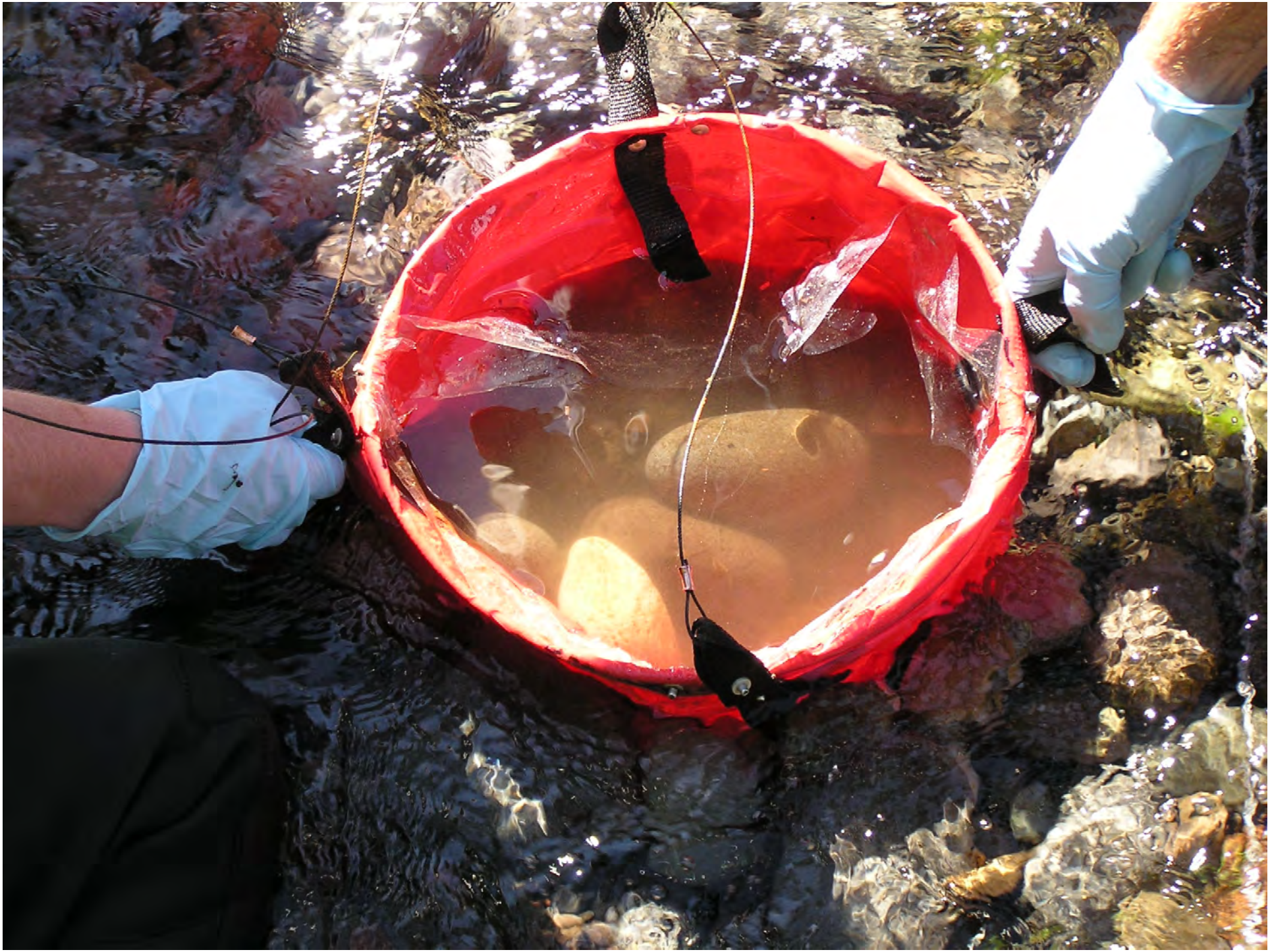
Retrieval

- July 2004
  - 3 major events during winter
  - At least one trap lost from background site
- At least 1 good bag retrieval from each site

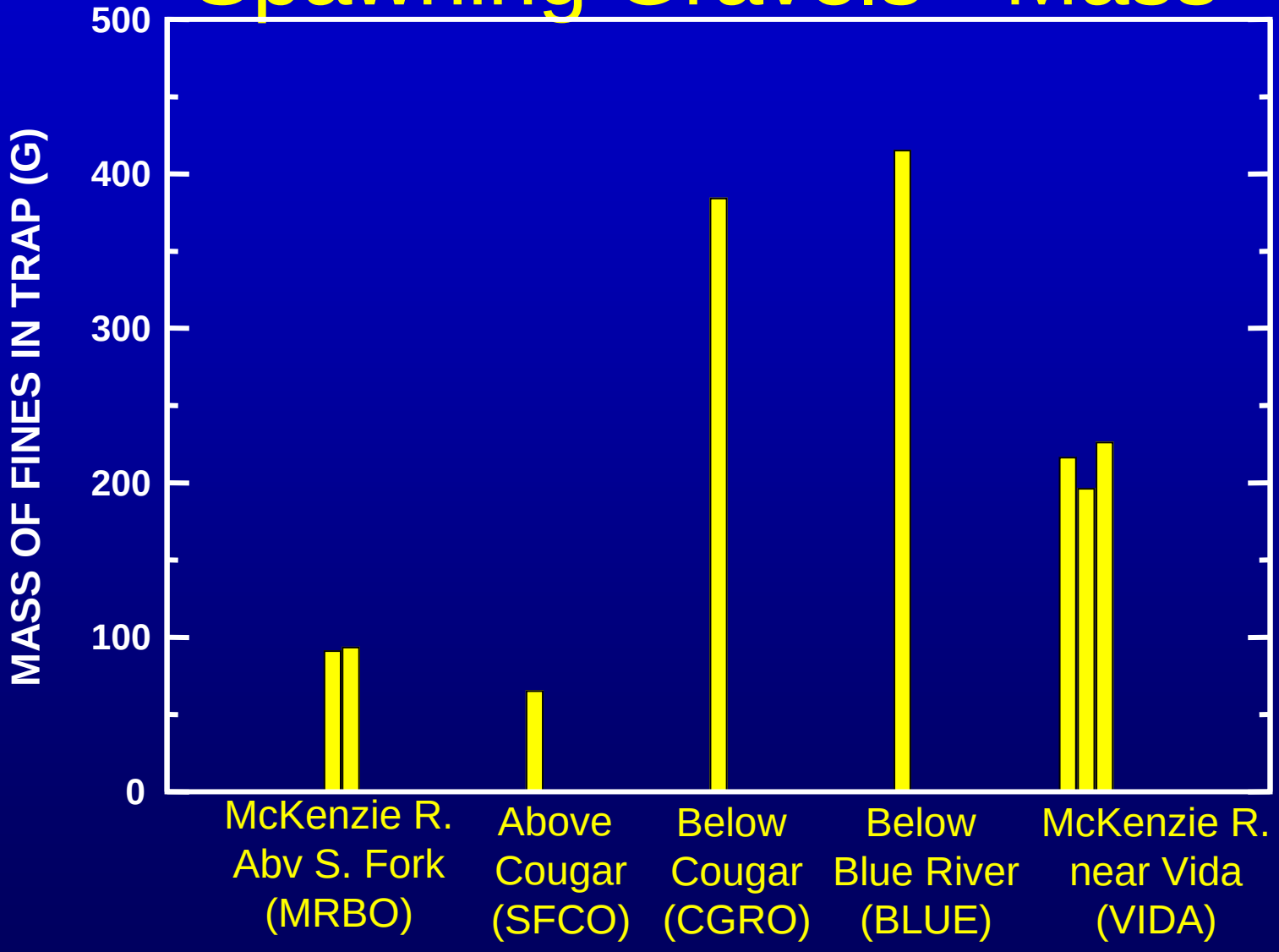




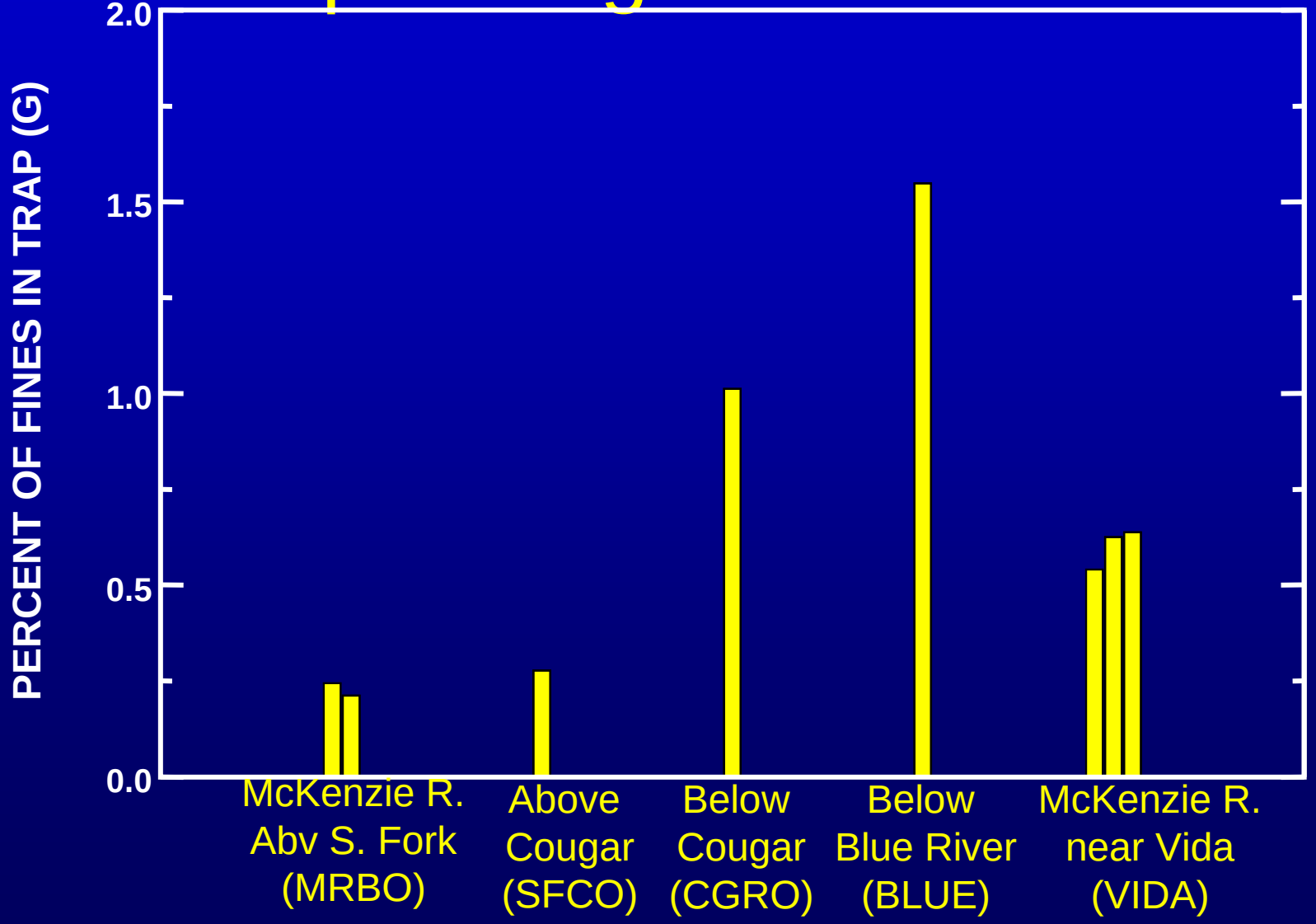




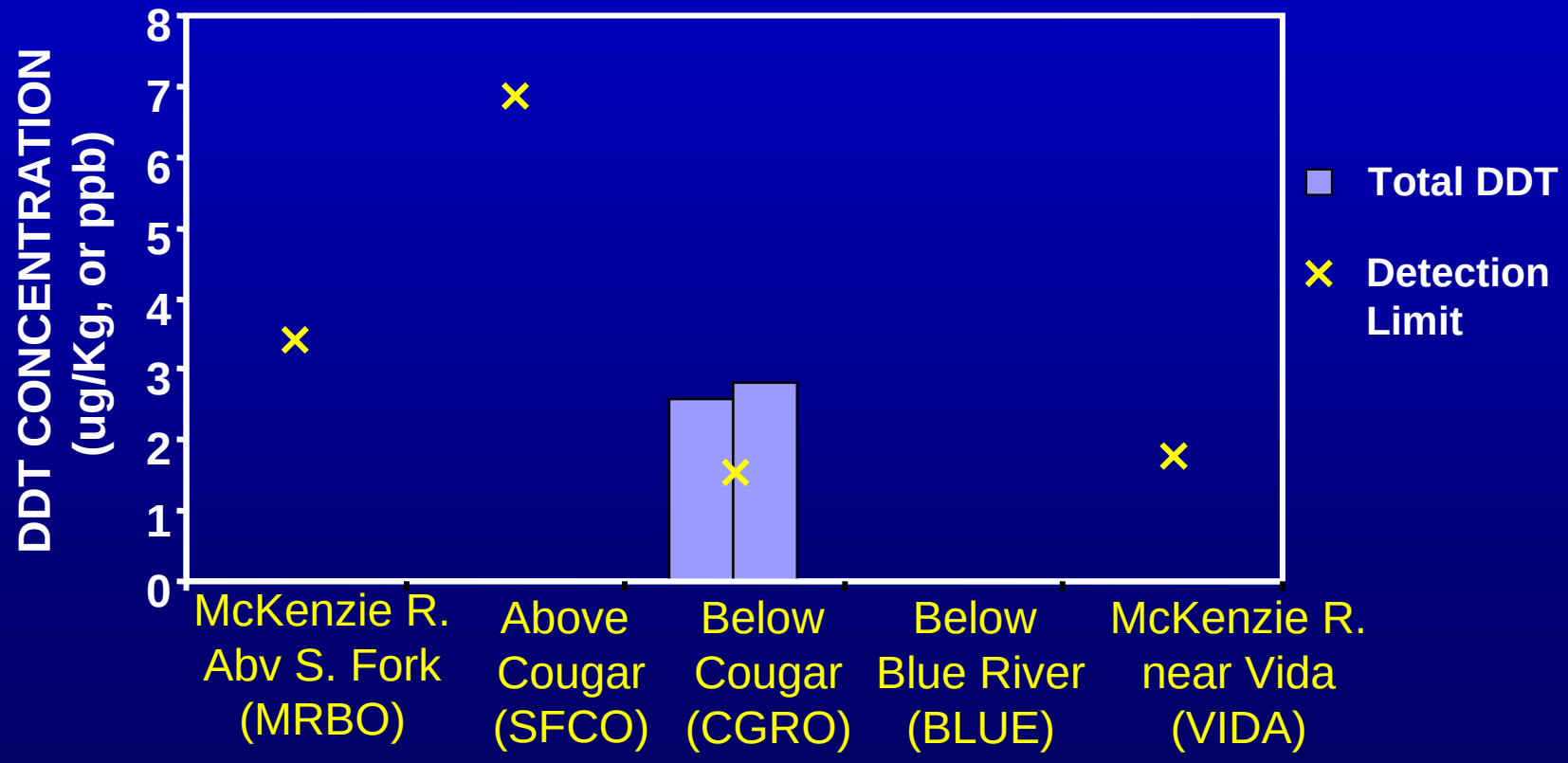
Accumulation of Fine Materials in Spawning Gravels - Mass



Accumulation of Fine Materials in Spawning Gravels - %



DDT CONCENTRATIONS IN DEPOSITED SEDIMENT



Conclusions– Sediment

- Sites below Cougar and Blue River dams had the highest deposition of fine sediment in redds
  - Slightly elevated % clays in fine material
  - Confirms previous study results
  - Contrary to much of the literature indicating coarsening of bed below dams
  - Bed moving events during the winter may allow scouring of fine material from the bed at unregulated sites

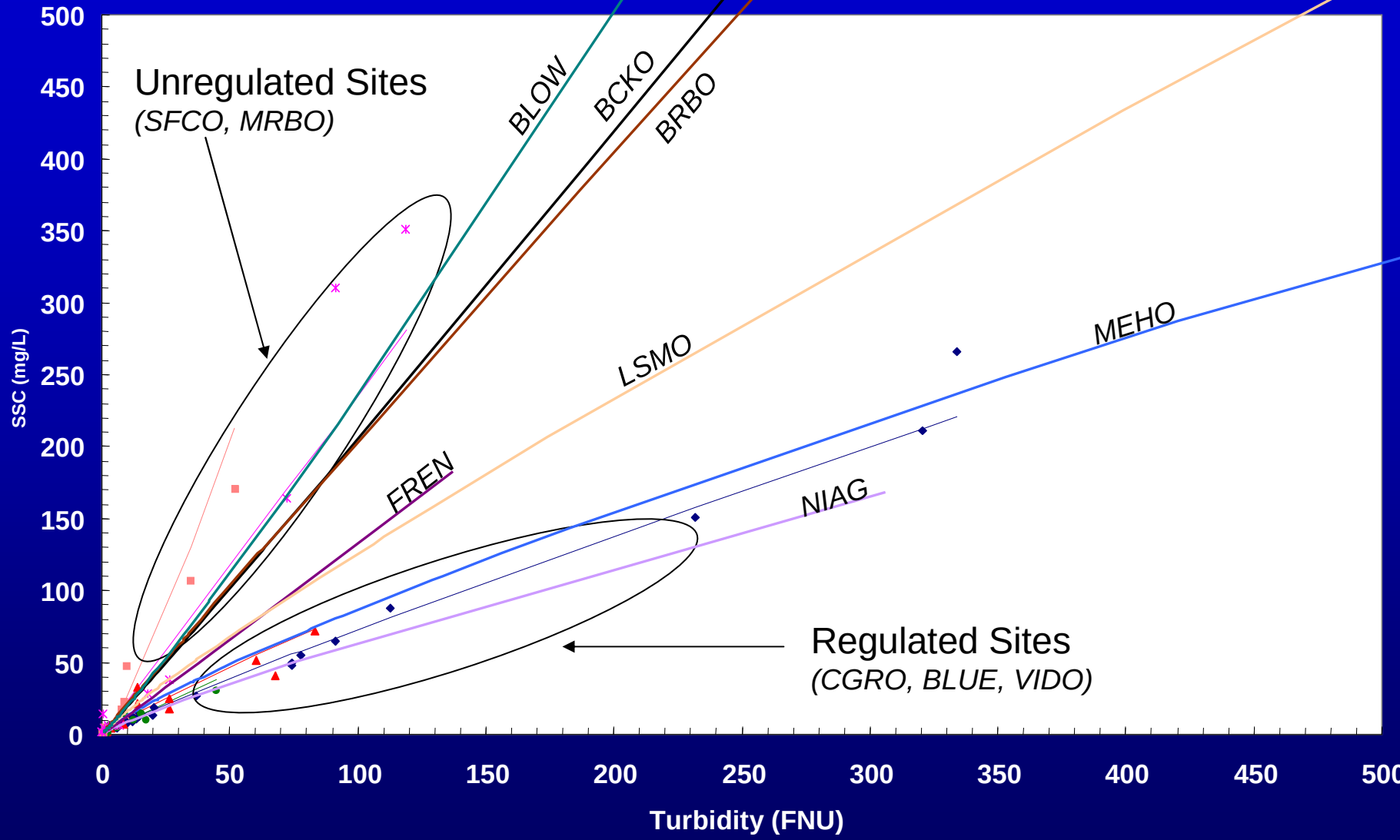
Conclusions– DDT

- DDT detected at low levels below Cougar but nowhere else
  - Probably transported downstream also but diluted by upstream sediment sources
  - Analytical issues may have obscured other DDT detections
- Concentration detected in sediment traps is about the same as detected in suspended sediment during storms, and in bank sediment (COE sampling)
- Reservoir may have acted as a sink prior to drawdown but a source during drawdown

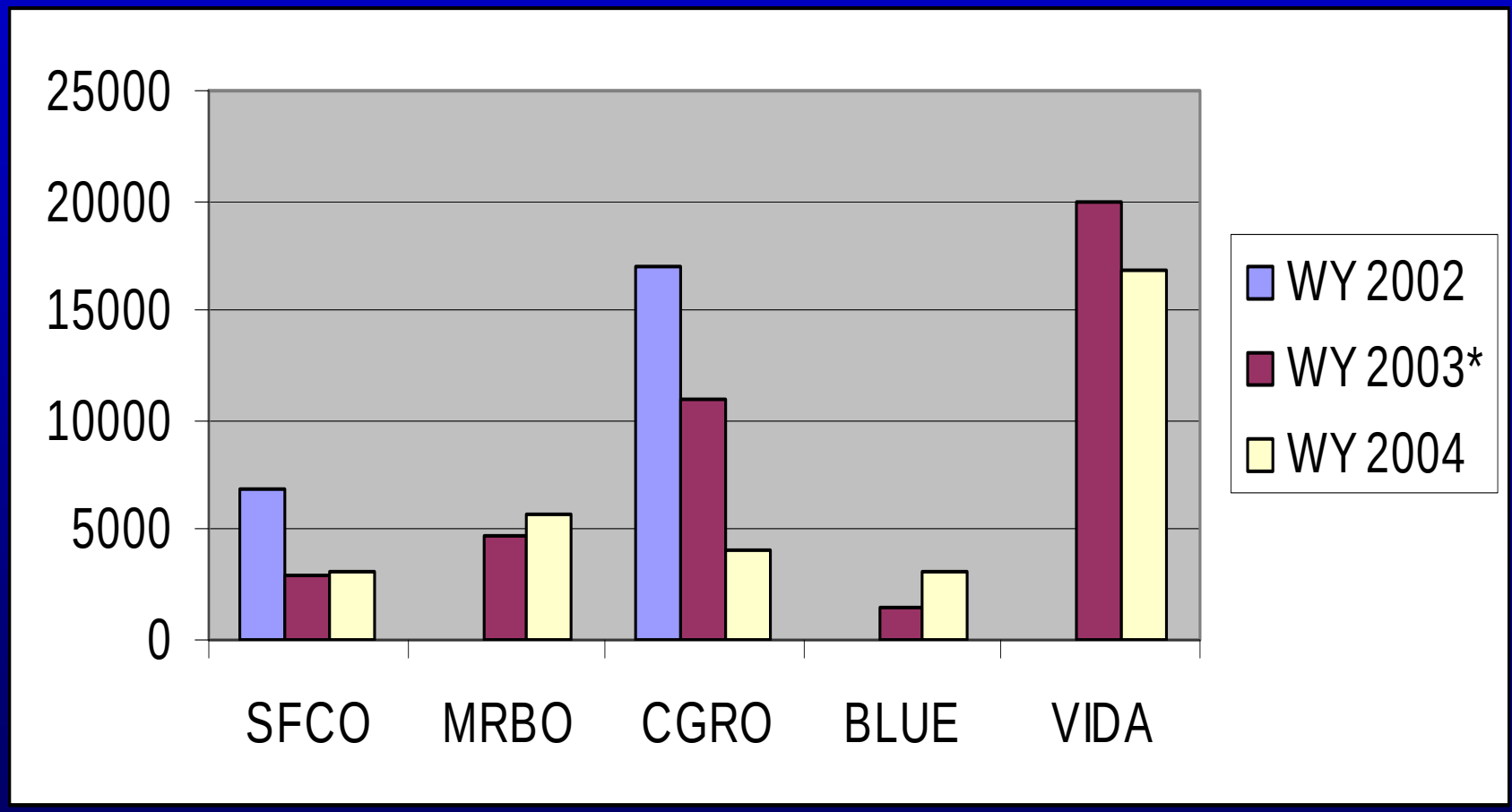
SSC-T Relationships

- Turbidity (T) is a good surrogate for Suspended Sediment Concentration (SSC)
- SSC-Turbidity relationships for Santiam were used to estimate sediment discharge from Cougar in SIR
- Relationships are site specific – lots of factors, clays, silts, sands have a different turbidity signature.
- SCC-T relationships are developed using sediment sampling over a range of flows
- Useful sediment management tool

SSC-Turbidity Relations

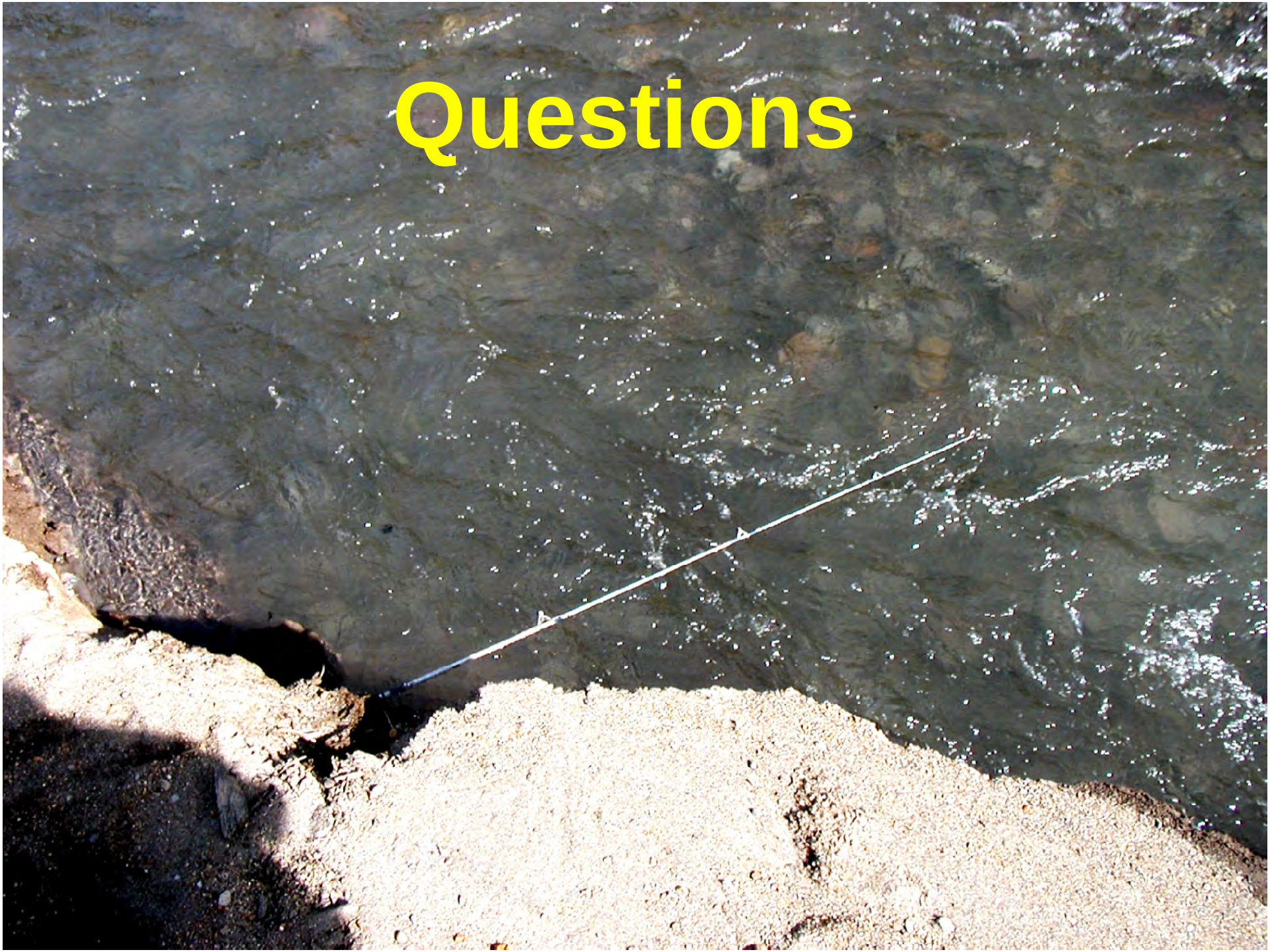


Sediment Management Report Card



More Information

- http://www.nwp.usace.army.mil/issues/wrtcp/cms/documents.asp
- Appendix C – Reservoir Operational Modeling
- Appendix D – Sediment (Estimated sediment released based on measured turbidity)


Questions

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Omaha District

MISSOURI RIVER SHALLOW WATER HABITAT CREATION

Dan Pridal

Omaha District Corps of Engineers

Missouri River Region
Omaha District
Kansas City District
Location Map
SCALE 1:9,000,000
Kilometers
Statute Miles
Projection: Albers Equal Area Conic
National Rec. River
Omaha District Navigation Channel – RM 752 to 498
Omaha Federal Levee Reach
Corps Projects
USBR Authorized Flood Control Projects
Other Non-Federal Projects
Montana
North Dakota
South Dakota
Minnesota
Iowa
Nebraska
Wyoming
Colorado
Kansas
Missouri
Army Corps of Engineers
Northwest Division
Missouri River Region
Reservoir Control Center
Missouri River Basin

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Mitigation History

- WRDA 1986 (Section 1135, Missouri River Mitigation)
- WRDA 1999 – Expanded Mitigation
- Biologic Opinion 2000
- Amended BiOp 2003

LEAST TERN

PIPING PLOVER

US Army Corps
of Engineers

PALLID STURGEON

US Army Corps
of Engineers
Omaha District

BiOp

Reasonable and Prudent Alternatives

1) Flow Enhancement
2) **Habitat Restoration / Creation / Acquisition**
3) Unbalance System Regulation
4) Adaptive Management / Monitoring
5) Propagation / Augmentation

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BiOp Shallow Water Habitat Creation

- Create 20-30 acres of shallow water per mile
- Criteria for shallow water habitat at August 50% flow:
  - <5 feet deep
  - < 2.5 feet/second velocity
- Existing Acres Estimate ~ 3,000 Acres
- Construction
  - With max. Flow Mod. – 10,380 to 17,820
  - Without Flow Modification – 11,680 to 19,020

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Habitat Creation Goals

Project near term goals:

- 10% (2000 acres) of shallow-water habitat by year 2005 (Achieved)
- 40% (7300 acres) of shallow-water habitat by year 2010

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Past Major Activities

- Construction 6 main stem dams (system filled in 1967)
- Navigation and Bank Stabilization to Sioux City
  - 9x300 foot minimum navigation channel
  - Declared Operational Complete in 1981
- Extensive river modifications
  - Systematic design to set alignment and width
  - Extensive side channel cut-offs and shortening
- Intermittent federal levees - Omaha to St. Louis

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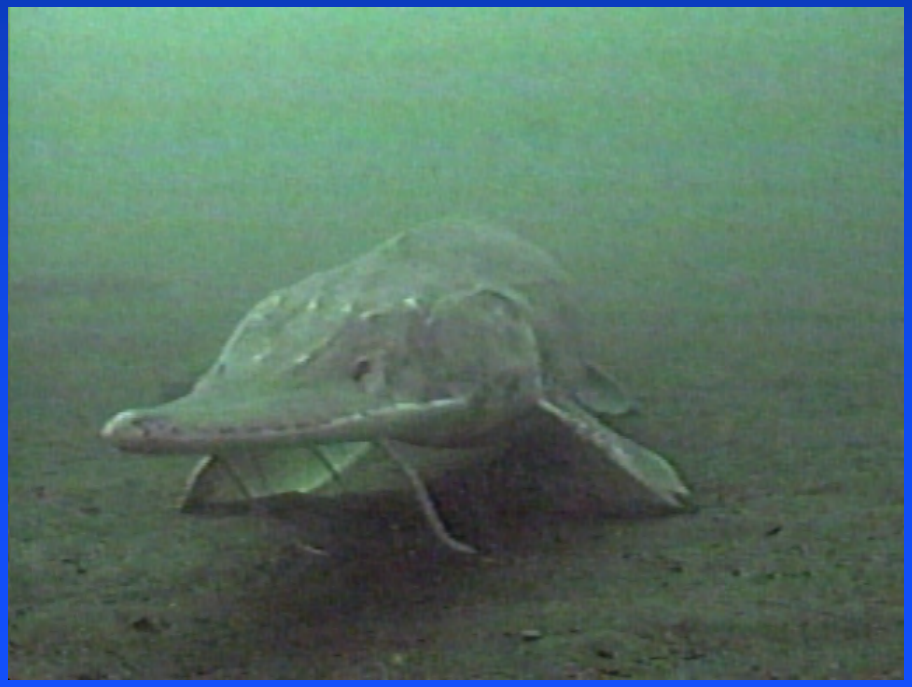
Why Create Habitat?

