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
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

Tri-Service Infrastructure Systems Conference & Exposition 2005

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: Room 230	Acquisition Strategies for Civil Works	*Walt Norko*
Track 2: Room 231	Risk and Reliability Engineering	*Anjana Chudgar* *David Schaaf*
Track 3: Room 232	Portfolio Risk Assessment	*Eric Halpin*
Track 4: Room 240	Hydrology, Hydraulics and Coastal Engineering Support for USACE	*Jerry Webb* *Darryl Davis*
Track 5: Room 241	Civil Works R&D Forum	*Joan Pope*
Track 6: Room 242	Civil Works Security Engineering	*Joe Hartman* *Bryan Cisar*
Track 7: Room 226	Building Information Model Applications	*Brian Huston* *Daniel Hawk*
Track 8: Room 220	Design Build for Military Projects	*Mark Grammer*
Track 9: Room 221	Army Transformation/Global Posture Initiative/ Force Modernization	*Al Young* *Claude Matsui*
Track 10: Room 222	Force Protection - Army Access Control Points	*John Trout*
Track 11: Room 227	Cost Engineering Forum on Government Estimates vs. Actual Costs	*Ray Lynn*, *Jack Shelton*, *Kim Callan* *Miguel Jumilla*, *Ami Ghosh*, *Joe Bonaparte*
Track 12: Room 228	Engineering & Construction Information Technology	*MK Miles*
Track 13: Room 223	Sustainable Design	*Harry Goradia*
Track 14: Room 224	ACASS/CCASS/CPARS	*Ed Marceau* *Marilyn Nedell*
Track 15: Room 229	Whole Building Design Guide	*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

Room	Session	8:00 AM	8:30 AM	9:00 AM	9:30 AM	Session	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*	Break in Exhibit Hall	**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*	Break in Exhibit Hall	**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*	Break in Exhibit Hall	**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*	Break in Exhibit Hall	**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*

12 Noon — **Lunch in Exhibit Hall**

Room	Session	1:30 PM	2:00 PM	2:30 PM	3:00 PM	Session	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*	Break in Exhibit Hall	**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*	Break in Exhibit Hall	**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 Brauer*	Bank erosion and morphology of the Kaskaskia river *Michael Rodgers*	Sediment movement at Kansas City from water years 1920 to 2004 *Alan Tool*	Break in Exhibit Hall	**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 & surveying to support national FEMA *Mark Flick*	Break in Exhibit Hall	**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*

Wednesday, August 3, 2005 Concurrent Sessions

Geotechnical Track

Room	Track / Session	8:00 AM	8:30 AM	9:00 AM	9:30 AM	Track / Session	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*	Break in Exhibit Hall	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, conceptual 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*	Break in Exhibit Hall	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*	Break in Exhibit Hall	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*	Break in Exhibit Hall	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*

12 Noon **Lunch in Exhibit Hall**

Room	Track / Session	1:30 PM	2:00 PM	2:30 PM	3:00 PM	Track / Session	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*	Break in Exhibit Hall	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*	Break in Exhibit Hall	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*	Break in Exhibit Hall	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*	Break in Exhibit Hall	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*

Wednesday, August 3, 2005 Concurrent Sessions

Structural Engineering Track

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

12 Noon — **Lunch in Exhibit Hall**

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

Wednesday, August 3, 2005 Concurrent Sessions

Dam Safety Track & Construction Track

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

12 Noon — **Lunch in Exhibit Hall**

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

Wednesday, August 3, 2005 Concurrent Sessions

Electrical & Mechanical Engineering Track

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

12 Noon — **Lunch in Exhibit Hall**

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

Thursday, August 4, 2005 Concurrent Sessions

HH&C Track

Room	Track / Session	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 / TRACK 1 Sedimentation, Case Examples Session 1F	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*	Break in Exhibit Hall	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 / TRACK 2 Water Management Session 2F	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*	Break in Exhibit Hall	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 / TRACK 3 Case Studies Session 3F	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*	Break in Exhibit Hall	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 / TRACK 4 Modeling Session 4F	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*	Break in Exhibit Hall	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*

12 Noon — **Lunch**

Room	Track / Session	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 / TRACK 1 Watershed Management Session 1H	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*	Break	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 / TRACK 2 Water Management Session 2H	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*	Break	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 / 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*	Break	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 / TRACK 4 Modeling Session 4H	Little Calumet River unsteady flow model conversion *Rick Ackerson*	Kansas City River basin model *Edward Parker*	Design guidance for breakup ice control *Andrew Tuthill*	Break	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*

Thursday, August 4, 2005 Concurrent Sessions

Geotechnical Track

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

12 Noon — **Lunch**

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

Thursday, August 4, 2005 Concurrent Sessions

Geotechnical, Specifications, Electrical & Mechanical Engineering & Construction Tracks

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

12 Noon — **Lunch**

Room	Track / Session	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 Session 9G	Seismic Manual *GROUP DISCUSSION*	Seismic Manual (Continued) *GROUP DISCUSSION*	Seismic Manual (Continued) *GROUP DISCUSSION*				

Thursday, August 4, 2005 Concurrent Sessions

Dam Safety Track & Structural Engineering Track

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

12 Noon **Lunch**

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

Thursday, August 4, 2005 Concurrent Workshops

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

NOTES

NDIA
NATIONAL DEFENSE INDUSTRIAL ASSOCIATION
STRENGTH THROUGH INDUSTRY & TECHNOLOGY

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

Mississippi River Sedimentation Study

Investigators

- MVK Basil Arthur, Joey Windham, Ron Copeland
- MVM Andy Gaines, Elizabeth Burks
- MVN Leslie Lombard, Nancy Powell
- MVS Dennis Stephens
- MVD Eddie Brooks, Clarence Thomas

Mississippi River HEC-6T Sediment Study

Purpose of Study

To identify the effects of planned Mississippi River and Tributaries Project features and dredging strategies on long-term sedimentation trends between Cario, Illinois and East Jetty, Louisiana

Mississippi River HEC-6T Sediment Study

Study Approach

- HEC-6T numerical model.
- This model has been applied successfully to evaluate long-term sedimentation responses to various engineering projects along the Lower Mississippi River. These applications have included river response to dredging, flow diversions through distributaries, construction of a low-flow sediment sill and contraction works.

Mississippi River HEC-6T Sediment Study

Study Approach

- It is recognized that river response to dikes, especially overtopping dikes, is not strictly a one-dimensional, steady-flow, problem; however, it is hypothesized that one-dimensional effects are dominant and that careful application of the numerical model will be useful in determining appropriate lengths, heights, and longitudinal extent for dike field construction and long-term sedimentation trends in the river

HEC-6T
GENERAL CAPABILITIES

- Calculates one-dimensional cross-section averaged hydraulic and sediment parameters in a single channel or stream network including divided flow
- Couples sedimentation processes with system hydraulics
- Accounts for stream bed armoring and hydraulic sorting of grain sizes
- Maintains sediment continuity by size class

HEC-6T
GENERAL CAPABILITIES

- Calculates by particle size from clay through cobbles
- Provides 19 sand sediment transport functions
- Allows tributary inflows and/or diversions
- Calculates dredging volumes
- Calculates sediment delivery
- Will model up to 1200 cross sections, 20 grain sizes, a 50 segment network and 50 local inflow points per segment

Coding Enhancements Beyond HEC-6 Significant to this Study

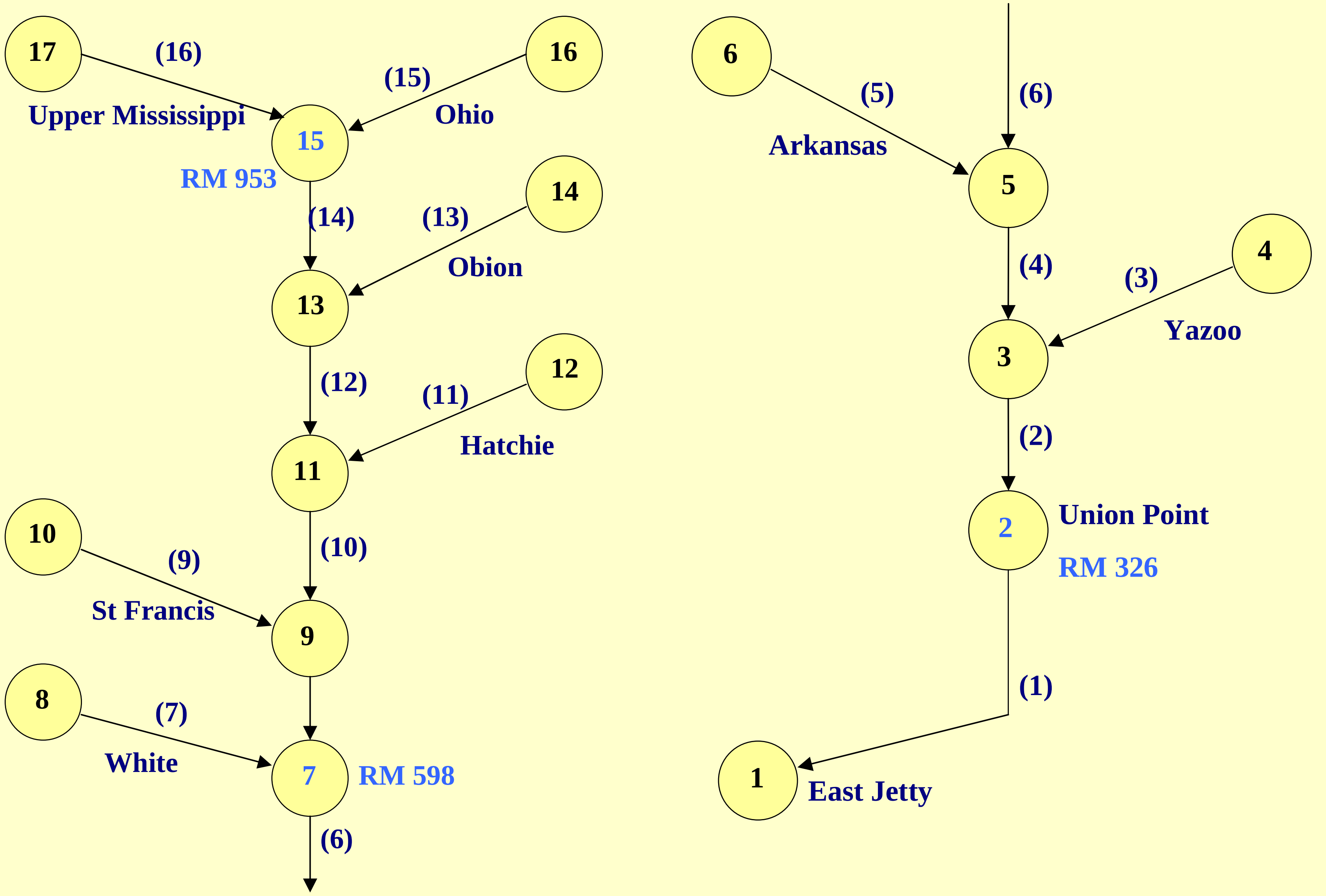
- Graphical User Interface
- Hotstart file
- Vary n value with depth
- Vary n laterally across the cross-section
- Flow around islands
- Separate erosion and deposition widths

Mississippi River HEC-6T Sediment Study

Study Characteristics

- The model will consider reaches of the river (2-4 miles) and not try to study specific areas.
- The model will be developed as one model from the upstream boundary to the downstream boundary.
- The model will be constructed so that it can be refined with more detail to study specific problem areas.

HEC-6T Network



Percent of Annual Discharge At Vicksburg 1989-2003

Ohio River	46.6
Upper Mississippi River	35.5
Arkansas River	8.0
White River	4.4
Yazoo River	3.2
St Francis River	1.3
Hatchie River	0.6
Obion River	0.4

Input Data Requirements

- Geometry
  - HEC-2 or HEC-RAS geometry file
  - Width and depth of bed sediment reservoir
- Sediment
  - Properties of the bed sediment reservoir
  - Inflowing sediment load
- Hydrology
  - Discharge
  - Duration – Computational time step

HEC-6T Geometry General

- Channel Geometry developed from 1988-92 hydrographic surveys.
- Overbank geometry developed from surveys and USGS quads
- Dikes constructed up to 1992 coded at top of crest
- Overbank roughness calculated using conveyance method
- Channel roughness calculated using equal velocity method varied by discharge.

HEC-6T Geometry Mississippi River

- New Orleans channel and overbank from 1991-1992 hydrographic survey.
- Vicksburg channel and overbank from HEC-2 model based on 1988-89 hydrographic survey.
- Memphis channel from 1988-89 hydrographic survey. Overbank from 1988-89 surveys and USGS quads.
- St Louis channel and overbank from 1988 hydrographic survey.

HEC-6T Geometry Yazoo River

- Cross Sections at RM 1.51 and 3.69 from 1988-89 Mississippi River hydrographic survey.
- Cross Section at RM 16.7 from Redwood Discharge Range.
- Big Sunflower River Confluence (RM 44.4) to Yazoo City (RM 75.6) from 1990 Post Construction survey HEC-2 model.

HEC-6T Geometry Arkansas River

- Cross Sections from Little Rock District HEC-RAS Model.
- Channel surveys 2003.
- Overbank data from USGS quads and 1992 Mississippi River hydrographic survey.
- Arkansas River confluence moved to RM 580.5 from RM 585 as per 1995 survey. Cutoff was in 1989.
- 28.2 Miles simulated to Dam No. 2.

HEC-6T Geometry White River

- Channel from 1997-98 hydrographic survey.
- Overbank from 2000 surveys and USGS quads
- 100 River Miles

HEC-6T Geometry Obion and Hatchie Rivers

- Channel cross sections from discharge range. Elevations estimated by translation using valley slope. Widths adjusted using aerial photos
- Overbanks from USGS quads
- 0.2 miles simulated

HEC-6T Geometry Saint Francis River

- Cross Sections from 2000 HEC-6T Model.
- Channel surveys 1997-98.
- Overbank data from 1997-98 survey and USGS quads.
- 57.9 miles modeled

HEC-6T Geometry Ohio River

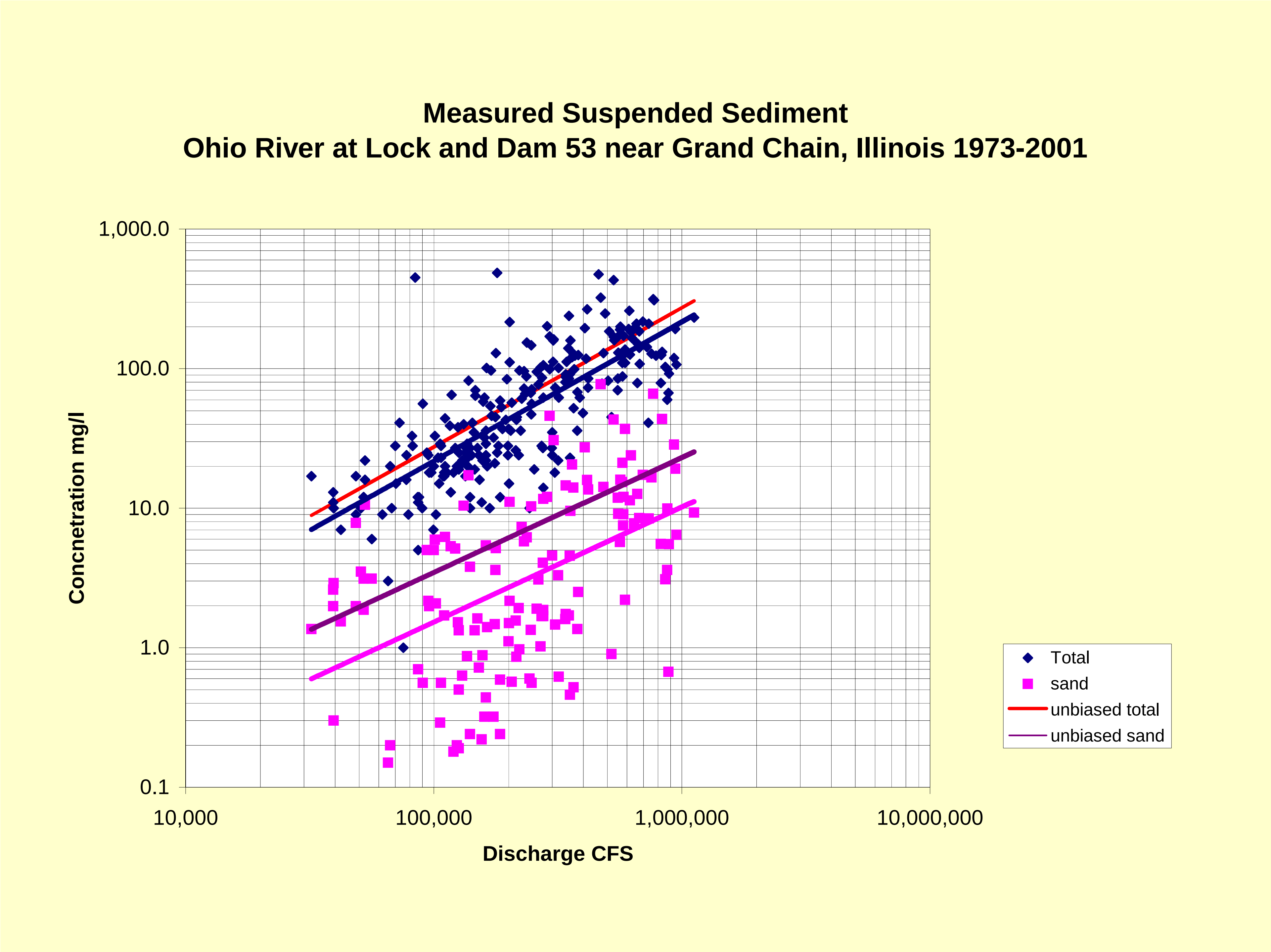
- Geometry from Louisville District HEC-2 model based on mid-1960’s survey data.
- 59.2 River miles simulated - RM 1014 upstream from Cario

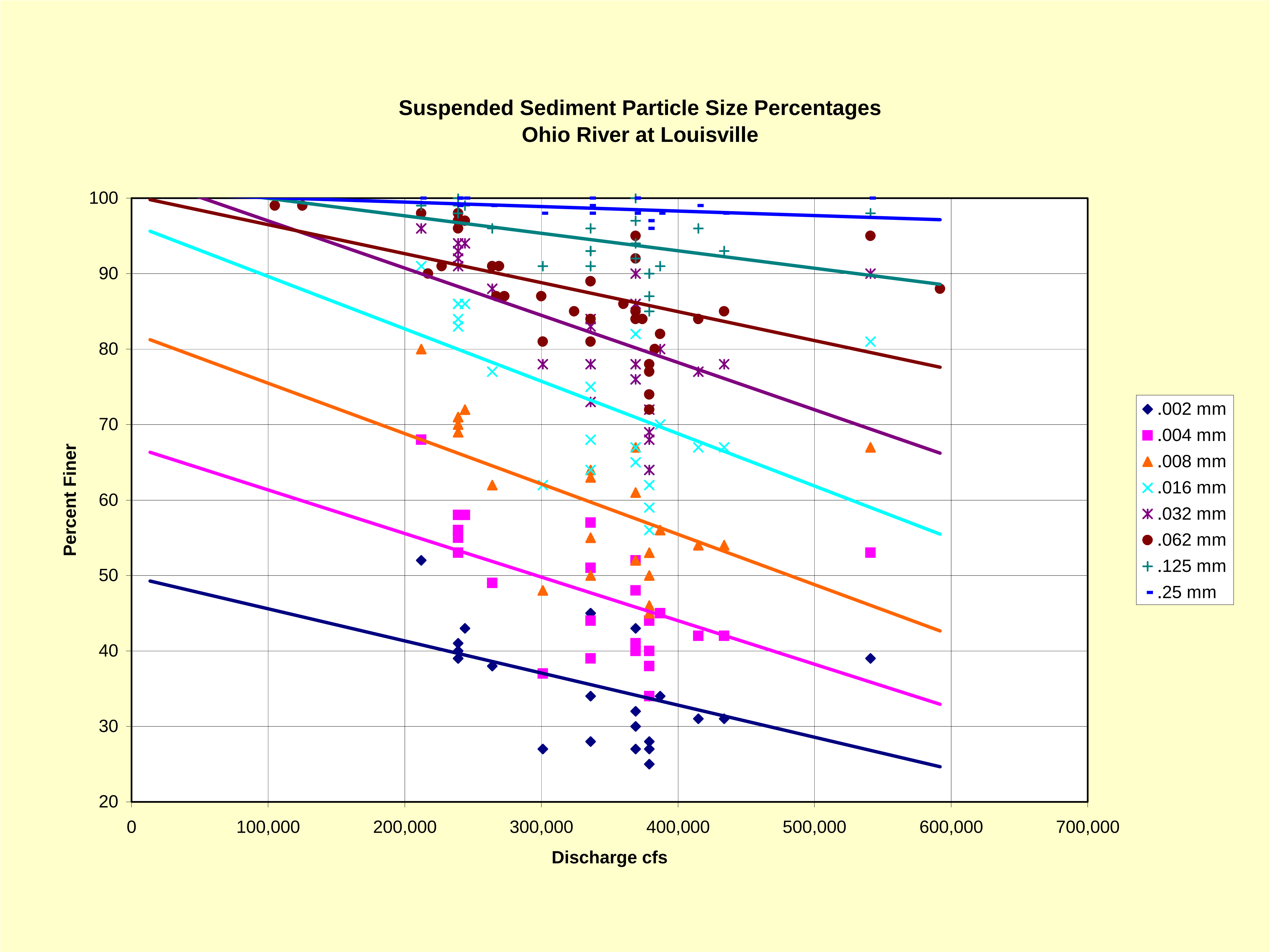
Sediment Inflow

- Combination of Measured and Calculated Data
- Measured data for wash load and suspended bed-material load
- Calculated data for bed-material load
- Where data are not available, assumed values will be checked during calibration phase of study

Sediment Inflow Ohio River

- Measured fine and sand suspended loads at Lock and Dam No. 53 - RM 17 (USGS)
- Measured size class distributions at Louisville (USGS 1978-82)
- Calculated bed-material load using bed gradations from Louisville District from three transects.

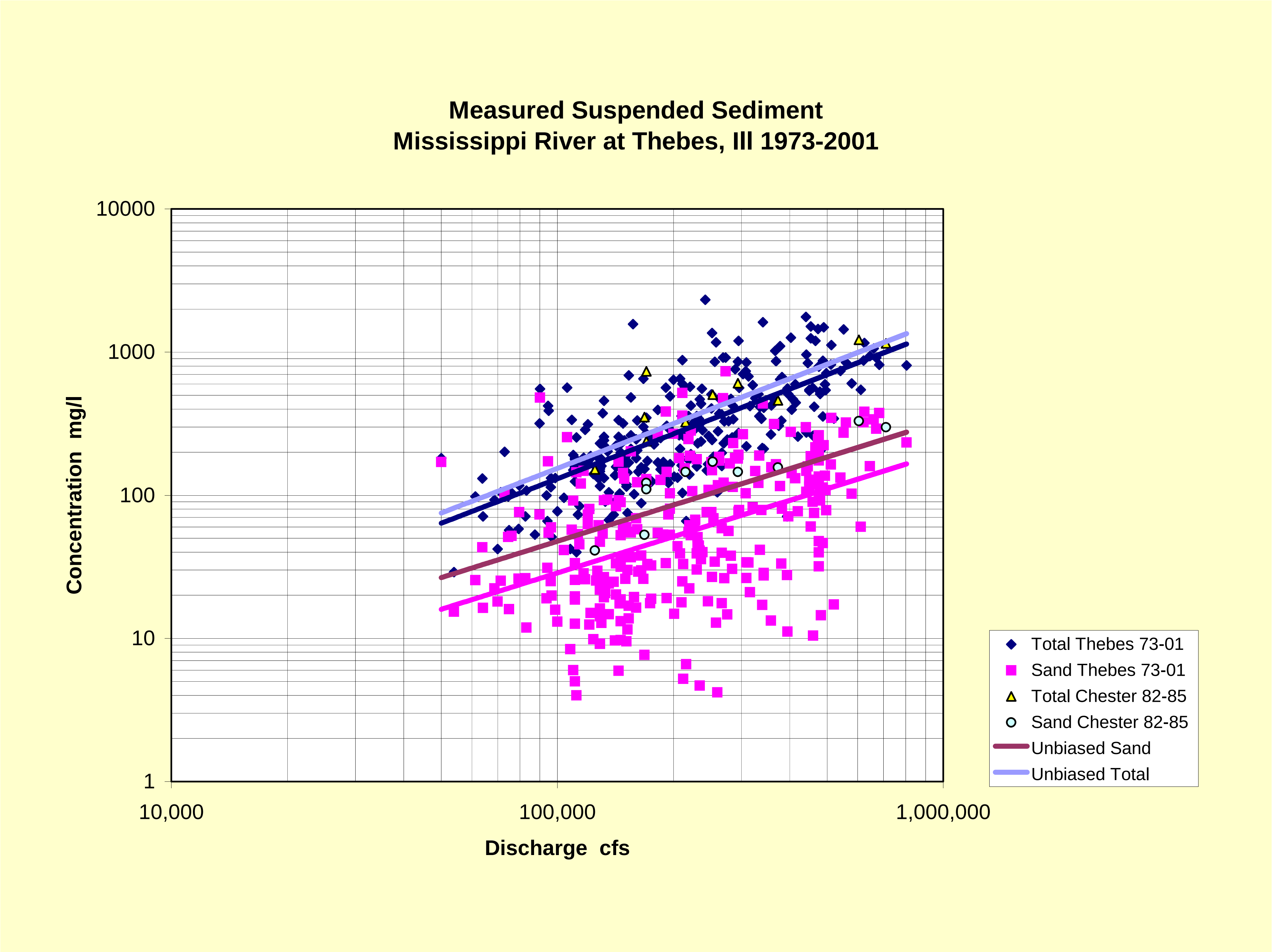

Measured Suspended Sediment
Ohio River at Lock and Dam 53 near Grand Chain, Illinois 1973-2001
1,000.0
100.0
10.0
1.0
0.1
Concnetration mg/l
10,000
100,000
1,000,000
10,000,000
Discharge CFS
Total
sand
unbiased total
unbiased sand

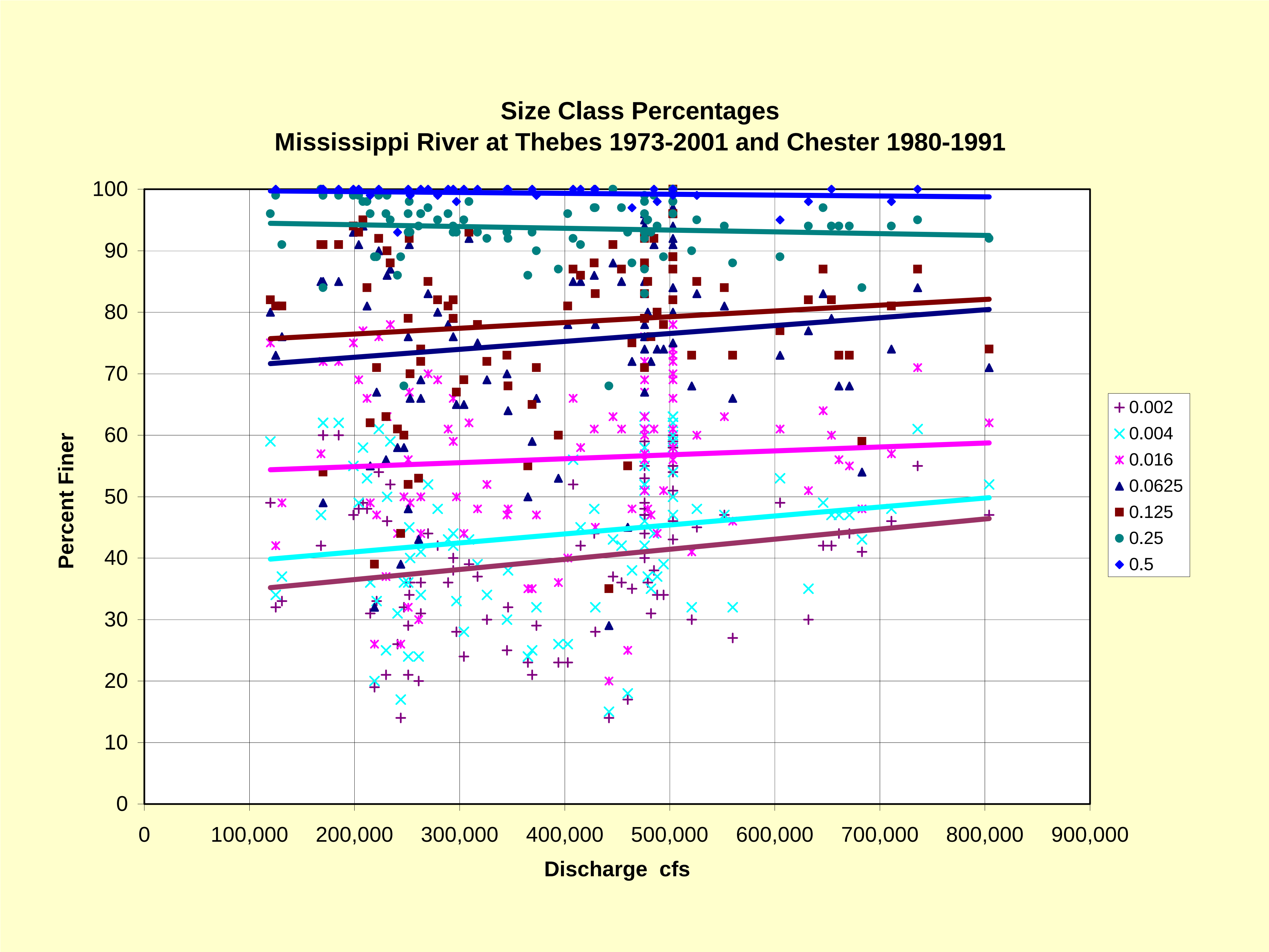

Suspended Sediment Particle Size Percentages
Ohio River at Louisville
Percent Finer
100
90
80
70
60
50
40
30
20
0
100,000
200,000
300,000
400,000
500,000
600,000
700,000
Discharge cfs
.002 mm
.004 mm
.008 mm
.016 mm
.032 mm
.062 mm
.125 mm
.25 mm

Sediment Inflow
Upper Mississippi River

- Measured suspended loads, including size class distributions, at Thebes and Chester - RM 43.7 and 109.9 (USGS)

- Calculate bed-material load using bed gradations from Thebes gage (USGS)


Measured Suspended Sediment
Mississippi River at Thebes, Ill 1973-2001
Concentration mg/l
10000
1000
100
10
1
10,000
100,000
1,000,000
Discharge cfs
Total Thebes 73-01
Sand Thebes 73-01
Total Chester 82-85
Sand Chester 82-85
Unbiased Sand
Unbiased Total



Size Class Percentages
Mississippi River at Thebes 1973-2001 and Chester 1980-1991
Percent Finer
Discharge cfs
0
10
20
30
40
50
60
70
80
90
100
0
100,000
200,000
300,000
400,000
500,000
600,000
700,000
800,000
900,000
0.002
0.004
0.016
0.0625
0.125
0.25
0.5

Sediment Inflow
St Francis River

- Measured fine and sand suspended loads from 1998 HEC-6T study (USGS measurements)
- Measured bed load and size class distributions from 1998 HEC-6T study (USGS measurements)
- Bed gradations collected for 1998 HEC-6T study.

Sediment Inflow Arkansas River

- Combination of measured fine and sand suspended loads at Dam No. 2 and Terry Lock and Dam - RMs 28.2 and 124.2 (USGS)
- Calculated bed-material load and size class distributions using bed gradations from Little Rock District.
- Assumed size class distribution for wash load will be verified during calibration.

Sediment Inflow White River

- Combination of measured fine and sand suspended loads at Newport, Devalls Bluff and Clarendon – RM’s 257.6, 125.3 and 99.9 (USGS)
- Calculated bed-material load and size class distributions using bed gradations from Little Rock District at RM 4 (2003) and Memphis District at RMs 50 and 99 (2005).
- Assumed size class distribution for wash load will be verified during calibration..

Sediment Inflow
Yazoo River

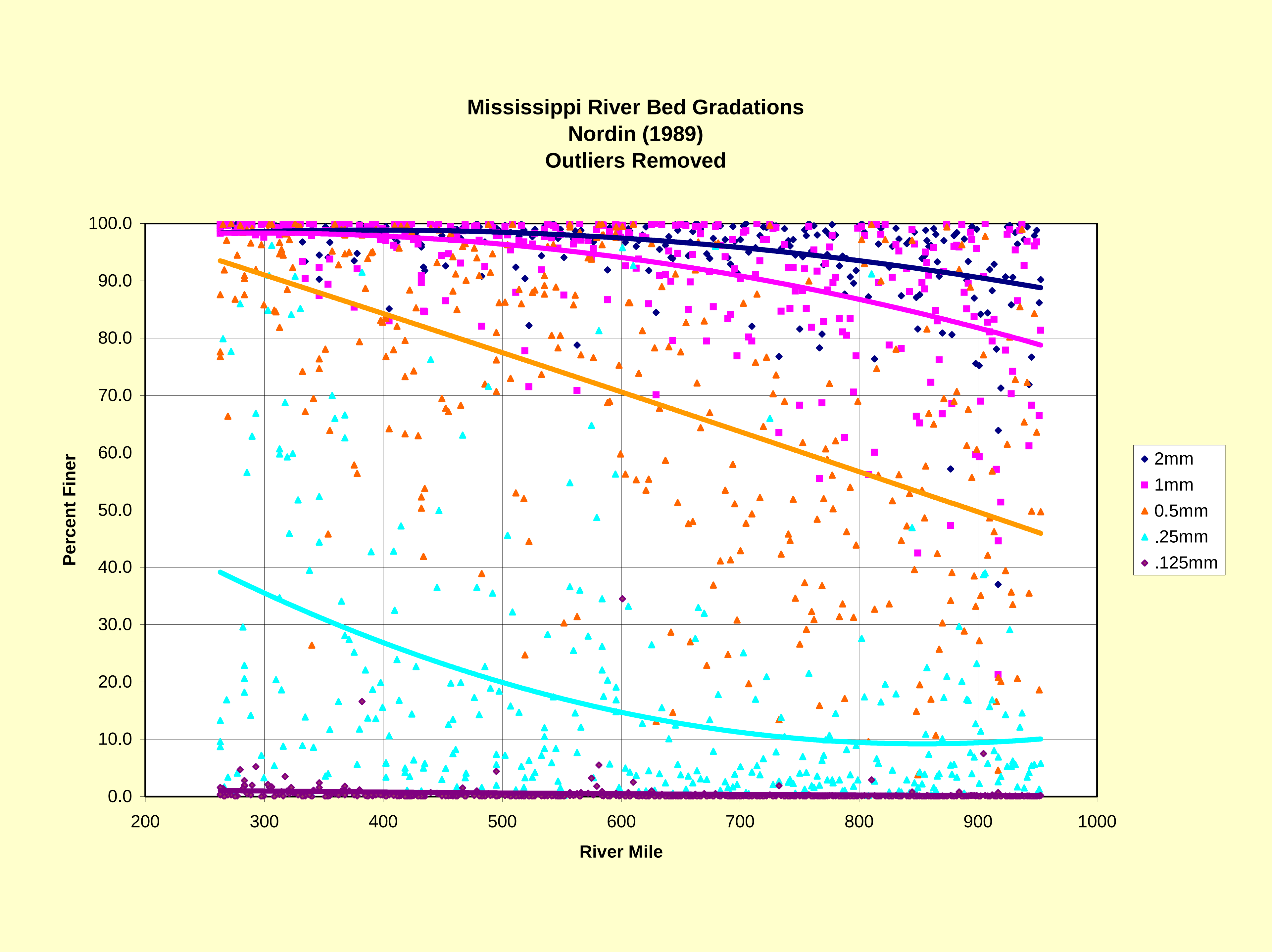
- Combination of measured fine and sand suspended loads at Steel Bayou (USGS)
- Calculated bed-material load and size class distributions using bed gradations collected at two transects in 2005.
- Assumed size class distribution for wash load will be verified during calibration.

Sediment Inflow Obion and Hatchie Rivers

- Calculated bed-material load and size class distributions using bed gradations collected at two transects in each river in 2005.
- Assumed size class distribution for wash load will be verified during calibration.

Initial Bed Material Gradations

- 1989 Mississippi River thalweg sampling by Carl Nordin from Head of Passes to Cario.
- Calibrated so that changes are insignificant with constant bankfull discharge

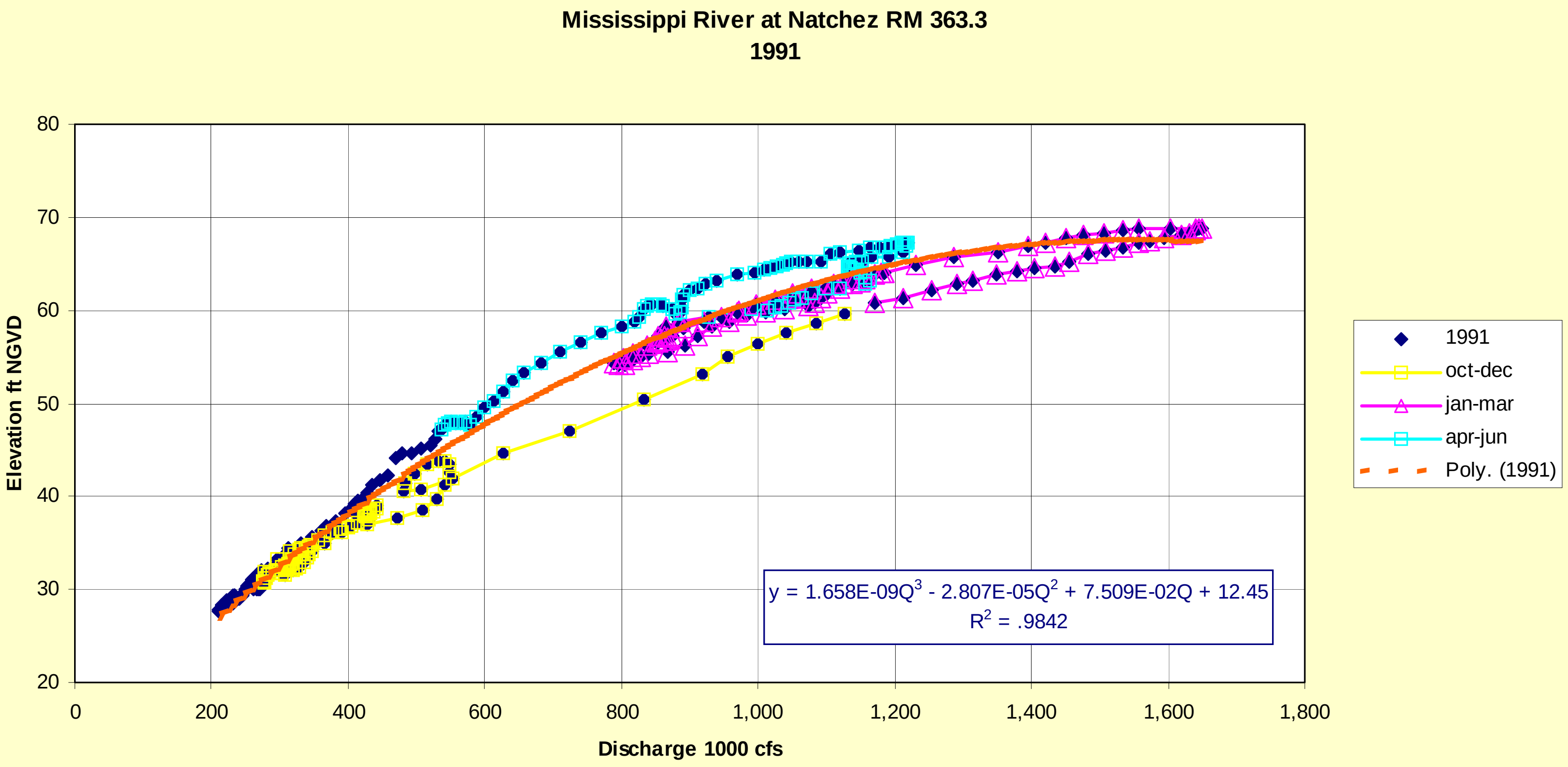


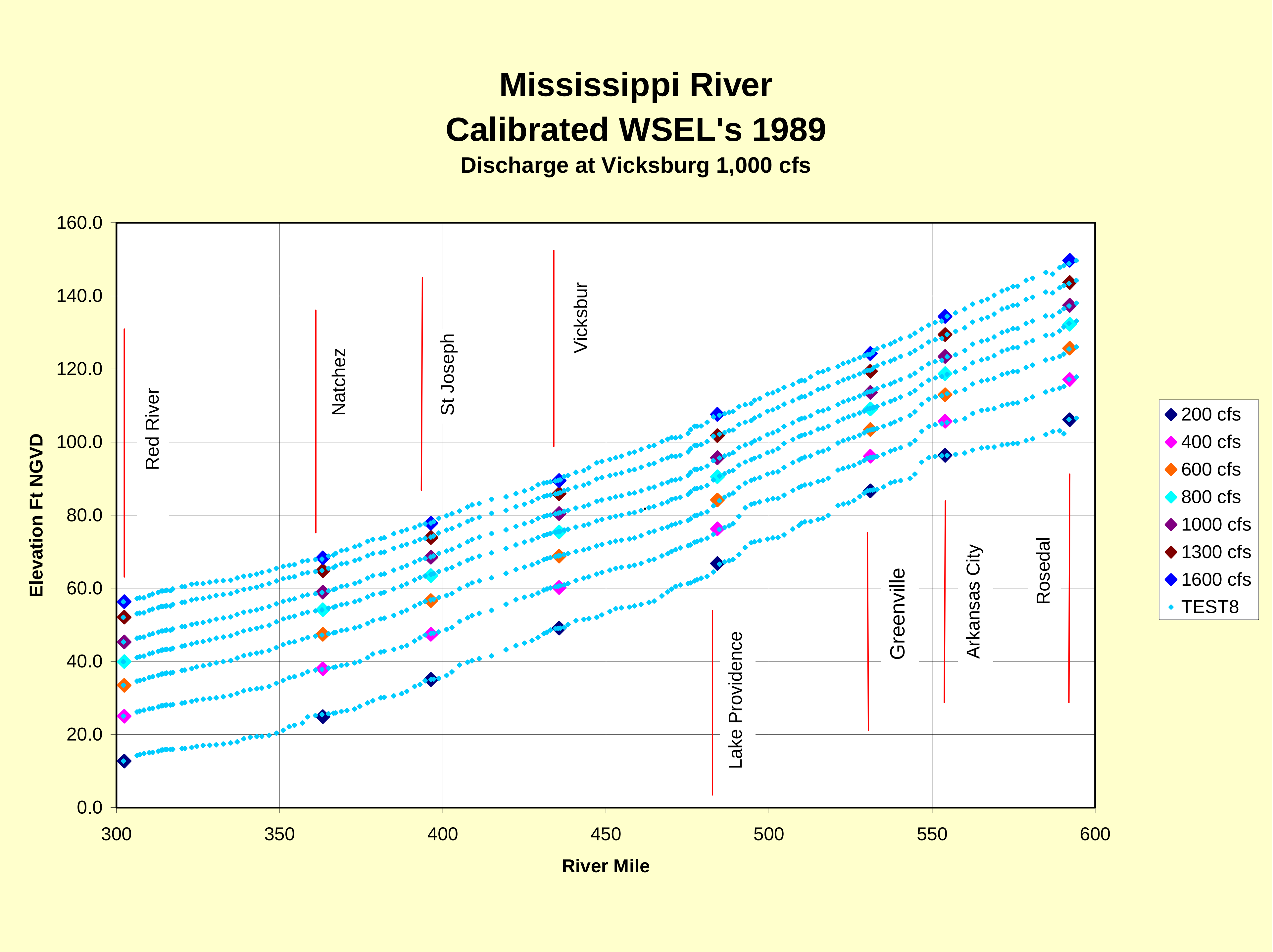
Mississippi River Bed Gradations
Nordin (1989)
Outliers Removed
Percent Finer
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
200
300
400
500
600
700
800
900
1000
River Mile
2mm
1mm
0.5mm
.25mm
.125mm

Model Calibration

- Water surface elevation
- Sediment transport at intermediate gages
  - Memphis
  - Vicksburg
  - Natchez
  - Tarbert Landing
- Specific gage trends

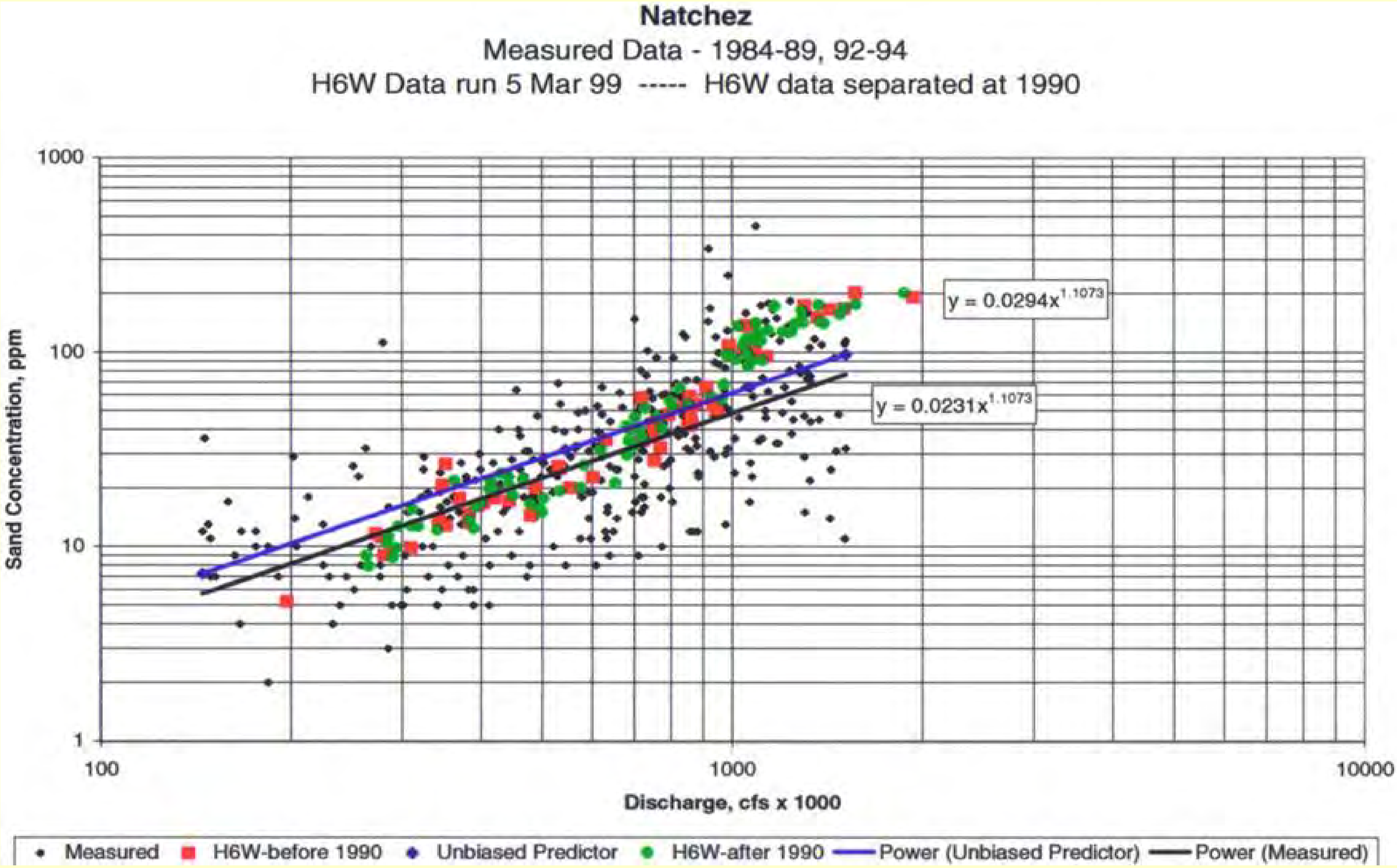
Water Surfaces Calibrated to Average Stage Rating Curves





Mississippi River
Calibrated WSEL's 1989
Discharge at Vicksburg 1,000 cfs
Elevation Ft NGVD
River Mile
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
300
350
400
450
500
550
600
Red River
Natchez
St Joseph
Vicksbur
Lake Providence
Greenville
Arkansas City
Rosedal
200 cfs
400 cfs
600 cfs
800 cfs
1000 cfs
1300 cfs
1600 cfs
TEST8

Verification to Measured Sediment Transport

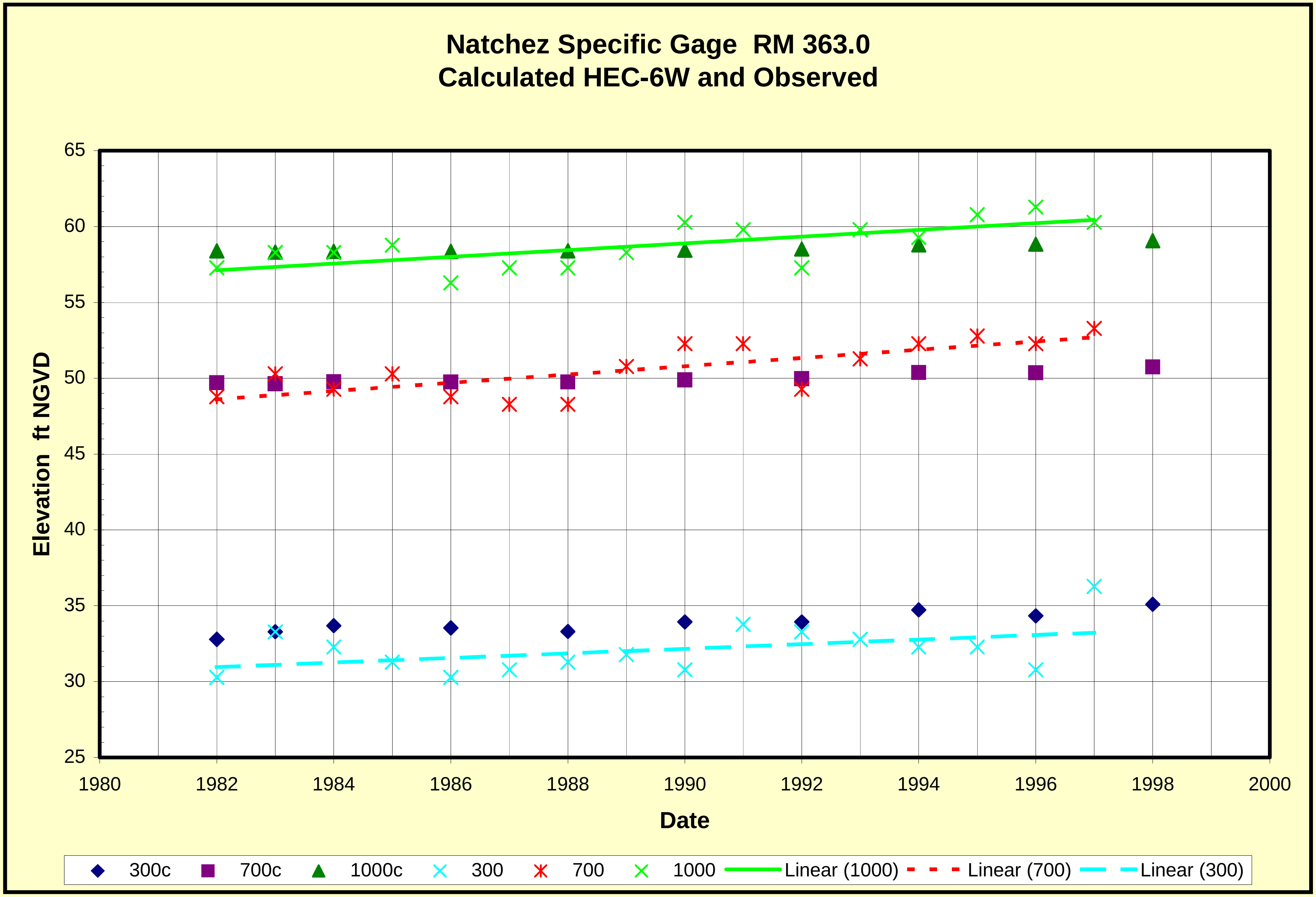


Verification to Measured Size Class Distributions

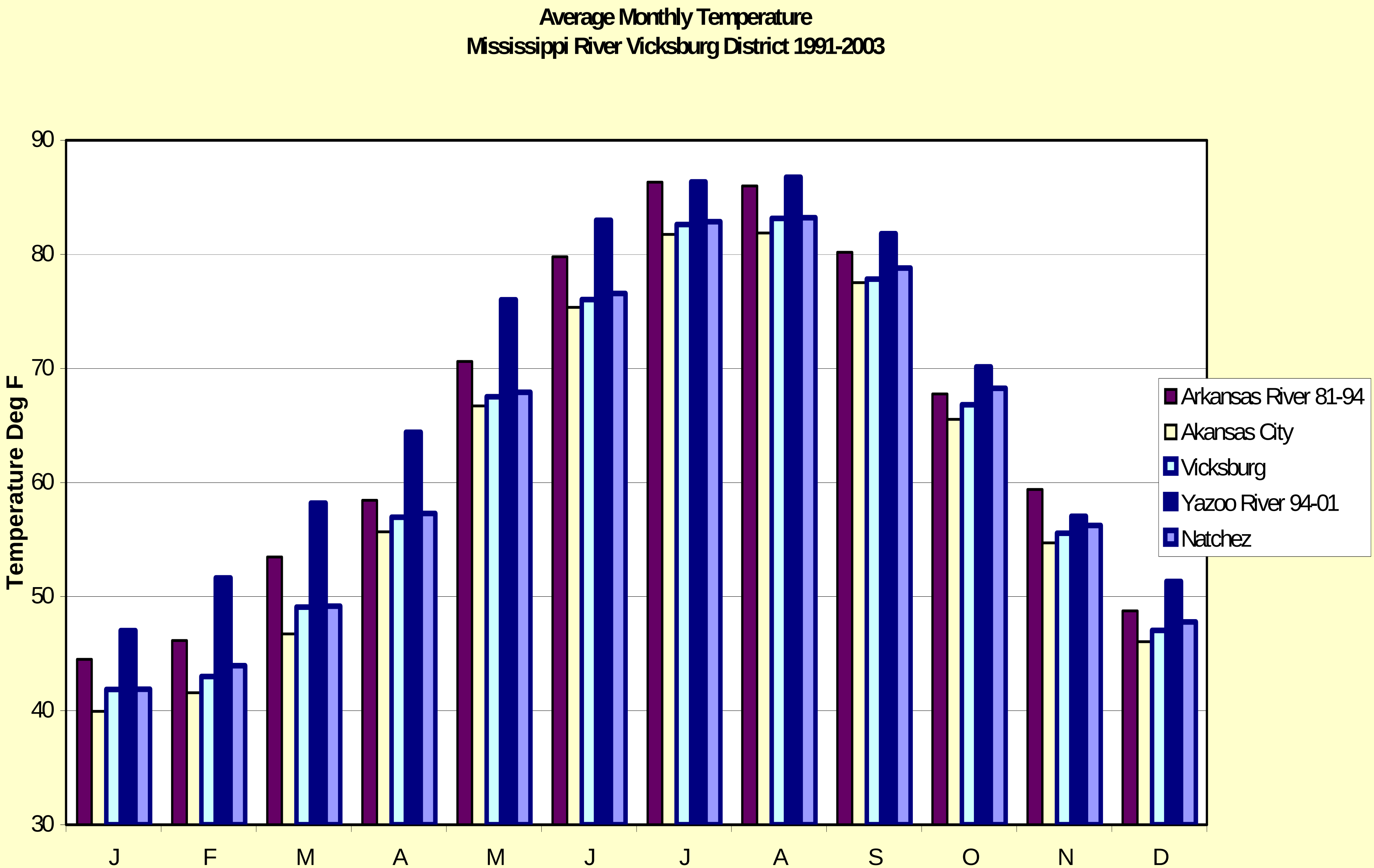
Size Class Distributions

Tarbert Landing				Coochie/Union Point		
RM 306.3				RM 317.3		
	Calculated	**Measured**			**Calculated**	**Measured**
Grain Size	Total Sand Load 1982-1998 fractions	Sand Load 1982-1996 fractions		Grain Size	Total Sand Load 1982-1998 fractions	Sand Load 1982-1996 fractions
VFS	0.36	0.35		VFS	0.38	0.35
FS	0.48	0.55		FS	0.48	0.54
MS	0.15	0.09		MS	0.13	0.10
CS	0.01	0.01		CS	0.01	0.01

Verification to Measured Specific Gage Curves



Average Monthly Temperatures



Model Predictions

- Long-term aggradation and degradation trends in response to MR&T Project construction
- Bed changes during a flood event
- Aid in designing features to enhance backwater reaches
- Effects of various project features – channel constriction, channel straightening, and dredging
- Effect of reducing or increasing sediment supply both upstream and through diversions

Status of Study

- Each District has calibrated a fixed-bed hydraulic model.
- The hydraulic model is calibrated for flow distribution across each cross section and water-surface elevation for a range of discharges.
- Sediment inflow has been determined for boundaries with measured data.

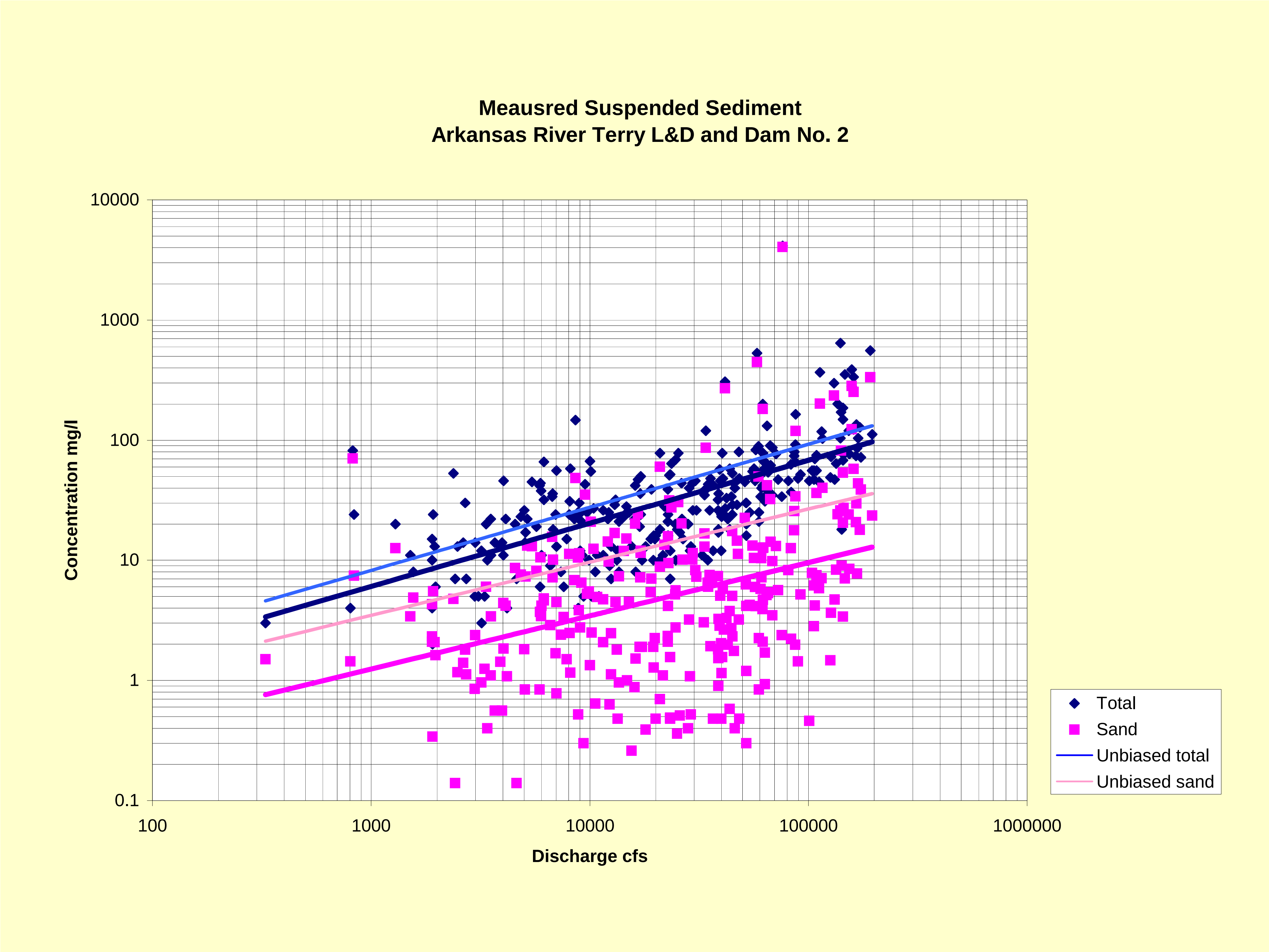
Mississippi River Sediment Study

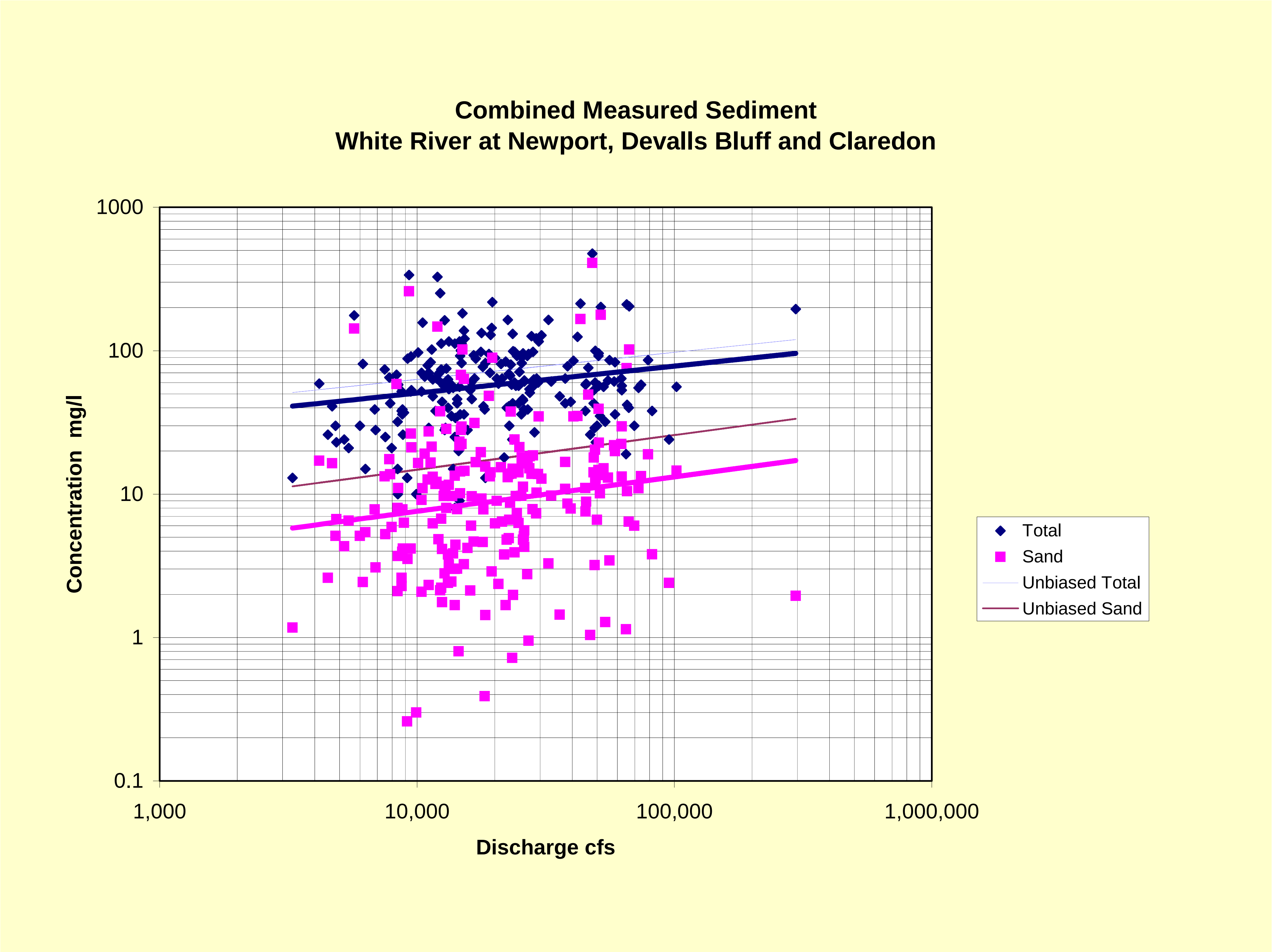
Suggestions?

HEC-6T
MAINTENANCE AND SUPPORT

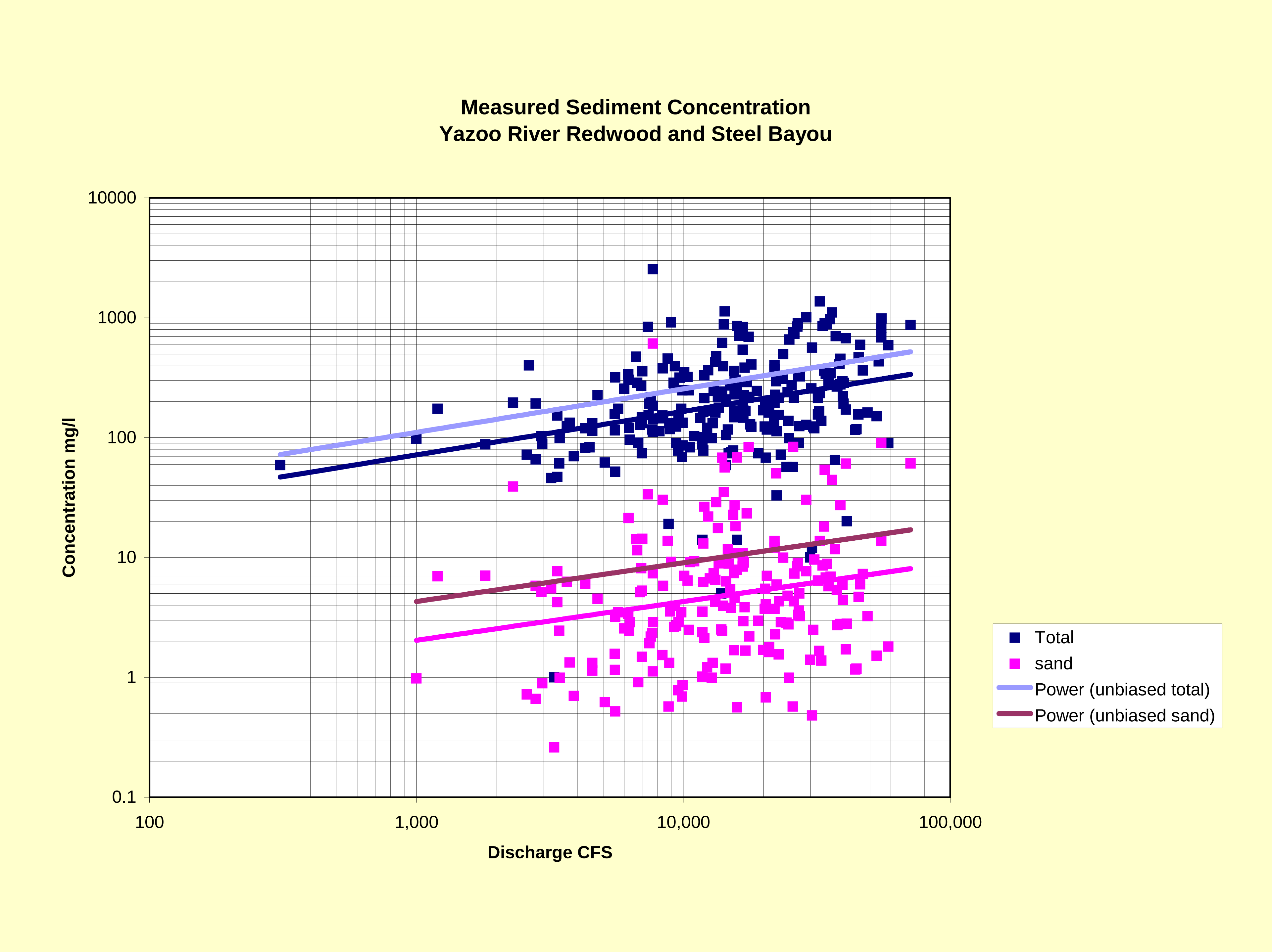
- Documented
- Maintained
- Supported
- Consulting Services

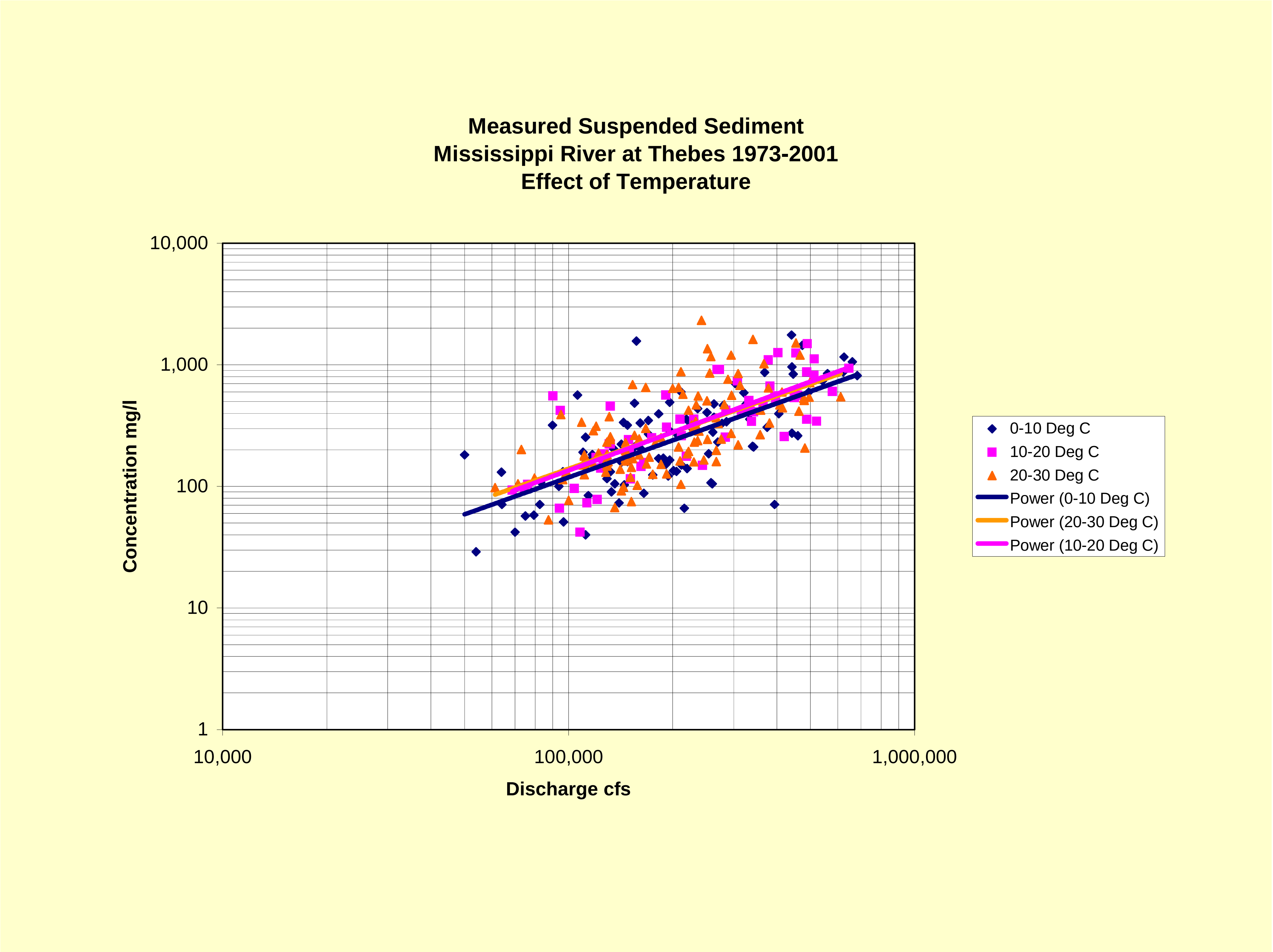
Mississippi River Sedimentation Study


Meausred Suspended Sediment
Arkansas River Terry L&D and Dam No. 2
Concentration mg/l
10000
1000
100
10
1
0.1
100
1000
10000
100000
1000000
Discharge cfs
Total
Sand
Unbiased total
Unbiased sand



Combined Measured Sediment
White River at Newport, Devalls Bluff and Claredon
1000
100
10
1
0.1
Concentration mg/l
1,000
10,000
100,000
1,000,000
Discharge cfs
Total
Sand
Unbiased Total
Unbiased Sand


Measured Sediment Concentration
Yazoo River Redwood and Steel Bayou
Concentration mg/l
10000
1000
100
10
1
0.1
100
1,000
10,000
100,000
Discharge CFS
Total
sand
Power (unbiased total)
Power (unbiased sand)


Measured Suspended Sediment
Mississippi River at Thebes 1973-2001
Effect of Temperature
Concentration mg/l
10,000
1,000
100
10
1
10,000
100,000
1,000,000
Discharge cfs
0-10 Deg C
10-20 Deg C
20-30 Deg C
Power (0-10 Deg C)
Power (20-30 Deg C)
Power (10-20 Deg C)

Missouri River Geospatial Decision Support Framework

Bryan Baker, Martha Bullock
US Army Corps of Engineers

US Army Corps of Engineers

Introduction

- Operation of the Missouri River Mainstem Reservoir System to adequately provide for flood control, navigation, irrigation, hydropower, water supply, water quality, recreation, and fish and wildlife requirements is an ongoing challenge for the the Corps
- Revision of the Missouri River Master Water Control Manual in 2004 addresses requirements set by USFWS to restore the Missouri River ecosystem and to protect and recover threatened and endangered species
- To facilitate a comprehensive approach to recovery implementation, the Missouri River Recovery Implementation Committee (MRRIC) has been established

Introduction

- The strategy defined and implemented by the MRRIC will generate volumes of research data on the ecological habitat needs, physiological endpoints and population modes of species
- To address these requirements, and to encourage a collaborative approach to restoration activities, a web portal has been developed that permits access to associated data and information about the shallow water habitat restoration on the Missouri River
- The web portal integrates the data, tools, and utilities into a comprehensive system to facilitate stakeholder collaboration, data sharing, and sound decision-making

Web Portal

- Single, uniform access point for all stakeholders to load, view, modify, and share data, documentation, and information

- Provide incentive to stakeholders to collect and distribute data in a standard and systematic way

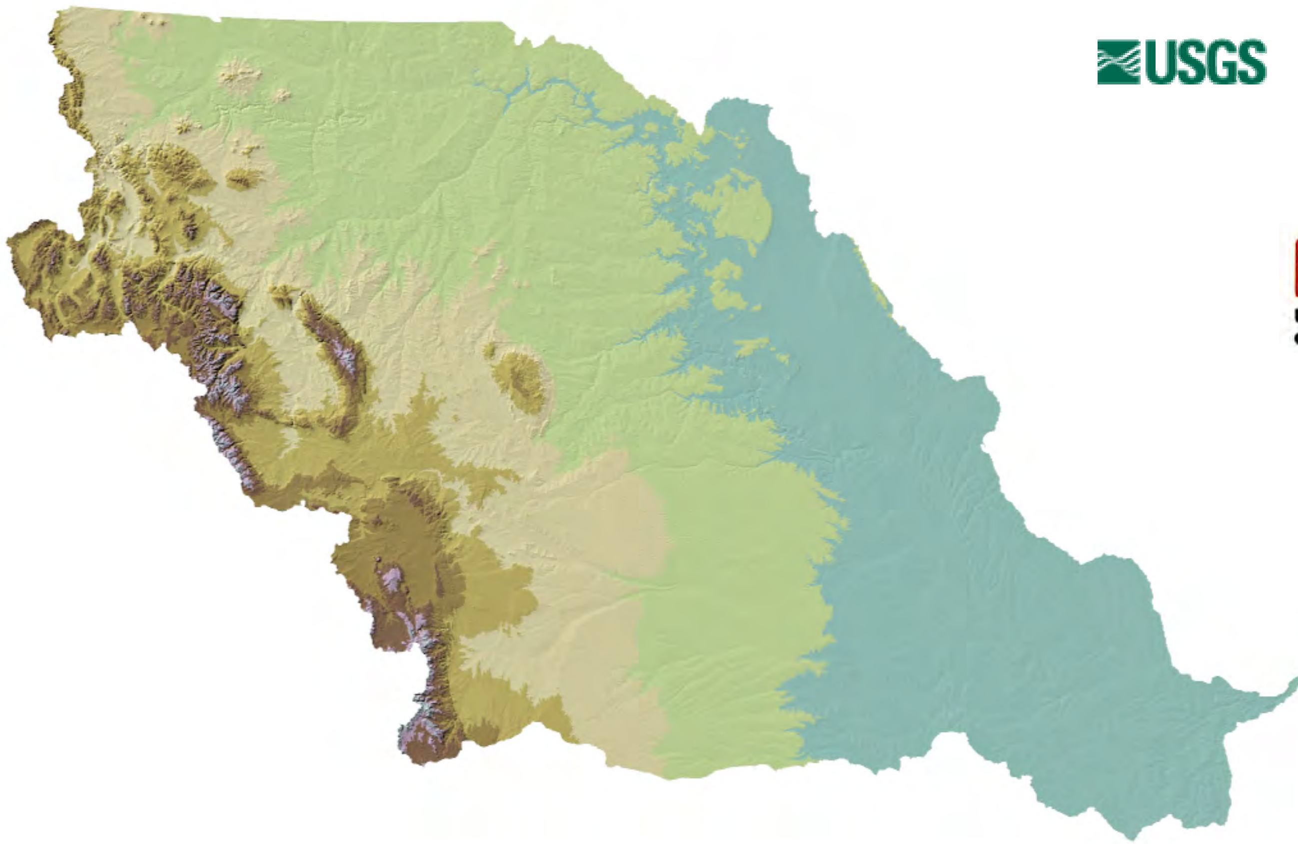
US Army Corps of Engineers

Active stakeholders include:

RECLAMATION
Great Plains Region
Managing Water in the West

RS/GIS

USGS



US Army Corps of Engineers

Some States have shown interest like IA

National Biological Information Infrastructure

Approach To Problem

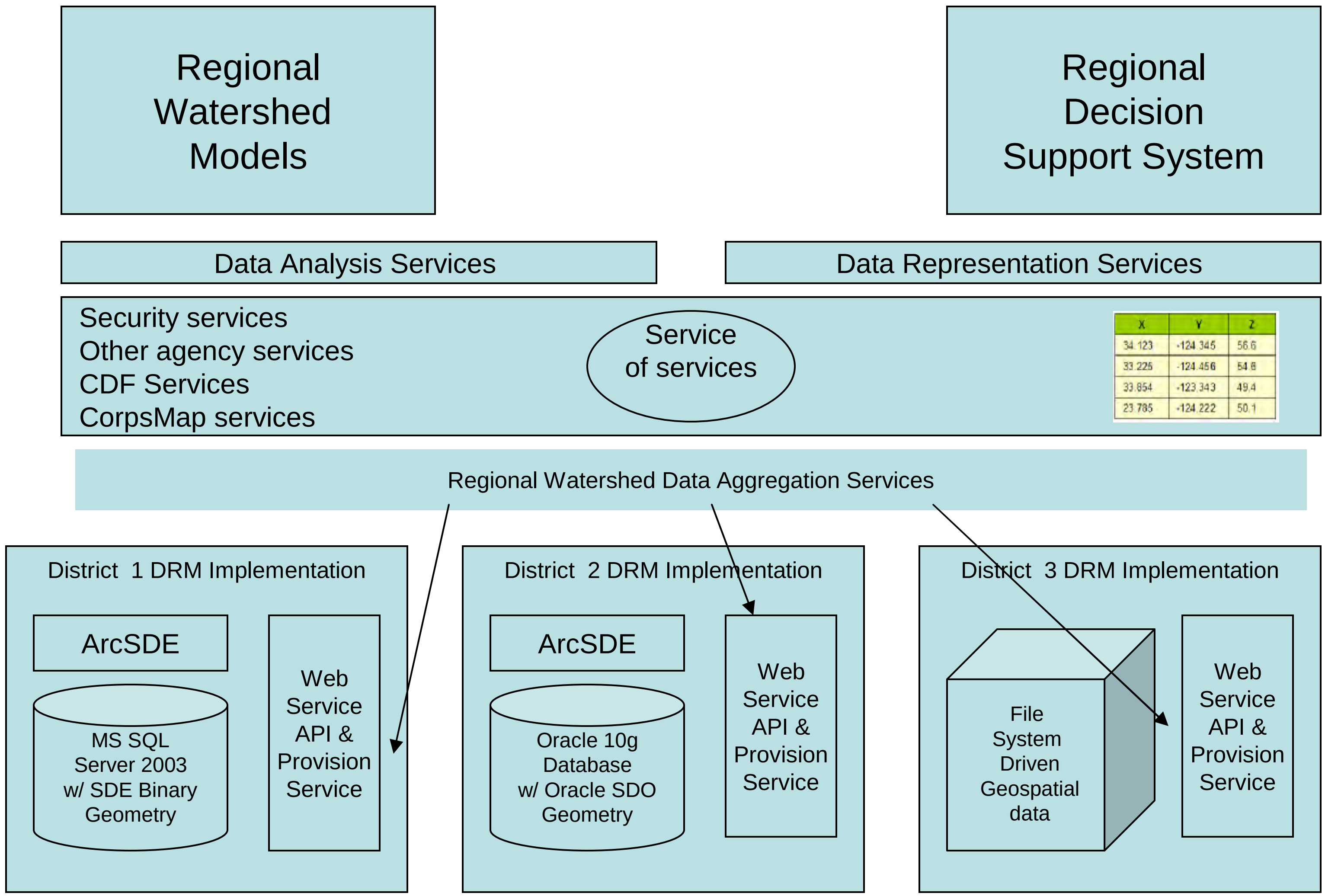
- Net-centric data strategy encourages local control of distributed databases, rather than data standardization
- Support for Oracle Integrating Architecture
  - Vector data available as Oracle Tables through straight SQL queries or through Oracle API (OCI)
  - Any CADD or GIS client that can access Oracle geometry can use these data
- Support for ESRI integrating architecture
  - Vector data available as seamless SDE 8.3 layers
  - Map views available as ArcIMS Services
- Support for Service Oriented Architecture
  - Application can consume as well as expose web services
  - Integrates services developed for and supported by other Corps automates information systems (AIS)

Application

- Database driven – distributed Oracle database
  - Consistent with standard established by the Corps of Engineers and other federal and state agencies
- Spatially enabled database – Oracle/ESRI ArcSDE
  - Attributes and geometries fully integrated in the database
  - Geometries accessible via open standards-based interfaces
  - Full integration with suite of ESRI software including ArcGIS and ArcIMS
- System architecture supports real-time access to and analysis of other Corps and cooperating agency information systems
  - NWD-MR CWMS (Oracle service integration)
  - METerological Aerodrome Report (METAR) (SOAP XML)
  - USGS Sturgeon tracking data (WMS)
  - USFWS Critical Habitat Data (WMS)

Implementation of Approach

This proposed method for integration of distributed enterprise geospatial data via service oriented architecture is consistent with Corps enterprise architecture and industry best-practices



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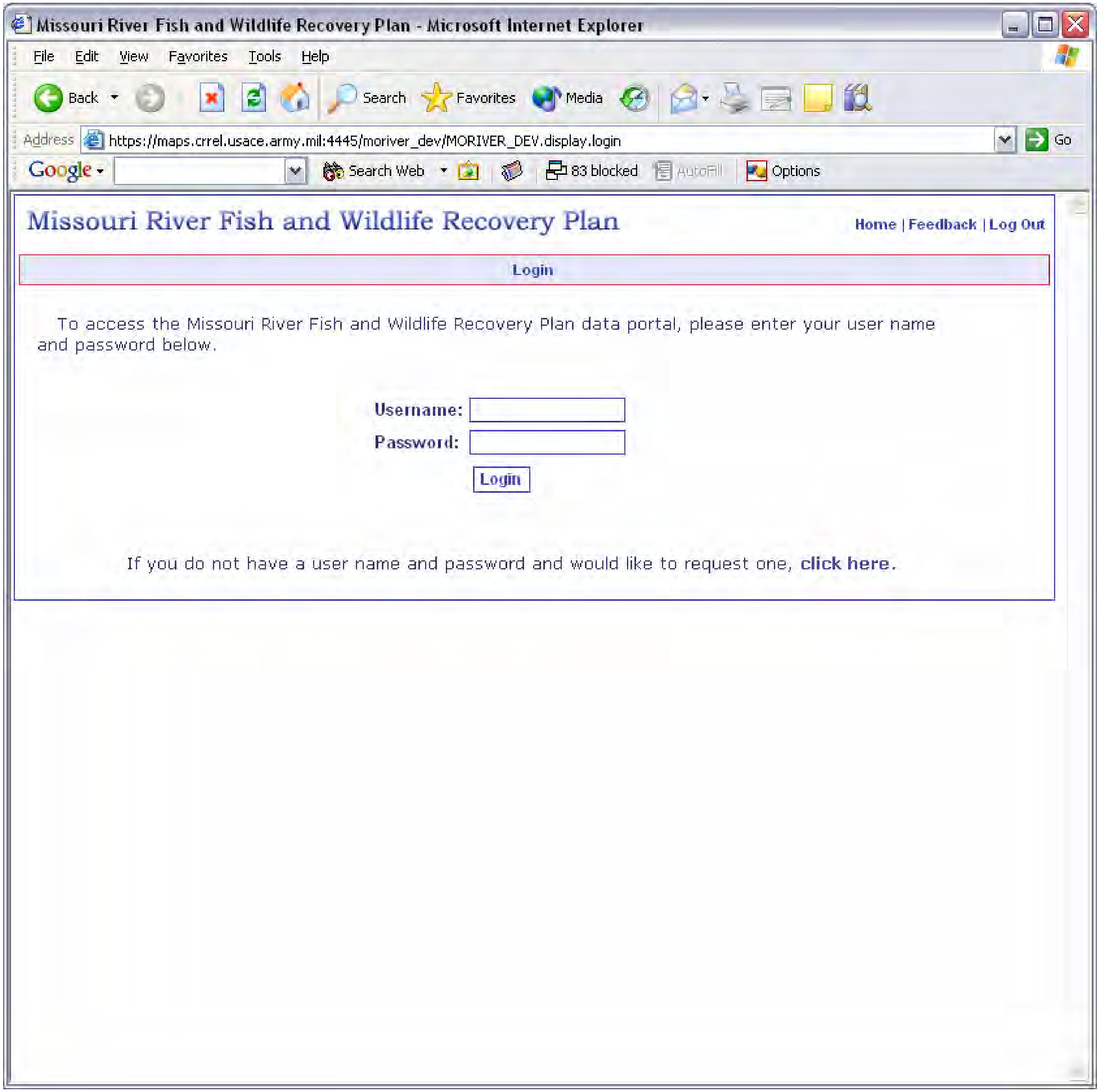
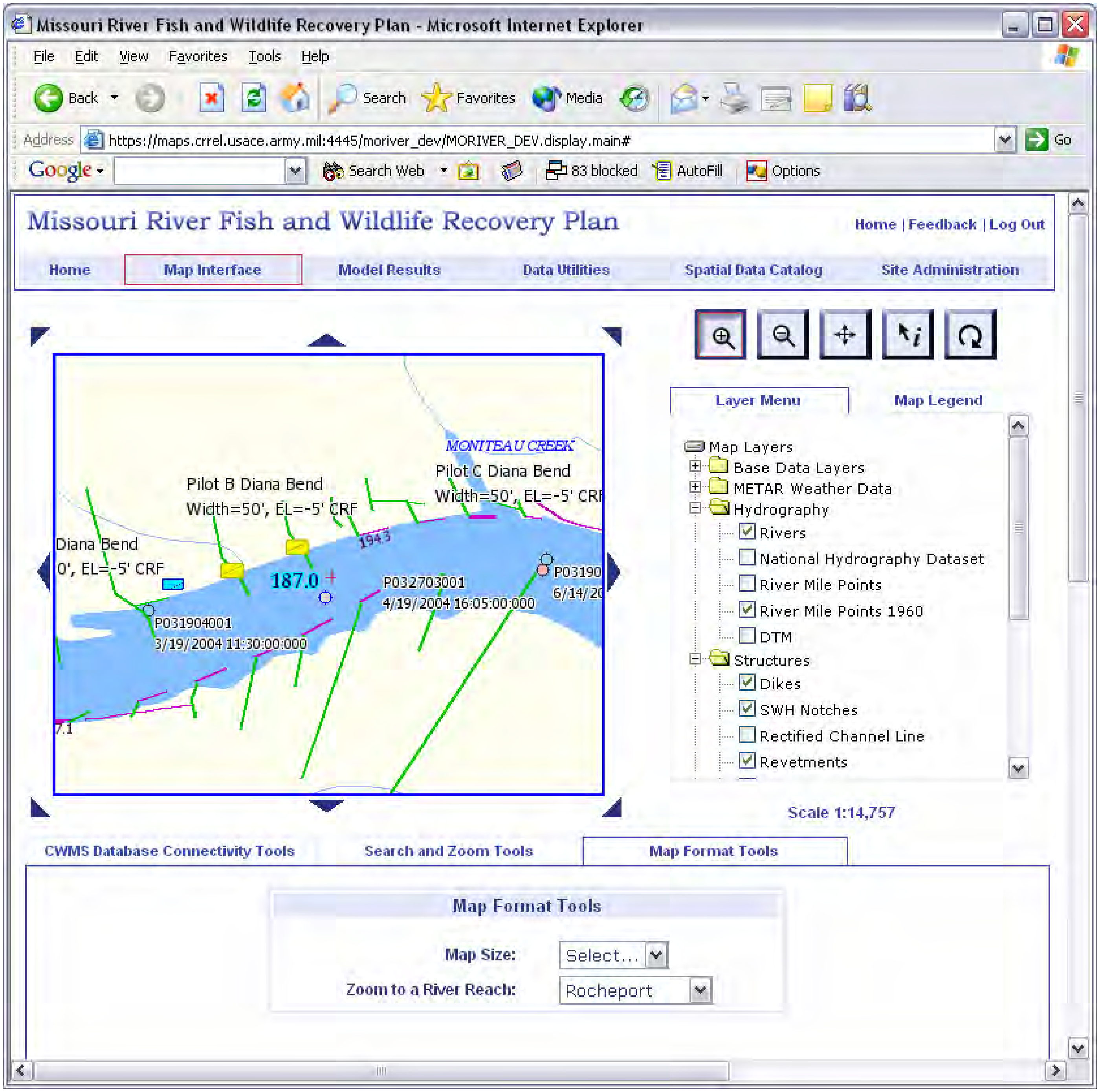


RS/GIS



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RS/GIS

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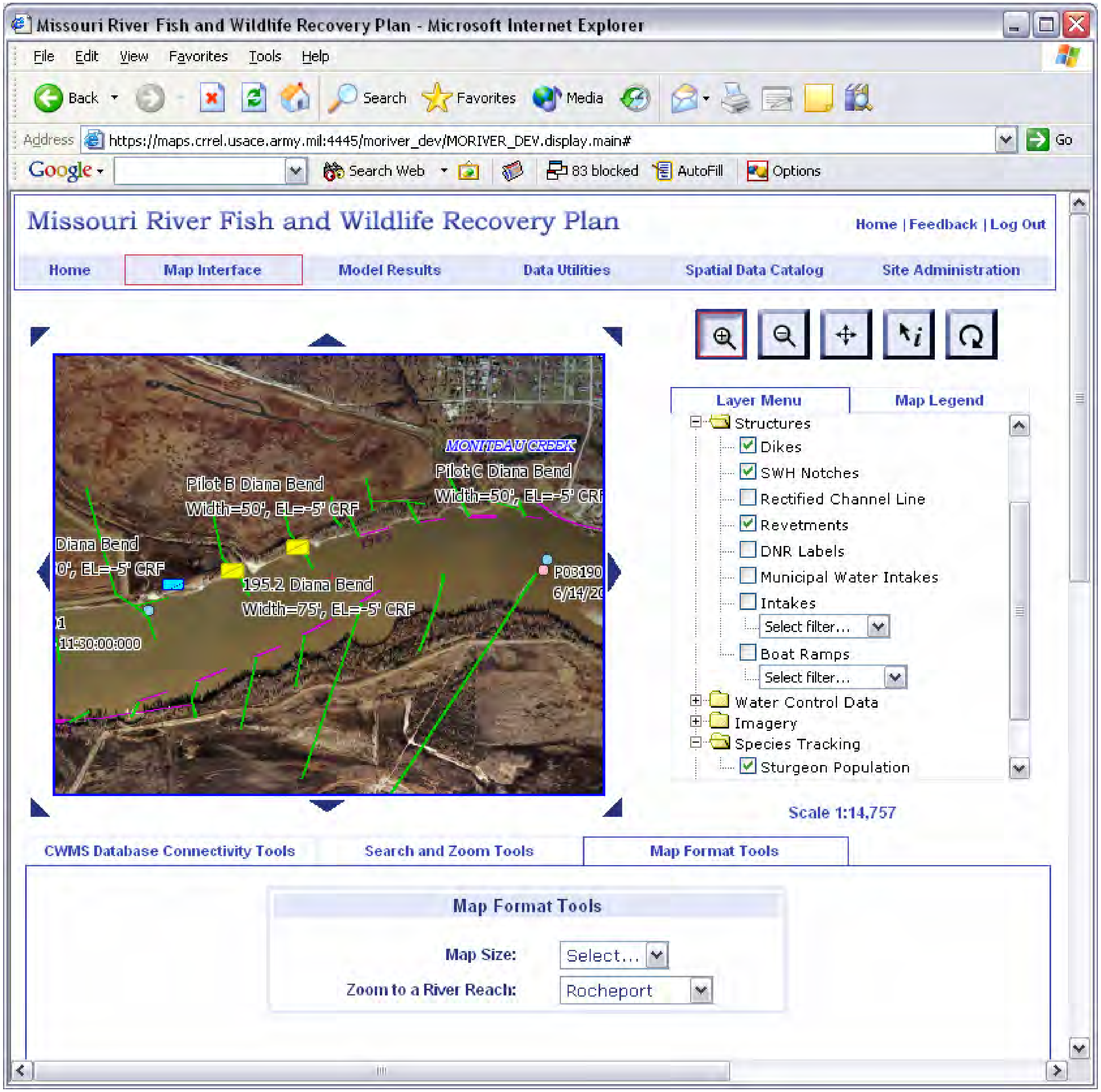

RS/GIS

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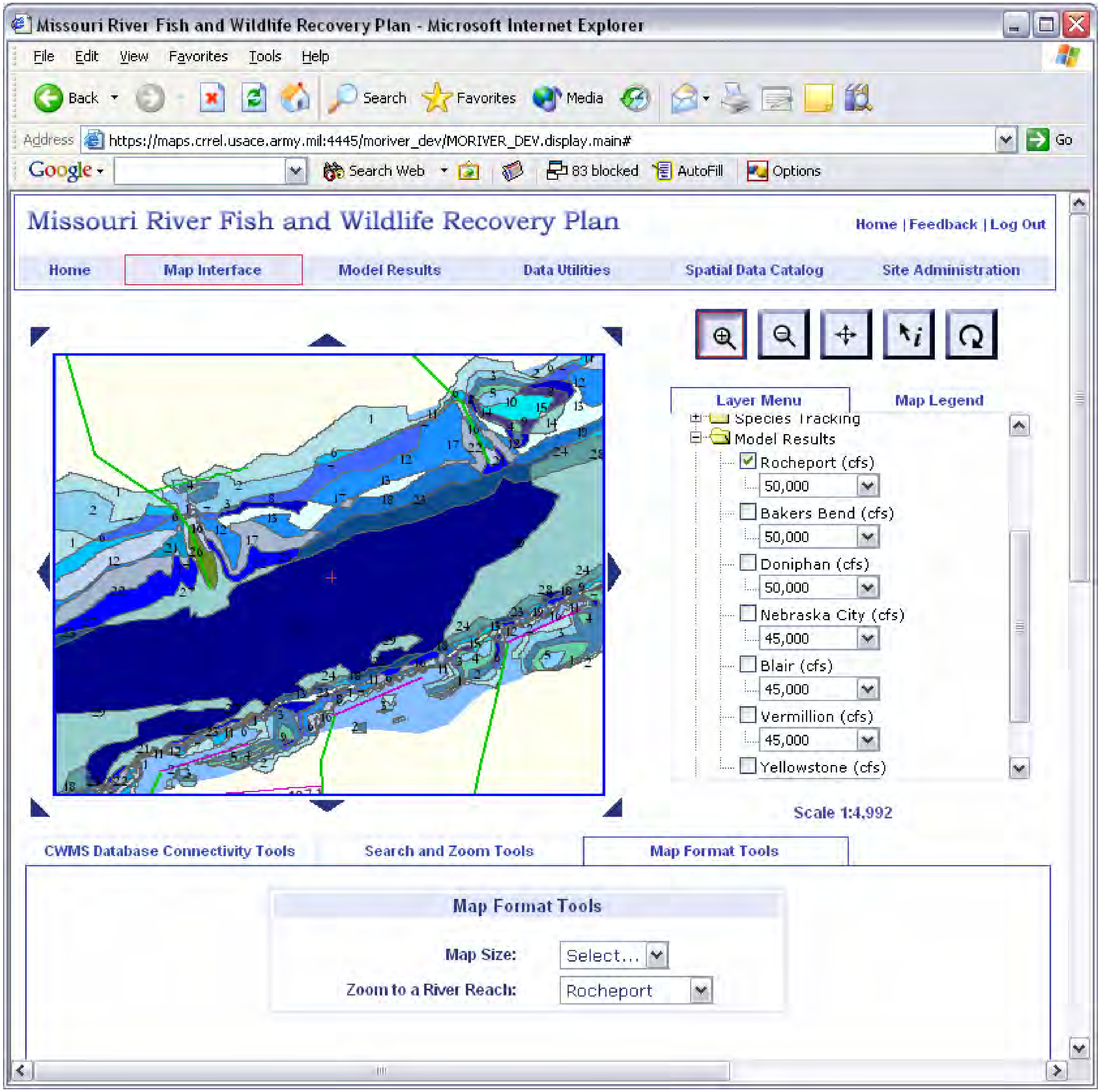

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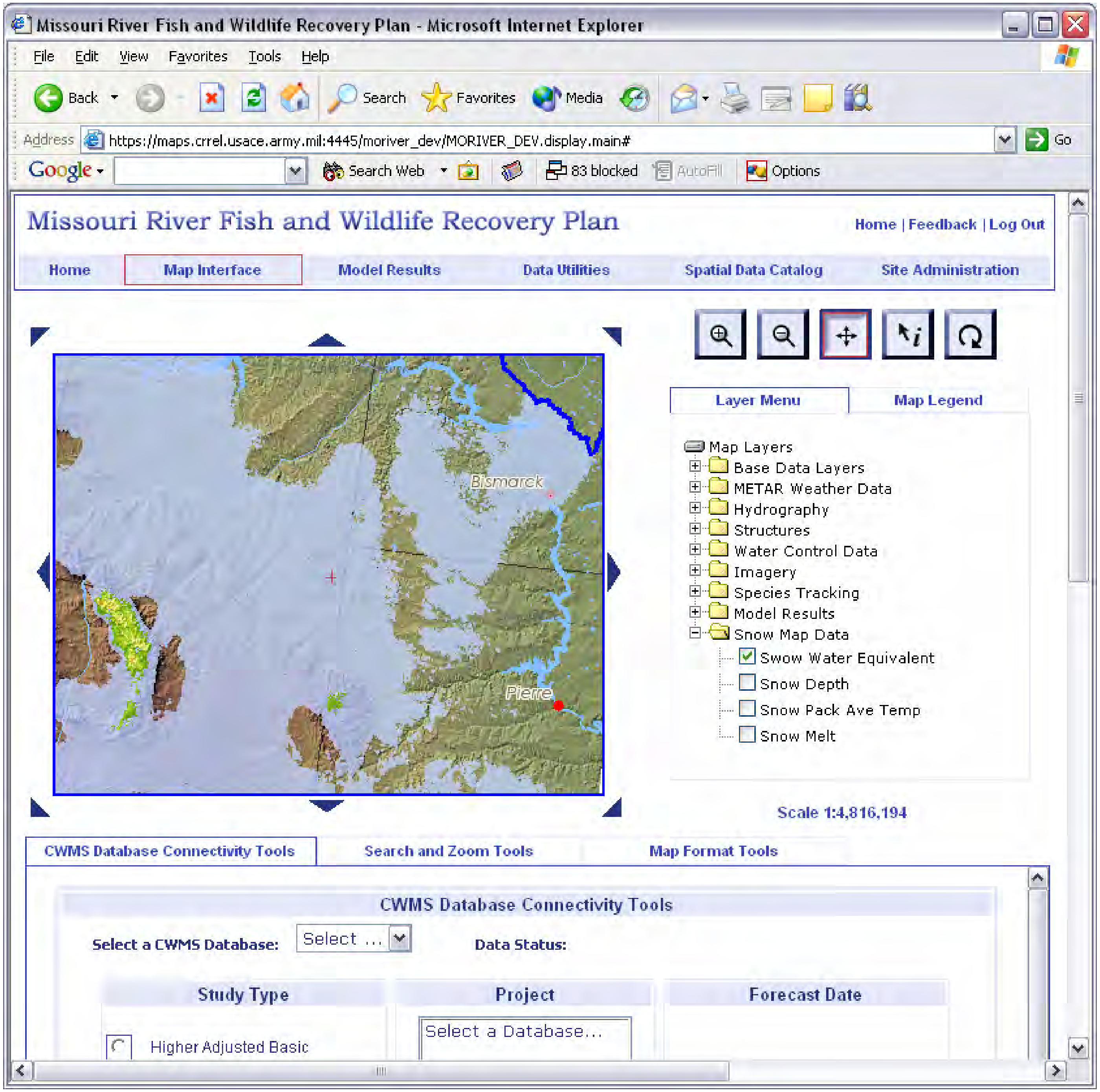
Missouri River Fish and Wildlife Recovery Plan - Microsoft Internet Explorer
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Home | Feedback | Log Out
Home
Map Interface
Model Results
Data Utilities
Spatial Data Catalog
Site Administration
Bismarck
Pierre
Layer Menu
Map Legend
Map Layers
Base Data Layers
METAR Weather Data
Hydrography
Structures
Water Control Data
Imagery
Species Tracking
Model Results
Snow Map Data
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Snow Depth
Snow Pack Ave Temp
Snow Melt
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CWMS Database Connectivity Tools
Search and Zoom Tools
Map Format Tools
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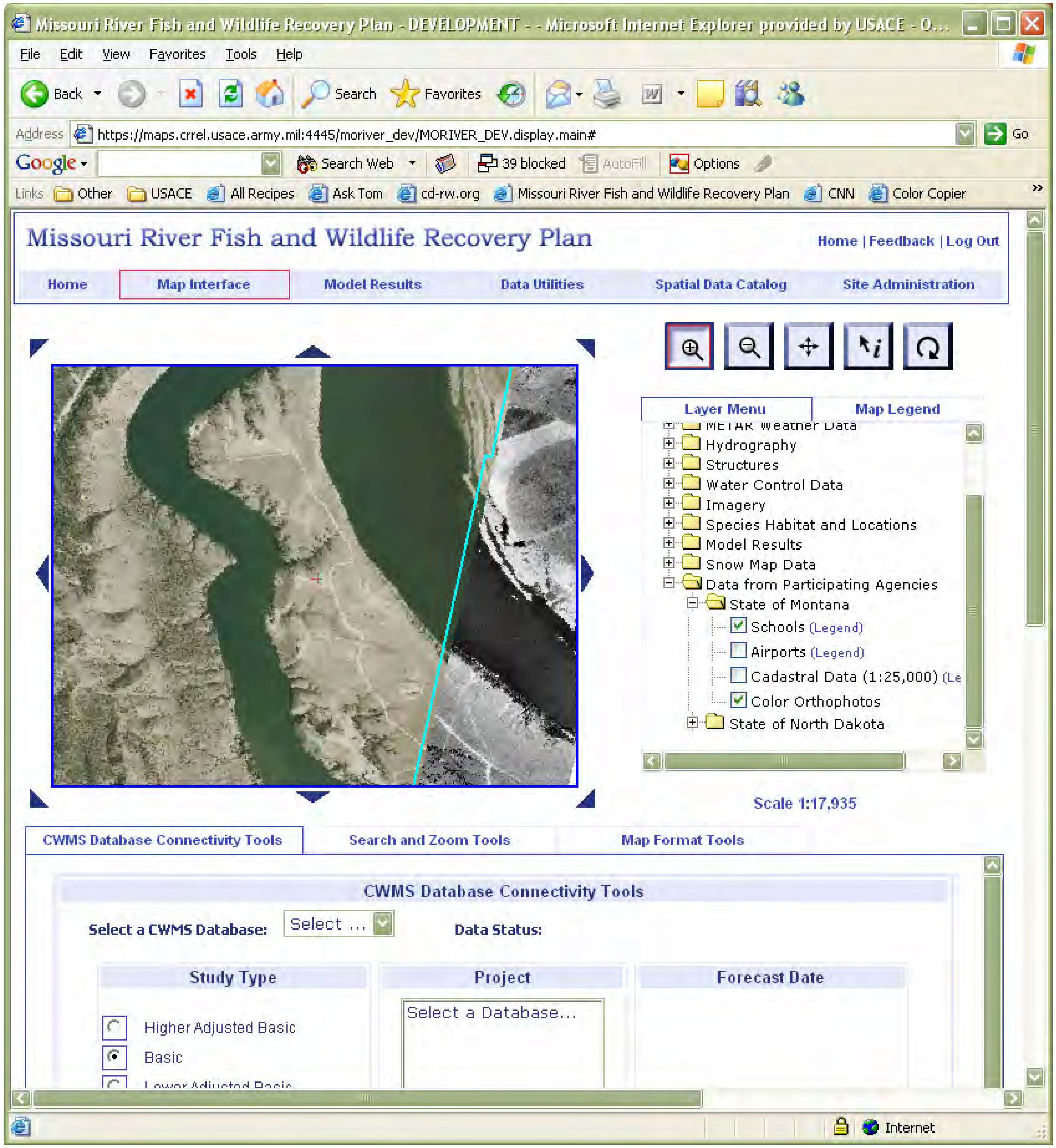
Select ...
Data Status:
Study Type
Project
Forecast Date
Higher Adjusted Basic
Select a Database...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Site Administration
Layer Menu
Map Legend
METAR Weather Data
Hydrography
Structures
Water Control Data
Imagery
Species Habitat and Locations
Model Results
Snow Map Data
Data from Participating Agencies
State of Montana
Schools (Legend)
Airports (Legend)
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State of North Dakota
Scale 1:17,935
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Search and Zoom Tools
Map Format Tools
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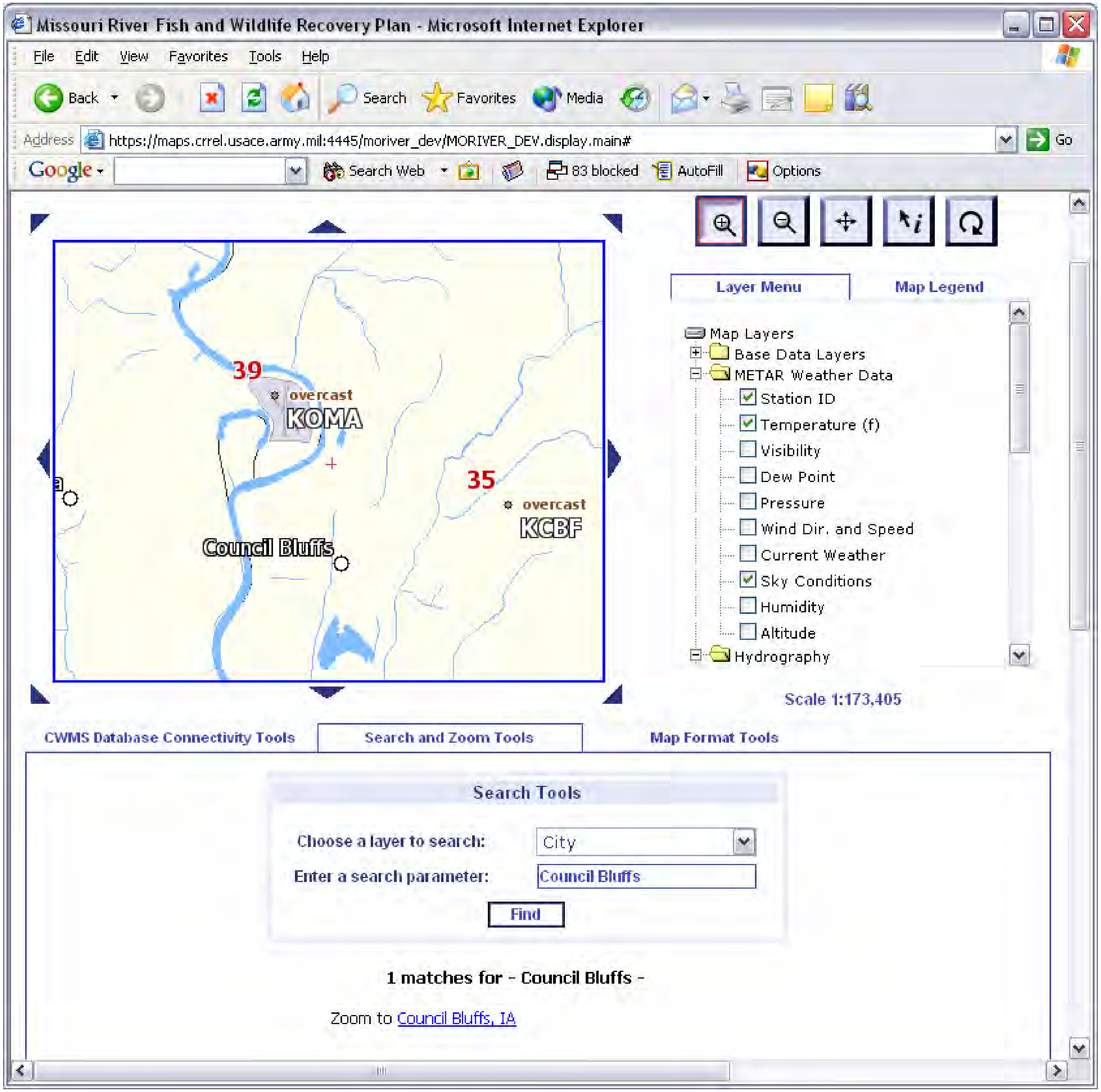
Missouri River Fish and Wildlife Recovery Plan - Microsoft Internet Explorer
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overcast
KOMA
35
overcast
KCBF
Council Bluffs
Layer Menu
Map Legend
Map Layers
Base Data Layers
METAR Weather Data
Station ID
Temperature (f)
Visibility
Dew Point
Pressure
Wind Dir. and Speed
Current Weather
Sky Conditions
Humidity
Altitude
Hydrography
Scale 1:173,405
CWMS Database Connectivity Tools
Search and Zoom Tools
Map Format Tools
Search Tools
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City
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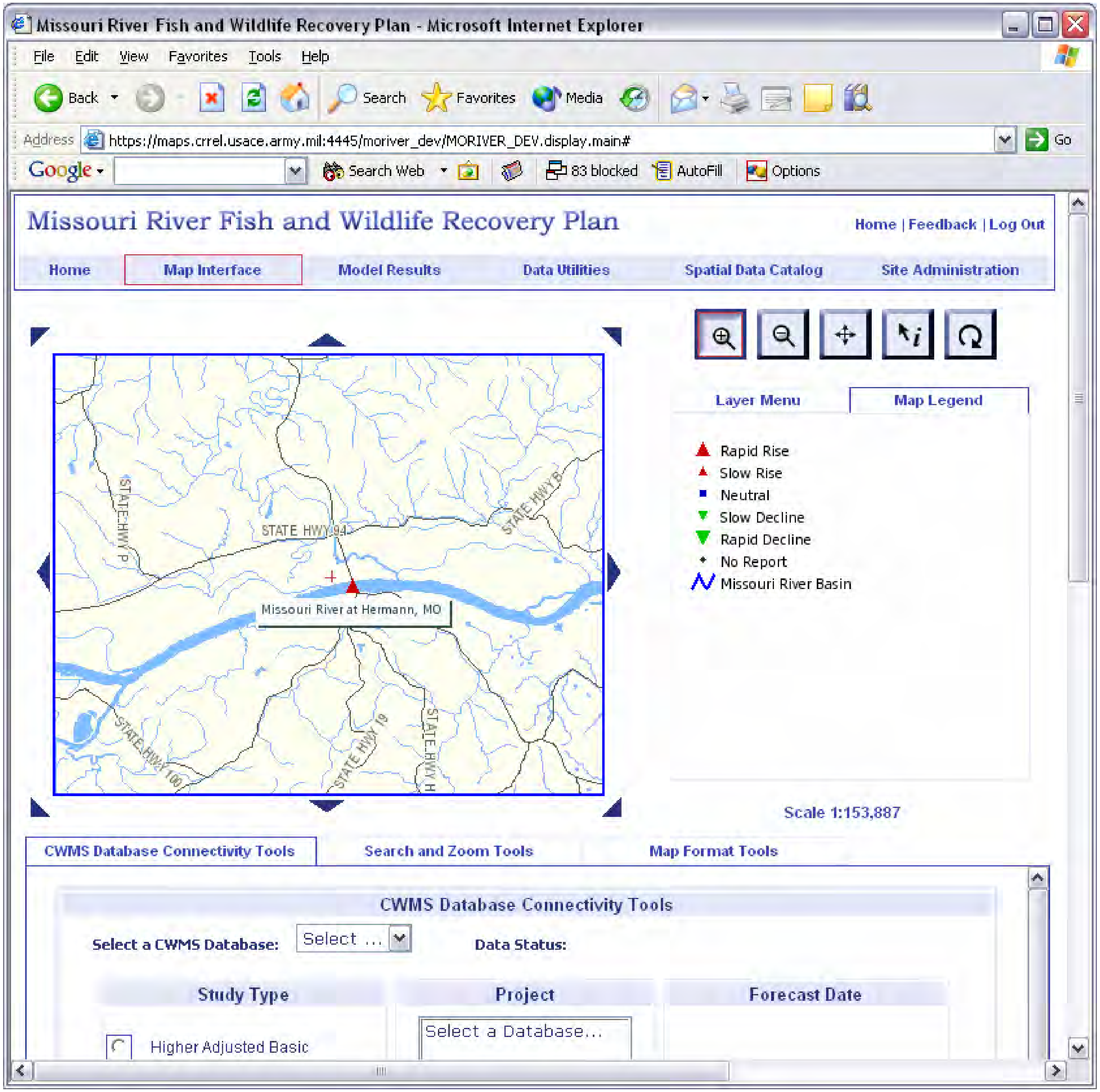
Council Bluffs
Find
1 matches for - Council Bluffs -
Zoom to Council Bluffs, IA


Missouri River Fish and Wildlife Recovery Plan - Microsoft Internet Explorer
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Model Results
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Spatial Data Catalog
Site Administration
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STATE HWY 94
STATE HWY B
Missouri River at Hermann, MO
STATE HWY 100
STATE HWY 19
STATE HWY H
Layer Menu
Map Legend
Rapid Rise
Slow Rise
Neutral
Slow Decline
Rapid Decline
No Report
Missouri River Basin
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Search and Zoom Tools
Map Format Tools
CWMS Database Connectivity Tools
Select a CWMS Database:
Select ...
Data Status:
Study Type
Project
Forecast Date
Higher Adjusted Basic
Select a Database...

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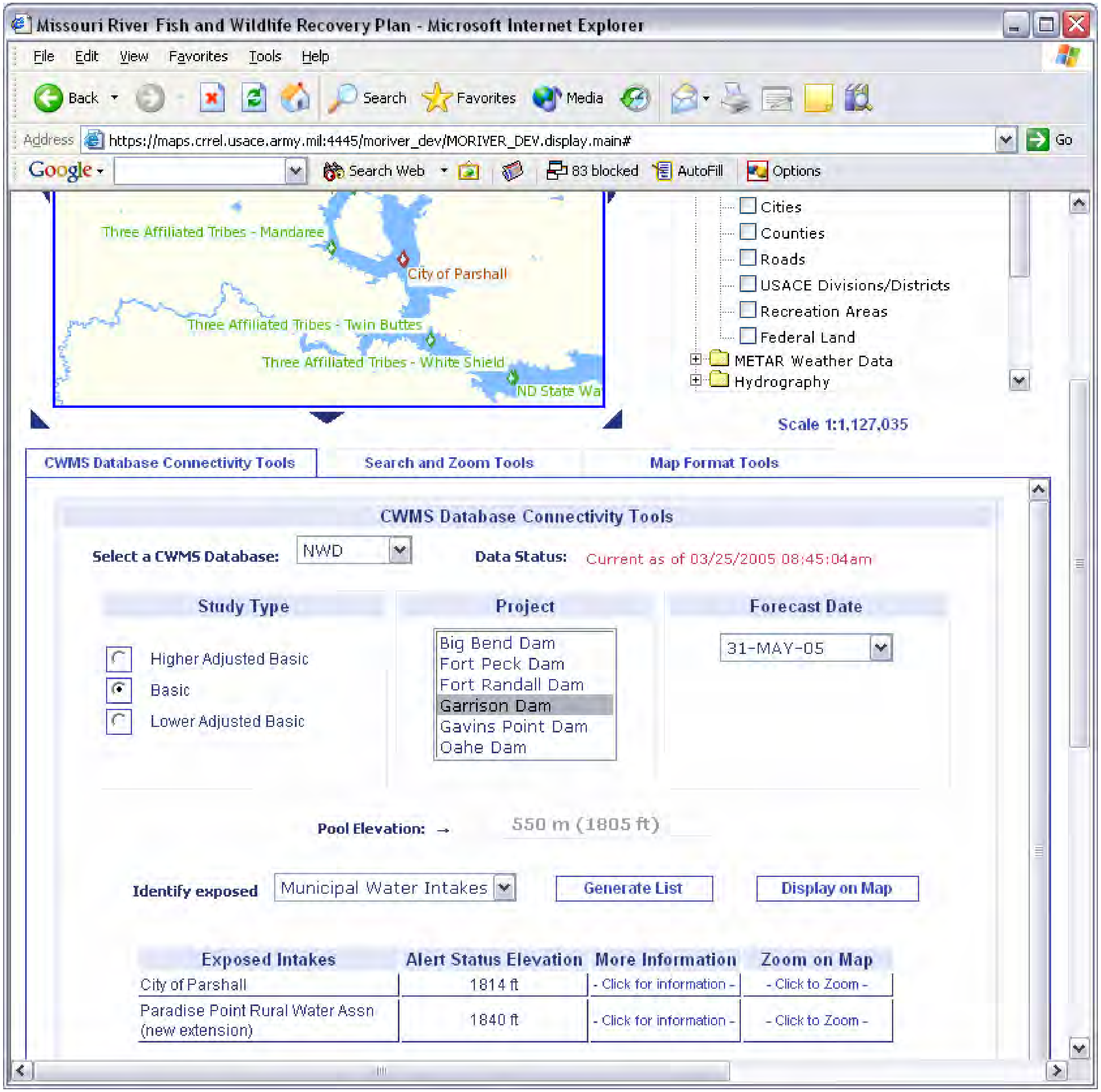

RS/GIS

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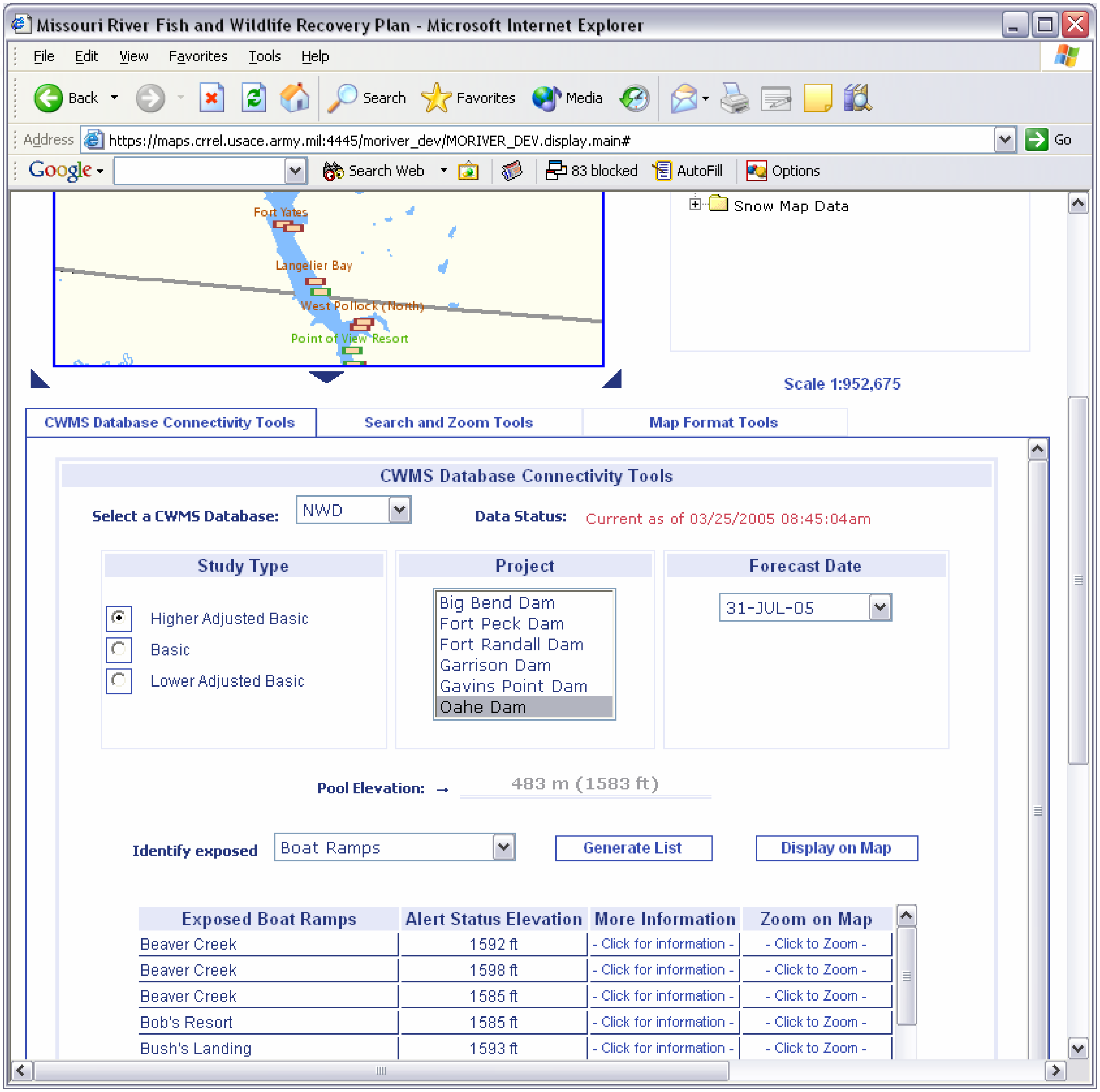

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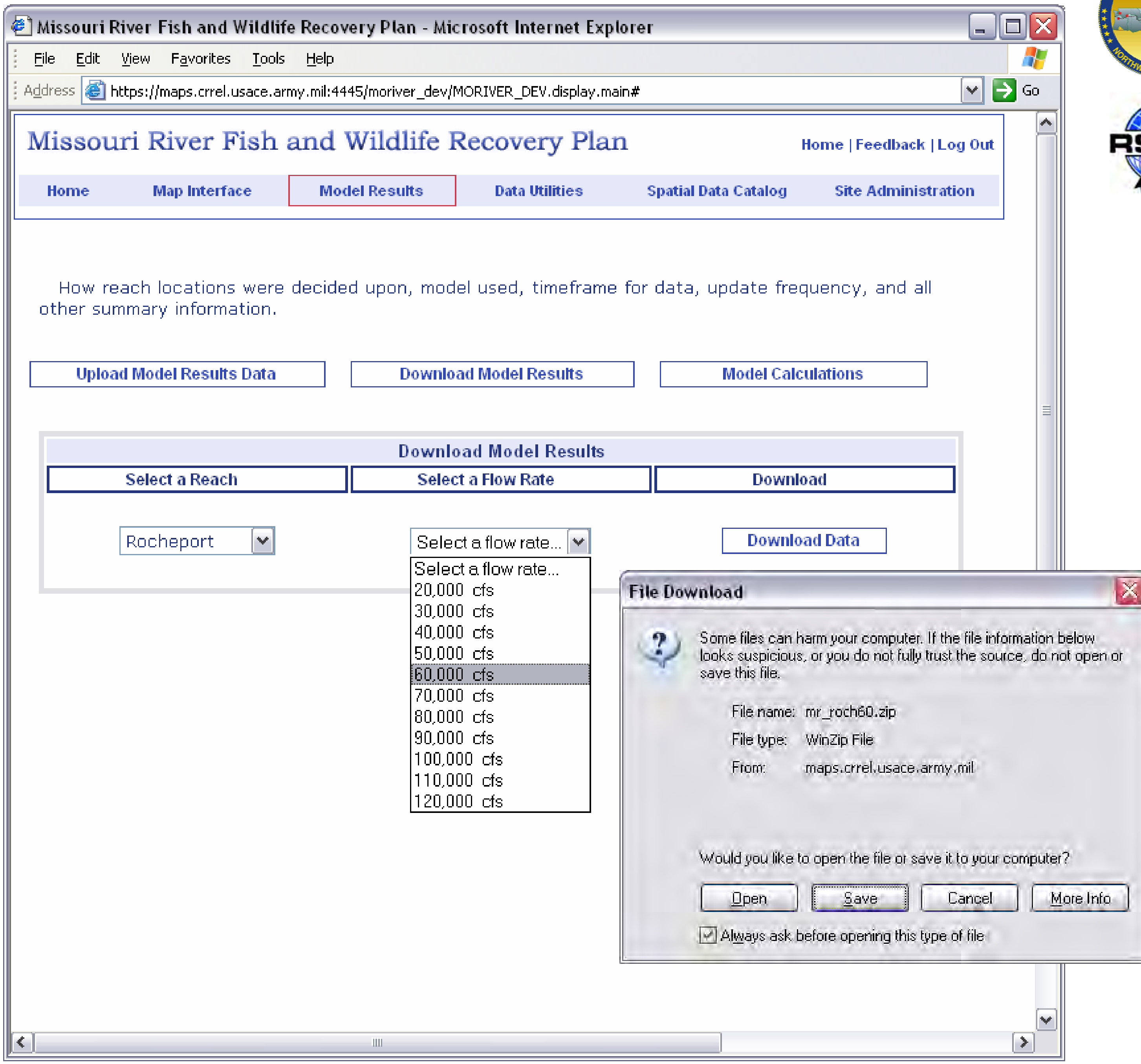

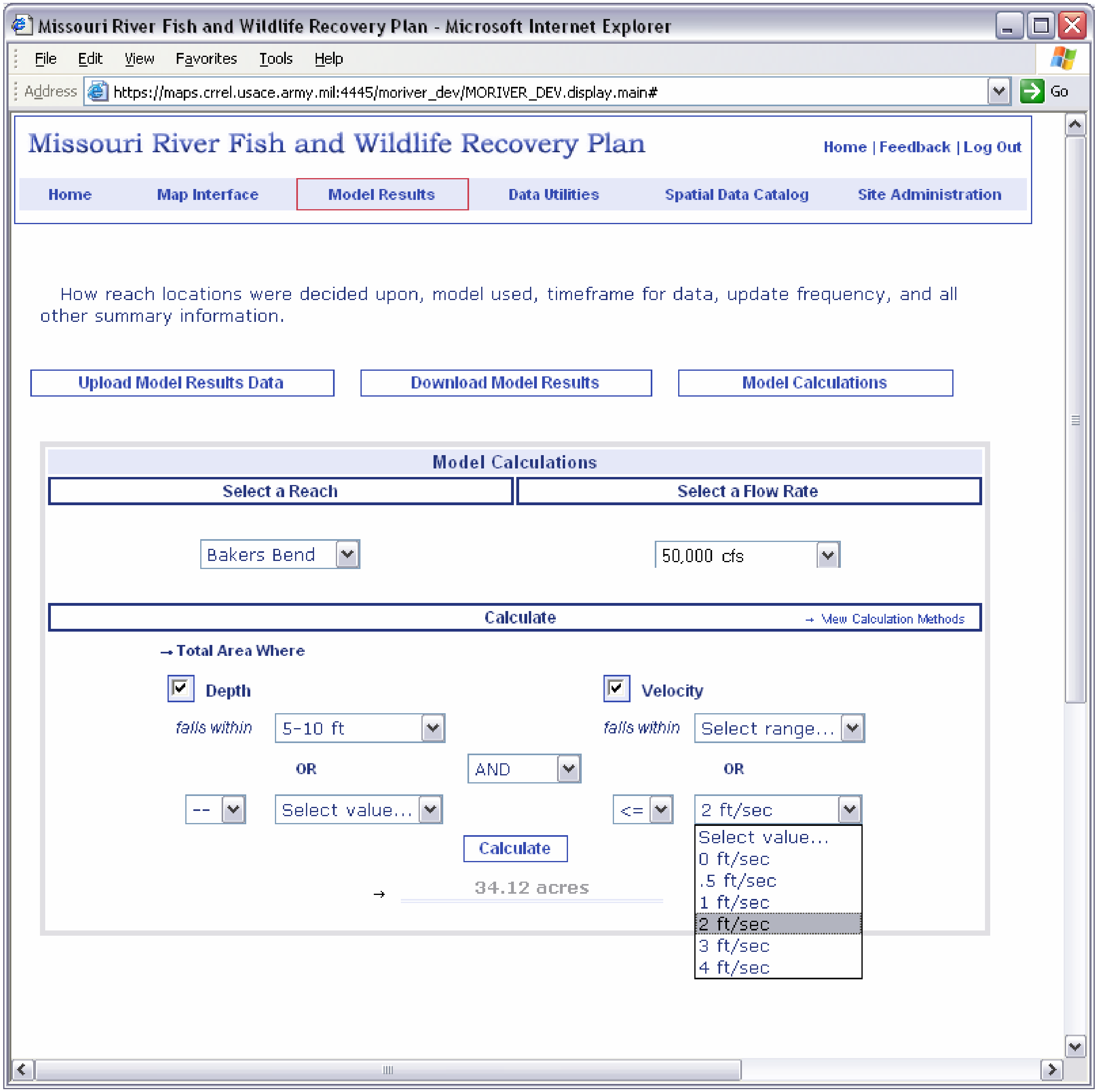

Missouri River Fish and Wildlife Recovery Plan - Microsoft Internet Explorer
File Edit View Favorites Tools Help
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Go
Missouri River Fish and Wildlife Recovery Plan
Home | Feedback | Log Out
Home
Map Interface
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Data Utilities
Spatial Data Catalog
Site Administration
How reach locations were decided upon, model used, timeframe for data, update frequency, and all other summary information.
Upload Model Results Data
Download Model Results
Model Calculations
Model Calculations
Select a Reach
Select a Flow Rate
Bakers Bend
50,000 cfs
Calculate
View Calculation Methods
Total Area Where
Depth
Velocity
falls within
5-10 ft
falls within
Select range...
OR
AND
OR
--
Select value...
<=
2 ft/sec
Select value...
0 ft/sec
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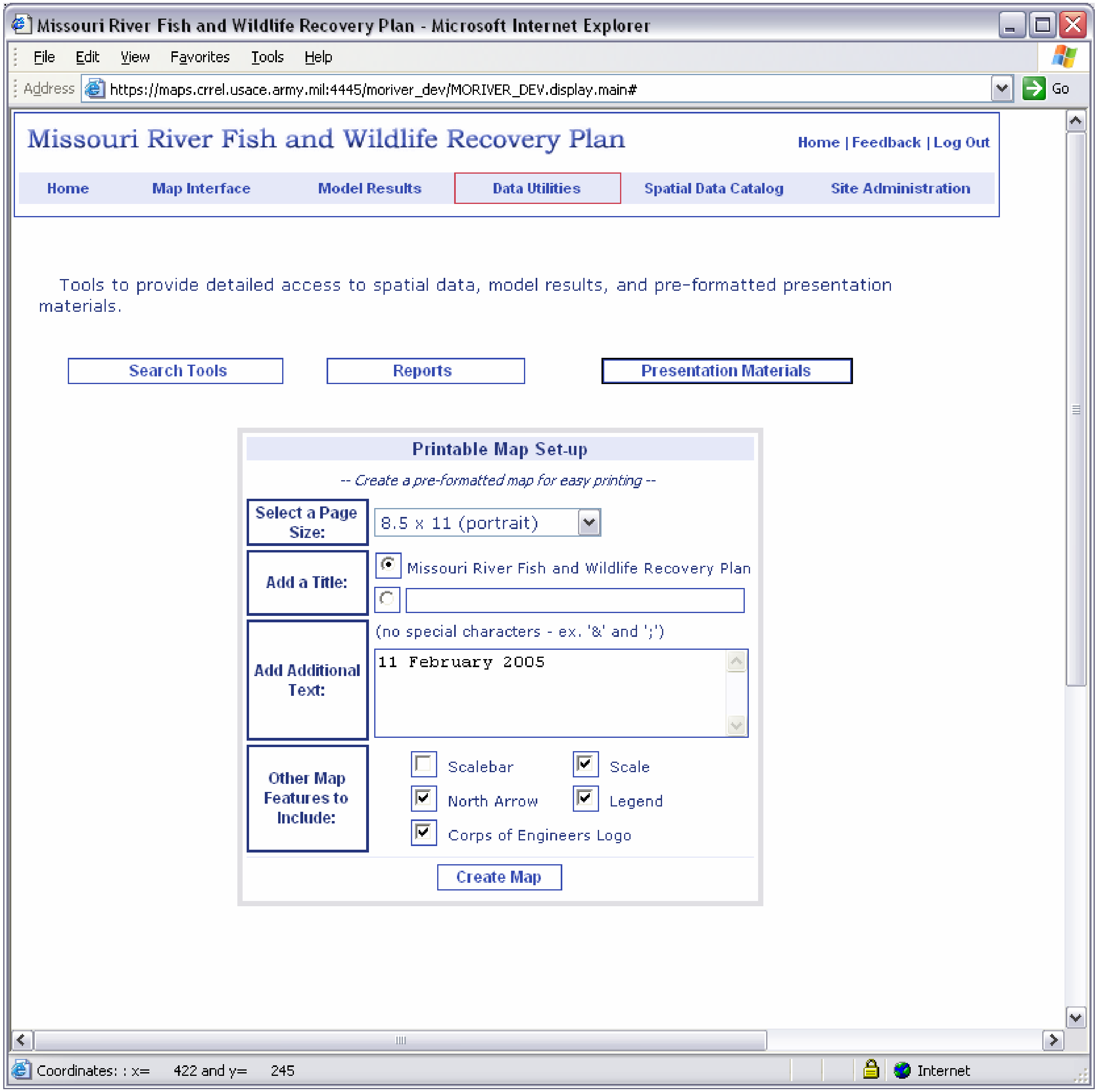
1 ft/sec
2 ft/sec
3 ft/sec
4 ft/sec
Calculate
34.12 acres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Map Interface
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Spatial Data Catalog
Site Administration
Tools to provide detailed access to spatial data, model results, and pre-formatted presentation materials.
Search Tools
Reports
Presentation Materials
Printable Map Set-up
-- Create a pre-formatted map for easy printing --
Select a Page Size:
8.5 x 11 (portrait)
Add a Title:
Missouri River Fish and Wildlife Recovery Plan
(no special characters - ex. '&' and ';')
Add Additional Text:
11 February 2005
Other Map Features to Include:
Scalebar
Scale
North Arrow
Legend
Corps of Engineers Logo
Create Map
Coordinates: : x= 422 and y= 245
Internet

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Missouri River Fish and Wildlife Recovery Plan

Home | Feedback | Log Out

Home | Map Interface | Model Results | Data Utilities | Spatial Data Catalog | Site Administration

To view the spatial data available in the Map Interface, select the data type from the buttons below. Data are listed by file name. To get more information about the source of each dataset, click on the link listed under the "Source" column for each "Theme Name". Most datasets are available for download by clicking the "Download" button. Data are delivered in a .zip file and include the spatial dataset (ESRI shapefile) and available metadata.

Base Data | Missouri River Data | Missouri River Imagery

Base Data

THEME NAME	SOURCE	DOWNLOAD
Airports	GDT	Download Data
Airports	ESRI	Download Data
Arial Landmarks	GDT	Download Data
Cities	ESRI	Download Data
Cities	Navigation Data Center	Download Data
Counties	USGS National Atlas	Download Data
Counties	GDT	Download Data
Countries	ESRI	Download Data
Dams	USGS National Atlas	Download Data
Digital Ortho Quads	i-cubed	- not available at this time -
Federal Land	USGS National Atlas	Download Data
Interstate Exits	GDT	Download Data
Interstates	ESRI	Download Data
Lakes	USGS National Atlas	Download Data

US ARMY CORPS OF ENGINEERS NORTHWESTERN DIVISION

RS/GIS

US Army Corps of Engineers

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Base Data | Missouri River Data | Missouri River Imagery

Missouri River

THEME NAME	SOURCE	DOWNLOAD
Boat Ramps	NWD	Download Data
CWMS Data	NWO CWMS Database	- not available at this time -
DNR Labels	NWD	Download Data
Dikes (NWK)	NWD	Download Data
Dikes (NWO)	NWD	Download Data
Intakes	NWD	Download Data
Missouri River Basin	NWD	Download Data
Rectified Channel Line	NWD	Download Data
Revetments	NWD	Download Data
River Miles	NWD	Download Data
River Miles 1960	NWD	Download Data
SWH Notches	NWD	Download Data
Sturgeon	NWD	Download Data

RS/GIS

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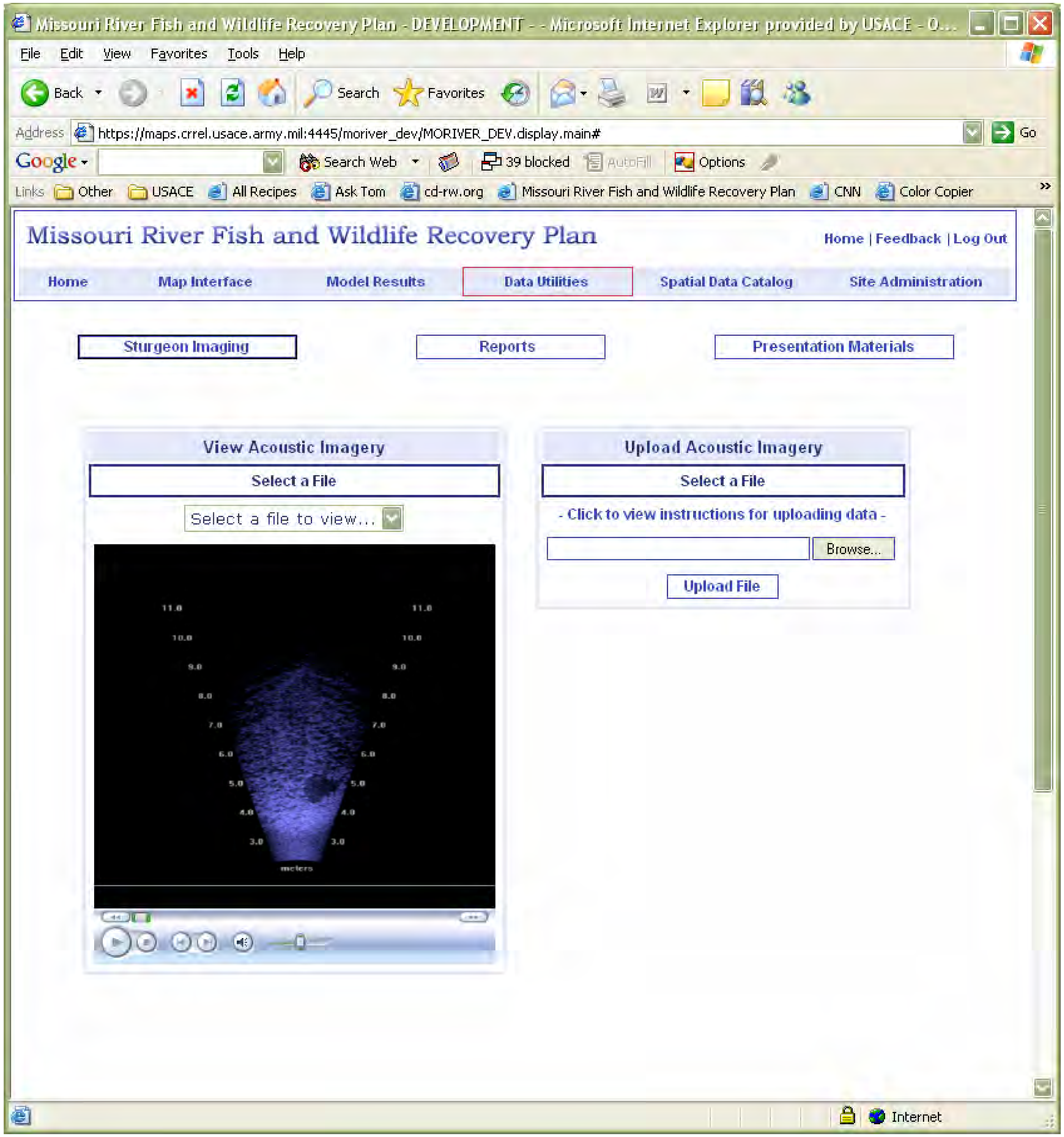

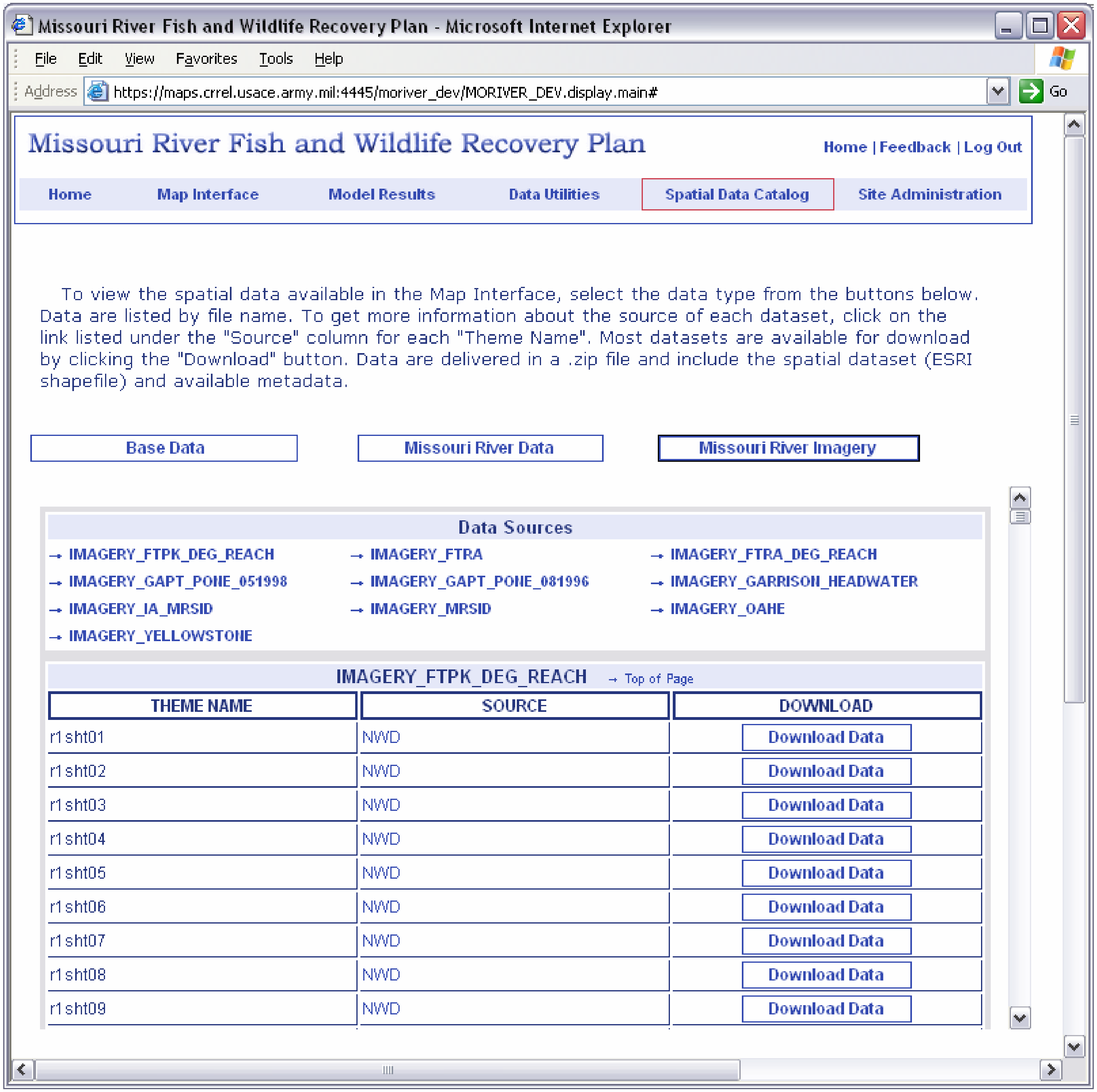

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Missouri River Fish and Wildlife Recovery Plan

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Base Data | Missouri River Data | Missouri River Imagery

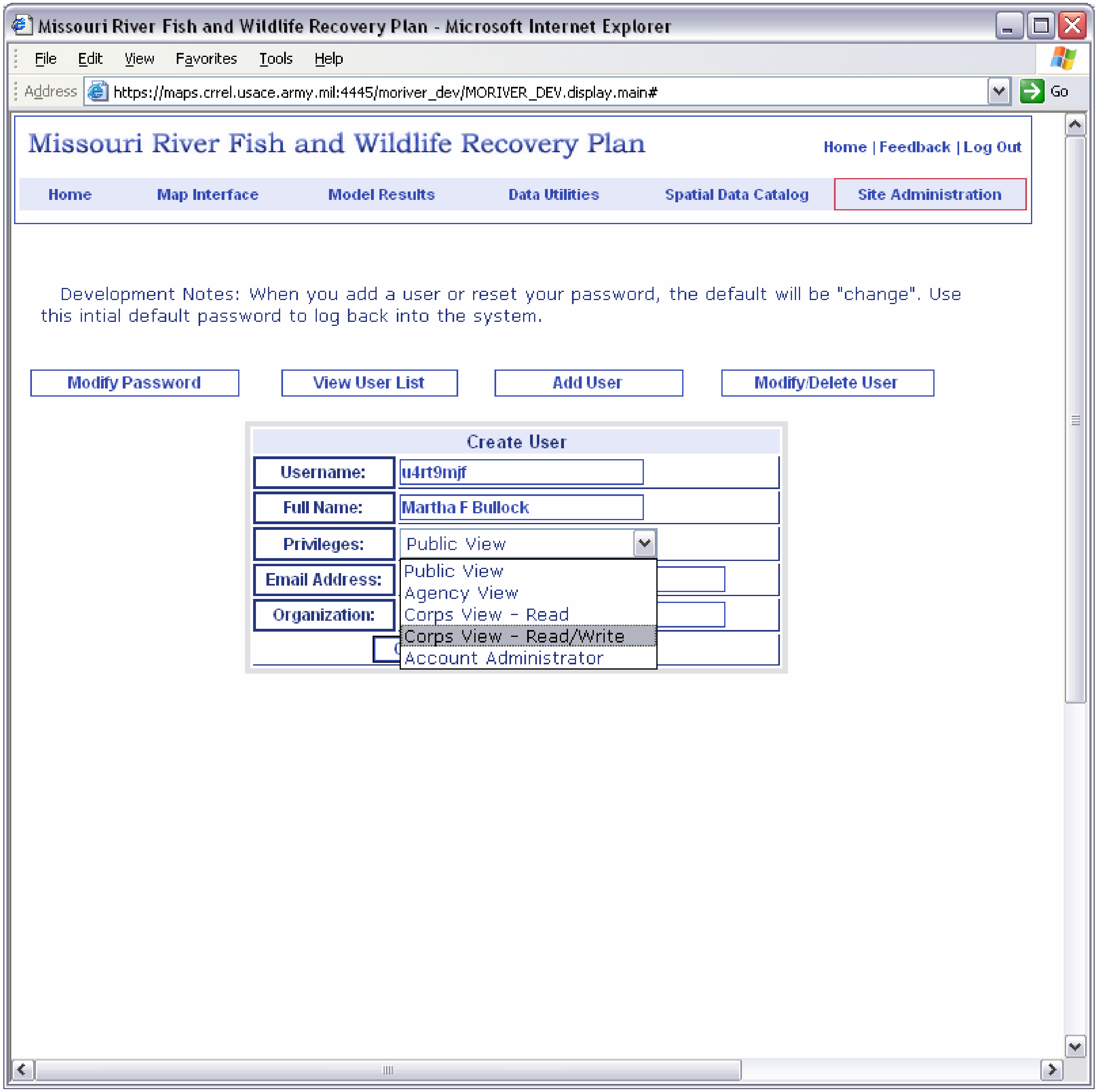
Data Sources

- IMAGERY_FTPK_DEG_REACH
- IMAGERY_FTRA
- IMAGERY_FTRA_DEG_REACH
- IMAGERY_GAPT_PONE_051998
- IMAGERY_GAPT_PONE_081996
- IMAGERY_GARRISON_HEADWATER
- IMAGERY_IA_MRSID
- IMAGERY_MRSID
- IMAGERY_OAHE
- IMAGERY_YELLOWSTONE

IMAGERY_FTPK_DEG_REACH → Top of Page

THEME NAME	SOURCE	DOWNLOAD
r1sht01	NWD	Download Data
r1sht02	NWD	Download Data
r1sht03	NWD	Download Data
r1sht04	NWD	Download Data
r1sht05	NWD	Download Data
r1sht06	NWD	Download Data
r1sht07	NWD	Download Data
r1sht08	NWD	Download Data
r1sht09	NWD	Download Data

US Army Corps of Engineers



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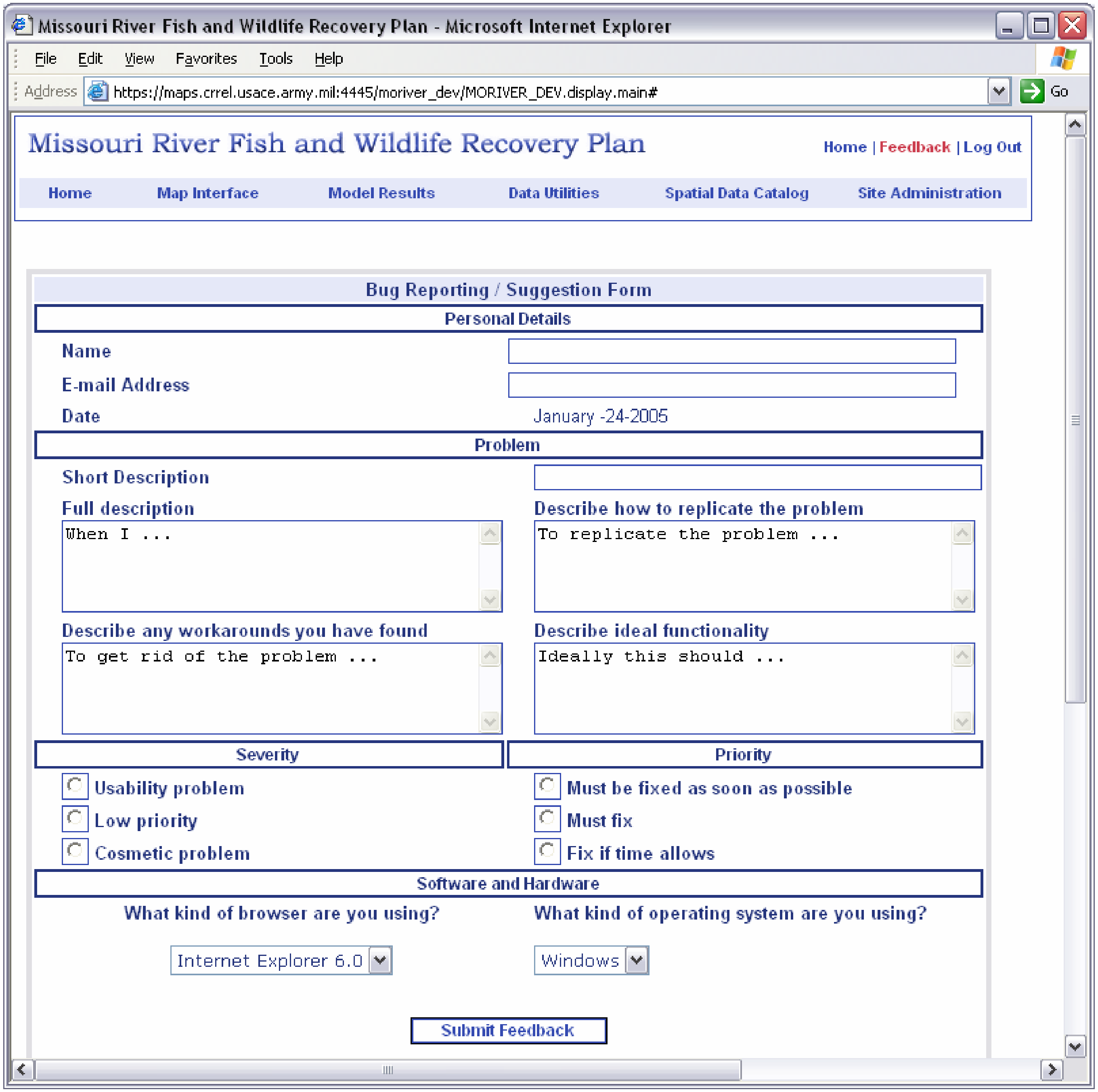

Missouri River Fish and Wildlife Recovery Plan - Microsoft Internet Explorer

File Edit View Favorites Tools Help

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Missouri River Fish and Wildlife Recovery Plan

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Bug Reporting / Suggestion Form

Personal Details

Name

E-mail Address

Date January -24-2005

Problem

Short Description

Full description

When I ...

Describe how to replicate the problem

To replicate the problem ...

Describe any workarounds you have found

To get rid of the problem ...

Describe ideal functionality

Ideally this should ...

Severity

- Usability problem
- Low priority
- Cosmetic problem

Priority

- Must be fixed as soon as possible
- Must fix
- Fix if time allows

Software and Hardware

What kind of browser are you using? Internet Explorer 6.0

What kind of operating system are you using? Windows

Submit Feedback

US Army Corps of Engineers

Comments/Questions?

Bryan E Baker
Northwest Division, Missouri River Region
US Army Corps of Engineers
Omaha, NE

Martha F Bullock
Remote Sensing/GIS Center of Expertise
US Army Corps of Engineers
Hanover, NH

Sediment Model of Rivers

Charlie Berger

601-634-2570

Charlie.R.Berger@erdc.usace.army.mil

CHL and HQ constraints "consolidate capabilities"

- TABS, HIVEL2D → Unstructured Mesh
- HIVEL2D → Super- and sub-critical flow
- HIVEL2D → Tow and ship effects
- CH3D → Multi-grain size sands
- TABS, CH3D-co-sed → Clays (cohesive)

Approach

- Create library of routines for sediment that are reusable in most hydrodynamic codes – Sediment Library
- Create modular hydrodynamic type code that includes many physical environments – Multiphysics

Sediment Library Development and application in ADH

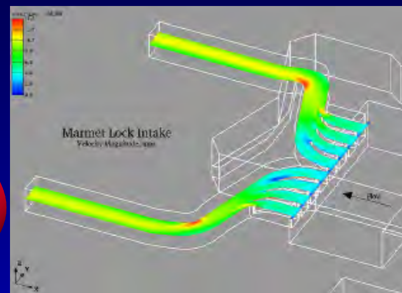
- Multiple grain size
- Cohesive and Noncohesive
- Suspended and Bed Load

ADH Features

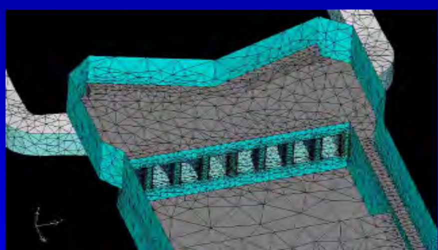
- Multi-Physics
- Adaptive Mesh
- Single to Multiprocessor - Portable

ADH Philosophy

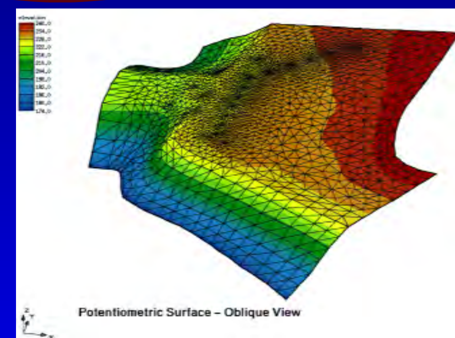
Navier-Stokes Equations

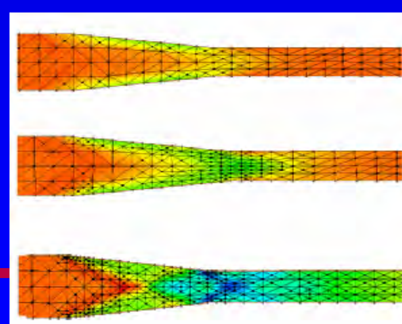


Unsaturated Groundwater Equations

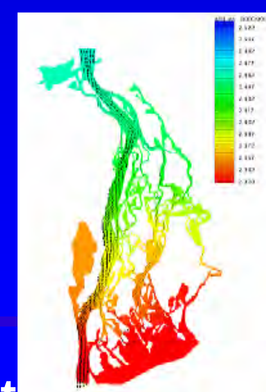


Computational Engine
(FE utilities, preconditioners, solvers, I/O to xMS GUIs)





Shallow Water Equations

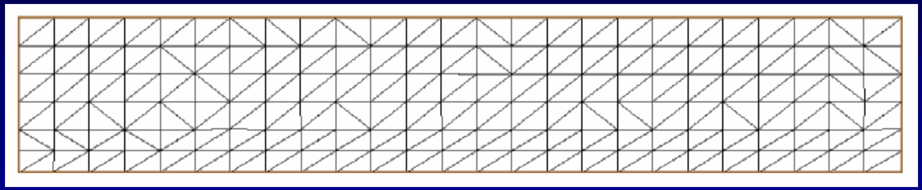


Adaption

Why should we care about adaption?

- Hydrodynamic models, with sufficient resolution, converge to the equations of motion. With coarse resolution they will converge to a different problem.
- Modelers have a feel for the resolution needed to capture the geometry, but not necessarily the hydro, sediment, . . .

How important is grid resolution?

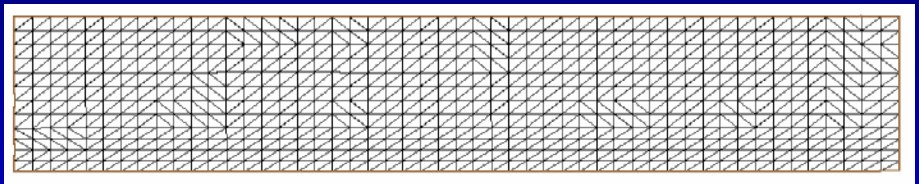


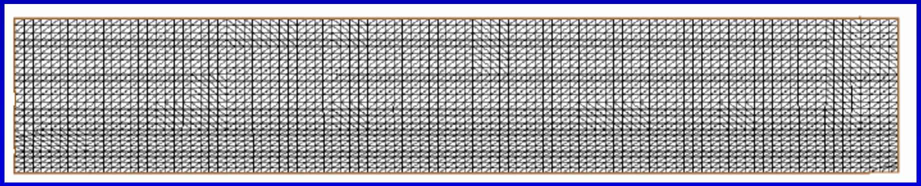
Coarse Mesh

182 nodes/300 elements

Refined Mesh #1

663 nodes/1200 elements



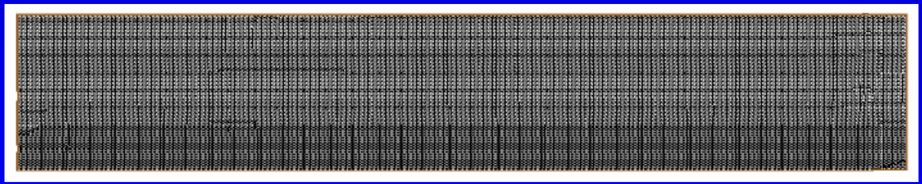


Refined Mesh #2

2525 nodes/4800 elements

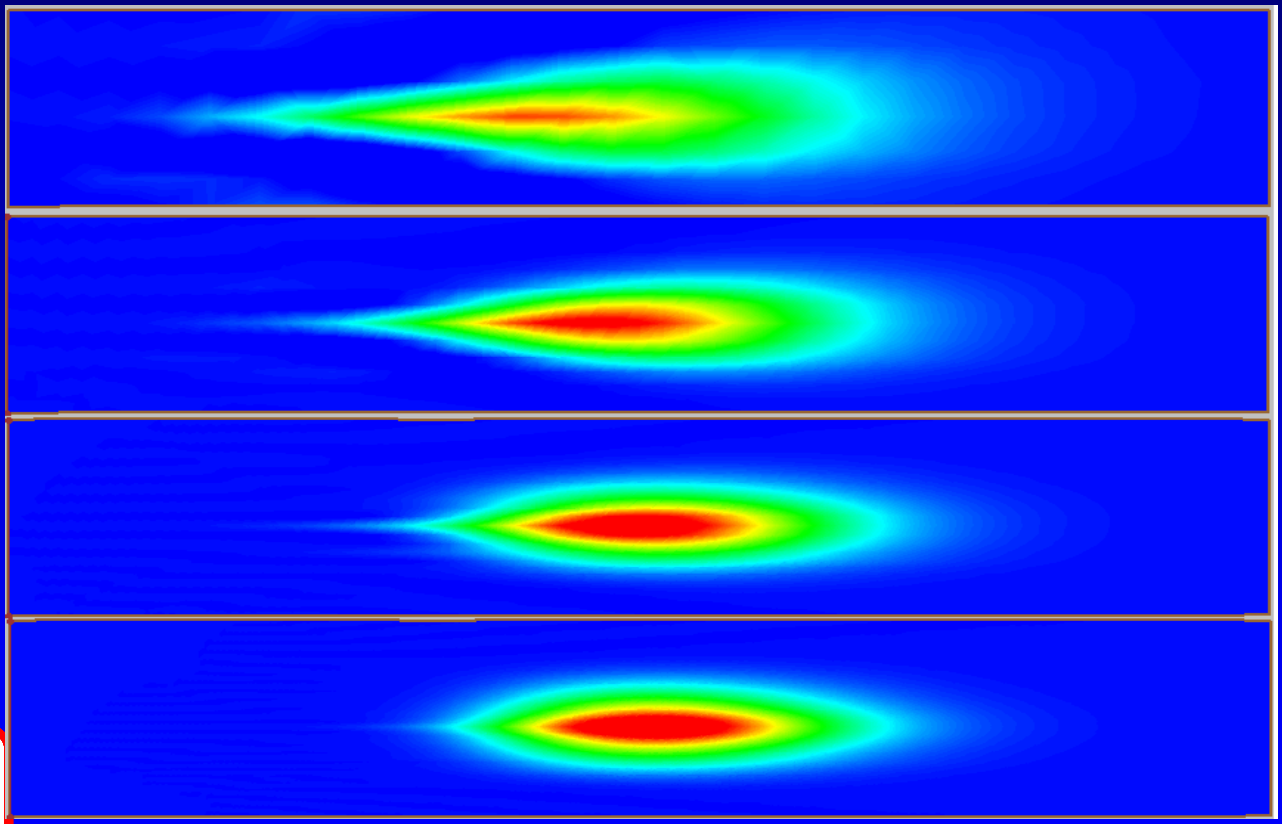
Refined Mesh #3

9849 nodes/19200 elements



Initial Concentration Cloud

Grid Resolution Results…



Coarse

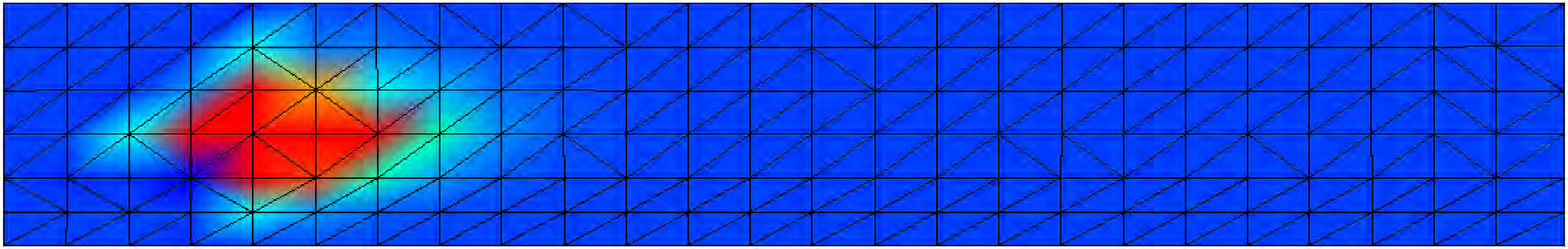
Refined #1

Refined #2

Refined #3

at timestep = 380 seconds

Adaptive Mesh with Concentration Plume



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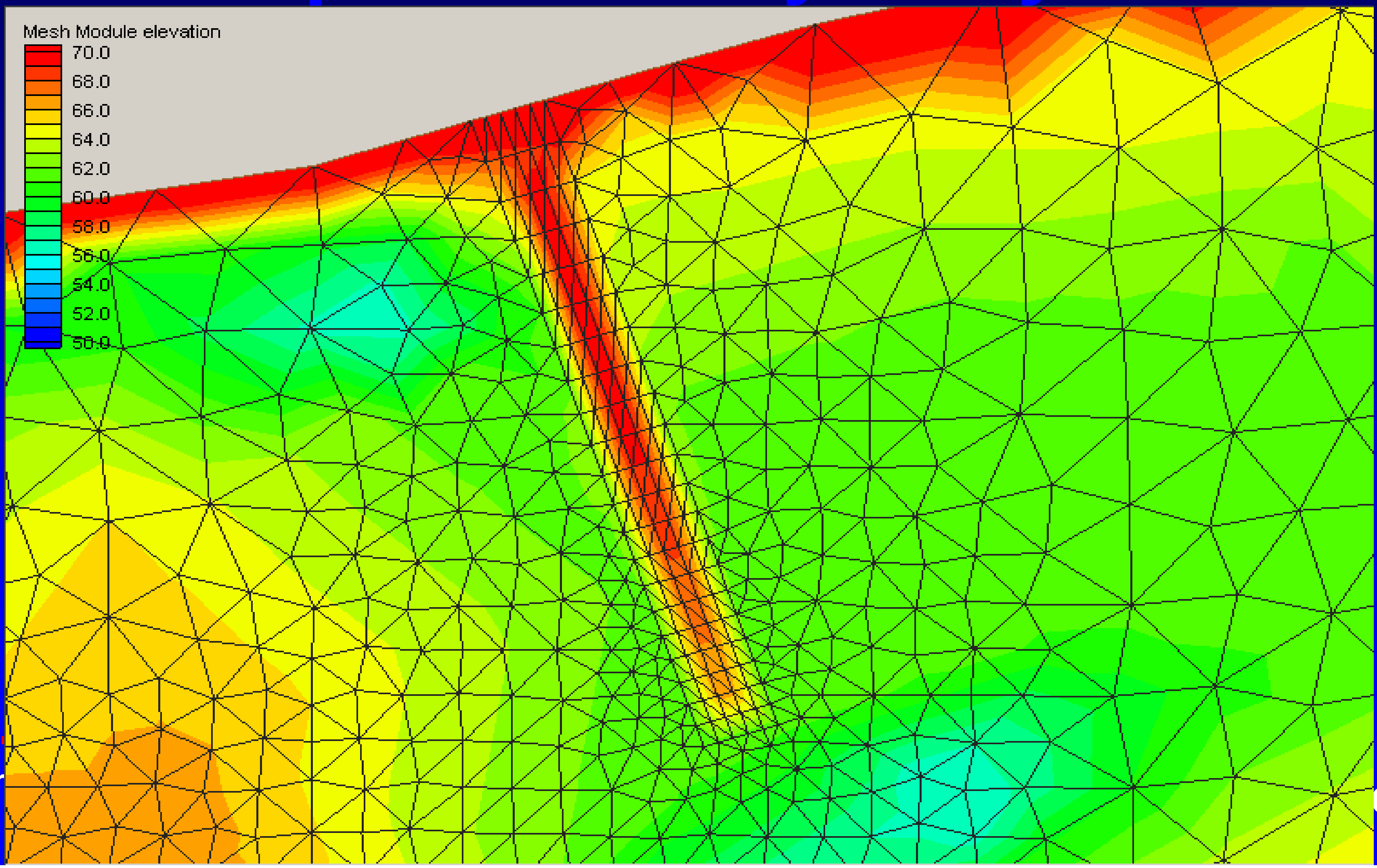
Benefit to users

- Create a mesh to capture the depths and geometry, let model refine mesh to capture hydraulic and sediment gradients.