- Loss of physical habitat
- Loss of alluvial dynamics



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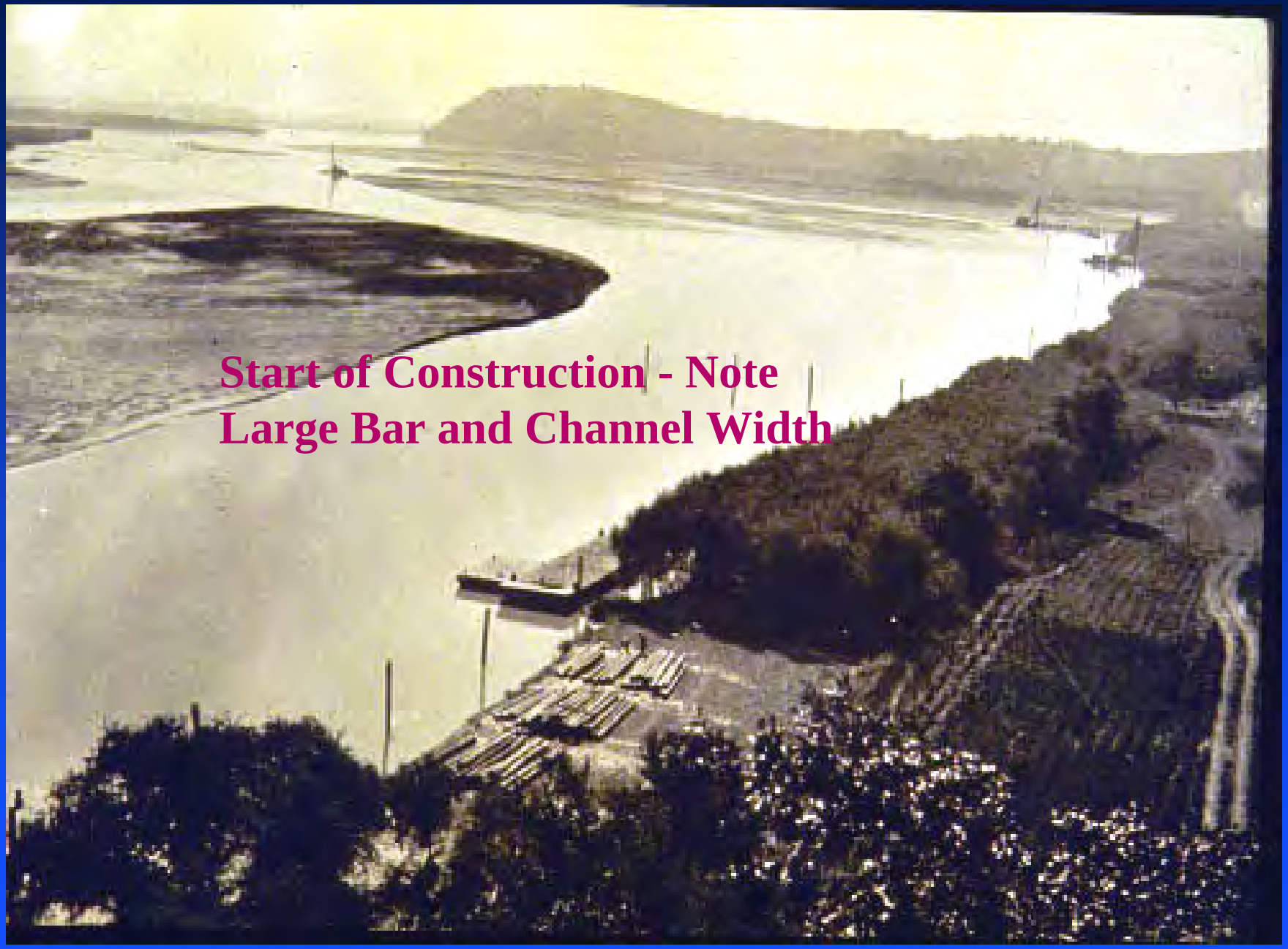
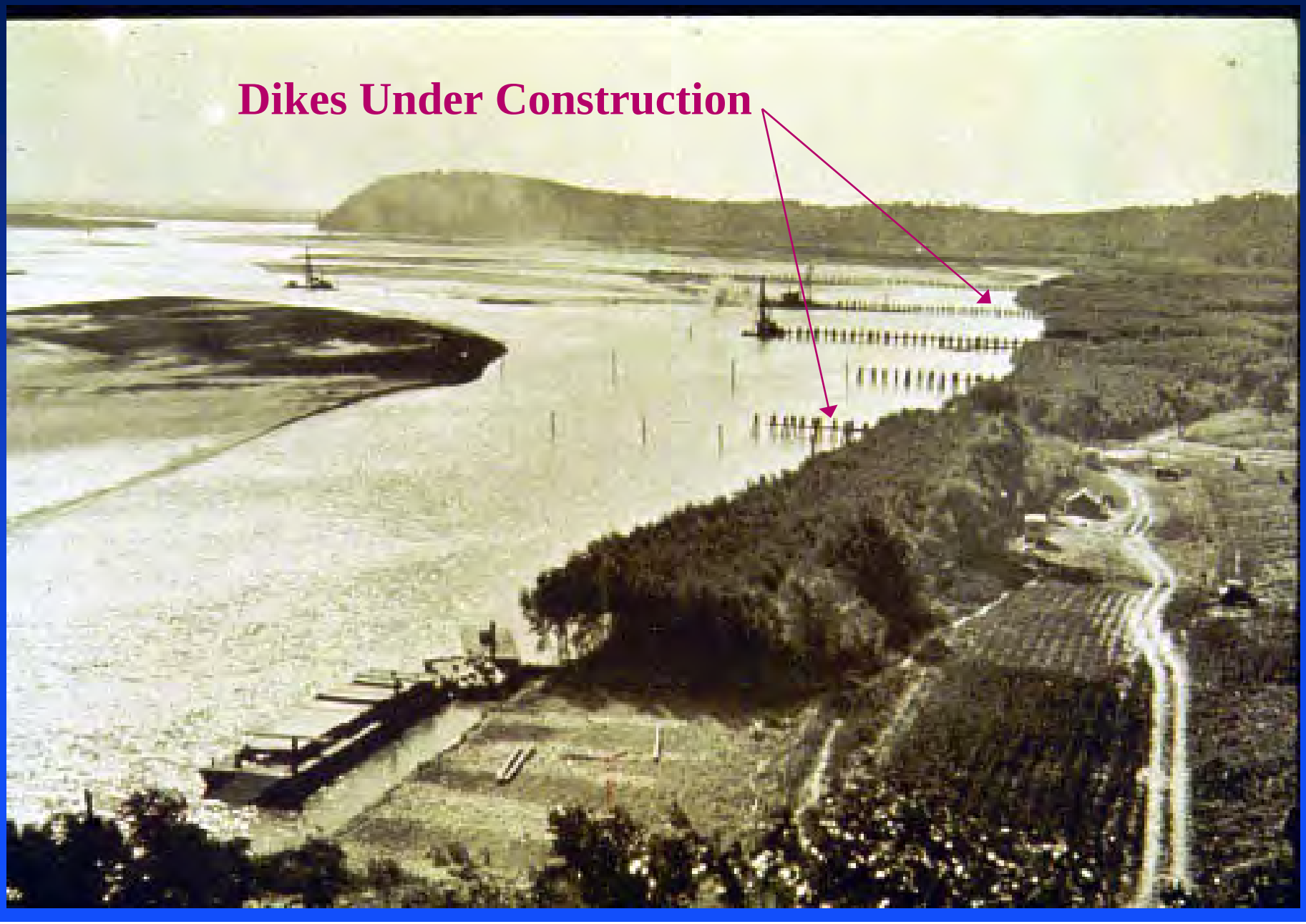
Channel Impacts

- Decreased depth diversity
- Channel meander stopped
- Aggradation on flood plain
- Limited dynamic interaction of channel and floodplain
- Channel degradation downstream of dams – lower floodplain connectivity
- Removed nearly 500,000 acres of habitat

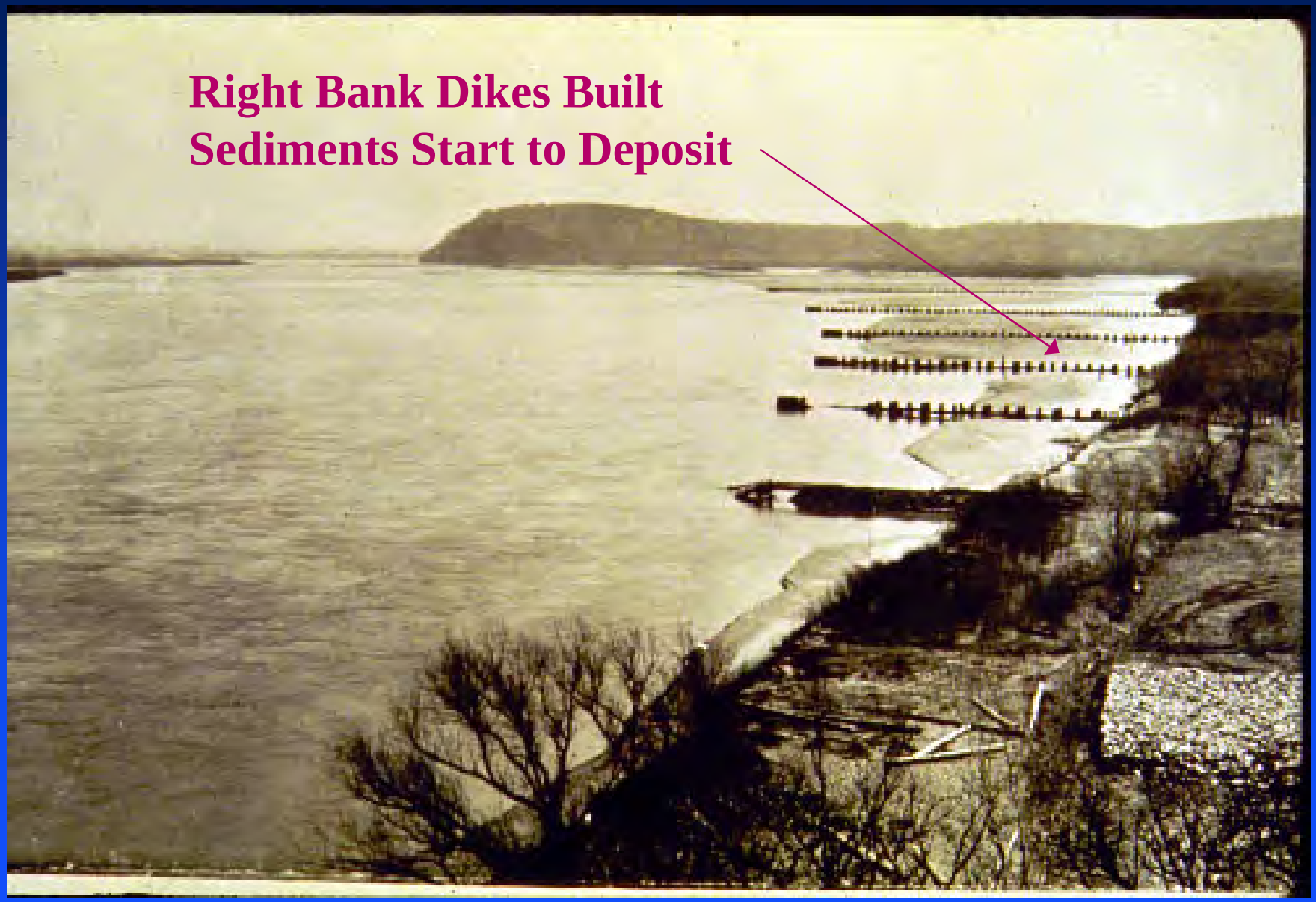
Rock Bluff Bend (RM 583 – 584) - Sep 1934



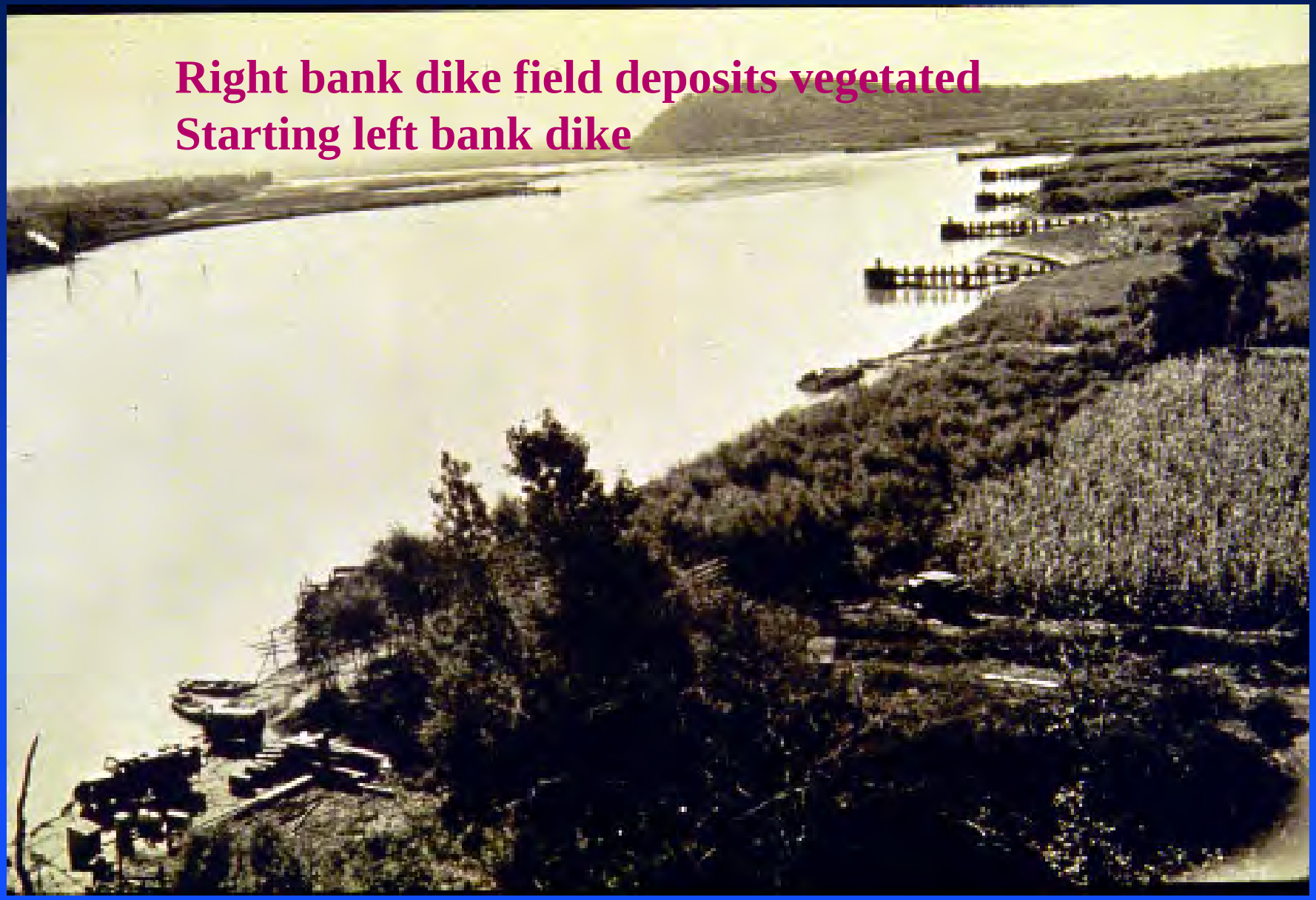
Rock Bluff Bend - Oct 1934



Rock Bluff Bend - Mar 1936

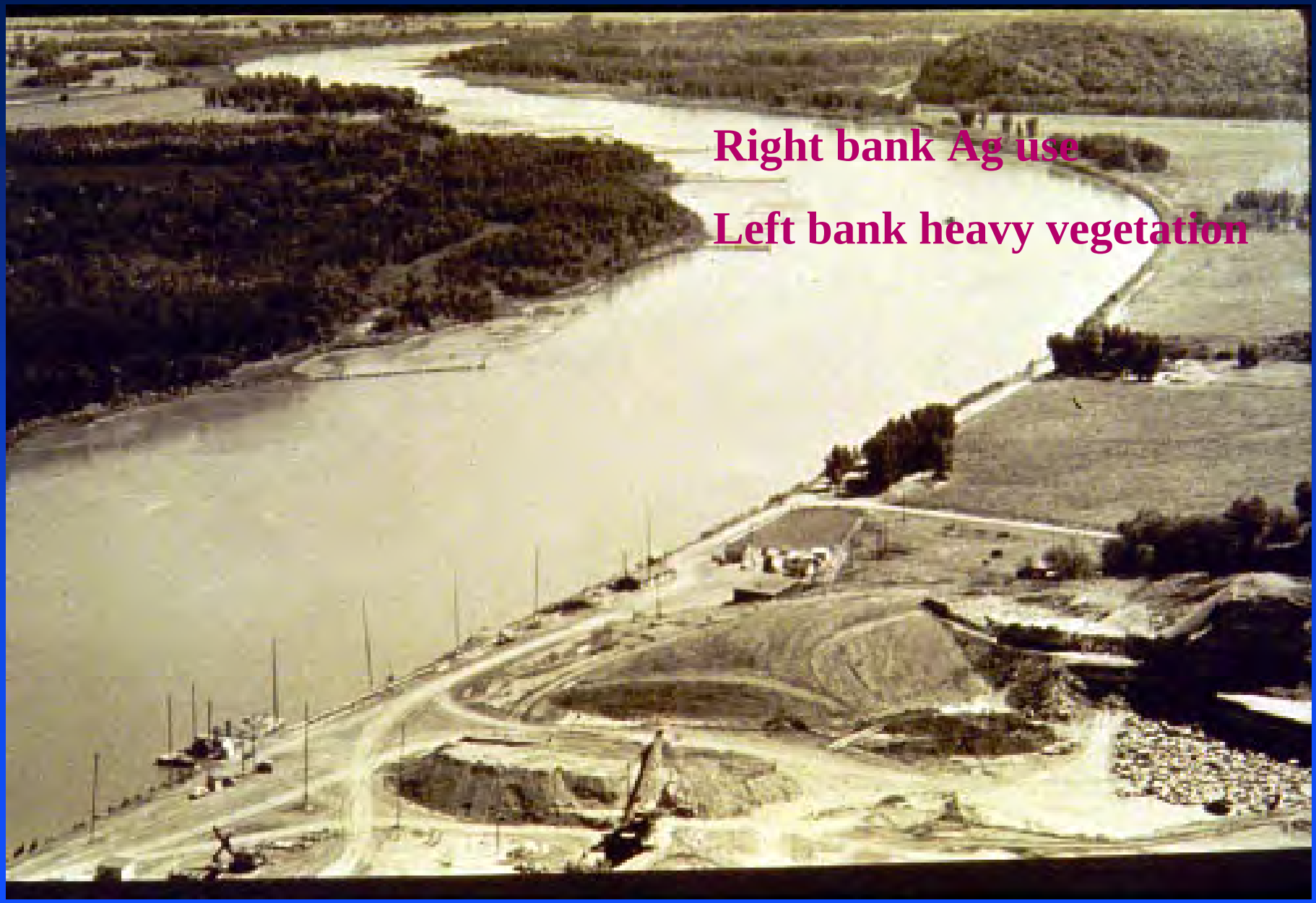


Rock Bluff Bend - Oct 1939 (5 years)



Rock Bluff Bend - 1942 (8 years)

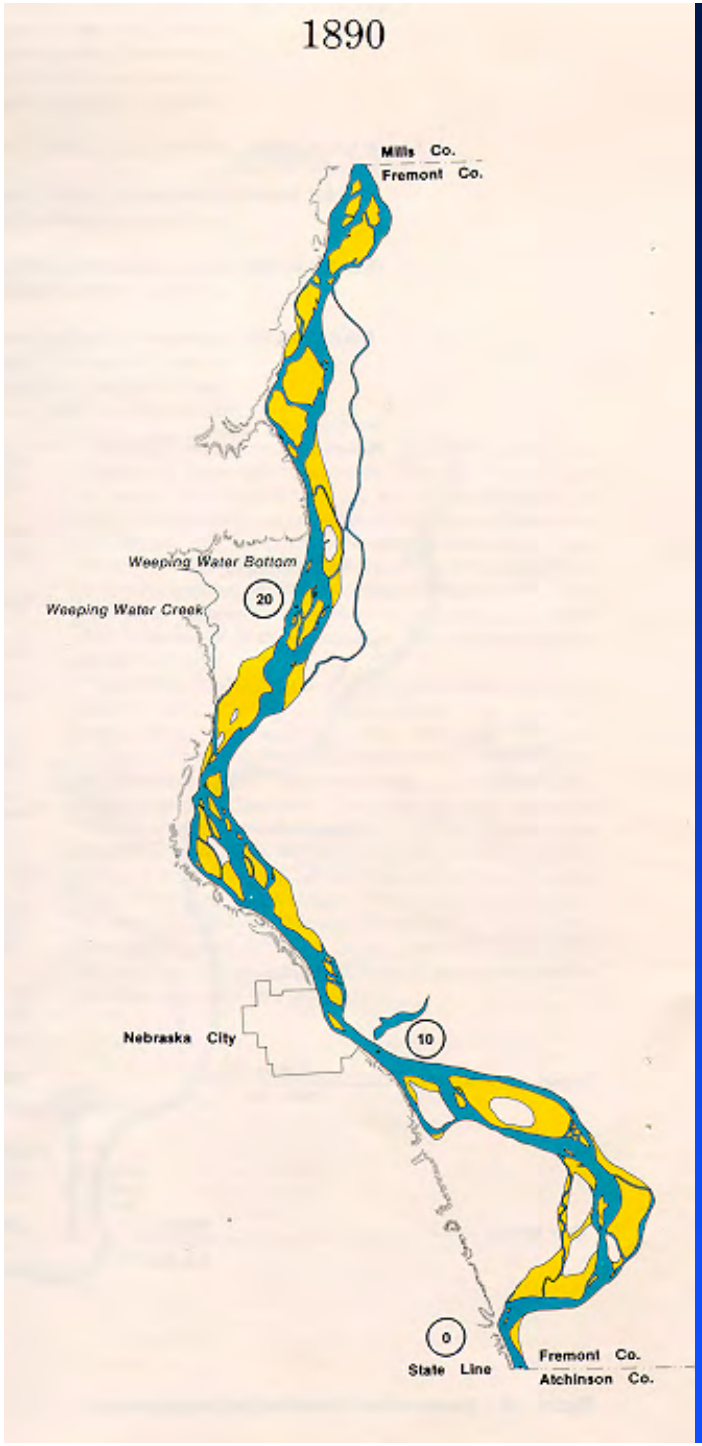
Rock Bluff Bend - May 1956 (22 years)

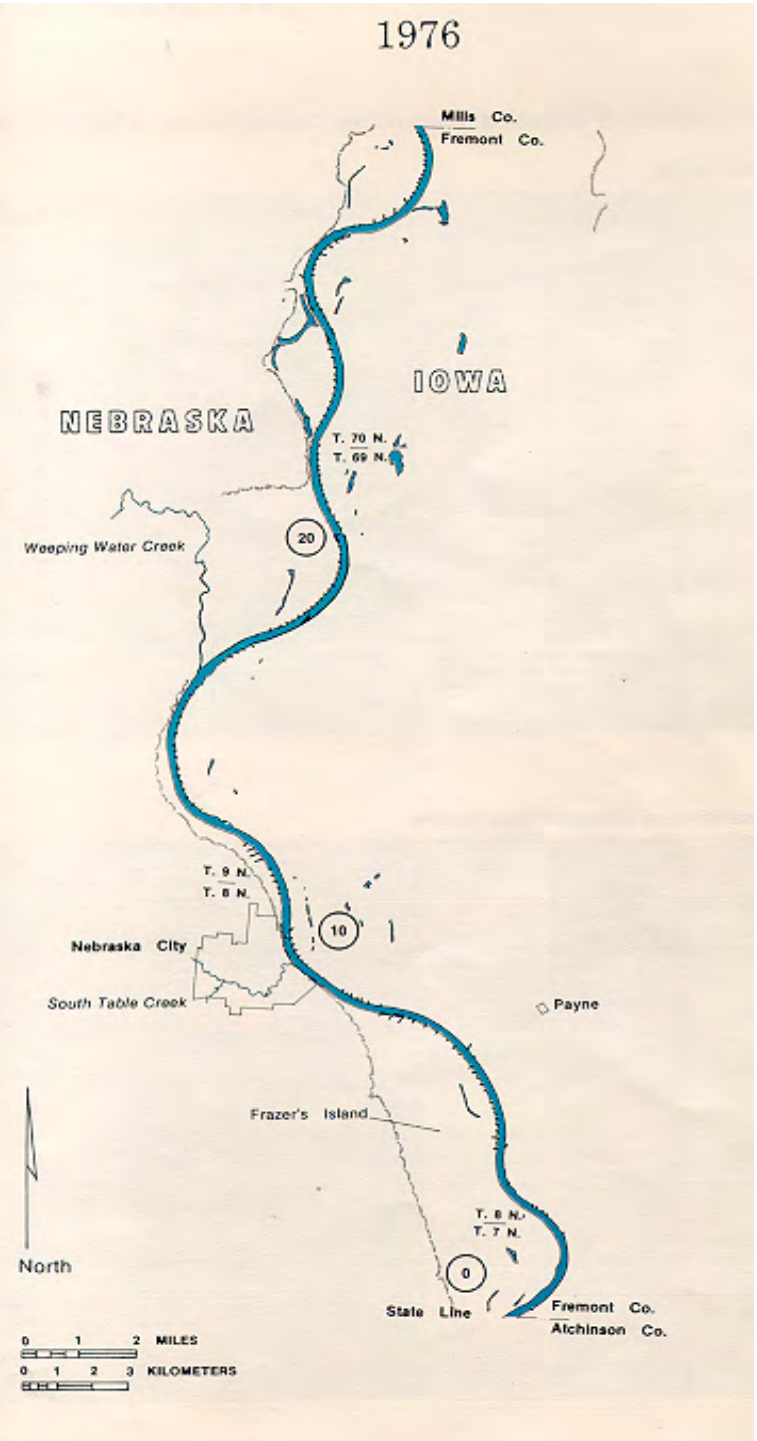


Rock Bluff Bend - Mar 1983 (50 years)

Both banks vegetation cleared with agricultural use

Plan View Channel Changes





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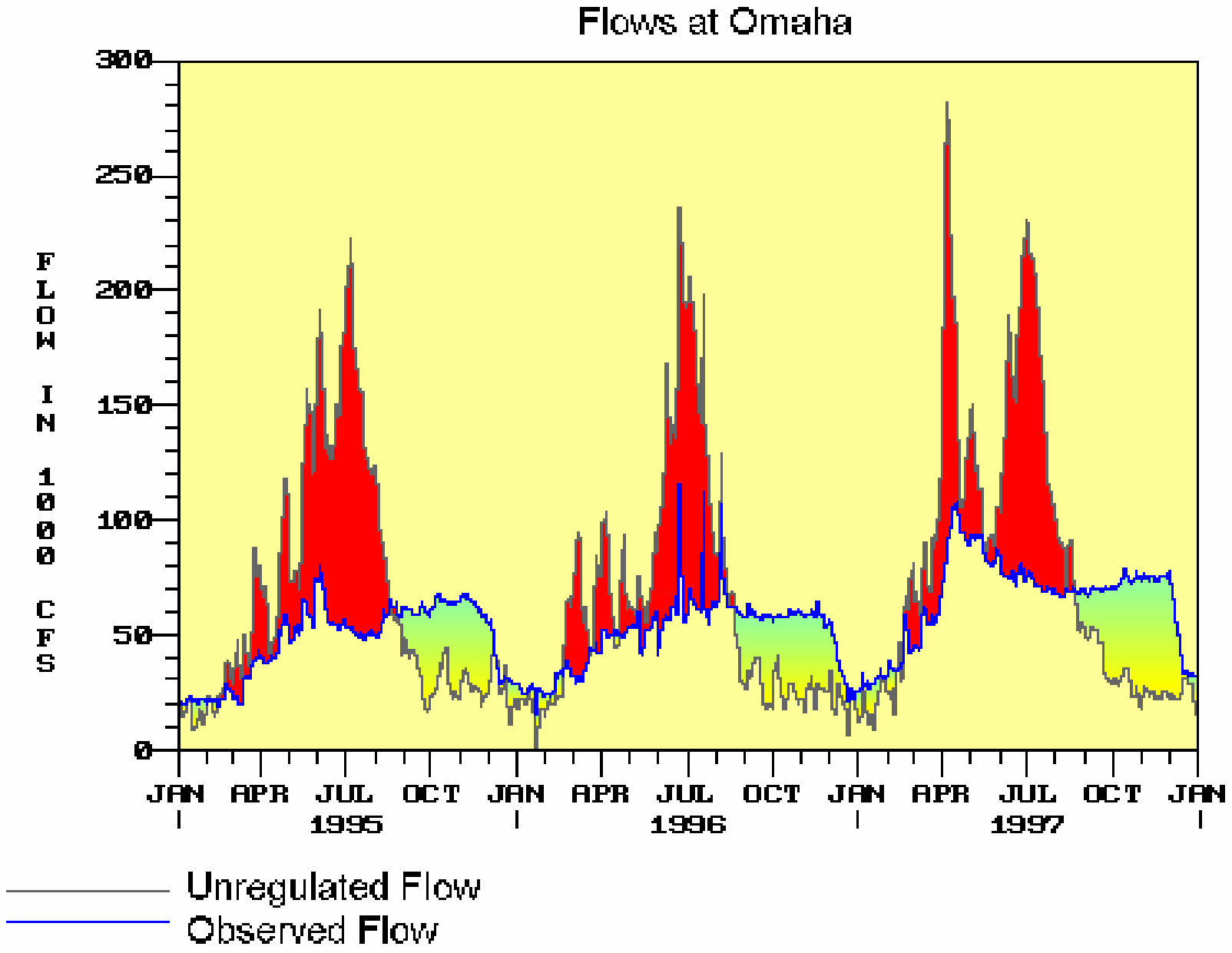
Reservoir Impacts

- Decreased peak flows (Flood Control)
- Increased base flows (Water Supply, Navigation, Hydropower)
- Operation Constraints – Hydropower and Recreation
- Trapped sediments
- Consumptive use reduces annual volume (about 20-30%)


Flows at Omaha
FLOW IN 10000 CFS
300
250
200
150
100
50
0
JAN
APR
JUL
OCT
JAN
APR
JUL
OCT
JAN
APR
JUL
OCT
JAN
1995
1996
1997
Unregulated Flow
Observed Flow

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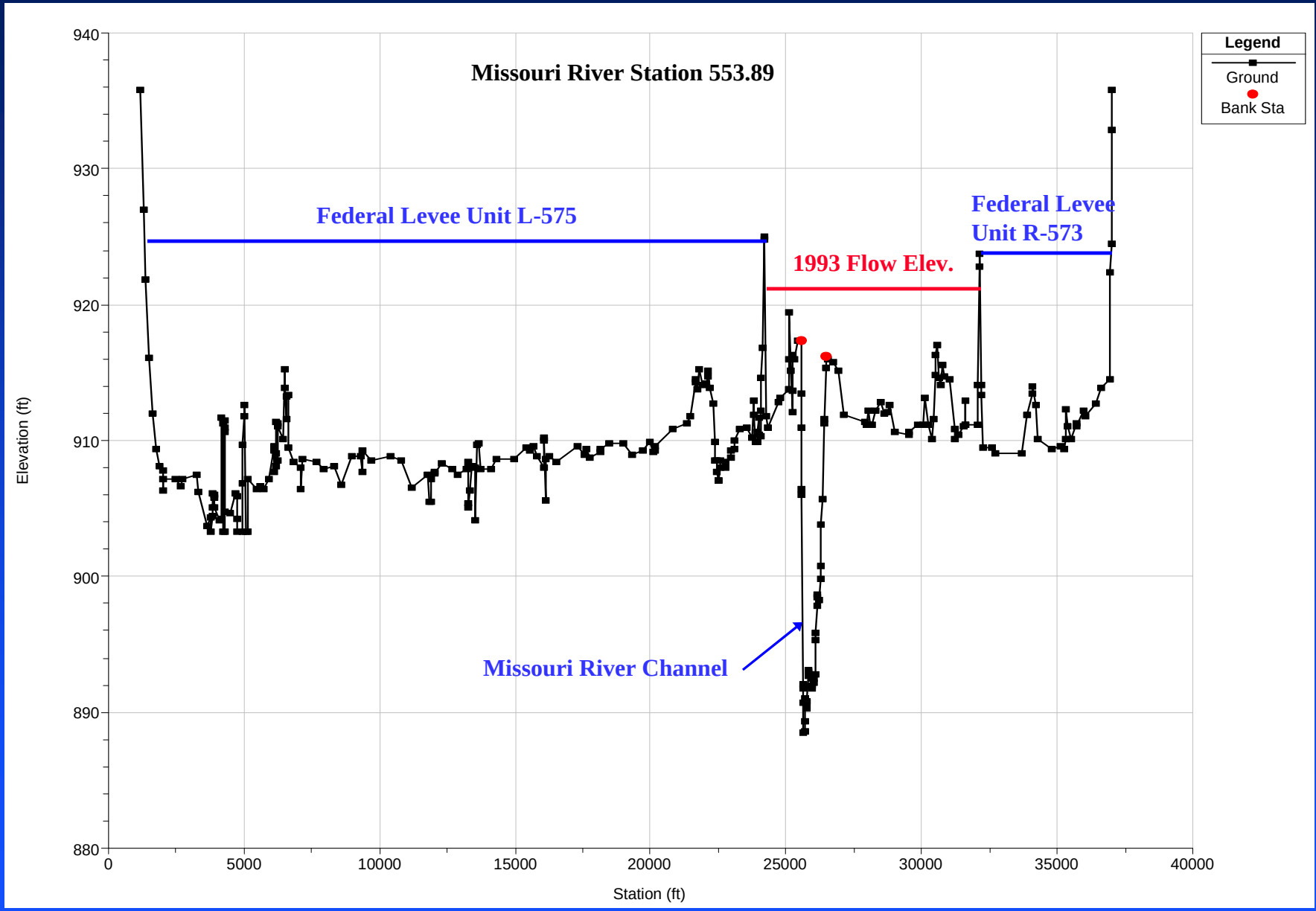
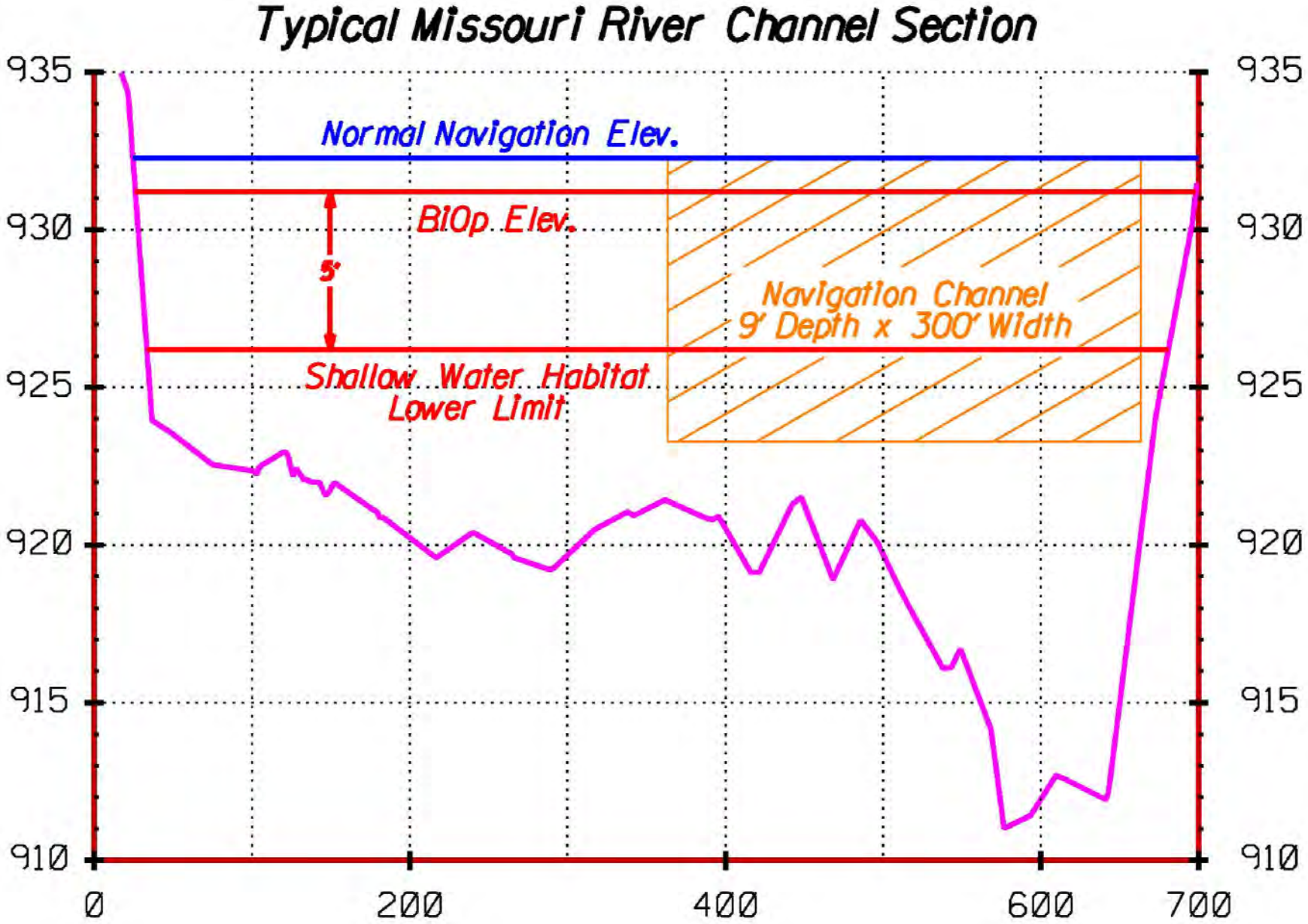
SWH Challenge

Construct SWH while maintaining existing project purposes:

- Navigation channel
- Streambank stabilization
- Flood control channel capacity
- Water supply water quality
- Recreation and public safety
- Irrigation

Typical Cross Section




Typical Missouri River Channel Section
935
930
925
920
915
910
0
200
400
600
700
Normal Navigation Elev.
BlOp Elev.
5'
Navigation Channel
9' Depth x 300' Width
Shallow Water Habitat
Lower Limit

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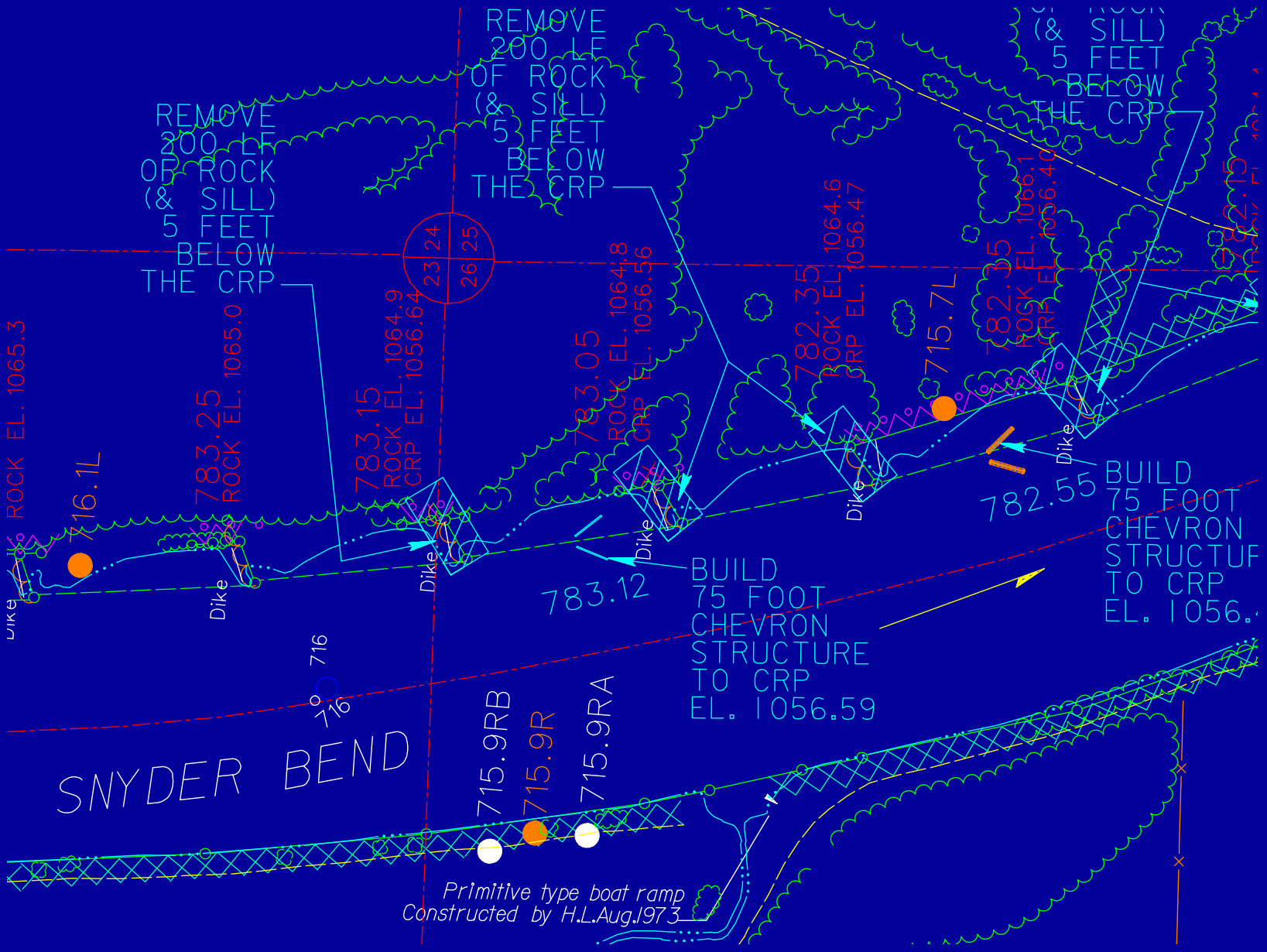
Methods to Create SWH

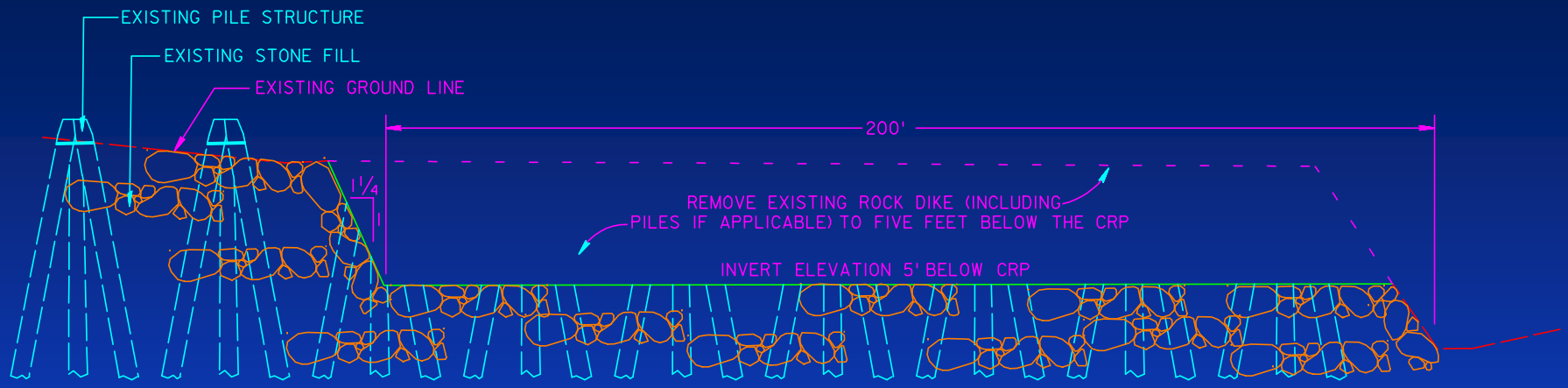
- Chutes and backwater areas
- Dike lowering / notching / removal
- Placement of new structures
- Combination of dike modification and new structures

Dredged Backwater – California Bend

Major Dike Modification - Plan

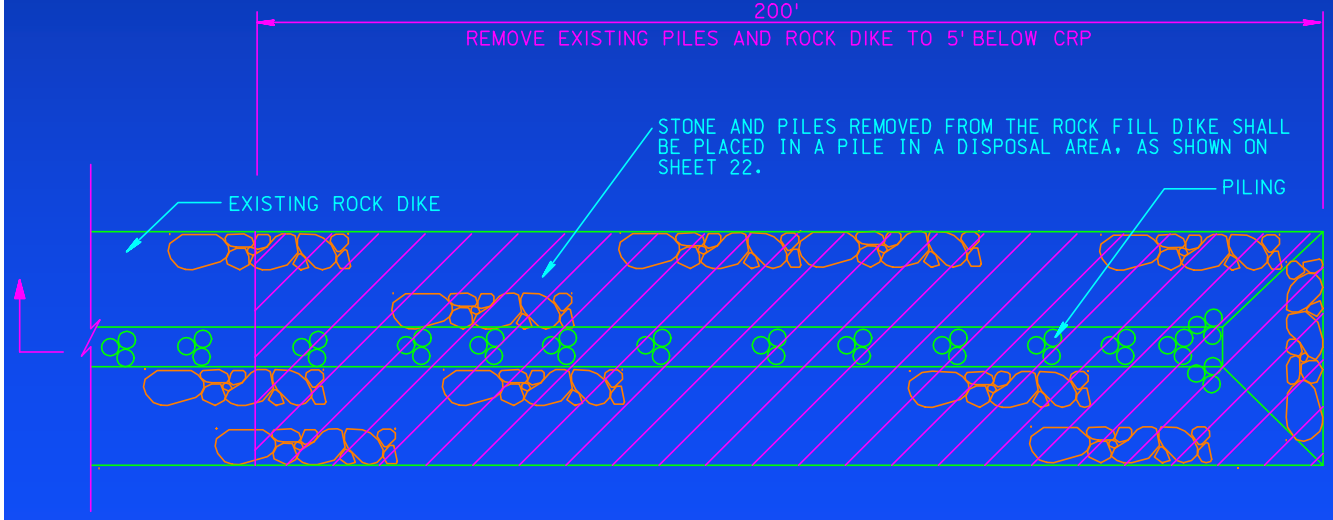


Major Dike Modification - Section



SECTION 1

NOT TO SCALE

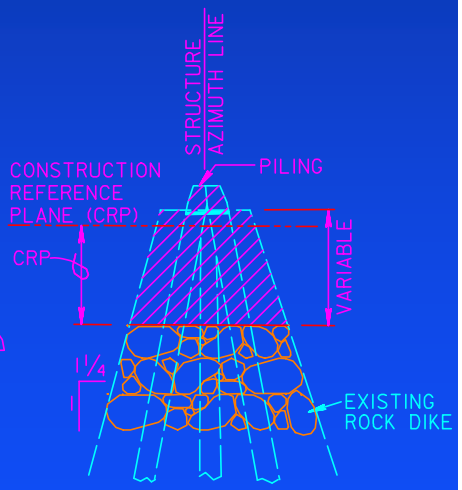


DIKE REMOVAL DETAIL

PLAN VIEW

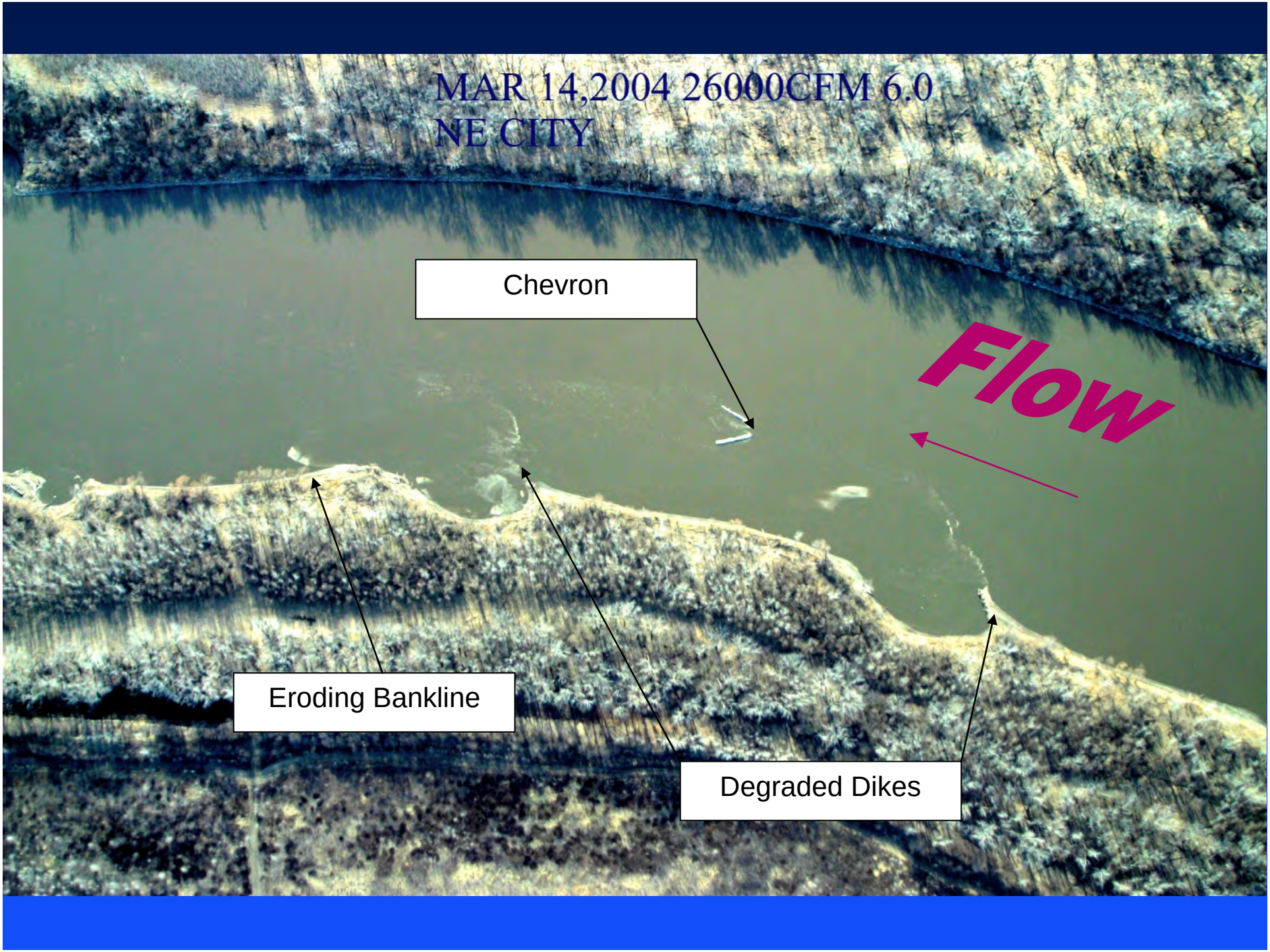
NOT TO SCALE

REMOVE EXISTING ROCK DIKE (INCLUDING PILES) TO FIVE FEET BELOW THE CRP

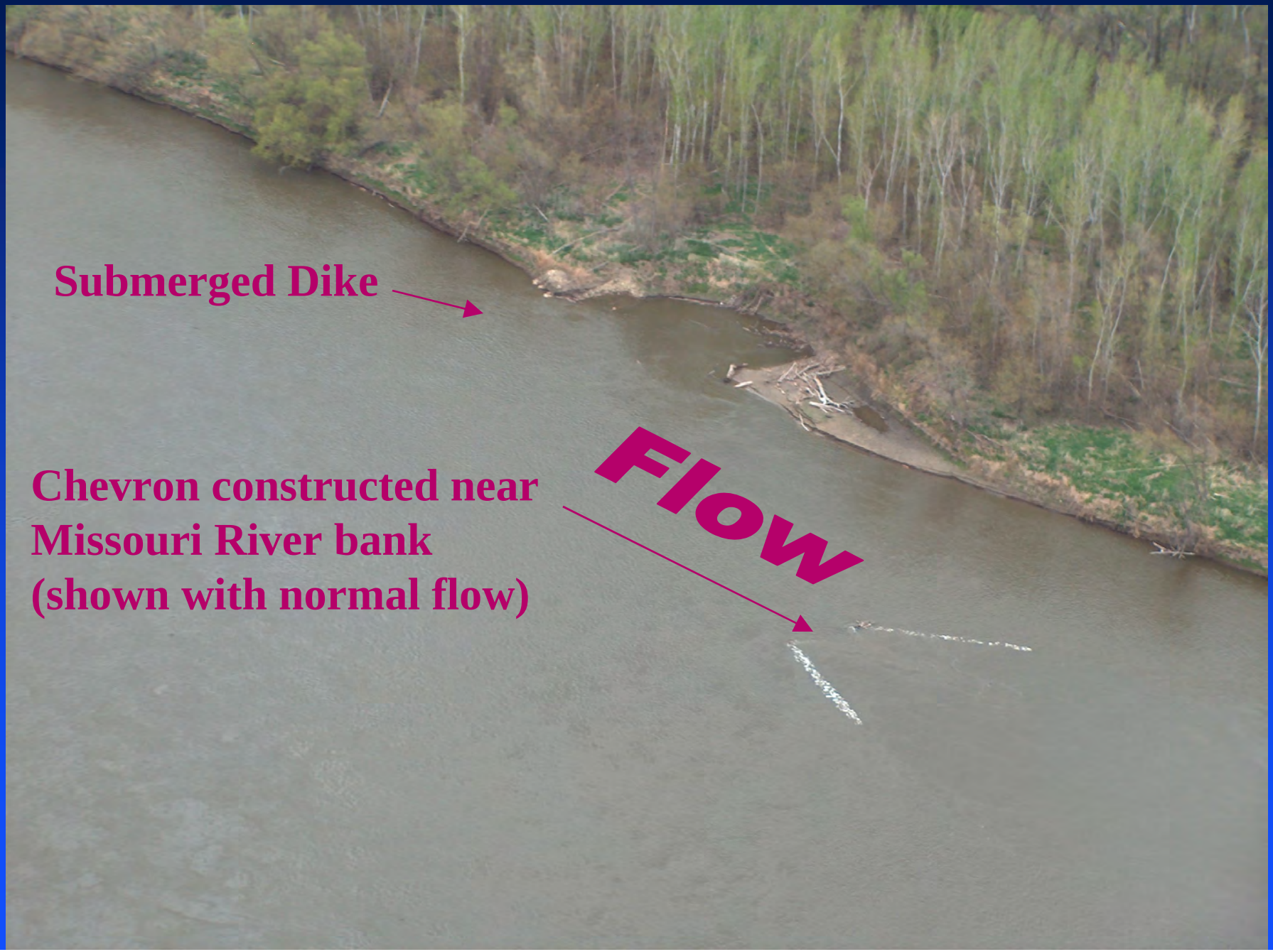


SECTION 2

NOT TO SCALE


MAR 14,2004 26000CFM 6.0
NE CITY
Chevron
Flow
Eroding Bankline
Degraded Dikes

Chevron Aerial View



Chevron with Sandbar Deposit

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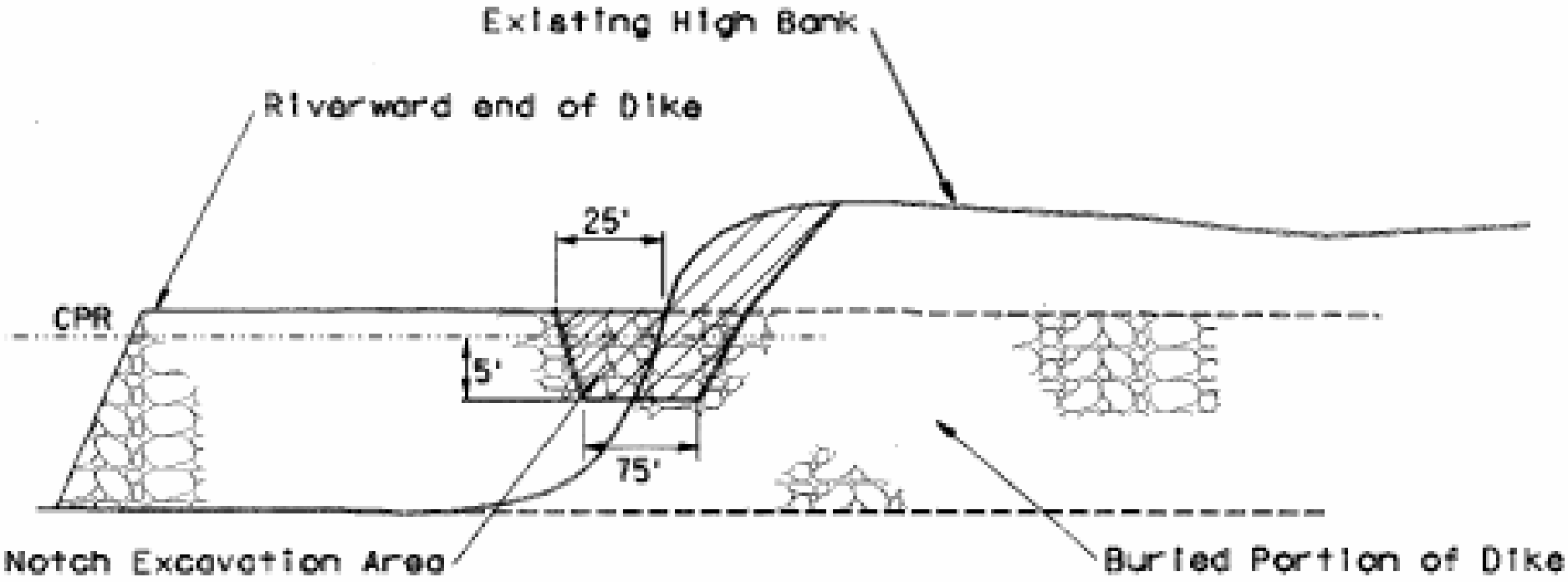
Type B Dike Notch



Notch Typical Profile - Type B

Dike Field with Type B Notches

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After Construction Field Observations

- **Increase in Measurable SWH per site**
- Increase in top width and depth diversity
- Erosion of high bank (slight to extensive)
- Ongoing erosion processes, sandbars are dynamic
- Spoil placement critical, some debris accumulation in notches

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Design and Monitoring Data Tools

- Numerous orthophotos
- 1999 4 foot contour interval DTM with 1995 hydrographic sections
- Site specific survey data
- ADCP velocity data
- Measured water surface profiles
- Rated USGS gages and COE stage gages
- CRP flow profile
- Calibrated RAS and UNET models

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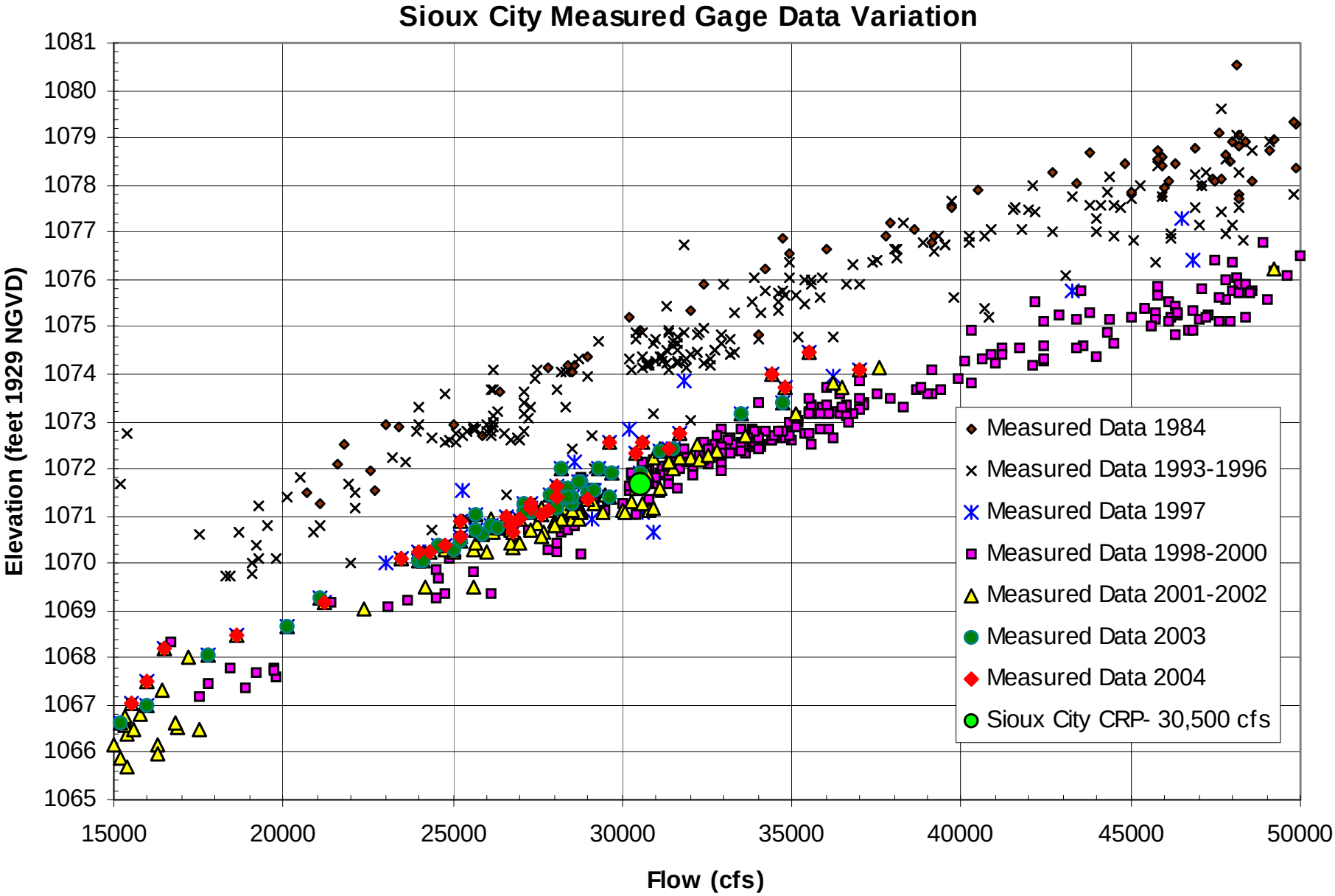
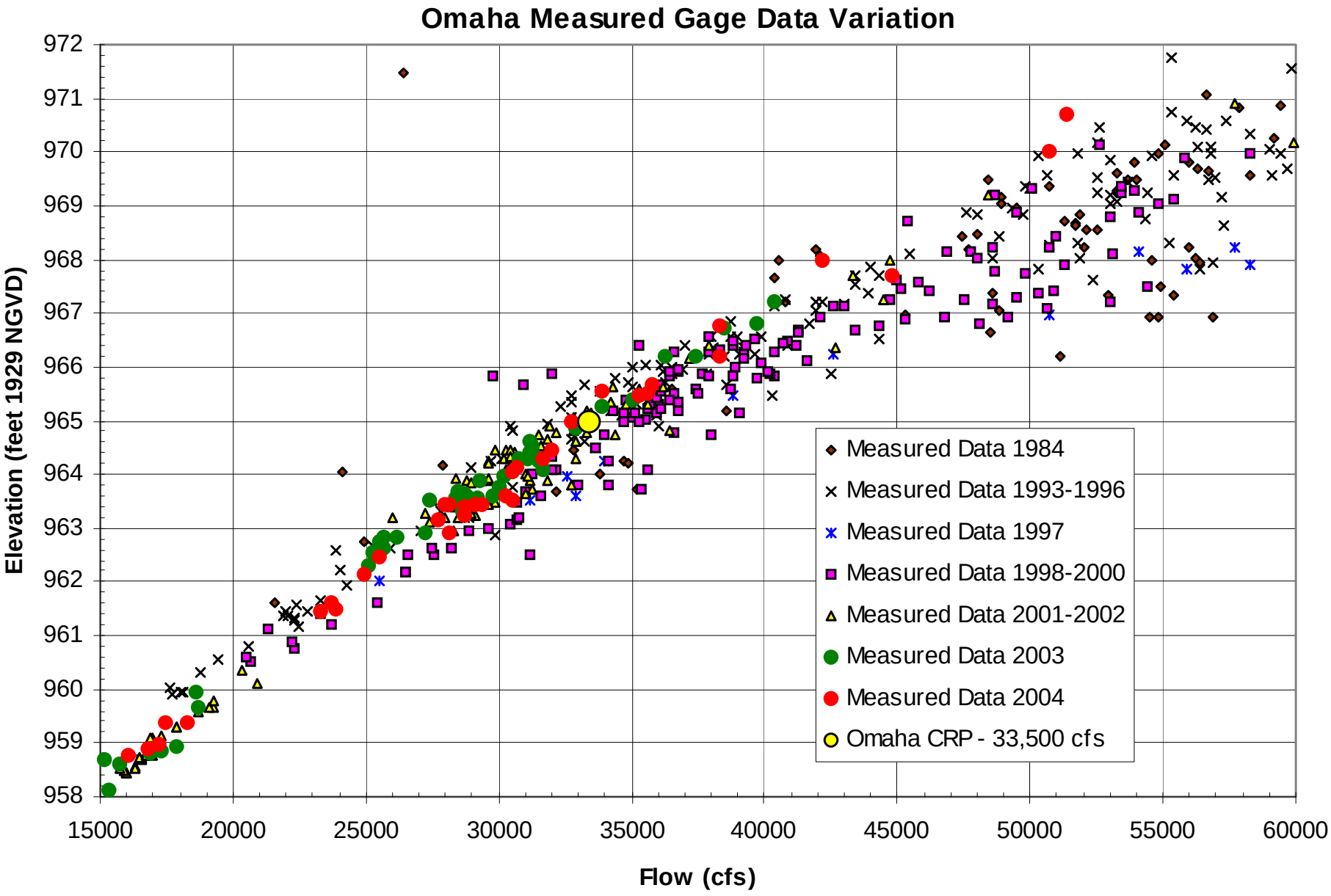
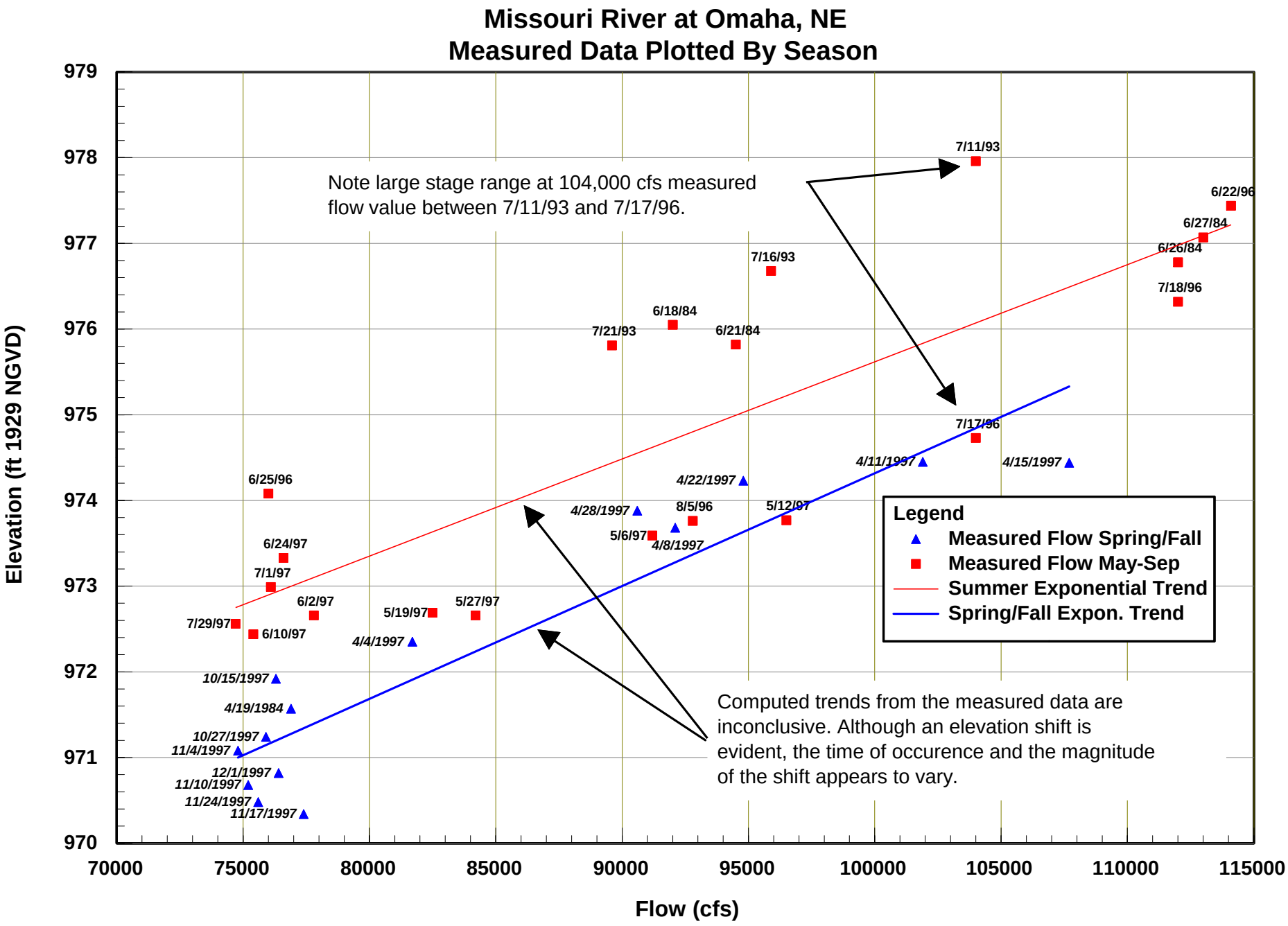
Design Challenges