Original Mesh
Captures Bathymetry



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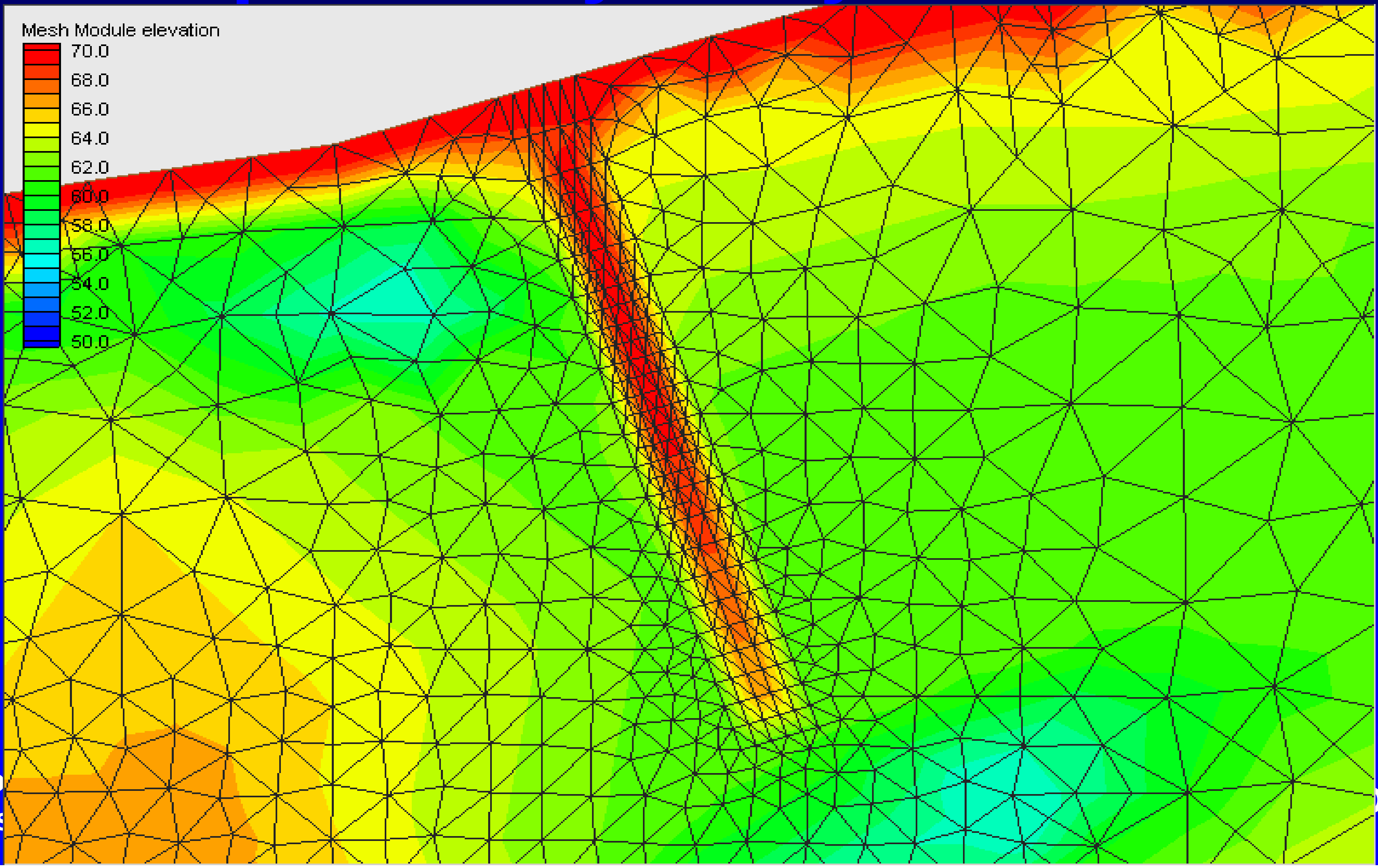
C

Adapted Mesh
Captures Hydrodynamics

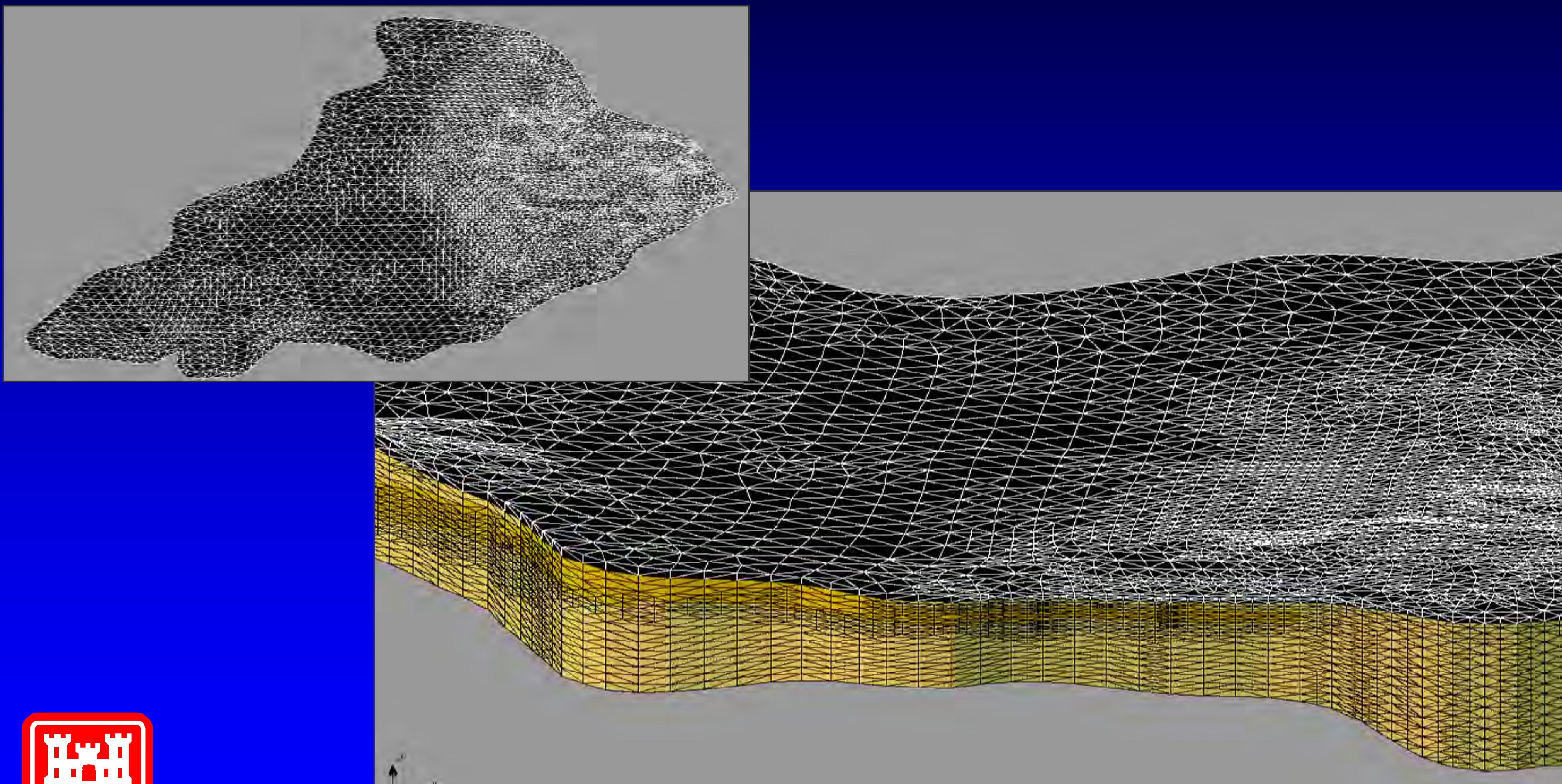


US Army Co
of Engineers

DC

Adaption in 3D Example

Mesh Adaption in the Subsurface



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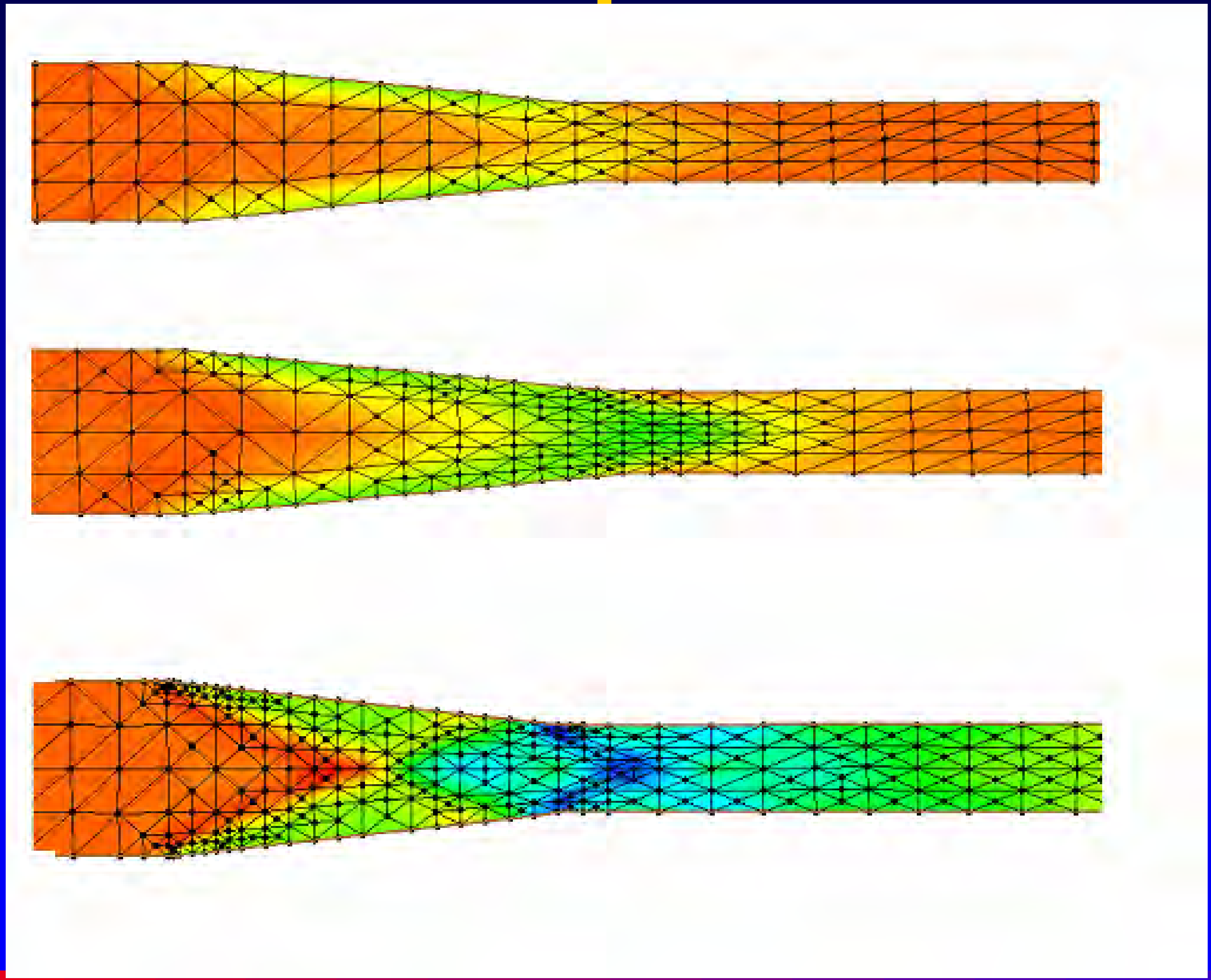
Adaption in 2D Examples

Supercritical Transition; Water Depth

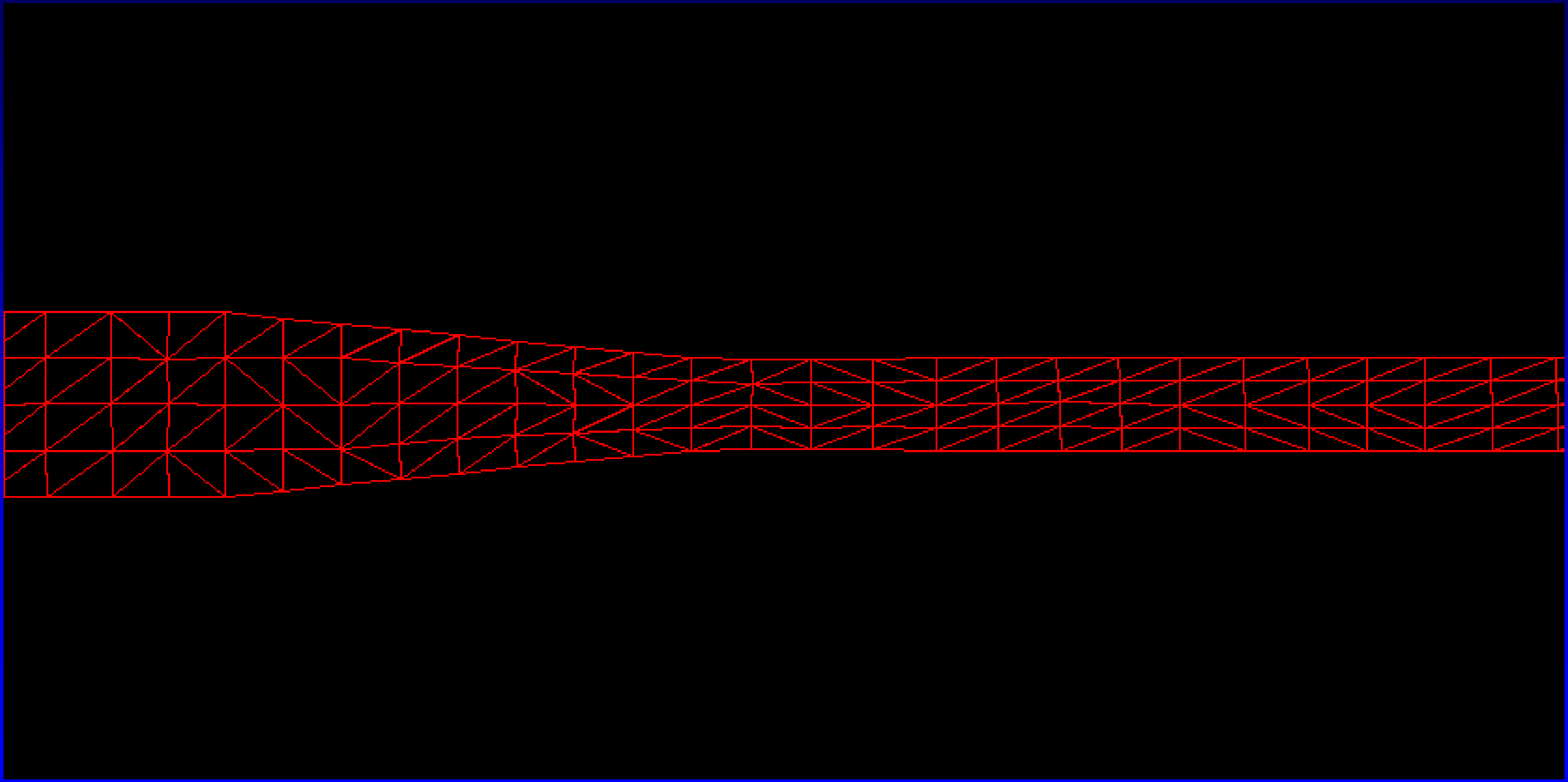


Early

Intermediate

Final

Supercritical Contraction



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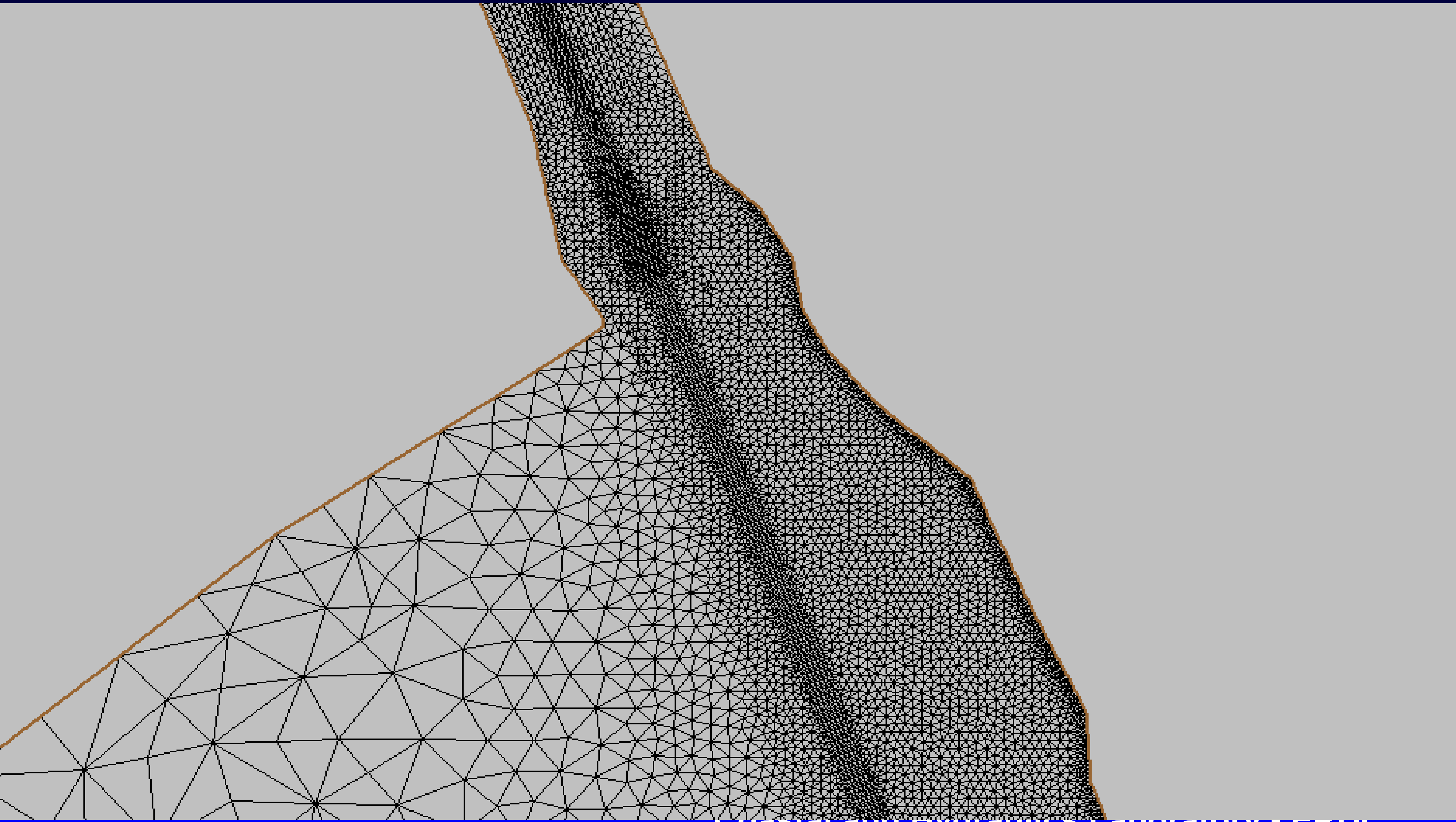
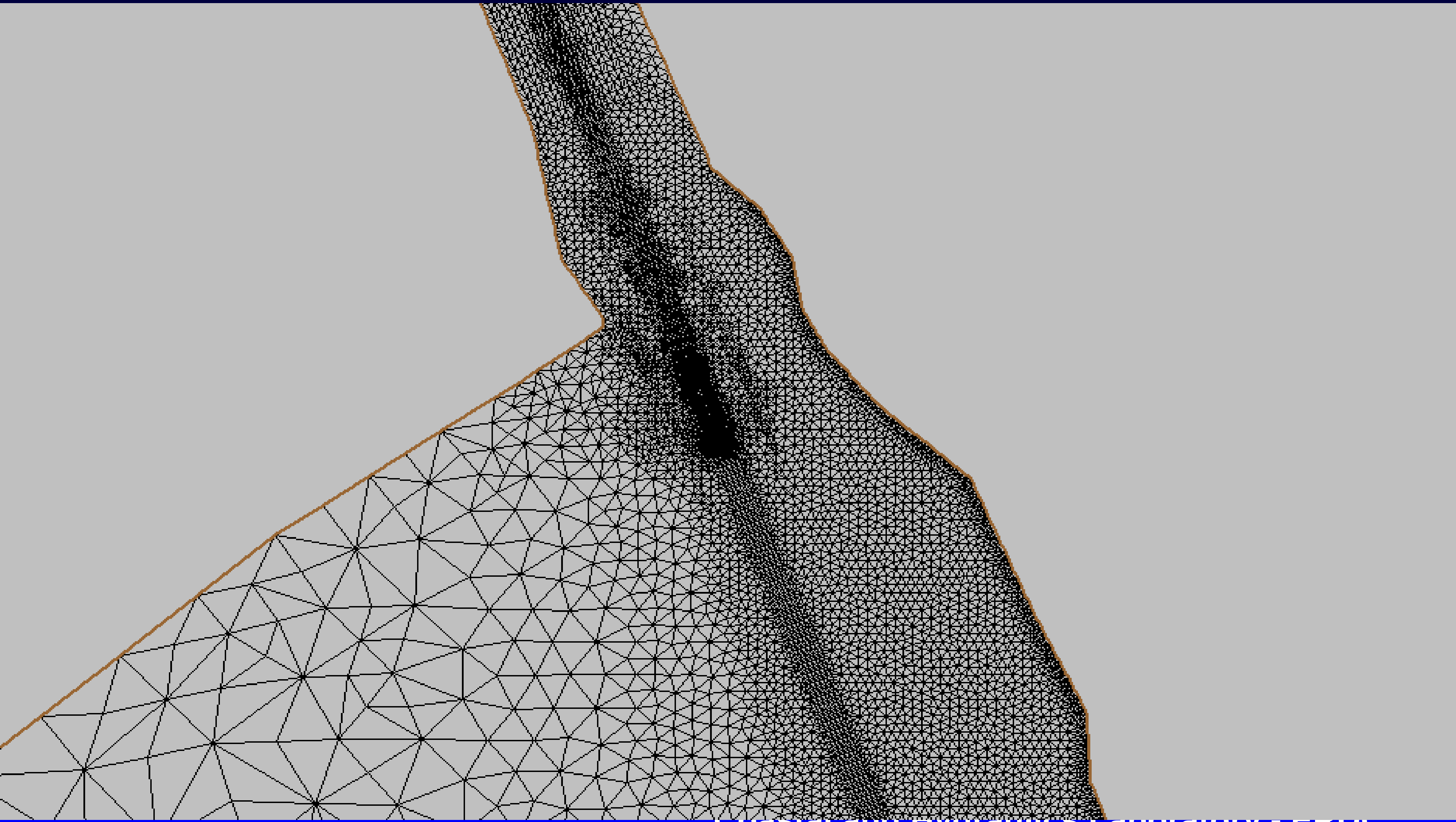
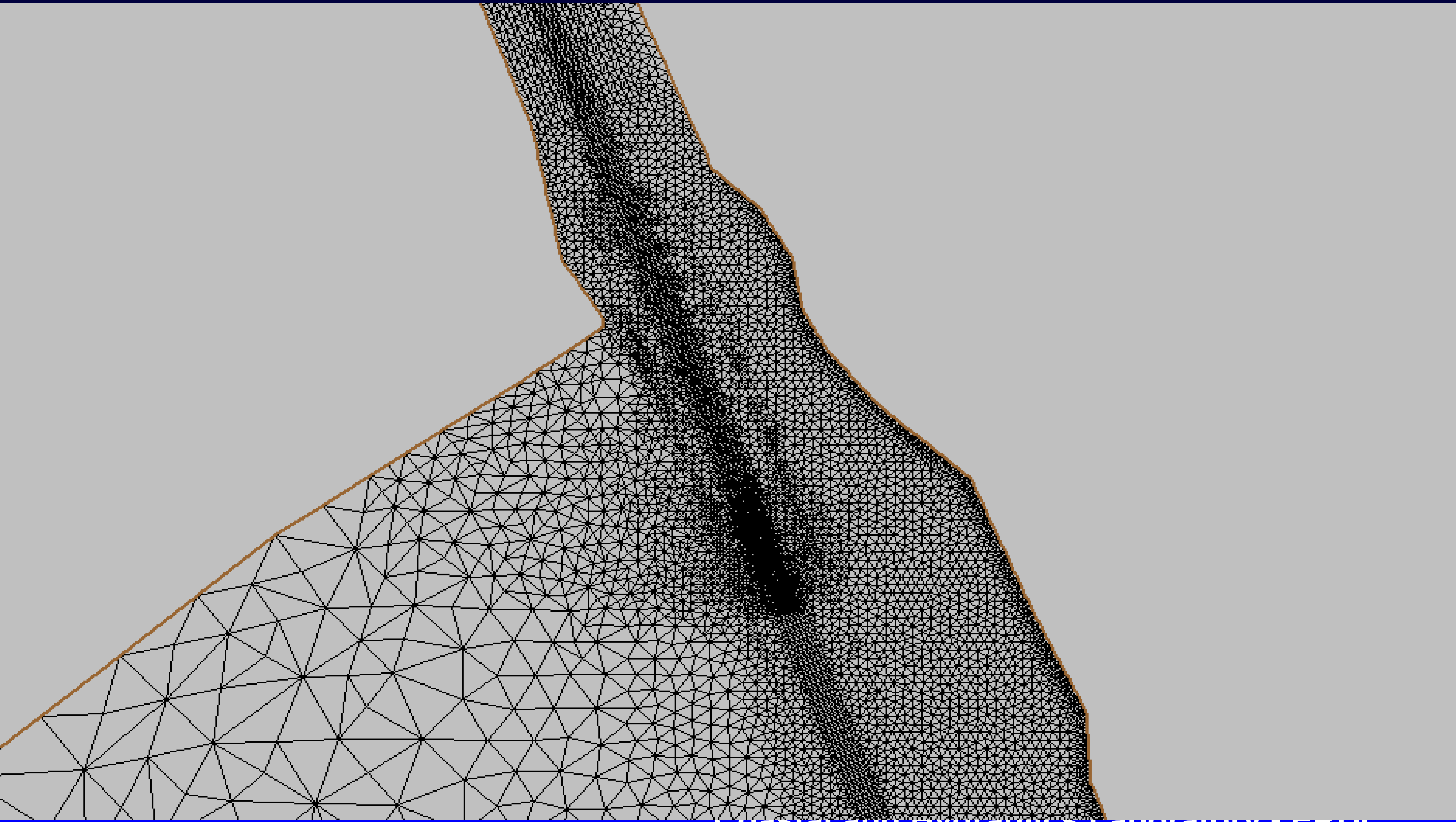
Adaption 1



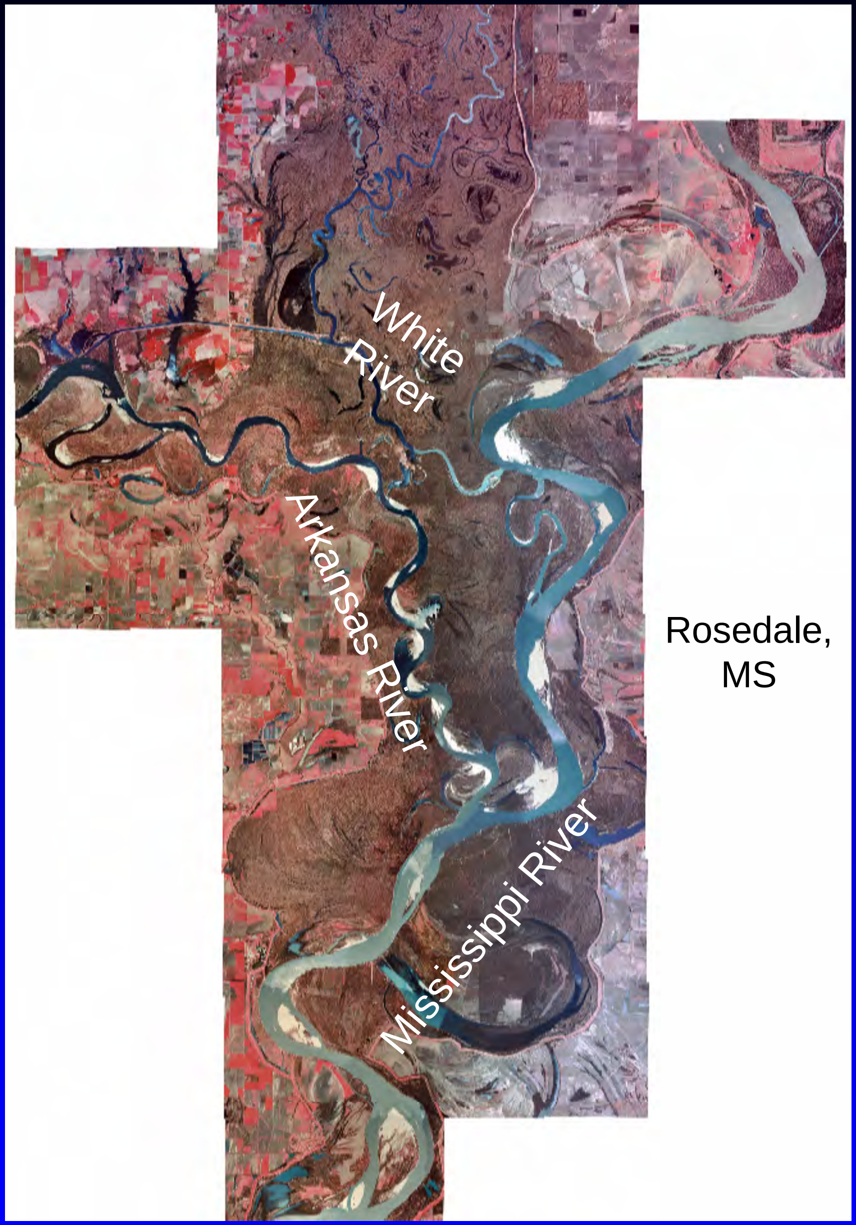
Adaption 2

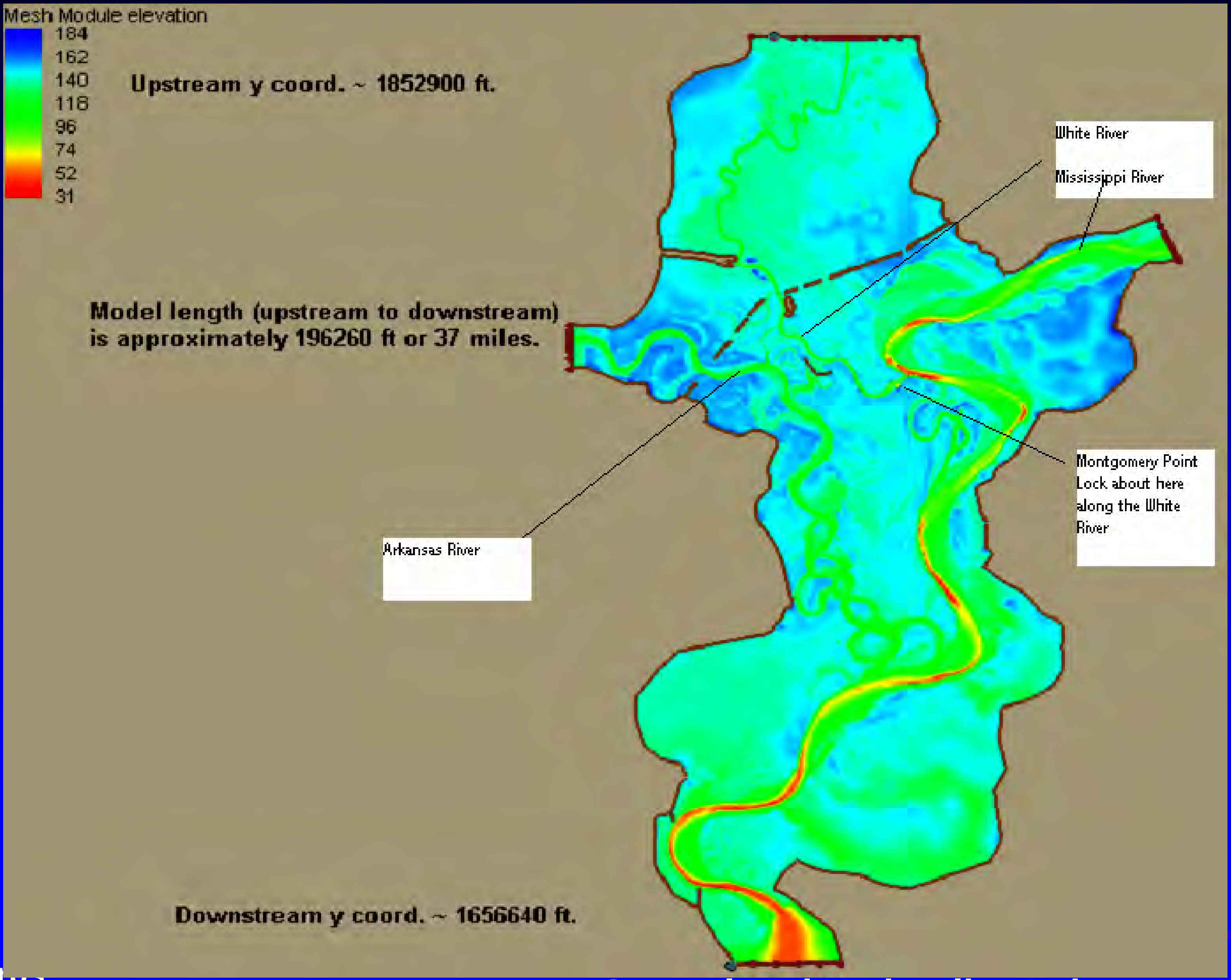


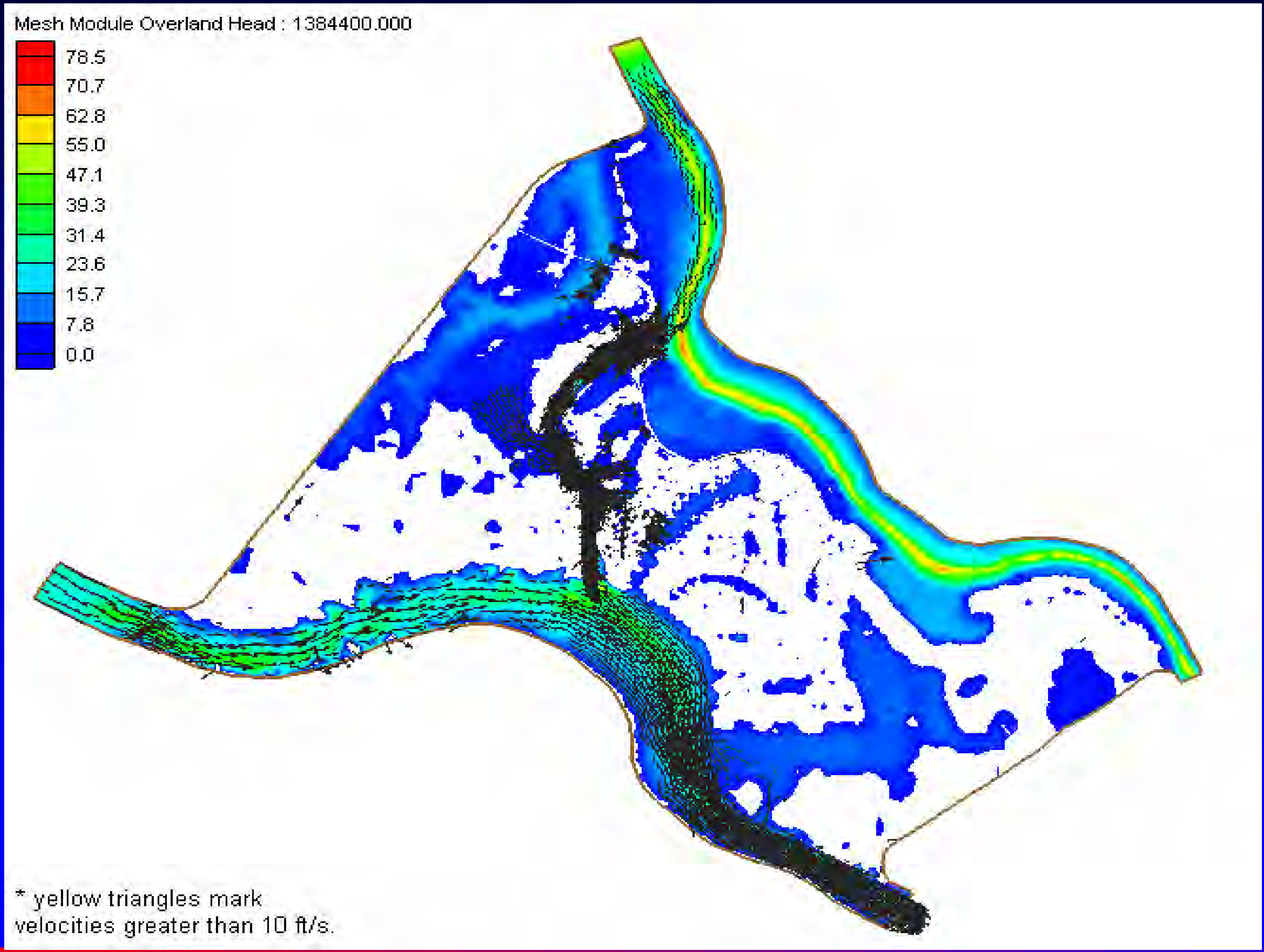
Adaption 3



Flooding Example – 2D


White River
Arkansas River
Mississippi River
Rosedale, MS


Mesh Module elevation
184
162
140
118
96
74
52
31
Upstream y coord. ~ 1852900 ft.
White River
Mississippi River
Model length (upstream to downstream) is approximately 196260 ft or 37 miles.
Montgomery Point Lock about here along the White River
Arkansas River
Downstream y coord. ~ 1656640 ft.



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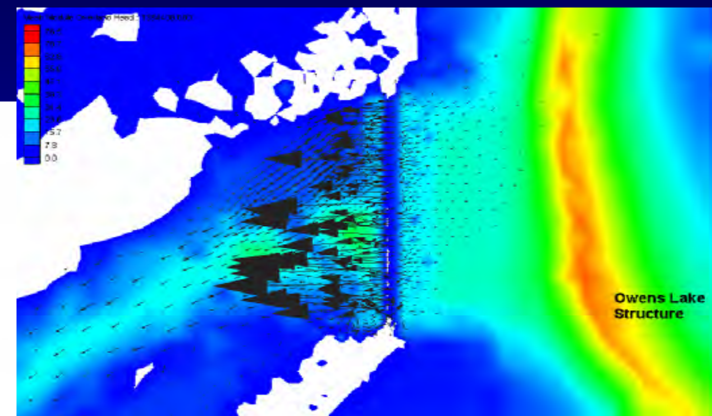
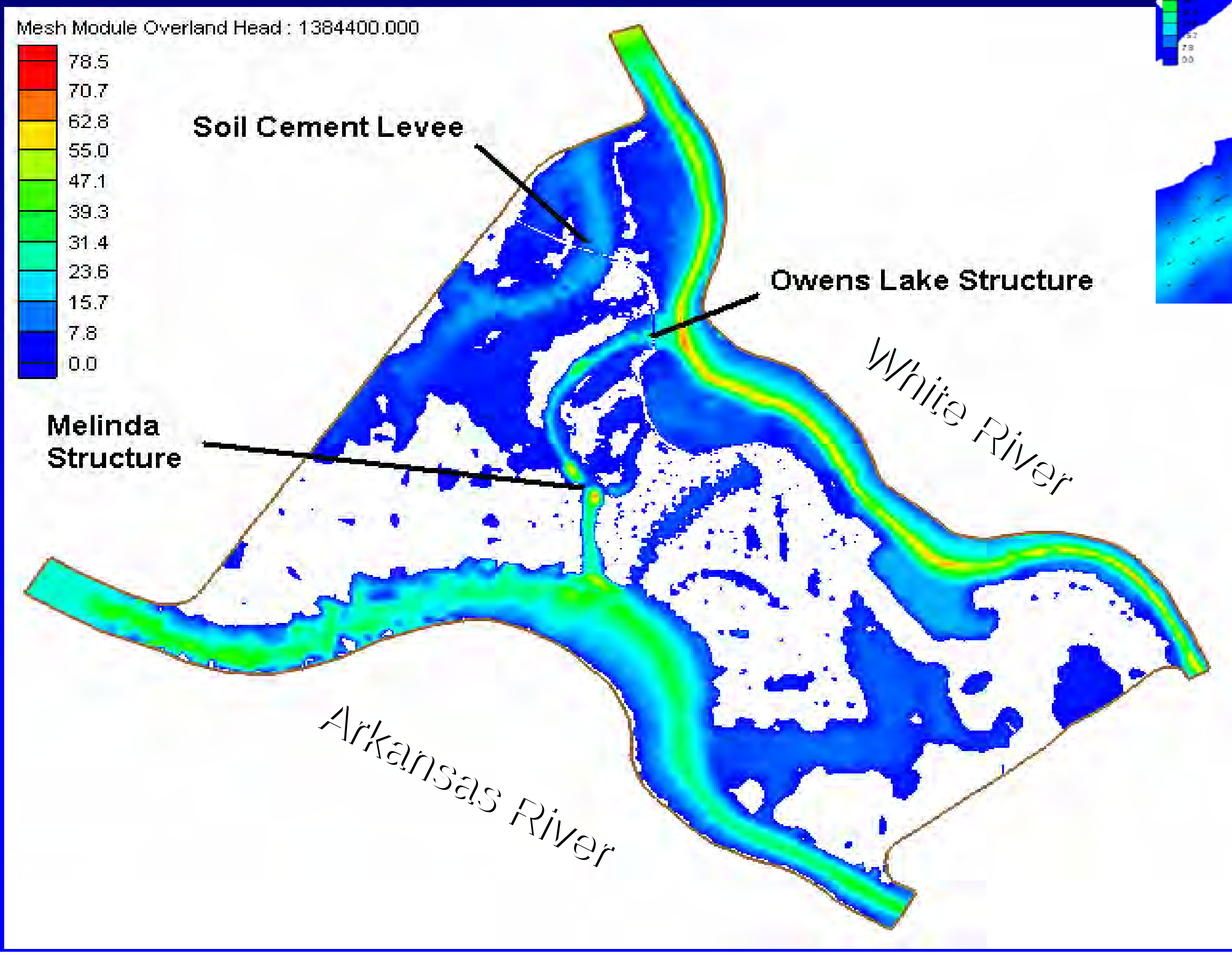
Arkansas and White Rivers Example

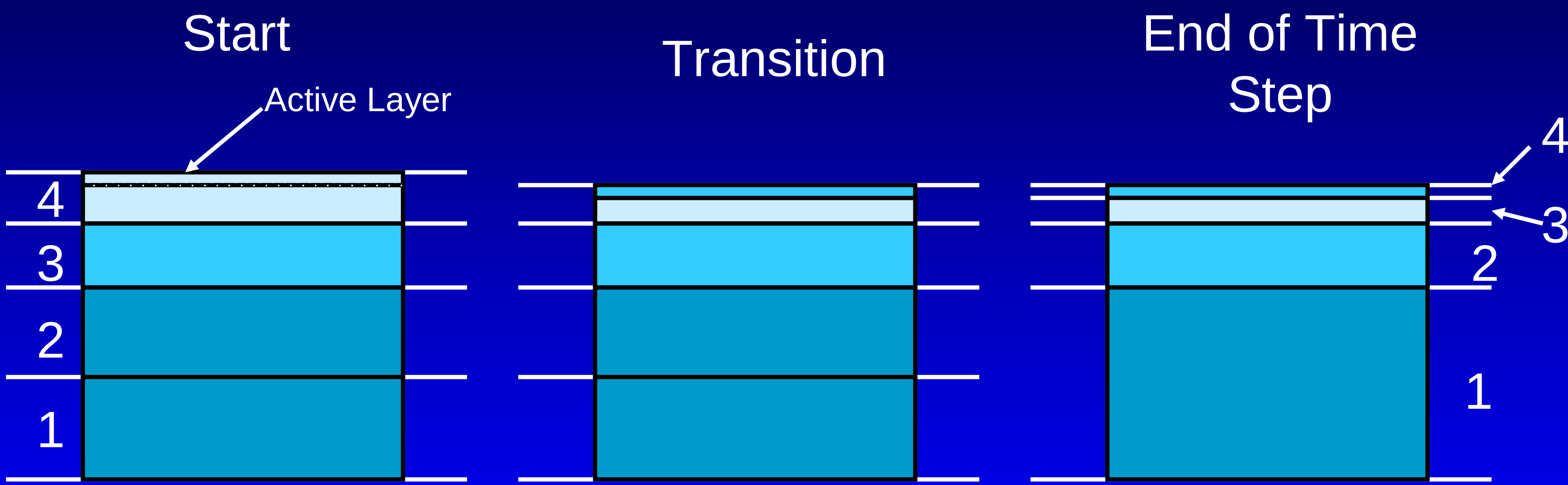
Flow over levee - Velocity



Inundation – water depths



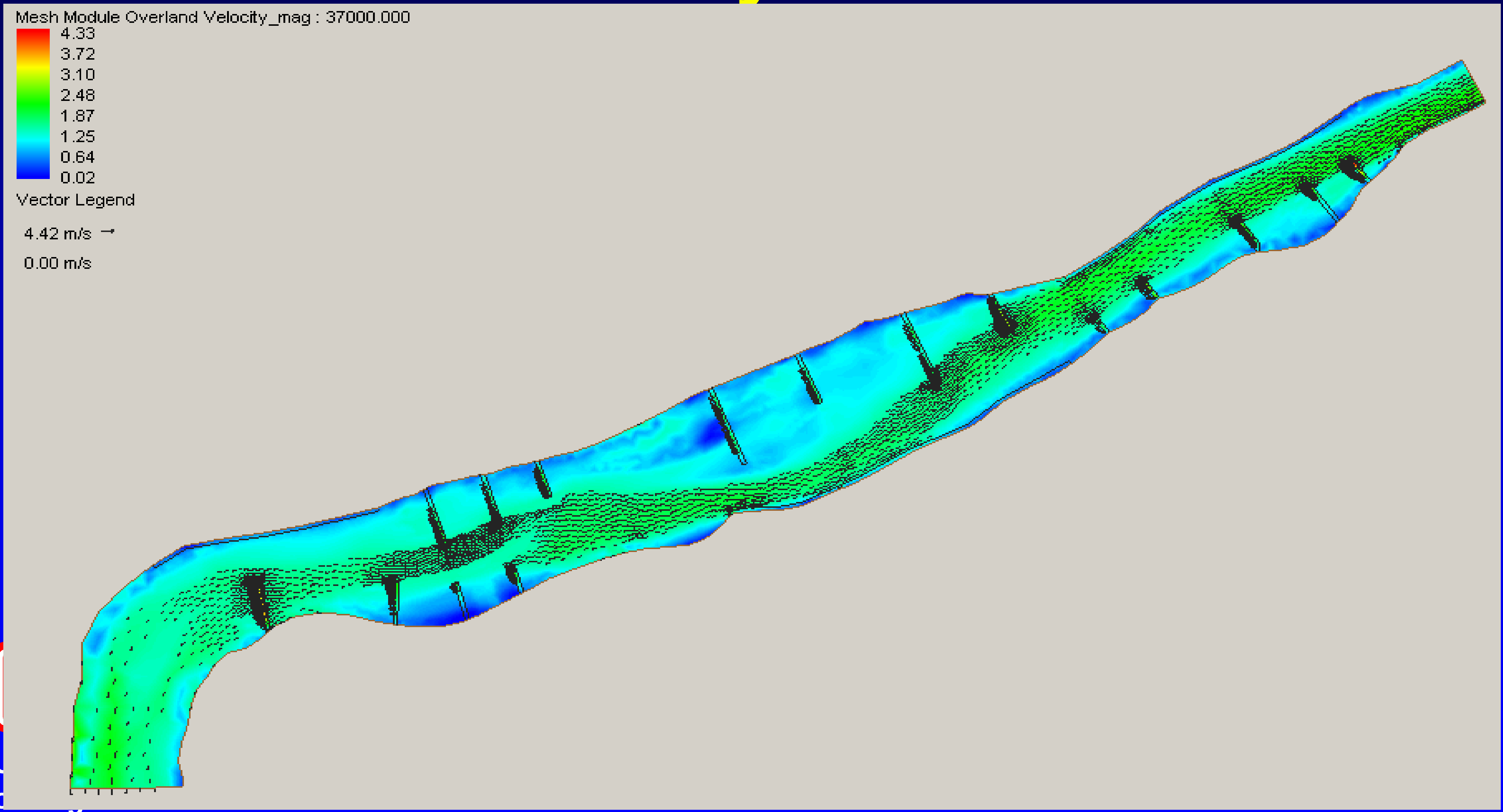
Bed Algorithm



Erosion with armoring

Combine most similar strata

Kate Aubrey - Currents



1975 Kate Aubrey – Miss. River

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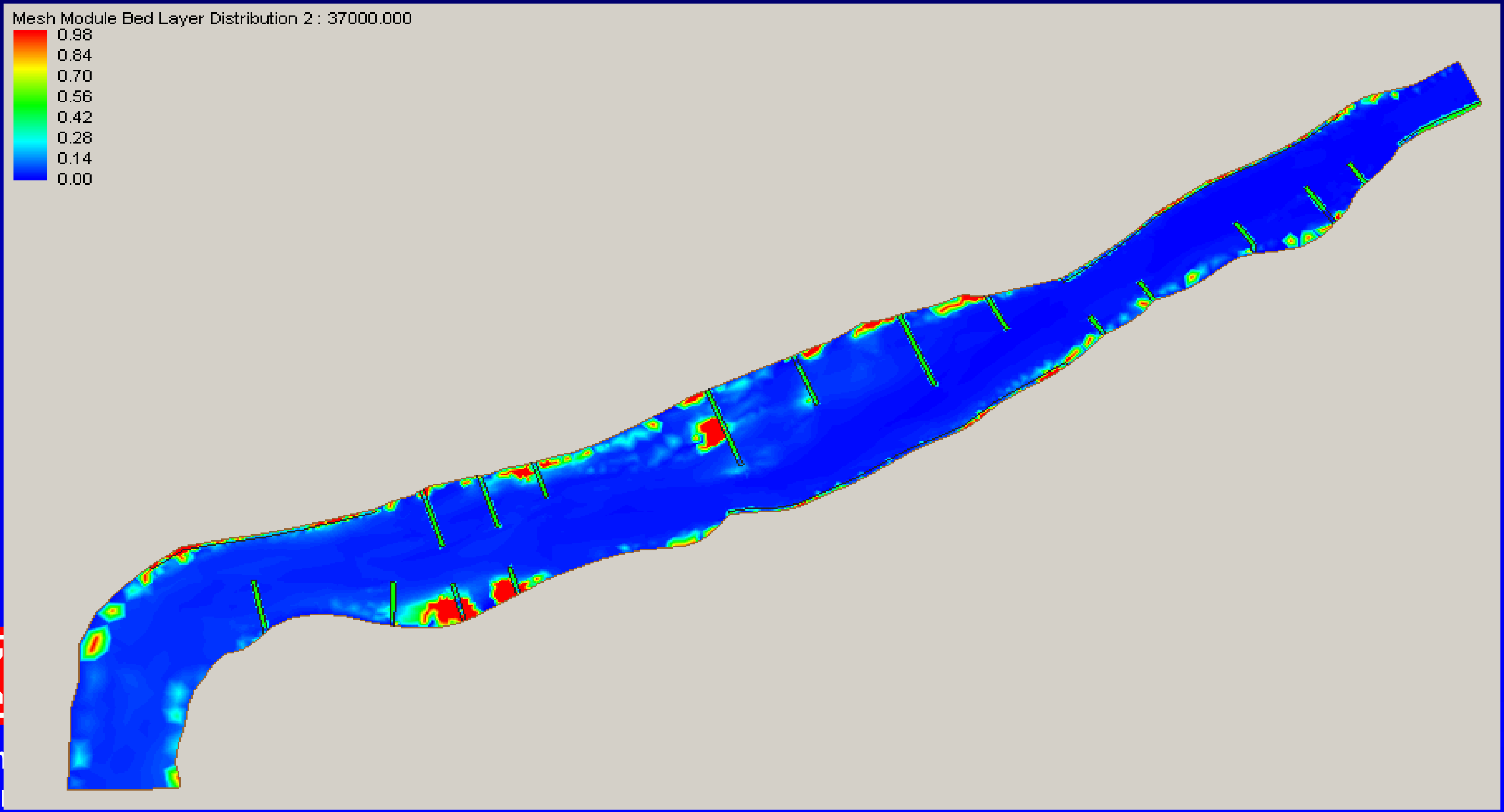
of Engineers

Coastal and Hydraulics Laboratory - ERDC

Sediment Bed
Very Fine Sand Deposits



US Army Corps of Engineers

1999 Kate Aubrey – Miss. River

2D Module Features

- Bendway Correction
- Integration from 3D
- Coupled bed/flow calculations
- Wetting/drying

Development Path

- Long term simulation
- Water Quality Library connection
- 2D/3D meshes

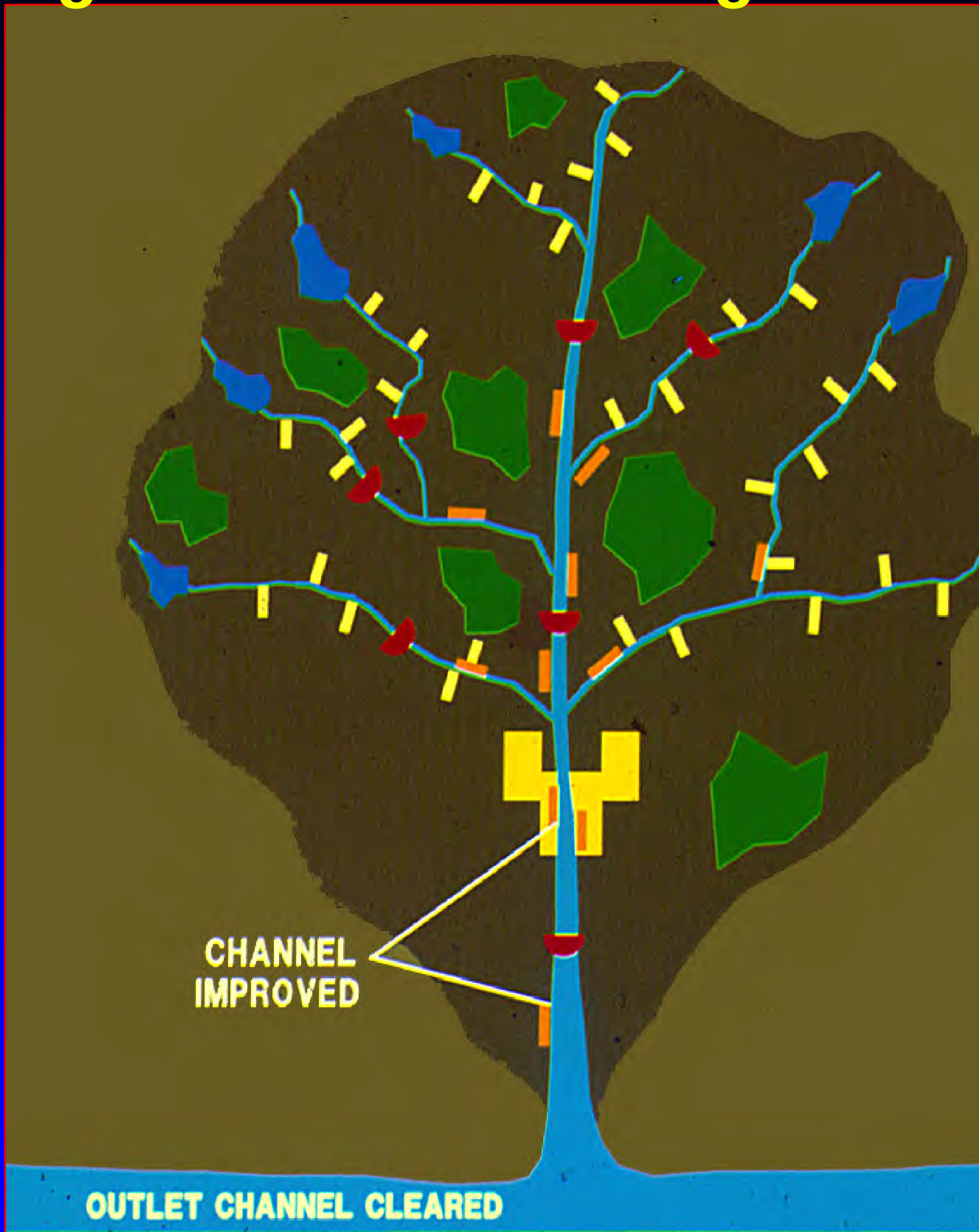
Conclusions

- Modular Design
  - Multiphysics
  - Library – Sediment
- Adaption
- Bed Load, Suspended Load, Bendway Correction (flow and sediment)

Sediment Impact Assessment Model (SIAM)

David S. Biedenharn & Meg Jonas
U.S. Army Corps of Engineers
Engineer Research Development Center

Regional Sediment Management






Sediment Impact Assessments

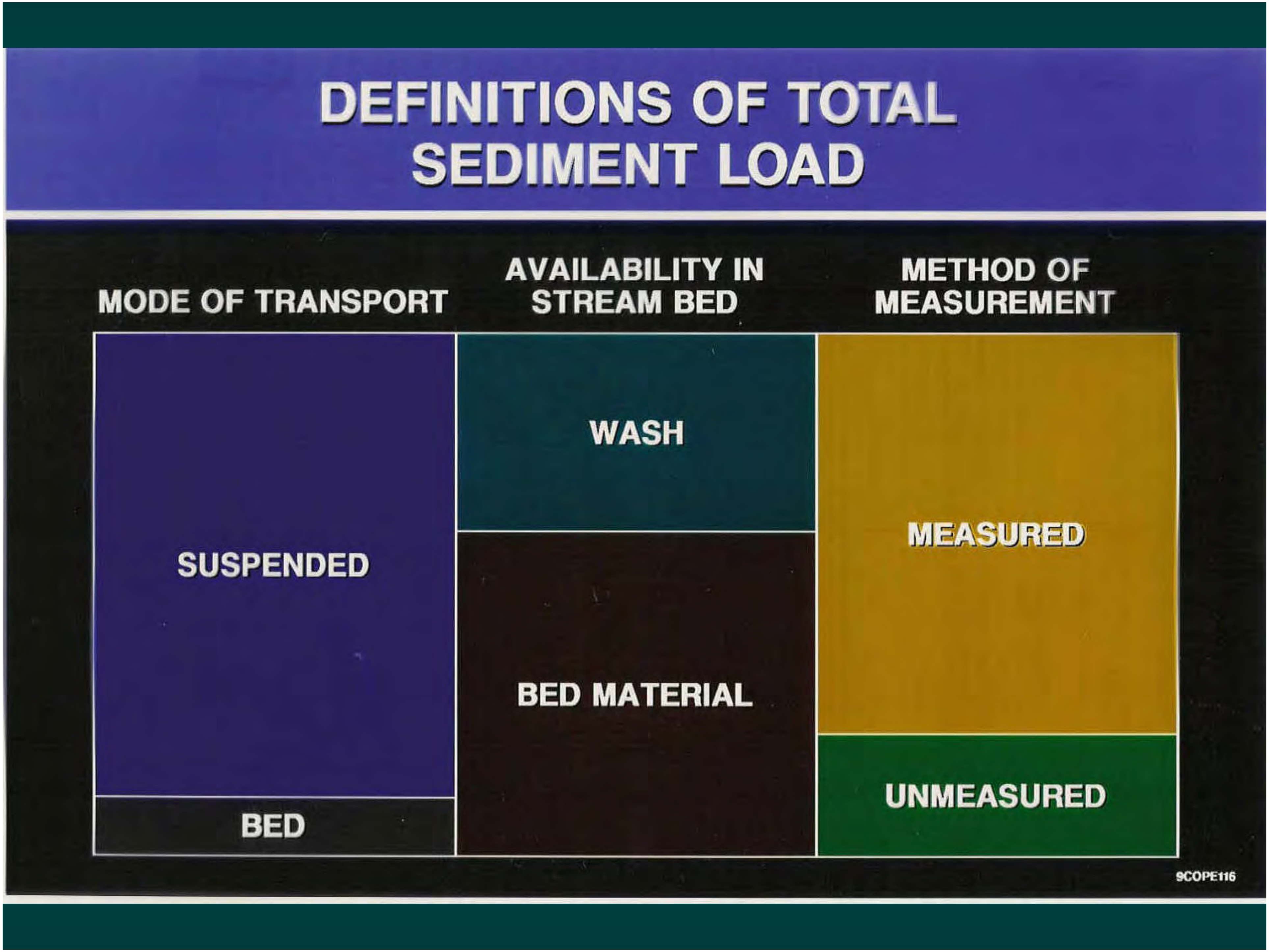
- Sediment Budget Analysis
- Numerical Models (HEC-6)
- SIAM

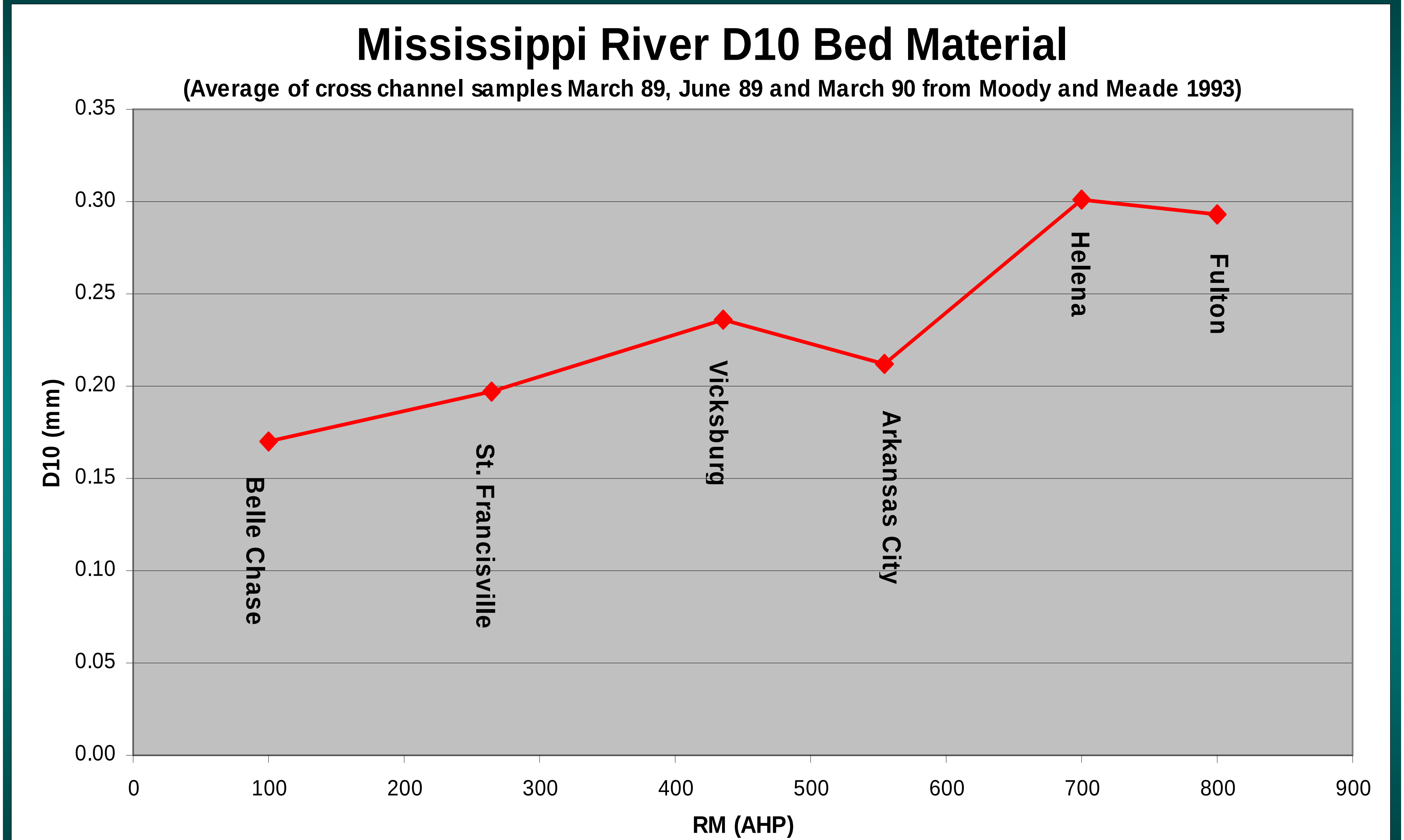
Sediment Impact Assessments

- **Sources**
- **Pathways**
- **Sinks**

Wash Load – Bed Material Load Relationship

- Wash load is the material that is not found in appreciable quantities in the channel bed
- Bed material is the material that is found in appreciable quantities in the channel bed
- Typically, the grain diameter for which 10 percent of the bed mixture is finer (D_{10})is selected as the dividing size between bed material and wash load.

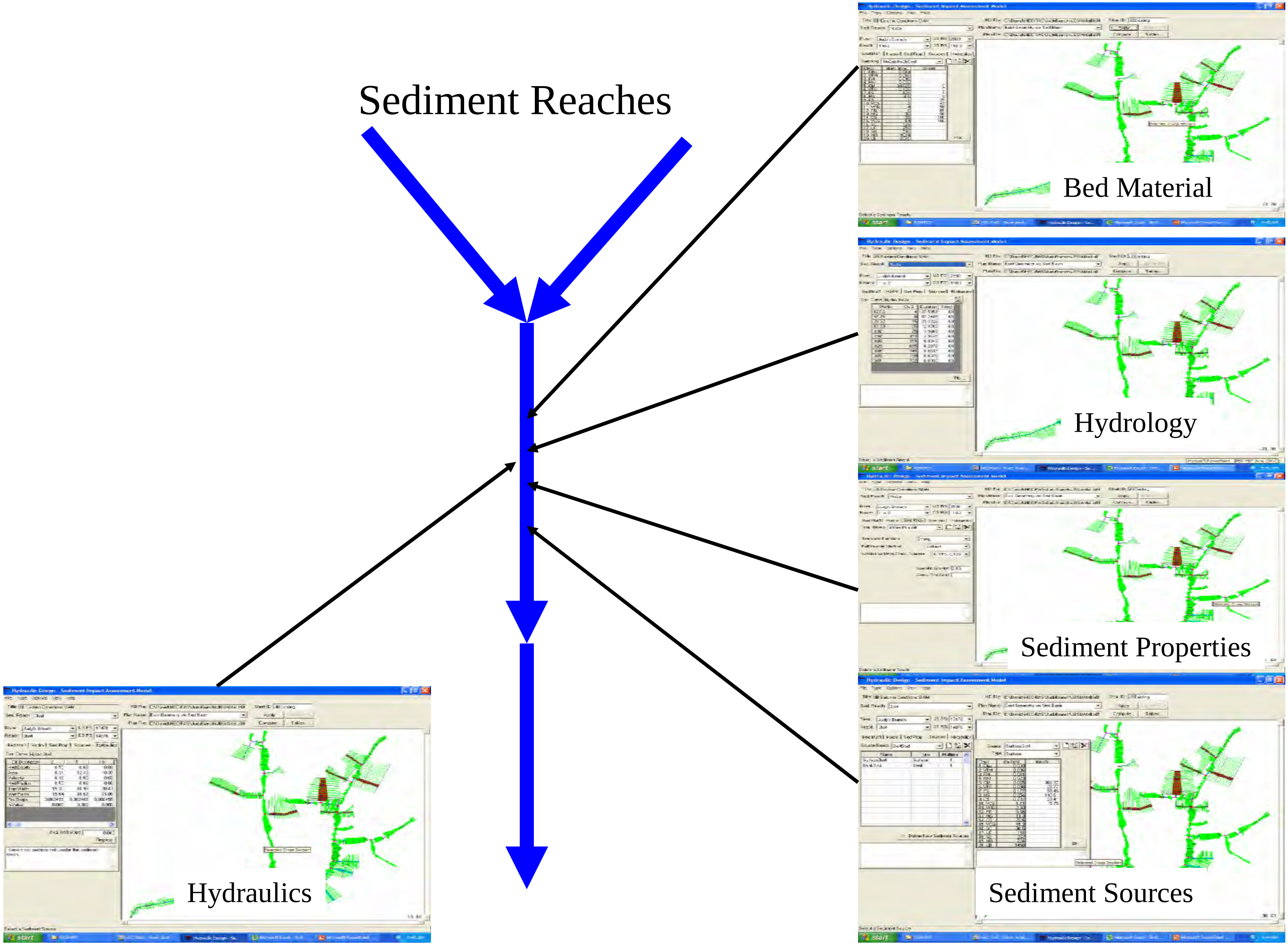

DEFINITIONS OF TOTAL SEDIMENT LOAD
MODE OF TRANSPORT
AVAILABILITY IN STREAM BED
METHOD OF MEASUREMENT
SUSPENDED
BED
WASH
BED MATERIAL
MEASURED
UNMEASURED
9COPE116


Mississippi River D10 Bed Material
(Average of cross channel samples March 89, June 89 and March 90 from Moody and Meade 1993)
D10 (mm)
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
100
200
300
400
500
600
700
800
900
RM (AHP)
Belle Chase
St. Francisville
Vicksburg
Arkansas City
Helena
Fulton

Sediment Impact Assessment Model (SIAM)

SIAM

- One-Dimensional
- Reach Average Hydraulics
- Sediment Continuity
- Sediment Transport by Grain Size
- Average Annual Loads Based on Flow Duration Data
- Wash Load – Bed Material Load Distinction



Sediment Reaches
Bed Material
Hydrology
Sediment Properties
Sediment Sources
Hydraulics

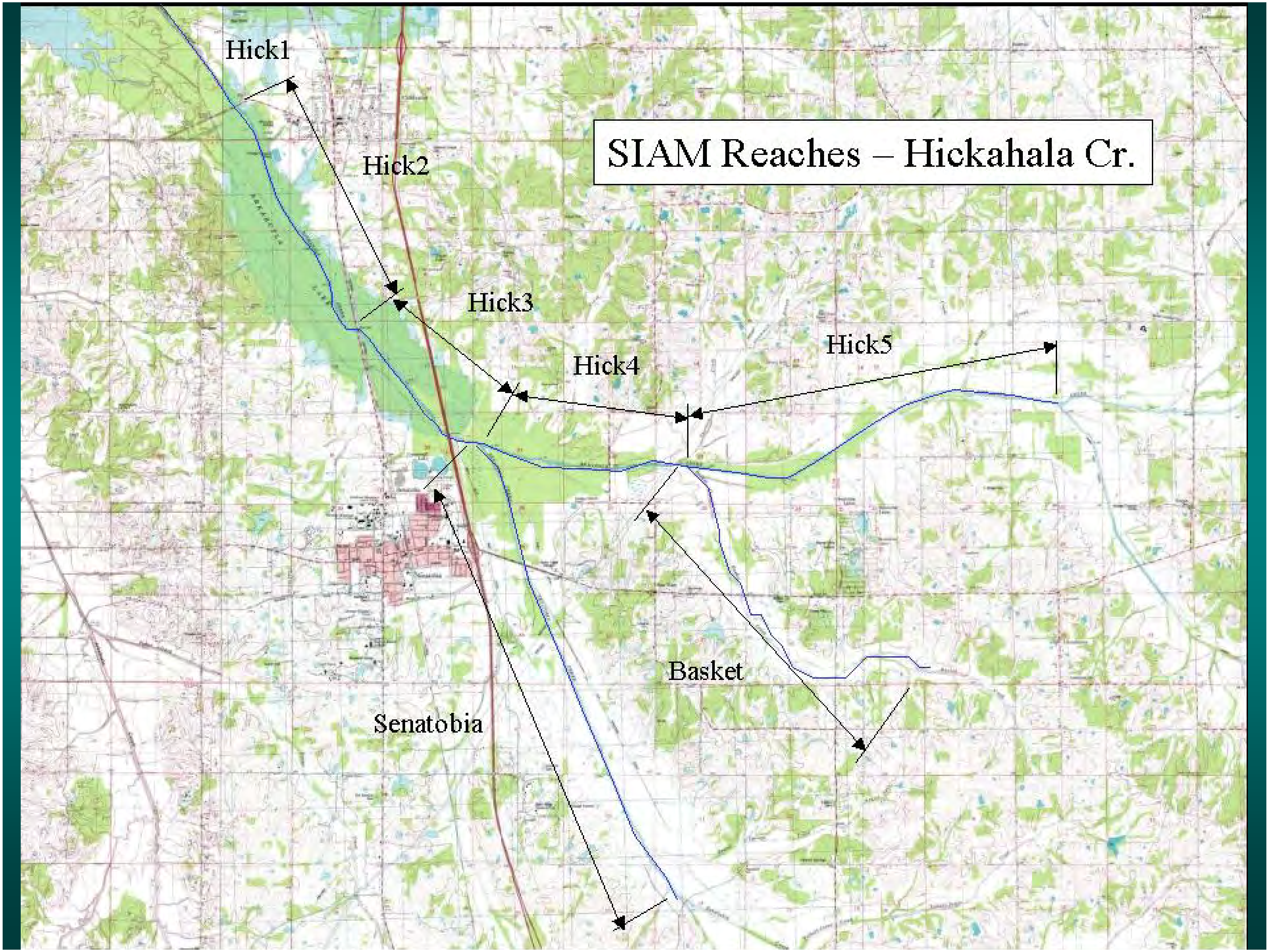
SIAM Output

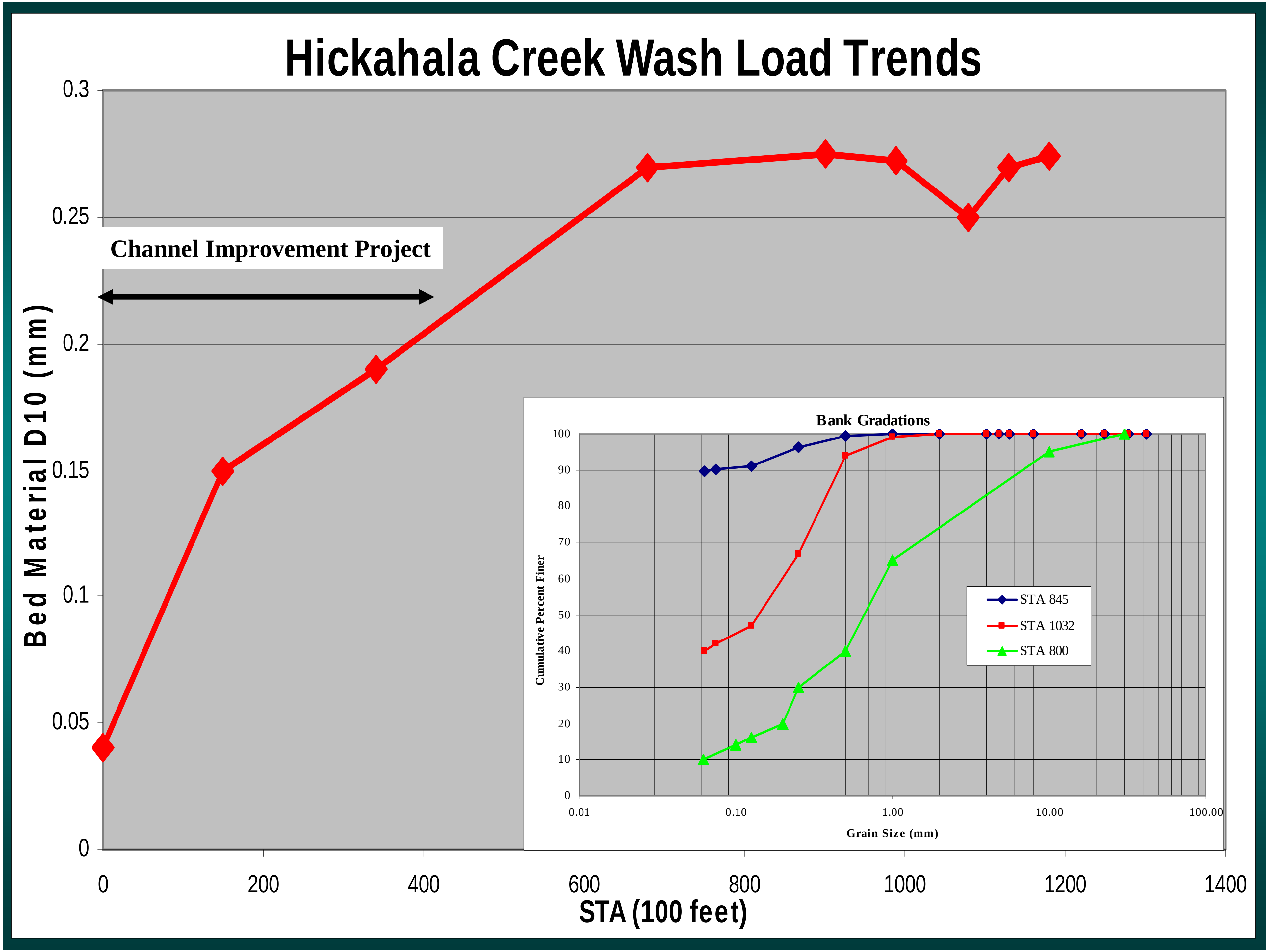
- For each reach and each grain size class the output table displays the total supply from sediment sources, upstream wash load supply, upstream bed material supply, the transport capacity, and sediment balance
- Output from the SIAM model can also be summarized in a tabular format which provides the ability to view the stability of multiple scenarios simultaneously over all reaches. Color-coding identifies significant trends.

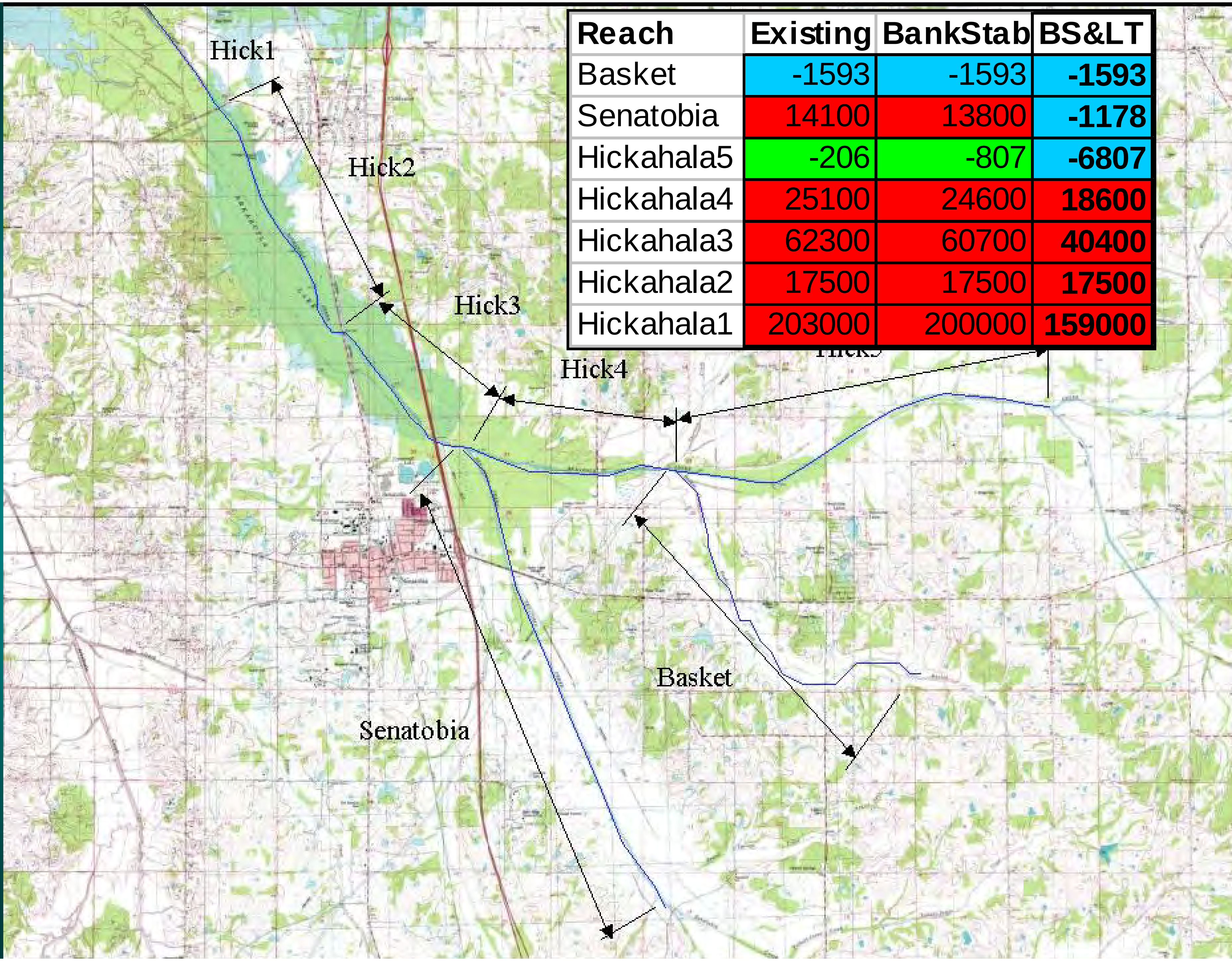
Judy's Branch Total Sediment Loads (tons/yr) and Sediment Balance (Transport Capacity Minus Supply in Tons/yr)

Reach Name	Total Load Existing Tons/yr	Balance Existing Tons/yr	Total Load SB Tons/yr	Percent Reduction	Balance SB Tons/yr	Total Load SB VFS Tons/yr	Percent Reduction	Balance SB VFS Tons/yr	Total Load SB VFS BS Tons/yr	Percent Reduction	Balance SB VFS BS Tons/yr	Total Load SB VFS BS GC Tons/yr	Percent Reduction	Balance SB VFS BS GCS Tons/yr
1to2a Bed	27,462	-116	18,109	34	-104	12,266	55	-104	10,447	62	-104	10,352	62	-104
1to2b Bed	27,008	220	17,828	34	69	11,823	56	69	10,105	63	69	10,105	63	69
1to2c Bed	26,133	362	16,826	36	235	11,080	58	235	9,585	63	235	9,585	63	235
2to3 Bed	24,882	602	15,837	36	478	10,340	58	338	9,003	64	293	8,883	64	173
3to4 Bed	16,542	185	9,684	41	283	6,034	64	161	5,330	68	113	5,330	68	113
4to5 Bed	15,701	300	8,882	43	246	5,523	65	218	4,917	69	190	4,917	69	190
5to6 Bed	15,436	374	8,801	43	364	5,499	64	347	4,957	68	338	4,906	68	287
6to7 Bed	16,183	1260	9,182	43	586	5,925	63	586	5,407	67	586	4,792	70	22
7to8 Bed	10,425	-1058	5,955	43	-588	3,905	63	-588	3,459	67	-588	3,444	67	13
8to9 Bed	8,842	-14	4,774	46	19	3,033	66	19	2,684	70	19	2,683	70	33
9to10 Bed	9,409	1122	5,032	47	813	3,434	64	813	3,168	66	813	2,412	74	58
10to11 Bec	8,043	-1112	4,108	49	-883	2,514	69	-883	2,253	72	-883	2,199	73	-182
11to12 Bec	7,317	389	3,977	46	381	2,623	64	381	2,395	67	381	1,966	73	-4
12to13 Bec	6,317	29	2,893	54	-22	1,751	72	-22	1,623	74	-22	1,625	74	135
13to14 Bec	6,350	353	2,971	53	162	1,840	71	162	1,726	73	162	1,582	75	16
4toEnda Be	4,325	-386	2,321	46	-202	1,306	70	-202	1,237	71	-202	1,237	71	-58
4toEndb Be	2,756	-149	833	70	-68	510	81	-68	452	84	-68	452	84	-68
Trib1 Bed	389	-33	0	100	-35	0	100	-35	0	100	-35	0	100	-35
Trib2 Bed	139	43	0	100	-4	0	100	-4	0	100	-4	0	100	-4
Trib3 Bed	322	67	0	100	-62	0	100	-62	0	100	-62	0	100	-62
Trib4 Bed	505	161	0	100	-37	0	100	-37	0	100	-37	0	100	-37
Trib5 Bed	4,443	247	2,437	45	301	1,365	69	301	1,365	69	301	1,365	69	301
Trib5a Bed	723	-222	226	69	-104	113	84	-104	113	84	-104	113	84	-104
Trib5b1 Bec	2,958	-264	1,878	37	-229	919	69	-229	919	69	-229	862	71	-286
Trib5b2 Bec	2,327	-129	1,302	44	-74	594	74	-74	594	74	-74	594	74	-17
Trib5b3 Bec	1,566	-44	1,133	28	-28	566	64	-28	566	64	-28	566	64	-28
Trib6 Bed	677	-373	414	39	-267	207	69	-267	207	69	-267	207	69	-267
Trib7 Bed	115	-2	115	0	-2	57	50	-2	57	50	-2	57	50	-2
Trib8 Bed	164	-65	0	100	-14	0	100	-14	0	100	-14	0	100	-14
Trib9 Bed	1,005	64	355	65	19	149	85	19	149	85	19	149	85	29
Trib9a1 Bec	824	25	308	63	46	189	77	46	189	77	46	189	77	46
Trib9a2 Bec	671	-137	238	65	-70	119	82	-70	119	82	-70	119	82	-70
Trib9b Bed	94	-24	0	100	-7	0	100	-7	0	100	-7	0	100	-7
Trib10 Bed	310	-286	310	0	-318	155	50	-318	155	50	-318	155	50	-44
Trib11 Bed	232	-20	0	100	-16	0	100	-16	0	100	-16	0	100	-16
Trib12 Bed	1,078	-183	0	100	-72	0	100	-72	0	100	-72	0	100	-72
3toAa Bed	7,658	242	5,417	29	90	3,815	50	90	3,251	58	90	3,096	60	56
3toAb Bed	5,894	-176	3,825	35	-4	2,735	54	-4	2,346	60	-4	2,157	63	-38
AtoB Bed	3,696	-137	2,312	37	-91	1,676	55	-91	1,435	61	-91	1,298	65	-39
BtoC Bed	1,249	-51	1,070	14	-25	914	27	-25	749	40	-25	618	51	-20
CtoD Bed	548	-351	553	-1	-167	450	18	-167	361	34	-167	328	40	-68
DtoEnd Bec	203	-55	203	0	-60	136	33	-60	115	43	-60	115	43	-27
TribA Bed	626	-48	0	100	-35	0	100	-35	0	100	-35	0	100	-35
TribB Bed	1,128	-62	0	100	-11	0	100	-11	0	100	-11	0	100	-11

Hickahala Creek SIAM

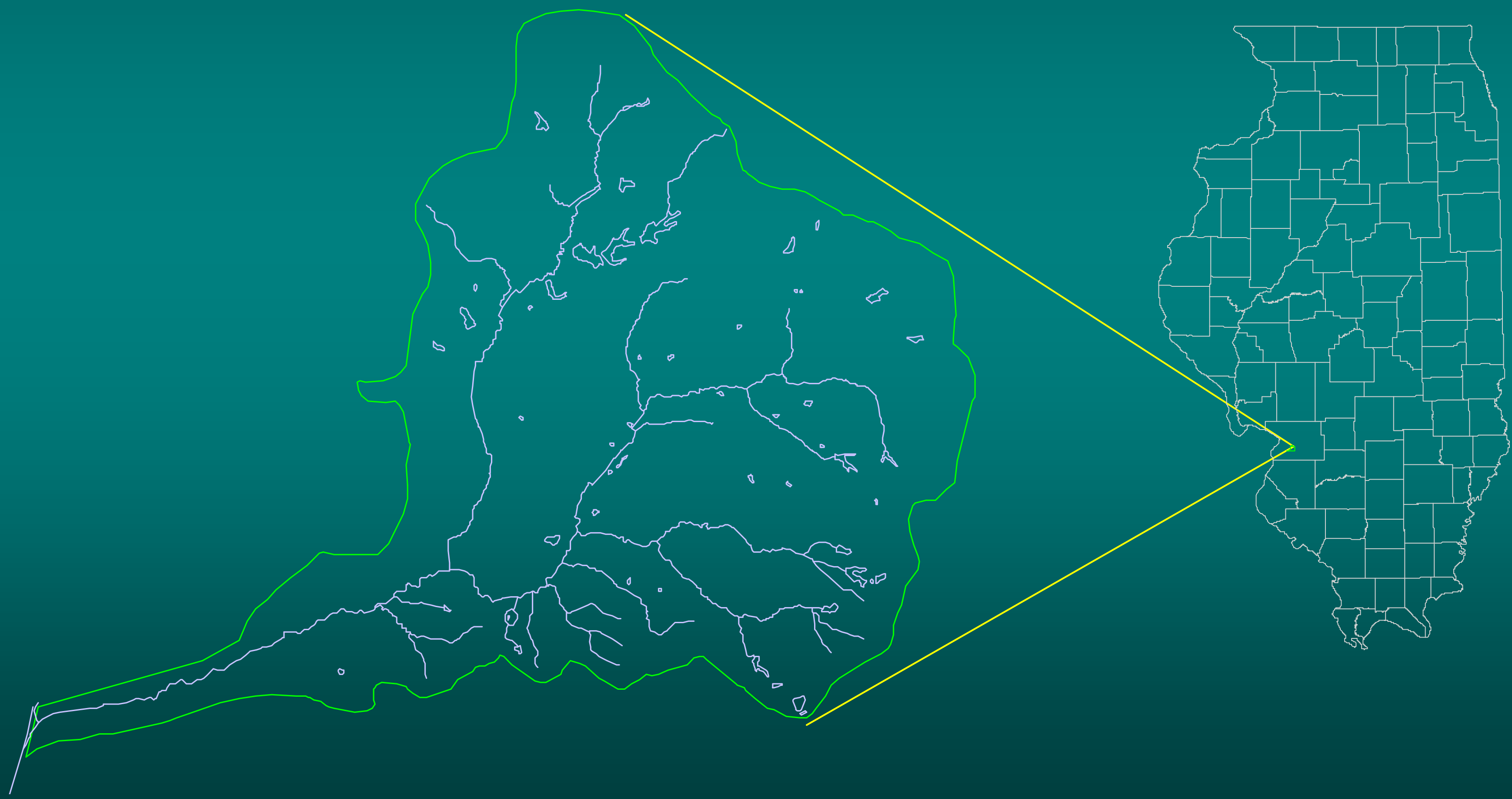

SIAM Reaches – Hickahala Cr.
Hick1
Hick2
Hick3
Hick4
Hick5
Basket
Senatobia


Hickahala Creek Wash Load Trends
Bed Material D10 (mm)
STA (100 feet)
Channel Improvement Project
0
0.05
0.1
0.15
0.2
0.25
0.3
0
200
400
600
800
1000
1200
1400
Bank Gradations
Cumulative Percent Finer
Grain Size (mm)
STA 845
STA 1032
STA 800
0
10
20
30
40
50
60
70
80
90
100
0.01
0.10
1.00
10.00
100.00



Reach	Existing	BankStab	BS&LT
Basket	-1593	-1593	**-1593**
Senatobia	14100	13800	**-1178**
Hickahala5	-206	-807	**-6807**
Hickahala4	25100	24600	**18600**
Hickahala3	62300	60700	**40400**
Hickahala2	17500	17500	**17500**
Hickahala1	203000	200000	**159000**

Judys Branch Watershed



Judy's Branch Total Sediment Loads (tons/yr) and Sediment Balance (Transport Capacity Minus Supply in Tons/yr)

Reach Name	Total Load Existing Tons/yr	Balance Existing Tons/yr	Total Load SB Tons/yr	Percent Reduction	Balance SB Tons/yr	Total Load SB VFS Tons/yr	Percent Reduction	Balance SB VFS Tons/yr	Total Load SB VFS BS Tons/yr	Percent Reduction	Balance SB VFS BS Tons/yr	Total Load SB VFS BS GC Tons/yr	Percent Reduction	Balance SB VFS BS GCS Tons/yr
1to2a Bed	27,462	-116	18,109	34	-104	12,266	55	-104	10,447	62	-104	10,352	62	-104
1to2b Bed	27,008	220	17,828	34	69	11,823	56	69	10,105	63	69	10,105	63	69
1to2c Bed	26,133	362	16,826	36	235	11,080	58	235	9,585	63	235	9,585	63	235
2to3 Bed	24,882	602	15,837	36	478	10,340	58	338	9,003	64	293	8,883	64	173
3to4 Bed	16,542	185	9,684	41	283	6,034	64	161	5,330	68	113	5,330	68	113
4to5 Bed	15,701	300	8,882	43	246	5,523	65	218	4,917	69	190	4,917	69	190
5to6 Bed	15,436	374	8,801	43	364	5,499	64	347	4,957	68	338	4,906	68	287
6to7 Bed	16,183	1260	9,182	43	586	5,925	63	586	5,407	67	586	4,792	70	22
7to8 Bed	10,425	-1058	5,955	43	-588	3,905	63	-588	3,459	67	-588	3,444	67	13
8to9 Bed	8,842	-14	4,774	46	19	3,033	66	19	2,684	70	19	2,683	70	33
9to10 Bed	9,409	1122	5,032	47	813	3,434	64	813	3,168	66	813	2,412	74	58
10to11 Bec	8,043	-1112	4,108	49	-883	2,514	69	-883	2,253	72	-883	2,199	73	-182
11to12 Bec	7,317	389	3,977	46	381	2,623	64	381	2,395	67	381	1,966	73	-4
12to13 Bec	6,317	29	2,893	54	-22	1,751	72	-22	1,623	74	-22	1,625	74	135
13to14 Bec	6,350	353	2,971	53	162	1,840	71	162	1,726	73	162	1,582	75	16
4toEnda Be	4,325	-386	2,321	46	-202	1,306	70	-202	1,237	71	-202	1,237	71	-58
4toEndb Be	2,756	-149	833	70	-68	510	81	-68	452	84	-68	452	84	-68
Trib1 Bed	389	-33	0	100	-35	0	100	-35	0	100	-35	0	100	-35
Trib2 Bed	139	43	0	100	-4	0	100	-4	0	100	-4	0	100	-4
Trib3 Bed	322	67	0	100	-62	0	100	-62	0	100	-62	0	100	-62
Trib4 Bed	505	161	0	100	-37	0	100	-37	0	100	-37	0	100	-37
Trib5 Bed	4,443	247	2,437	45	301	1,365	69	301	1,365	69	301	1,365	69	301
Trib5a Bed	723	-222	226	69	-104	113	84	-104	113	84	-104	113	84	-104
Trib5b1 Bec	2,958	-264	1,878	37	-229	919	69	-229	919	69	-229	862	71	-286
Trib5b2 Bec	2,327	-129	1,302	44	-74	594	74	-74	594	74	-74	594	74	-17
Trib5b3 Bec	1,566	-44	1,133	28	-28	566	64	-28	566	64	-28	566	64	-28
Trib6 Bed	677	-373	414	39	-267	207	69	-267	207	69	-267	207	69	-267
Trib7 Bed	115	-2	115	0	-2	57	50	-2	57	50	-2	57	50	-2
Trib8 Bed	164	-65	0	100	-14	0	100	-14	0	100	-14	0	100	-14
Trib9 Bed	1,005	64	355	65	19	149	85	19	149	85	19	149	85	29
Trib9a1 Bec	824	25	308	63	46	189	77	46	189	77	46	189	77	46
Trib9a2 Bec	671	-137	238	65	-70	119	82	-70	119	82	-70	119	82	-70
Trib9b Bed	94	-24	0	100	-7	0	100	-7	0	100	-7	0	100	-7
Trib10 Bed	310	-286	310	0	-318	155	50	-318	155	50	-318	155	50	-44
Trib11 Bed	232	-20	0	100	-16	0	100	-16	0	100	-16	0	100	-16
Trib12 Bed	1,078	-183	0	100	-72	0	100	-72	0	100	-72	0	100	-72
3toAa Bed	7,658	242	5,417	29	90	3,815	50	90	3,251	58	90	3,096	60	56
3toAb Bed	5,894	-176	3,825	35	-4	2,735	54	-4	2,346	60	-4	2,157	63	-38
AtoB Bed	3,696	-137	2,312	37	-91	1,676	55	-91	1,435	61	-91	1,298	65	-39
BtoC Bed	1,249	-51	1,070	14	-25	914	27	-25	749	40	-25	618	51	-20
CtoD Bed	548	-351	553	-1	-167	450	18	-167	361	34	-167	328	40	-68
DtoEnd Bec	203	-55	203	0	-60	136	33	-60	115	43	-60	115	43	-27
TribA Bed	626	-48	0	100	-35	0	100	-35	0	100	-35	0	100	-35
TribB Bed	1,128	-62	0	100	-11	0	100	-11	0	100	-11	0	100	-11

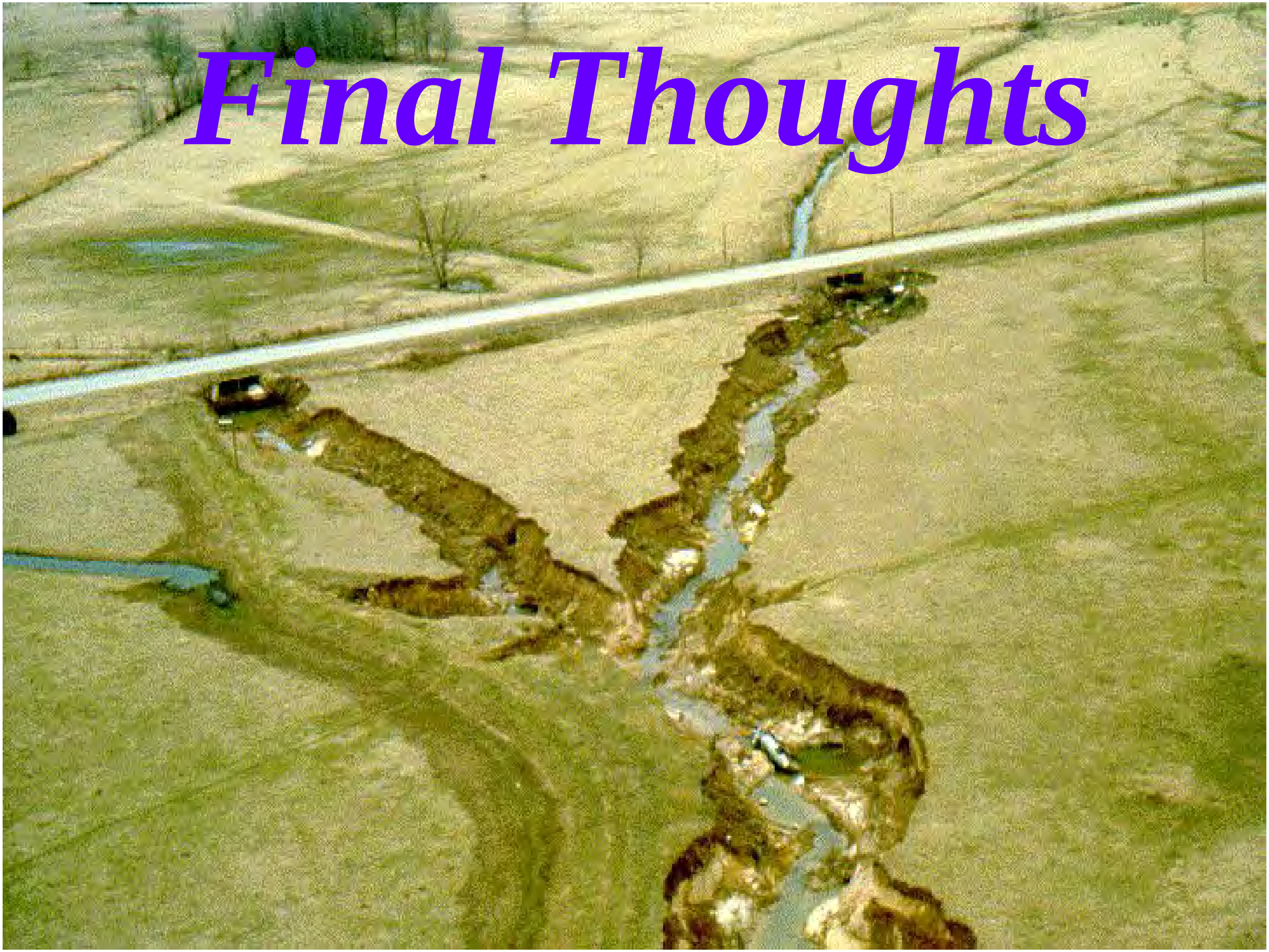
Features of SIAM

- Unique in bridging gap between sediment yield models and sediment transport models
- Separate wash load and bed material load transport processes
- Accounts for change in wash load gradation
- Explicitly allows for input of any sediment source in reach (bank erosion, upland yield, mining, etc.)
- Allows tracking of sediment source to impact
- Evaluates channel stability for each reach for all alternatives

Features of SIAM (cont.)

- Unique in its ability to perform a quantitative analysis on large networks of nested tributaries
- Incorporation in HEC-RAS for ease of use
- Easily scalable for different levels of detail
- Multiple management alternatives can be rapidly evaluated
- Sensitivity analyses can be quickly performed
- Changes in hydrology or hydraulics easy to evaluate
- Easy update for long-term sediment management

Final Thoughts



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Geomorphology Study of the Middle Mississippi River

APPLIED RIVER ENGINEERING CENTER

US Army Corps of Engineers
St. Louis District

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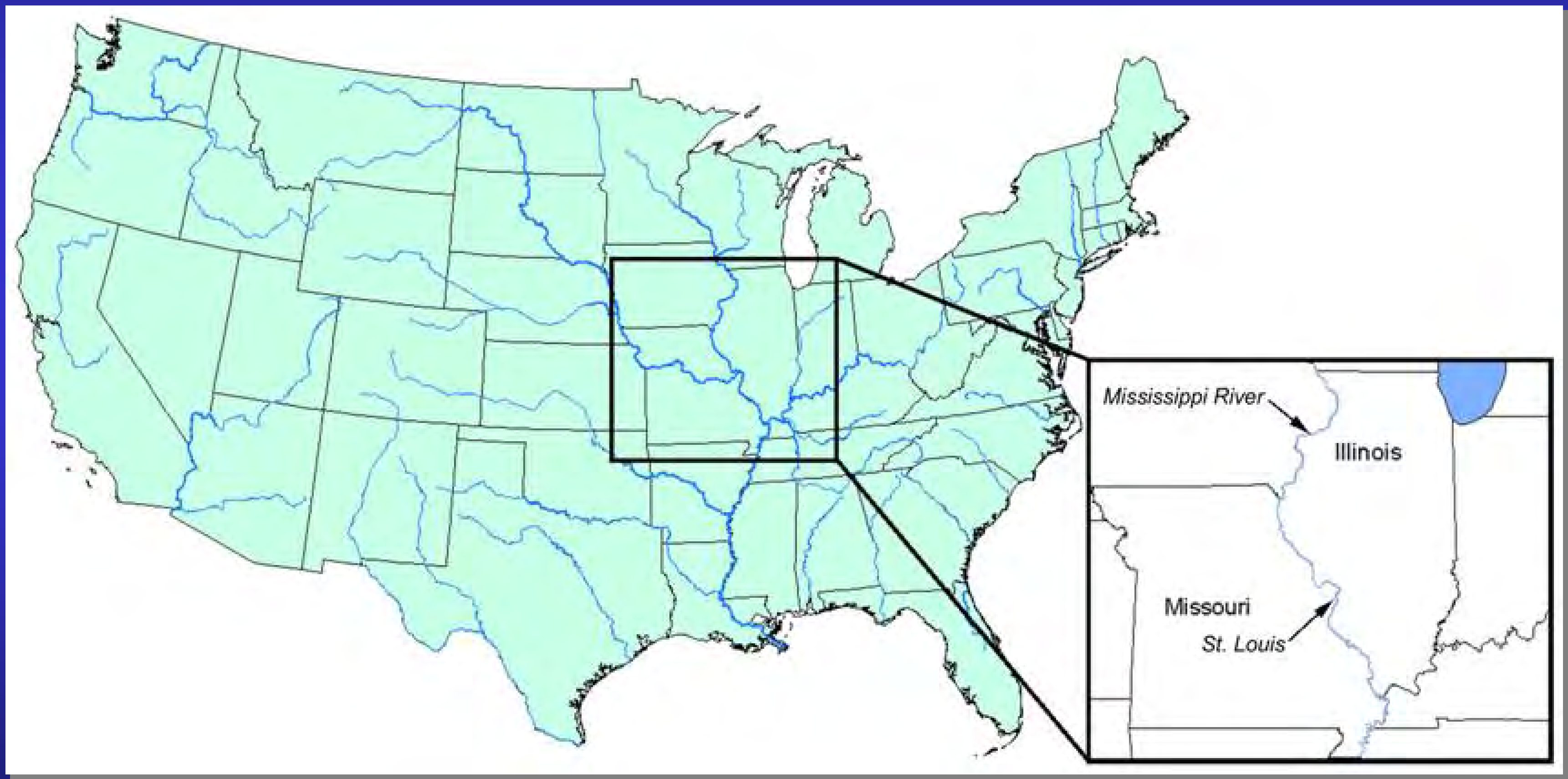
Study Reach



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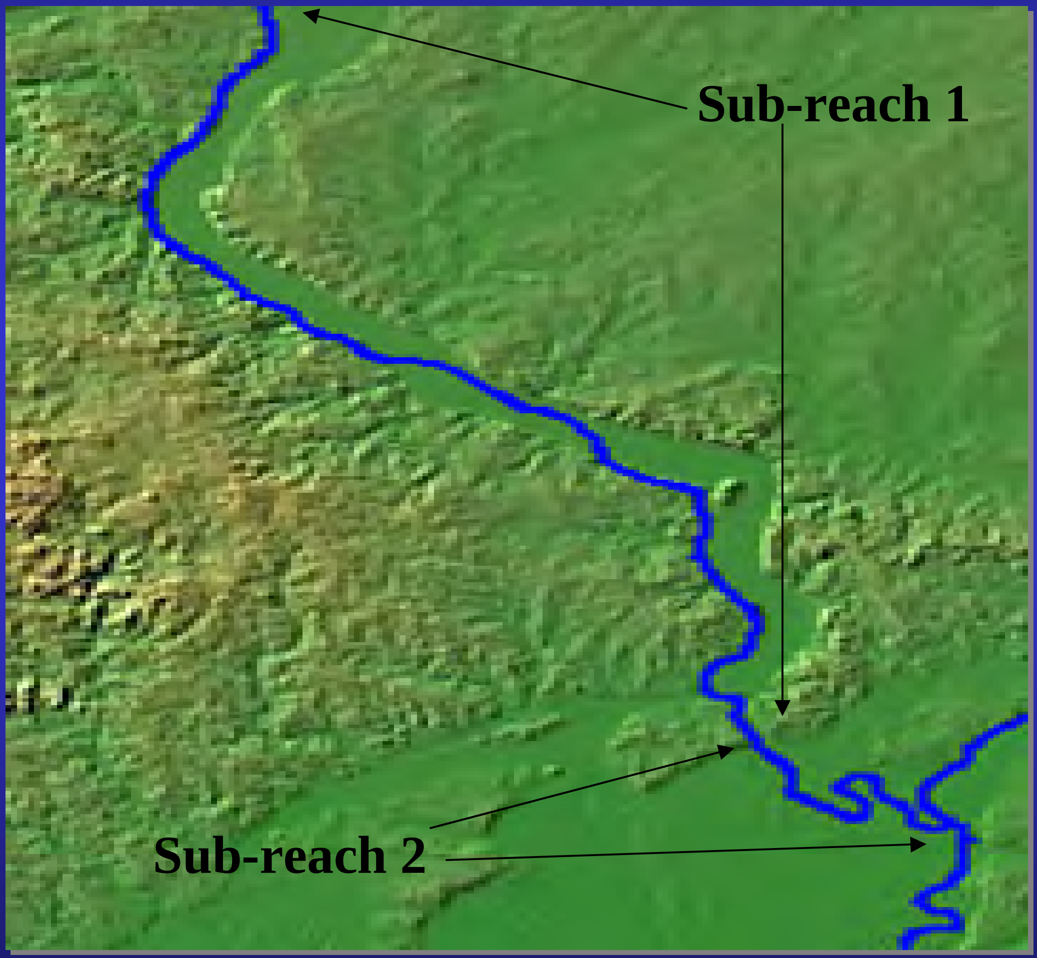
Study Reach



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Sub-Reach 1 (Mi 40-180)

- Floodplain Width Between 10,000’-40,000’
    - Average= 31,000
- Channel Width Between 1400’-3800’
- Floodplain Width to Channel Width Ratio Between 7-10
- Mildly sinuous canaliform
    - Narrow crescent-shaped point bars
    - Notably uniform width
    - Lack of braiding
    - Low to moderate sinousity
- Alluvium: Fine Sands, Silts, Clays

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Sub-Reach 2 (Mi 0-40)

- Floodplain Width Between 10,300'- over 500,000'
  - Average= 333,000'
- Channel Width Between 1,000'-7,000'
- Floodplain Width to Channel Width Ratio Between 5-200
- Highly Sinuous Point Bar Canaliform
  - Prominent point bars
  - Lower bank erosion resistance compared to sub-reach 1
- Average Slope in Both Sub-Reaches is Approximately 0.5'/mile

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Early History

Marquette and Jolliet paddled down the Mississippi River 1673

City Of St. Louis

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Annual Steamboat Arrivals

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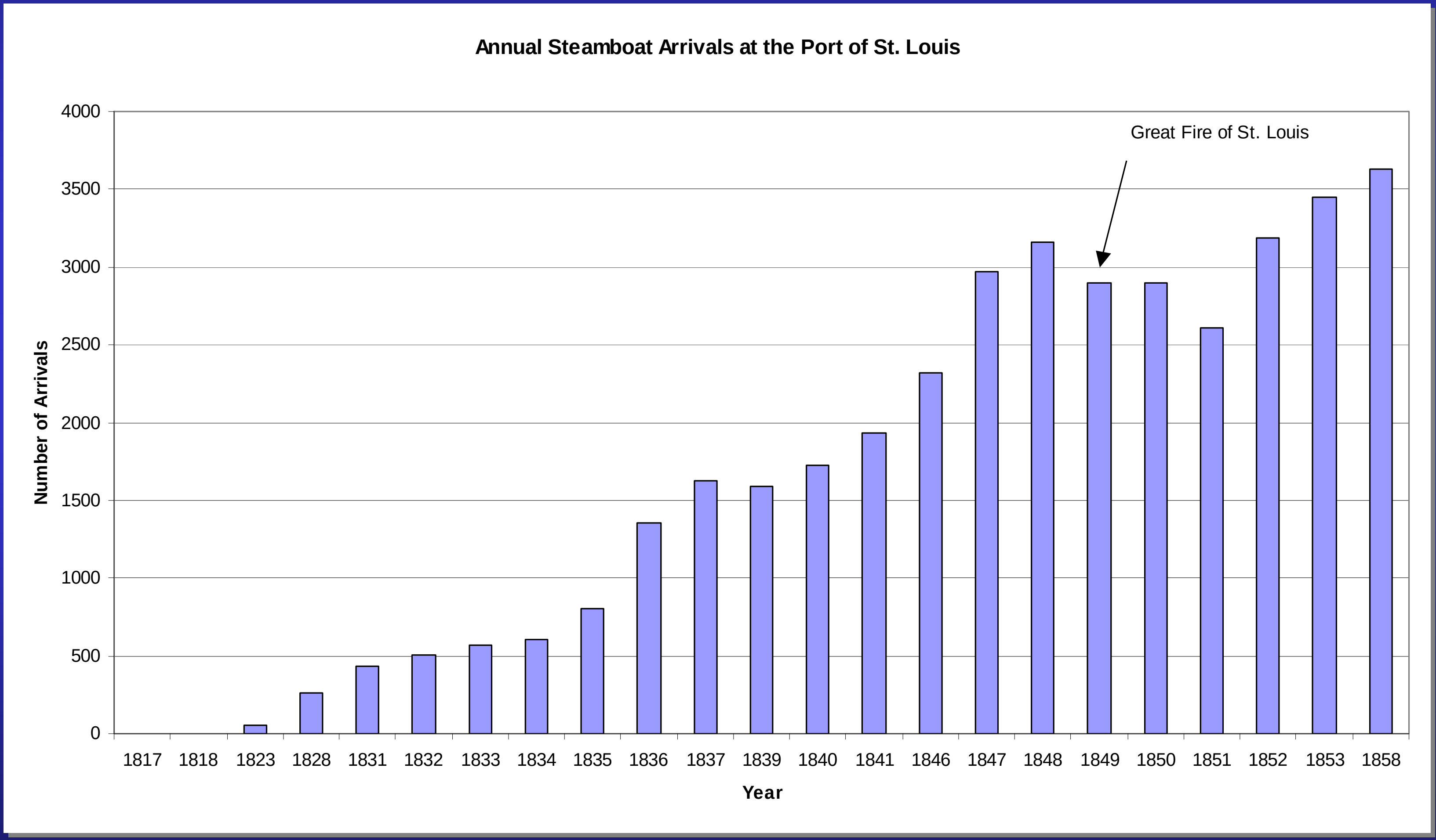

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US Army Corps of Engineers

City of St. Louis 1859

US Army Corps of Engineers

Dangers

"the Mississippi changes its channel so constantly that the pilots used to always find it necessary to run down to Cairo to take a fresh look, when their boats were to line in port for a week; that is, when the water was at a low state"

- Mark Twain

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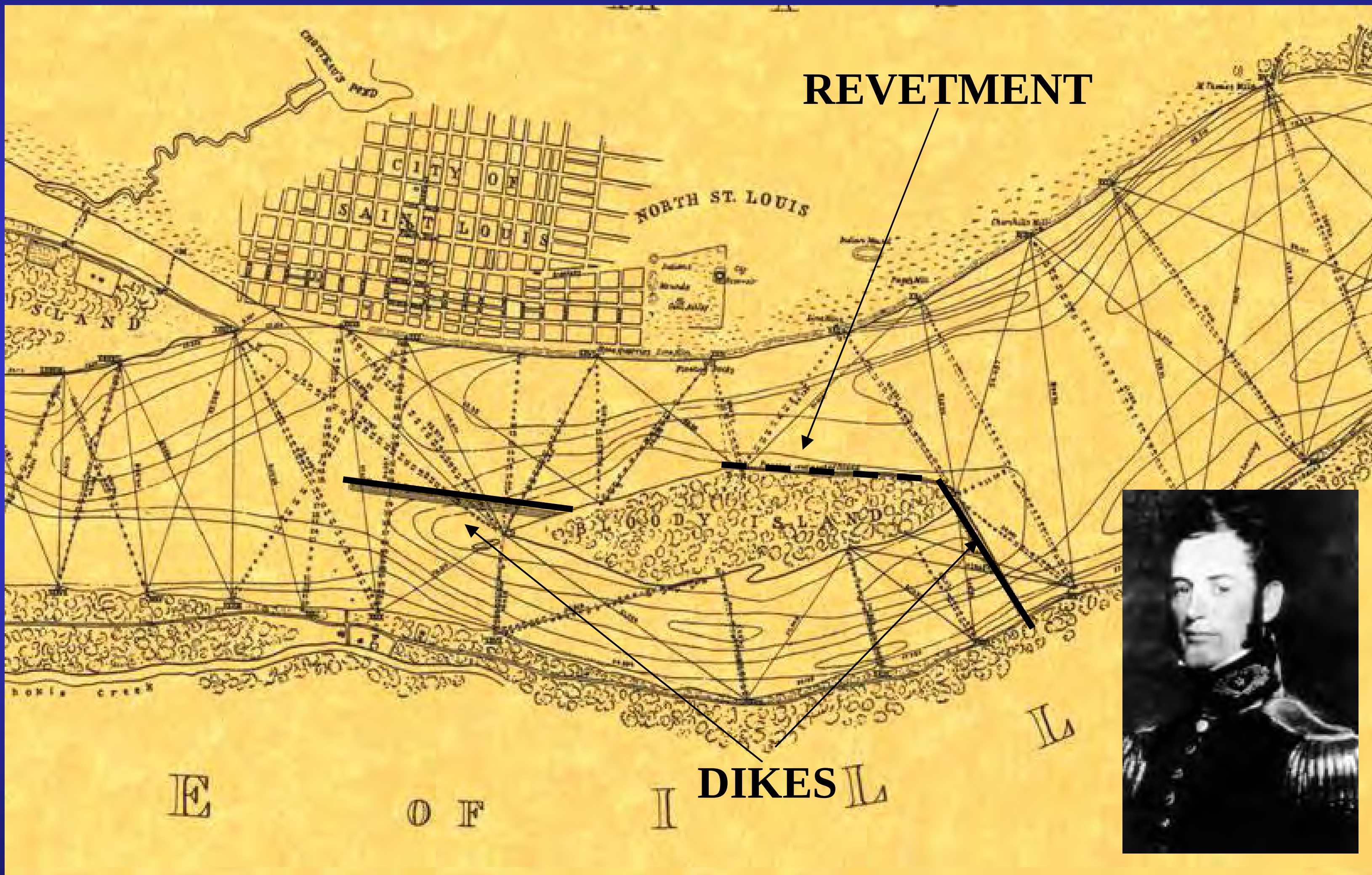
River Training Structures



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Mississippi River Commission

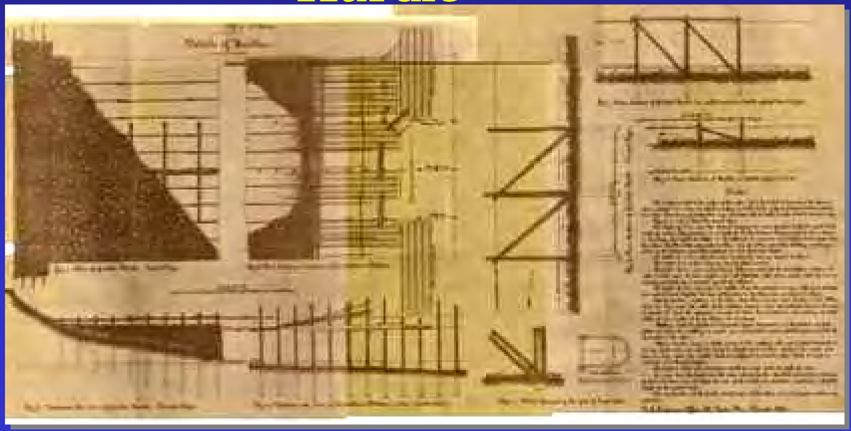
- Formed in 1879
- To "improve and give safety and ease to navigation" and "prevent destructive floods" on Mississippi River
- All Members were appointed by the President of the United States and confirmed by the Senate
- All work done through the U.S. Army Corps of Engineers

MRC Master Plan

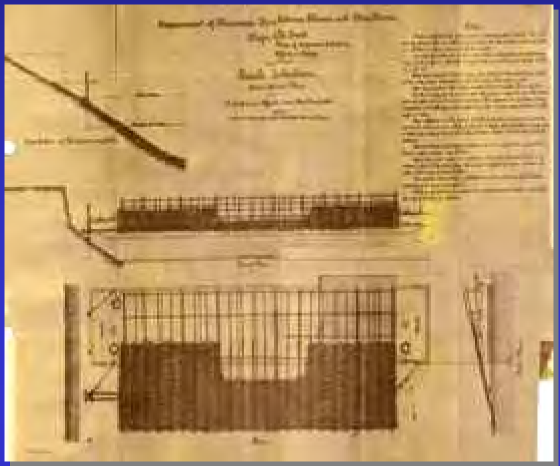
- "To make the improvement continuous, working downstream from St. Louis, by reclaiming land and building up new banks, thus reducing the width of the river to the uniform width of about 2500 feet"
- Construction was intended to "simply restore what once existed, and to do it in such a way that the restoration shall be permanent"

River Training Structures

Hurdle



Willow Weave Mattress



Workers Constructing Pile Dikes

Hand Placing Stone Riprap

Environmental River Engineering

US Army Corps of Engineers

Bolters Bar, Pool 26, River Miles 226 – 225

The Bolters Bar Project has:

- **Eliminated 2 years of dredging thus far**
- **Improved alignment for navigation**
- **Created unique aquatic habitat**
- **Maintained access to the side channels for recreational boaters**

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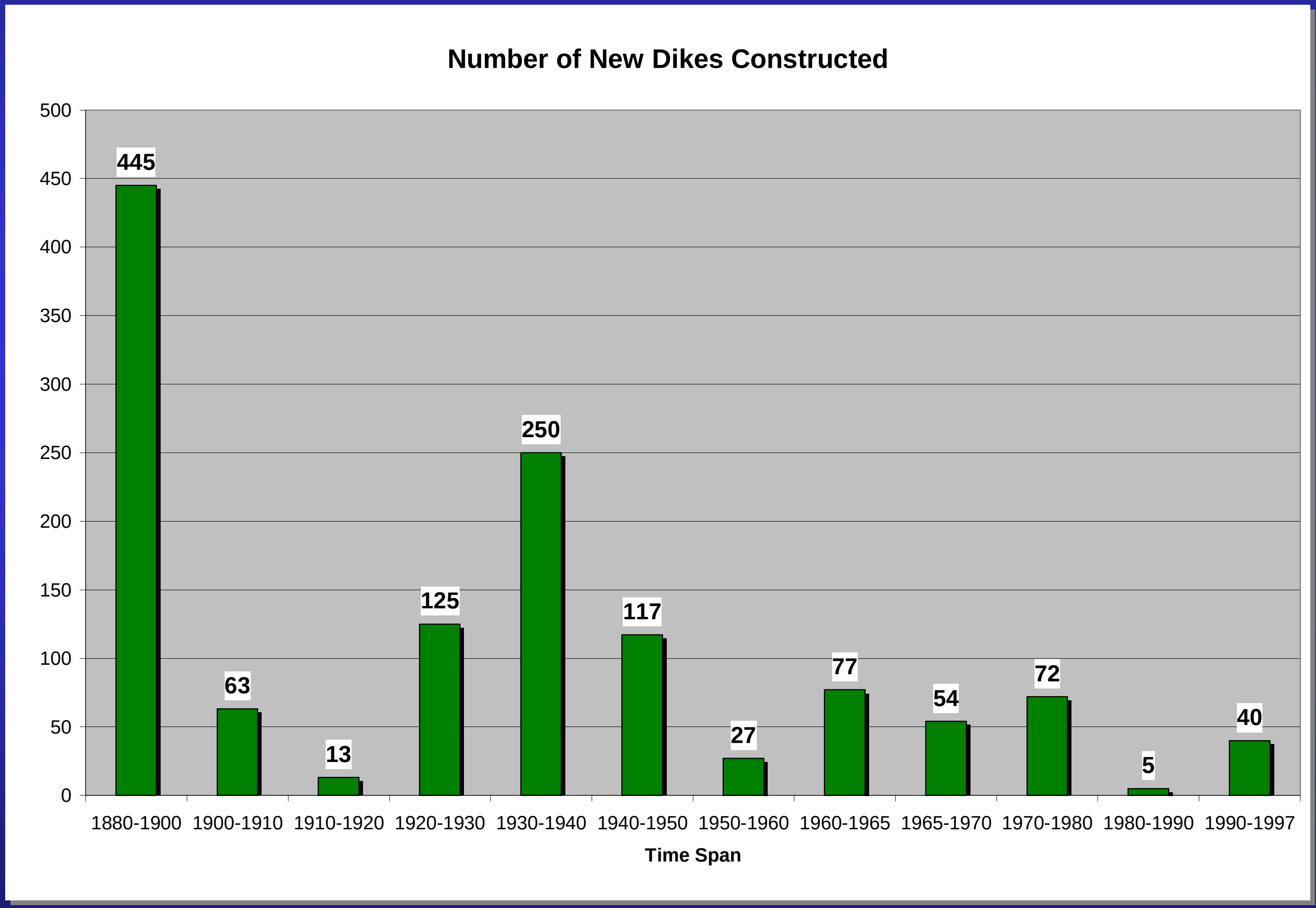
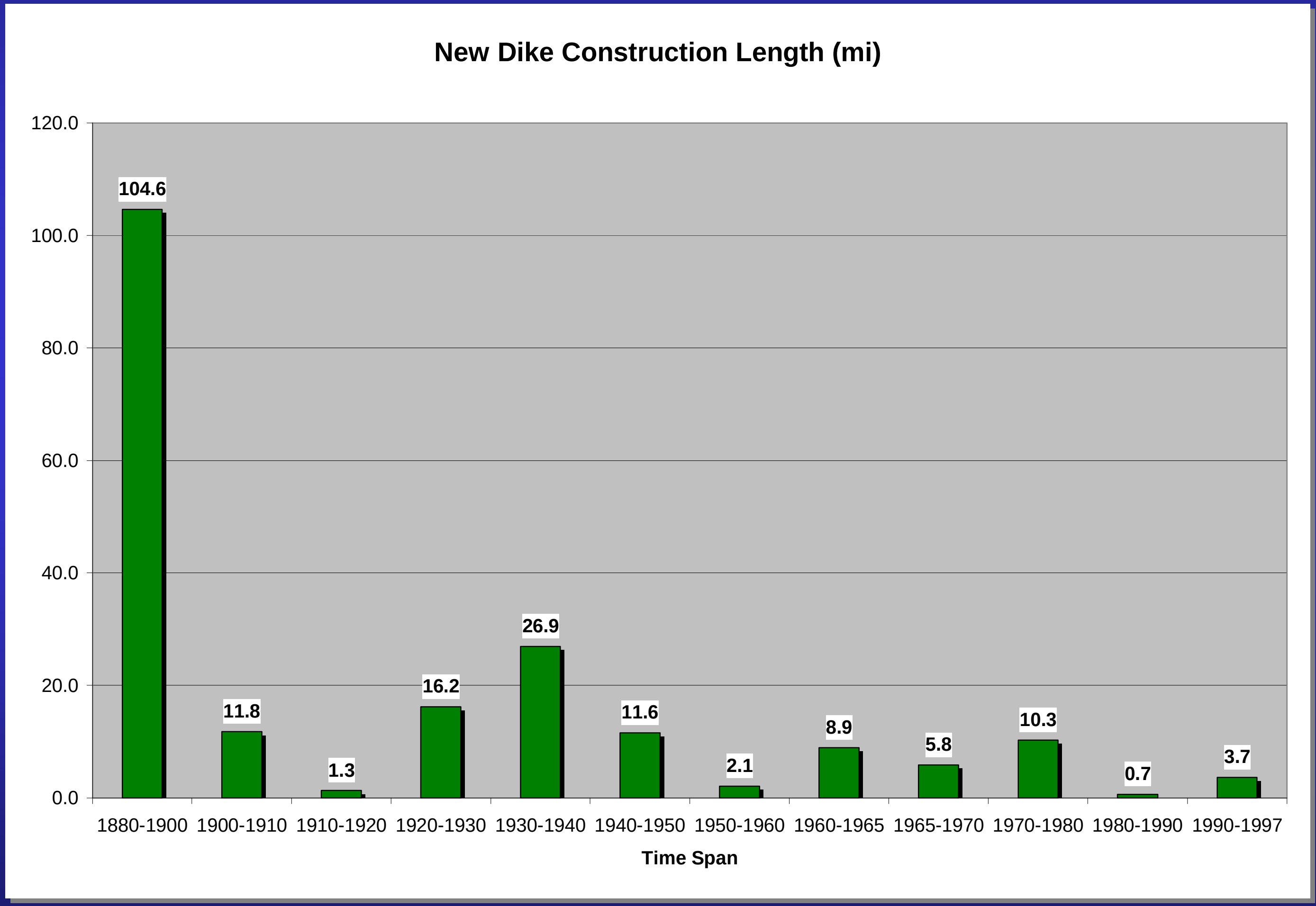
Number of New Dikes Constructed



New Dike Construction



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Geomorphology Study

- **Primary Goals:**
  - **Define and Develop a Detailed Historical Baseline of the Mississippi River Prior to the Steamboat Era to Qualitatively and Quantitatively Compare the "undisturbed" River to the Modern Day River**
  - **Develop Conclusions to be Used to Formulate Ideas that May Influence Future Environmental Initiatives**

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Available Maps & Data

- **Task was accomplished by Researching all Available Records and Maps in Order to Find the Most Complete and Accurate Historical Data of the Mississippi River**

- **Requirements of Accuracy and Completeness made Task Difficult**
  - **Many Early Maps Were Either Rough Maps (sketches) or Maps of a Particular Reach**

Creating the Planforms

- Raw Data was Digitized Using a Flatbed Scanner
- Images were Georeferenced
  - Georeferencing is the process of putting digitized images into their correct place in space by matching known points
- Georeferenced Images Were Used to Accurately Digitize Bank Locations, River Widths, Dike Locations, Weir Locations and Island Locations

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Government Land Office Surveys

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1817 Planform

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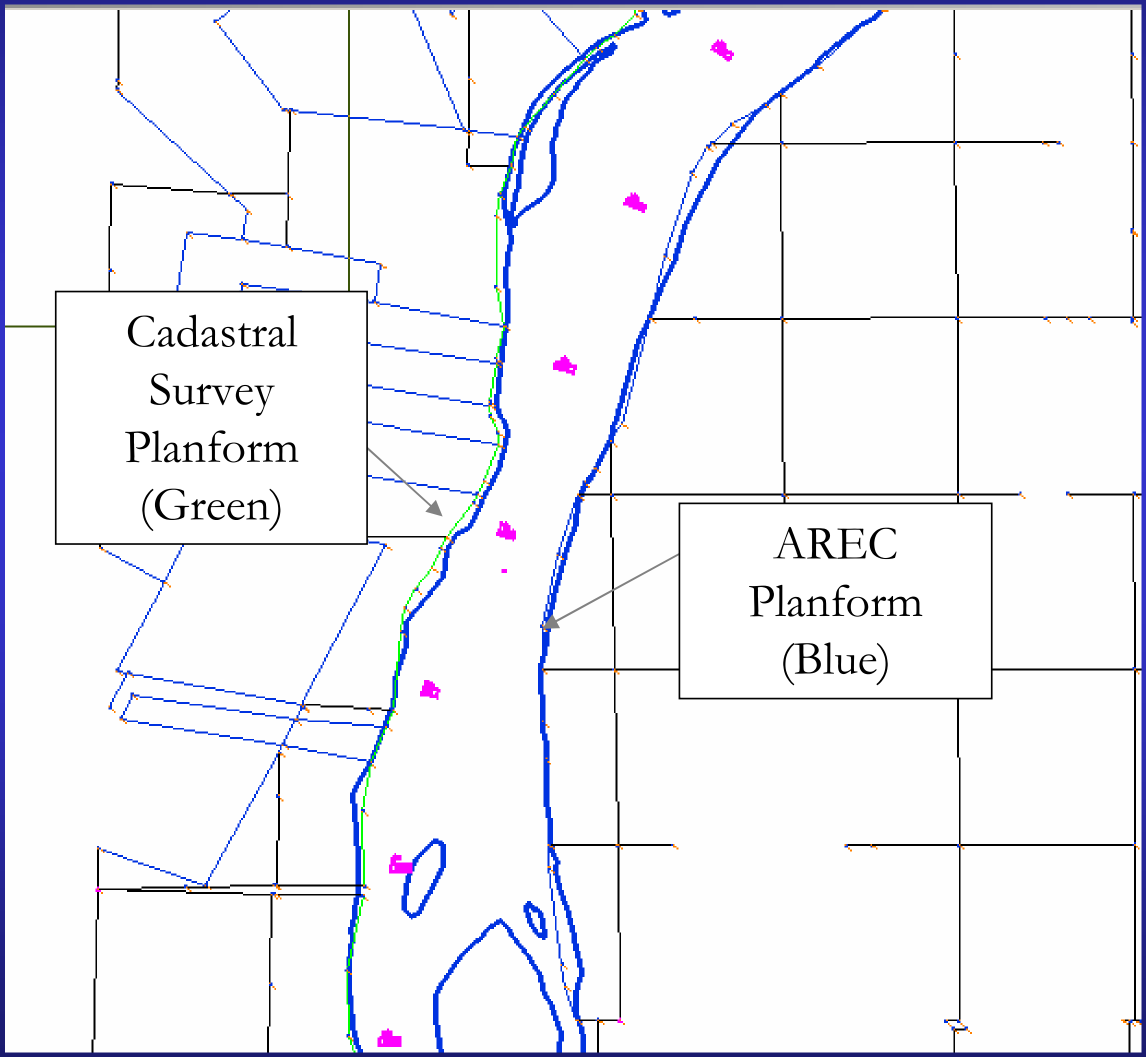
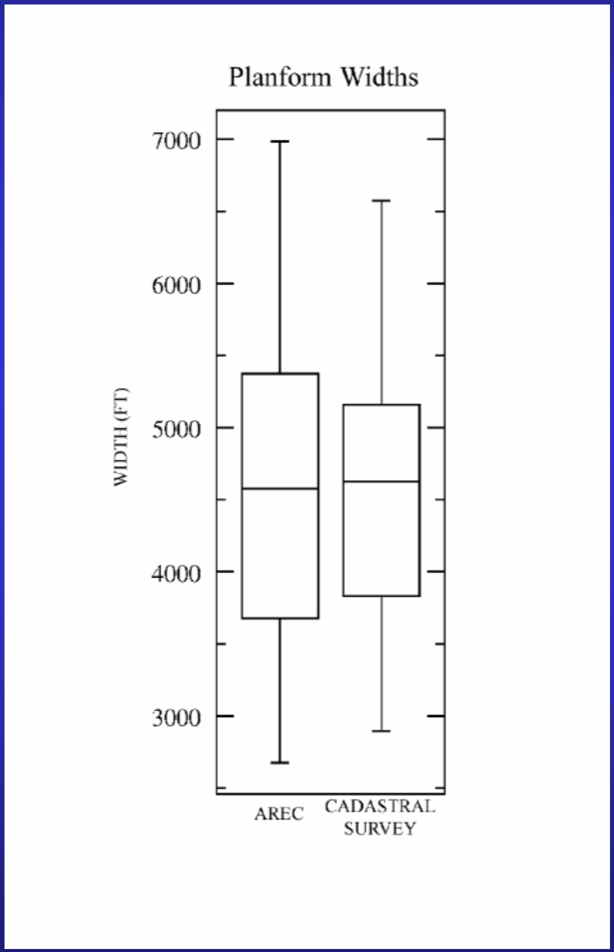
Cadastral Survey



Unpaired t-Test



River Widths Measured at ½ Mile Increments

t-value=0.011907

P-value=.99

AREC planform in substantial agreement with cadastral survey

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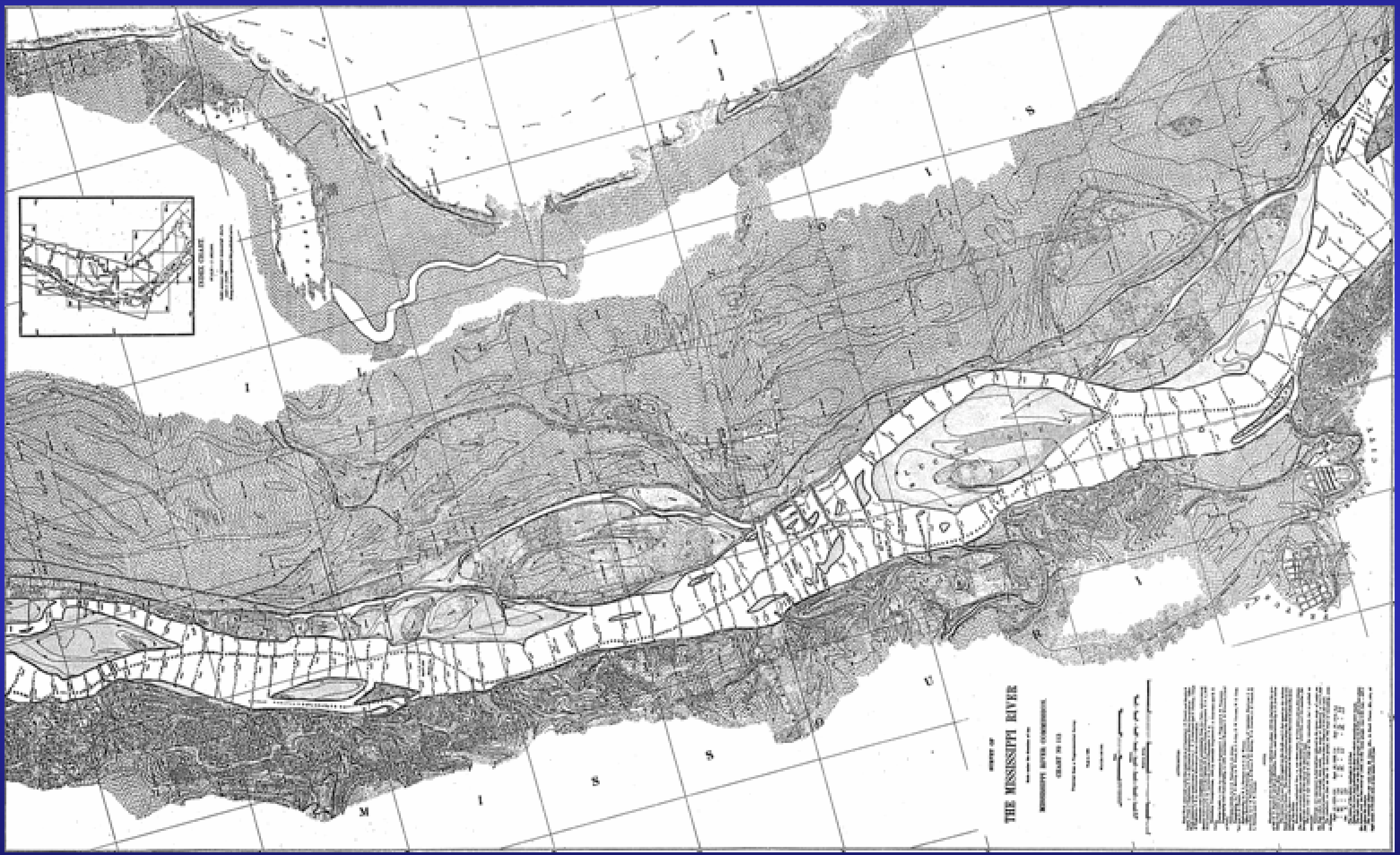
MRC Survey



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Aerial Photographs

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Physical Changes

- Planforms were analyzed using ArcMap
- River Width was defined as the distance between the vegetated banks observed on all maps taken normal to the general direction of flow in the river
- Widths were measured at approximately one-half mile increments along the centerline of the planform

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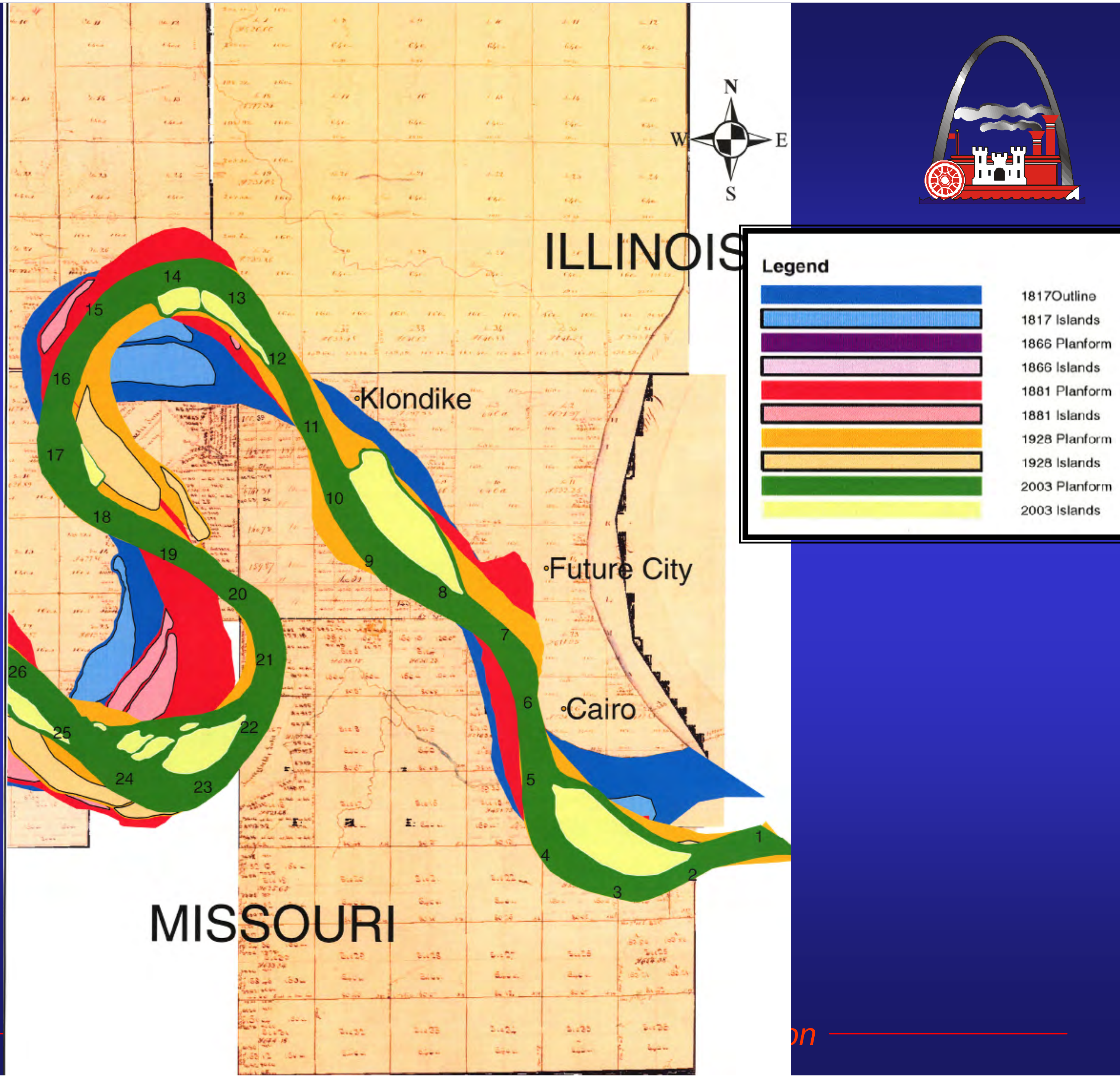

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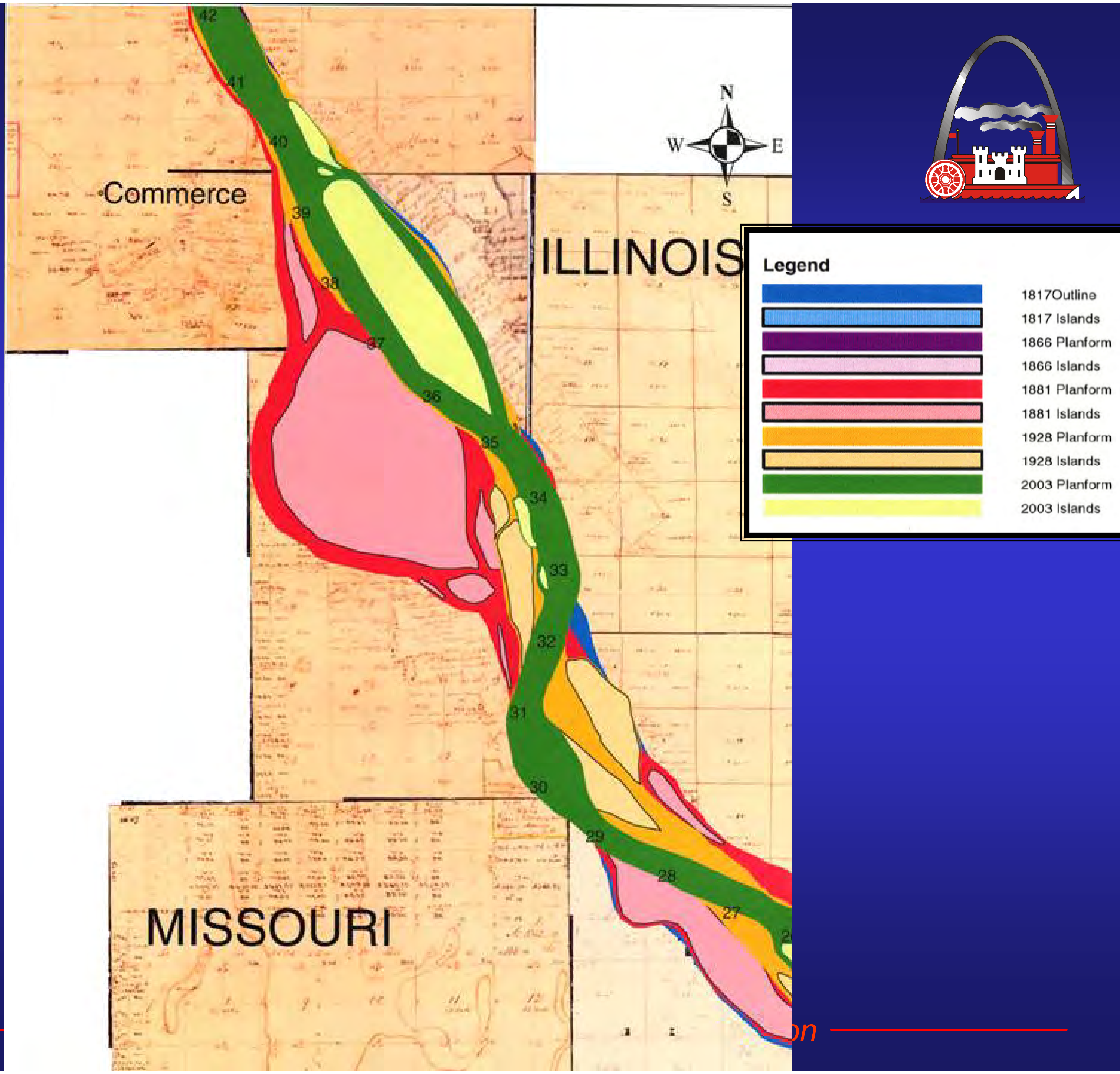

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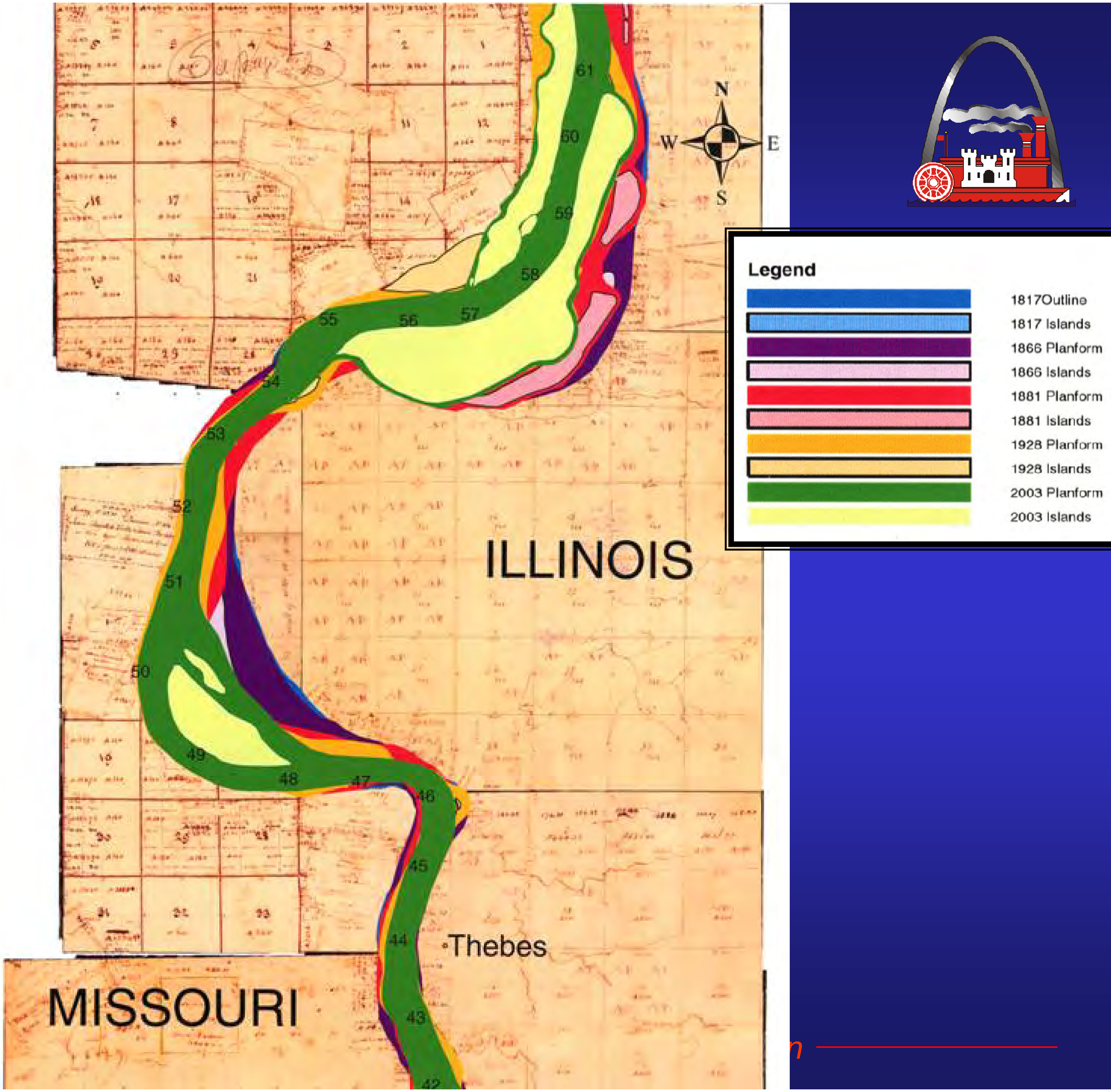

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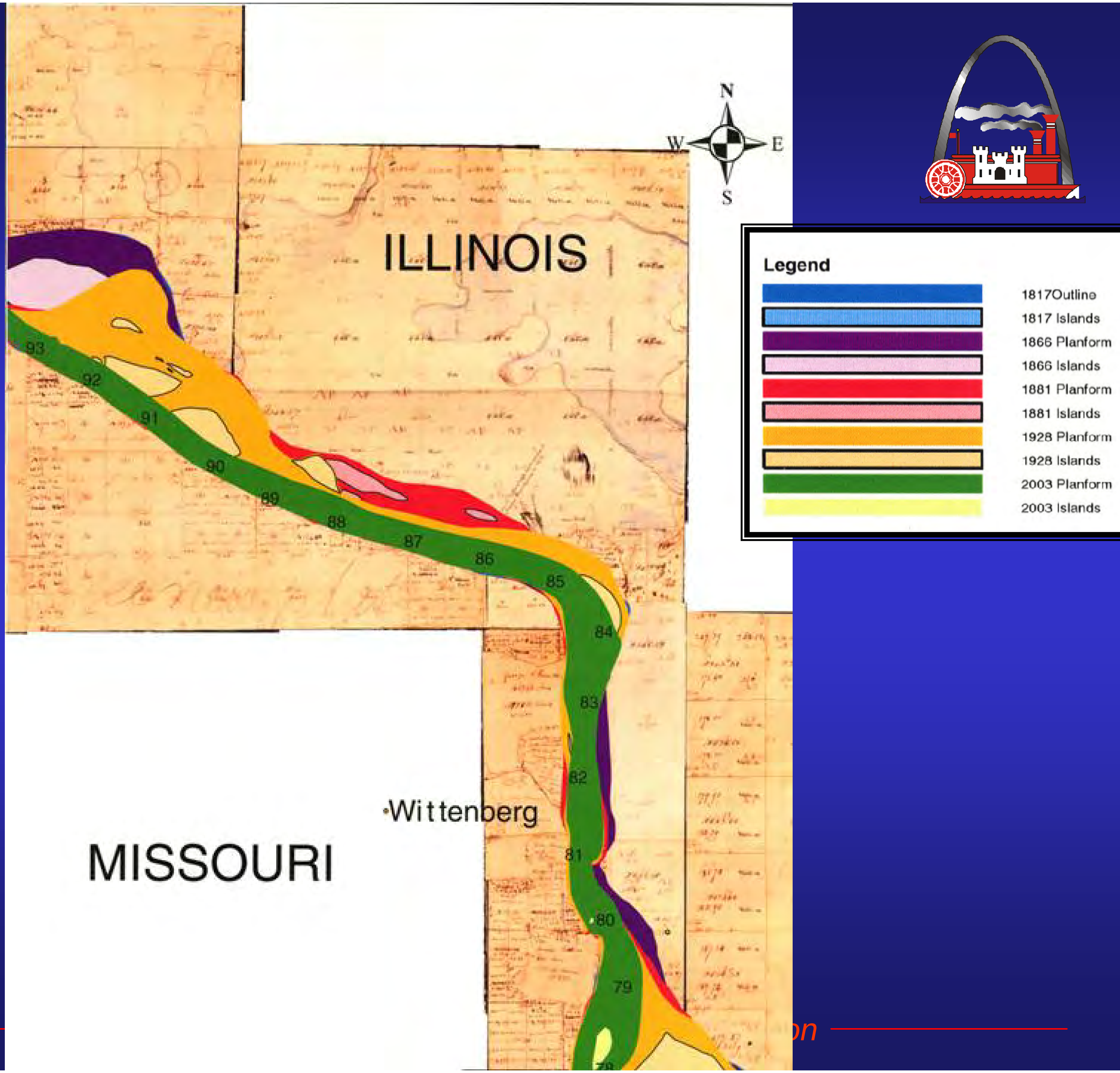

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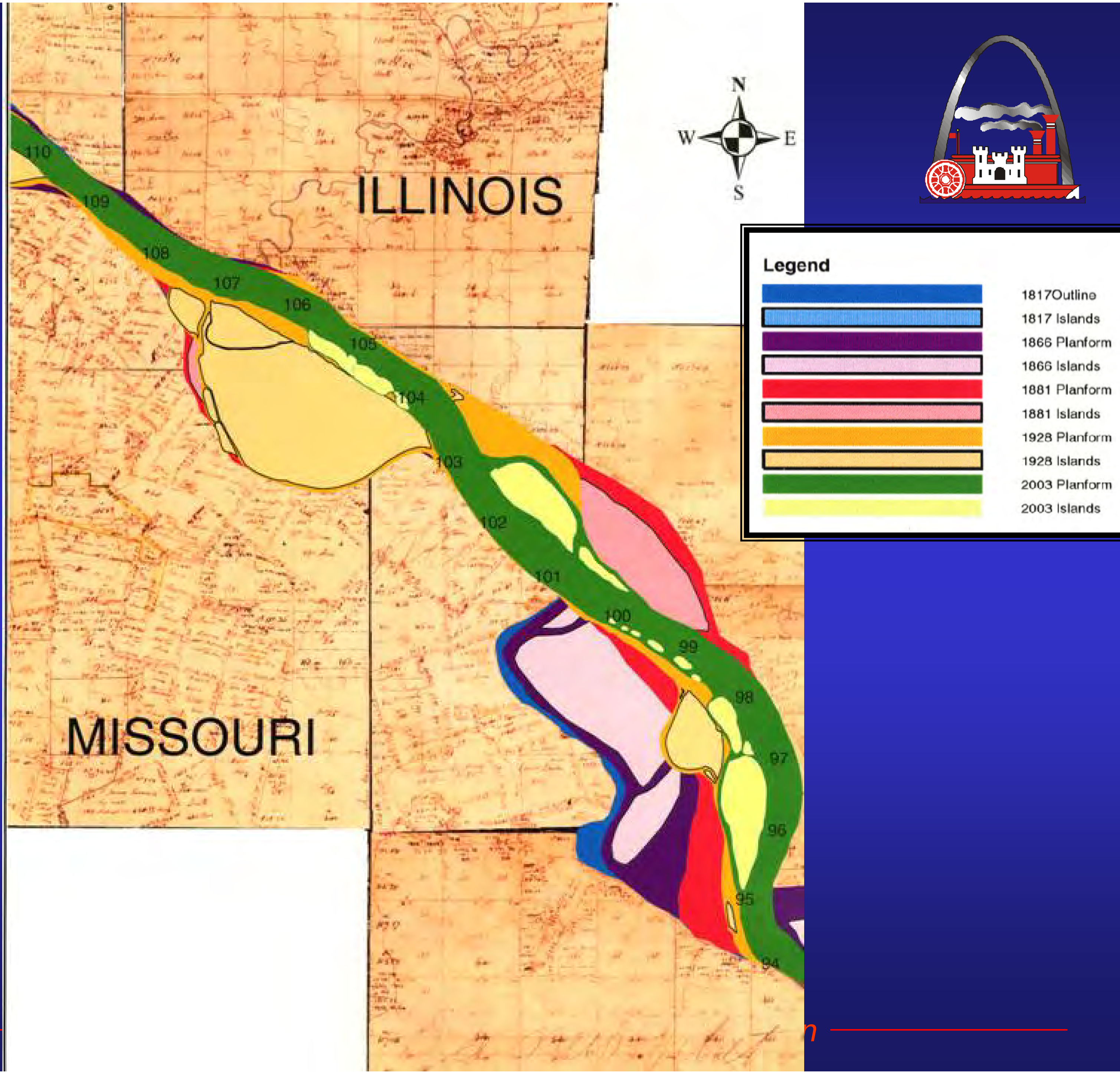

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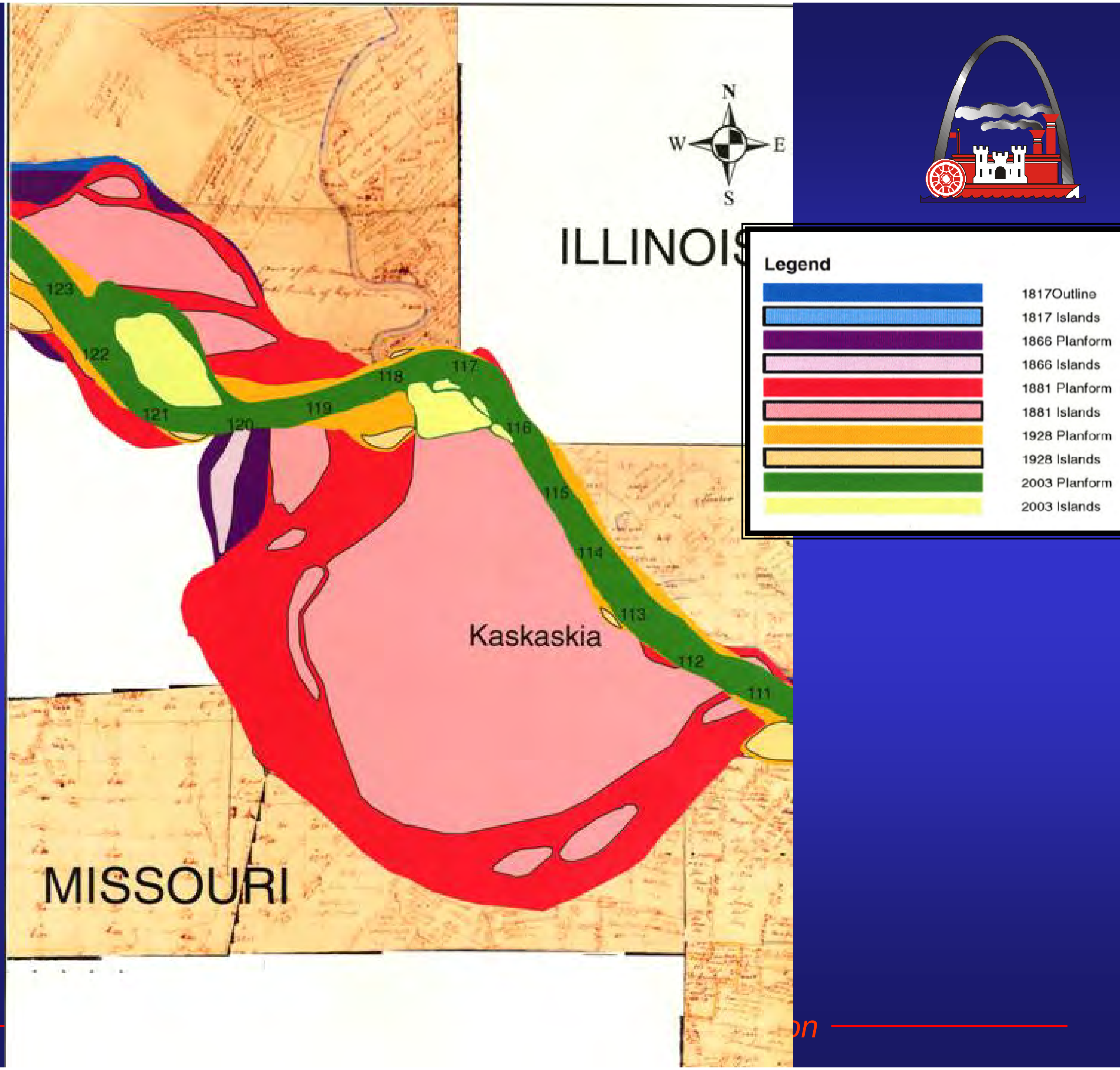

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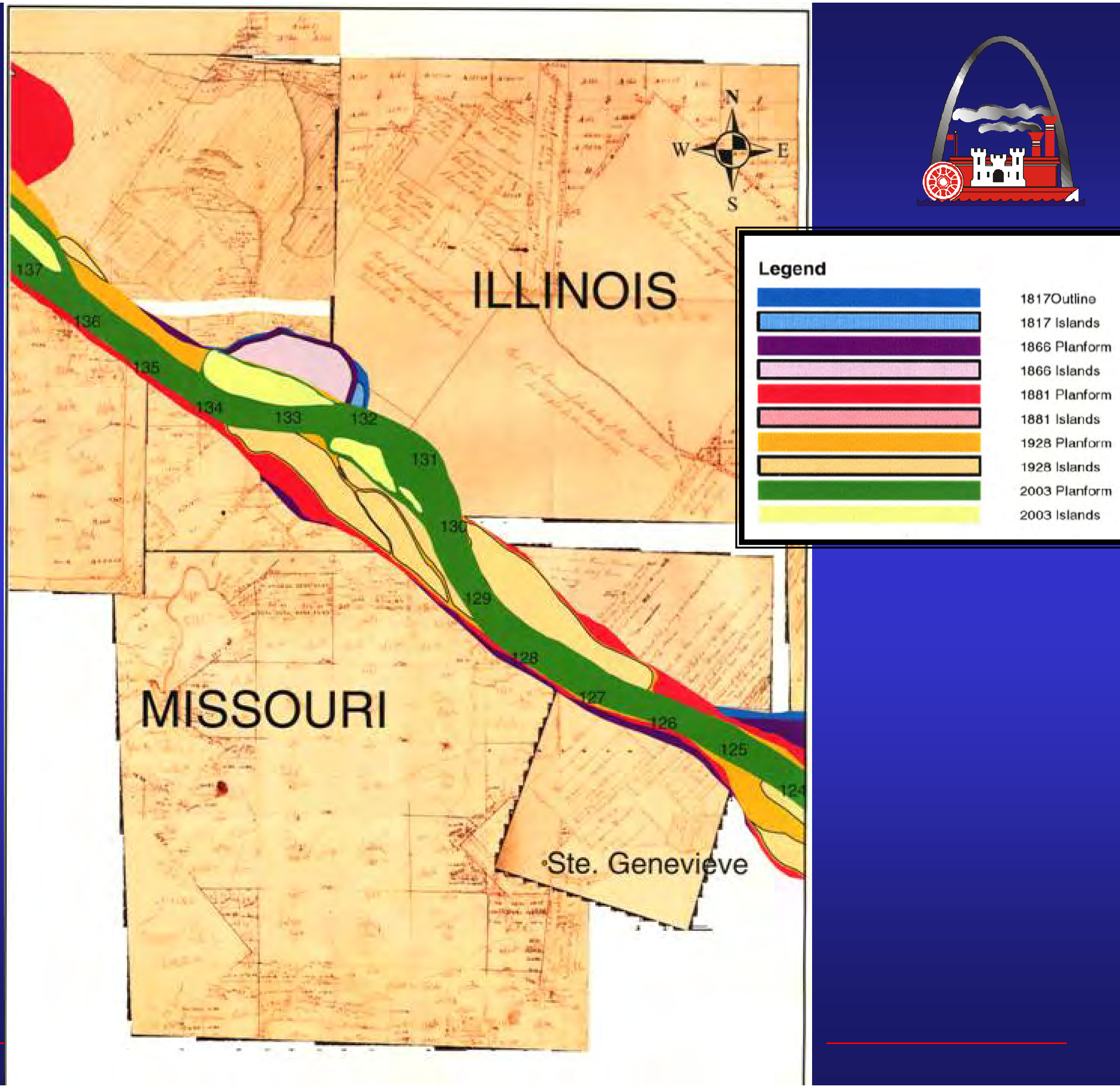

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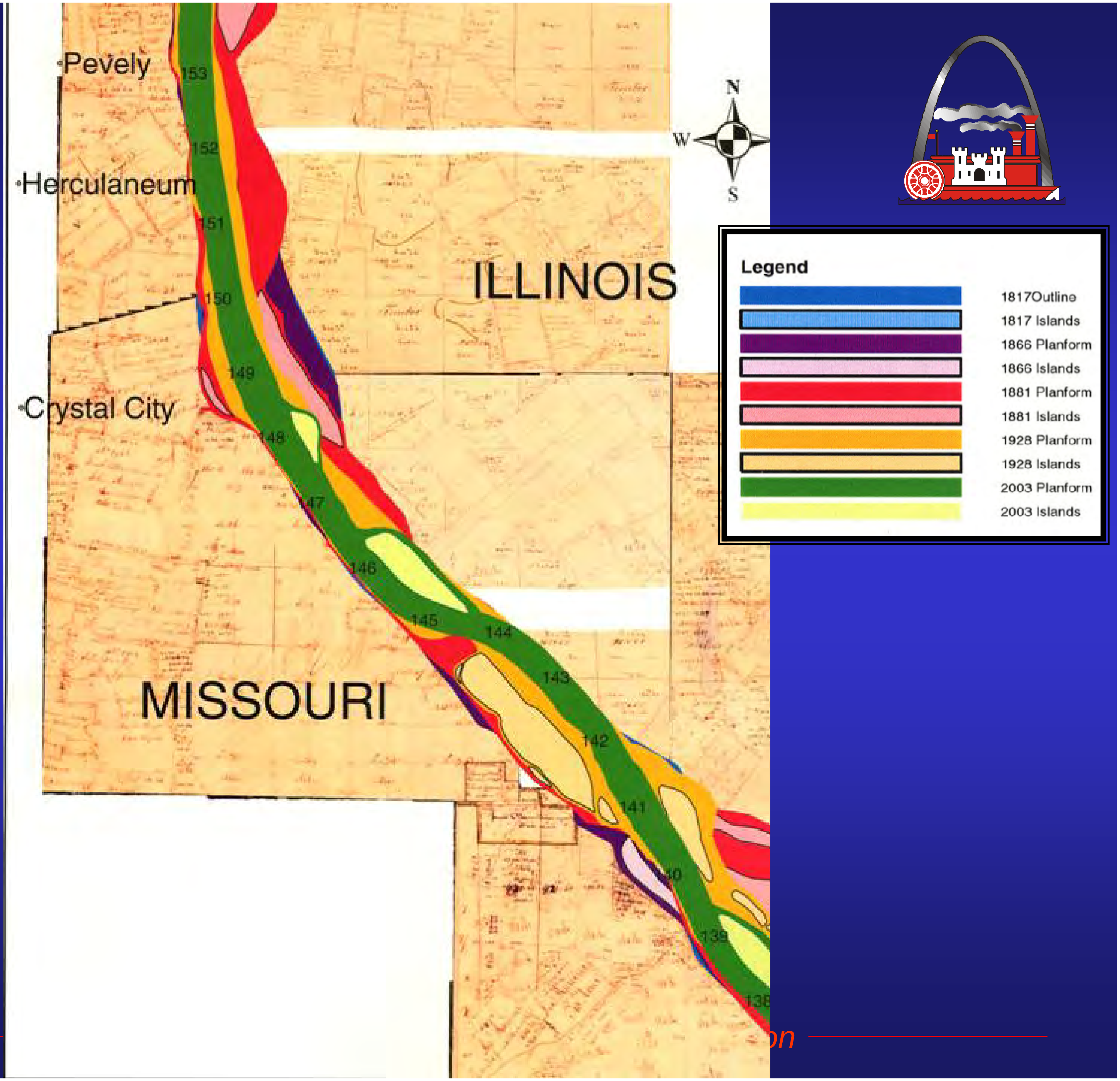

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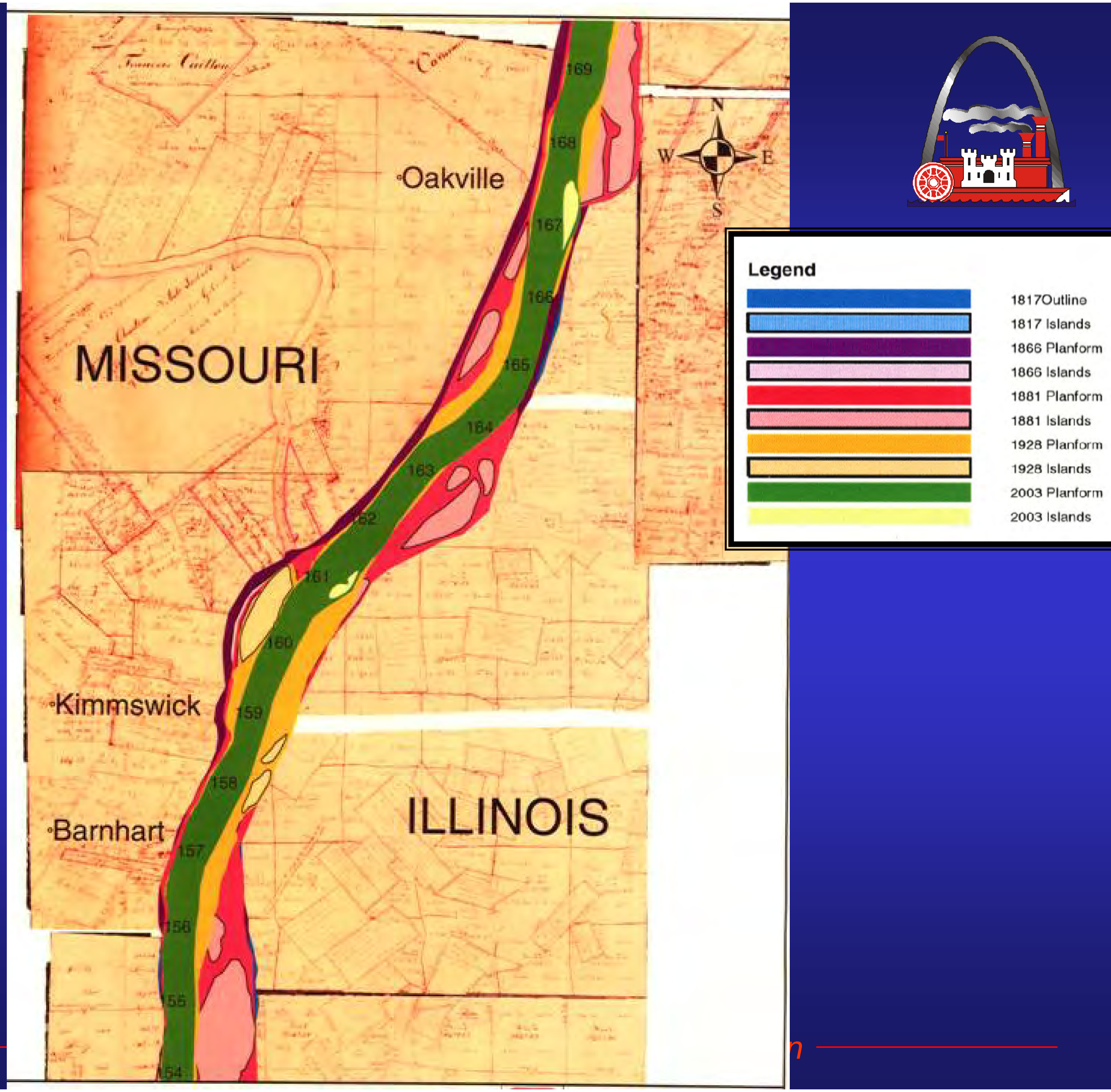

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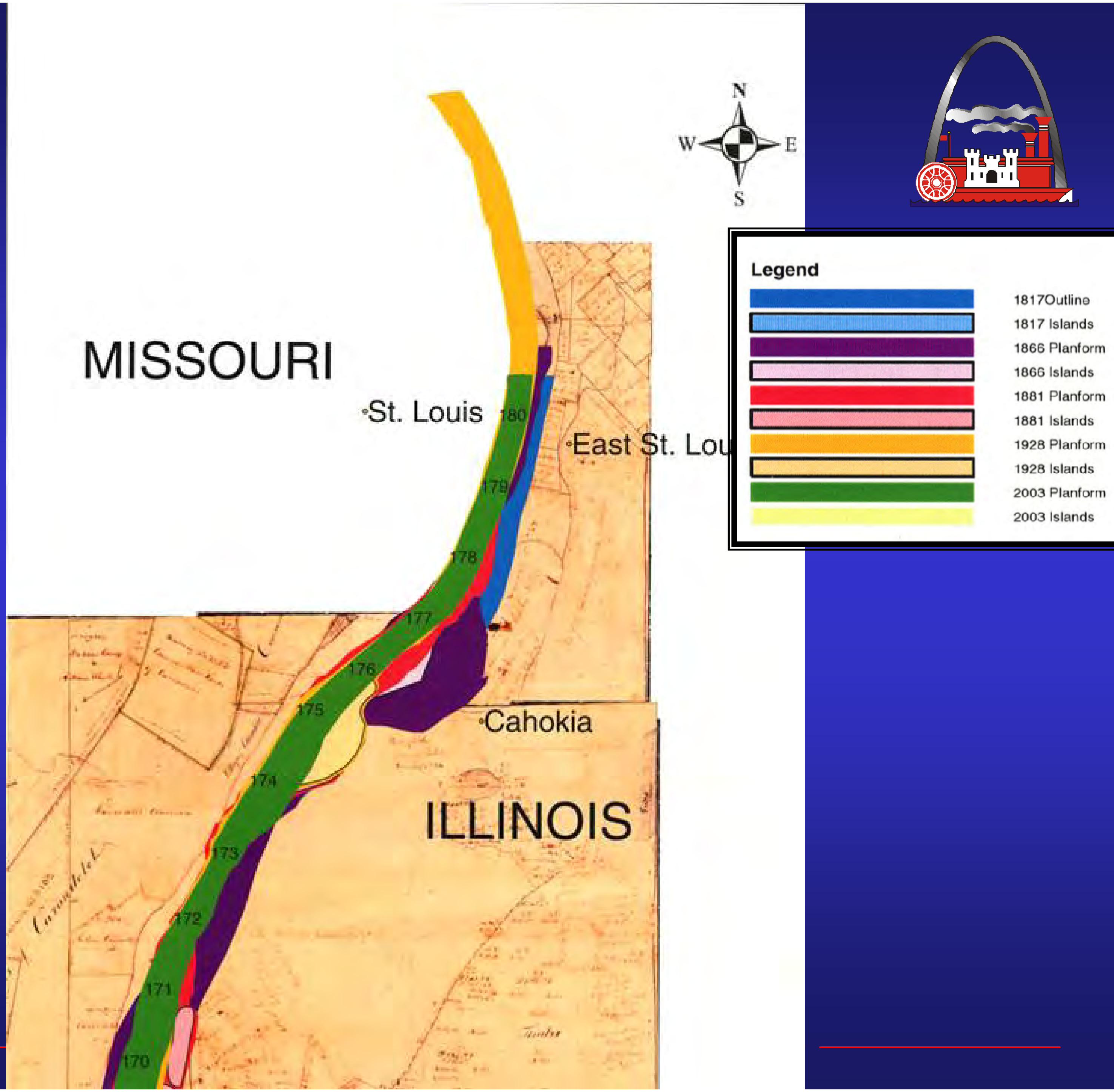

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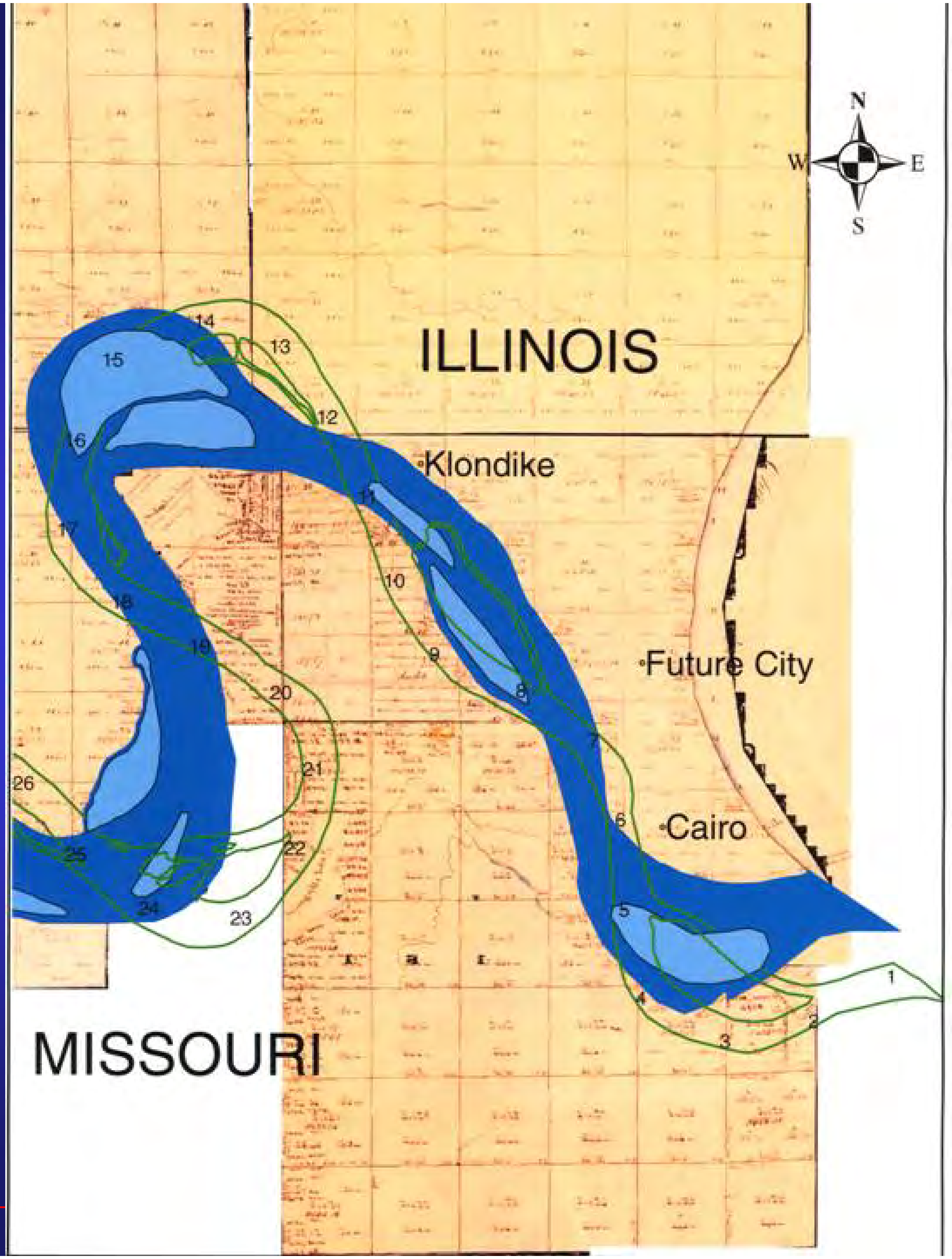

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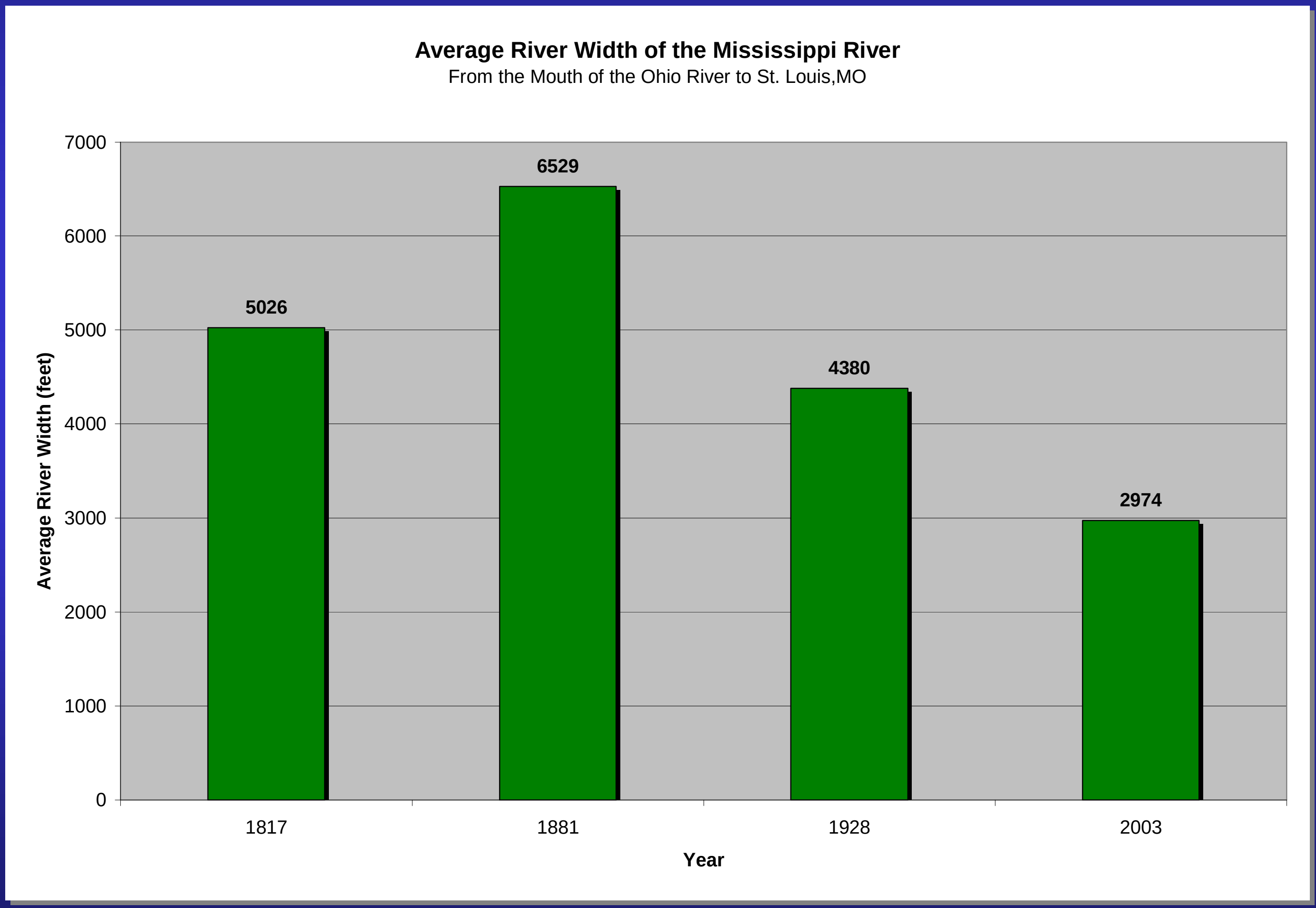
Average Planform Width



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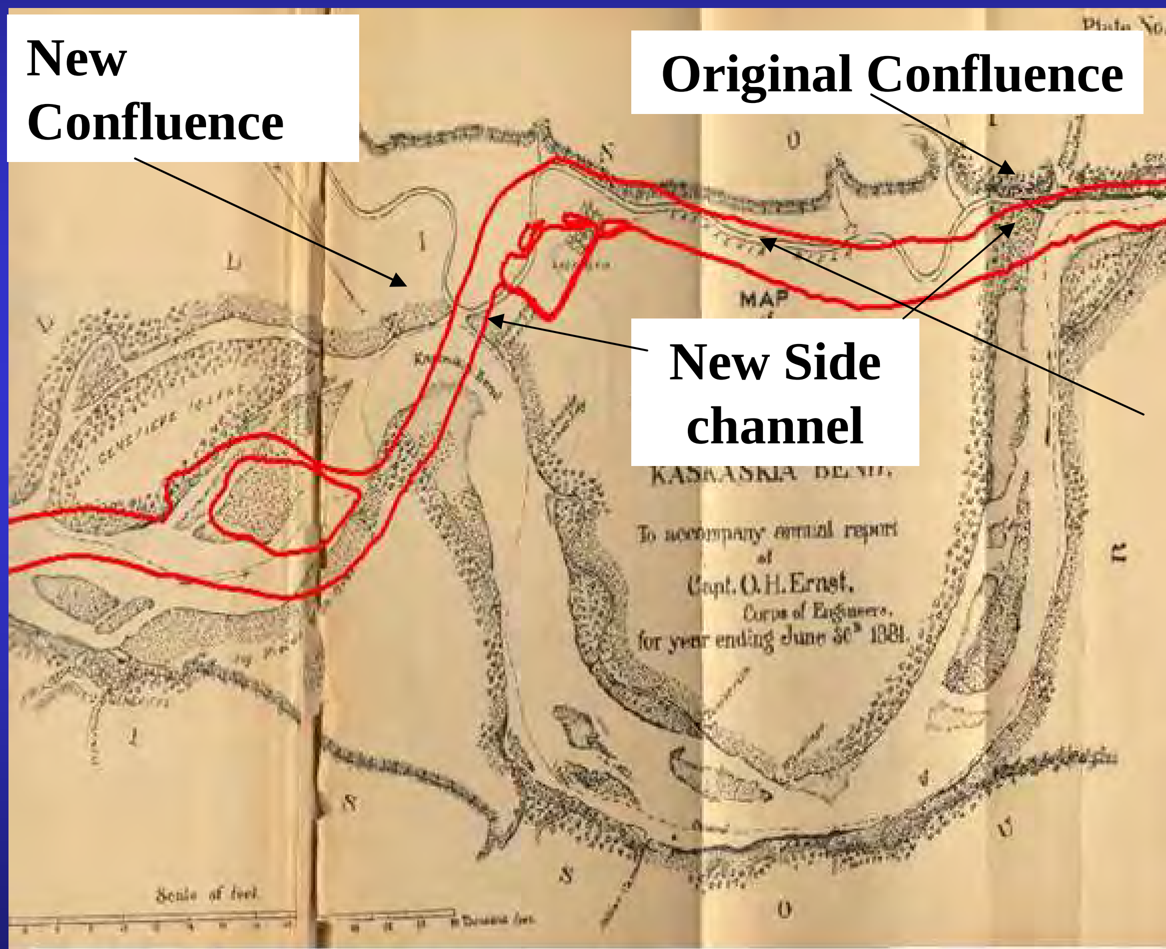
Kaskaskia River Capture



Approximate Location of 2003 Planform

Average River Width Excluding the Kaskaskia Island reach

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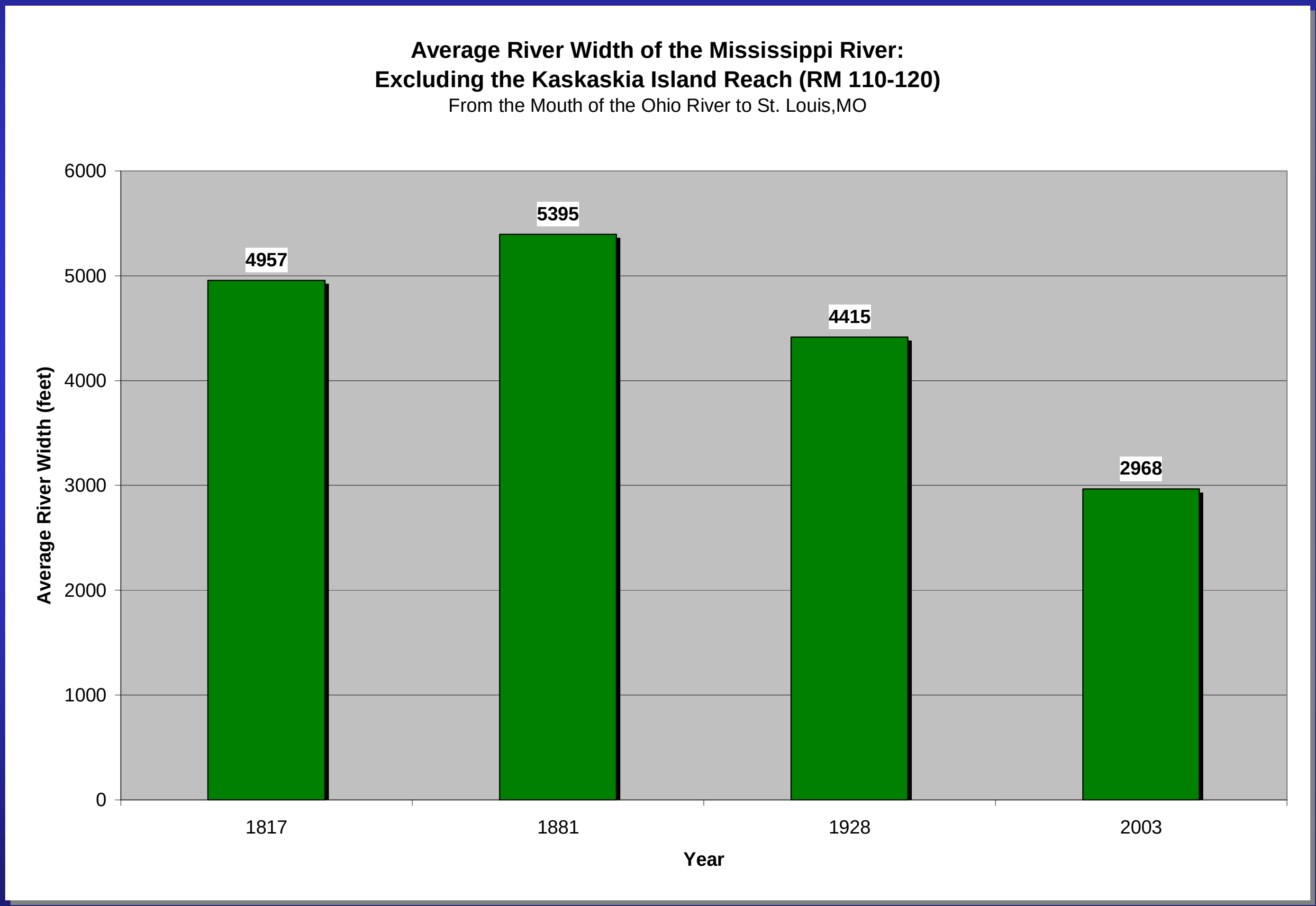

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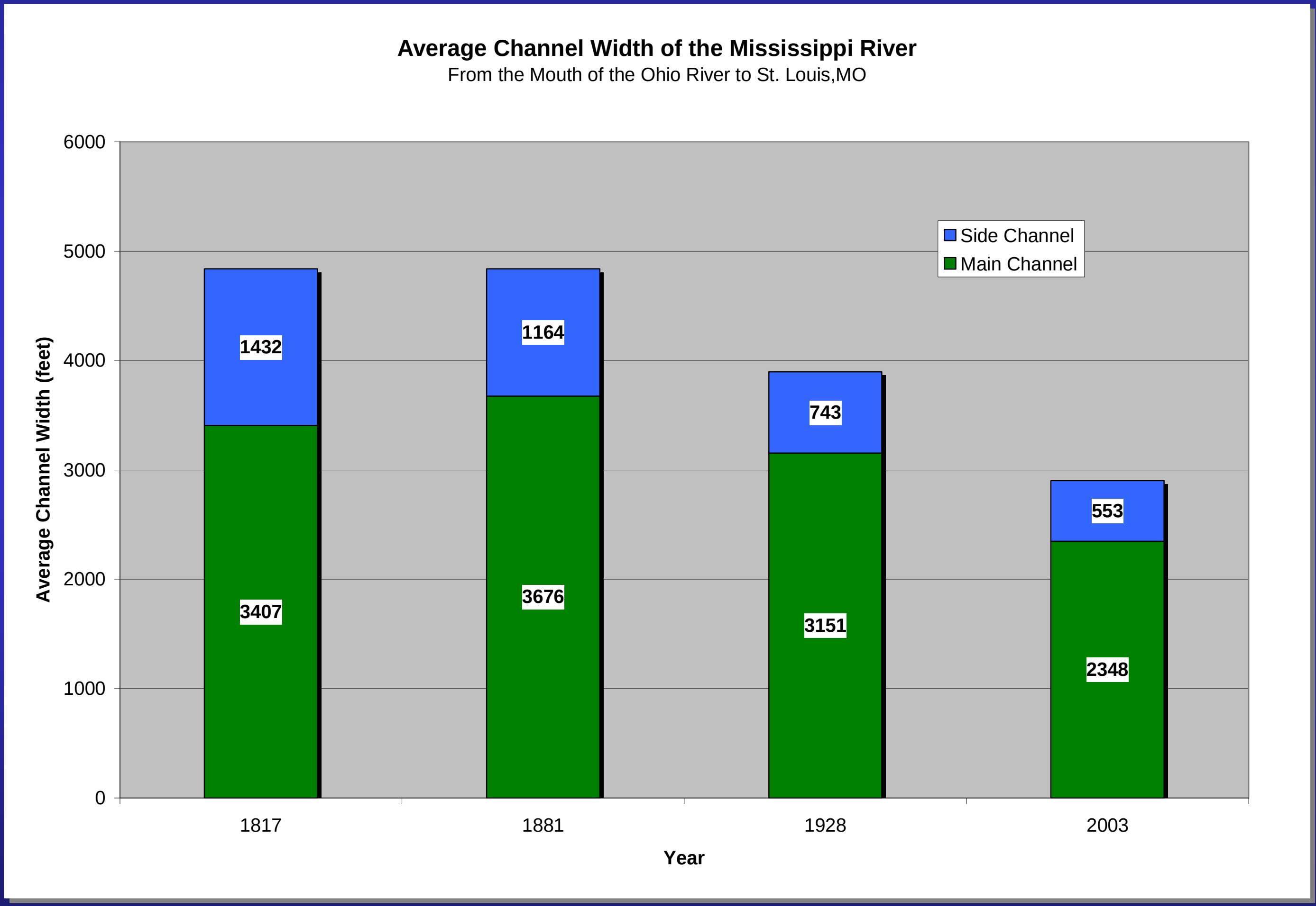
Average Channel Width