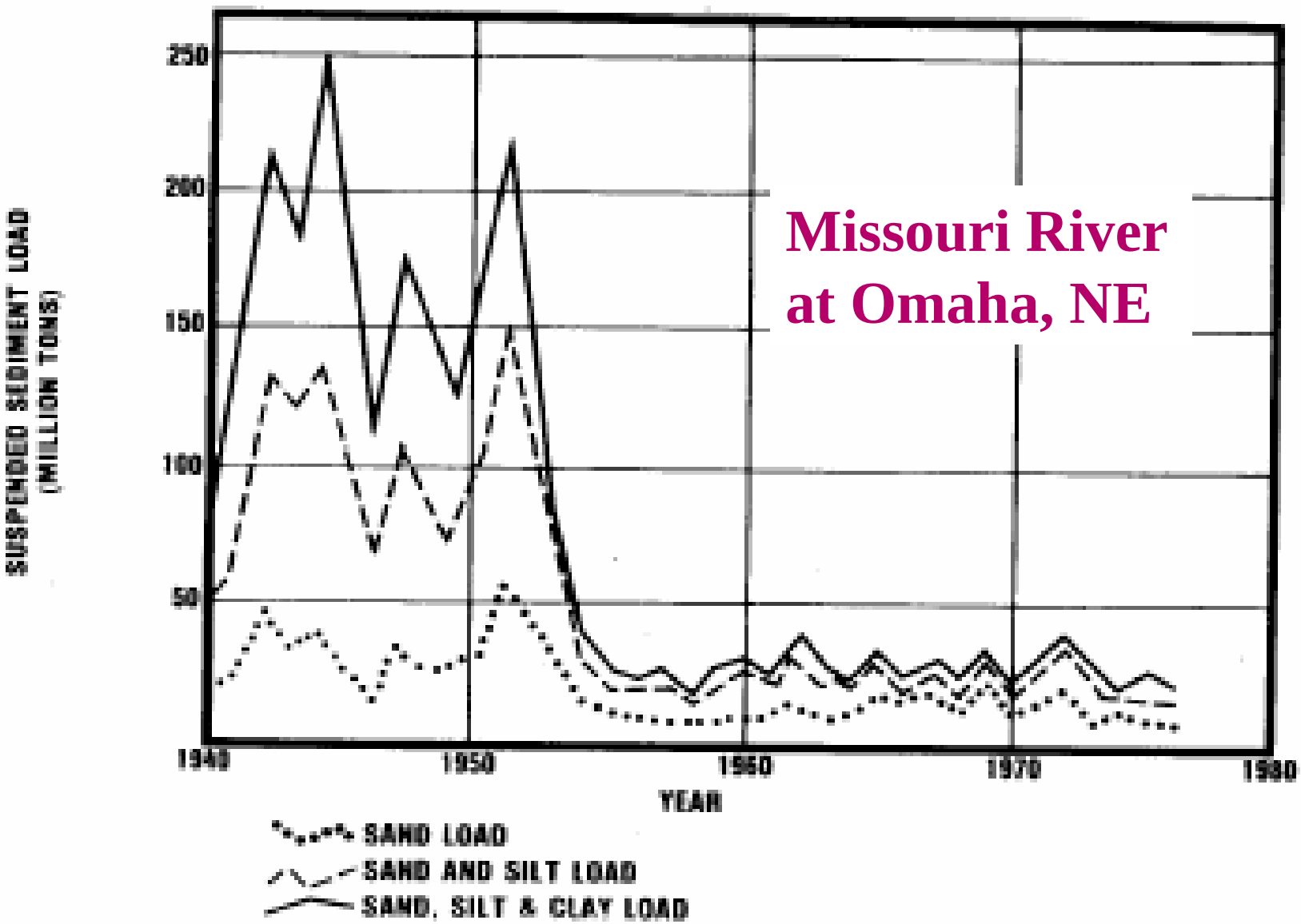
- Variable flow – stage rating (re-calibrate)
- Maintain flood capacity
- Maintain sediment transport
- Monitoring to demonstrate compliance
- Coordinate with numerous federal, state, local agencies
- Changing criteria and operating plan
- Real estate acquisition, easements


Sioux City Measured Gage Data Variation
Elevation (feet 1929 NGVD)
1081
1080
1079
1078
1077
1076
1075
1074
1073
1072
1071
1070
1069
1068
1067
1066
1065
15000
20000
25000
30000
35000
40000
45000
50000
Flow (cfs)
Measured Data 1984
Measured Data 1993-1996
Measured Data 1997
Measured Data 1998-2000
Measured Data 2001-2002
Measured Data 2003
Measured Data 2004
Sioux City CRP- 30,500 cfs


Omaha Measured Gage Data Variation
Elevation (feet 1929 NGVD)
Flow (cfs)
972
971
970
969
968
967
966
965
964
963
962
961
960
959
958
15000
20000
25000
30000
35000
40000
45000
50000
55000
60000
Measured Data 1984
Measured Data 1993-1996
Measured Data 1997
Measured Data 1998-2000
Measured Data 2001-2002
Measured Data 2003
Measured Data 2004
Omaha CRP - 33,500 cfs


Missouri River at Omaha, NE
Measured Data Plotted By Season
Elevation (ft 1929 NGVD)
Flow (cfs)
979
978
977
976
975
974
973
972
971
970
70000
75000
80000
85000
90000
95000
100000
105000
110000
115000
Note large stage range at 104,000 cfs measured flow value between 7/11/93 and 7/17/96.
Computed trends from the measured data are inconclusive. Although an elevation shift is evident, the time of occurence and the magnitude of the shift appears to vary.
Legend
Measured Flow Spring/Fall
Measured Flow May-Sep
Summer Exponential Trend
Spring/Fall Expon. Trend
7/11/93
6/22/96
6/27/84
6/26/84
7/18/96
7/16/93
6/18/84
7/21/93
6/21/84
7/17/96
4/11/1997
4/15/1997
6/25/96
4/22/1997
4/28/1997
8/5/96
5/12/97
5/6/97
4/8/1997
6/24/97
7/1/97
6/2/97
5/19/97
5/27/97
7/29/97
6/10/97
4/4/1997
10/15/1997
4/19/1984
10/27/1997
11/4/1997
12/1/1997
11/10/1997
11/24/1997
11/17/1997

Sediment Load Change



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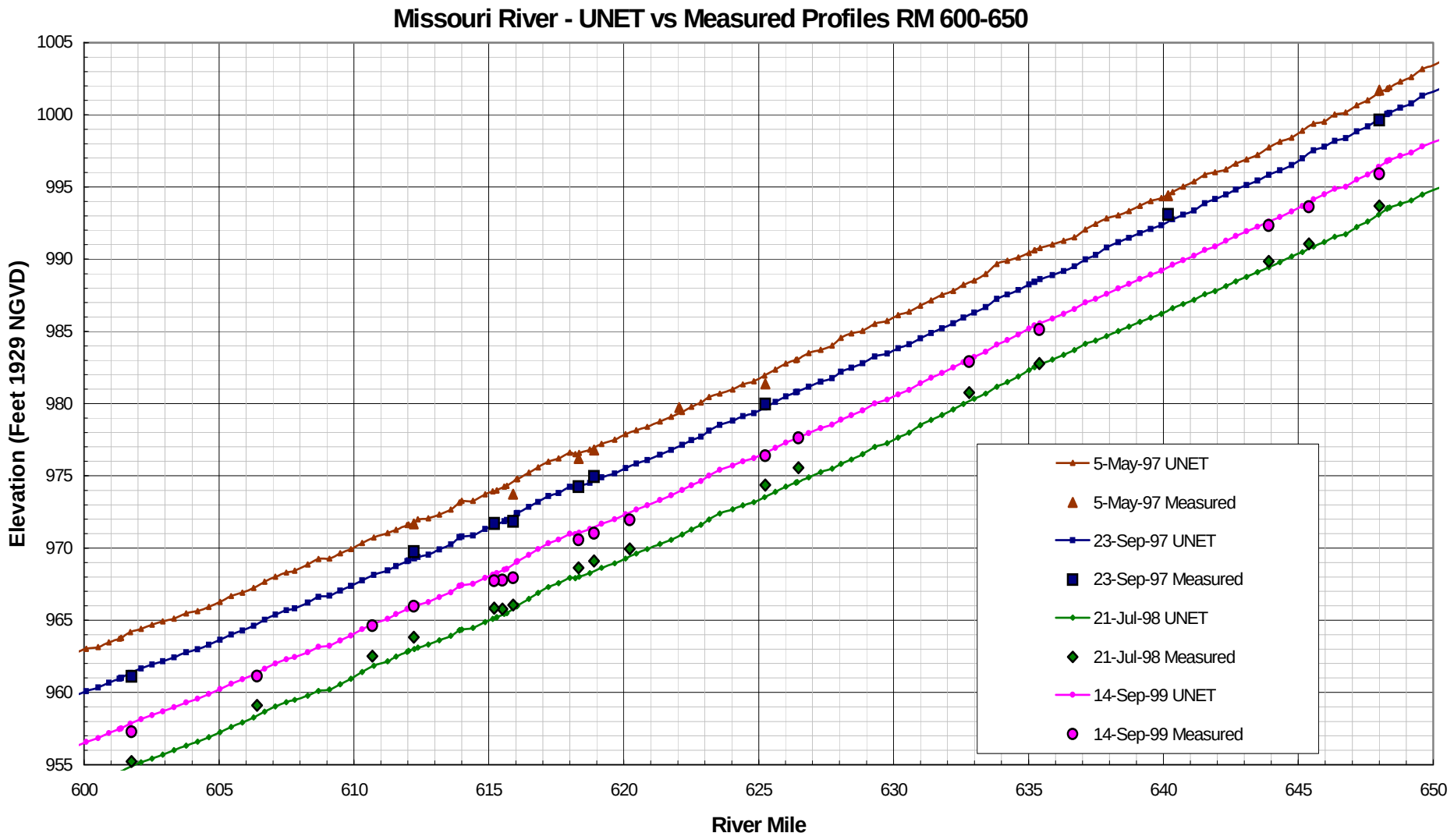
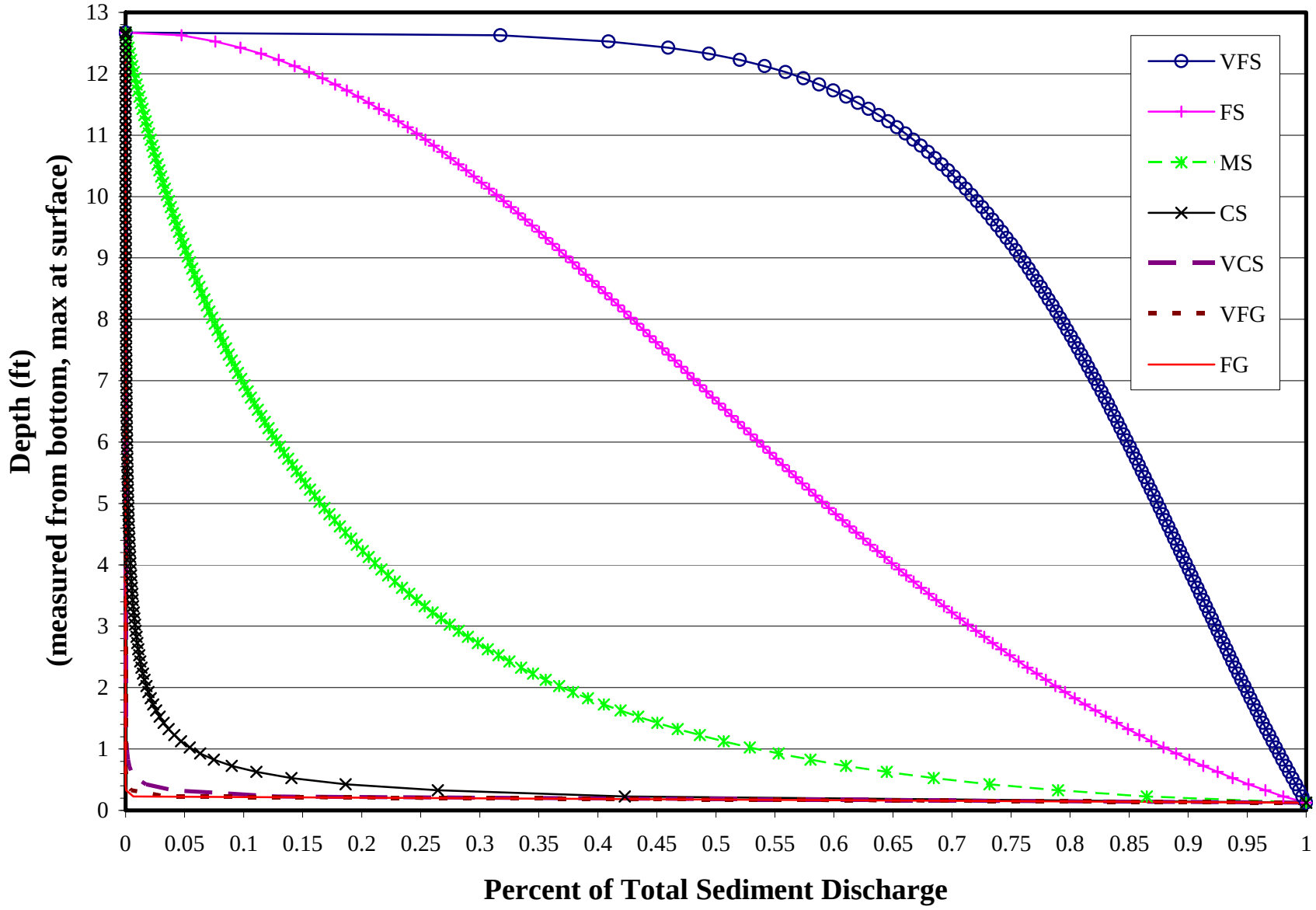
Chute Analysis

- Typically HEC-RAS split flow analysis
- Set invert using CRP to limit sediment intake
- Calibrate to measured profiles
- Provide upstream and downstream control, additional site specific
- Generally 5-10% of channel flow with velocity above 2 ft/sec at CRP flow
- SAM (used on Platte River chute)
- HEC-6 for Missouri River sediment transport

Calibration to Measured Profiles



Sediment Distribution



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Dike Modification

- 2 Dimensional (SMS and RMA-2)
- 3 Dimensional (Iowa IHR)
  - Limited applicability due to run time, sediment modeling, and result interpretation
- Micro Model
  - Modeled various widths to widen the channel, results set thresholds of channel widths
- HEC-6 Model
  - System model lacking detail to evaluate depth diversity and velocity changes
- Movable Bed Physical Model
  - Limited experience, scale, dike flow too shallow

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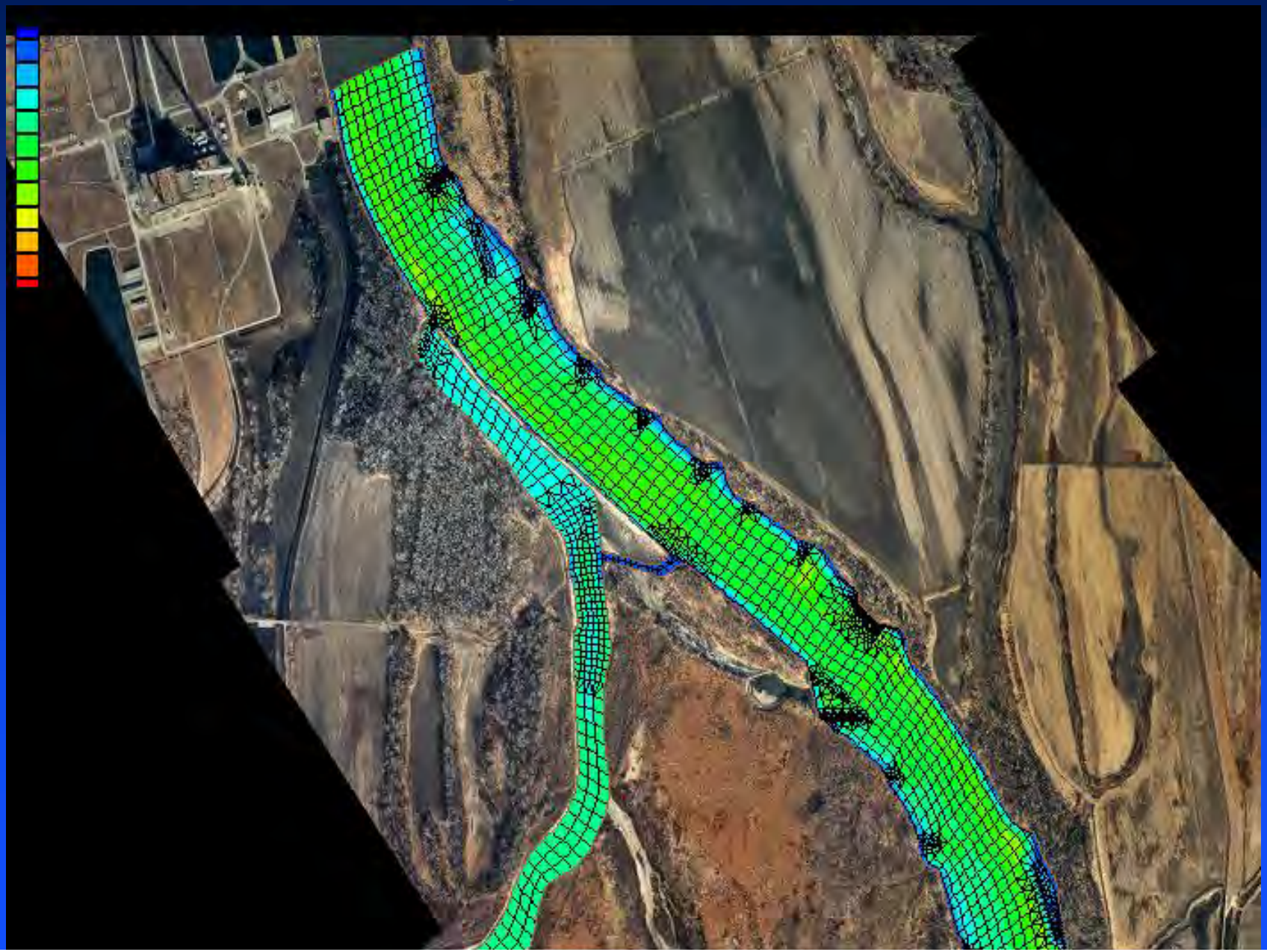
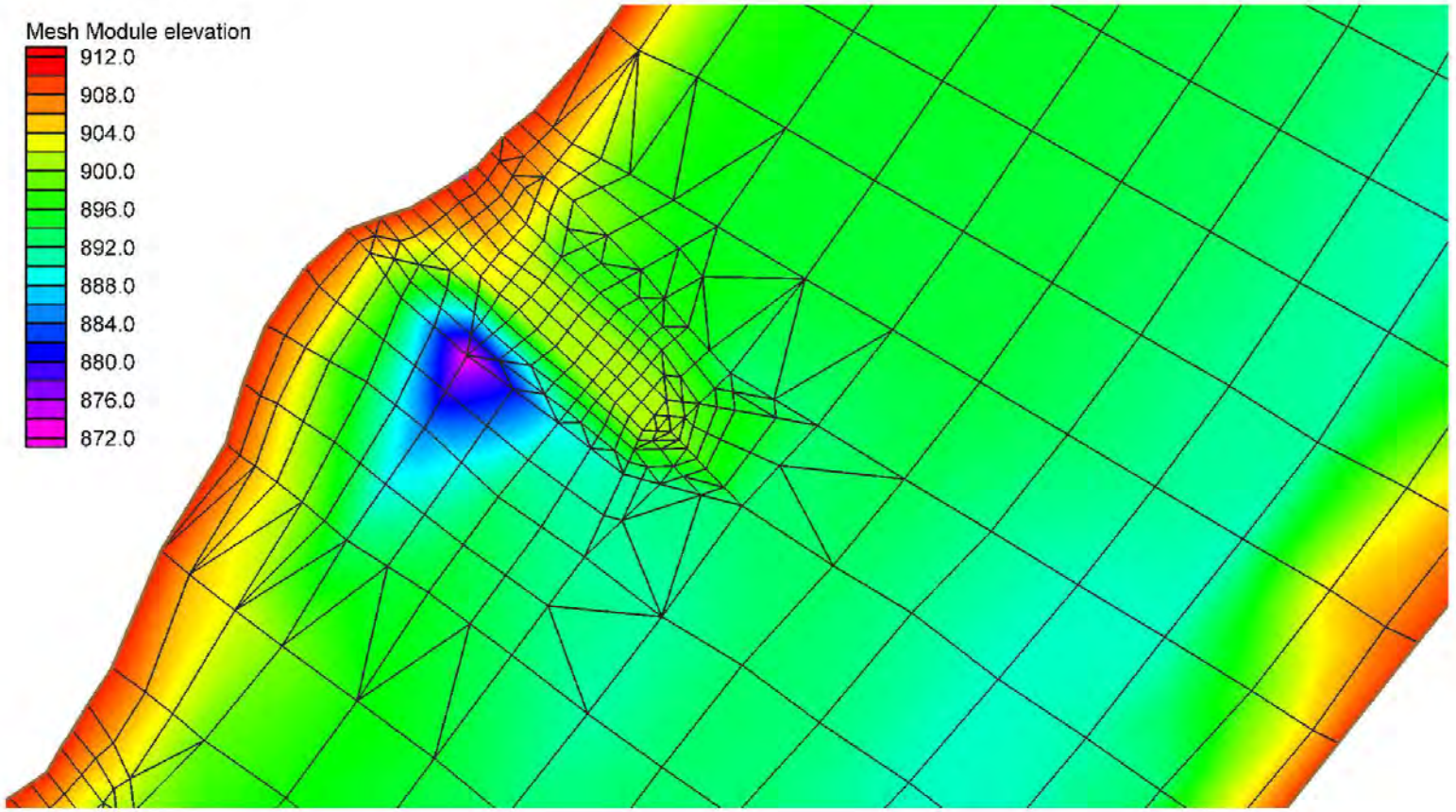
2D Modeling

- Model analysis performed through dike fields
- Calibrated to stage and ADCP velocity data
- Grid density increased for dike areas
- Sediment analysis limited by SED2D and not accurate in dike fields
- Next generation is to model a navigation season hydrograph with sediment to evaluate pre and post channel response

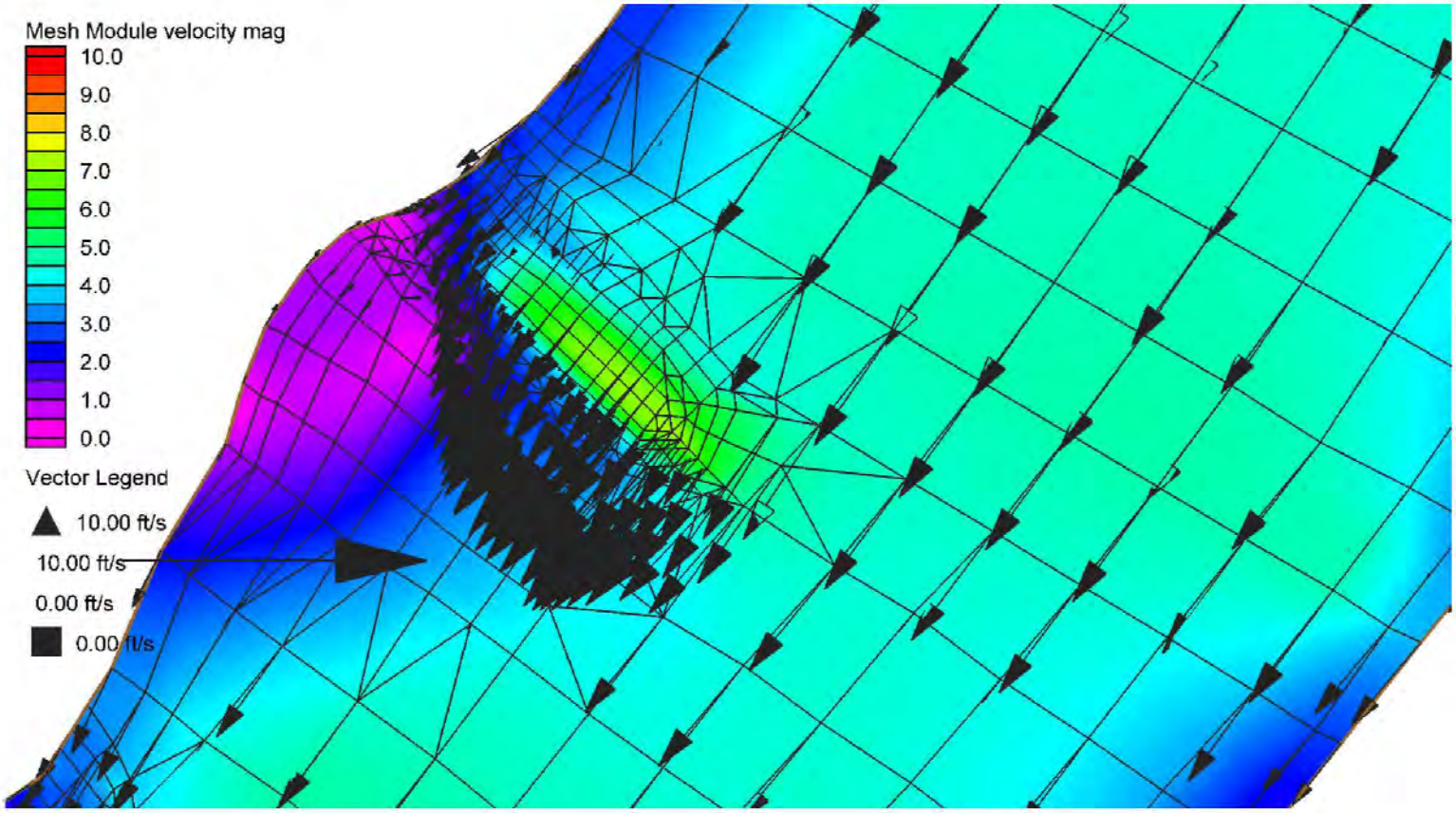
Hamburg Bend 2D Mesh

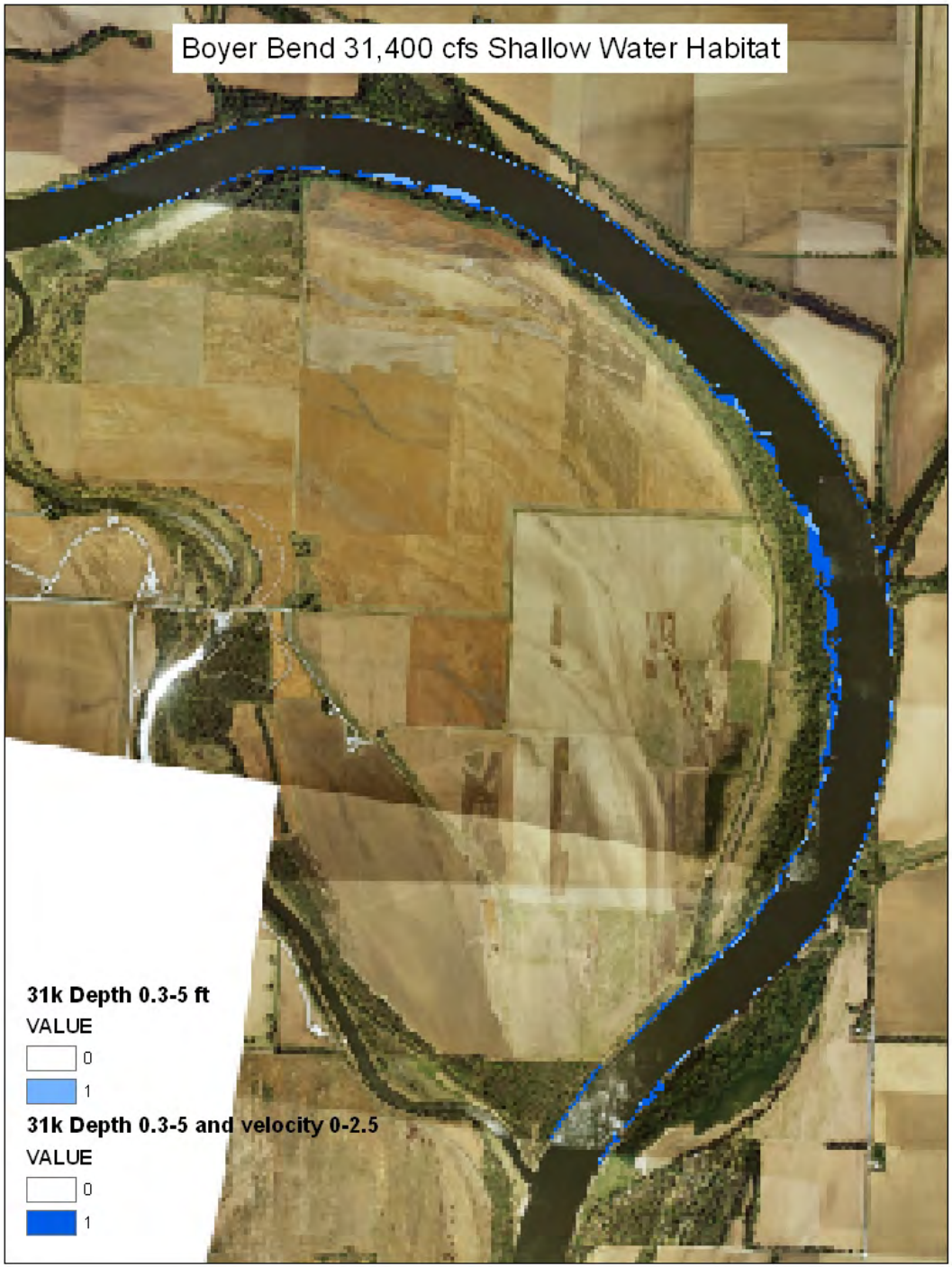


Typical Mesh Topography



Computed Velocity




Boyer Bend 31,400 cfs Shallow Water Habitat
31k Depth 0.3-5 ft
VALUE
0
1
31k Depth 0.3-5 and velocity 0-2.5
VALUE
0
1

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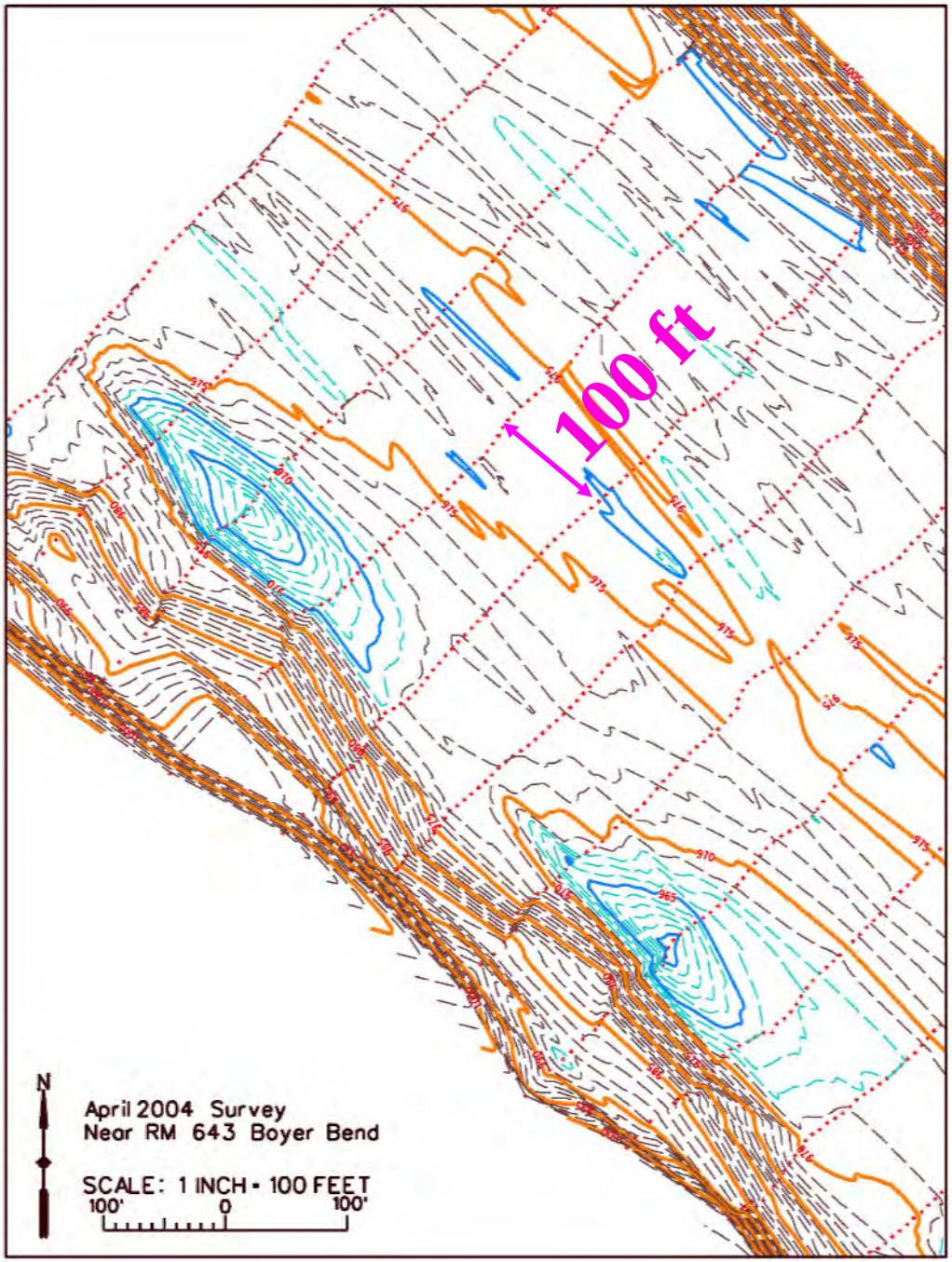
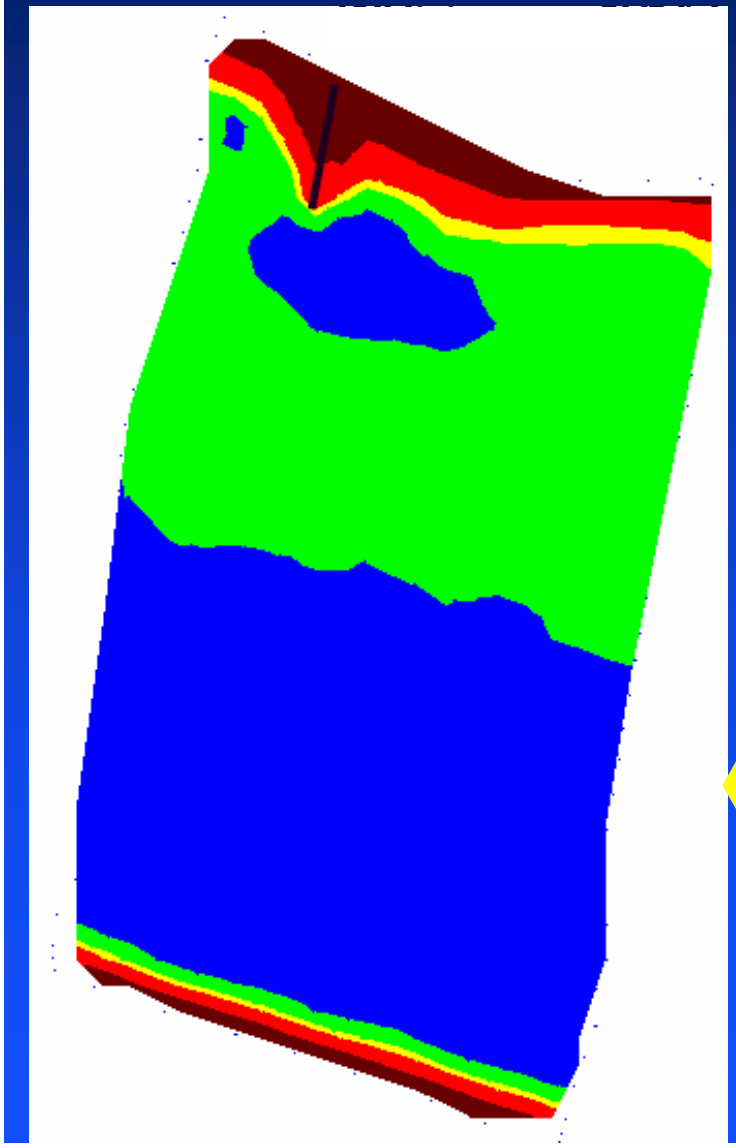
Physical Monitoring

- Data collection and analysis to define SWH quantity and quality, track changes
- Analyze impacts on project purposes
- Develop SOP's for data collection, data analysis, data storage
- Impacts outside the project reach

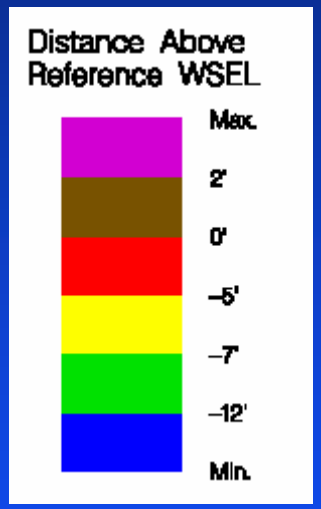
Evaluation of survey data collected using 100 feet spacing



Dike Notching

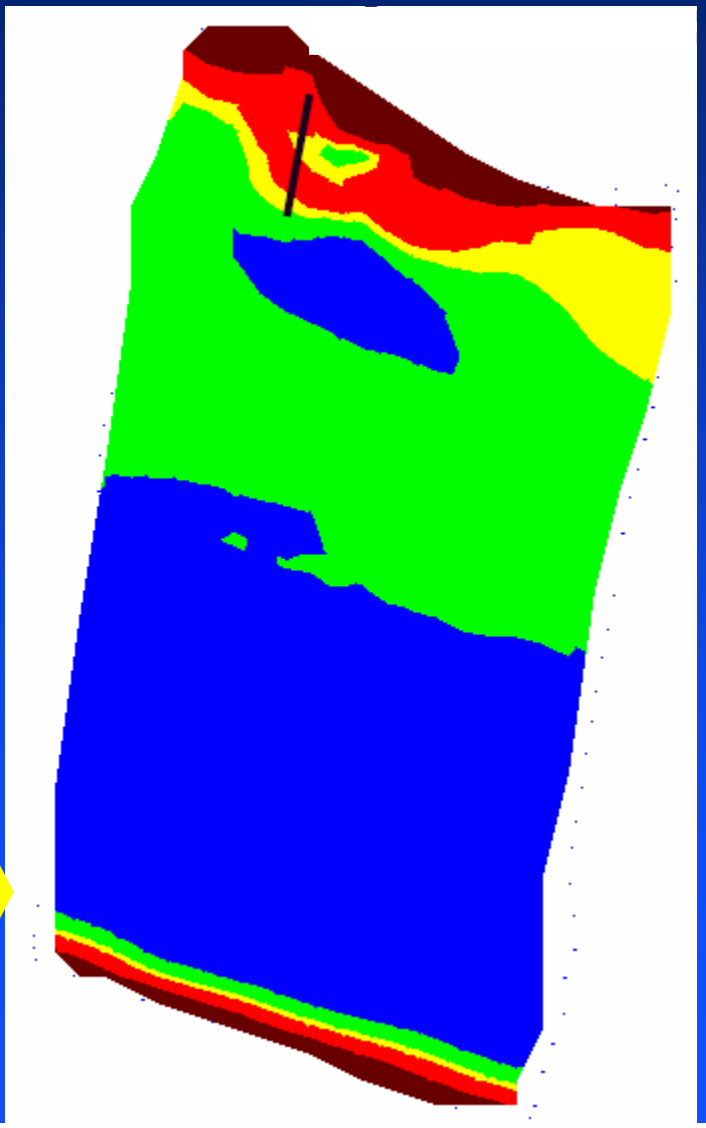


Dike 723.8



Pre Const.

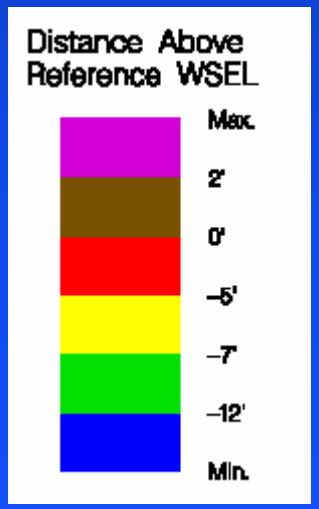
May 2004

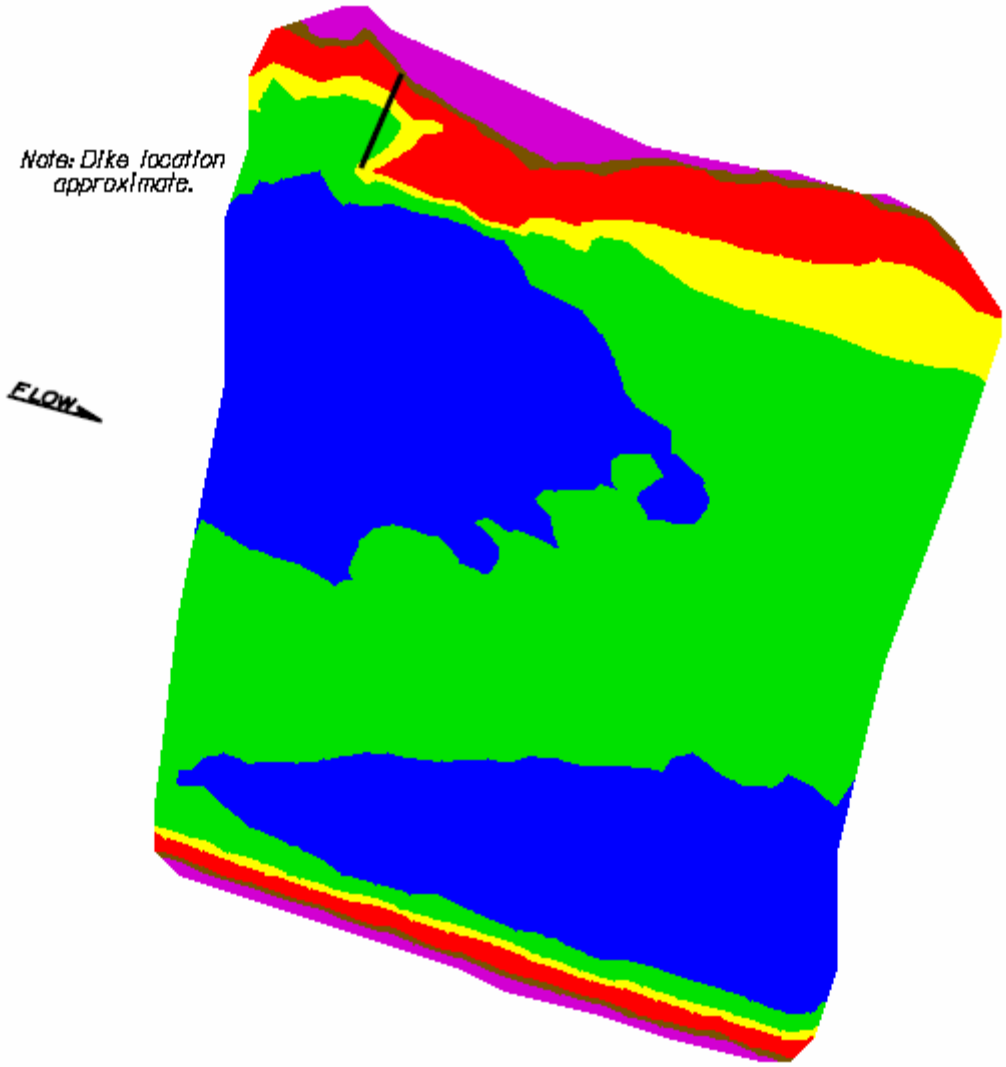


Dike Notching – After 3+ Months

Dike 723.8

August 2004





Major Dike Mod.
Tobacco Bend

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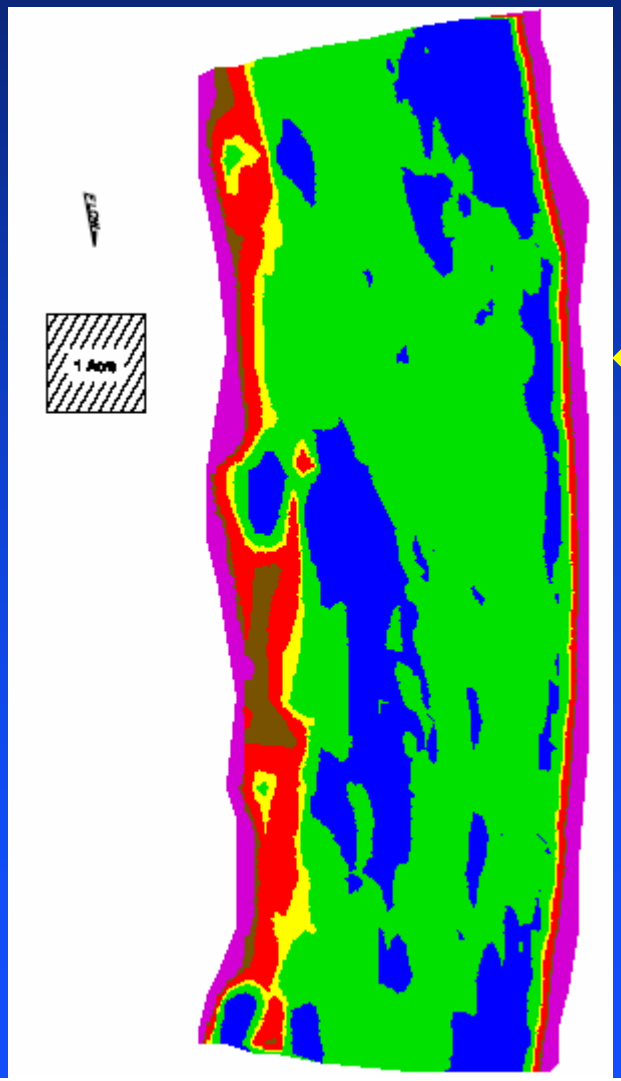
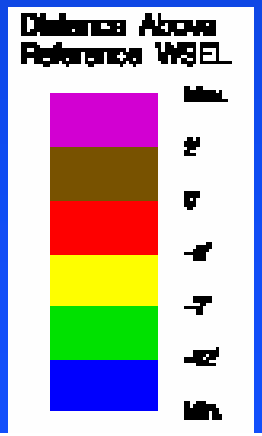
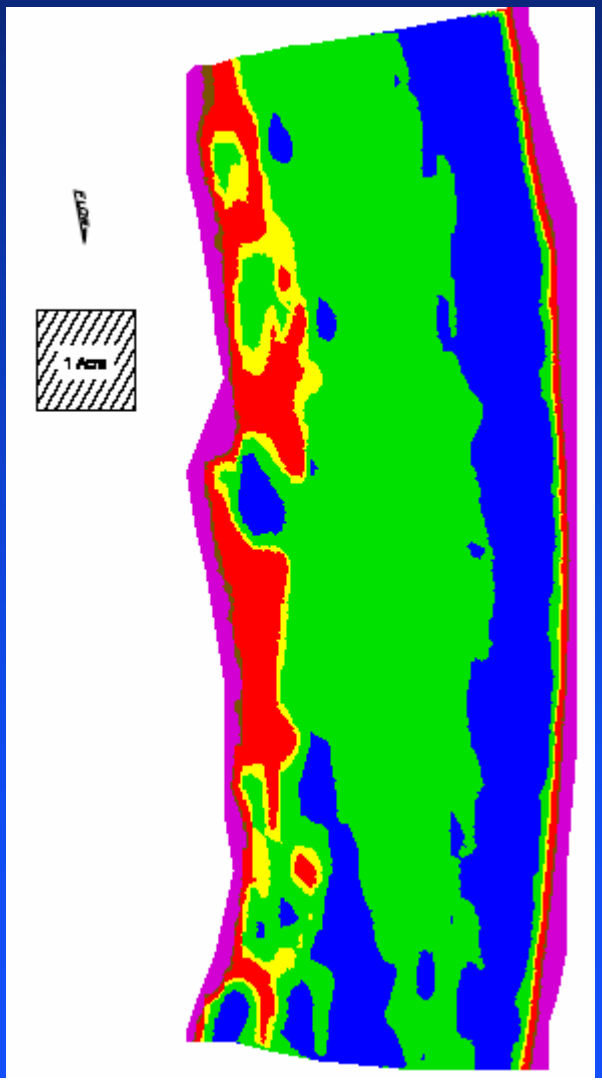


16 Dikes
8 Chevrons

Pre Const.

August 2004





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Monitoring and Assessment

- Multi-disciplinary team developed scientific study design to gather pertinent information
- Beginning implementation 2005
- Design is Before/After/Control/Impact
- Sample unit is the Bend
- Design includes 16 treatments and 28 controls between Ponca and the mouth
- Physical and Biological data collection

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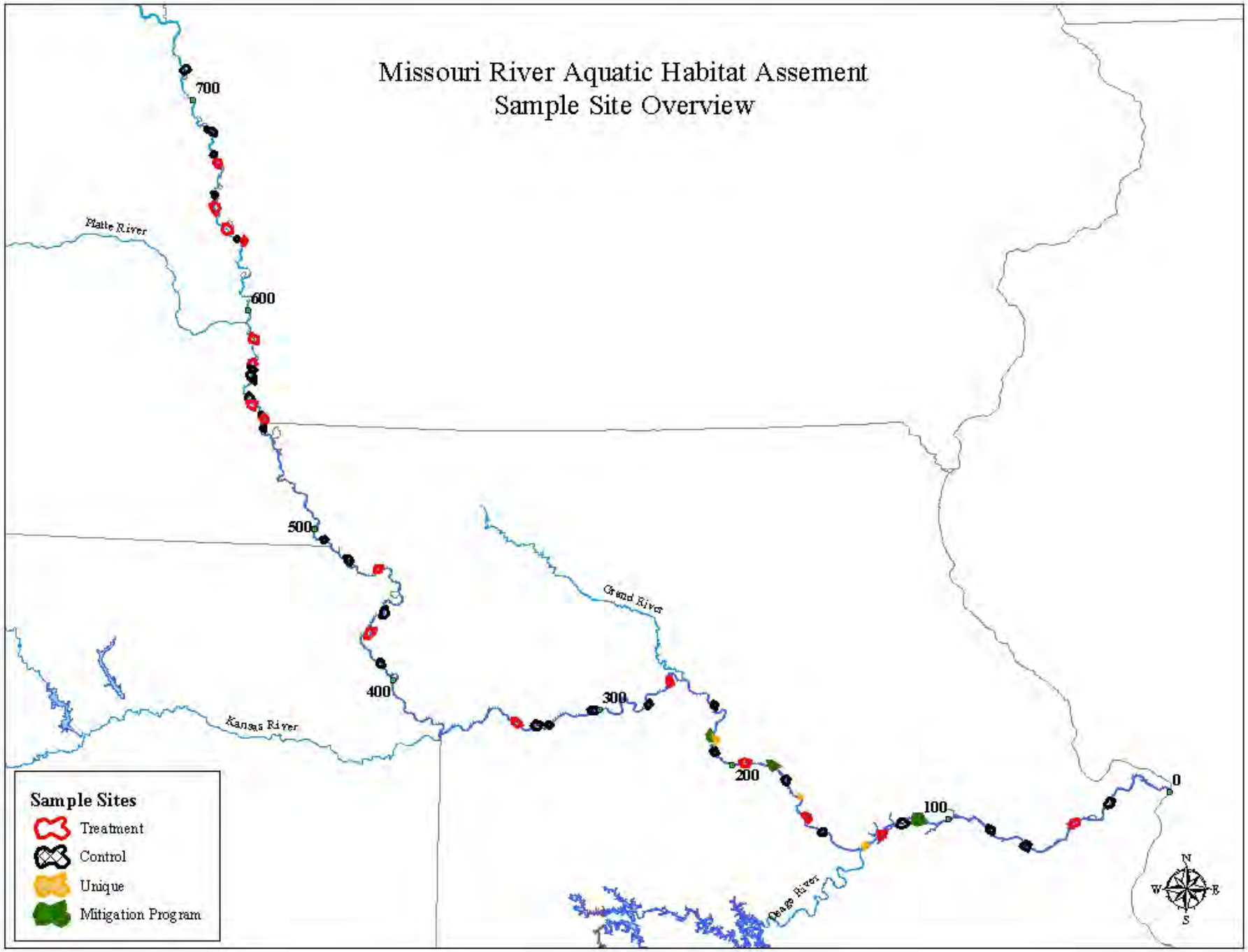
Bend Selection

- Divided Missouri into 5 representative reaches
- Bend selection based on 75/25 percentile radius
- Each treatment (dike mod., dike notch, etc.) has 2 controls – one for before and after construction, one for no modification


Missouri River Aquatic Habitat Assement
Sample Site Overview
700
600
500
400
300
200
100
0
Platte River
Grand River
Kansas River
Osage River
Sample Sites
Treatment
Control
Unique
Mitigation Program
N
W
E
S

Bend Selection Table

Major Dike Modification Projects

Bend Index	Bend Name	Bend Location	Upstream River Mile (1960)	Downstr. River Mile (1960)	Bend Length (miles)	Upstream Dike #	Downstr. Dike #	Avg. Dike Spacing (ft)	Avg. River Width (ft)	Bend Radius (ft)	Arc Length (ft)	Approx. River Energy Slope (ft/ft)
	Snyder Bend, RM 715.2 to 714.7, Left Bank, Located in IA/NE, 5 Structures Modified, 3 Chevrons Constructed											
S-1	Snyder		716.4	714.3	2.1	783.3	779.1	500	650	9300	11000	0.0002234
	Winnebago Bend, RM 710.0 to 708.7, Left Bank, Located in NE, 12 Structures Modified, 5 Chevrons Constructed											
S-2	Winnebago		710.4	708	2.4	770.65	767.7	500	650	5800	12638	0.0001488
	Desoto Bend, RM 644.0 to 642.0, Right Bank, Located in NE, 12 Structures Modified, 6 Chevrons Constructed											
S-3	**DeSoto Cut-off**		**644.8**	**641.8**	**3**	**691.41**	**684.05**	**500**	**650**	**10500**	**15578**	**0.0001559**
	Boyer Bend, RM 637.0 to 634.0, Right Bank, Located in Nebraska, 20 Structures Modified, 8 Chevrons Constructed											
S-4	Boyer	Upper	637.3	636	1.3	680	679.5	750	650	6700	6717	0.0001773
S-4	**Boyer**	**Lower**	**636**	**634.1**	**1.9**	**679.37**	**678.24**	**750**	**650**	**5400**	**9629**	**0.0001964**
	Tobacco Island, RM 589.0 to 586.2, Right Bank, Located in Nebraska, 16 Structures Modified, 8 Chevrons Constructed											
S-5	**Tobacco**		**589.4**	**586.3**	**3.1**	**632.48**	**629.62**	**550**	**650**	**7700**	**16145**	**0.0002125**
	Upper/Lower Hamburg Bend, RM 555 to 551											
S-6A	**Hamburg**	**Upper**	**555.5**	**552.9**	**2.6**	**601**	**597.55**	**600**	**650**	**5400**	**13510**	**0.000191**
S-6B	Hamburg	Lower	552.9	550.9	2	597.5	595.3	600	650	5500	10877	0.0002167
	Langdon Bend, RM 531.7 to 529.0, Right Bank, Located in Nebraska, 20 Structures Modified, 10 Chevrons Constructed											
S-7	Langdon	0	532	529.2	2.8	574.2	570.85	500	650	5800	15254	0.0001918

Proposed Major Dike Modification monitoring sites noted by red shade (25% bend radius representative sites) and blue shade (75% radius representative sites)

Dike Notching Projects

Bend Index	Bend Name	Bend Location	Upstream River Mile (1960)	Downstr. River Mile (1960)	Bend Length (miles)	Upstream Dike #	Downstr. Dike #	Avg. Dike Spacing (ft)	Avg. River Width (ft)	Bend Radius (ft)	Arc Length (ft)	Approx. River Energy Slope (ft/ft)
	Lower Dakota Bend, RM 722.5 to 722.1, Right Bank, Located in Iowa, 5 Dikes Notched											
D-1	Dakota	Lower	723.6	722.3	1.3	799	797.5	600	650	7200	6732	0.000170
	Lower Monona Bend, RM 700.8 to 699.6, Right Bank, Located in Iowa, 10 Dikes Notched											
D-2	Monona	Lower B	700	697.7	2.3	758.2	751.98	600	650	10300	12336	0.000200
	Middle Blenco Bend. RM 679.6 to 678.9, Left Bank, Located in Iowa, 6 Dikes Notched											
D-3	Blencoe	Middle	679.7	678	1.7	732	730.71	600	600	3800	8794	0.000212
	Lower Little Sioux Reach Bend, RM 672.4 to 670.5, Left Bank, Located in Iowa, 14 Dikes Notched											
D-4	**Little Sioux Reach**	**Lower**	**672.8**	**670.5**	**2.3**	**725.4**	**723.6**	**750**	**650**	**6300**	**12106**	**0.000171**
	Sandy Point Bend, RM 657.4 to 656.5, Right Bank, Located in Iowa, 7 Dikes Notched											
D-5	Sandy Point		657.8	655	2.8	707	704.5	650	650	8000	14797	0.000162
	Tyson Bend, RM 655.4 to RM 653.0, Left Bank, Located in Iowa, 7 Dikes Notched											
D-6	**Tysons**		**655**	**651.6**	**3.4**	**704.4**	**701.55**	**550**	**650**	**8700**	**17507**	**0.000166**
	Rock Bluff Bend - Nottleman Island, RM 585.8 to 582.8, Left Bank, Located in Iowa, 15 Dikes Notched											
D-7	Rock Bluff		586.3	582.7	3.6	629.6	626.33	550	650	13500	18626	0.000172
	Pin Hook Bend - Aulden Bar, RM 578.7 to 576.8, Left Bank, located in Iowa, 13 Dikes Notched											
D-8	**Pin Hook**		**579.2**	**576.8**	**2.4**	**623.6**	**622.05**	**550**	**650**	**5300**	**12685**	**0.000211**
	Copeland Bend, RM 569.2 to 565.4, Left Bank, Located in Iowa, 21 Dikes Notched											
D-9A	Copeland	Upper A	569.8	567	2.8	615.45	613	600	650	12000	14390	0.000207
D-9B	Copeland	Upper B	567	565.1	1.9	612.9	610.9	600	650	7500	10072	0.000187
	Nebraska Bend, RM 562.7 to 561.5, Left Bank, Located in Iowa, 8 Dikes Notched											
D-10	**Nebraska**		**562.9**	**560.4**	**2.5**	**608.75**	**606.4**	**550**	**650**	**9200**	**13182**	**0.000276**
	U/L Deroin and Indian Cave Bend, RM 519.7 to 516.3, 17 Dikes Notched											
D-11A	Deroin	Upper	520.1	518.4	1.7	561.3	560.1	550	650	4500	9020	0.000213
D-11B	Deroin	Lower	518.4	517.7	0.7	559.9	559.5	500	650	7300	3616	0.000240
D-11C	Indian Cave		517.7	516.4	1.3	559.45	558.31	650	650	7300	6872	0.000189
	Cottier Bend, RM 509.2 to 508.5, Left Bank, Located in Missouri, 1 Dike Notched											
D-12	Cottier	Upper	512.1	508.2	3.9	553.75	548.4	550	650	11100	20622	0.000189

Proposed Dike Notching monitoring sites noted by red font (25% bend radius representative sites) and blue font (75% radius representative sites)

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Technical Focus

- Sediment evaluation and system wide impact analysis
- Prototype experience - refinements
- Limited experience with high flow events – what is expected?
- Dynamic river with constant change – look for predictor variables
- Monitoring may lead to adaptive management and changing criteria based on biologic response

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Omaha District

QUESTIONS?

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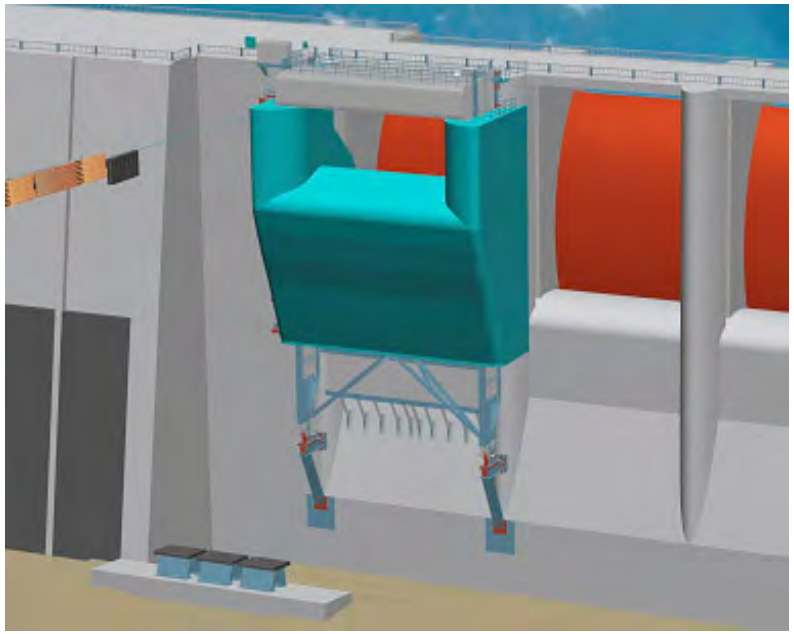
WALLA WALLA DISTRICT

SURFACE BYPASS
&
REMOVABLE SPILLWAY WEIRS



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INTRODUCTION

Pacific Northwest

- Walla Walla District Snake and Columbia River Projects

United States

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BACKGROUND

- Endangered Species / Regional Impacts
- Recovery Plan Options
  - Dam Removals
  - System Improvements

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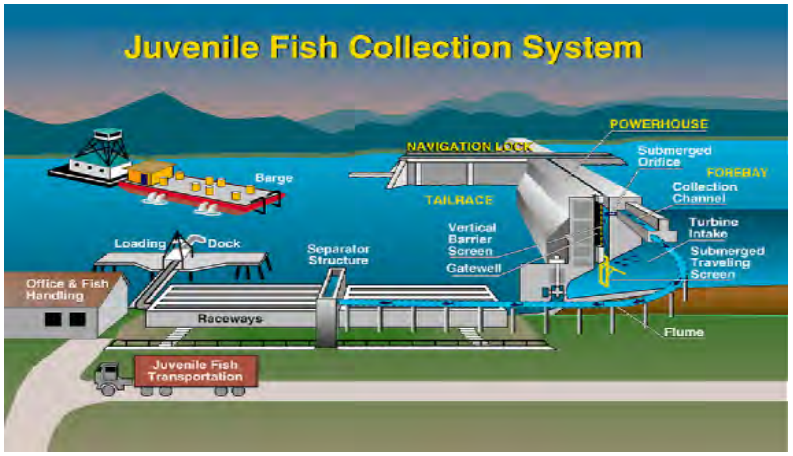
FISH PASSAGE ROUTES



- Juvenile Fish Passage Methods
  - Multiple Paths
  - Traditional Spill Currently Favored for In-River

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TRADITIONAL FISH SPILL DRAWBACKS

- Fish Passage
  - Deep Spill Gates
- Water Quality
  - Exceeds 110% TDG
- Forgone Power
  - $186 Million Annually (LCR and LSR)
  - $40 Million Annually (LSR)

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SURFACE BYPASS SPILL ALTERNATIVE

- Fish Goals
  - Increase Passage Non-Turbine Routes
  - Increase Survival
  - Reduce Delay
- Water Quality Goals
  - Lower Dissolved Gas Levels
- Power Goals
  - Higher Revenues

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SURFACE BYPASS DEVELOPMENT

Lower Granite Dam

- Columbia and Snake River Projects
  - Numerous Prototypes (mid 1990's / early 2000's)
  - Lower Granite Dam

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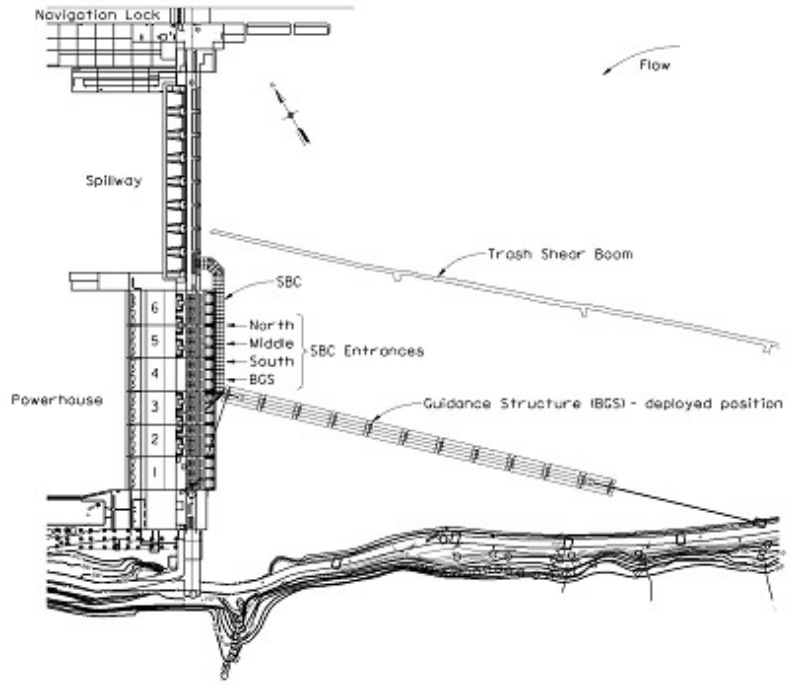
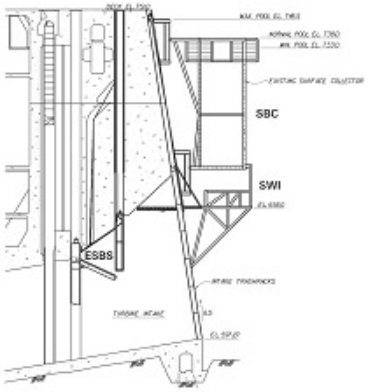
LOWER GRANITE PRE-RSW DEVELOPMENT



Site Plan
(1998-2000)

Powerhouse / SBC – Side View



BGS – Isometric View

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LOWER GRANITE RSW DESCRIPTION

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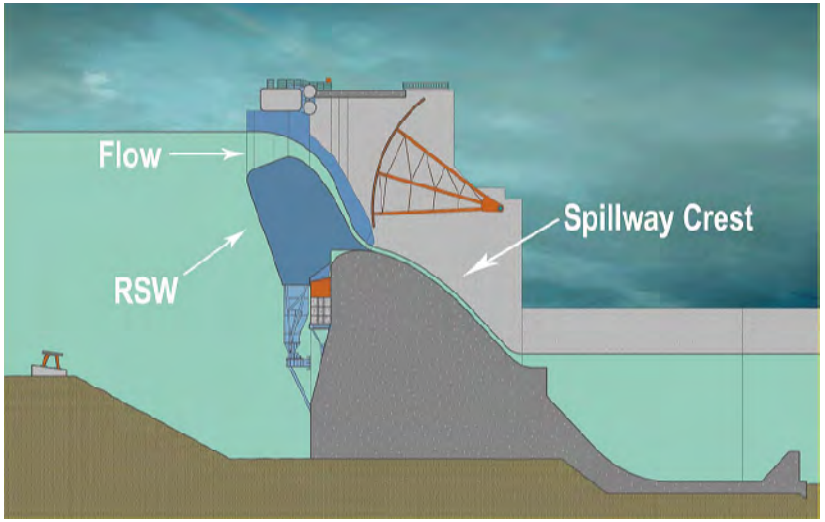
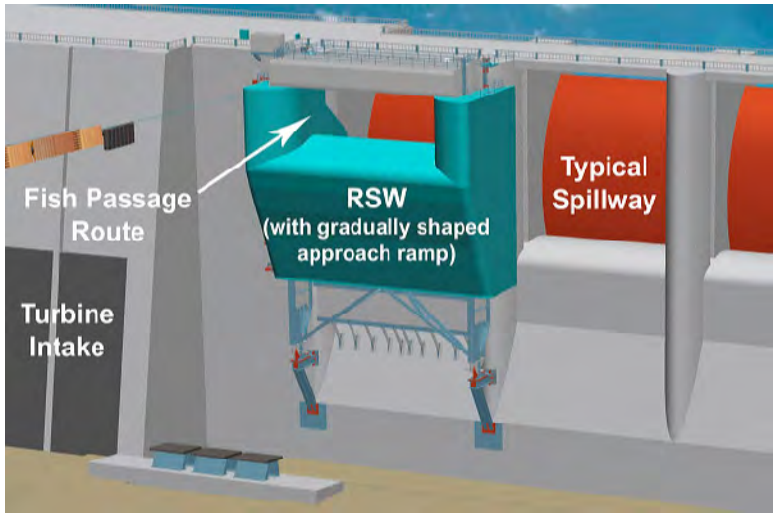
LOWER GRANITE RSW OPERATING POSITON