Channel Length

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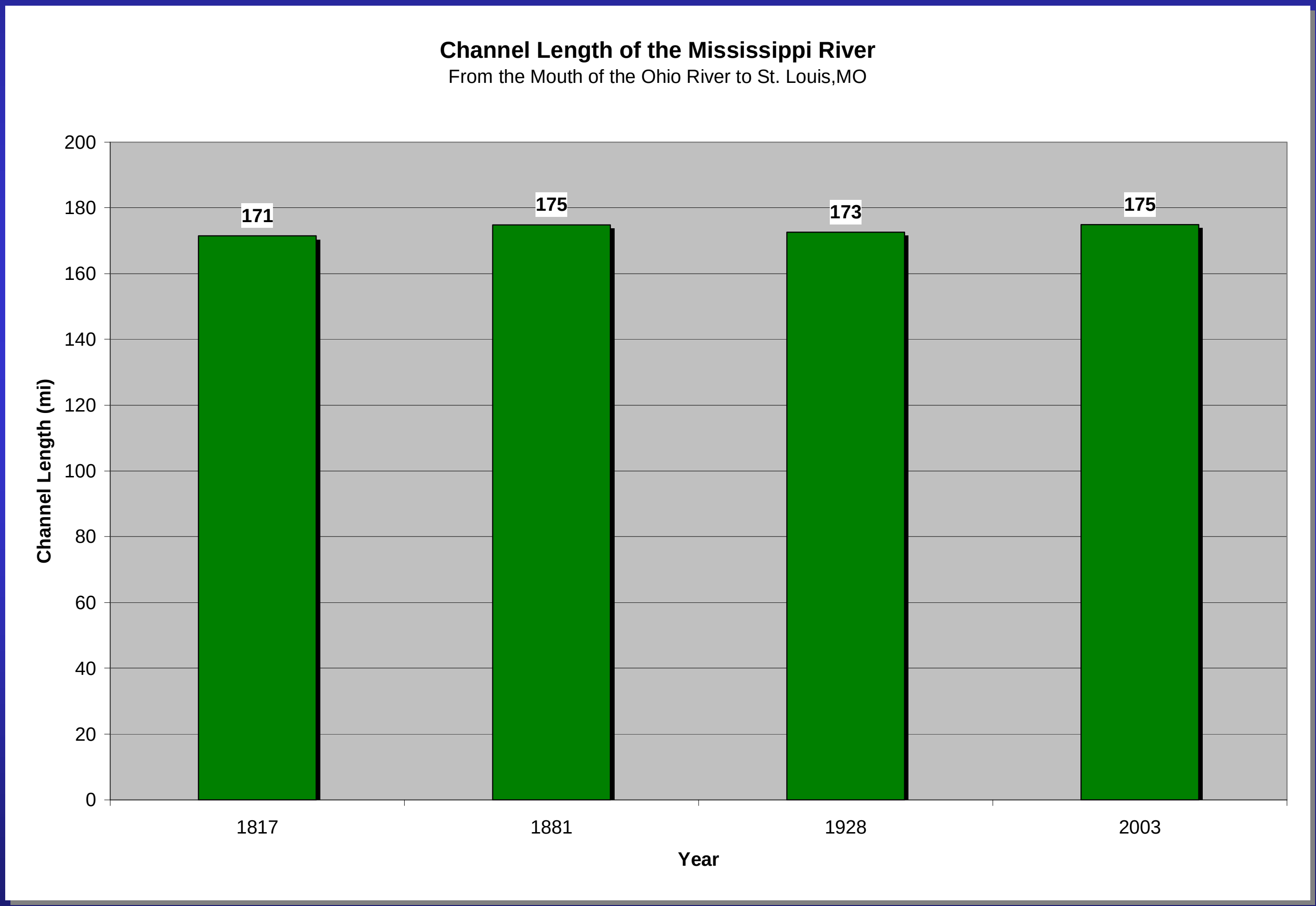

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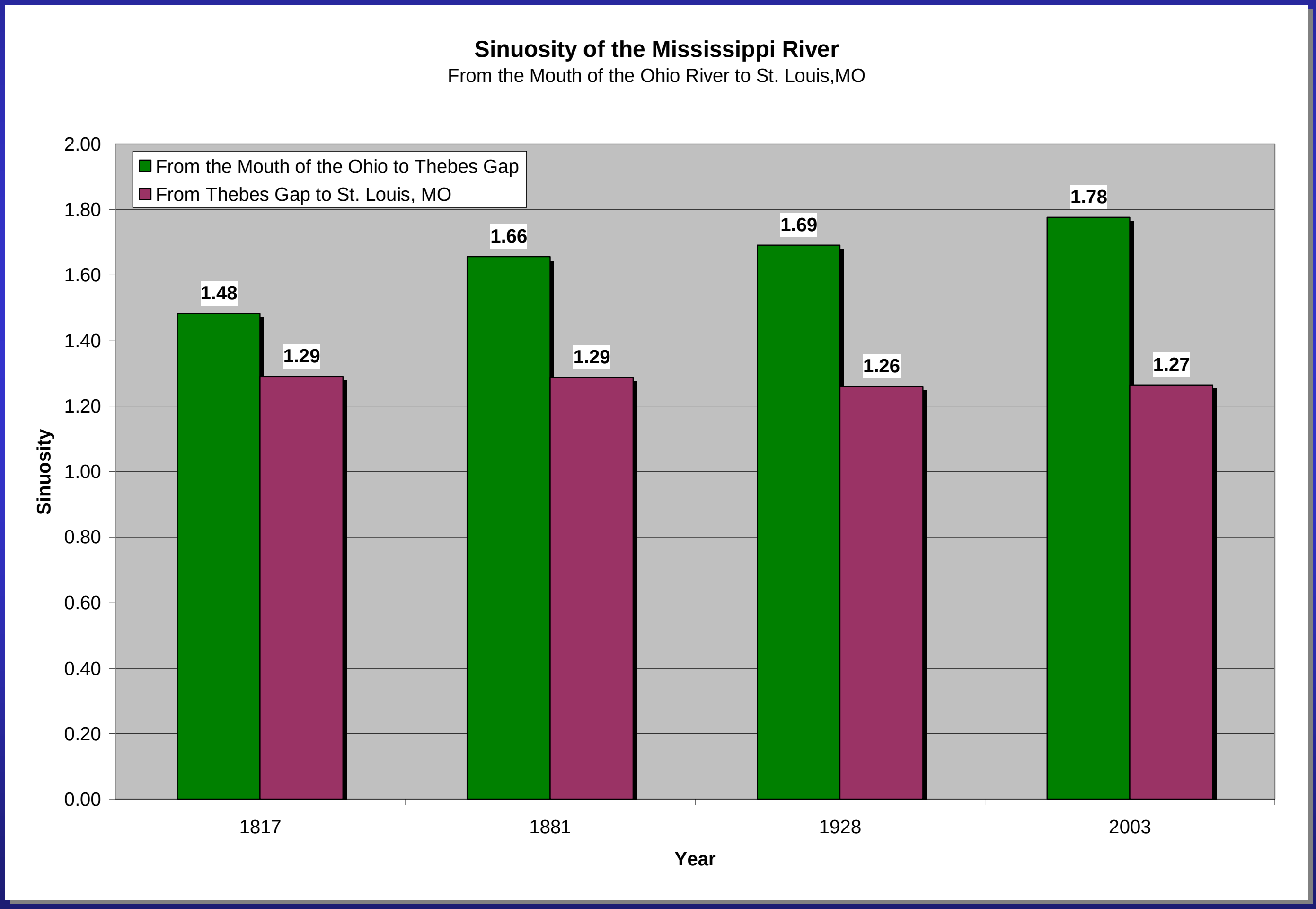

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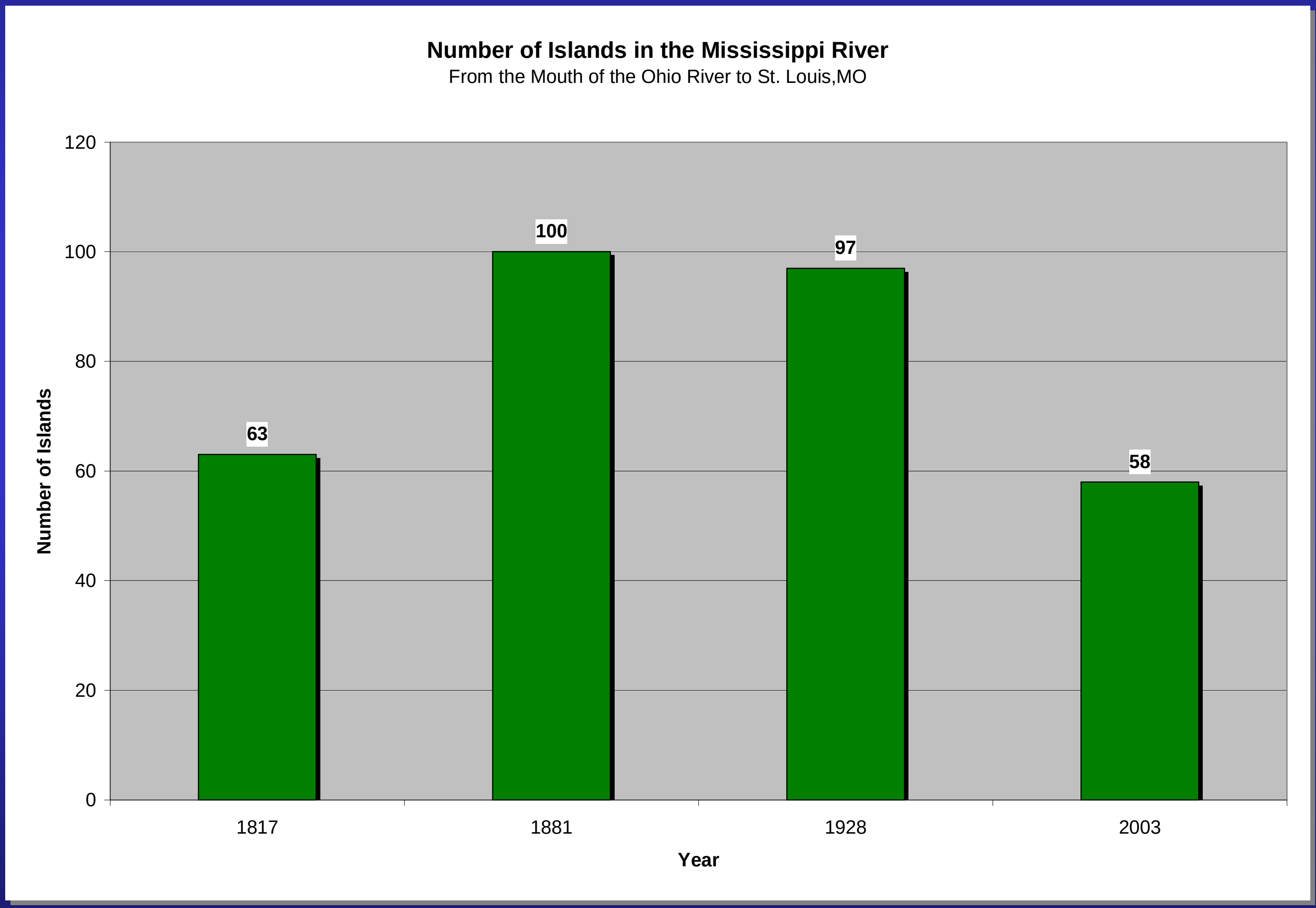
Number of Islands



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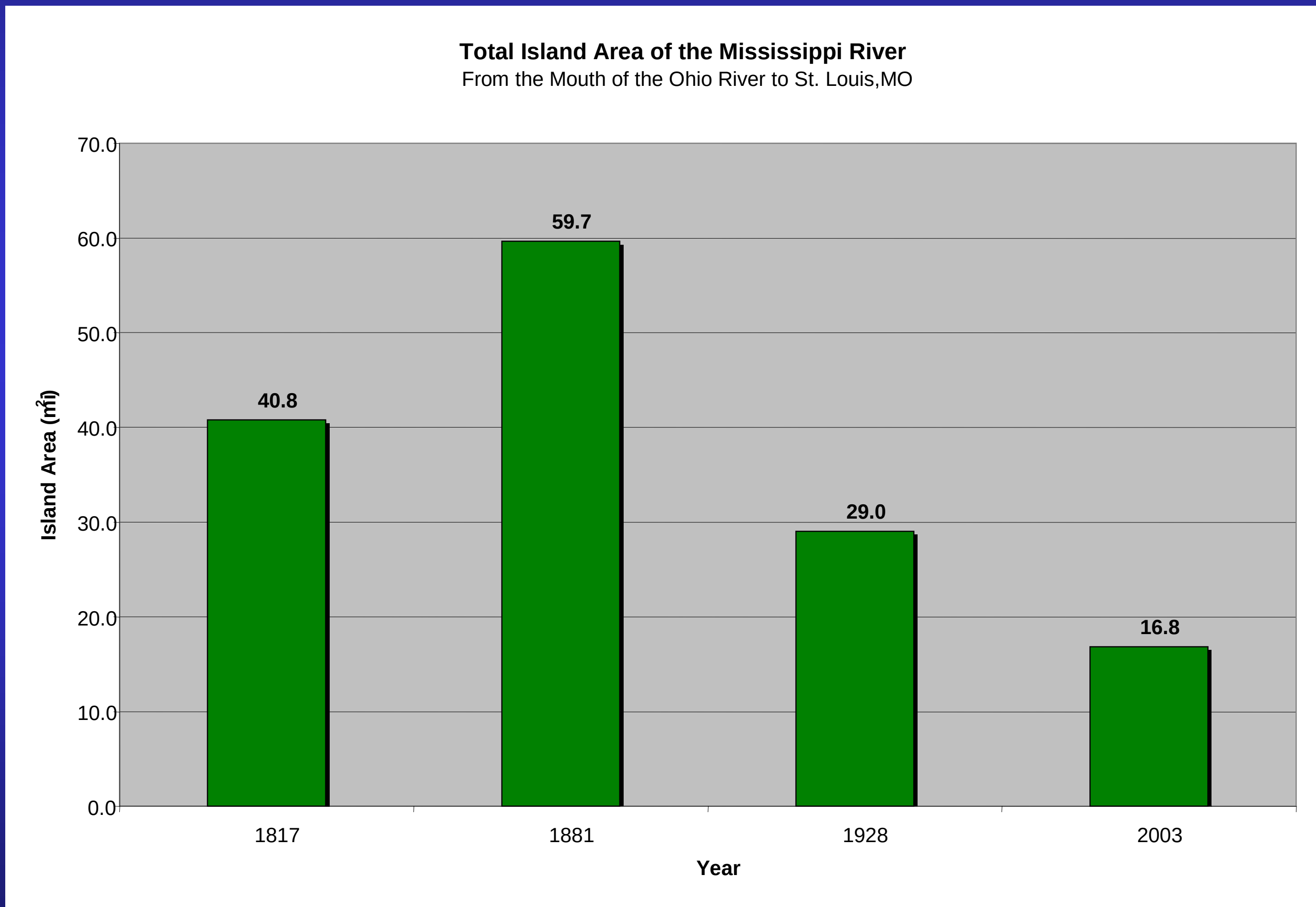
Total Island Area



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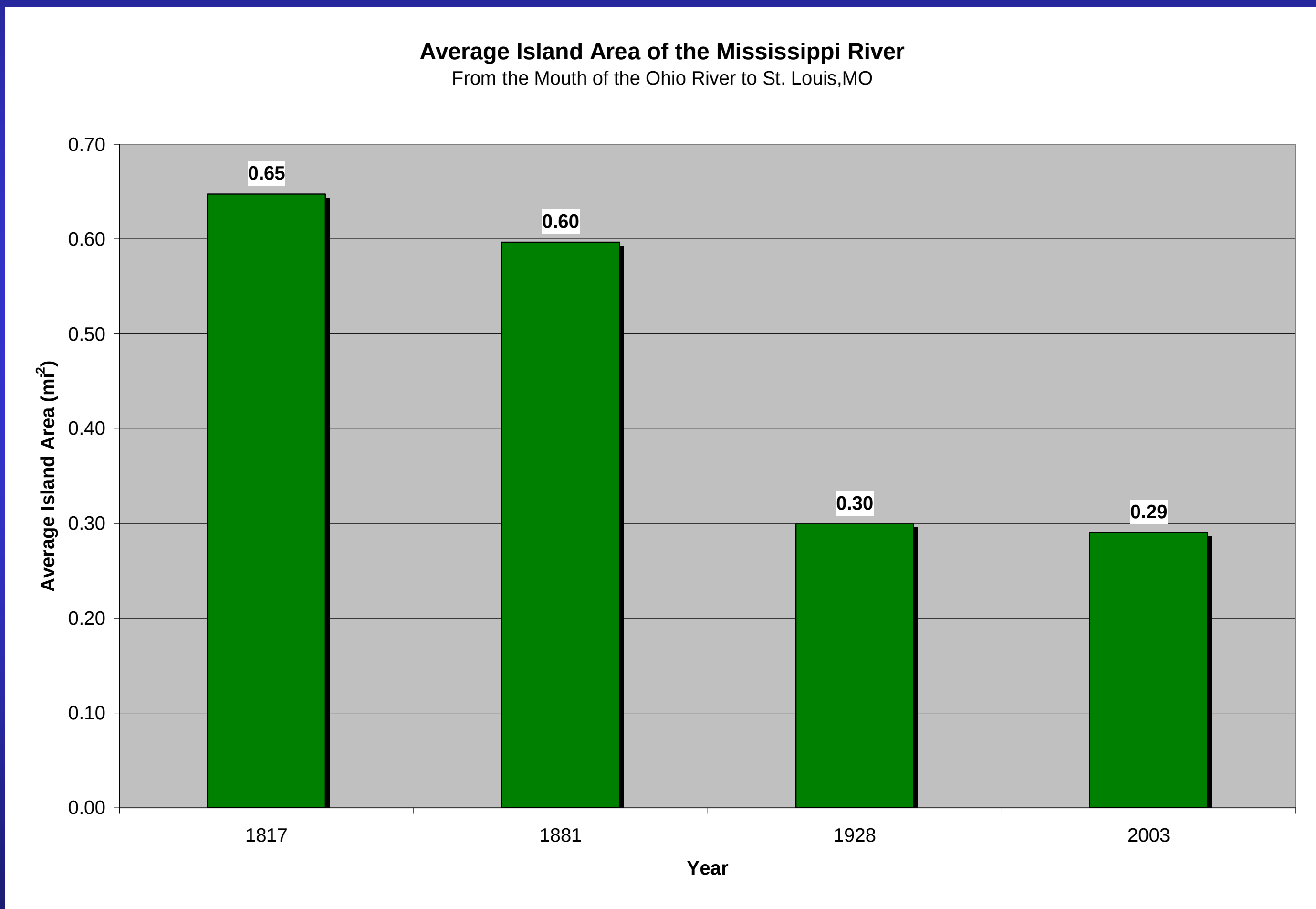
Average Island Area



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Surface Area

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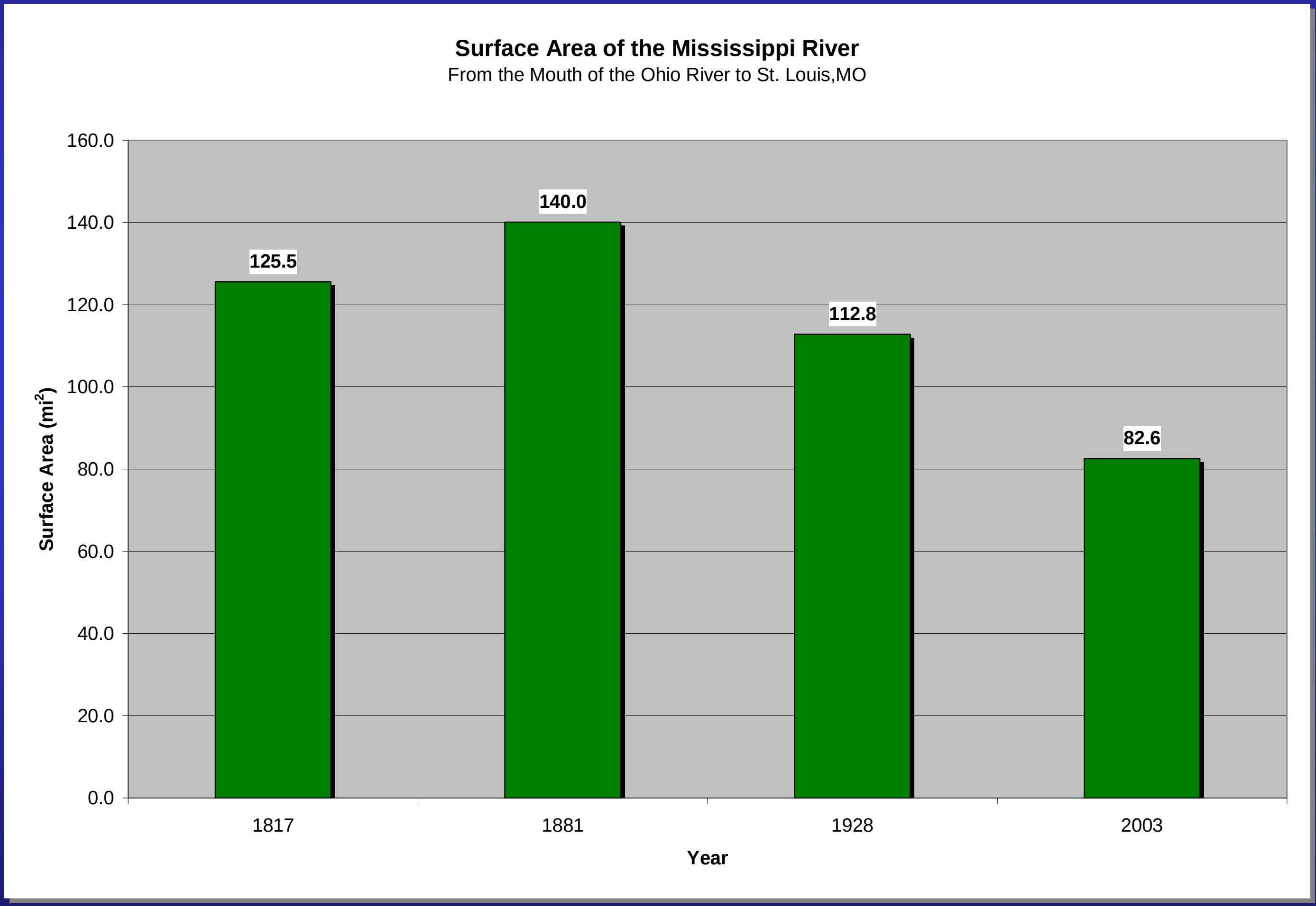

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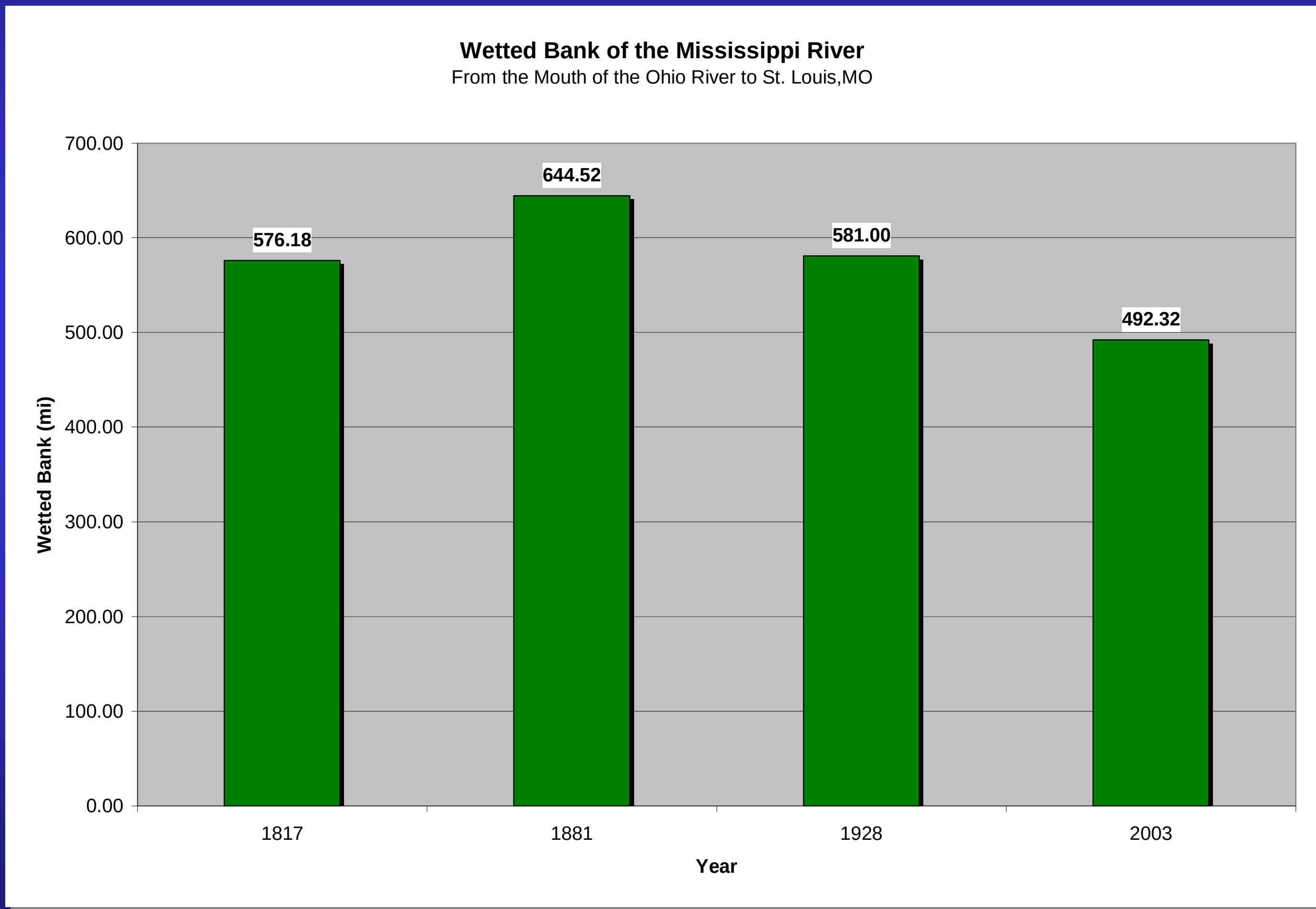
Wetted Bank



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Cumulative Side Channel Length

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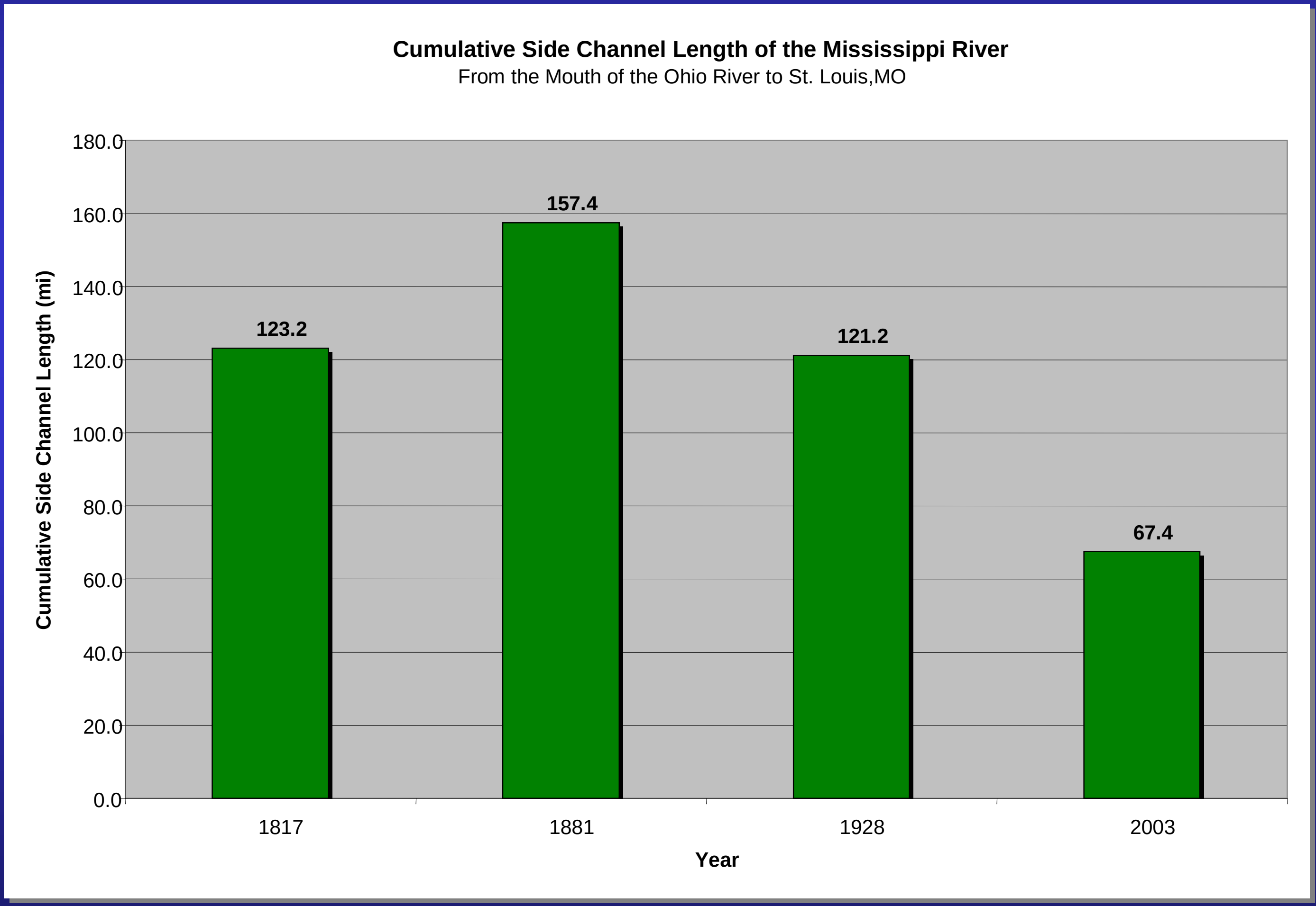

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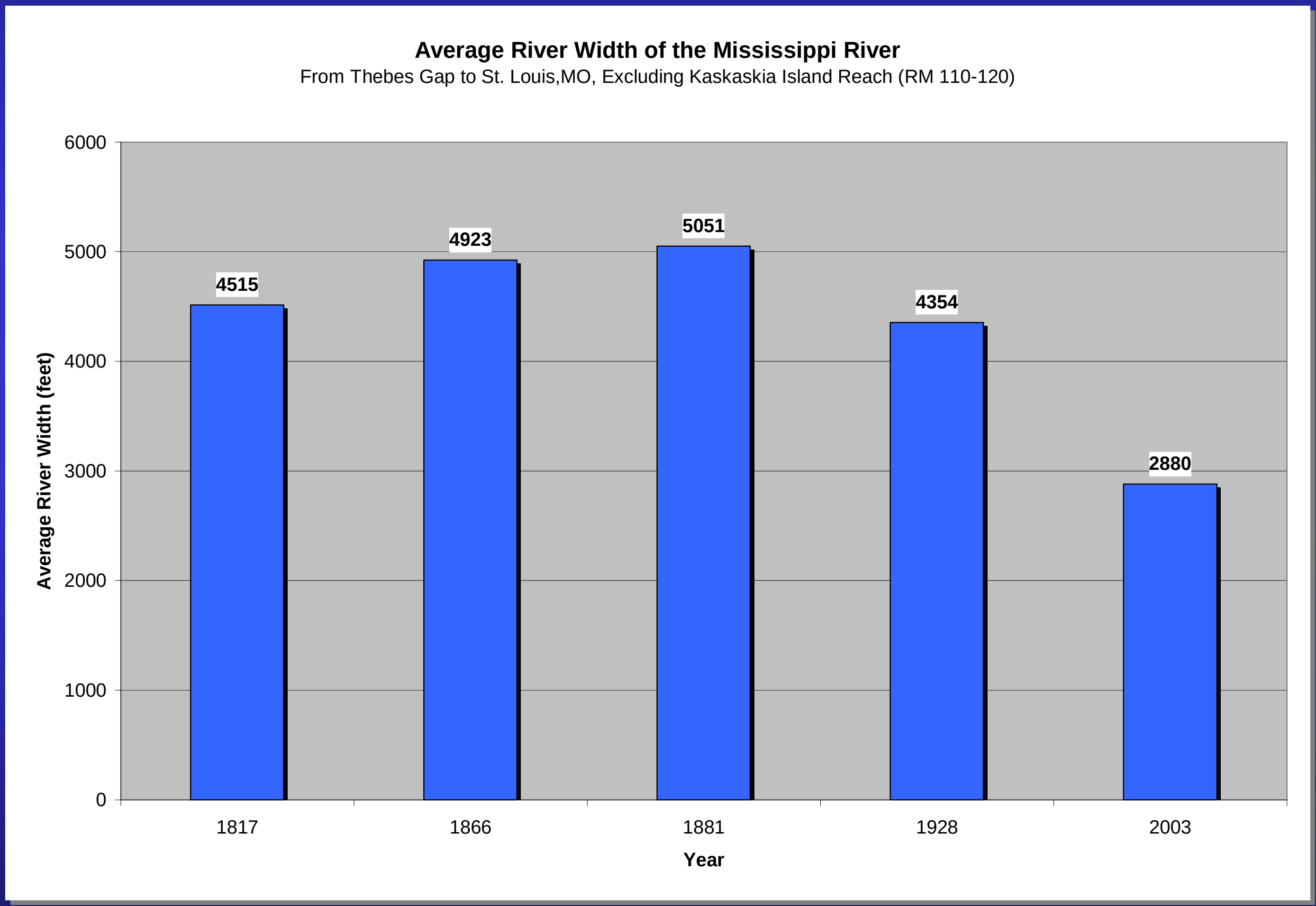
Average River Width



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Blueprint For Restoration

US Army Corps of Engineers

- This Purpose of this Study is to Serve as a Reference for Future Restoration Initiatives
- It is Physically Impossible to Return to the 1817 Planform
  - Unless navigation ceases and landowners evacuate the floodplain
- It is Possible to Develop a River that Achieves all of the Goals of a Healthy Ecosystem
  - Using modern river engineering methods combined with the latest fisheries and waterfowl management strategies

RIPARIAN CORRIDOR

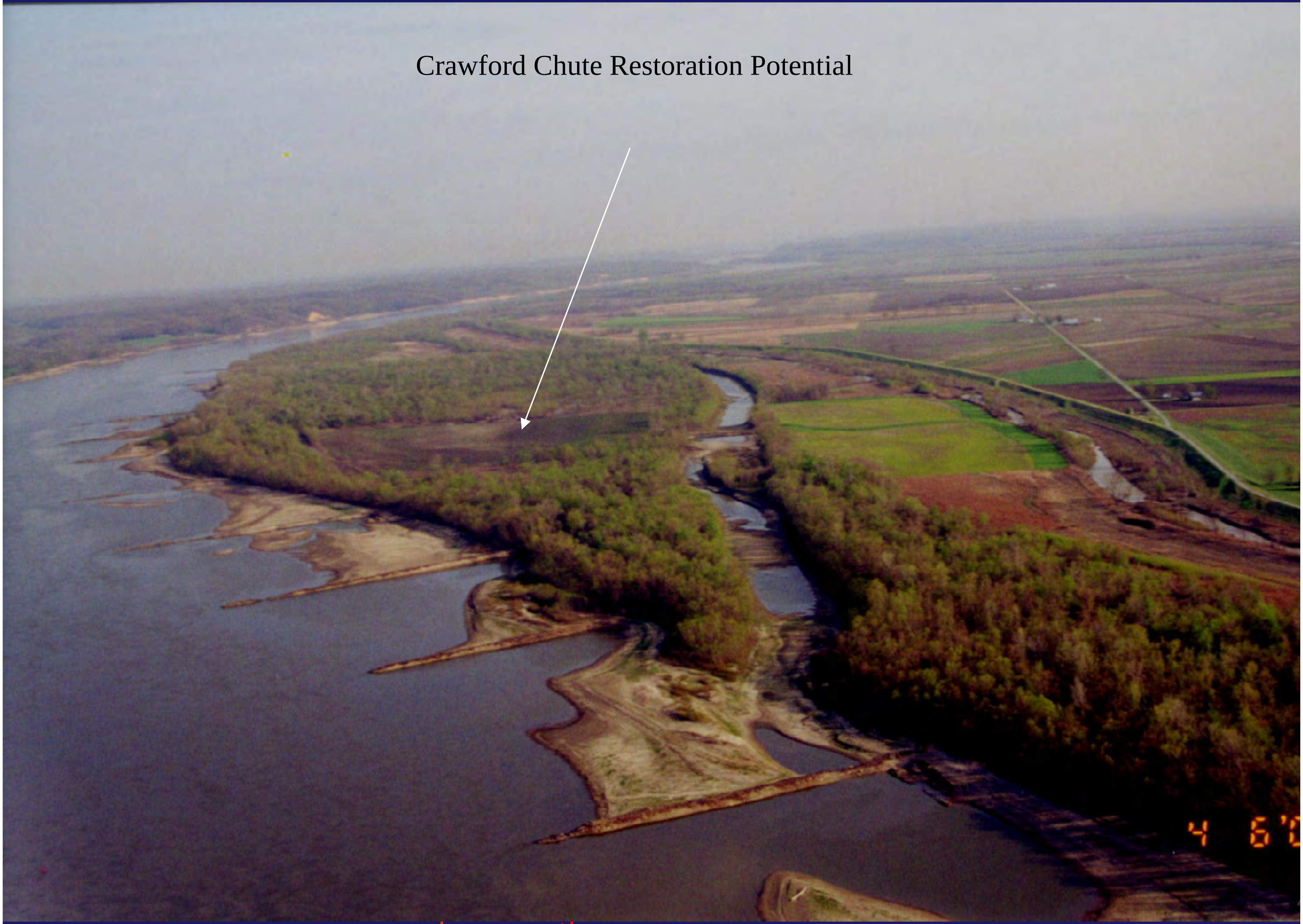
US Army Corps of Engineers

Crawford Chute Restoration Potential Mile 74 to 71

Crawford Chute Restoration Potential

Crawford Chute Restoration Potential

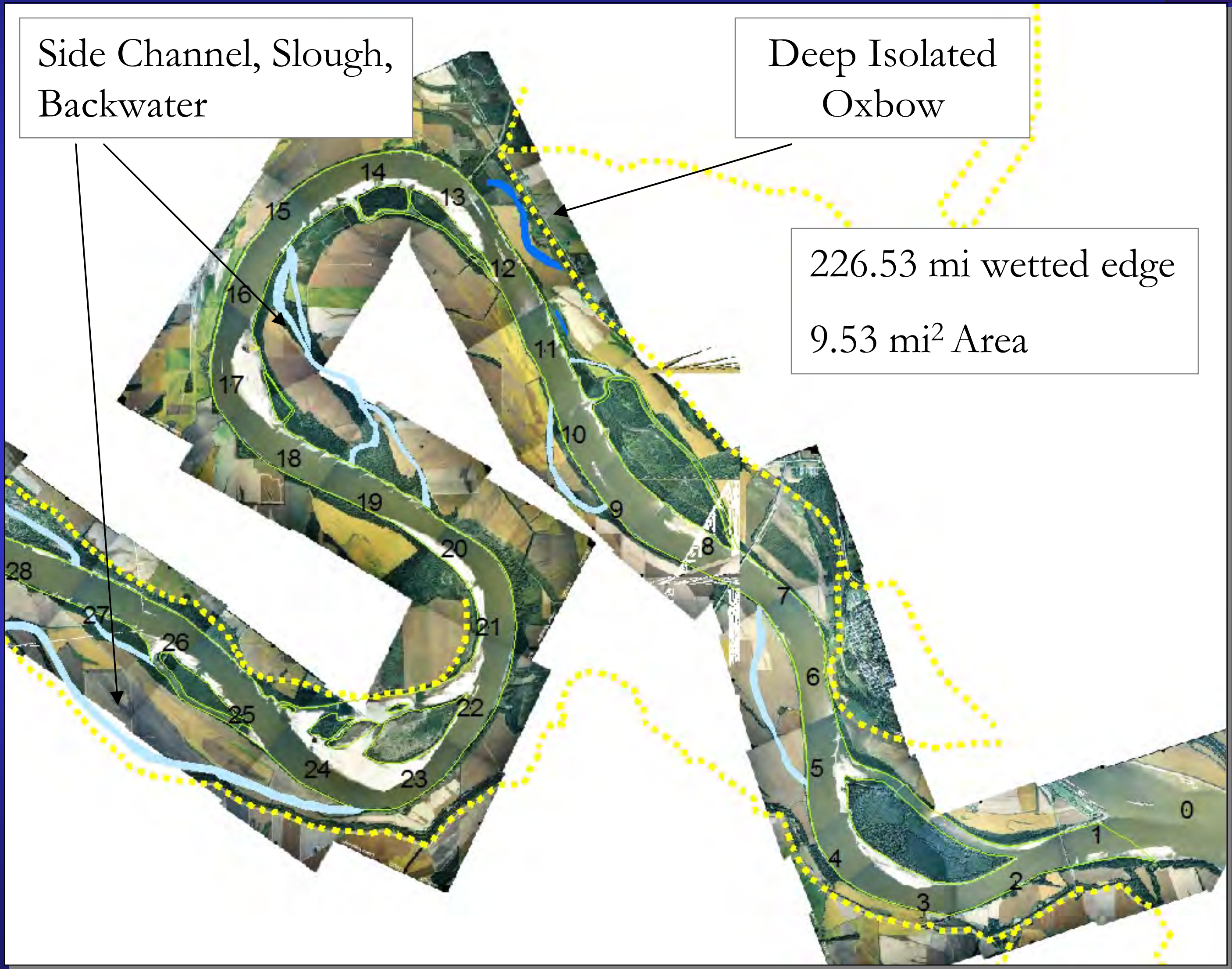

Crawford Chute Restoration Potential


Crawford Chute Restoration Potential


Crawford Chute Restoration Potential
4 6'00

Restoration Potential

US Army Corps of Engineers



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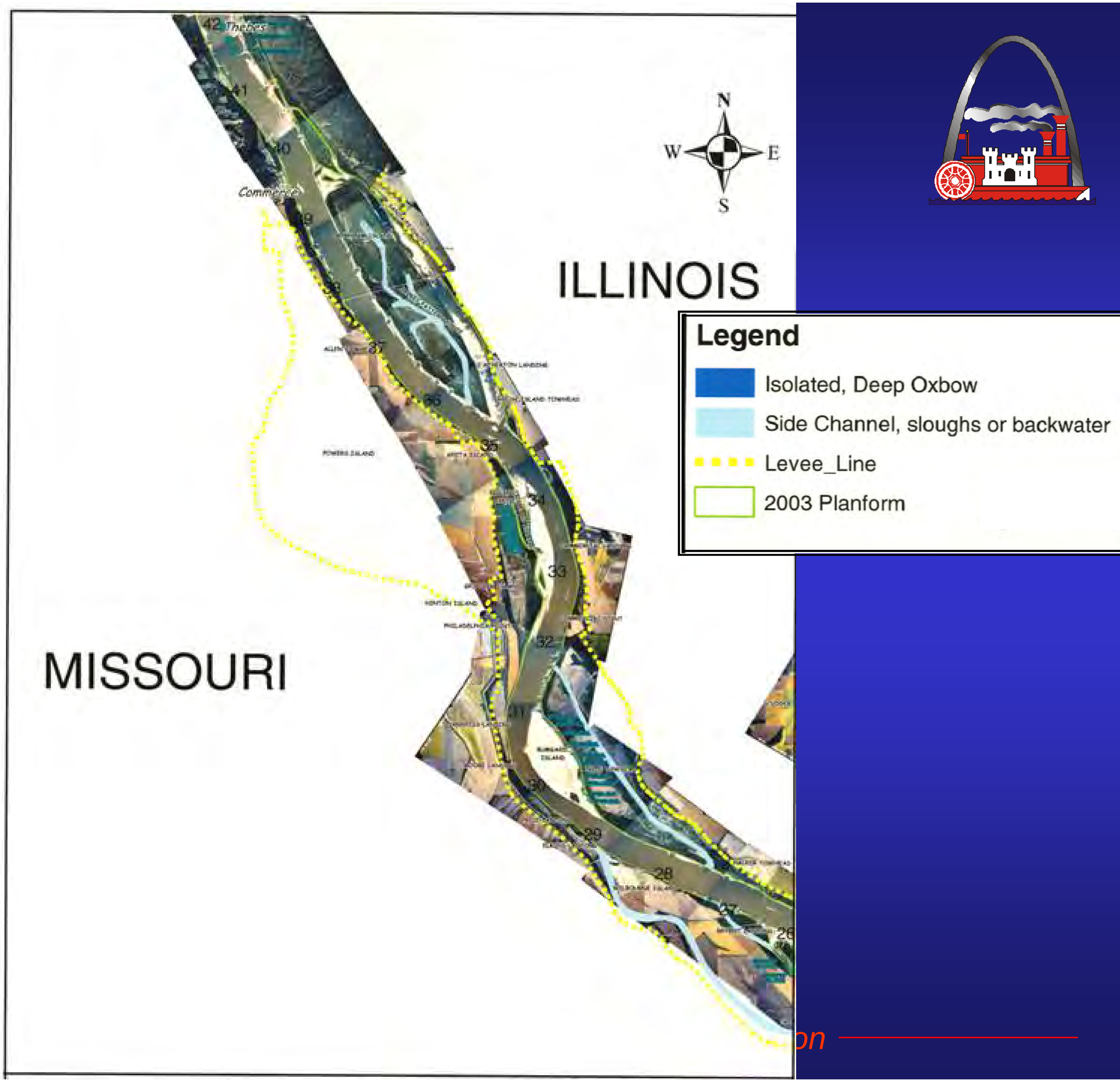

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Legend
Isolated, Deep Oxbow
Side Channel, sloughs or backwater
Levee_Line
2003 Planform

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Blueprint For Restoration

- The Proposed Restoration Shown in the Blueprint reclaims:
  - 965 Feet of Average Planform Width
    - 50% of difference between 1817 and 2003
  - 226 Miles of Wetted Bank
    - 25% more than 1817
  - 9.53 Square Miles of Area

US Army Corps of Engineers

Eddie Brauer

Applied River Engineering Center
U.S. Army Corps of Engineers- St. Louis
314-263-8094

Edward.j.brauer@mvs02.usace.army.mil

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Questions?

"That's good enough water for any one, you couldn't improve it without putting in a little whisky."

-Mark Twain

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US Army Corps of Engineers®

Vicksburg District

US Army Corps of Engineers®
Vicksburg District

Southeast Arkansas Feasibility Study

Hydrologic and Hydraulic Analyses

August 4, 2005

US Army Corps of Engineers
Vicksburg District

Scope of Work

1. Hydrology/Hydraulics for existing conditions and 3 flood control alternatives
   a. HEC-HMS (Develops flows)
   b. HEC-RAS (Develops water- surface profiles)
   c. FEAT (Develops flooded acres)

2. Water supply analysis
   a. Water demand for study area
   b. Water available from Arkansas River

Southeast Arkansas Study Area

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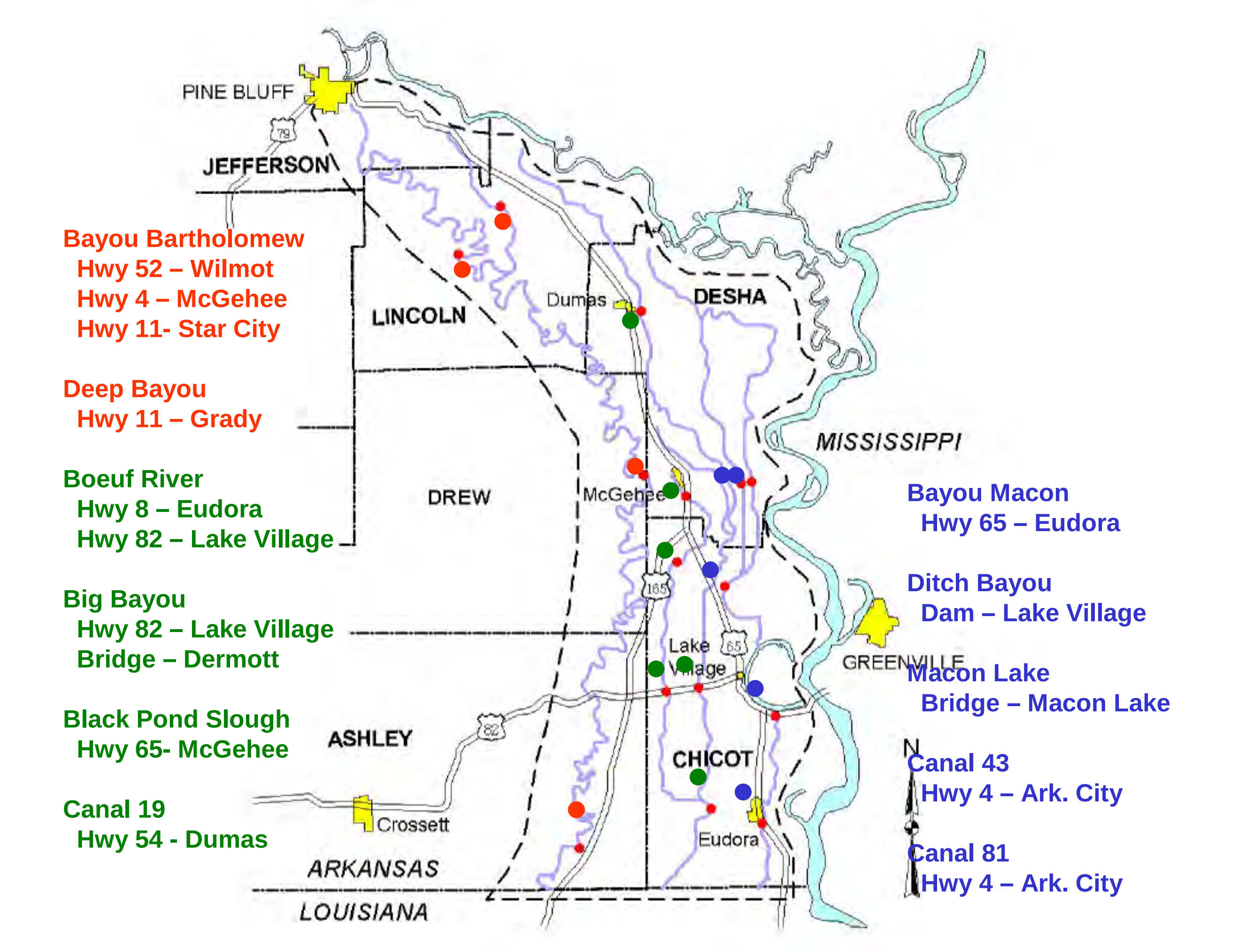

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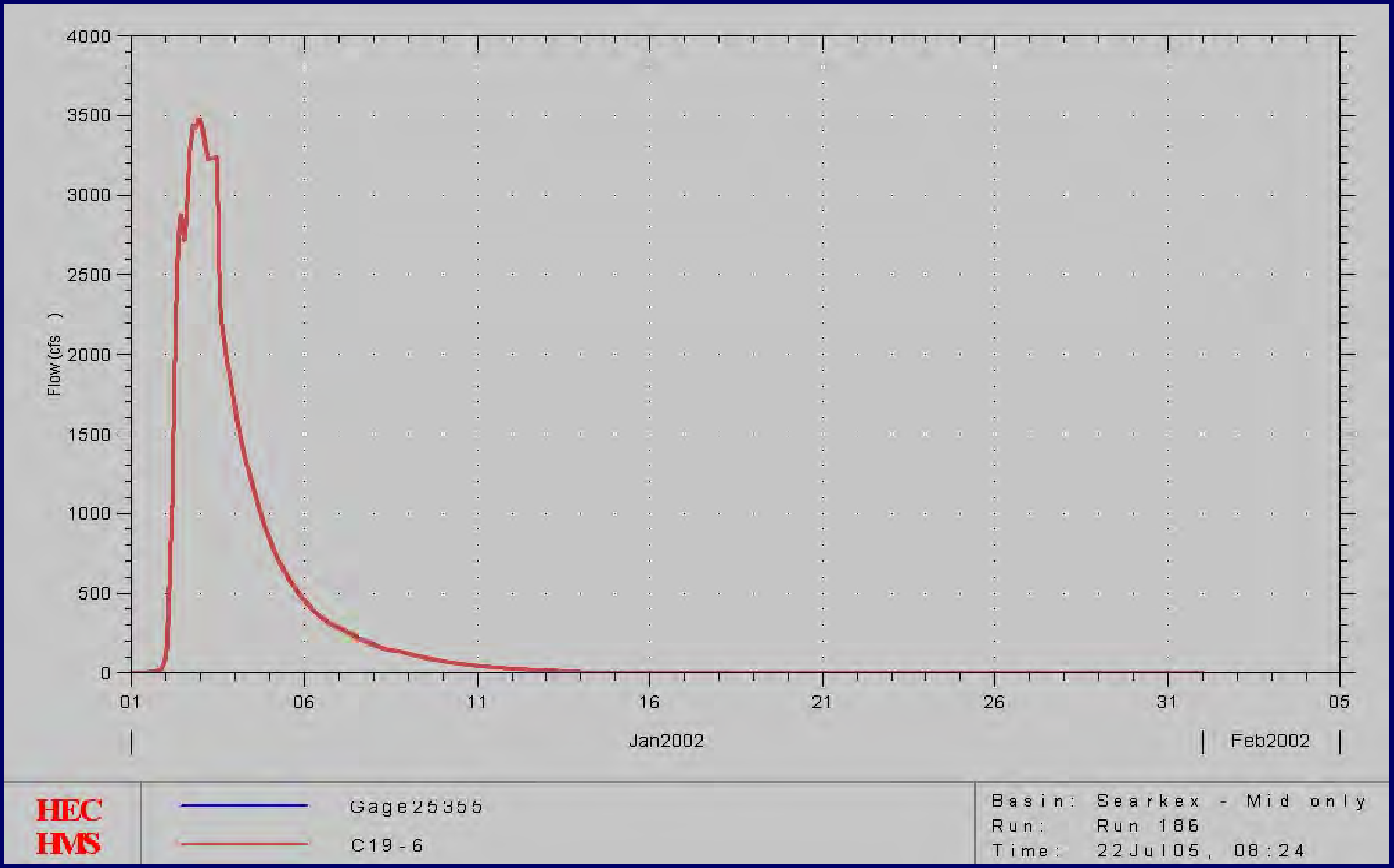
Existing Conditions HEC-HMS Modeling

1. Determine basin characteristics.
2. Obtain frequency rainfall data from TP40.
3. Calibrate to measured flows at gage locations.
4. Input frequency rainfall and make runs.

Canal 19 – Exis Conds 2-yr Flow Hydrograph



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Existing Conditions HEC-RAS Modeling

1. Obtain channel geometry.
2. Field observation to determine channel and overbank roughness.
3. Calibrate to known events.
4. Input HEC-HMS discharges and make runs.

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Surveyed Cross Sections

Basin Section	Stream	Number of Cross Sections
West	Bayou Bartholomew	144
	Deep Bayou / Jacks Bayou	23
Middle	Boeuf River / Canal 19	93
	Big Bayou / Black Pond Slough	52
	Canal 18	21
East	Bayou Macon / Ditch Bayou	23
	Connerly Bayou / Macon Lake/ Canal 81	56
	Canal 43	36
Total		448

Canal 19
2-Yr WS Profile
Existing Conds

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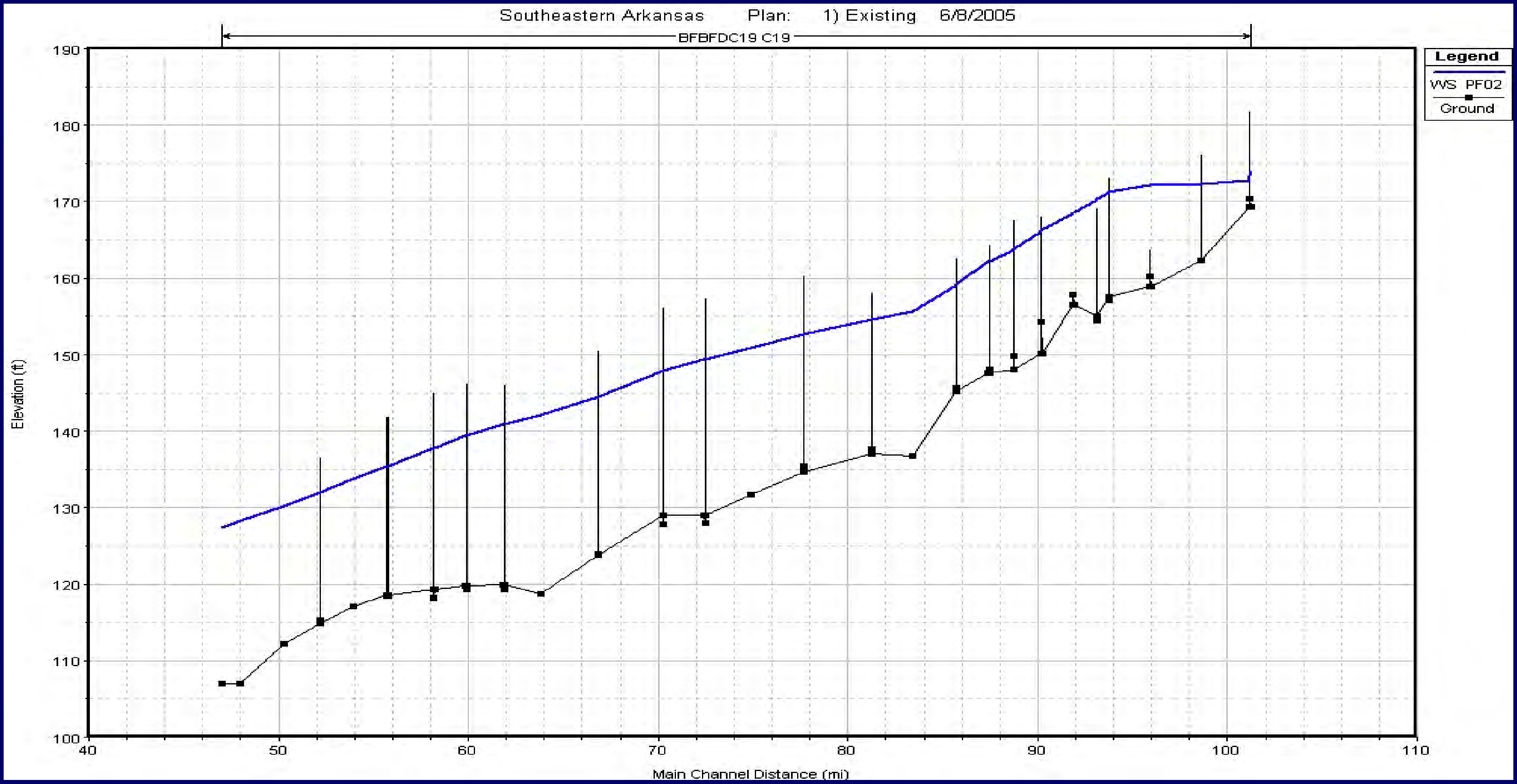
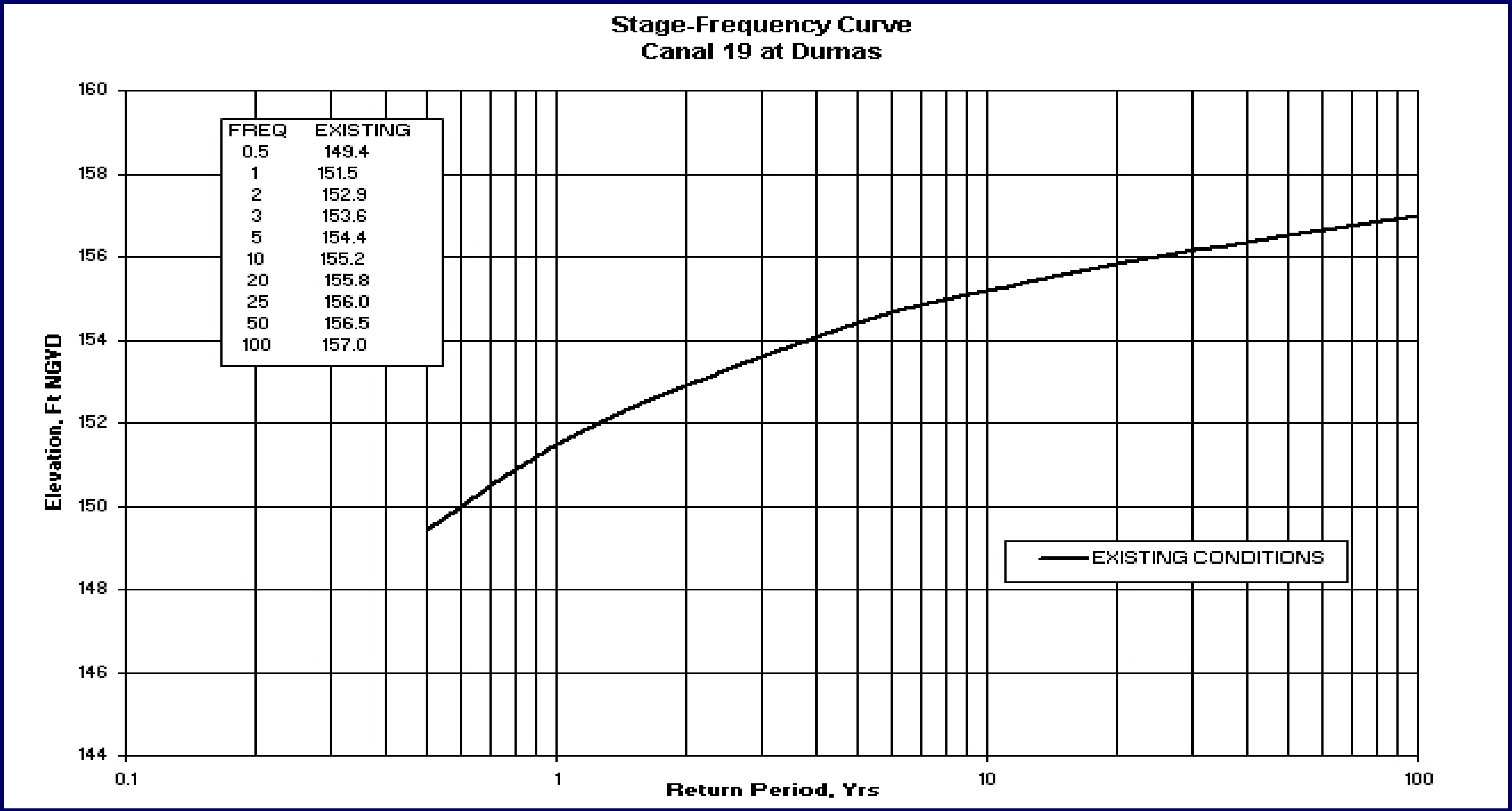


Canal 19 Stage-Frequency Existing Conds



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Existing Conditions FEAT Modeling

1. Obtain DEM (Digital Elev. Model) data from USGS.
2. Input HEC-RAS water-surface profiles for selected frequencies into model.
3. Calibrate obtained flooded areas to known events using satellite photos.
4. Make production runs.

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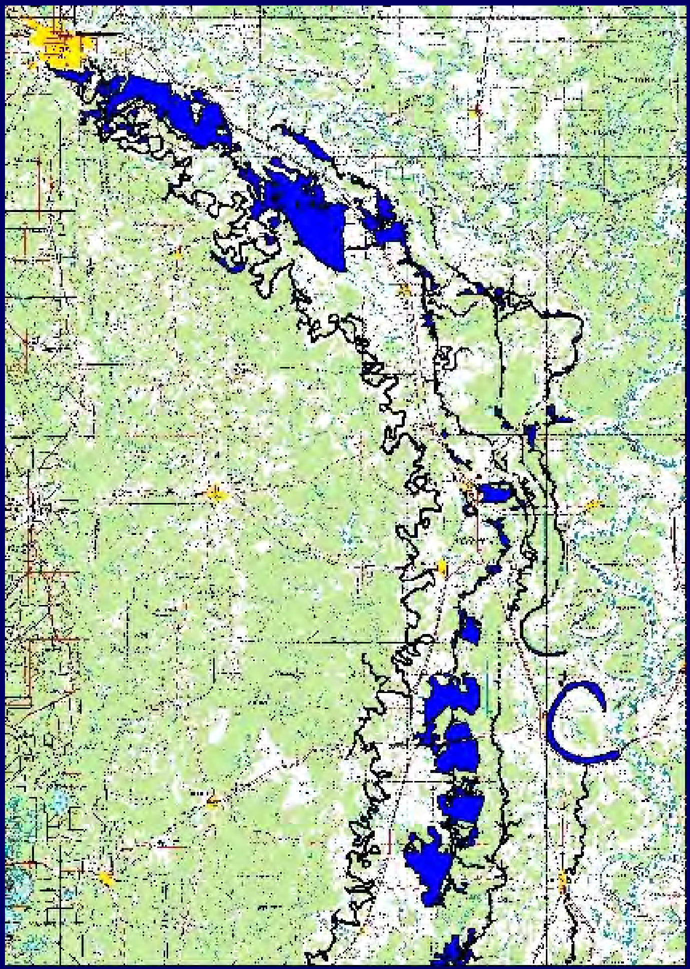
Existing 1-yr Flood



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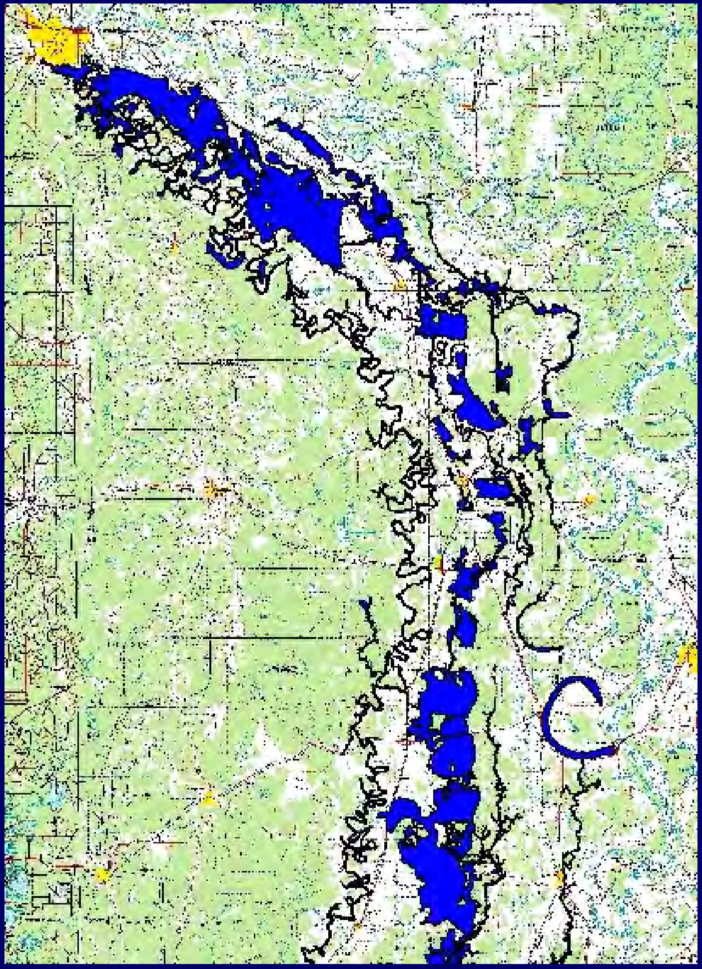
Existing 2-yr Flood



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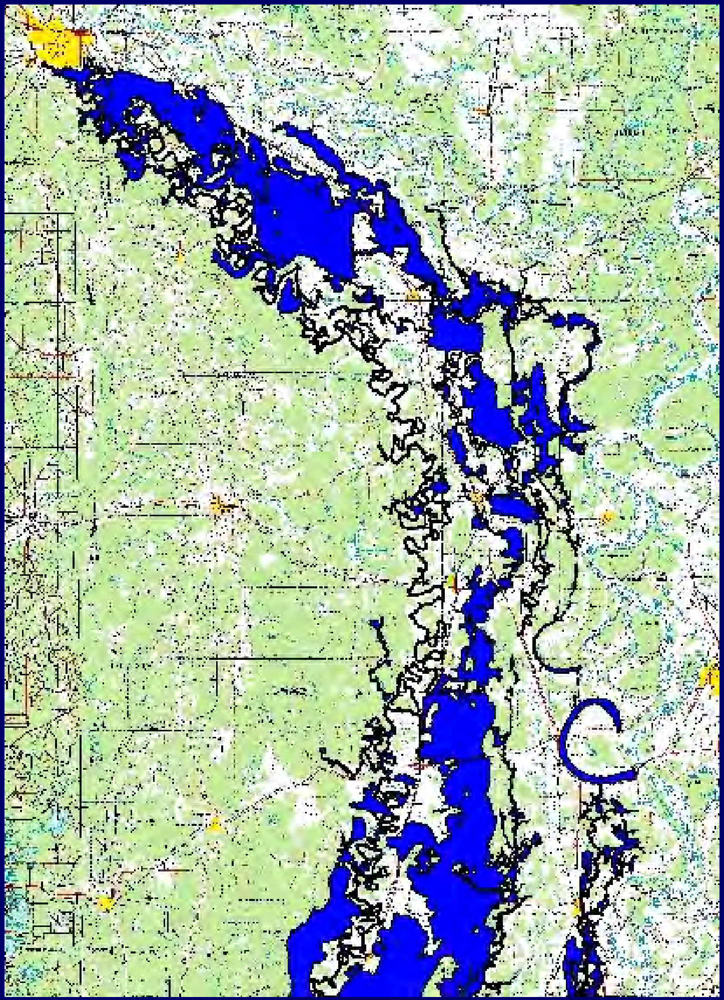
Existing 5-yr Flood



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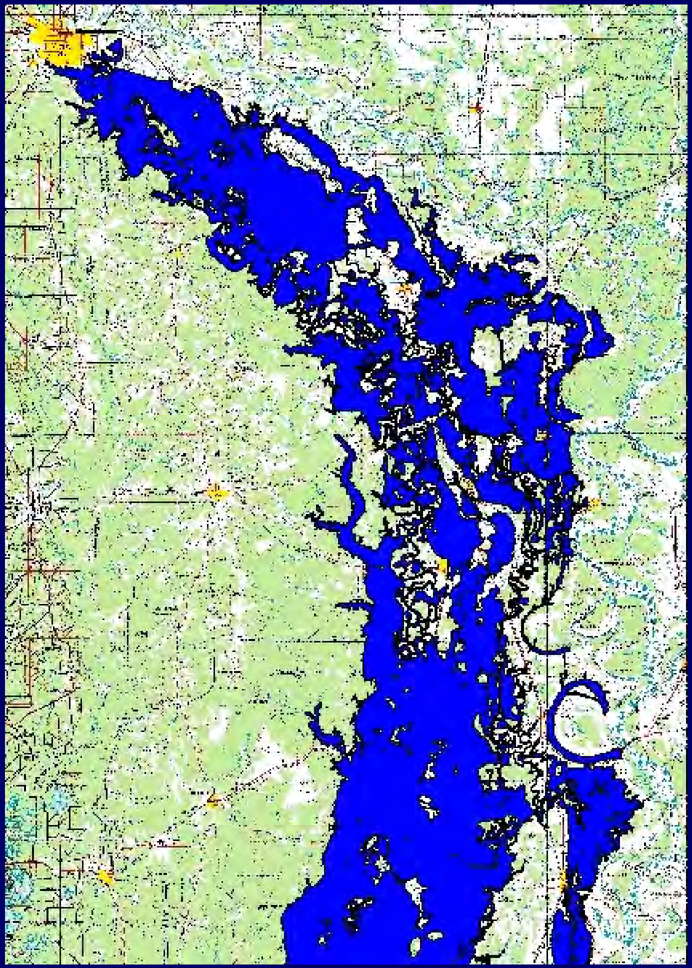
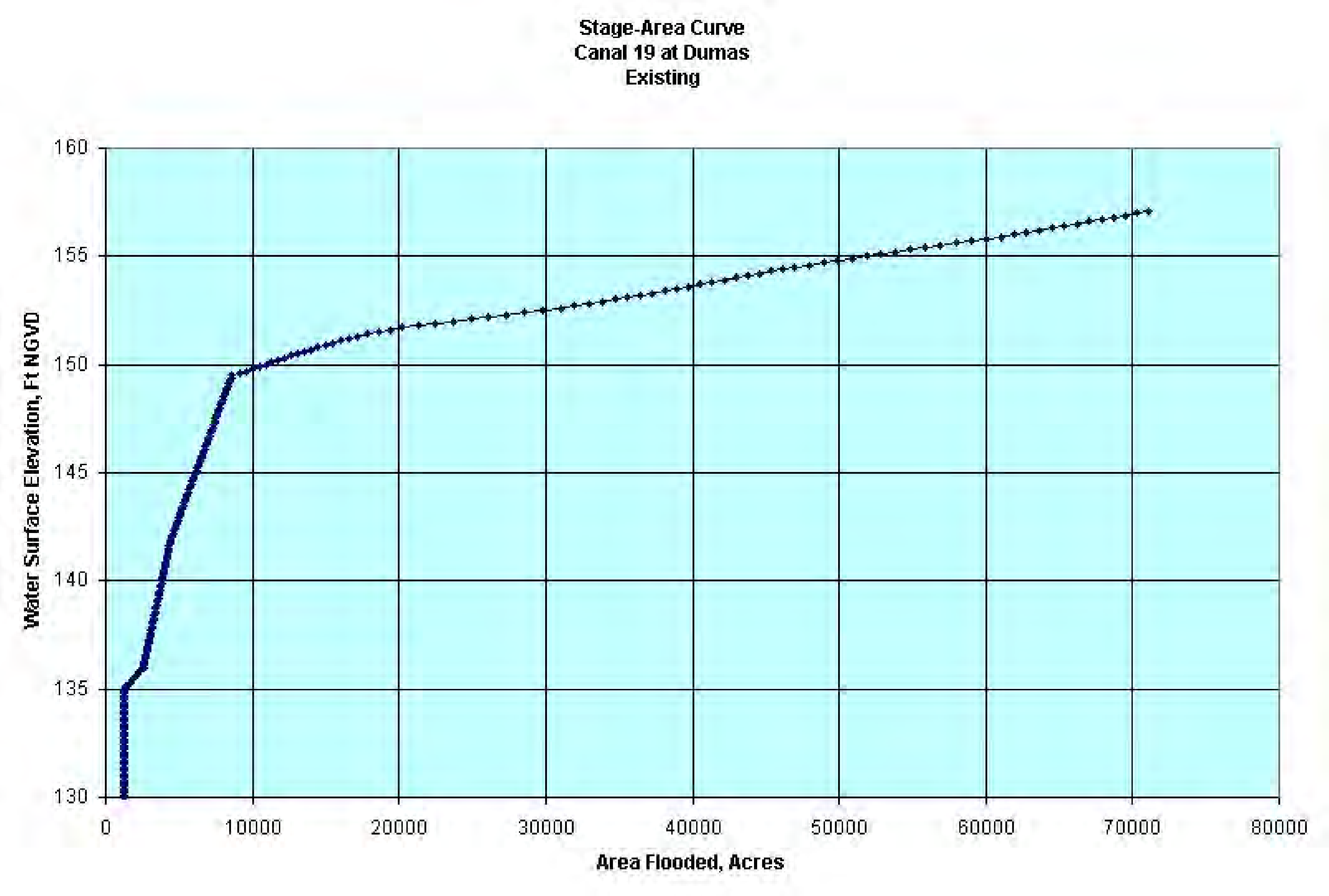
Existing 100-yr Flood



Canal 19
Stage-Area Curve



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Alternative 1

Proposed work consists of clearing and snagging along Deep Bayou, Boeuf River, Canal 19, Big Bayou, Black Pond Slough, Canal 43, Canal 81, Macon Lake, and Bayou Macon.

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Alternative 1
HEC-HMS Modeling

1. Change routing parameters (storage – outflow relationship) to reflect Alternative 1 conditions.

2. Make runs.

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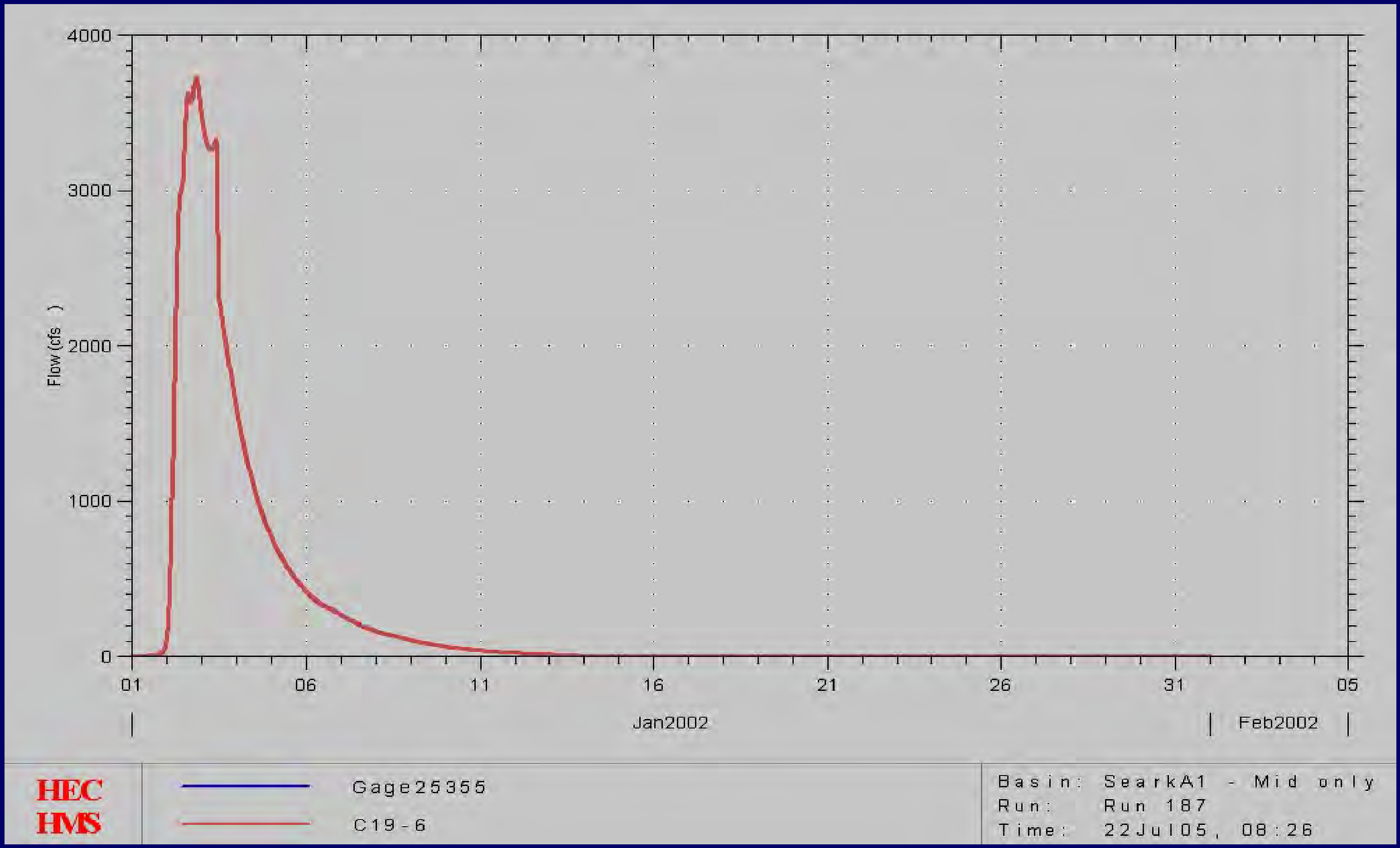
Canal 19 – Alt 1
2-yr Flow Hydrograph



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Alternative 1 HEC-RAS Modeling

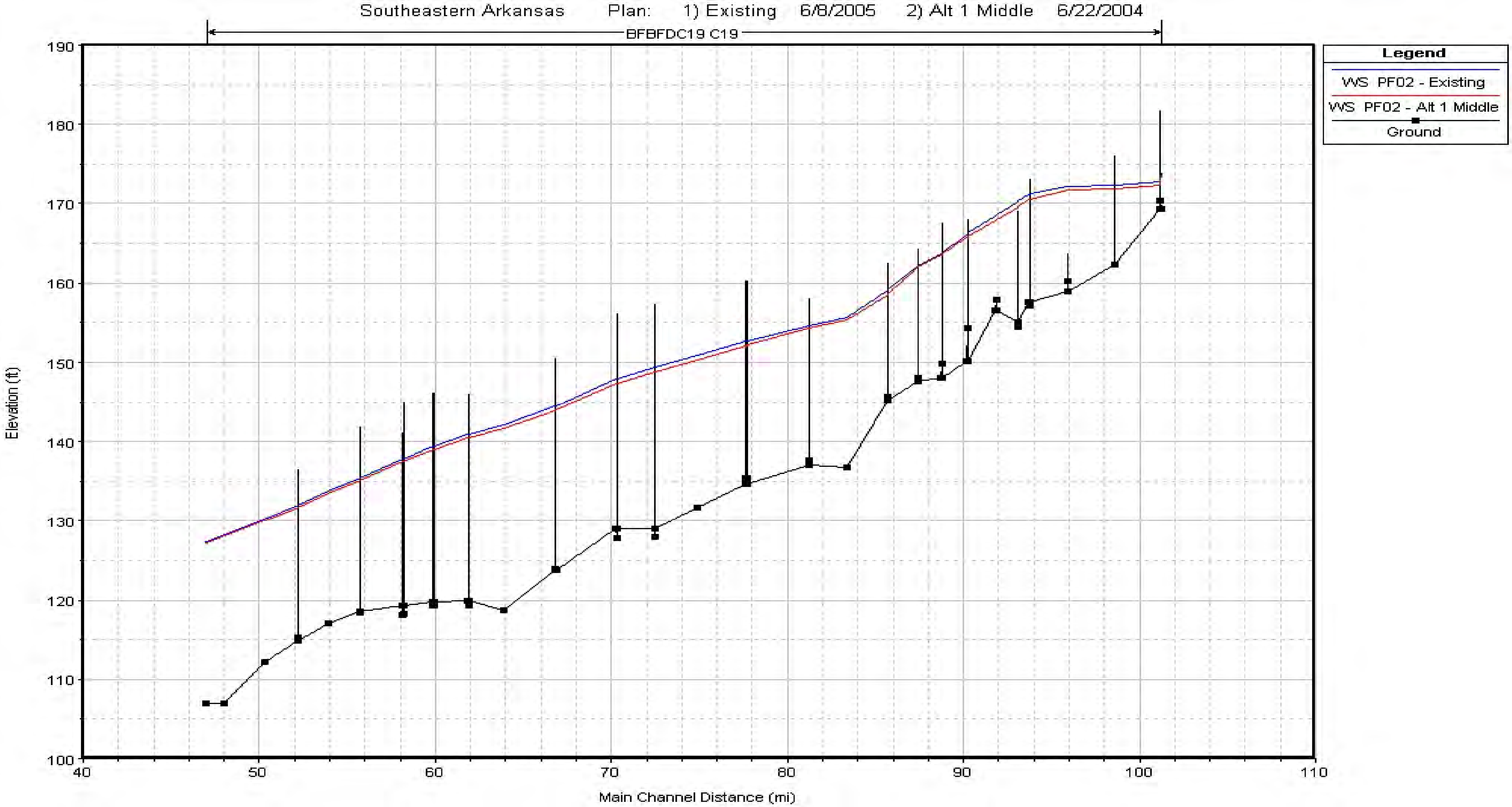
1. Revise channel n-values to reflect Alternative 1 conditions.

2. Input revised HEC-HMS flows and make runs.

Canal 19

2-Yr WS Profile

Exis vs Alt 1



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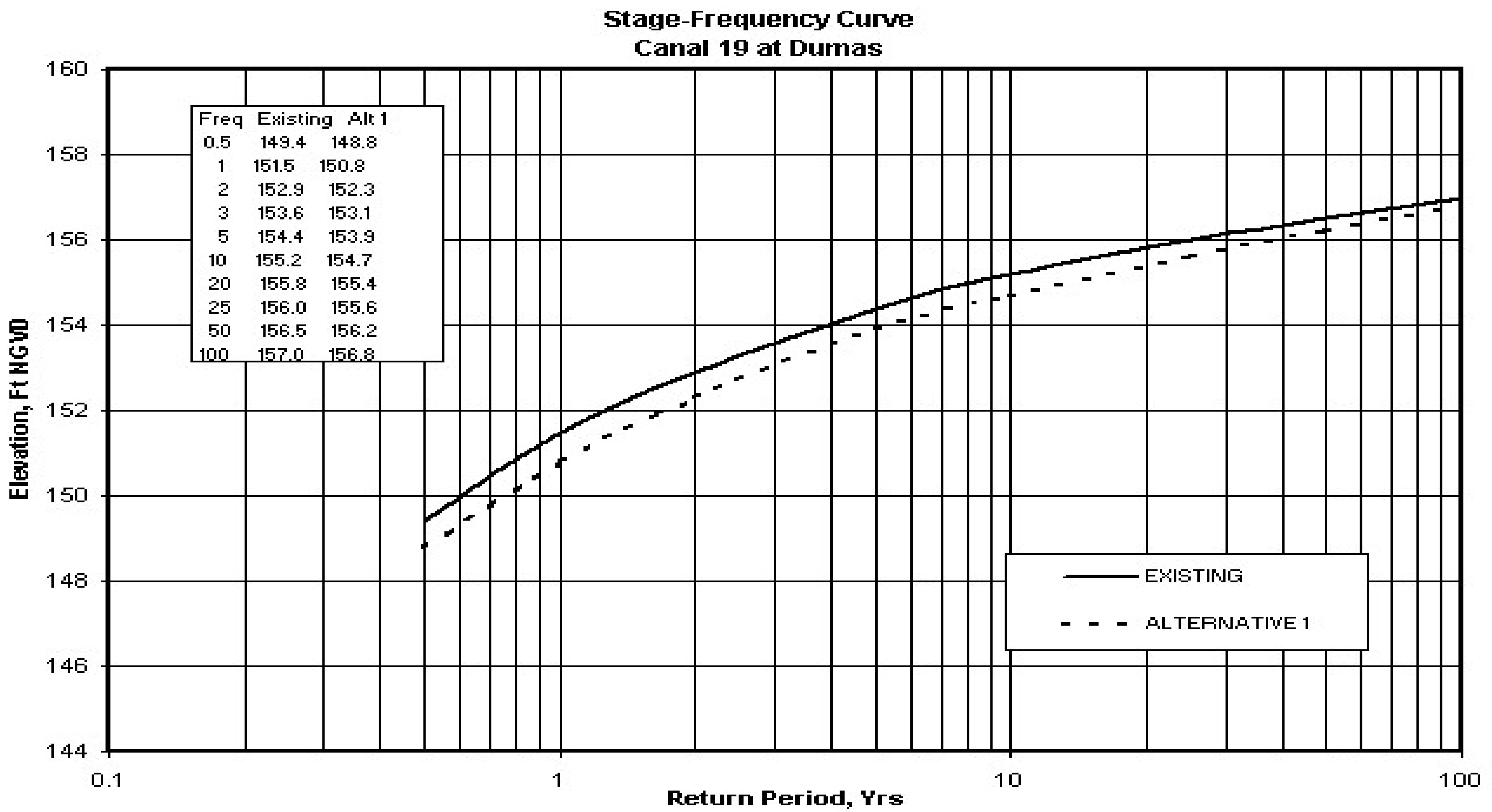
Canal 19 Stage-Frequency Alt 1 vs Existing



Alternative 1
FEAT Modeling

1. Input revised HEC-RAS water-surface profiles for selected frequencies into model.

2. Make production runs.

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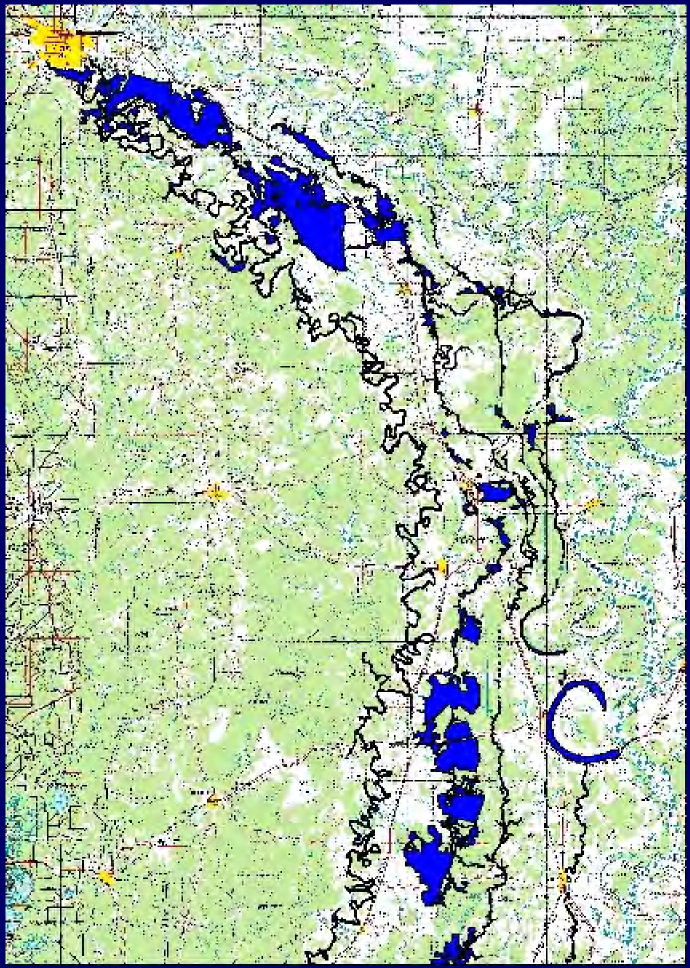
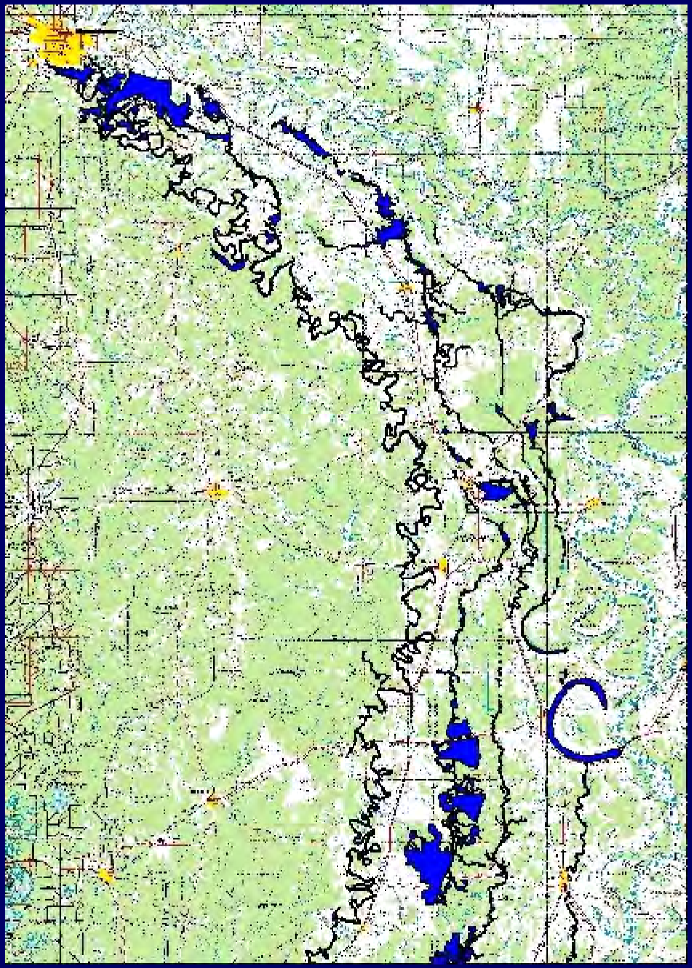
Existing vs Alt 1 1-yr Flood





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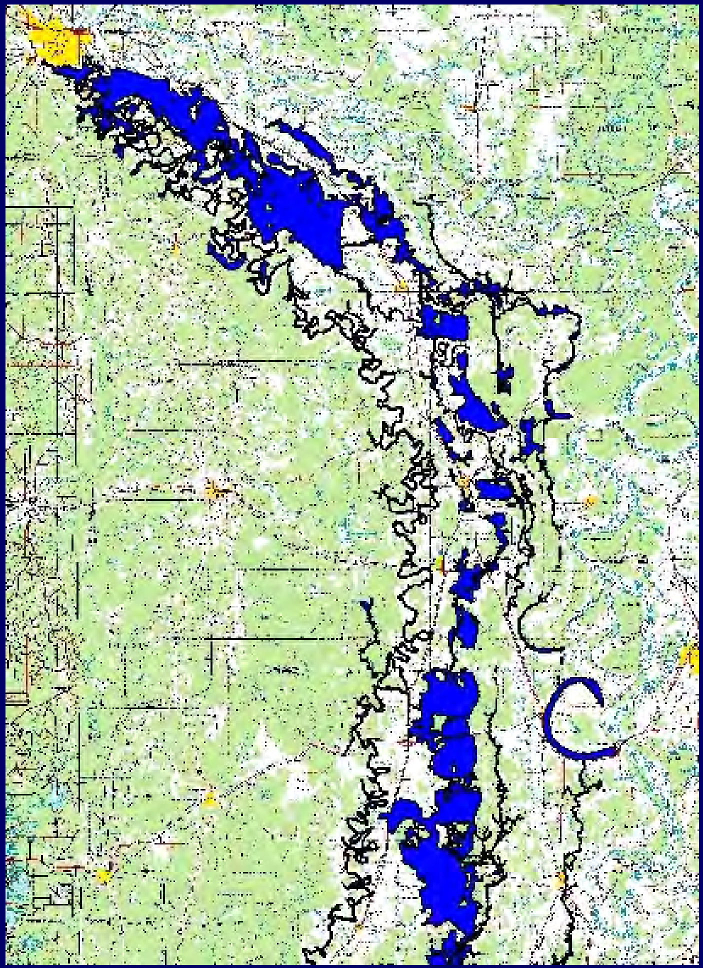
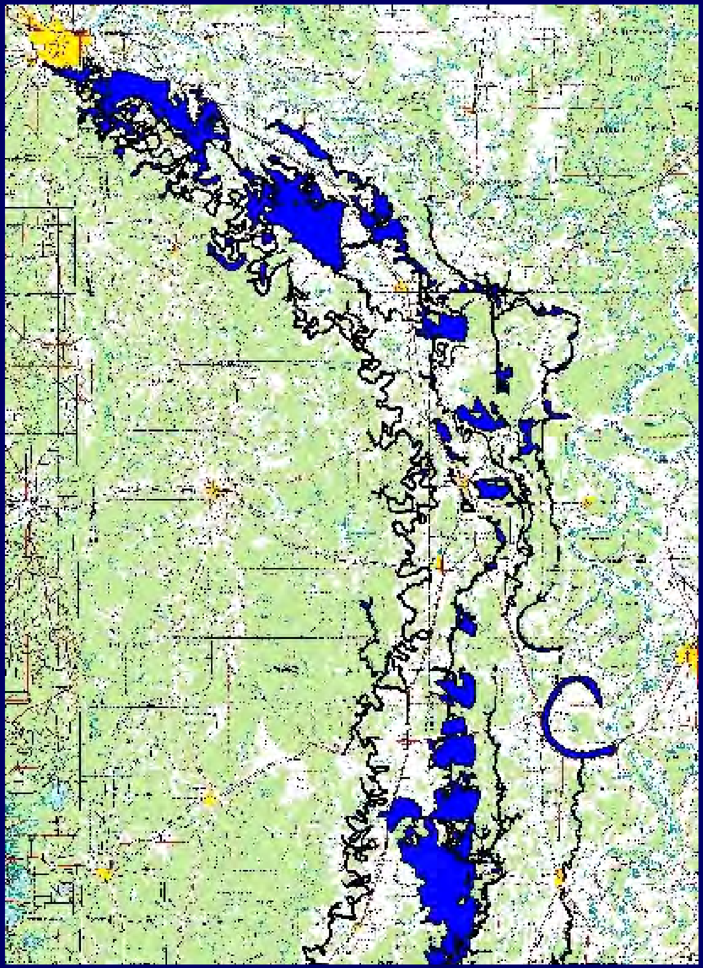
Existing vs Alt 1
2-yr Flood





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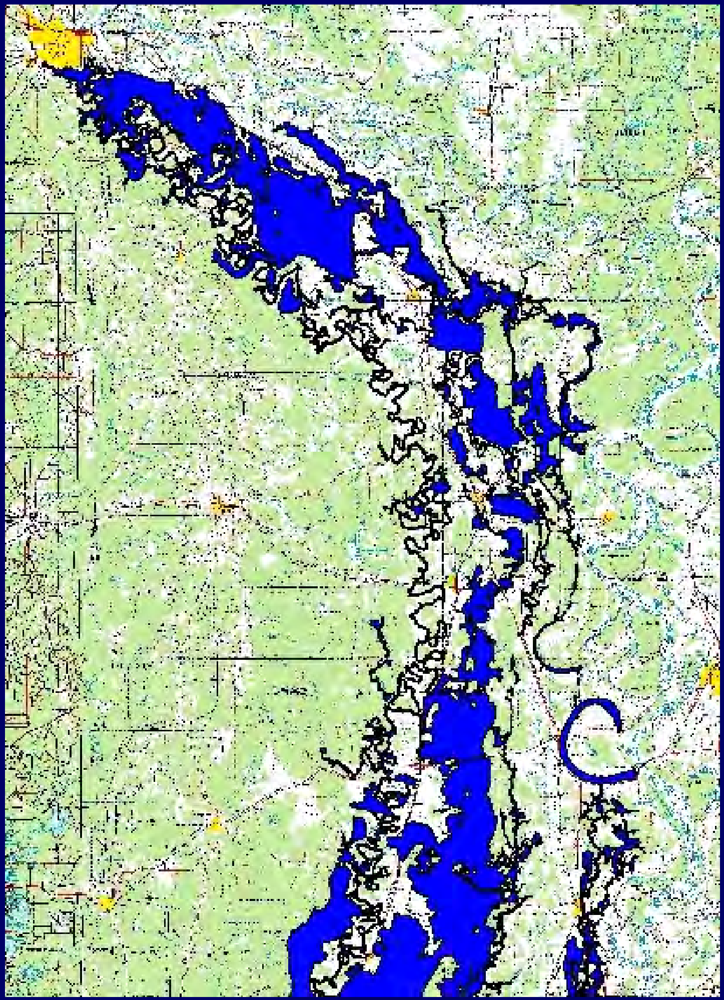
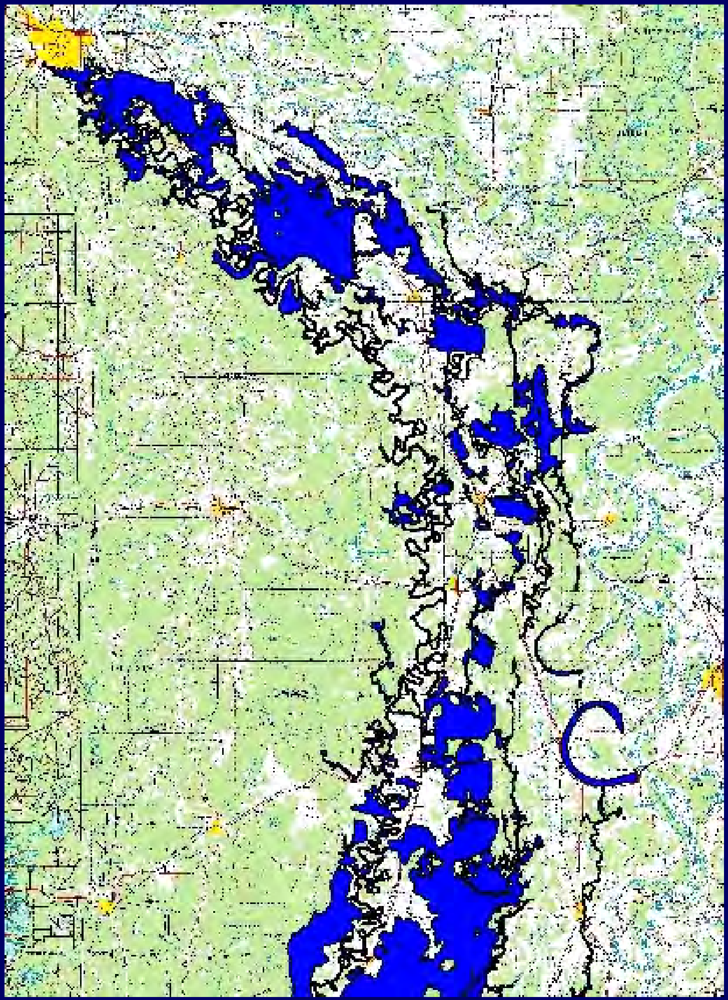
Existing vs Alt 1 5-yr Flood





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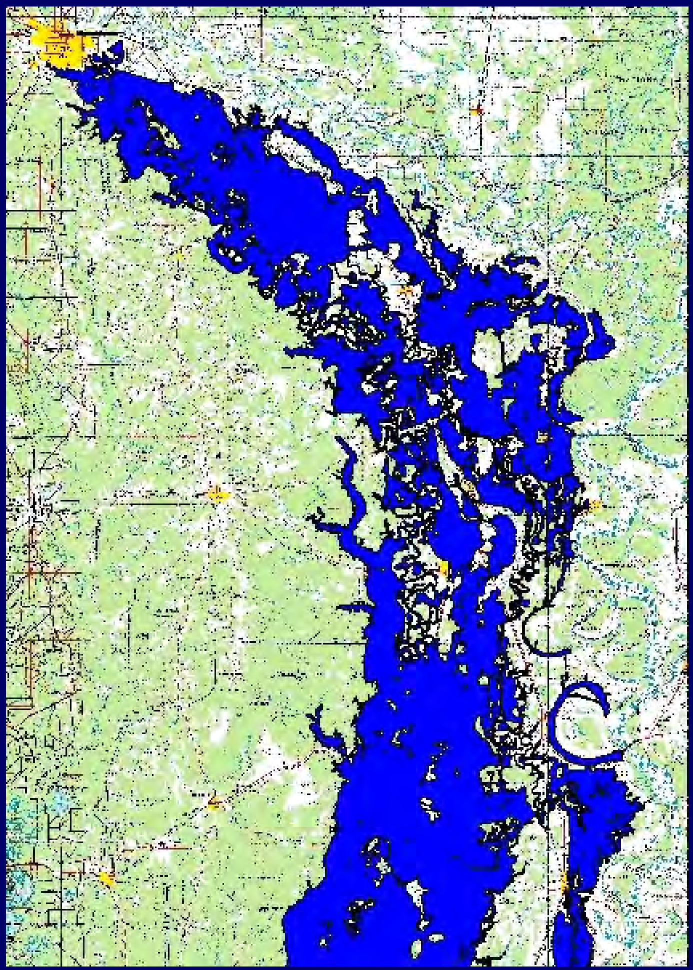
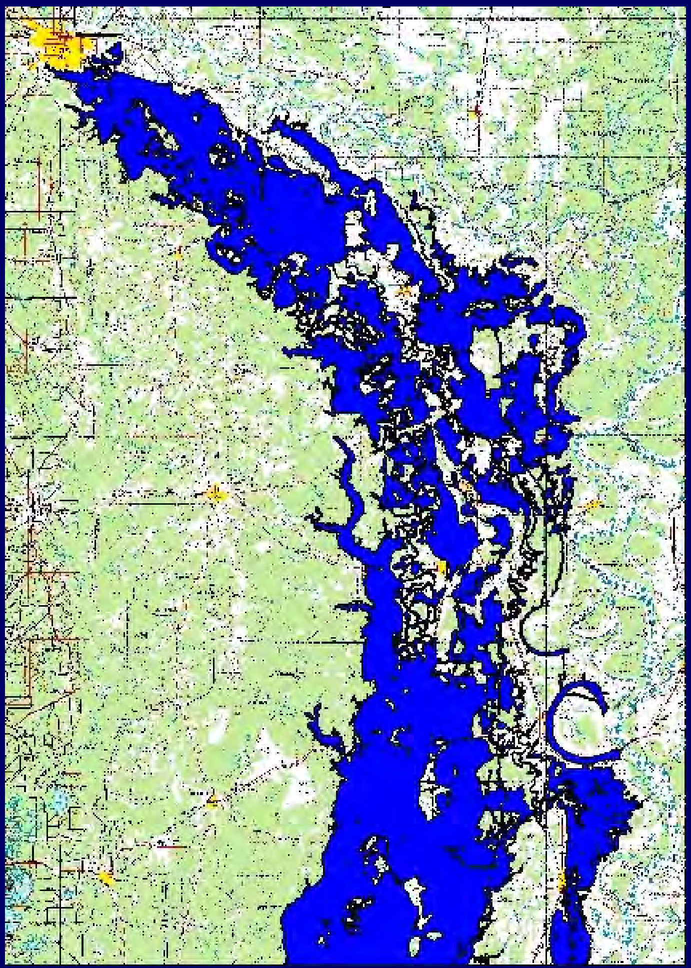
Existing vs Alt 1
100-yr Flood





Alternative 2

Proposed work consists of channel enlargement along Deep Bayou, Boeuf River, Canal 19, Big Bayou, and Black Pond Slough. Also, clearing/snagging will be proposed for Canal 43, Canal 81, Macon Lake, and Bayou Macon.

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Alternative 2
HEC-HMS Modeling

1. Change routing parameters (storage – outflow relationship) to reflect Alternative 2 conditions.

2. Make runs.

Canal 19 – Alt 2
2-yr Flow Hydrograph

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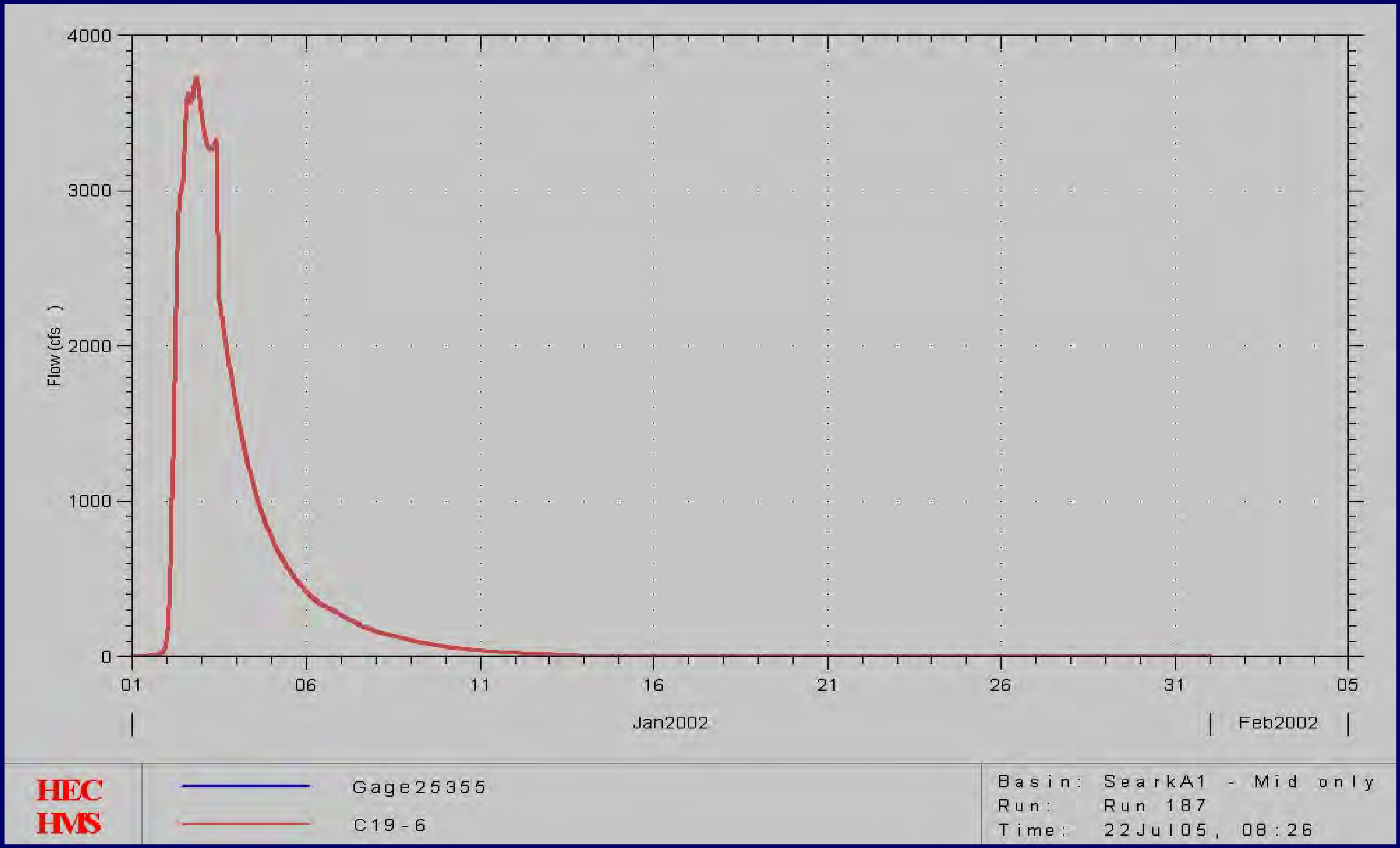

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Alternative 2 HEC-RAS Modeling

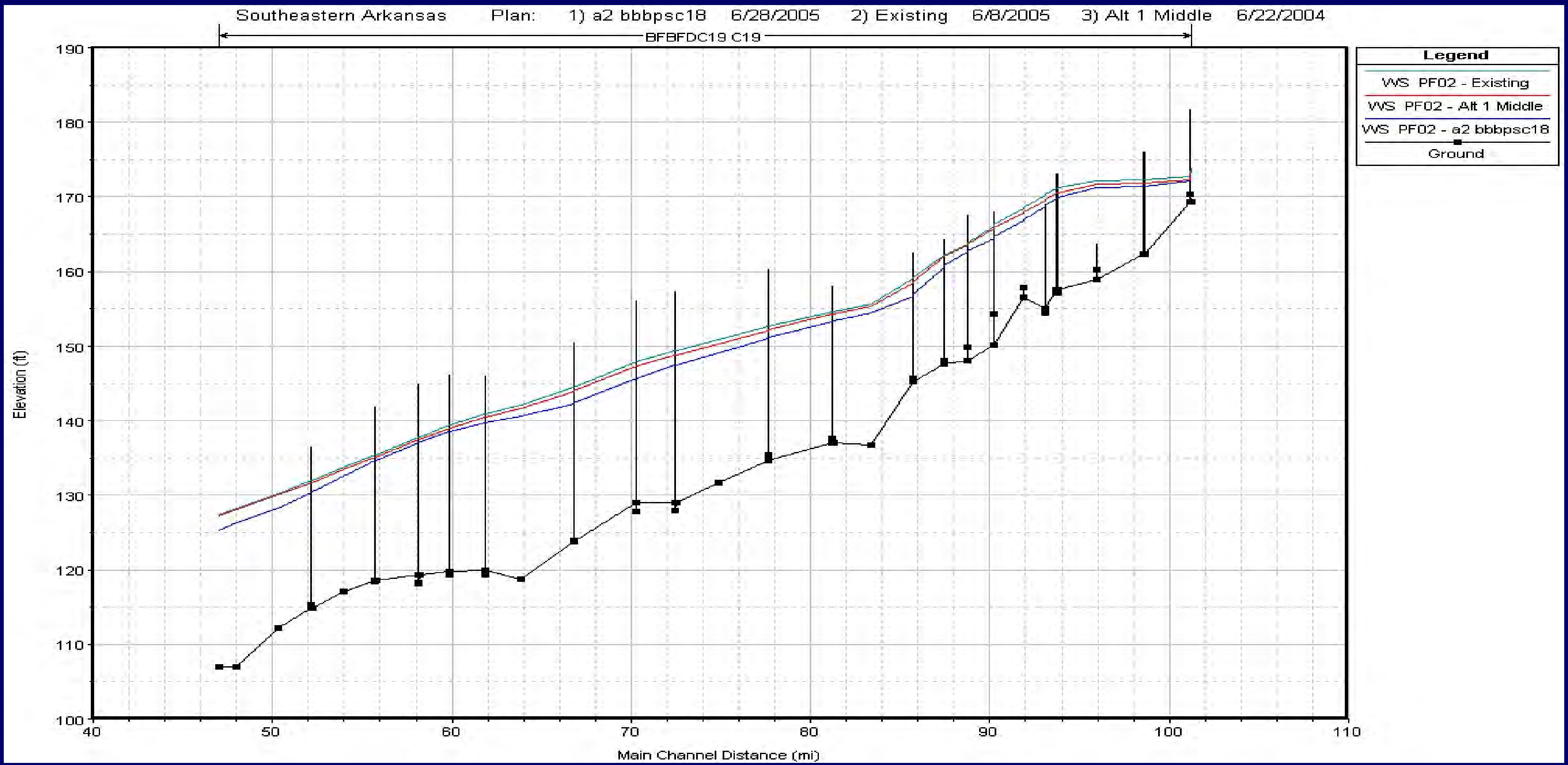
1. Revise channel geometry, channel n-values, etc., to reflect Alternative 2 conditions.

2. Input revised HEC-HMS flows and make runs.

Canal 19

2-Yr WS Profile

Exis vs Alt 1, Alt 2



Canal 19 Stage-Frequency Alt 2 vs Existing, Alt 1

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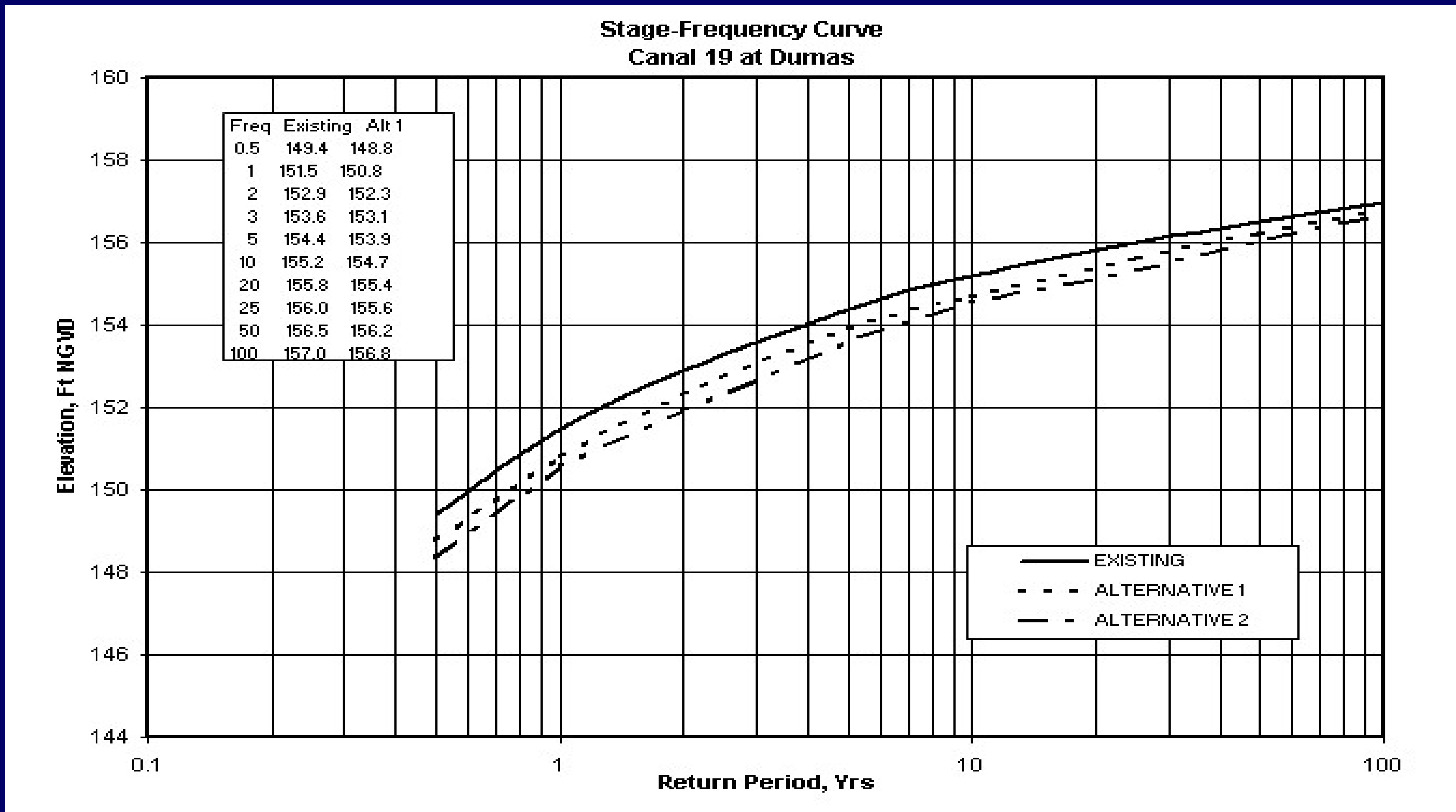

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Alternative 2
FEAT Modeling

1. Input revised HEC-RAS water-surface profiles for selected frequencies into model.

2. Make production runs.

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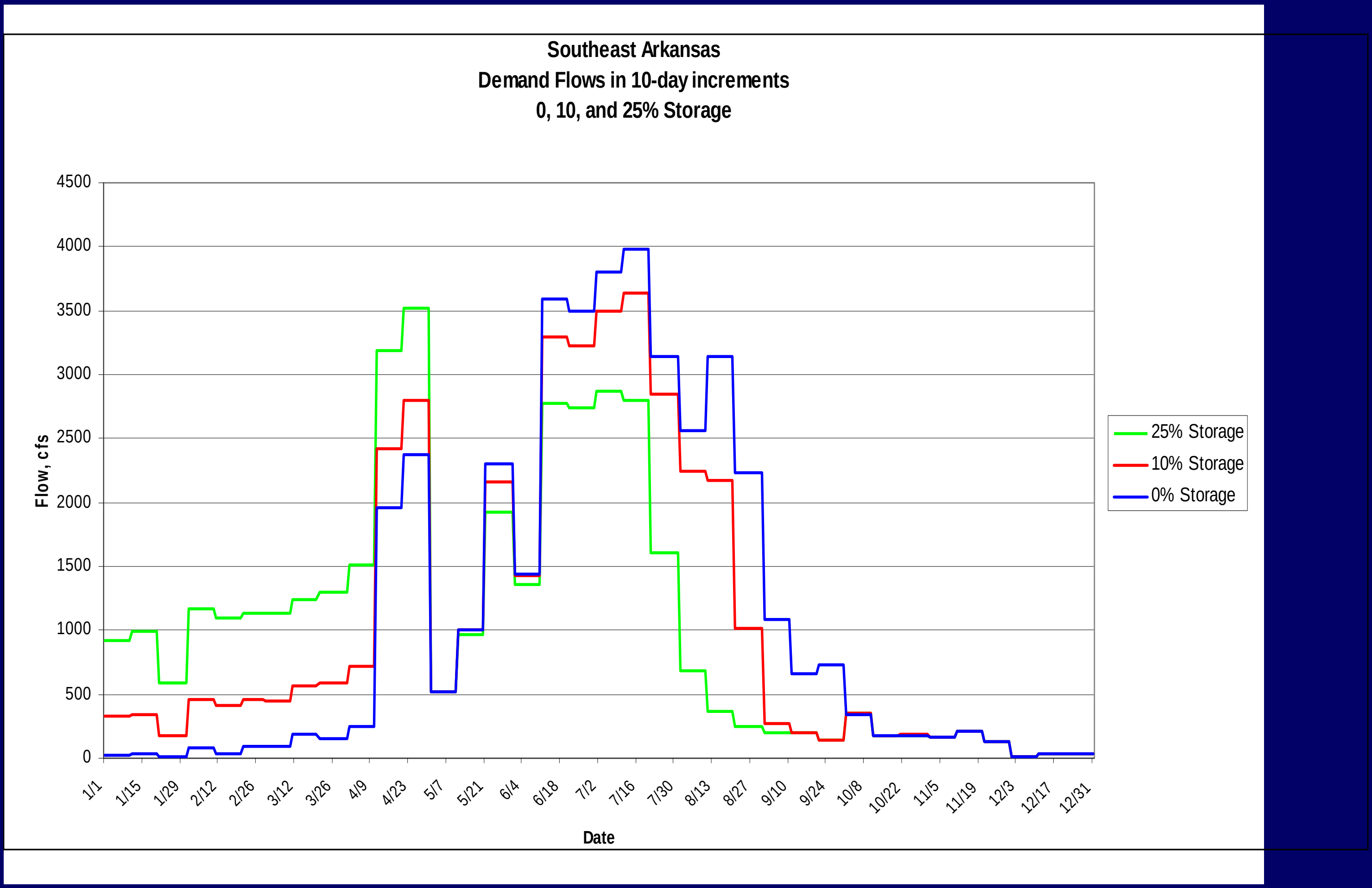
Water Demand

1. Demand curves provided by NRCS for entire study area.

2. Three different scenarios analyzed.
   a. 0% increase in on-farm storage (existing conditions).
   b. 10% increase…
   c. 25% increase…

Southeast Arkansas Demand Flows



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Water Available

1. Arkansas River flow data acquired for P. O. R. 1970 – 2002.

2. Required minimum flows (per Arkansas Soil and Water) removed based on navigational needs and Fish and Wildlife regulations (3000 – 6778 cfs).

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Water Available (Cont'd)

3. Flows removed for Bayou Meto project, based on demand curve from Memphis District COE.

4. Remaining flows assumed to be available for use. Statistical analysis shows % of time demand flows are available.

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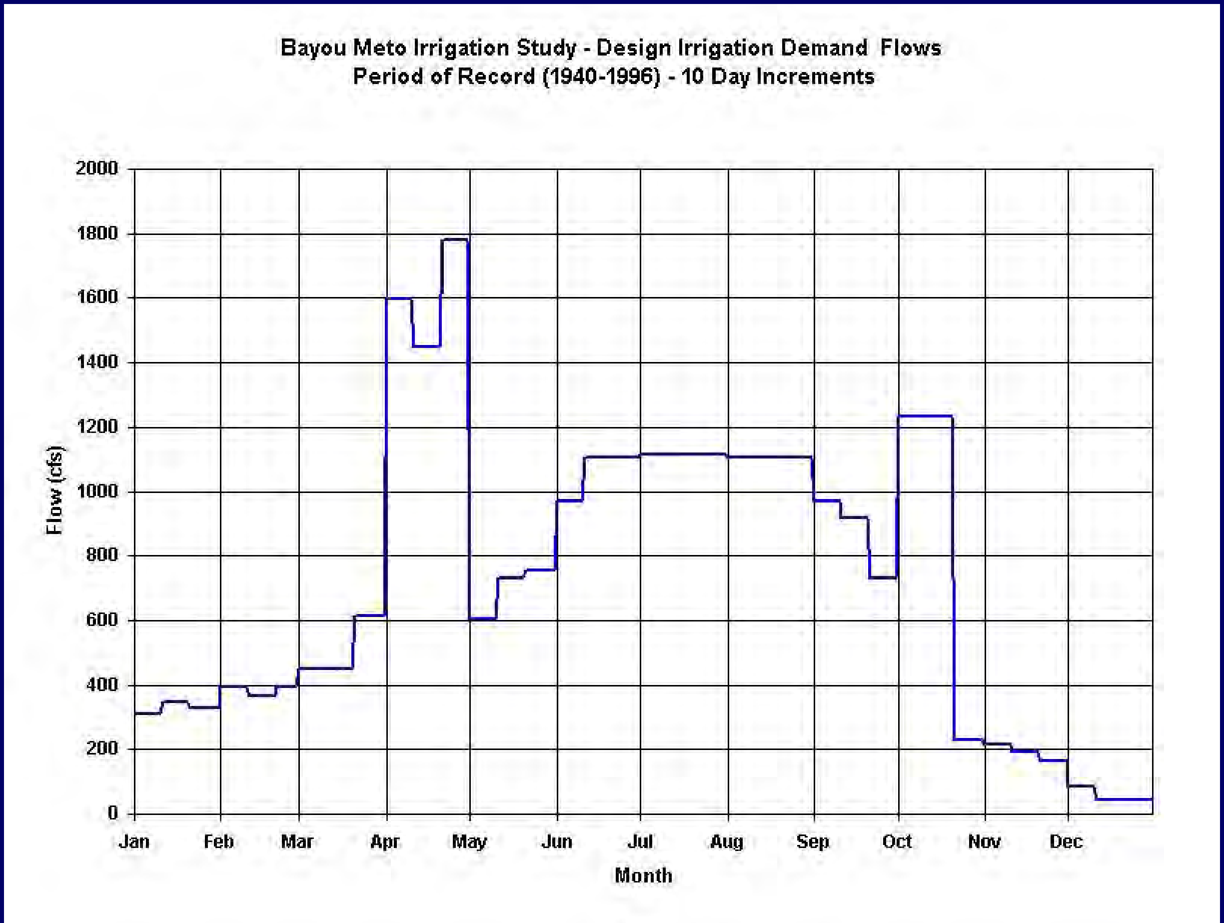
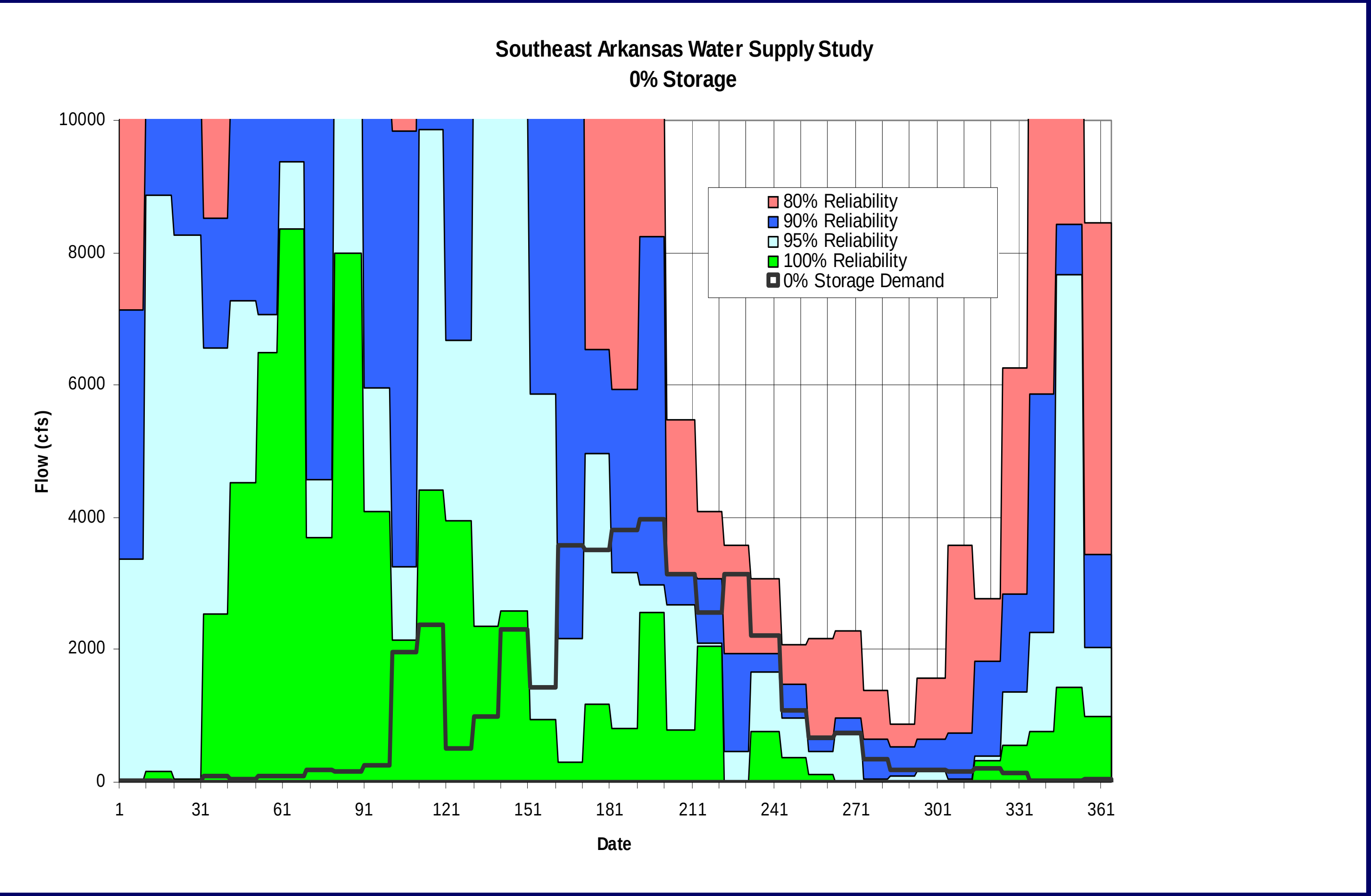
Bayou Meto Demand Flows



0% Storage



Southeast Arkansas Water Supply Study
0% Storage
Flow (cfs)
Date
80% Reliability
90% Reliability
95% Reliability
100% Reliability
0% Storage Demand
10000
8000
6000
4000
2000
0
1
31
61
91
121
151
181
211
241
271
301
331
361

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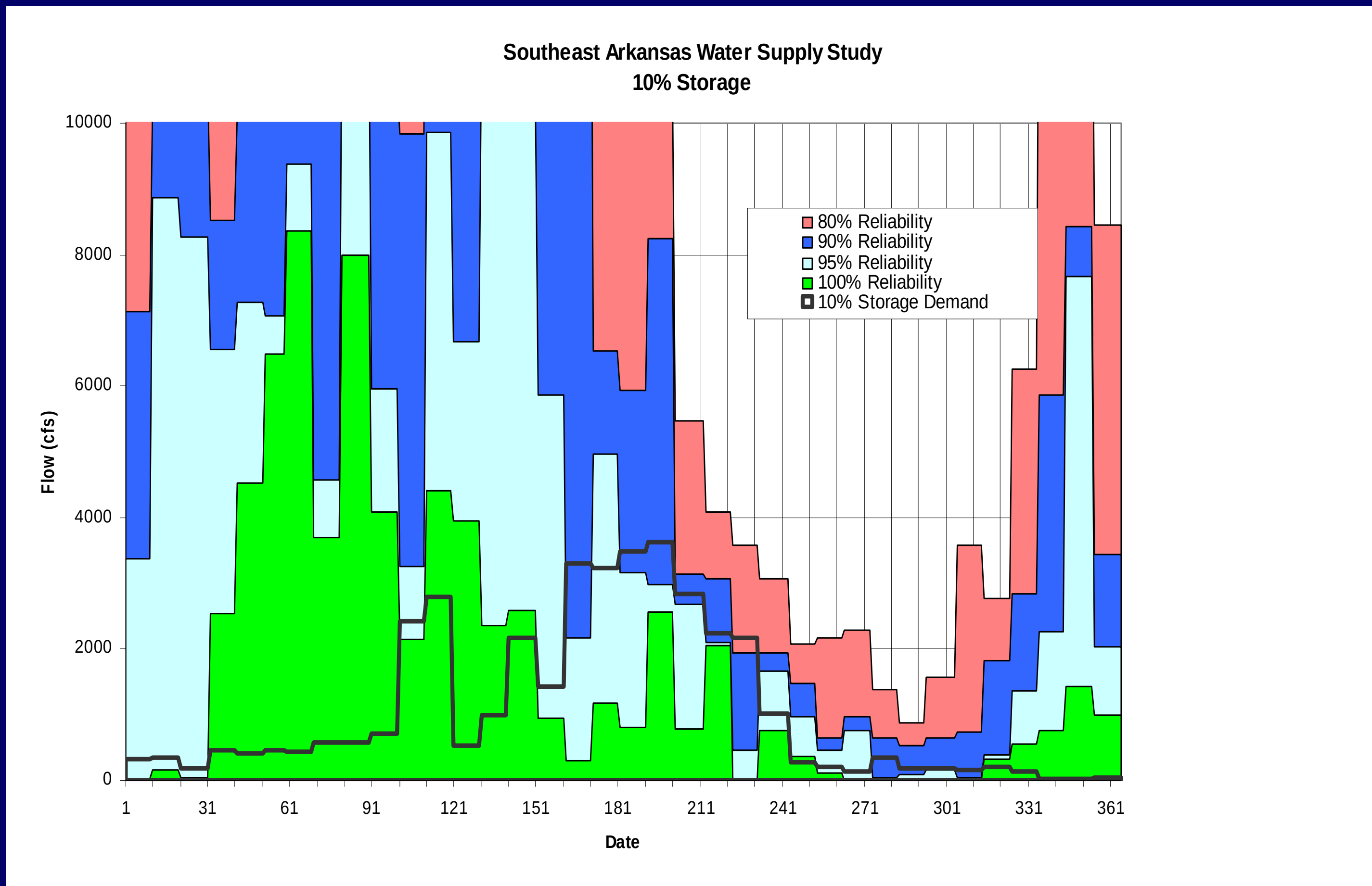
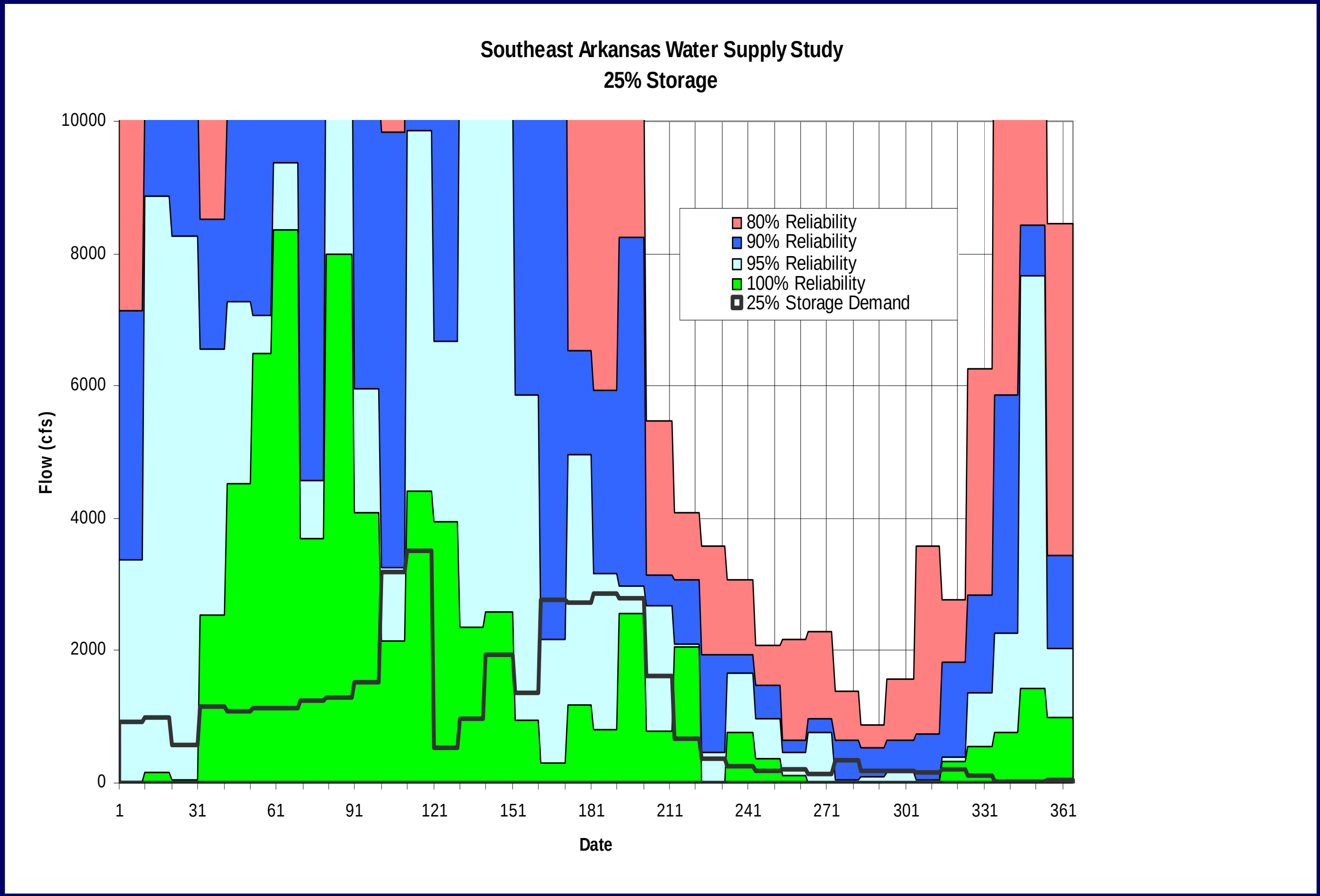
10% Storage



25% Storage


Southeast Arkansas Water Supply Study
25% Storage
Flow (cfs)
Date
80% Reliability
90% Reliability
95% Reliability
100% Reliability
25% Storage Demand
10000
8000
6000
4000
2000
0
1
31
61
91
121
151
181
211
241
271
301
331
361

Environmental Analysis

1. Waterfowl - Analyze daily flooded acres (01 Nov – 28 Feb), considering depth and duration of flooding.

2. Aquatics - Analyze daily flooded acres (01 Mar – 30 Jun), considering depth and duration of flooding.

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Environmental Analysis (Cont'd)

3. Terrestrial - Analyze daily flooded wooded acres, considering seasonal durations.
4. Wetlands – Analyze daily flooded acres, considering seasonal durations.

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Work in Progress

1. Finish evaluation of Alternative 2 channel enlargement.
2. Evaluate Alternative 3 (channel enlargement, possible flow diversions).
3. Evaluate water supply requirements.

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West Section
Bayou Bartholomew

Description: looking downstream
Contract No.: DACW38-00-D-0002 Task Order No.: 008
Date: 1/23/2001 Original: 14_ds.jpg Filename: bth14ds.jpg

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West Section
Deep and Jacks Bayous

Description: looking upstream
Contract No.: DACW38-00-D-0002 Task Order No.: 008
Date: 1/24/2001 Original: 4b_us.jpg Filename: dpb4bus.jpg

Deep Bayou

Description: looking upstream
Contract No.: DACW38-00-D-0002 Task Order No.: 008
Date: 1/24/2001 Original: 4b_a_us.jpg Filename: jb4baus.jpg

Jacks Bayou

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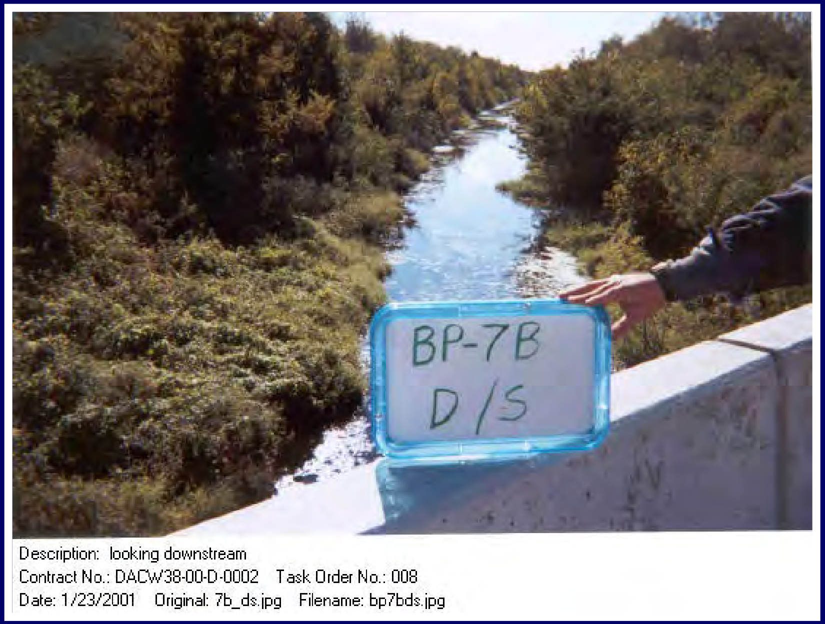
Middle Section - Big Bayou and Black Pond Slough

Big Bayou



Black Pond Slough

Middle Section
Boeuf River and Canal 18

Description: looking upstream
Contract No.: DACW38-00-D-0002 Task Order No.: 008
Date: 1/23/2001 Original: 4b_us.jpg Filename: bfd4bus.jpg

Description: looking upstream
Contract No.: DACW38-00-D-0002 Task Order No.: 008
Date: 1/24/2001 Original: 8b_us.jpg Filename: c18_8bus.jpg

Beouf River (Diversion)

Canal 18

Middle Section
Canal 19

Description: looking at upstream face
Contract No.: DACW38-00-D-0002 Task Order No.: 008
Date: 1/24/2001 Original: 3b_usface.jpg Filename: c19_3bus_face.jpg

East Section
Ditch and Connerly Bayous

Description: looking downstream
Contract No.: DACW-38-00-D-0002 Task Order No.: 008
Date: 1/21/2001 Original: 2ds.jpg Filename: DB-2-DS

Ditch Bayou

Description: looking upstream
Contract No.: DACW38-00-D-0002 Task Order No.: 008
Date: 2/19/2001 Original: 2_us.jpg Filename: cb2us.jpg

Connerly Bayou

Department of the Army

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A Proud Tradition…A Vision for the Future

The Engineer of Choice for the 21st Century

Southeast Arkansas Feasibility Study

Thomas R. Brown, Hydraulics Engineer

Work phone: 601 631-5678

US Army Corps of Engineers
Vicksburg District

Email: tommy.r.brown@usace.army.mil

Uncertainty Analysis: Parameter Estimation

Jackie P. Hallberg

Coastal and Hydraulics Laboratory

Engineer Research and Development Center

Outline

- ADH
- Optimization Techniques
- Parameter space
- Observation data
- PEST Application
- Surrogate models

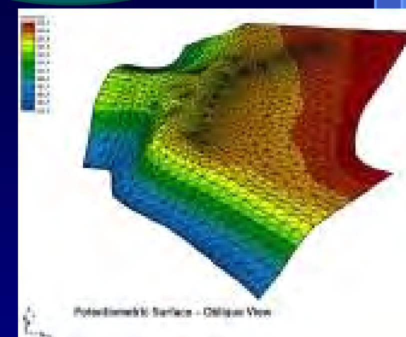
Department of Defense Environmental Concerns

- estuaries
- coastal regions
- river basins
- reservoirs
- groundwater
- heat transport

ADH

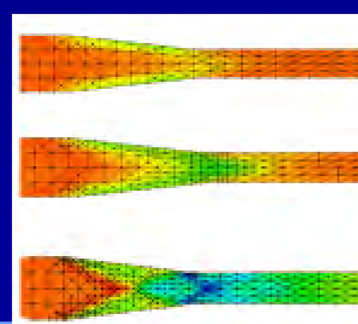
Navier-Stokes Equations

Unsaturated Groundwater Equations

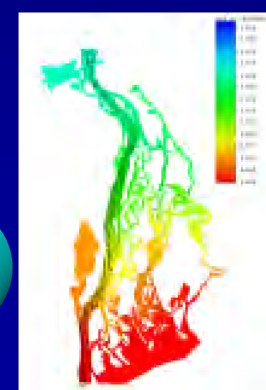


Computational Engine
(finite element utilities,
generic PDE integration routines,
mesh adaption and coarsening,
preconditioners and solvers,
I/O to GUIs)

Heat Transport Equations



Shallow Water Equations



Advantages

- Code Reuse
  - Takes advantage of large investment in element adaption and parallelization.
- Code Consolidation
  - Maintain a single code.
  - Advances are felt immediately across multiple hydrologic applications.
- Interchange of fluid and constituents among previously-separate hydraulic systems.

Challenges

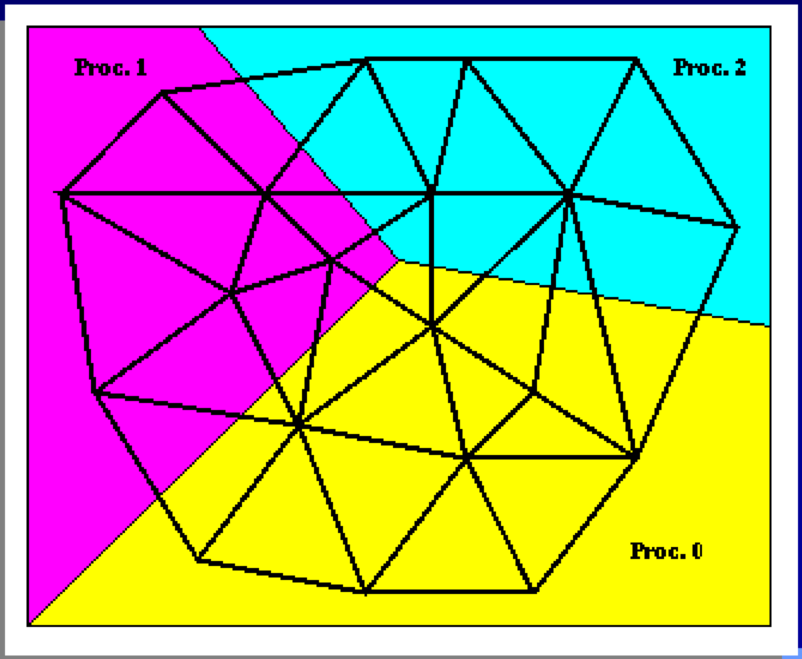
- Single solver for many types of problems
- Overhead
  - Extra baggage can make the combined simulator larger and slower than problem-specific code.
- Maintenance
  - Must retain compartmental, structured code or the model becomes unwieldy.
  - Revision control --- many cooks in the kitchen.

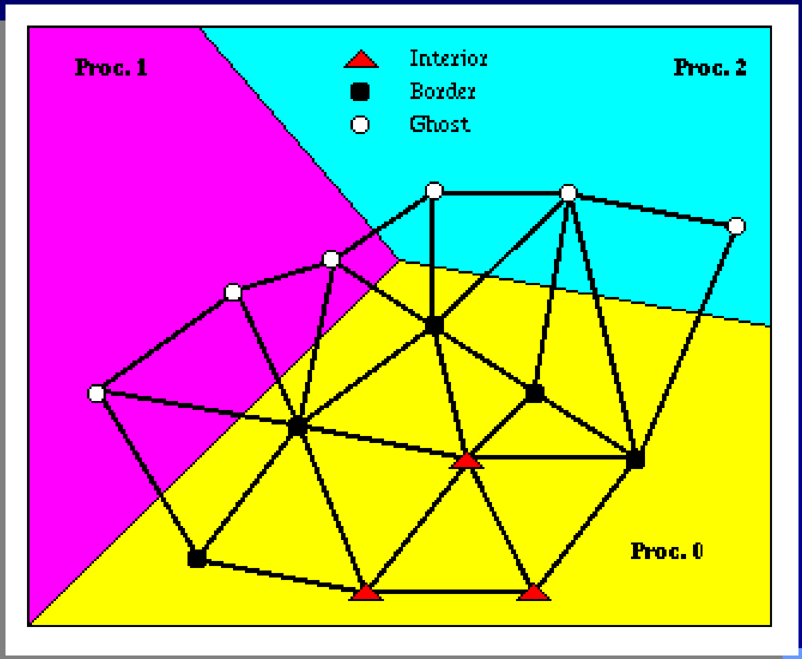
ADH Model

- Linear, simplex, continuous finite elements (tetrahedra, triangles, lines)
- Dynamic mesh adaption
- Written in C using dynamic memory allocation
- MPI message-passing model
- Bi-CGSTAB linear solver
- Variety of pre-conditioners (Jenkins)
- Inexact Newton nonlinear solver
- Dynamic load balancing
- Galerkin Least Squares-like stabilization
- CVS and SVN revision control

Parallel Finite Element Approach

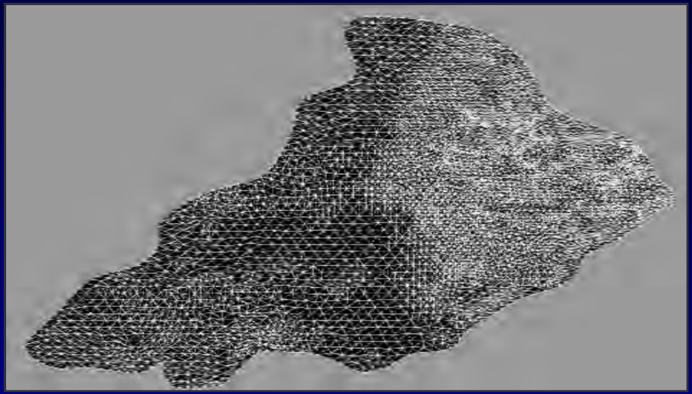
- Partition grid and distribute partitions to processors.
  - Assign nodes to processors.
  - Share elements along processor boundaries.

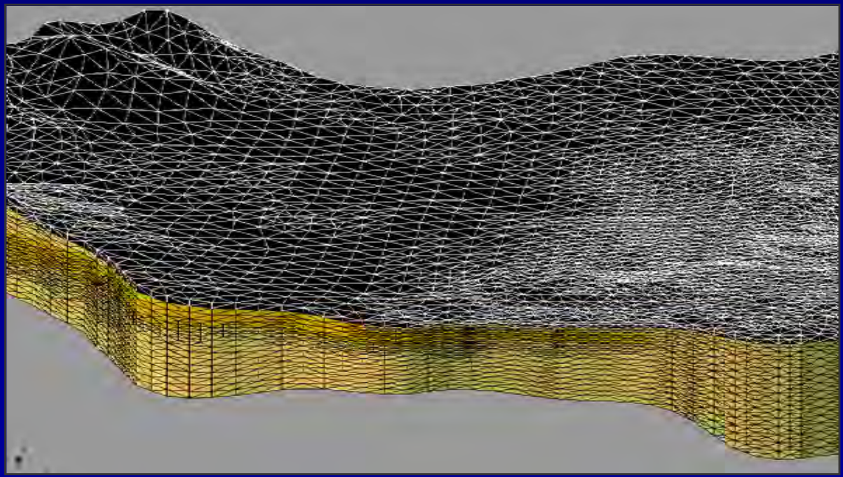




Adaption Details

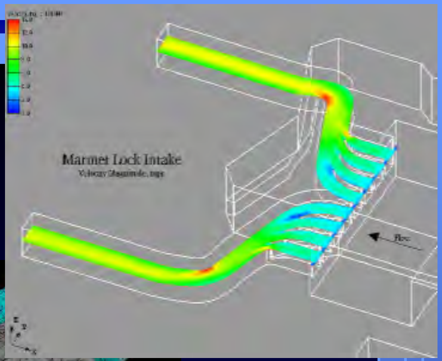
- Refinement
  - Error Indicator
  - Splitting Edges
  - Closure
- Coarsening
  - Finding duplicates

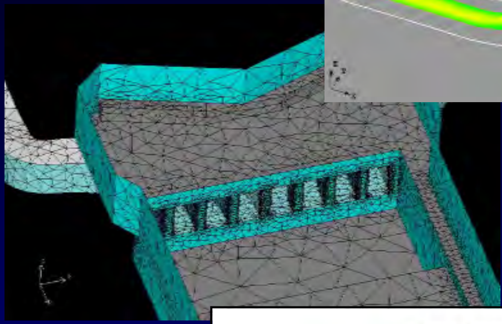


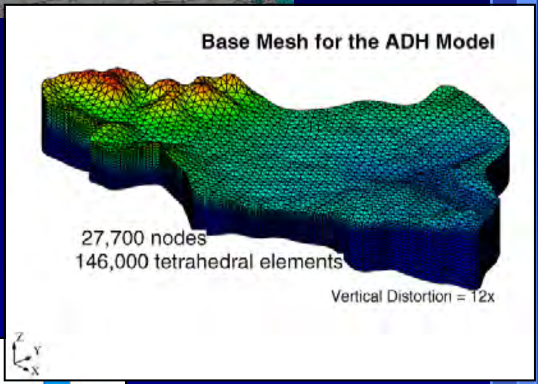


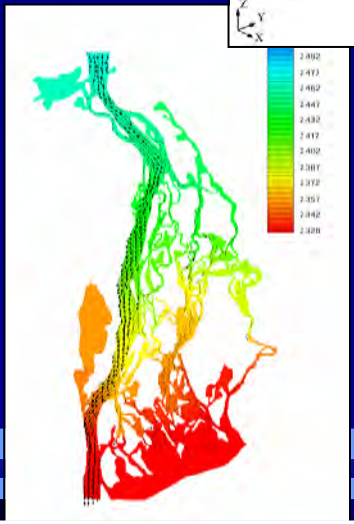
Problems Addressed

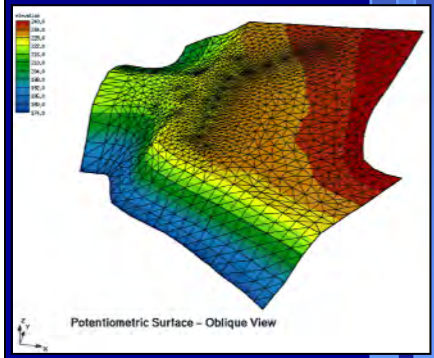
- Physical Systems
  - Partially saturated groundwater
  - Shallow water (with wave stresses)
  - Navier-Stokes (hydrostatic and non-hydrostatic)
  - Non-cohesive and cohesive sediment erosion/deposition and transport
  - Turbulence effects
  - Multi-constituent transport
  - Heat transport
- Internal coupling of groundwater and surface water simulations.



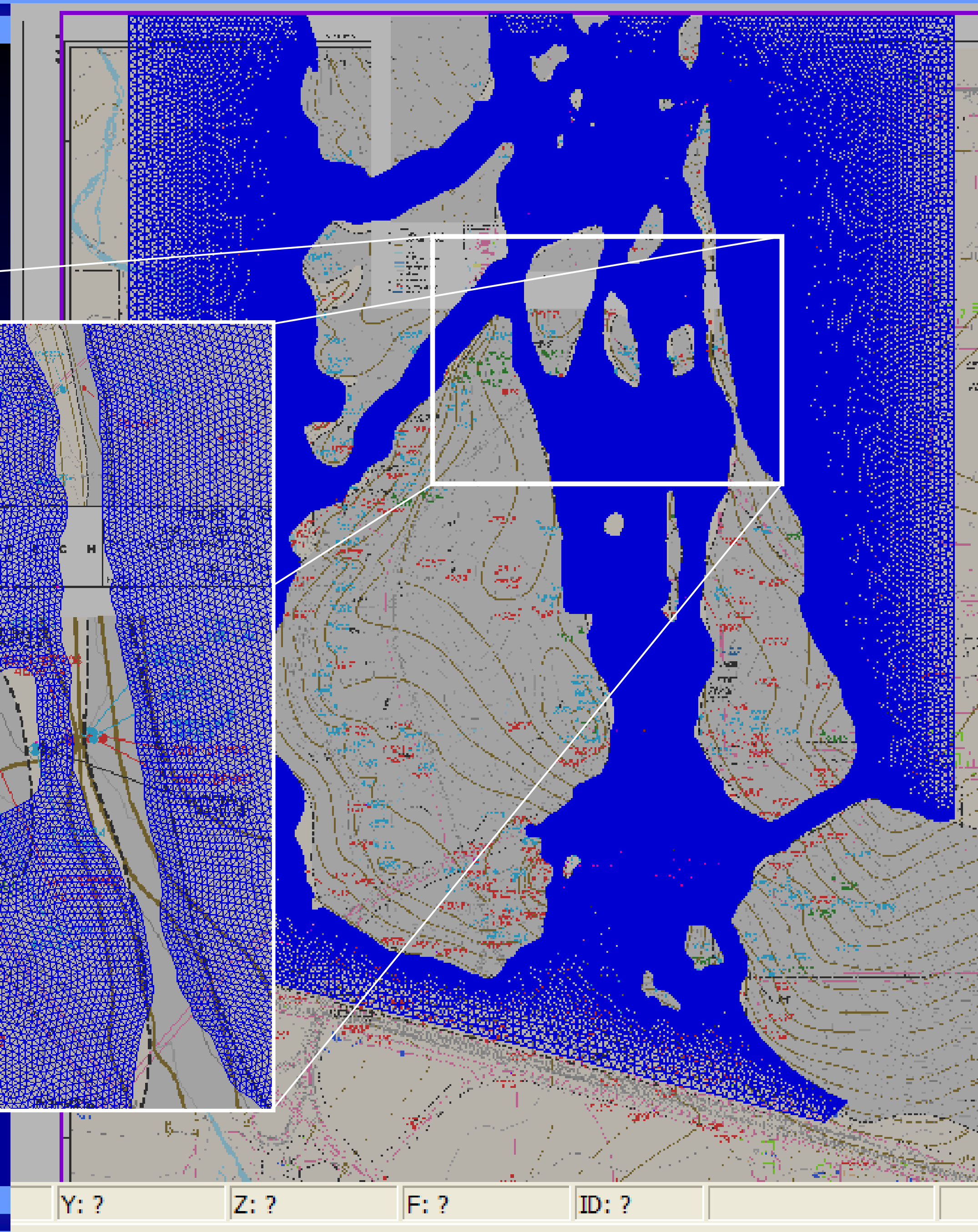


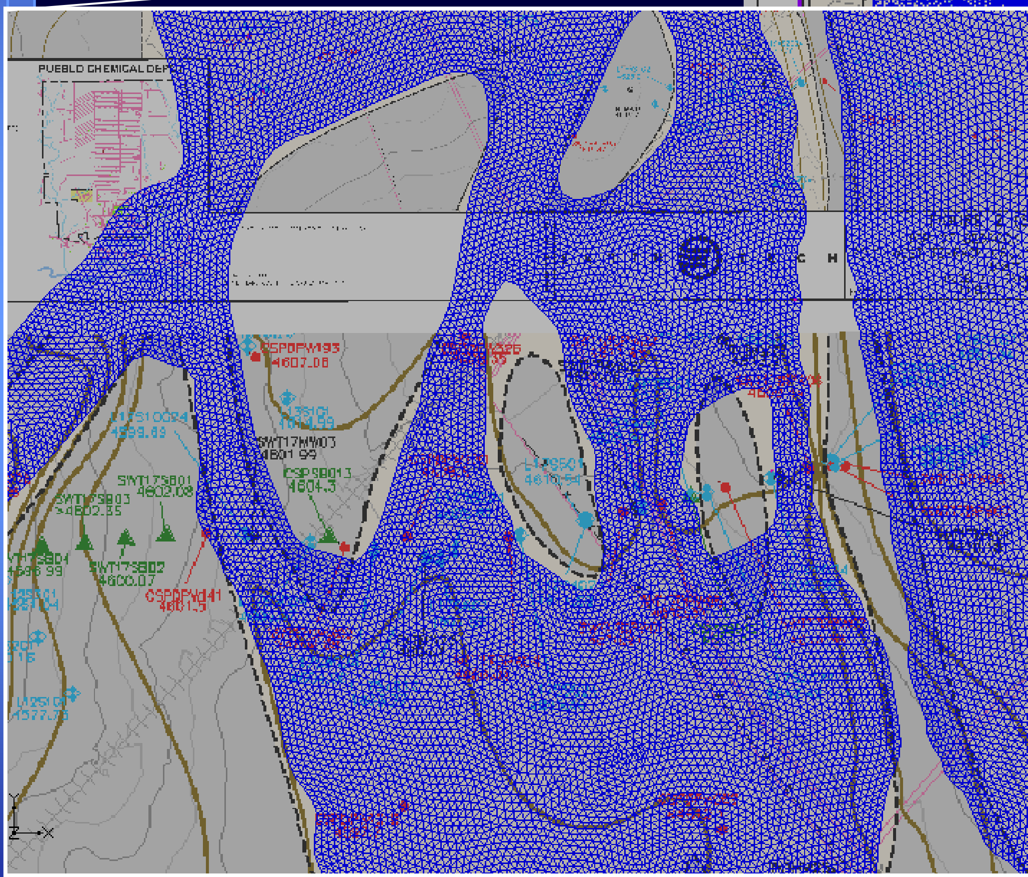






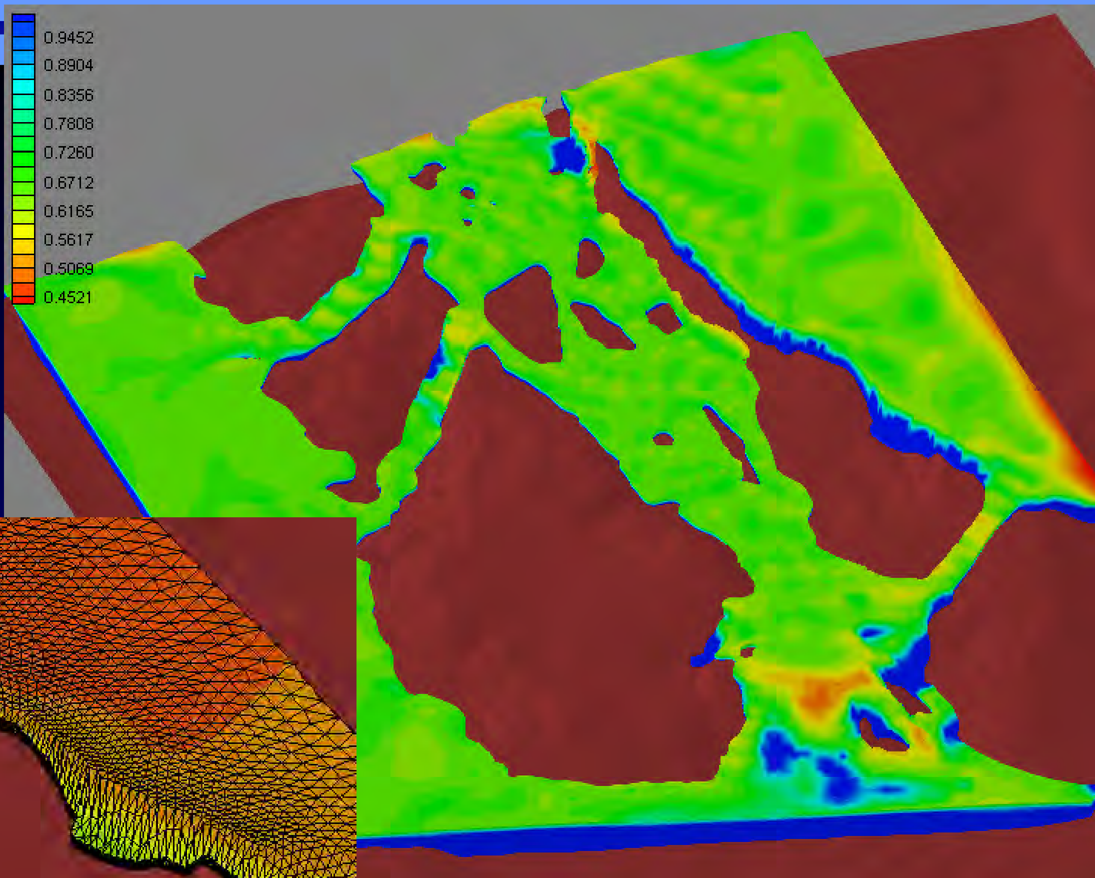
Pueblo Chemical Depot Fine Mesh

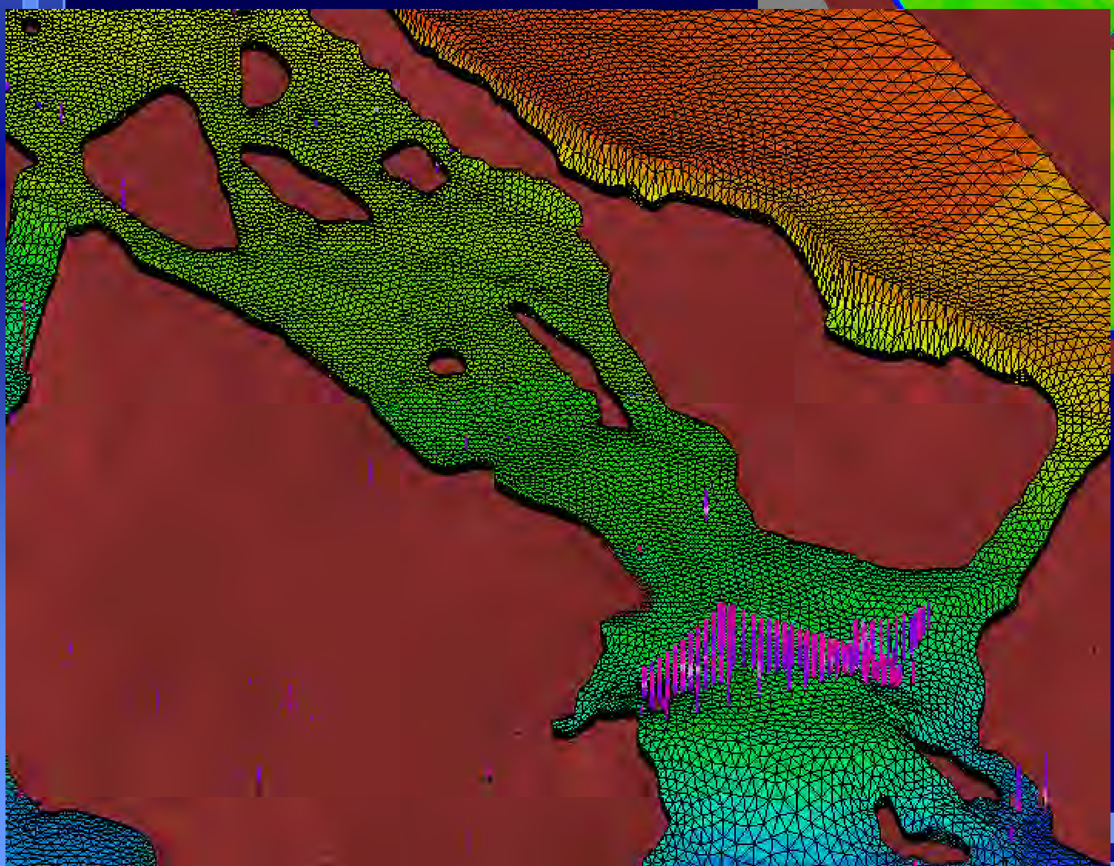




318,000 nodes, 2M elements

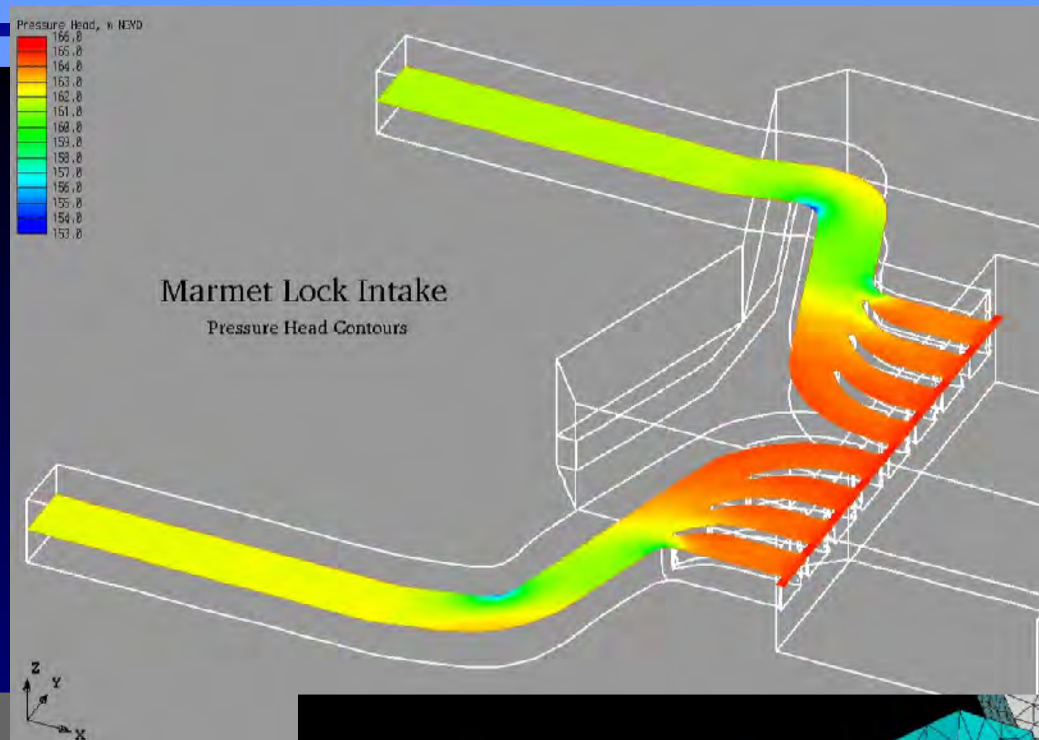
Pueblo Chemical Depot Coarse Mesh

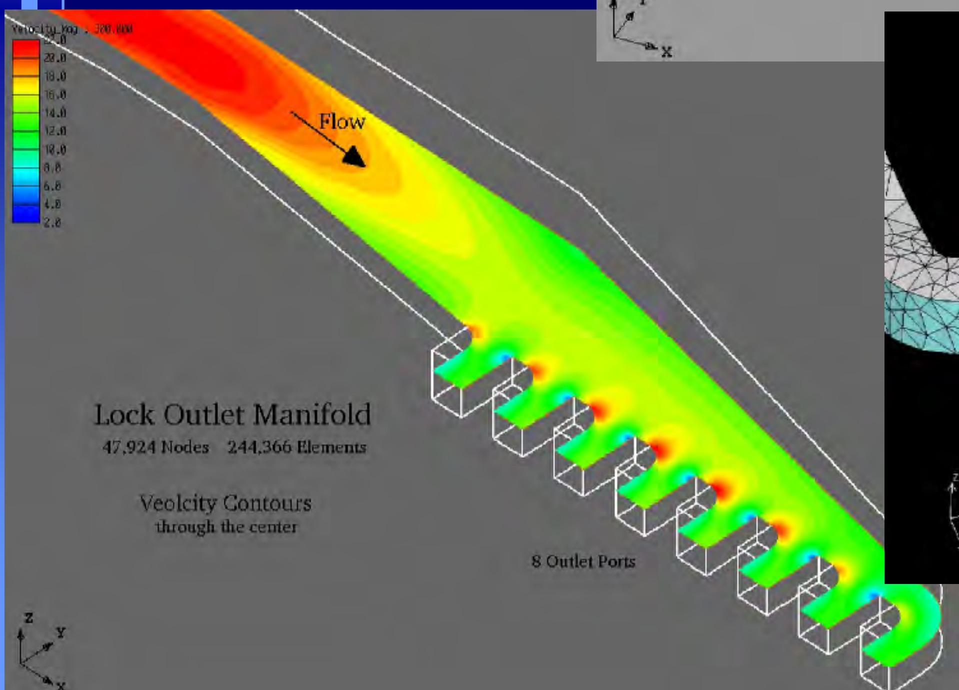


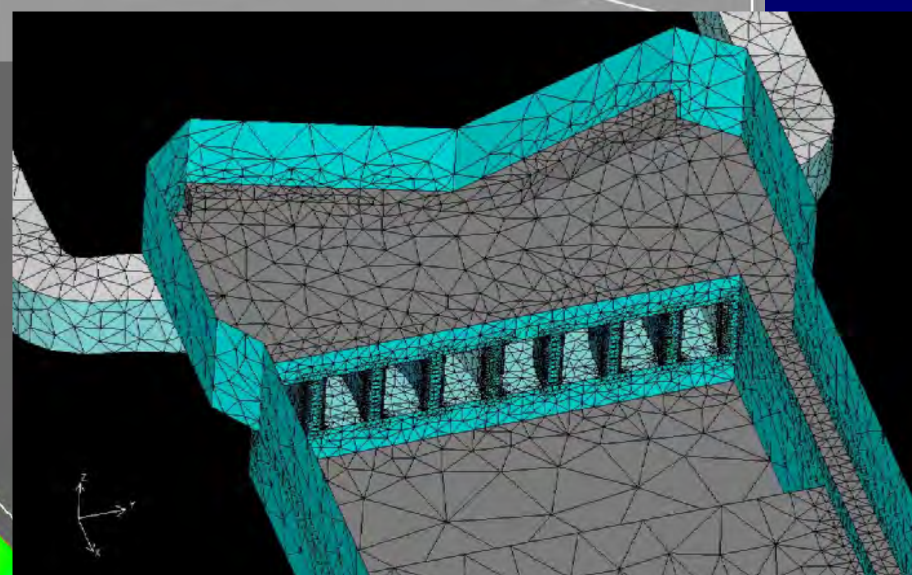


89,000 nodes,
420,000 elements

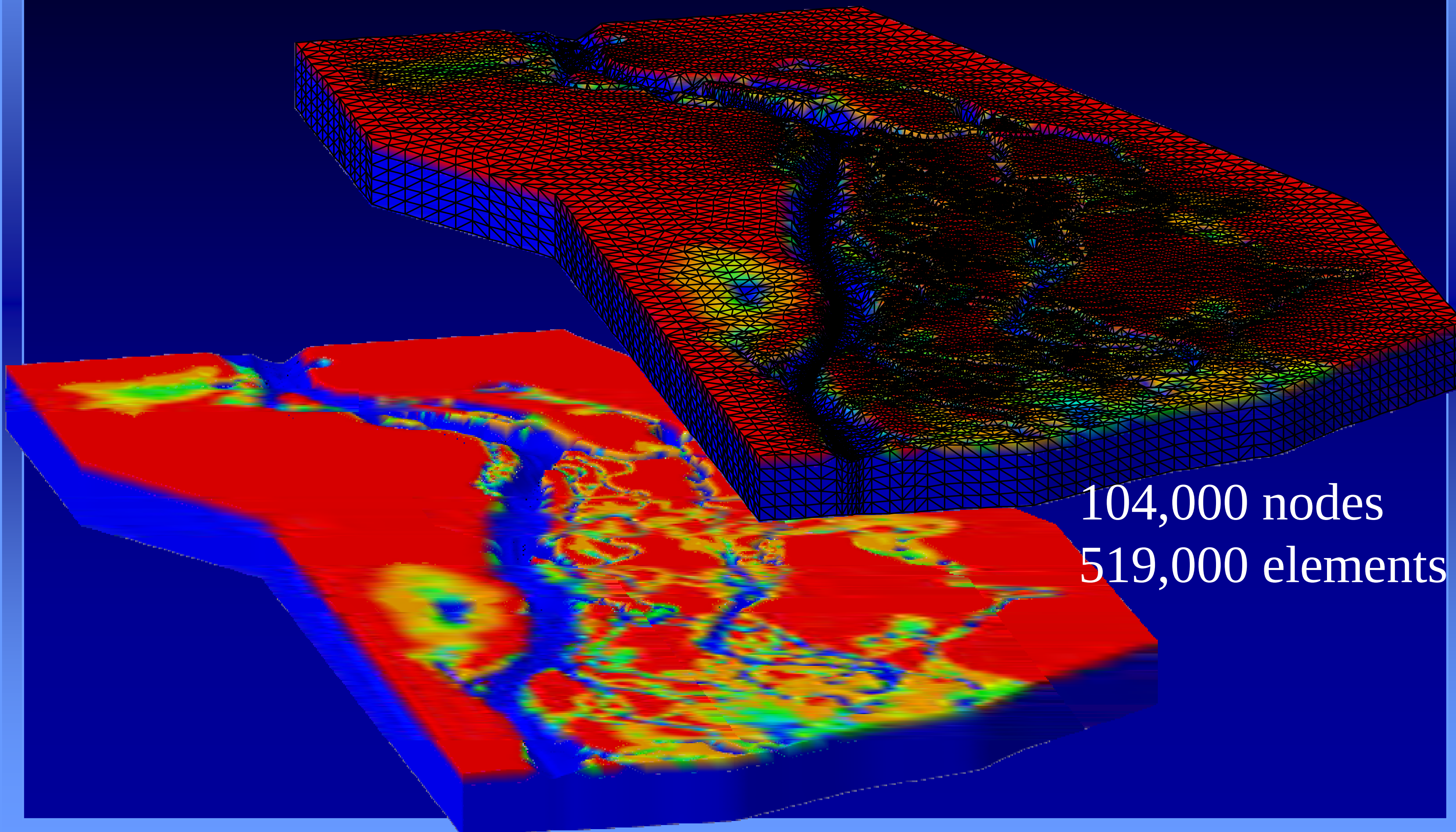
Lock Intake and Outlet





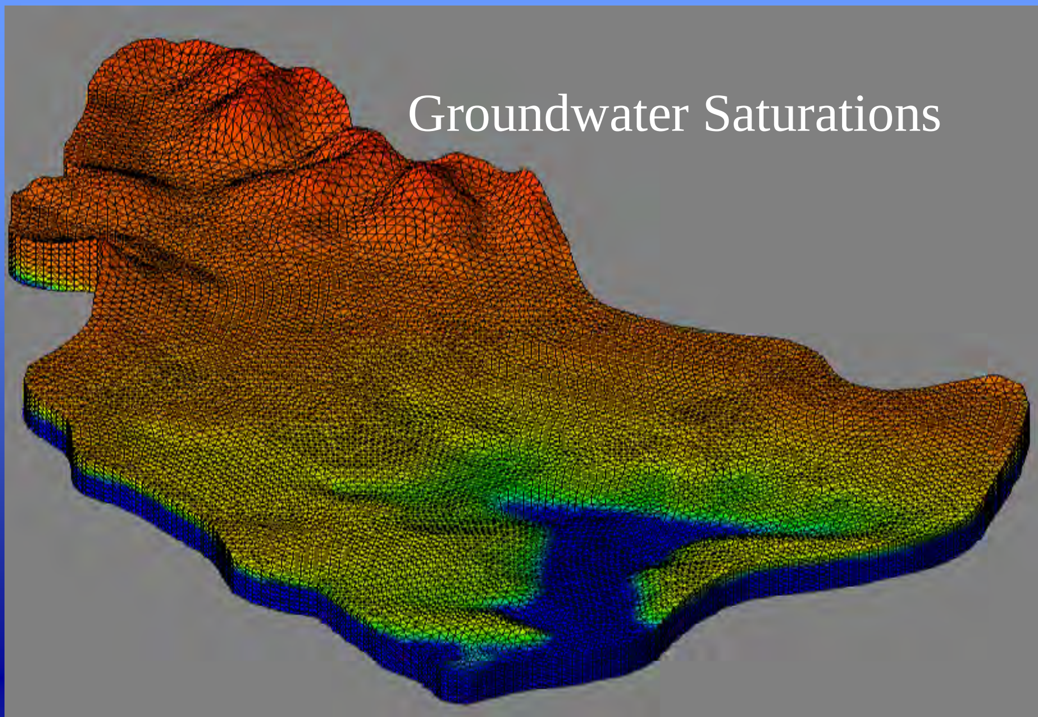


Pool 8 Mississippi River
Groundwater Surface Water Interaction



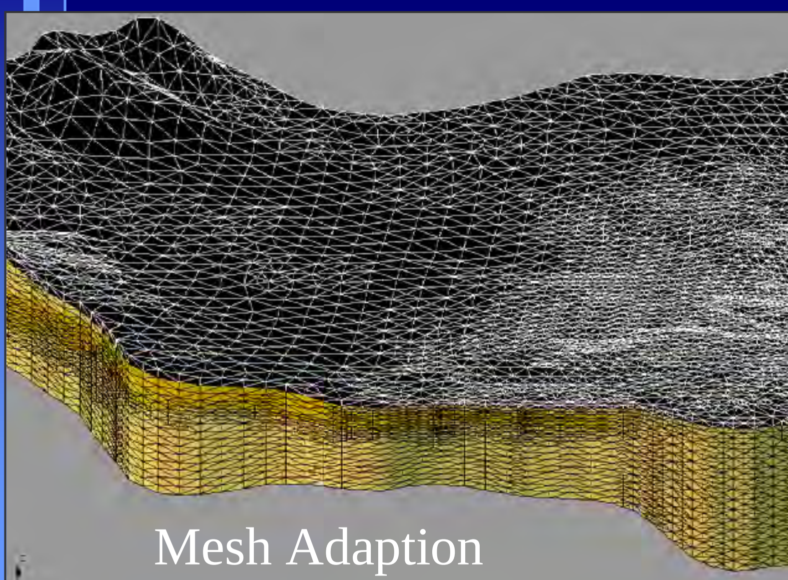
104,000 nodes
519,000 elements

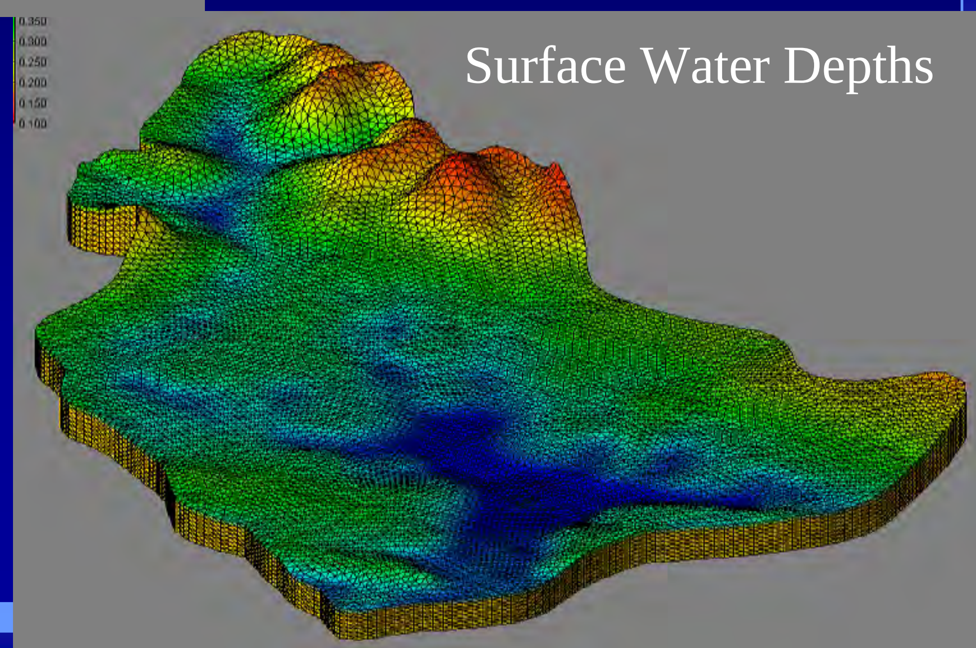
Goose Prairie Creek Watershed



72,000 nodes

375,000 elements





Optimization in Engineering

- Aerospace Applications
  - Airfoil design
  - Design of aerodynamic structures
- Groundwater Applications
  - Design of pump-and-treat remediation system
  - Location of wells for monitoring
- Surface Water Applications
  - Design of open channel structures
  - Location and scheduling of dredging
  - Multi-reservoir systems operation
  - Control of contaminant releases in rivers

Optimization Techniques

- Nonlinear constrained optimization problem

Minimize: $F(x)$ objective function

Subject to:

$$g_j(X) \leq 0$$ j=1,m inequality constraints

$$h_k(X) = 0$$ k=1,*l* equality constraints

$$X_i^l \leq X_i \leq X_i^u$$ i=1,n side constraints

Optimization Techniques

where $$X = \begin{Bmatrix} X_1 \\ X_2 \\ X_3 \\ . \\ . \\ . \\ X_n \end{Bmatrix}$$ design variables

Optimization Method	Type of Problem	Advantages	Disadvantages
Inverse Methods	Analytic Formula	Highly Efficient	Not Generally Applicable
Genetic Algorithm (Probabilistic Methods)	Discontinuous, Discrete, Cheap Simulations, Multi-Model	Avoids Local Minim, No Gradient Needed	Many Function Evaluation
Finite Difference	Any	Easiest To Use	Large Computer Cost, Accuracy
ADIFOR, CTSE	Any	Highly Accurate Derivative, Easy to Use	Large Computer Cost, Accuracy
Continuous Sensitivity Analysis	Explicit High-Fidelity	Computationally Efficient	Derive and Solve Adjoint Equations
Discrete Sensitivity Analysis	Implicit High-Fidelity	Accurate Derivatives, Efficient	Jacobian Matrix Needed

Burg 2001

Parameter Space

- Groundwater
  - Hydraulic conductivity
  - Constitutive Equations
- Surface Water
  - Roughness
  - Elevation of wetlands
- Overland Flow
  - Roughness
  - Runoff coefficients
- Heat Transport
  - Heat capacity
  - Heat conductivity

Observation Data

- Groundwater
  - Head values
  - Flux from/to surface water
- Surface Water
  - Tidal data
  - Fluxes
- Overland Flow
  - Hydrograph
- Heat
  - Temperature

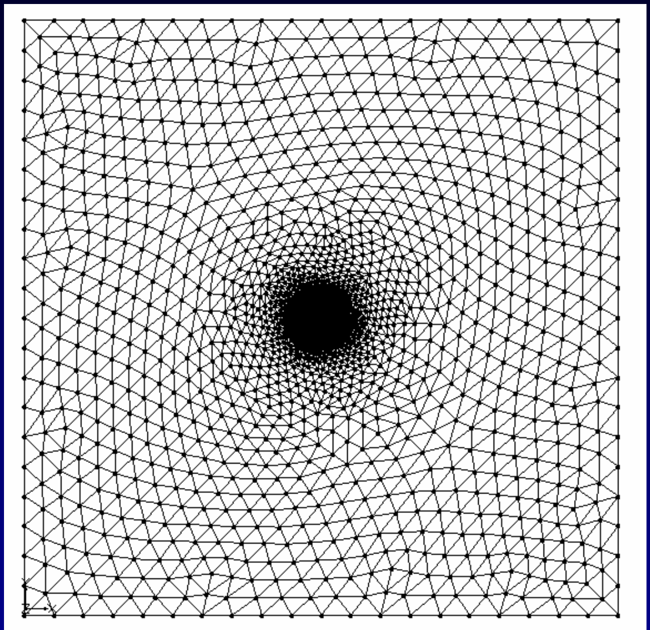
Treatment of Observation Data

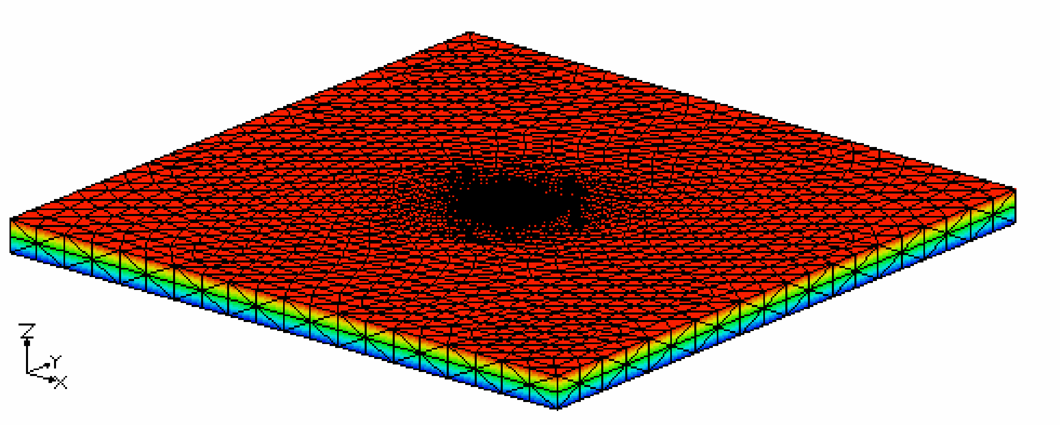
- Sufficient data to properly define the problem
- Data that is sparse spatially, but dense temporally
- How do you deal with tidal data when matching the range, max, and min is the objective?