Side View



Isometric View

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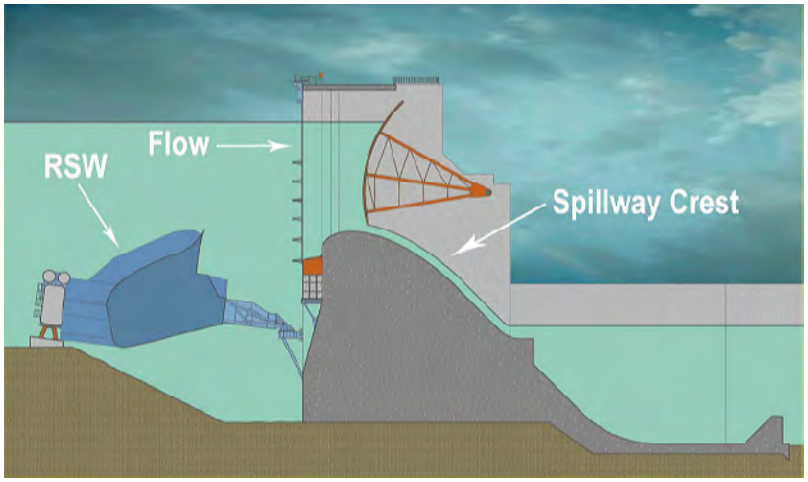
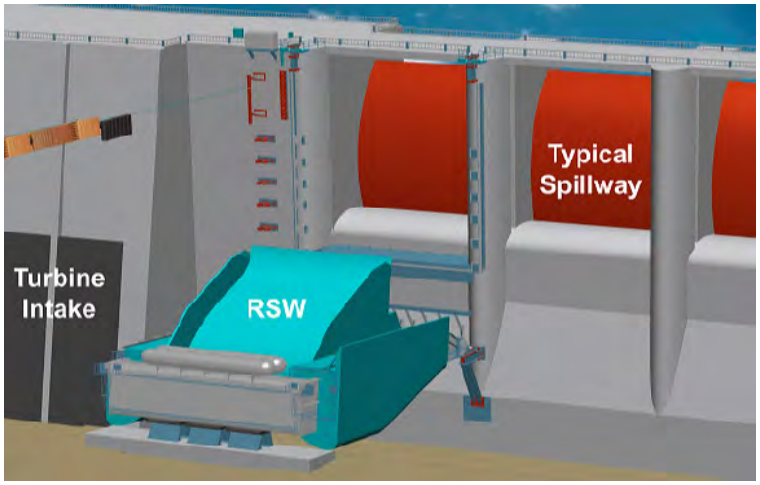
LOWER GRANITE RSW FLOOD CONTROL POSITION



Side View



Isometric View

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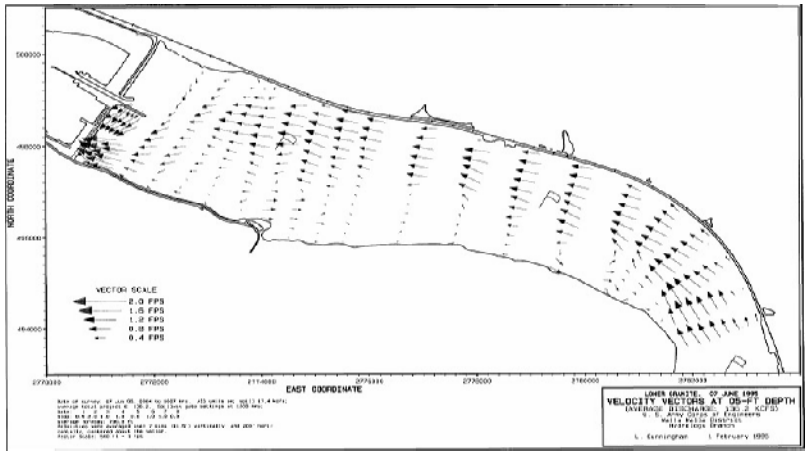
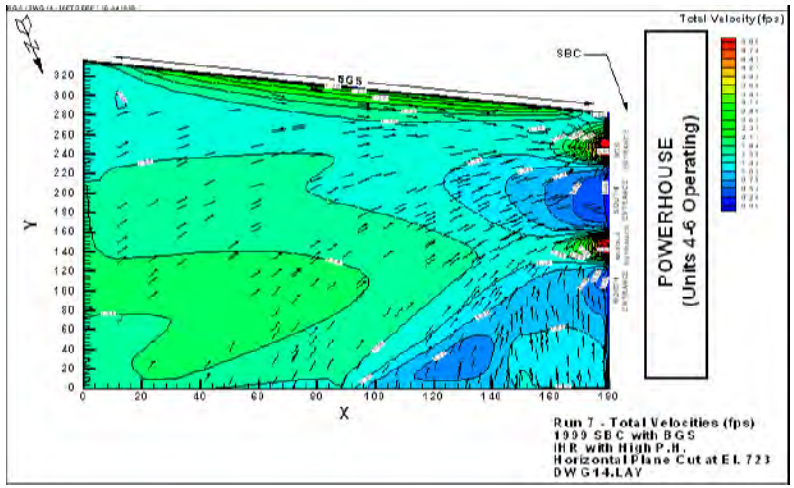
HYDRAULIC EVALUATIONS

Field Measurements





Numeric Models

Physical Models

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BIOLOGICAL EVALUATIONS

- Biological Methods
  - Radio Tracking
  - Hydroacoustics
  - Balloon Tags
  - Acoustic Tags / 3D Tracking

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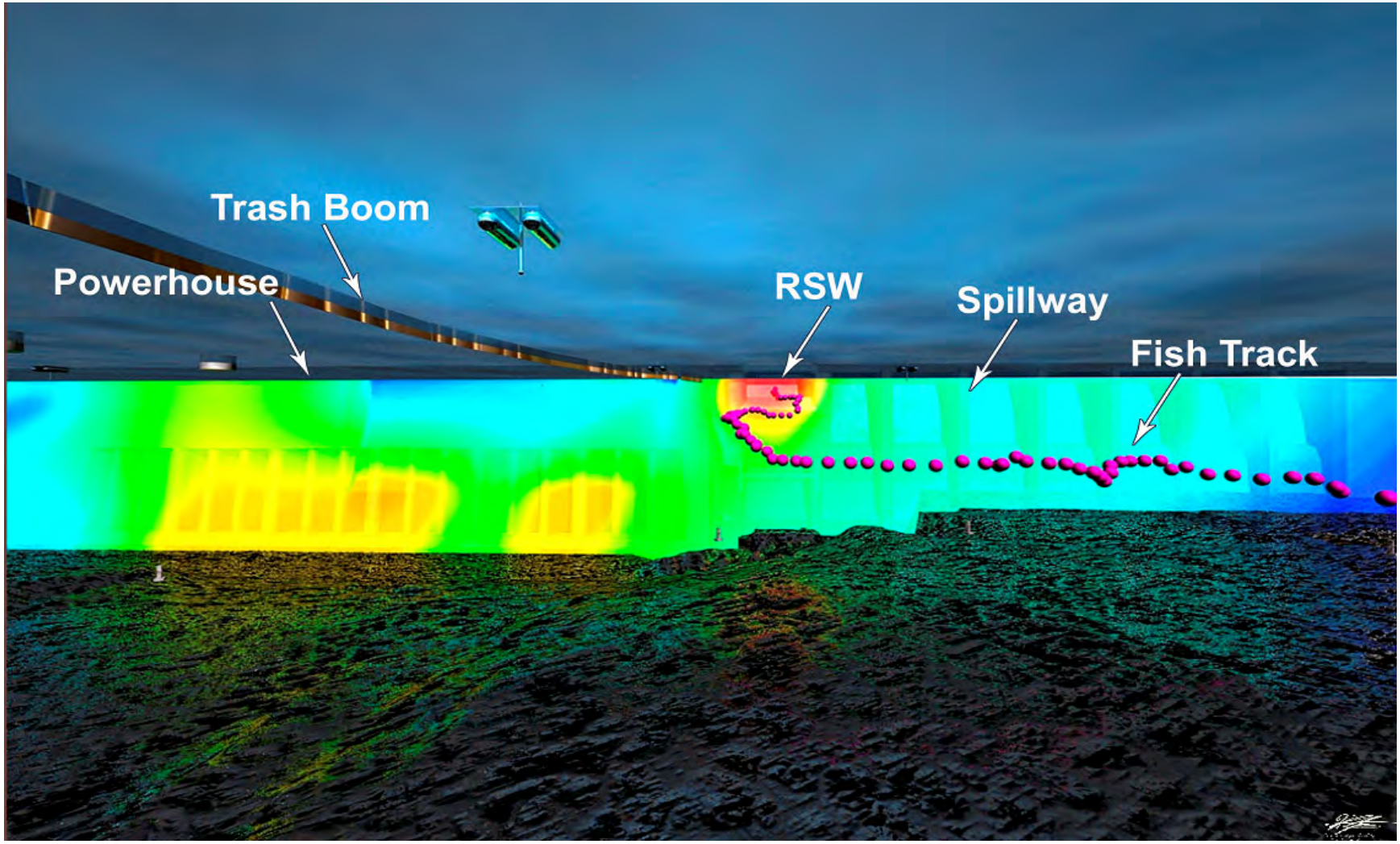
CORRELATION FISH BEHAVIOR / HYDRAULICS



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RSW
RESULTS AND BENEFITS

- Improved Fish Passage
  - Highly Efficient
  - Less Delay
  - Greater Survival Potential
- Better Water Quality
  - 120% to 110% TDG
- Increased Power Revenues
  - $13-20 Million Annual Savings (Four LSR Dams)

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FUTURE

- Broad Regional Support
- Lower Granite RSW Normal Operations
- Ice Harbor RSW in 2005
- High Interest for Other Projects

Ice Harbor Dam

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QUESTIONS?

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CONTACT INFORMATION

- Lynn Reese
- Walla Walla District COE
- 509-527-7531
- lynn.a.reese@usace.army.mil

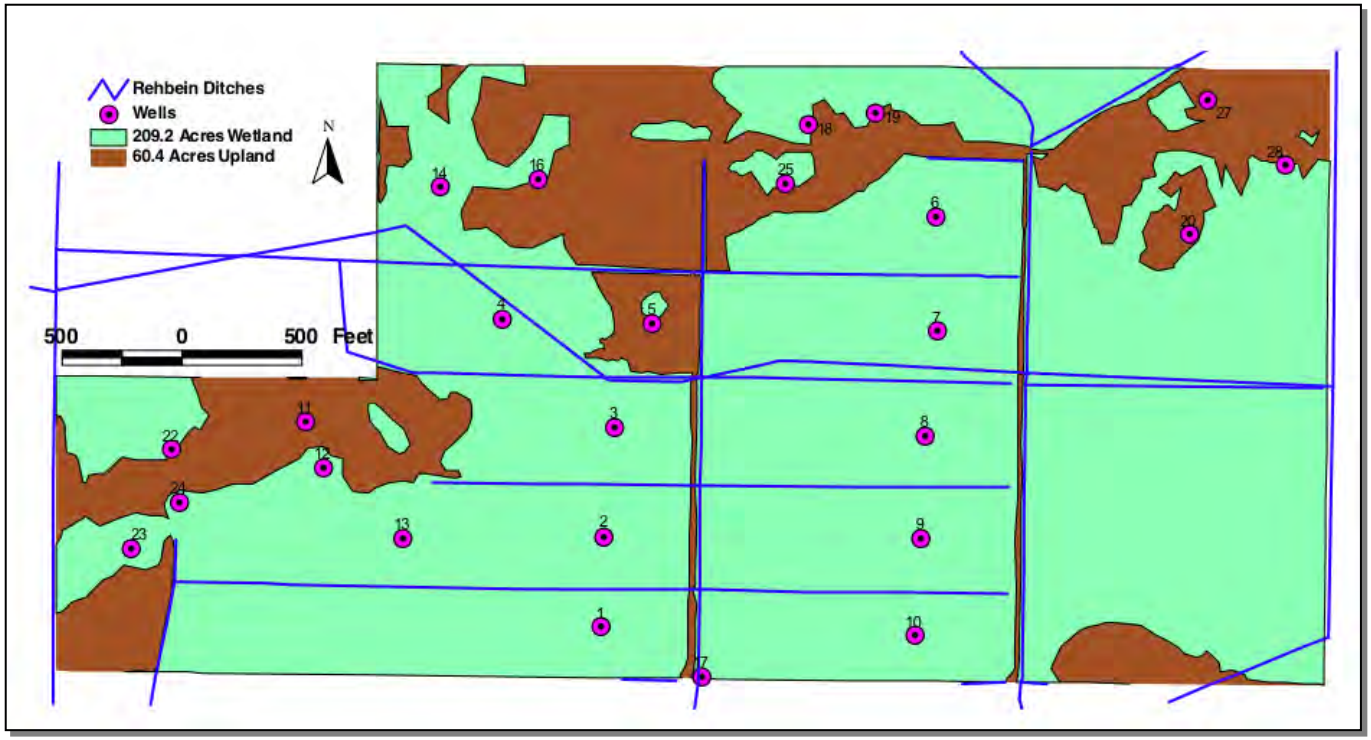
Tools for Wetlands Permit Evaluation: Modeling Groundwater and Surface Water Interaction

Cary Talbot

Coastal & Hydraulics Laboratory

Example Wetland Permit Problem

- Applicant claimed proper drainage ditch maintenance would reduce acreage classified as wetland in proposed development area



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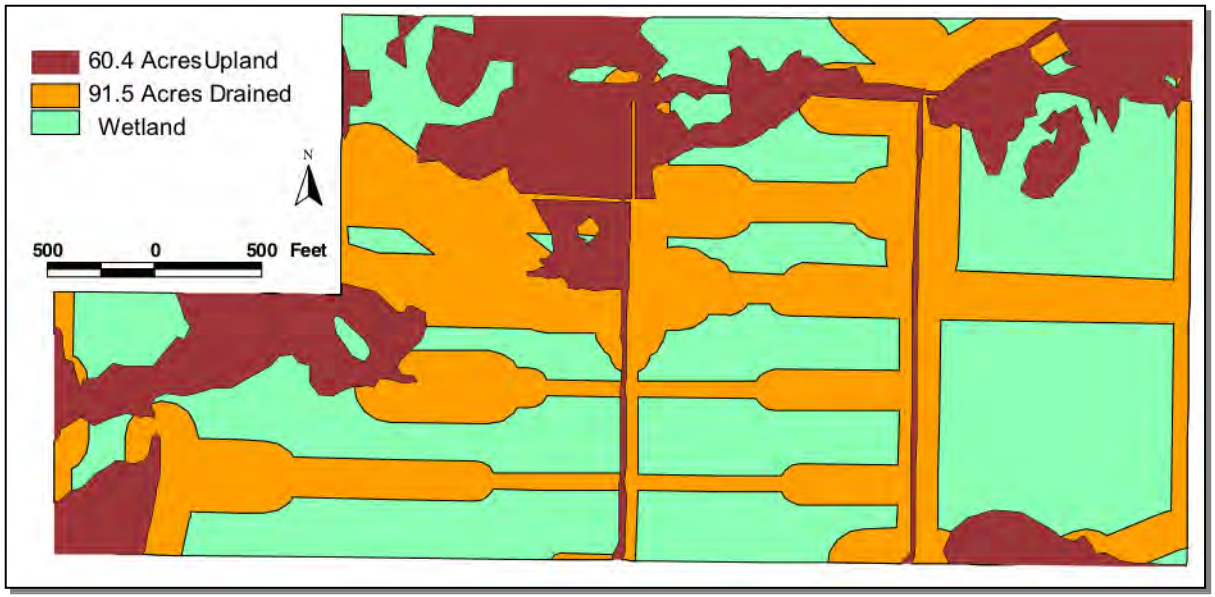
Example Wetland Permit Problem

- Applicant used various analytic 1-D approaches along with a 3-D saturated flow-only groundwater model (MODFLOW) to estimate drainage
- No surface water-groundwater interaction effects simulated



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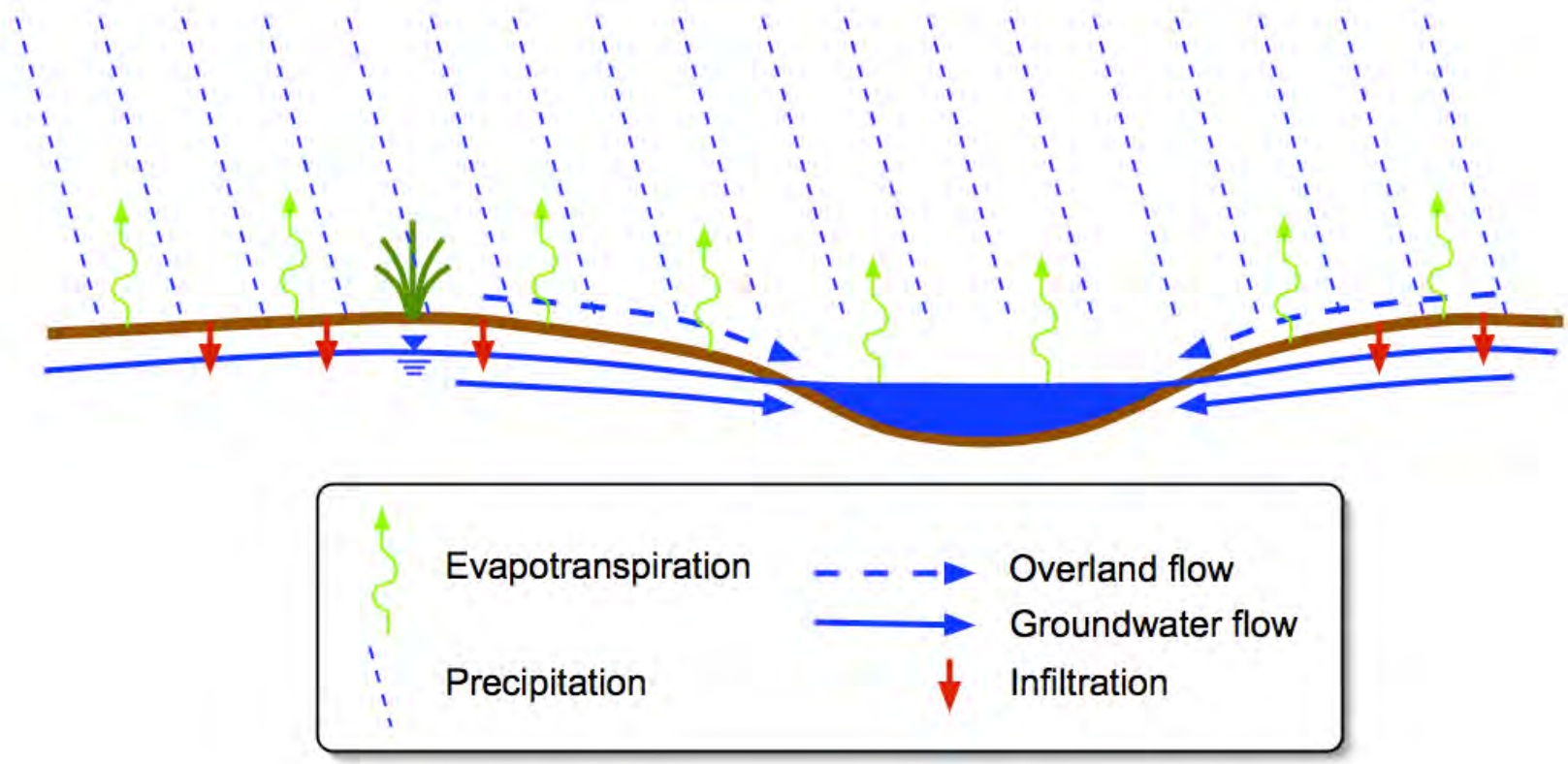
Typical Wetland System with Surface Water Flow Channels



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EM 1110-2-1421 ~ Groundwater Hydrology

DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, DC 20314-1000

EM 1110-2-1421

CECW-EH

Manual
No. 1110-2-1421

28 February 1999

Engineering and Design
GROUNDWATER HYDROLOGY

1. Purpose. The purpose of this manual is to provide guidance to Corps of Engineers personnel who are responsible for groundwater-related projects.

2. Applicability. This manual applies to all USACE Commands having responsibility for design of civil works projects.

3. Distribution Statement. Approved for public release, distribution is unlimited.

FOR THE COMMANDER:

ALBERT J. GENETTI, JR.
Major General, USA
Chief of Staff

US Army Corps
of Engineers

EM 1110-2-1421 ~ Groundwater Hydrology

- Section 6-11, Numerical Modeling of Surface Water and Groundwater Systems:

  "Although mathematically exact, analytic models generally can be applied only to simple one-dimensional problems because of rigid boundary conditions and simplifying assumptions. However, for many studies, analysis of one-dimensional flow is not adequate. Complex systems do not lend themselves to analytical solutions, particularly if the types of stresses acting on the system change with time. Numerical models allow for the approximation of more complex equations and can be applied to more complicated problems without many of the simplifying assumptions required for analytical solutions…" *(emphasis added)*

EM 1110-2-1421 ~ Groundwater Hydrology

- Section 6-11, Numerical Modeling of Surface Water and Groundwater Systems (cont.)

  "…Ideally, a computer model of the surface-water/groundwater regime should be able to simulate three-dimensional variably-saturated flow including: fluctuations in the stage of the surface-water body, infiltration, flow in the unsaturated zone, and flow in the saturated zone. Additionally, simulation of watershed runoff, surface-water flow routing, and evapotranspiration will allow for completeness. However, this is often a complex task, and no matter how powerful the computer or sophisticated the model, simplifying assumptions are necessary." *(emphasis added)*

System-Wide Water Resources Program (SWWRP)

- 7-year USACE R&D initiative designed to assemble and integrate the diverse components of water resources management
- The ultimate goal is to provide to the Corps, its partners, and stakeholders the overall technological framework and analytical tools to restore and manage water resources and balance human development activities with natural system requirements

System-Wide Water Resources Program
SWWRP Water Resources Depot

https://swwrp.usace.army.mil

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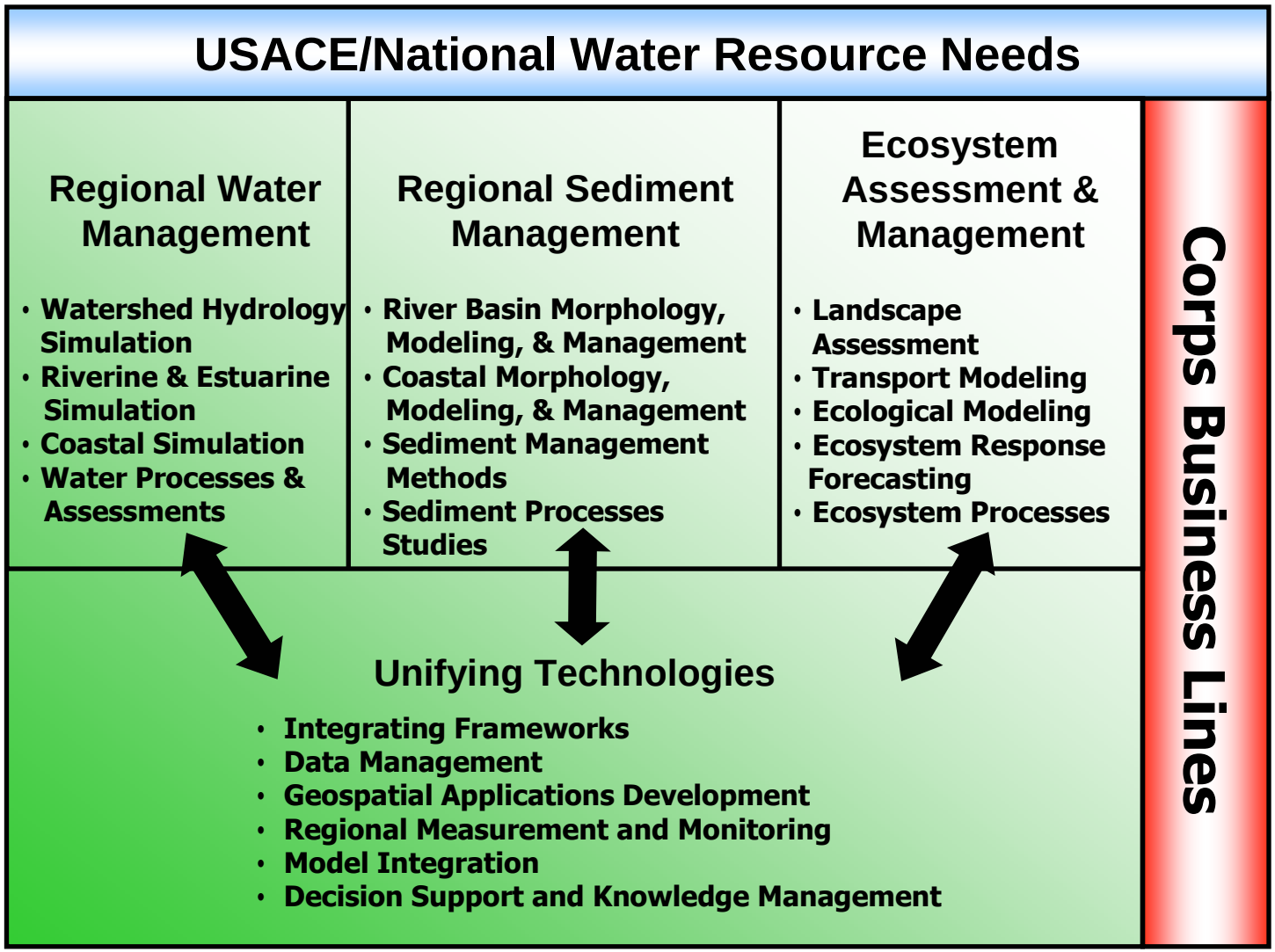
SWWRP Program Structure



SWWRP Watershed Hydrology Simulation

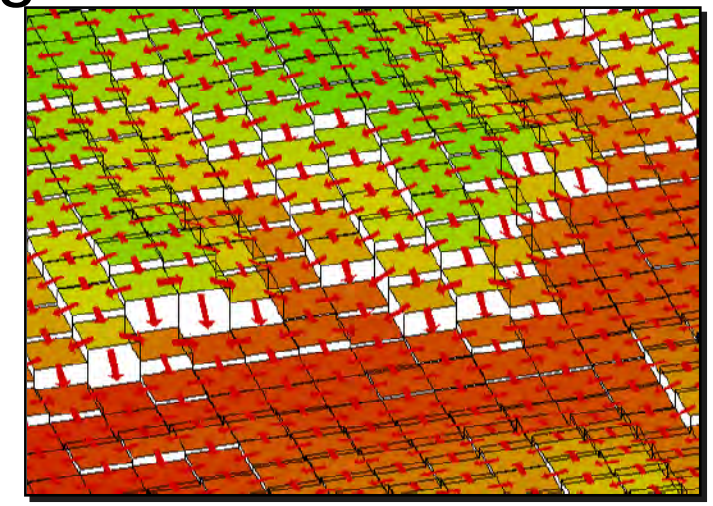
- 5 research areas
  - HMS development
  - GSSHA development
  - Uncertainty/parameter estimation/stochastic simulation tools for system-scale models
  - Regional flood prediction
  - Coupled, multi-dimensional groundwater-surface water interaction simulation

USACE Toolbox of GW-SW Interaction Codes

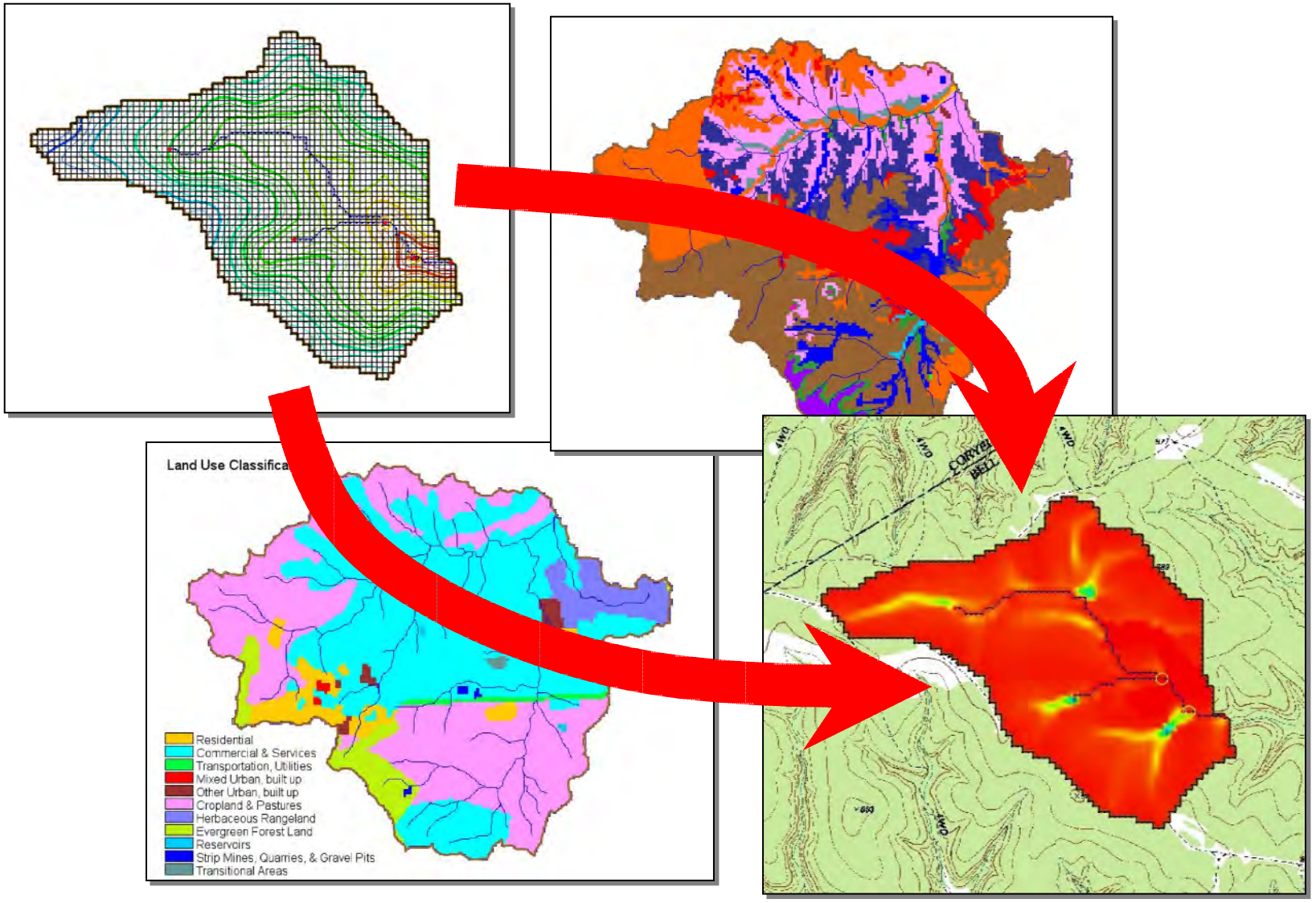
- Coupled, multi-dimensional, SWWRP-supported GW-SW interaction codes
  - GSSHA
  - WASH123D
  - ADH
- All codes fully integrated and supported in XMS (GMS, SMS, WMS)

GSSHA

- Distributed, physically-based Gridded Surface Subsurface Hydrological Analysis (GSSHA) model
- Simulates 2D overland flow, 1D channel routing, 2D saturated groundwater flow, canopy retention, microtopography, 1D infiltration and ET using finite-difference and finite-volume methods



GSSHA



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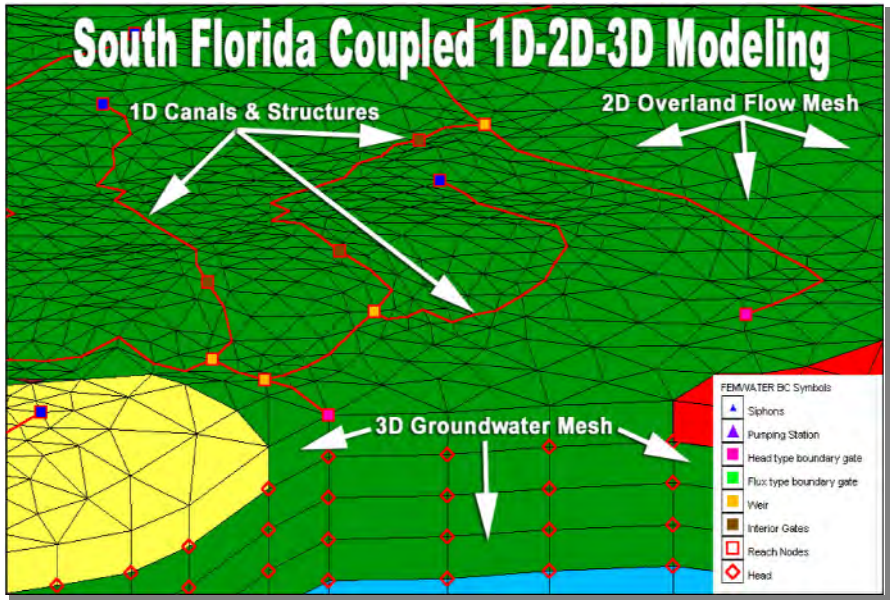
WASH123D