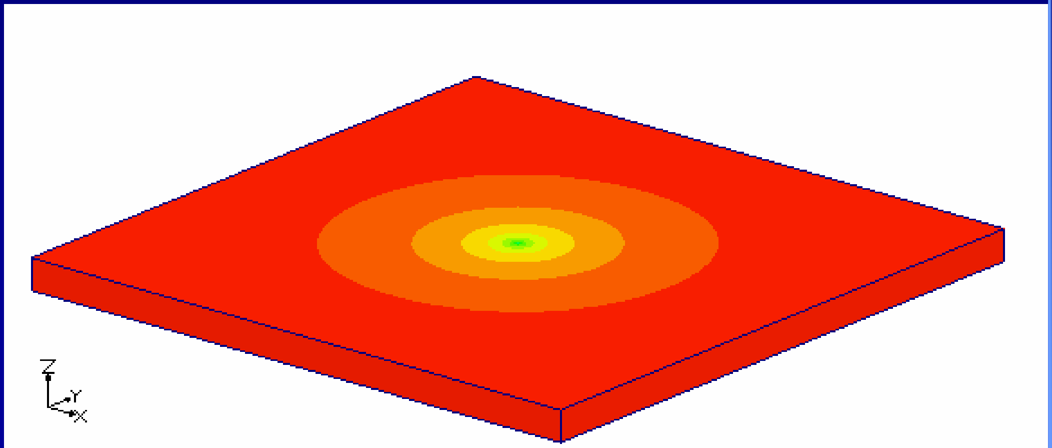
PEST

- based on Gauss-Marquardt-Levenberg (GML) method
- facilitates the use of multi-component objective functions
- performs three model operations
  - parameter estimation
  - regularization
  - predictive analysis

Theis Problem







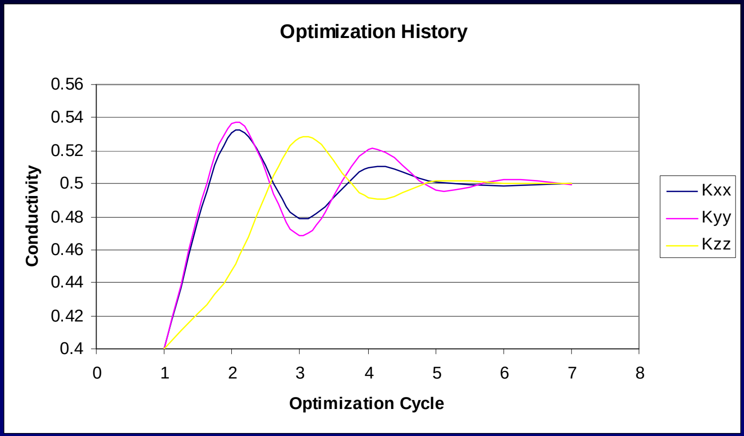
9483 nodes

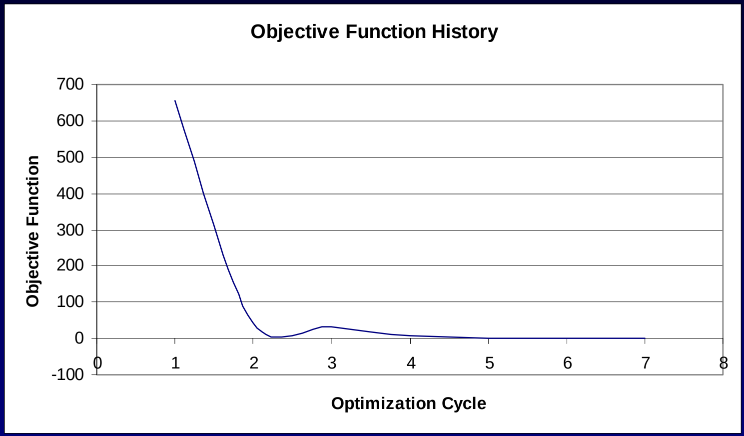
37440 elements

1 material

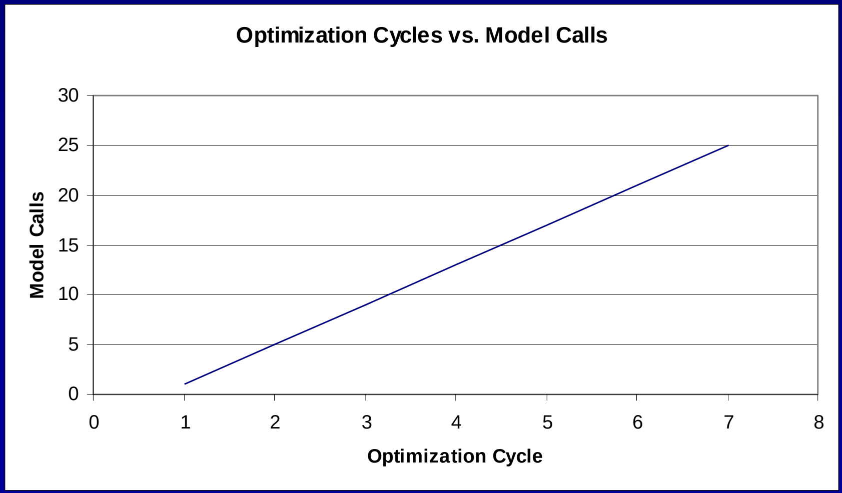
1 extraction well

Optimization History





- 9 observation points with head values
- 3 parameters varied Kxx, Kyy, Kzz
- Kxx = 0.500462
  - 95% confidence interval = 0.499112 to 0.501812
- Kyy=0.499490
  - 95% confidence interval = 0.498167 to 0.500814
- Kzz = 0.499969
  - 95% confidence interval = 0.459354 to 0.540585
- Computational time per function call = 4.6 minutes



Surrogate Models

- Model built from function values to represent the original model with less computational cost
- Accomplished, for example, by neural nets or reducing the underlying physical equations
- May not be possible to build surrogate due to complexity of the model

Summary

- ADH solves multi-physics problems
- Major component of uncertainty analysis is parameter estimation
- PEST can be used with ADH for parameter estimation

Original Approximate Method Studies

- Approximate method studies were typically developed using drainage area based regression techniques to find depths above streambed. A flooded area was then drawn on the best available USGS Quadrangles (typically either 10-, 20- or 40-foot contour intervals).

- One method to define the flooded area was to plot a streambed profile based on the rivermile the contour lines cross the streamline. The regression based depths were added to this streambed and the resulting flood profile was interpolated (outlined) based on the shape of the contour lines.

Possible Methods to Convert Approximate Study Streams Under the New Map Modernization Program

Adapt Old Method

- Drainage area based regression equations
- Use digitally georeferenced USGS quad or best available georeferenced digital map
- Digitize flooded area based on estimating techniques

(Generally NO BETTER THAN original flooded areas, just on better mapping)

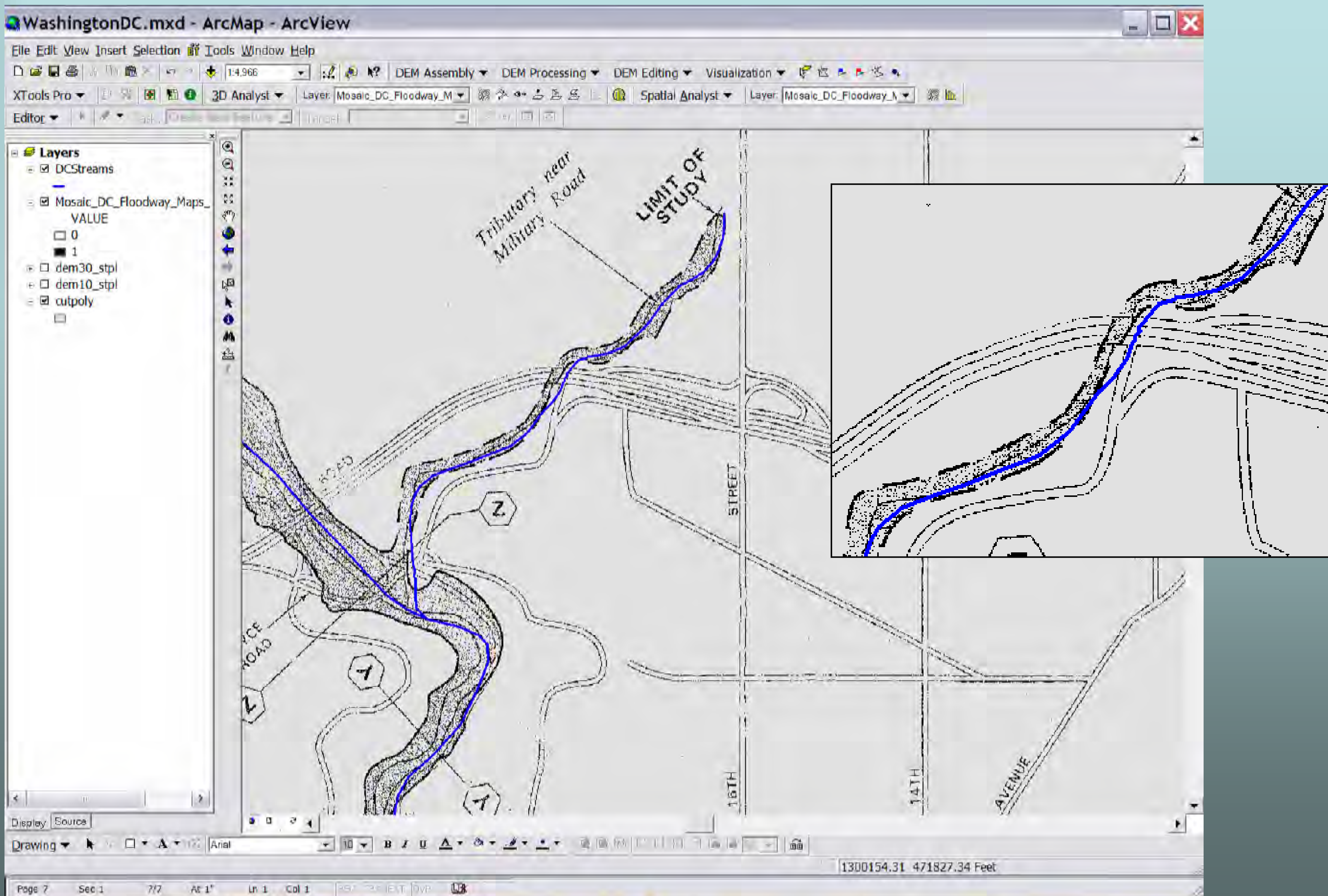
Scan and Digitize

- Scan FIS Map
- Georeference scanned map to digitally georeferenced USGS quad maps
- Digitize flood zone from georeferenced FIS map

(Problems with original flooded area as well as georeferencing problems)

Come Up With a New Method

Georeferenced Scanned FIS Maps compared with NHD stream data

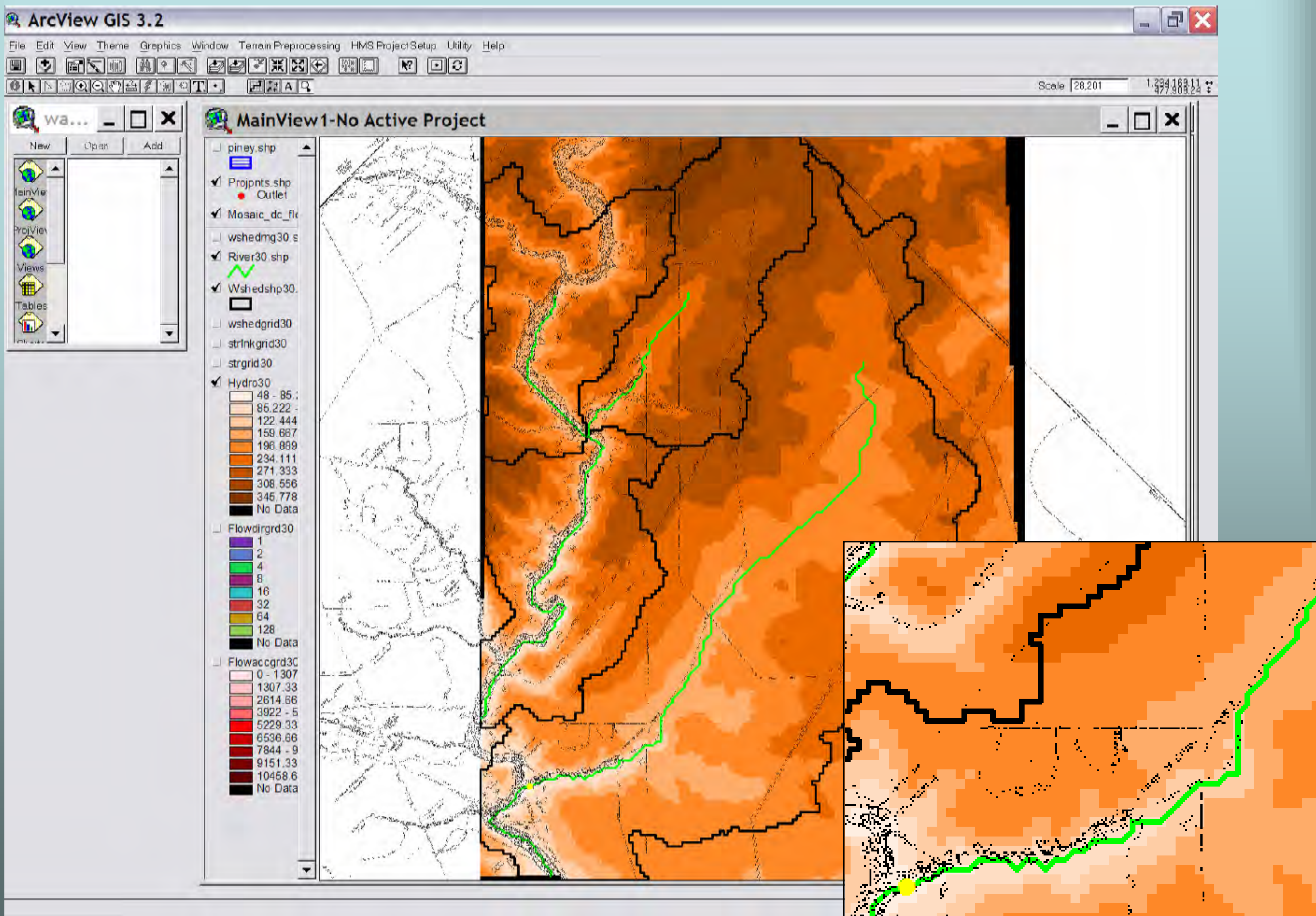


Any new method should adapt to all available digital mapping options

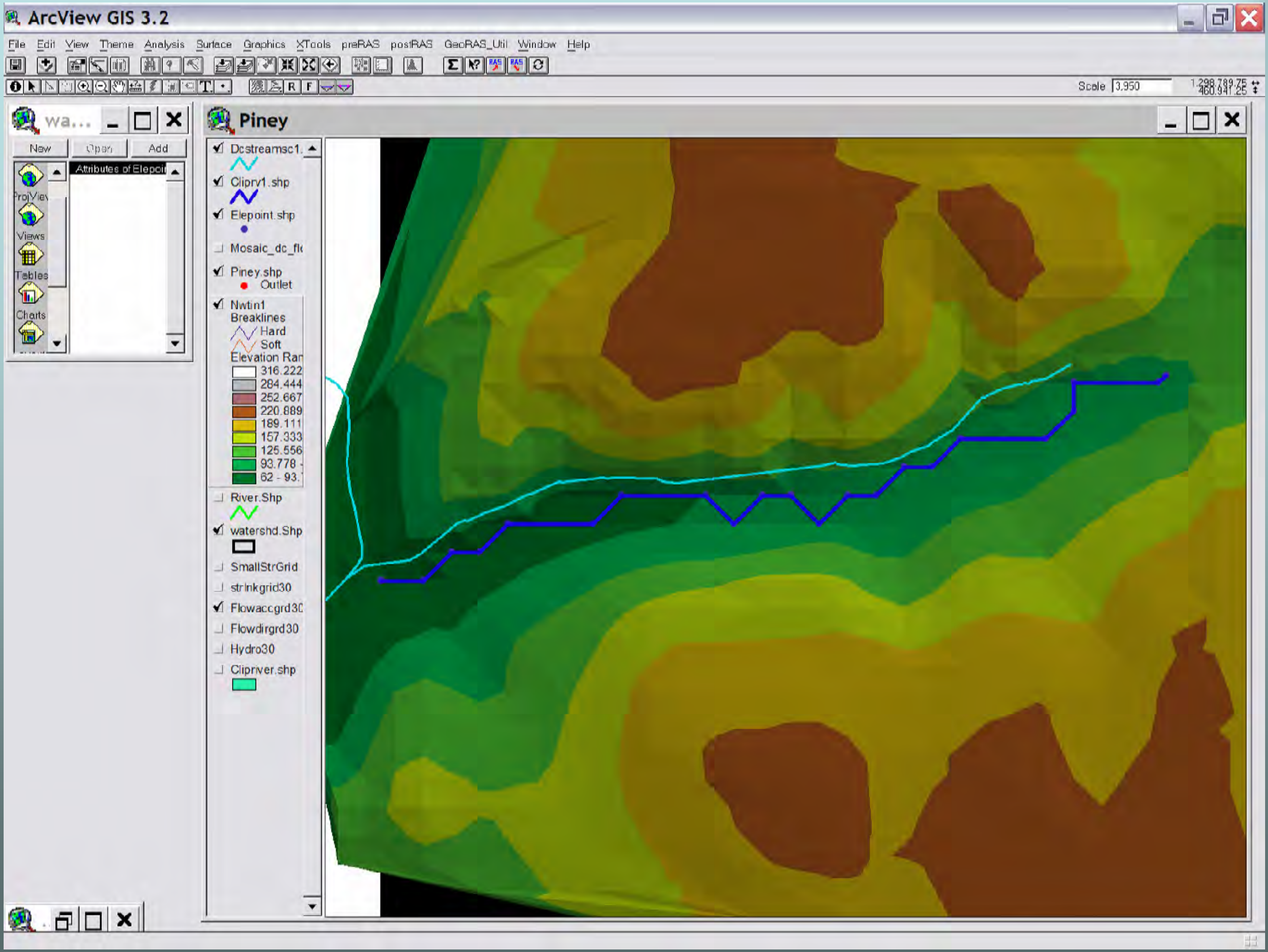
(so choose a worst case as a test case)

- 30-meter Digital Elevation Model (DEM)
- 10-meter DEM
- 1-meter DEM
- Light Detection and Ranging (LIDAR) data
- 5-foot or less contour maps

View of GeoHMS developed subbasin from 30-meter DEM

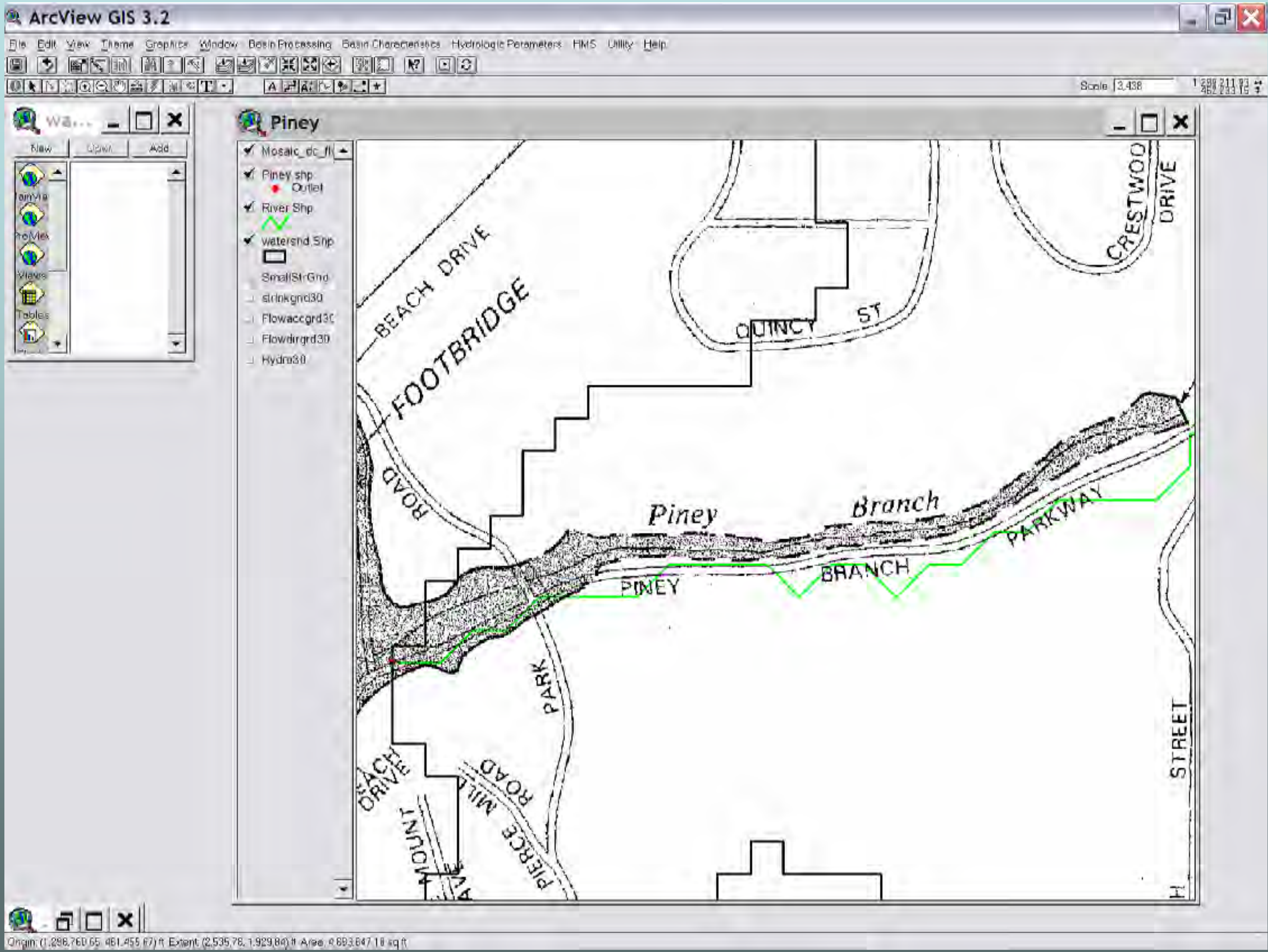


Comparison of 30-meter DEM GeoHMS flowline and NHD



Comparison of 30-meter DEM GeoHMS flowline overlaid on FIS Map

(Can it be possible to use 30-meter DEM data?)



So Let's Begin Developing a Better Lightbulb

Software Needed

- ArcMap 8.3
- Spatial Analyst for ArcMap 8.3
- 3D Analyst for ArcMap 8.3
- EZ GeoWizards for ArcMap 8.3
- Xtools for ArcMap 8.3
- ArcView 3.X
- Spatial Analyst for ArcView 3.X
- 3D Analyst for ArcView 3.X
- Xtools for ArcView 3.X
- GeoHMS for ArcView 3.X
- GeoRAS for ArcView 3.X
- MrSid Extension

Let's start with a few simple Steps

ArcMap 8.3

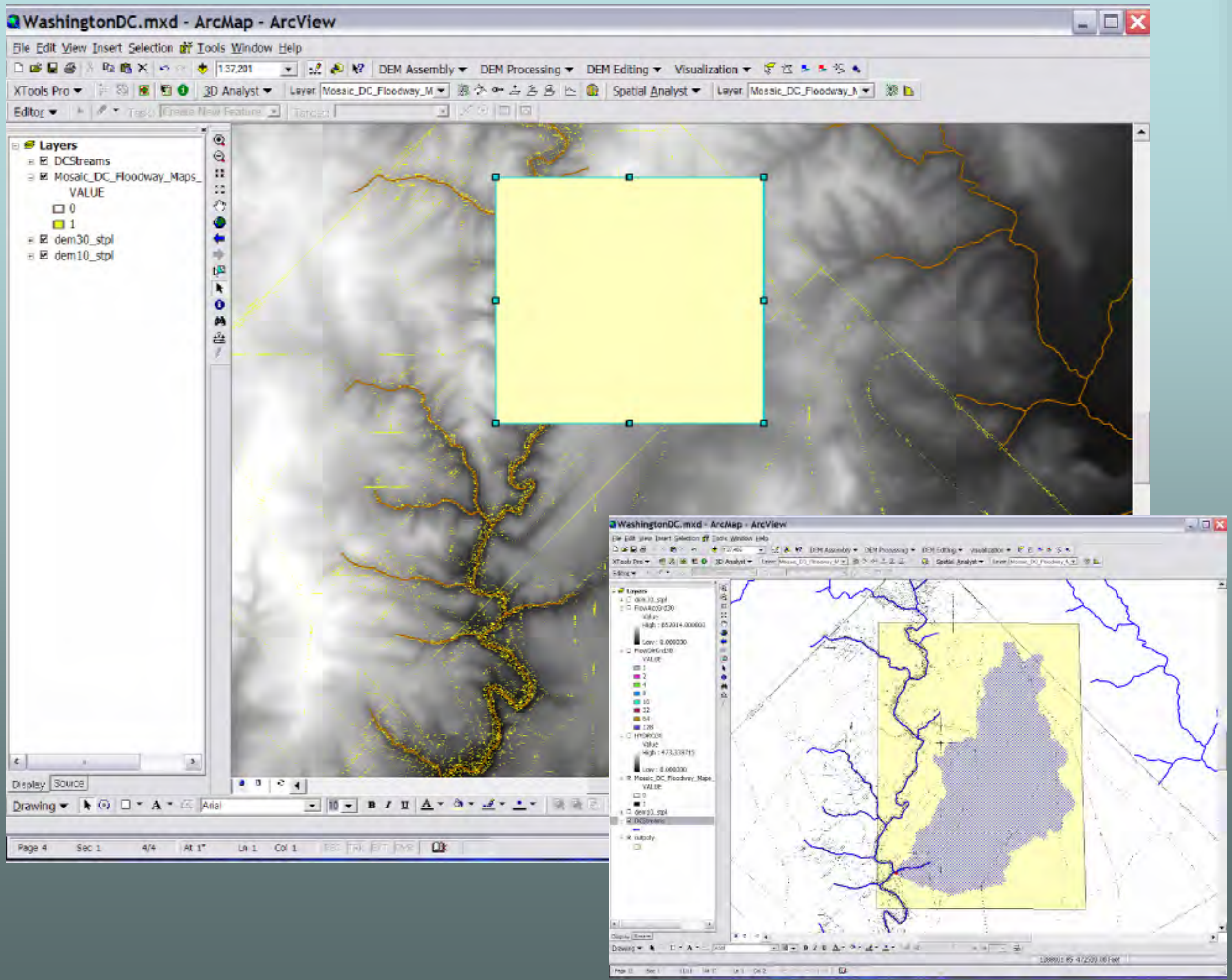
Step 1: Load base data obtained for study
Step 2: Draw a rectangle encompassing watershed
Step 3: Convert rectangle to shapefile
Step 4: Set the Extent of the data
Step 5: Clip data layers
Step 6: Digitize Stream
Step 7: Convert Vertices of the Digitized Streamline to a Points Shapefile and Add Streambed Elevations to Vertices
Step 8: Convert Points Shapefile to a 3D Line
Step 9: Densify the 3D Polyline
Step 10: Convert Dense 3-D Polyline to a Raster
Step 11: Convert 3D Polyline to a Points File
Step 12: Set an Analysis Mask Using the Raster Grid of the Stream Flowline
Step 13: Assign an Elevation to Each Cell of the Stream Grid
Step 14: Reset "Options" in Spatial Analysis
Step 15: Cropping the DEM
Step 16: Create TIN from Clipped DEM
Step 17: Create a Resampled Raster from the TIN
Step 18: Burn Stream into Resampled DEM
Step 19: Create Final TIN from Resampled Grid using 3D Analyst
Step 20: Run the HEC ArcMap Software
Step 21: Create Flowlines
Step 22: Create Top of Bank lines

ArcView 3.X

Step 1: Prepare ArcView
Step 2: Add data created previously in ArcMap
Step 3: Step through GeoHMS Terrain Preprocessing
Step 4: Create Study Area
Step 5: HMS Basin Characteristics
Step 6: HMS Export File Creation
Step 7: Export Basin Data for Input into EXCEL
Step 8: Import ArcView Table into EXCEL
Step 9: Create a HMS File
Step 10: Import the Basin File Created in ArcView
Step 11: Bring in the Basin Map Created in ArcView
Step 12: Enter the Hydrologic Parameters into HMS
Step 13: Get Hypothetical Rainfall Data from Internet
Step 14: Input Frequency Rainfall Data into a HMS MET file
Step 15: Set a Control Specification and Run Model
Step 16: Begin Developing RAS Export File using GeoRAS
Step 17: Covert Stream, banks and flowlines to GeoRAS Shapefiles
Step 18: Create Cross Sections for RAS model
Step 19: Complete preRAS Processing
Step 20: Create HEC-RAS file to Import GIS RAS file
Step 21: Set Bank Stations and n-values
Step 22: Improve geometry data
Step 23: Input Steady Flow Data, Run and Export GIS data
Step 24: Input UnSteady Flow Data, Run and Export GIS data
Step 25: Run postRAS in ArcView for Steady Flow
Step 26: Run postRAS in ArcView for Unsteady Flow

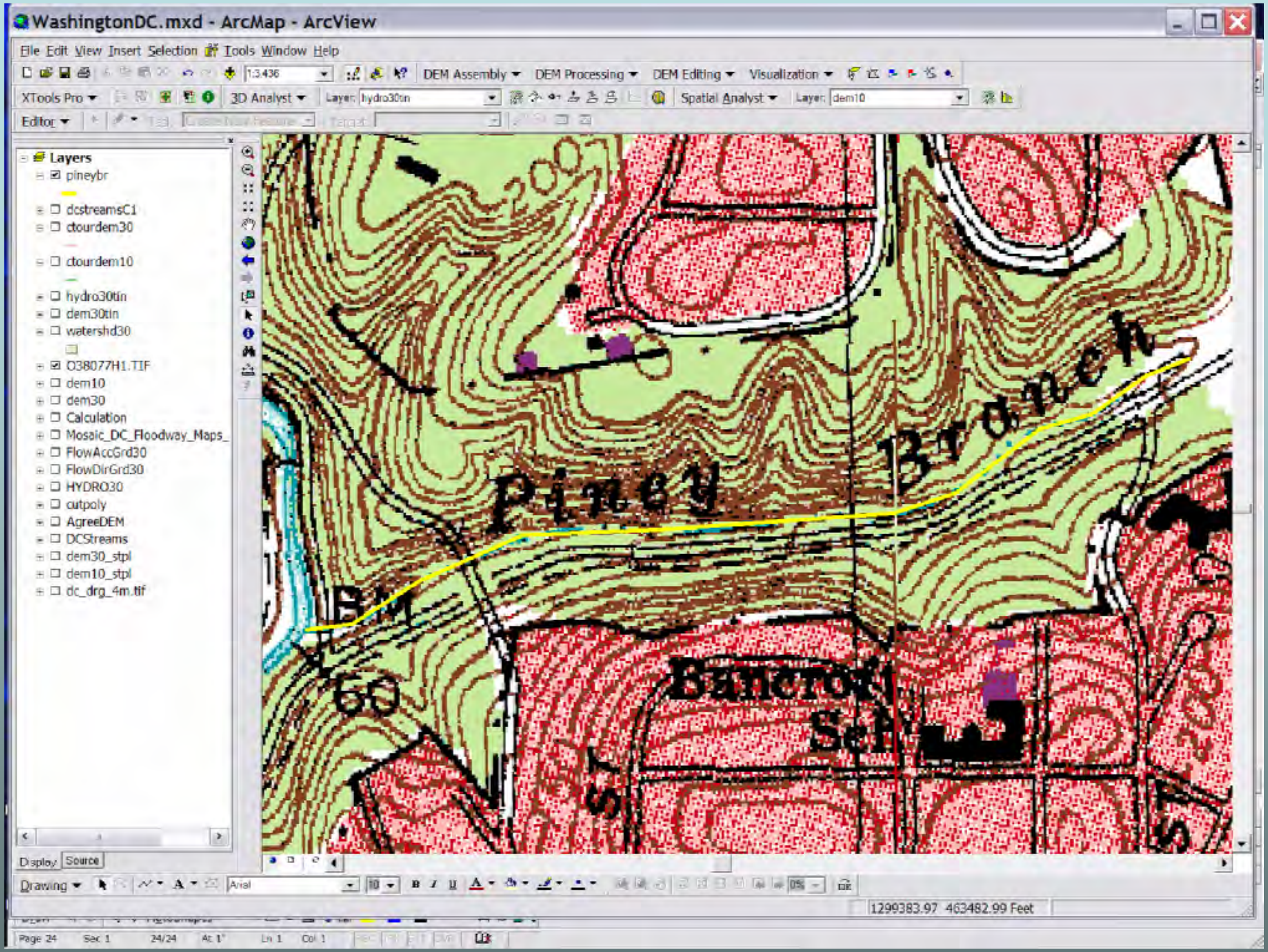
Clip Only Data Needed!

Step 1: Load base data obtained for study
Step 2: Draw a rectangle encompassing watershed
Step 3: Convert rectangle to shapefile
Step 4: Set the Extent of the data
Step 5: Clip data layers



Digitize stream using best available data and fewest vertices needed (Quad Map assumed as worst case)

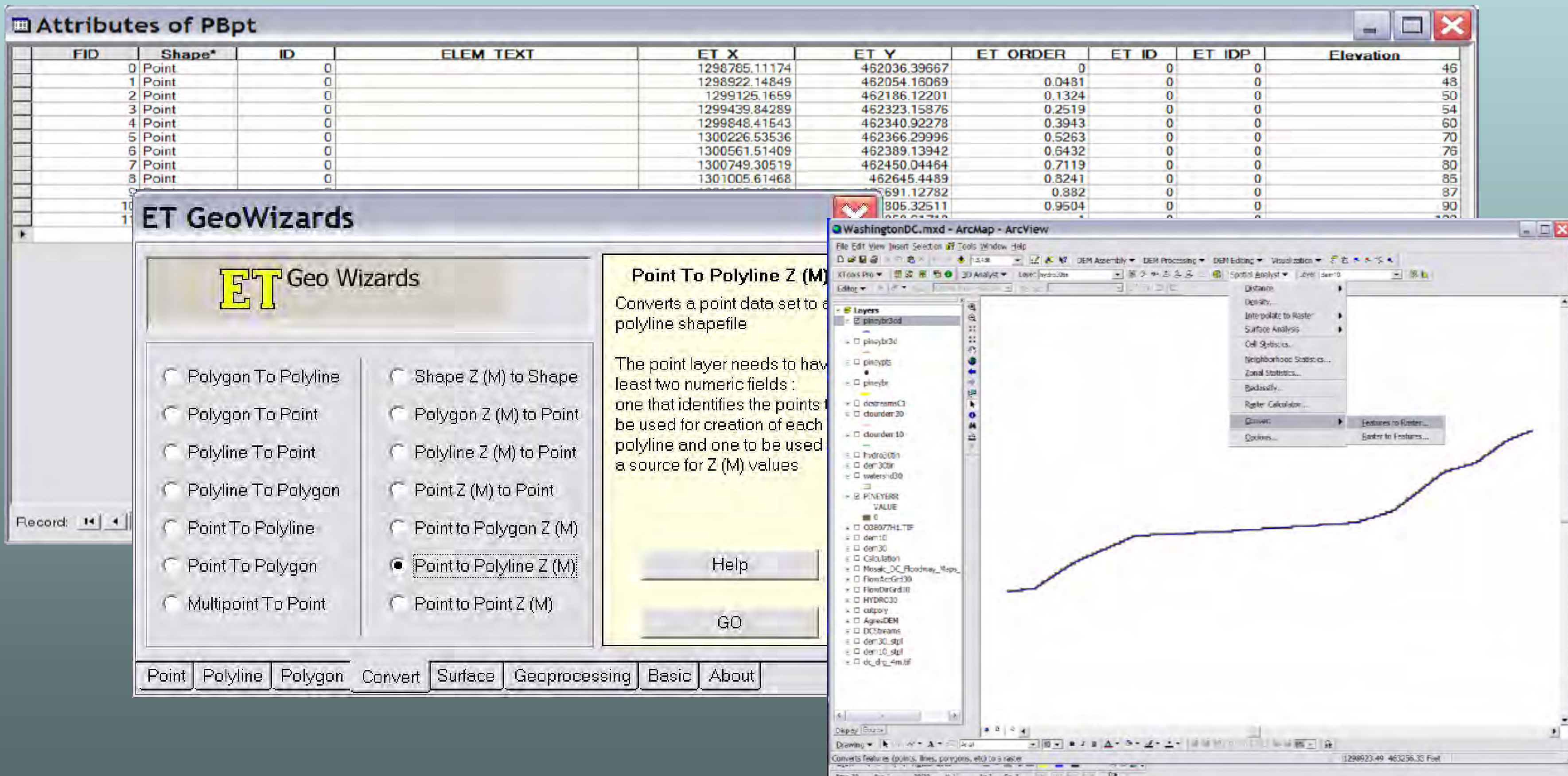
Step 6: Digitize Stream



Add elevations to each of the vertices defining the stream

Step 7: Convert Vertices of the Digitized Streamline to a Points Shapefile and Add Streambed Elevations to Vertices

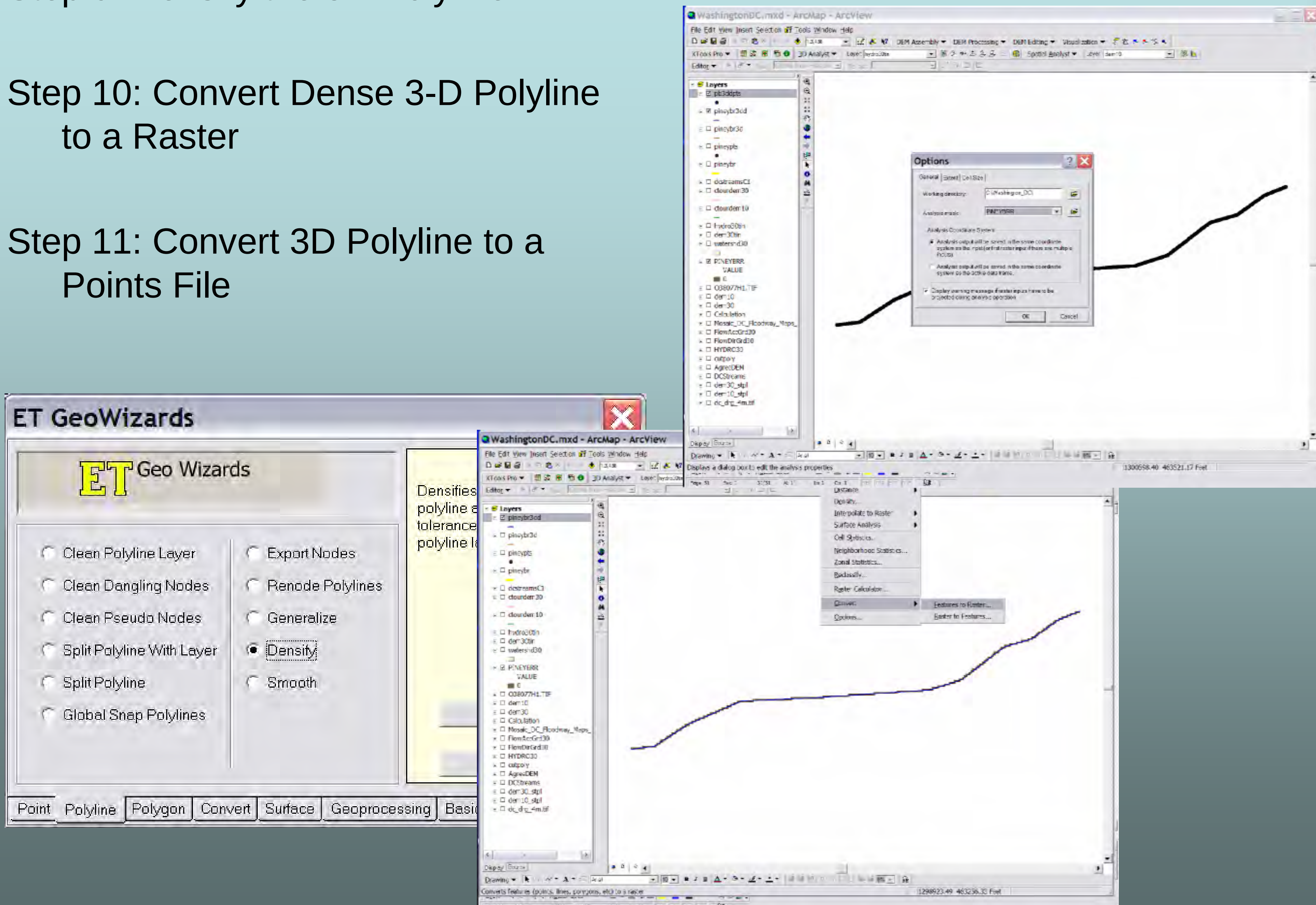
Step 8: Convert Points Shapefile to a 3D Line Vertices of the Digitized Streamline to a Points Shapefile and Add Streambed Elevations to Vertices



Step 9: Densify the 3D Polyline

Step 10: Convert Dense 3-D Polyline to a Raster

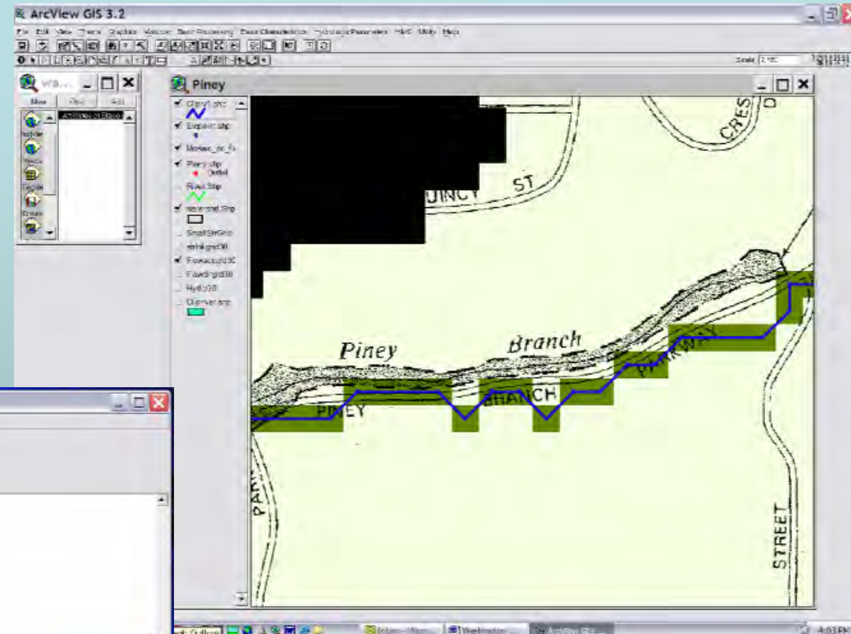
Step 11: Convert 3D Polyline to a Points File

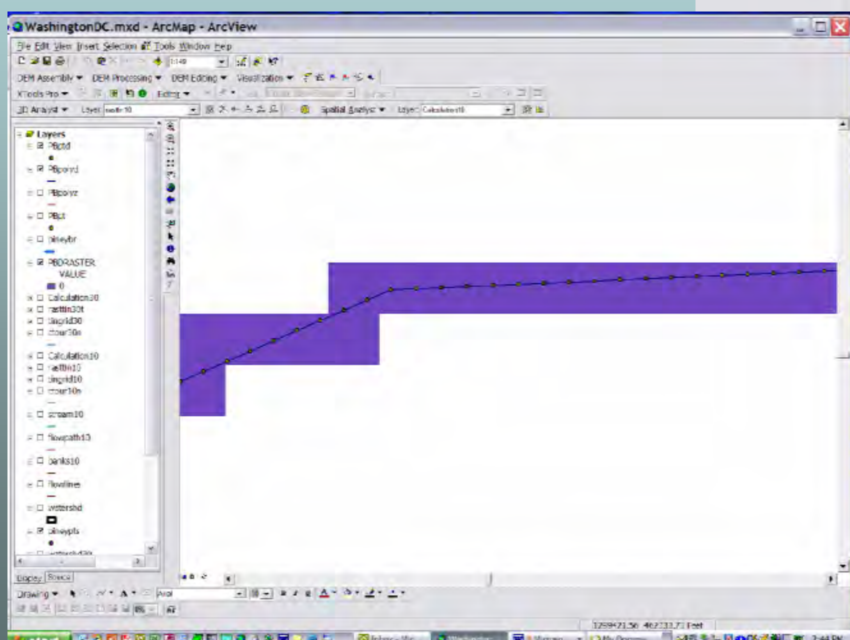


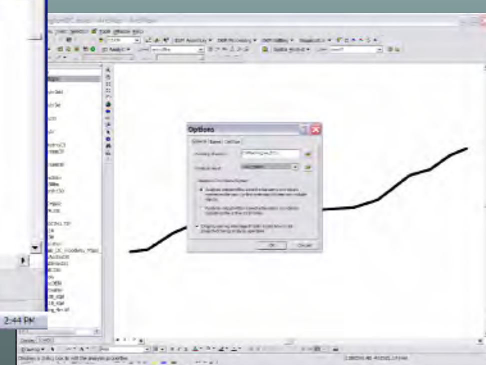
Properly prepare DEM to burn in stream

Step 12: Set an Analysis Mask Using the Raster Grid of the Stream Flowline

Step 13: Assign an Elevation to Each Cell of the Stream Grid

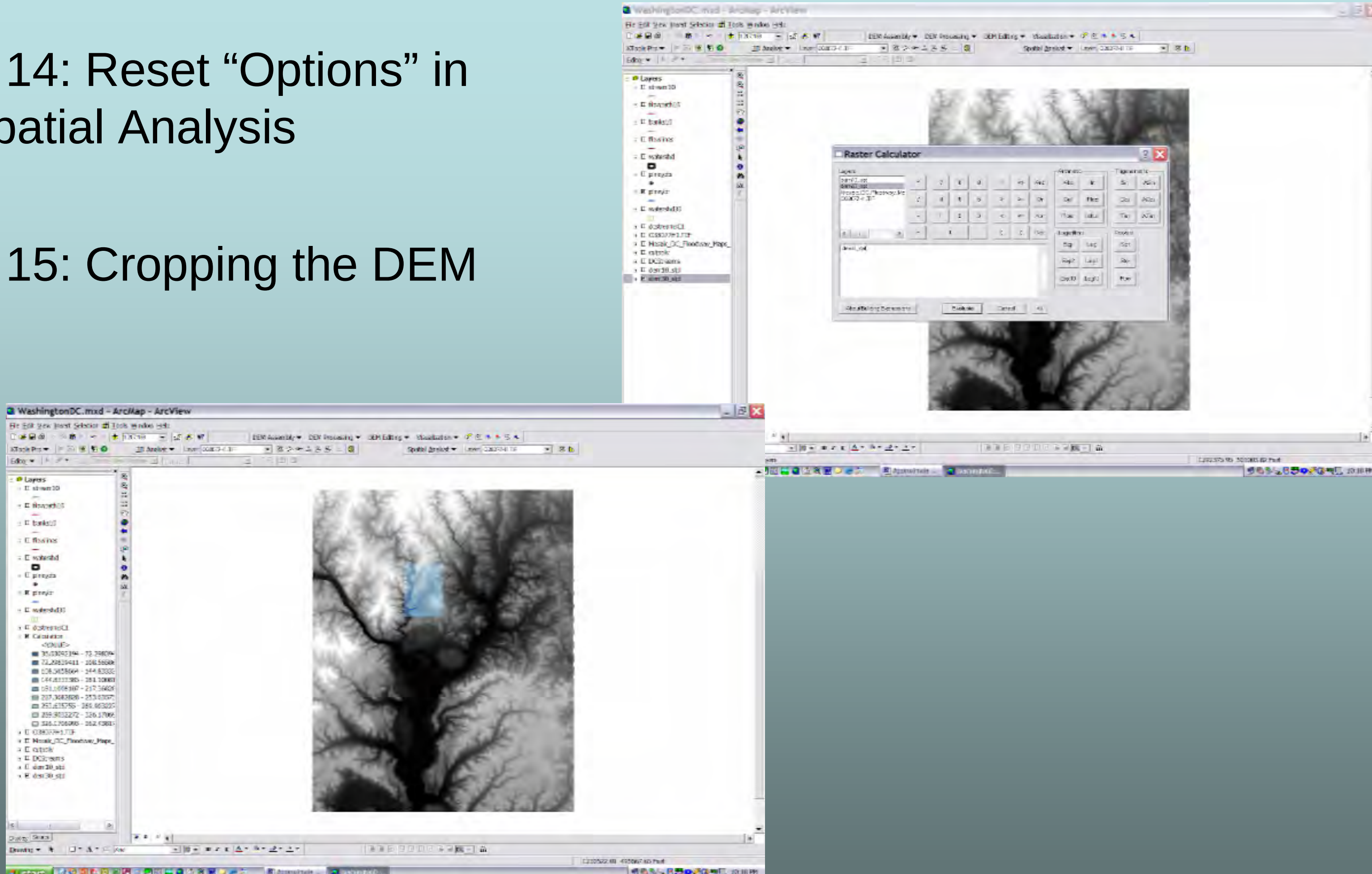






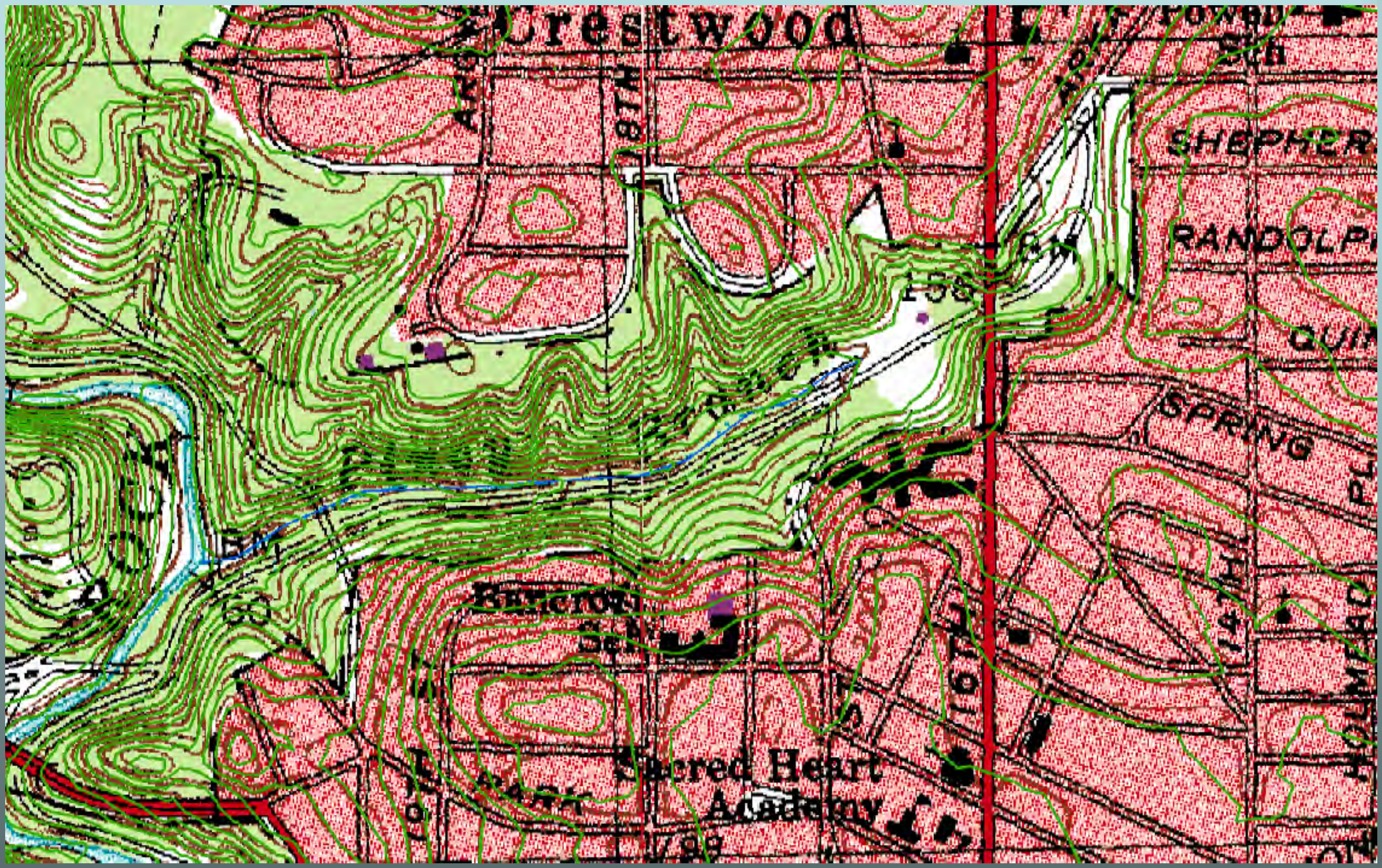
Step 14: Reset “Options” in Spatial Analysis

Step 15: Cropping the DEM



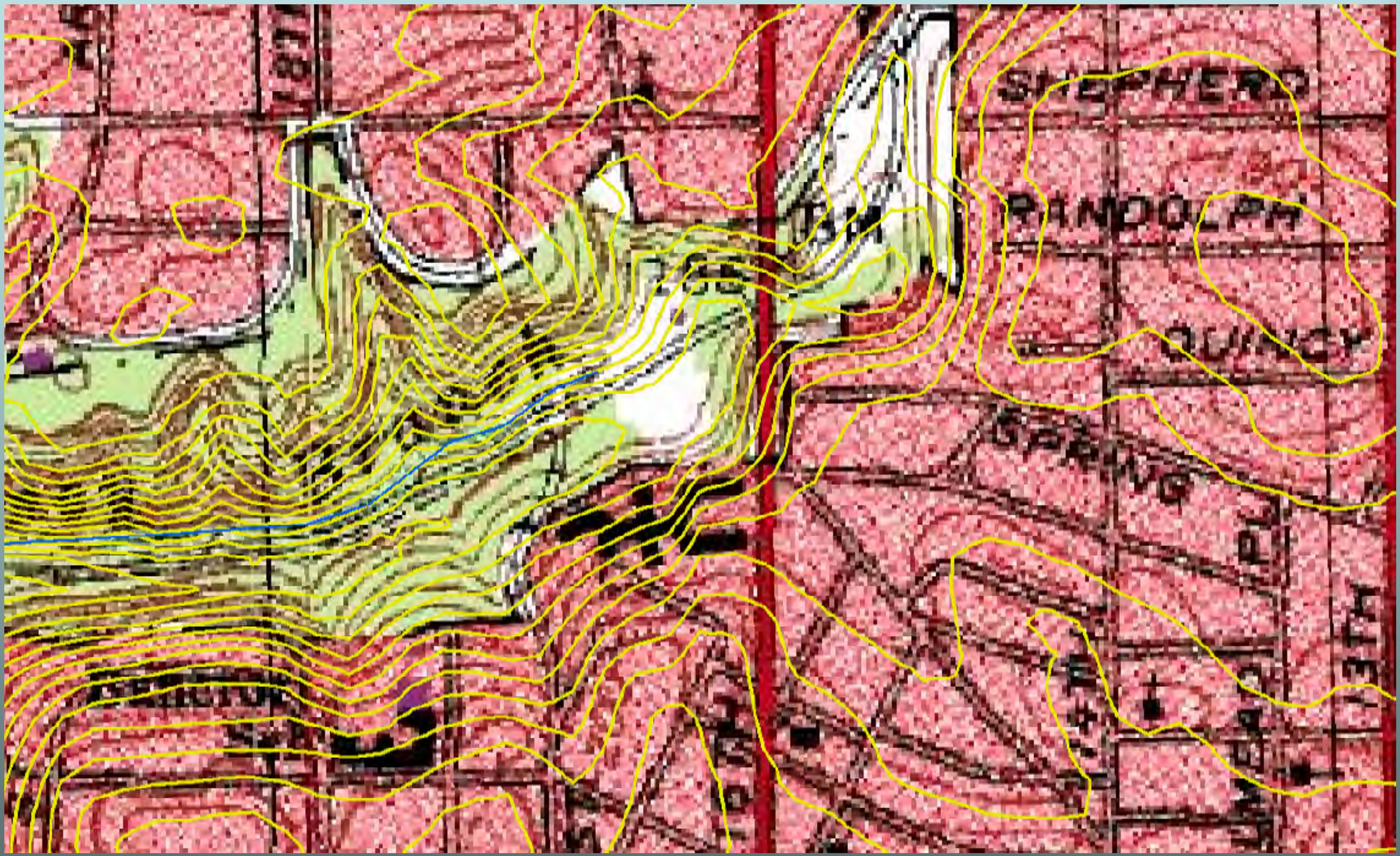
Quick Check by Comparing 10-meter DEM at this point to 10-foot contour Quad

- Compute Contours to make comparison
- First check 10-meter DEM



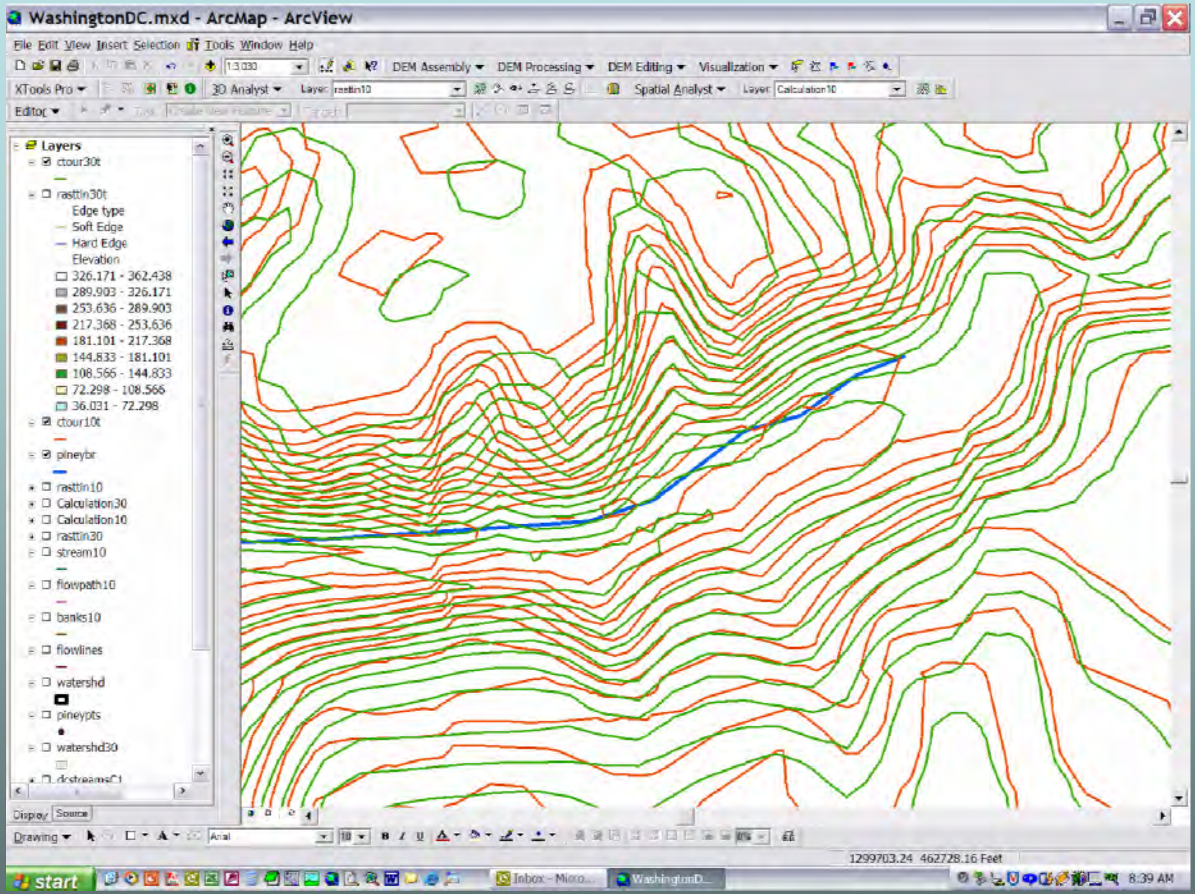
Quick Check by Comparing 30-meter DEM at this point to 10-ft contour Quad

- Compute Contours to make comparison
- Next check 30-meter DEM



Quick Check by Comparing 30-meter DEM at this point to 10-meter DEM

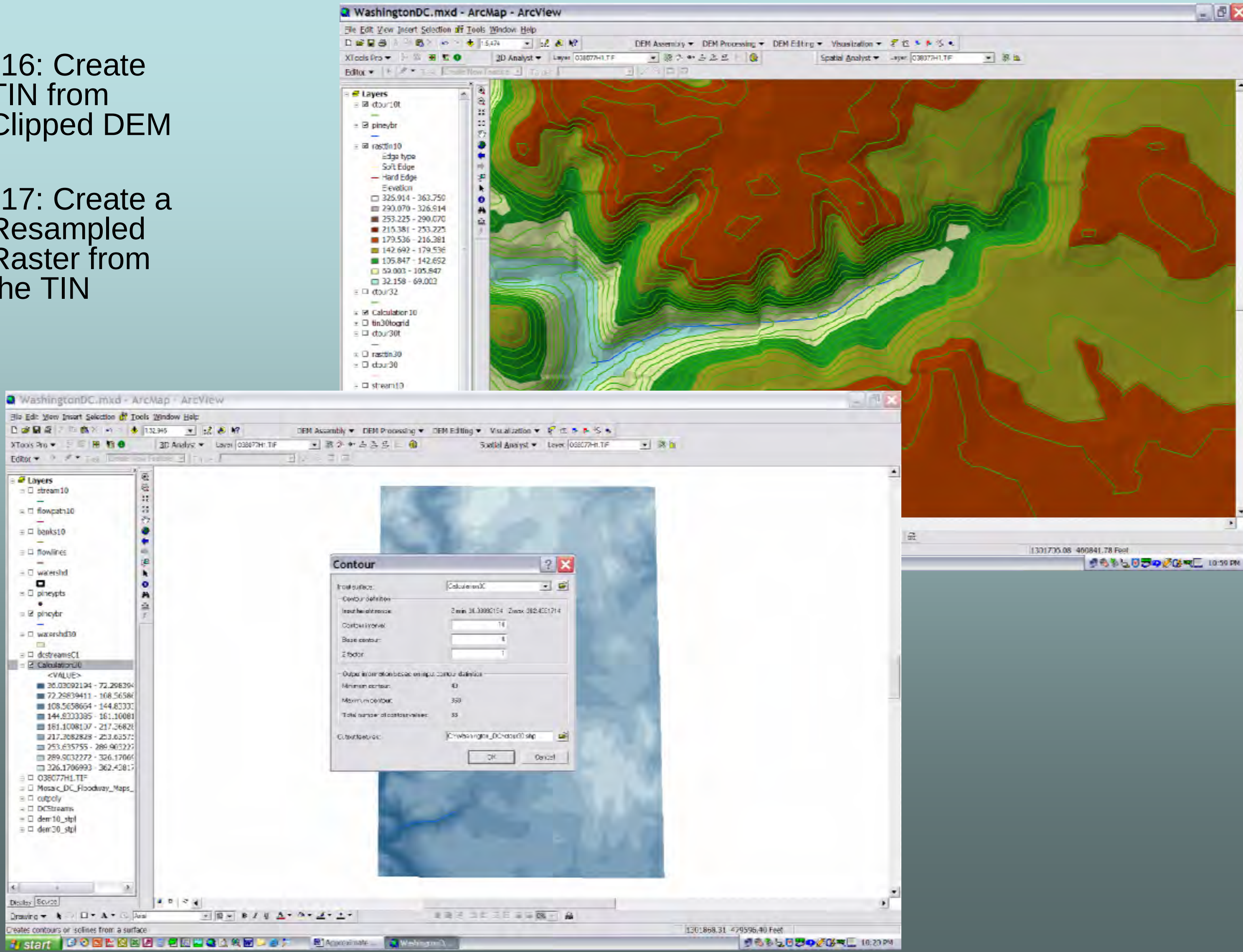
- Overlay of only the Contours to make comparison
- Looks pretty bad so far!



Create a TIN from 30-meter DEM then Resample a 10-foot DEM from the TIN

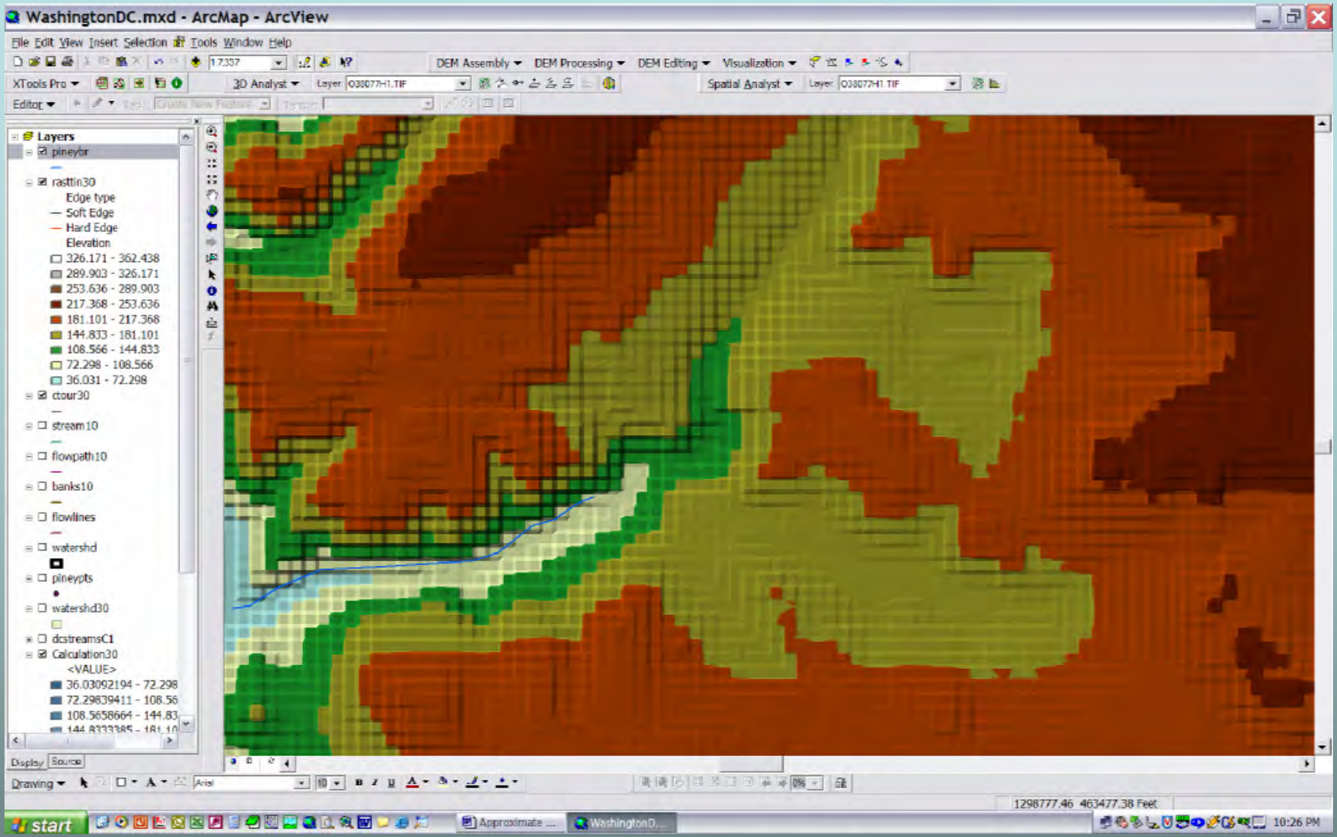
Step 16: Create
TIN from
Clipped DEM

Step 17: Create a
Resampled
Raster from
the TIN



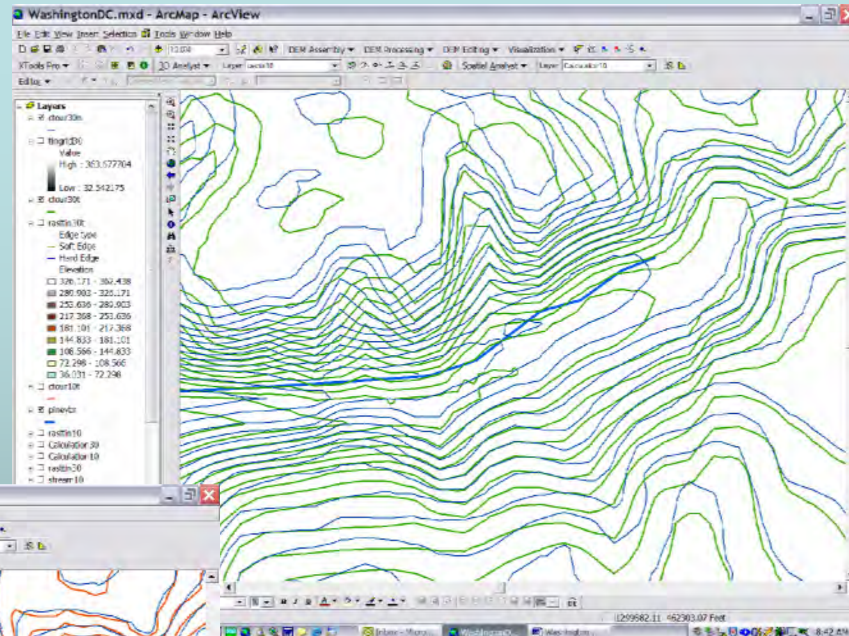
OOOPs

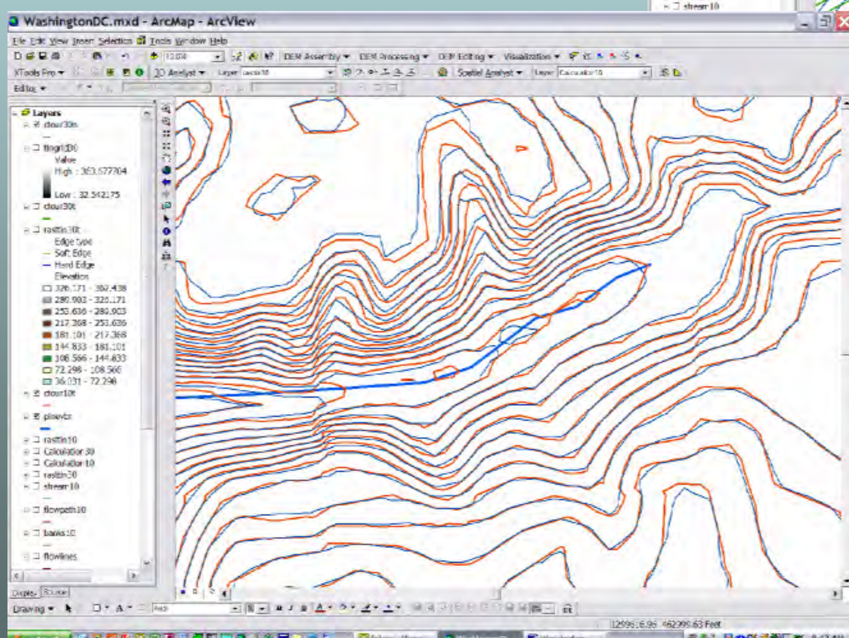
- This is what a TIN looks like if the wrong cell size of the original 10-meter DEM is entered as 10 feet



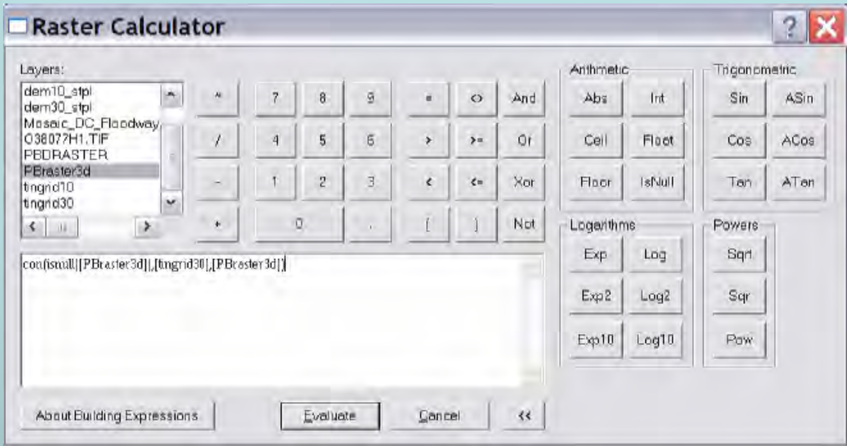
Improvement by Resampling DEM from a TIN

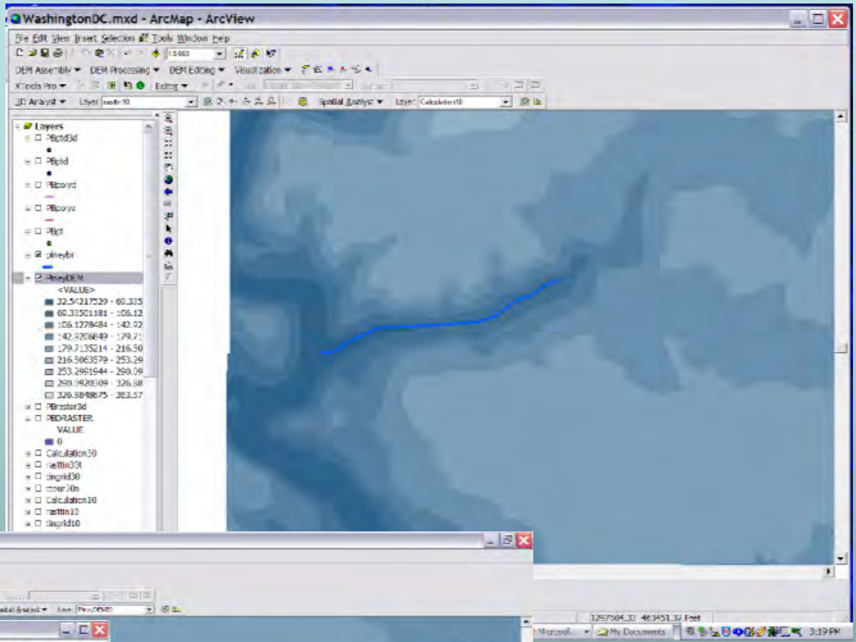
- Let’s check for any improvements by resampling a 10-foot DEM from a TIN based on a 30-meter DEM



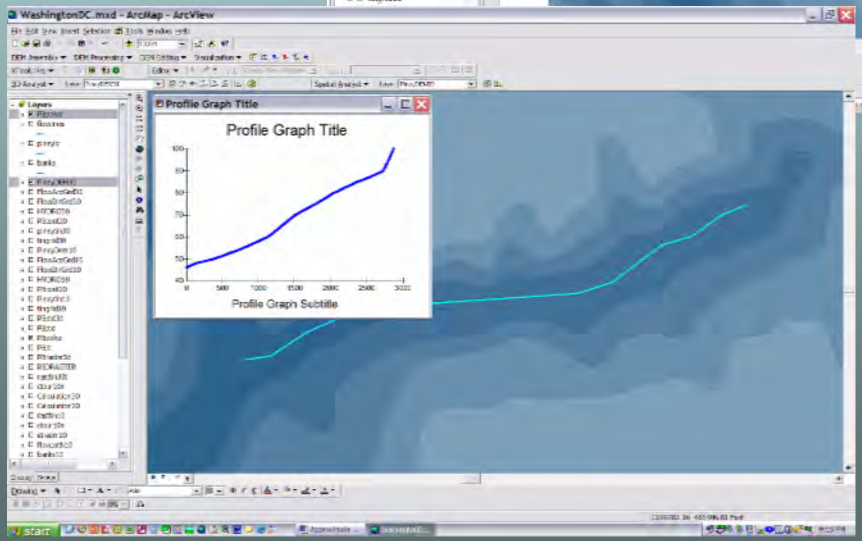


Step 18: Burn Stream into Resampled DEM using Stream DEM created in Steps 12 and 13



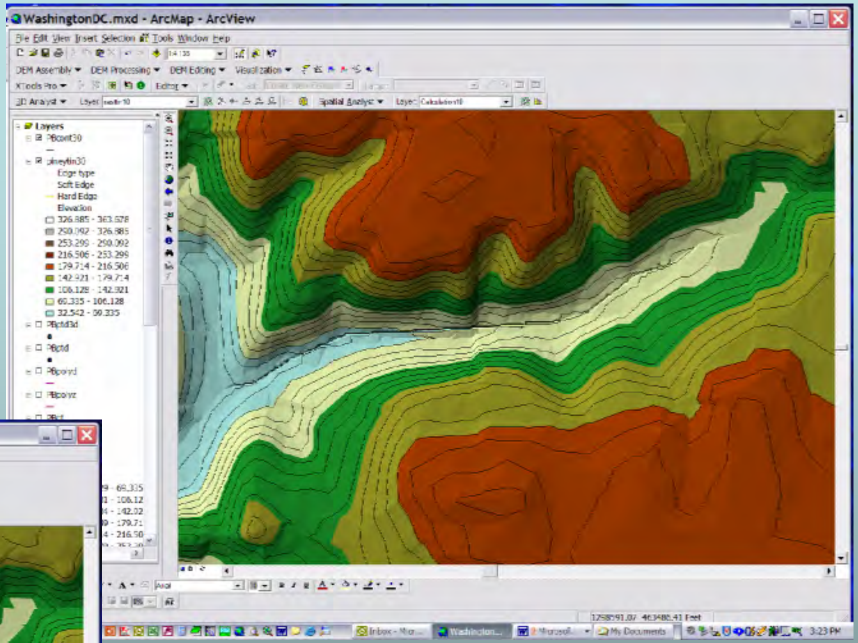


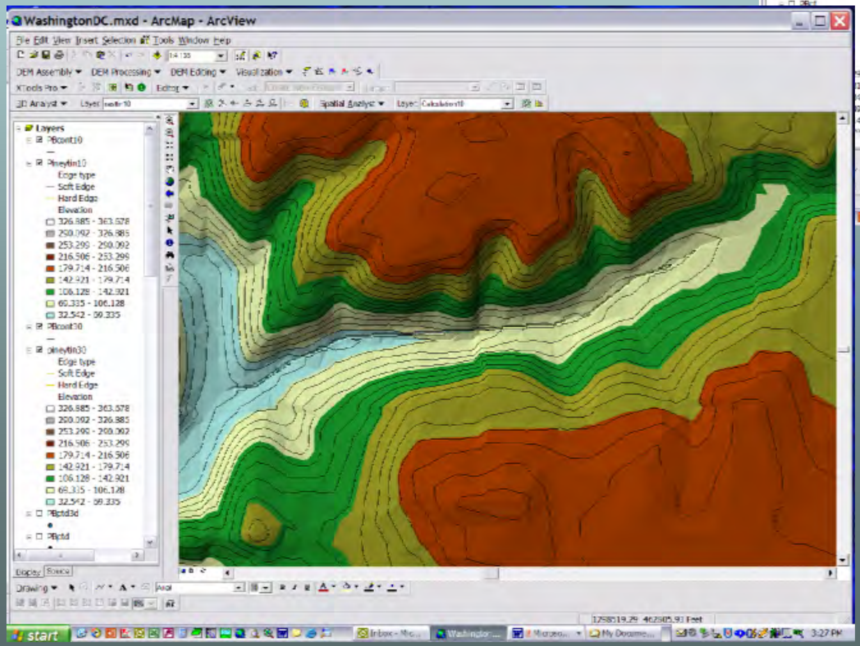
To insure the stream is burned in, the elevations on the grid under the digitized stream line can be plotted



Step 19: Create Final TIN from Resampled Grid using 3D Analyst

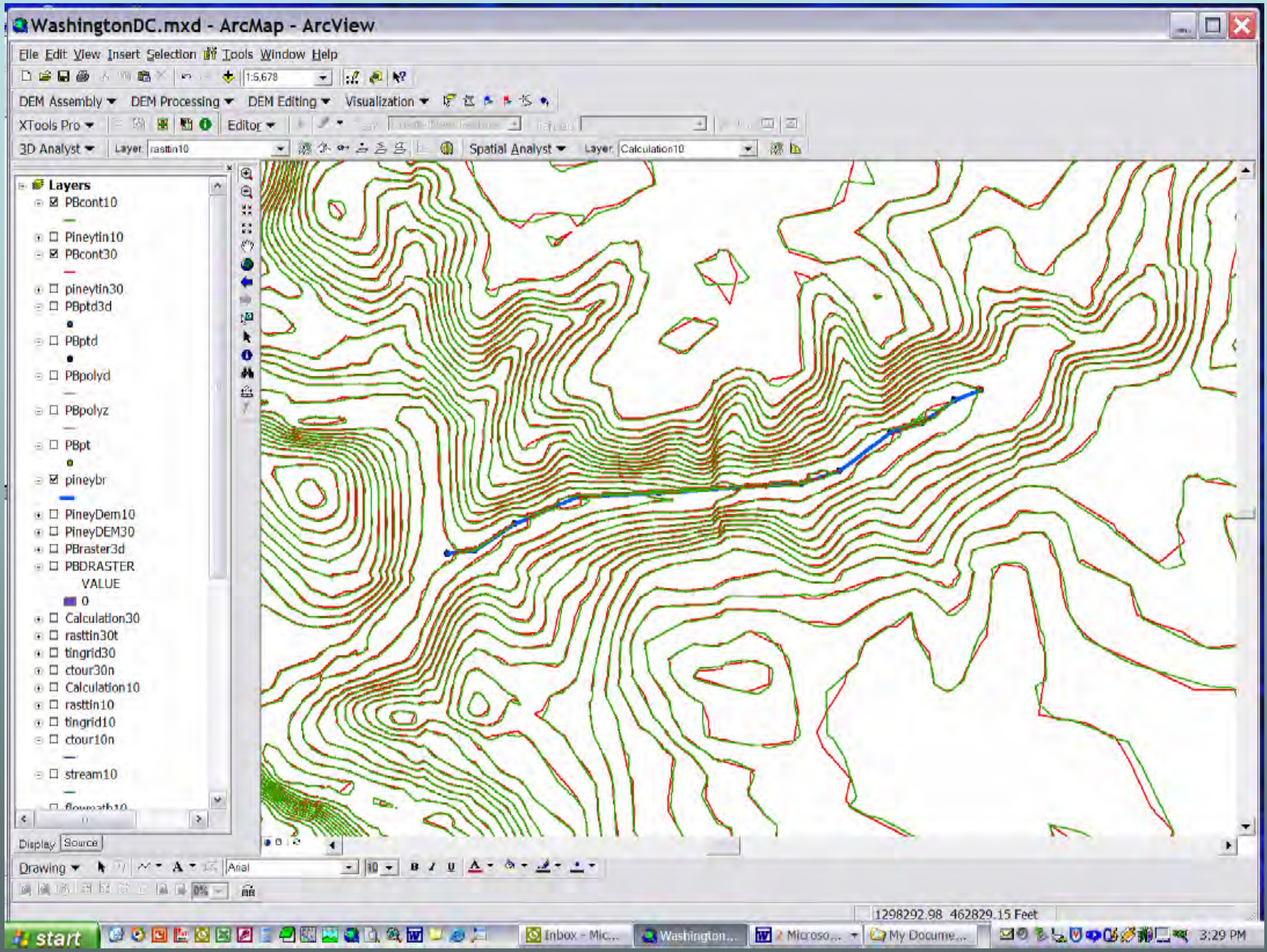
- A comparison is shown here between starting with a 30-meter DEM to starting with a 10-meter DEM and completing all steps through step 19





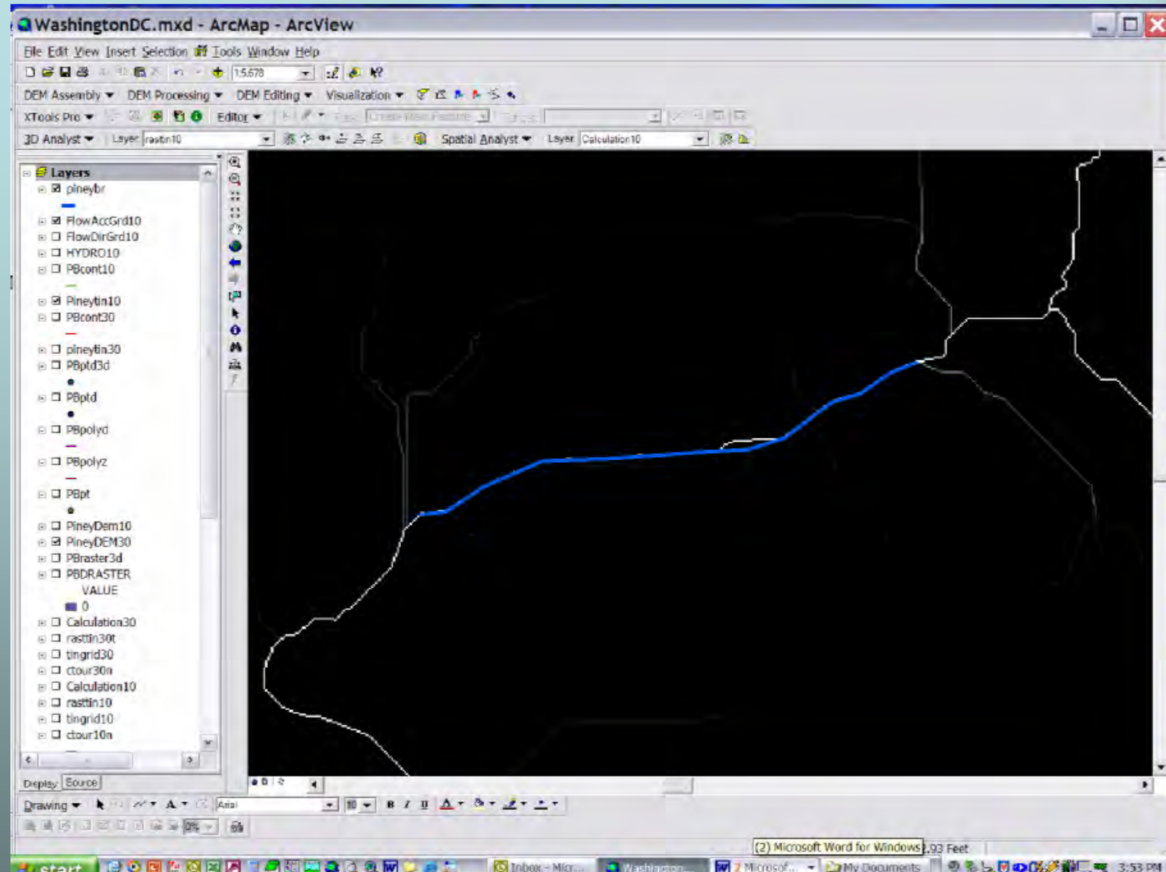
They are nearly identical

This comparison is further emphasized by comparing contours



Step 20: Run the HEC ArcMap Software

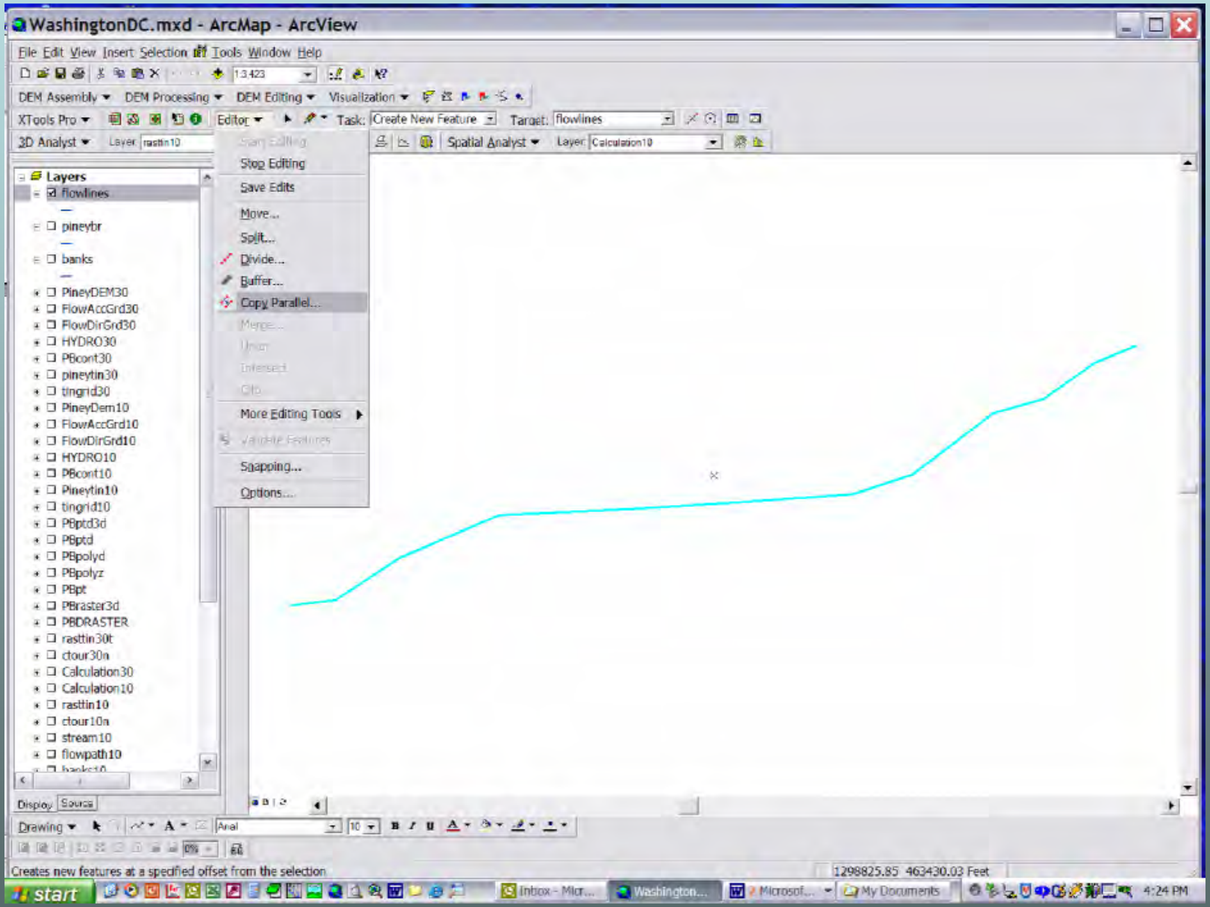
- Although we have finished hydraulically correcting and improving our DEM, there are a few more processes that may be easier to do in ArcMap before we switch to ArcView 3.X.
- Using the HEC ArcMap extension now run the following processes.
- Fill Sinks
- Flow Direction
- Flow Accumulation



Comparison of Flow Accumulation stream lines and our digitized stream line

Step 21: Create Flowlines
Step 22: Create Top of Bank lines

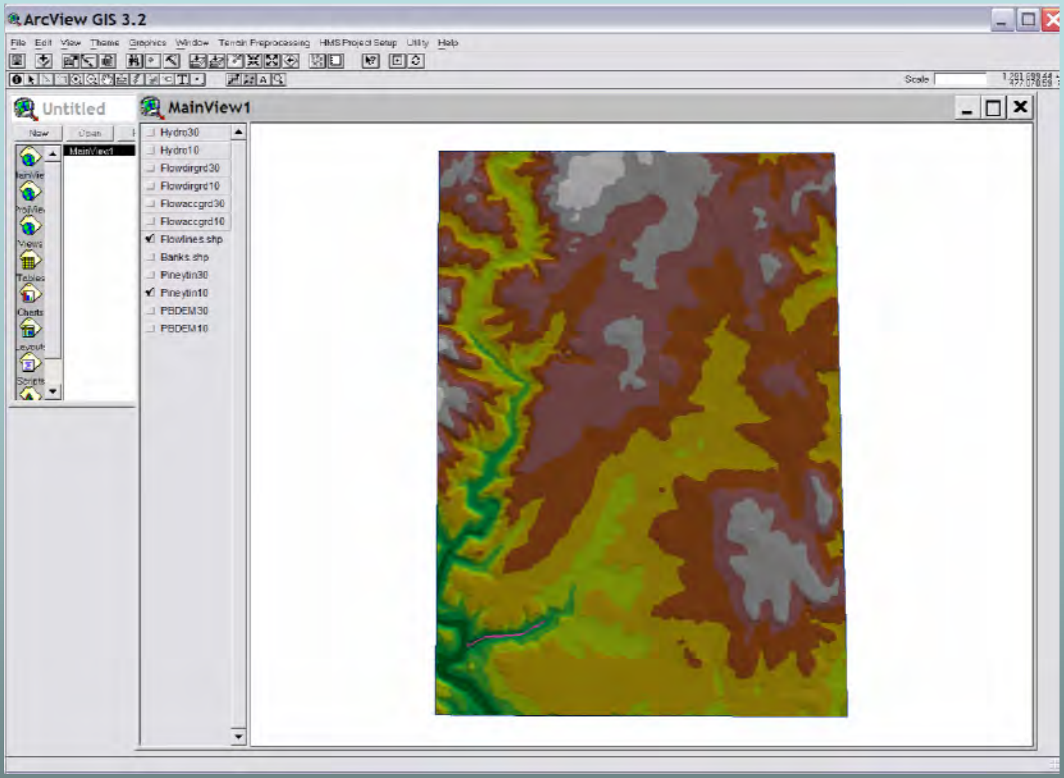
Flowlines and top of bank lines can also be quickly developed by coping lines parallel to the digitized stream line



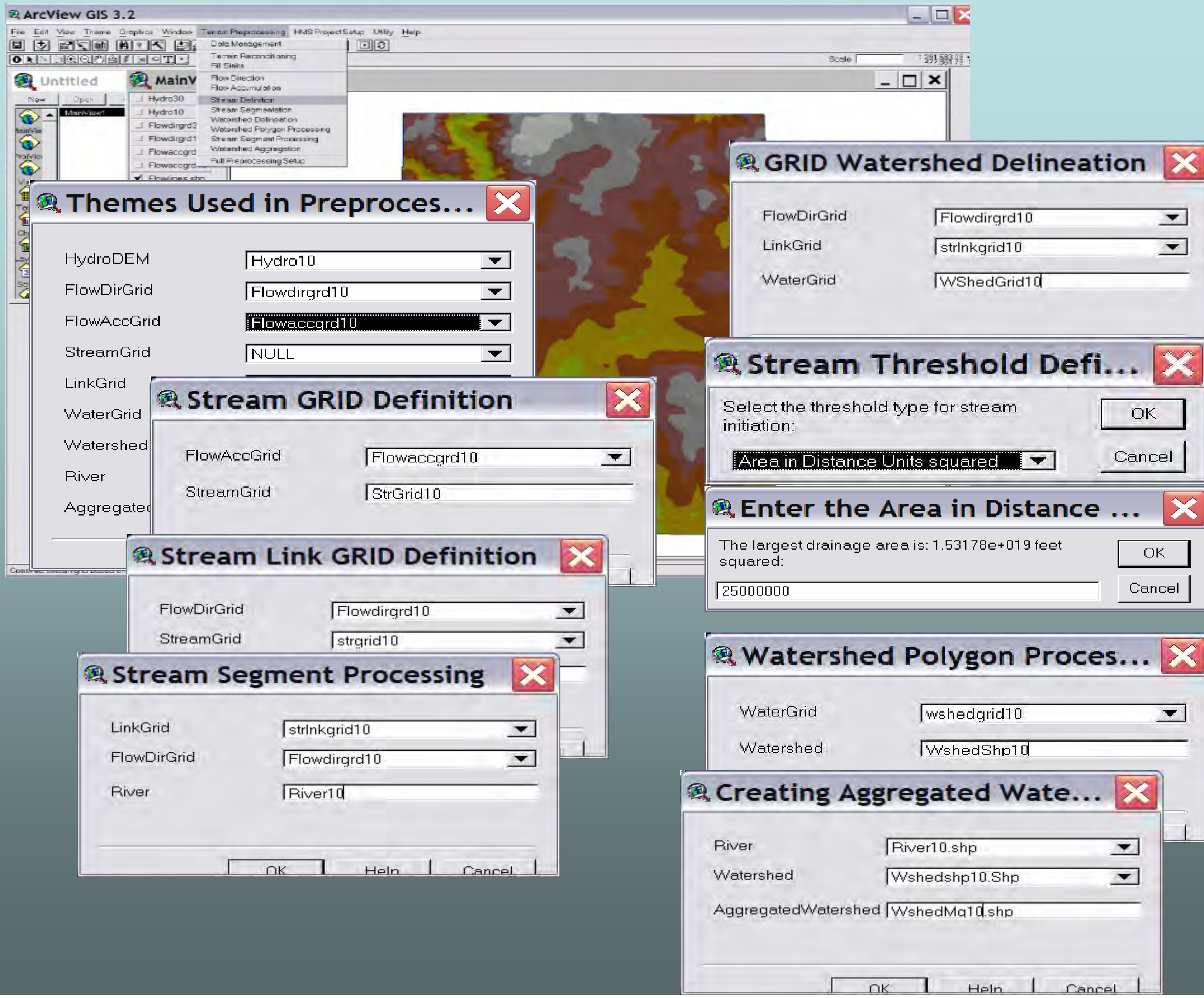
We now switch to ArcView 3.X
and begin using HEC's GeoHMS extension

- Step 1: Prepare ArcView
- Step 2: Add data created previously in ArcMap

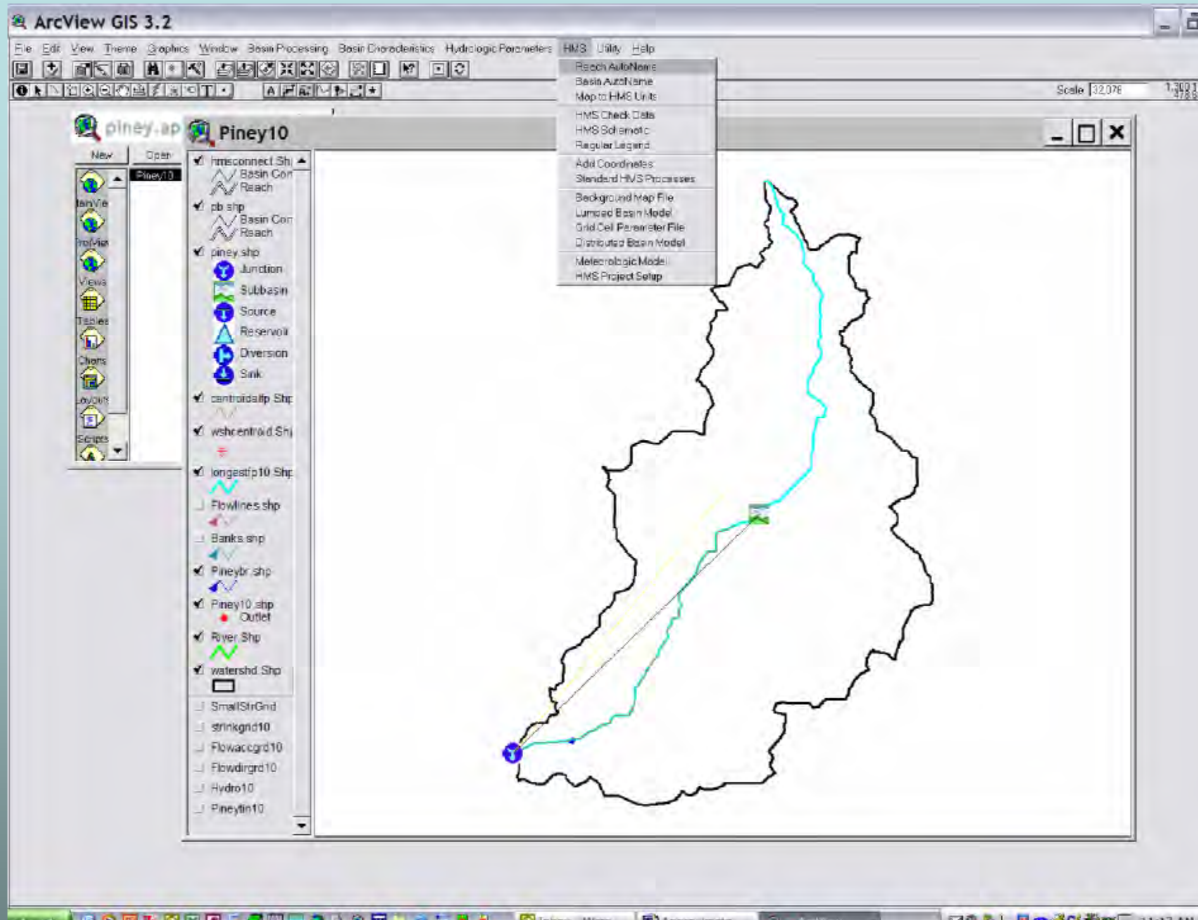
(10-foot DEM with stream burn in)

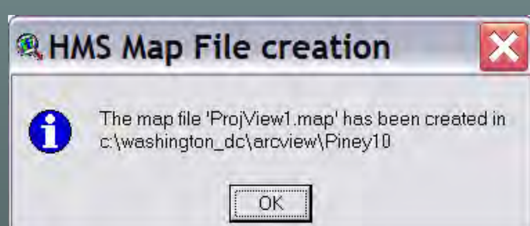


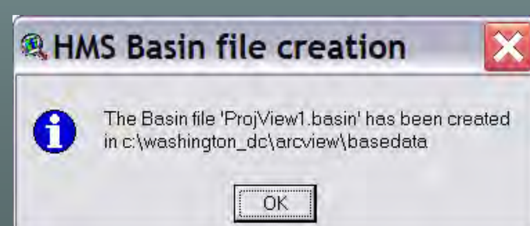
Step 3: Step through GeoHMS Terrain Preprocessing



Step 4: Create Study Area

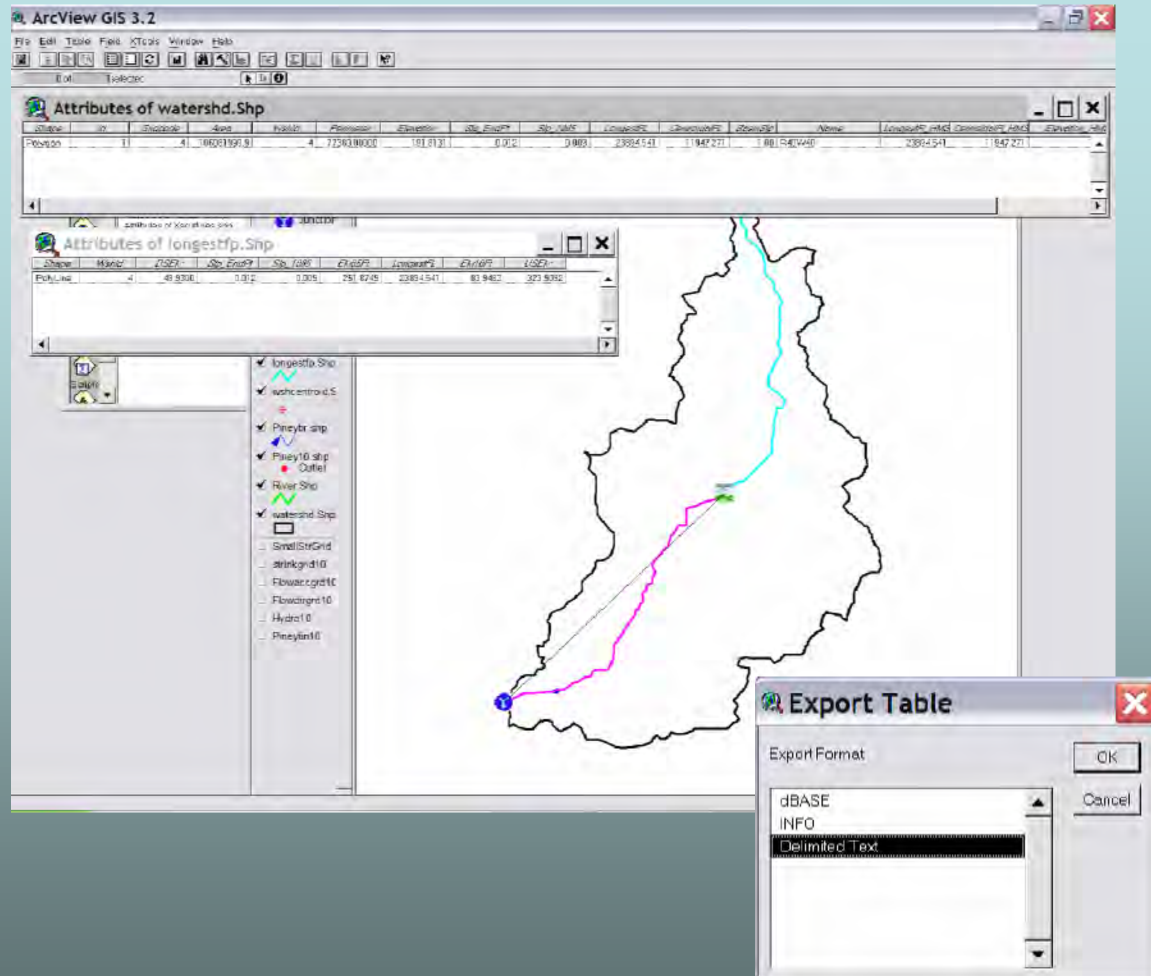






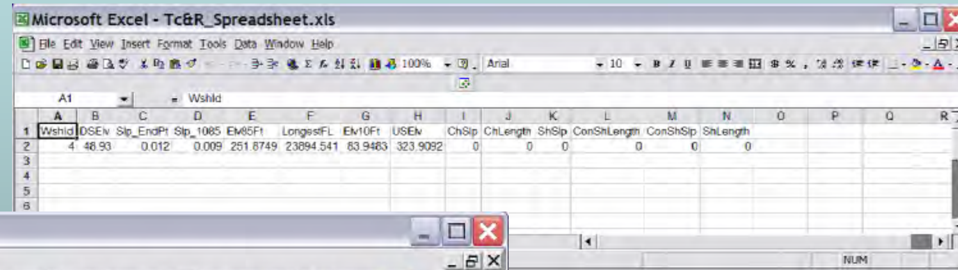
- Step 5: HMS Basin Characteristics
- Step 6: HMS Export File Creation
- Step 7: Export Basin Data for Input into EXCEL

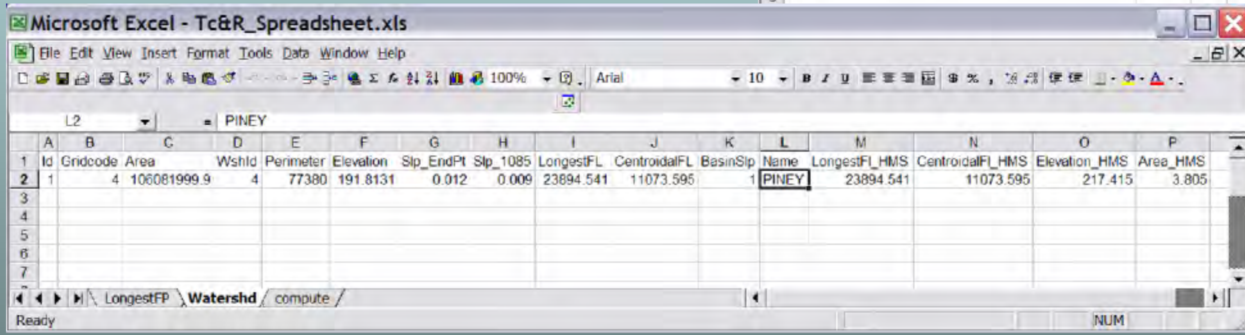
Note: must select centroid procedure along stream



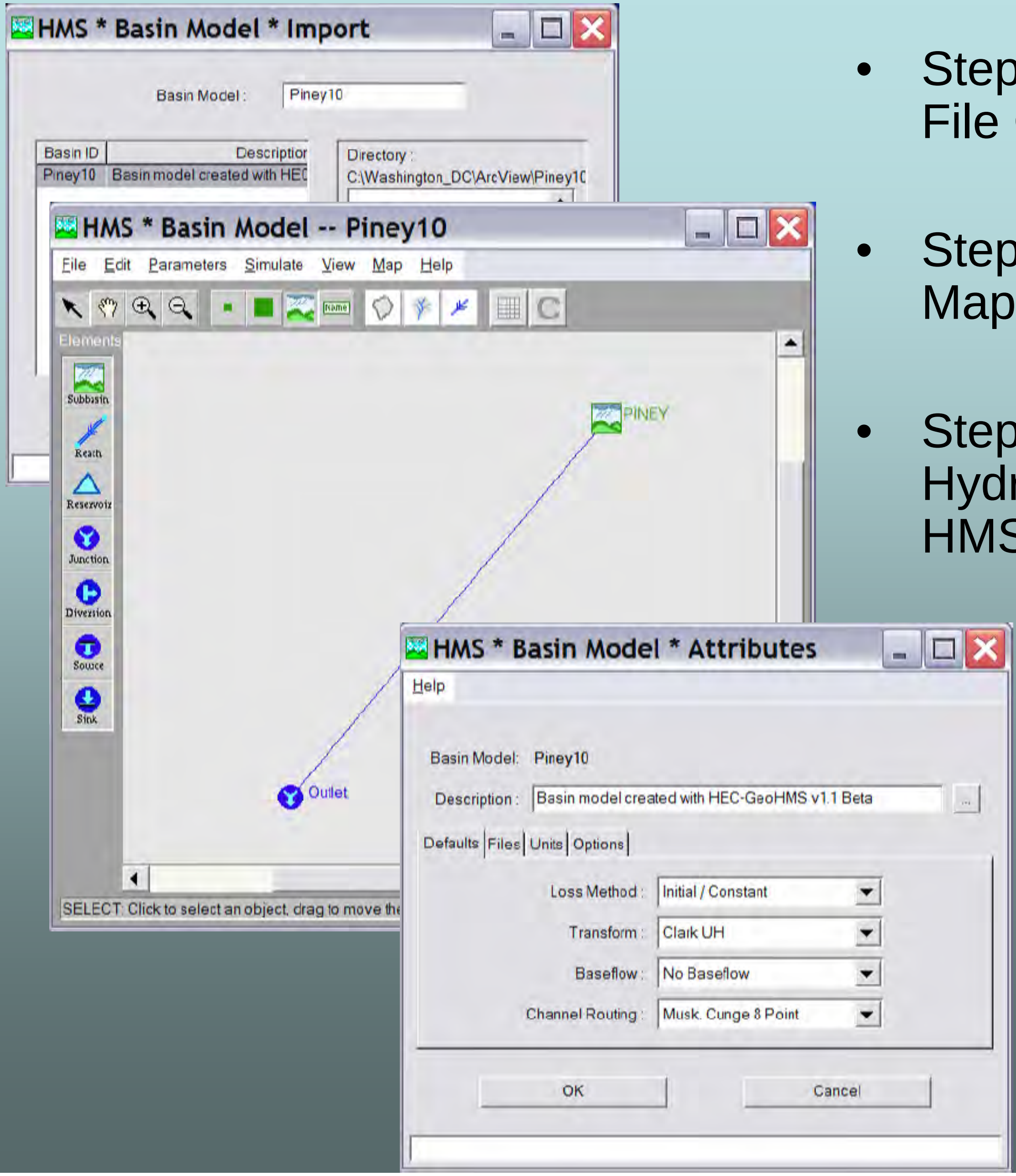
Step 8: Import ArcView Table into EXCEL

- An Excel spreadsheet has been created that will compute Tc and R values needed for the Clark Unit Hydrograph method within HMS



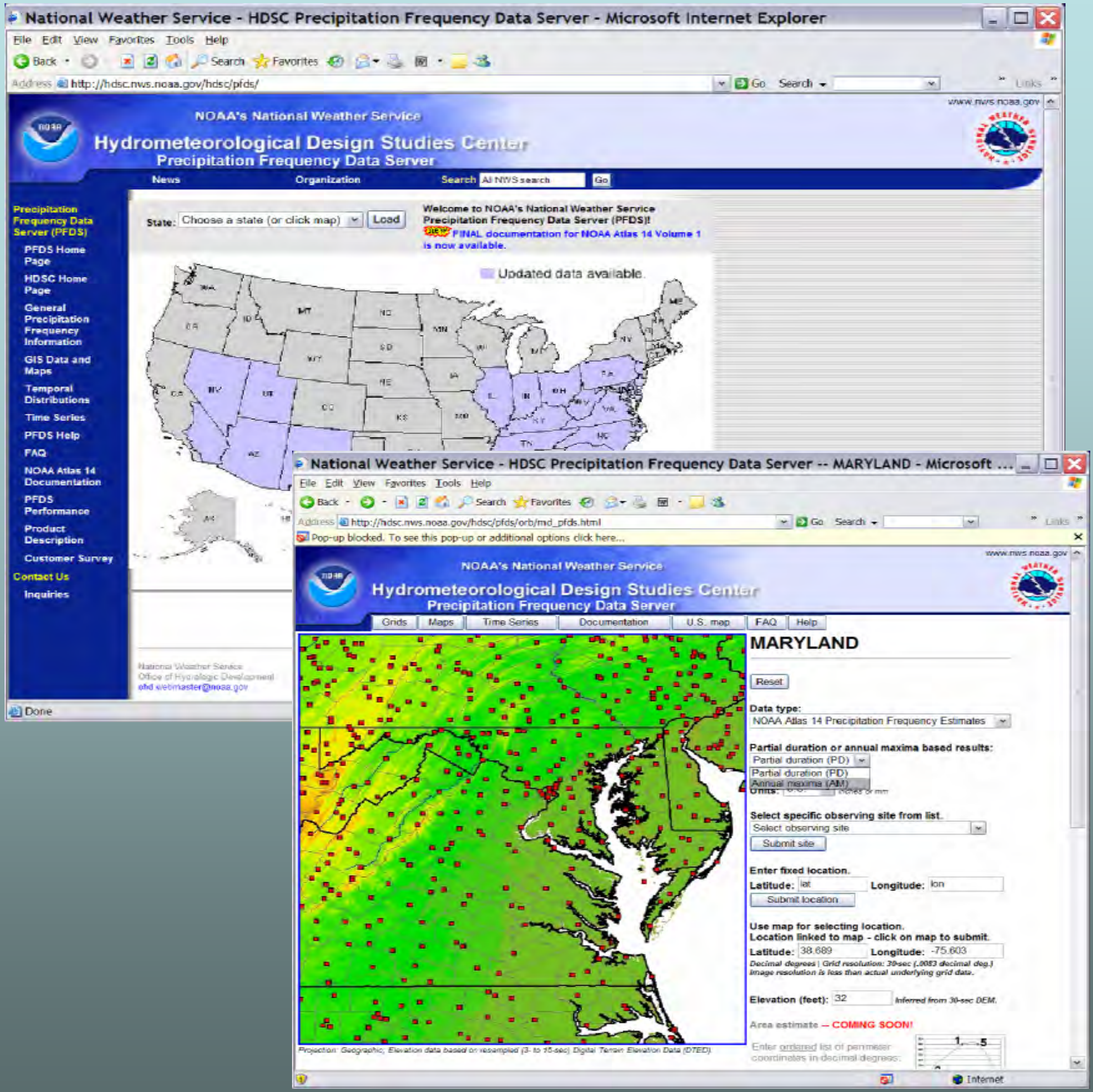


Step 9: Create a HMS File

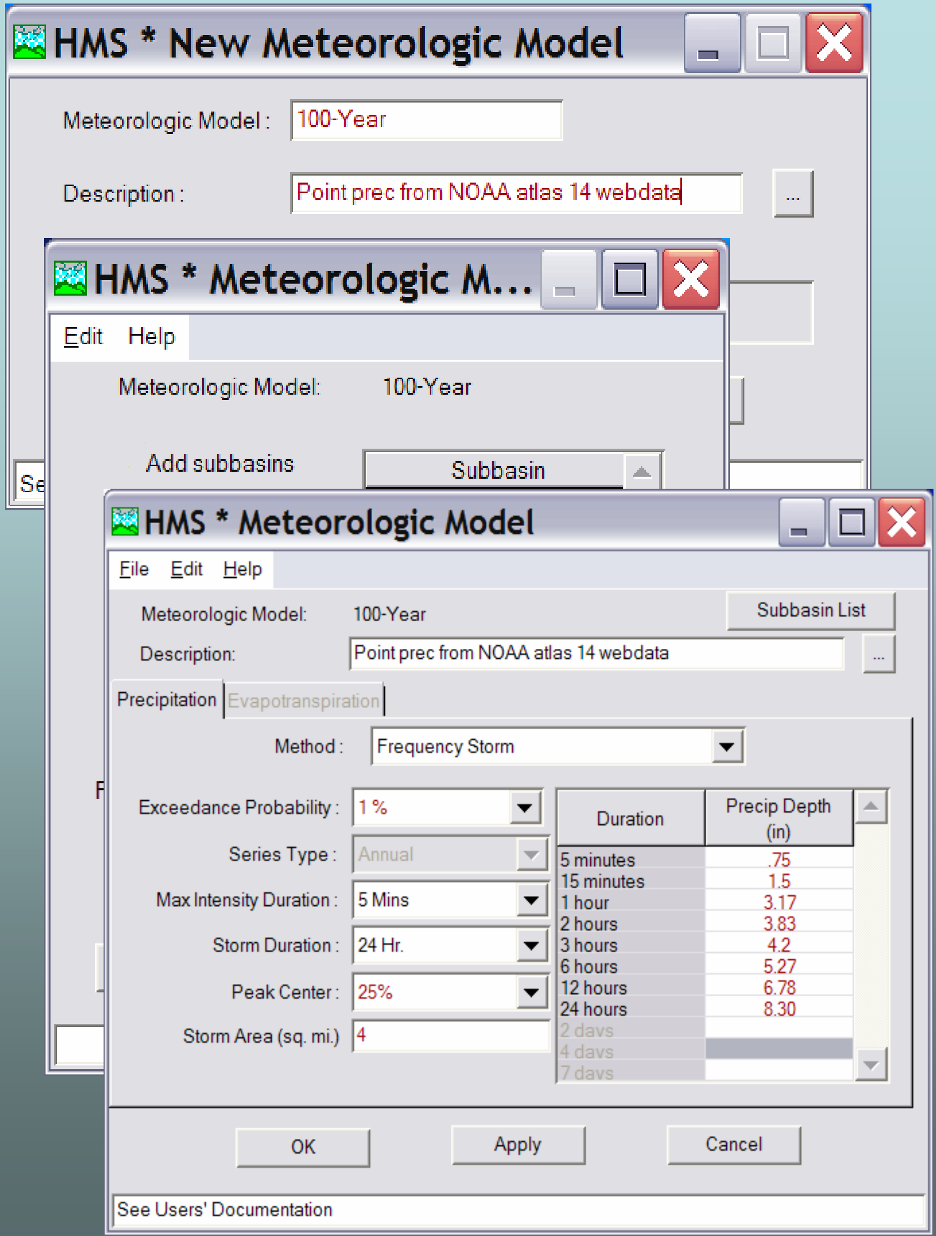


- Step 10: Import the Basin File Created in ArcView
- Step 11: Bring in the Basin Map Created in ArcView
- Step 12: Enter the Hydrologic Parameters into HMS

Step 13: Get Hypothetical Rainfall Data from Internet



Step 14: Input Frequency Rainfall Data into a HMS MET file



Step 15: Set a Control Specification and Run Model

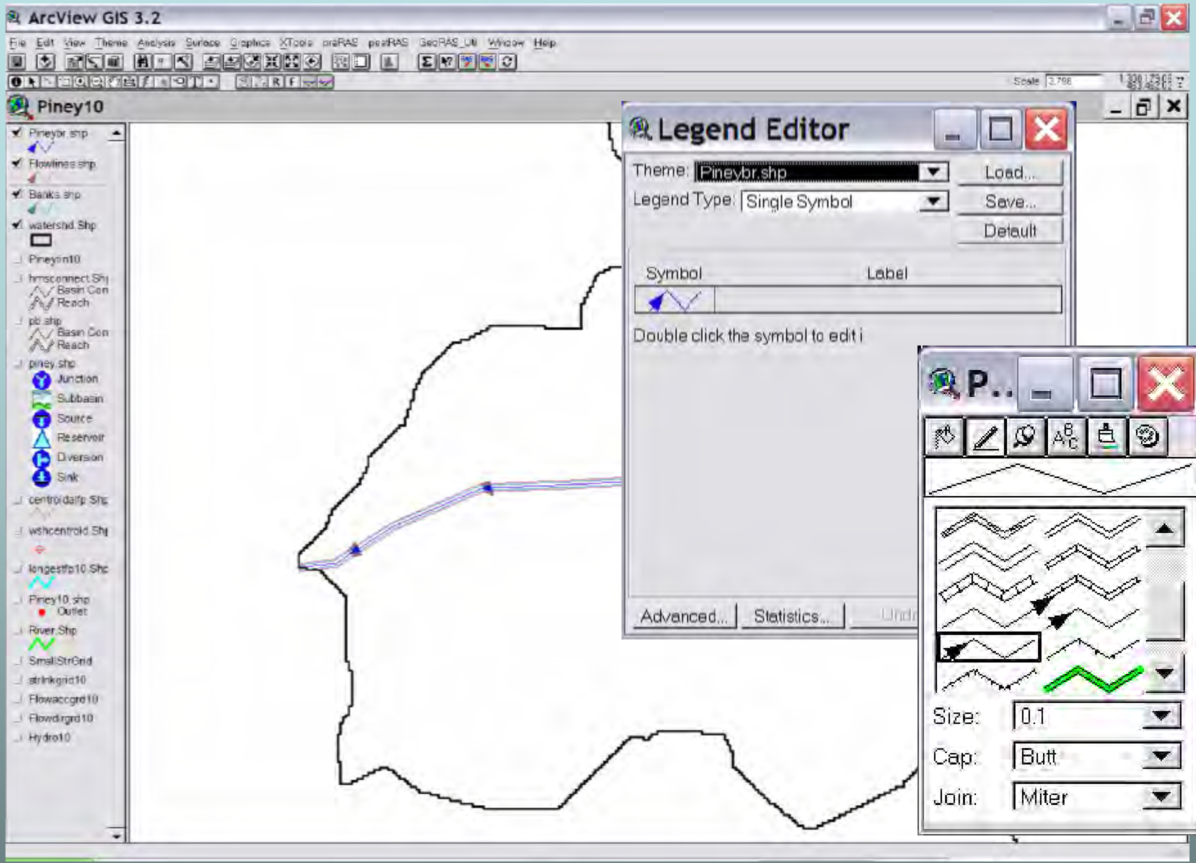
Note:

You now have both a peak discharge and a complete runoff hydrograph for the 100-year frequency storm.

Now let's develop a HEC-RAS model utilizing HEC's GeoRas

- Step 16: Begin Developing RAS Export File using GeoRAS

- Step 17: Covert Stream, banks and flowlines to GeoRAS Shapefiles

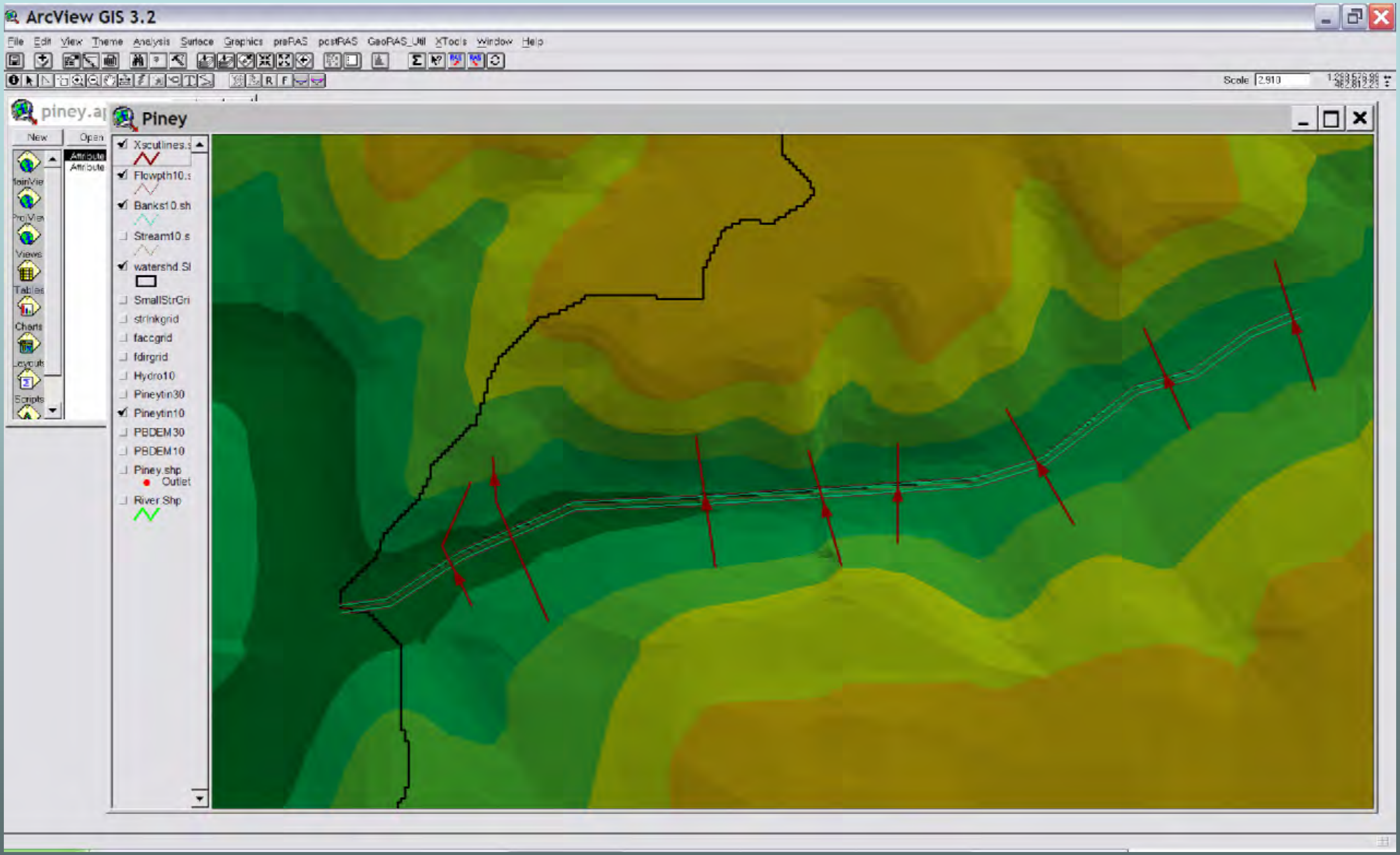


Note:

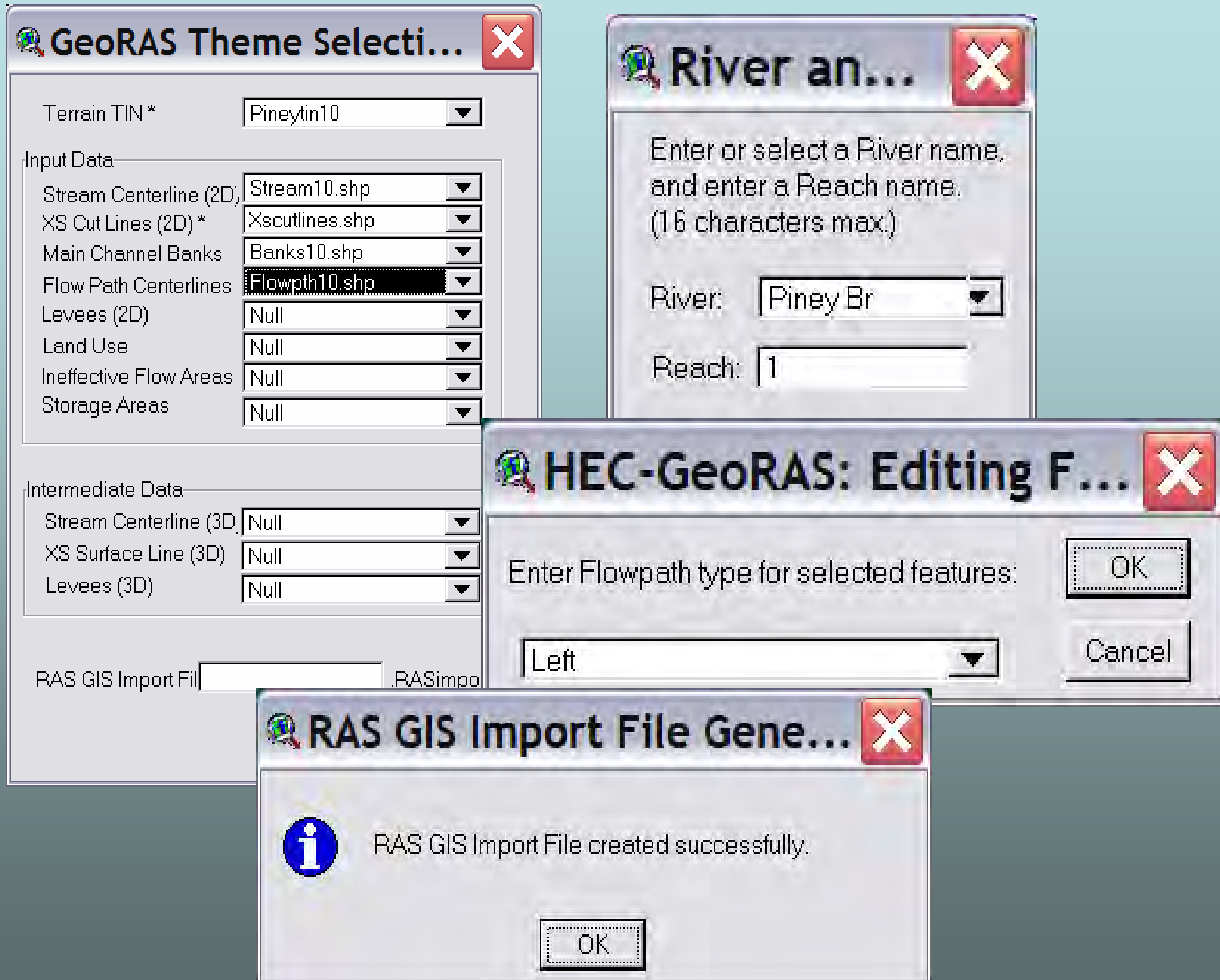
Change line symbols to lines with arrows to insure proper direction for RAS

Step 18: Create Cross Sections for RAS model

Note: Make sure the final TIN file from ArcMap is added into work area

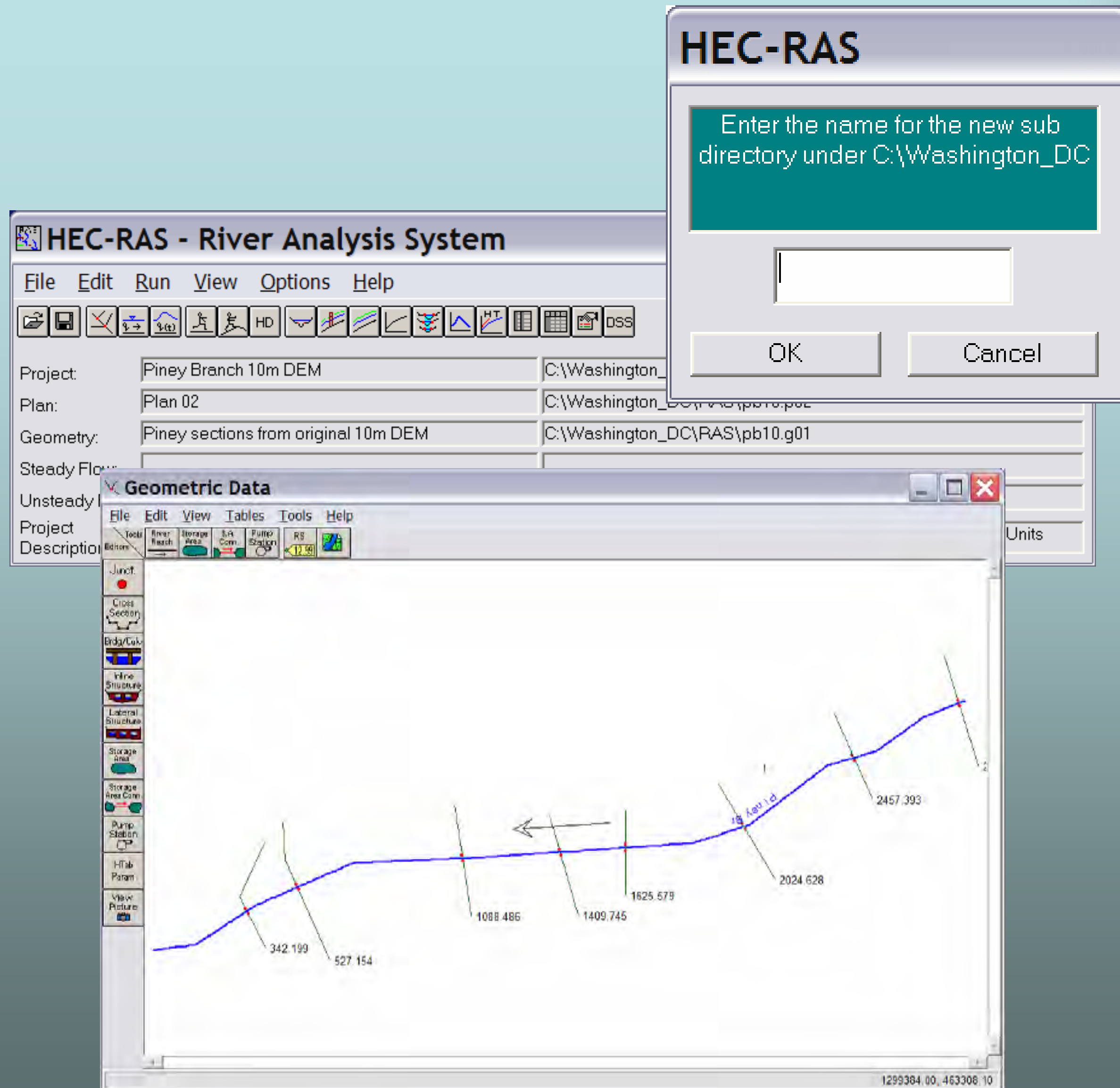


Step 19: Complete preRAS Processing



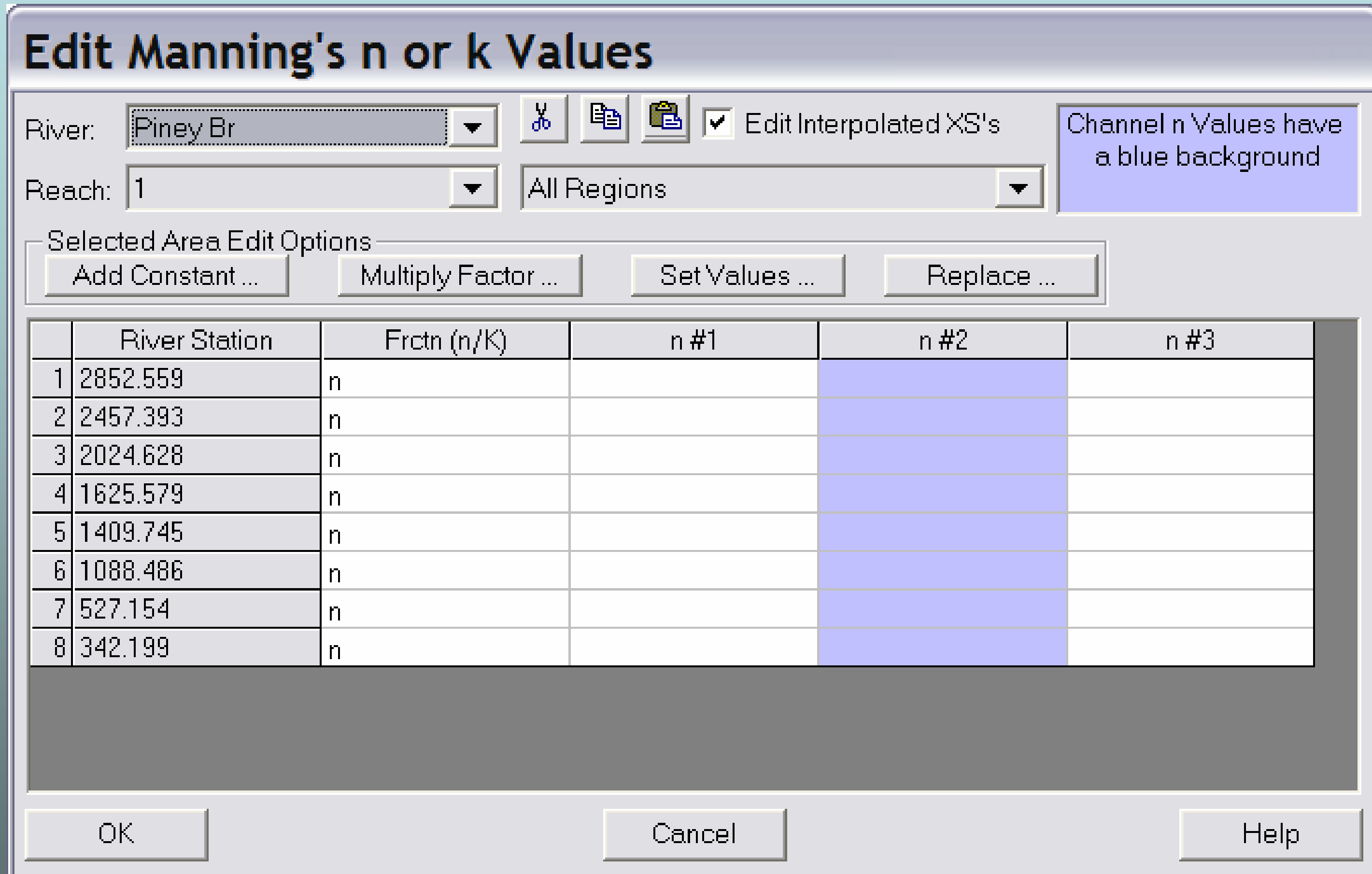
Step 20: Create HEC-RAS file

Create a RAS project and save, then open Geometric Data in import the export file created in Step 19 by GeoRAS

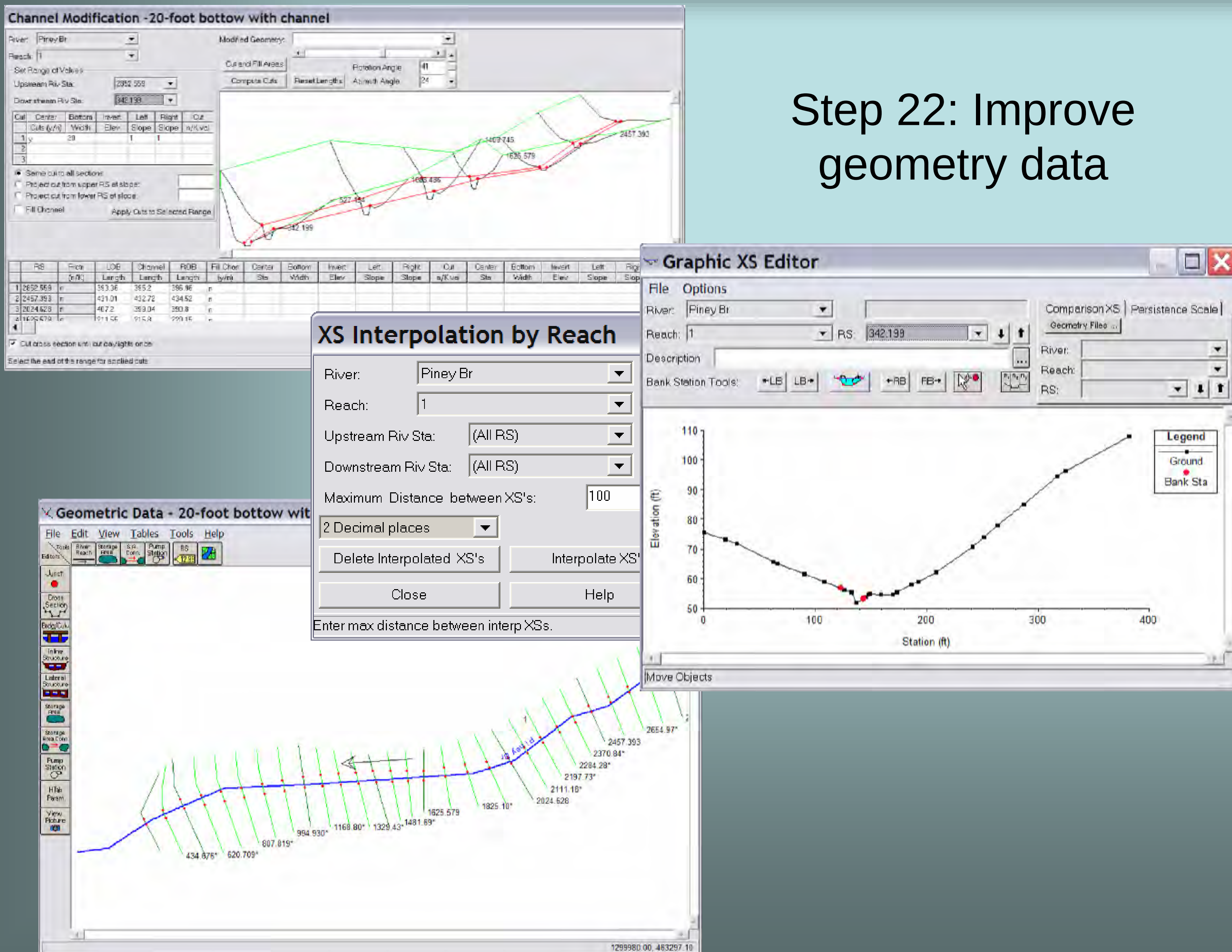


Step 21: Set Bank Stations and n-values

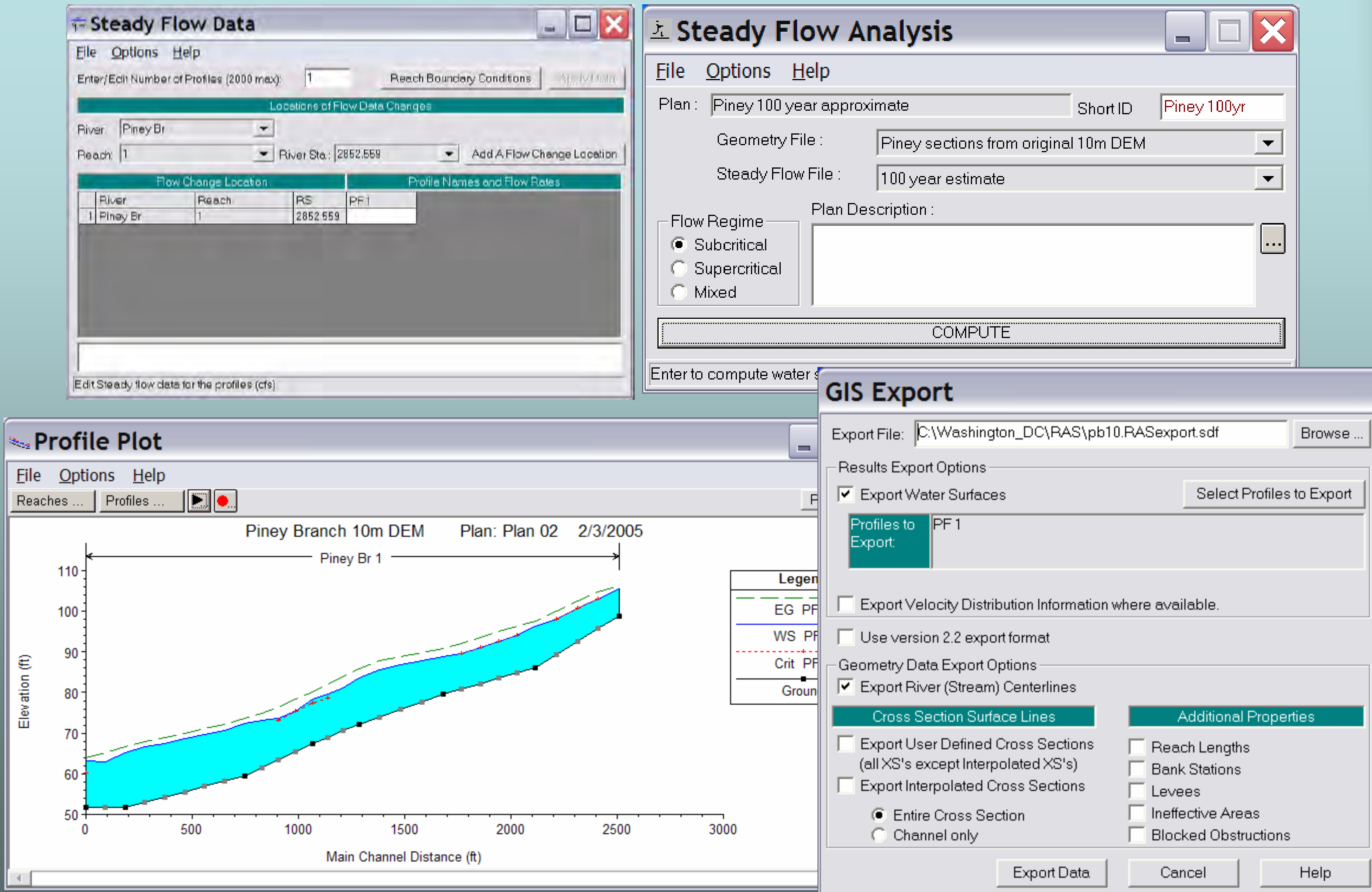
This can be done quickly by setting each column of data at a time



Step 22: Improve geometry data

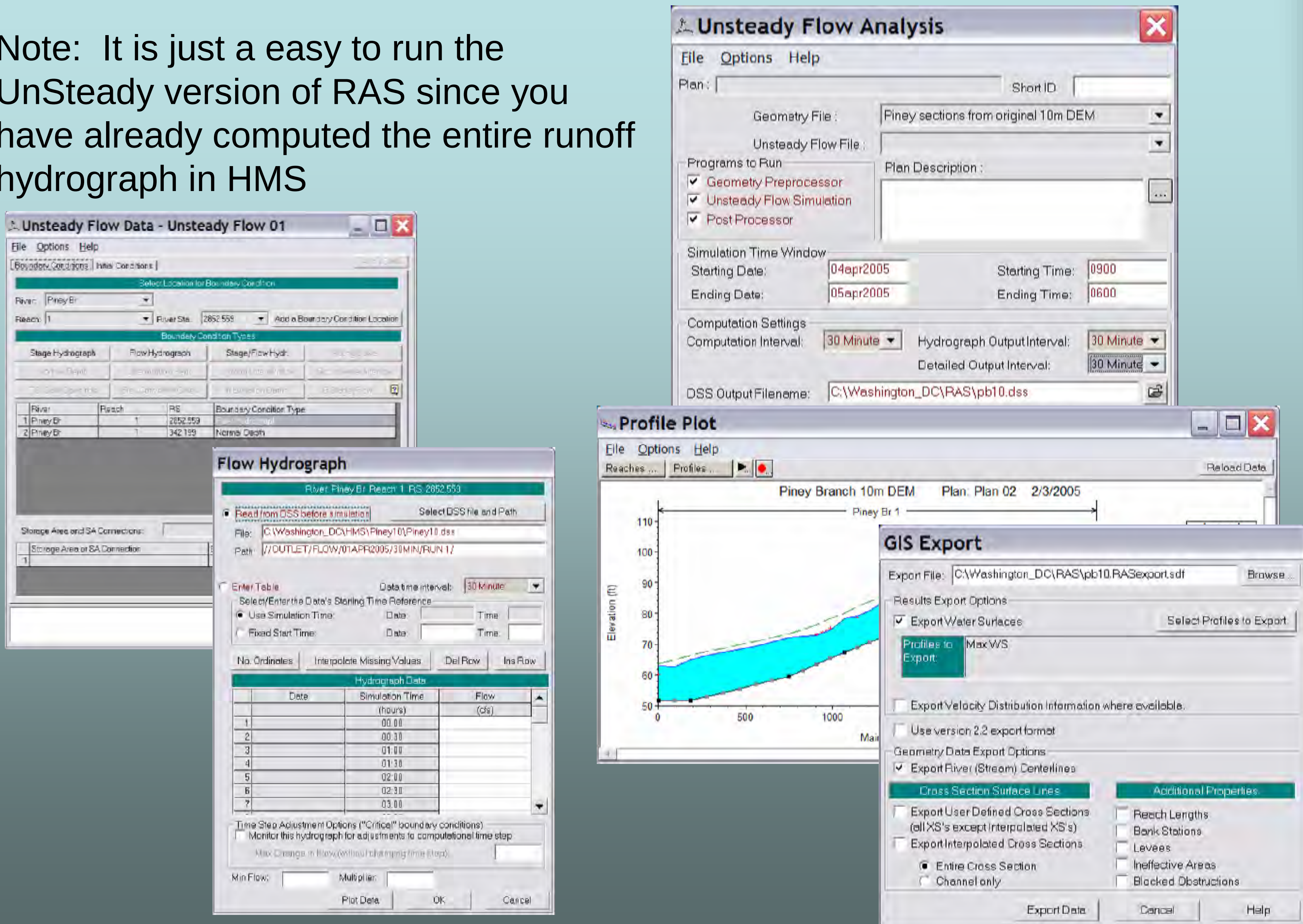


Step 23: Input Steady Flow Data, Run and Export GIS data

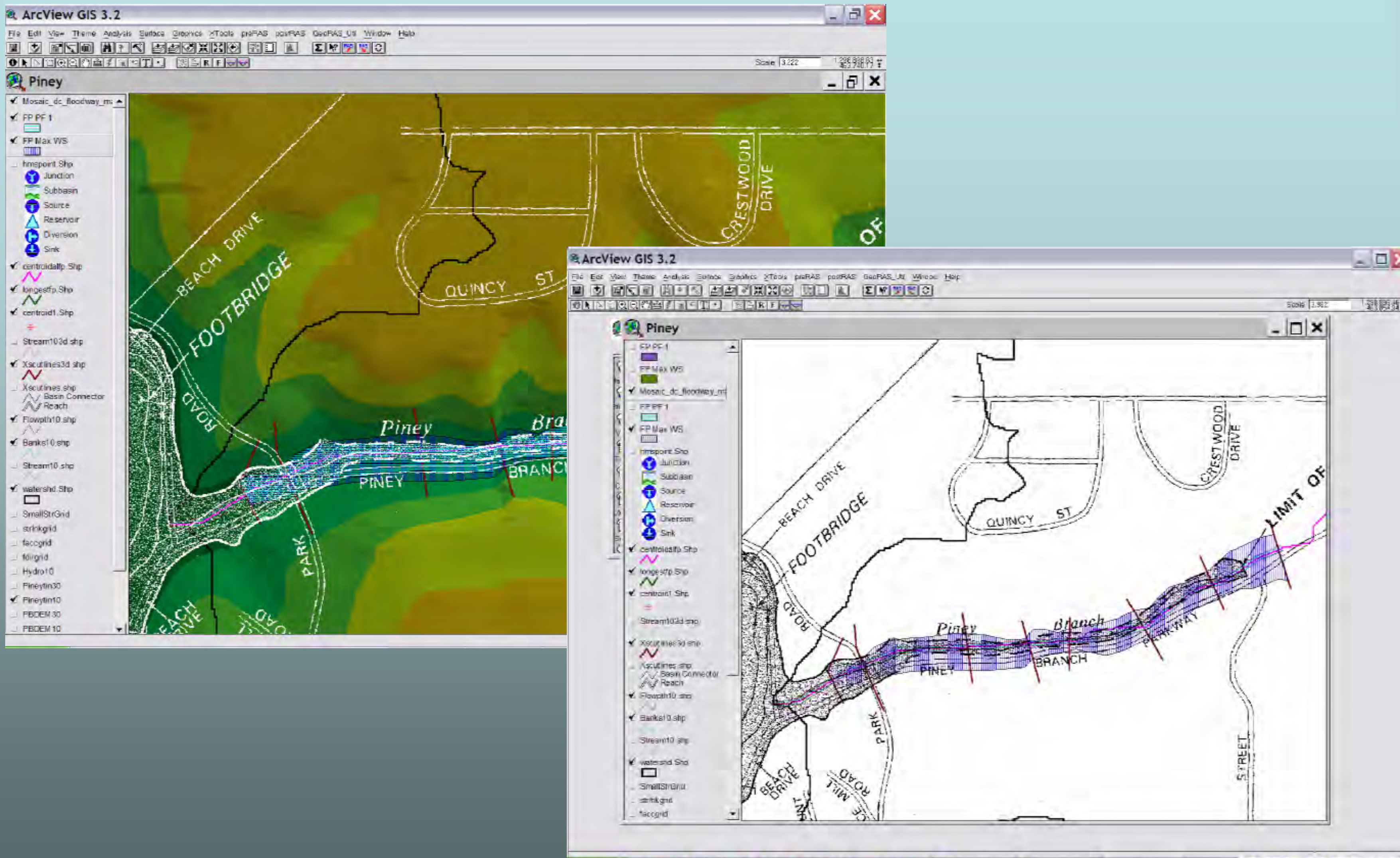


Step 24: Input UnSteady Flow Data, Run and Export GIS data

Note: It is just a easy to run the UnSteady version of RAS since you have already computed the entire runoff hydrograph in HMS



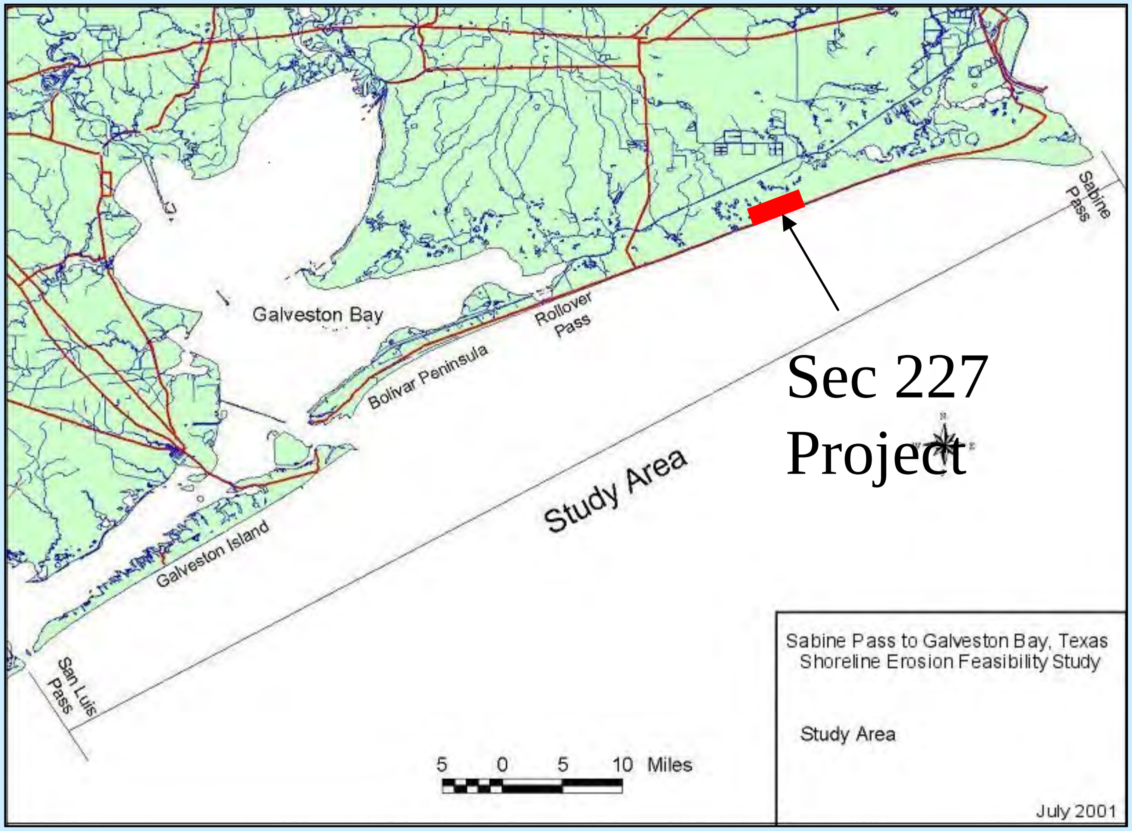
Step 25: Run postRAS in ArcView for Steady Flow
Step 26: Run postRAS in ArcView for Unsteady Flow



SECTION 227

Jefferson County, TX – Low Volume Beach Fill

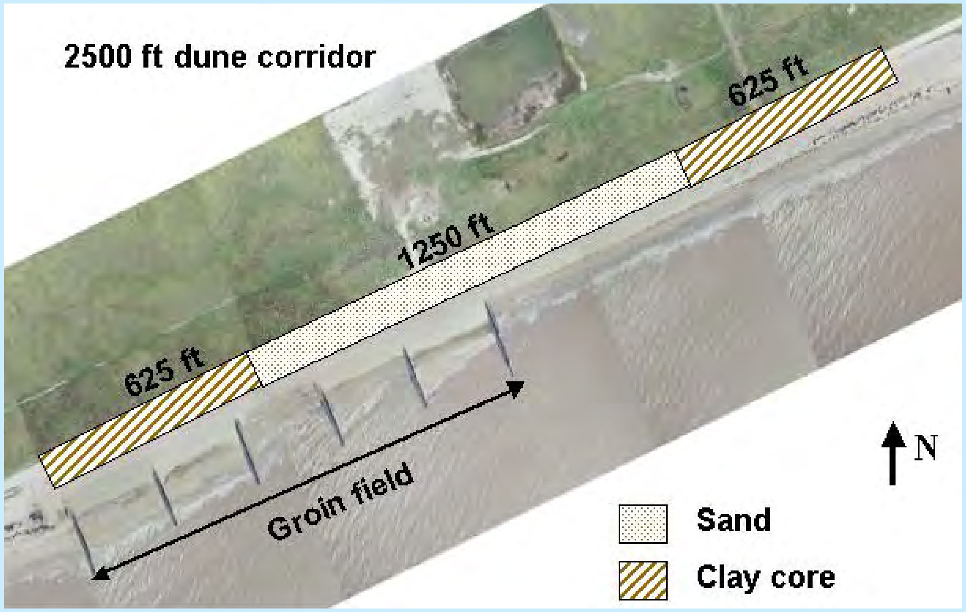
SECTION 227



Project fronts the McFaddin NWR – area is charcterized by a broad salt marsh with a muddy substrate

SECTION 227

Project Features



2500 ft dune

½ sand

½ sand/clay

Geotube Groins

5 Nourishment Cells

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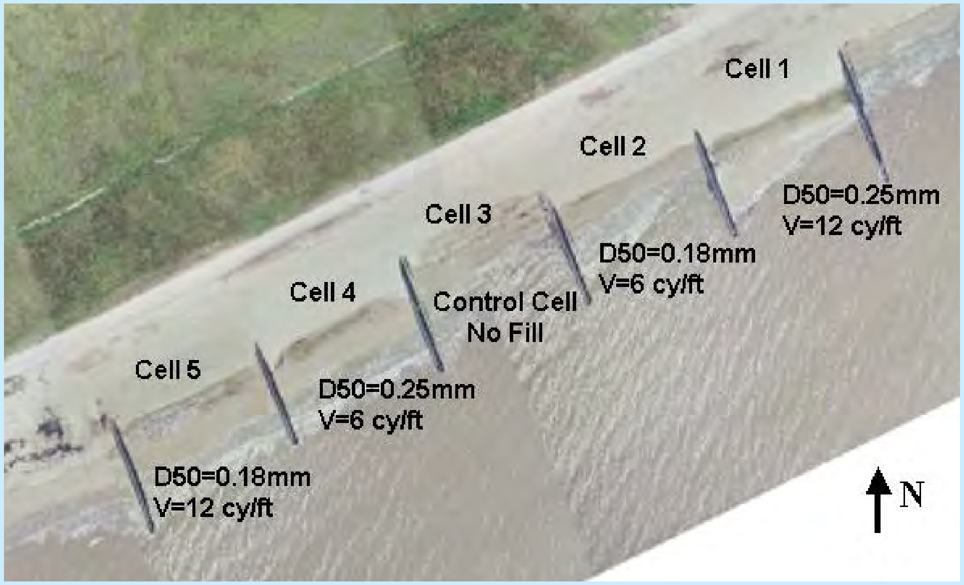
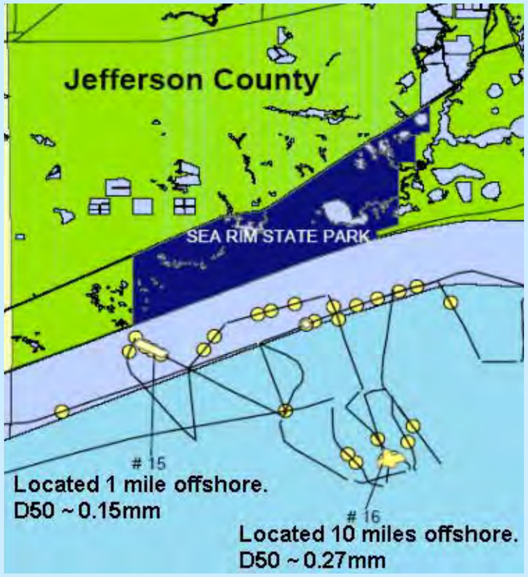


Experiment Groin Cells with Low Volume Beach Fill



SECTION 227

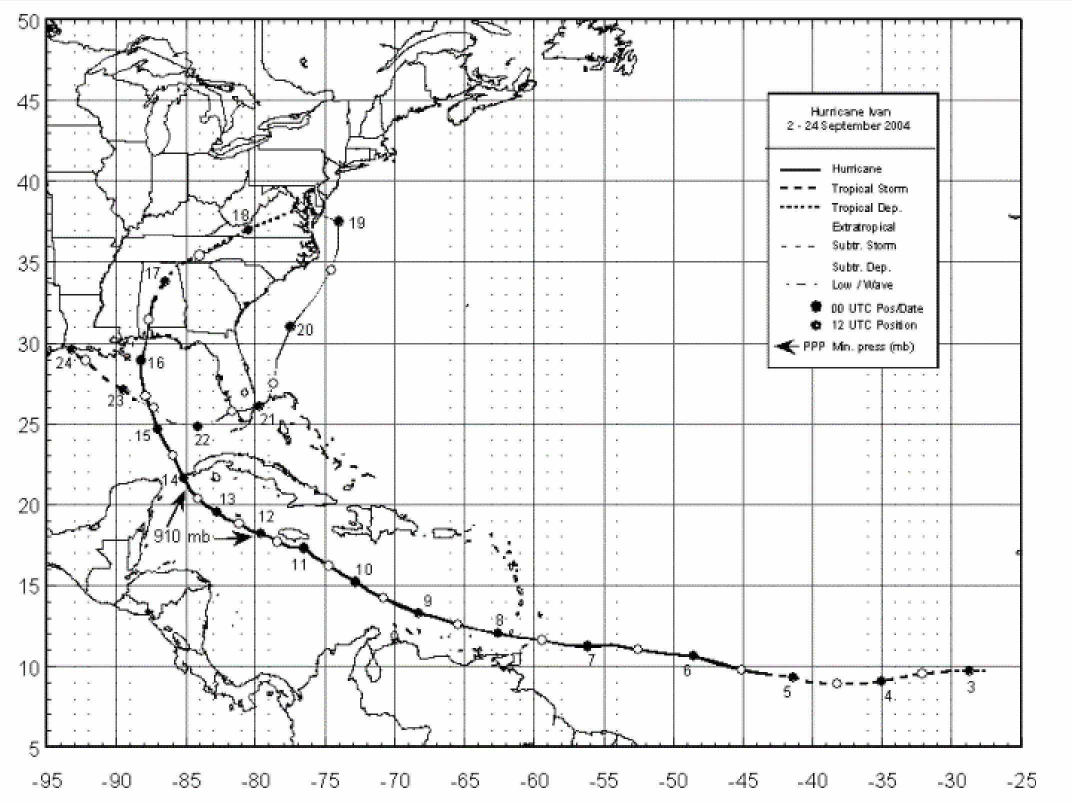
Project Objectives

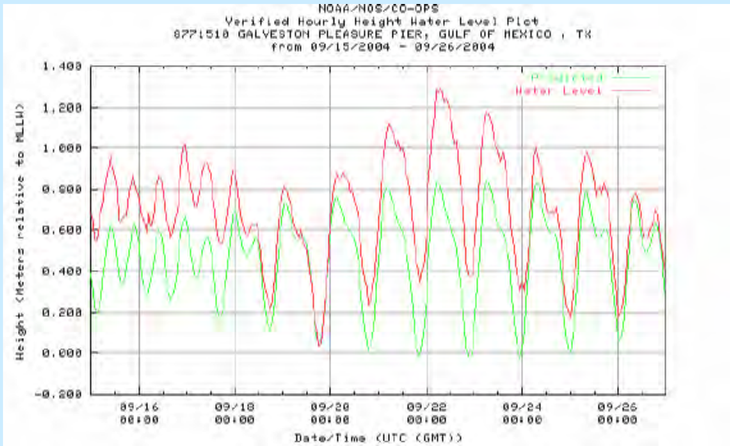
- Evaluate effectiveness of the dune at reducing overwash and retaining sand in the swash zone
- Assess performance of clay-cored dune and sand dune at both nourished and unnourished sites
- Determine effectiveness of low volume beach fill to reduce erosion of underlying clay layers
- Evaluate effectiveness of different grain sizes and nourishment rates
- Evaluate effectiveness of groins at retaining sand in cells and performance of geotextile structures

SECTION

227

Project Performance – Hurricane Ivan



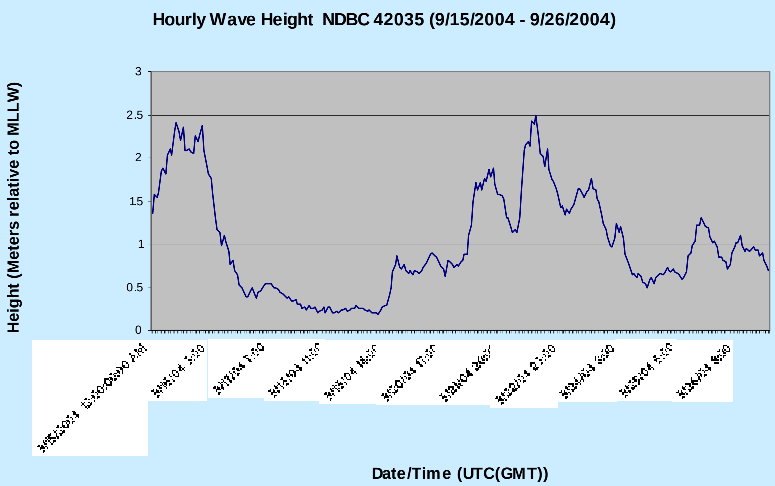


Hourly Water Levels

Pleasure Pier, Galveston

Wave Heights

NDBC 42035



SECTION

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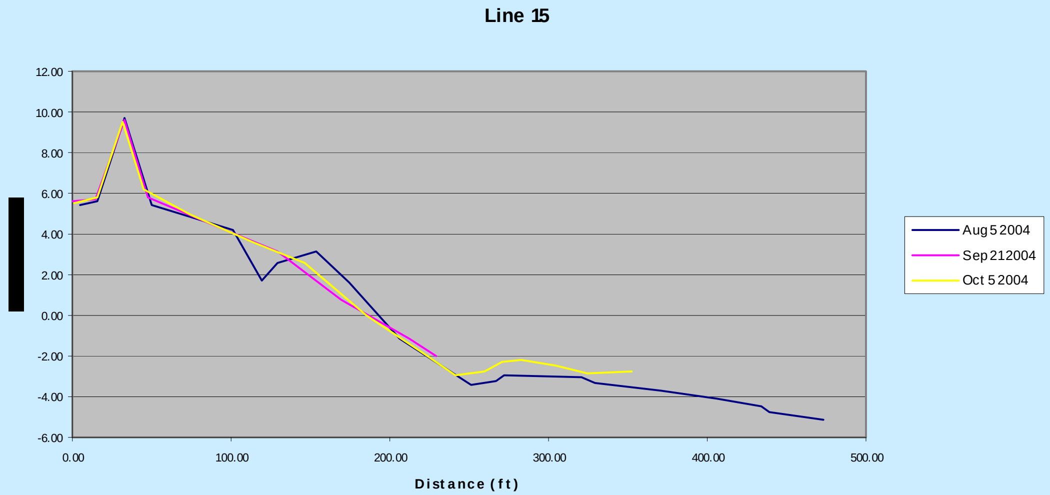
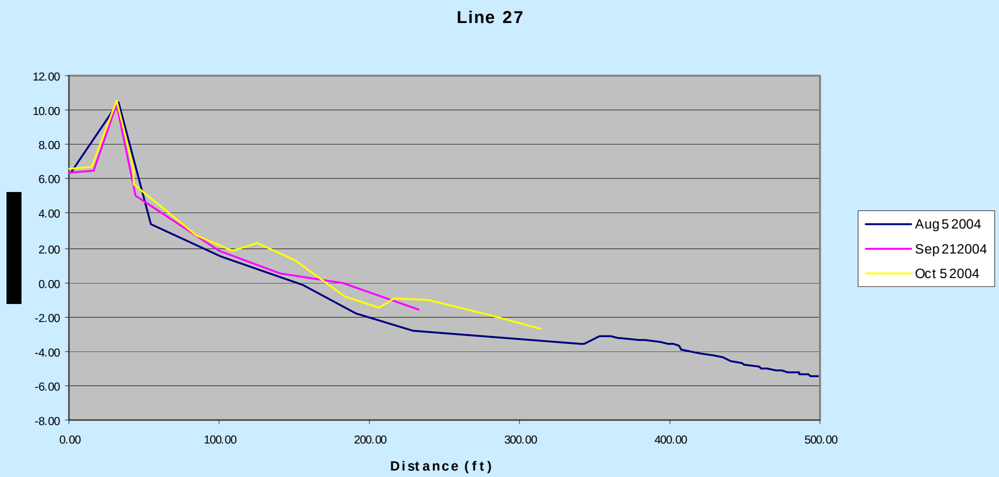


Post construction and post event profile data for Cell #1

SECTION

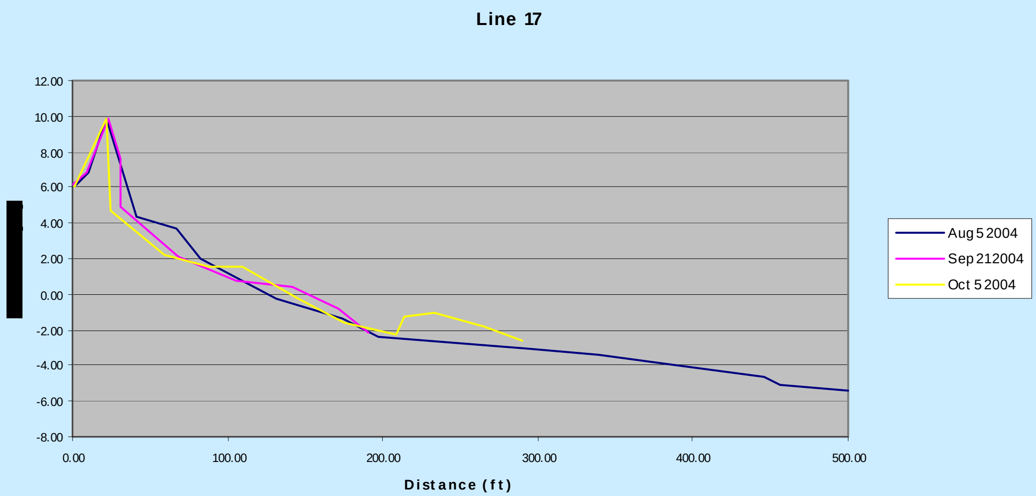
227



Post construction and post event profile data for Cell #3

SECTION

227



Dune Response

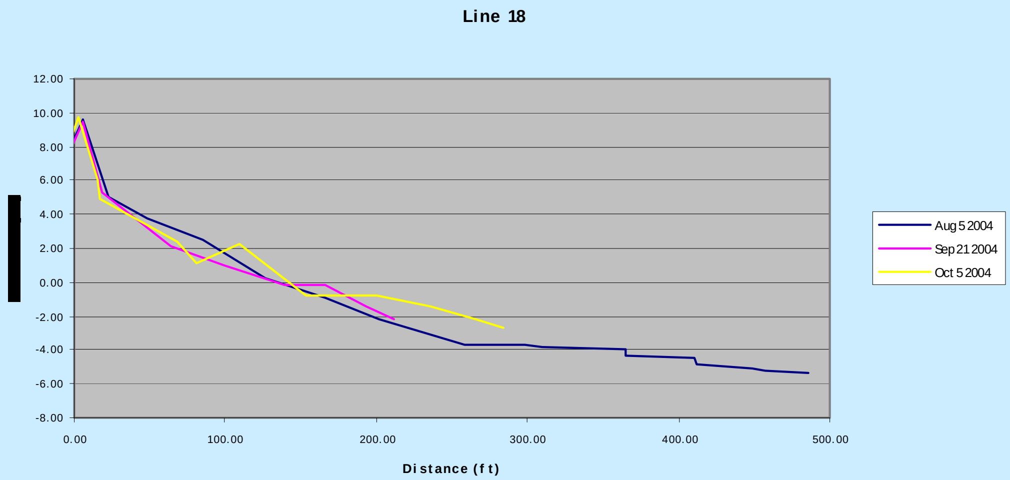
Sand-cored Dune

SECTION

227

Dune Response

Clay-cored Dune



SECTION

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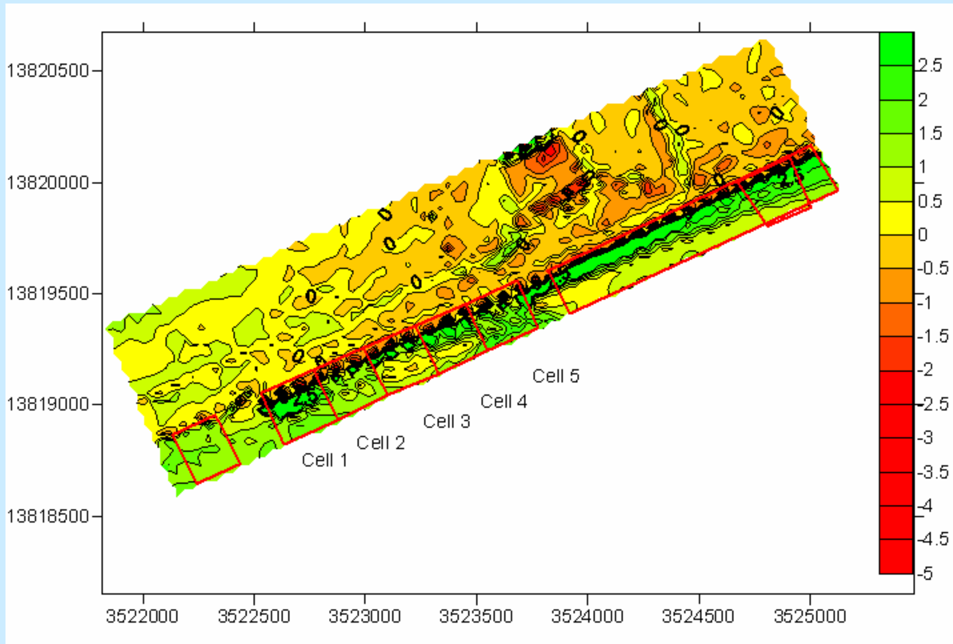

Volume change calculations from digital terrain models, August 14, 2004 and January 14, 2005

SECTION

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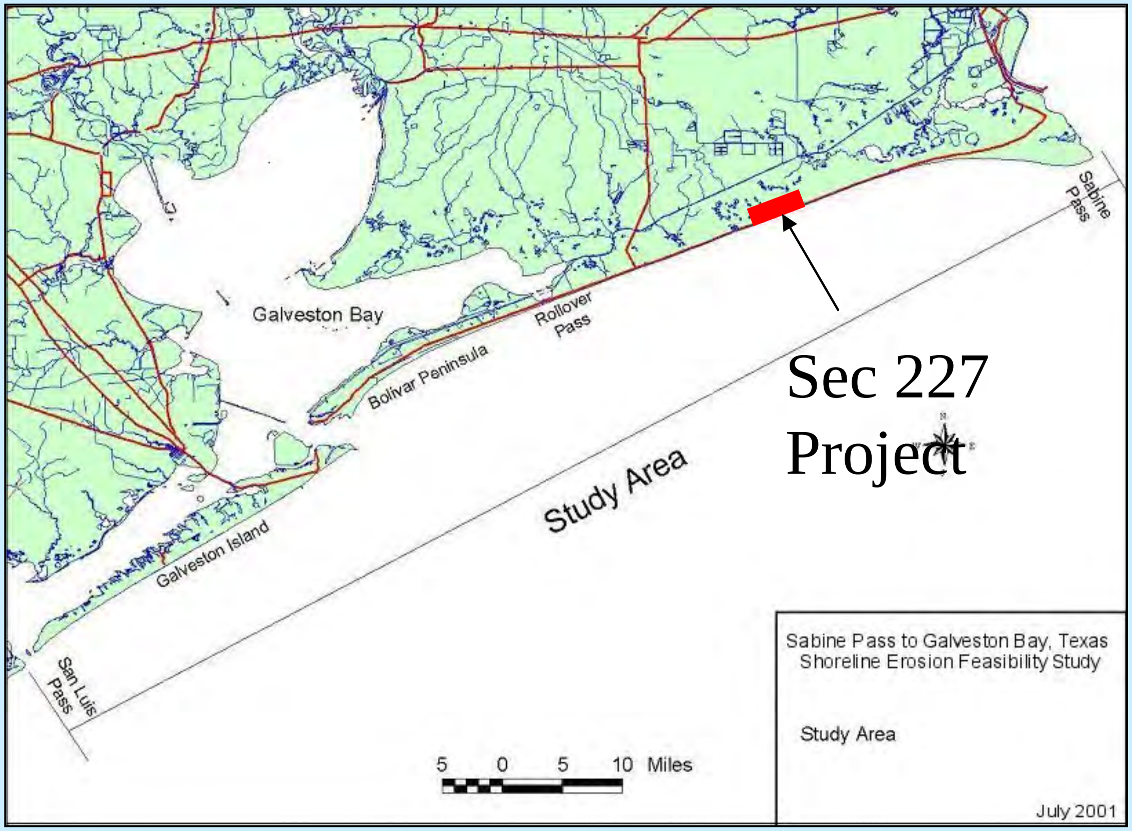
Jefferson County, TX – Low Volume Beach Fill

SECTION 227



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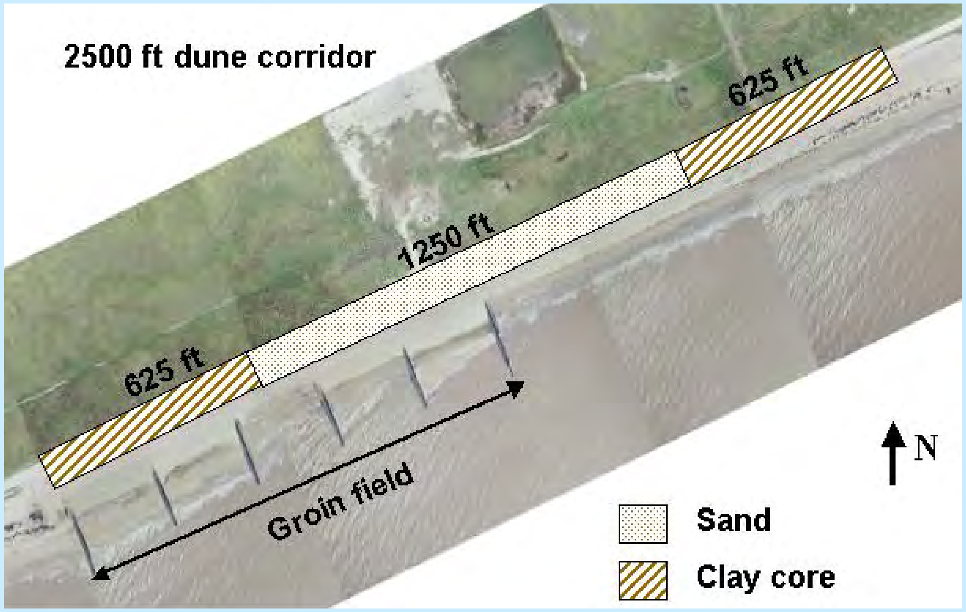

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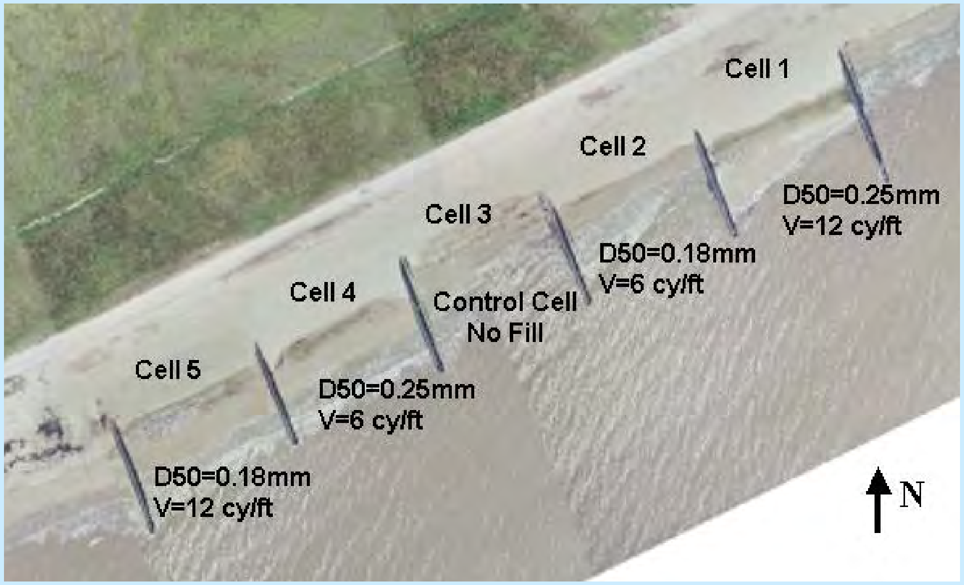

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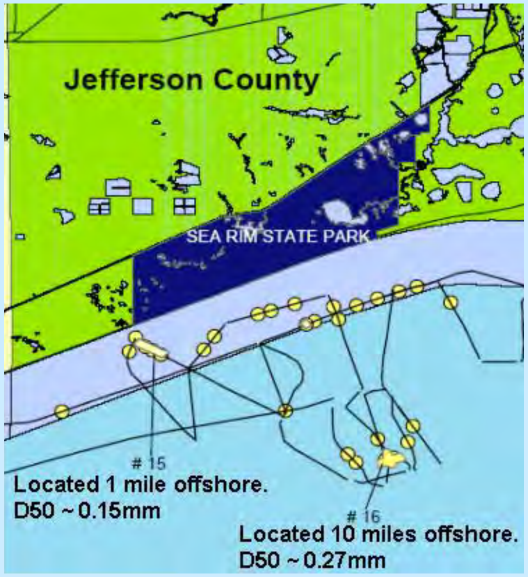

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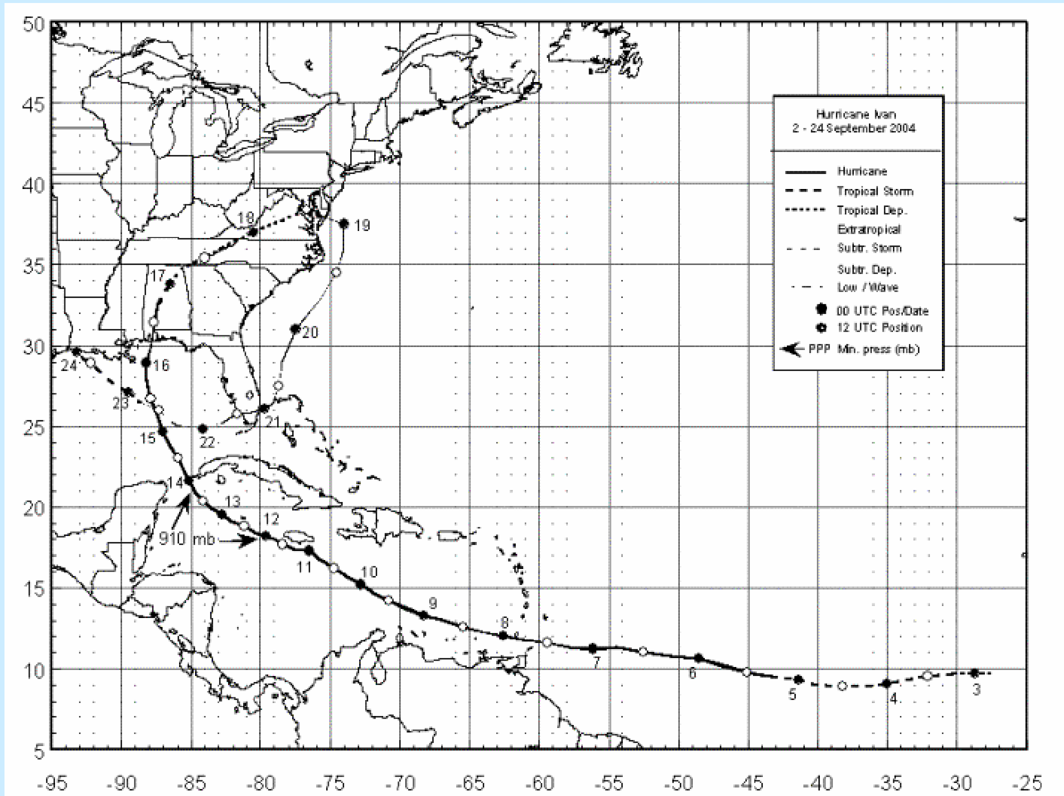
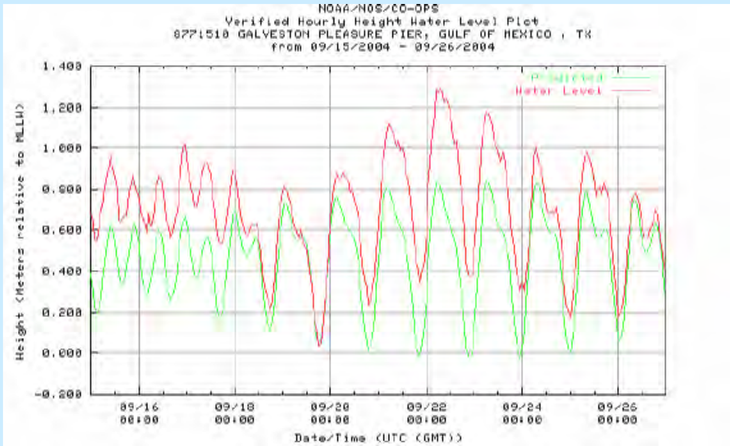


SECTION 227



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Pleasure Pier, Galveston

Wave Heights

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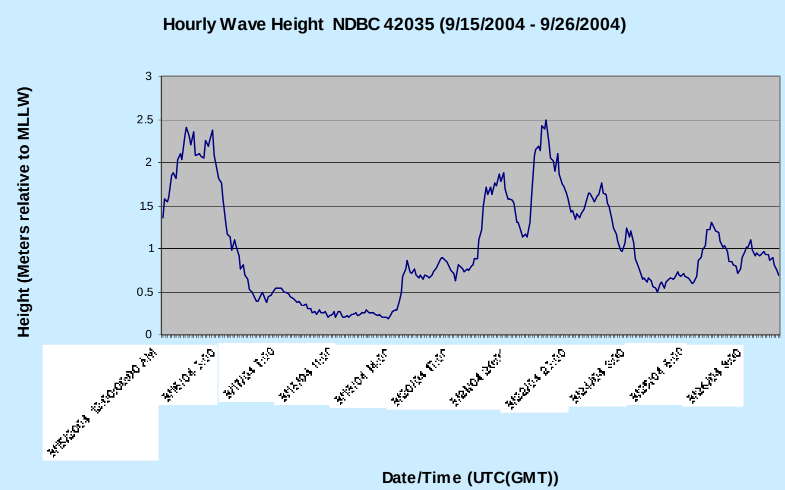

SECTION

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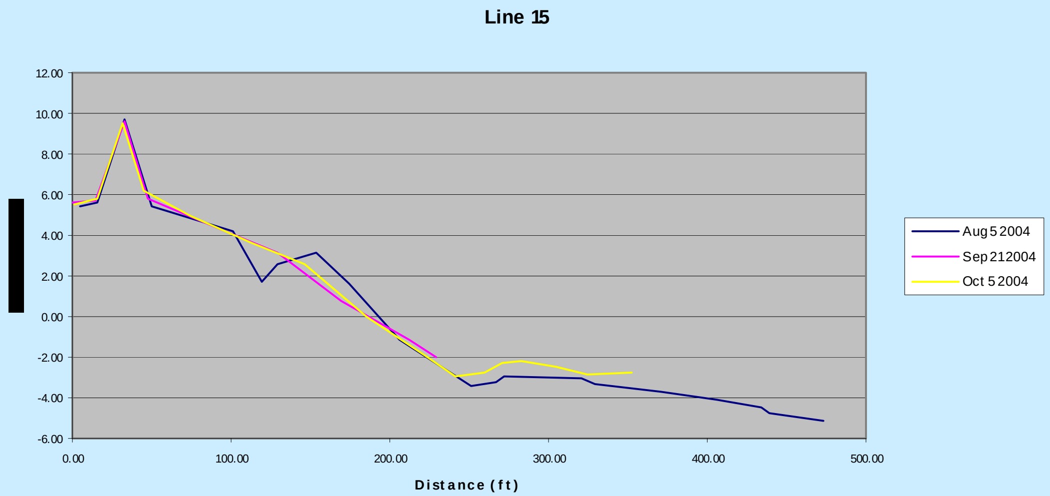
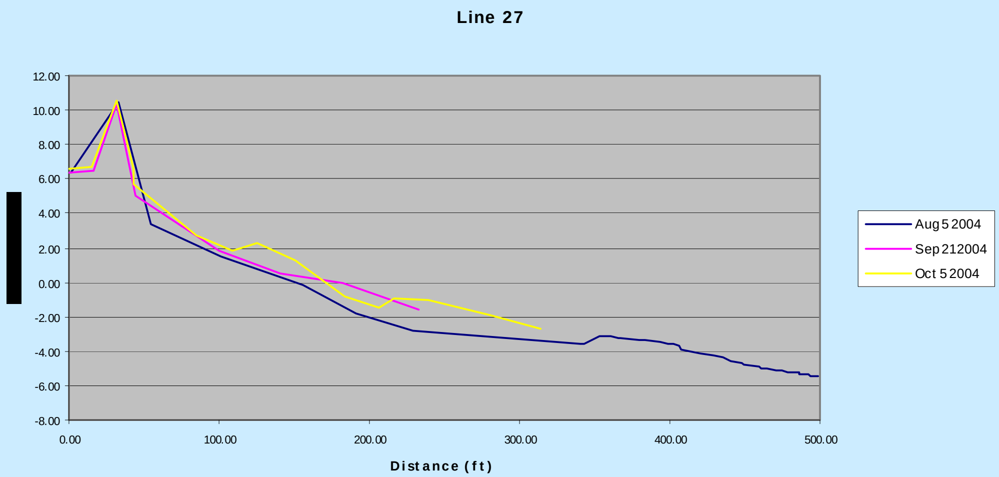
Post construction and post event profile data for Cell #1



SECTION

227

Post construction and post event profile data for Cell #3



SECTION

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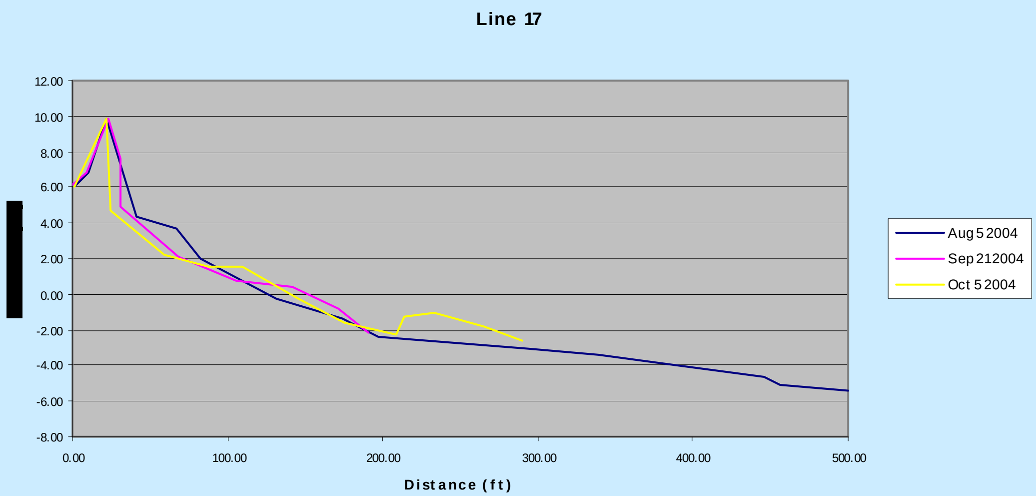

Dune Response

Sand-cored Dune

SECTION

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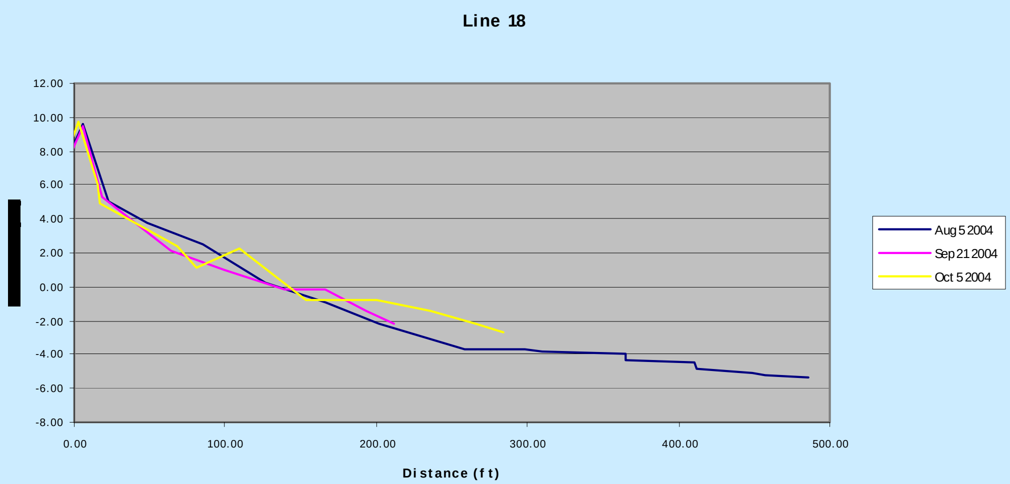

Dune Response

Clay-cored Dune

SECTION

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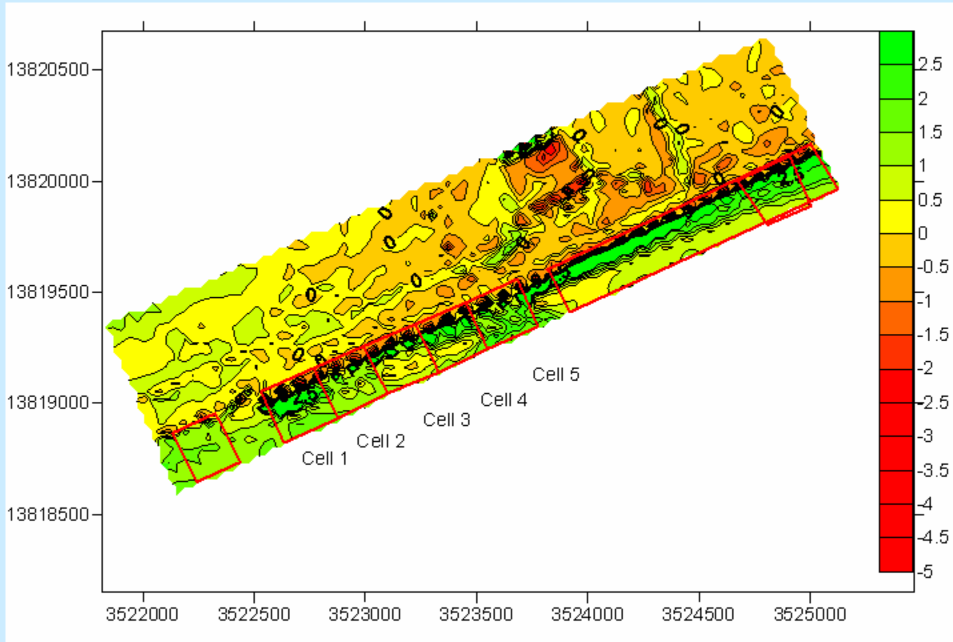

Volume change calculations from digital terrain models, August 14, 2004 and January 14, 2005

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227

Bluff Stabilization along Lake Michigan, using Active and Passive Dewatering Techniques

Rennie Kaunda, Western Michigan University, Geosciences
Eileen Glynn, ERDC, Geotechnical and Structures Laboratory
Ron Chase, WMU Geosciences
Alan Kehew, WMU Geosciences
Amanda Brotz, WMU Geosciences
Jim Selegean, USACE Detroit District

SECTION 227

Problem:

Bluff recession along Lake Michigan’s Coast causes substantial property loss annually.