- Water flow and contaminant and sediment transport in WAterSHed systems
- First-principle, physics-based finite element watershed model simulating 1D canal, 2D overland and 3D subsurface flow and transport



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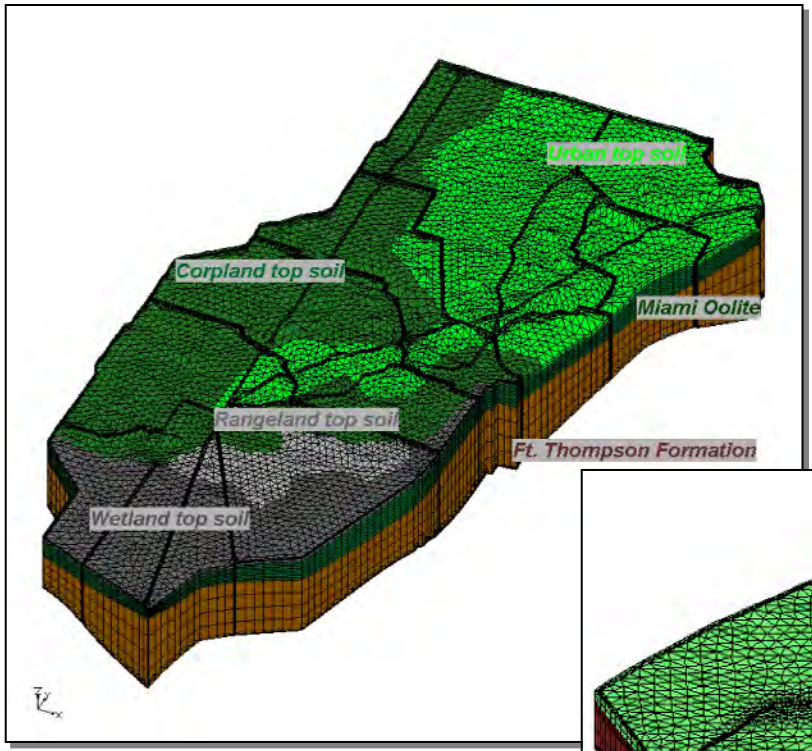
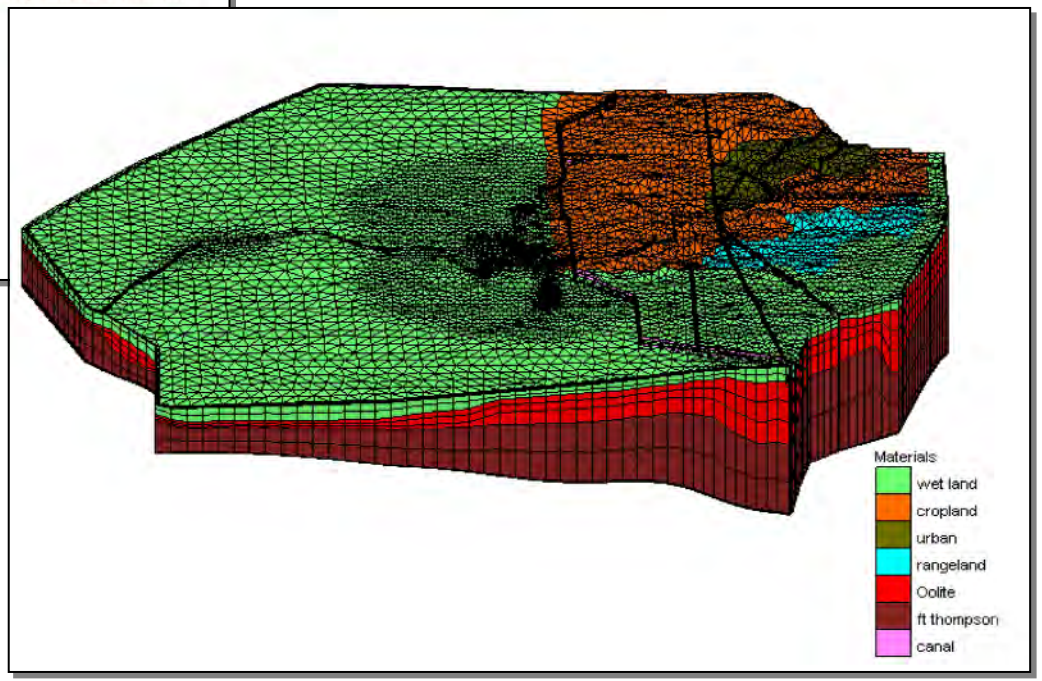
WASH123D



C-111 Spreader Canal Mesh



Biscayne Bay Coastal Wetland Mesh

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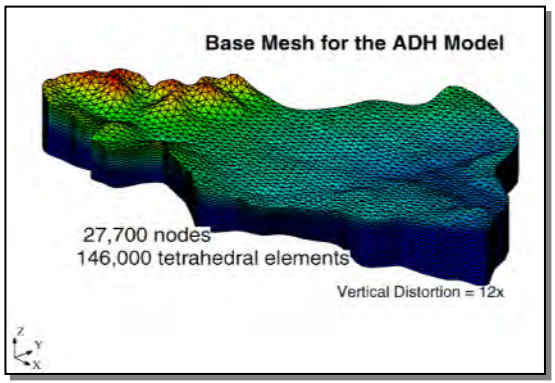
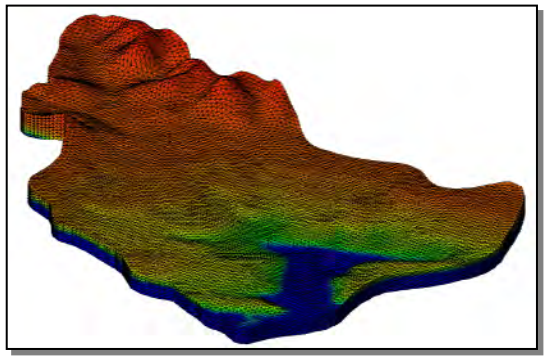
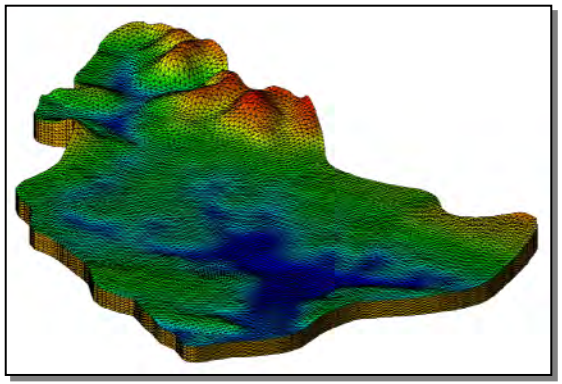
ADH

- ADaptive Hydrology/Hydraulics model that simulates flow and transport in coupled surface water - groundwater systems
- Modular, parallel, adaptive finite element simulation of 2D and 3D dynamic wave surface water and 3D Richards' equation groundwater flow and transport







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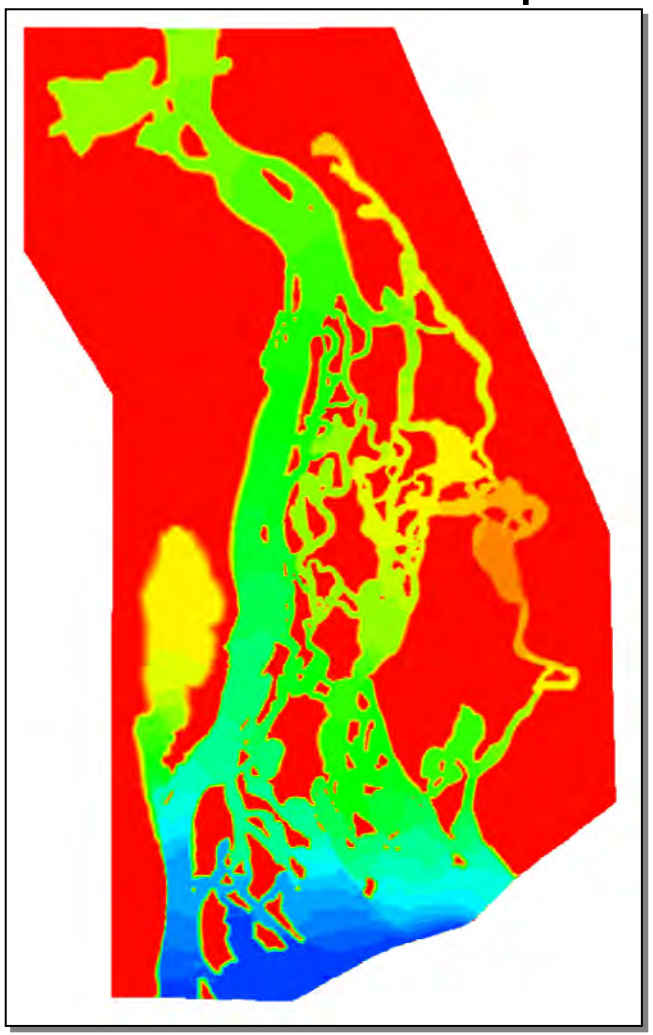
ADH GW-SW Interaction Capabilities

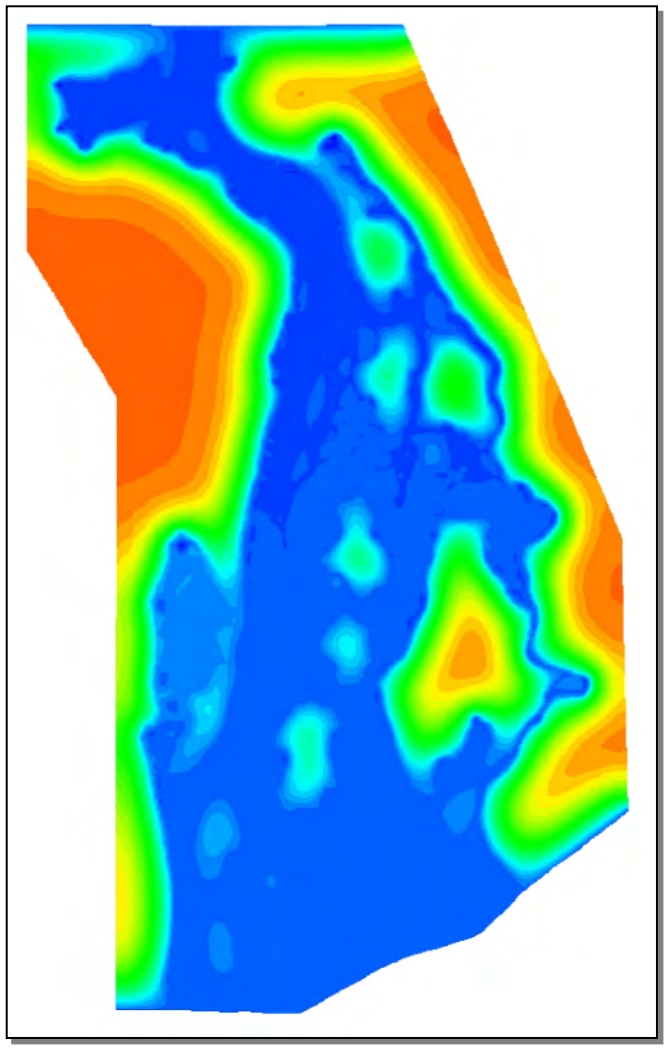
- Coupled 3D groundwater and 2D surface water (diffusive wave and full shallow water) equations
- Flux-based communication avoids switching flux/head boundary
- Dual-valued (SW/GW) nodes on ground surface
- Communication interval is time step
- Separate solves maintain reasonable sizes for the linear systems
- Potential for different time advancement for the hydrologic components

Pool 8 GW-SW ADH Model

Surface Water Depths



Groundwater Heads



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GSSHA Wetland Example

Coon Creek Watershed

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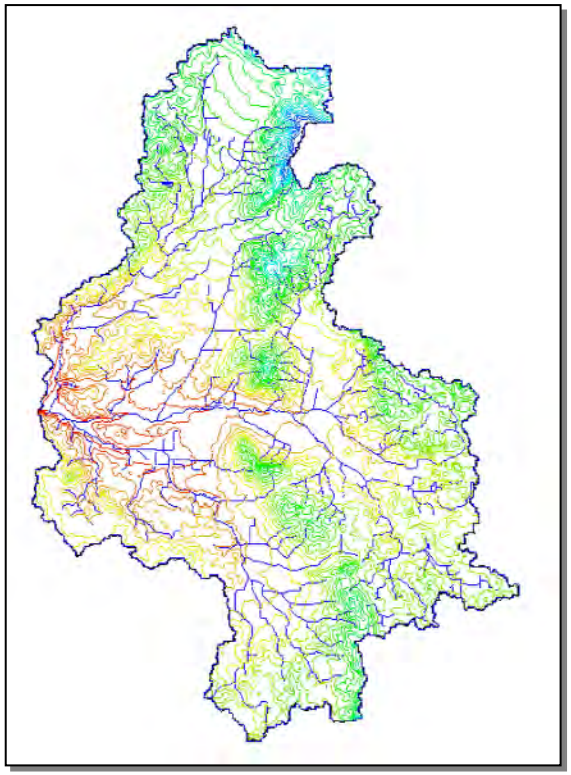
Coon Creek Watershed

- Locate 1600 acre wetland in watershed southwest of Chicago
- Remove tile drains
- Assess impacts of future use



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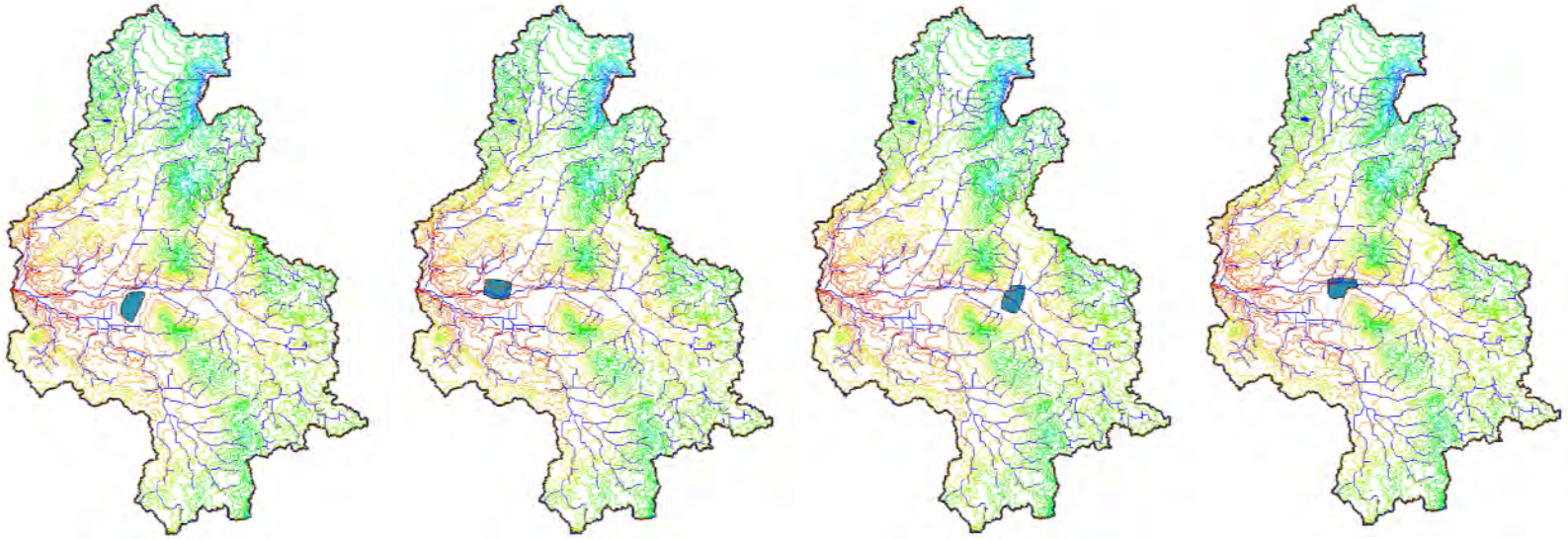
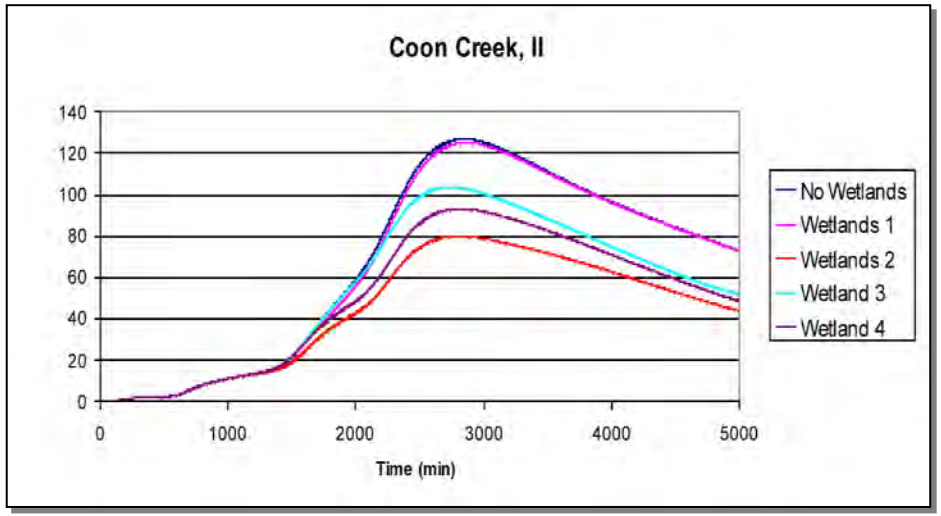
Wetland Placement





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Current Status of GW-SW Interaction Toolbox Codes

- GSSHA
  - Fully supported in WMS version 7.x
  - http://chl.erdc.usace.army.mil/software/wms
- WASH123D
  - Fully supported in GMS version 6.0beta
  - http://chl.erdc.usace.army.mil/software/gms
- ADH
  - Supported in GMS version 5 but full support still under development

SWWRP Deliverables

- Improve infiltration modeling speed by finding physically-based alternatives to Richards' equation
- Addition of 3D unsaturated flow to GSSHA
- Completion of ADH interface development
- Guidance on selection of appropriate physical processes in GW-SW interaction models
- Incorporation of ecological and sediment modeling tools developed in other SWWRP efforts
- Merging of ADH and WASH123D capabilities into single model

Conclusions

- Coupled, multi-dimensional GW-SW interaction codes are needed in complex wetland studies (EM 1110-2-1421)
- Currently, several tools exist for performing such studies
- SWWRP is continuing the development of these tools

Questions? Comments?

- https://swwrp.usace.army.mil
- Cary.A.Talbot@erdc.usace.army.mil

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Improved Water Supply Forecasts for the Kootenay Basin

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Hydraulic Engineer

August 4, 2005

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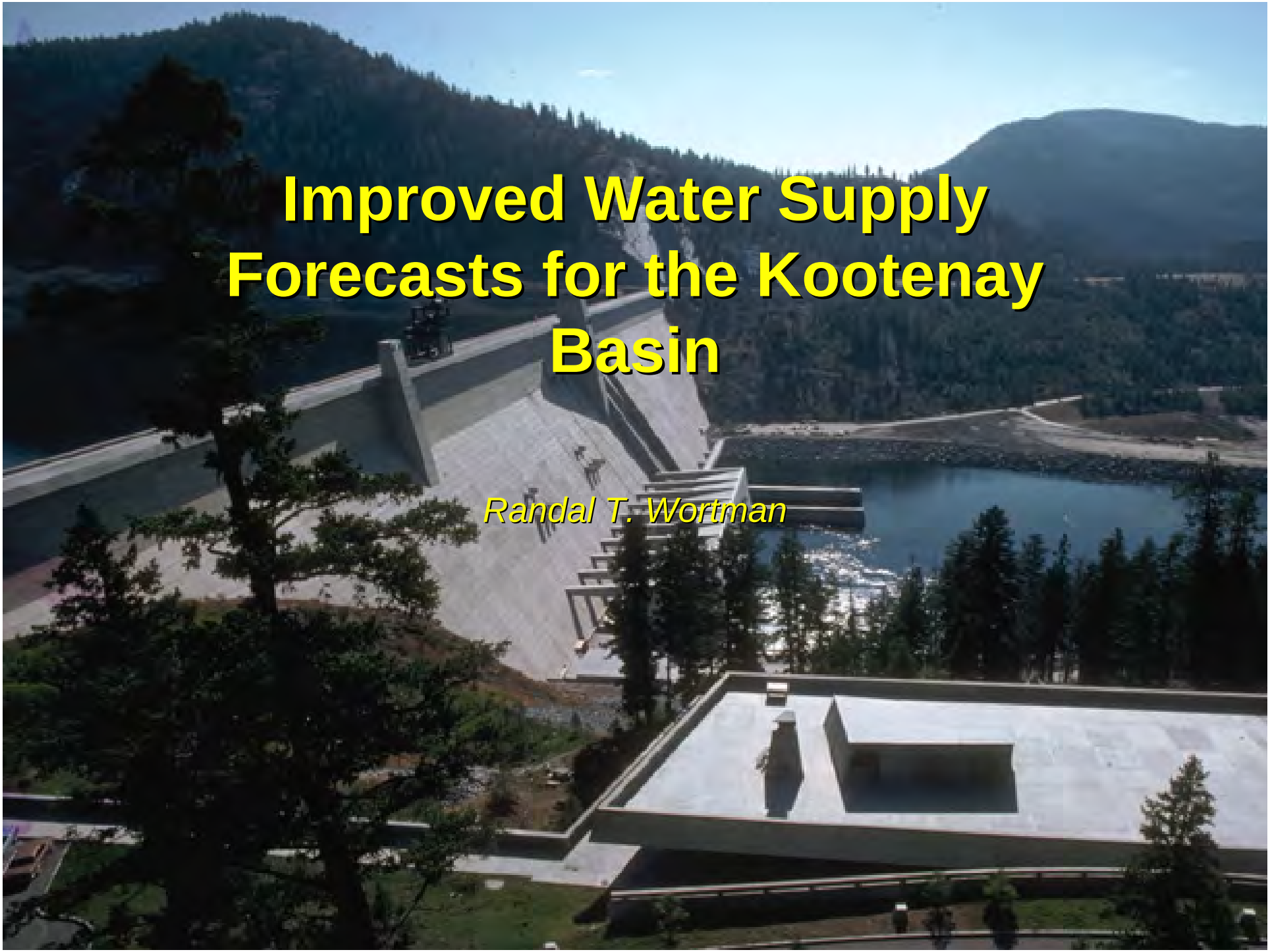
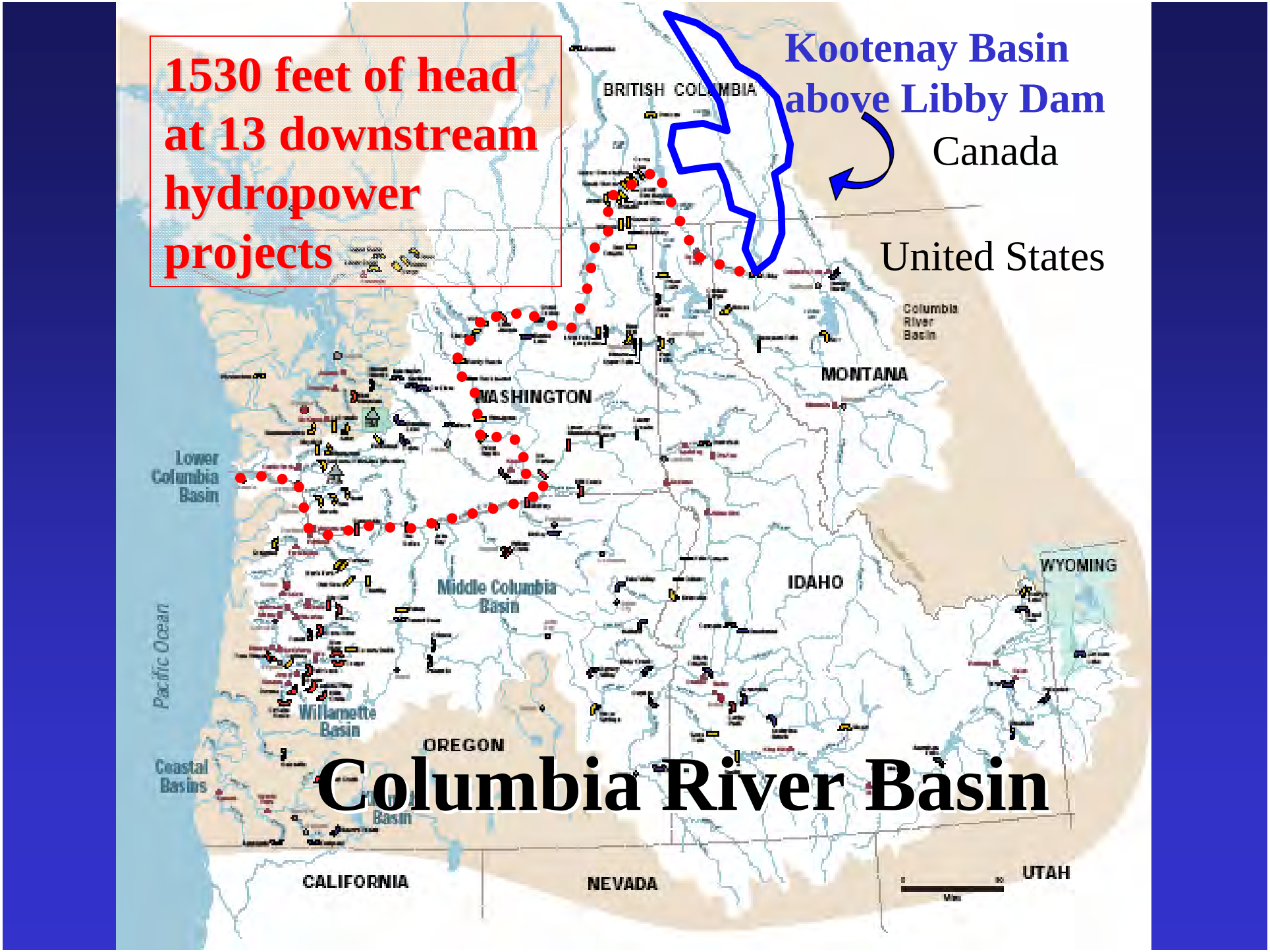
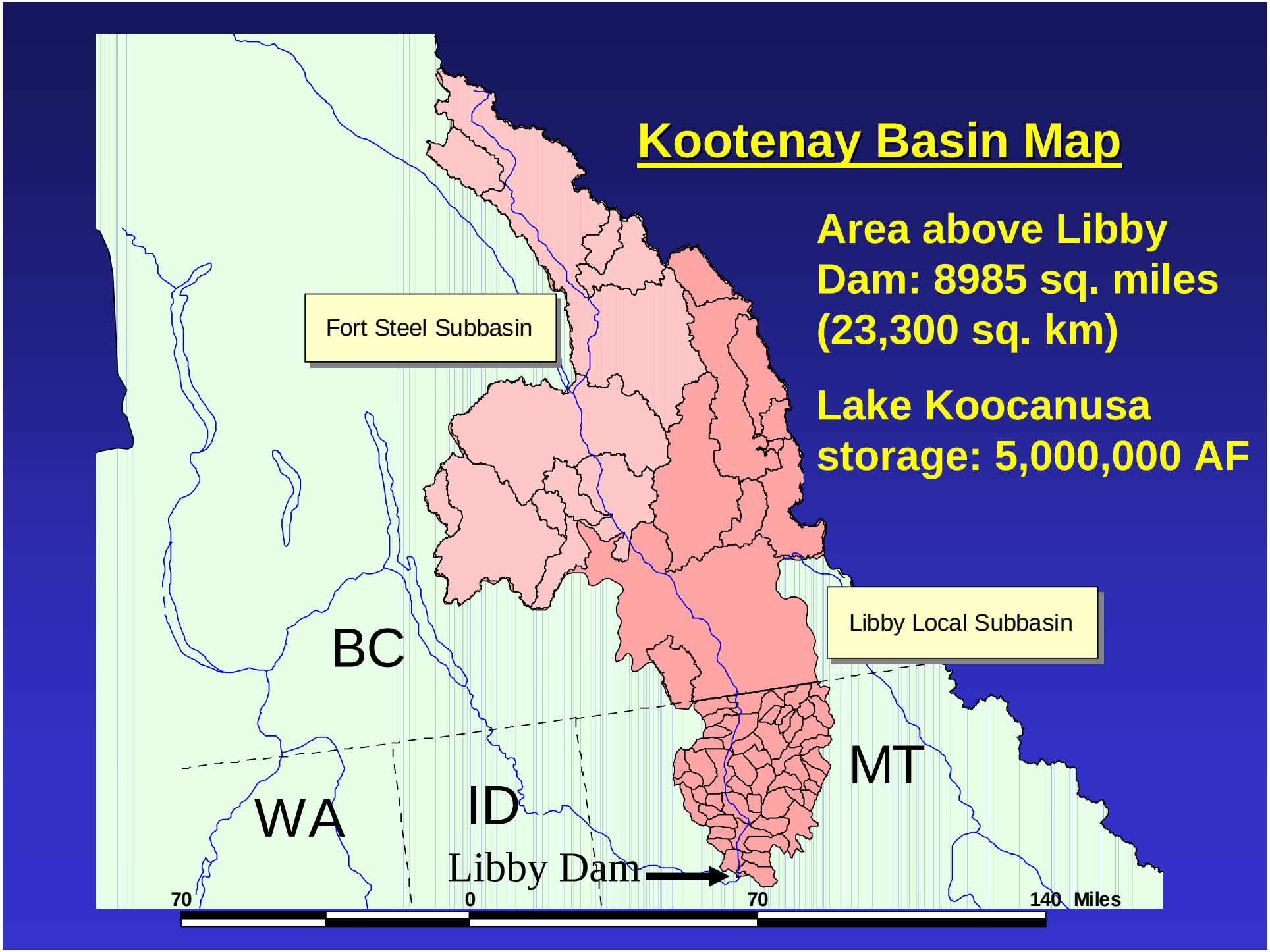


Improved Water Supply Forecasts for the Kootenay Basin

Randal T. Wortman


1530 feet of head at 13 downstream hydropower projects
Kootenay Basin above Libby Dam
Canada
United States
BRITISH COLUMBIA
Columbia River Basin
MONTANA
WASHINGTON
Lower Columbia Basin
Middle Columbia Basin
IDAHO
WYOMING
Pacific Ocean
Willamette Basin
OREGON
Coastal Basins
Columbia River Basin
CALIFORNIA
NEVADA
UTAH


Kootenay Basin Map
Area above Libby Dam: 8985 sq. miles (23,300 sq. km)
Lake Koocanusa storage: 5,000,000 AF
Fort Steel Subbasin
Libby Local Subbasin
BC
WA
ID
MT
Libby Dam
70
0
70
140 Miles

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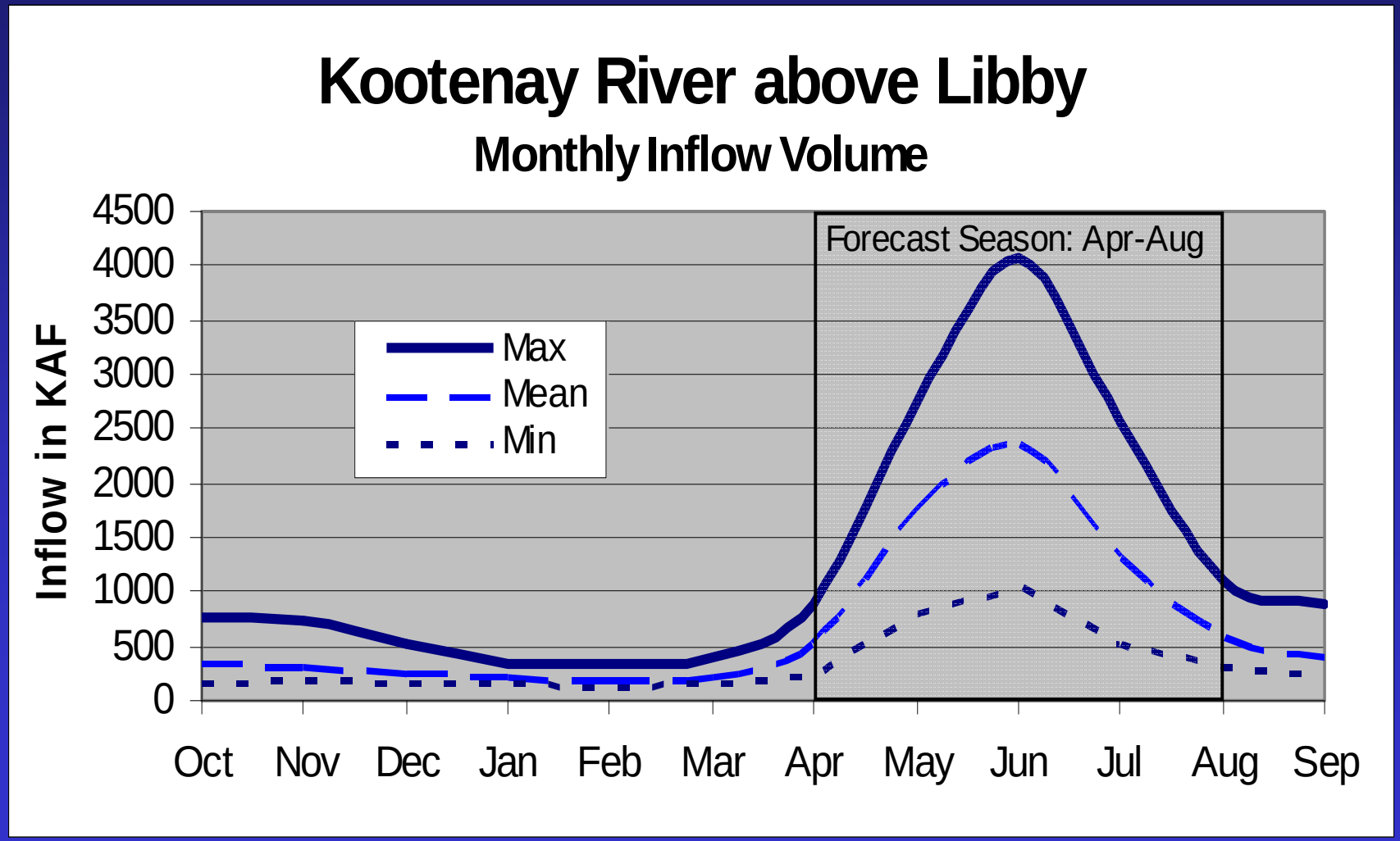
Kootenay Inflow above Libby Dam