Recession rates:- 1 to 2 ft/yr at study site over the past 135 years.

Engineered structures consistently fail to deter erosion:

- Typically designed to prevent toe erosion, while precipitation and groundwater discharge from the bluff face may be the governing factor in bluff failure.

Bluff Stabilization - Lake Michigan's Coast,
Allegan Co. Michigan

SECTION

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Phase II - Dewatering the site

- Developed plan to dewater with pumps in vertical wells & passive horizontal wells drilled into bluff face
- Plan included instrumentation of slope for remote monitoring of:-
  - displacement
  - groundwater levels
  - ground temperatures
  - atmospheric conditions
  - bluff face freezing

Bluff Stabilization - Lake Michigan’s Coast,
Allegan Co. Michigan

SECTION

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Conclusions of first year's dewatering efforts

- After bluff face froze, groundwater flow direction changed periodically
- Horizontal wells were not as effective as vertical wells
- Mean shear displacement in wells on dewatered site was about 2.83 in. per well
- Mean shear displacement in wells on control site was about 11.50 in. per well
- Removal of perched groundwater during the 2004-05 winter spring cycle created a three times more stable bluff than at control site
- Repeated experiments between now and 2009 will test repeatability of 2004-05 results

Bluff Stabilization - Lake Michigan's Coast,
Sheboygan Co. Wisconsin

SECTION
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Bluff Stabilization - Lake Michigan's Coast,

Sheboygan Co. Wisconsin

SECTION

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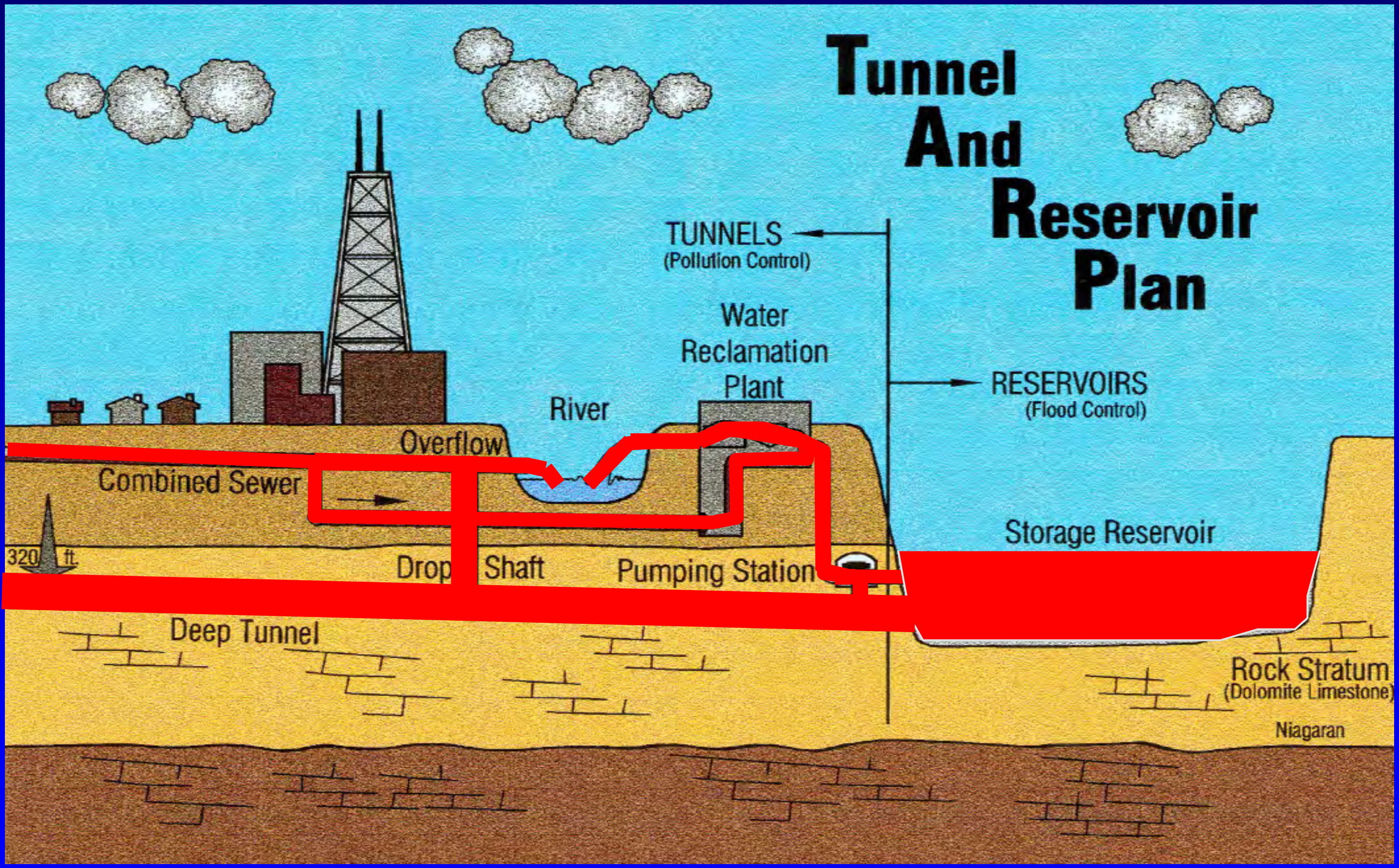
HYDROLOGIC AND HYDRAULIC MODELING OF THE MCCOOK AND THORNTON TUNNEL AND RESERVOIR PLANS

Chicago, Illinois

DAVID KIEL, U.S. ARMY CORPS OF ENGINEERS

US Army Corps
of Engineers
Chicago District



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Chicago District

TUNNEL AND RESERVOIR PLAN

- Reduce waterway pollution from CSOs
- Prevent backflows to Lake Michigan
- Provide storage for floodwaters
  - Reduces basement flooding from CSOs (economic justification of project)

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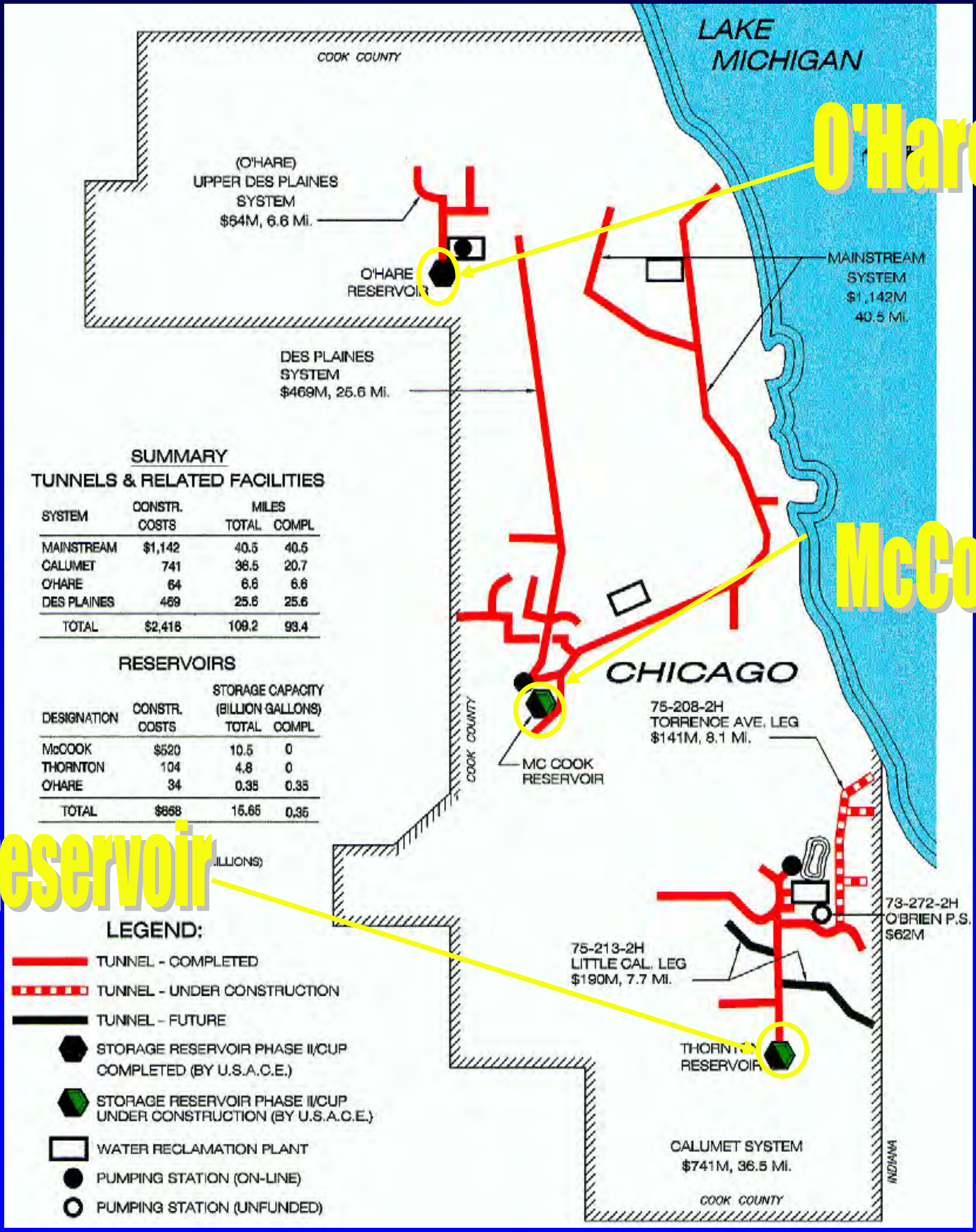
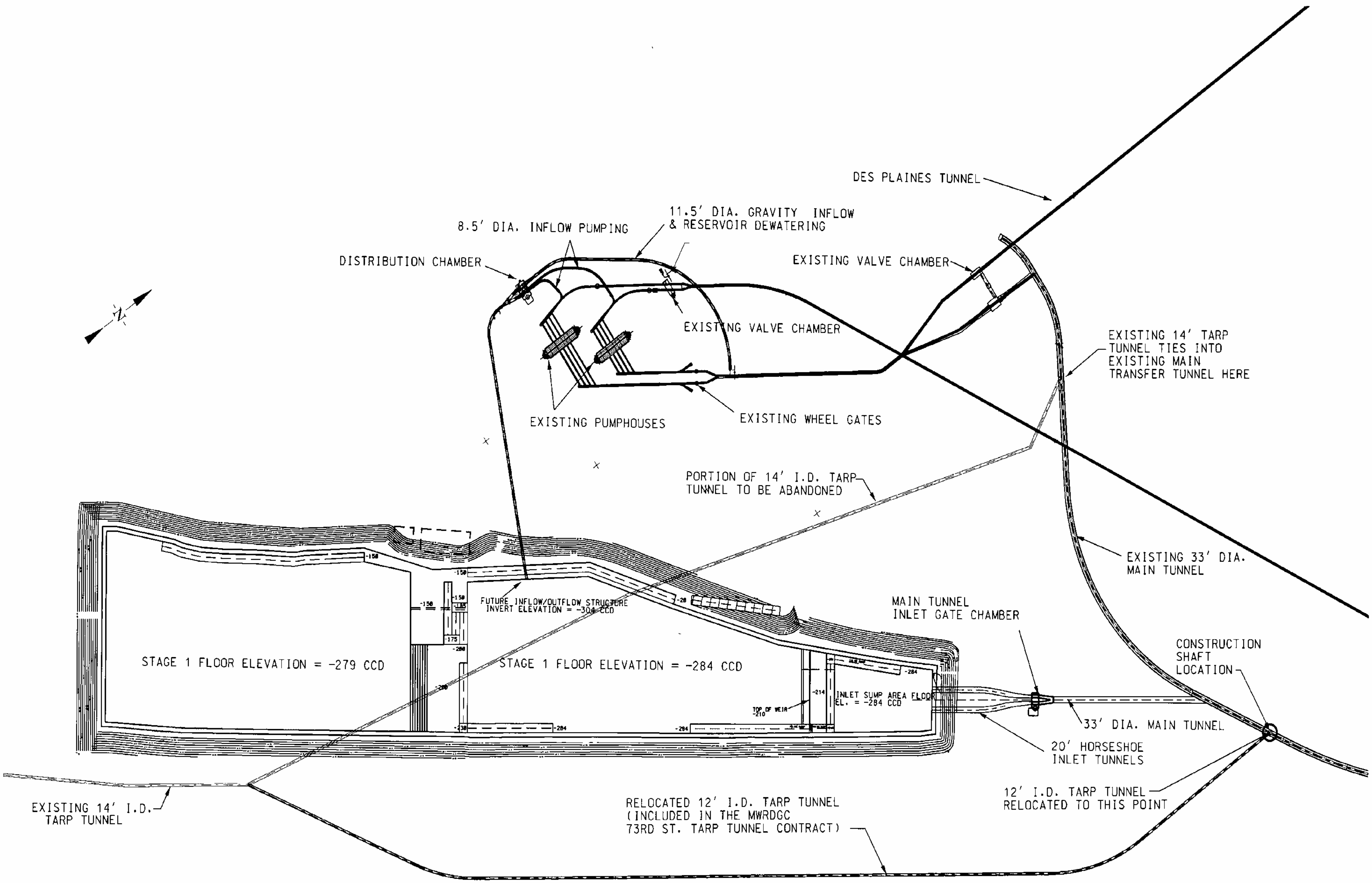
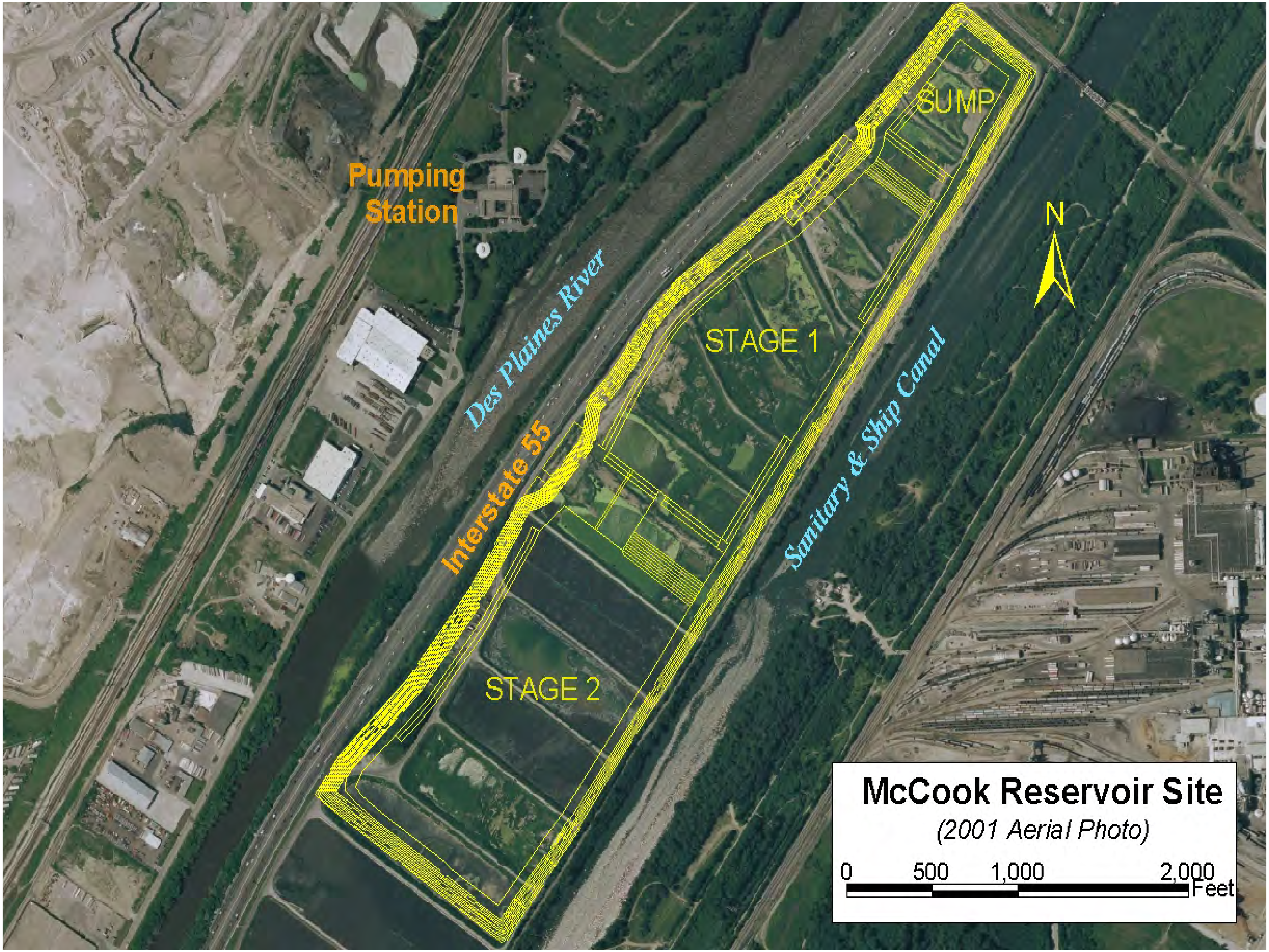
of Engineers
Chicago District





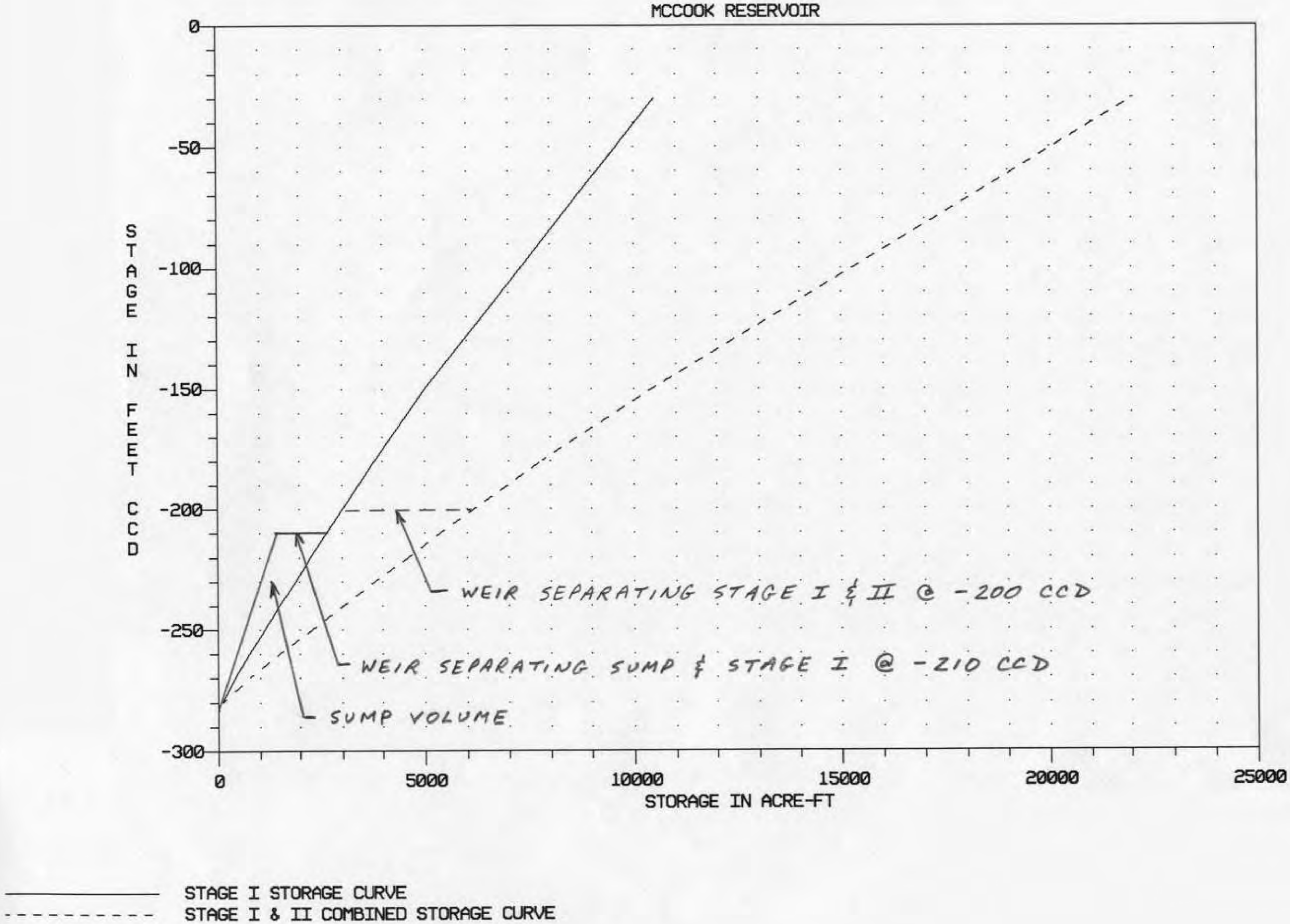
GENERAL RESERVOIR LAYOUT



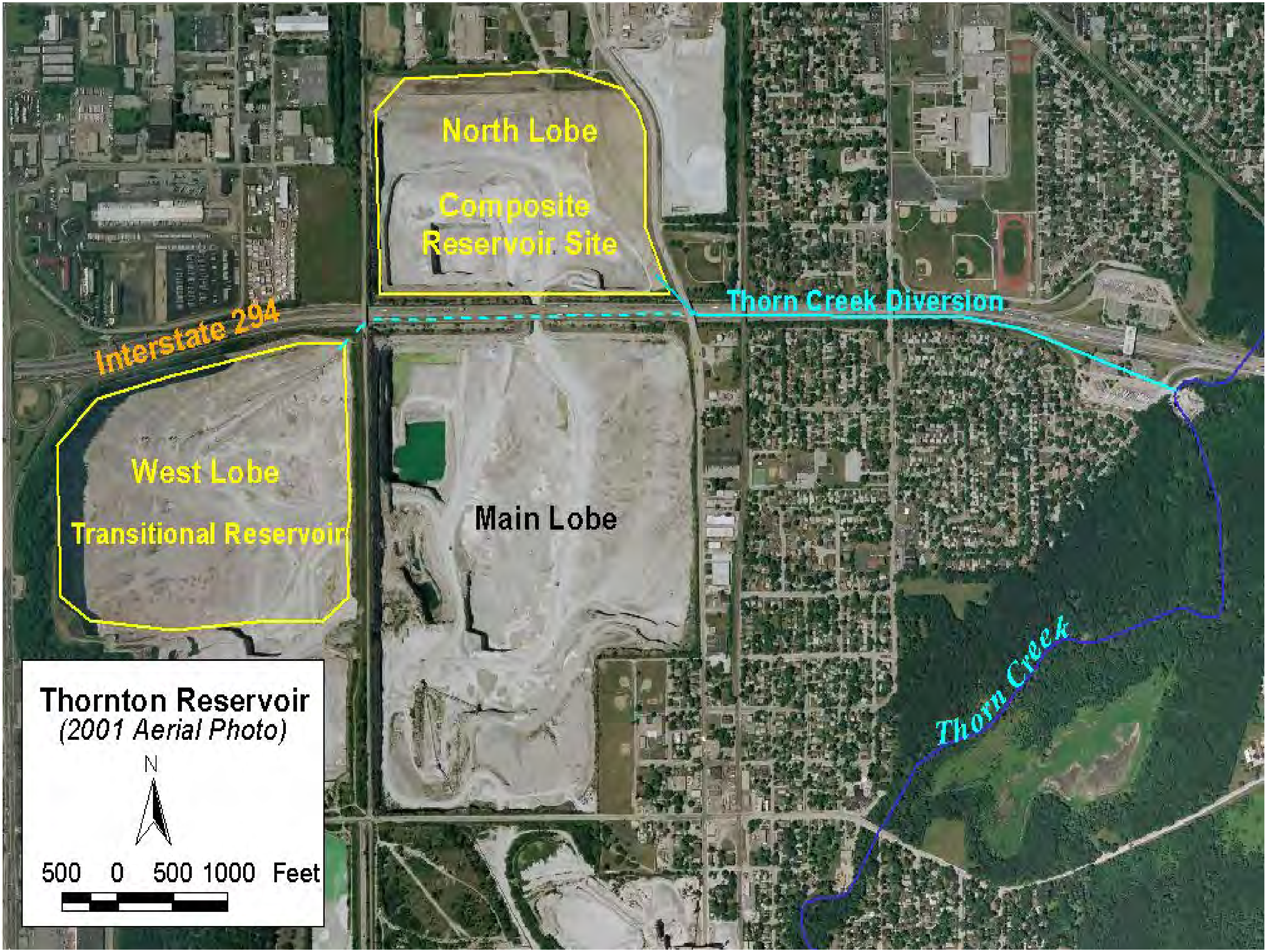
Pumping Station
Des Plaines River
Interstate 55
SUMP
STAGE 1
STAGE 2
Sanitary & Ship Canal
N
McCook Reservoir Site
(2001 Aerial Photo)
0
500
1,000
2,000
Feet

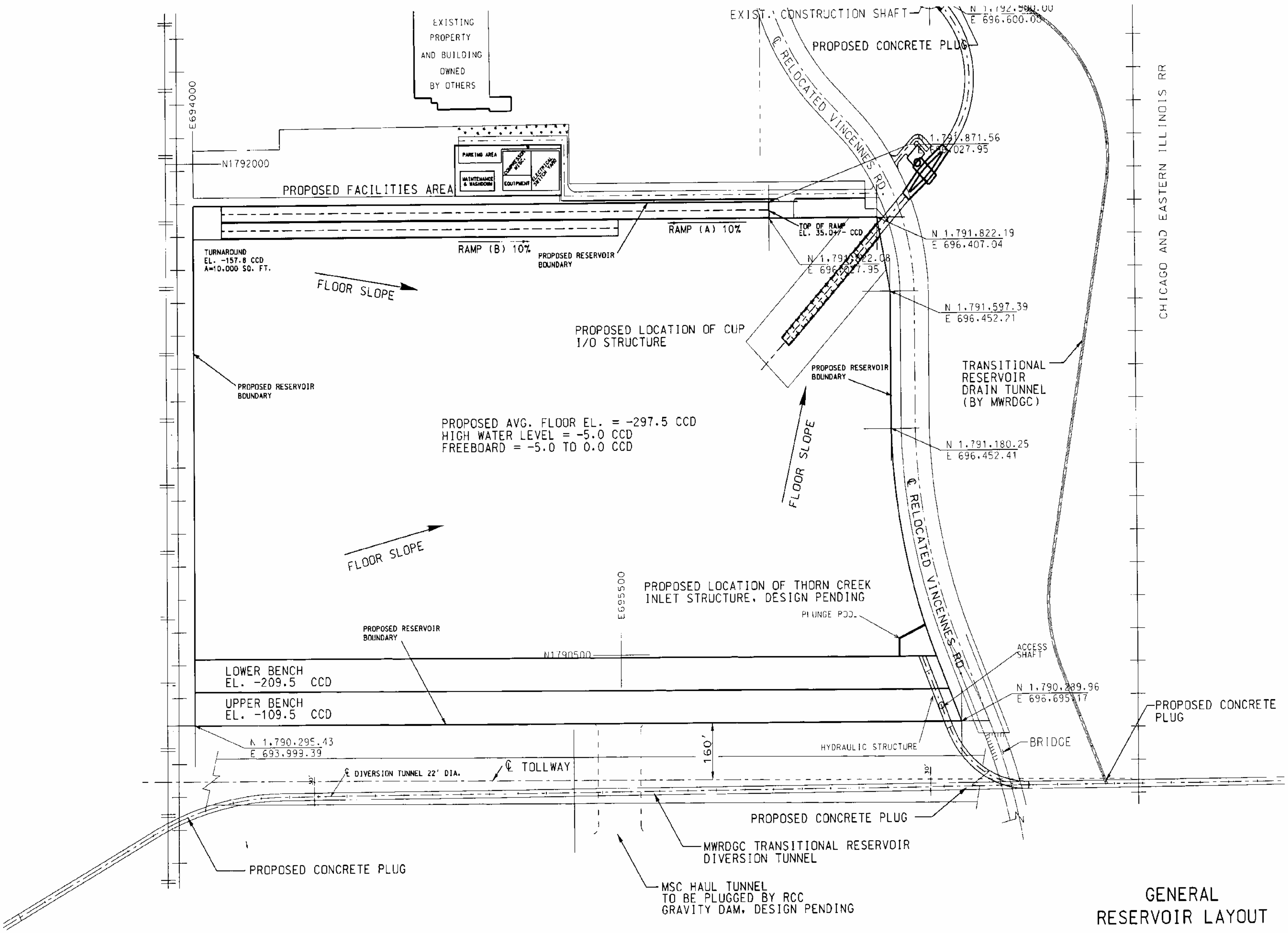
US Army Corps
of Engineers
Chicago District

McCook Reservoir



MCCOOK RESERVOIR
STAGE IN FEET CCD
0
-50
-100
-150
-200
-250
-300
0
5000
10000
15000
20000
25000
STORAGE IN ACRE-FT
WEIR SEPARATING STAGE I & II @ -200 CCD
WEIR SEPARATING SUMP & STAGE I @ -210 CCD
SUMP VOLUME
STAGE I STORAGE CURVE
STAGE I & II COMBINED STORAGE CURVE


North Lobe
Composite
Reservoir Site
Thorn Creek Diversion
Interstate 294
West Lobe
Transitional Reservoir
Main Lobe
Thorn Creek
Thornton Reservoir
(2001 Aerial Photo)
N
500 0 500 1000 Feet



GENERAL RESERVOIR LAYOUT

US Army Corps
of Engineers
Chicago District

THORNTON RESERVOIR

US Army Corps
of Engineers
Chicago District

COMPUTER SIMULATION MODELS

- Hydrologic Simulation Program - Fortran (HSPF)
- Hydraulic Sewer Routing Model, (SCALP) Special Contributing Area Loading Program
- Tunnel Network Model (TNET) for TARP, Tunnel and Reservoir Plan
- UNET Canal Model
- PAR3D Fluid Dynamics and Water Quality Model
- First 4 Models use DSS database

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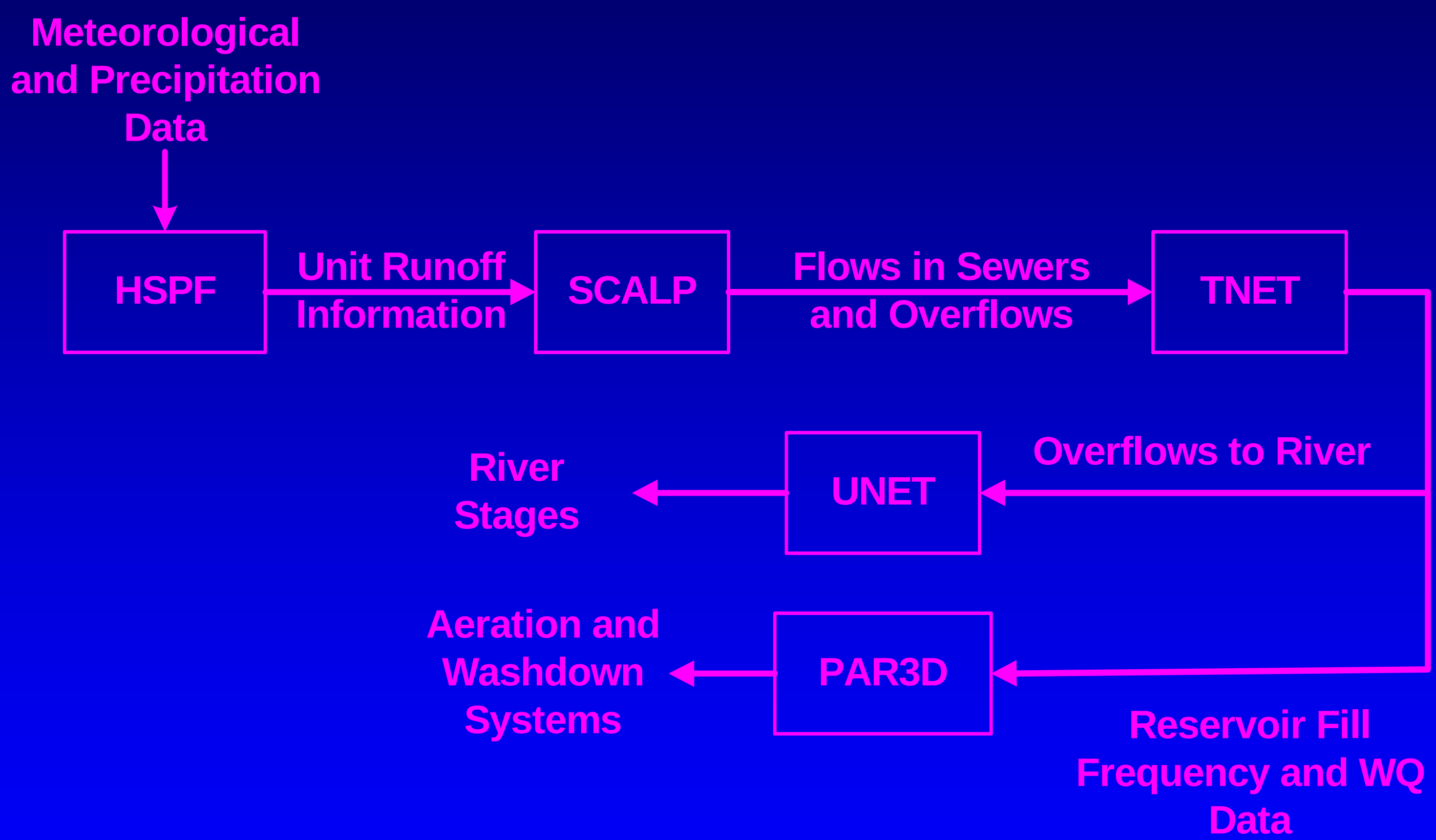
Summary of Models



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HSPF: HYDROLOGIC SIMULATION PROGRAM- FORTRAN

- Continuous simulation of rainfall-runoff process including snow accumulation and melt
- Physically based model representing:
  - interception storage above soil
  - infiltration through soil
  - storage within soil (upper and lower zones)
  - losses to deep aquifer
- 39 parameters define soil, land cover, infiltration rates, etc.

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HSPF RUNOFF COMPONENTS

- Surface Runoff
- Interflow
  - infiltration that moves laterally through soil towards stream
  - function of infiltration rate and soil moisture
- Active Groundwater or baseflow

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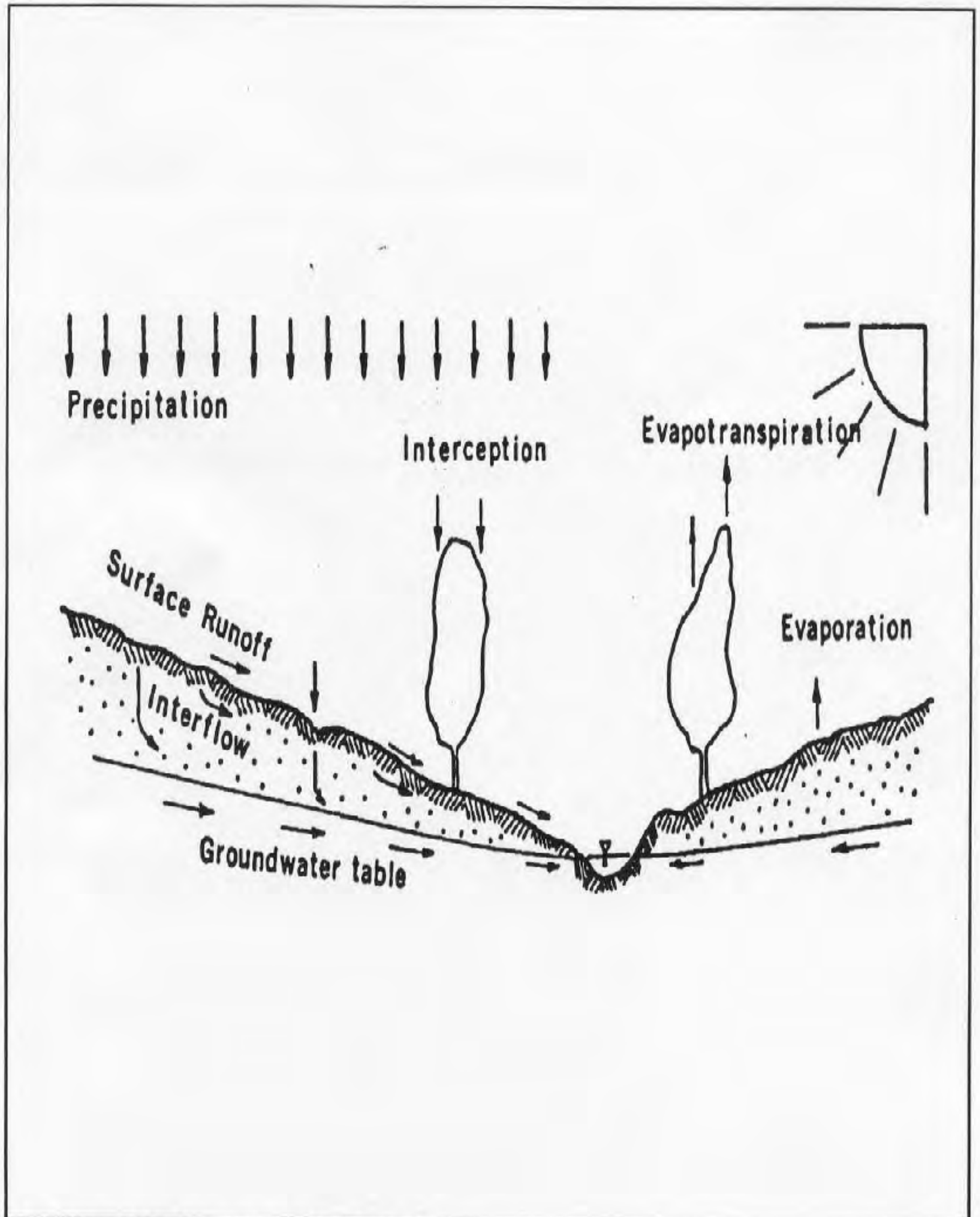

Figure 4.2(1).3-1 Hydrologic cycle

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HSPF WATER STORAGE

- Defines antecedent soil moisture at start of an event
  - interception storage
  - surface storage
  - interflow storage
  - upper zone storage
  - lower zone storage
  - active groundwater storage

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HSPF MODEL

- 13 Precipitation Gages thru WY89, 25 Gages WY90
- Theissen Polygons define 13 and 25 areas
- 3 Land Type Runs — Unit Area Runoff Output (in/hr)
  - Impervious — IMPRO
  - Grassland — OLFRO, SUBRO
  - Forestland — OLFRO, SUBRO

  - IMPRO = impervious runoff
  - OLFRO = pervious surface runoff
  - SUBRO = pervious subsurface runoff
    = interflow + active groundwater

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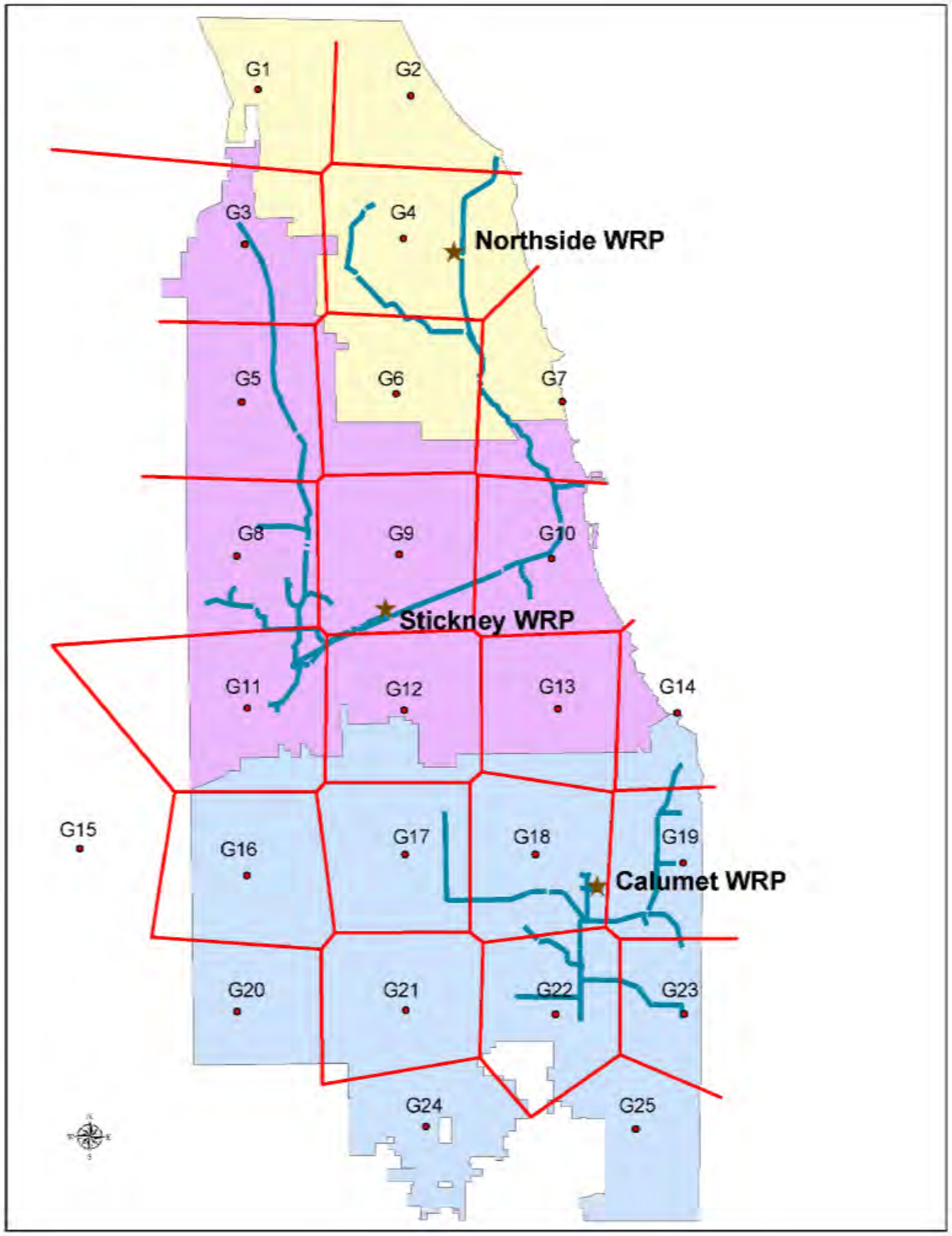

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HSPF MODEL INPUT

- Meteorologic Input
  - Precipitation (13 and 25 gages)
  - Air Temperature (4 gages)
  - Dew Point
  - Wind
  - Cloud Cover
  - Solar Radiation
  - Evapotranspiration

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HYDRAULIC SEWER ROUTING MODEL - (SCALP)

- Input is HSPF runoff output (IMPRO, OLFRO, SUBRO) from Impervious and Grassland runs

- 3 MWRDGC WRP service basins modeled
  - Stickney
  - Northside
  - Calumet

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SCALP MODEL SUBBASINS

- Each MWRDGC service basin subdivided into combined and separate sewer subareas called SCAs (Special Contributing Areas)

	Combined	Separate
• Stickney	100	3
• Northside	33	2
• Calumet	64	8

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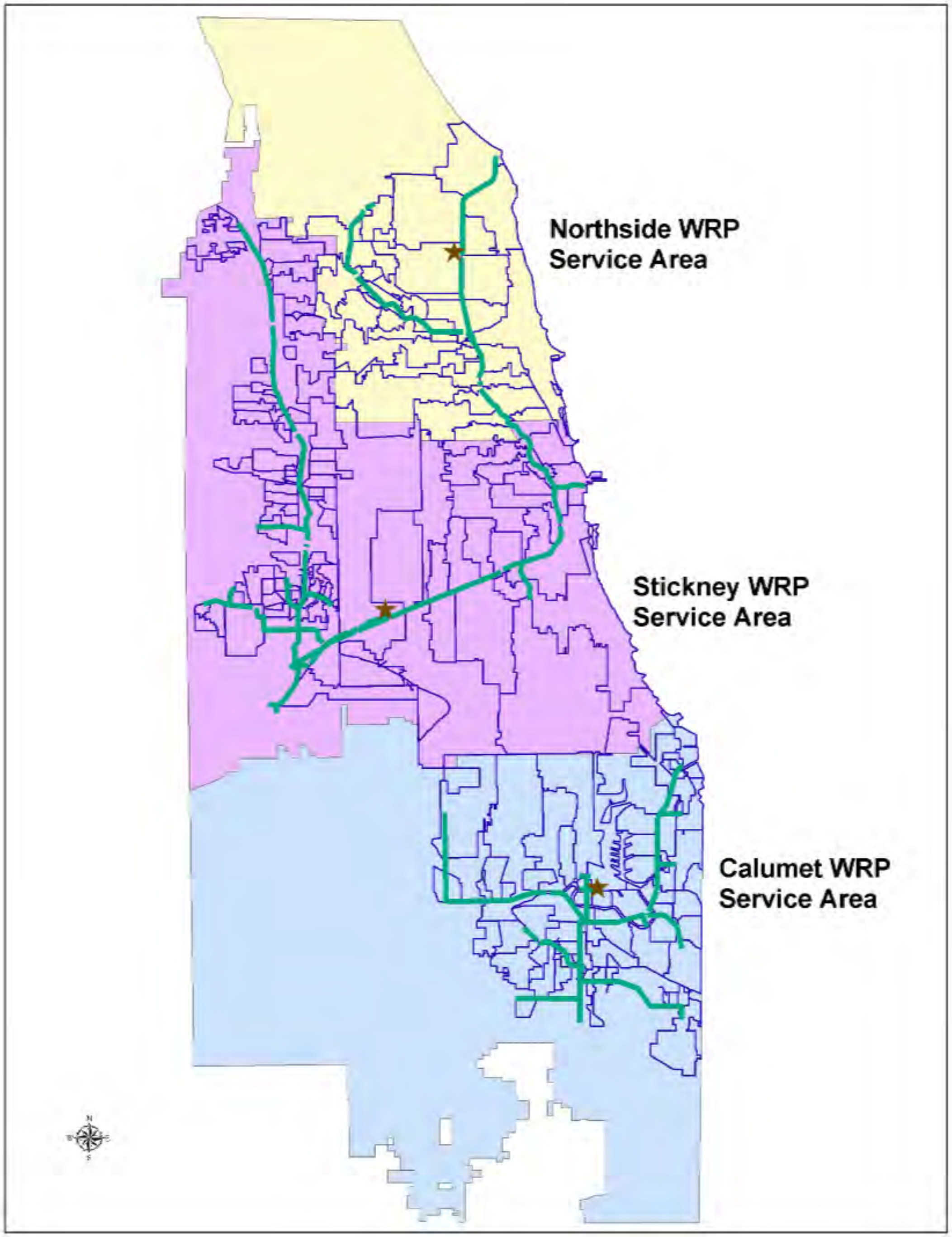

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SCALP MODEL

- Sewer flows based on linear storage routing scheme
  - Lateral sewers
  - Submain sewers
  - Main sewers
- 3 Sources of Sewer Flow
  - Wastewater (Sanitary)
  - Stormwater Surface Runoff (Inflow)
  - Stormwater Subsurface Runoff (Infiltration)

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SCALP AREA DETERMINATION

- Impervious and Grassland Area based on 161 1”=400’ Aerial Photos from 1990
- Photos subdivided into 10 landuse categories each with assumed %’s for impervious, grassland, and forestland

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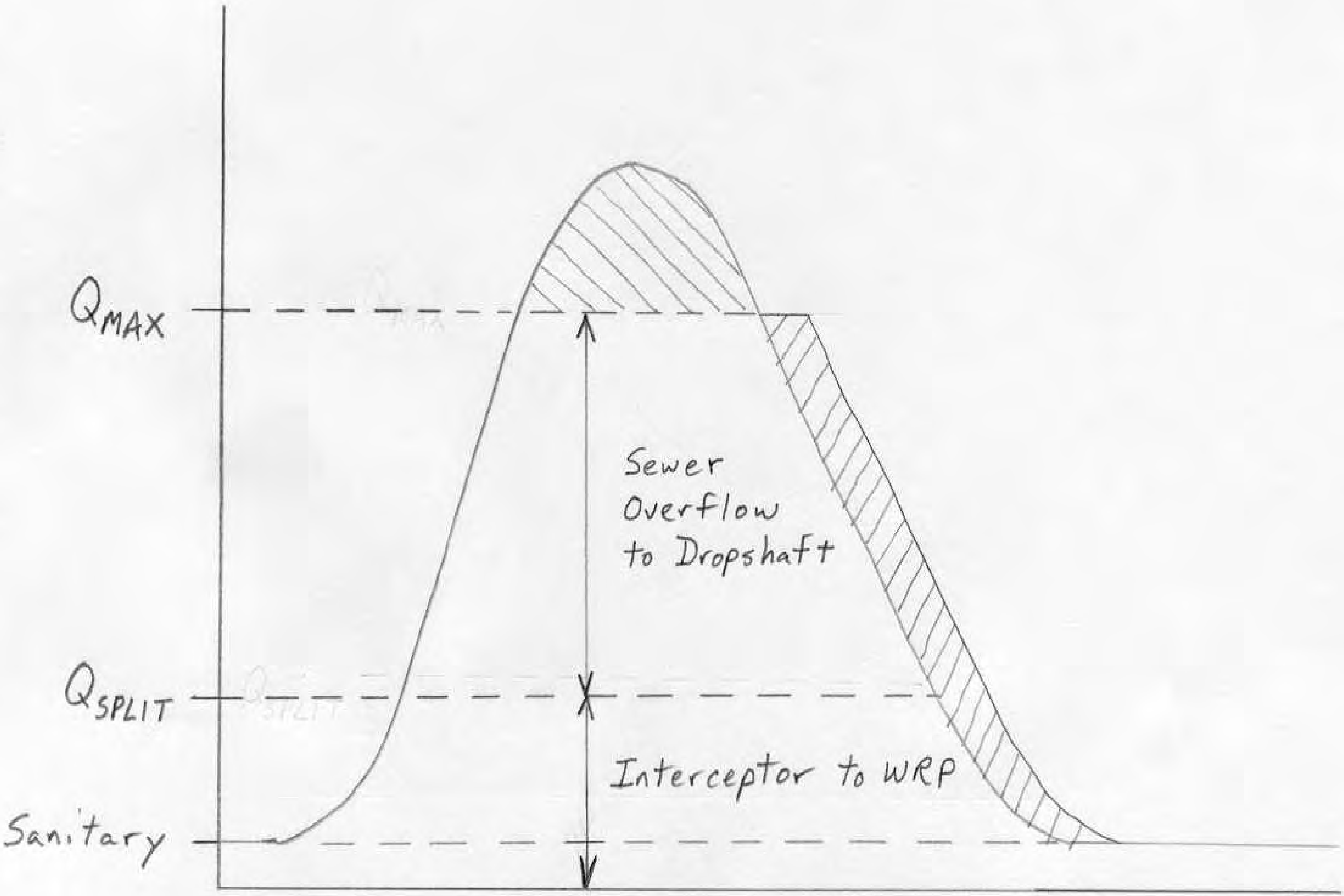
SCALP OVERFLOW SIMULATION

- Based on Q SPLIT
  - Flows in excess of Q SPLIT are overflows
- 8 Flow Outputs for each SCA
  - WRP: Inflow, Infiltration, Sanitary, Total
  - OVF: Inflow, Infiltration, Sanitary, Total
- 8 Water Quality outputs for each SCA
  - WRP: BOD, DO, TSS, Water Temperature
  - OVF: BOD, DO, TSS, Water Temperature
- Modeled interceptor flows calibrated at WRPs
- Total OVFs are routed to TARP (Tunnel and Reservoir) Tunnels as input to TNET model



Q_{MAX}
Sewer Overflow to Dropshaft
Q_{SPLIT}
Interceptor to WRP
Sanitary

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TARP TUNNEL NETWORK MODEL - (TNET)

- Modified version of UNET, the one dimensional unsteady state flow model for open channel flow developed by Dr. Bob Barkau
- TNET solves the unsteady flow equations of continuity and momentum and adds a Priesmann slot for pressurized flow forcing the open channel flow equations to correctly propagate the high celerity of the pressure waves
- Total OVFs including flow and water quality data (SCALP output) from individual SCAs are routed to TARP tunnels through drop shafts
- Model simulates operation of drop shaft gates, main inlet gate, the pumping station, WRP operations, and overflows into the canal system

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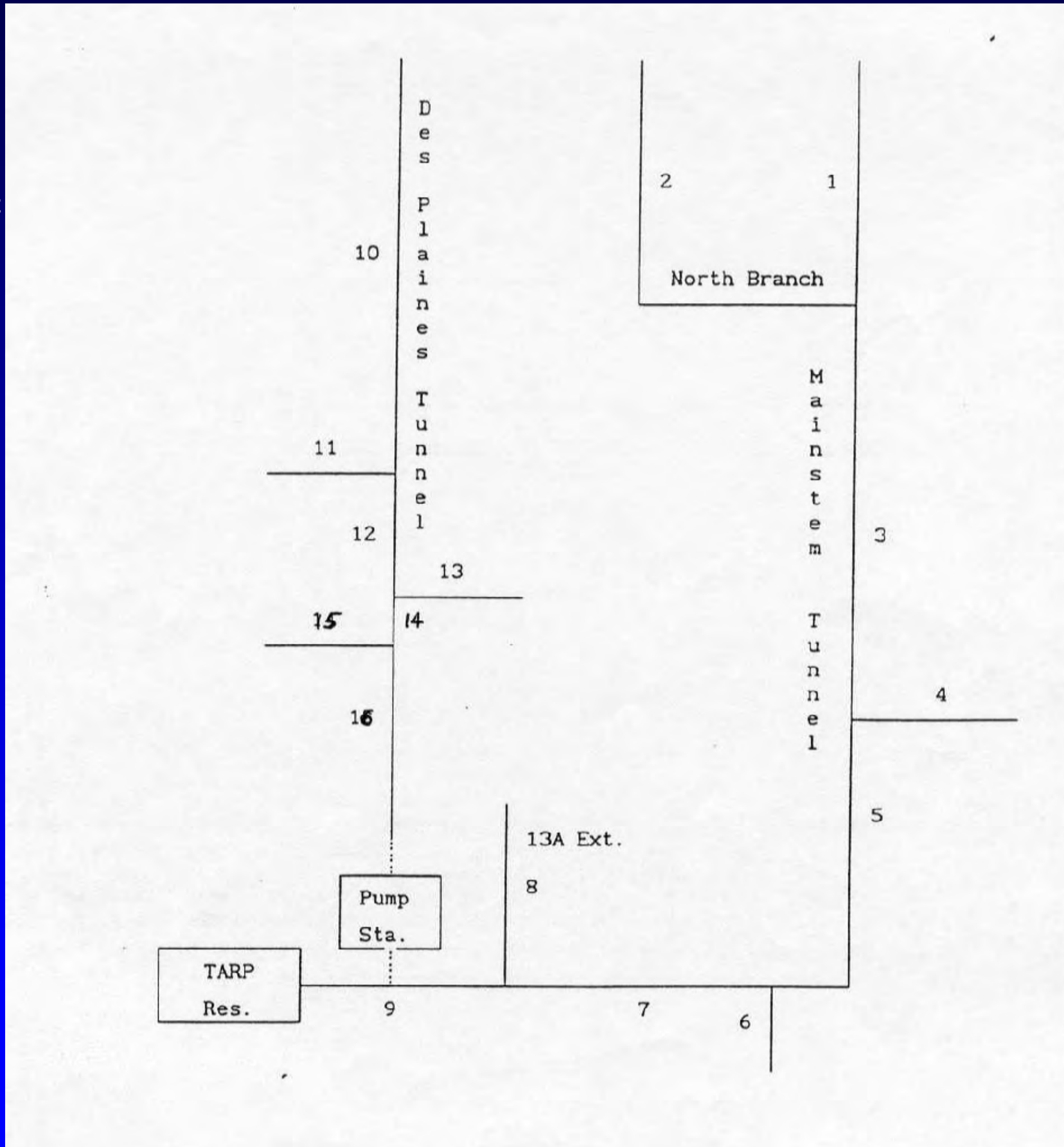

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TNET – DROPSHFTS AND SUBAREAS

- Mainstream/Des Plaines TARP (McCook)
  - 175 dropshafts, 136 subareas
- Calumet TARP (Thornton)
  - 84 dropshafts, 69 subareas

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TNET TARP MODEL

- Flow into the tunnels is controlled by dropshaft gates which are opened or closed based on MWRDGC Operation Plan
- TNET models gate openings and closings based on Index Drop Shaft(s)
- Operation of TARP pumps controlled by:
  - tunnel water surface elevation at pump
  - available treatment plant capacity (based on simulated interceptor flows from SCALP)

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TNET TARP MODEL - MCCOOK

- Dry weather WRP capacity 1900 cfs
- Maximum WRP capacity 2200 cfs sustained during event and until tunnels are pumped dry
- TNET outputs hourly data and stores them in a unique DSS pathname

- overflows to river from each dropshaft or dropshaft grouping
- gravity inflows to reservoir
- pumping from tunnels to reservoir
- pumping from tunnels to WRP
- pumping from reservoir to WRP
- water quality data in the reservoir
    - BOD, DO, TSS, Water Temperature

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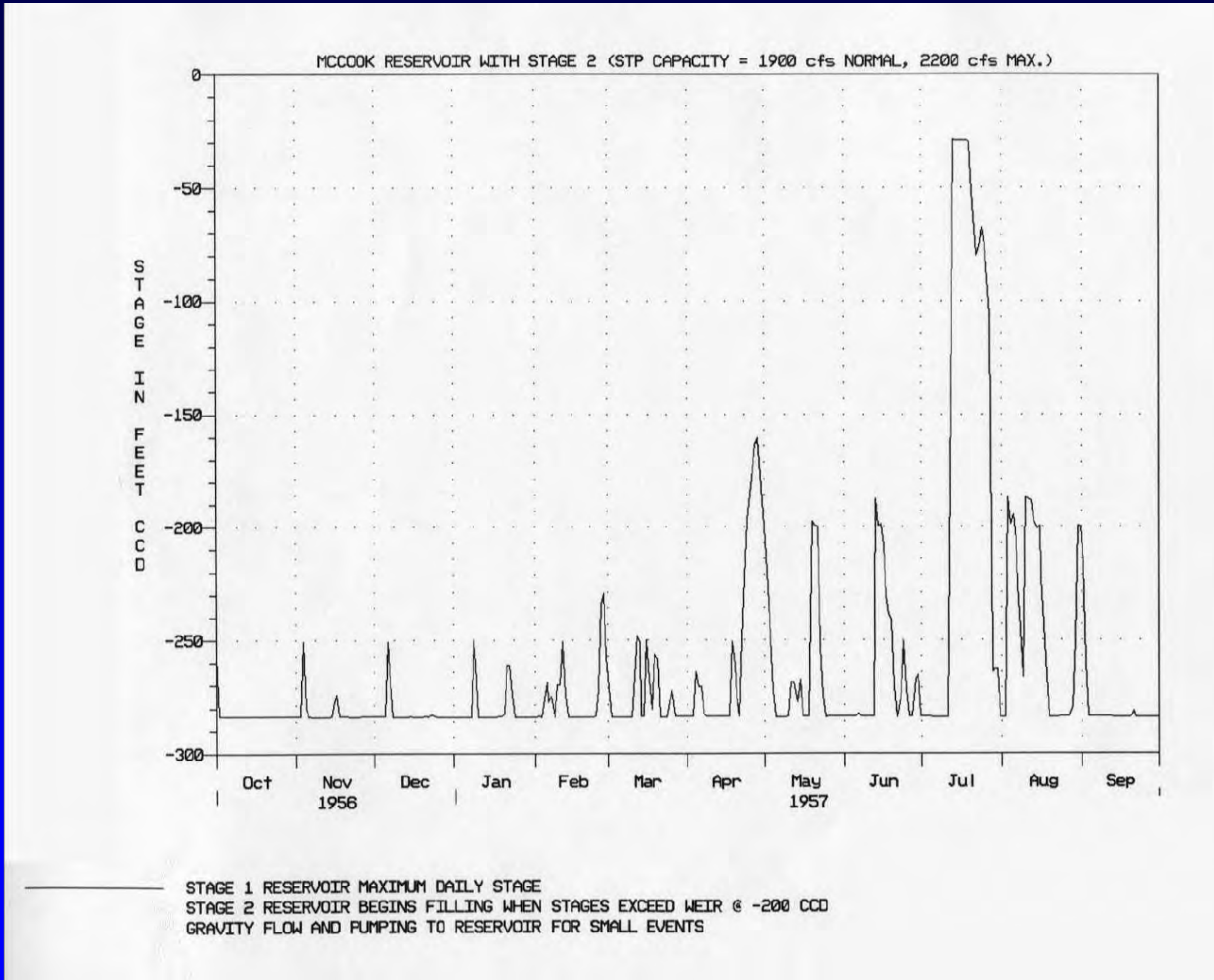
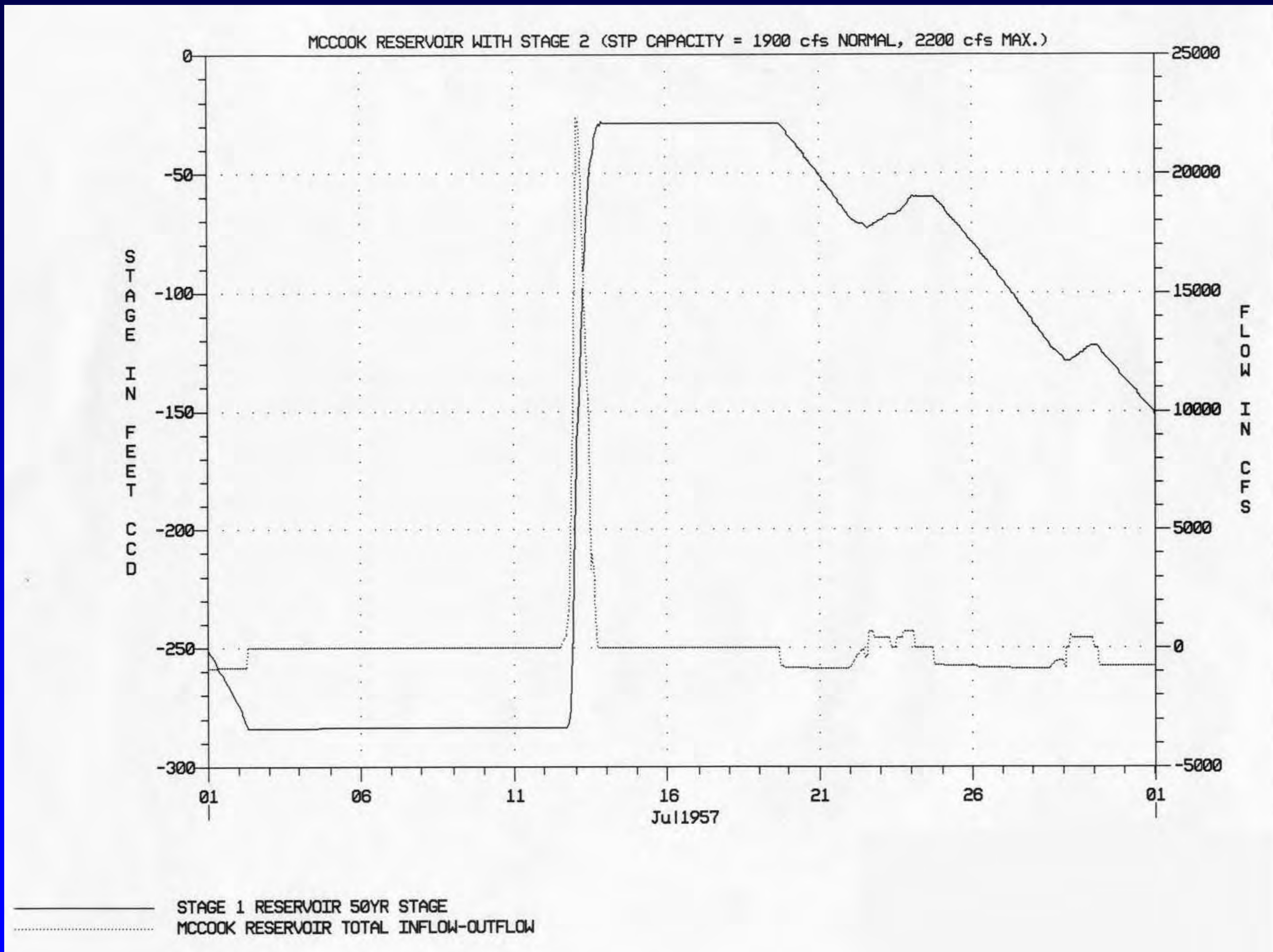
TNET – MODELED EVENTS

- 52 Year Period of Record (1949 – 2000)
- Synthetic Events
  - 1, 2, 5, 10, 20, 50, 100 and 500-Year storms
  - SPFs and PMPs for 1954 and 1957



MCCOOK RESERVOIR WITH STAGE 2 (STP CAPACITY = 1900 cfs NORMAL, 2200 cfs MAX.)
STAGE IN FEET CCD
0
-50
-100
-150
-200
-250
-300
Oct
Nov
1956
Dec
Jan
Feb
Mar
Apr
May
1957
Jun
Jul
Aug
Sep
STAGE 1 RESERVOIR MAXIMUM DAILY STAGE
STAGE 2 RESERVOIR BEGINS FILLING WHEN STAGES EXCEED WEIR @ -200 CCD
GRAVITY FLOW AND PUMPING TO RESERVOIR FOR SMALL EVENTS


MCCOOK RESERVOIR WITH STAGE 2 (STP CAPACITY = 1900 cfs NORMAL, 2200 cfs MAX.)
STAGE IN FEET CCD
FLOW IN CFS
0
-50
-100
-150
-200
-250
-300
25000
20000
15000
10000
5000
0
-5000
01
06
11
16
21
26
01
Jul1957
STAGE 1 RESERVOIR 50YR STAGE
MCCOOK RESERVOIR TOTAL INFLOW-OUTFLOW

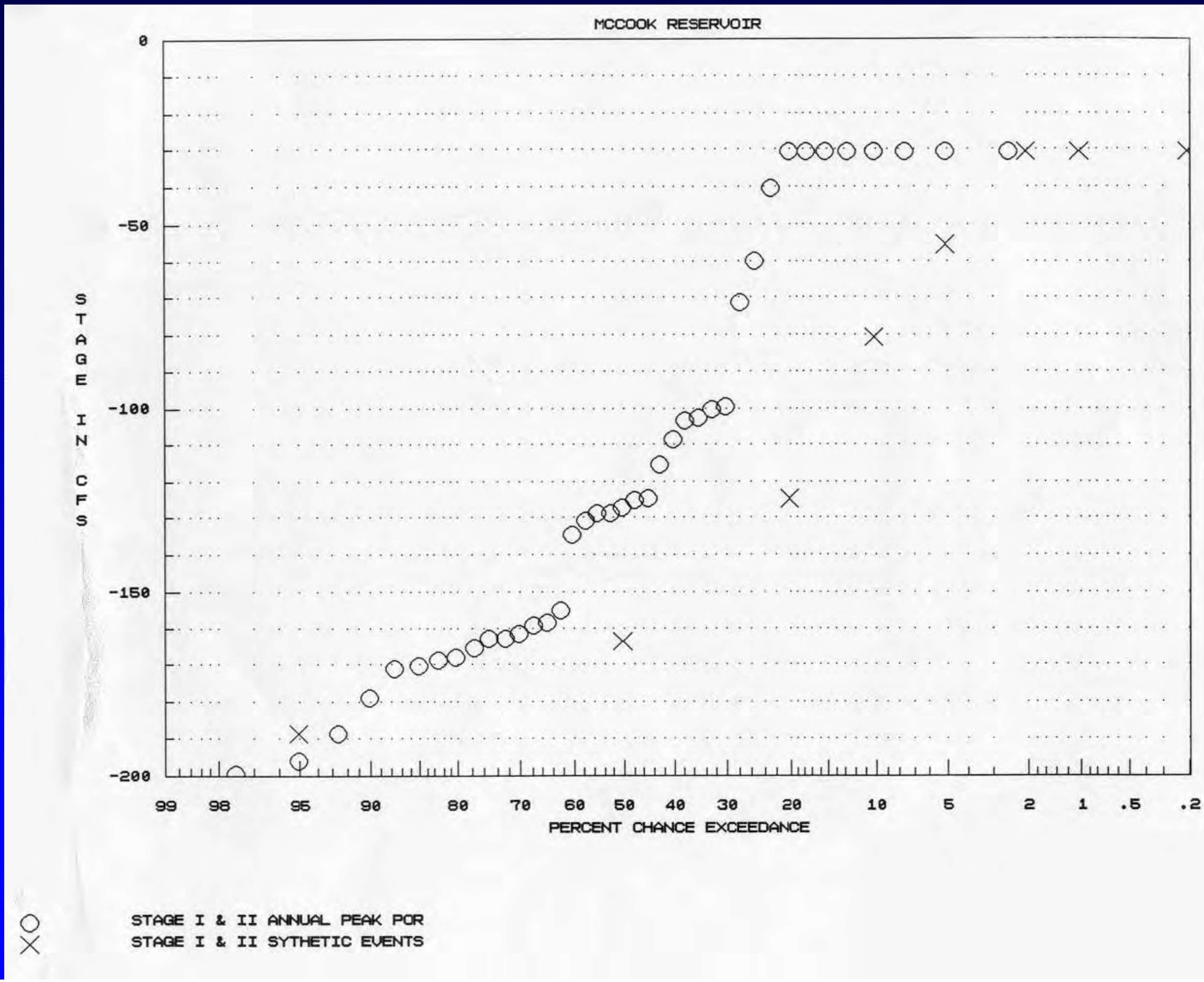

MCCOOK RESERVOIR
0
-50
-100
-150
-200
STAGE IN CFS
99
98
95
90
80
70
60
50
40
30
20
10
5
2
1
.5
.2
PERCENT CHANCE EXCEEDANCE
STAGE I & II ANNUAL PEAK POR
STAGE I & II SYTHETIC EVENTS

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Table A-7
Summary of CUP McCook
Period of Record Stages
Stage I Reservoir

Target Elevation Exceeded (ft. CCD)	Number of Specific Events	Maximum Event Duration (days)	Average Event Duration (days)	Total Days Exceeded (days)	Percent of Time Exceeded (%)
-30	10	13	8.1	81	0.6
-40	11	13	8.1	89	0.6
-60	13	24	10.3	134	0.9
-80	14	25	12.1	170	1.2
-100	17	34	12.0	204	1.4
-120	28	48	10.2	286	2.0
-140	42	49	9.4	395	2.7
-150	47	51	10.0	468	3.2
-160	52	51	10.2	532	3.6
-180	94	52	8.1	765	5.2
-200	259	53	5.4	1403	9.6
-220	308	60	5.8	1784	12.2
-240	361	66	6.1	2208	15.1
-260	491	67	5.7	2807	19.2
-280	803	74	5.0	4048	27.7
-283	869	74	4.9	4290	29.4
			Stage II Reservoir		
-200	112	53	8.8	986	6.7
-220	138	60	8.7	1204	8.2
-240	153	66	9.4	1440	9.9
-260	191	67	9.4	1791	12.3
-270	213	67	9.5	2013	13.8
-275	222	68	9.8	2185	15.0

Note: The period of record spans 40 years, from 01JAN1949 to 31DEC1988.
The stage-storage curve used for this analysis was developed in July 1998. Any later revisions are not reflected.
The Stage I reservoir target elevation extends to only -283 and The Stage II reservoir target elevation extends to only -275 Because the model leaves some water near the reservoir floor for computational stability.
The Stage I and Stage II reservoirs will respond the same above elevation -200 CCD.

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UNET CANAL MODEL

- Simulates the operation of the canal system including operations at Lockport (including drawdowns) as well as backflows to Lake Michigan
- Input is TNET TARP model overflow output
- Input also includes stream gage records (recorded for POR, simulated for synthetic events), and simulated ungaged area inflows
- Calibrated at Lockport

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PAR3D MODEL

- PAR3D – computational fluid dynamics model used to model fluid dynamic and water quality related processes for the water in the reservoir.
- Developed by Dr. Bob Bernard of the Coastal and Hydraulics Laboratory at WES, the Corps of Engineers Waterways Experiment Station
- Processes modeled include: gas transfer from the water surface and from bubbles, biochemical oxygen demand, sediment oxygen demand, and sedimentation.

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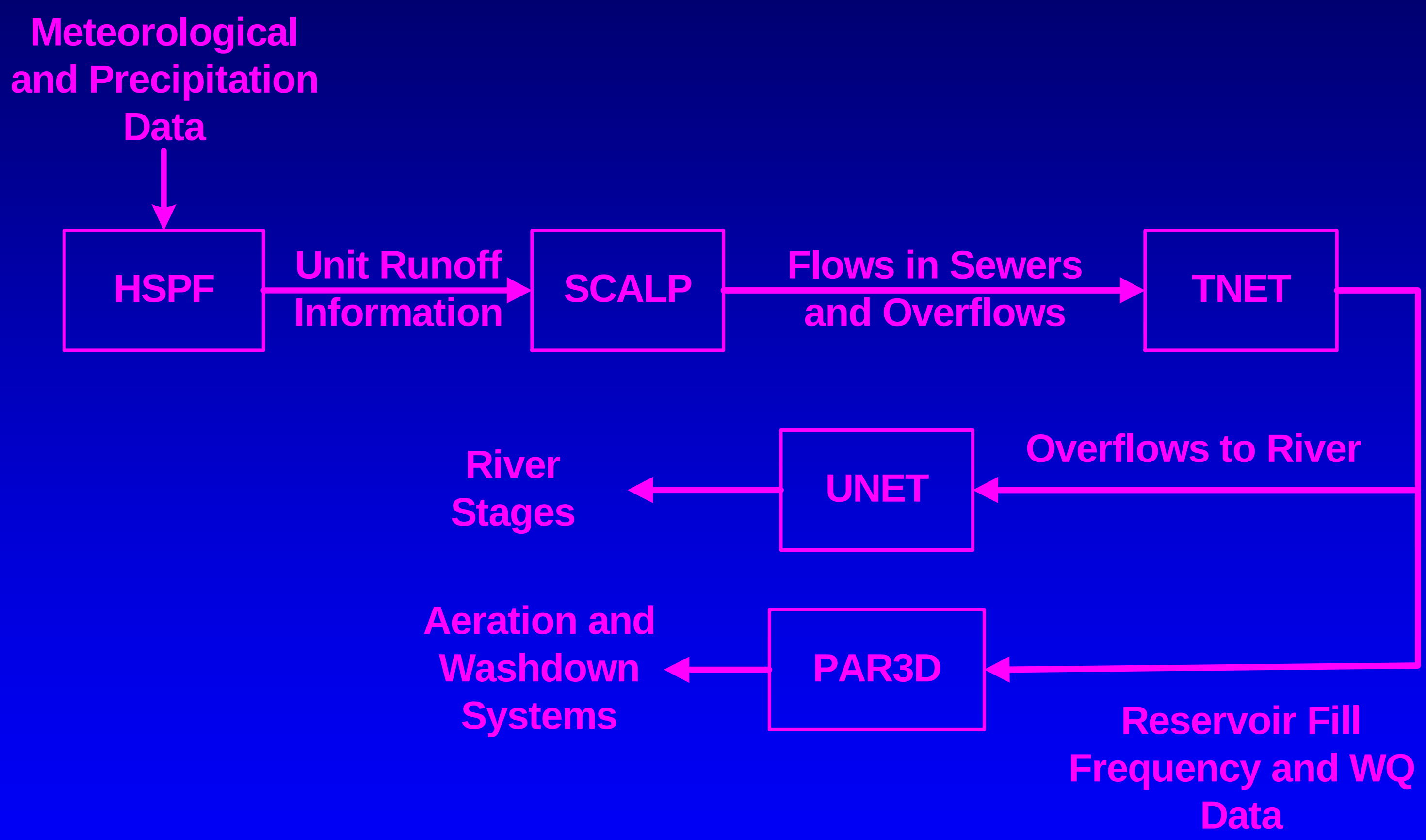
Summary of Models



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WES PHYSICAL MODELS

- Main Tunnel inlet gates, inlet tunnels, sump, weir structure, stage 1 reservoir floor (1:40)

- Distribution Chamber (1:12)
  - gravity inflow gates and conduits for Des Plaines tunnel gravity inflow

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WES PHYSICAL MODELS

- Main Tunnel inlet gates, inlet manifold, sump, weir structure, stage 1 reservoir floor
  - 1:40 model to determine:
    - Velocities on the sump and stage 1 reservoir floor for aeration design and rock protection plan
    - Stepped weir loadings and adequacy of design for energy dissipation
    - Pressures in the gate chamber, inflow conduits, and inlet manifold
    - Adequacy of inlet conduit and manifold wrt flow conditions, air entrainment, air/water surging through vents

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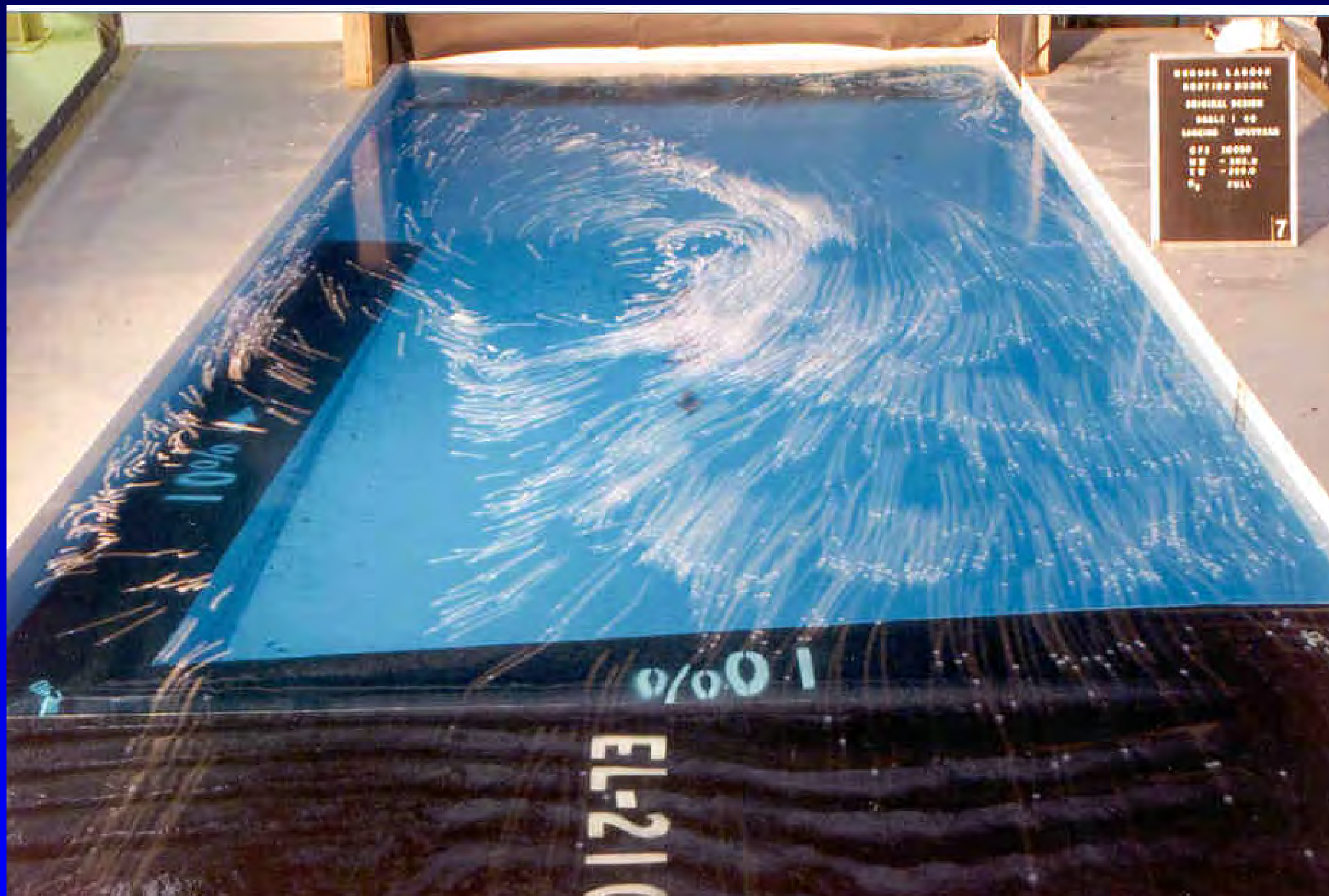

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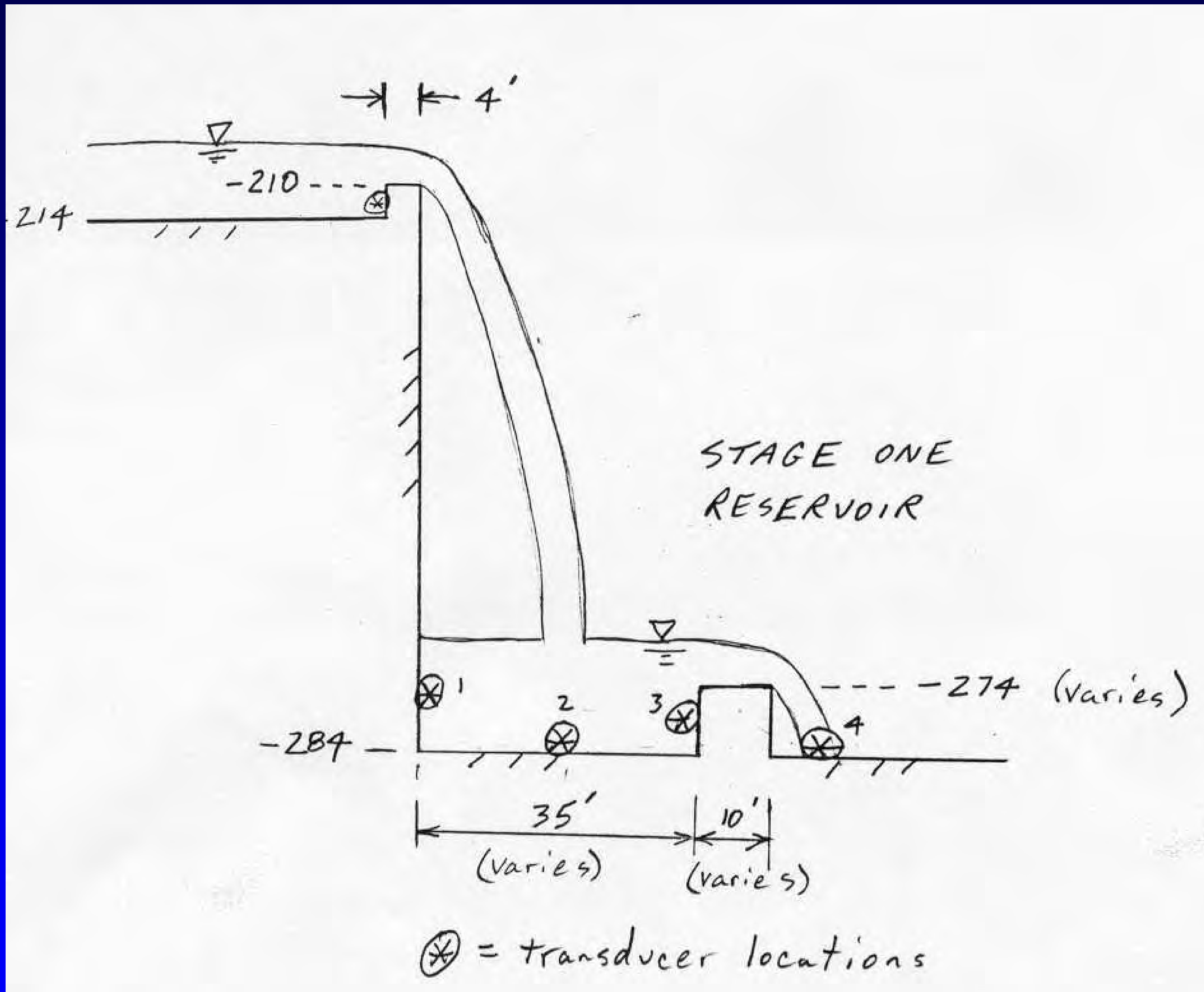

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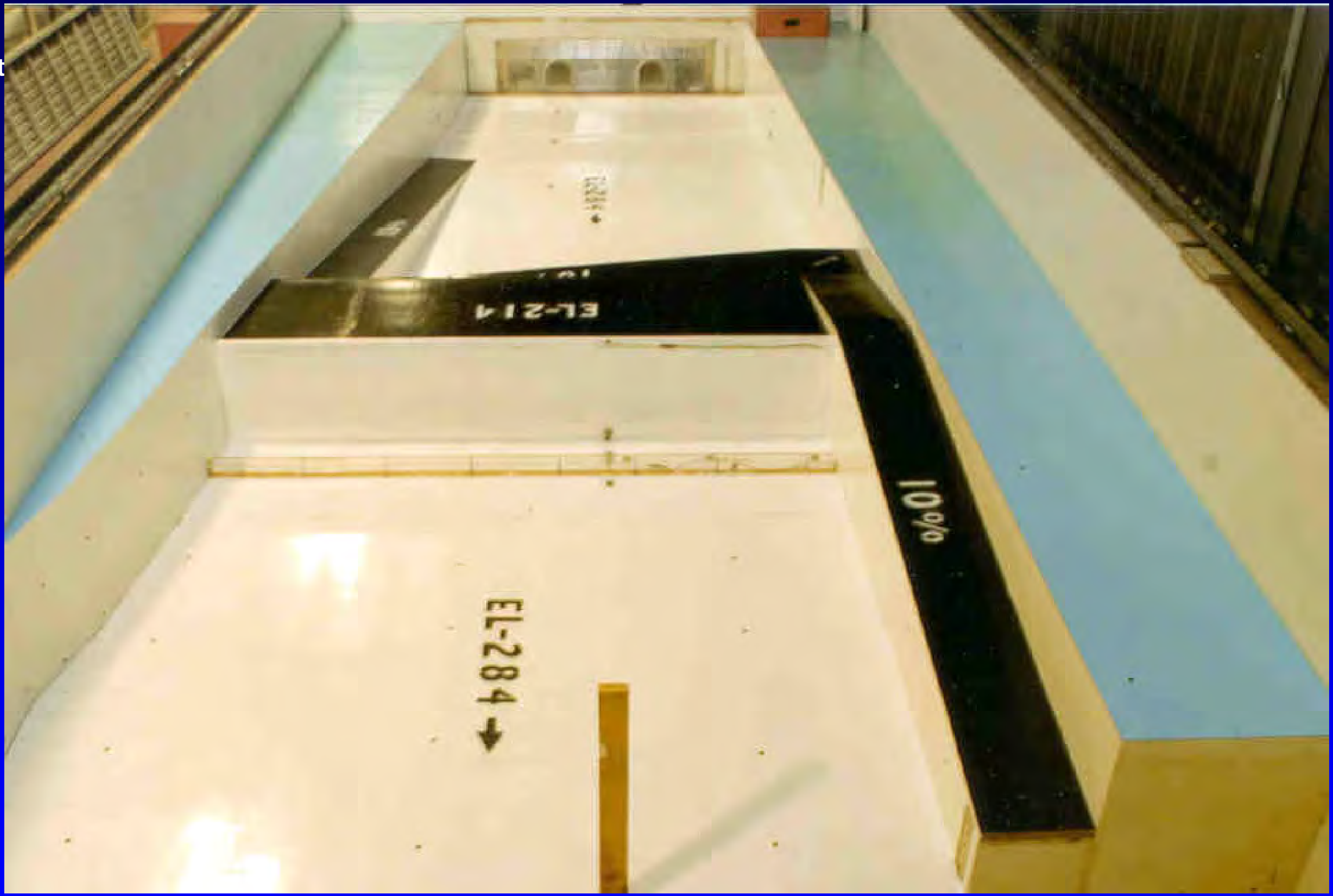

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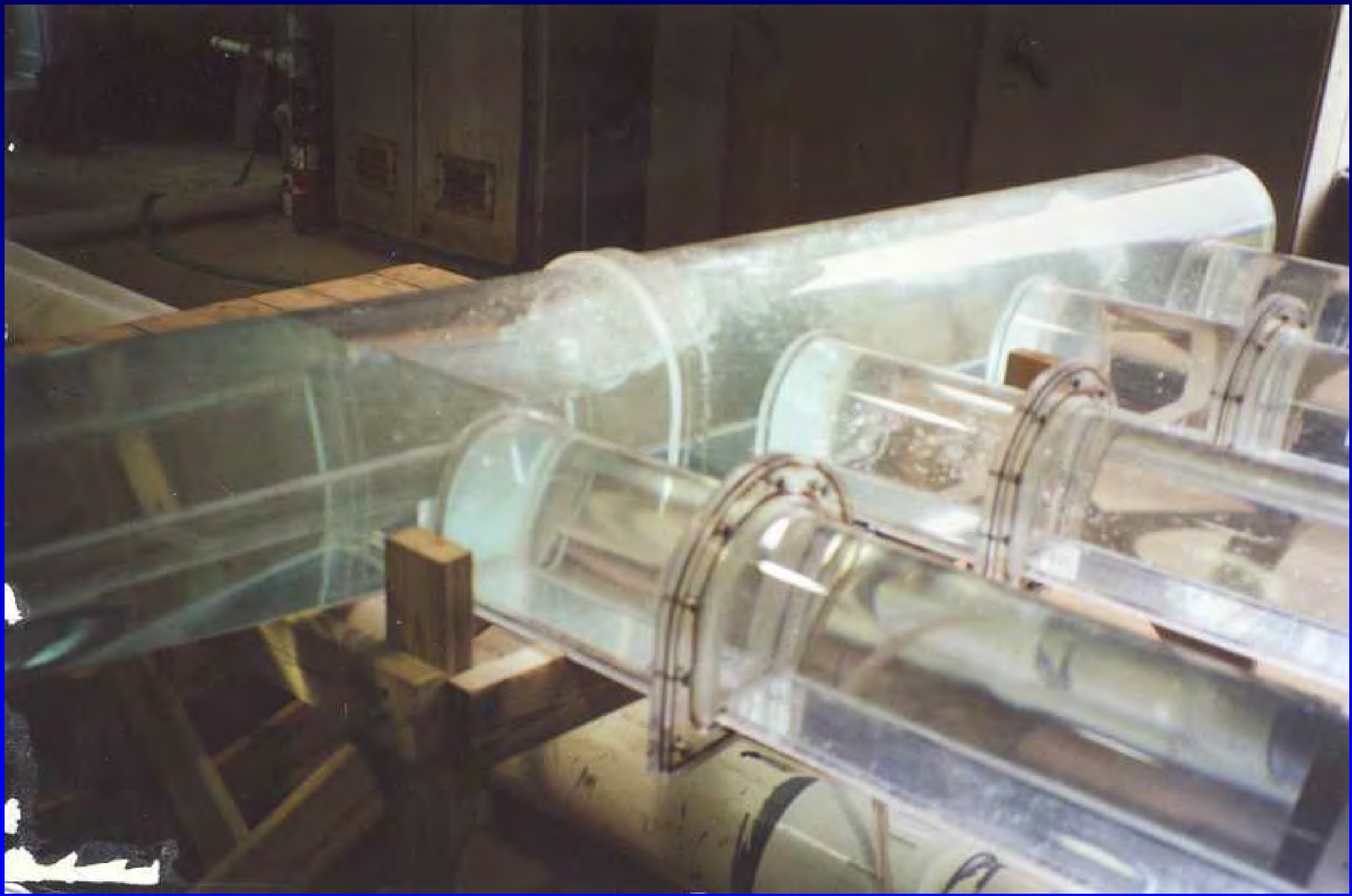

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WES PHYSICAL MODELS

- Distribution Chamber (gravity inflow gates and conduits for Des Plaines tunnel gravity inflow)
  - 1:12 model to determine:
    - Operational constraints on the bonneted slide gates wrt headwater and tailwater conditions and gate closure speeds
    - Gate loadings and pressures within the conduits
    - Cavitation potential
    - Information on the transient hydraulics in the vicinity of the bifurcations
    - Recommendations for geometric and or material changes

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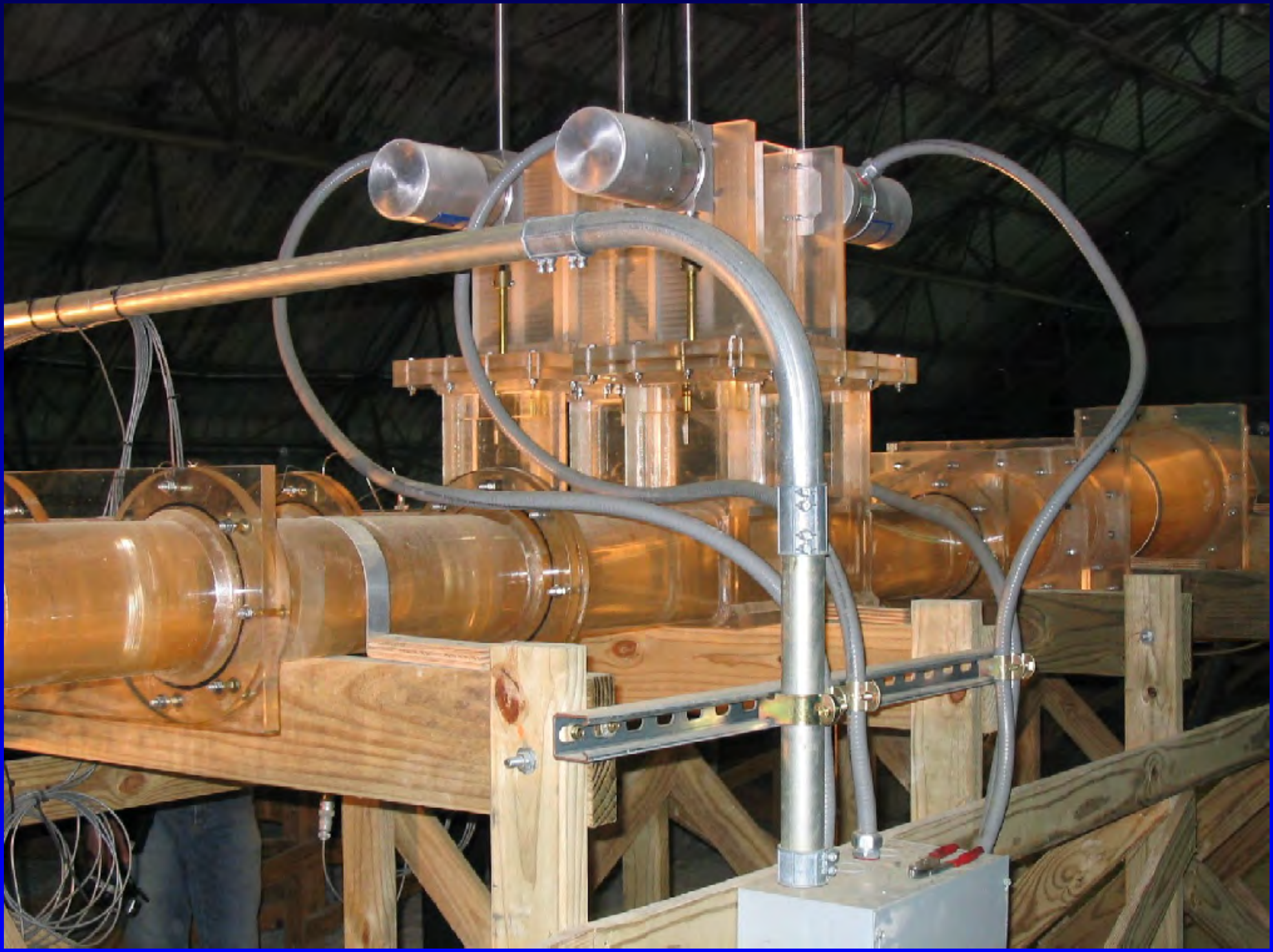

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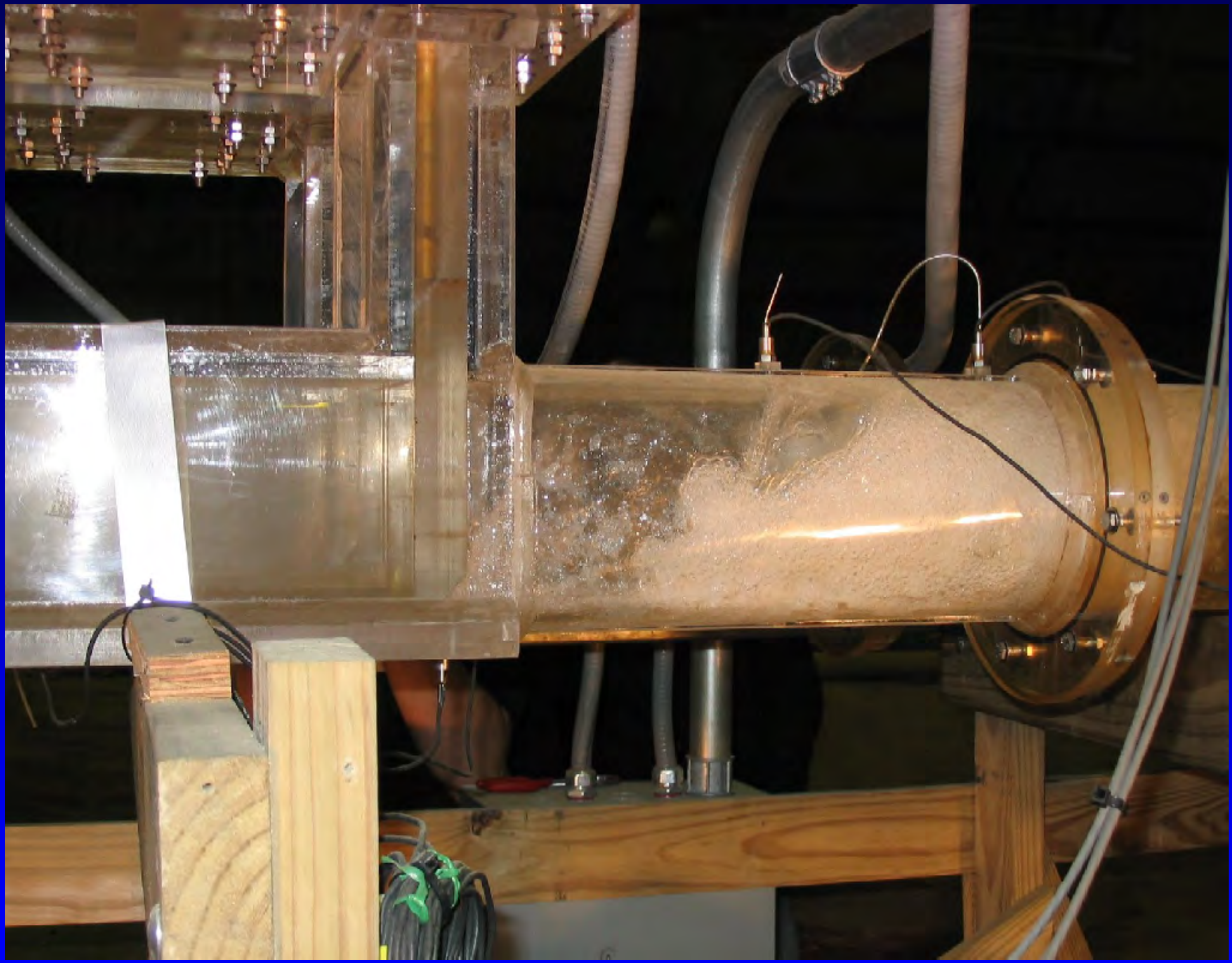

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ADDITIONAL MODELS

- MXTRANS Hydraulic Transient Model
  - University of Minnesota, St. Anthony Falls Hydraulic Laboratory
  - Applies to steady and unsteady flows including pressurized flows, free-surface flows and mixed flows
  - Based on explicit characteristic method
  - Interface between pressurized flow and free-surface flow (shock surface) is computed with the shock fitting method
  - Primarily used to determine
    - operational procedures for minimizing geysering through dropshafts
    - hydraulic loading on main gate
    - effect of main gate operation on hydraulic transients

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ADDITIONAL MODELS

- WHAMO (water hammer and mass oscillation) Hydraulic Transient Model
  - Corps of Engineers (HDC) and Camp Dresser and McKee
  - Applies to steady and unsteady fully pressurized closed conduit flows of various complexities and boundary conditions
  - Based on implicit finite difference method
  - Used to determine loadings on the distribution tunnels small gates and valves as well as surge effects resulting from various operations and mis-operations of the system (including power failures)
  - Operations investigated include pumping from tunnels to reservoir, pumping from tunnels to WRP, pumping from reservoir to WRP, and gravity inflows from Des Plaines tunnel

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QUESTIONS?

East Grand Forks, MN Grand Forks, ND Local Flood Damage Reduction Project

Presentation for the

2005 Infrastructure Conference
HH&C CoP Sessions

by
Michael Lesher
Hydraulic Engineer

4 August 2005

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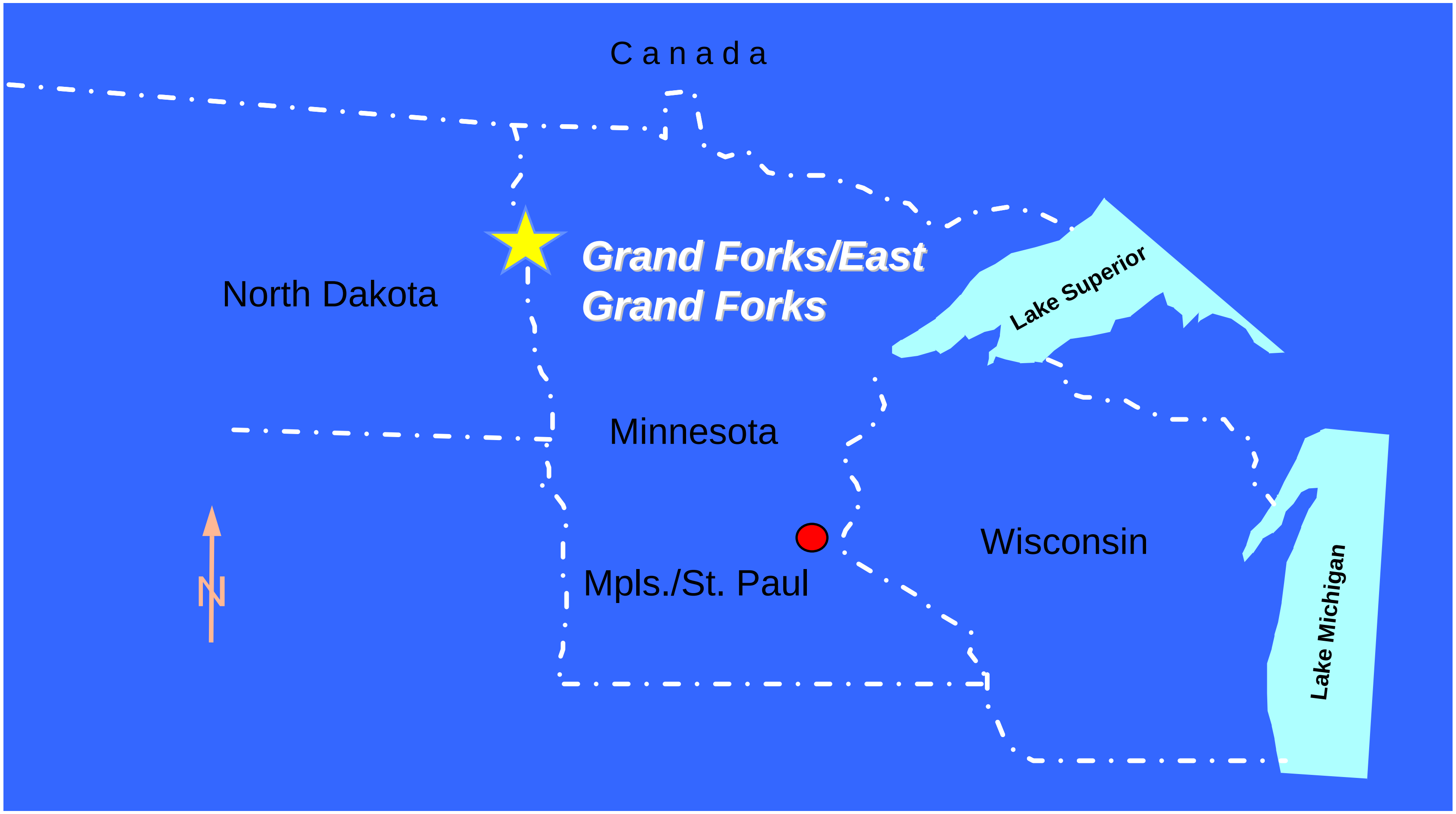
Mississippi Valley Division
Mississippi River Commission

Presentation Summary

- ✓ Project Location & Background
- ✓ Top-of-Levee Design
- ✓ Superiority Profile Complications
- ✓ Interior Flood Control Analysis
- ✓ Pump, Control & Generator Supply Contracts
- ✓ 15 Construction Contracts
- ✓ East Grand Forks "Removable" Floodwall
- ✓ Stepped Dam converted to Rock Rapids
- ✓ RR Closure Sill Installation
- ✓ Construction Using GPS
- ✓ Ice Bridge used to haul Borrow
- ✓ Design Team & Construction Office Issues

Project Location



Project Background

- ✓ Both Cities have Long History of Significant Flooding
- ✓ Most Damaging was in April 1997 when Temporary Levees & Heroic Flood Fighting were not Successful
- ✓ General Reevaluation Report completed in Dec. 1998
- ✓ Plan consists of Levees, Floodwalls, Two Diversion Channels and Interior Flood Control Facilities
- ✓ Current Working Estimate is $410 Million
- ✓ Pre-Certification Package Submitted to FEMA in May 2005
- ✓ Substantially Complete in Dec. 2006 & Certified in Spring of 2007

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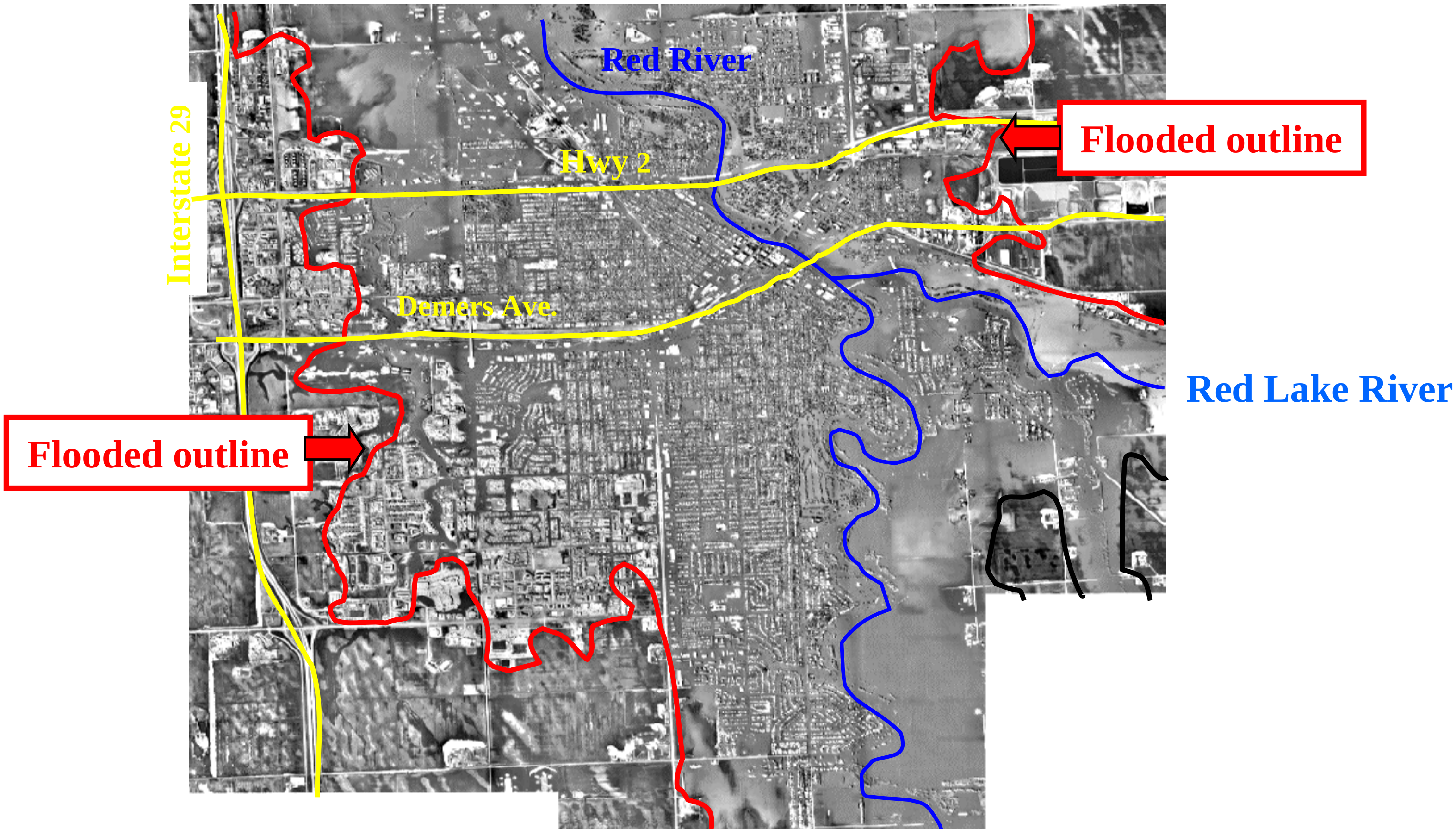
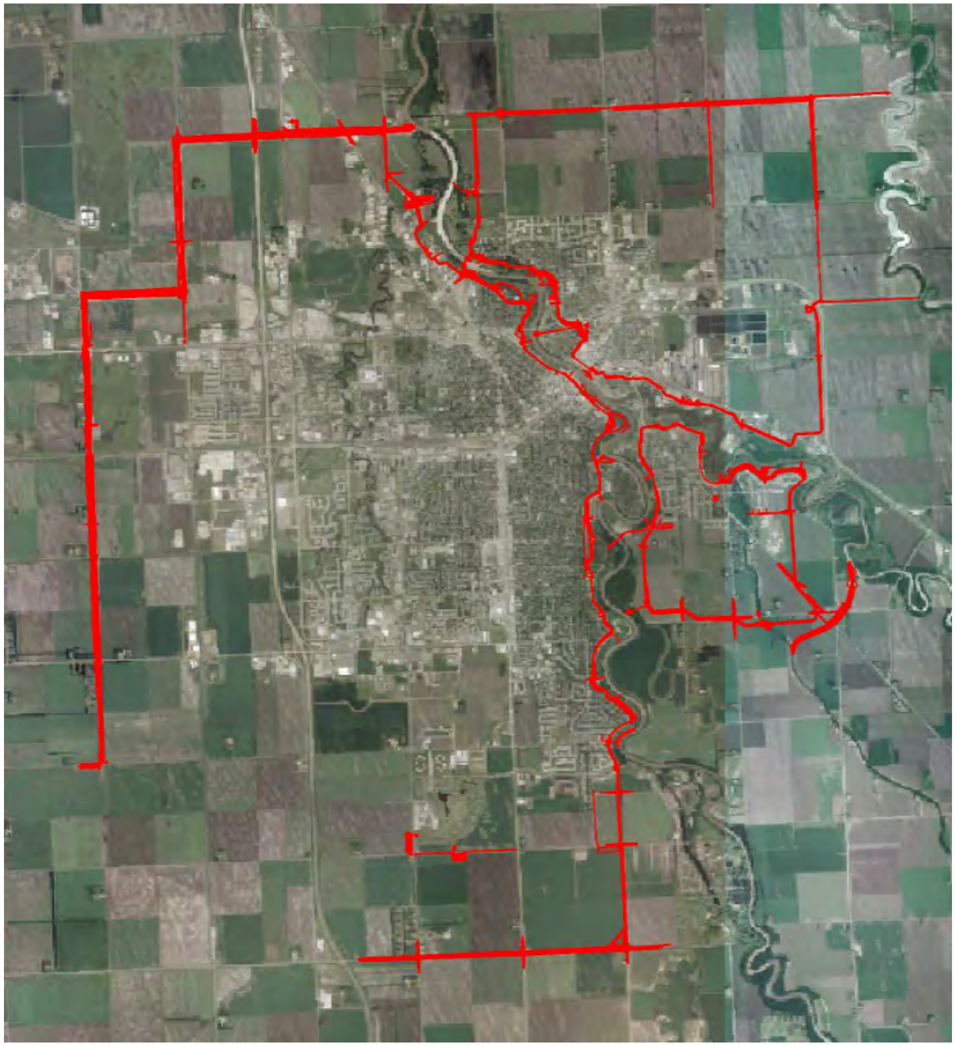
East Grand Forks & Grand Forks Flood of 1997

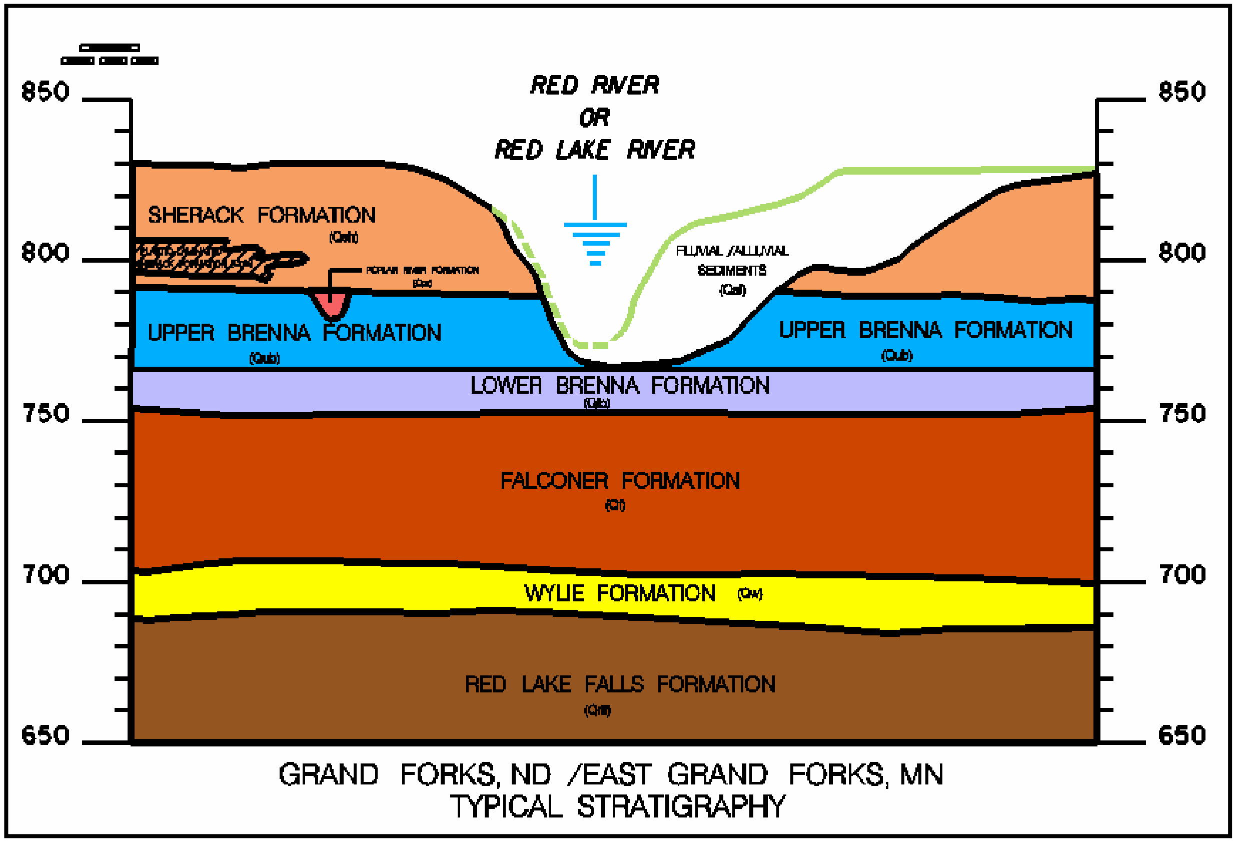


Project Overview



Top-of-Levee Design

Iterative Process based on Hydraulic Analysis & Geotechnical Slope Stability Analysis



Levee Overbuild for Settlement

Settlement Range:

- ✓ **Minimum of 6 inches for a 5’ to 10’ high levee**
- ✓ **Maximum of 60 inches for a 35’ high levee**

Superiority Profile for Overtopping at the Least Critical Location was Complicated by the Settlement Overbuild

Gravity Outlet Profiles were Adjusted to Accommodate the Settlement

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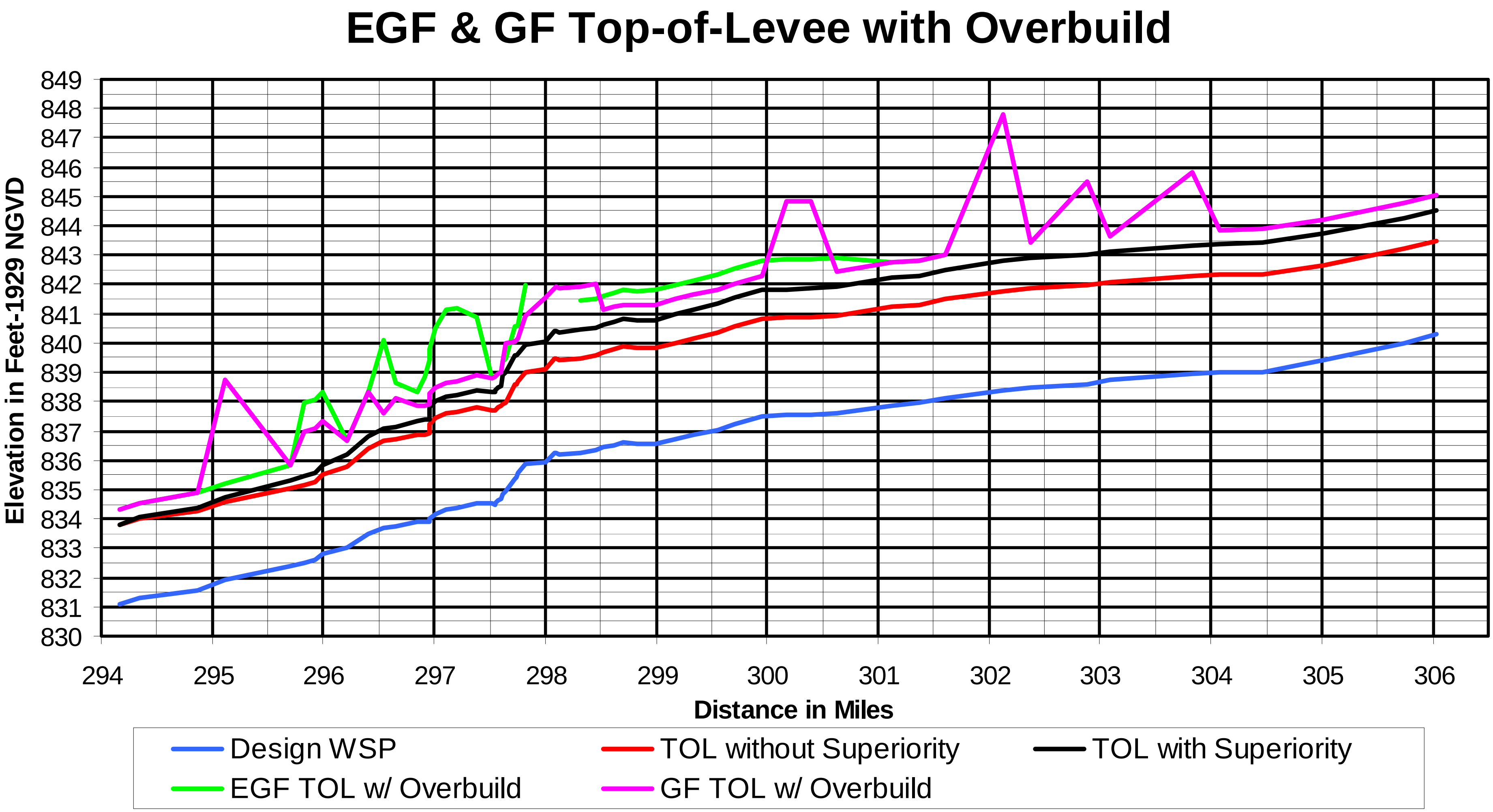
Top-of-Levee with Overbuild



Interior Flood Control Analysis

Gravity Outlets:

- ✓ Economic Optimization Analysis performed for Several Outlets
- ✓ Results were Inconclusive
- ✓ Outlets were Sized for the 4% (25-Year) Event with No Surcharge & No Damages for the 1% (100-Year) Event

Pump Stations:

- ✓ All were Sized based on Economic Optimization Analysis
- ✓ Included Analysis of Alternatives to Reduce the Number of Pump Stations via Interceptor Sewers.

Pump Stations

- ✓ Standard Pump Sizes of 3,000; 6,000 and 15,000 gpm were Selected based on Results of IFC Analyses
- ✓ Standard Pump Station Configurations were Developed & used throughout the Project
- ✓ Generators were included in All Pump Stations & were Sized to Power 1 of 2 or 2 of 3 Pumps
- ✓ Pumps, Pump Controls & Generators were Purchased under a Supply Contract
- ✓ Generators were also Sized to Power an Adjacent Sanitary Lift Station in two locations

Pump Stations

East Grand Forks – 11 Pump Stations

- ✓ Includes retrofit of an existing Station
- ✓ Smallest Station Capacity is 6,000 gpm
- ✓ Largest Station Capacity is 18,000 gpm

Grand Forks – 12 Pump Stations

- ✓ Includes one Station with a Capacity of 116,000 gpm that does not use the standard pumps and station configuration
- ✓ Smallest Station Capacity is 6,000 gpm
- ✓ Largest Station Capacity using standard pumps sizes is 60,000 gpm

Pump Stations

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Pump Stations

Pump Stations

Pump Stations

Construction Contracts

Plans & Specs - EGF & GF

- ✓ Old Railroad (Pedestrian) Bridge Removal – In-house
- ✓ Riverside Dam – In-house
- ✓ Pedestrian Bridges – Ayres Associates

Plans & Specs – East Grand Forks

- ✓ Phase 1 - Short, Elliot, Hendrickson, Inc.
- ✓ Phase 2 - Short, Elliot, Hendrickson, Inc.
- ✓ Phase 3 - In-house
- ✓ Phase 4 – In-house
- ✓ Heartsville Coulee Diversion - Short, Elliot, Hendrickson, Inc.

Plans & Specs – Grand Forks

- ✓ English Coulee Diversion – HDR, Inc.
- ✓ English Coulee Pump Station – Ayres Associates
- ✓ Phase 1 – Stanley Consultants
- ✓ Phase 2 – Stanley Consultants
- ✓ Phase 3 – Stanley Consultants
- ✓ Phase 4 – Stanley Consultants
- ✓ 55th Street Pump Station – In-house

EGF "Removable" Floodwall

- City of EGF received an Economic Development Administration grant that was used for "Removable" Floodwall
- Removable Floodwall is a proprietary system from "Flood Control America"
- Designed and Constructed before Corps FCP started Construction (with some Corps Input)
- Floodwall is 880' long including three full height road closures (two 80' long and one 60' long)
- Floodwall begrudgingly accept by St. Paul District
- Floodwall Portion has a 4' high Parapet Wall at about the 1% (100-Year) Flood Elevation
- Modifications required to include in FCP include changing pedestals to a grade beam and extending the footing ~6' riverward

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EGF "Removable" Floodwall

Parapet Wall with Intermediate Columns

EGF "Removable" Floodwall

Floodwall Portion with some Stop Logs Installed

EGF "Removable" Floodwall

Demers Avenue, 80' Wide, 14' High Closure

EGF "Removable" Floodwall

Flood Control America Stop Log

EGF “Removable” Floodwall

Footing Modifications to Include in FCP

EGF "Removable" Floodwall

Pedestal Modifications to Include in FCP

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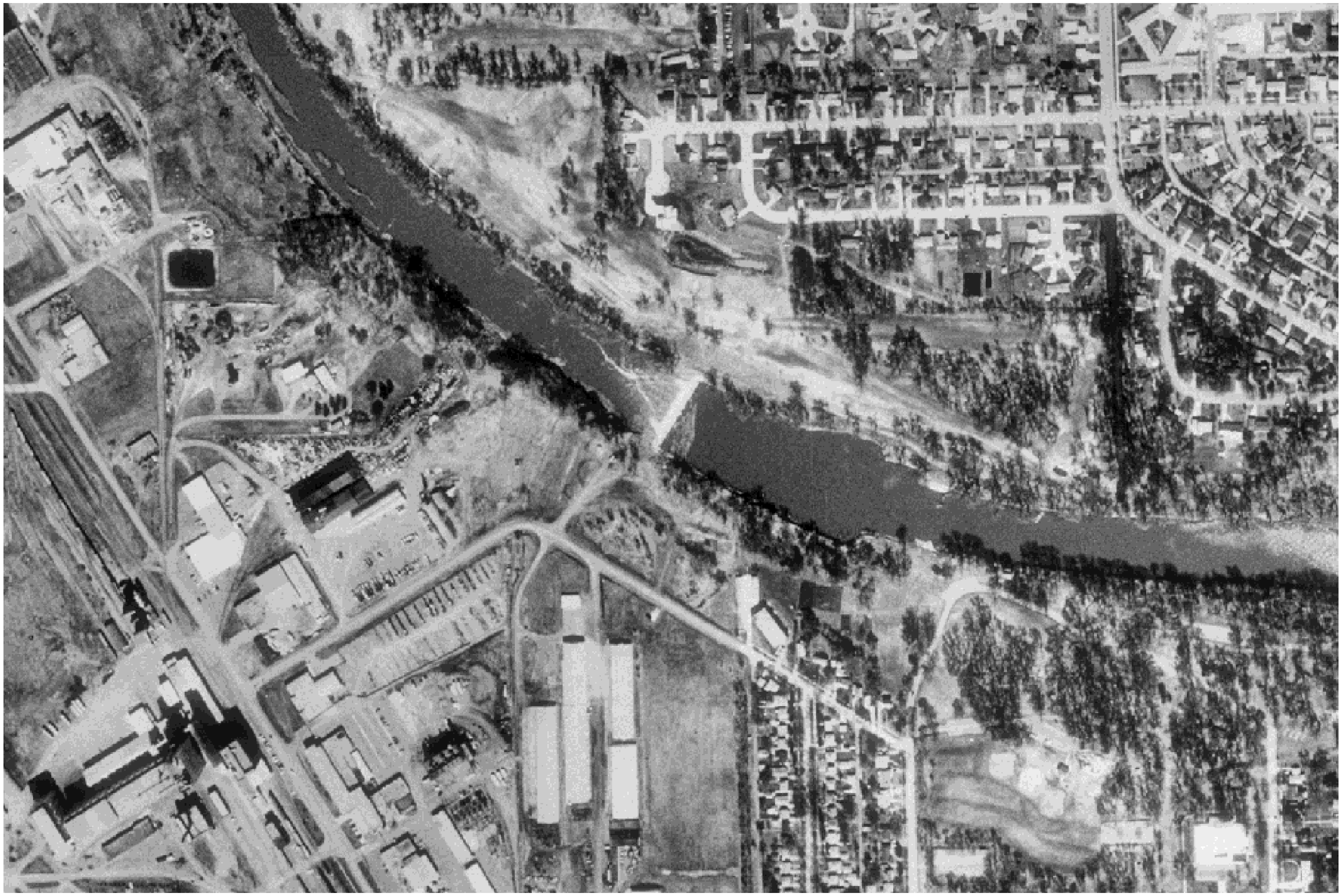
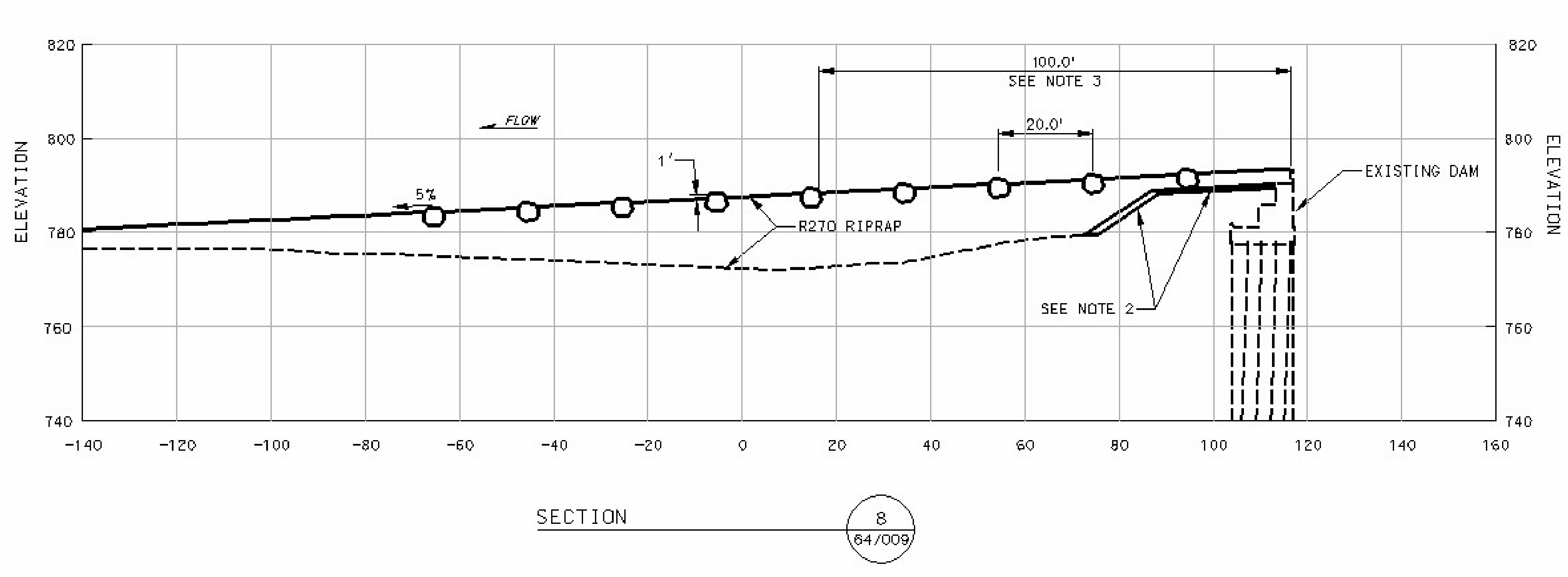
Riverside Dam



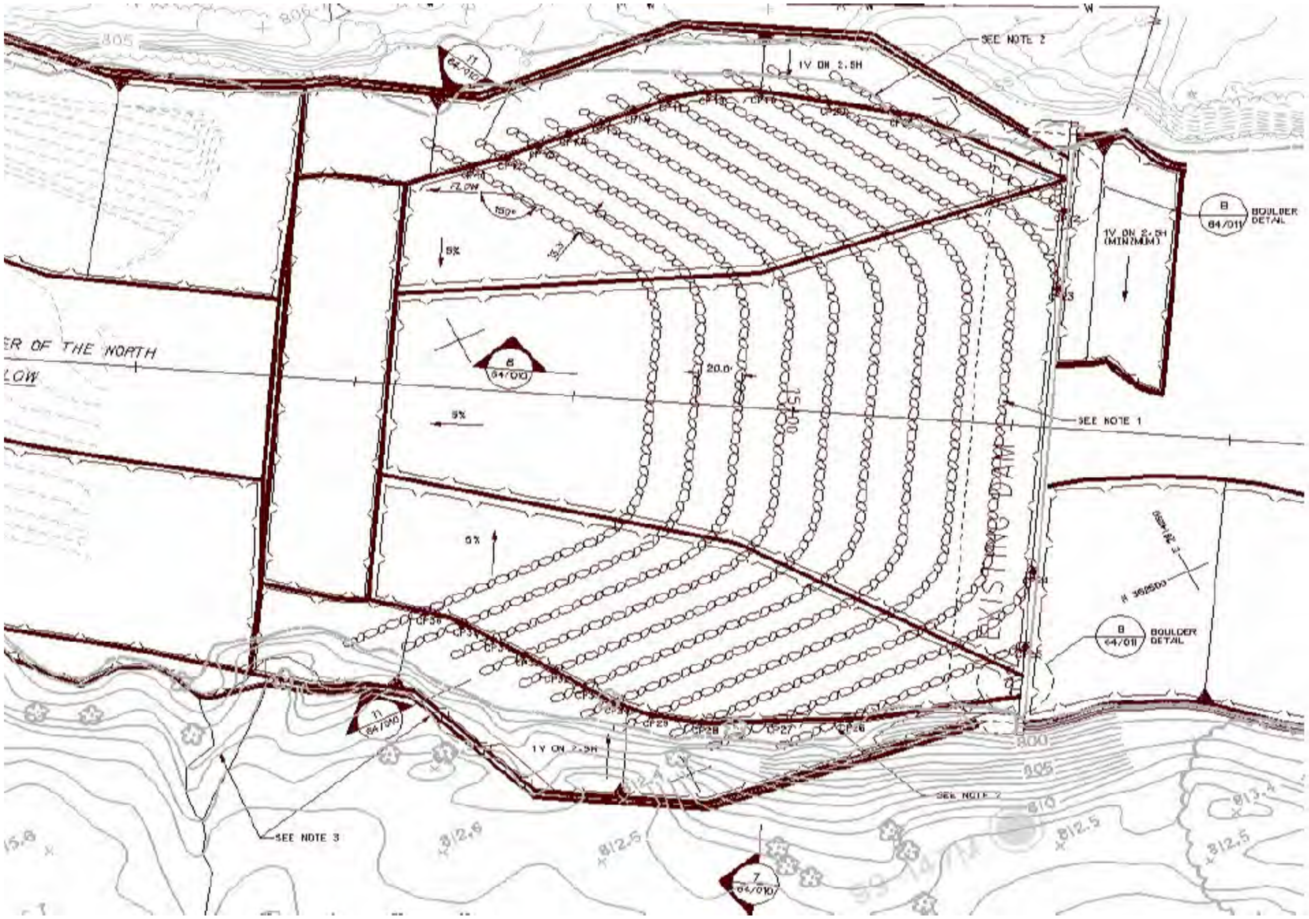
Riverside Dam

Riverside Dam



Section along Channel Centerline

Riverside Dam



Riverside Dam - Plan View of Rock Rapids Structure

Riverside Dam

Riverside Dam

Riverside Dam

Riverside Dam

Riverside Dam

Before

After

Railroad Closures

Three RR Closure Sills had to be completed in a single 24-hour track outage

24-hour outage included time for the RR to remove and replace the tracks

Contractor had 14 hours to excavate sites, drive sheetpile cutoffs, place rebar & forms, pour concrete, strip forms and backfill sites

Concrete mix included an accelerator additive, all test cylinders had strengths > 5,100 psi after 24 hours

Railroad Closures

Track & Tie Removal (by RR Crew)

Railroad Closures

Excavating Site

Railroad Closures

Driving Sheetpile Cutoff

Railroad Closures

Setting Rebar Mat

Railroad Closures

Pouring Concrete

Railroad Closures

Fit Test of Stoplog

Railroad Closures

Installing & Setting Ties & Tracks (by RR Crew)

Construction using GPS

- ✓ Subcontractor requested Corps' model files including the 3D models from Microstation InRoads
- ✓ Subcontractor loaded Microstation files into their software
- ✓ Computer in Bulldozer cab and GPS unit on each end of blade
- ✓ Monitor in cab can display either plan view or cross-section view
- ✓ In plan view, dozer is shown in respect to project centerline and footprint
- ✓ In cross-section view, dozer is shown in elevation in respect to design
- ✓ Cut or fill depths are indicated for each end of blade
- ✓ When cut or fill depths are within a few inches, dozer may be switched to automatic mode to grade to design elevations

Construction using GPS

GPS Units on Each End of Blade

Construction using GPS

GPS Base Station at the Subcontractor's Shop

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Construction using GPS

Monitor in Cab showing Plan View

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Construction using GPS

Monitor in Cab showing Cross-Section View

Construction using GPS

Monitor in Cab showing Coordinates, Existing & Design Elevations, and GPS Status

Ice Bridge

- ✓ Subcontractor approached Corps regarding using an Ice Bridge to haul material across the Red Lake River.
- ✓ Ice bridge shortened haul route from 5 miles to ½ mile.
- ✓ Eliminated hauling through residential neighborhoods & by two schools.
- ✓ Eliminated Wear & Tear on Roads.
- ✓ Residents not Irritated by Traffic on Roads.
- ✓ MN DNR contacted for Permit Requirements.
- ✓ CRREL contacted for Technical Support.
- ✓ 22" of Clear, Sound Ice needed for 30-ton Trucks.
- ✓ To increase ice depth, subcontractor plowed snow from the area then flooded it & let it freeze.

Ice Bridge

- ✓ Ice was 18” thick at beginning of January.
- ✓ Ice was 40” thick on January 28th.
- ✓ Operators wore personal floatation devices and crampons and kept their truck windows open.
- ✓ Operators limited to 20 mph over the Ice Bridge.
- ✓ In just under a month, Subcontractor hauled & stockpiled more than 300,000 CY of Impervious Fill.
- ✓ Hauling would have taken three months without the Ice Bridge.
- ✓ Subcontractor kept detailed ice, weather and haul records that CRREL will use in studies re: Ice Bridges.
- ✓ Ice Bridge was deemed a success by Everyone.

Ice Bridge

Comparison of Routes

Ice Bridge

Plowing Snow from the Site

Ice Bridge

Flooding the Site to Increase Ice Thickness

Ice Bridge

Loading Borrow

Ice Bridge

Truck Crossing Ice Bridge

Ice Bridge

Stockpiling Borrow

Construction Office & Design Team Issues

Shop Drawings not Submitted according to Schedule

Numerous Design Changes made without Coordinating with Designers

Changes made to Interior Flood Control Facilities required Contract Modifications to Correct

- ✓ Street grades raised
- ✓ Curb Cuts to Drop Inlets Eliminated
- ✓ Drop Inlet Elevations Raised
- ✓ Toe Ditches Modified

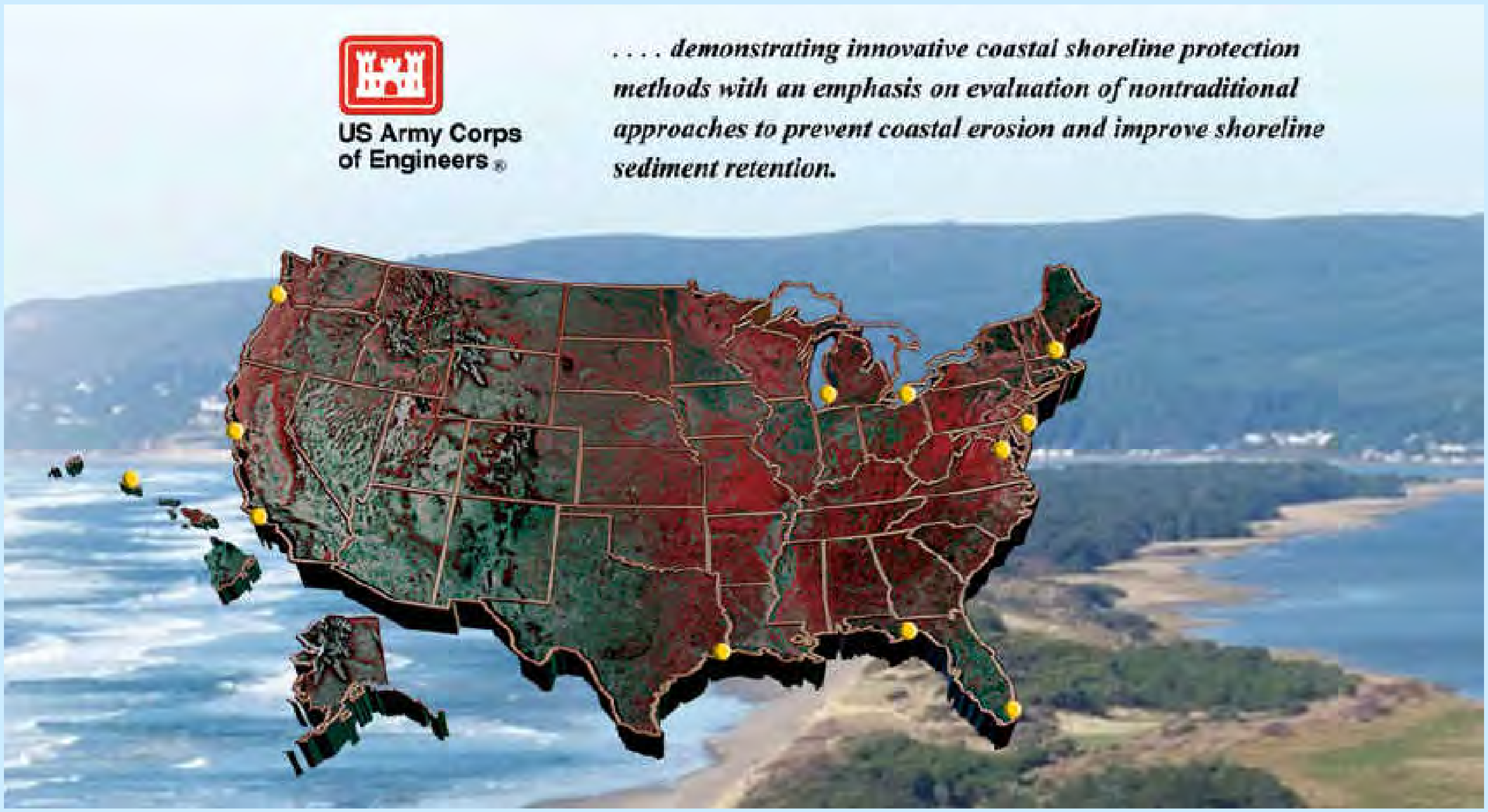
EGF & GF
Local Flood Damage Reduction Project

Questions?

Comments?

SECTION 227

National Shoreline Erosion Control Demonstration and Development Program



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227

Storm Damage at Cape Lookout

SECTION 227

Natural Dunes North of Cape Lookout

SECTION

227

North End of Project

SECTION 227

SECTION

227

Dune and Beachfill

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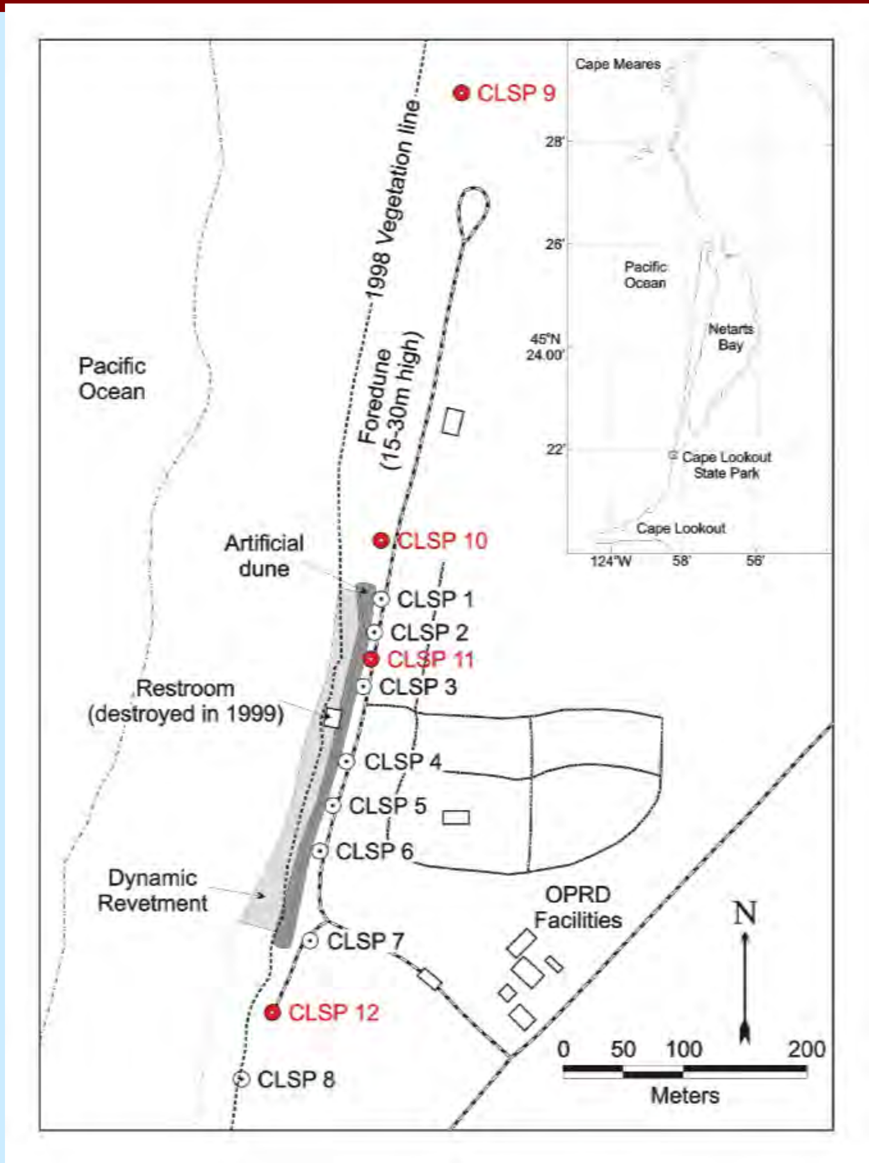
227

Large Stones Rolled Up Dune

SECTION

227

SECTION
227



Survey Grid

Continued Erosion South of Project

SECTION 227

September 2004

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SECTION 227

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SECTION 227

Branchbox Breakwater Design at Pickleweed Trail, Martinez, CA

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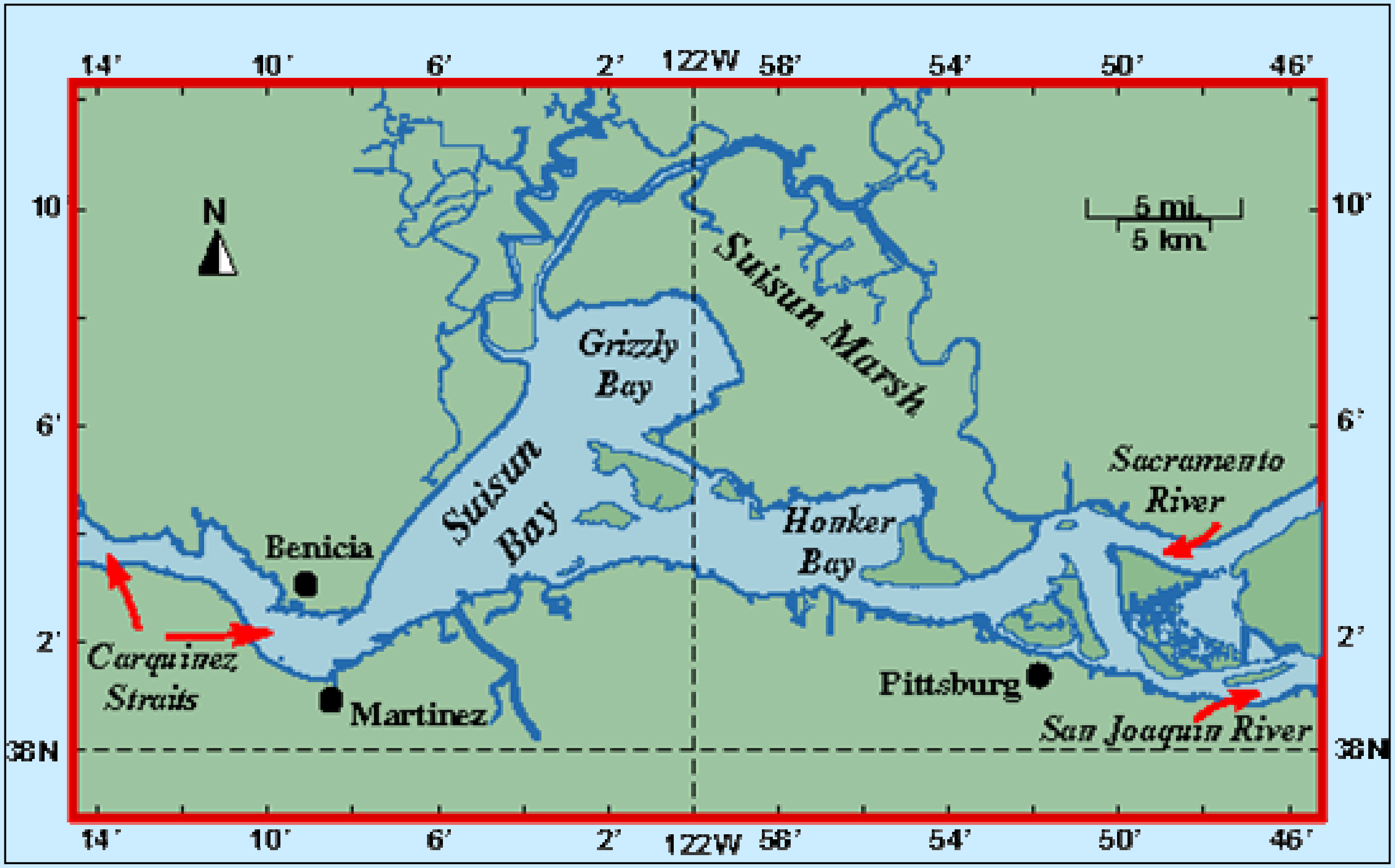
Pickleweed Trail, Martinez, CA



SECTION 227

❖ Part of the Martinez Regional Shoreline Parks

❖Wetlands next to demo site

❖Land managed by the East Bay Regional Parks District (EBRPD)

❖Full public access

S E C T I O N 227

- ❖Erosion probably caused by tidal currents and waves (wind and boat)
- ❖Natural shoreline consists mostly of mudflat to berm of bay mud covered by vegetation
- ❖Failure mechanism appears to be slumping and removal of berm by waves and currents

SECTION 227

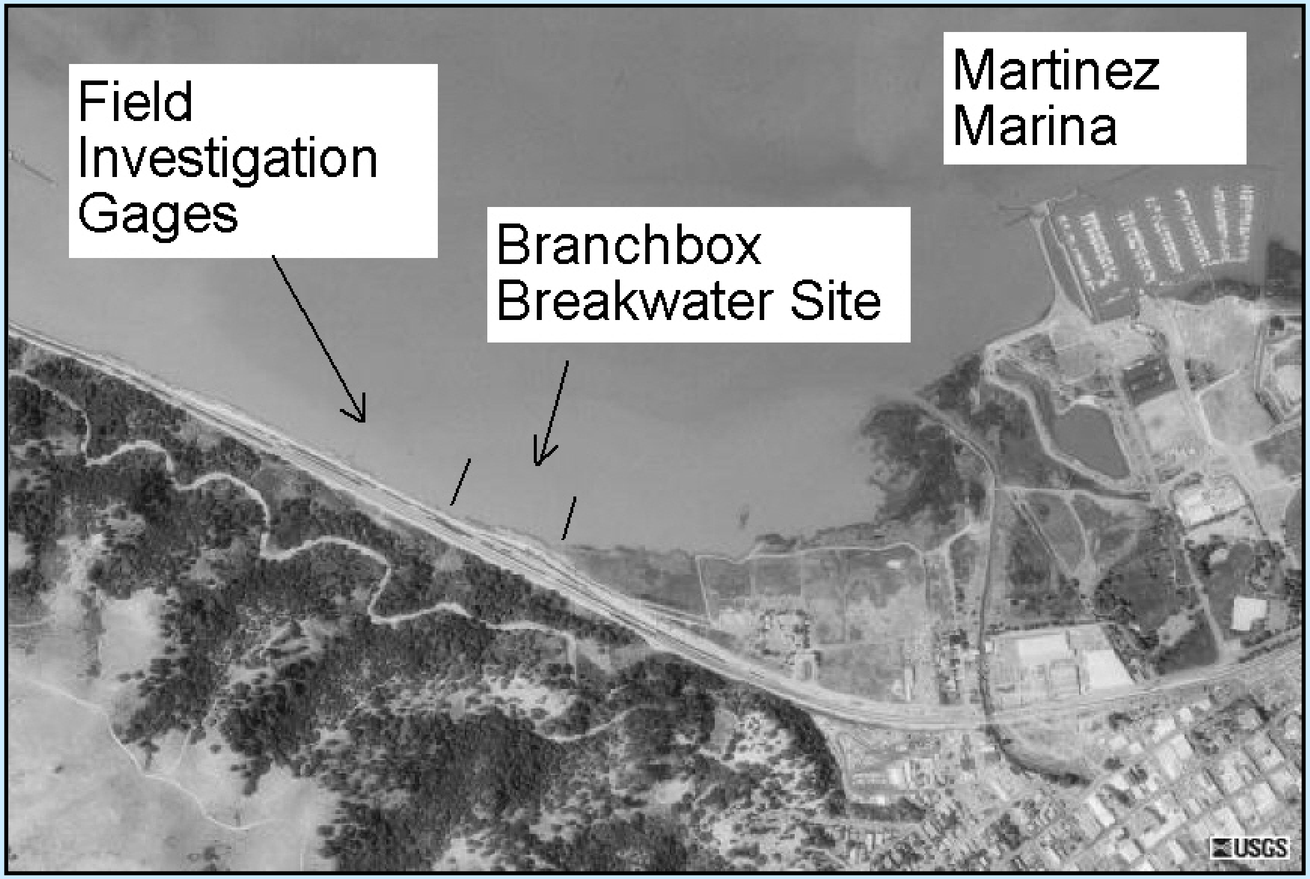
Erosion at the Pickleweed Trail

2000

2002

SECTION 227

Pickleweed Trail Shoreline

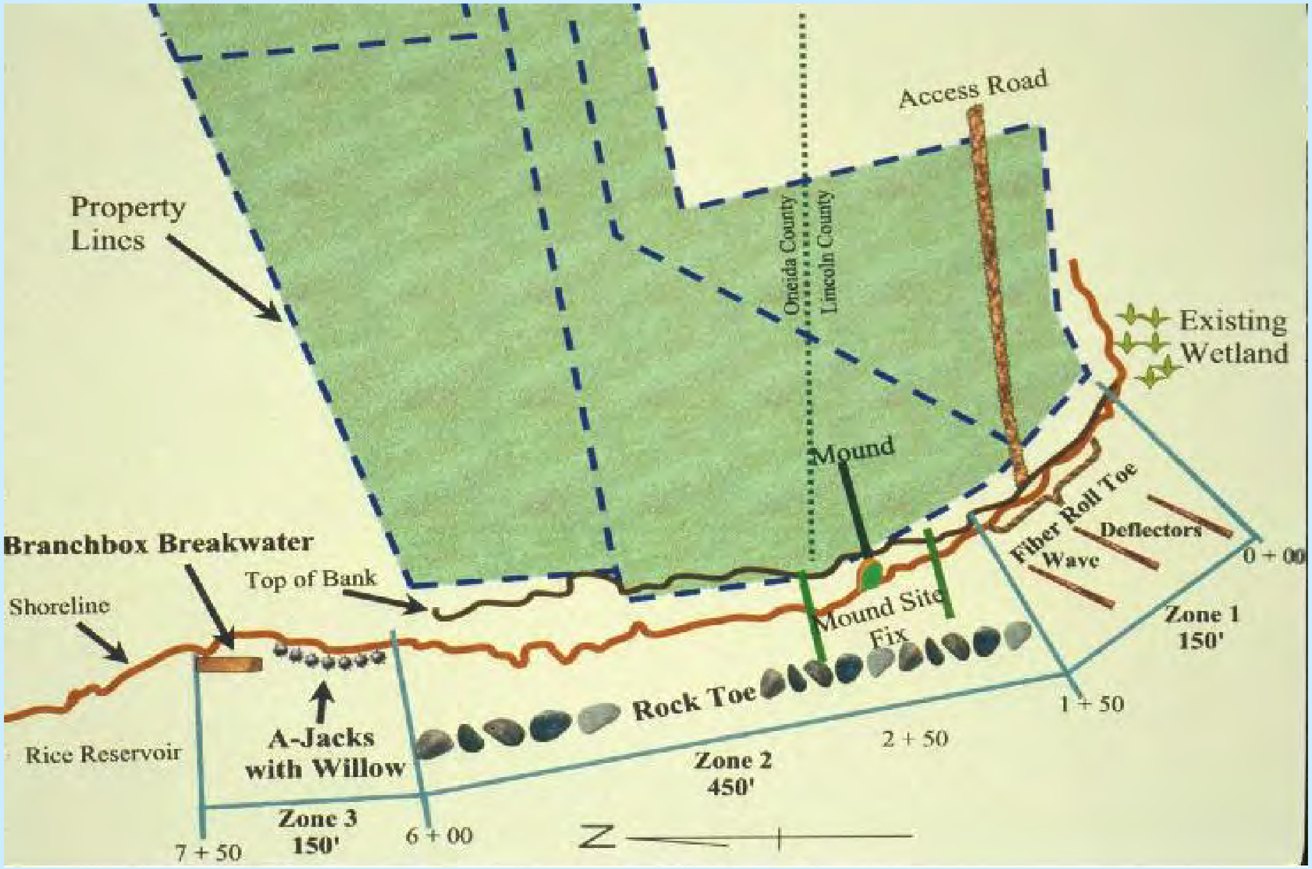


SECTION 227

Field Investigations
Shoreline Erosion Control Alternatives

SECTION 227

WVIC, Rice Reservoir



SECTION

227

Branchbox Breakwater Rice Reservoir

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Georgiana Slough

SECTION 227

Branchbox Breakwater
Georgiana Slough

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Slab Bundles

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Slab Bundles
Ohio River

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Project History

APR 2000 – Initial meetings, site visit, and submittal

NOV 2000 – Presentation at Pacific Rim Workshop

DEC 2000 thru JUL 2002 – Period of limited activity and Funding

AUG 2002 to present – Developing design scheme

SECTION 227

LOCAL INTEREST

East Bay Regional Park District (EBRPD)

Coastal Sediment Management Workgroup (CSMW)

Bay Conservation & Development Commission (BCDC)

SECTION

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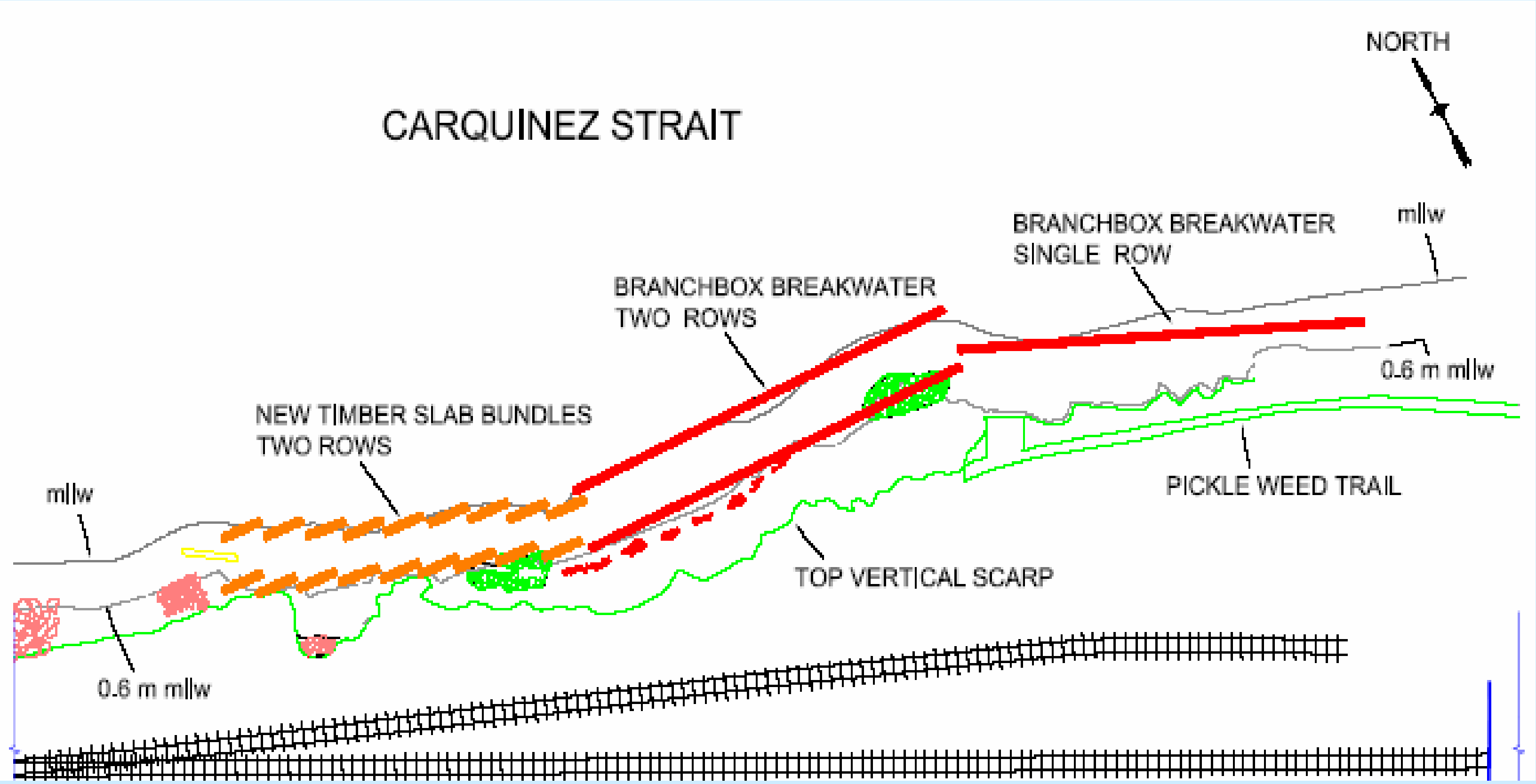
Proposed Design for Pickleweed Trail



SECTION 227

Questions

SECTION

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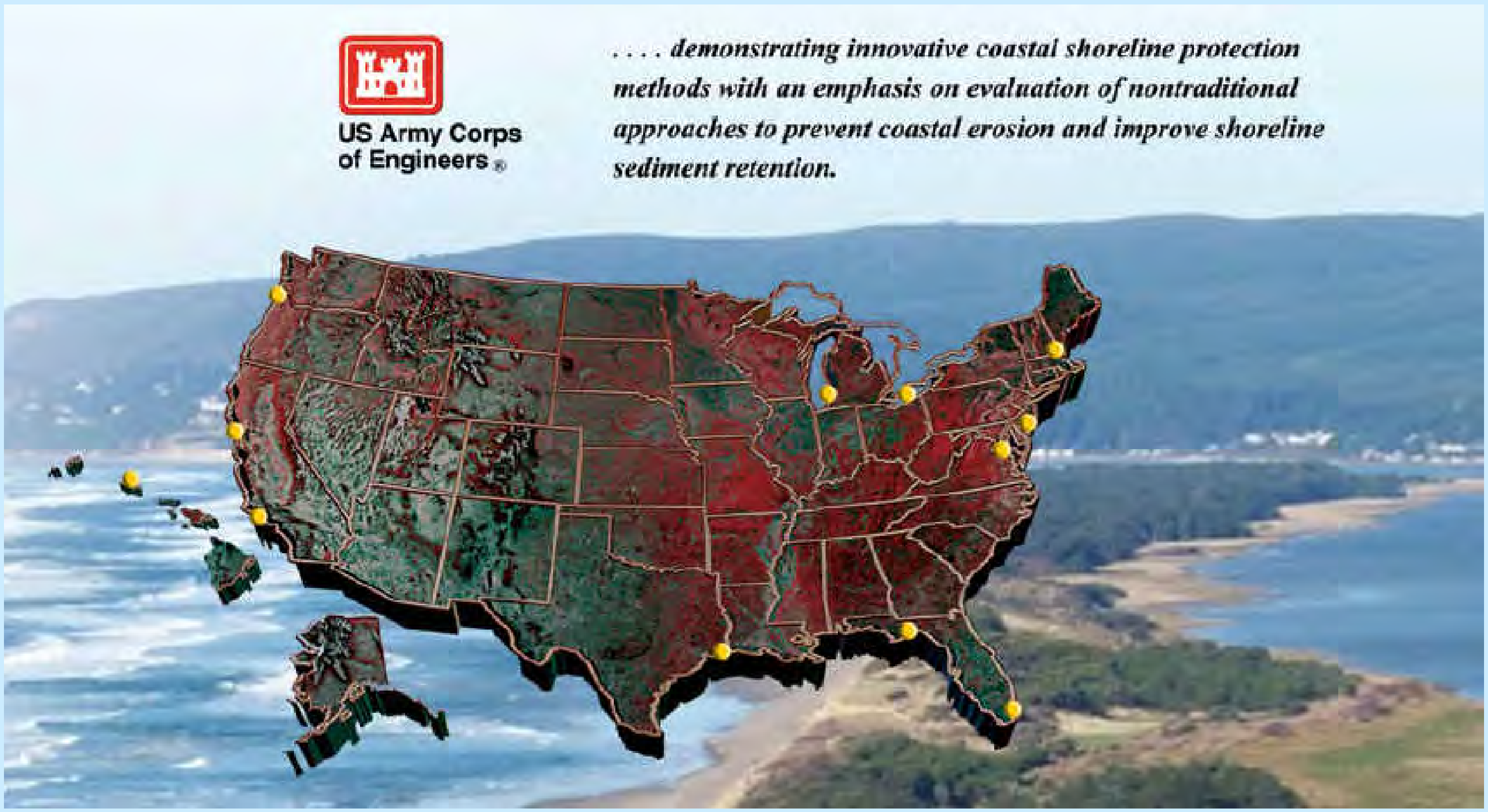
National Shoreline Erosion Control Demonstration and Development Program



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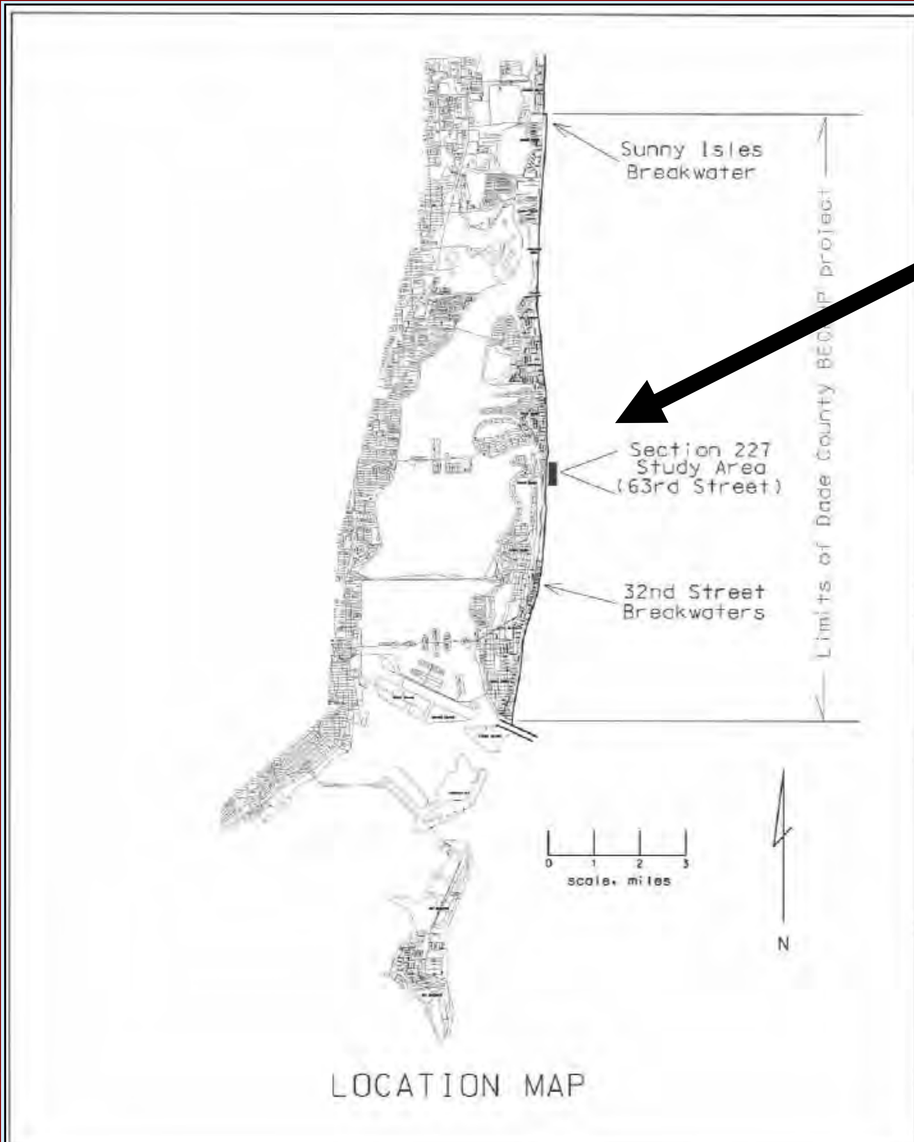

Dade County Beach Erosion Control Projects

SECTION

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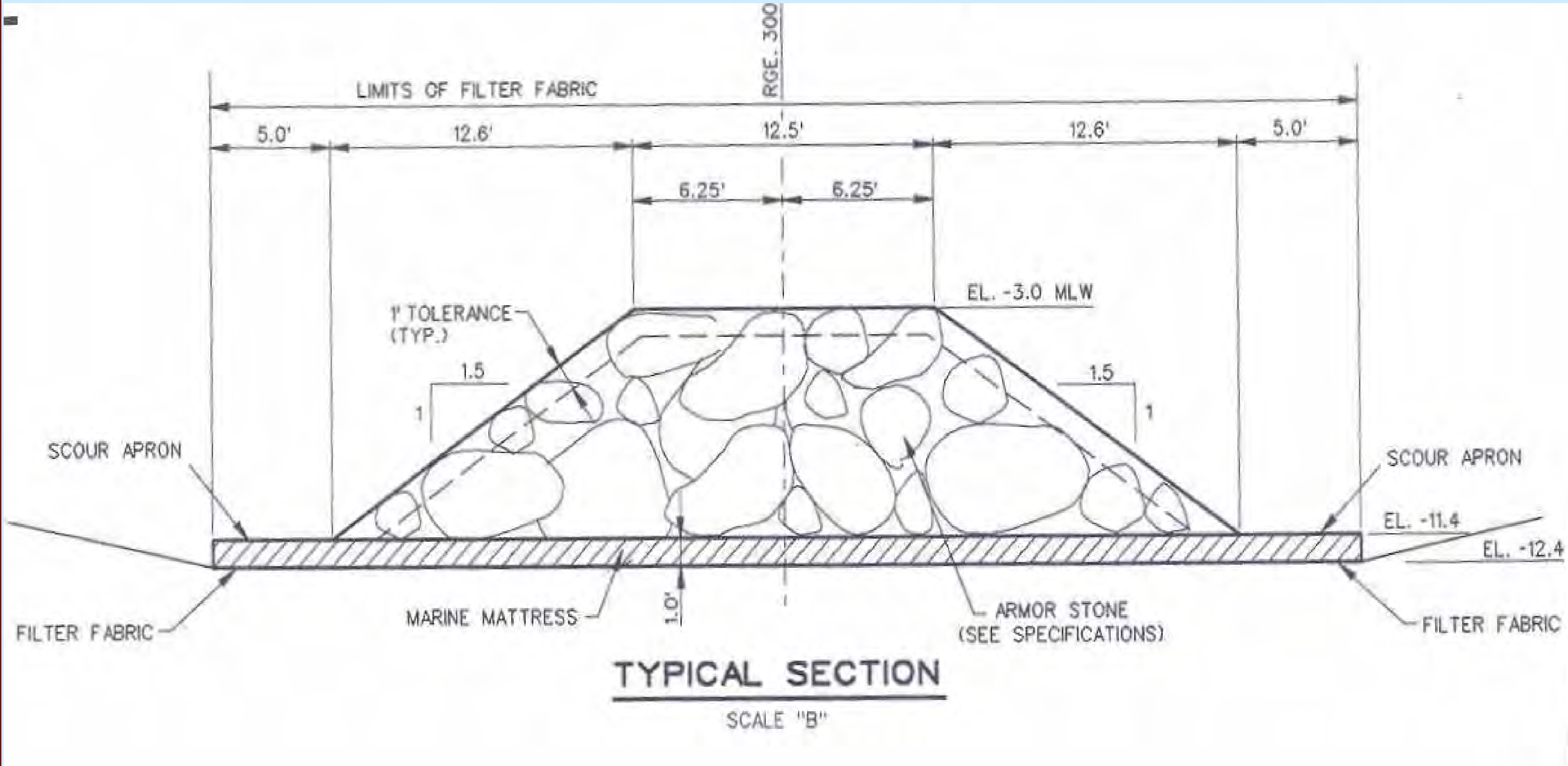
Sunny Isles Submerged Breakwaters

SECTION

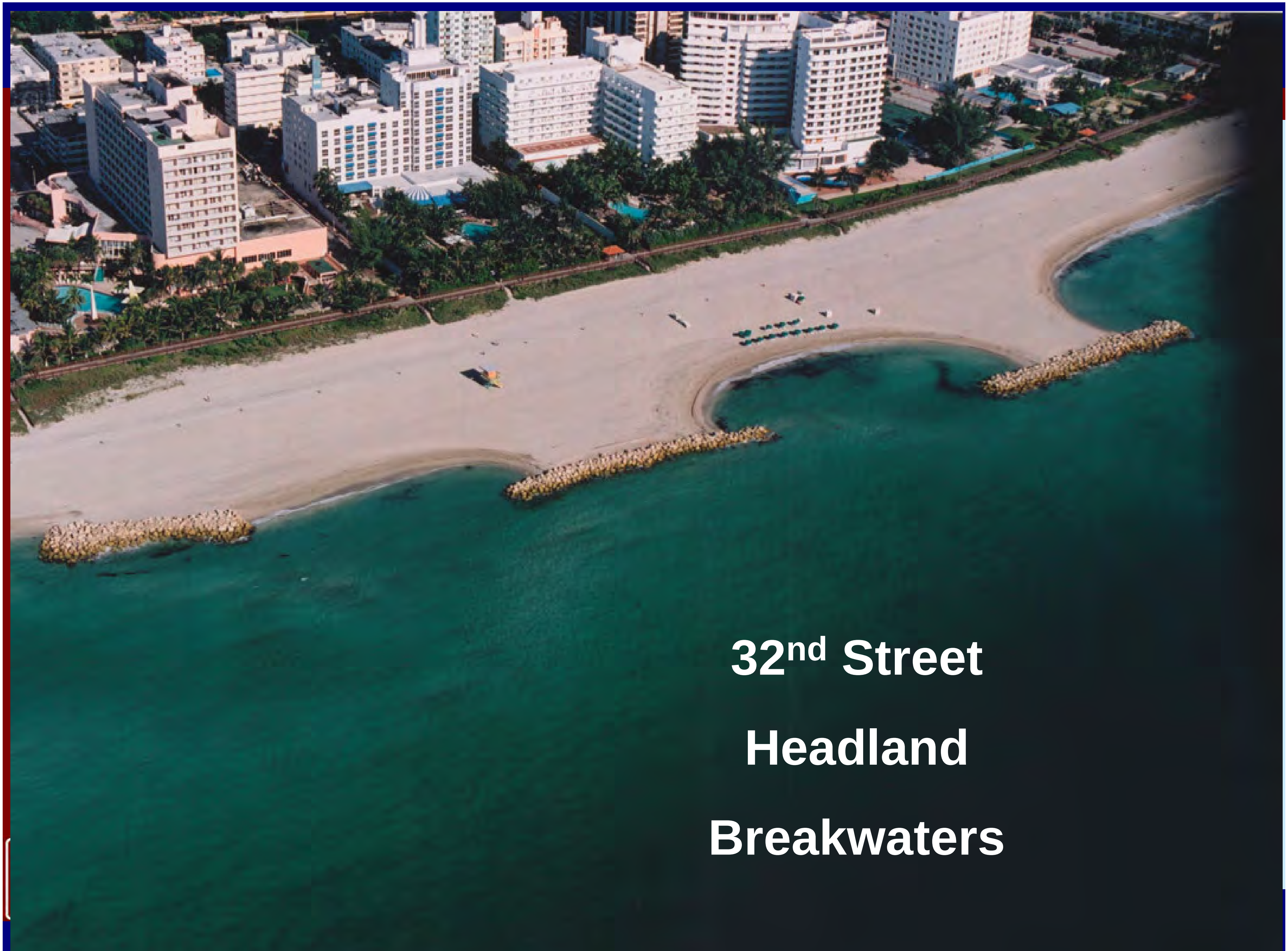
227

Sunny Isles Breakwaters



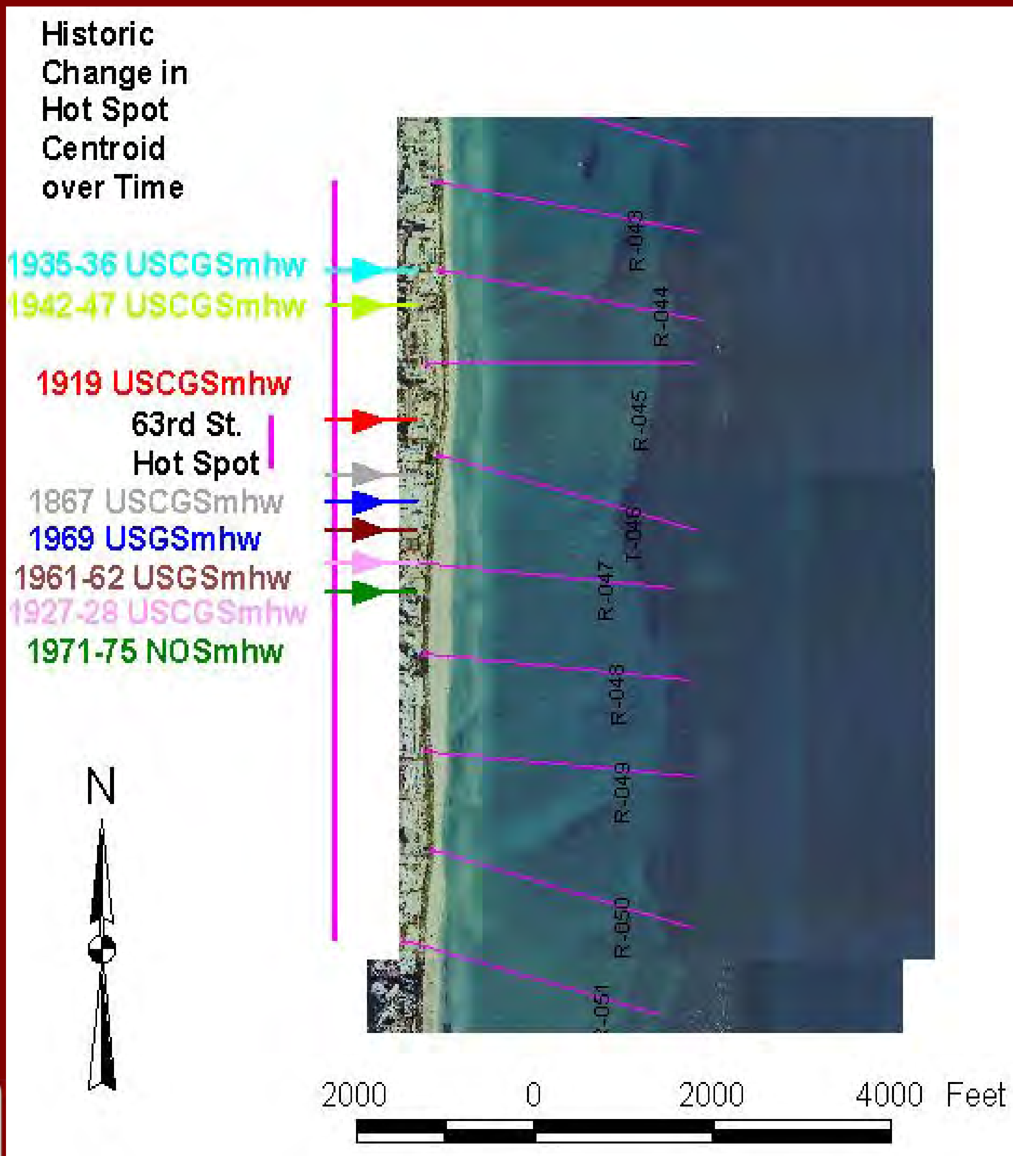
SECTION 227

32nd Street Headland Breakwaters


32nd Street
Headland
Breakwaters

Miami Beach, FL

SECTION 227



Miami Beach, FL

Typical Reef Balls

SECTION 227

Maiden Island, Antigua

Concrete Articulated Mat

SECTION

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Pouring a Reefball

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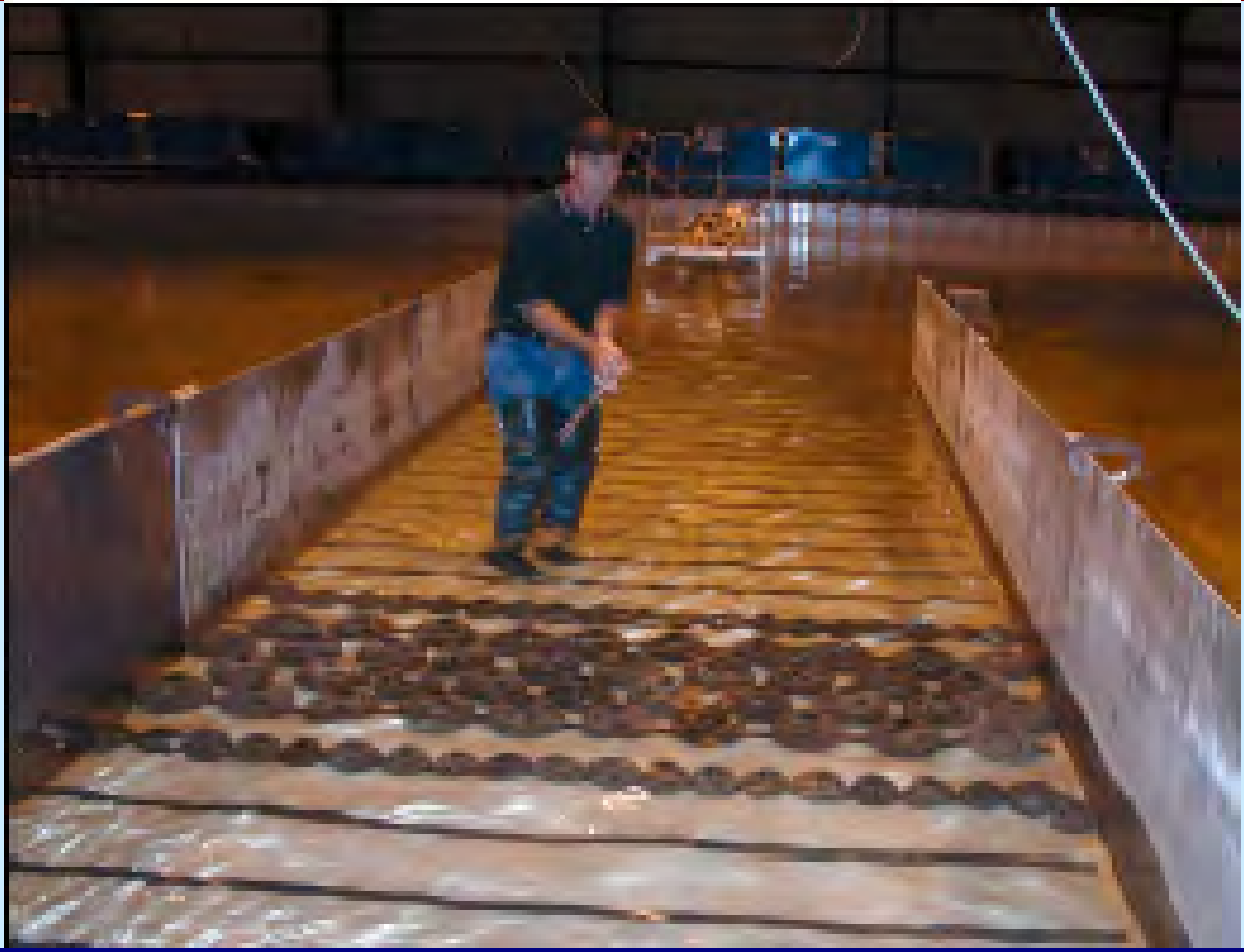
Wave Energy Dissipation Study

SECTION 227



Physical Model Study

SECTION

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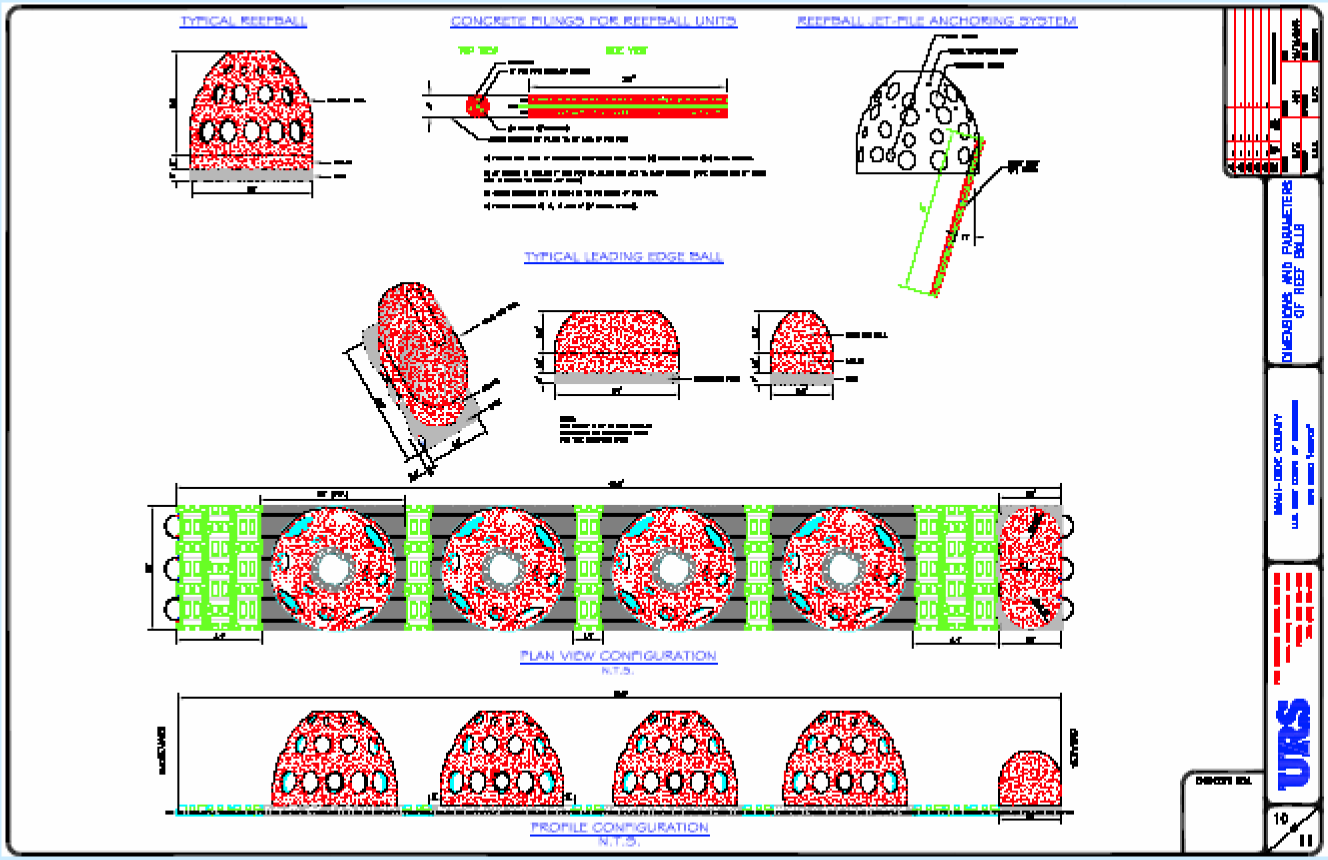

TYPICAL REEFBALL
CONCRETE PILINGS FOR REEFBALL UNITS
REEFBALL JET-PILE ANCHORING SYSTEM
TYPICAL LEADING EDGE BALL
PLAN VIEW CONFIGURATION
N.T.S.
PROFILE CONFIGURATION
N.T.S.
URS

SECTION

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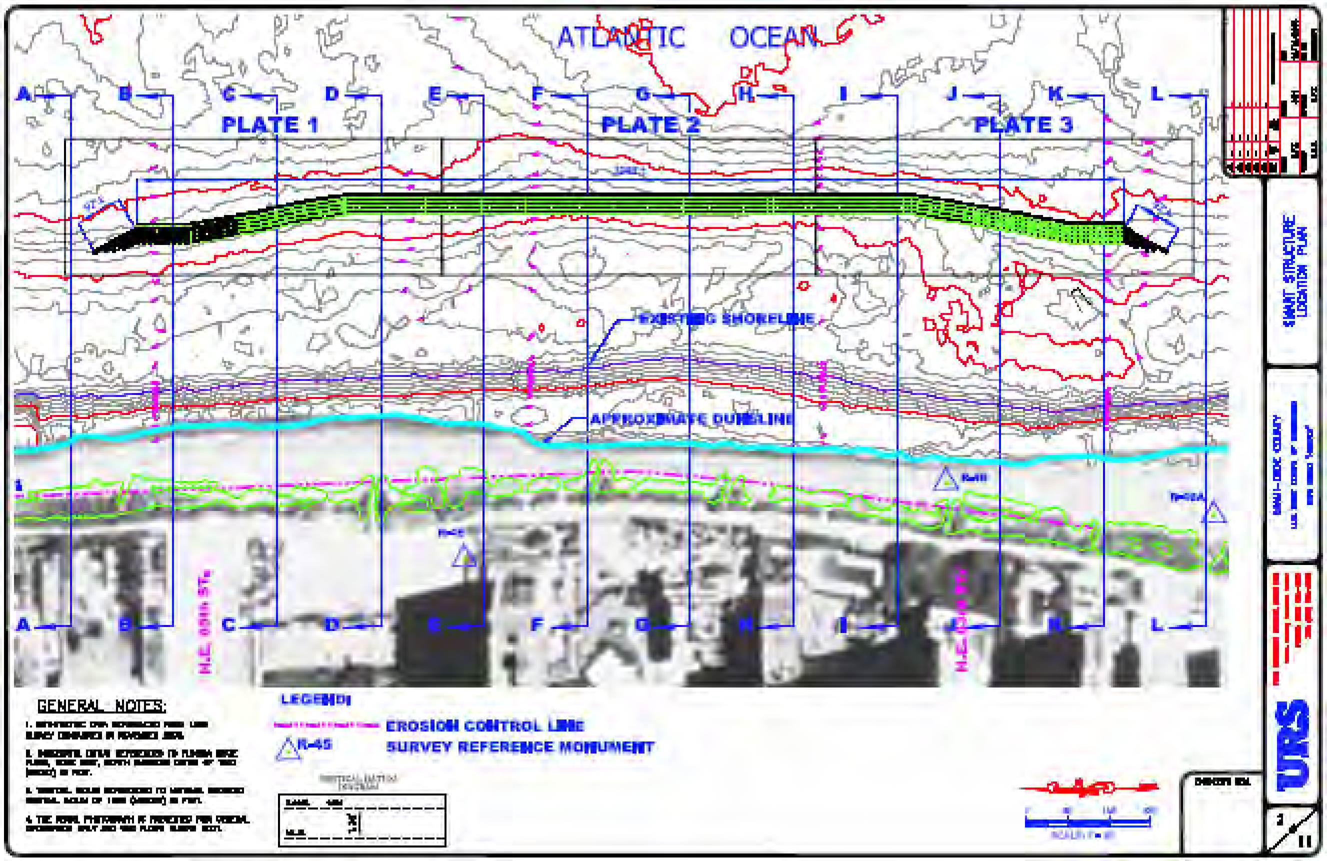

ATLANTIC OCEAN
PLATE 1
PLATE 2
PLATE 3
EXISTING SHORELINE
APPROXIMATE DUNELINE
N.E. 69th ST.
GENERAL NOTES:
LEGEND:
EROSION CONTROL LINE
R-45
SURVEY REFERENCE MONUMENT
URS

Advantages of a ReefBall Reef

SECTION 227

- Stabilize the Beach!
- Provide excellent aquatic habitat
- Provide a rich and scenic snorkeling area
- Develop design guidance for Reefballs

Areas of Applicability

SECTION 227

- Almost any wave environment
- Fresh- or saltwater
- Areas with shallow nearshore shelf
- Areas not subject to icing and ice floes

STATUS

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(Major Milestones)

- Contract Awarded: April 2003
- Design Completion: December 2003
- Environmental/NEPA Coordination: Aug 2004
- Technical Review: August/September 2004
- Construction Complete: August 2005

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Hydrologic and Hydraulic Contributions to Risk and Uncertainty Propagation Studies

Robert E. Moyer, IV
Hydraulic Engineer

Introduction

- Hydrologic and Hydraulic (H&H) Modeling determines flood levels where human and financial costs occur during events
- Uncertain H&H modeling parameters must be examined to determine risk for the flood reduction study
- Examples: flow rates, gauge record lengths, drainage areas, Manning's "n" values, coefficients of contraction and expansion and pier debris at bridges
- The final results of this analysis will describe the likelihood that an alternative will produce a degree of economic benefit and its probability of exceedance

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Terminology

- Parameter – A quantity in a function that determines the specific form of the relationship of known input and unknown output. Example Manning's "n"
- Parameter uncertainty – Lack of complete knowledge or accuracy of the value of a parameter.
- Sensitivity Analysis – Computation of the effect on the output of changes in input values or assumptions.
- Function uncertainty – Lack of complete knowledge or accuracy of the form of a hydrologic or hydraulic function used in an application such as a flood damage reduction study.

EM-1110-2-1619

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Hydrological and Hydraulic Contributions to Risk and Uncertainty Studies

- Hydrologic Uncertainty

Uncertainty with the Discharge – Probability Curve

- Hydraulic Uncertainty

Uncertainty with the Stage – Discharge Function

- Interior Flooding Uncertainty

Storm Runoff from the watershed that drains to the interior of a levee must be passed through or over the levee (EM-1110-2-1619). Performance of facilities like gravity outlets, pump stations, pump discharge outlets, collection facilities, storm sewers, and detention storage/flooding involves uncertainty

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Hydrologic Uncertainty

- Flood damage reduction projects such as reservoirs, detention storage, diversions, levees, and channels affect the discharge –probability curve
- Therefore, an **uncertainty propagation** study must be performed

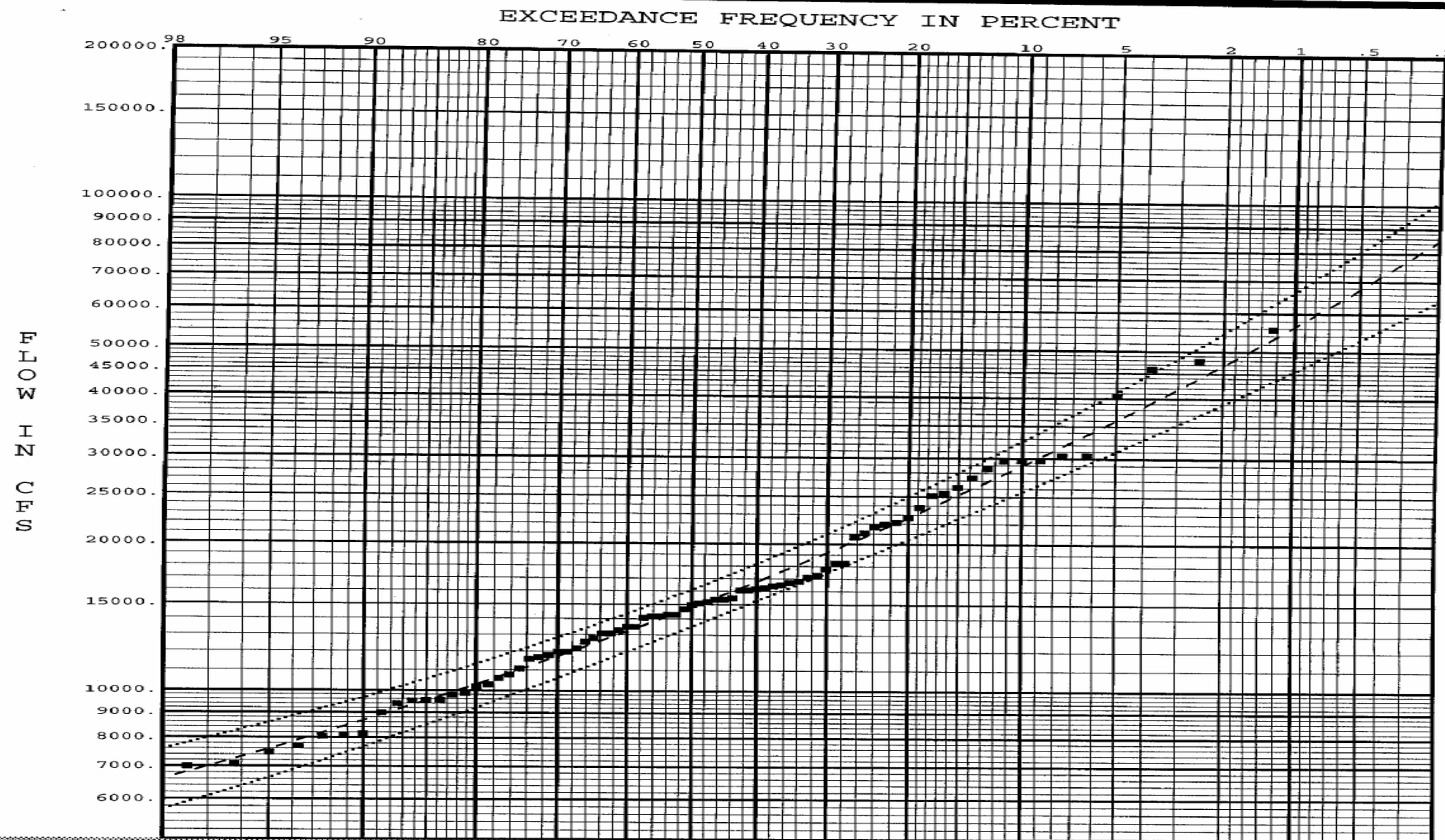
2 Methods to perform hydrologic uncertainty propagation study

- Direct Analytical Approach

  When a sample of stream gage data and annual peak discharge data are available and can be fit with a statistical distribution. Uncertainty is attributed primarily to the probability distribution
- Analytical / Synthetic Approaches

  When the discharge-frequency function is derived from methods such as transfer, regression, empirical equations, and modeling simulations.

The example case in Montoursville, Pennsylvania used a **regional transfer** approach for hydrologic uncertainty



- - - FLOW Frequency (with Exp. Prob.)
■ Weibull Plotting Positions
.... 5% and 95% Confidence Limits

FREQUENCY STATISTICS LOG TRANSFORM OF FLOW, CFS		NUMBER OF EVENTS	
MEAN	4.1878	HISTORIC EVENTS	0
STANDARD DEV	.2032	HIGH OUTLIERS	0
SKEW	.5218	LOW OUTLIERS	0
REGIONAL SKEW	.4500	ZERO OR MISSING	0
ADOPTED SKEW	.5000	SYSTEMATIC EVENTS	79

ANNUAL FLOOD PEAK FREQUENCY R
LOYALSOCK CREEK AT LOYALSOCKV
BASIN AREA = 435 SQ MI
WATER YEARS IN RECORD
1926-2004

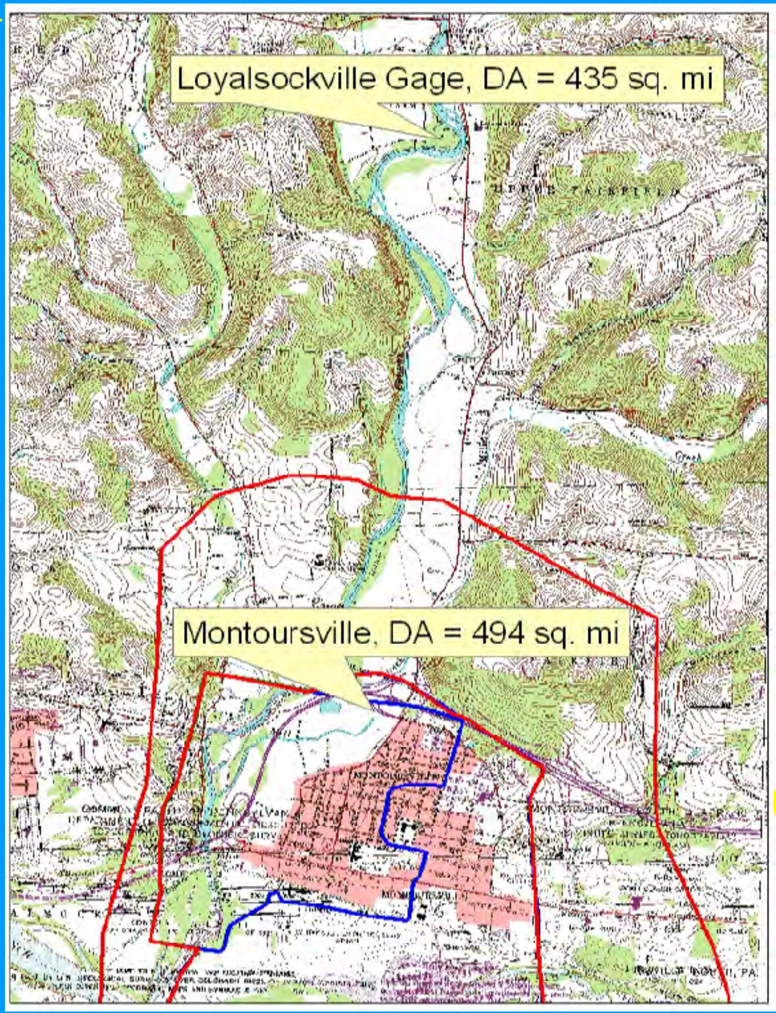
Analytical Approaches

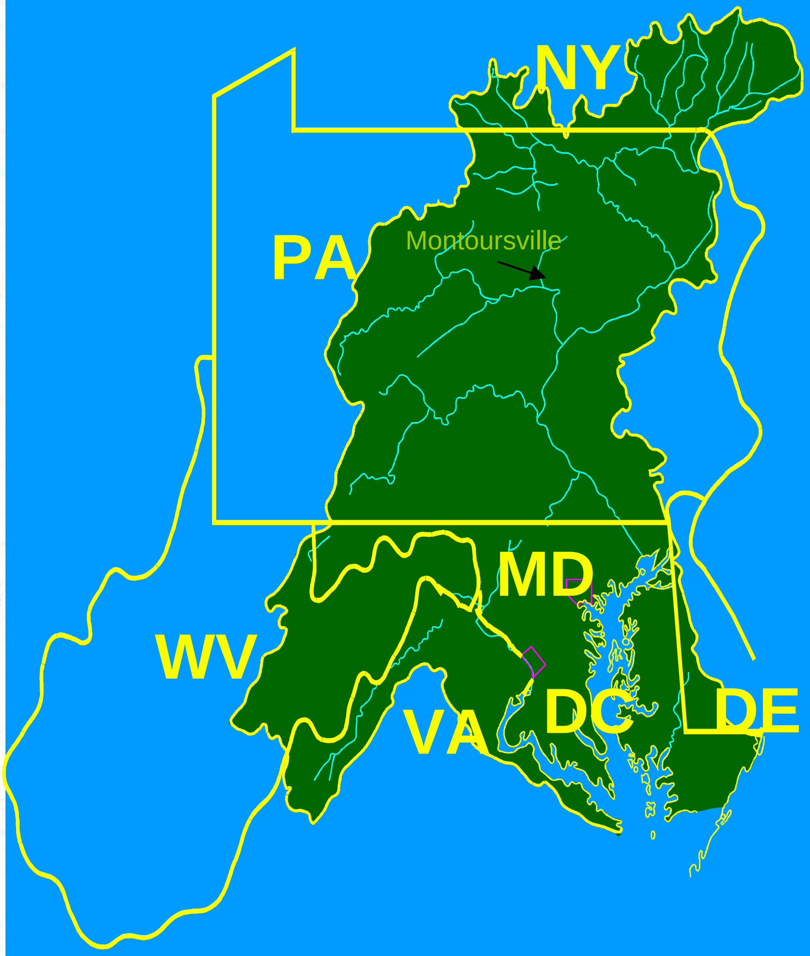
Table 4-1
Procedures for Estimating Discharge-Probability Function Without Recorded Events (adapted from USWRC (1981))

Method	Summary of Procedure
Transfer	Discharge-probability function is derived from discharge sample at nearby stream. Each quantile (discharge value for specified probability) is extrapolated or interpolated for the location of interest.
Regional estimation of individual quantiles or of function parameters	Discharge-probability functions are derived from discharge samples at nearby gauged locations. Then the function parameters or individual quantiles are related to measurable catchment, channel, or climatic characteristics via regression analysis. The resulting predictive equations are used to estimate function parameters or quantiles for the location of interest.
Empirical equations	Quantile (flow or stage) is computed from precipitation with a simple empirical equation. Typically, the probability of discharge and precipitation are assumed equal.
Hypothetical frequency events	Unique discharge hydrographs due to storms of specified probabilities and temporal and areal distributions are computed with a rainfall-runoff model. Results are calibrated to observed events or discharge-probability relations at gauged locations so that probability of peak hydrograph equals storm probability.
Continuous simulation	Continuous record of discharge is computed from continuous record of precipitation with rainfall-runoff model, and annual discharge peaks are identified. The function is fitted to series of annual hydrograph peaks, using statistical analysis procedures.

Analytical Approach: Regional Transfer

Montoursville, Pennsylvania





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Analytical Approach: Regional Transfer

Montoursville, Pennsylvania

- The flood frequency analysis from nearby Loyalsockville was available, but was located 5 miles upstream of Montoursville
- The drainage area ratio below was used to transfer the flows

$$\left(\frac{Q_M}{Q_L}\right) = \left(\frac{DA_M}{DA_L}\right)^{0.733}$$

, where the subscript M represents Montoursville and L represents Loyalsockville

- The results of the study below show the record length from Loyalsockville was reduced from 79 to 71 years.

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Analytical Approach: Regional Transfer

Montoursville, Pennsylvania

Montoursville Local Flood Protection Project: Hydrologic Routing					rem
	20-Mar-03	Study		11-Feb-05	Study
Recurrance	Loyalsockville	Montoursville		Loyalsockville	Montoursville
Interval	Rte. 973			Rte. 973	
Drainage Area	435	494		435	494
(sq. miles)					
1-year				6000	6559
2-year				14800	16178
5-year				22600	24704
10-year	28500	31154		28900	31591
20-year	35400	38696		36000	39352
25-year				38500	42085
50-year	45900	50174		46900	51267
100-year	55300	60449		56500	61761
500-year	83100	90838		85000	92915
Ivan				40500	44271
Agnes				47900	52360
Hydrologic Risk and Uncertainty				15-Jul-05	rem
Montoursville Flow is		114	percent of Loyalsockville's Flow		
Therefore, the Montoursville **Equivalent Record Length** is about					90
percent of Loyalsockville's systematic record length,				79	
which equals	71				

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Analytical Approach: Regional Transfer

Montoursville, Pennsylvania

Table 4-5
Equivalent Record Length Guidelines

Method of Frequency Function Estimation	Equivalent Record Length[1]
Analytical distribution fitted with long-period gauged record available at site	Systematic record length
Estimated from analytical distribution fitted for long-period gauge on the same stream, with upstream drainage area within 20% of that of point of interest	90% to 100% of record length of gauged location
Estimated from analytical distribution fitted for long-period gauge within same watershed	50% to 90% of record length
Estimated with regional discharge-probability function parameters	Average length of record used in regional study
Estimated with rainfall-runoff-routing model calibrated to several events recorded at short-interval event gauge in watershed	20 to 30 years
Estimated with rainfall-runoff-routing model with regional model parameters (no rainfall-runoff-routing model calibration)	10 to 30 years
Estimated with rainfall-runoff-routing model with handbook or textbook model parameters	10 to 15 years

[1] Based on judgment to account for the quality of any data used in the analysis, for the degree of confidence in models, and for previous experience with similar studies.

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Hydraulic Uncertainty

- Uncertainties exist with stage-discharge functions because of measurement errors, the use of numerical models, and the inability of these models to exactly reproduce the complex nature of hydraulics. Therefore, uncertainty propagation studies must be performed for hydraulic parameters
- Hydraulic uncertainties are also handled differently for gaged reaches and ungaged reaches

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Hydraulic Uncertainty

Gaged Reaches

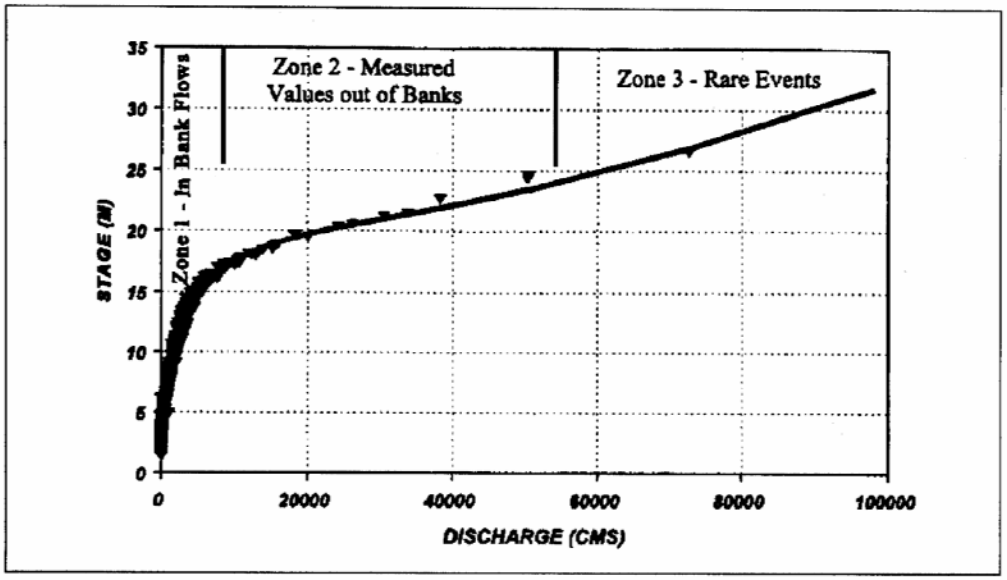

Figure 5-1. Stage-discharge plot showing uncertainty zones, observed data, and best-fit curve

The standard deviation defined by stage residuals determines the uncertainty for gauged reaches due to the nature of how the observed points fit the selected probability distribution.

Hydraulic Uncertainty

Ungaged Reaches

- For Ungaged reaches, uncertainty can be approximated from the Gamma Distribution. Figure 5-3 Below shows how this is done

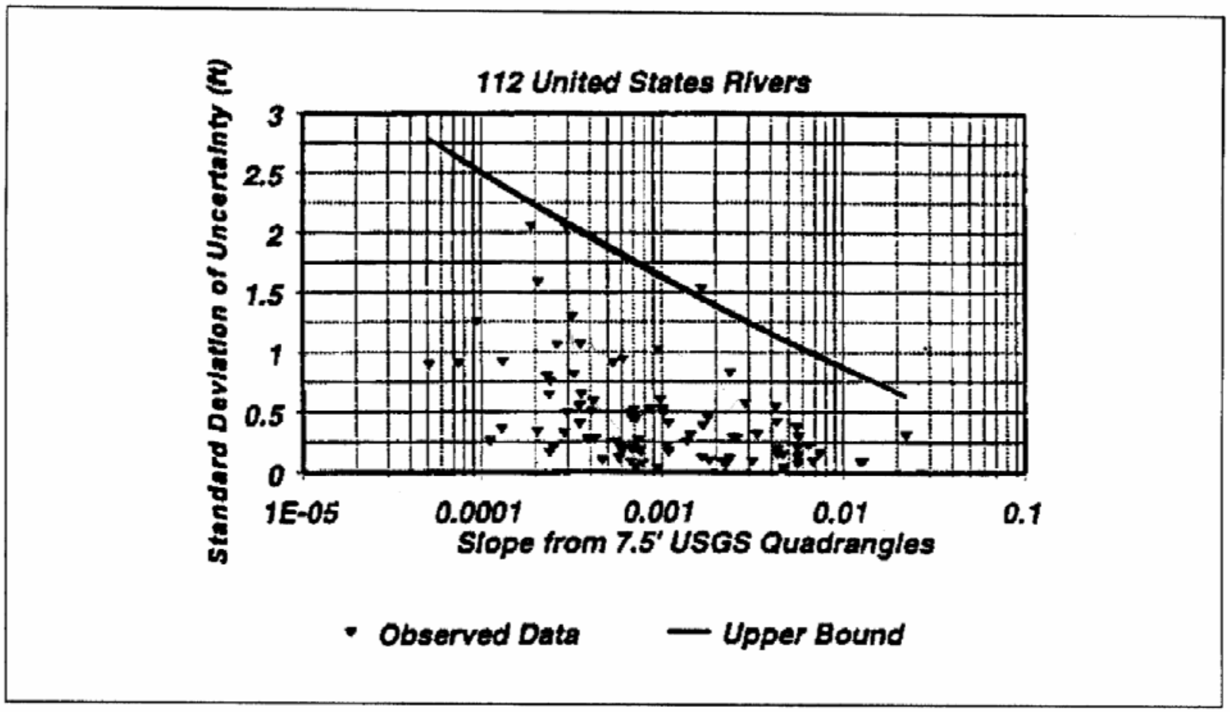

Figure 5-3. Stage-discharge uncertainty compared with channel slope from USGS 7.5-in. quadrangles, with upper bound for uncertainty

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Hydraulic Uncertainty

Ungaged Reaches

- For many ungaged areas, the hydraulic analysis is performed by computing water surface profiles. Uncertainties arise from the model's parameters. For the Montoursville case, uncertainties with Manning's "n" values, pier debris at bridges, and contraction/expansion coefficients were computed.
- A "Low Risk", an "Expected Risk", and a "High Risk" HEC-RAS model was produced for the Loyalsock Creek in Montoursville. Arbitrary increases in coefficients and parameters based on previous studies in the Baltimore District were chosen.
- The next slide shows the chosen parameters for the Montoursville hydraulic risk and uncertainty contribution

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Baltimore District

Hydraulic Uncertainty

Ungaged Reaches – Montoursville Study

HEC-RAS Model Parameters for Low, Expected, and High Risk Scenarios

Coefficients of Contraction and Expansion

Location		Low	Expected	High
Contraction	Channel	0.1	0.1	0.3
	Bridge XS	0.3	0.3	0.5
Expansion	Channel	0.3	0.3	0.5
	Bridge XS	0.5	0.5	0.8

Pier Debris at Bridges

	Low	Expected	High
Pier Width increase	0%	25%	50% (max. 3 ft)
Lowering of Bridge Deck	0 ft.	0.5 ft	1.0 ft

Manning's n in Channels / Overbanks

(Next Slide)

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Baltimore District

Hydraulic Uncertainty

Ungaged Reaches – Montoursville Study

Montoursville LFPP: Risk and Uncertainty Analysis --- Manning's n values								Percent Change		15	%	
+- 5% difference for n values												
				7.5	% Decrease					15	% Increase	
Edit Manning's n or k Values					Low Risk			Expected Risk			High Risk	
	River Station	Frctn (n/K)		n #1	n #2	n #3	n #1	n #2	n #3	n #1	n #2	n #3
1	10158.62	n		0.093	0.040	0.102	0.100	0.043	0.110	0.115	0.049	0.127
2	9802.355	n		0.093	0.040	0.102	0.100	0.043	0.110	0.115	0.049	0.127
3	9446.365	n		0.093	0.040	0.102	0.100	0.043	0.110	0.115	0.049	0.127
4	9038.917	n		0.093	0.040	0.102	0.100	0.043	0.110	0.115	0.049	0.127
5	8554.058	n		0.093	0.040	0.102	0.100	0.043	0.110	0.115	0.049	0.127
6	8122.26	n		0.093	0.040	0.102	0.100	0.043	0.110	0.115	0.049	0.127
7	7577.909	n		0.093	0.040	0.102	0.100	0.043	0.110	0.115	0.049	0.127
8	7219.518	n		0.093	0.040	0.102	0.100	0.043	0.110	0.115	0.049	0.127
9	6725.547	n		0.093	0.040	0.102	0.100	0.043	0.110	0.115	0.049	0.127
10	6326.275	n		0.093	0.040	0.102	0.100	0.043	0.110	0.115	0.049	0.127
11	6006.965	n		0.093	0.040	0.102	0.100	0.043	0.110	0.115	0.049	0.127
12	5715.366	n		0.093	0.040	0.102	0.100	0.043	0.110	0.115	0.049	0.127
13	5418.719	n		0.093	0.040	0.102	0.100	0.043	0.110	0.115	0.049	0.127
14	5207.008	n		0.093	0.040	0.102	0.100	0.043	0.110	0.115	0.049	0.127
15	4915.59	n		0.093	0.040	0.102	0.100	0.043	0.110	0.115	0.049	0.127
16	4703.012	n		0.093	0.040	0.102	0.100	0.043	0.110	0.115	0.049	0.127
17	4442.749	n		0.093	0.040	0.102	0.100	0.043	0.110	0.115	0.049	0.127
18	4187.805	n		0.093	0.040	0.102	0.100	0.043	0.110	0.115	0.049	0.127
19	3900.896	n		0.093	0.040	0.102	0.100	0.043	0.110	0.115	0.049	0.127
20	3713.969	n		0.093	0.040	0.102	0.100	0.043	0.110	0.115	0.049	0.127
21	3532.658	n		0.093	0.040	0.102	0.100	0.043	0.110	0.115	0.049	0.127
22	3276.832	n		0.093	0.040	0.102	0.100	0.043	0.110	0.115	0.049	0.127
23	3161.825	n		0.093	0.040	0.102	0.100	0.043	0.110	0.115	0.049	0.127
24	3040.741	n		0.093	0.040	0.102	0.100	0.043	0.110	0.115	0.049	0.127
25	2929.254	n		0.093	0.040	0.102	0.100	0.043	0.110	0.115	0.049	0.127

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Baltimore District

Hydraulic Uncertainty

Ungaged Reaches – Montoursville Study

Montoursville LFPP: Risk and Uncertainty Analysis — Results / Standard Deviation Computations — 25-Mar-05 rem

Reach	River Sta	Profile	Low Risk Q Total (cfs)	Low Risk Min Ch El (ft)	Low Risk W.S. Elev (ft)	Expected Risk Q Total (cfs)	Expected Risk Min Ch El (ft)	Expected Risk W.S. Elev (ft)	High Risk Q Total (cfs)	High Risk Min Ch El (ft)	High Risk W.S. Elev (ft)	Risk / Uncertainty Statistics: Stage Difference (ft)	Risk / Uncertainty Statistics: Estimated Standard Deviation (ft)
Loyal_main	10158.62	100y	61761	525.93	540.04	61761	525.93	540.29	61761	525.93	540.97	0.93	0.23
Loyal_main	9802.355	100y	61761	524.1	538.05	61761	524.10	538.49	61761	524.10	539.42	1.37	0.34
Loyal_main	9446.365	100y	61761	522.19	537.05	61761	522.19	537.49	61761	522.19	538.41	1.36	0.34
Loyal_main	9038.917	100y	61761	520.17	536.42	61761	520.17	536.88	61761	520.17	537.77	1.35	0.34
Loyal_main	8554.058	100y	61761	520.38	535.95	61761	520.38	536.41	61761	520.38	537.30	1.35	0.34
Loyal_main	8122.26	100y	61761	519.59	535.54	61761	519.59	536.01	61761	519.59	536.92	1.38	0.34
Loyal_main	7577.909	100y	61761	516	534.47	61761	516.00	534.98	61761	516.00	535.90	1.43	0.36
Loyal_main	7219.518	100y	61761	515.78	533.32	61761	515.78	533.87	61761	515.78	534.80	1.48	0.37
Loyal_main	6725.547	100y	61761	515.12	531.41	61761	515.12	532.10	61761	515.12	533.11	1.70	0.43
Loyal_main	6326.275	100y	61761	514.14	529.61	61761	514.14	530.71	61761	514.14	531.88	2.27	0.57
Loyal_main	6006.965	100y	61761	513.31	529.22	61761	513.31	530.53	61761	513.31	531.75	2.53	0.63
Loyal_main	5715.366	100y	61761	512.56	529.24	61761	512.56	530.34	61761	512.56	531.54	2.30	0.57
Loyal_main	5418.719	100y	61761	511.8	529.25	61761	511.80	530.30	61761	511.80	531.48	2.23	0.56
Loyal_main	5207.008	100y	61761	506.86	529.38	61761	506.86	530.39	61761	506.86	531.51	2.13	0.53
Loyal_main	4915.59	100y	61761	502.43	529.25	61761	502.43	530.29	61761	502.43	531.38	2.13	0.53
Loyal_main	4703.012	100y	61761	501.11	529.25	61761	501.11	530.26	61761	501.11	531.36	2.11	0.53
Loyal_main	4442.749	100y	61761	501.69	529.19	61761	501.69	530.20	61761	501.69	531.30	2.11	0.53
Loyal_main	4187.805	100y	61761	507.87	529.05	61761	507.87	530.12	61761	507.87	531.22	2.17	0.54
Loyal_main	3900.896	100y	61761	506.95	528.56	61761	506.95	529.73	61761	506.95	530.84	2.28	0.57
Loyal_main	3713.969	100y	61761	506.32	528.22	61761	506.32	529.47	61761	506.32	530.59	2.37	0.59
Loyal_main	3532.658	100y	61761	505.81	527.99	61761	505.81	529.29	61761	505.81	530.41	2.42	0.60
Loyal_main	3276.832	100y	61761	505.79	527.42	61761	505.79	528.86	61761	505.79	529.98	2.56	0.64
Loyal_main	3161.825	100y	61761	505.76	527.44	61761	505.76	528.65	61761	505.76	529.77	2.33	0.58
Loyal_main	3040.741	100y	61761	505.71	527.03	61761	505.71	528.37	61761	505.71	529.51	2.48	0.62
Loyal_main	2929.254	100y	61761	505.66	526.87	61761	505.66	528.18	61761	505.66	529.31	2.44	0.61
Loyal_main	2802.688	100y	61761	505.6	526.72	61761	505.60	527.95	61761	505.60	529.08	2.36	0.59

Hydraulic Uncertainty

Ungaged Reaches – Montoursville Study

US Army Corps of Engineers
Baltimore District

Loyal_main	2619.493	100y	61761	505.28	526.58		61761	505.28	527.85		61761	505.28	529.01		2.43	0.61
Loyal_main	2504.836	100y	61761	504.83	526.45		61761	504.83	527.74		61761	504.83	528.91		2.46	0.61
Loyal_main	2420.983	100y	61761	504.51	526.37		61761	504.51	527.66		61761	504.51	528.82		2.45	0.61
Loyal_main	2219.247	100y	61761	499.78	526.3		61761	499.78	527.59		61761	499.78	528.71		2.41	0.60
Loyal_main	2089.226	100y	61761	499.3	526.17		61761	499.30	527.47		61761	499.30	528.59		2.42	0.61
Loyal_main	1862.067	100y	61761	503.38	526.07		61761	503.38	527.38		61761	503.38	528.46		2.39	0.60
Loyal_main	1692		Bridge				Bridge				Bridge					
Loyal_main	1538.278	100y	61761	504.56	525.43		61761	504.56	526.77		61761	504.56	527.72		2.29	0.57
Loyal_main	1462.307	100y	61761	502.39	525.38		61761	502.39	526.73		61761	502.39	527.66		2.28	0.57
Loyal_main	1419.472	100y	61761	502.48	525.32		61761	502.48	526.68		61761	502.48	527.60		2.28	0.57
Loyal_main	1320		Bridge				Bridge				Bridge					
Loyal_main	1211.046	100y	61761	501.77	524.47		61761	501.77	524.65		61761	501.77	525.66		1.19	0.30
Loyal_main	1155.62	100y	61761	502.09	524.29		61761	502.09	524.47		61761	502.09	525.47		1.18	0.30
Loyal_main	1100.197	100y	61761	503.28	524.11		61761	503.28	524.29		61761	503.28	525.27		1.16	0.29
Loyal_main	1029.615	100y	61761	503.74	524.05		61761	503.74	524.22		61761	503.74	525.19		1.14	0.29
Loyal_main	981.576	100y	61761	504.73	523.77		61761	504.73	523.94		61761	504.73	524.90		1.13	0.28
Loyal_main	952.636	100y	61761	504.73	523.79		61761	504.73	523.95		61761	504.73	524.89		1.10	0.28
Loyal_main	884.634	100y	61761	505	523.8		61761	505.00	523.95		61761	505.00	524.85		1.05	0.26
Loyal_main	802.63	100y	61761	505	523.24		61761	505.00	523.37		61761	505.00	524.03		0.79	0.20
Loyal_main	700		Bridge				Bridge				Bridge					
Loyal_main	623.907	100y	61761	504	522.77		61761	504.00	522.82		61761	504.00	523.04		0.27	0.07
Loyal_main	577.211	100y	61761	499.11	522.83		61761	499.11	522.87		61761	499.11	523.02		0.19	0.05
Loyal_main	510.647	100y	61761	498.41	522.8		61761	498.41	522.83		61761	498.41	522.96		0.16	0.04
Loyal_main	386.34	100y	61761	498.27	522.89		61761	498.27	522.91		61761	498.27	522.98		0.09	0.02
Loyal_main	324.825	100y	61761	499.07	522.82		61761	499.07	522.84		61761	499.07	522.89		0.07	0.02
Loyal_main	232.376	100y	61761	499.06	522.79		61761	499.06	522.80		61761	499.06	522.84		0.05	0.01
Loyal_main	150.779	100y	61761	498.94	522.79		61761	498.94	522.79		61761	498.94	522.81		0.02	0.00
Loyal_main	71.709	100y	61761	498.77	522.8		61761	498.77	522.80		61761	498.77	522.80		0.00	0.00
										(EM 1110-2-1619 Eq. 5-7)			**Mean ---------->**		**1.62**	**0.40**

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Hydrological and Hydraulic Contributions to Risk and Uncertainty Studies

- Hydrologic Uncertainty

Uncertainty with the Discharge – Probability Curve

- Hydraulic Uncertainty

Uncertainty with the Stage – Discharge Function

➢ Interior Flooding Uncertainty

Storm Runoff from the watershed that drains to the interior of a levee must be passed through or over the levee (EM-1110-2-1619). Performance of facilities like gravity outlets, pump stations, pump discharge outlets, collection facilities, storm sewers, and detention storage/flooding involves uncertainty

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Baltimore District

Interior Flooding Uncertainty

- Optimal Process

Select four cases by identifying critical factors that define the best case, the Most-likely case, the worst-case, and a conservative case for interior facility Operation. Then, select a probability distribution to represent a likelihood of these scenarios (EM 1110-2-1619). The function should consider:

Table 7-1
Factors That Influence Interior-Area Facility Performance

- Number of pumps or the proportion of the total pumping capacity that remains if one or two pumps are inoperative.
- Reliability of the electrical power supply.
- Type and design of pumps.
- Configuration and design of the pumping station.
- Configuration and capacity of the associated ponding area and gravity outlets.
- Hydrologic and hydraulic characteristics of both the major (exterior) river basin and the interior watershed.
- Adverse weather conditions that may occur during a flood such as high winds, intense precipitation, hurricanes, or ice.
- Effectiveness of flood monitoring, forecasting, and warning systems.
- Institutional, organizational, financial, and personnel capabilities for maintaining and operating the project.
- Perceived importance of the closure.

Interior Flooding Uncertainty

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- Optimal Process

And the result should look like the following:

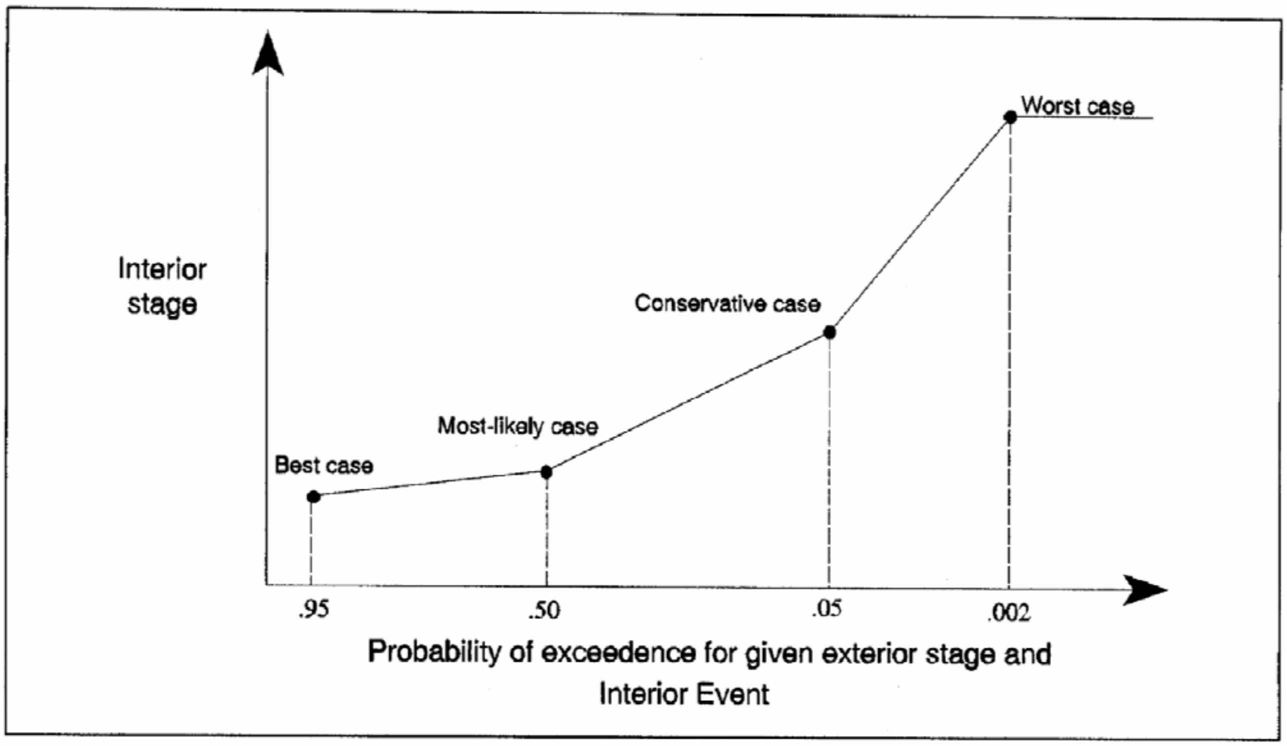

Figure 7-5. Probability function representing interior-stage uncertainty

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Interior Flooding Uncertainty

- Optimal Process

An annual exceedance curve for error probability similar to that from the HEC-FFA analysis would then be generated:

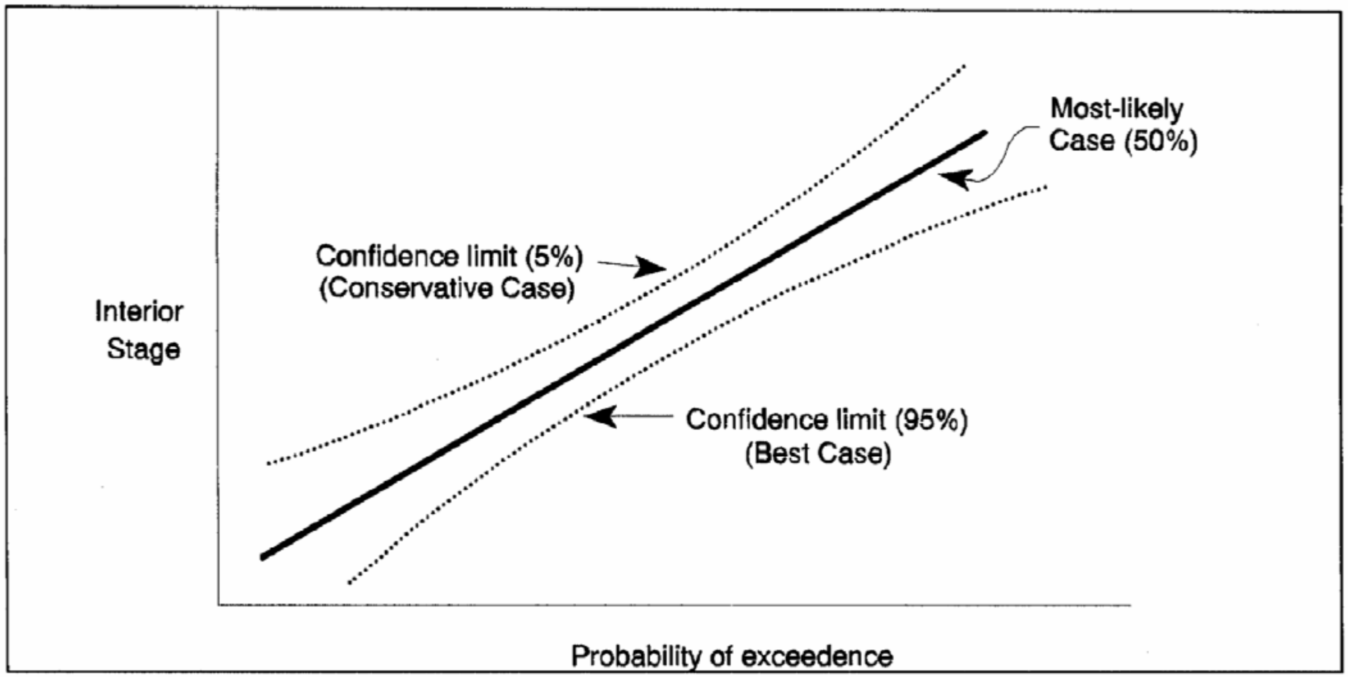

Figure 7-6. Example interior stage-exceedance probability function

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Interior Flooding Uncertainty

- Optimal Process

This process would be repeated for a range of values for exterior stage.

However, a study performed earlier

Indicated the best-fit curve did not fit well through points.

Interior Flooding Uncertainty

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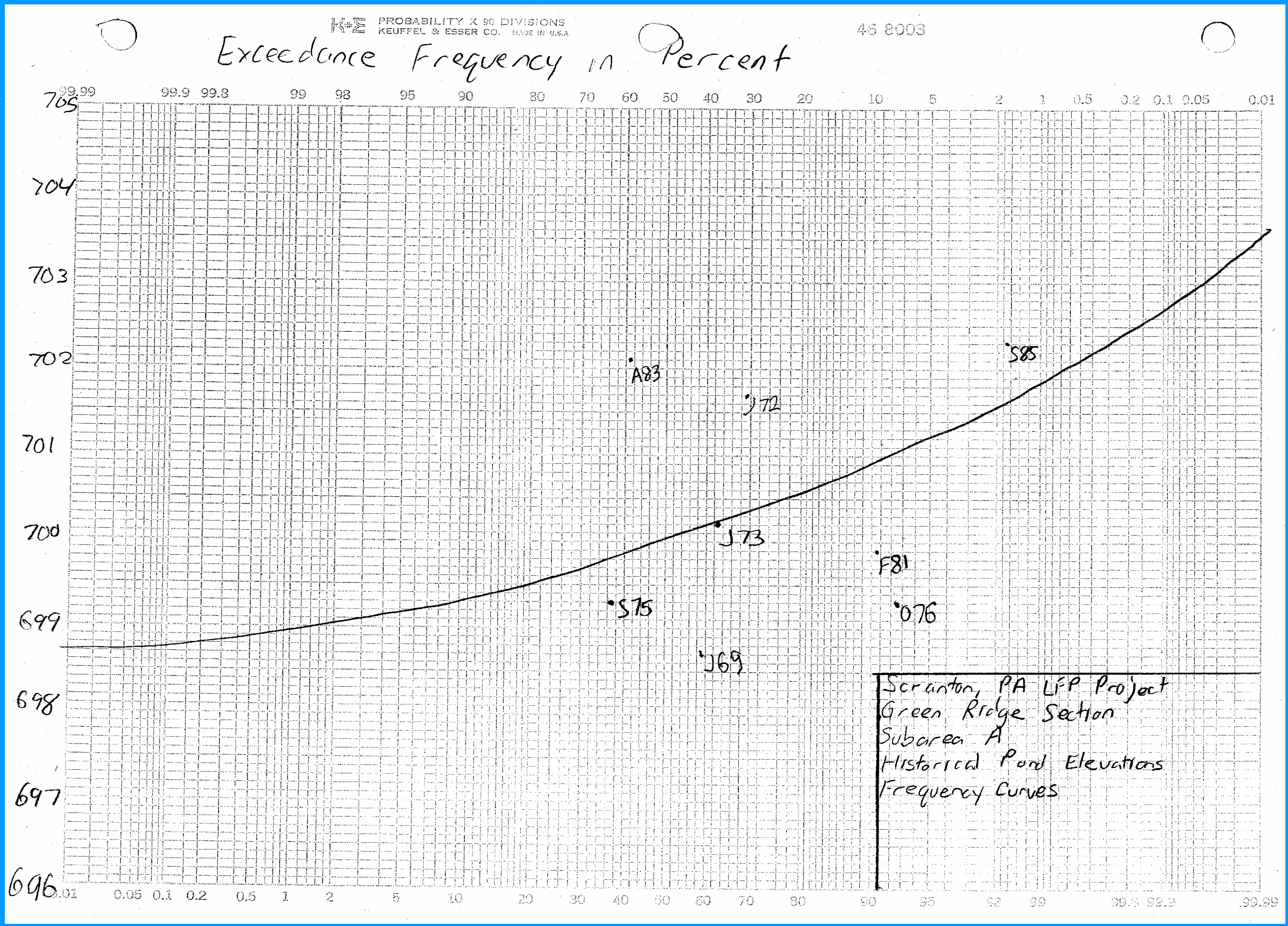

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Interior Flooding Uncertainty

Presently, there is no standard automated way to perform Interior Flooding analyses and their contributions to risk and uncertainty analyses. Presently used expensive procedures could be more efficient.

Standard procedure:

- HEC -1 for Hydrology and HEC-IFH / INTDRA3 for flooding analysis

Recommendation

- I believe in updating and merging HEC-IFH functionality into HEC-HMS and adding automated risk/uncertainty functionality compliant with EM 1110-2-1619 and EM 1110-2-1413, perhaps even an interior sub area delineation feature or something for HEC-GeoHMS

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Example Results

Table 9-13
Present Economic Benefits of Alternatives

Plan	Annual With-Project Residual Damage, $1000's	Annual Inundation Reduction Benefit, $1000's	Annual Cost, $1000's	Annual Net Benefit, $1000's
Without project	78.1	0.0	0.0	0.0
6.68-m levee	50.6	27.5	19.8	7.7
7.32-m levee	39.9	38.2	25.0	13.2
7.77-m levee	29.6	48.5	30.6	17.9
8.23-m levee	18.4	59.7	37.1	22.6
Channel modification	41.2	36.9	25.0	11.9
Detention basin	44.1	34.0	35.8	-1.8
Mixed measure	24.5	53.6	45.6	8.0

Table 9-14
Annual Exceedance Probability and Long-term Risk

Plan	Median Estimate of Annual Exceedance Probability	Annual Exceedance Probability with Uncertainty Analysis	Long-term Risk		
			10 yr	25 yr	50 yr
6.68-m levee	0.010	0.0122	0.12	0.26	0.46
7.32-m levee	0.007	0.0082	0.08	0.19	0.34
7.77-m levee	0.004	0.0056	0.05	0.13	0.25
8.23-m levee	0.002	0.0031	0.03	0.08	0.14
Channel modification	0.027	0.031	0.27	0.55	0.79
Detention basin	0.033	0.038	0.32	0.62	0.86
Mixed measure	0.014	0.016	0.15	0.33	0.55

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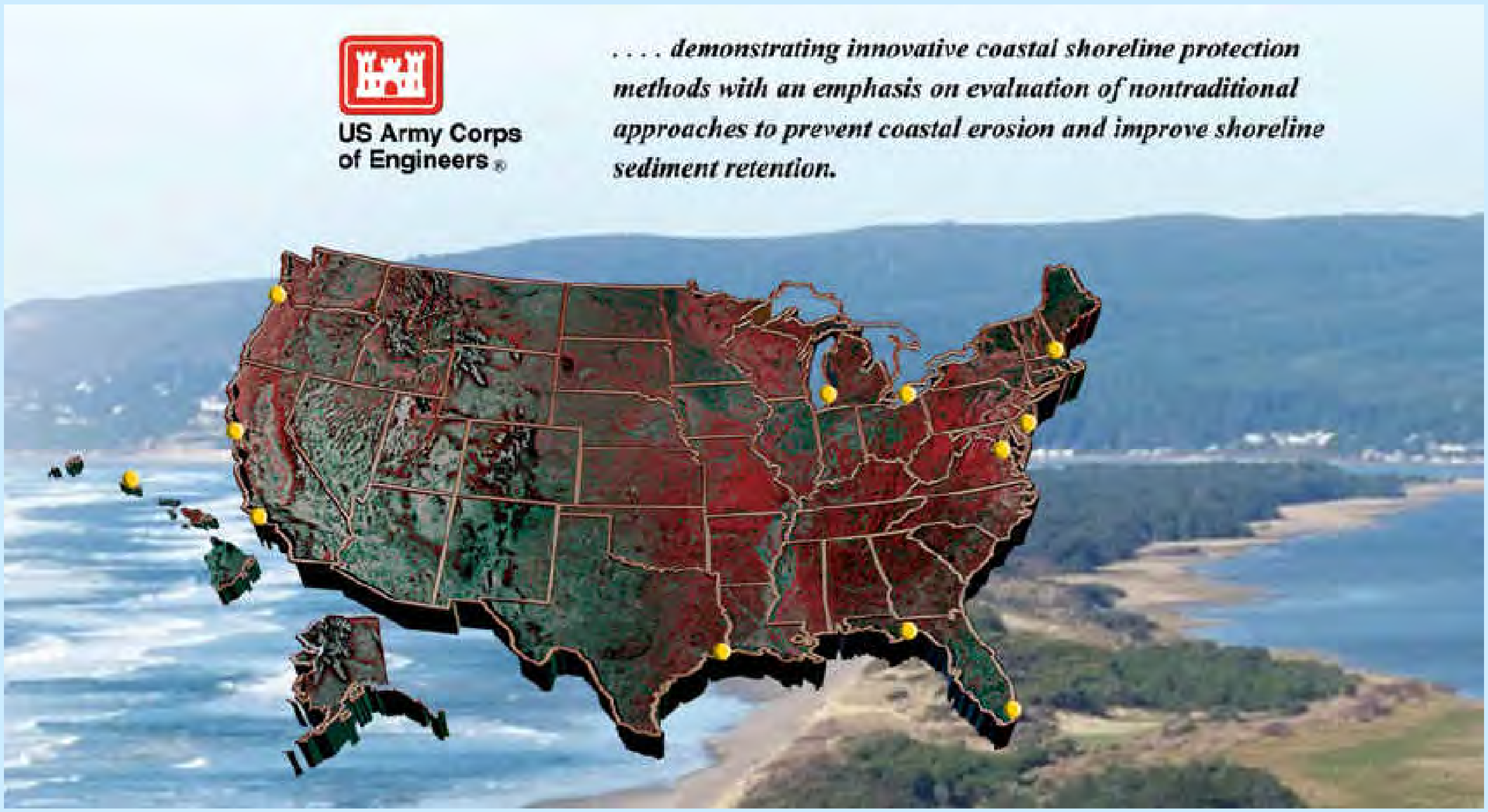
Summary

- Hydrologic and Hydraulic uncertainty needs to be properly studied to account for risk and make better informed decisions with flood situations.
- Current methodology accounts for uncertainty in most hydrologic and hydraulic parameters, EXCEPT

The ability to account for interior flooding uncertainties is still not straightforward at this time and a statistical software add-on in addition to updates to current interior flooding analysis packages would be recommended.

SECTION 227

National Shoreline Erosion Control Demonstration and Development Program



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227

National Shoreline Erosion Control Development and Demonstration Program Annual Workshop

August 4, 2005
St. Louis, MO

Workshop Objectives

SECTION 227

Discuss

- ***Program authority modifications***
- ***Tech transfer***
- ***Project status & issues***
- ***Future directions for SPP R&D***

Not a program review!

R&D Focus

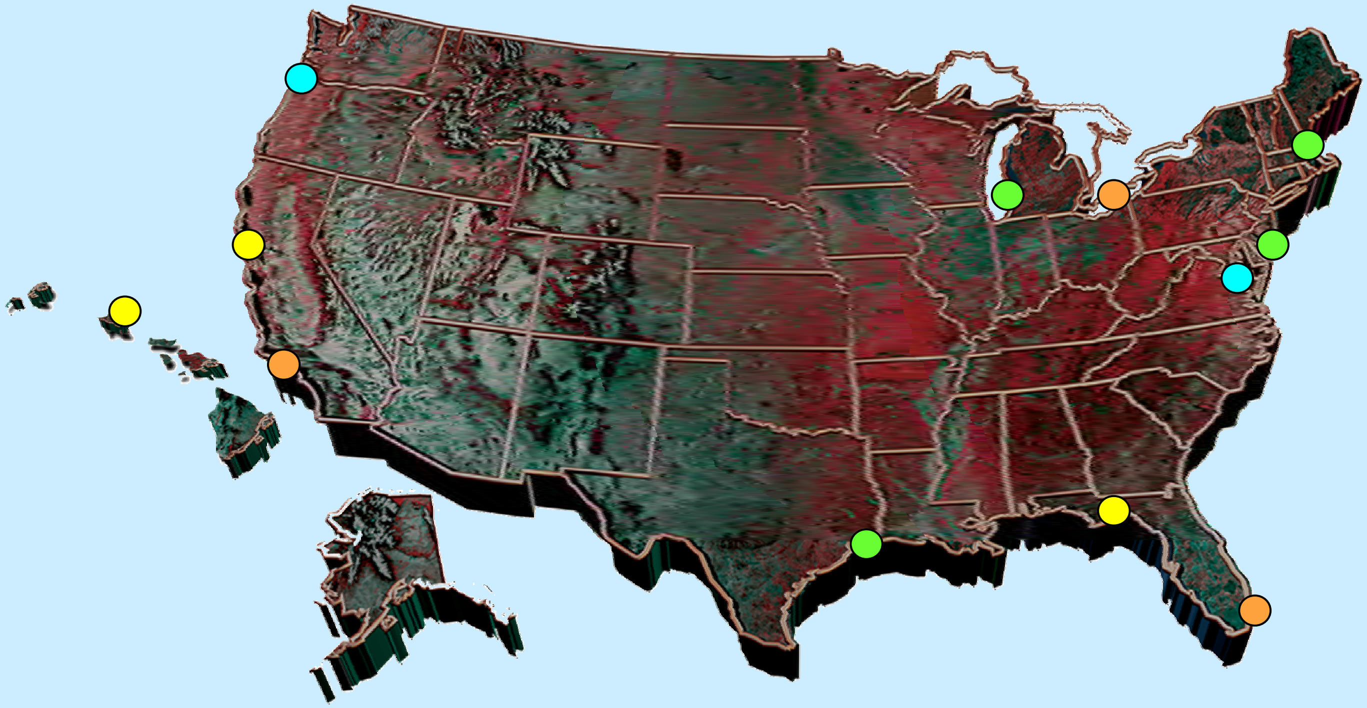
SECTION

227

…. <u>demonstrate</u> innovative coastal shoreline protection methods with an emphasis on evaluation of nontraditional approaches to prevent coastal erosion and improve shoreline sediment retention.

Project Locations

SECTION 227



…. developed in partnership with USACE Districts, Local & State Governments, Academia and Private Industry.

Project Evaluation

SECTION 227

Performance Statement

- Quantifiable metrics

Shore protection technologies evaluated for

- ***functional performance,***
- ***stability,***
- ***lifecycle cost,***
- ***environmental compliance,***
- ***value added over traditional methods***

Morphologic Settings

SECTION

227

Morphologic Settings

SECTION

227

Technologies

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227

Thermoplastic/Composites
Geotextiles
Low-Volume Beach Nourishment
Groundwater Manipulation
Narrow-Crested Pre-cast Concrete Sill
Wide Crested Pre-cast Concrete BW
Rubble Mound Headland/Sill/Tuned BW
Wide-crested BW Matrix
Wave Rotating Structure
Branch-Box BW
Dynamic/Cobble Revetment
Dune Fortification

Benefit

SECTION

227

Potential for improved shore protection project performance

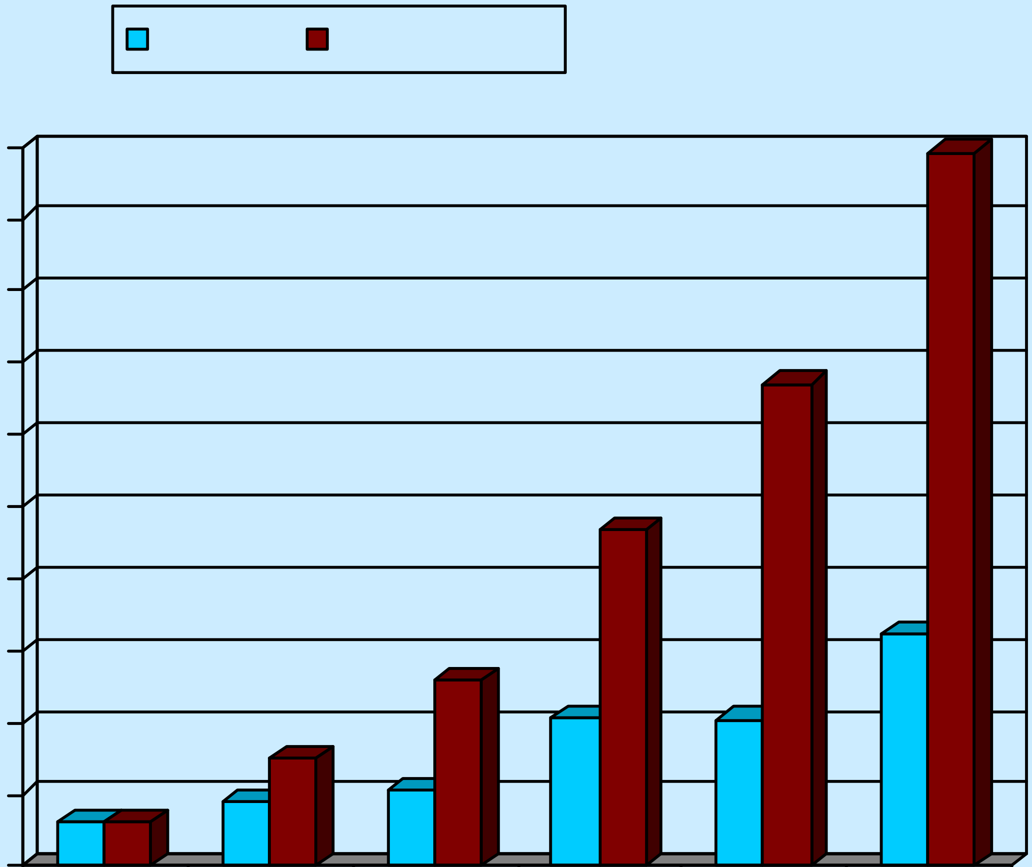
Improved Design and Regulatory Guidance

Administration-Supported Shore Protection Authority

Budget Summary

SECTION

227



	FY00	FY01	FY02	FY03	FY04	FY05
Annual	1250	1785	2133	4158	4084	6441
Cumulative	1250	3035	5168	9326	13411	19852

Estimated 06-09 Capability: $10M+

Action Item

S E C T I O N 227

FY'06 – '09 Project Budget

- Assume continued program authority
- Capability by FY
- Estimated time and cost schedule
- Include Lab/District activities
- Suspense: Aug 31
- Submit to PM thru Lab POC
- Assume 5-year monitoring/evaluation

Action Item

SECTION 227

ASBPA 2005 Conference and Annual Meeting
10-12 October 2005
San Francisco, CA

- Resubmittal of 2004 Section 227 abstracts
- 10+ presentations
- No special session
- Possible program meeting to discuss new authority and ’06 plans

Register before 09 September!

Authority Modifications

S E C T I O N 227

Duration:

108th: 10 yrs ($10M additional)

109th: Indefinitely (up to $10M annual, Section 103)

Emphasis:

• Improve design and formulation tools
• Improve project performance
• Improve lifecycle cost
• Native vegetation

Sites:

• Broader then existing law and consistent with Federal beach nourishment standards

Authority Modifications

SECTION 227

Responsibility:
- Acting through Chief of Engineers

Report:
- Annual to Senate Cmte on Environmental and Public Works
- Annual to House Cmte on Transportation and Infrastructure
- 31 December suspense

Cost Sharing/O&M:
- 108th: Cost share w/ Partner for construction/monitoring
- 109th: Cost share as 108th, Cost share removal, O&M not borne by Program

Flood Fighting Structures Demonstration And Evaluation Program (FFSD)

Tri-Service Infrastructure Systems Conference
August 3, 2005

US Army Corps
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Coastal and Hydraulics Laboratory
Geotechnical and Structures Laboratory

Flood Fighting Structures Demonstration And Evaluation Program (FFSD)

1. Background
2. Product Selections
3. Laboratory Testing
4. Field Testing
5. Product Summaries
6. Remaining Work

Flood Fighting Structures Demonstration And Evaluation Program (FFSD)
Authorization

2004 Energy and Water Development Bill

"The conferees therefore direct the Corps of Engineers to act immediately to devise real world testing procedures for Rapid Deployment Flood Wall (RDFW) and other promising alternative flood fighting technologies."

Product Selections

Congressional Directive

Rapid Deployment Flood Wall (RDFW)

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Product Selections

Standard for Comparison
Sandbags

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Product Selections

1. Develop Evaluation / Selection Criteria
2. Issue Solicitation for Technical Proposals
   - 9 Proposals Received
   - Categories - Product Type

     Impermeable Liner (with or without frame)

     Granular Filled Container

     Water Filled Bladder
3. Evaluate Proposals and Make Selections Based on Technical Merit

Product Selections
Competitive Technical Proposals
Portadam

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Product Selections

Competitive Technical Proposals
Hesco Bastion

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Evaluation Parameters

1. Product Requirements

- Footprint and ROW requirements
- Durability
- Ease of Construction and Removal
  - Time / Manpower/ Equipment
- Adaptability to Varying Terrain
- Seepage
- Fill Requirements
- Cost
- Repair and Reusability
- Ability to Raise During Flood

2. Tests

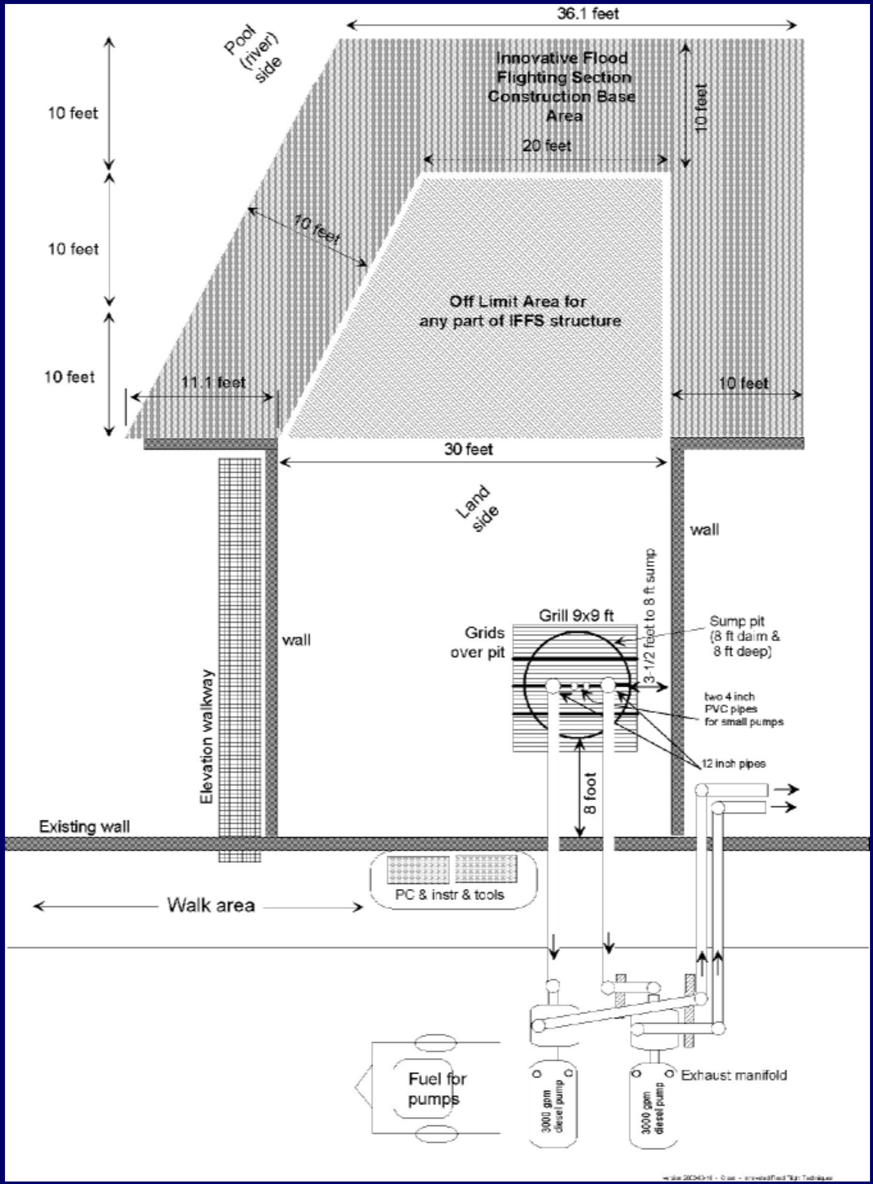
- Static Loading
- Overtopping
- Wave Impact
- Debris Impact

3. Performance on Various Surfaces

- Freshly Graded
- Grass / Weeds
- Finished Concrete

Laboratory Testing

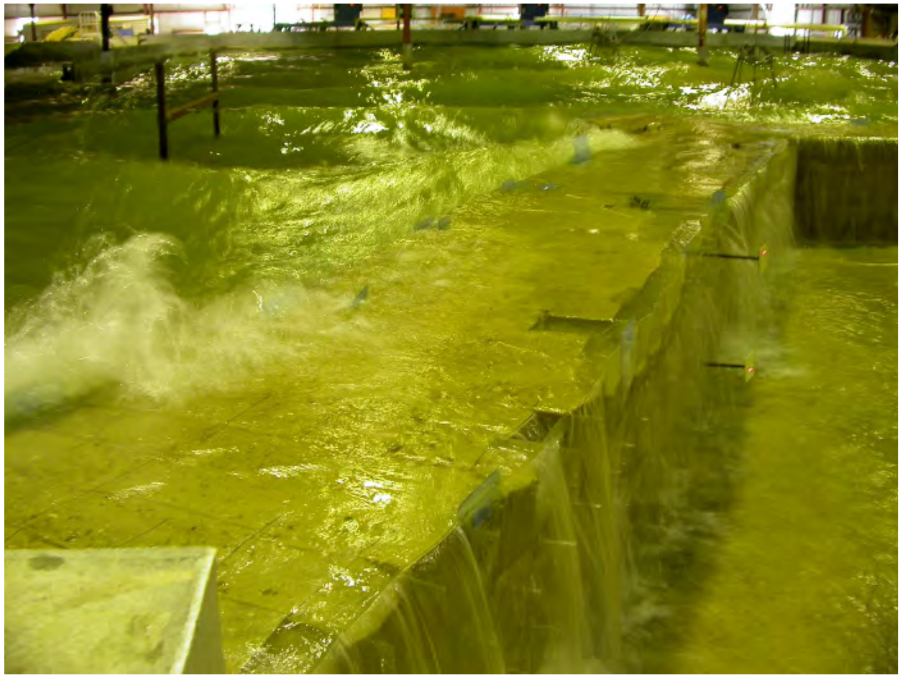
Construction Footprint



Laboratory Testing

Sandbag Structure

RDFW



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Laboratory Testing
Debris Impact

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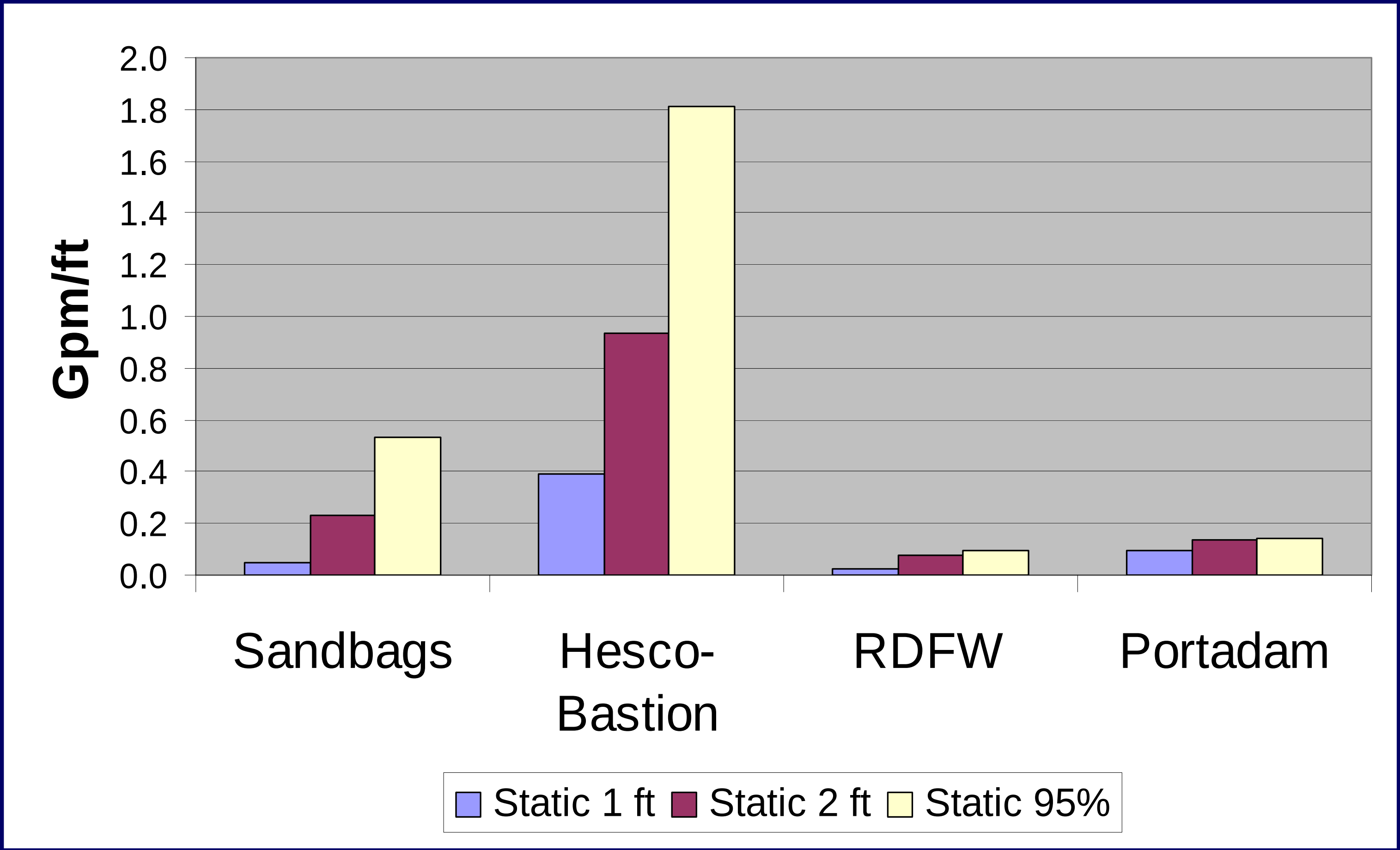
Laboratory Results

Structure	Construction Effort (man hours)	Removal Effort (man hours)
Portadam	24.4	4.4
Hesco	20.8	13.4
Sandbags	205.1	9.0
RDFW	32.8	42.0

Laboratory Results

Seepage



Laboratory Results - Damage

Sandbag Structure

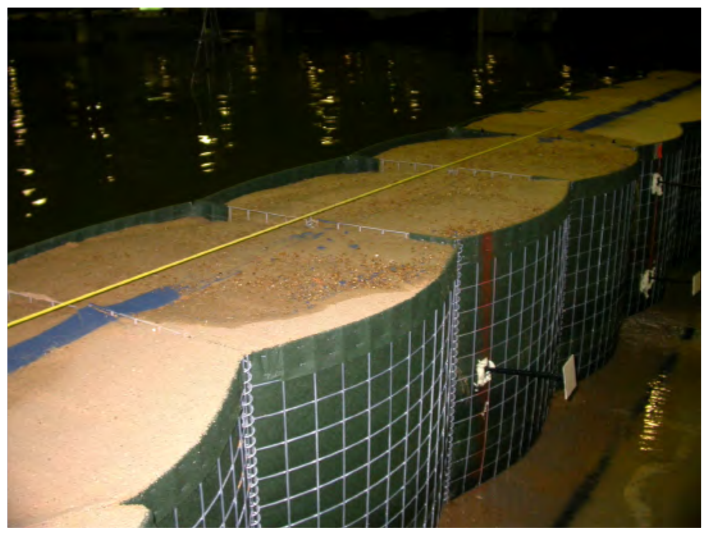
Repeatedly damaged by waves

Failed during overtopping

Hesco-Bastion

Minor sand settling and washout

Wire bent during debris impact tests



Laboratory Results - Damage

RDFW

Minor sand settling

Significant washout along edges and toe

Toe damaged during large waves or overtopping

10% of structure broken

Portadam

Liner torn during debris impact test

Field Testing

Site Selection

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Field Testing
As Constructed

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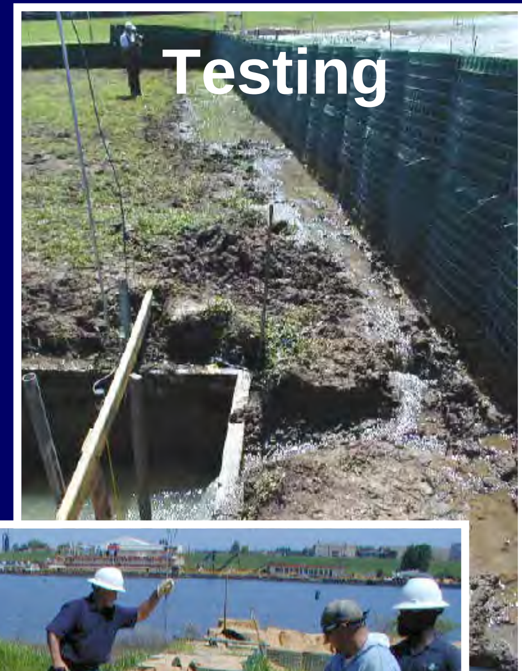
Geotechnical and Structures Laboratory

Portadam – As Delivered

Portadam Structure

Hesco Bastion – As Delivered

Hesco Bastion Structure



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Hesco Bastion
Installation Modification

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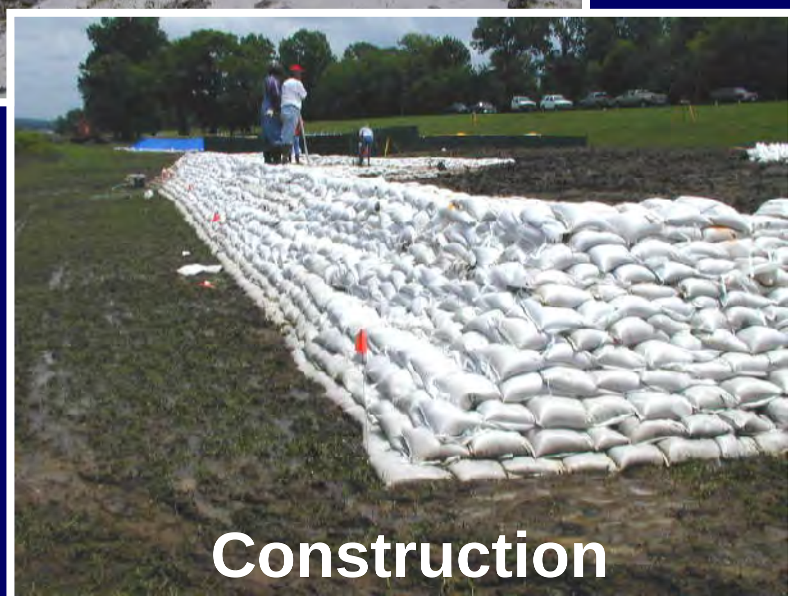
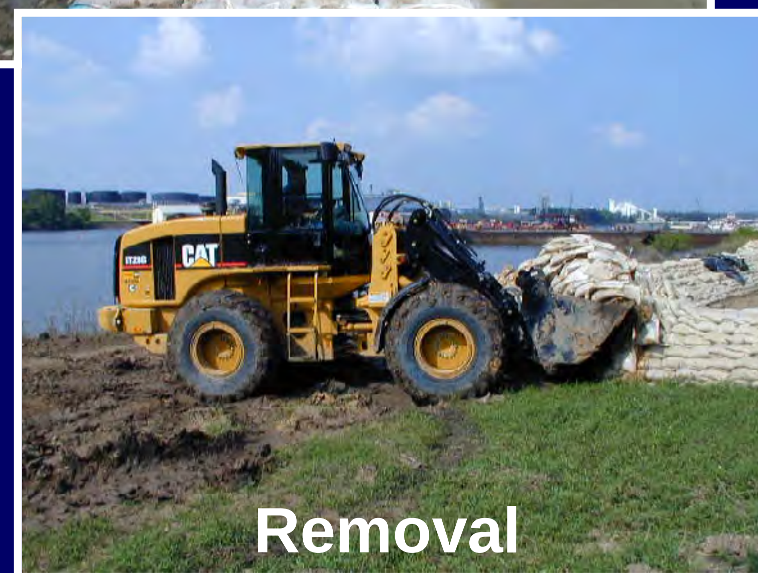
Sandbag Structure





RDFW – As Delivered

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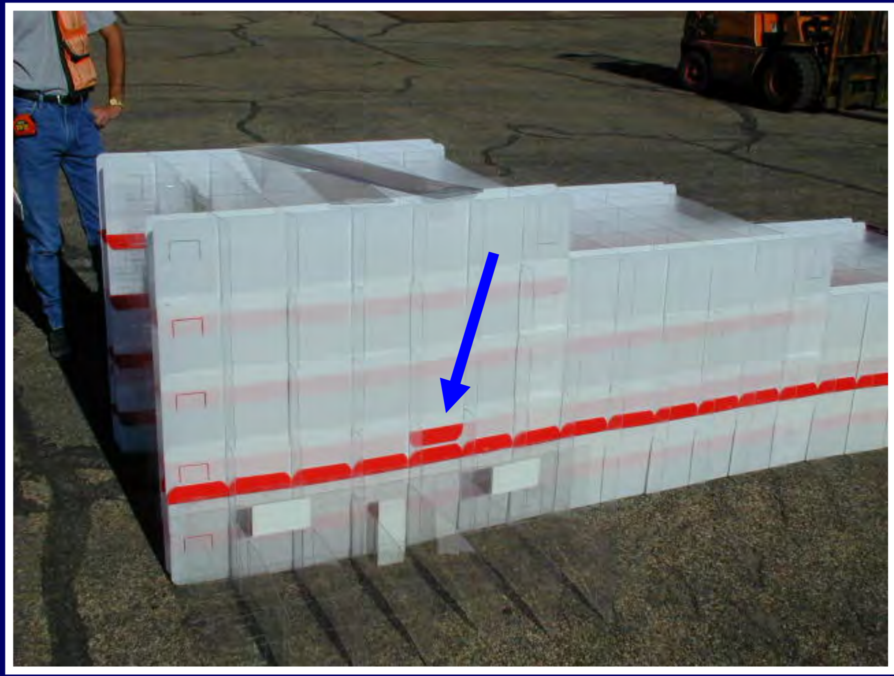
RDFW Structure

RDFW
Post Testing Modifications



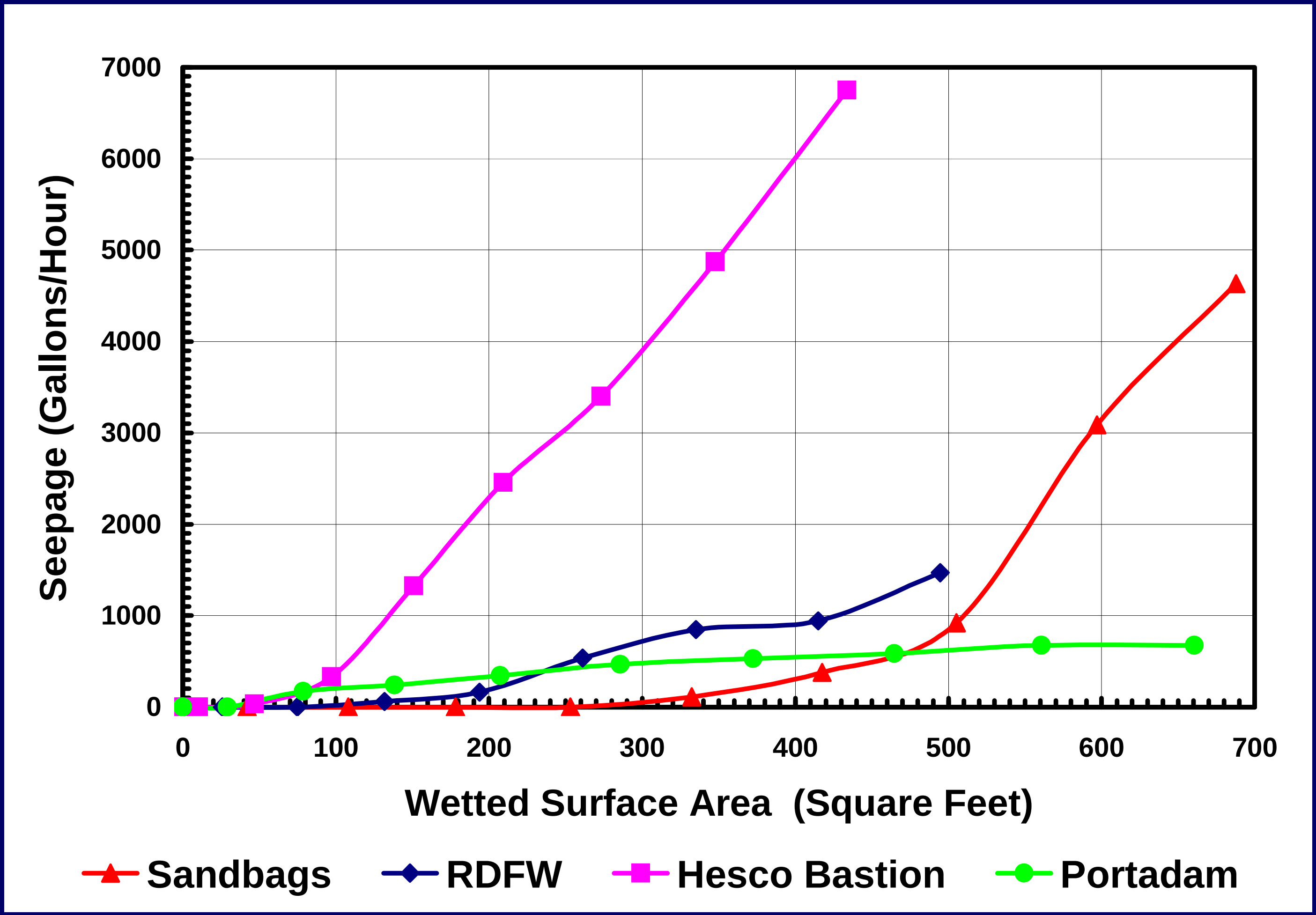
- Color Coded for Accurate Installation
- Rounded Corners
- Suction Trailer Available to Expedite Removal

Field Testing
Construction and Removal

Structure	Construction Time (hours)	Construction Effort (man hours)	Removal Time (hours)	Removal Effort (man hours)
Portadam	5.1	26.2	2.9	12.6
Hesco Bastion	8.9	57.5	8.7	36.3
Sandbags	30.5	453.1	2.6	3.5
RDFW	7.5	48.4	17.3	113.4

Field Testing

Seepage



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Field Testing - Damage

Portadam

None - 100% reusable

Hesco Bastion

Bent some panels and coils
Over 95% reusable

Sandbags

Bags began to deteriorate
All sandbags disposed

RDFW

Broke some unit pieces
95% of pieces reusable

Portadam Summary

Strengths

Ease of Construction / Removal (time, manpower, equipment)

Low seepage rates

No fill required

High degree of reusability

Least ROW required

Weaknesses

Punctured during debris impact test

Can’t be raised in typical application

Hesco Bastion Summary

Strengths

Ease of Construction / Removal

(time & manpower)

Low cost

High degree of reusability

Can be raised

Weaknesses

Significant ROW required due to granular fill

Highest seepage rates

Sandbag Summary

Strengths

Low Cost (volunteer / prison labor)

Conforms well to varying terrain

Low seepage rates

Can be raised

Weaknesses

Very labor intensive

Not reusable

RDFW Summary

Strengths

Ease of Construction (time & manpower)

Low seepage rates

High degree of reusability

Can be raised

Most height flexibility (8 inch units)

Weaknesses

Significant ROW required due to granular fill

High cost

Difficult to remove

Remaining Work

1. Place testing data and results on publicly accessible web page.

2. Conduct pilot tests at 3 locations around the country.
   - Philadelphia / Baltimore Districts
   - Omaha District
   - Sacramento District

3. Use purchased products in actual flood events.

Pilot Testing
Omaha District - Missouri River

As Installed

July 2005

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Geotechnical and Structures Laboratory

Use During Actual Flood
Iron County, Utah

Installation
May 2005

Removal
July 2005

Flood Fighting Structures Demonstration And Evaluation Program (FFSD)

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Bank Erosion and Morphology of the Kaskaskia River

US Army Corps of Engineers

US Army Corps
Of Engineers
St. Louis District

APPLIED RIVER ENGINEERING CENTER

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

Team Partners :

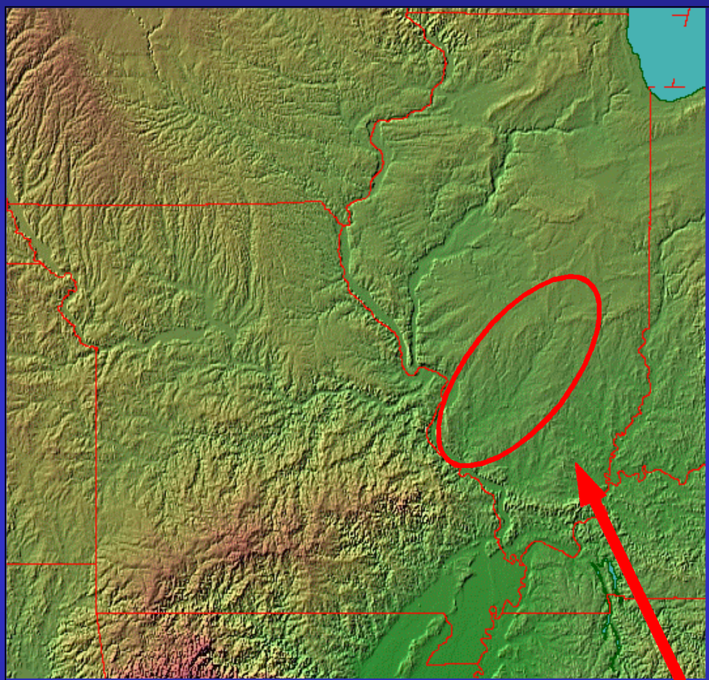
Fayette County
Soil and Water
Conservation District

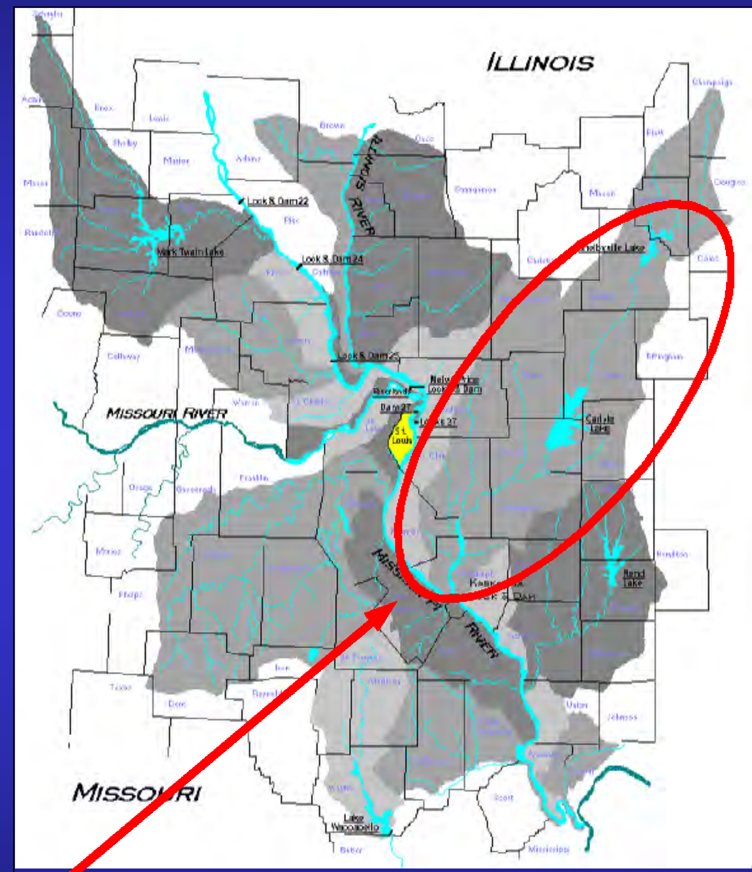
Carlyle Lake
Ecosystem Partnership

USDA NRCS Natural Resources Conservation Service

Vicinity

US Army Corps of Engineers





Study Reach

Background Information

• The Kaskaskia is a typical alluvial channel with a length of over 300 miles, while the total fall is approximately 390 ft

•The watershed of the Kaskaskia River covers 5,790 mi^2, the second largest in the state of Illinois

• The length of the watershed is about 175 miles and has an average width of 33 miles, with a maximum width of 55 miles

•The natural flow regime has been altered by three major Corps of Engineer's projects. Two flood control reservoirs; the 26,000-acre Carlyle Lake Project (1967) and the 11,200-acre Lake Shelbyville (1970). The final project was the Kaskaskia River Navigation Project (1972)

Study Divided into Two Sections

Middle Kaskaskia – Shelbyville Dam to Carlyle Lake

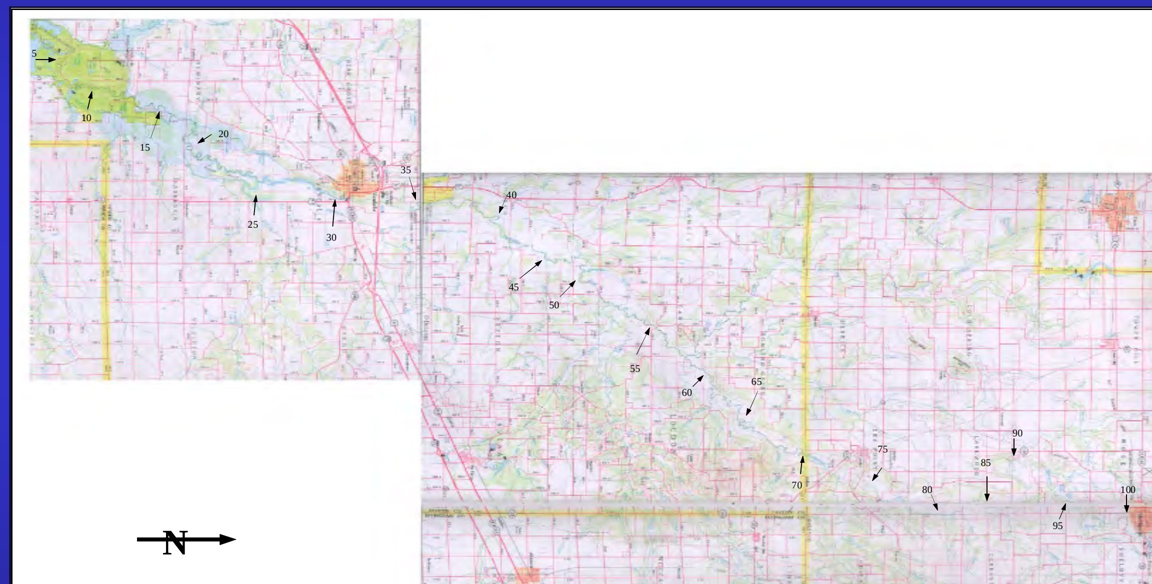
- **Consists of 98 River Miles**
- **Major Factors in the present river morphology were the major land use changes that occurred during the past 170 years**
- **Bank Erosion Study Completed in 2003**

Lower Kaskaskia – Carlyle Dam to the Confluence of the Mississippi

- **Consists of 95 River Miles**
- **Major Factor in the present river morphology was the straightening of 52 miles of river for navigation purposes**
- **Effect of the Kaskaskia River Navigation Project Completed in 1999**

Middle Kaskaskia Section
Shelbyville Dam to Carlyle Lake

- Drainage area of 2140 mi^2
- Peak flow at Vandalia 19,300 cfs
- Researched several land use maps and aerial photos
- Analyzed over 100 river bends

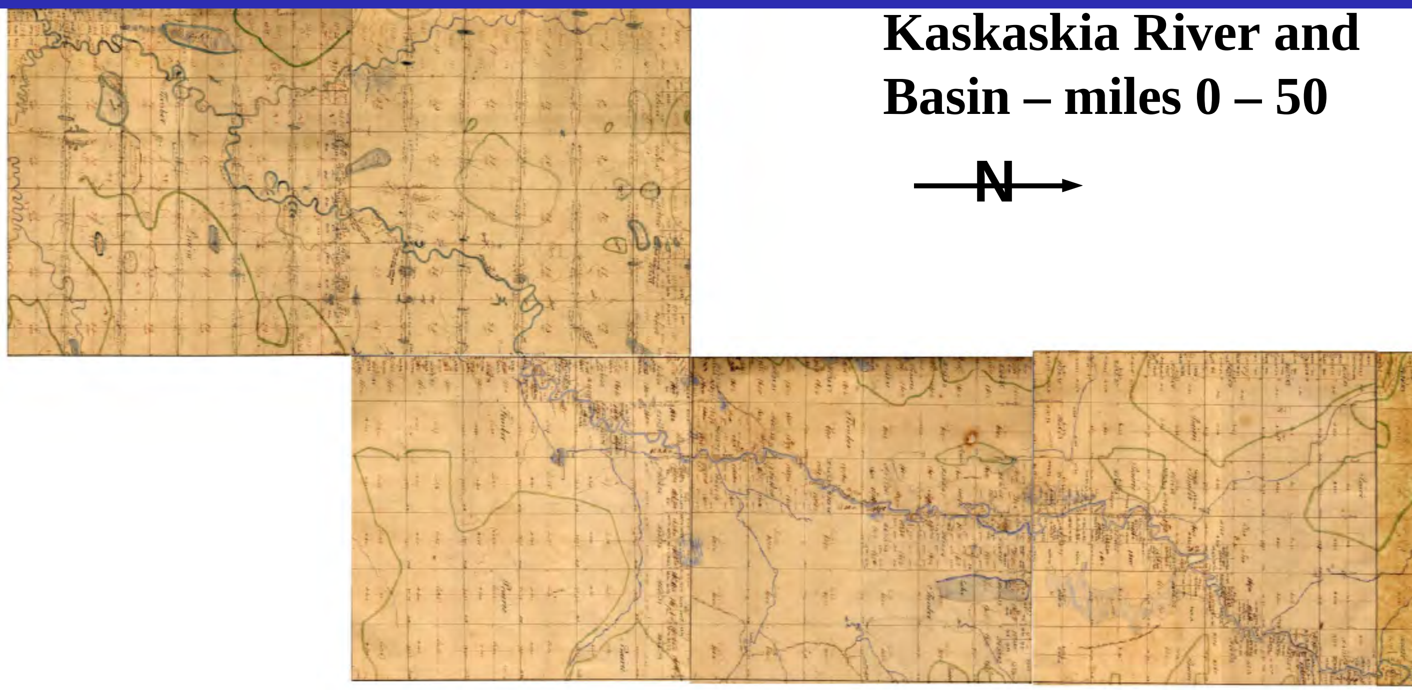


Analysis and Data Collection Methodology

US Army Corps of Engineers

- The first complete survey of the State of Illinois was conducted by the Government Land Office (GLO) between 1820 and 1830. Of the GLO, only miles 0-50 of the Kaskaskia River and its floodplain were available
- Aerial photos of the entire main channel and floodplain of the Kaskaskia River were gathered for the years 1938, 1966, and 1998. The aerial photos were scanned in and large mosaics were generated
- The GLO was used for qualitative comparison of the relative position of the river in 1820 versus 1998. It was also used for land use changes of the floodplain in 1820 versus 1938, 1966, and 1998
- The 1938, 1966, and 1998 aerial photos were used for qualitative comparison of relative position of the river attributes such as width, length, wetted edge, etc. and also for land use changes, feet of bare bank, etc.

1820 GLO Survey



Kaskaskia River and Basin – miles 0 – 50

N

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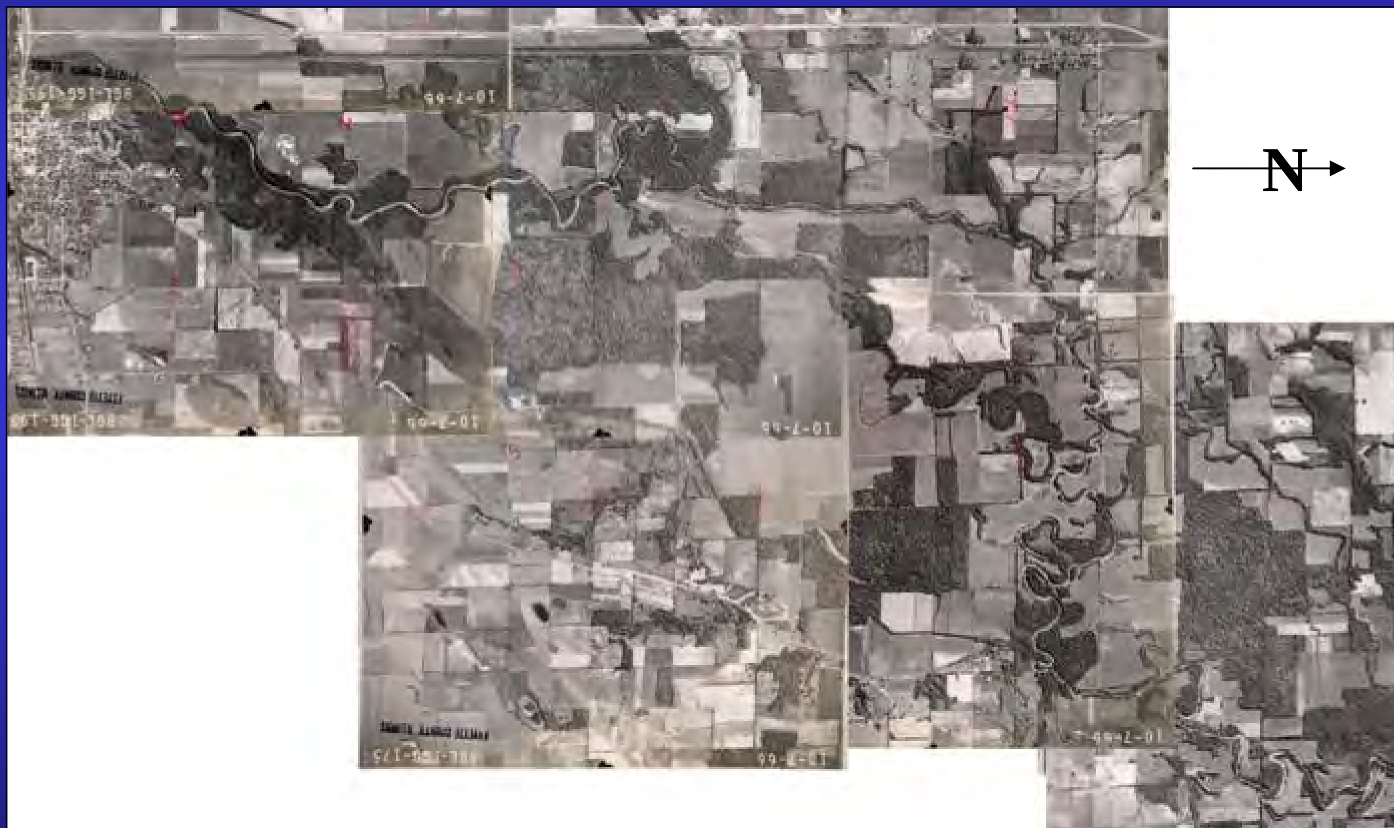
of Engineers

1966 Mosaic



River Length and Sinuosity

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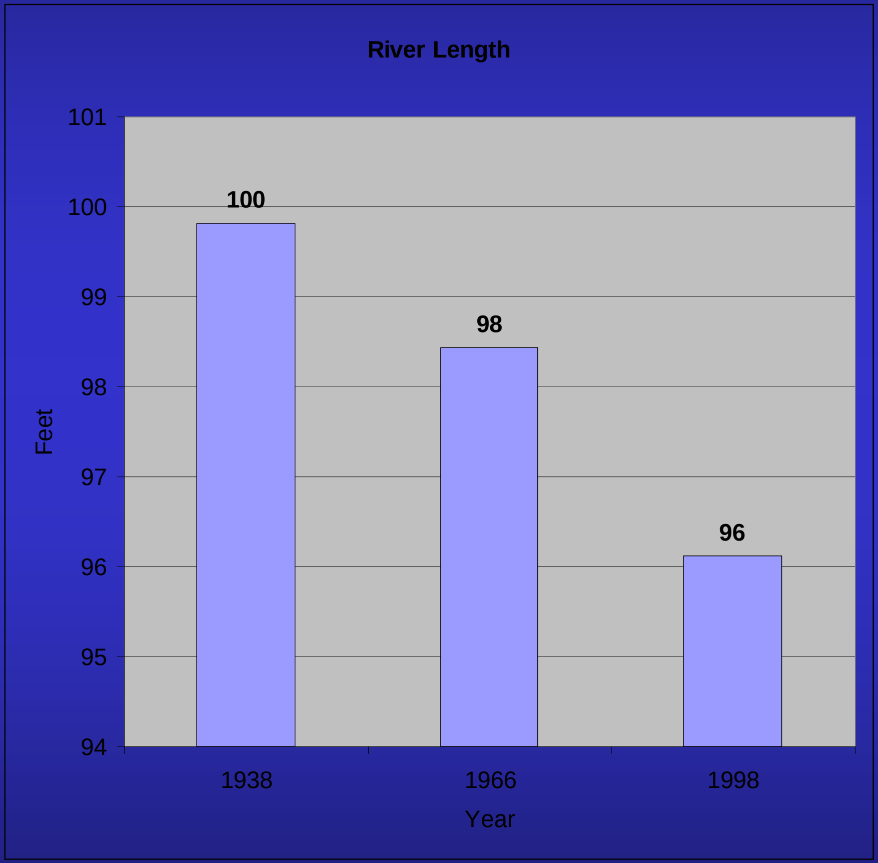
- The river was measured as approximately 102 miles in 1938 and 98 miles in 1998, an overall loss of 4 miles

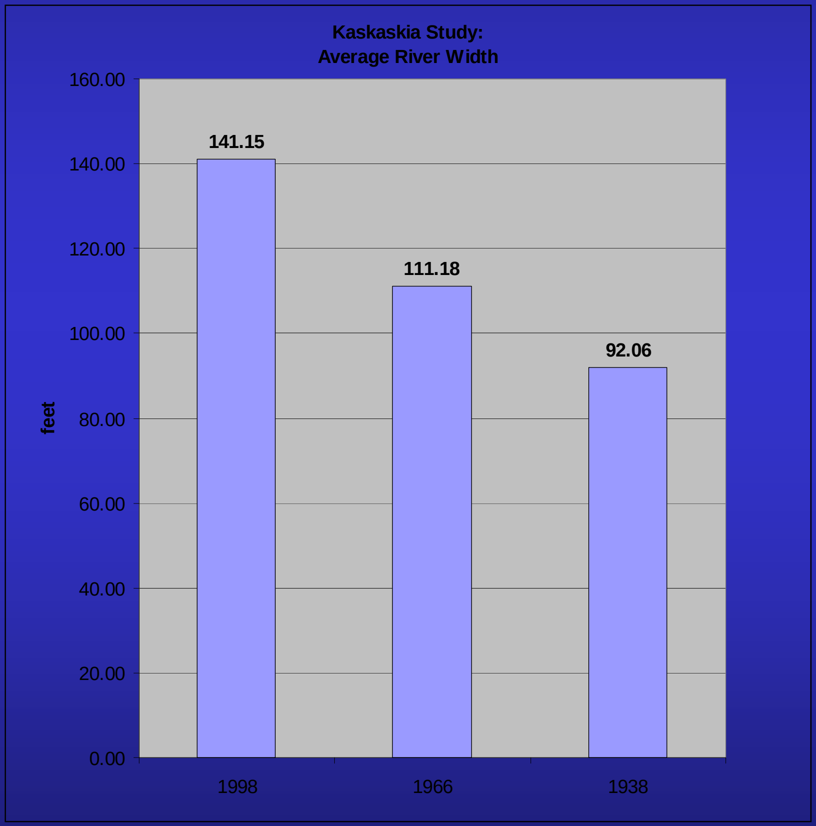
- The sinuosity of the entire study reach was computed as 1.8 in 1938 and 1.7 in 1998



Average Channel Widths and Widening Rates

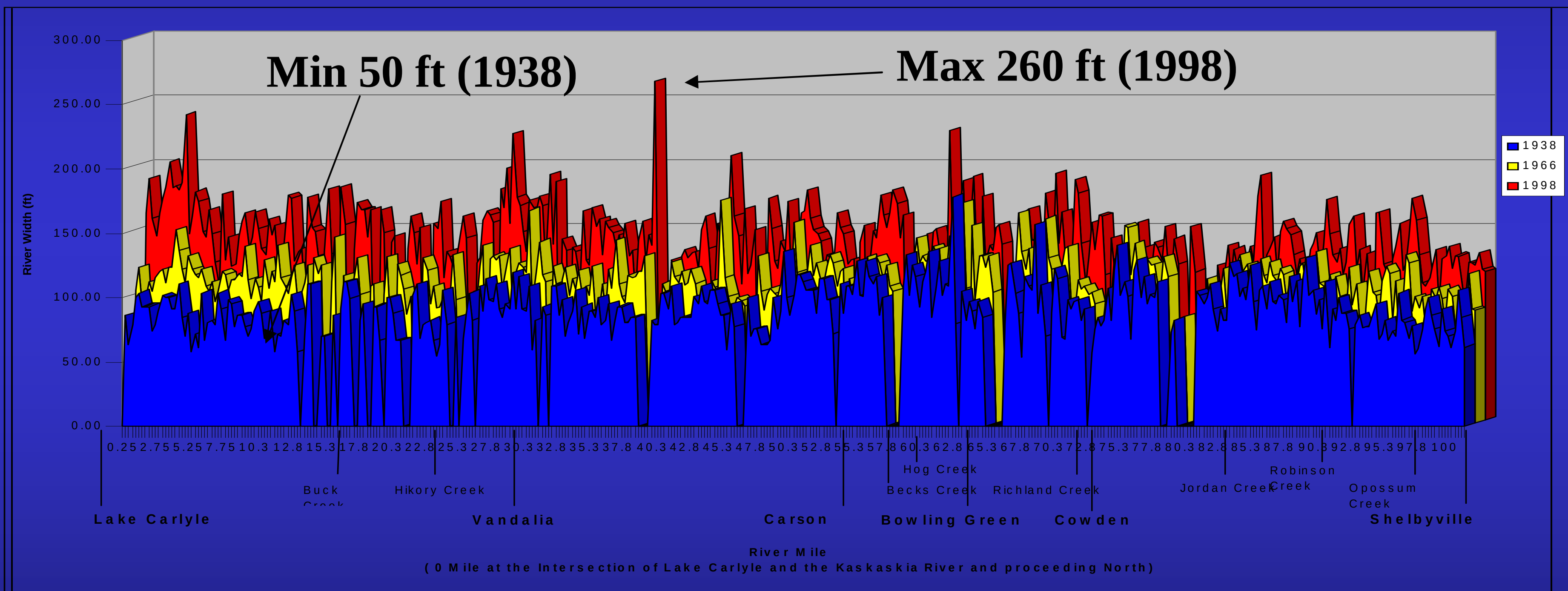
US Army Corps of Engineers

- The average channel width was approximately 92 ft in 1938, 111 ft in 1966, and 141 ft in 1998
- This resulted in an overall channel width increase of over 54% from 1938 to 1998
- The channel widened, on average of 0.8 ft/yr between 1938 and 1998
- Widening rate immediately downstream of Shelbyville Dam is the same as the average widening rate



Channel Widths

(1938, 1966, and 1998)



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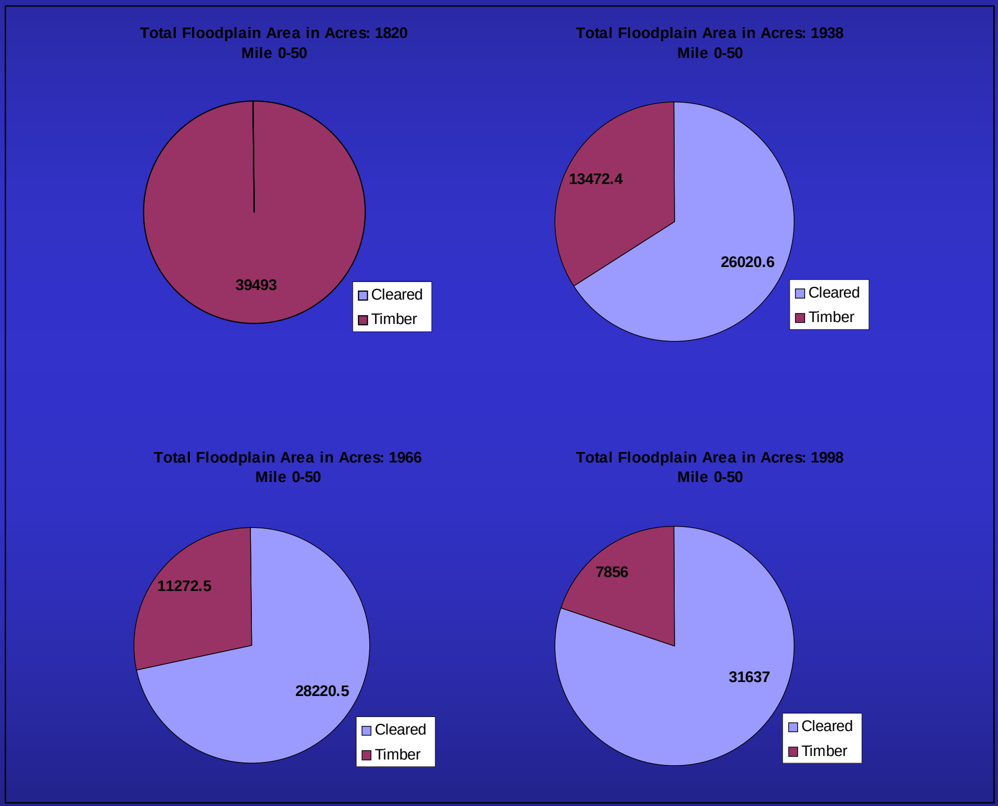
Land Use Change

(River Miles 0-50)

US Army Corps of Engineers

- The total floodplain area between miles 0 and 50 was approximately 39,500 acres
- In 1820, 99.9 % of the floodplain was forested
- By 1998, 80% of the floodplain was cleared

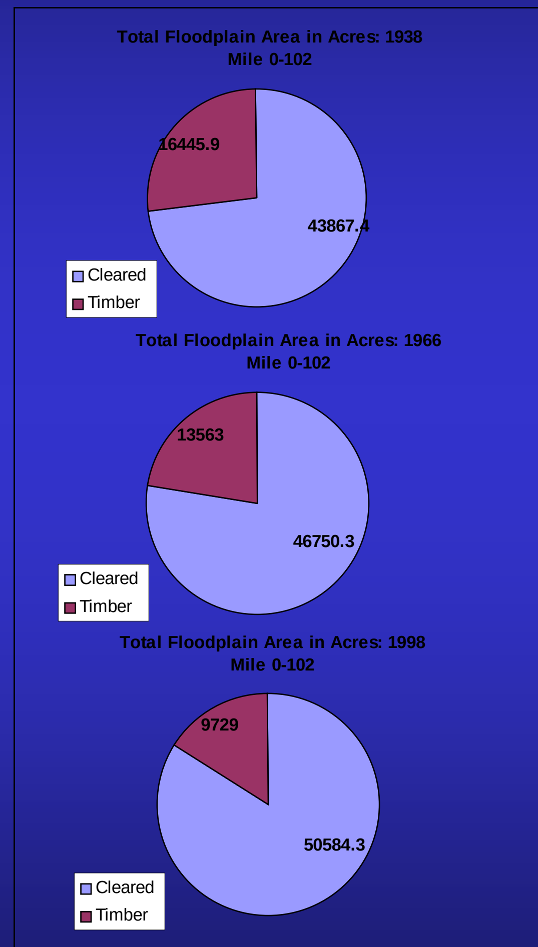


Land Use Change

(Total Floodplain)

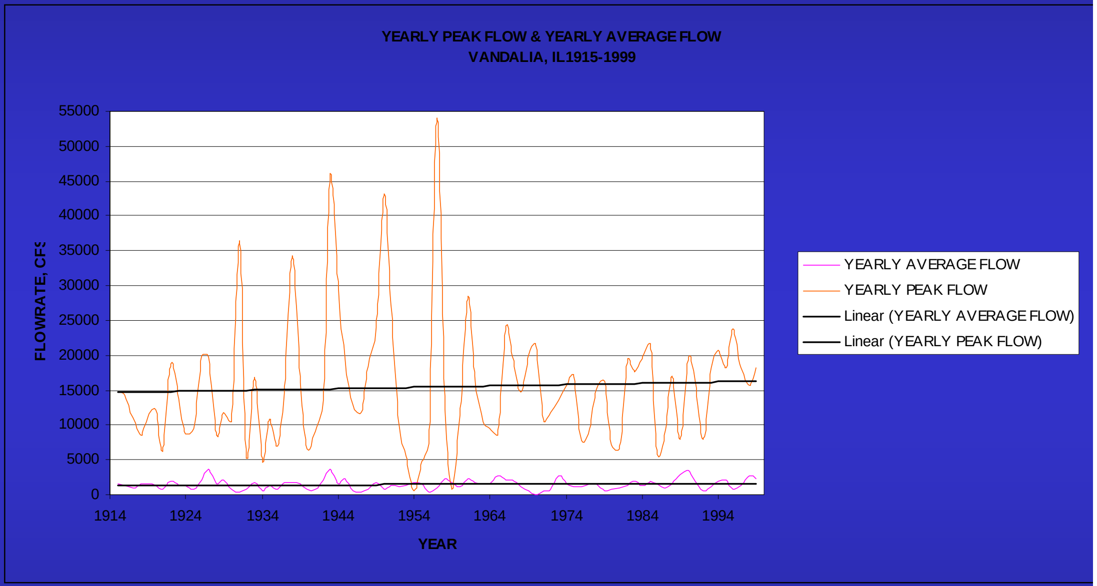
US Army Corps of Engineers

- The total floodplain area between miles 0 and 102 was measured as approximately 60,300 acres
- It was estimated that by 1966, 73% of the total floodplain was cleared and by 1998 over 84% was cleared



Historical Flow Trends

- Historical flow trends were examined at the Vandalia and Shelbyville gages
- Average annual flow rate increased 17% between the period 1972 to 1999 (1,841cfs) compared to the period 1842-1969 (1,532cfs)

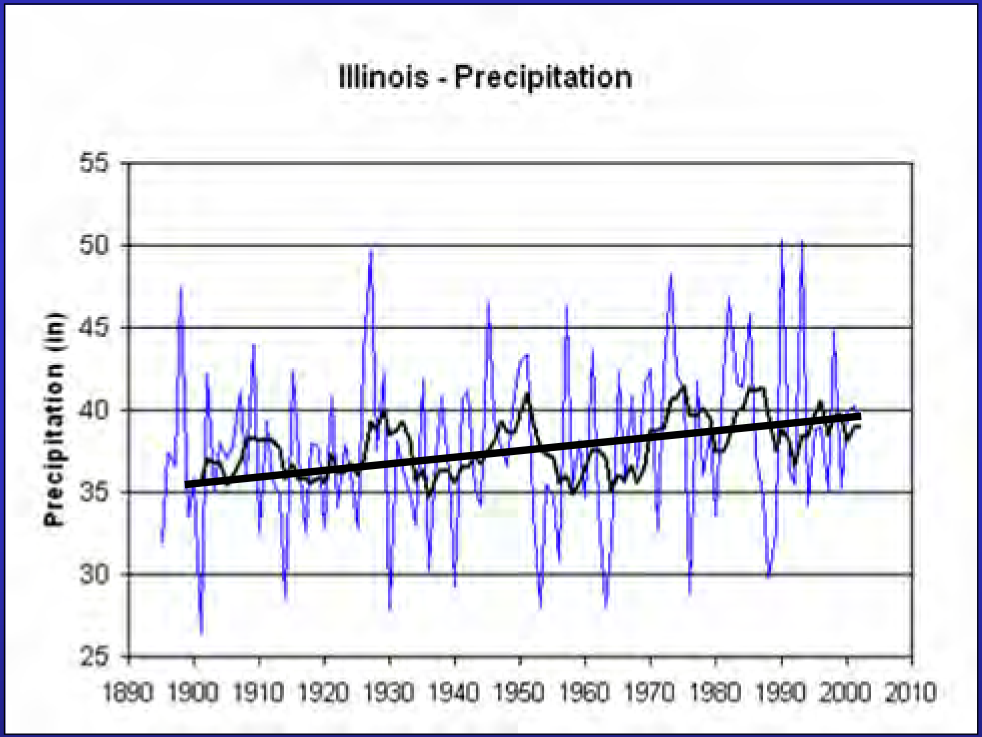


Historical Precipitation Trends

US Army Corps of Engineers

• **Annual precipitation at Urbana, Illinois between 1900 and 2001**

• **Tend line indicates that the average annual rain fall is increasing**



Current State of the Middle Kaskaskia River

• Bank erosion was prevalent throughout the study reach

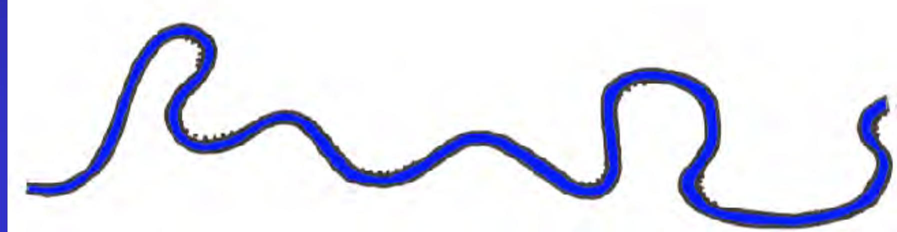
• Most bend channels were actively eroding, containing vertical banks, large sand bars, downed trees and channel blockages

Current State of the Middle Kaskaskia River

US Army Corps of Engineers

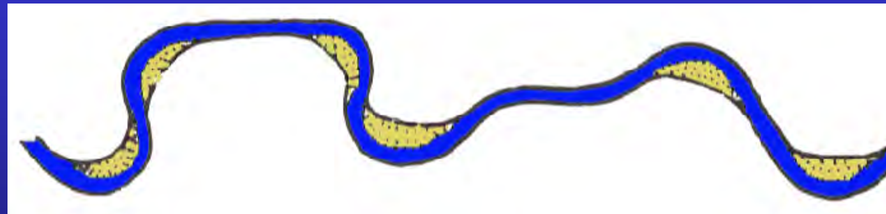
- **Due to the increased widening, decrease in sinuosity and reduction of the channels ability to transport sediment the channel is transforming**

1938



Sinuous Canaliform

1998



Sinuous Braided Canaliform

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Effects on Tributaries

- Most of the tributaries have been channelized in the basin
- Headcutting has occurred along most of these channels, with widespread deposition of fine material
- The middle reaches of the tributaries have experienced moderate to sustainable bank erosion

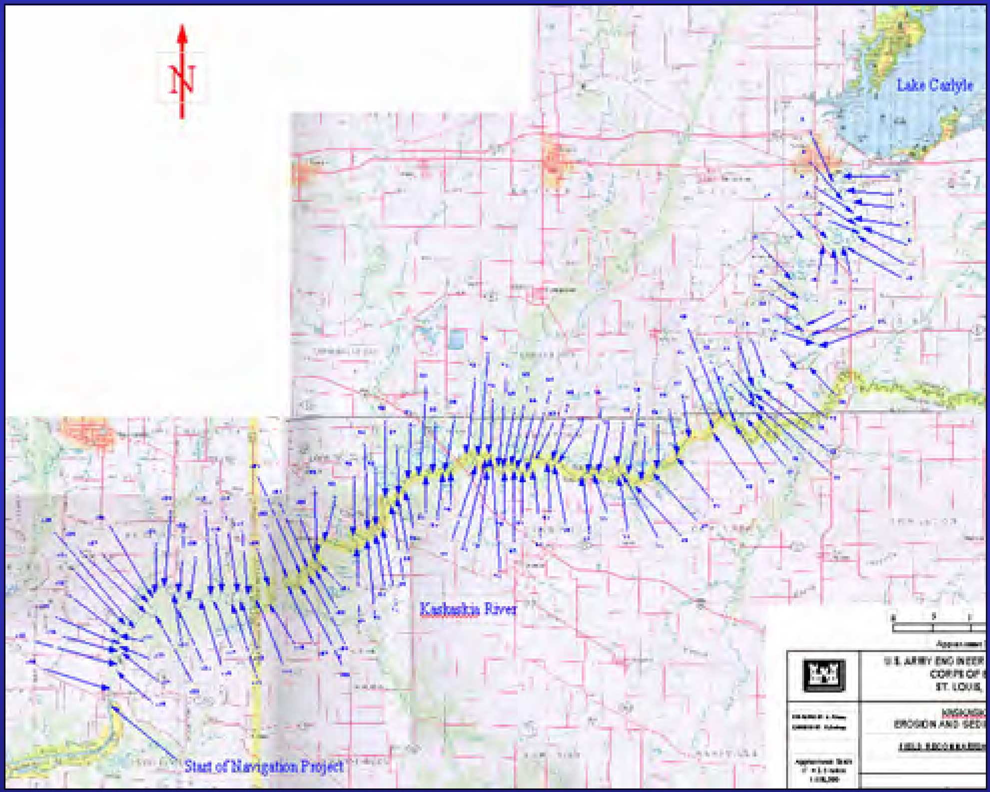

Middle Robinson Creek


Eroded Drainage Ditch

Lower Kaskaskia Section

Carlyle Dam to Confluence of Mississippi

- Divided into three river regimes
- Drainage area of over 3,800 mi^2
- Peak flow at Kasky Lock 50,300 cfs
- Analyzed over 130 bends



US Army Corps of Engineers

The Kaskaskia River Navigation Project

- The Kaskaskia River Project is part of the national transportation system. It is integrated with a part of the 26,000 mile inland waterway system. It is also integrated with the North American railway system and highway system, giving it intermodal connectivity.
- The Kaskaskia River Project was completed in 1976 at a Federal cost of $140 Million. The State of Illinois was the local sponsor for the project contributing $24 Million in funding for land acquisition and spoil site development.
- Since opening in 1976 the Kaskaskia River Project has originated or terminated more than 53 million tons of cargo valued in excess of $2.6 Billion.

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A River Transformed

- **The final excavation of the navigation channel was completed in 1972**
- **The lock and dam was completed in 1974**

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Morphological Effects of the Navigation Project

• Channelization of 36 miles, forming a 9 ft deep and 300 ft wide navigation channel (1972), overall reduction of 16 miles of channel length

• Channel straightening induced a destructive headcut near Fayetteville and moved upstream causing loss of private property and damage to the bottomland forest and aquatic habitat.

• The slope increased on average of 80% from 0.25 ft/mile to 0.45 ft/mile and width increased on average of 80% from 125 ft to 225 ft

• From 1972 to 1982 an estimated 2,500,000 yd^3 deposited within 6 miles of the upper navigation reach between Fayetteville and New Athens

• In 1982 a grade control structure was built in Fayetteville at the upstream end of the navigation channel to eliminate the headcutting but the structure was unable to arrest the headcuts that had already moved upstream of the project reach.

Common Effects of Channel Straightening

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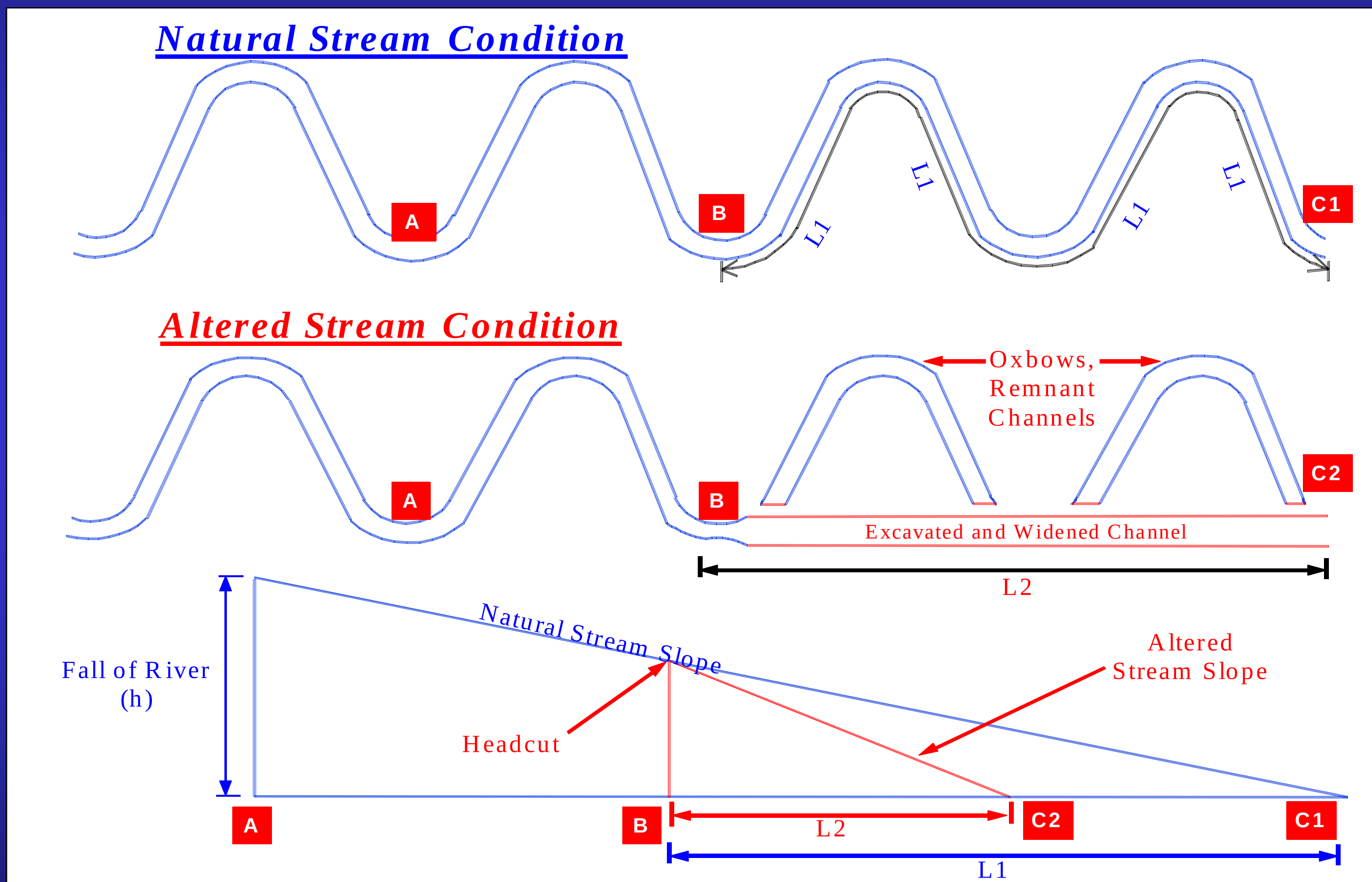

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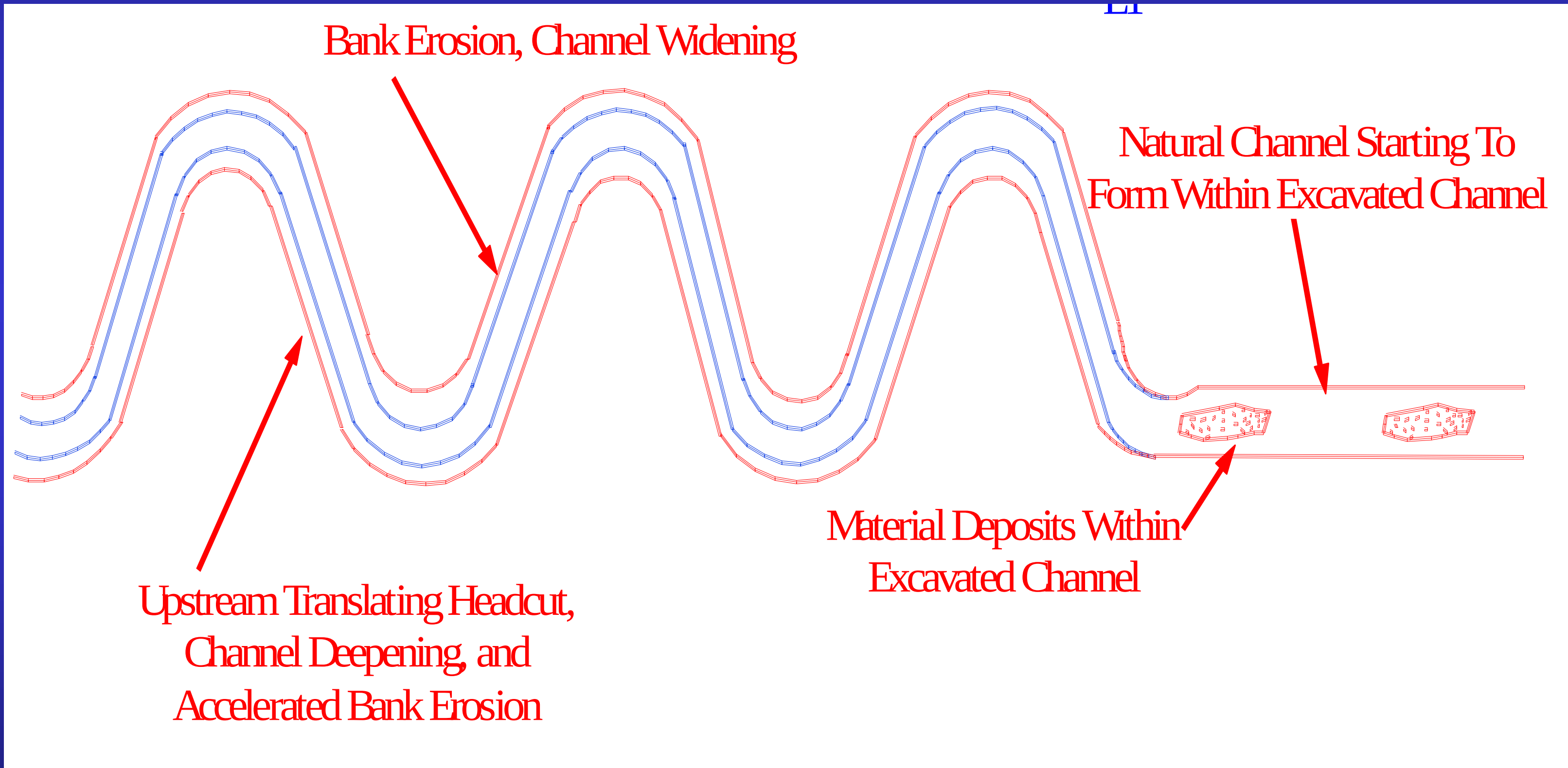
Results of Headcutting



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Modeling a Headcut

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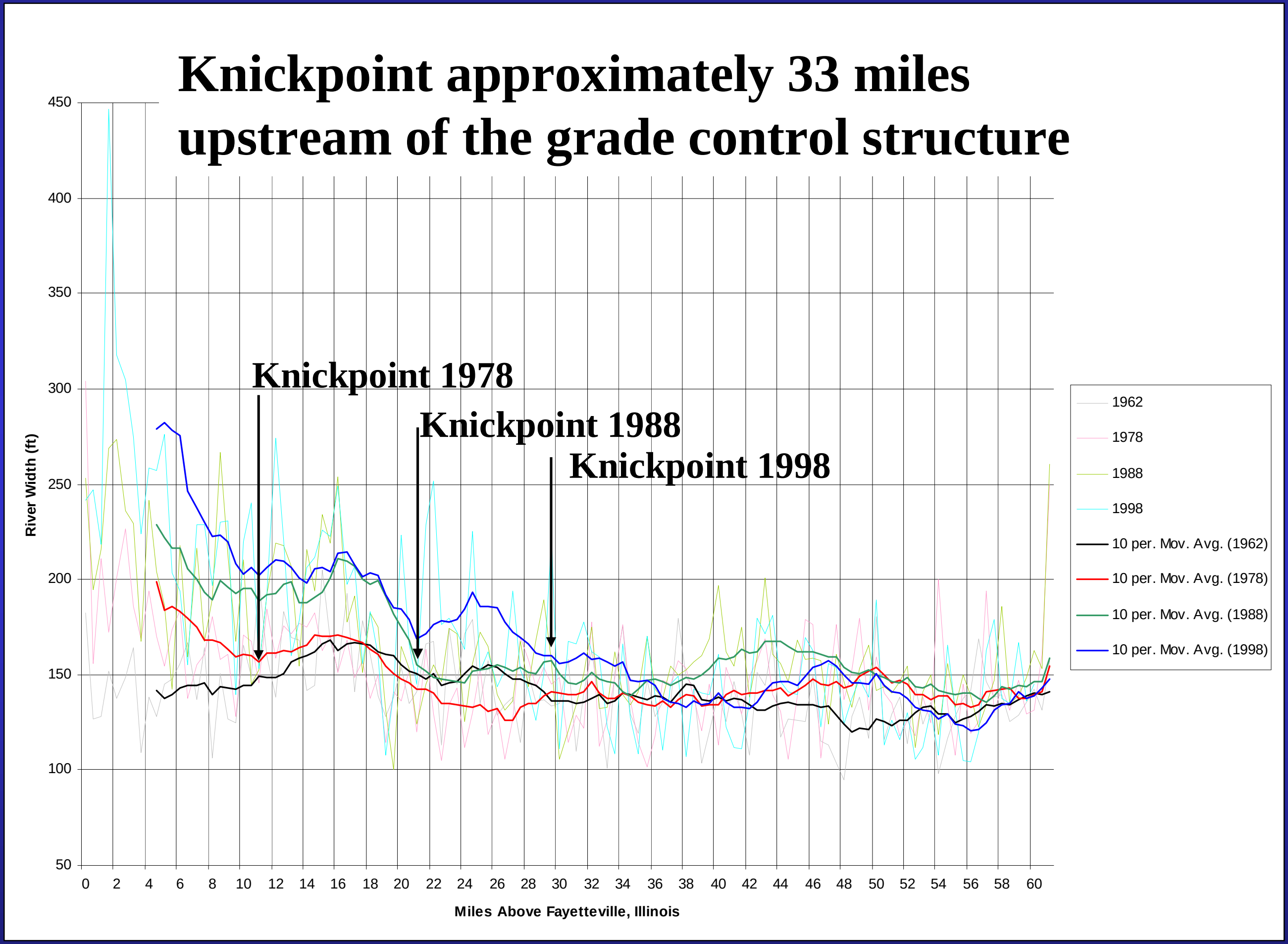
Knickpoint Location



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Effects on Tributaries

- **Headcuts are not isolated to the main channel, they adversely effect the entire system**

Current Sate of River

Three Distinct River Regimes

Regime One

- **Lake Carlyle to 7 miles downstream of Highway 160 (14 Miles Upstream of Fayetteville)**
- **Low to Moderate Traditional Bank Erosion**

Current Sate of River
Three Distinct River Regimes

<u>Regime Two</u>

- 7 miles downstream of Highway 160 (14 Miles Upstream of Fayetteville) to approximately 2 miles below High Banks
- High Erosion, Channel Widening, Channel Downcutting, Loss of Bottomland Trees

Immediately after project construction

Present day

Current Sate of River

Three Distinct River Regimes

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Regime Three

- 2 Miles Below High Banks to Fayetteville
- Dominant Sand Bar Formations, Development of Willows (Natural Healing)

General River Morphology

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- Pattern – 1.44 to 2.10 sinuosity
- Dimension – 1962, 1978, 1988 and 1998 aerials were analyzed and the widening rate ranged from 0.14ft/yr to 5ft/yr
- Profile – Degradation is occurring on the lower part of the study reach due to the headcut. The knickpoint is located approximately 33 miles above Fayetteville, upstream of this point there is no major degradation of the channel.
- The Carlyle Dam has no apparent effect on the stability of the channel. Bends were measured immediately downstream of the dam and no significant increase in bank erosion was evident. (Lane's Equation – discharge and load are on opposite sides of scale so they cancel each other out)

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of Engineers

Questions ?

US Army Corps of Engineers

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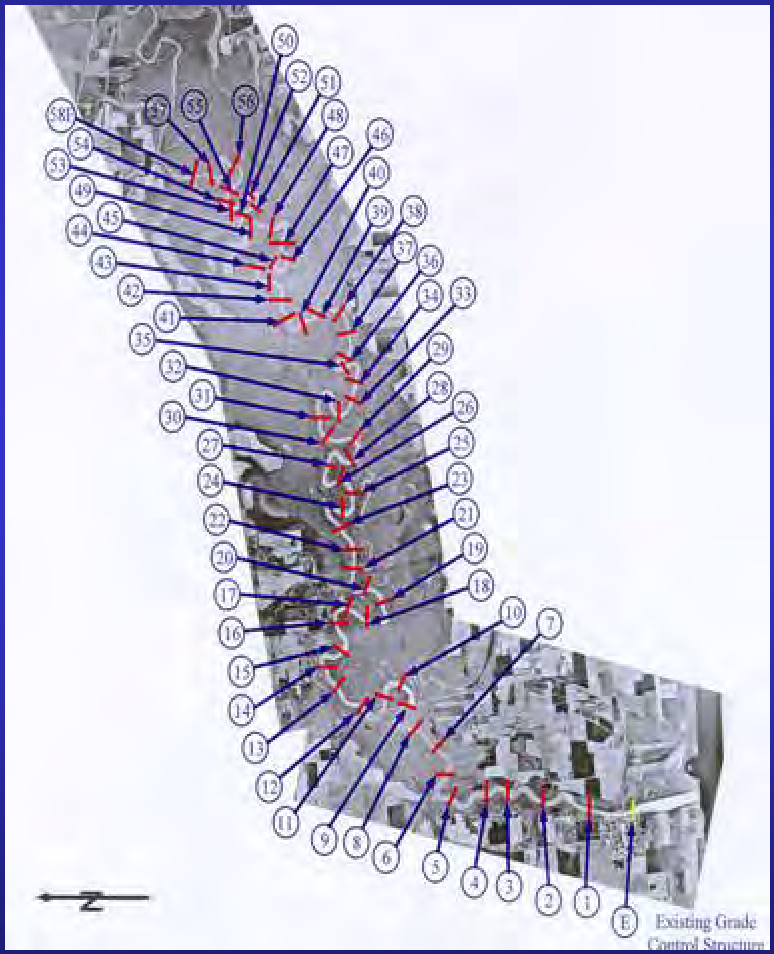
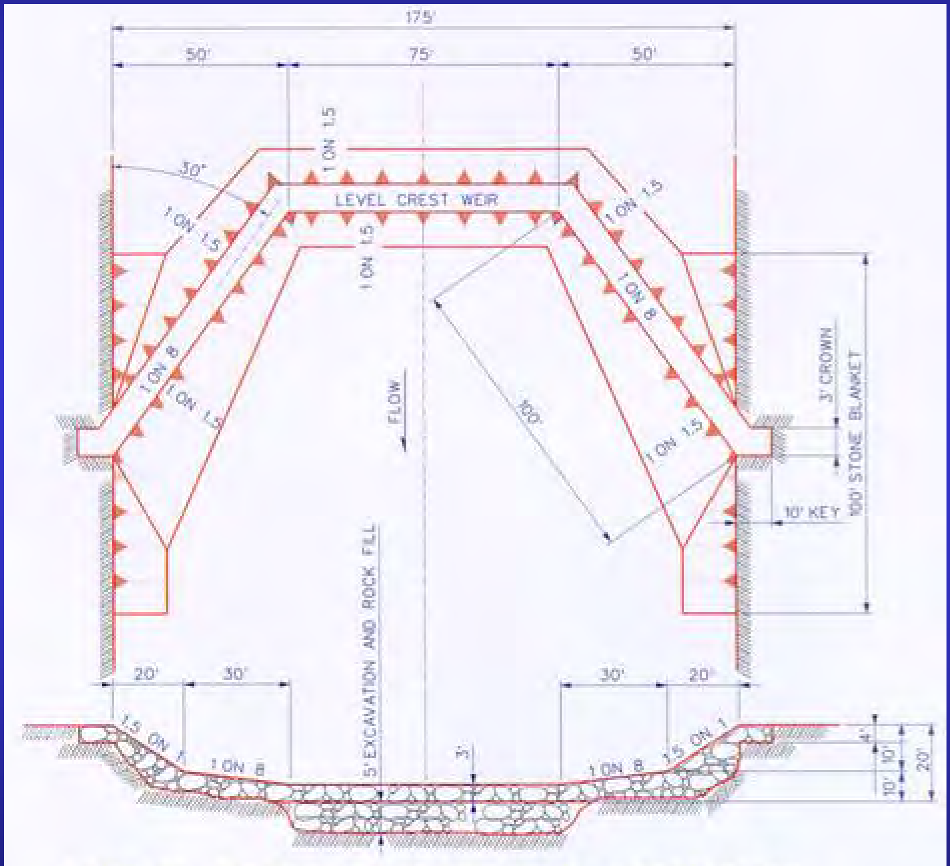
Grade Control Structures



Structure Design



TYPICAL HEADCUT ABATEMENT STRUCTURE

SACRED FALLS, OAHU SECTION 227 DEMONSTRATION PROJECT

cosponsored by:
US Army Corps of Engineers
Honolulu District

and:
State of Hawaii
Department of Land and Natural Resources
Office of Conservation and Coastal Lands

Program Workshop
St. Louis, MO
4 August 2005

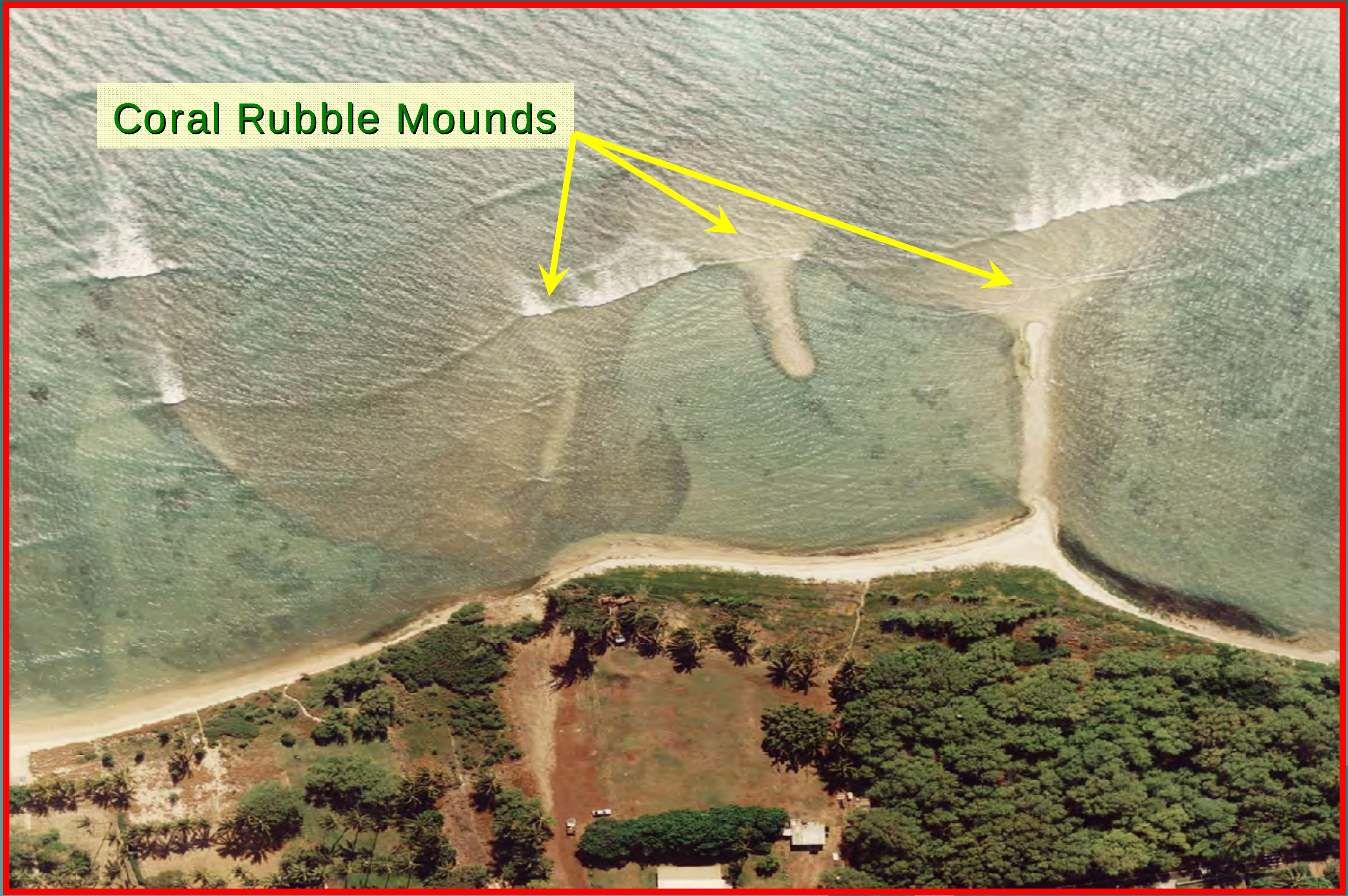
US Army Corps
of Engineers®

TOPICS

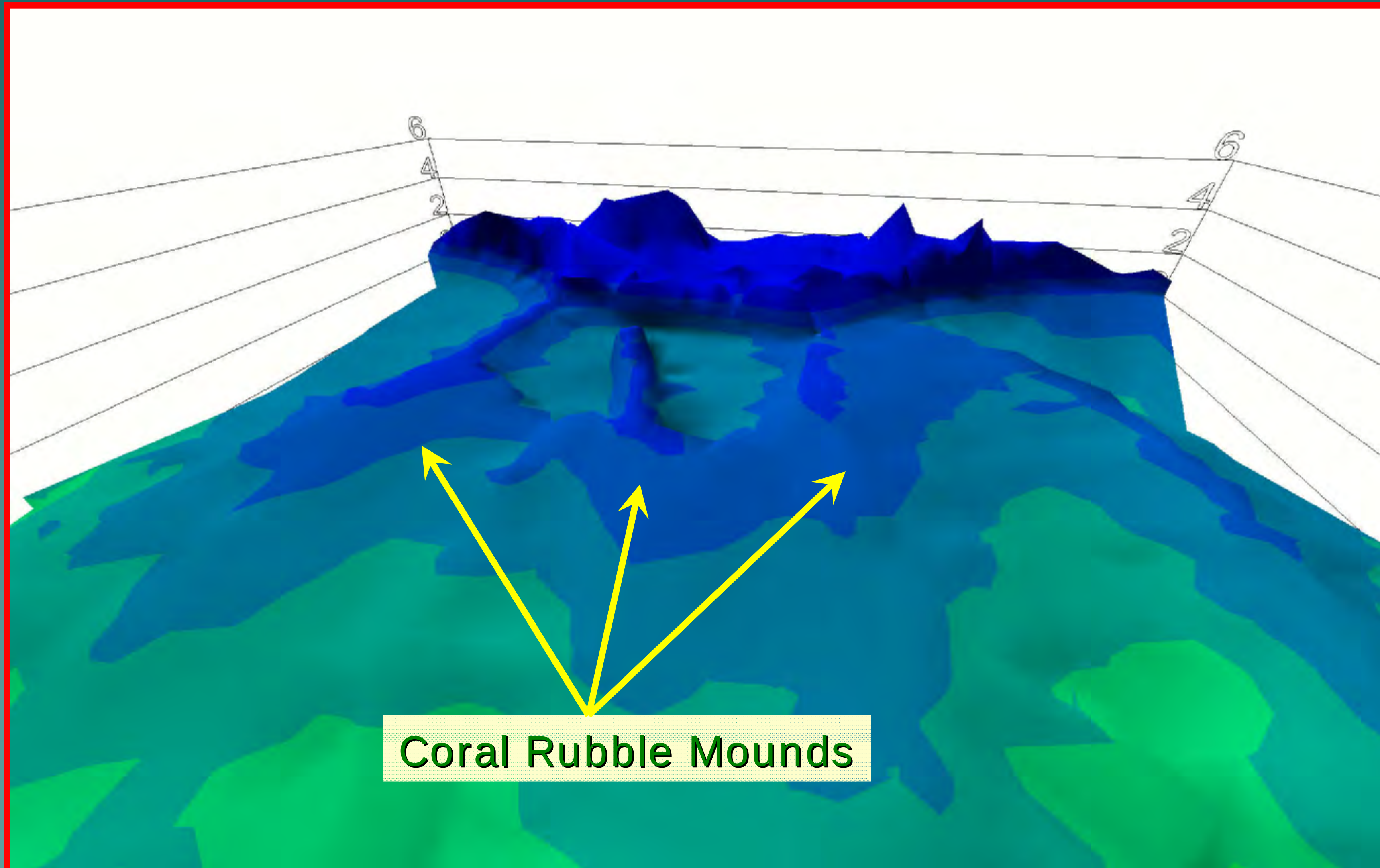
- Site Characterization
  - Kihei, Maui
  - Sacred Falls, Oahu
- Numerical Modeling
- Physical Model
  - Shape Evaluation
  - Shape Performance
  - Modular Design
- Next Steps

SITE CHARACTERIZATION

PROTOTYPE SITE: Kihei, Maui



PROTOTYPE SITE: Bathymetry

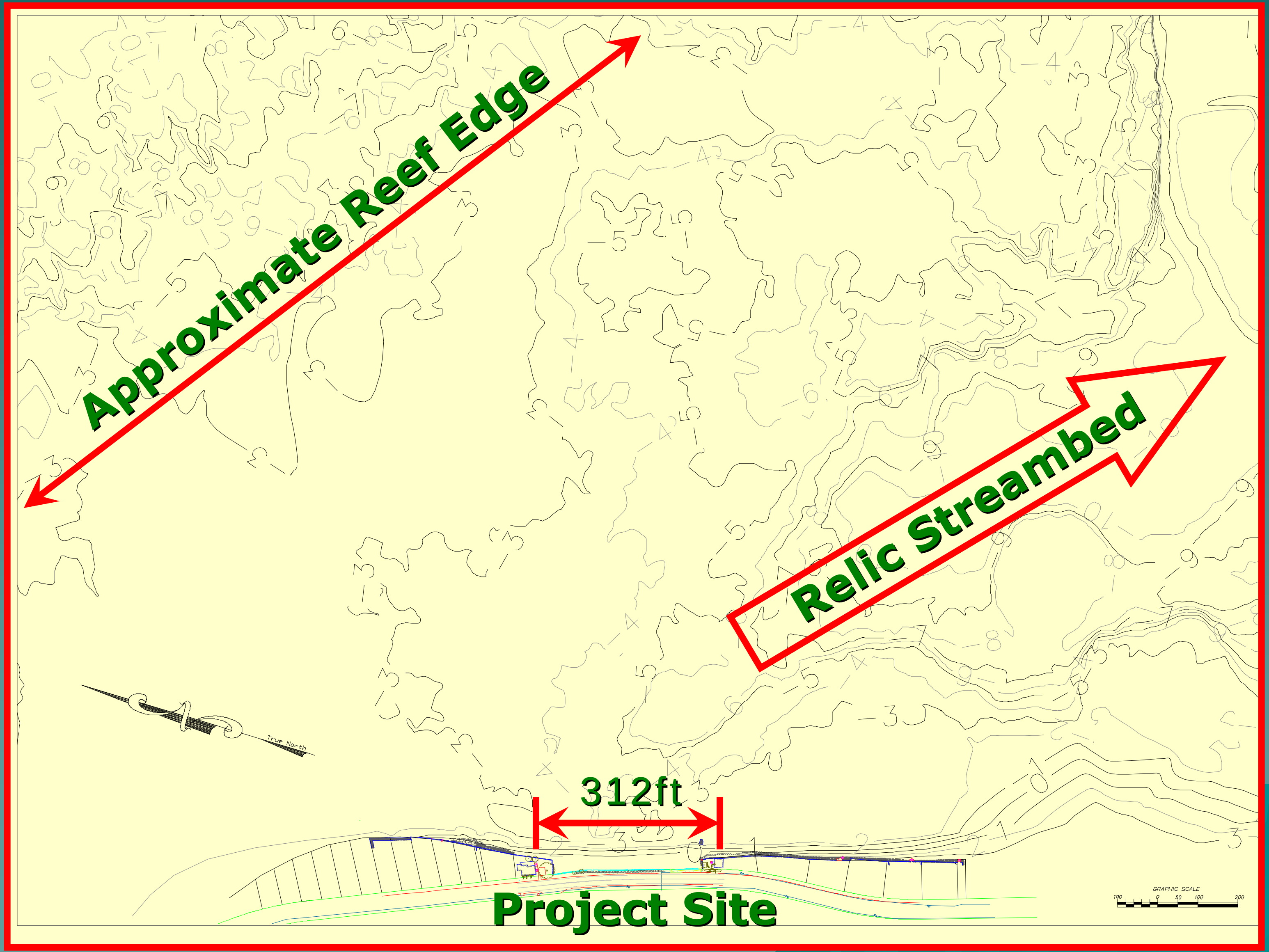


SACRED FALLS, OAHU

PROJECT SITE: Looking North

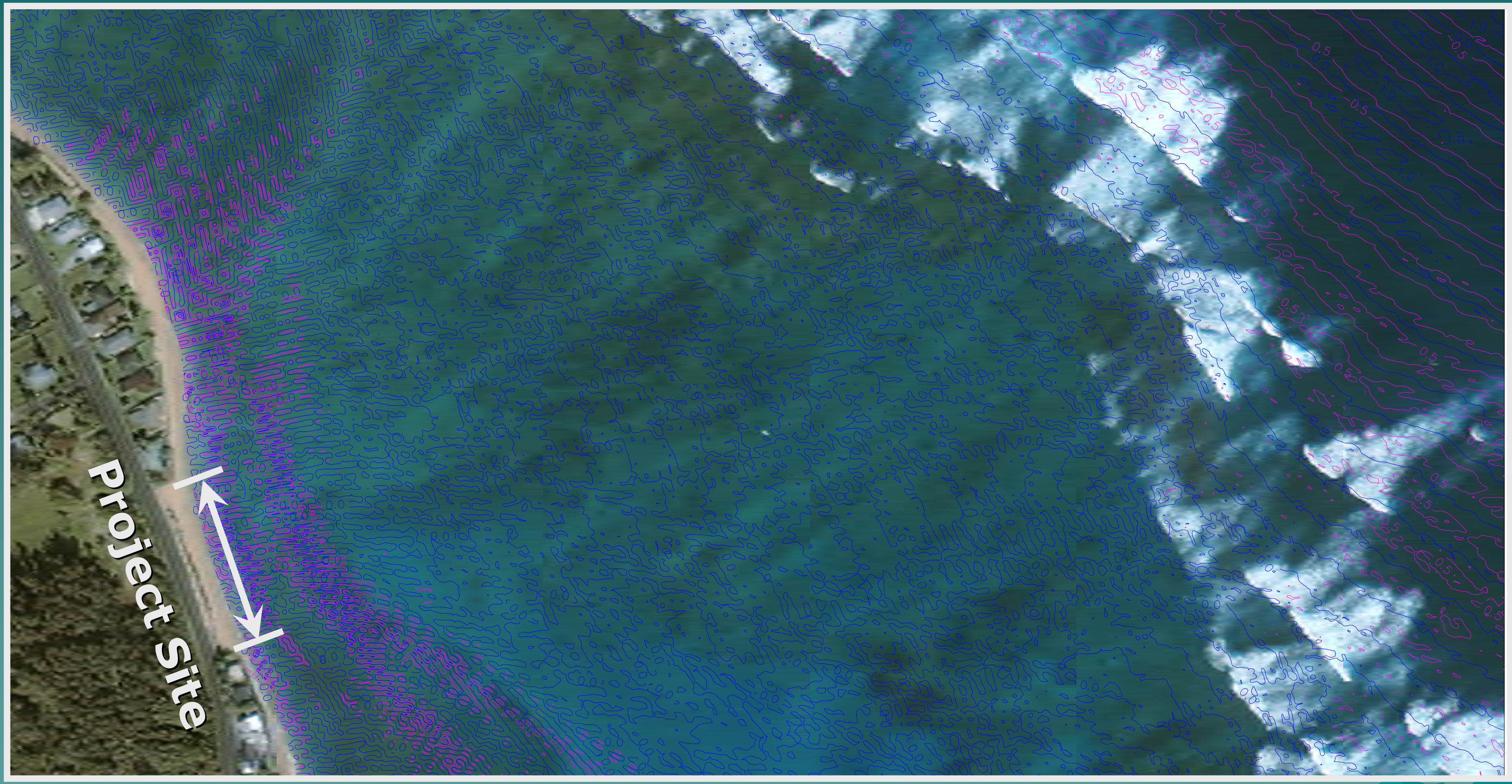
PROJECT SITE: Looking South

SACRED FALLS: Bathymetry



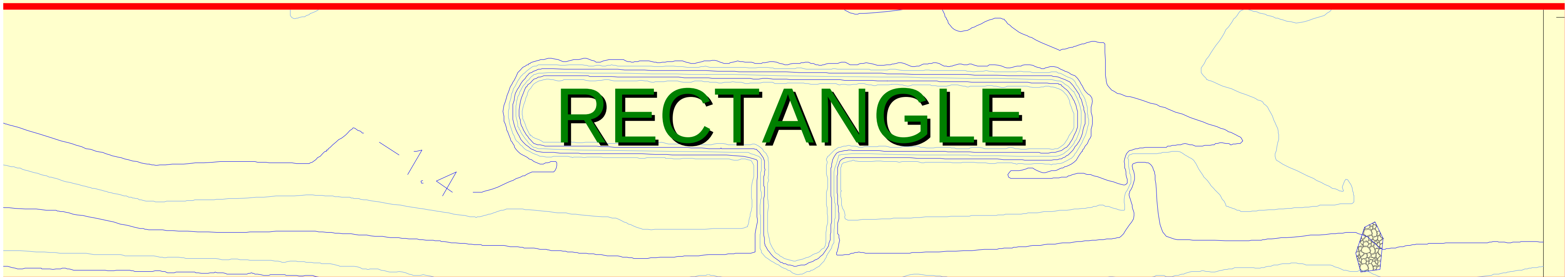
NUMERICAL MODELING

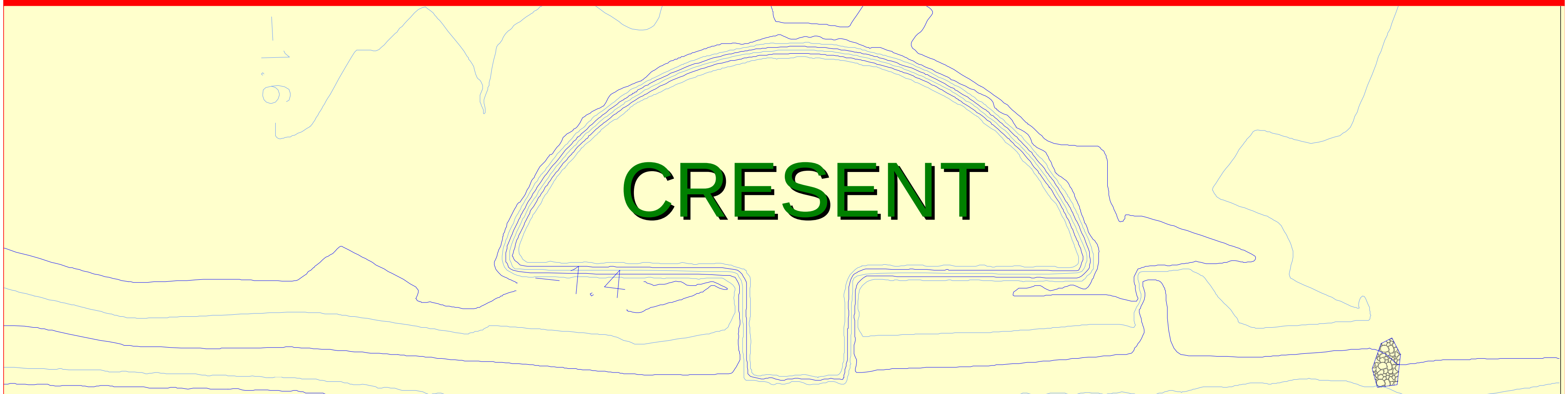
WAVE TRANSFORMATION

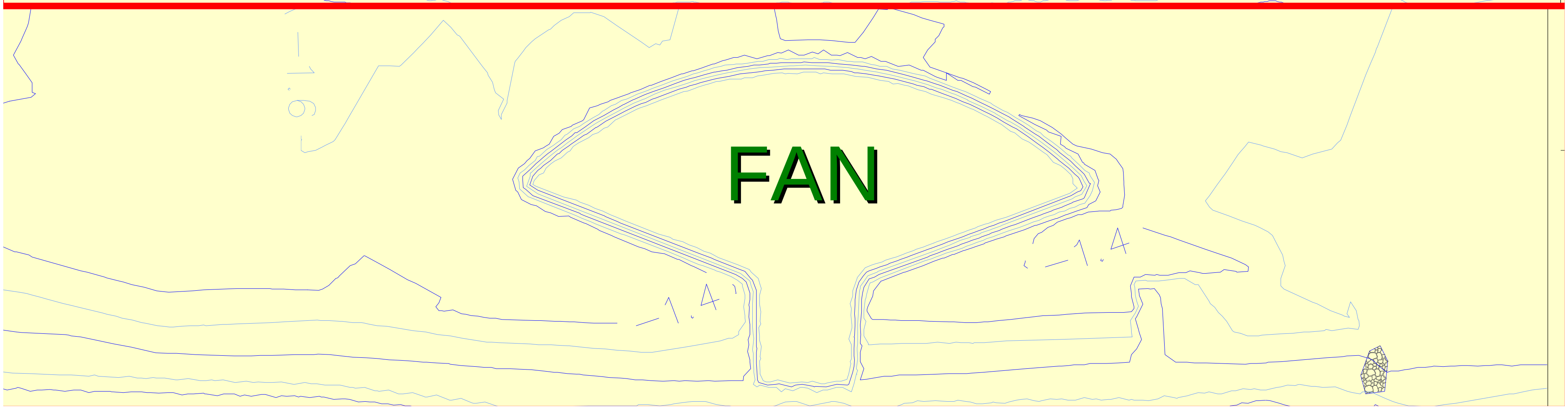


RefDif model results overlaid on IKONOS imagery.