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Standard Multiple-Variable Regression in Water Supply Forecasting

- *The dependent variable is a seasonal inflow volume, e.g. April-August runoff in thousand-acre-feet (KAF)*
- *Predictor variables are pseudo-variables created from weighted combinations of similar stations (e.g. sum or average of three snow stations)*

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Original Libby Forecast "Split-Basin" Regression Equations

Variable	Ft Steel Basin	Libby Local Basin
1 April Snow Water Equivalent (SWE)	Σ MILB, MORB, KGHB, SUMB, MBCB, GRPB, NFRB	Σ SUMB, NFRB, RMTM, **KIMB**, WSLM, 0.5*MORB
Winter (Oct--Mar) Precipitation (WP)	Σ Oct, Nov, Dec, Jan, Feb, Mar Σ **ELKB**, BABB, GRPB, BRIB, KASB	Σ Oct, Nov, Dec, Jan, Feb, Mar Σ **ELKB**, **FENB**, FTIM, LRSM, BONI, **POLM**
Spring (Apr--Aug) Precipitation (SP)	Σ Apr, May, .8 Jun, .5 Jul, .2 Aug Σ BRIB, KASB, PTHI, **WASB**, CRSB	Σ Apr, May, .8 Jun, .5 Jul, .2 Aug Σ FTIM, PTHI, KASB, WHFM
Fall Runoff (FRO)	Σ Oct, Nov Ft Steele basin runoff	Σ Oct, Nov Libby Local basin runoff

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Original Libby Forecast "Split-Basin" Regression Equations

Fort Steele Regression Model

1.309 FRO + 0.067 SWE + 0.068 WP + 0.167 SP – 5.114

R^2=.914 Sept 1 Forecast Std Error=213 KAF

Libby Local Regression Model

0.921 FRO + 0.046 SWE + 0.086 WP + 0.152 SP – 4.183

R^2=.874 Sept 1 Forecast Std Error=262 KAF

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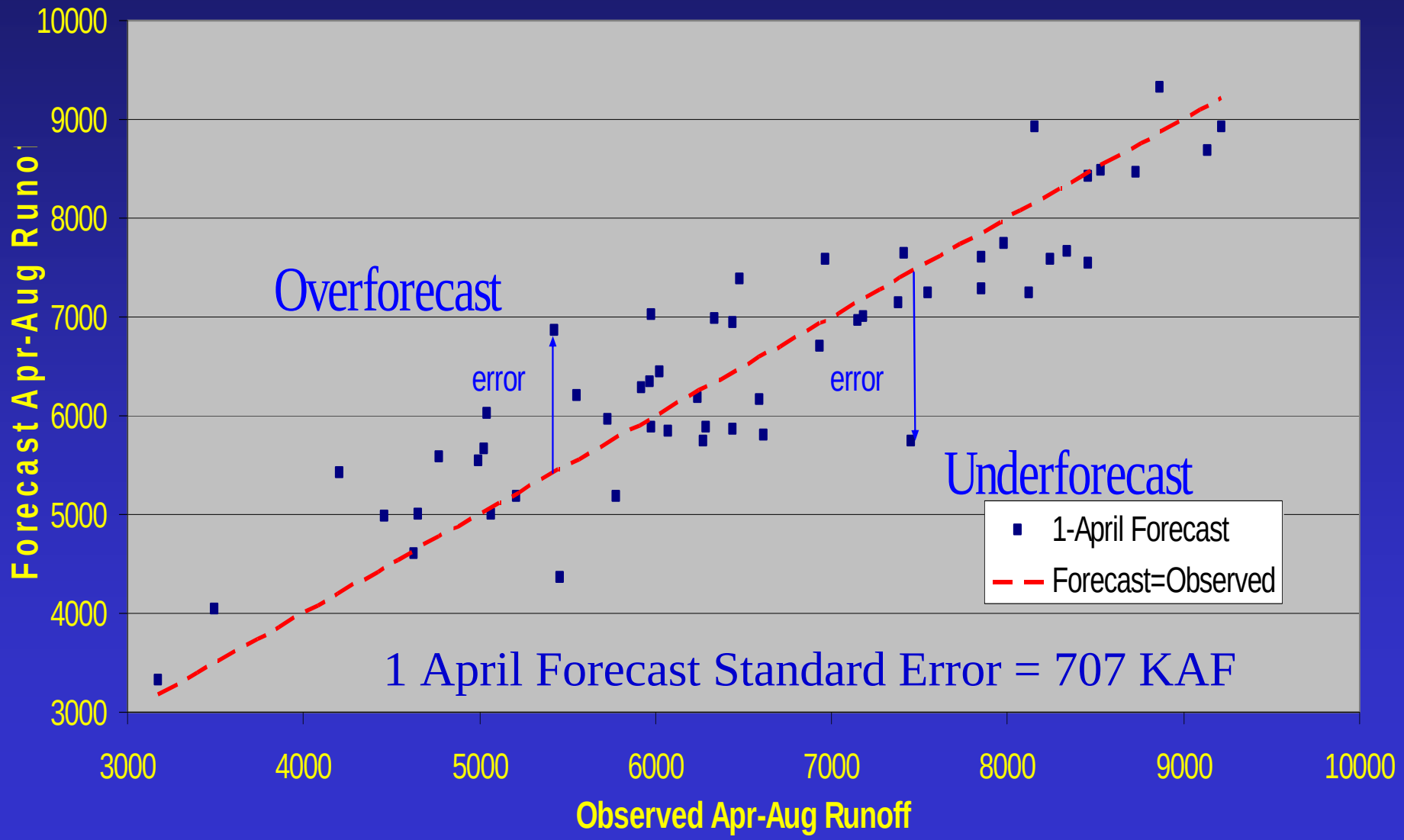
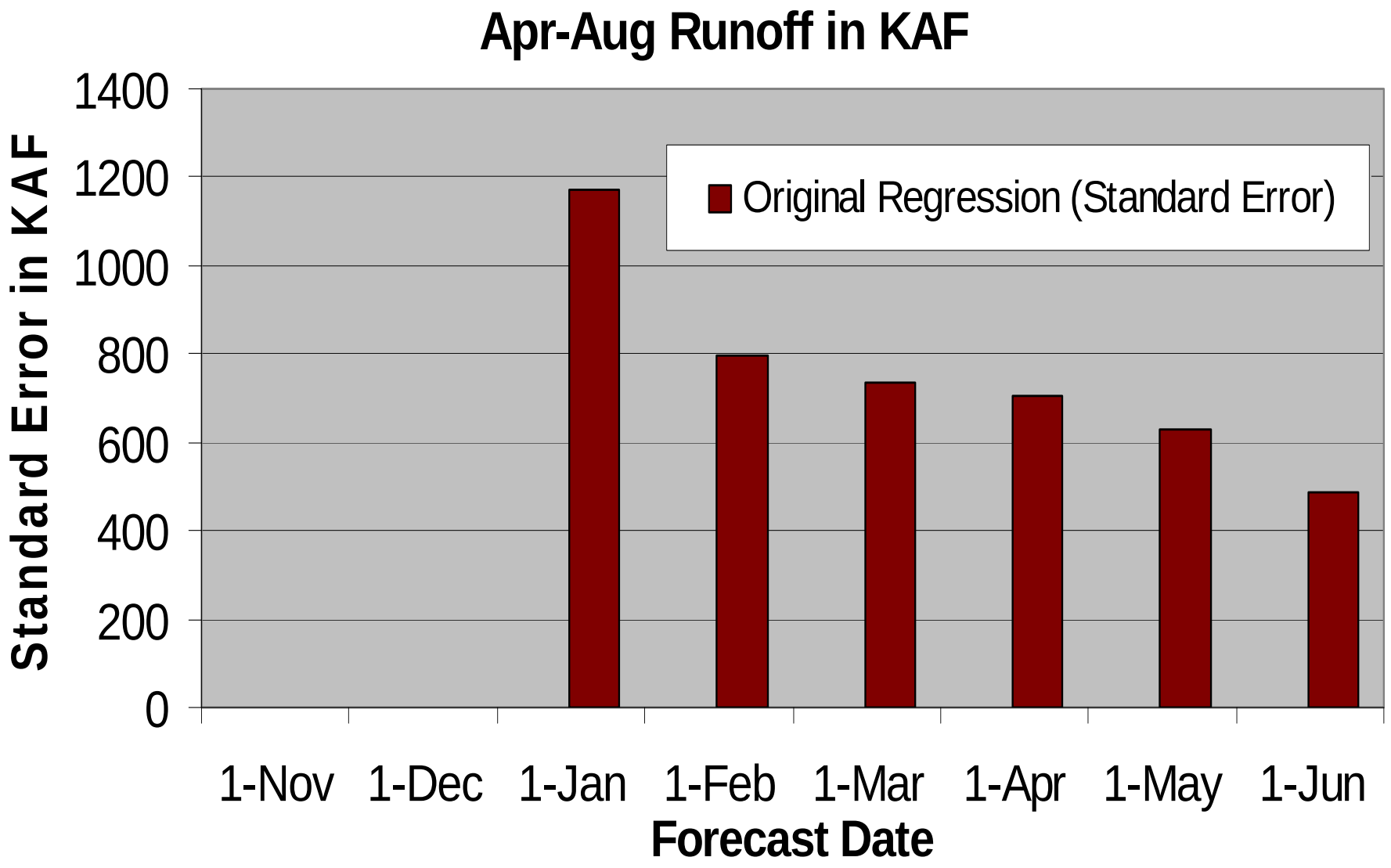
Libby Forecast Performance – 1 April Split-Basin Regression



Libby Water Supply Forecast using "Split-Basin" Standard Regression



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Concerns with Traditional Regression Models

- *Subjective station selection*
- *Subjective station weighting/aggregating*
- *Use of "normal subsequent" variable as a surrogate for a "future value" variable (Avoid)*
- ***Predictor variables are frequently highly intercorrelated. Intercorrelated variables produce interactions and problems with the regression coefficients and goodness-of-fit model statistics.***

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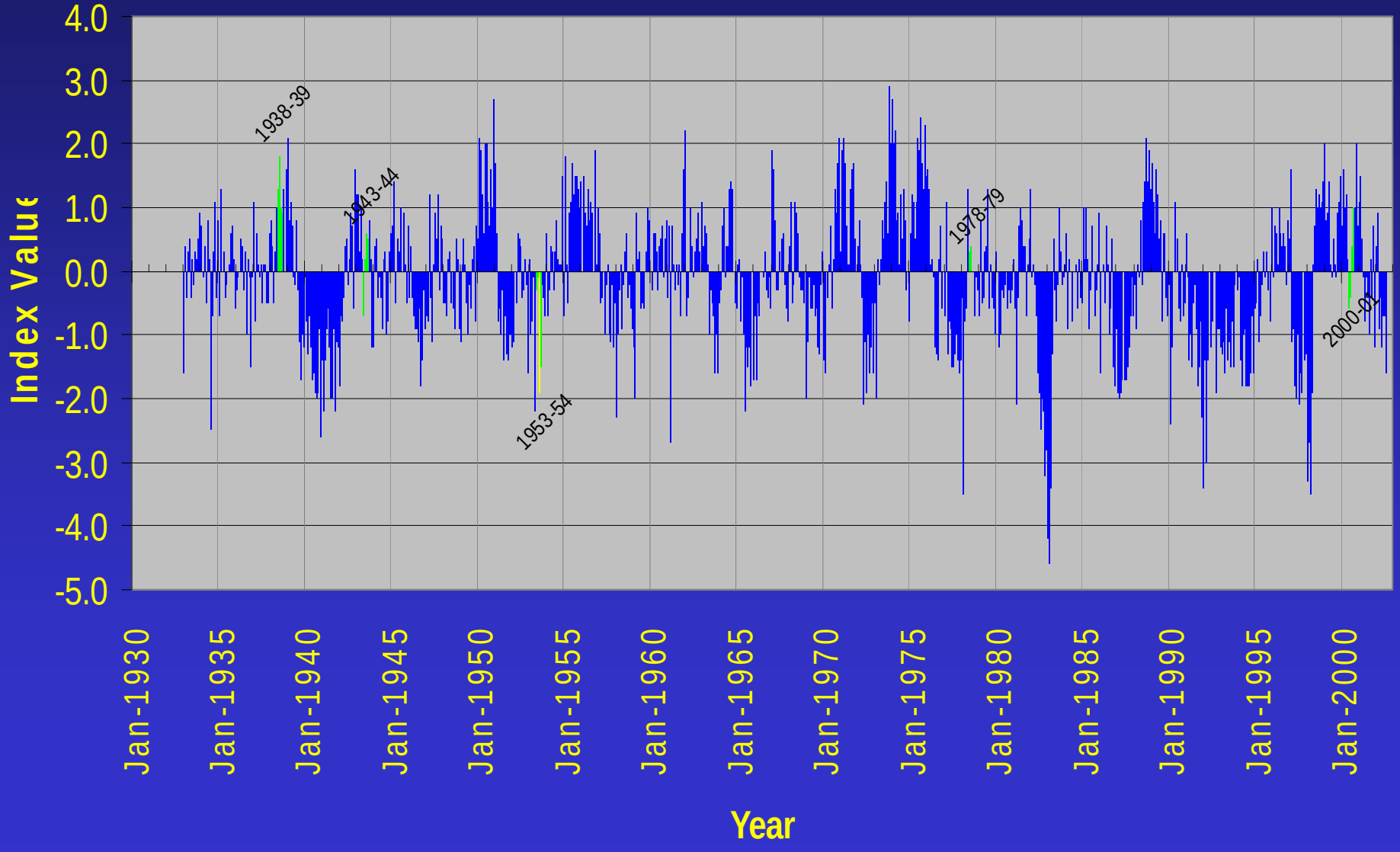
Objectives for New Forecast Equations

- Single regression model for the entire basin
  - New equation for each month
  - Choose models to maintain month-to-month consistency of variables
- Investigate climate variables
  - SOI and PDOI
- Eliminate intercorrelation between predictor variables
- Optimize variable weighting and selection procedures
- Model evaluation/selection utilizes cross-validation statistics

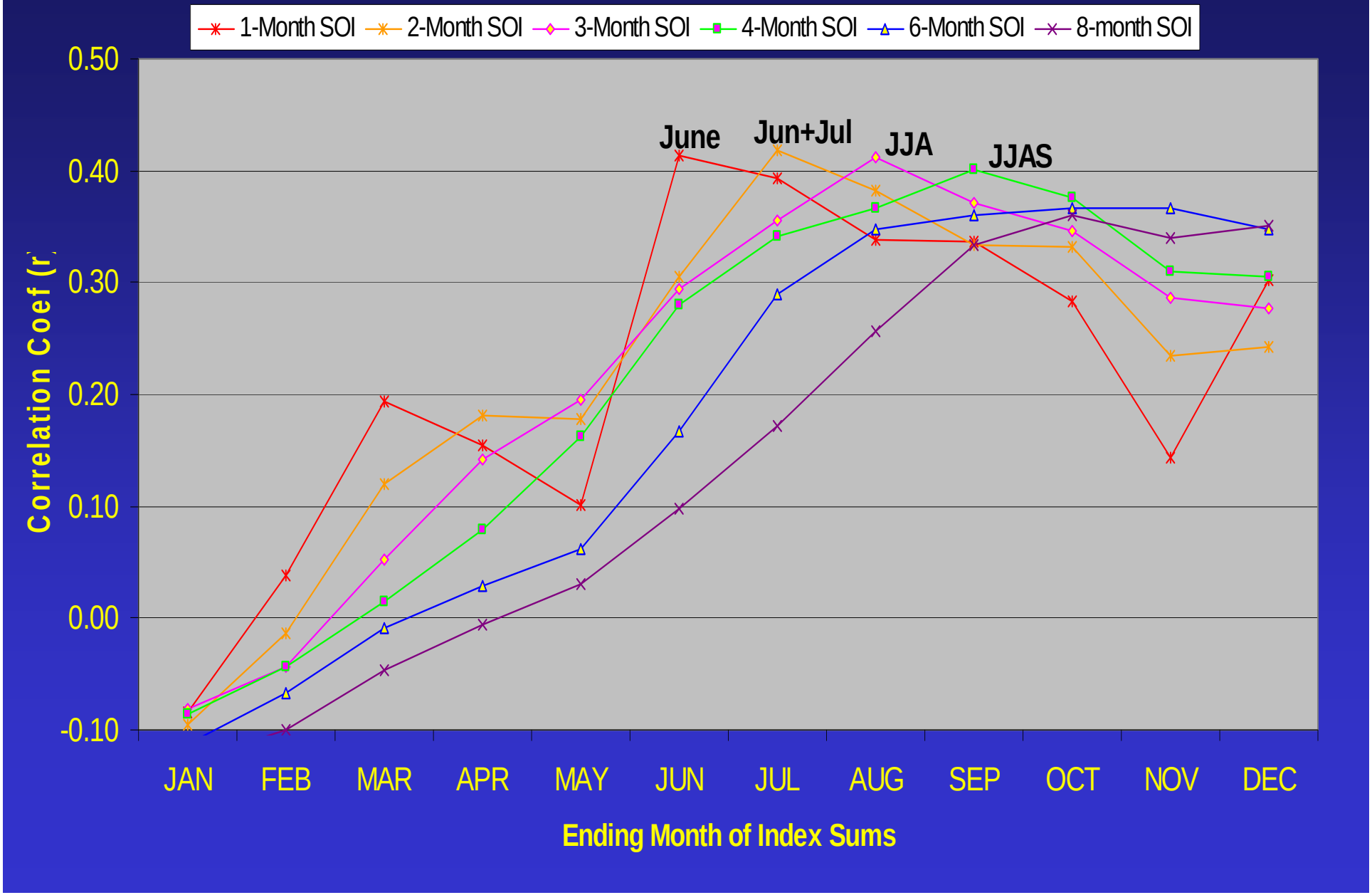
=>Regression variables selected and fitted utilizing NRCS Principal Components regression procedure

Historic Monthly SOI

1933-2002



Correlation: SOI vs Subsequent Apr-Aug KAF



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Principal Components

Observed Data			Principal Components		
$X1_1$	$X2_1$	$X3_1$	$PC1_1$	$PC2_1$	$PC3_1$
$X1_2$	$X2_2$	$X3_2$	$PC1_2$	$PC2_2$	$PC3_2$
$X1_3$	$X2_3$	$X3_3$	$PC1_3$	$PC2_3$	$PC3_3$
$X1_4$	$X2_4$	$X3_4$	$PC1_4$	$PC2_4$	$PC3_4$
$X1_5$	$X2_5$	$X3_5$	$PC1_5$	$PC2_5$	$PC3_5$
$X1_6$	$X2_6$	$X3_6$	$PC1_6$	$PC2_6$	$PC3_6$
...	...	...	...	...	...
$X1_N$	$X2_N$	$X3_N$	$PC1_N$	$PC2_N$	$PC3_N$

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Principal Components

- *Creates surrogate variables (principal components) that are a weighted combination of the original variables.*
- *The principal components have the property of being fully independent of one another (zero intercorrelation)*
- *Most of the "variability" in the predictor variables is loaded into the first one or two components.*
- ***Eigenvalues** reflect the proportion of the variability in original variables loaded into each component*
- *Note: PCs combine the information within the predictor variables, but "have no knowledge" of the dependent variable, the variable to be forecasted.*

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Principal Components Regression

Observed Data

$X1_1$	$X2_1$	$X3_1$
$X1_2$	$X2_2$	$X3_2$
$X1_3$	$X2_3$	$X3_3$
$X1_4$	$X2_4$	$X3_4$
$X1_5$	$X2_5$	$X3_5$
$X1_6$	$X2_6$	$X3_6$
…	…	…
$X1_N$	$X2_N$	$X3_N$

Traditional Regression Model

$$Y = \beta_0 + \beta_1 * X1 + \beta_2 * X2 + \beta_3 * X3$$

Principal Components

$PC1_1$	$PC2_1$	$PC3_1$
$PC1_2$	$PC2_2$	$PC3_2$
$PC1_3$	$PC2_3$	$PC3_3$
$PC1_4$	$PC2_4$	$PC3_4$
$PC1_5$	$PC2_5$	$PC3_5$
$PC1_6$	$PC2_6$	$PC3_6$
…	…	…
$PC1_N$	$PC2_N$	$PC3_N$

Principal Component Regression Model

$$Y = \beta_0 + \beta_1 * PC1 + \beta_2 * PC2 + \beta_3 * PC3$$

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Principal Components Regression

Example using SOI, 2 Precip & 4 snow variables

- *Properties of the Principal Component Regression Model with all "P" Components ("p"= # of original variables)*
  - Component R-squared values
  - Component R-squared loading
  - Eigenvalue loading
- 7 original variables -> 7 principal components:

PC Analysis	PC_1	PC_2	PC_3	PC_4	PC_5	PC_6	PC_7
R-Square	0.84144	0.00383	0.00040	0.00003	0.00495	0.00336	0.00068
R-Square %	98.5%	0.4%	0.0%	0.0%	0.6%	0.4%	0.1%
Cumul R-Sqr	0.8414	0.8453	0.8457	0.8457	0.8506	0.8540	0.8547
Eigenvalues	4.41	0.80	0.74	0.55	0.36	0.09	0.04

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Principal Components Regression

- *Variable Selection (Which components do I keep?)*
  - Component retention criteria:
    - Eigenvalue: provides the proportion of variability of X variables contained in each PC
    - significant R-squared: indicates the variability in the Y variable explained by this PC in a linear model, i.e. the usefulness of this PC in predicting the Y variable
    - significant *Beta:* reject this component when the regression coefficient is indistinguishable from zero.
    - sign of *Beta*: be wary of this component if the sign is negative (applies to water supply forecasting)

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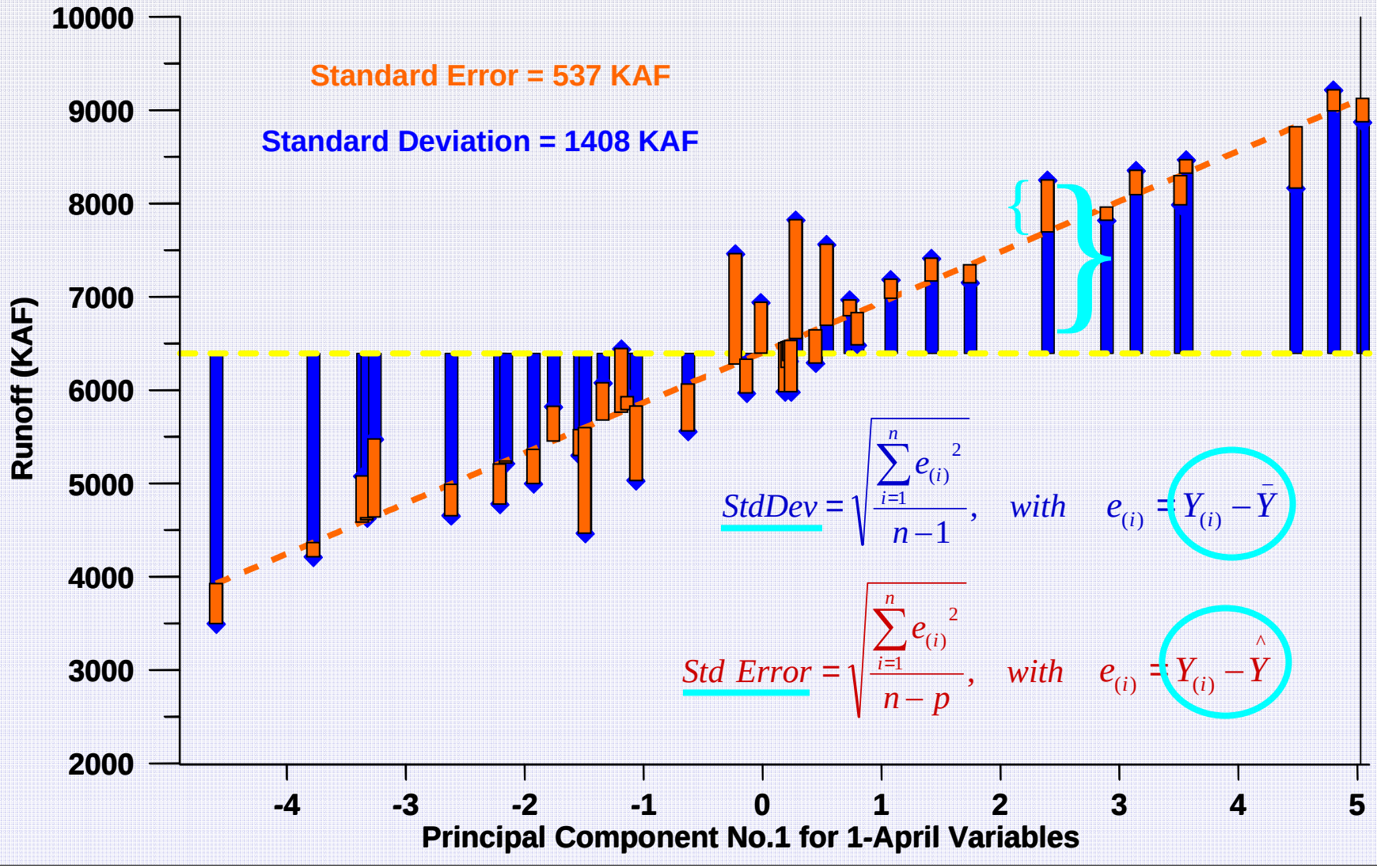
Comparing and Evaluating Models

- Be cautious of statistical models that have too many variables in comparison to the number of observations (years of data).
- Fitting too many variables leads to a model that is "overfit", i.e. is not parsimonious. Overfit models usually produce poor forecasts!
- Both the **Adjusted R-square** and **Standard Error** statistics are useful in comparing models, as they include a "degrees-of-freedom adjustment" to account for the number of coefficients used to fit the regression model to the data.

Standard Error



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Model Comparison: Validation Statistics

- **Calibration statistics** reflect the errors of the model optimized to fit to a given set of data.
- *Adjusted R-Square* and *Standard Error* are both statistics of the calibration model.
- **Validation statistics** reflect the errors of the calibrated model being applied to data not used in the calibration.
- **Calibration statistics** tend to be overly optimistic. Forecast models are best suited to be evaluated and compared based on **validation statistics**.

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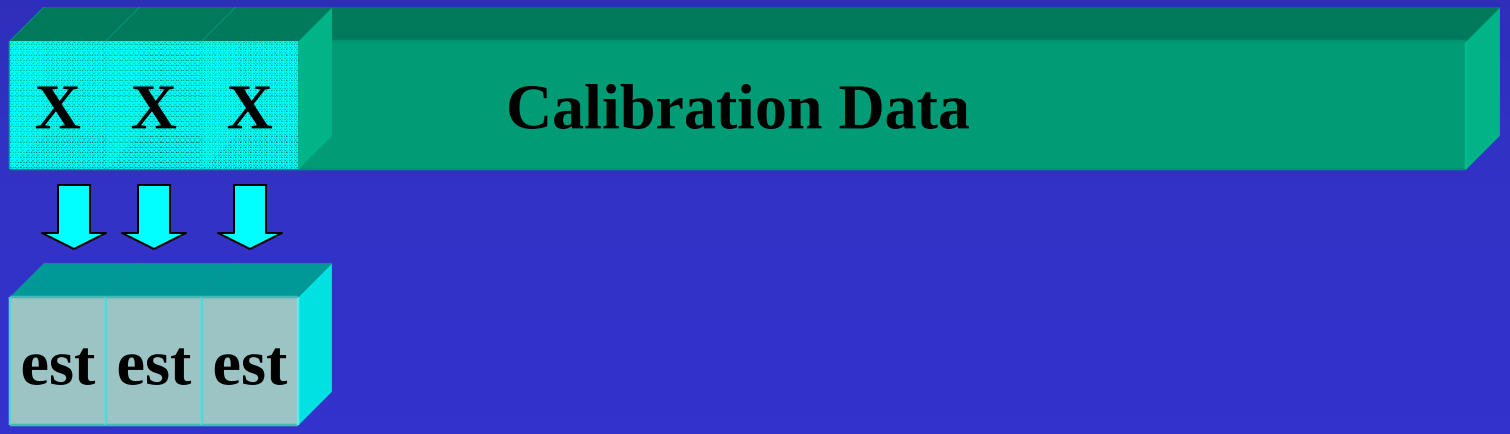
Model validation

- Split-Sample validation

Fit your model to this data

Compute your error statistics using this data

- Leave-one-out validation



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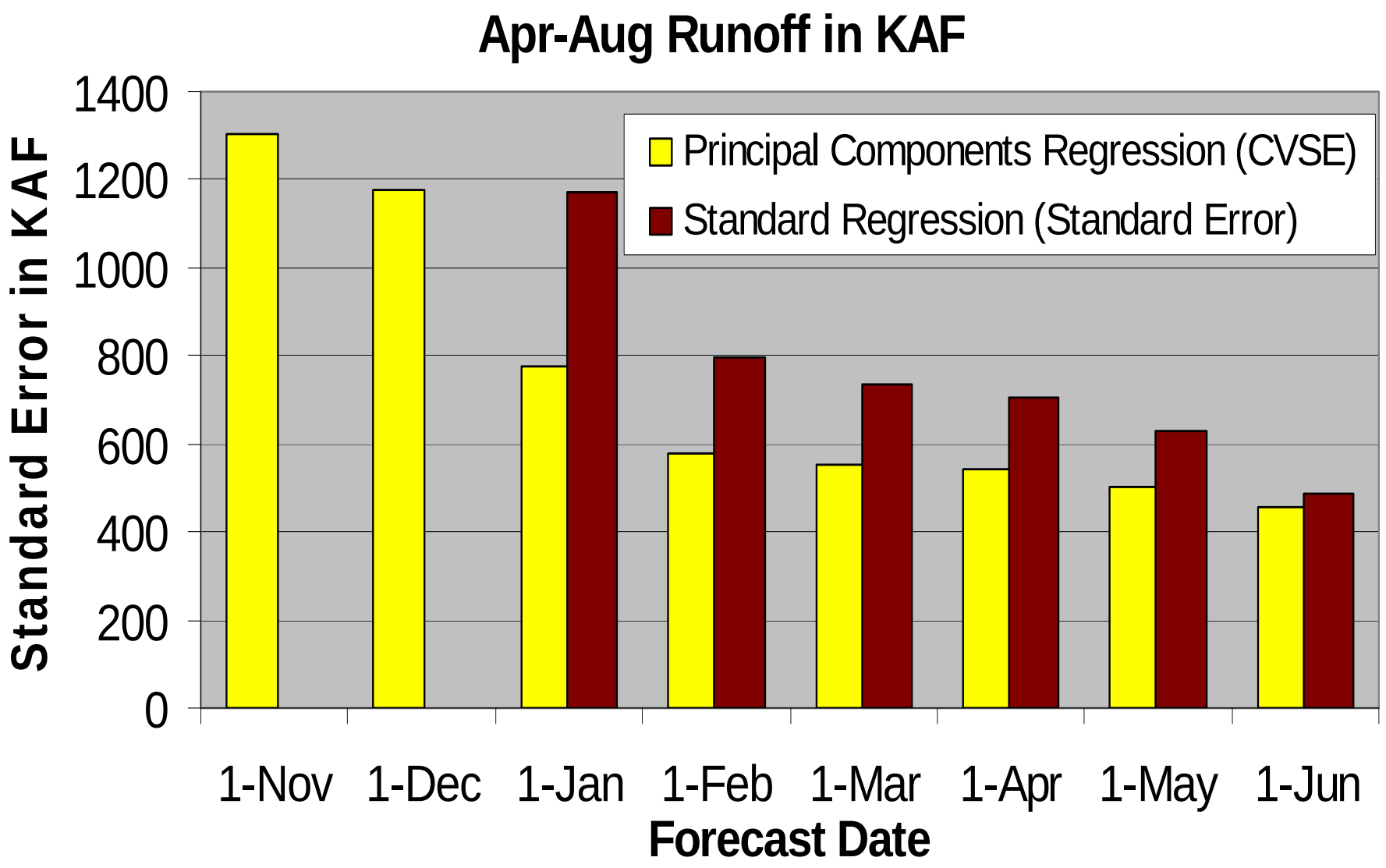
Cross-Validation Standard Error

$$CVSE = \sqrt{\frac{\sum e_{(i)}^{\,2}}{n - p}}$$

Where $e_{(i)}$ is the forecast error for the leave-one-out forecast of observation i

- Cross-validation standard error ("Jackknife" Std Err)
- CVSE supports model parsimony by including d-f adj.
- CVSE better indicator of how the model performs with data not used in the calibration, that it "hasn't seen yet"
- CVSE = PRESS statistic adjusted for degrees-of-freedom
- CVSE can be directly calculated from either Projection matrix or "Hat" matrix (calculated by NRCS PCREG)

Libby Water Supply Forecast using Principal Components Regression



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Endorsements

The following agencies use Principal Components regression in their Water Supply Forecasting procedures:

- *National Water and Climate Center, Natural Resources Conservation Service*
- *Northwestern Division, U.S. Army Corps of Engineers*
- *Northwest River Forecasting Center, National Oceanic and Atmospheric Administration*
- *Columbia River Treaty Operating Committee; Canadian and United States Entities*
- *Bonneville Power Administration, Dept of Energy*
- *BC Hydro*

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Questions?