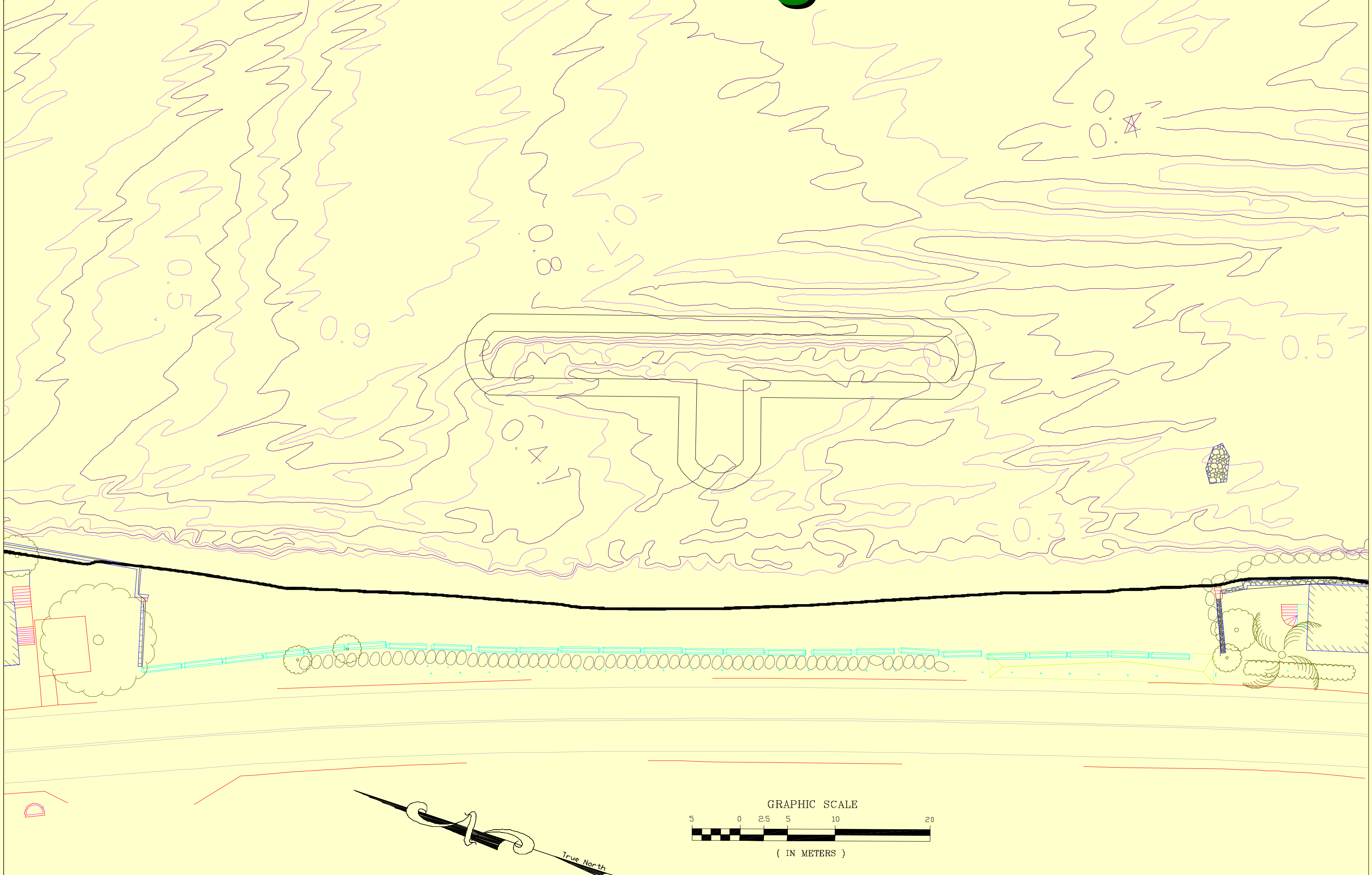
SHAPES CONSIDERED







WAVE HEIGHT CONTOURS
Rectangle



Depths in Meters

Sea Engineering, Inc.
MAKAI RESEARCH PIER
WAIMANALO, HI 96795
(808) 259-7966/FAX (808) 259-8143

KEYNOTES

1. Datum is MHW.
2. Depth accuracy ±x.x m or better.
3. Soundings collected at discrete intervals. Bottom conditions may vary between soundings.
4. Horizontal Control
Station:
Hawaii State Plane - Zone #
Description:
X
Y
5. Vertical Control
Station Name:
Elevation:
6. Survey Date:

04-18 Section 227
Ref/Dif Results: Heights
Block 24, MHW Tide
September 7, 2004

REVISIONS

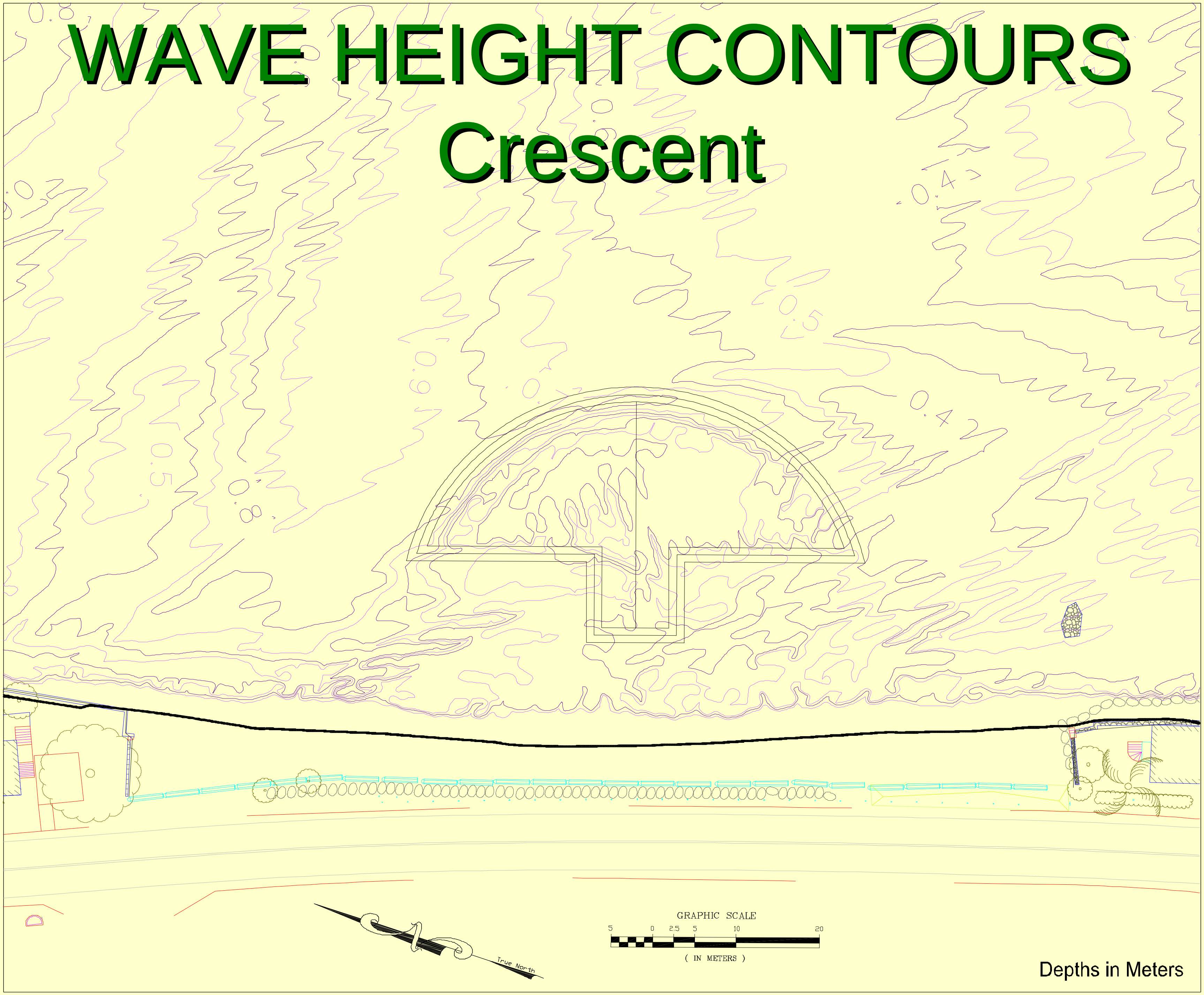
NO.	DATE	REVISION

XXX

XXX

PROJECT NUMBER XXX
PROJECT ENGINEER XXX
DRAWN BY XXX CHECKED BY XXX
SCALE XXX DATE XXX
FILE
XXX

WAVE HEIGHT CONTOURS
Crescent



Depths in Meters

SE
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(808) 259-7966/FAX (808) 259-8143

KEYNOTES

1. Datum is MHW.
2. Depth accuracy ±x.x m or better.
3. Soundings collected at discrete intervals. Bottom conditions may vary between soundings.
4. Horizontal Control
   Station:
   Hawaii State Plane - Zone #
   Description:
   X
   Y
5. Vertical Control
   Station Name:
   Elevation:
6. Survey Date:

04-18 Section 227
Ref/Dif Results: Heights
Block 20, MHW Tide
September 7, 2004

REVISIONS

NO.	DATE	REVISION

XXX

XXX

PROJECT NUMBER XXX

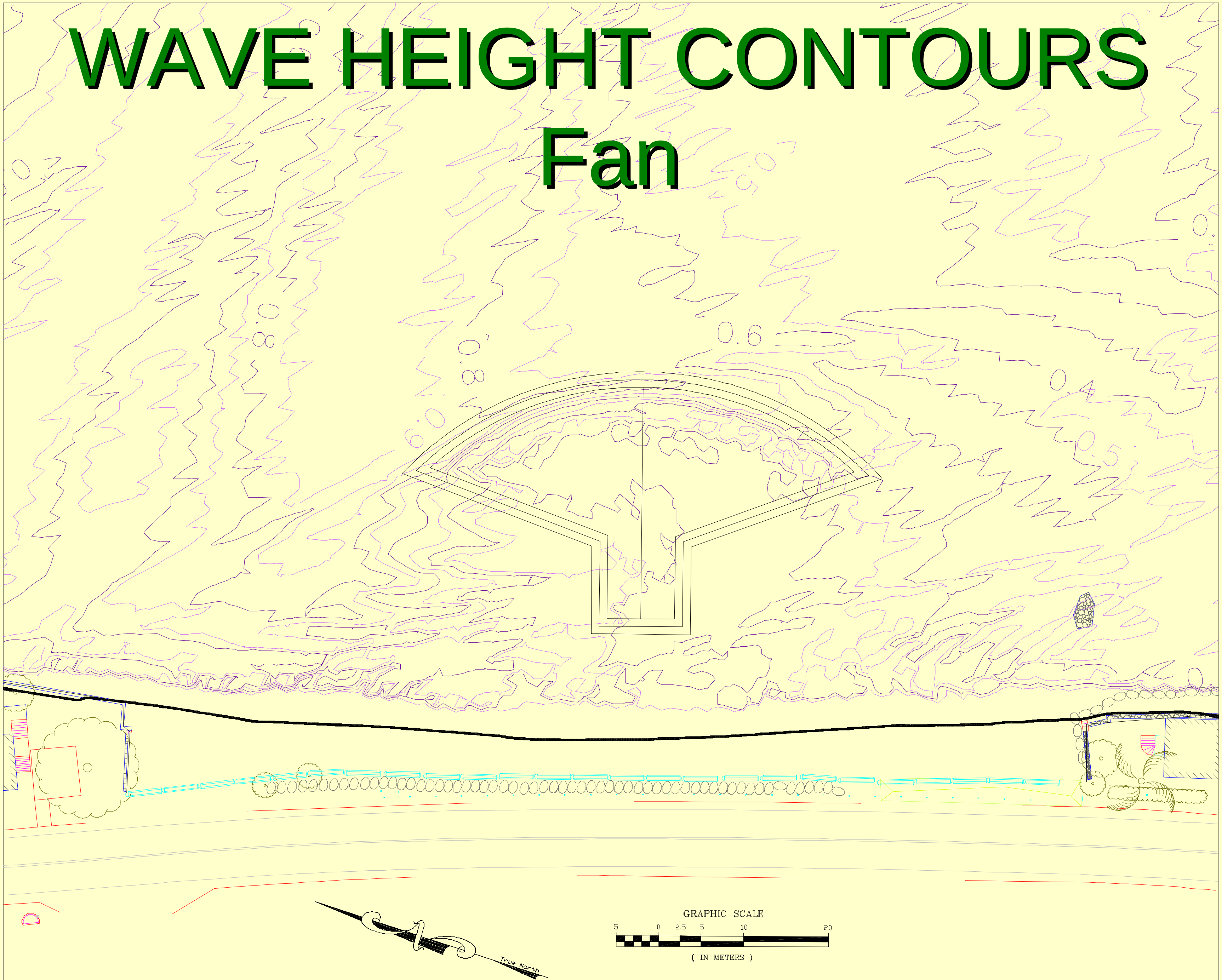
PROJECT ENGINEER XXX

DRAWN BY XXX CHECKED BY XXX

SCALE XXX DATE XXX

FILE
XXX

WAVE HEIGHT CONTOURS
Fan



Depths in Meters

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(808) 259-7966/FAX (808) 259-8143

KEYNOTES

1. Datum is MHW.
2. Depth accuracy ±x.x m or better.
3. Soundings collected at discrete intervals. Bottom conditions may vary between soundings.
4. Horizontal Control Station: Hawaii State Plane - Zone # Description: X Y
5. Vertical Control Station Name: Elevation:
6. Survey Date:

04-18 Section 227
Ref/Dif Results: Heights
Block 22, MHW Tide
September 7, 2004

REVISIONS

NO.	DATE	REVISION

XXX

XXX

PROJECT NUMBER XXX

PROJECT ENGINEER XXX

DRAWN BY XXX CHECKED BY XXX

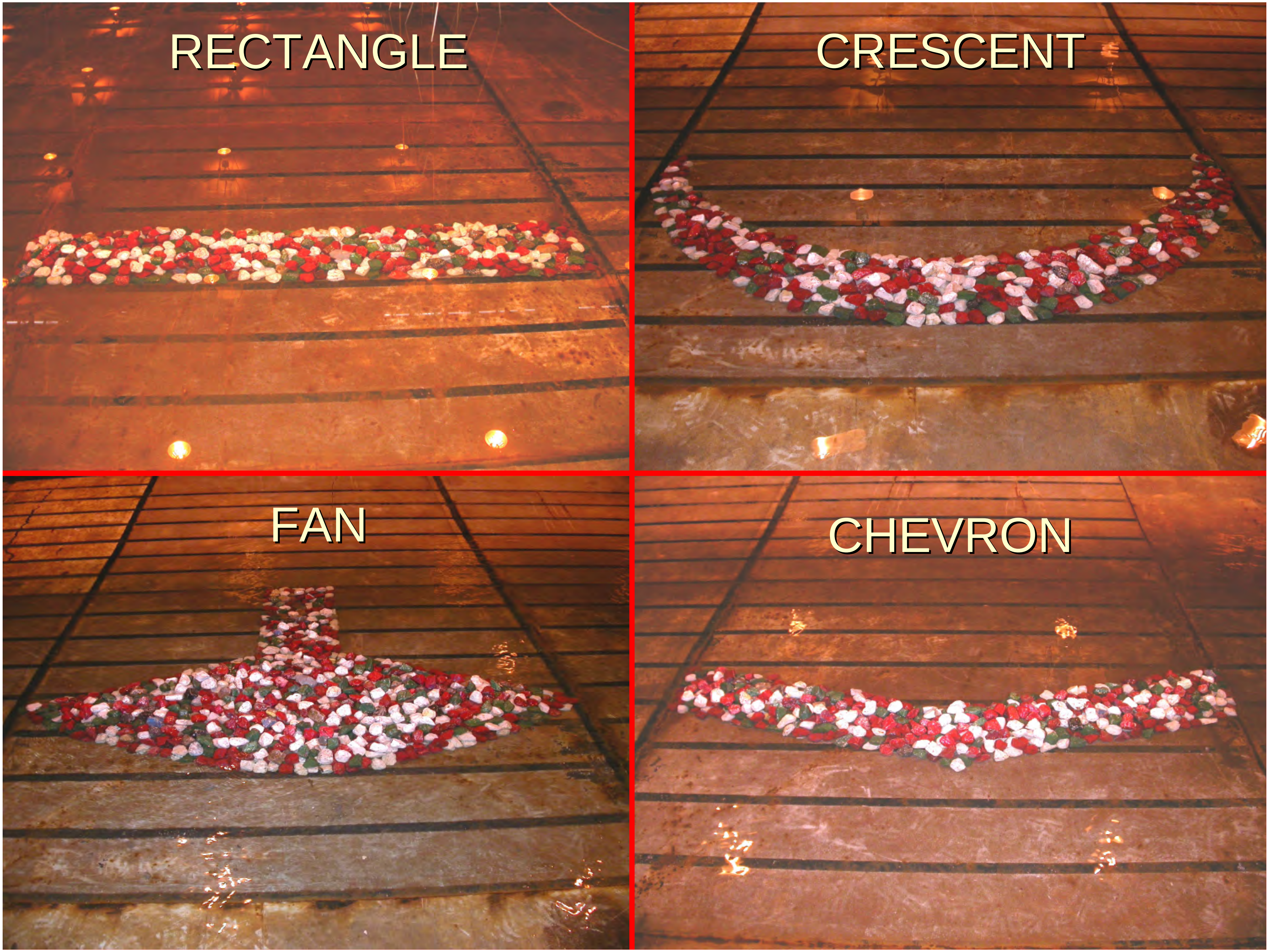
SCALE XXX DATE XXX

FILE XXX

PHYSICAL MODEL
Shape Evaluation

PHYSICAL MODEL

- Flume: 56ft long X 32ft wide
- Scale: 1/16
- Wave Parameters:
  - Height: Depth Limited over Reef
  - Period: 9 and 16 second
  - Direction: -7 degrees
- Longshore Current
- Sediment Transport


RECTANGLE
CRESCENT
FAN
CHEVRON

PHYSICAL MODEL

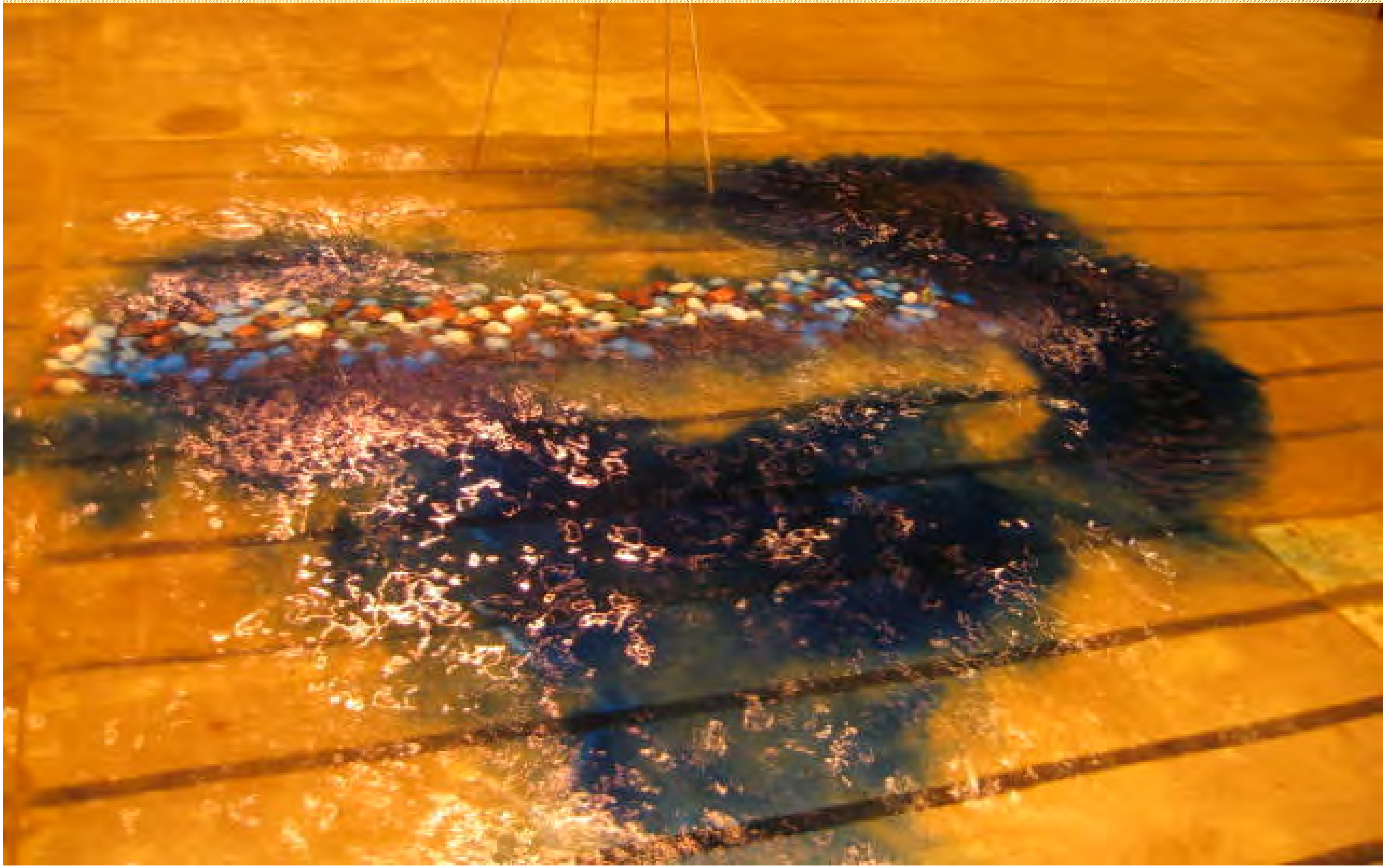
Shape Performance

RECTANGLE: Dye Study (1)

RECTANGLE: Dye Study (2)

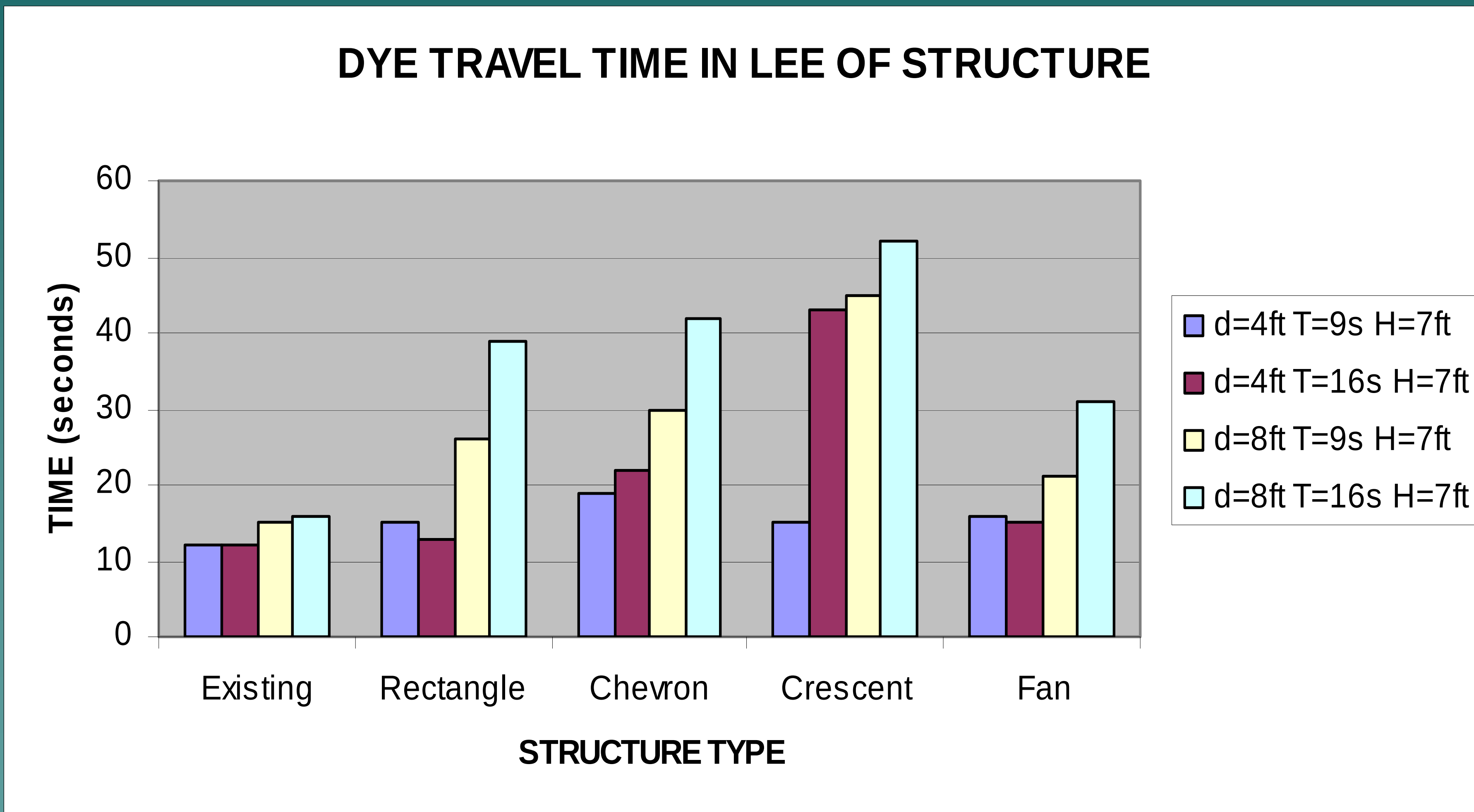
RECTANGLE: Dye Study (3)

RECTANGLE: Dye Study (4)



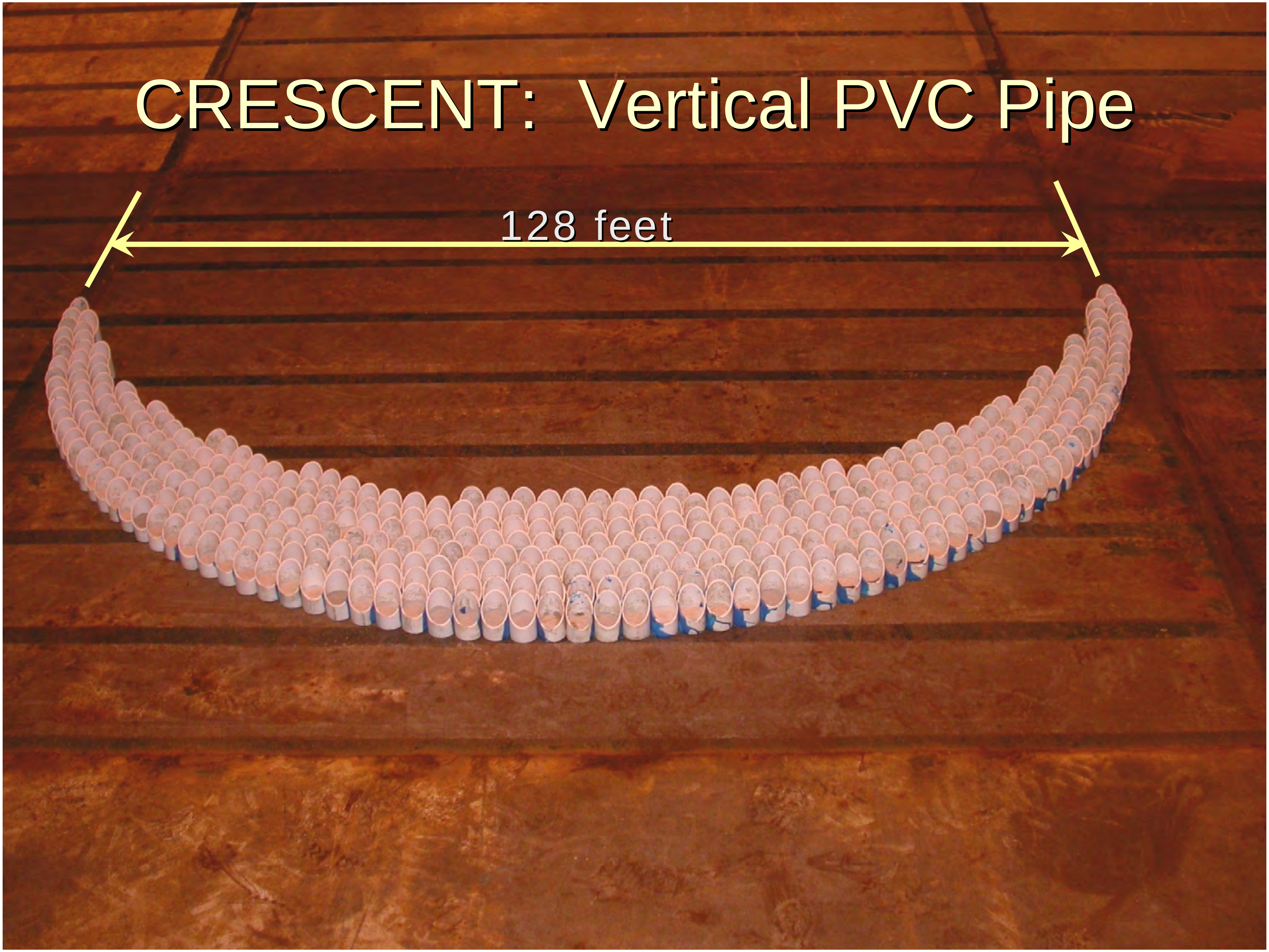
RECTANGLE: Dye Study (5)

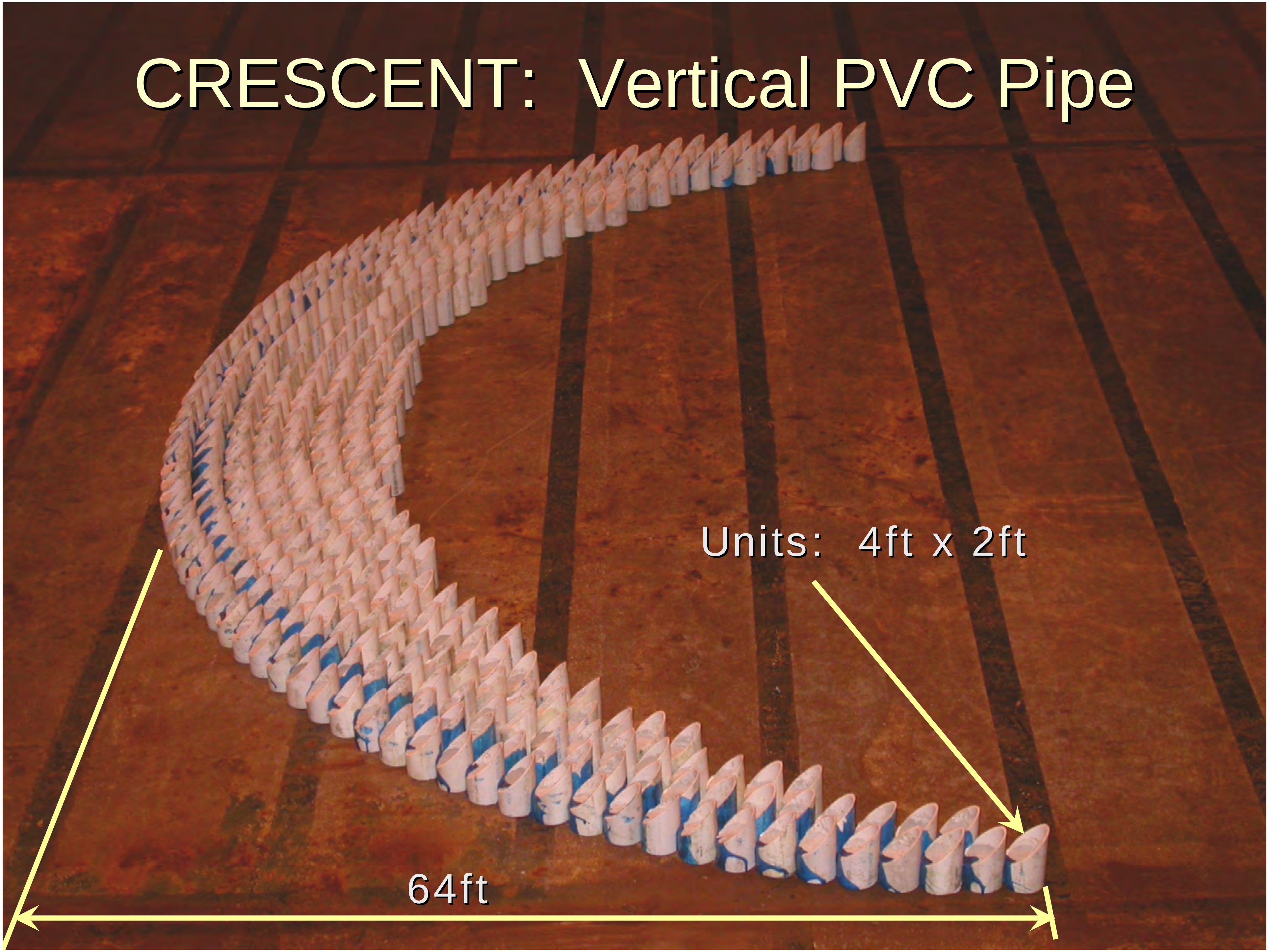
SHAPE PERFORMANCE



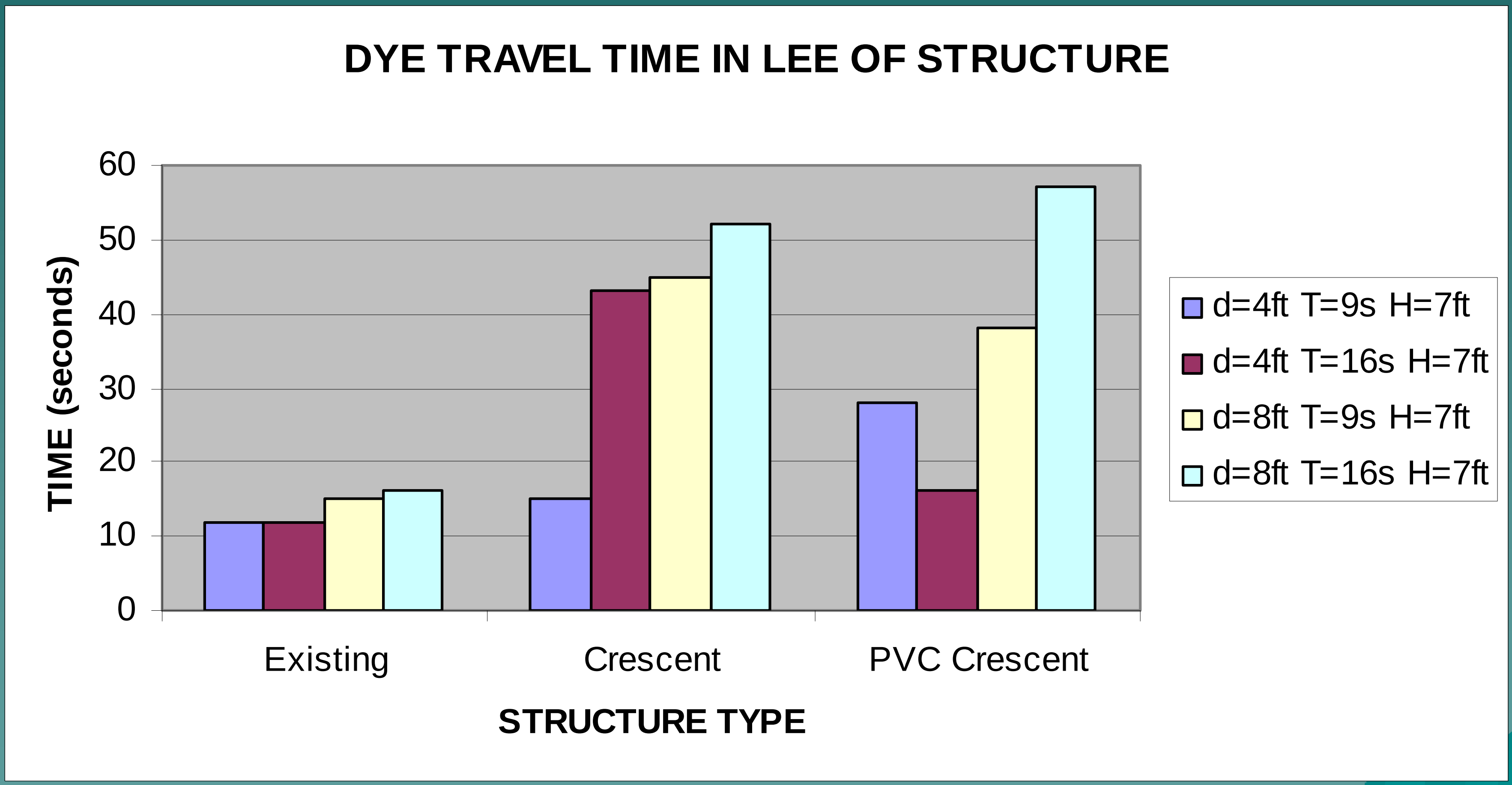
PHYSICAL MODEL
Modular Design

- PVC Pipes
- Plastic Traffic Barriers
- Cylindrical Storage Tanks
- Hawaiian Fish Pond Wall


CRESCENT: Vertical PVC Pipe
128 feet


CRESCENT: Vertical PVC Pipe
Units: 4ft x 2ft
64ft

MODULAR PERFORMANCE



NEXT STEPS

- Detailed Design (FY05)
- Sand Source Investigations (FY05)
- Environmental Coordination (FY05/06):
- Construction (FY06)
- Monitoring and Evaluation (FY07->)

THANK YOU

ALA WAI CANAL PROJECT

US ARMY CORPS OF ENGINEERS
Tri-Services Conference
St. Louis, Missouri
August 4, 2005

by

Lynnette F. Schaper, P.E
US Army Corps of Engineers, Honolulu District

- PROJECT AREA
- PROJECT PURPOSES
- PROJECT OBJECTIVES
- SPECIFICALLY AUTHORIZED PROCESS
- FEASIBILITY STUDY
- FLOOD CONTROL CONCEPTS
- RESTORATION CONCEPTS
- FEASIBILITY ALTERNATIVES
- HYDRAULIC MODELING
- ALTERNATIVE RESULTS
- NED PLAN

PROJECT AREA

- State of Hawaii
- Island of Oahu
- City & County of Honolulu

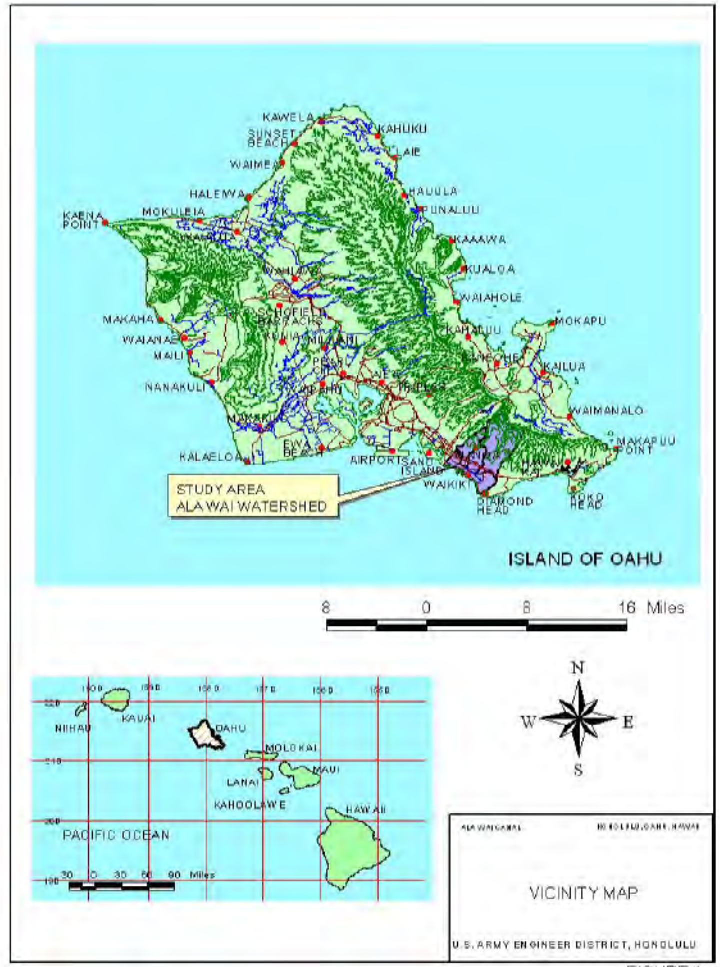
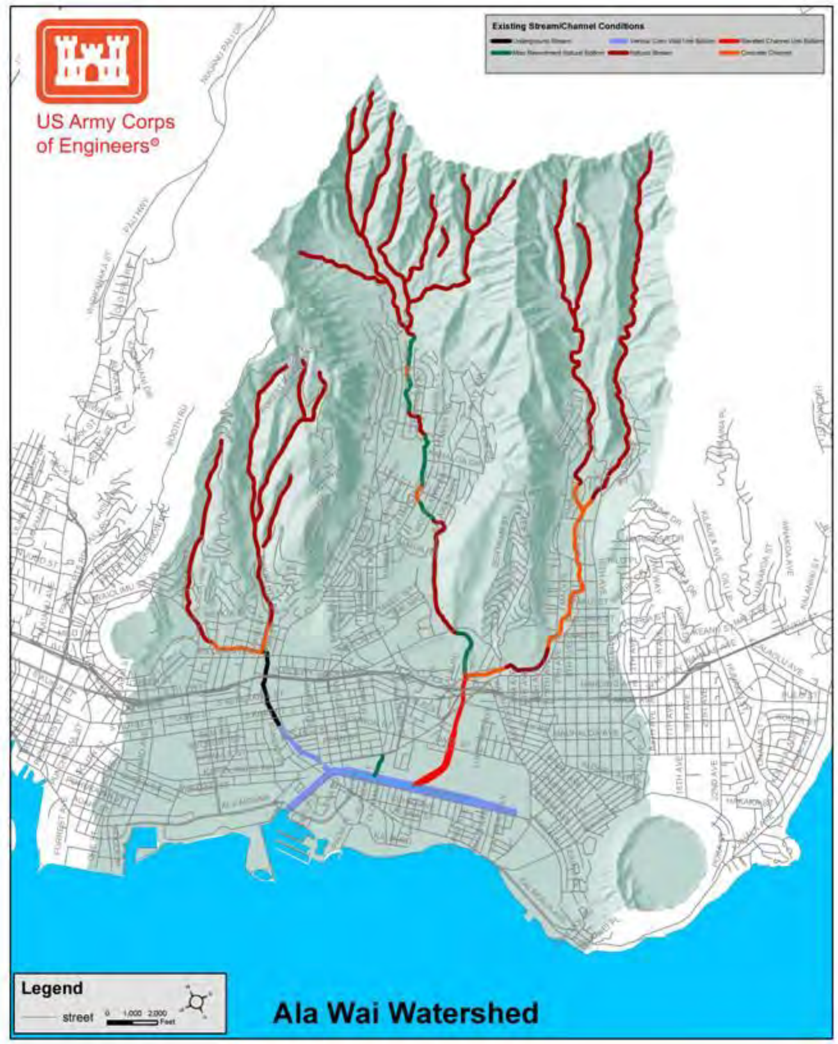


FIGURE 1

PROJECT AREA

- **Ala Wai Watershed**
  - Makiki
  - Mānoa
  - Pālolo
  - Waikīkī
  - Kapahulu
  - McCully
  - Mo‘ili‘ili



Ala Wai Canal, Honolulu, O‘ahu, Hawai‘i

PROJECT PURPOSES

- Flood Damage Reduction

- Insufficient channel capacity
- Prevent $130M Flood Damages to Structures (2001 Study)

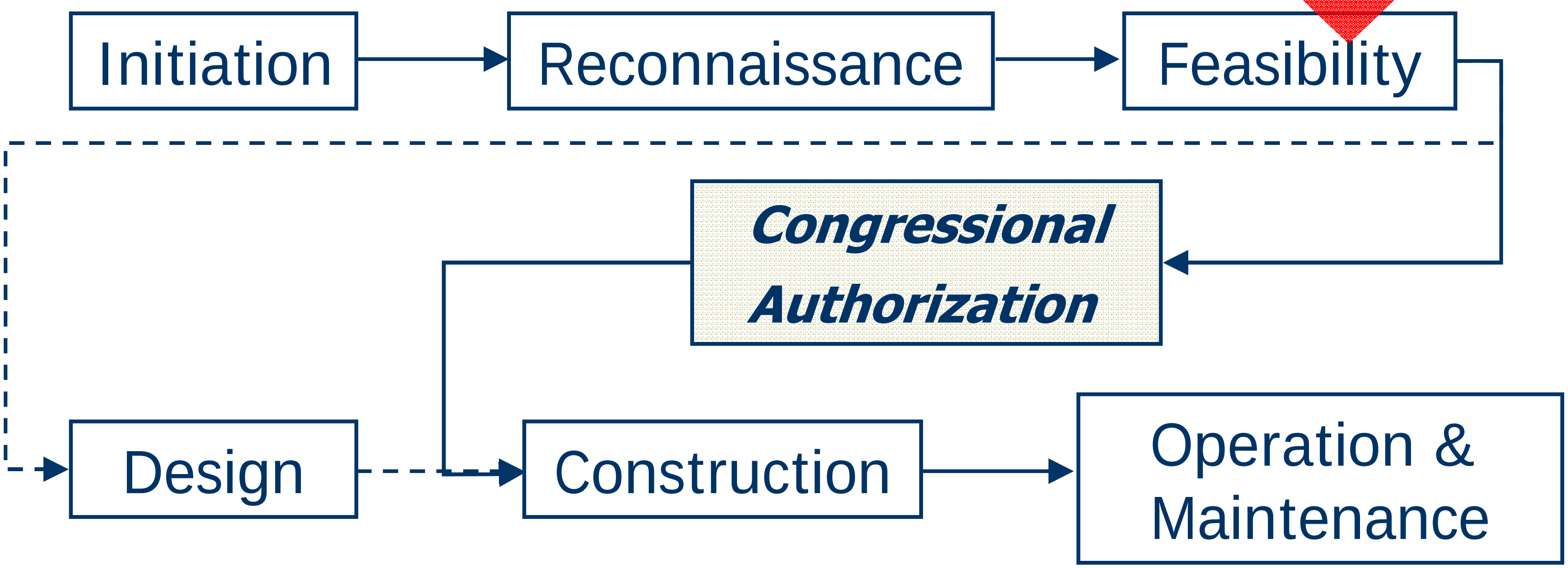
- Ecosystem Restoration

- poor habitat for native species; prevalence of alien species; poor water quality; contaminated materials; excessive sedimentation

PROJECT OBJECTIVES

- Flood Control – Protect Waikīkī and surrounding areas from 100-year storm event
- Restoration – Improve watershed health through reversal of environmental degradation

SPECIFICALLY AUTHORIZED PROCESS



ALA WAI CANAL PROJECT FEASIBILITY STUDY

- Section 209 of the FCA 1962
- Sponsor = State of Hawai‘i, DLNR
- Multipurpose project
- Watershed project; ‘Ahupua‘a concept
- Holistic approach; coordinating all actions
- Joint EIS and Feasibility Report
- Draft EIS in late 2005
- Study completion in 2006
- Construction start estimated for 2008
- Cost estimated between $80M - $120M

PUBLIC INVOLVEMENT

- Public information meeting in June 2001 & June 2004
- Technical Advisory Group (TAG)
- Agency Support Group (ASG)
- Biologists/scientists workshop
- Stakeholders workshop
- Agency workshops
- Various individual meetings
- AWWA meetings
- EIS Scoping meeting

COMMUNITY WATER RESOURCES INITIATIVES

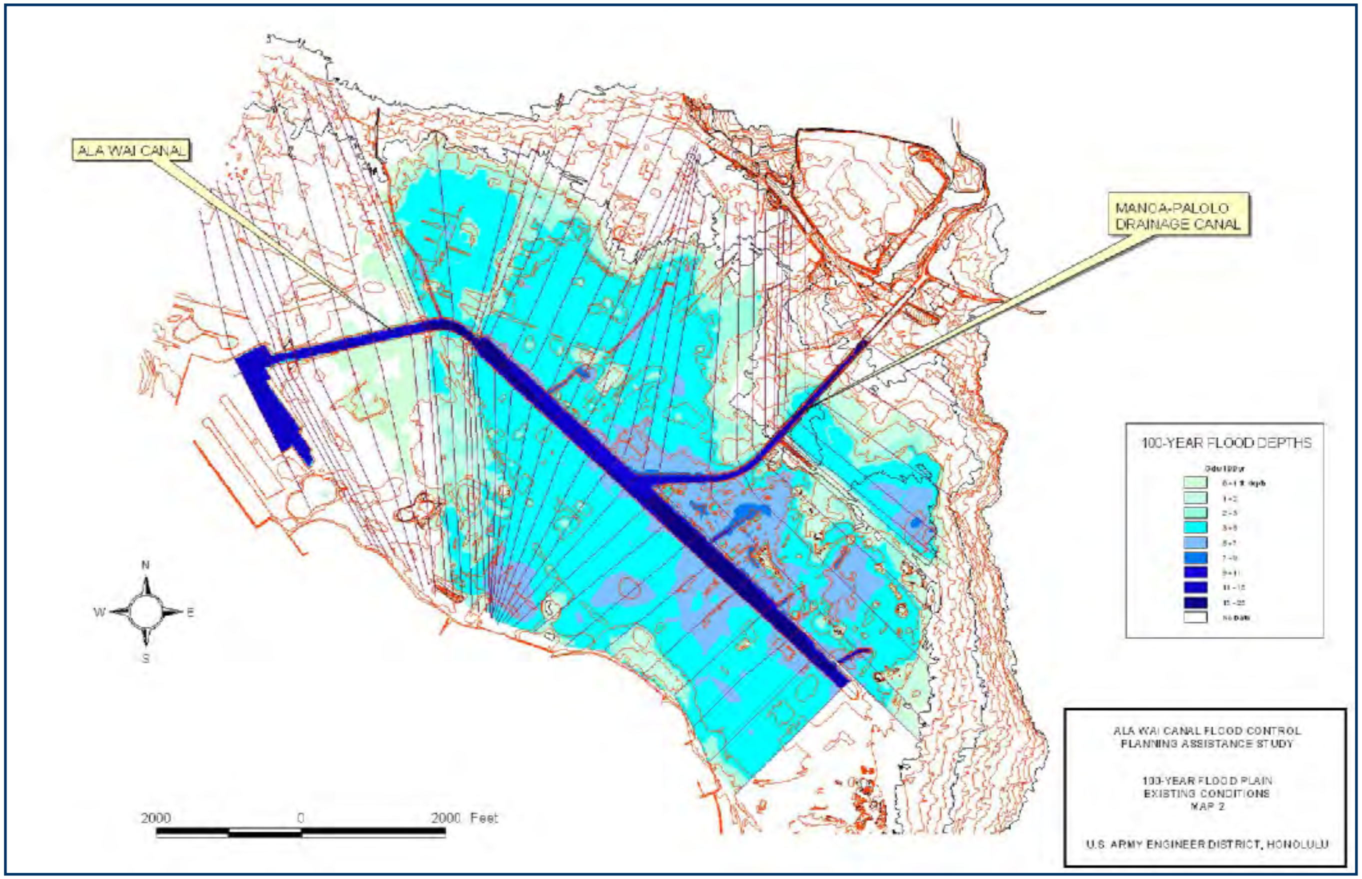
- Ala Wai Watershed Association
- Hawai‘i Nature Center
- Mālama ‘O Mānoa
- Makiki Stream Stewards
- Pālolo Pride
- Ko‘olau Mountain Watershed Partnership
- Waikīkī Aquarium
- Canoe clubs
- Public and Private Schools
- Hawai‘i Trails Organization
- Tantalus Association
- Kapi‘olani Park Advisory Council

GOVERNMENT WATER RESOURCE PROGRAMS

- Federal
- State of Hawaii
- City & County of Honolulu
- Honolulu Board of Water Supply

100-YEAR FLOOD INUNDATION AREA

- $130M Flood Damage Reduction Benefits (2001)



*2001 study focused on Canal area; 100-year storm will produce flooding in streams.

NOVEMBER 1965

- 25-year level event

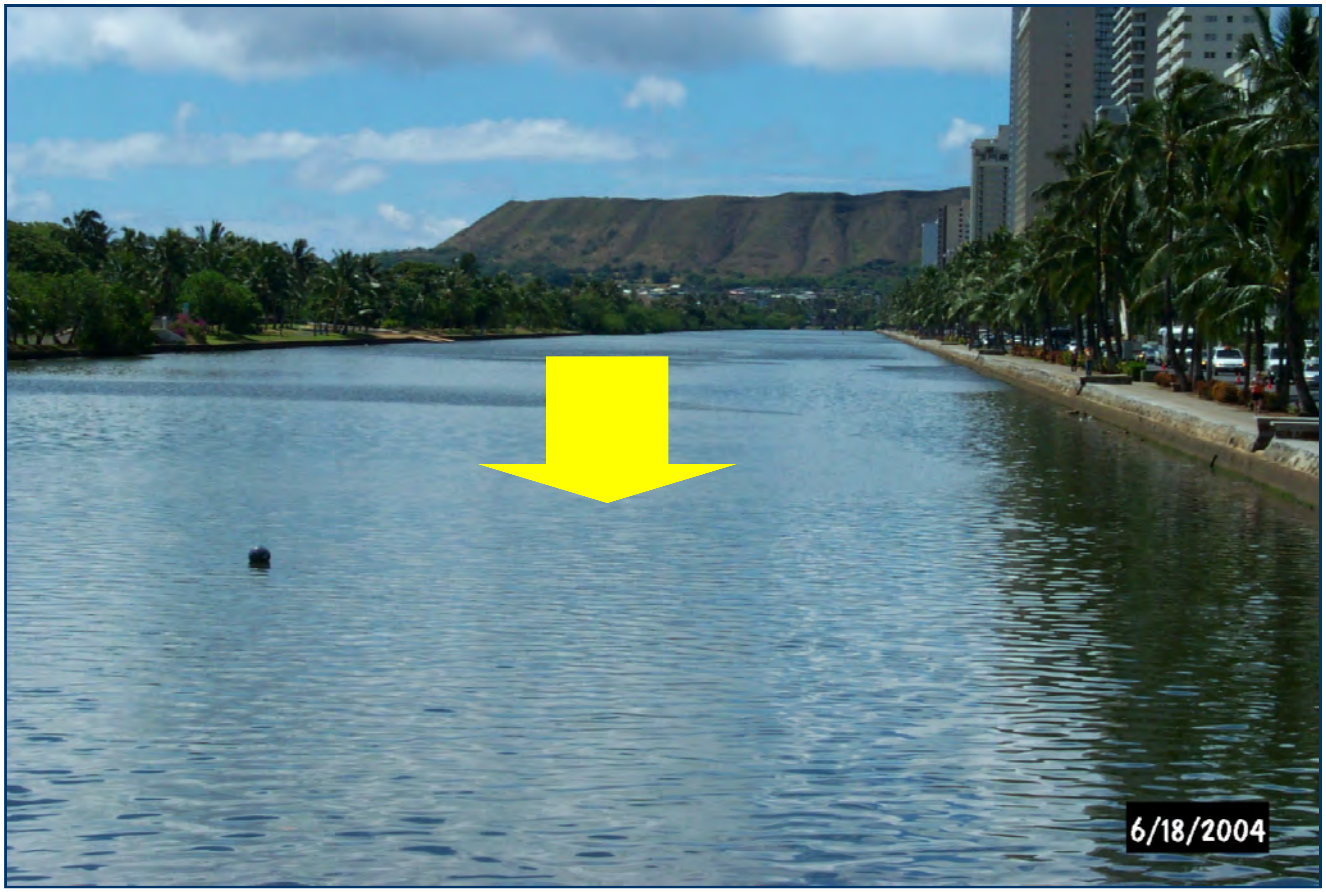
Honolulu Advertiser, Nov 1965

FLOOD CONTROL CONCEPTS

- Dredging
- Flood Walls
- Widen Canal
- Bridge Modifications
- Storage (golf course & other areas)

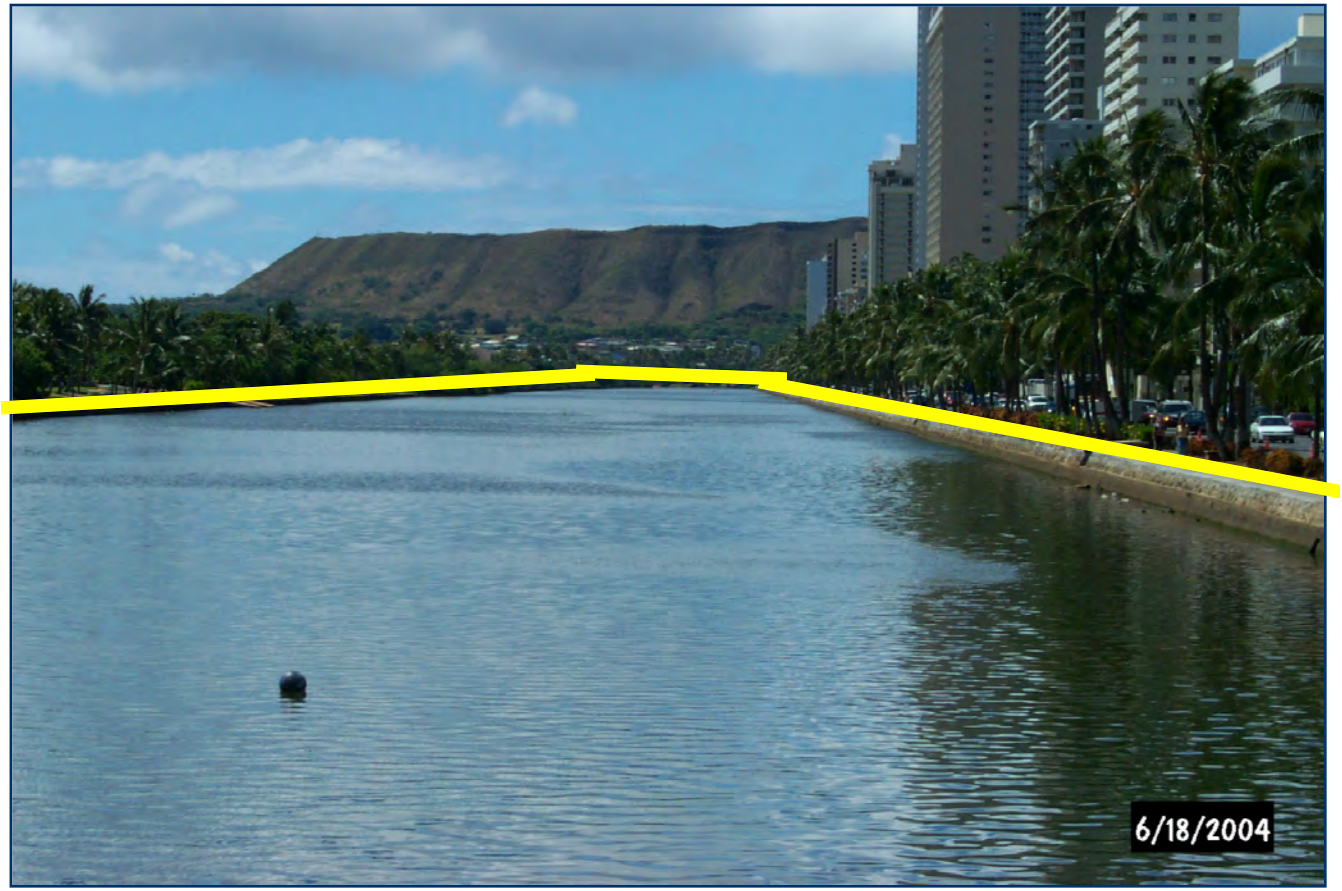
FLOOD CONTROL CONCEPTS

- Dredging



FLOOD CONTROL CONCEPTS

- Flood Walls



FLOOD CONTROL CONCEPTS

- Widen Canal

FLOOD CONTROL CONCEPTS

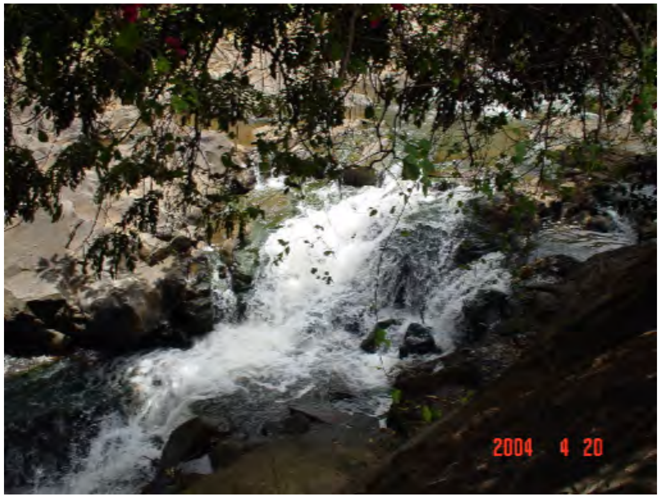
- Reconstruct Bridges

FLOOD CONTROL CONCEPTS

- Storage

RESTORATION CONCEPTS

- Restore stream habitat
- Stabilize stream bed and bank
- Restore stream cover/shade
- Re-create wetlands
- Reduce trash & sediment loads
- Construct check dams



FEASIBILITY ALTERNATIVES (initial)

- Existing Conditions Alternative- The do nothing alternative
- Alternative A- Dredging
- Alternative B- Floodwalls
- Alternative C- Dredging and Floodwalls

FEASIBILITY ALTERNATIVES (current)

- Alternative D- Dredging + widen canal at Convention Center + bridge modification + golf course storage
- Alternative E- Floodwalls + widen canal + bridge modification + golf course storage
- Alternative F- Dredging + floodwalls + golf course storage
- Alternative G- Dredging + widen canal + golf course storage
- Alternative H- ??

HYDRAULIC MODELING

- HEC-RAS (steady), initial
- FLO-2D, 2-dimensional, unsteady flow
- HEC-RAS (unsteady) calibrated to FLO-2D
- HEC-RAS output needed for input into HEC-FDA

EXISTING CONDITIONS

- Provide ~10-year level of protection
- Interior drainage problems in Waikiki area
- Canal acts as a sedimentation basin
- Recent dredging in Ala Wai Canal, $7.5M, 185,800 cubic yards removed of trash, debris & muck
- Ala Wai Golf Course, highly used municipal 18-hole course, 167,000 rounds/yr, 250,000 buckets at driving range/yr

ALTERNATIVES A, B & C - RESULTS

- Does not provide 100-year level of protection (LOP)
- Community resistance to floodwalls
- Eliminated as alternatives
- Look to a combination of flood control concepts in other alternatives

ALTERNATIVE D – RESULTS

Alternative D: Dredging + widen canal + bridge modification + golf course storage

- Provides a 10-year level of protection
- Channel cannot contain flow with modifications
- Dredging has little effect on WSE
- Widening does not change the WSE used for better flow transitions
- Bridge modification to the Kalakaua Bridge only, McCully bridge raising has little effect on WSE
- Golf course used as storage area

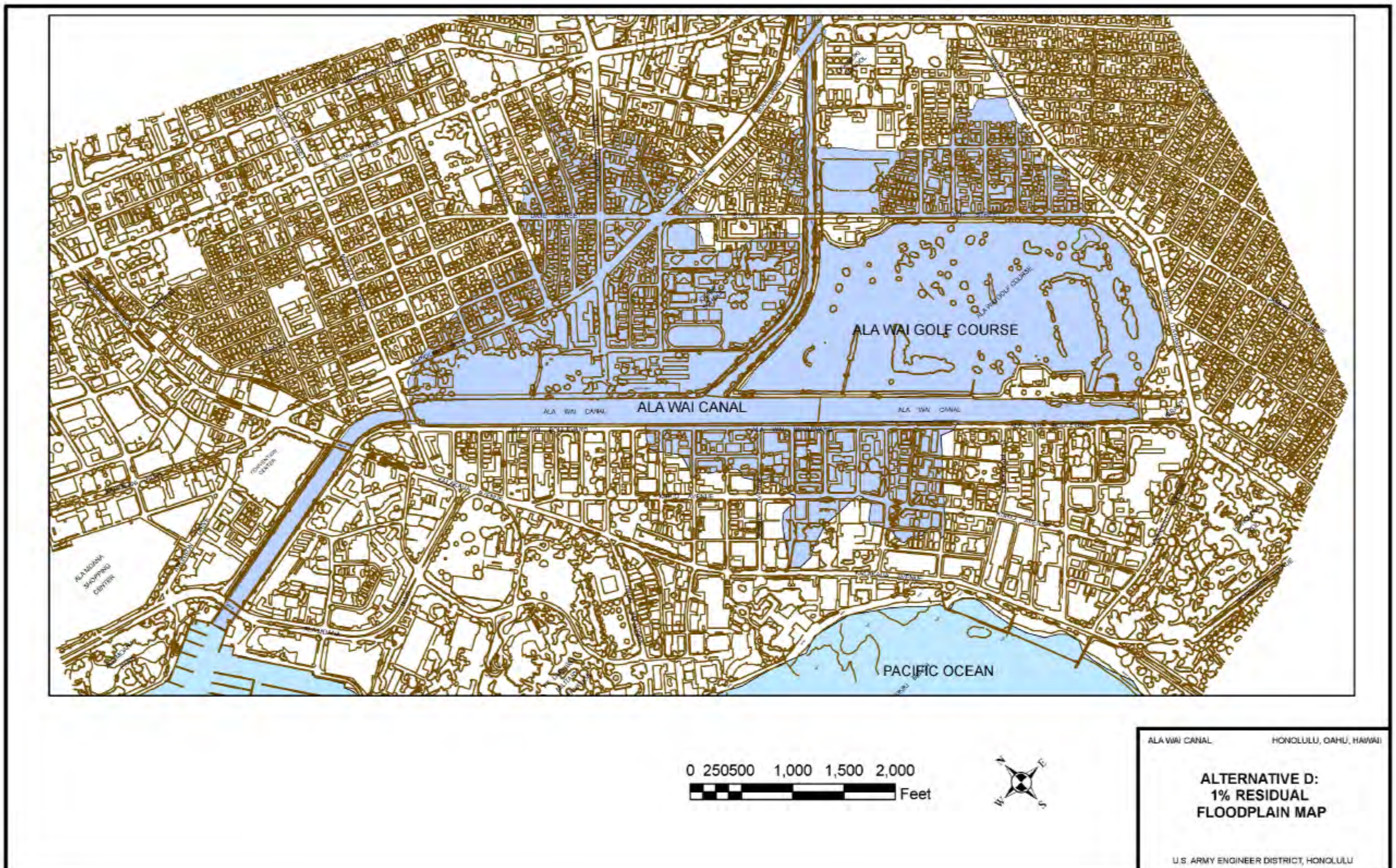

ALA WAI GOLF COURSE
ALA WAI CANAL
PACIFIC OCEAN
0 250500 1,000 1,500 2,000
Feet
ALA WAI CANAL
HONOLULU, OAHU, HAWAII
ALTERNATIVE D:
1% RESIDUAL
FLOODPLAIN MAP
U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 15

ALTERNATIVE E – RESULTS

Alternative E: Floodwalls + widen canal + bridge modification + golf course storage

- Provides 100-yr flood containment in channel
- Floodwall minimum height, 3.2 feet
- Modifications and floodwalls limit local/interior drainage causing interior flooding
- Widening does not change the WSE in canal
- Bridge modification to the Kalakaua Bridge only
- Golf course used as storage area

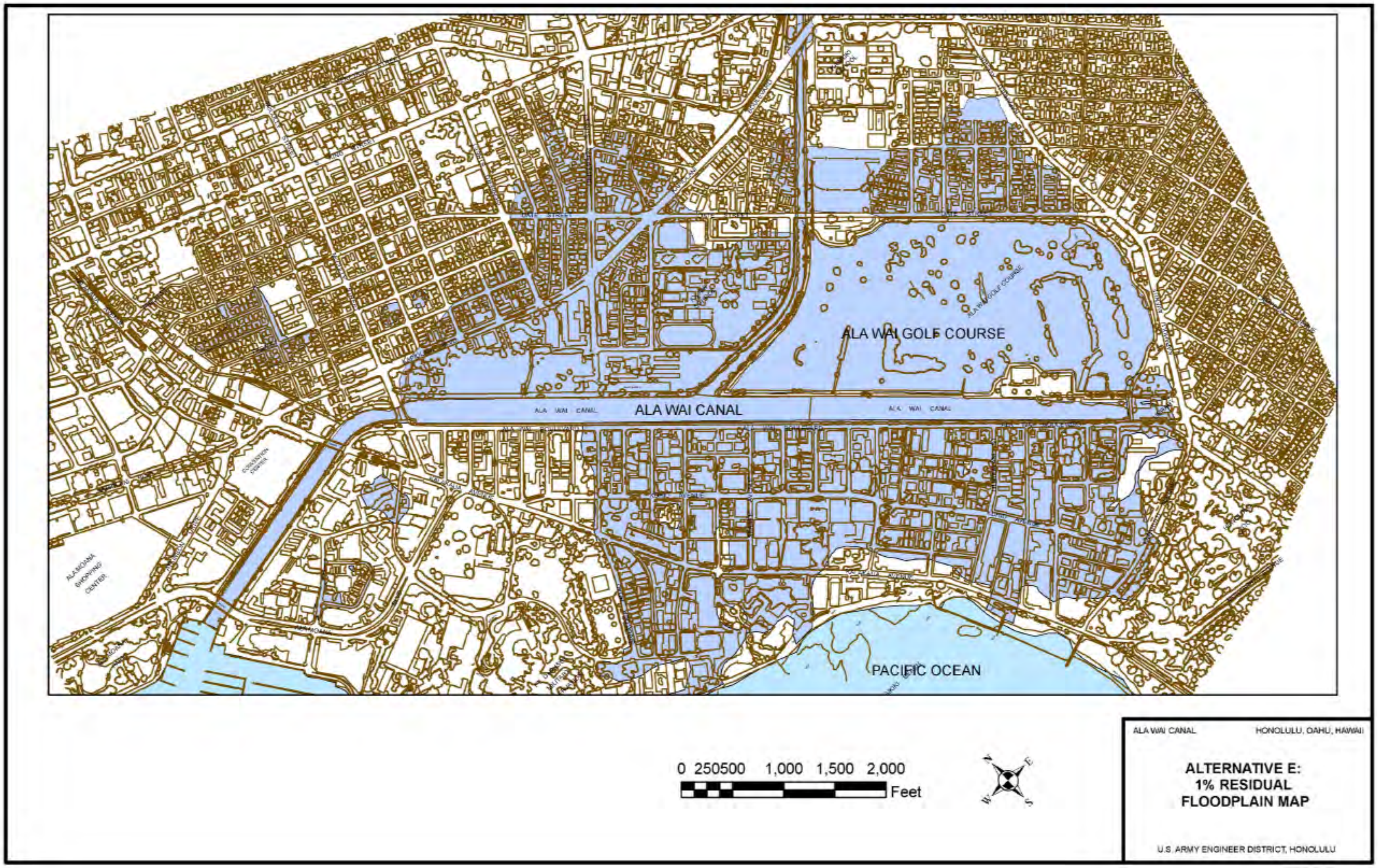

ALA WAI GOLF COURSE
ALA WAI CANAL
PACIFIC OCEAN
0 250500 1,000 1,500 2,000
Feet
ALA WAI CANAL
HONOLULU, OAHU, HAWAII
ALTERNATIVE E:
1% RESIDUAL
FLOODPLAIN MAP
U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 18

ALTERNATIVE F – RESULTS

Alternative F: Dredging + floodwalls + golf course storage

- Provides 100-yr flood containment in channel
- Floodwall minimum height, 2.5 feet
- Modifications and floodwalls limit local/interior drainage causing interior flooding
- Dredging has little effect on WSE
- Golf course used as storage area

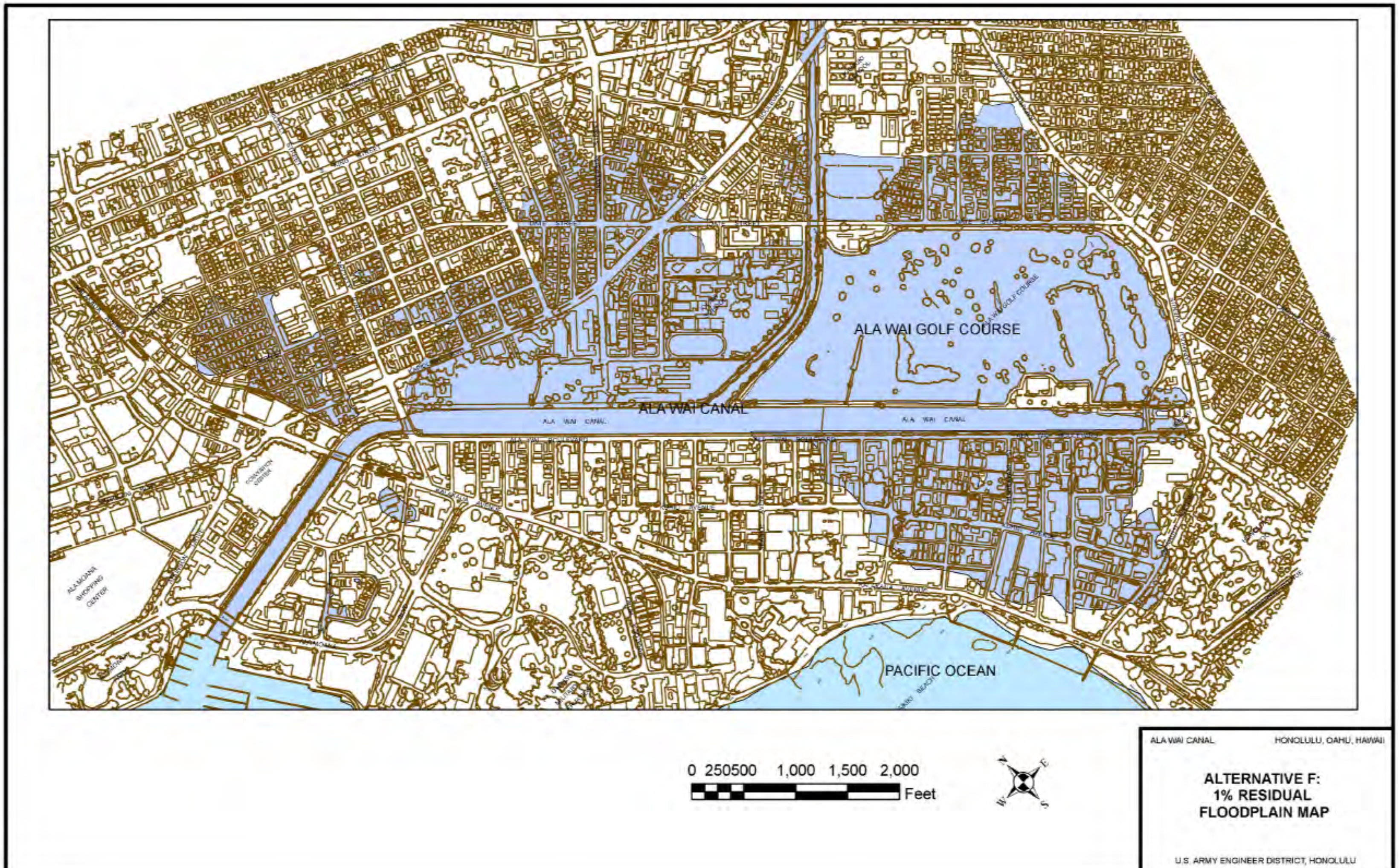

ALA WAI GOLF COURSE
ALA WAI CANAL
PACIFIC OCEAN
ALA MOANA SHOPPING CENTER
0 250500 1,000 1,500 2,000
Feet
ALA WAI CANAL
HONOLULU, OAHU, HAWAII
ALTERNATIVE F:
1% RESIDUAL
FLOODPLAIN MAP
U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 21

ALTERNATIVE G – RESULTS

Alternative G: Dredging + widen canal + golf course storage

- Provides a 10-year level of protection
- Widening does not change the WSE in canal
- Bridge modification to the Kalakaua Bridge only
- Golf course used as storage area

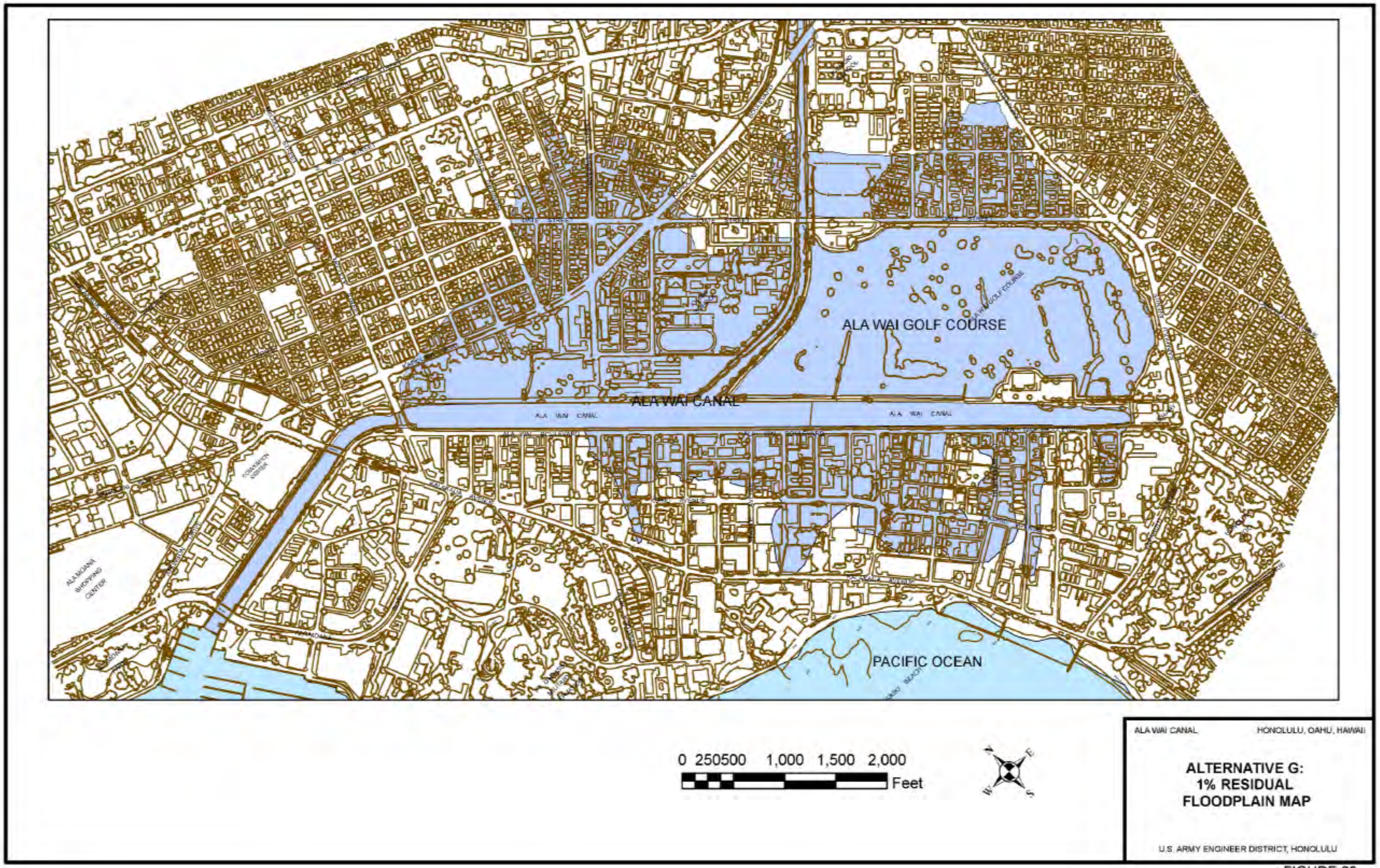

ALA WAI GOLF COURSE
ALA WAI CANAL
PACIFIC OCEAN
0 250500 1,000 1,500 2,000
Feet
ALA WAI CANAL
HONOLULU, OAHU, HAWAII
ALTERNATIVE G:
1% RESIDUAL
FLOODPLAIN MAP
U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 29

ALTERNATIVE H – OPTIMUM PLAN?

Alternative H: Variation of D-G? NED plan?

- Should provide 100-year level of protection
- Minimize floodwall heights
- Should address interior drainage
- Widening to help flow transitions
- Bridge modifications if needed
- Dredging if needed
- Golf course used as storage area
- Utilized additional storage areas

HYDRAULIC RESULTS IN DETERMING NED PLAN

- NED- National Economic Development, alternative with the most economic benefits, x-year event
- HEC-FDA, Flood Damage reduction Analysis model
- Hydraulic results used in HEC-FDA
- NED Plan tbd

AFTER FEASIBILITY STUDY

- Design Phase
- Anticipate a Design Documentation Report (DDR) as part of the Design Phase
- Will help to refine and study the NED Plan

WHAT IF…

WE GET THE 100-YEAR FLOOD EVENT BEFORE THE PROJECT IS BUILT?

MANOA STREAM — OCTOBER 30, 2004

50-YEAR RAINFALL — 25-YEAR RUNOFF

Special Thanks

- Ted Perkins – Seattle District
- Doug Knapp – Seattle District
- Mike Wong – Honolulu District
- Derek Chow – Honolulu District

For More Information

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Building 223
Fort Shafter, HI 96858
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-or-

MR. DEREK J. CHOW
Senior Project Manager
Civil & Public Works Branch
US Army Corps of Engineers, Honolulu District
Bldg 230, Room 312
Fort Shafter, HI 96858

Questions?

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2005 Section 227 Program Workshop
St. Louis, MO
4 August 2005

Section 227 – Oil Piers, Ventura County, CA

Heather Schlosser
U.S. Army Corps of Engineers
Los Angeles District

OIL PIERS, VENTURA

SECTION

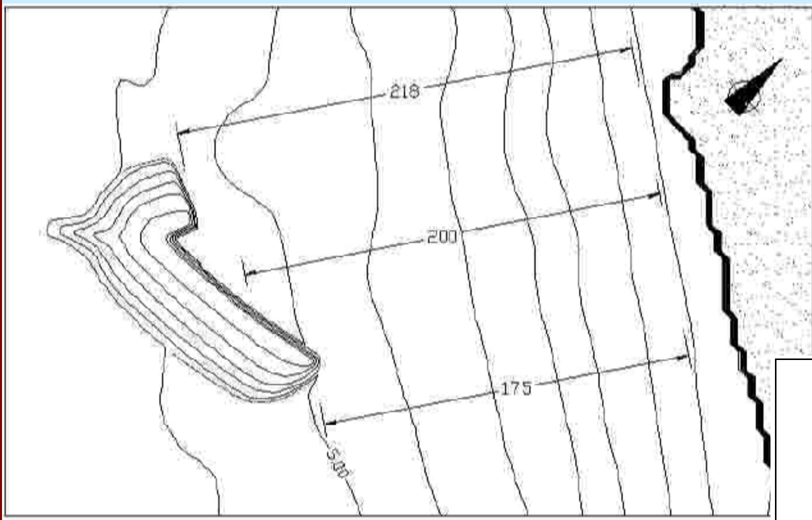
227

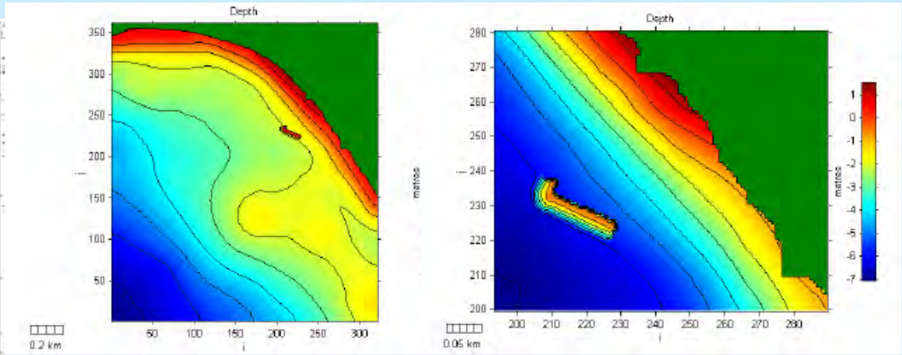
Oil Piers Site (1996)

100% DESIGN - ASR

SECTION

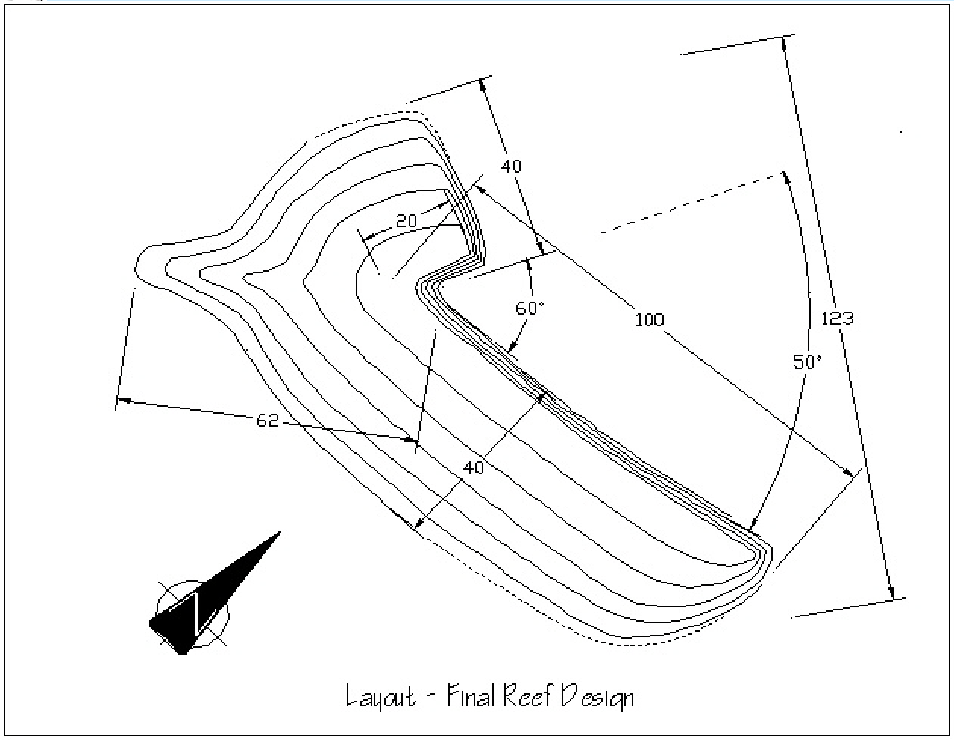
227





The Oil Piers Reef is 200 m offshore and 123 m alongshore, and has a volume of ~17,100 m^3, crest height –0.5 m

Cost - $2 to 2.5M



PROJECT DELIVERY TEAM

SECTION

227

❖ ASR Team

- ❖Shaw Mead
- ❖Kerry Black
- ❖Brad Scarfe
- ❖Chris Blenkinsopp
- ❖Lee Harris - FIT
- ❖Jay Sample - Advanced Coastal Technology Inc.
- ❖Ted Roche - DiveCon

❖CERB Member

- ❖Joan Oltman-Shay, Ph.D.

❖Corps Team

- ❖Susie Ming – Planning
- ❖Art Shak – Coastal Engineering
- ❖Lisa Louie – Environmental
- ❖John Sunshine – Real Estate
- ❖Stan Fujimoto – Construction
- ❖Heather Sumerell – Planning
- ❖Don Ward - ERDC

❖Non Federal Sponsor – BEACON

- ❖Brian Brennan – Executive Director
- ❖Jim Bailard
- ❖Karl Treiberg
- ❖Gerald Comati
- ❖Kevin Ready

❖Regulatory

- ❖State Lands – Jane Smith
- ❖Coastal Commission – Audrey McCombs

Status

SECTION 227

- 100% Design Complete
- Project Team Meeting – January 2005
- Plans and Specification in progress
- Environmental Assessment
  - Public Review – October 2004
  - BEACON approved EA document – January 2005
  - FONSI – March 2005
- Permitting
  - California State Lands Lease – BEACON application - October 2005
  - California Coastal Commission
    - BEACON coastal permit - October 2005
    - Corps – Consistency Determination for Construction
  - USACE – BEACON 404 Permit for O&M
- Memorandum of Agreement and Decision Support Statement – HQ for comments – received, responding to comments

Status

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- ❖ Sand Sources – Potential West Beach in Santa Barbara
- ❖ Fabrication of Geotextile Containment Cells –4-month lead time (or 8 months)
- ❖ Proposed Construction Spring/Summer 2006

MOVE FORWARD ASSUMING THERE IS FUNDING & AUTHORITY!

Seabrook, New Hampshire

SECTION

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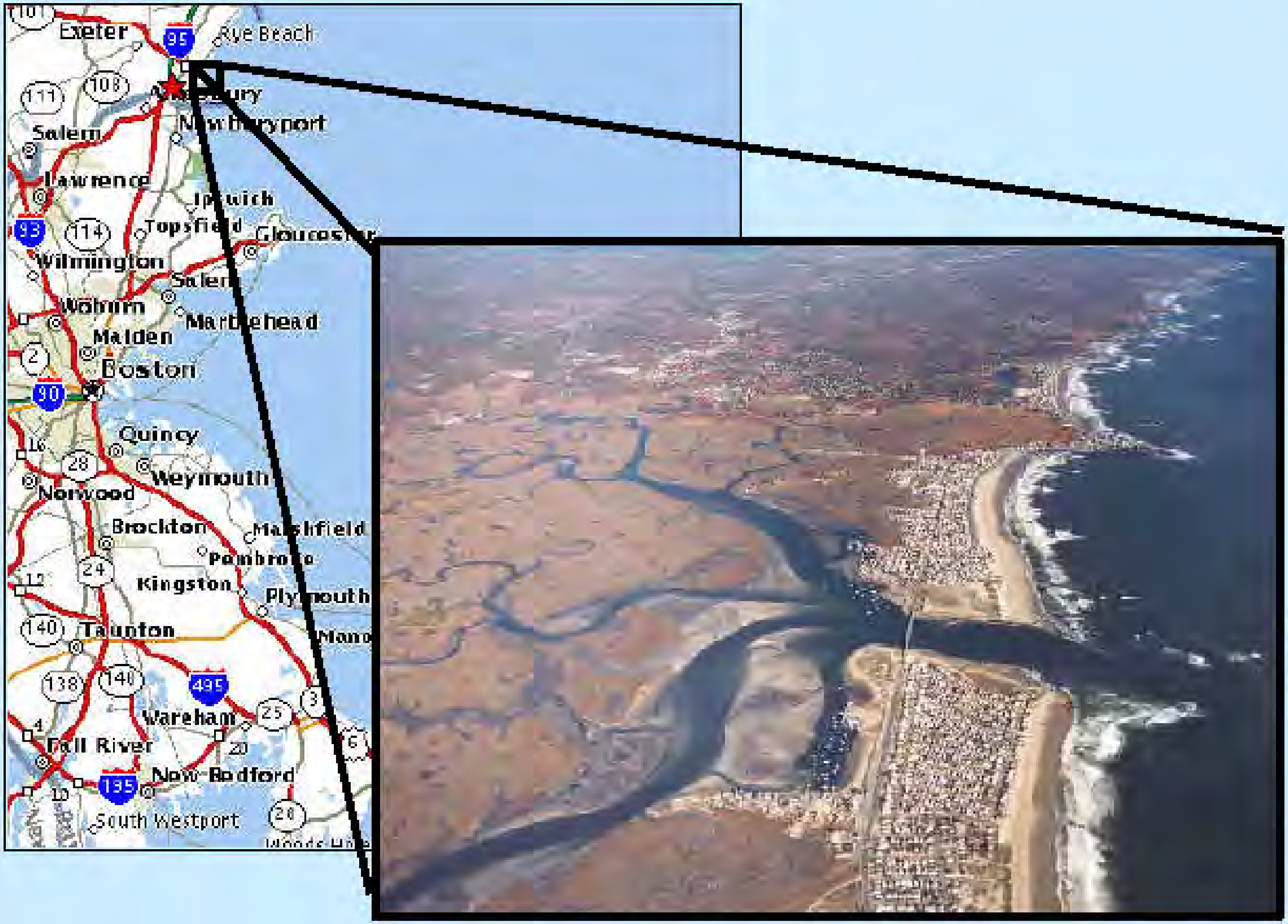

Seabrook, New Hampshire

SECTION 227

- **Sponsor: New Hampshire**

(Pease Development Authority, Division of Ports and Harbors)

- **Design: New England District**
- **Construction: Reed & Reed, Inc., Maine**
- **Composite Sheeting: CMI, Inc.**
- **Geogrid Marine Mattresses: Tritton**
- **Instrumentation: Geokon, Inc.**

Seabrook, New Hampshire

SECTION

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Seabrook, New Hampshire

SECTION

227

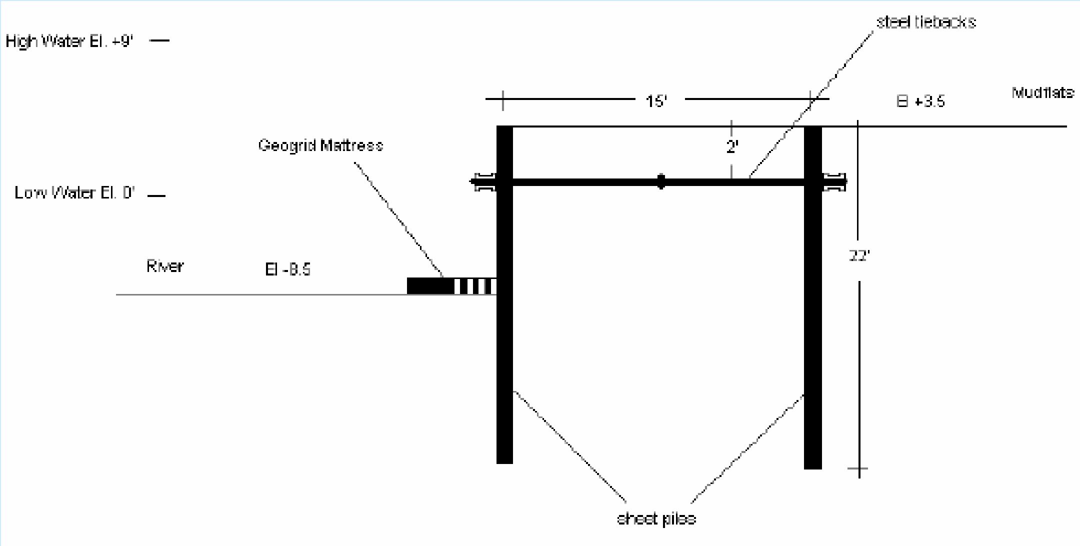
- Objectives:
  - Replace lost intertidal sands
  - Reduce sand migration into the Harbor
  - Prevent shoreline erosion
- Solutions:
  - Install two cofferdams (bulkheads) across the eroded channel
  - Dredge sand from the shoaled areas of the River to encourage flow
  - Use the dredged sand to fill between the cofferdams to restore the sand flats

Seabrook, New Hampshire

SECTION

227

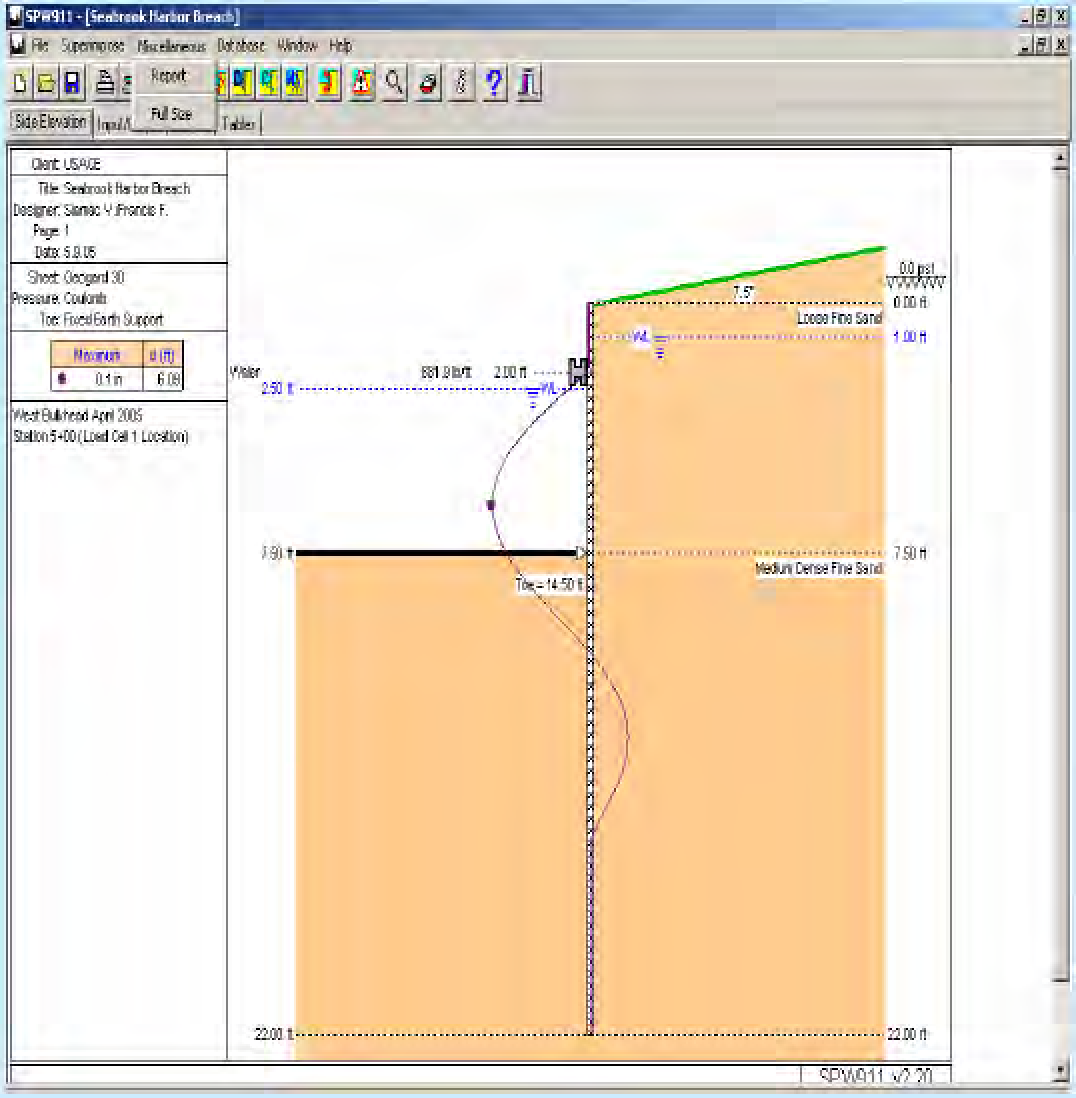
- Design
  - Synthetic sheeting: Corrosion, Cost
  - Galvanized steel tiebacks and wale: Reliability
  - Double Rows of sheets: No cantilever
  - Single Wale: No diving (winter)
  - Scour protection: Protect toe
  - Drainage: Reduce loads



Seabrook, New Hampshire

Design Parameters

- 50-year low tide
- 50% drainage in fill
- 12' depth to mudline
- 2 tons horizontal Load per linear foot
- Tiebacks 6' spacing
- 200 psf surcharge



Seabrook, New Hampshire

SECTION

227

Other Components

- **Wale: 2X 10" galvanized steel Channels on the outside**

- **Tiebacks: 18' long, 2.25" galvanized steel tiebacks with turnbuckle, Oversized to allow for corrosion**

- **Drains: 2 x 2" dia holes with wire mesh/geotextile backing, located under water to prevent freezing**

Construction

– October 2004 – April 2005

(within the November- March dredging window)

– hydraulic dredge

– two barges, three cranes, clam shell, dozer, supply boats

– hydraulic vibratory hammer

– sheetpile was initially coasted with a polyurethane resin; delivery and QC problems resulted in switch to different manufacturer and polyester resin

– geogrid marine mattresses

Seabrook, New Hampshire

SECTION

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Seabrook, New Hampshire

SECTION

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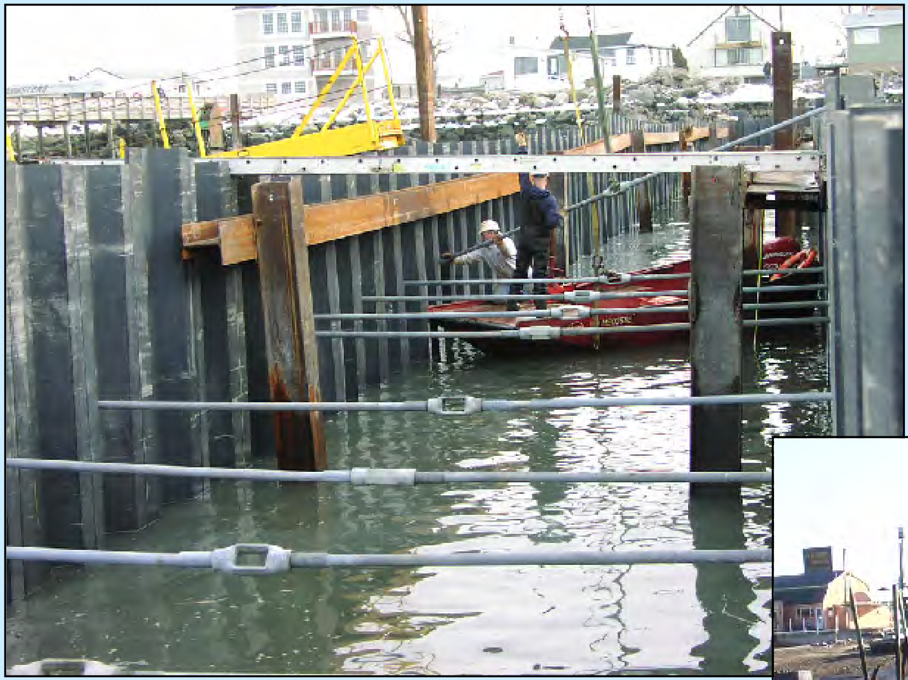
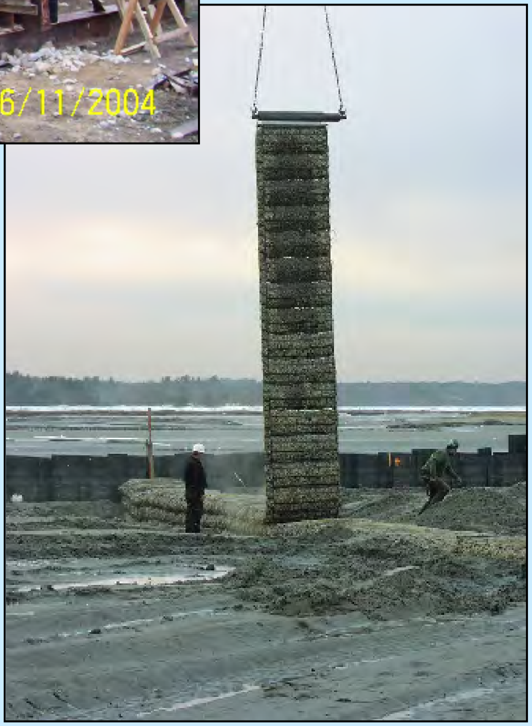


Seabrook, New Hampshire

SECTION 227



Seabrook, New Hampshire

SECTION

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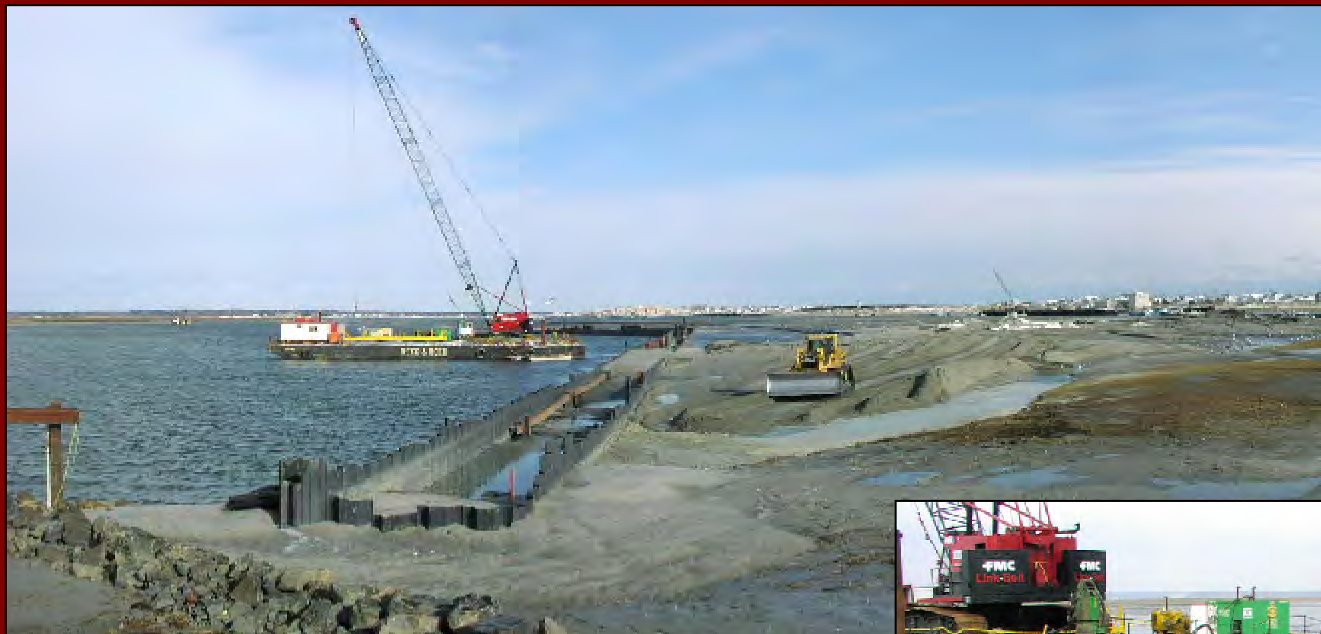
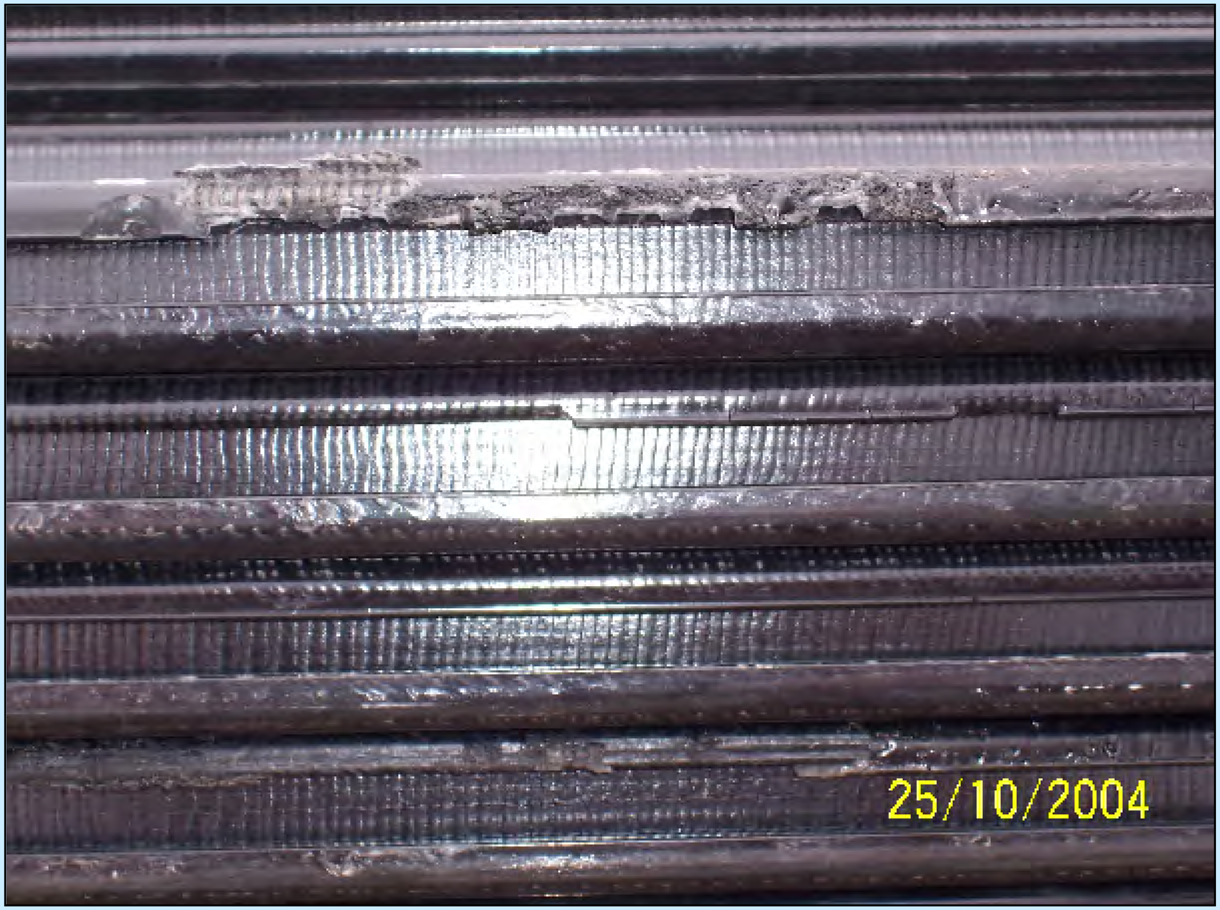
Seabrook, New Hampshire

SECTION 227



Seabrook, New Hampshire

SECTION 227



Seabrook, New Hampshire

SECTION 227

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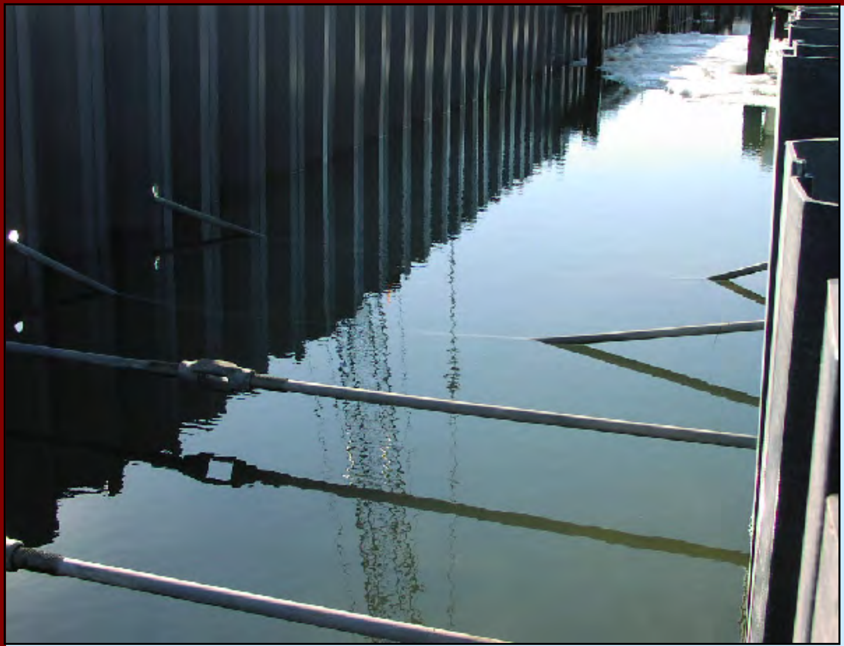

Seabrook, New Hampshire

SECTION 227

October 2004

April 2005

Seabrook, New Hampshire

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Current Project Status

- Post-construction monitoring with UNH & CCOM
- TABS and ADCIRC models
- Documentation
  - NAE overspent – no documentation to date
  - ERDC has started O&M report, lessons learned, and DDR
  - monitoring report

SECTION 227

Sheldon Marsh Nature Preserve

U.S. Army Engineer District
Buffalo, NY

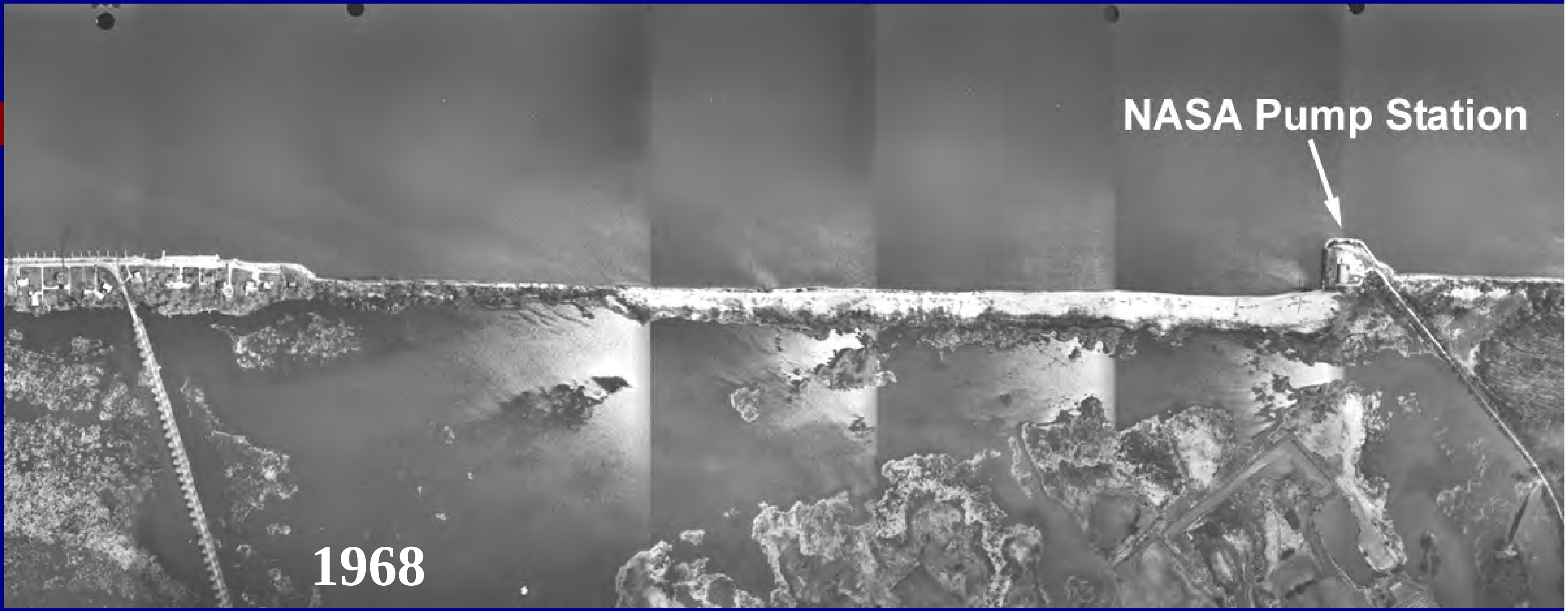
SECTION

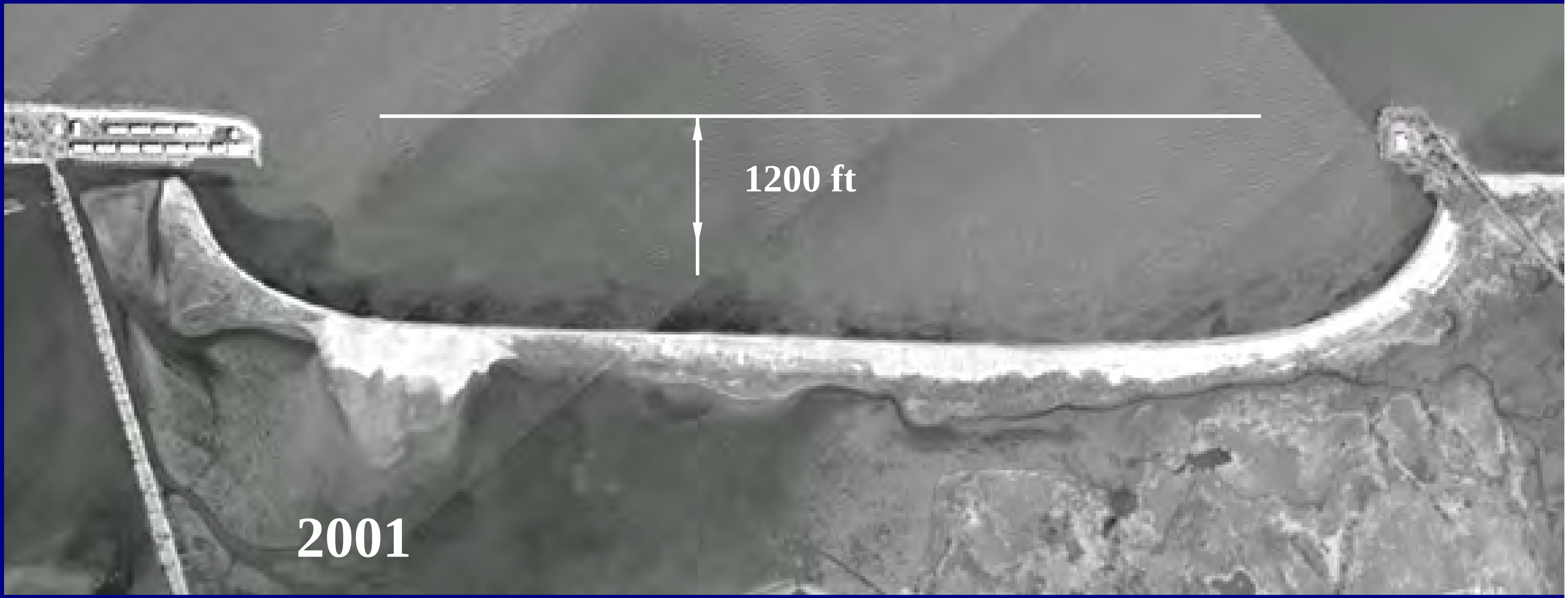
227

LAKE ERIE
SHELDON MARSH

N
CHAUSEE
LAKE ERIE
SHELDON MARSH
0 1000
SCALE IN FEET
OPEN WATER
NASA
ROUTE 6
AQUEDUCT
HULL RD.
CAMP ROAD
RAILROAD
SHELDONLOCATION.DGN
NOTE: BASE MAP TRACED FROM USGS QUAD MAP DATED 1969 BARRIER ISLAND POSITION AND WETLANDS UPDATED TO 2001.

SECTION 227





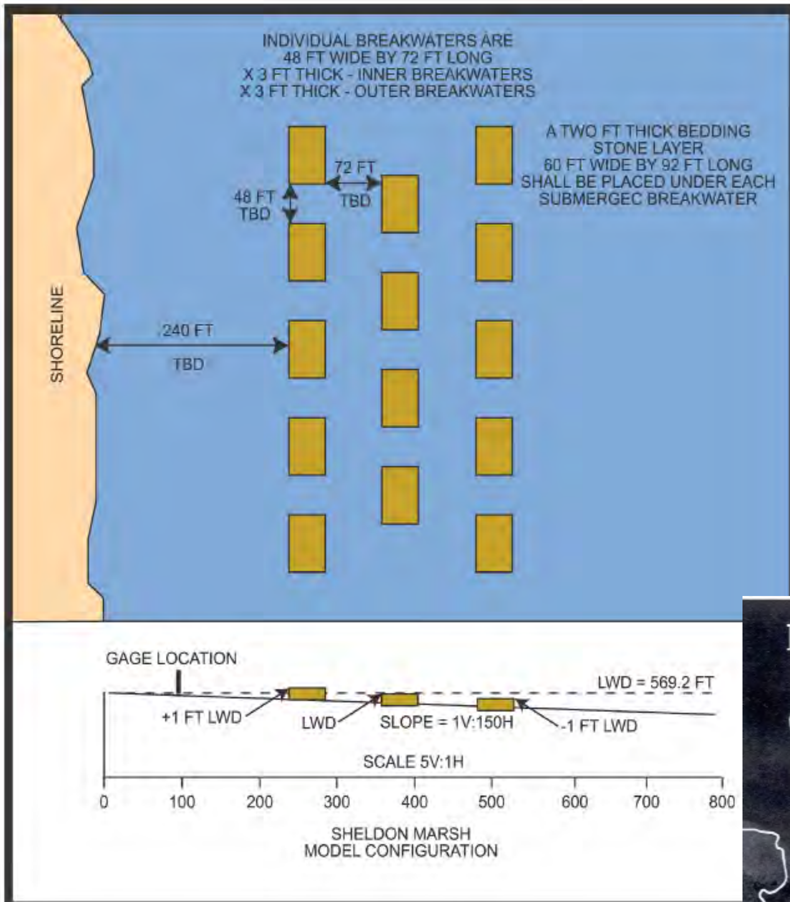
SECTION 227

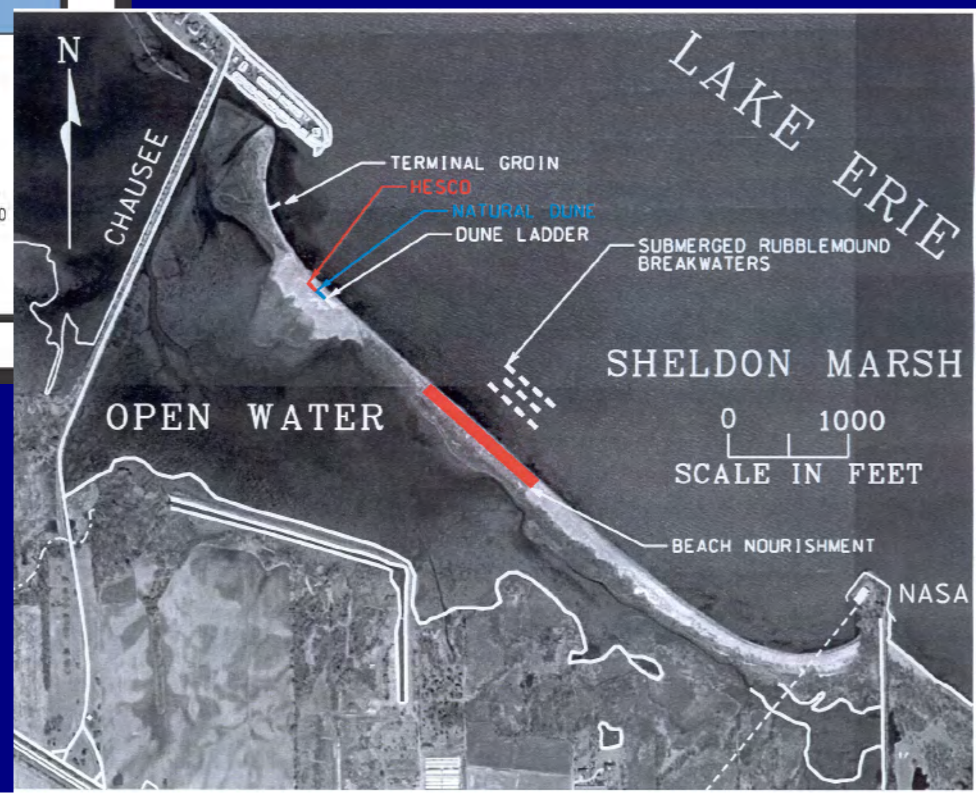
Project Goals

- Slow the retreat of the barrier and protect the interior wetlands
- Allow waves to wet the beach slope during wave activity
- Minimize visual impact over a wide range of water levels
- Provide additional fish habitat
- Minimal construction impact
- Minimize future maintenance

SECTION

227


INDIVIDUAL BREAKWATERS ARE
48 FT WIDE BY 72 FT LONG
X 3 FT THICK - INNER BREAKWATERS
X 3 FT THICK - OUTER BREAKWATERS
A TWO FT THICK BEDDING
STONE LAYER
60 FT WIDE BY 92 FT LONG
SHALL BE PLACED UNDER EACH
SUBMERGEC BREAKWATER
72 FT
TBD
48 FT
TBD
SHORELINE
240 FT
TBD
GAGE LOCATION
LWD = 569.2 FT
+1 FT LWD
LWD
SLOPE = 1V:150H
-1 FT LWD
SCALE 5V:1H
0
100
200
300
400
500
600
700
800
SHELDON MARSH
MODEL CONFIGURATION


N
LAKE ERIE
CHAUSEE
TERMINAL GROIN
HESCO
NATURAL DUNE
DUNE LADDER
SUBMERGED RUBBLEMOUND
BREAKWATERS
SHELDON MARSH
OPEN WATER
0
1000
SCALE IN FEET
BEACH NOURISHMENT
NASA

SECTION 227

SHELDON MARSH MODEL STUDY AVERAGE WAVE HEIGHT AT GAUGES 8-10				
WATER LEVEL	WAVE RECURRENCE INTERVAL	AVERAGE WAVE HEIGHT - FT		PERCENT REDUCTION
		EXISTING	WITH PROJECT	
AVERAGE	AVERAGE	2.119	1.176	45
	2-YEAR	2.364	1.567	34
	20-YEAR	2.803	1.513	46
10-YEAR	AVERAGE	3.067	2.376	23
	2-YEAR	4.484	3.918	13
	20-YEAR	4.638	3.861	17

SECTION 227

Conclusions

- Project will minimize wave impact on the marsh and surroundings
- Waves will periodically overtop existing dunes
- Waves will continue to wet the beach slope
- Visual impact will be minimized over a wide range of water levels
- Additional fish habitat will be provided
- Maintenance will be minimized
- Actual wave dissipation should be higher than model

SECTION 227

Current Progress

- Project report is at 95%
- Tech Note has been completed and formatted at ERDC
- Geomorphology report has been completed by Morang and Chader and is being formatted at ERDC
- Technical report for ERDC is at 50%
- Scope of work completed for independent reviewers (outside agency reviewers)
- Final Report will be sent out in next few weeks for independent review

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Current Issues

- Problems with obtaining construction access to the project site and staging area
- MOA current draft does not reflect Ohio's concerns re. project removal (if necessary).
- The proposed project area has restrictions due to its Nature Preserve status. USACE and ODNR are currently negotiating to obtain construction access via land to the project site and staging area.

SECTION 227

Current Issues – continued

- **Land access is easiest and cost effective**
  - **Non-Federal sponsor does not want land access, issues with possible road damage and tree removal**
  - **Preserve access by public will be impacted**
- **Water access is difficult and more costly**
  - **Dredging will be required**
  - **Bathymetry will be permanently altered - greater impact on ecosystem (organic peat lake bottom exists)**
  - **Still need to access beach for nourishment, dune work, etc.**

SECTION 227

SECTION 227

An Evaluation of Performance Measures for Prefabricated Submerged Concrete Breakwaters:

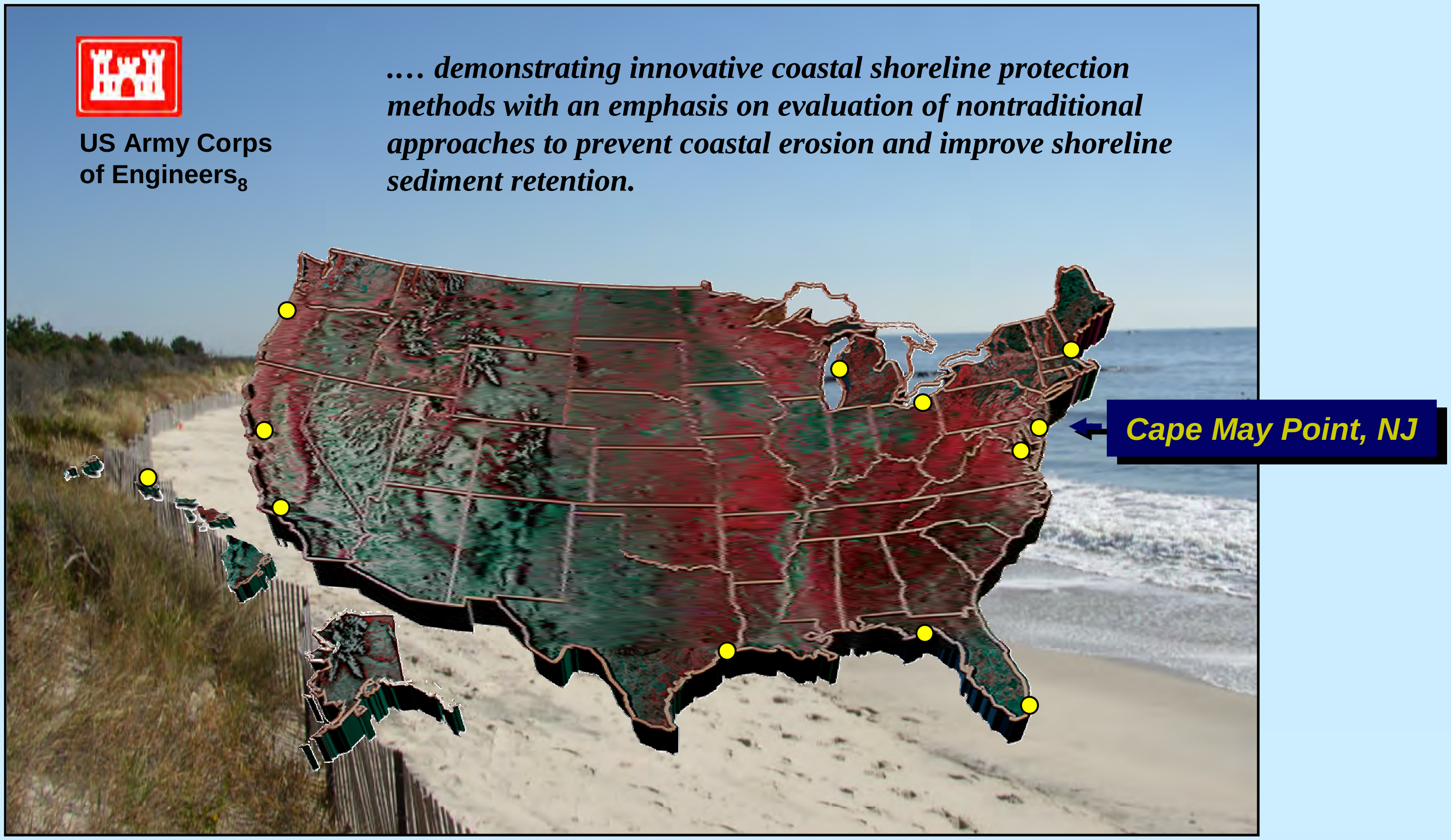
Section 227 Cape May Point, New Jersey Demonstration Project

2.5 Year Results

Donald K Stauble - Engineer Research & Development Center,
Coastal and Hydraulics Laboratory
J.B. Smith - Philadelphia District
Randall A. Wise - Philadelphia District

SECTION 227

National Shoreline Erosion Control Demonstration and Development Program



OBJECTIVES

SECTION 227

1) To evaluate the effectiveness of the two submerged structures in retaining sand on the beach as compared with unprotected groin compartments

2) Compare the effectiveness of the more costly *Beachsaver Reef* with the less costly *Double-T Sill* in retaining sand in groin compartments

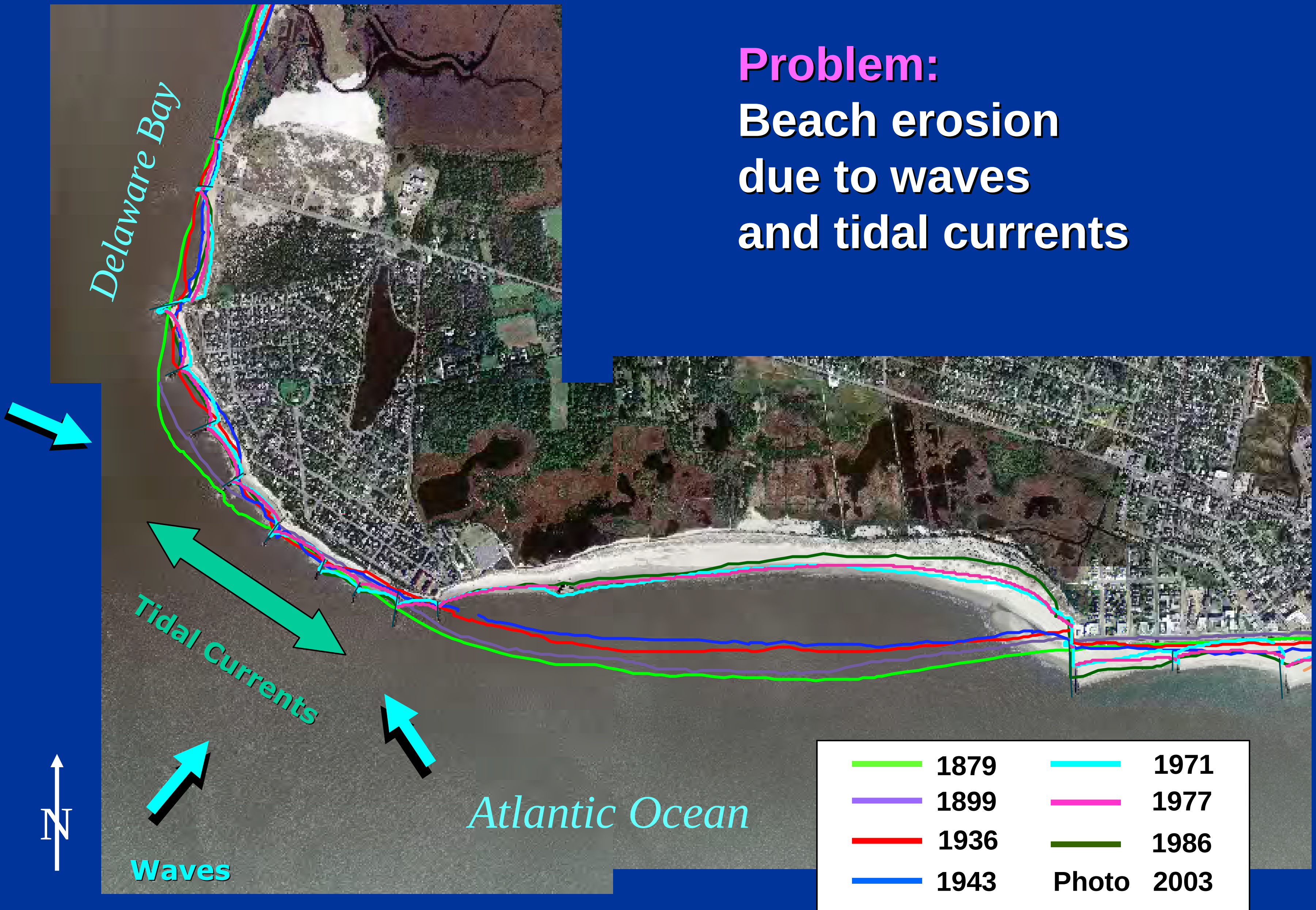
3) Evaluate ability of both structures to retain Beach Fill after placement

SITE LOCATION

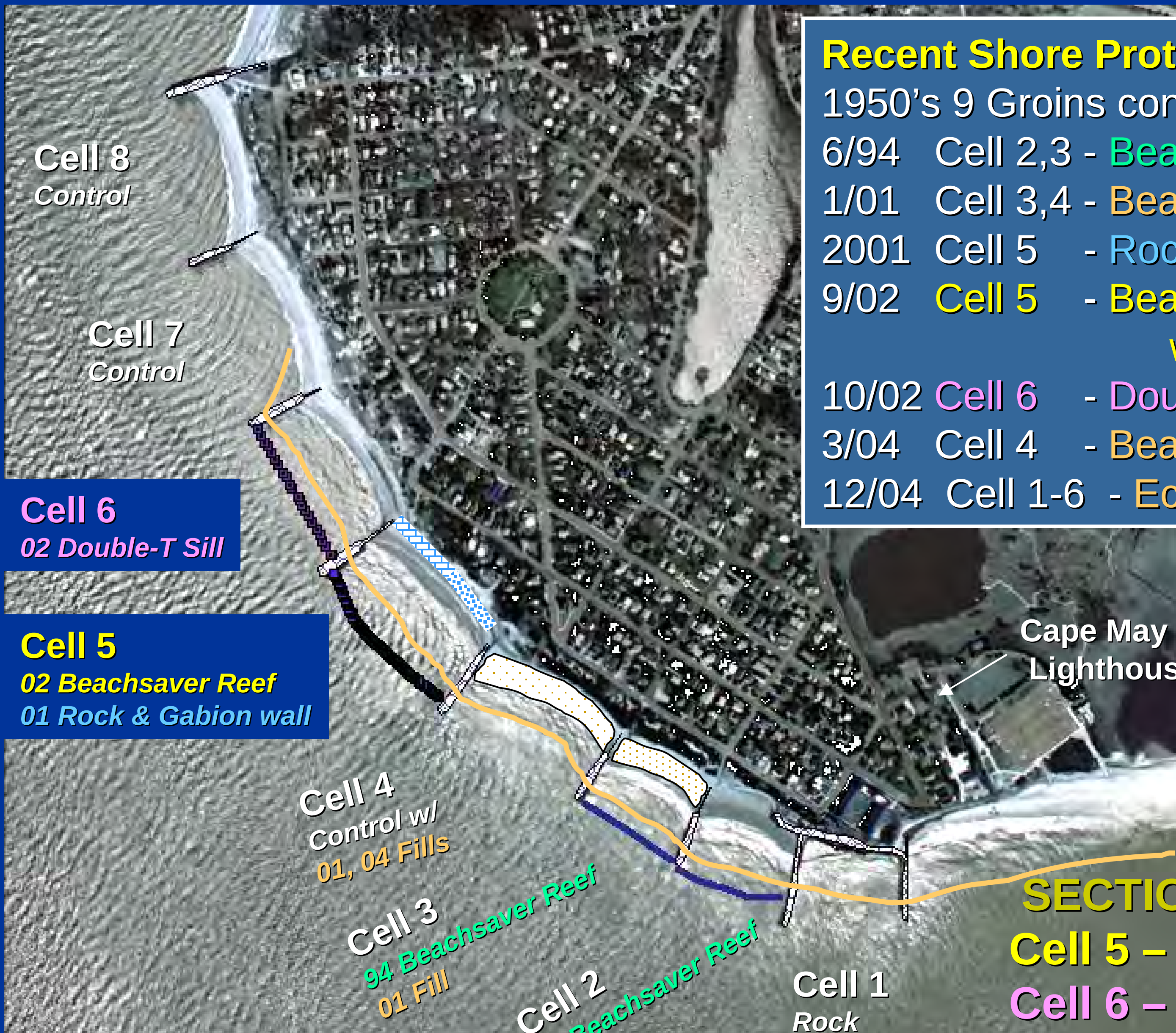
CAPE MAY POINT is southern most beach in New Jersey at entrance to Delaware Bay

HISTORICAL SHORELINE CHANGE

Problem:
Beach erosion due to waves and tidal currents



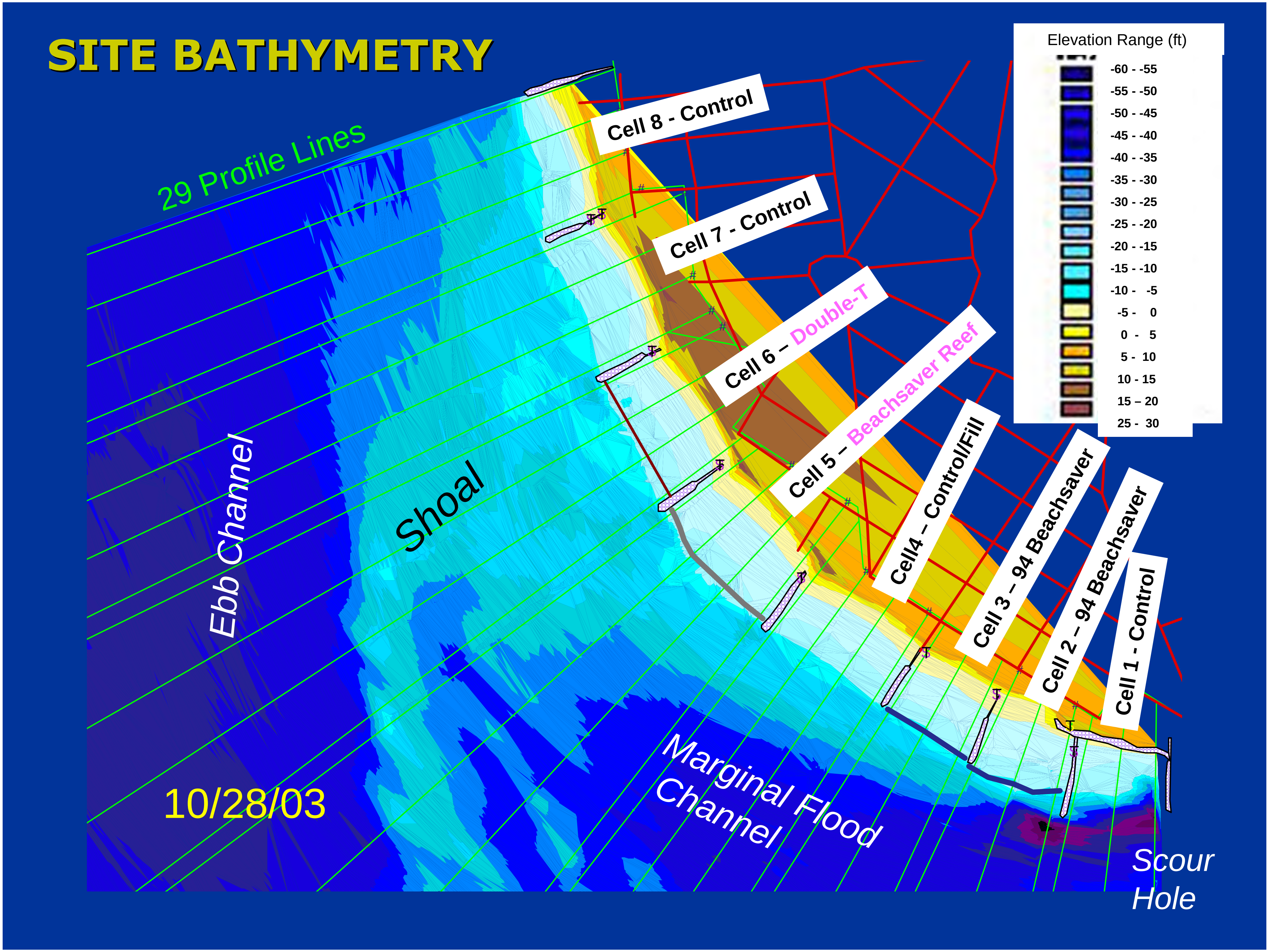
CAPE MAY POINT SITE LAYOUT



Recent Shore Protection History:

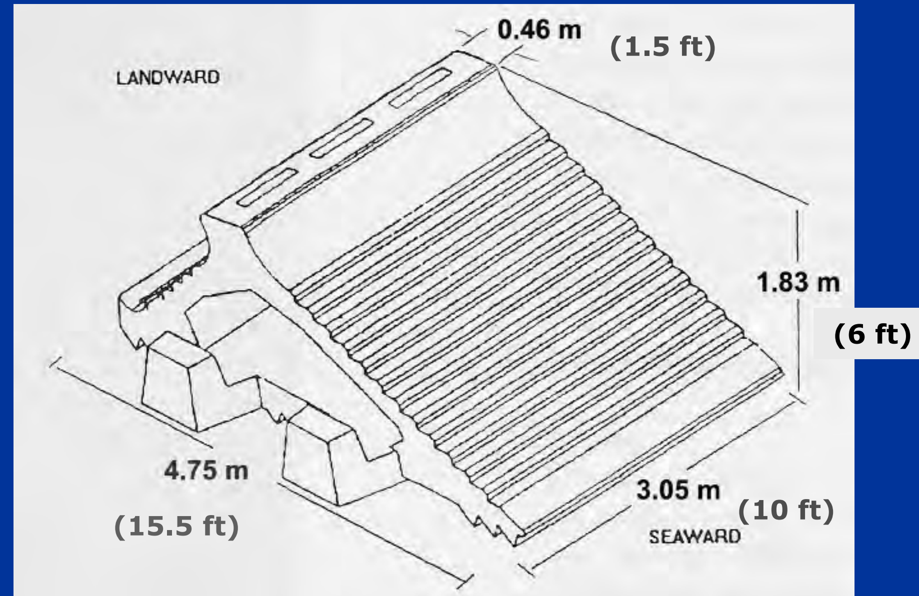
1950's 9 Groins constructed
6/94 Cell 2,3 - Beachsaver Reef
1/01 Cell 3,4 - Beach fill
2001 Cell 5 - Rock & Gabion wall
9/02 Cell 5 - Beachsaver Reef w/ filter
10/02 Cell 6 - Double-T Sill
3/04 Cell 4 - Beach Fill
12/04 Cell 1-6 - Eco Res. Beach Fill

SECTION 227 PROJECT
Cell 5 – Beachsaver Reef
Cell 6 – Double-T Sill

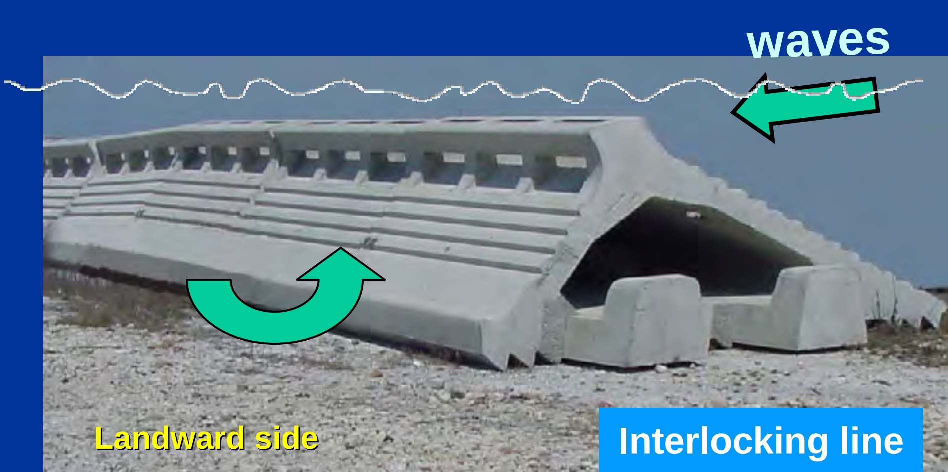

SITE BATHYMETRY
29 Profile Lines
Cell 8 - Control
Cell 7 - Control
Cell 6 – Double-T
Cell 5 – Beachsaver Reef
Cell4 – Control/Fill
Cell 3 – 94 Beachsaver
Cell 2 – 94 Beachsaver
Cell 1 - Control
Elevation Range (ft)
-60 - -55
-55 - -50
-50 - -45
-45 - -40
-40 - -35
-35 - -30
-30 - -25
-25 - -20
-20 - -15
-15 - -10
-10 - -5
-5 - 0
0 - 5
5 - 10
10 - 15
15 – 20
25 - 30
Ebb Channel
Shoal
Marginal Flood Channel
10/28/03
Scour Hole

BEACHSAVER REEF

Three reef units placed over
each filter fabric scour prevention layer

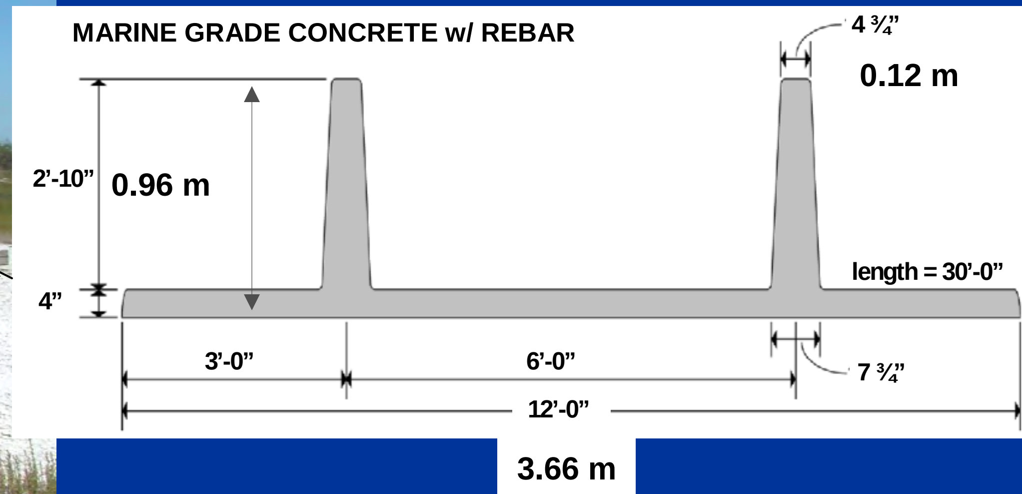


Placed in ~ -9 ft NAVD of water
~ -2.7 m NAVD
Top of reef just below water line at Low water

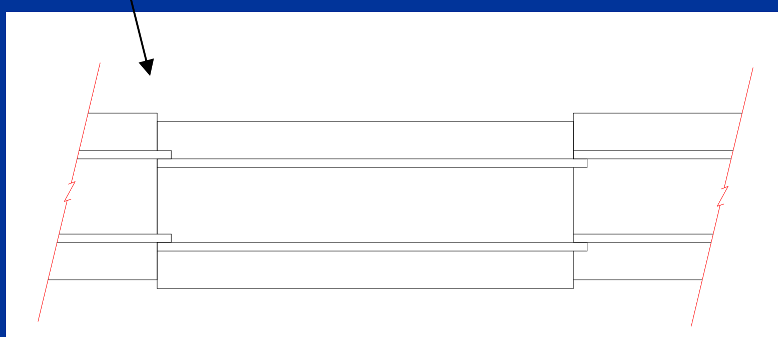


DOUBLE – T SILL

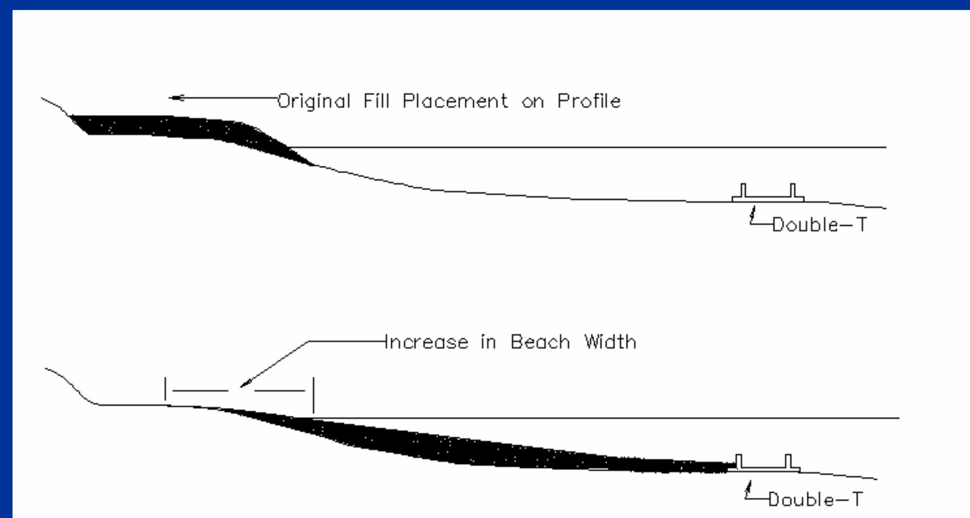
Units placed on sand (no filter cloth)
At ~ -9 ft NAVD w/ crest at –6 ft at low water
At ~ -2.7 m NAVD w/crest at –1.8 m at low water



Interlocking End



Alignment - Plan View



Sill Concept

MONITORING PROJECT PERFORMANCE

SECTION 227

- **Functional Performance**

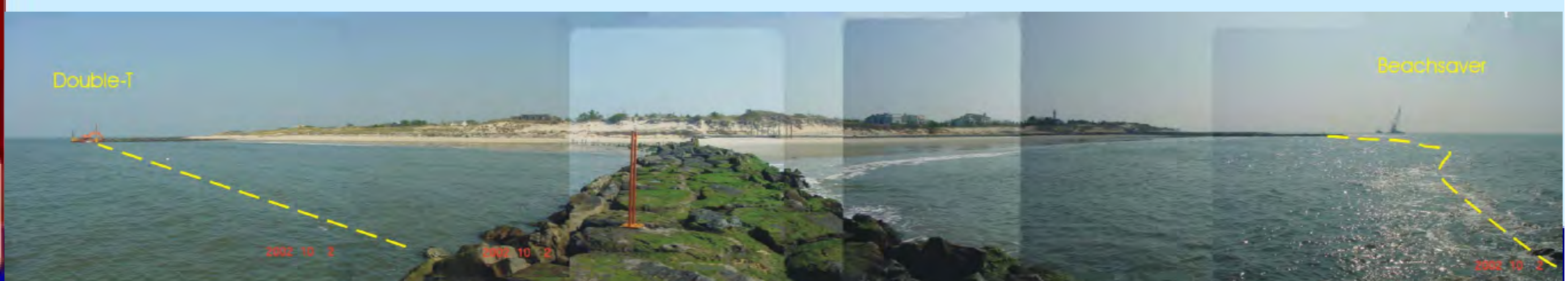
  Sand Retention - Volume Change
  Change in MHW Shoreline Position

- **Economic Performance**

  Reduction in Renourishment Quantities & Lengthening Fill Cycle - Improve Protection
  Reduce Uncertainty
  Reduce Costs

- **Structural Performance**

  Structural Stability - Change in Structure Crest Elevation
  Alongshore Integrity
  Depth of Scour



PERFORMANCE CRITERIA

Structure vs. Non-Structured Cells
Beachsaver Reef vs. Double-T Sill

SECTION 227

- **Functional Performance –** Sand Retention: *A) Sand Volume*
  B) Dry Beach Width

A1. Structure successful if retains >30% sand volume than non-structured cell
A2. Structure outperforms competing design if retains >30% sand volume
B1. Structure successful if retains >30% dry beach width than non-structured cell
B2. Structure outperforms competing design if retains >30% dry beach width

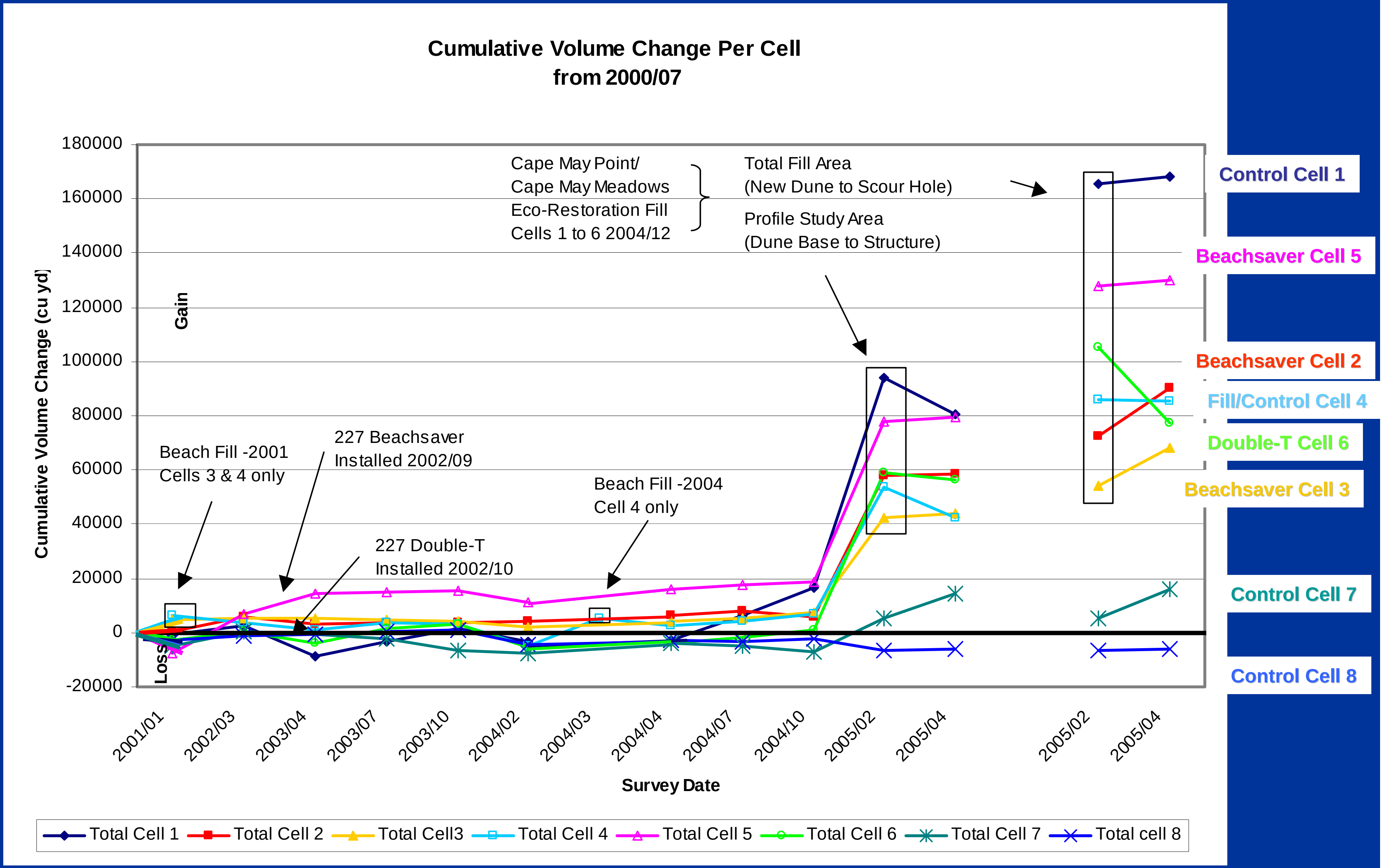
- **Economic Performance –** *A) Reduction in Renourishment Quantities*
  B) Lengthening Fill Cycle

A1. Structure successful if average annual renourishment cost savings > average annual cost of structure
A2. Structure outperforms competing design if incremental renourishment cost savings > incremental structure costs
B1. Structure successful if average annual cost savings of longer renourishment cycle > average annual cost of structure
B2. Structure outperforms competing design if incremental cost savings of longer renourishment cycle > incremental structure costs

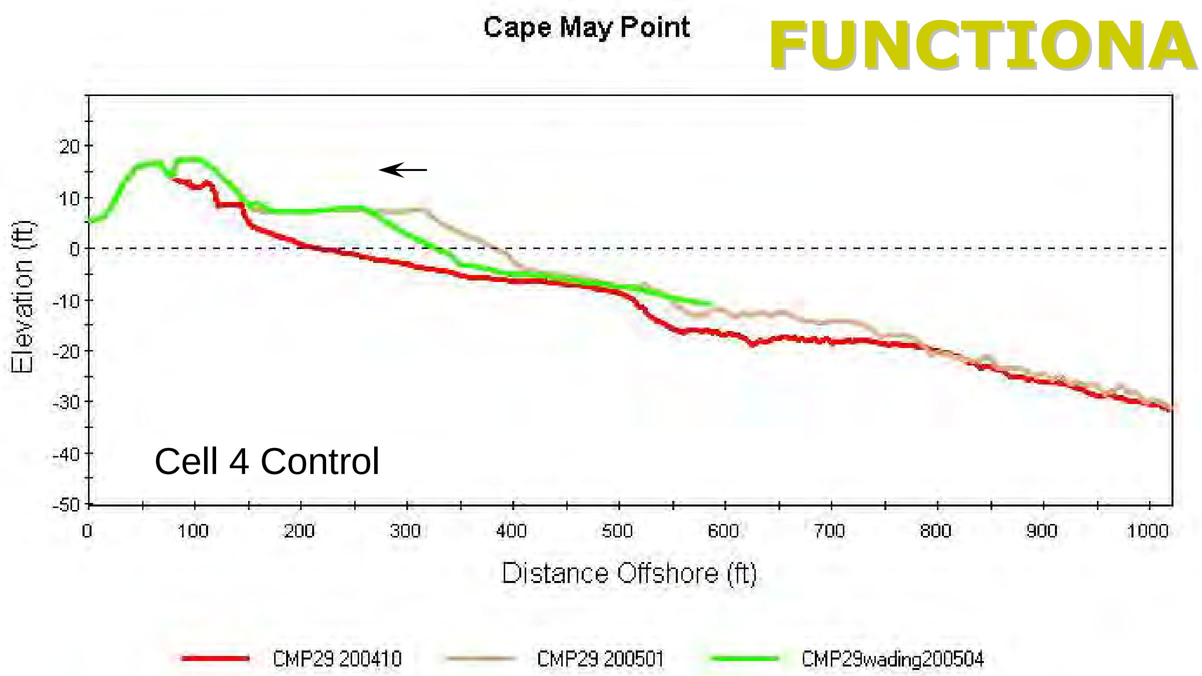
- **Structural Performance –** Structural Stability: *A) Crest Elevation*
  B) Alongshore Integrity
  C) Scour Depth

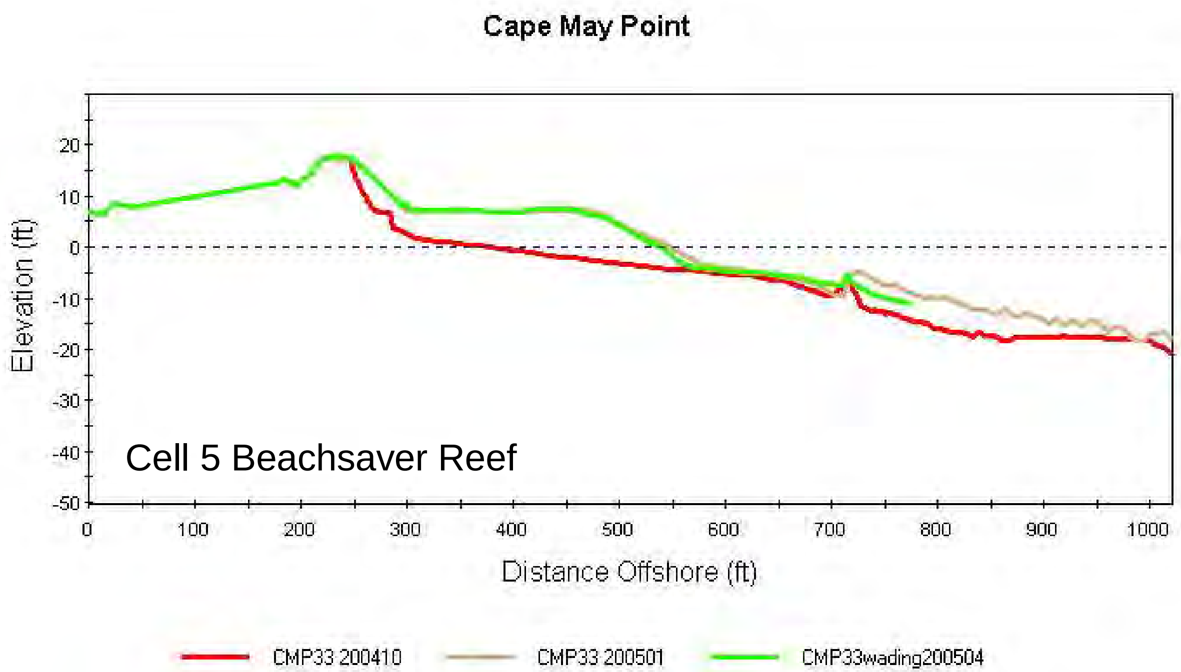
A1. Elevation Criteria: Successful if average lowering of crest elevation < 0.31 m (1 ft)
B1. Alongshore Integrity: Successful if no gaps form that result in localized sand loss through structure
C1. Scour: Successful if average scour is < 0.61 m (2 ft)

FUNCTION PERFORMANCE - Volume Change



FUNCTIONAL PERFORMANCE





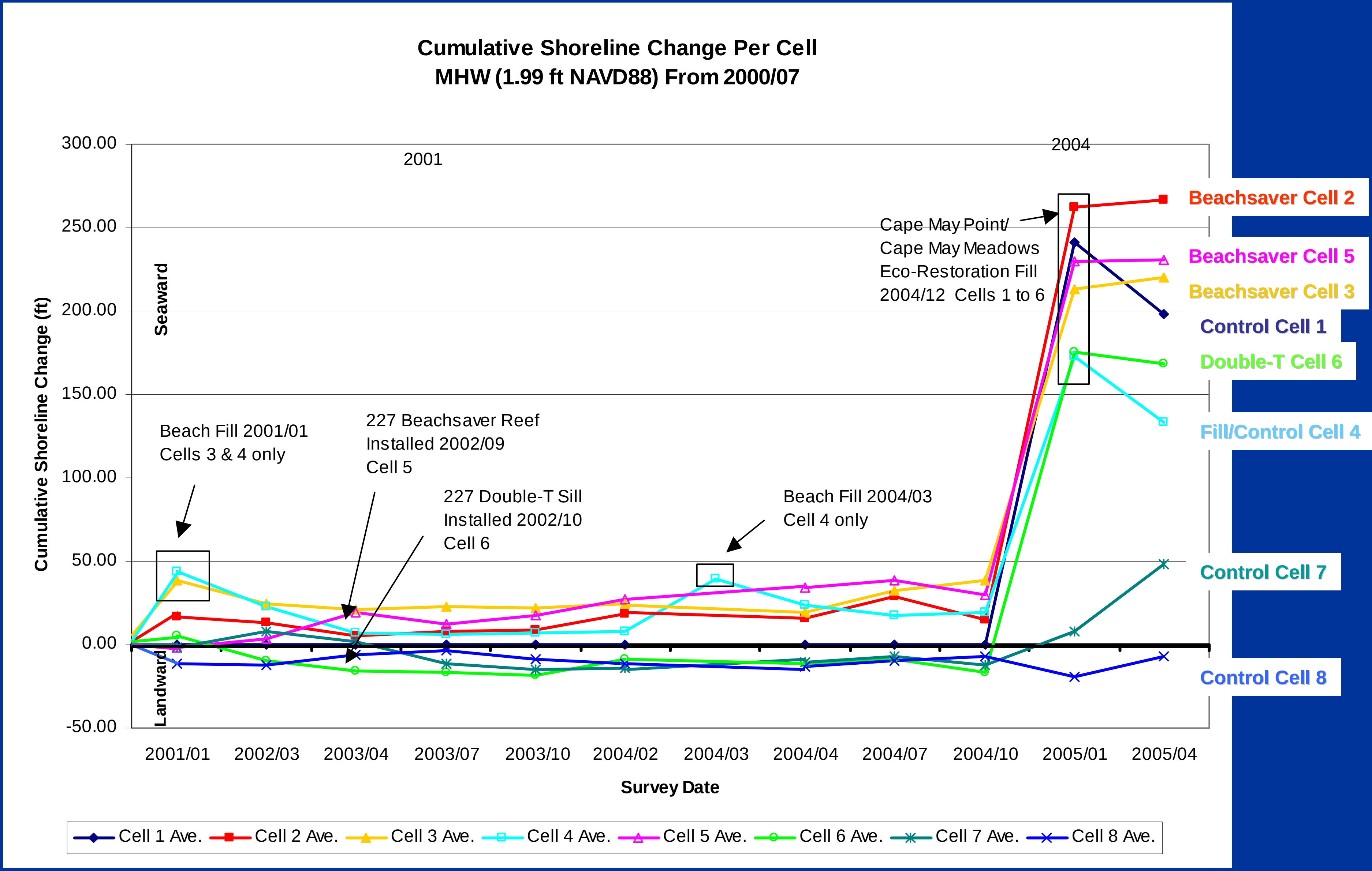
Volume Change

Pre -Fill

Post -Fill

4 Months

FUNCTION PERFORMANCE – MHW Shoreline Change




FUNCTIONAL PERFORMANCE
MHW Shoreline Change
Cell 6 - Double-T
Cell 5 - Beachsaver
Cell 4 - Control
Cell 3 - 94 Beachsaver
Cell 2 - 94 Beachsaver
Cell 1 - Control
Pre fill
Post-Fill
4 Months

ECONOMIC PERFORMANCE – Construction Costs

SECTION 227

Beachsaver Reef – 16 Aug to 25 Sep 02

- 5 weeks @cost of $1,440/lf

  72 10-ft-long units covering 720 ft
  - Filter cloth installation
  - Excavation and fill required
  - Placement of units w/ diver

Double-T Sill – 26 Sep to 2 Oct 02

- 4 days @ cost of $345/lf

  22 30-ft-long units covering 660 ft
  - NO Filter cloth installation
  - Excavation and fill NOT required
  - Placement of units w/ diver

(Cost of rock used in both cells to tie into groin tips not included in linear foot cost)

ECONOMIC PERFORMANCE -

S E C T I O N 227

Reduction in Renourishment Quantities & Lengthening Fill Cycle (Economic Performance/Life Cycle Cost Analysis)

Structures designed to act as a sill to retain sand within the groin compartment

2004 Cape May Meadows/Cape May Point Eco Restoration Project will document fill retention and extension of renourishment cycle time in cells with and without structures

Purpose: Relate engineering performance to economic costs

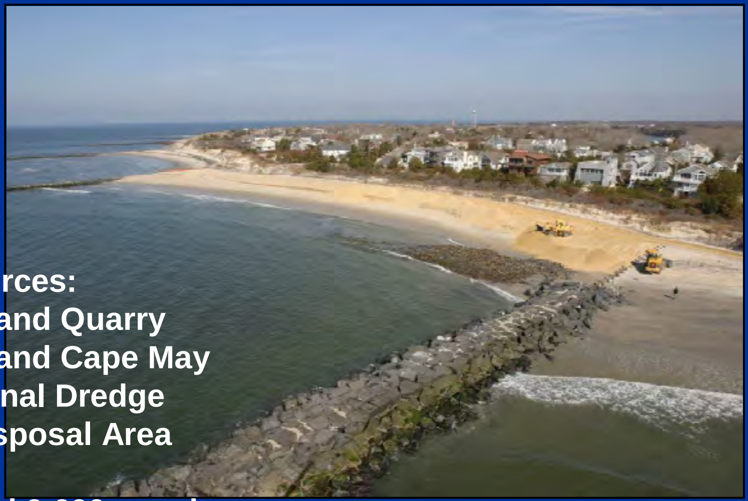
Goal: Evaluate improved performance (benefits) in relation to investment (costs)

Based on present monitoring Anticipated savings in:

- Initial fill retention
- Longer renourishment intervals in cells with Beachsaver Reefs

BEACH FILLS – 1

Placed Cell 4 only - March 2004
To Protect Dune Base



2 Sources:
- Upland Quarry
- Upland Cape May Canal Dredge Disposal Area

Placed 9,600 cu yd

4 months later

Post-fill: -16 ft shoreline retreat
48% volume remaining

2

Placed Cell 1-6 - December 2004
To Protect Coastal Wetland

1 Source:
- Nearshore

Placed 326,917 cu yd

4 months later

Post-fill: +7 ft to –42 ft shoreline gain/retreat
100% to 79% volume remaining

STRUCTURAL PERFORMANCE – Structural Stability

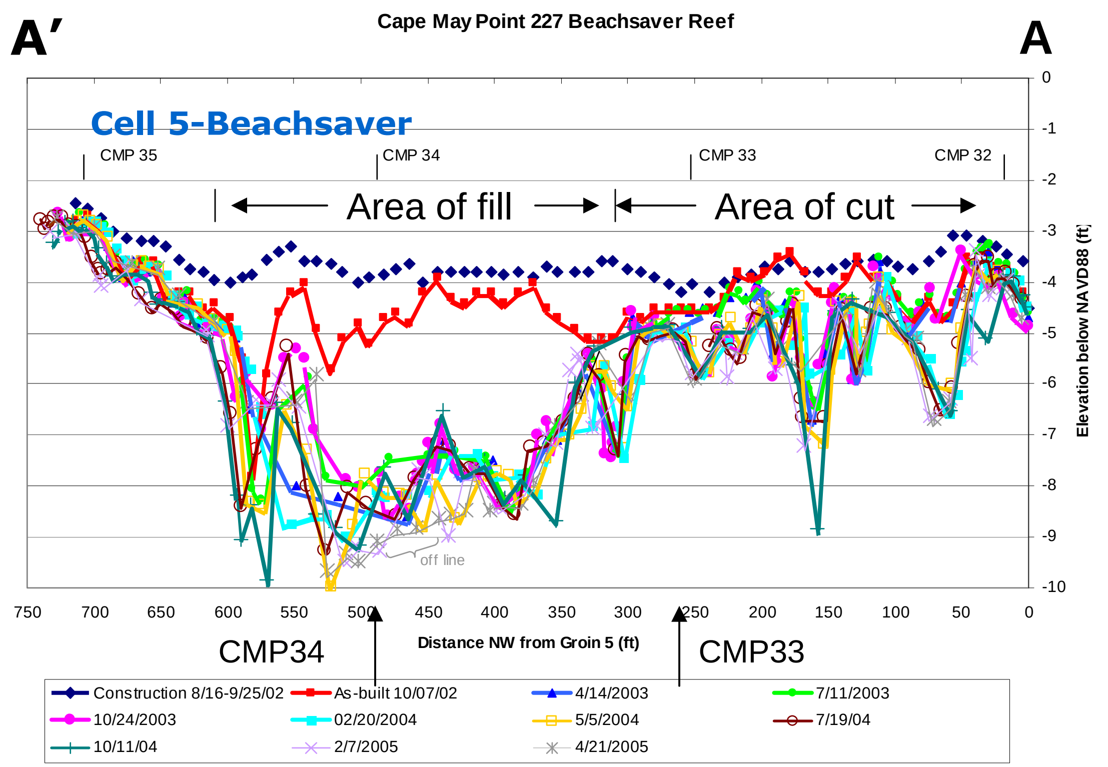
Measure Crest Elevations of Both Structures w/ Total Station to determine:

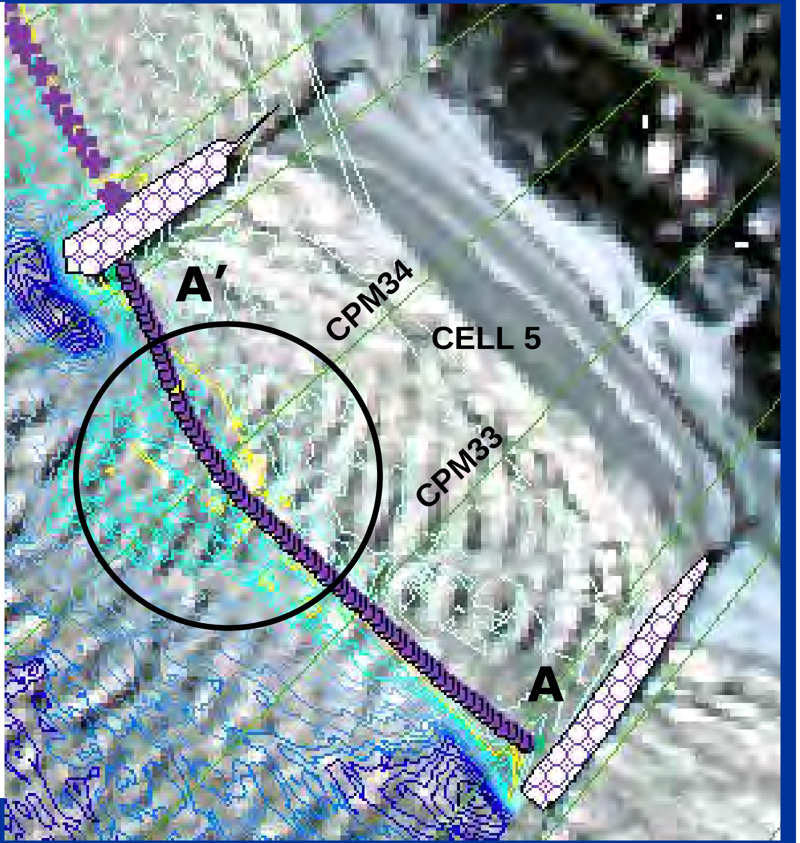
- Change in Structure Crest Elevation
- Alongshore Integrity
- Depth of Scour

STRUCTURAL PERFORMANCE

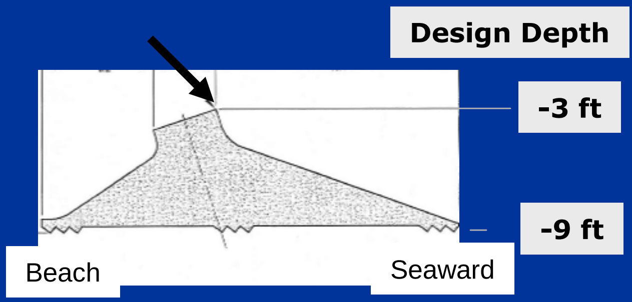
10/2002 to 4/2005

BEACHSAVER REEF - SETTLEMENT





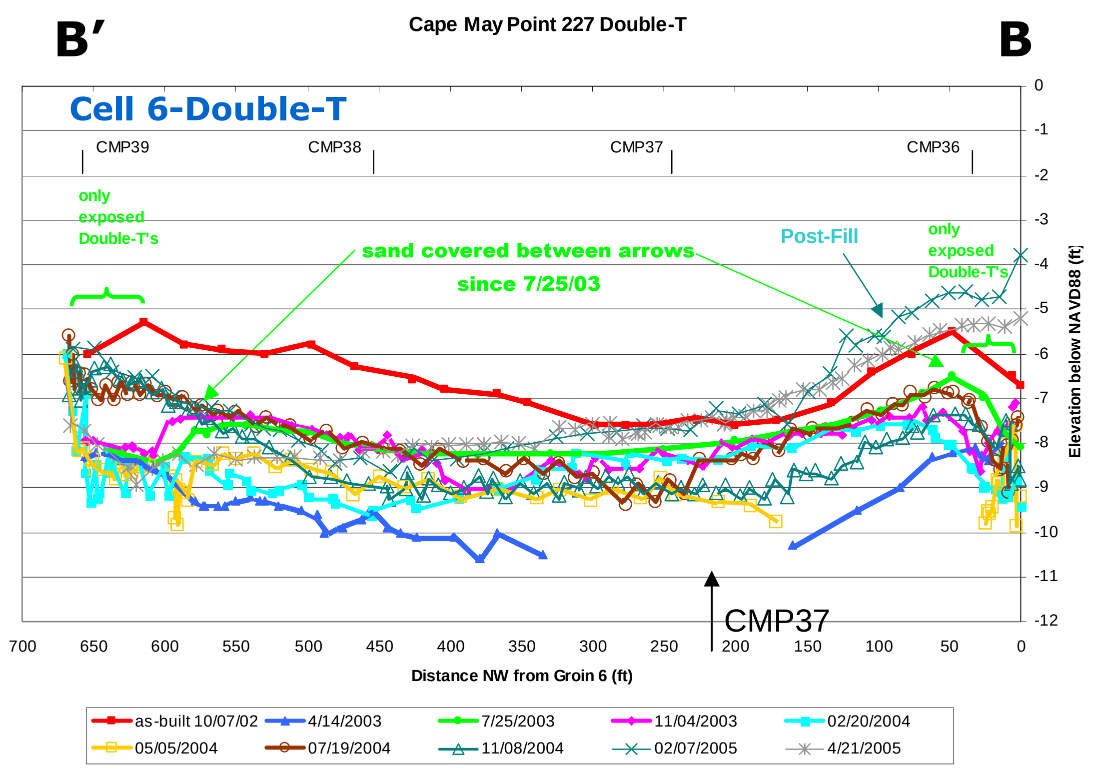
Area of most Settlement
up to 4 ft (1.2 m) within 6 months

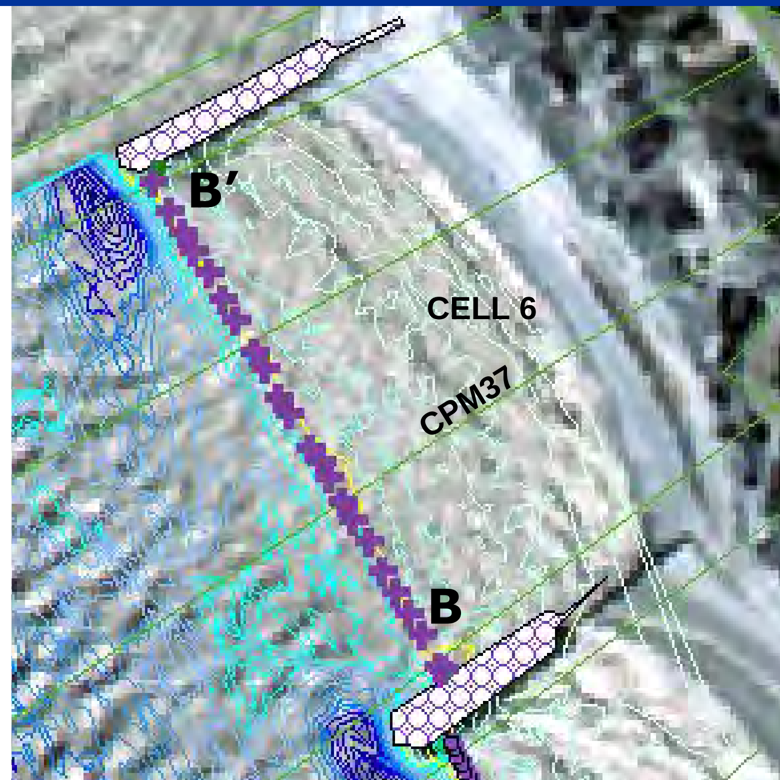


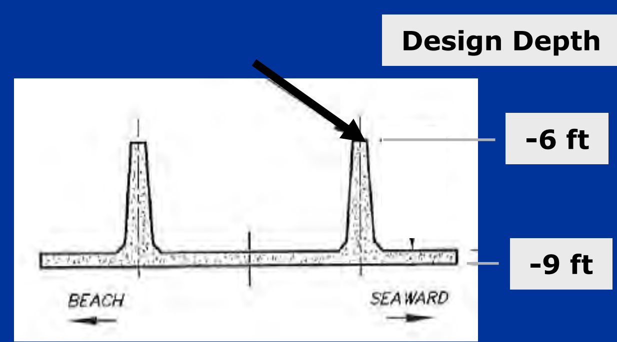
STRUCTURAL PERFORMANCE

10/2002 to
4/2005

DOUBLE T SILL - SETTLEMENT



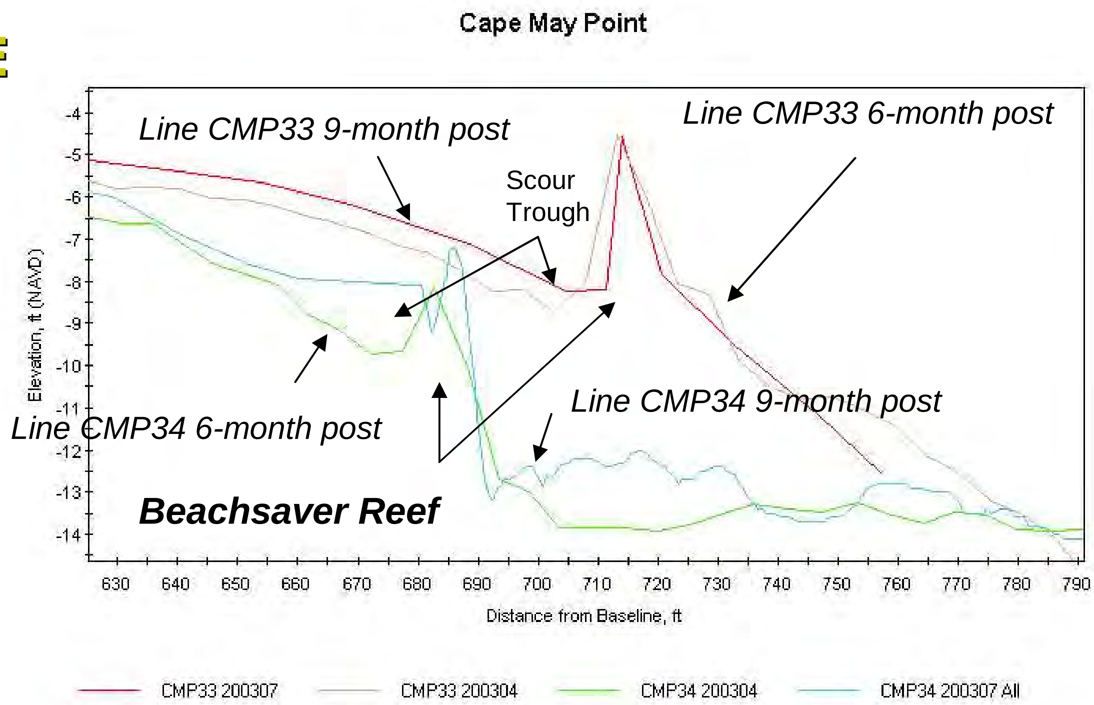


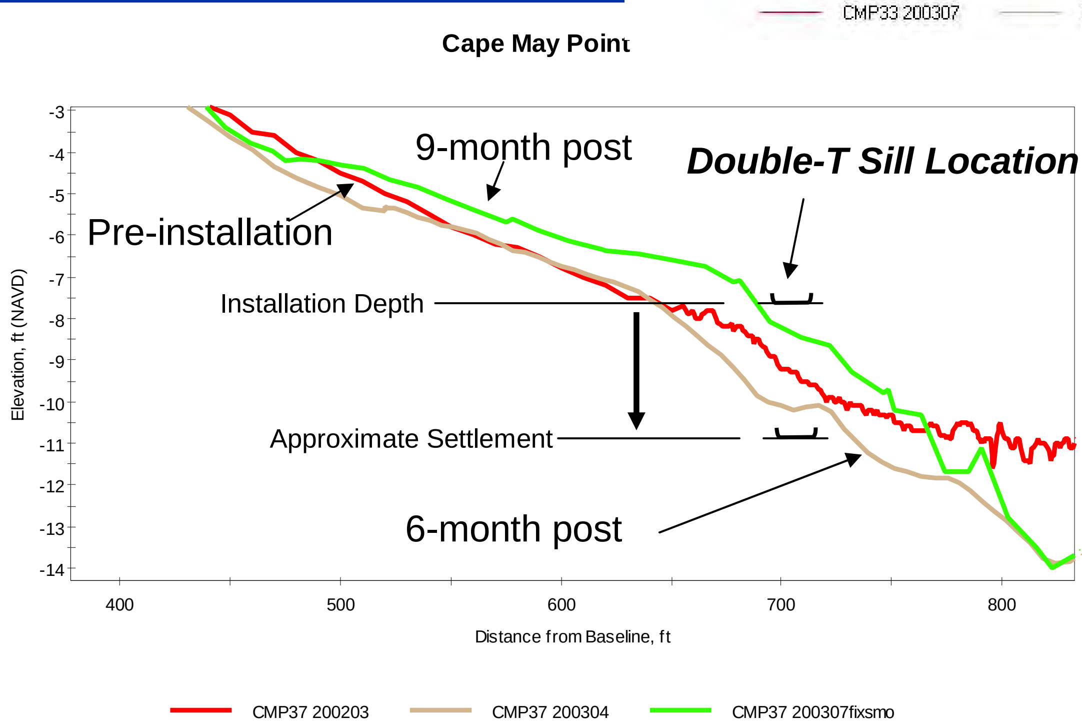


2 to 3 ft (0.5 to 1 m) Settlement &
Complete Burial under 1 to 2 ft (0.3 to 0.6 m)
of sand within 6 months

CHANGE IN STRUCTURE
Crest Elevation, Alongshore Integrity & Depth of Scour

Beachsaver Reef

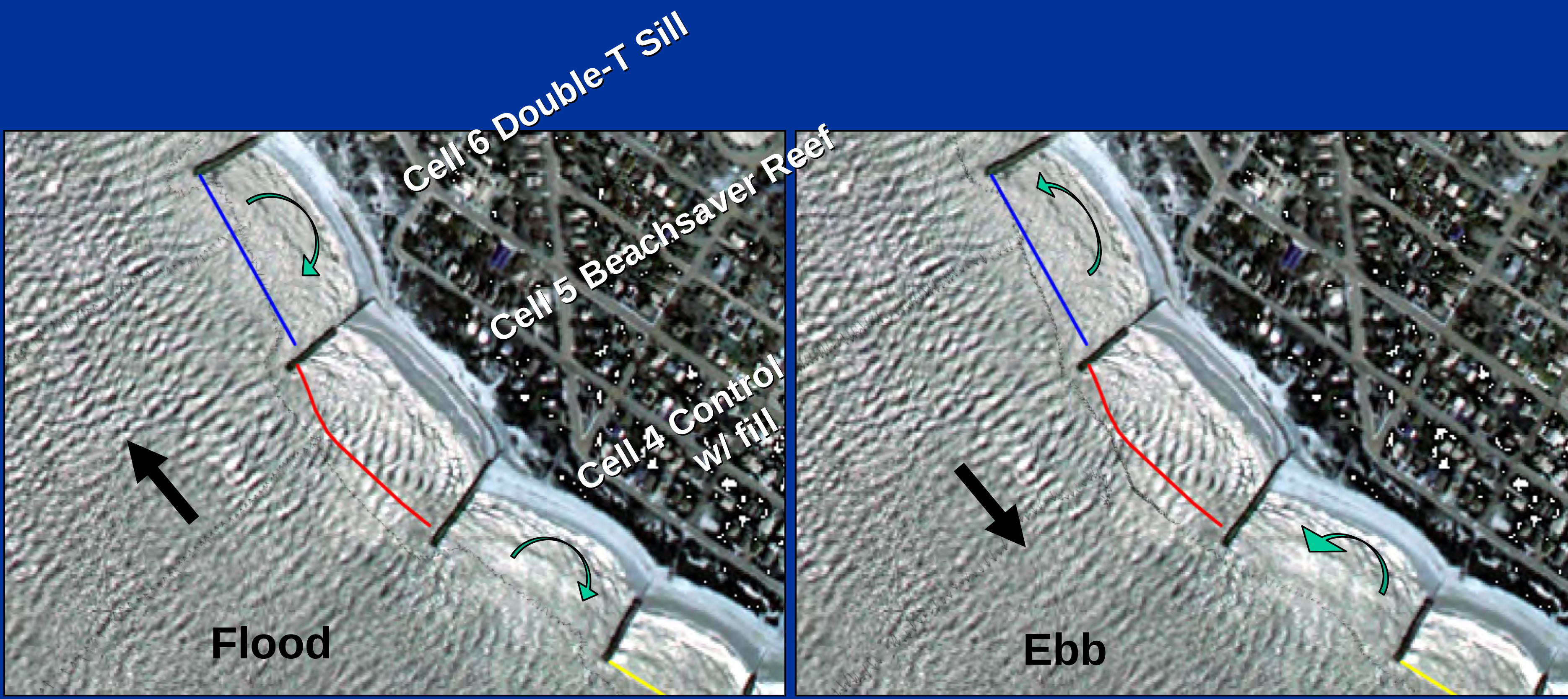




Double-T Sill

GROIN COMPARTMENT CIRCULATION

opposite tidal Flow based on ADCP current studies



Beachsaver Reef traps sand in compartment
Double-T Sill submerged w/ no trapping

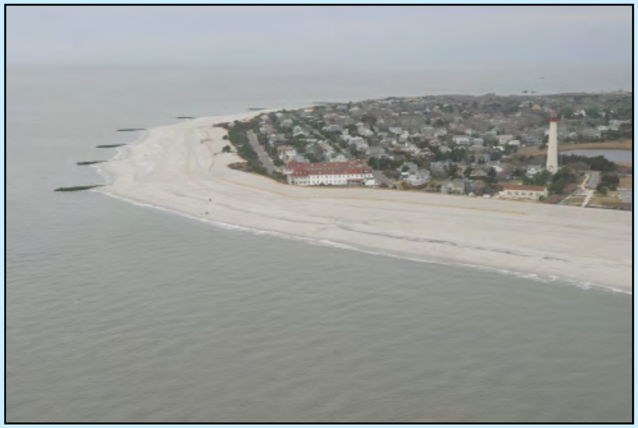
SUMMARY

S E C T I O N 227

227 Project constructed August - October 2002
2.5 Year Quarterly Monitoring Results Reported Here
Eco Restoration Project constructed December 2004

Preliminary Findings:

- **Retention of sand greatest in groin compartments w/ Beachsaver Reefs even w/ settlement**
- **Double-T Sill vs. Beachsaver Reef**
  - a) Could not be evaluated due to settlement of Double-T Sill
  - b) Settlement w/ Beachsaver Reef due to construction excavation



- **Anticipated savings in retention of beach fill w/ Beachsaver Reefs**

PRODUCTS

S E C T I O N 227

Accomplishments

2003 *Journal of Coastal Research* - Paper

National Conference on Beach Preservation Technology – Paper

Coastal Structures'03 – 2 papers

2005 TR – Performance of Beachsaver Reef with Filter Blanket, and Double-T Sill at Cape May Point, New Jersey, Section 227 Demonstration site – First Year Monitoring Report

Future

Summary Report - Economic Performance/Life Cycle Cost Analysis for the Section 227 Cape May Demo Project

Conference Papers – Waves/Current/Structure Interaction

- Beach Fill Retention

TR – Performance of Beachsaver Reef with Filter Blanket, and Double-T Sill at Cape May Point, New Jersey, Section 227 Demonstration site – 2 Year Monitoring Report

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SYSTEMIC ANALYSIS OF THE MISSISSIPPI & ILLINOIS RIVERS
UPPER MISSISSIPPI RIVER COMPREHENSIVE PLAN

2005 Tri-Service Infrastructure Systems Conference

August 2005

US Army Corps
of Engineers®

Authorization

WRDA 1999, Sec 459

COMP PLAN

"…shall develop a plan…in the interest of the systemic flood damage reduction…"

US Army Corps of Engineers®

“systemic flood reduction”

Major Challenges

- 838 miles of the Mississippi River
- 291 miles of the Illinois River
- Computed Frequency Analysis at all River Miles (Economics)
- Develop Alternatives
- Study completed in 3 years
- 713,200 sq. miles

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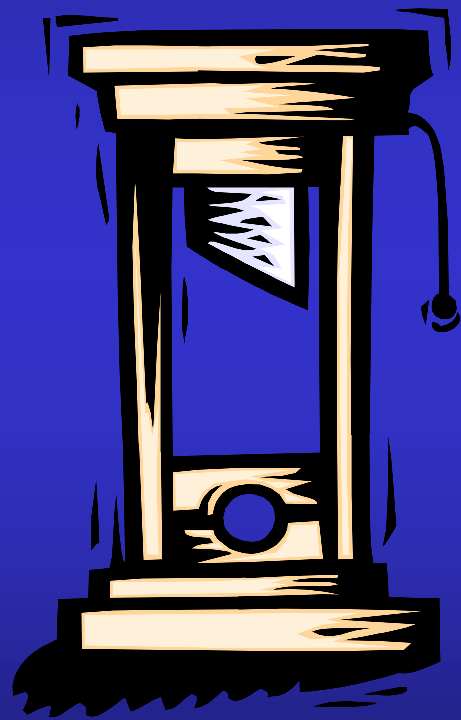
Stick Your Neck out and be Creative



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STOCHASTIC MODELING

- Extend period of record from 2101 TO 3100
  Dr. Robert Barkau
- Goals of Reproduction at gages
  1) Reproduce annual exceedence flow probability at gages
  2) Reproduce primary event volume probability.
  3) Approximately reproduce annual duration curve.

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Three Tools Available

1) Statistical Frequency Curves at Gages from Flood Flow Frequency

2) Existing UNET models from Flood Flow Frequency (Geometry)

3) Computer Power

1000 years at 3 hours intervals from Keokuk to Thebes takes 6 hours of computer time.

Frequency Curve at St. Louis, MO

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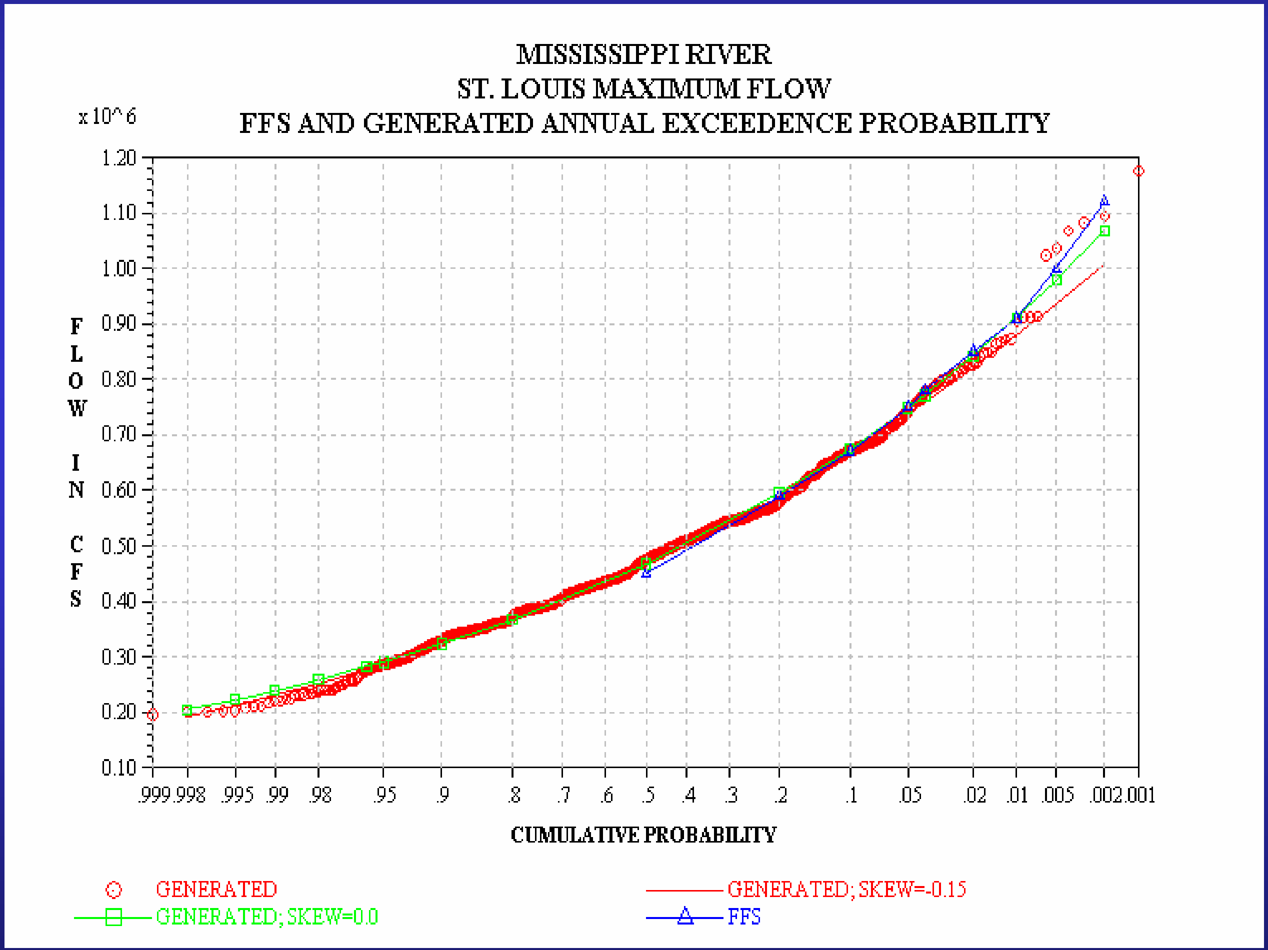

One Corps Serving the Armed Forces and the Nation

Event volume frequency at St. Louis, MO

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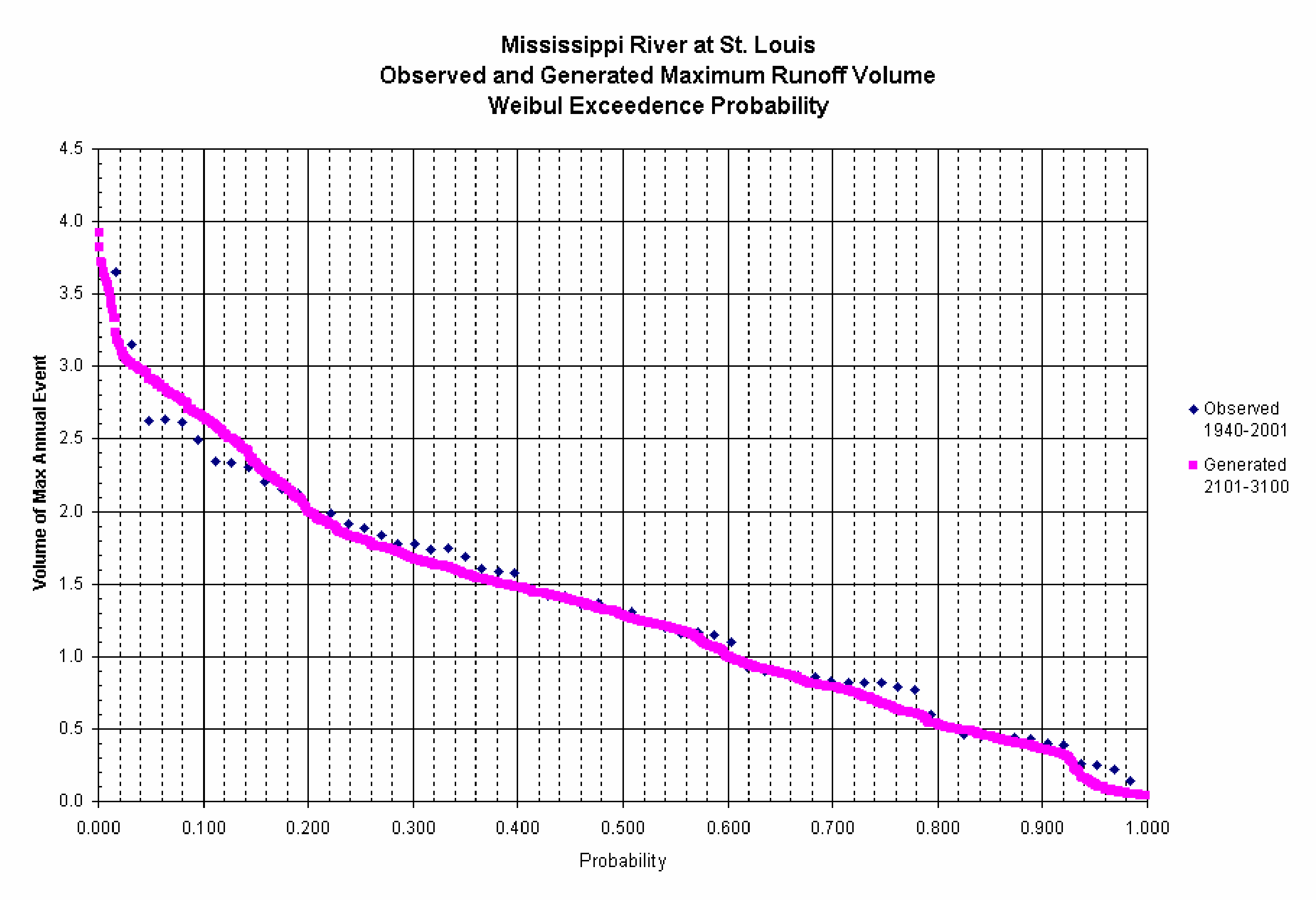

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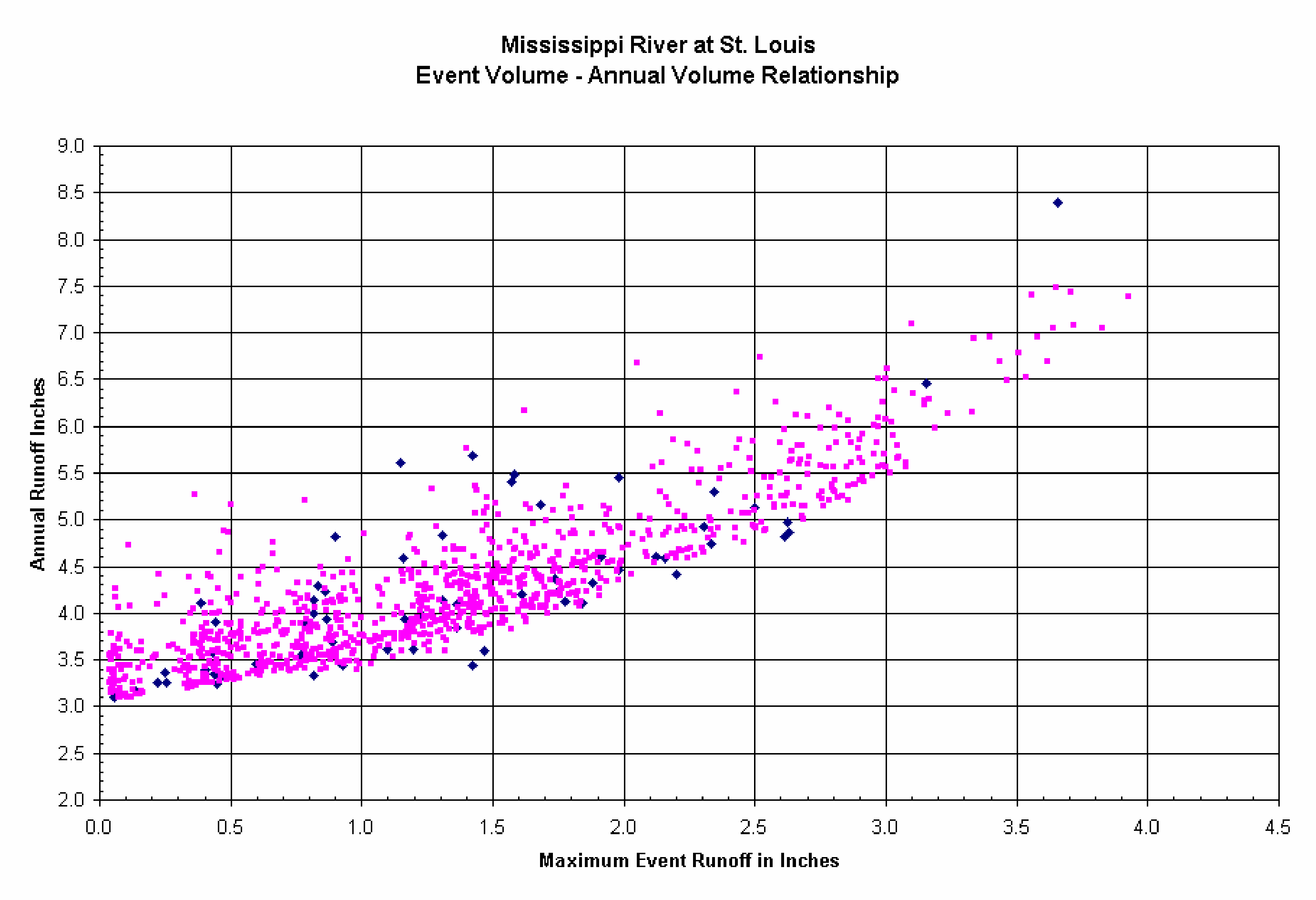
Annual Volume at St. Louis, MO



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Annual Duration Curve at St. Louis, MO

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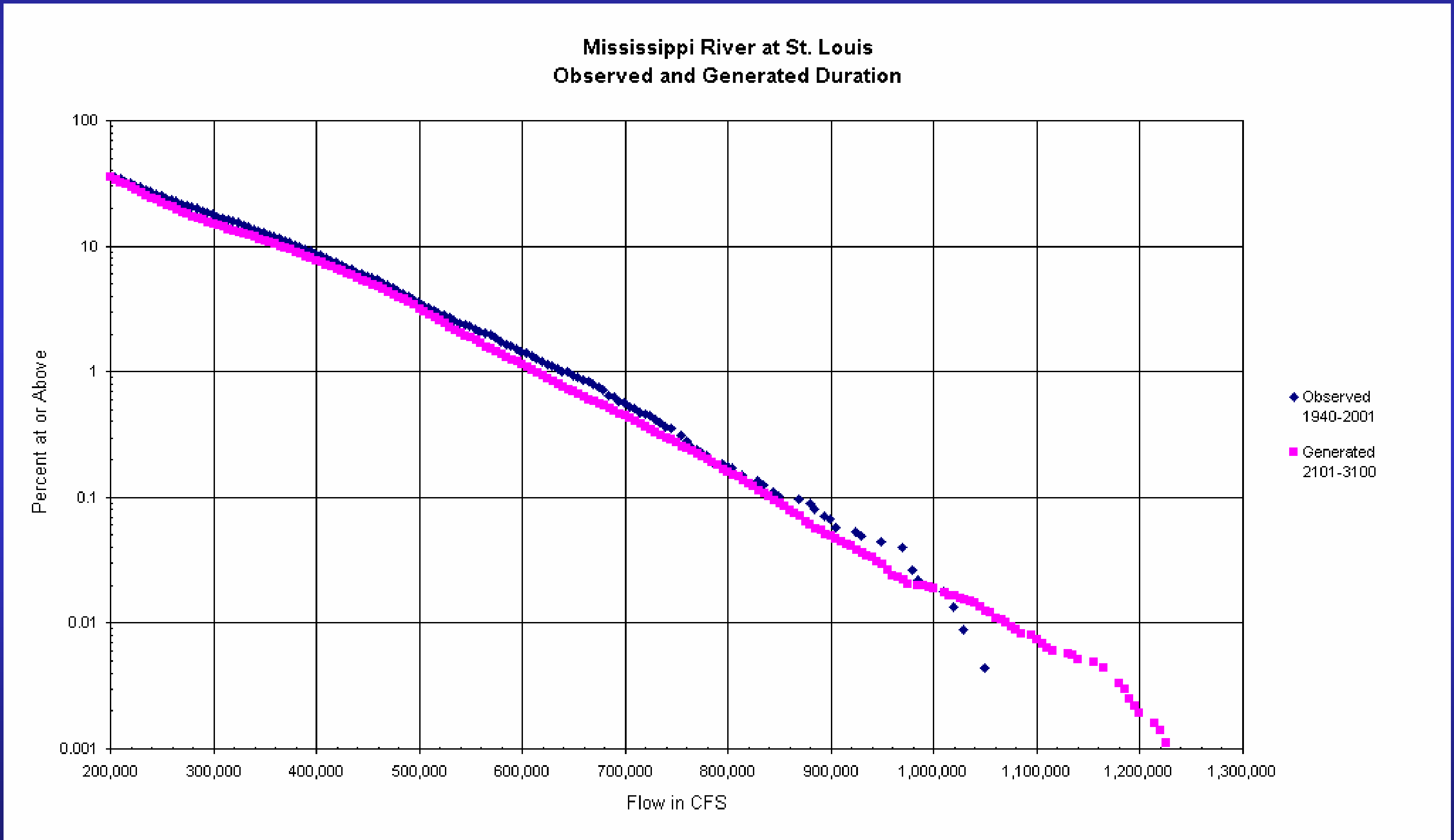

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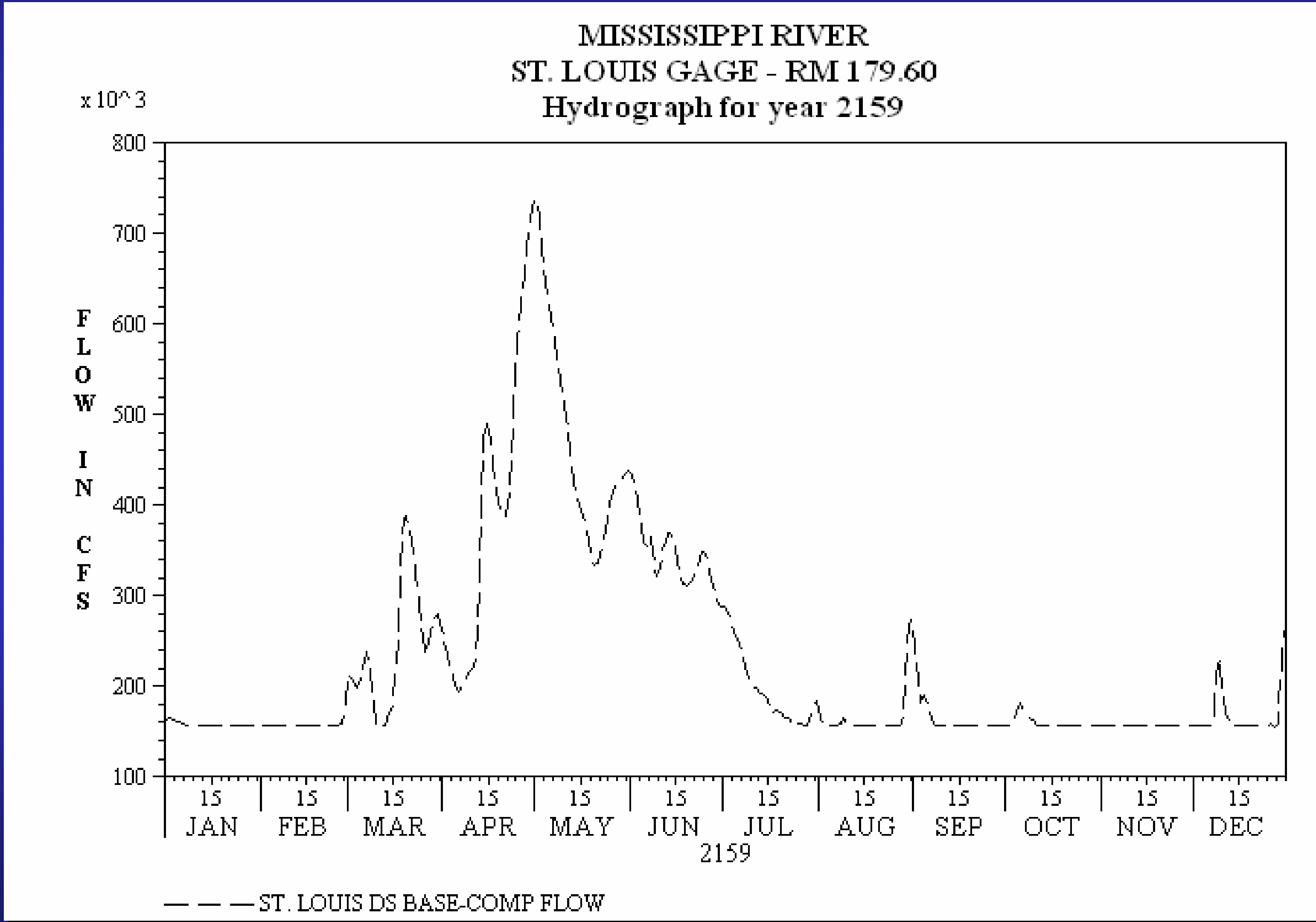
Year of 2159



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Divided Basin into 4 hydraulic reaches

Mississippi River

- 1) Anoka, MN (864.5) to Dubuque, IA(579.9)
- 2) Dubuque, IA (579.9) to Grafton, IL (218)
- 3) Keokuk, IA (364.2) to Thebes, IL (70.8)

Illinois River

- 4) Lockport, IL (290.9) to Grafton, IL (0.0)

Economic Reaches

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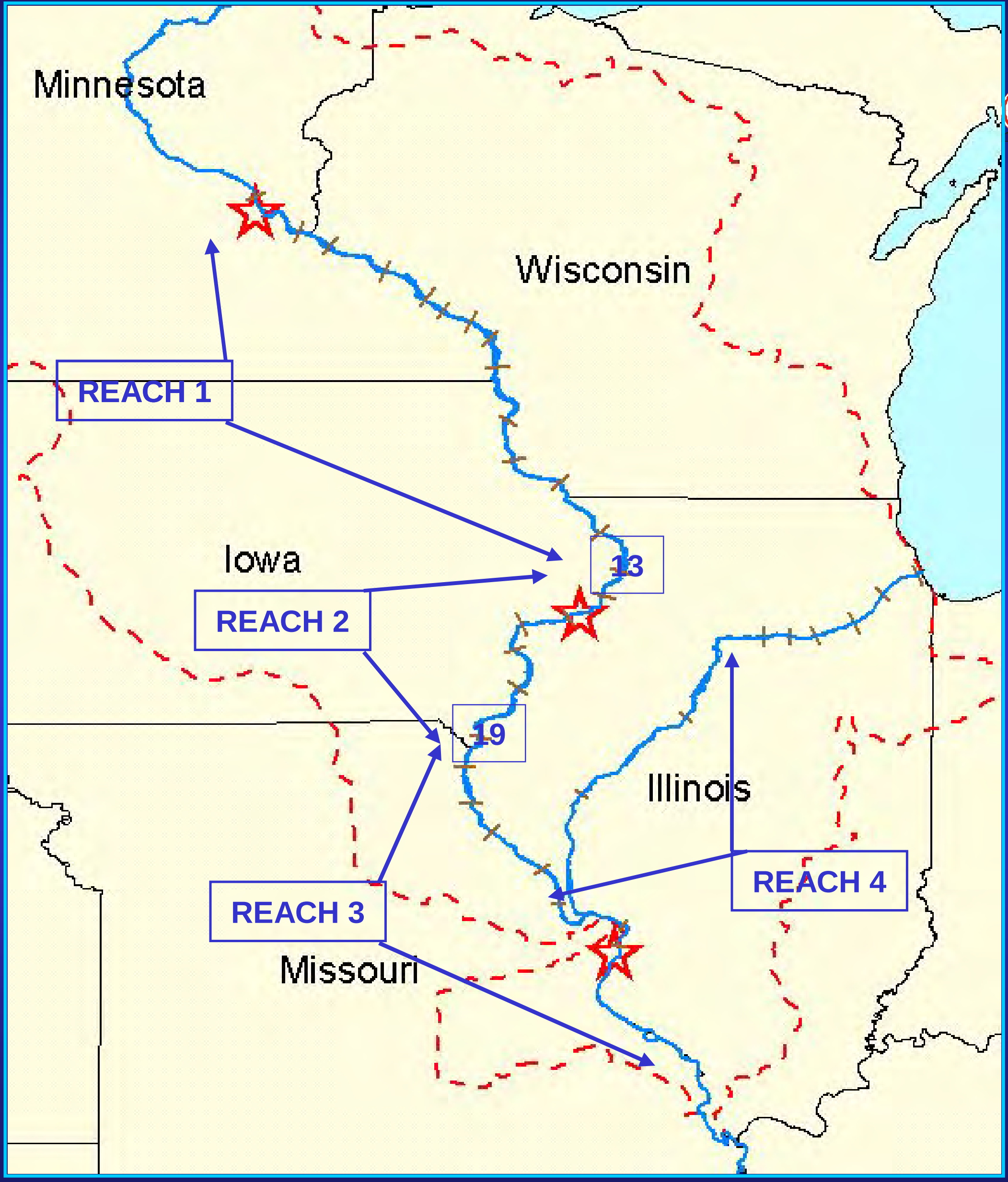
REACH 1
St. Paul to Clinton (Pool 13)

REACH 2
Clinton to Keokuk (Pool 19)

REACH 3
Keokuk to Thebes (Open River RM 40)

REACH 4
Illinois River



Existing Levee Conditions Summary

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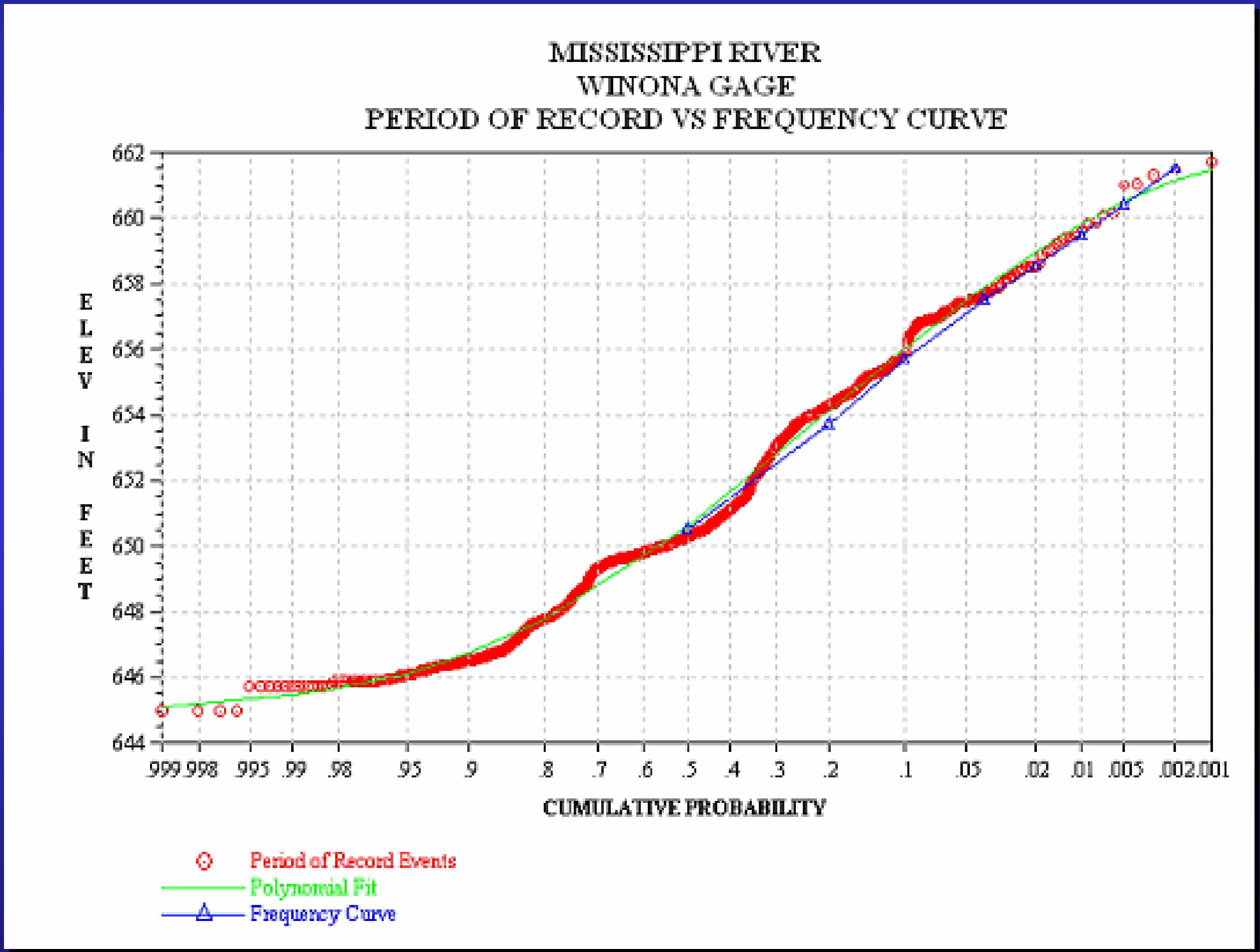
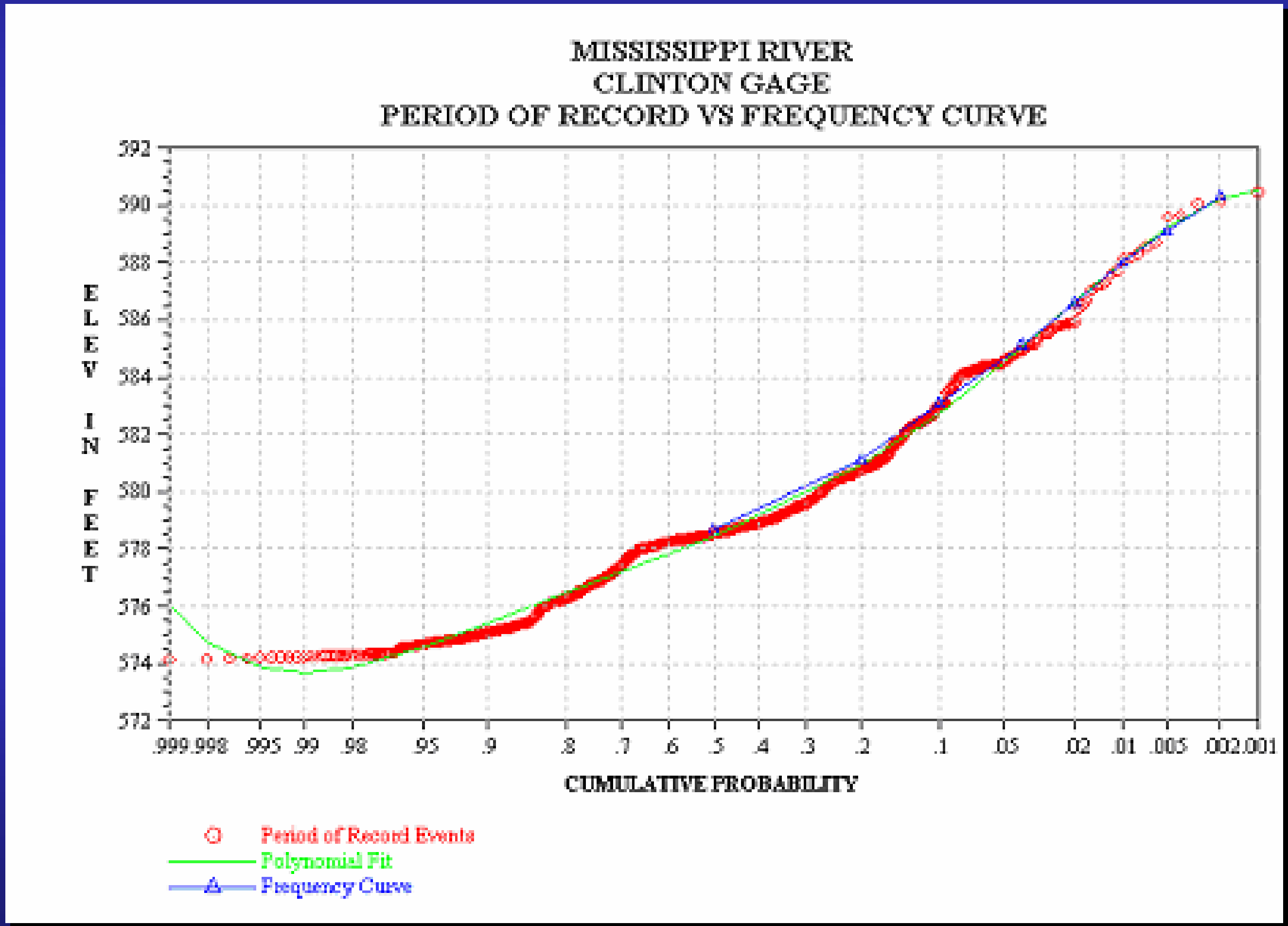
REACH	Urban	Unprot	Agri	OTHER
1	17	21	0	8
2	12	20	12	0
3	14	18	54	24
4	10	10	31	6
Total	53	69	97	38

Number of Urban Systems, Unprotected Towns, Agricultural Levees and Refuge/Wildlife Areas (OTHER).

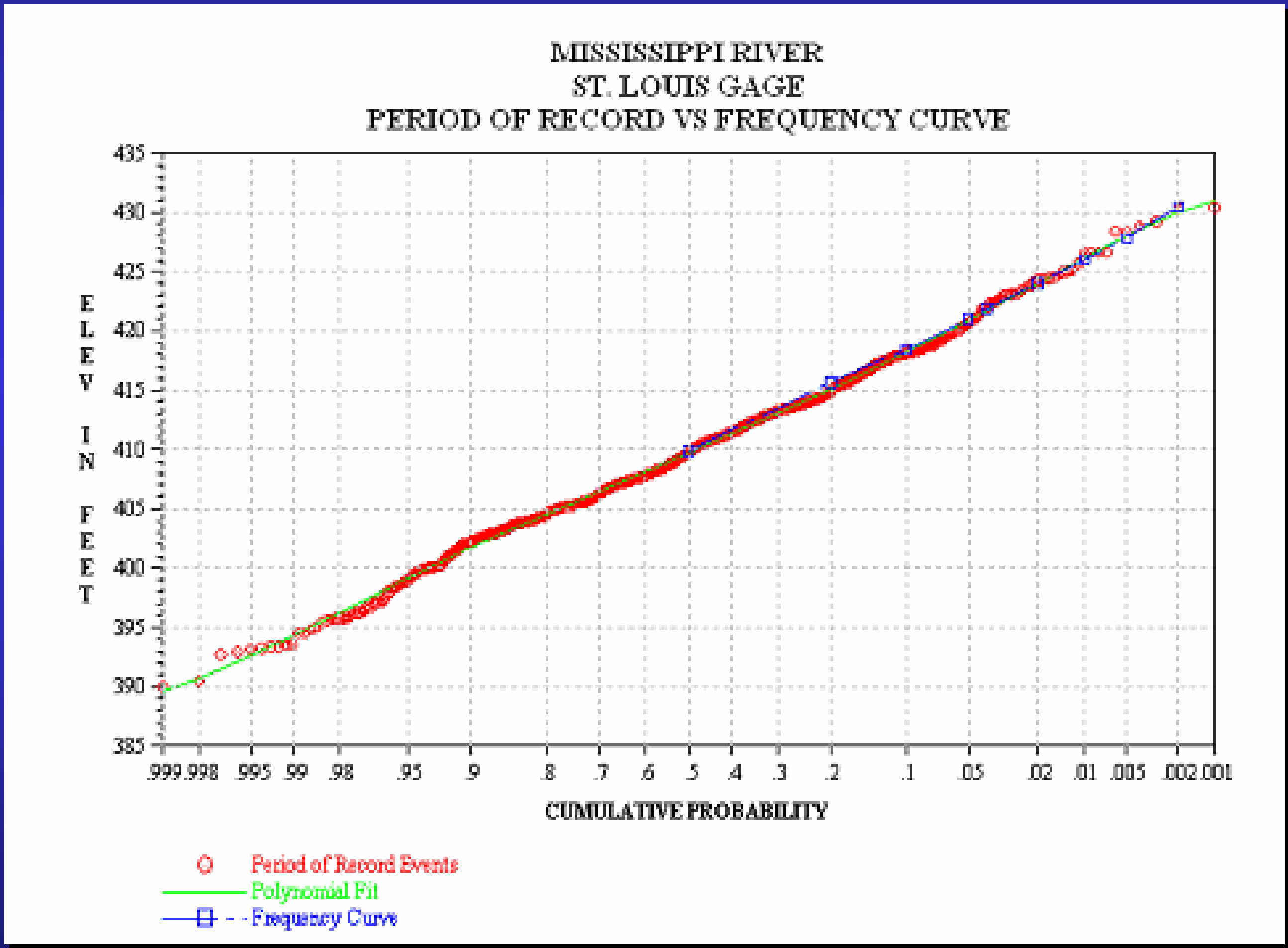
Stage-Frequency Curve at Winona, MN Reach 1



Stage-Frequency Curve at Clinton, IA Reach 2



Stage-Frequency Curve at St. Louis, MO Reach 3



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Stage-Frequency at Kingston Mines, IL Reach 4

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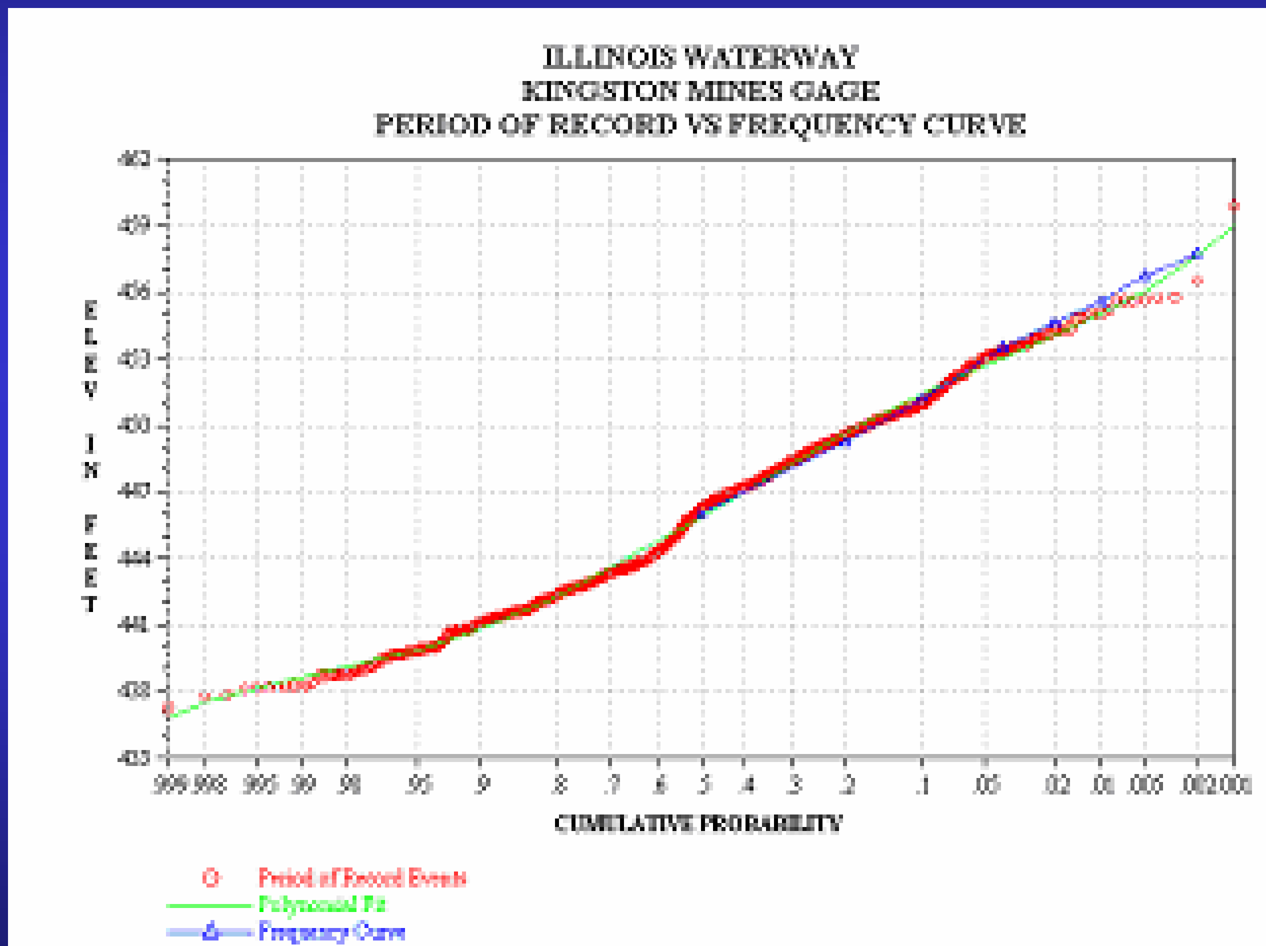

Alternative Criteria

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1) 1 foot allowable increase for the 100-year

2) Impact to existing MR&T levee system

3) Dollar damage per acre for levee district

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of Engineers®

Levee Measures Considered

- Levee Setback
- Levee Removal
- Levee Elevation altered (raised or lowered)
- New Levee

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Alternative Plans - FDR

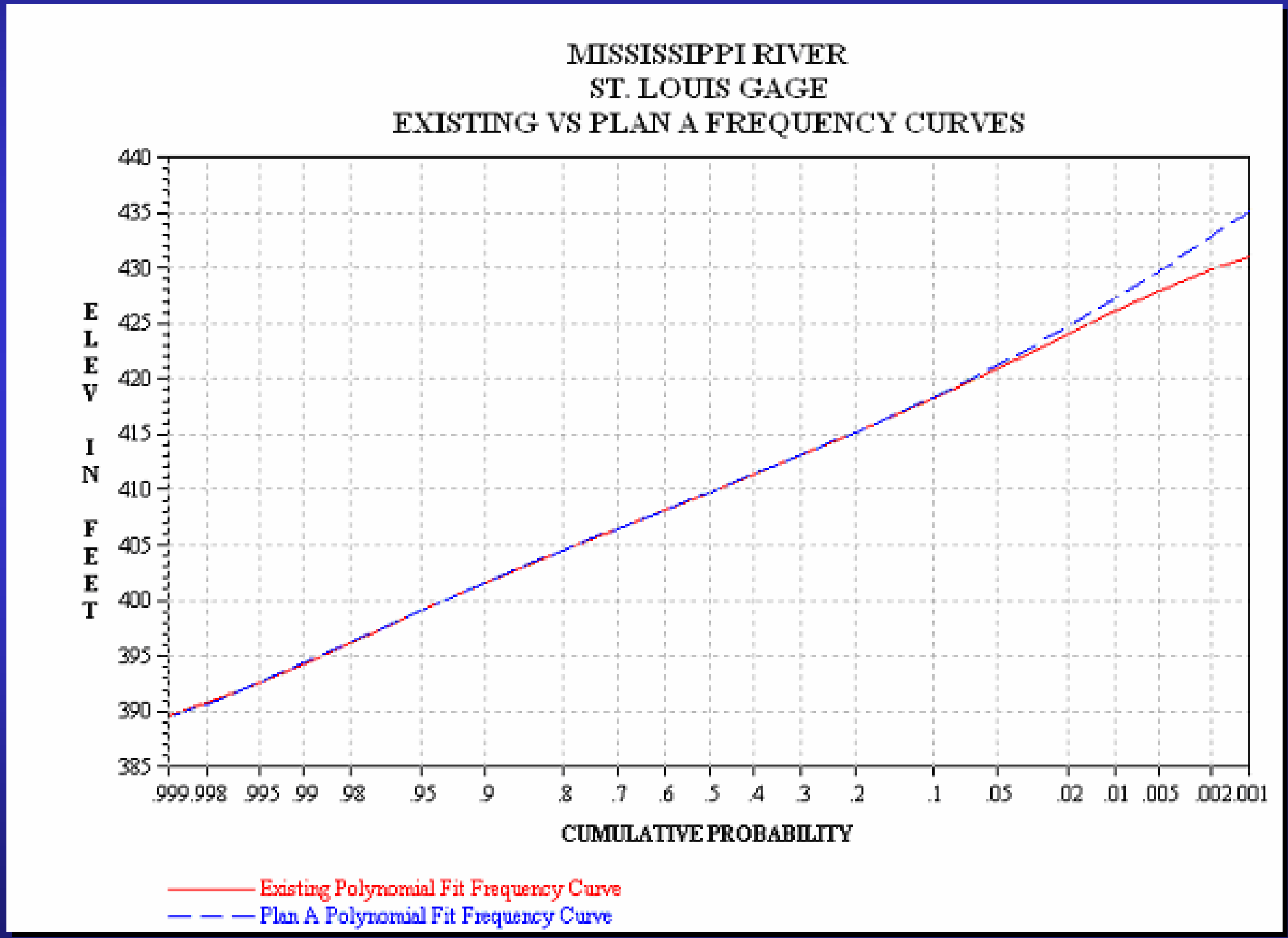
- 500-yr confined

- UNCONFINED (Must meet Criteria)
  - 500-yr Urban/Agri/Unprotected
  - 500-yr Urban + 200-yr Agri (no longer Ag)
  - 500-yr Urban + -100-yr Agri (not cert 100-yr)
  - 500-yr Urban + 50-yr Agri (only raise levees not 50-yr)

- Removing all Agri Levees (Agricultural & Natural Growth)

- Non-structural

FREQUENCY CURVE FOR 500-YEAR CONFINED ALTERNATIVE



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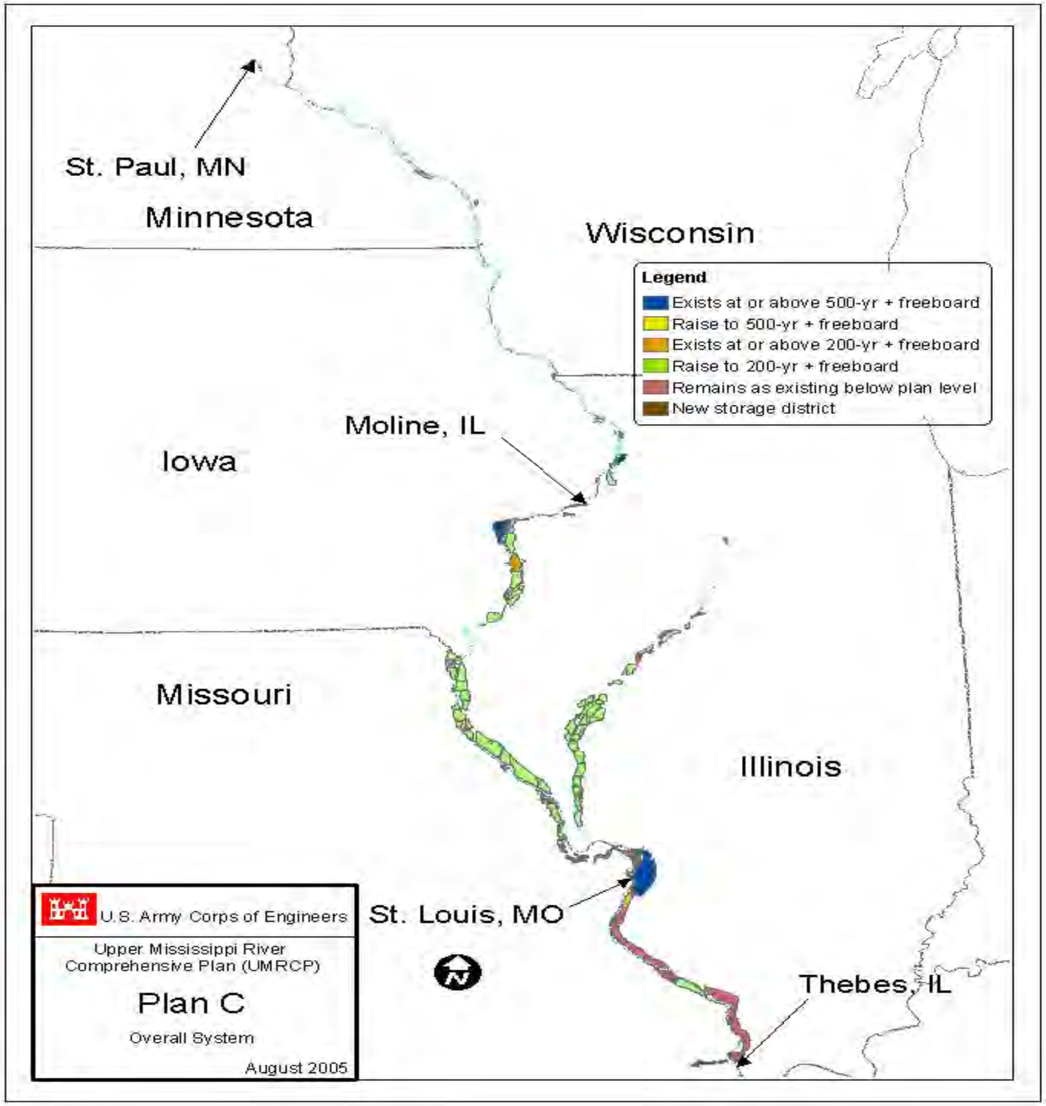

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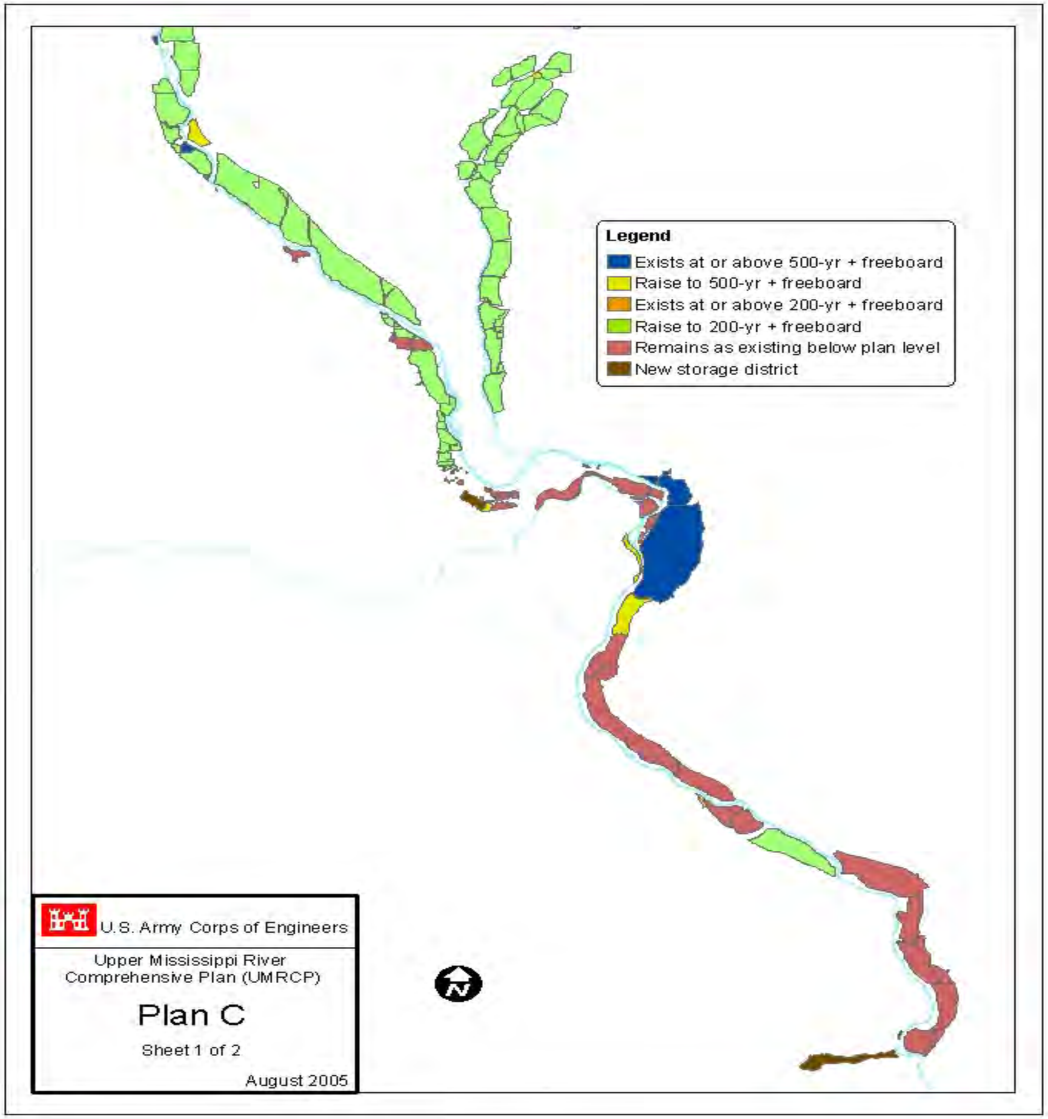

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ALTERNATIVE INCREASE OF THE 100-YEAR ELEVATION REACH 3

GAGE SITE	STATE	RIVER MILE	500-yr confined	500-yr Urban/Agri/ Unprotected*	500-yr Urban + 200-yr Agri*
KEOKUK	IA	364.2	0.1	0.1	0.1
HANNIBAL	MO	309	O.9	0.6	0.4
GRAFTON	IL	218	1.2	0.7	0.8
ST. LOUIS	MO	179.6	1.4	0.5	O.7
CHESTER	IL	109.9	2.7	0.4	0.6
THEBES	IL	43.7	2.2	0.2	0.2

*Must meet criteria

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Accomplishments

- This is the first time the basin has been analyzed systemically on a statistical frequency basic
- This has resulted in significant understanding of the relationship and impact of the major rivers on one another
- The systemic impacts of both large-and small-scale changes to the existing flood protection system are better understood

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Any Questions???

US Army Corps of Engineers®

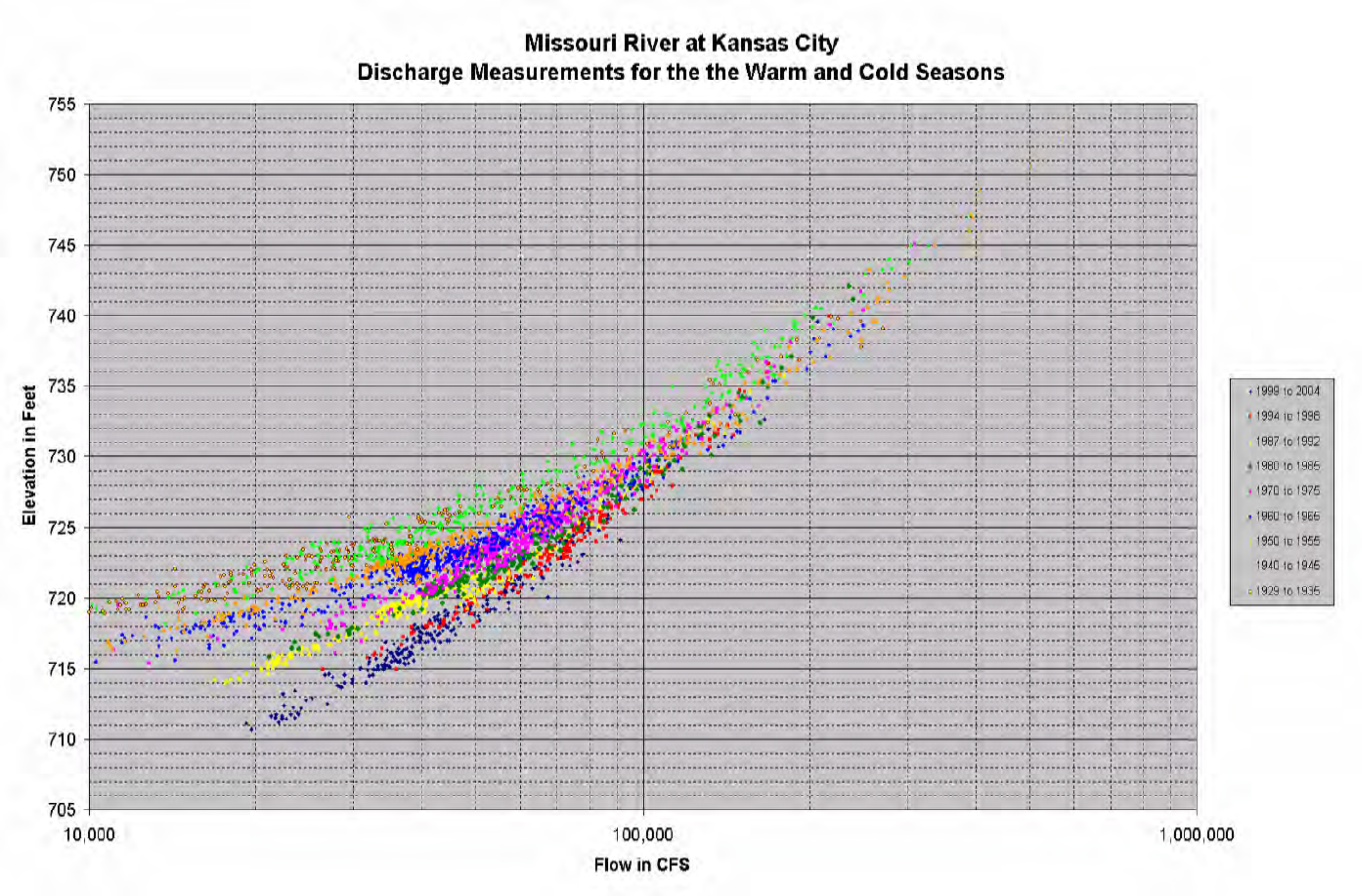
- Dennis L. Stephens
- 314-331-8359
- St. Louis District CEMVS-ED-HE
- Dennis.L.Stephens@mvs02.usace.army.mil

US Army Corps
of Engineers
Kansas City District

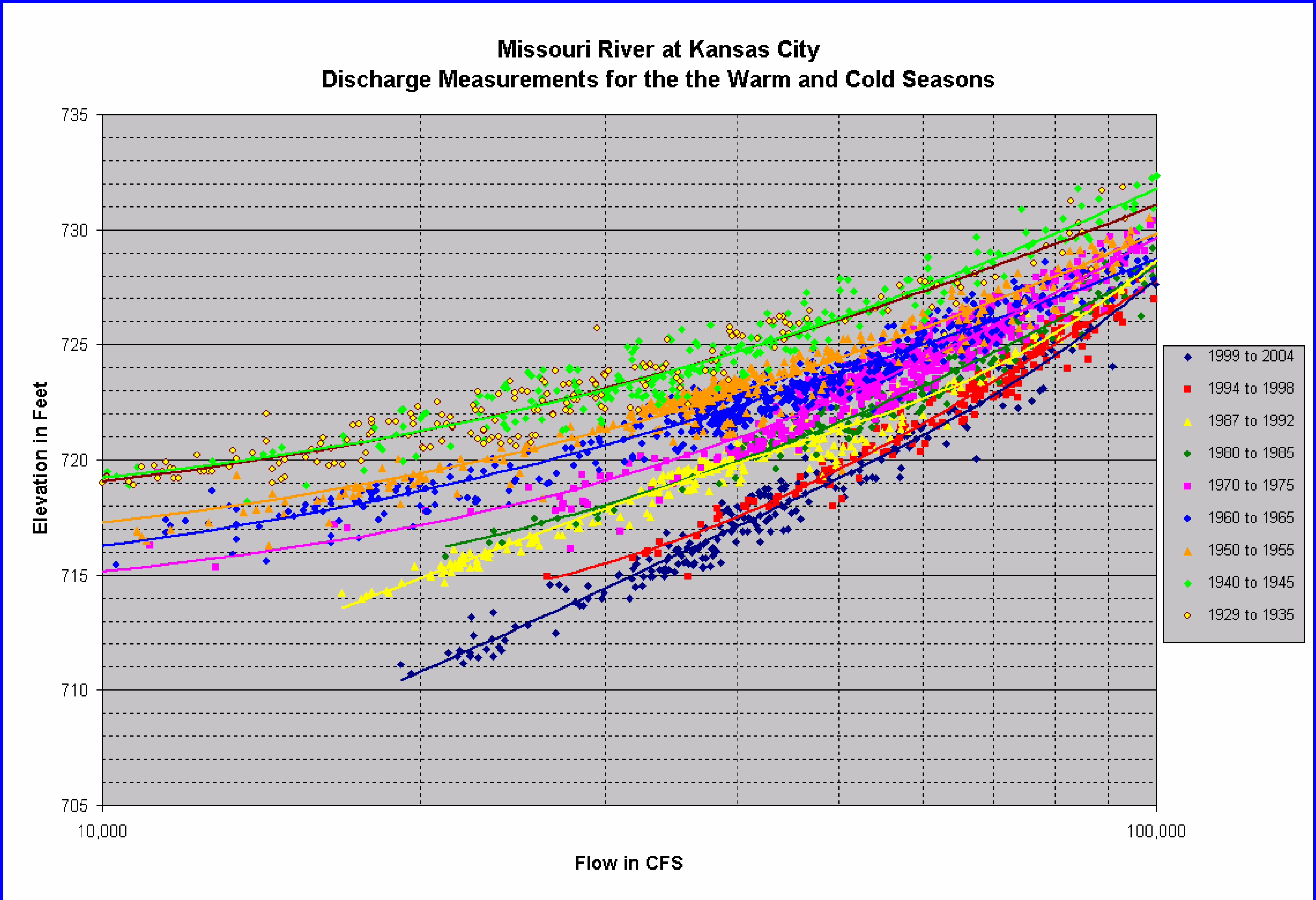
Degradation of the Kansas City Reach of the Missouri River

The Kansas City Reach

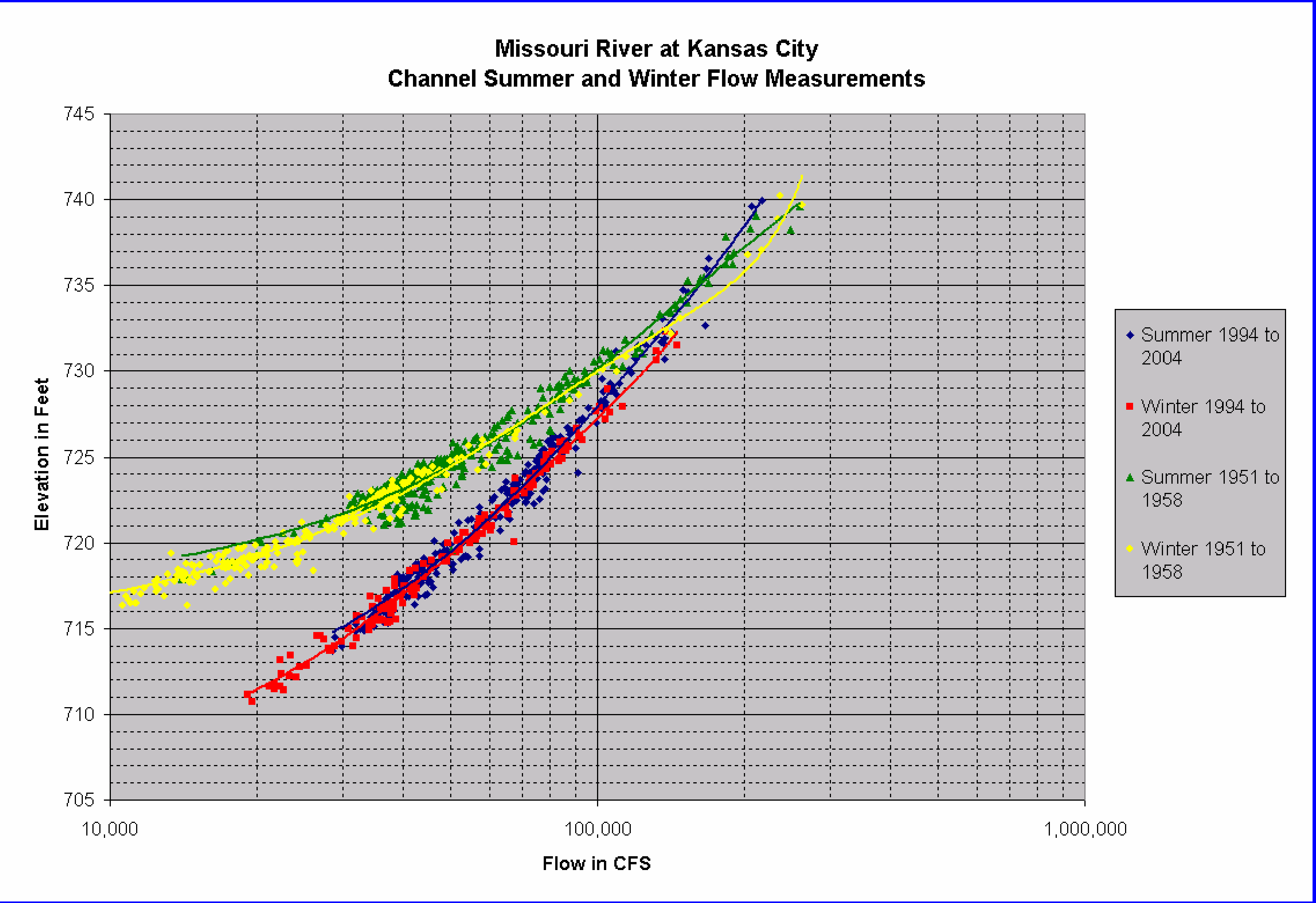
The Problem


Missouri River at Kansas City
Discharge Measurements for the the Warm and Cold Seasons
755
750
745
740
735
730
725
720
715
710
705
Elevation in Feet
10,000
100,000
1,000,000
Flow in CFS
1999 to 2004
1994 to 1998
1987 to 1992
1980 to 1985
1970 to 1975
1960 to 1966
1950 to 1955
1940 to 1946
1929 to 1935

Best Fit Lines



Seasonal Changes



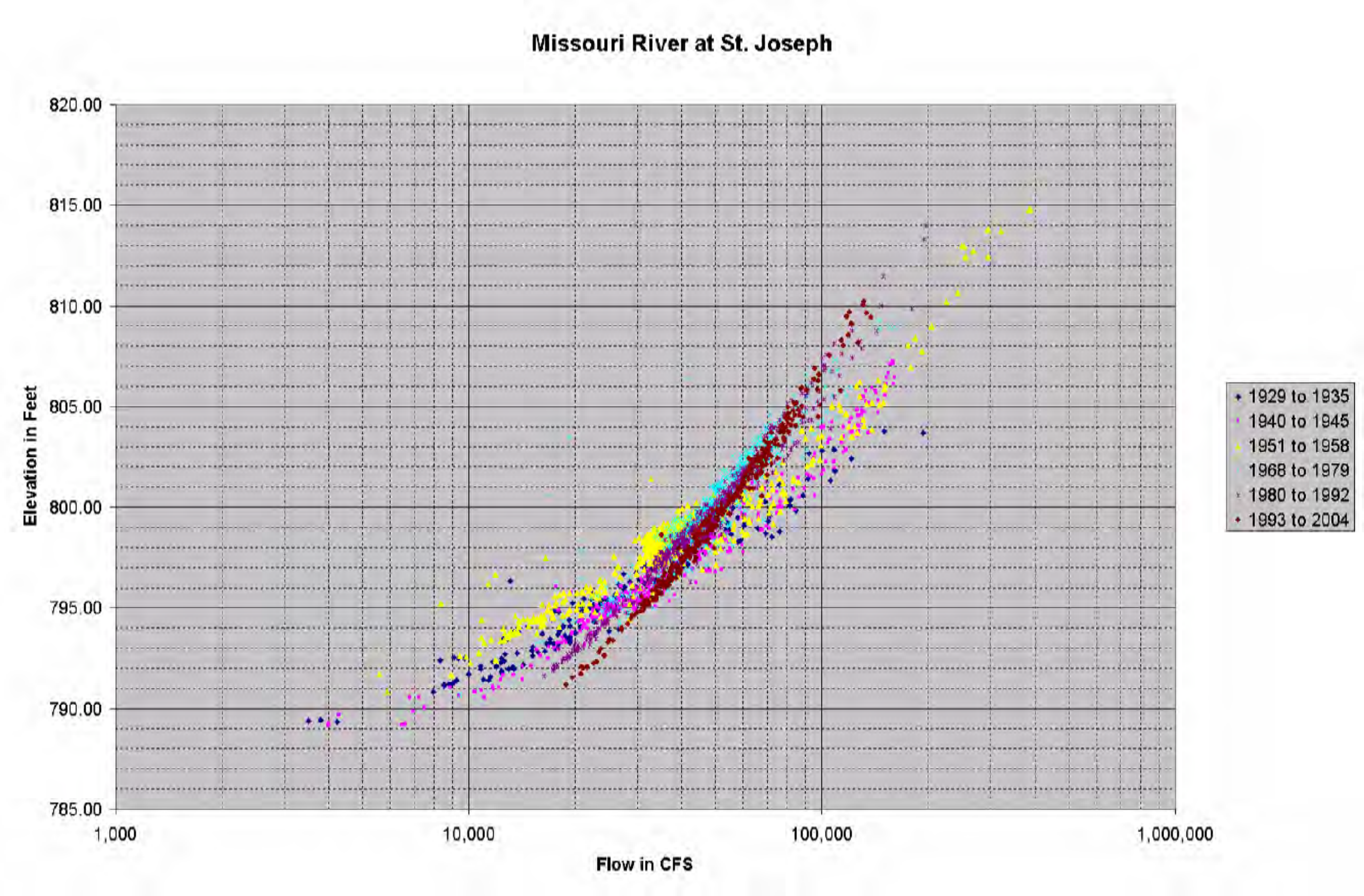
Why?

Hypothesis

1. Upstream reservoirs (hungry water).
2. River training structures (dikes and revetments).
3. Commercial sand mining (dredging).
4. Major Floods.
5. River cut-offs.

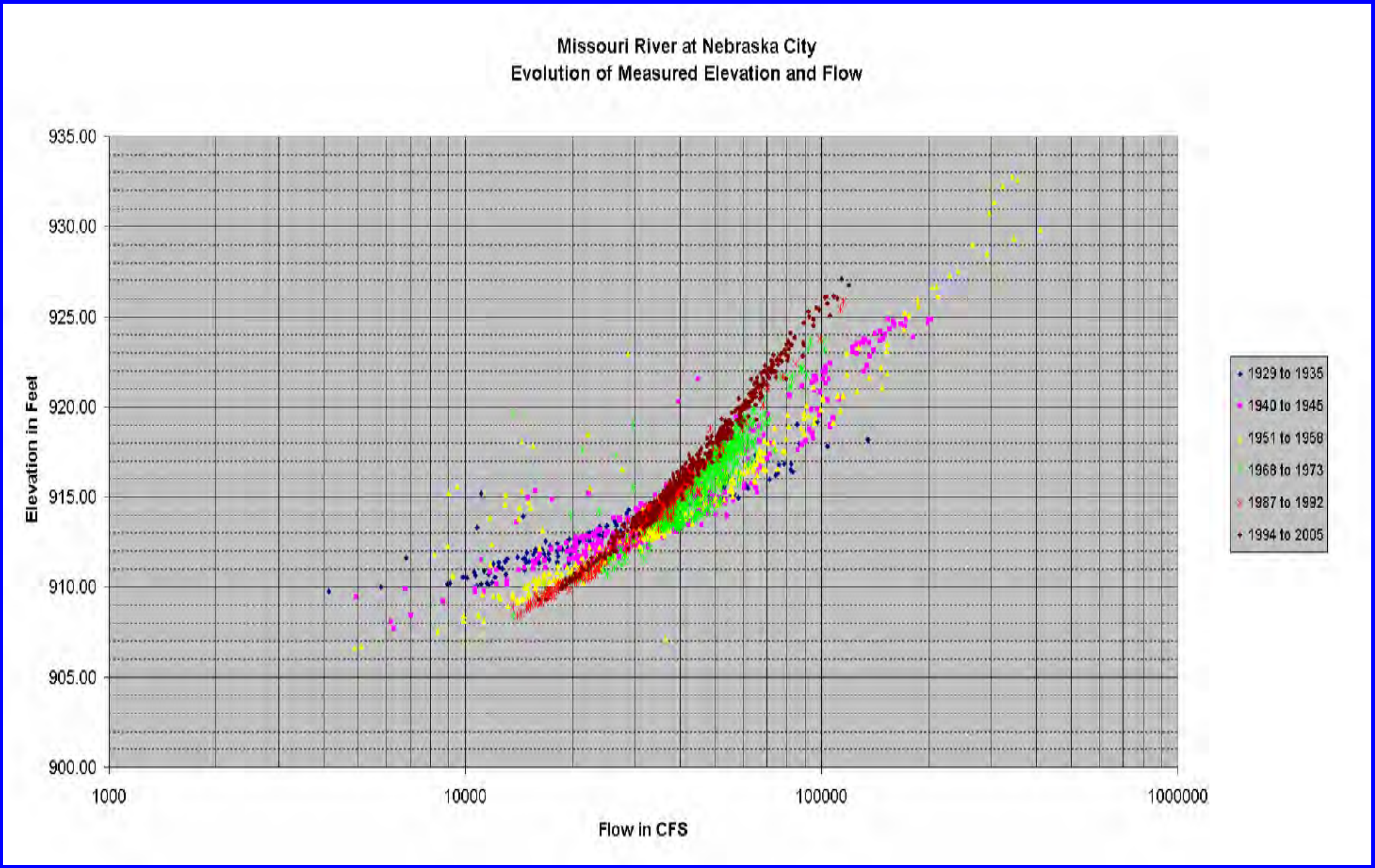
Upstream Reservoirs

St. Joseph

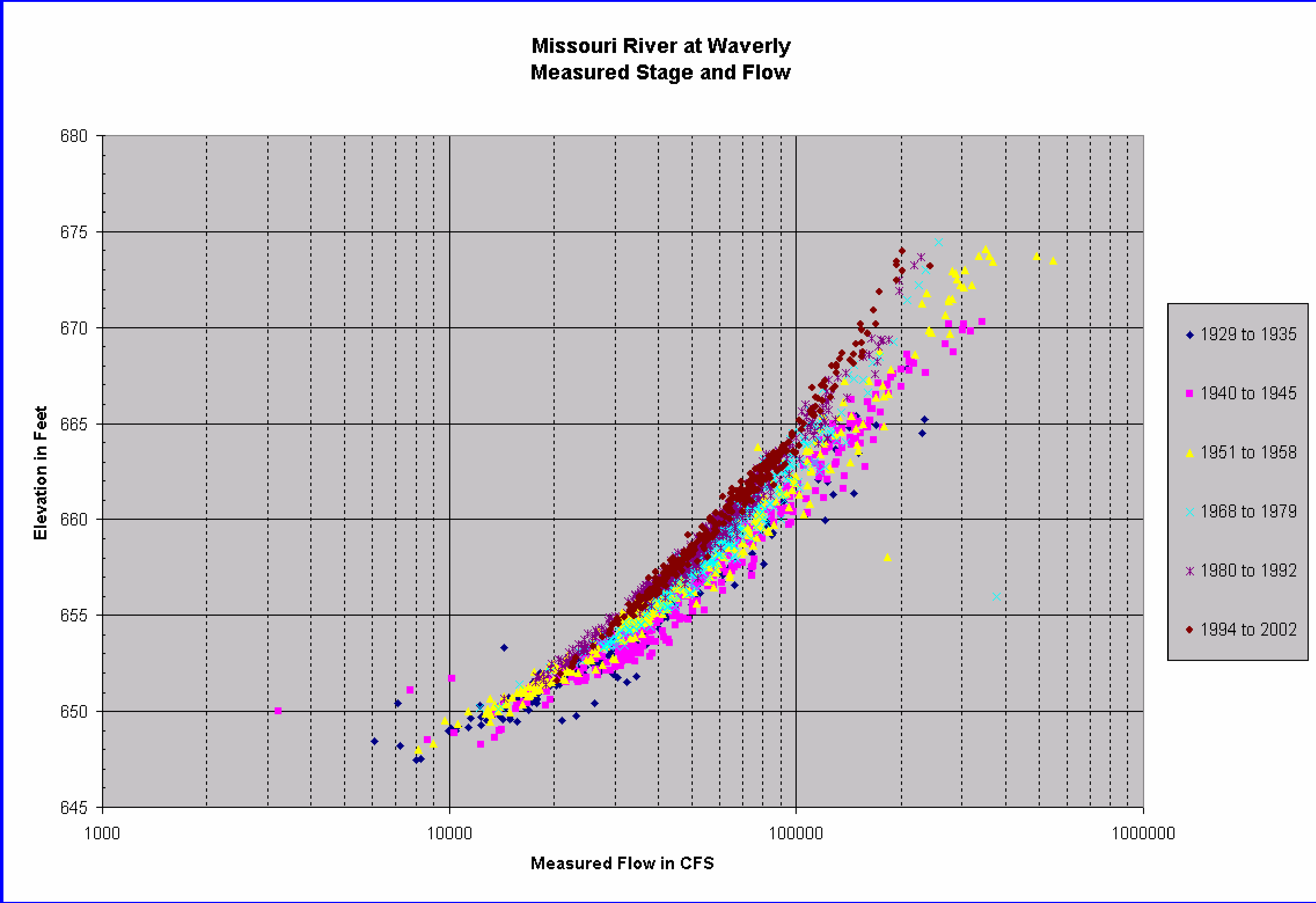


Missouri River at St. Joseph
820.00
815.00
810.00
805.00
800.00
795.00
790.00
785.00
Elevation in Feet
1,000
10,000
100,000
1,000,000
Flow in CFS
1929 to 1935
1940 to 1945
1951 to 1958
1968 to 1979
1980 to 1992
1993 to 2004

Nebraska City



Waverly



Missouri River at Waverly
Measured Stage and Flow
680
675
670
665
660
655
650
645
Elevation in Feet
1000
10000
100000
1000000
Measured Flow in CFS
1929 to 1935
1940 to 1945
1951 to 1958
1968 to 1979
1980 to 1992
1994 to 2002

Discounting the Impact of Upstream Reservoirs

- Mainstem reservoirs are 600 miles upstream.
- Kansas River only contributes 10% of Missouri River flow; therefore reservoirs inconsequential.
- Change in sediment supply is wash load – grain sizes not found in the bed.
- Bed load is only 5 to 15% of total load.
- Bed erosion has caused the problem at Kansas City.
- Similar erosion not seen at upstream and downstream gages

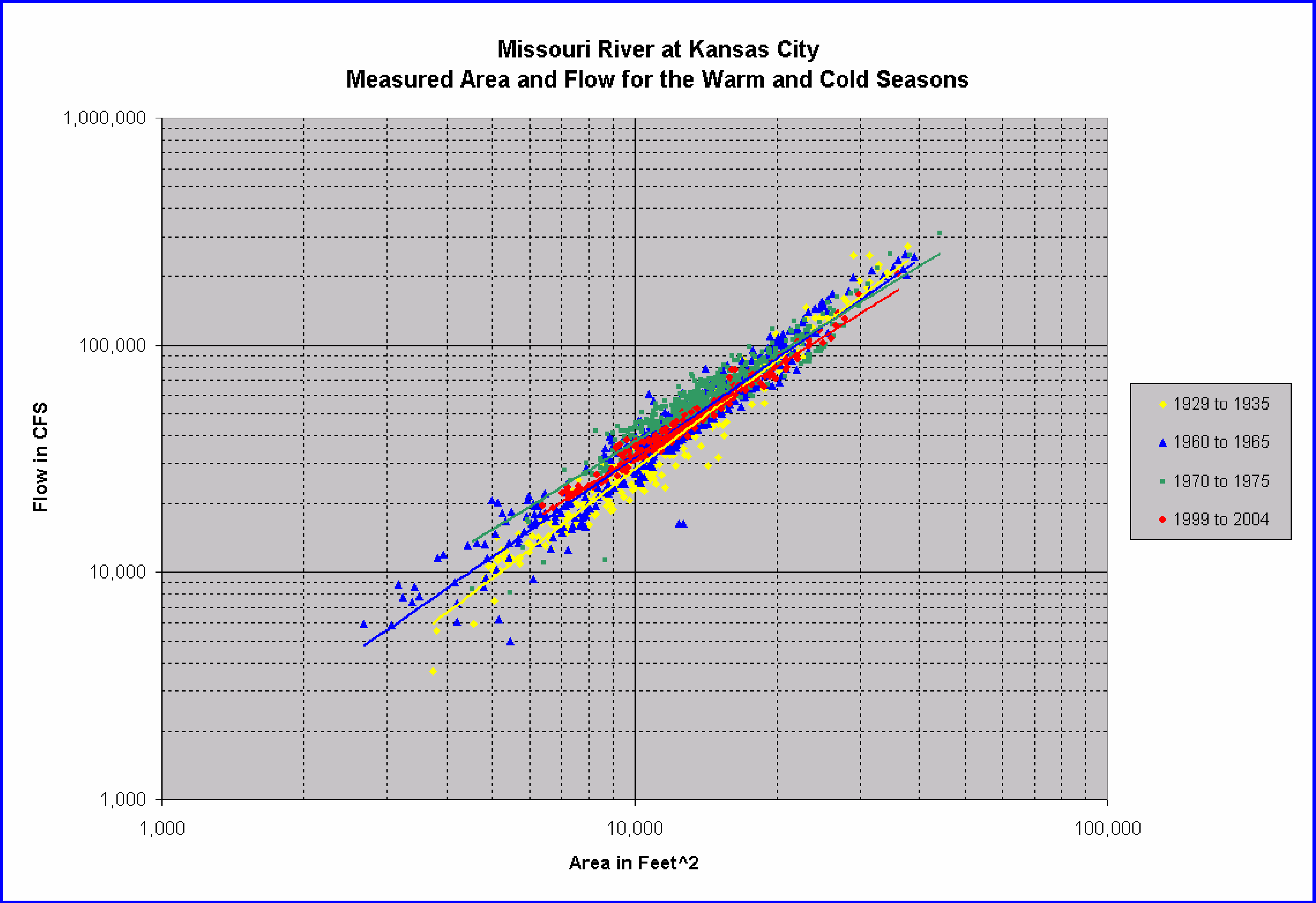
River Training Structures

Sediment Transport

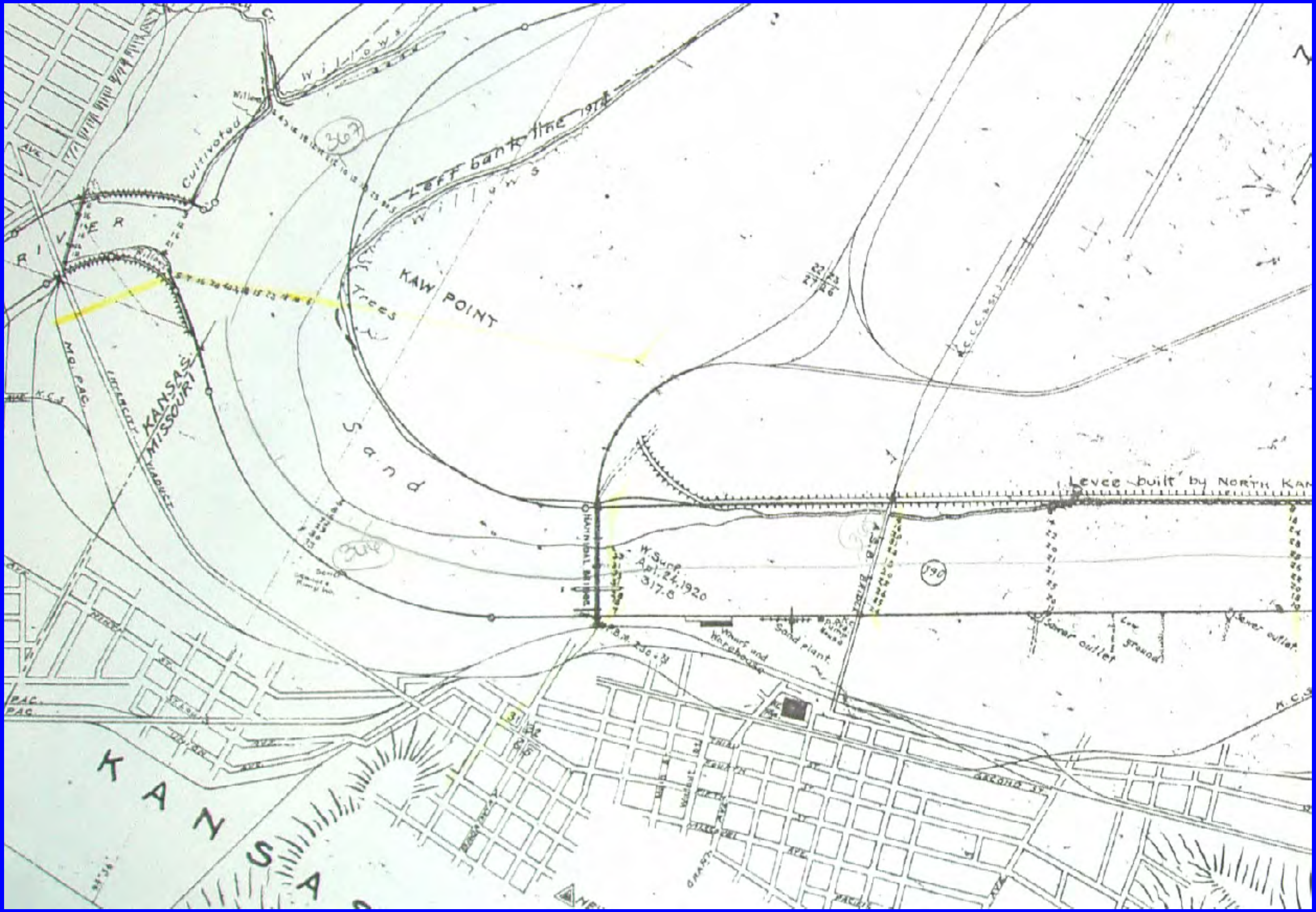
- Function of velocity, depth, roughness, grain size distribution, kinematic viscosity, fall velocity, etc.
- Velocity is a predominant parameter.
- From Yang's excess stream power and from excess shear stress:

$$\text{Transport potential} = f(V^5)$$

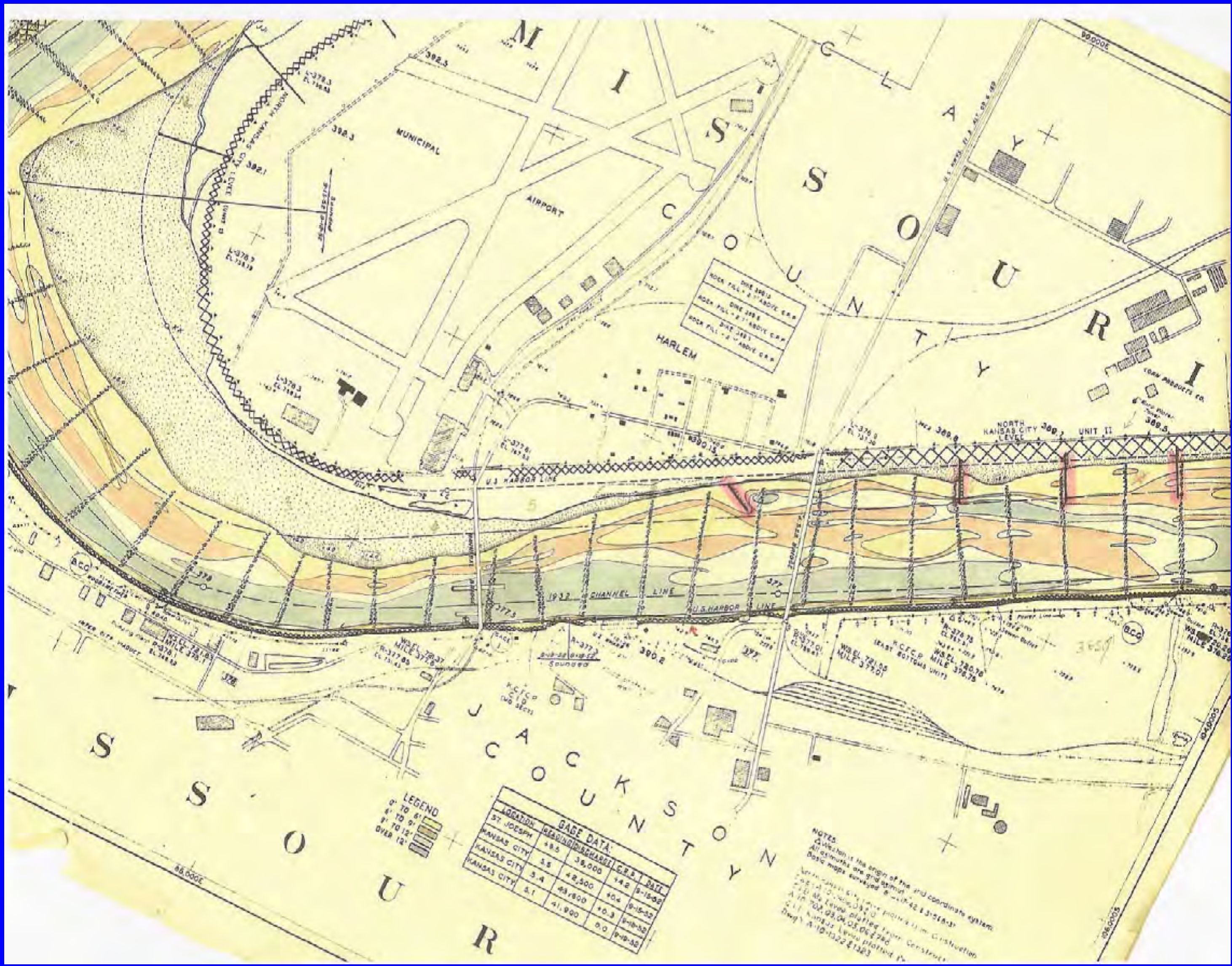
Area-Discharge as an Indicator of Velocity



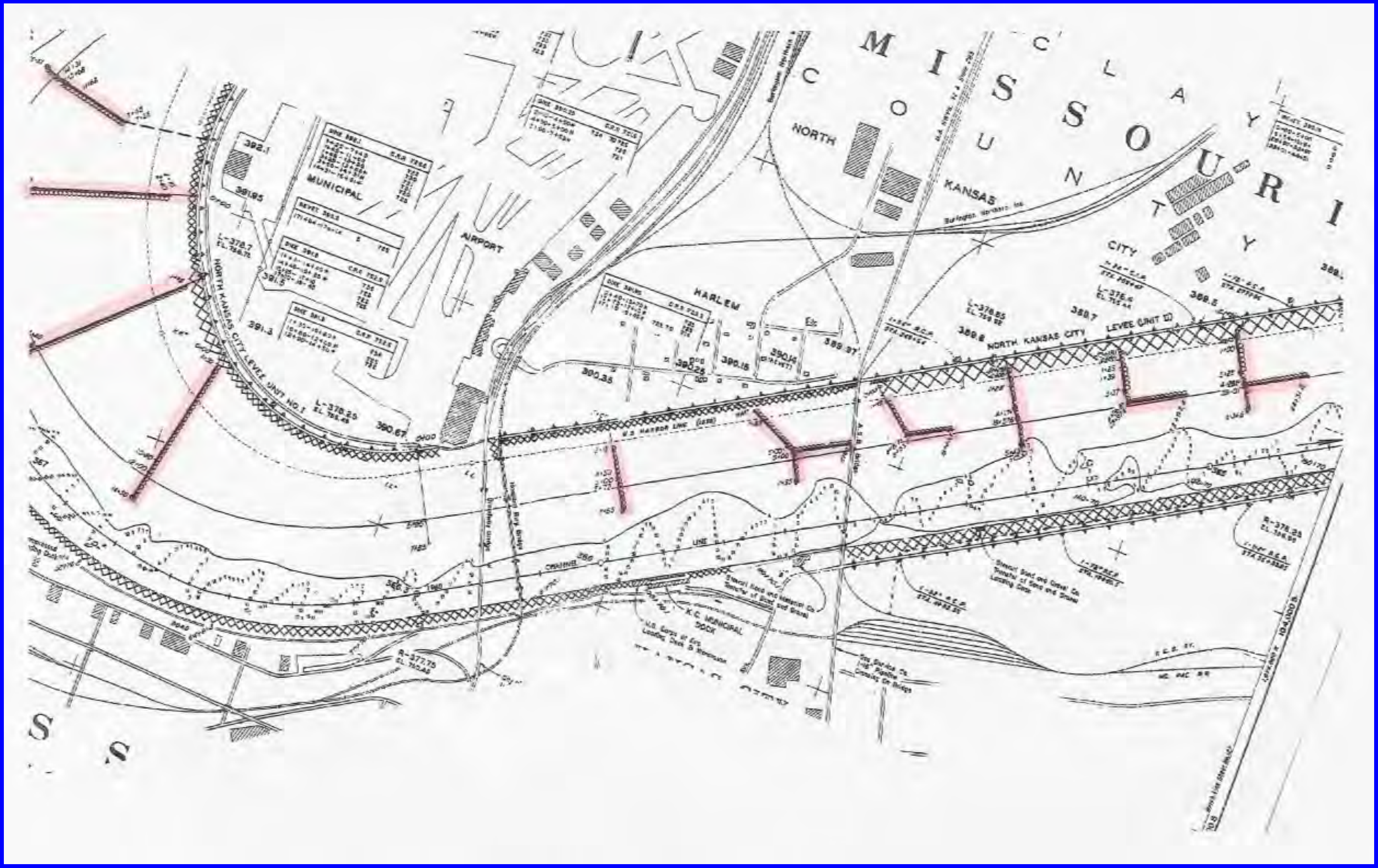
1920 Dikes and Revetments



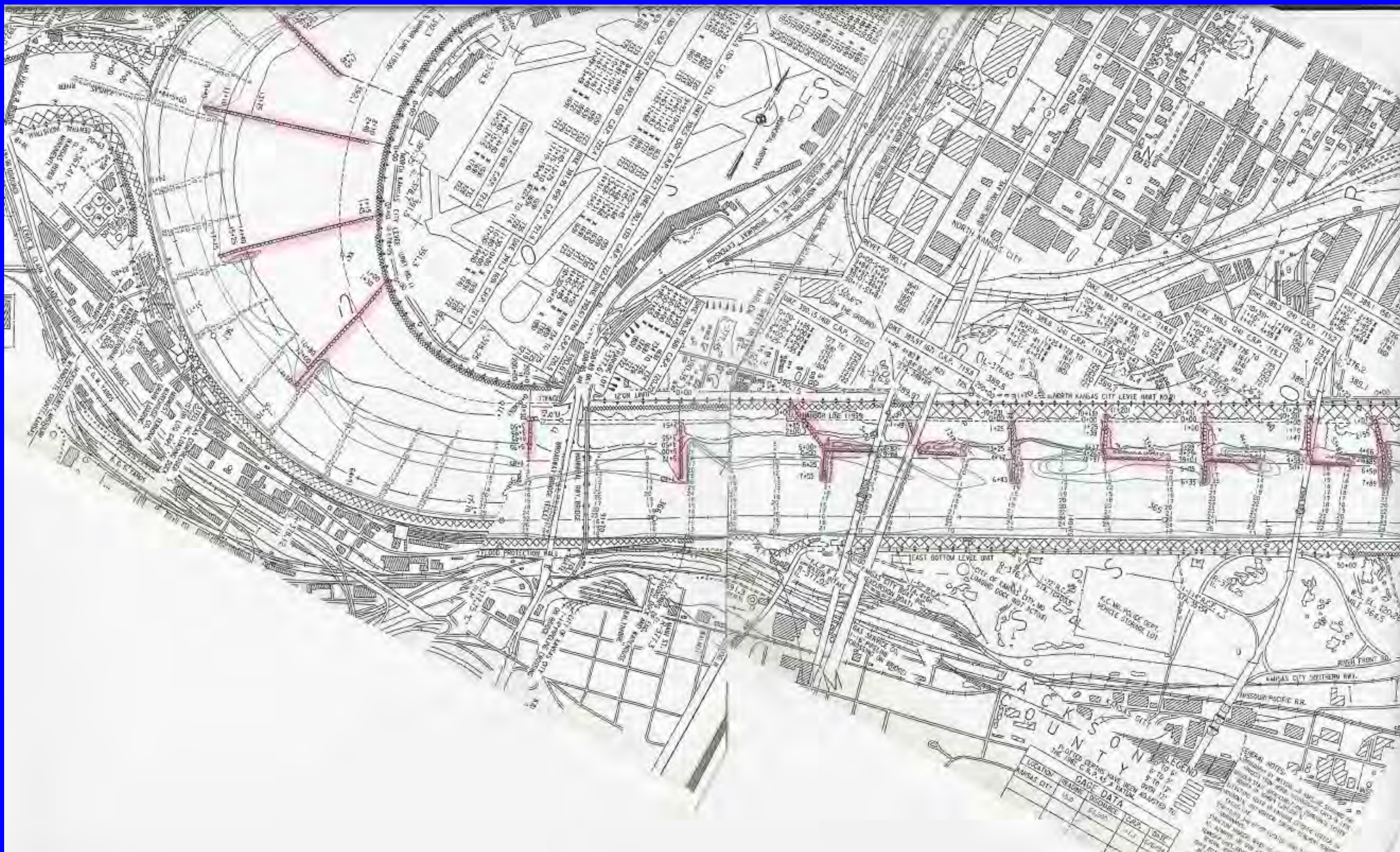
1952 Dikes and Revetments



1973 Dikes and Revetments



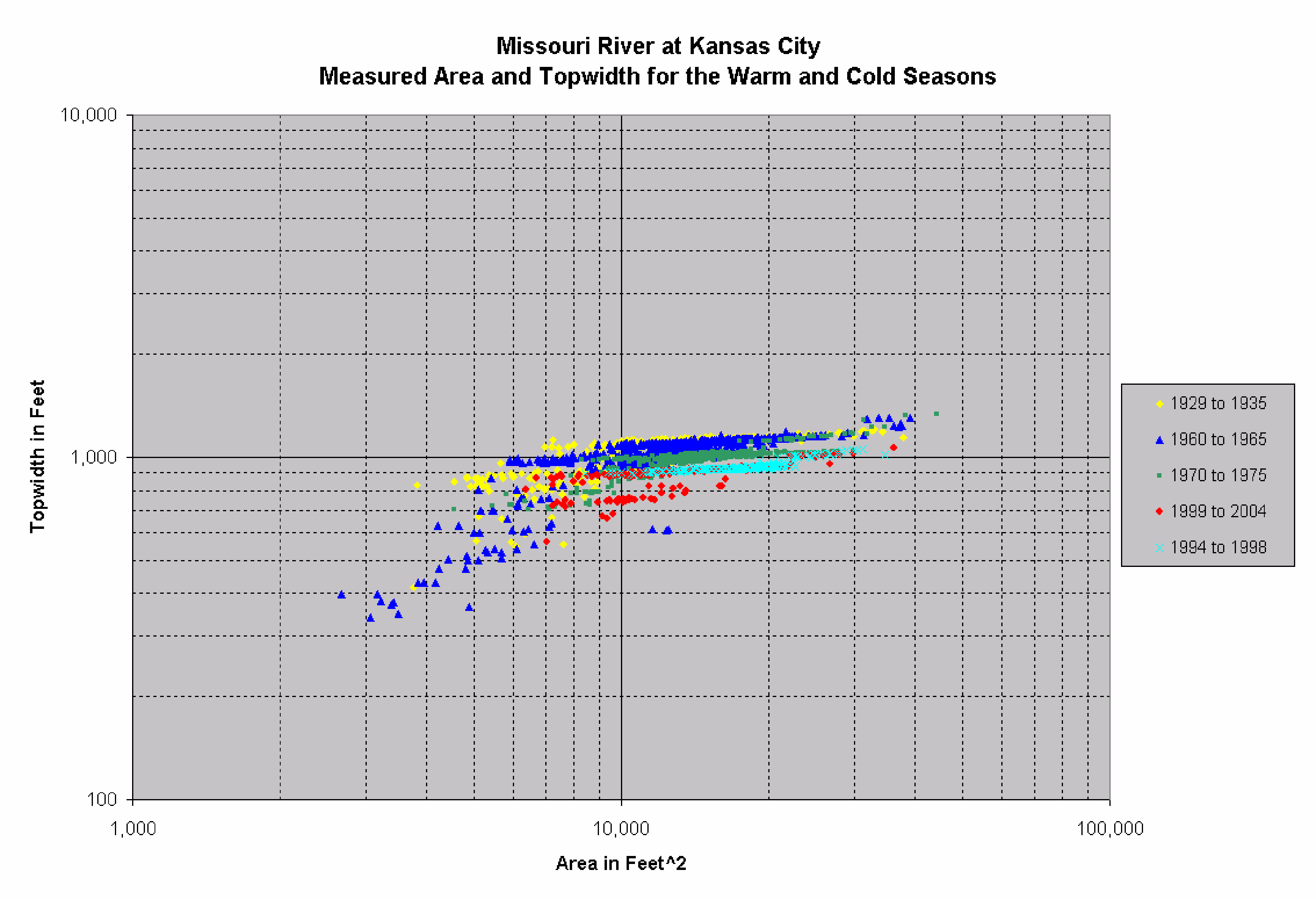
1994 Dikes and Revetments



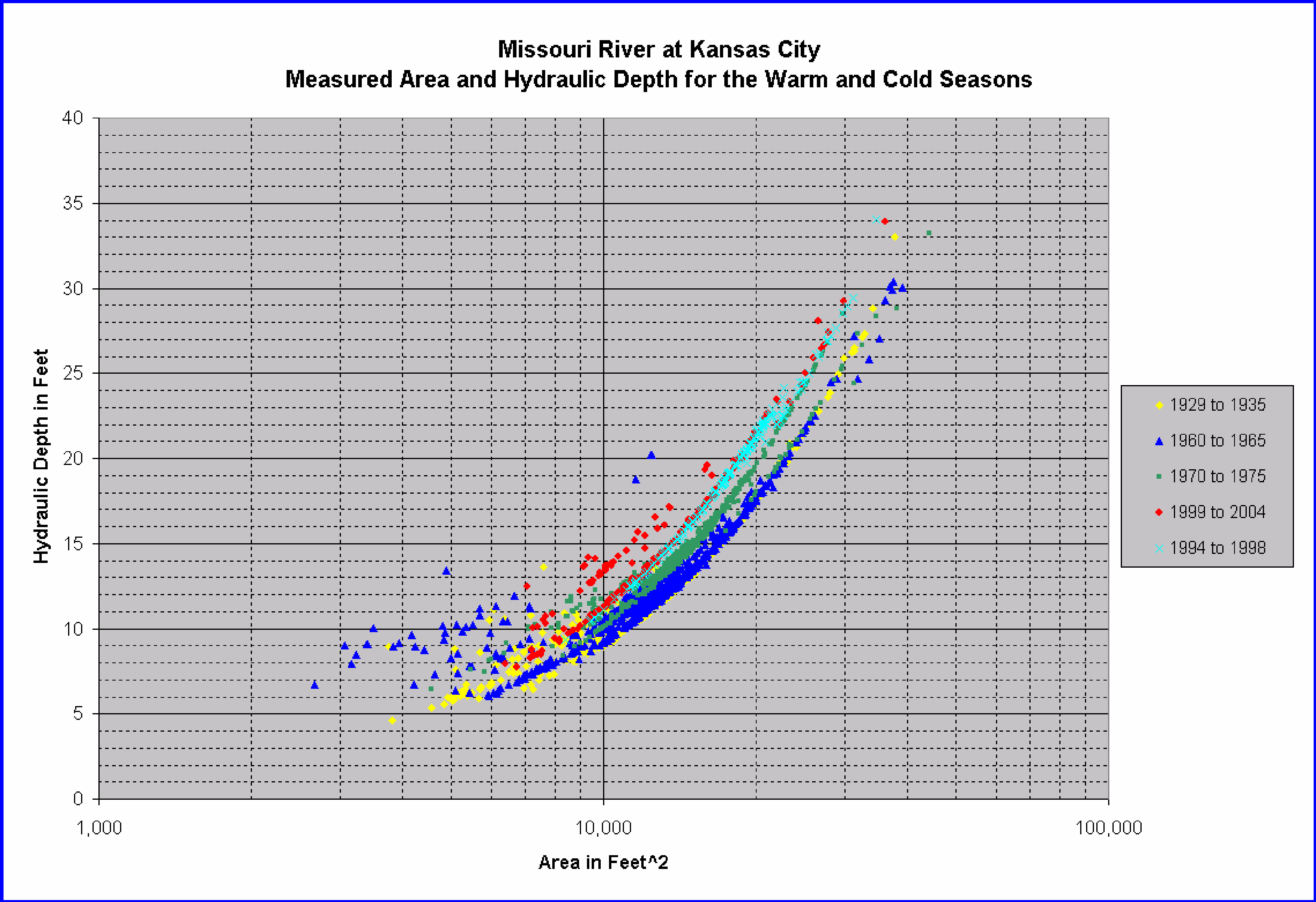
Effect of Dikes

Effect of Dikes (2)

Evolution of Topwidth



Evolution of Hydraulic Depth



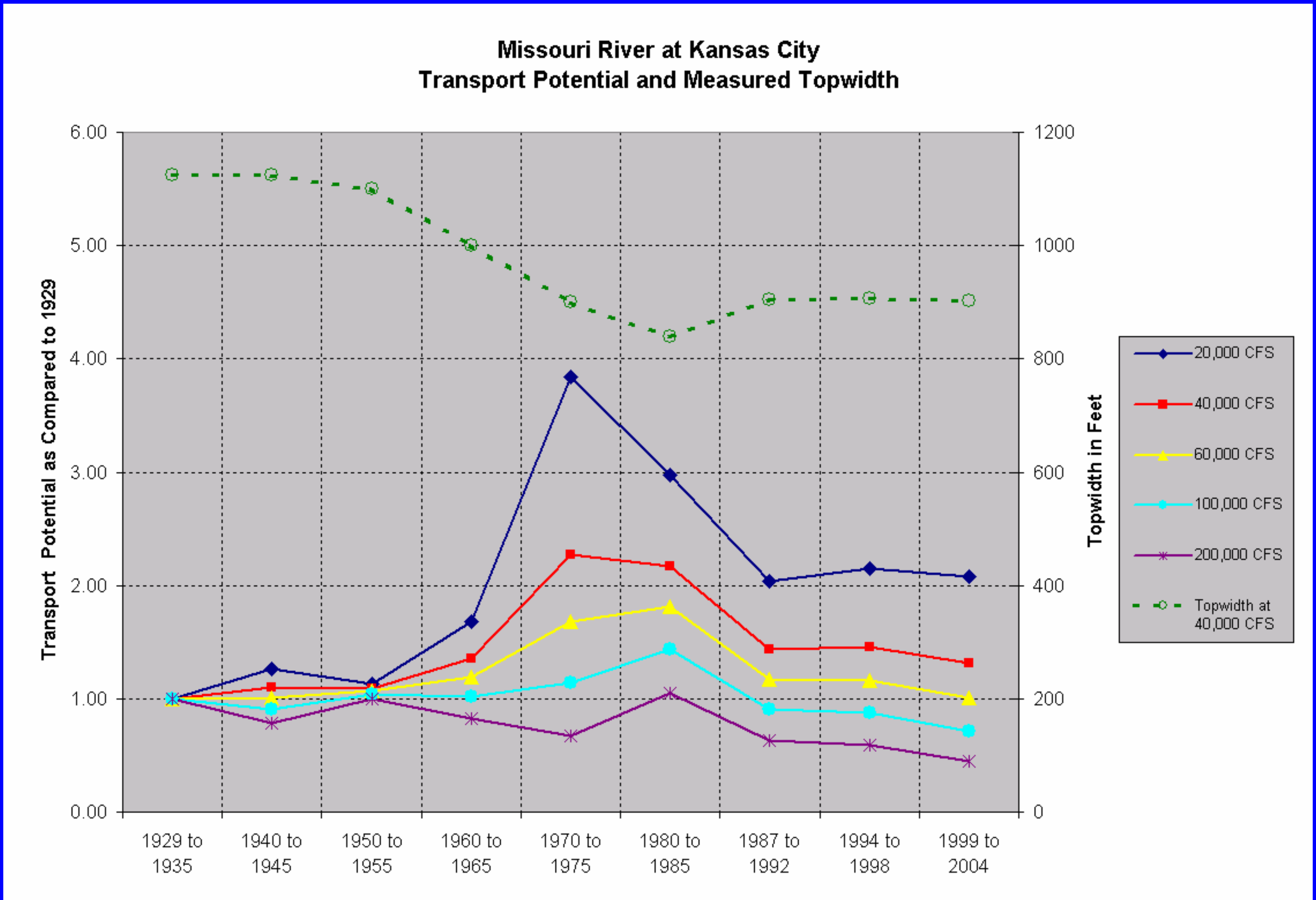
Transport Potential

- Assume that the 1929 to 1945 period is a stable, base-line condition.

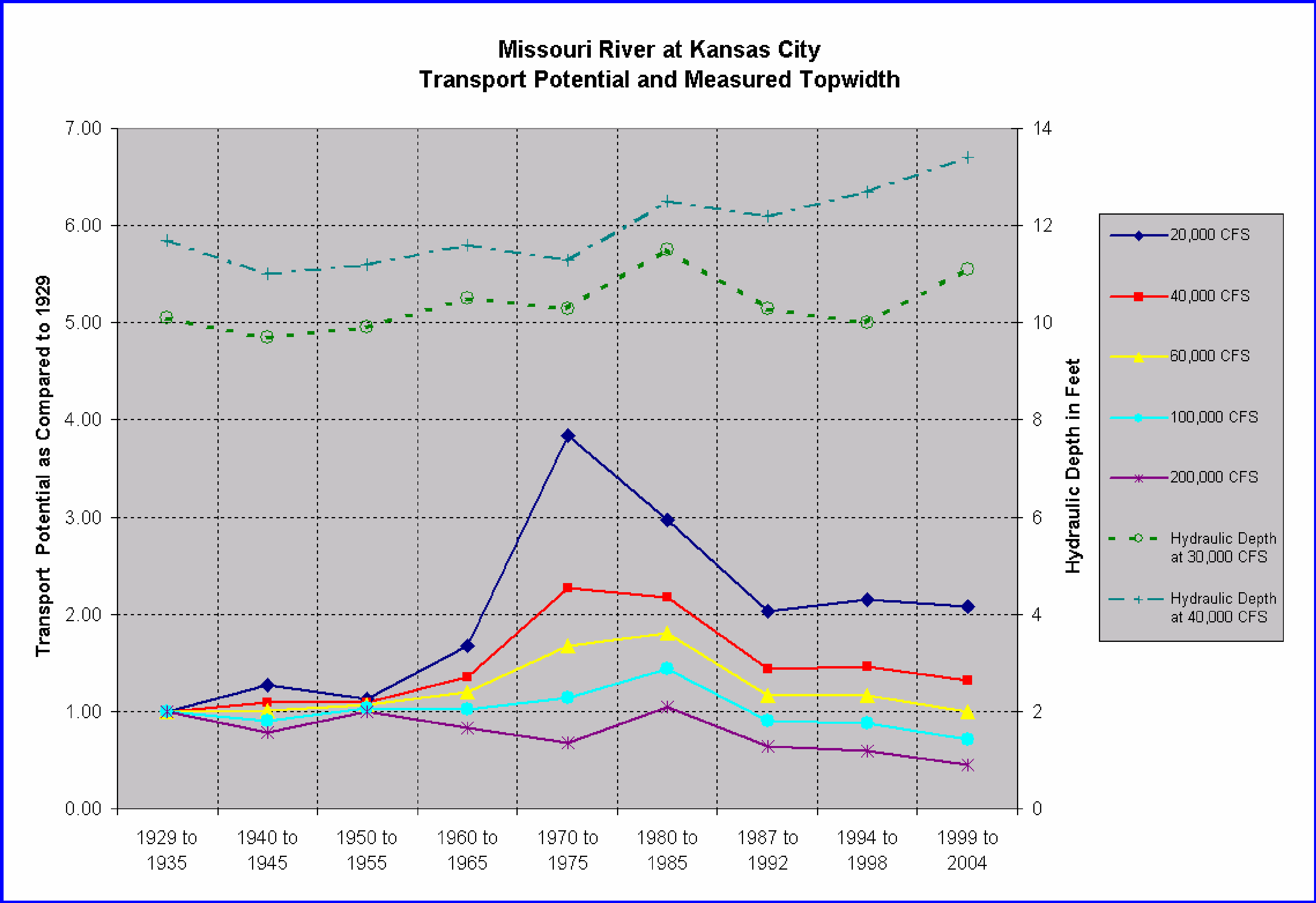
- Transport potential can be expressed as a ratio comparing the current period to the 1929 base line:

$$\text{Transport Ratio} = \frac{V_{\text{Period}}^{5}}{V_{1929}^{5}}$$

Transport Potential and Topwidth



Transport Potential and Hydraulic Depth



Minimization of Energy Expenditure

1. Rivers adjust their geometry to minimize energy expenditure.

2. In a natural setting, increased velocity would have stimulated:

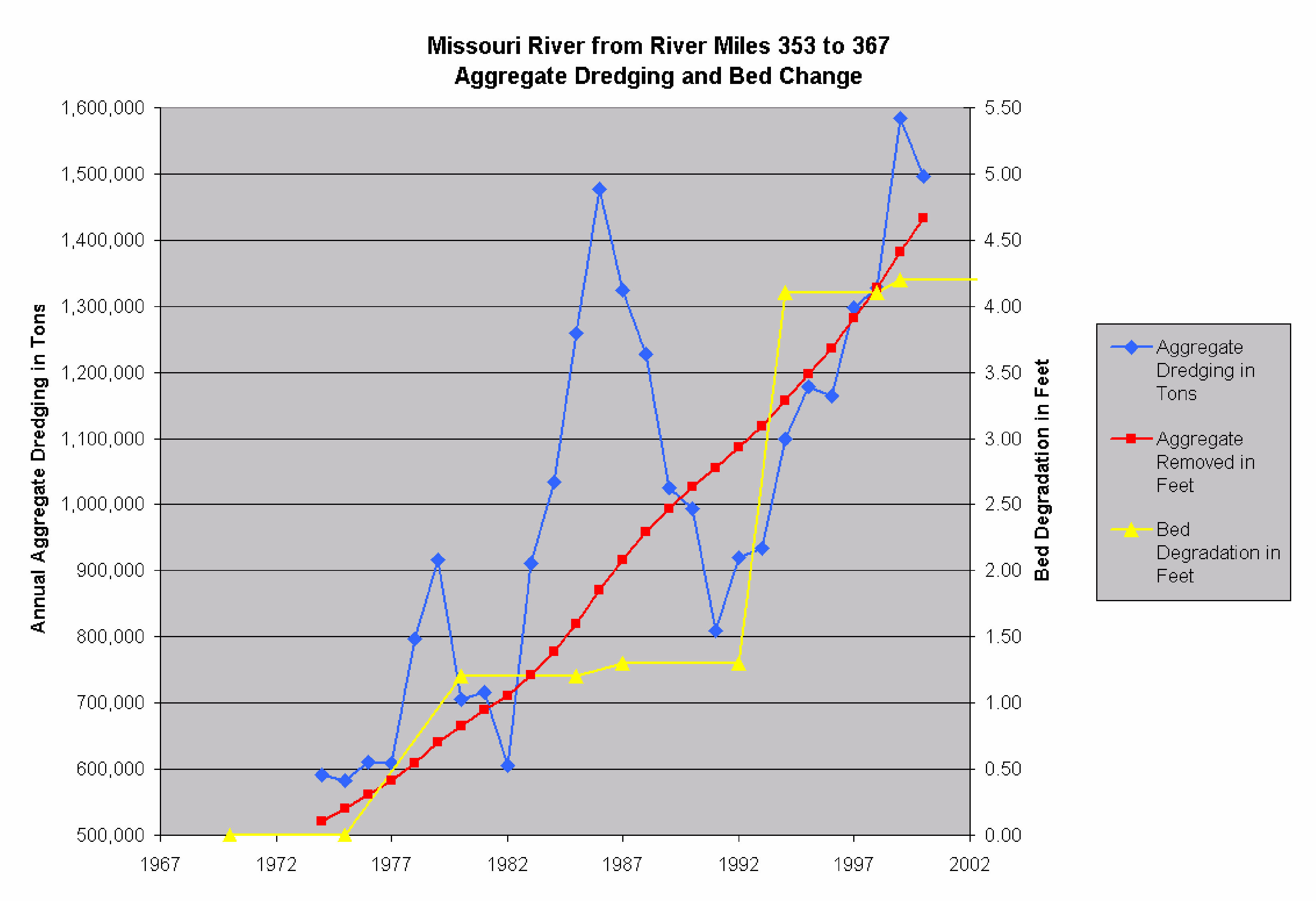
- Degradation.
- Bank caving.
- Meandering.

Minimization of Energy Expenditure (Cont.)

3. But the river is locked in place by dikes and revetments; therefore the bed can only erode to restore equilibrium.

Commercial Sand Dredging

Time History – RM 353 to 367



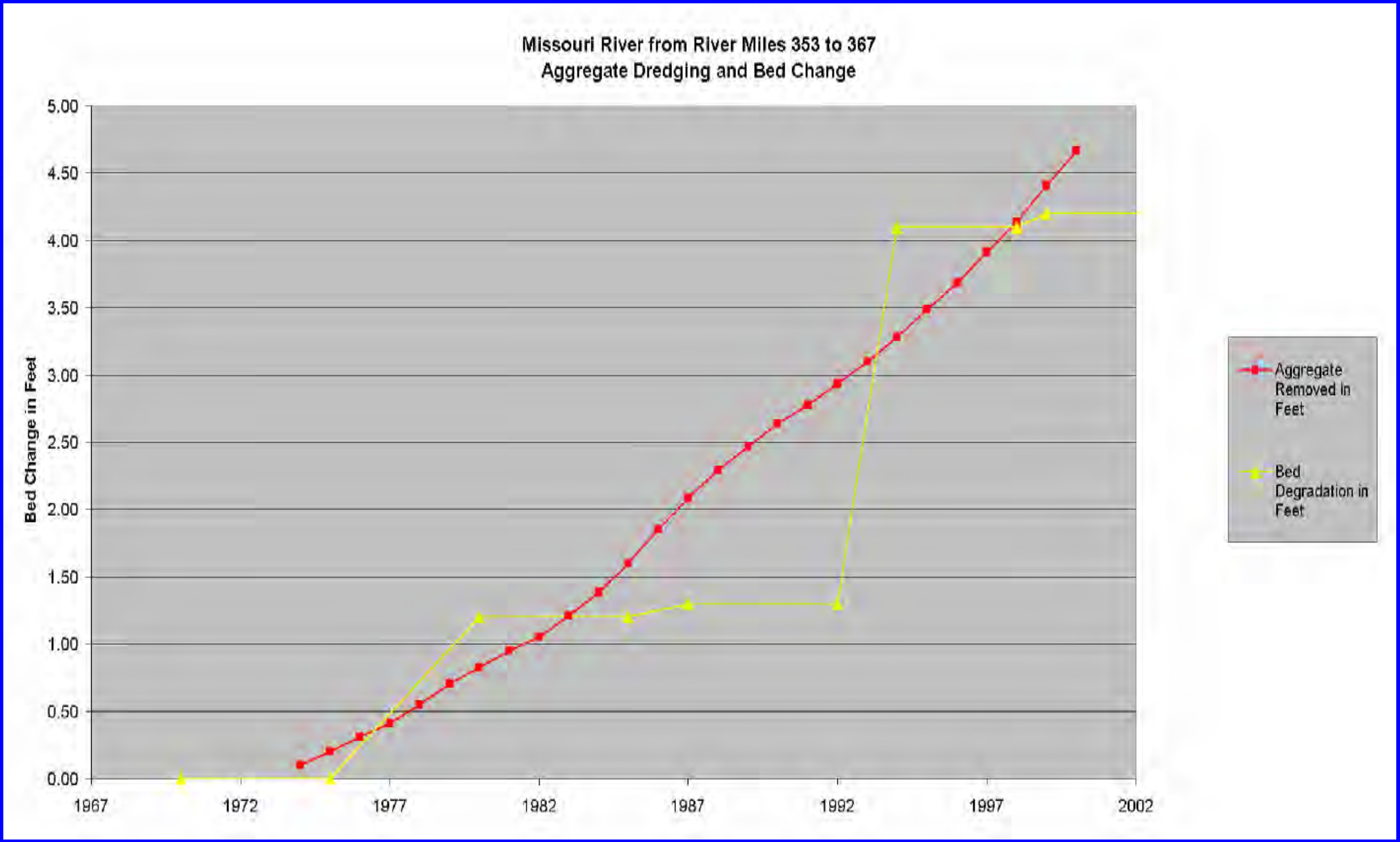
Two Ways of Analyzing Dredging

1. Since the volume of material removed is similar to the the change in the bed elevation, this implies that commercial dredging is responsible for the change.

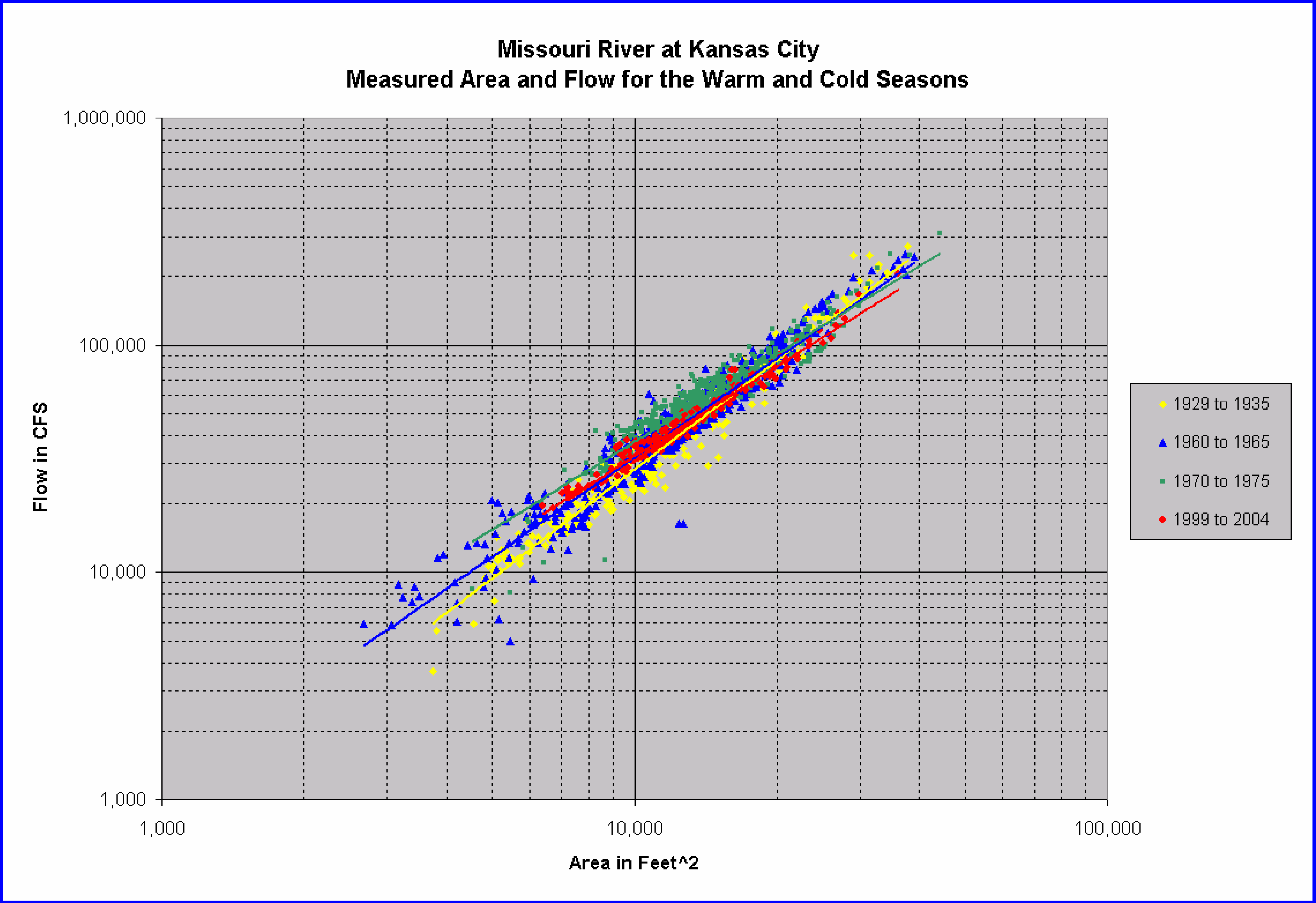
But –

- The time sequence does not agree.
- Unstable river.

Time Sequence does not Agree



River Moving Toward Stability



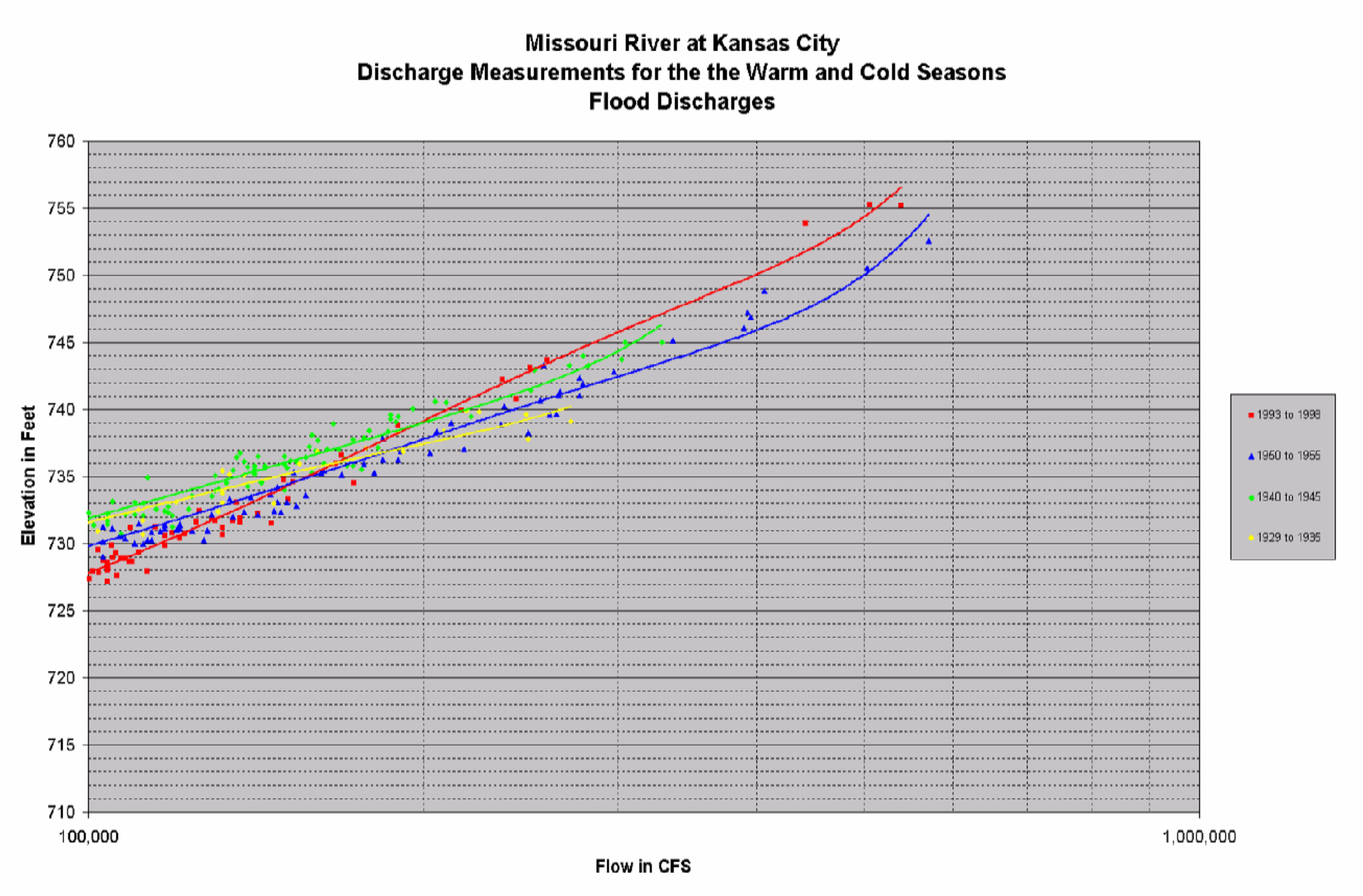
Second Way of Analyzing Dredging

2. Dredging is speeding the river's return to the 1929 area/velocity condition.

This implies: Once the river returns to the 1929 condition, continued dredging may degrade the river below the 1929 base condition.

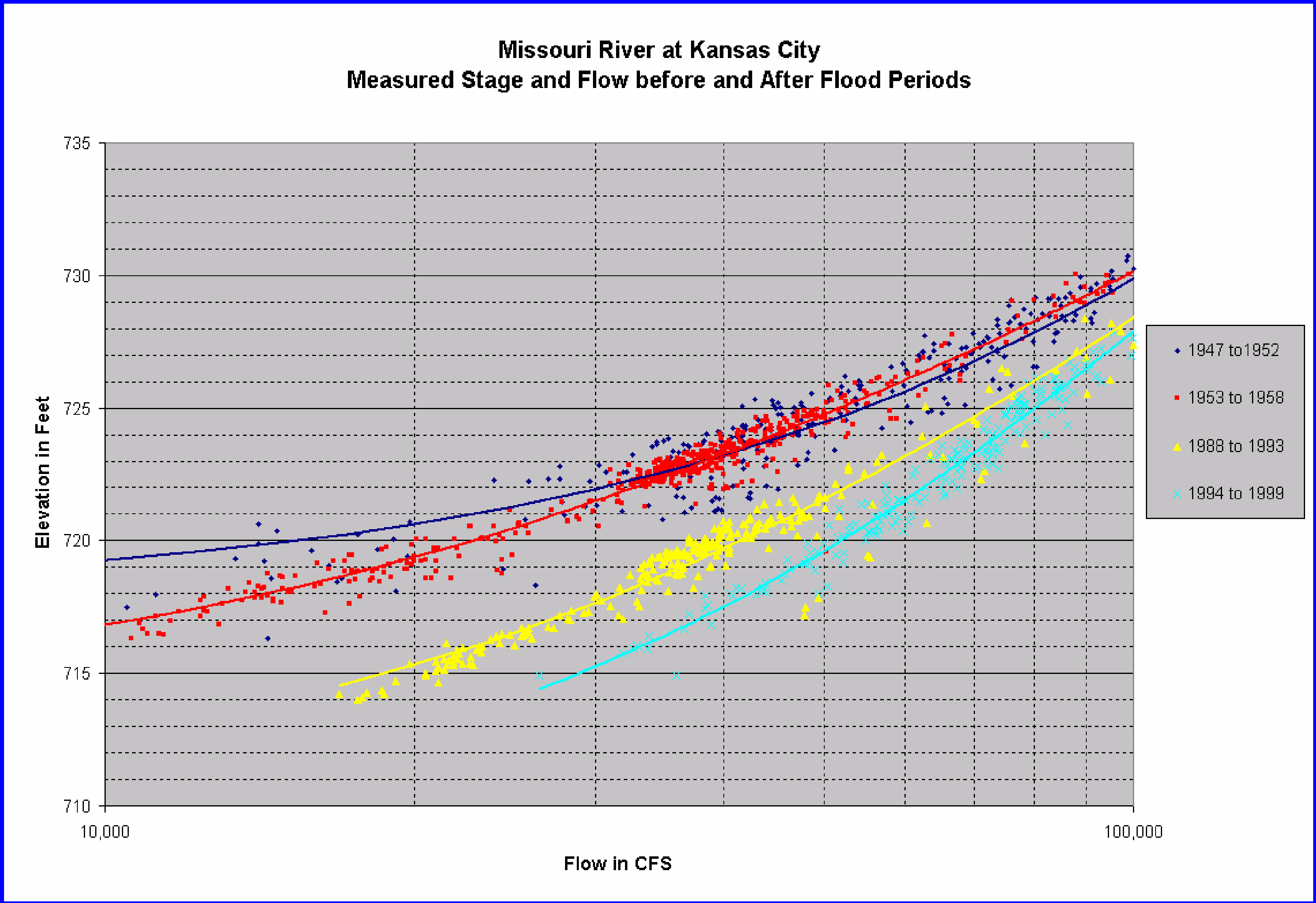
Major Floods

1951, 1952, and 1993 Floods



Increased Roughness

Flood Erosion

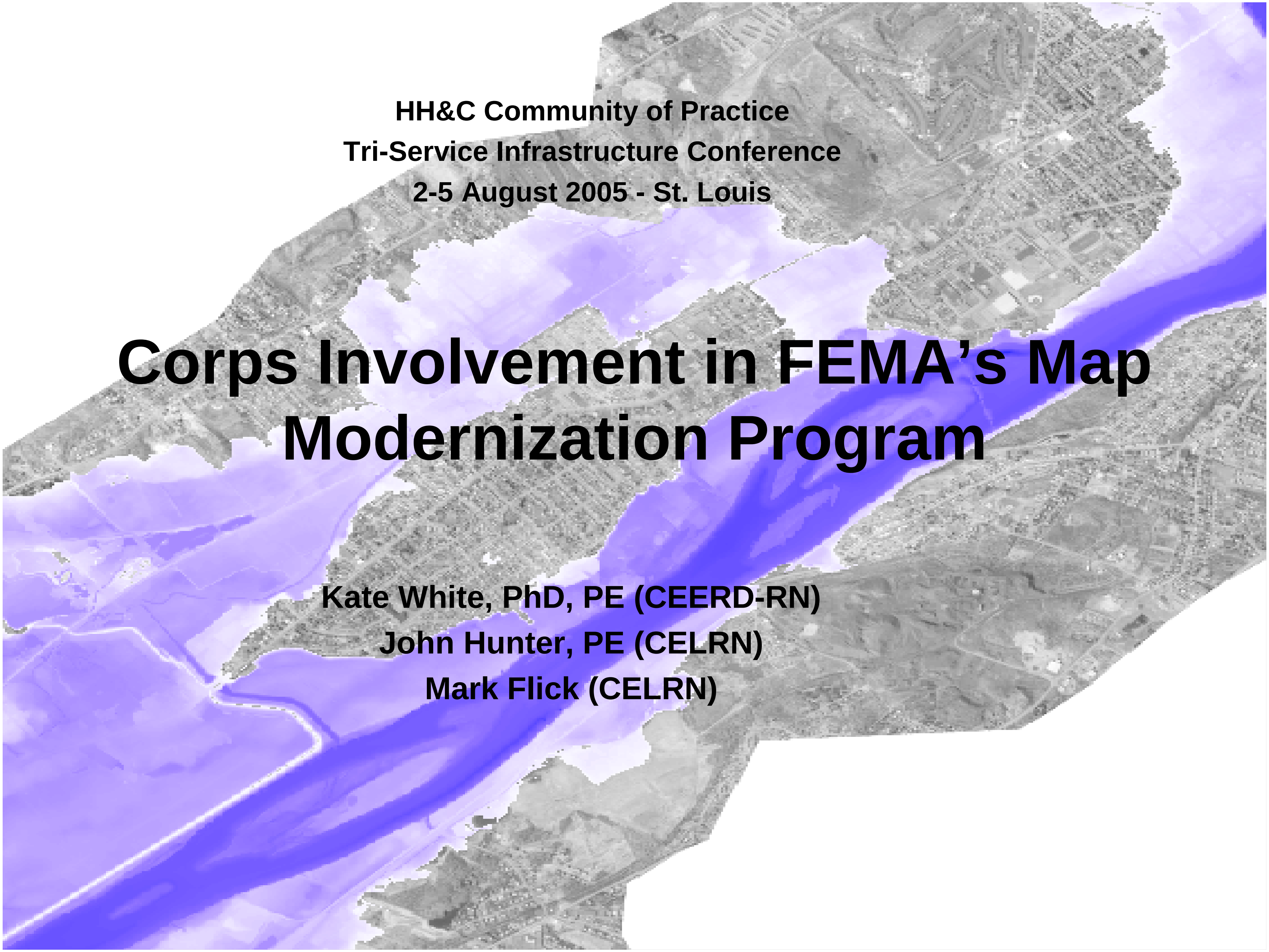


Conclusions

1. In channel velocity has been elevated by the presence of dikes.
2. 1.2 feet of further erosion is required to return to 1929 base-line condition.
3. Commercial dredging is accelerating the return to the base-line condition.
4. After the 1929 base-line condition is achieved, further dredging may adversely effect the river.
5. Major floods may result in erosion even below the 1929 base-line.

Further Work

1. Complete a report documenting this past year's work, including flow and stage duration, grain size analysis, and other Missouri River gages.
2. Major floods.
3. Time history of cross-section morphology.
4. Modeling:
   - Major floods.
   - Dredging.
   - Structural alternatives.

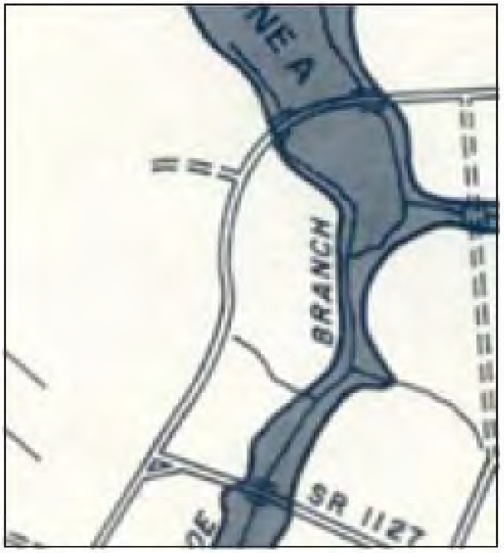


HH&C Community of Practice
Tri-Service Infrastructure Conference
2-5 August 2005 - St. Louis

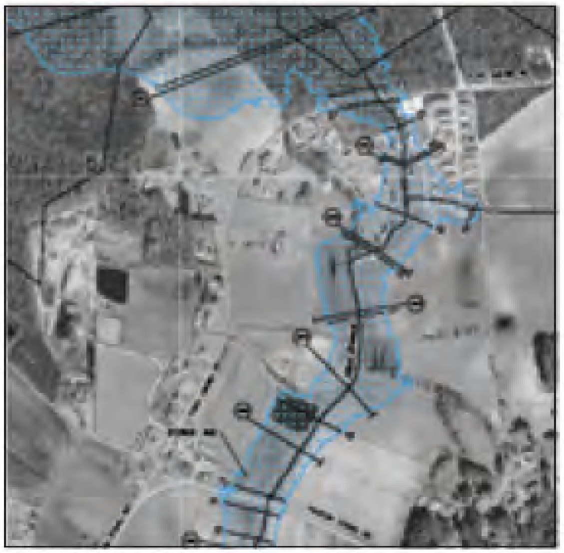
Corps Involvement in FEMA's Map Modernization Program

Kate White, PhD, PE (CEERD-RN)
John Hunter, PE (CELRN)
Mark Flick (CELRN)

FEMA Map Modernization Program



Paper flood map section


Digital flood map section

US Army Corps
of Engineers

Hydraulics, Hydrology, and Coastal
Community of Practice

FEMA Map Modernization Program

- >90K Flood Insurance Rate Map panels
- ~70% FIRM > 10 years old by 2005
- GAO recommended FEMA align funding to flood risk
- MMP details in Multi-year flood Hazard Identification Plan (MHIP) - living document
  - Studies for > 1/3 of counties started by FY05
  - ~ 40% of population will have digital maps by FY05
  - MHIP FY02-05 →08 with completion by FY10
  - FY05-09 sequence for DFIRM production
  - Dynamic scheduling for projects scheduled through FY08 (completion through FY10)
  - Risk-based method to establish appropriate level of detail, accuracy, and analysis for reliable maps

Source: FEMA Multi-year flood Hazard Identification Plan

Current MHIP

Table ES-2. Map Production Funding Distribution by Region, FY04-FY08

Region	FY04 Funding[1]	FY05 Funding[1]	FY06 Funding[2]	FY07 Funding[2]	FY08 Funding[2]
1	$4,206,000	$5,315,000	$5,661,000	$5,827,500	$5,827,500
2	$9,420,000	$11,475,000	$12,087,000	$12,442,500	$12,442,500
3	$9,752,000	$12,047,000	$12,852,000	$13,230,000	$13,230,000
4	$35,722,000	$35,725,000	$38,097,000	$39,217,500	$39,217,500
5	$12,798,000	$17,222,000	$18,207,000	$18,742,500	$18,742,500
6	$17,583,000	$23,159,000	$26,775,000	$27,562,500	$27,562,500
7	$7,411,000	$10,115,000	$10,710,000	$11,025,000	$11,025,000
8	$5,432,000	$6,908,000	$7,191,000	$7,402,500	$7,402,500
9	$11,462,000	$13,517,000	$15,453,000	$15,907,500	$15,907,500
10	$4,572,000	$5,849,000	$5,967,000	$6,142,500	$6,142,500
Total	**$118,358,000**	**$141,332,000**	**$153,000,000**	**$157,500,000**	**$157,500,000**

Notes: 1 – Actual
2 – Proposed

FEMA Regions

Corps Support to FEMA

- The US Army Corps of Engineers has played a vital role in the development of Flood Insurance Studies for the FEMA since the 1970's
- Local Corps Districts
  - Local knowledge of rivers, flooding, development patterns, regulatory permits, updated hydrology, bridges
- National Corps Districts
  - Experience with latest methods, use β version of HEC and CHL models first
  - One Door to the Corps enables flexible and time-sensitive scheduling

Corps Support to FEMA

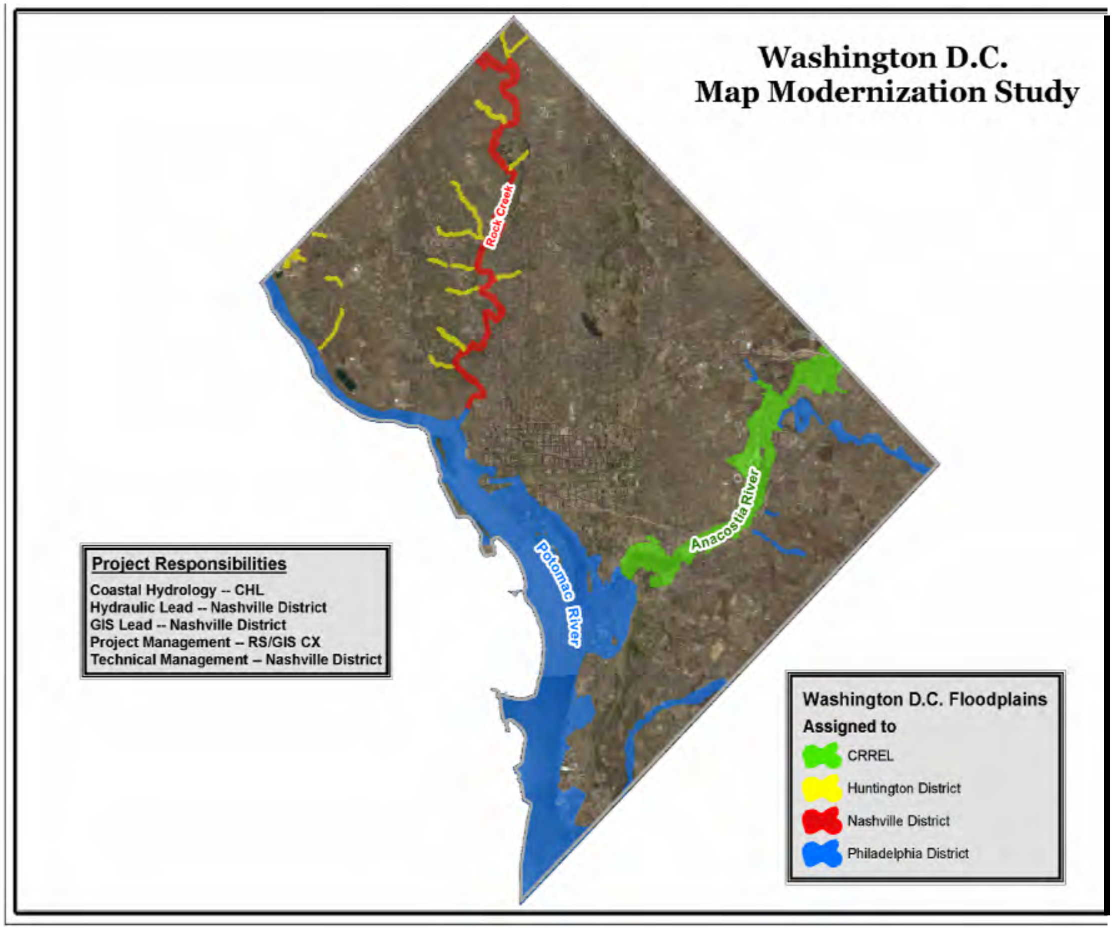
- **Corps Centers**
  - Hydrologic Engineering Center
    - Develops the HEC-RAS, GeoHEC-RAS, HMS, GeoHMS, and flood frequency analysis models used by Districts and others
  - Remote Sensing/GIS Center of Expertise
    - Develops local, regional, and national geospatial databases and supports Corps AIS for Emergency Management, O&M, and regulatory (in process)
- **Corps Laboratories**
  - Coastal and Hydraulics Laboratory
    - Develops the coastal models for local and regional wave and surge modeling (STWAVE, ADCIRC, WISWAVE)
    - Has access to LIDAR bathymetry, soundings, and other data collected for coastal studies
  - Cold Regions Research and Engineering Laboratory
    - Supports HEC in snowmelt and ice jam code for models
    - Develops geospatially enabled local and regional hydrology

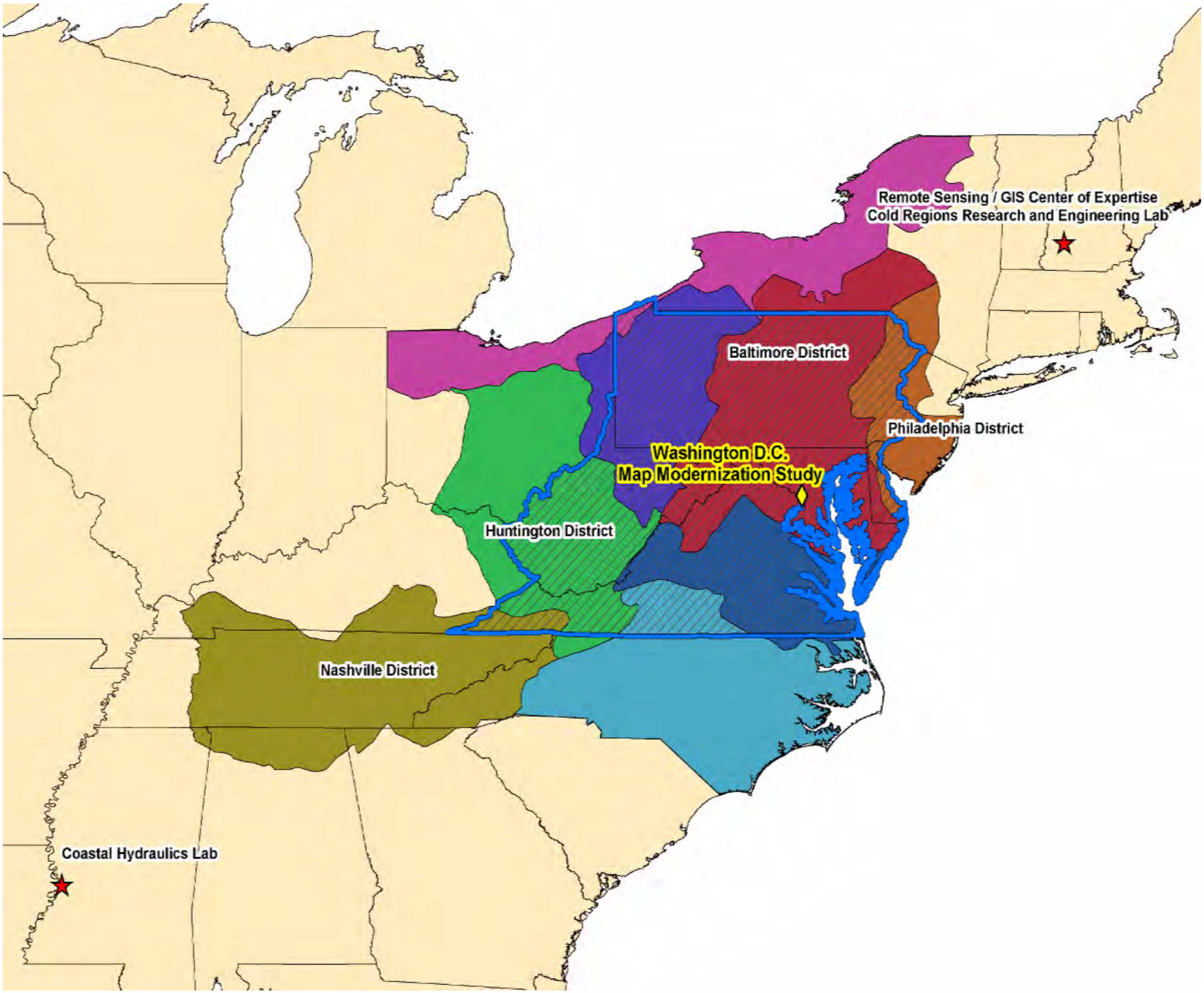
Corps Support for FEMA

- Regional Efforts Developing
  - National PDT (RS/GIS CX)
  - Gulf Coast (CEMVN)
  - Upper Mississippi (CEMVR)
  - Policy and Corporate Issues (IWR)
  - Hydrologic Studies (HQUSACE)
  - National-level MOU (HQUSACE)
- Corps expertise in the watersheds brings unique perspective to FEMA partners
  - Evaluating level of detail required for updates
  - Leveraging updates with other floodplain management outcomes (e.g. cumulative impacts)

National FEMA PDT

- **Formed to work with FEMA Region 3**
  - **One Door to the Corps**
- **First project: Washington DC**
  - **4 Districts (NAB, NAP, LRH, LRN)**
  - **2 labs (ERDC CHL and CRREL)**
  - **Developed bridge data collection format**
  - **Leveraged development of approximate study method**




Remote Sensing / GIS Center of Expertise
Cold Regions Research and Engineering Lab
Baltimore District
Philadelphia District
Washington D.C.
Map Modernization Study
Huntington District
Nashville District
Coastal Hydraulics Lab

National FEMA PDT

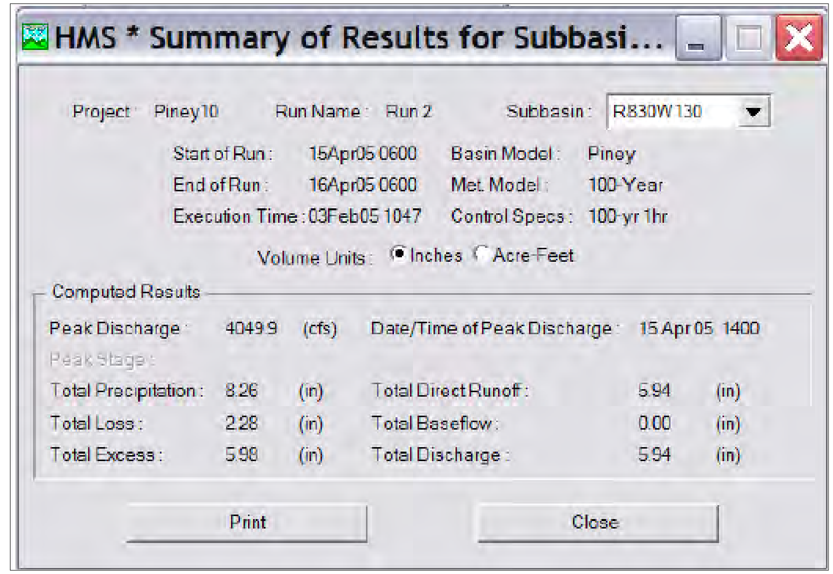
- **Networking:**
  - National PDT spreadsheet (NAB, NAE, NAO, NAP, LRB, LRH, LRN, MVN, MVP, MVS, NWS, NWP, SPA, ERDC, HEC)
  - Experience with Coastal, GIS, H&H, and PM aspects
- **Capacity Building DFIRM Tools Training**
  - Facilitated 3-day virtual training session for Corps, USGS, Michael Baker, contractors
- **Next Project:**
  - Coastal surge analysis for Chesapeake Bay
    - 2 Districts (NAB, NAP)
    - 1 lab (ERDC CHL)
  - Chesapeake Bay interagency workshop to maximize use and leveraging of map updates
- **More to come…..**

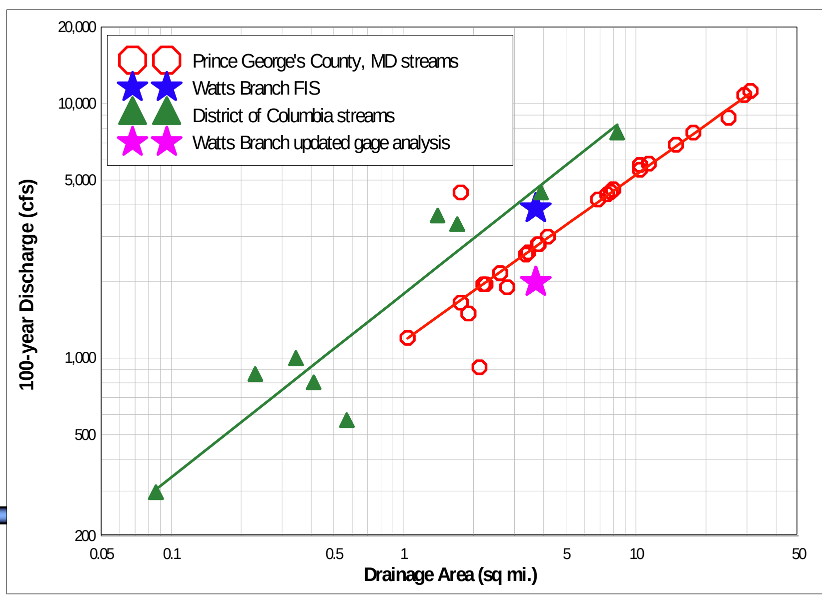
Example: District of Columbia Map Modernization Project

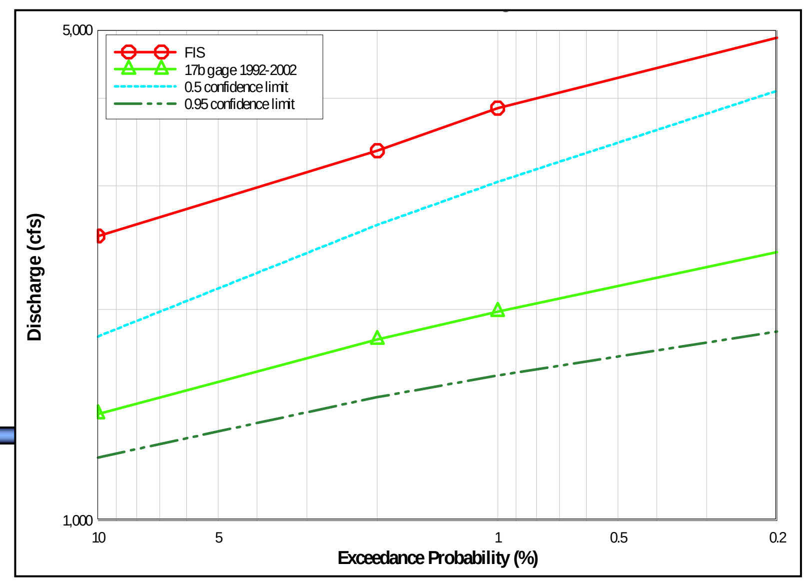
- **Base Mapping**
  - 1m contours for DC area (minus blackout areas)
  - Planimetrics (vector data for roads, etc)
  - Aerial photography (incorporated special DC dataset, except blackout areas)
- **Manipulation**
  - Vertical datum adjustments
  - Combining DEMS created from higher resolution data inside DC with DEMS created from other data outside to capture watershed areas

Example: District of Columbia Map Modernization Project

- **Hydrology**
  - **FIS provides very little data (e.g., skews)**
  - **Updated gage analyses**
  - **Verified Q's**
  - **Performed uncertainty analysis**
  - **Investigated flood history**







US Army Corps of Engineers

Example: District of Columbia Map Modernization Project

- **Hydraulics**
  - **Hard copy scans of HEC-2 output**
  - **Scan and digitize data**
  - **Update HEC2 to HEC-RAS**
  - **Develop automated inundation areas for approximate studies using GeoHEC-RAS**
  - **Bridge data/NPS/quick surveys/tied to GIS database**

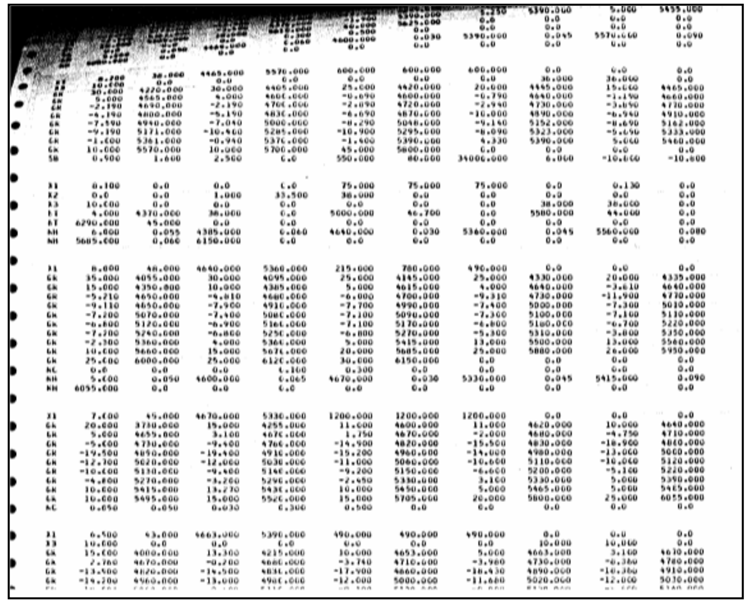
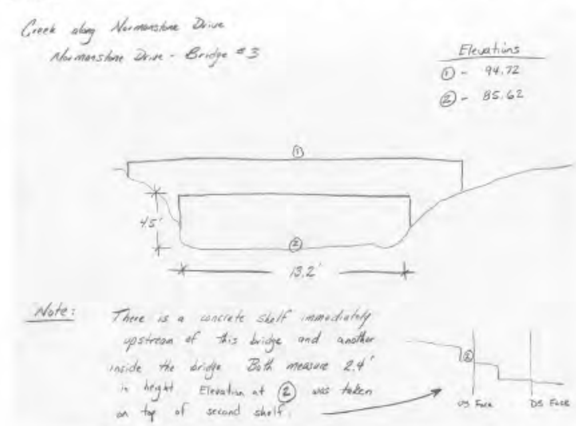


Photo below shows the downstream face of the Normanstone Drive - Bridge #3 over the Creek along Normanstone Drive.

The following sketch provides general dimensions and elevation data for the Normanstone Drive - Bridge #3 on the Creek along Normanstone Drive.

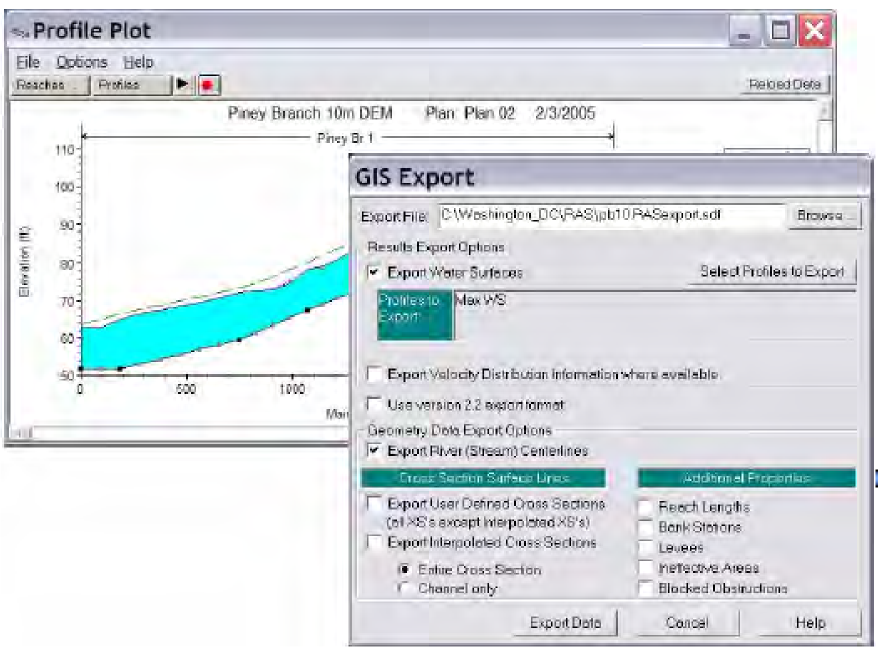


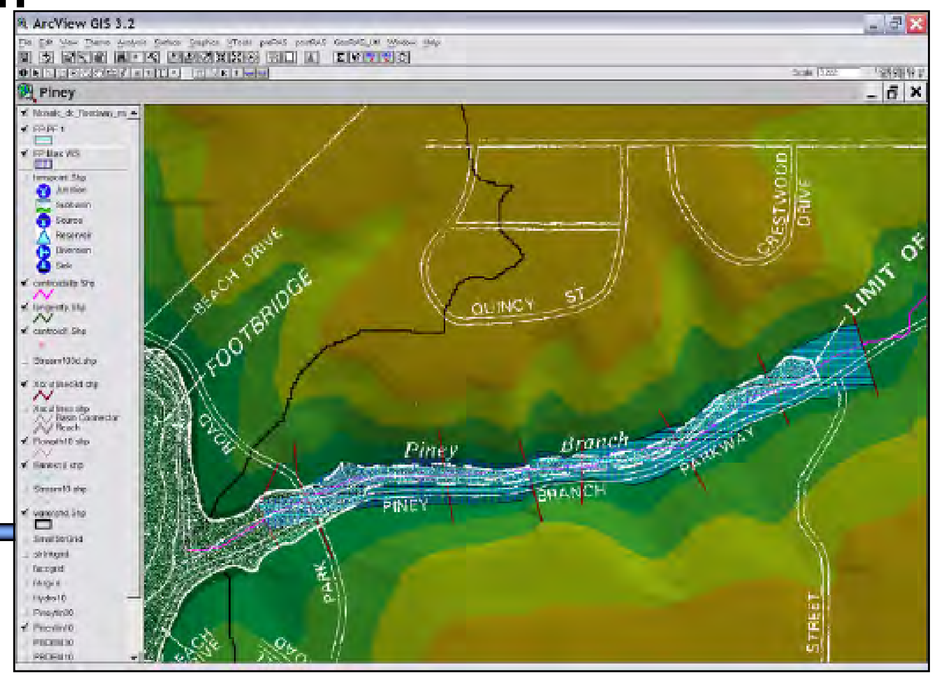
Example: District of Columbia Map Modernization Project

- **DFIRM Database and Map Graphics**
  - **Old = paper**
  - **New = digital, meets FEMA stds**
- **FIS**
  - **Old: basic, little information**
  - **New: Complete text description**

The software products that are needed to perform procedures outlined below are as follows:

- ArcMap 8.3
- Spatial Analyst for ArcMap 8.3
- 3D Analyst for ArcMap 8.3
- EZ GeoWizards for ArcMap 8.3
- Xtools for ArcMap 8.3
- ArcView 3.X
- Spatial Analyst for ArcView 3.X
- 3D Analyst for ArcView 3.X
- Xtools for ArcView 3.X
- GeoHMS for ArcView 3.X
- GeoRAS for ArcView 3.X
- MrSid Extension





Lessons Learned

- P2 structure for project management not necessarily optimal for financial management
- Bridges, bridges, bridges!
- National PDT is great example of 2012 in action:
  - Grassroots efforts lead to interested, energetic participants
  - Cross-District and cross-Division partnering enhanced
- Other efforts aligned with regional business center approach
- Thanks to:
  - GIS Lead: Mark Flick, LRN
  - Hydraulics Lead: John Hunter, LRN
  - Jerry Webb: HQUSACE support and encouragement

HH&C Community of Practice
Tri-Service Infrastructure Conference
2-5 August 2005 - St. Louis

Integrating Climate Dynamics Into Water Resources Planning and Management

Kate White, PhD, PE
Kathleen.D.White@erdc.usace.army.mil
Gerald E. Galloway, PhD, PE (Titan Corporation)
Lewis E. Link, PhD, PH (University of Maryland)

Corps Workshop on Climate Impacts
(November 2004, Baltimore)

- Purpose: To discuss the ramifications of climate variability and change on water management
- On-Site Attendees and presenters:
  - NAB, SPK, LRE, LRD, HQUSACE, ERDC, IWR,
  - Universities of Maryland and Washington
  - Scripps Oceanographic Institute
  - NOAA, NASA, NWS, and USGS
- Virtual attendees and presenters (via Live Meeting):
  - NWW, NWS, NWP, SWF, SWG, SAJ, SAD
  - University of Washington
- Supported by Flood and Coastal Storm Damage Reduction Research Program
- Outcomes:
  - MFR to HQUSACE
  - Technical Report
  - White Paper on Corps Policy Relative to Climate Variability

Key Presenters

- **General Galloway:**
  - Major challenges range from aging water infrastructure and overuse of groundwater to climate change
  - Primary issue in the US is the distribution of supply and demand, not the quantity of water available
  - Reduction in monitoring and assessment programs is a significant barrier to gaining the understanding required to solve climate-related issues
  - Policy challenges:
    - Formulate policy that provides the necessary flexibility and incorporates public values into water management without destabilizing investor's expectations
    - AWRA National Water Policy Dialogue points out the critical need for a holistic and watershed approach to water management and more effective collaboration between agencies

Key Presenters

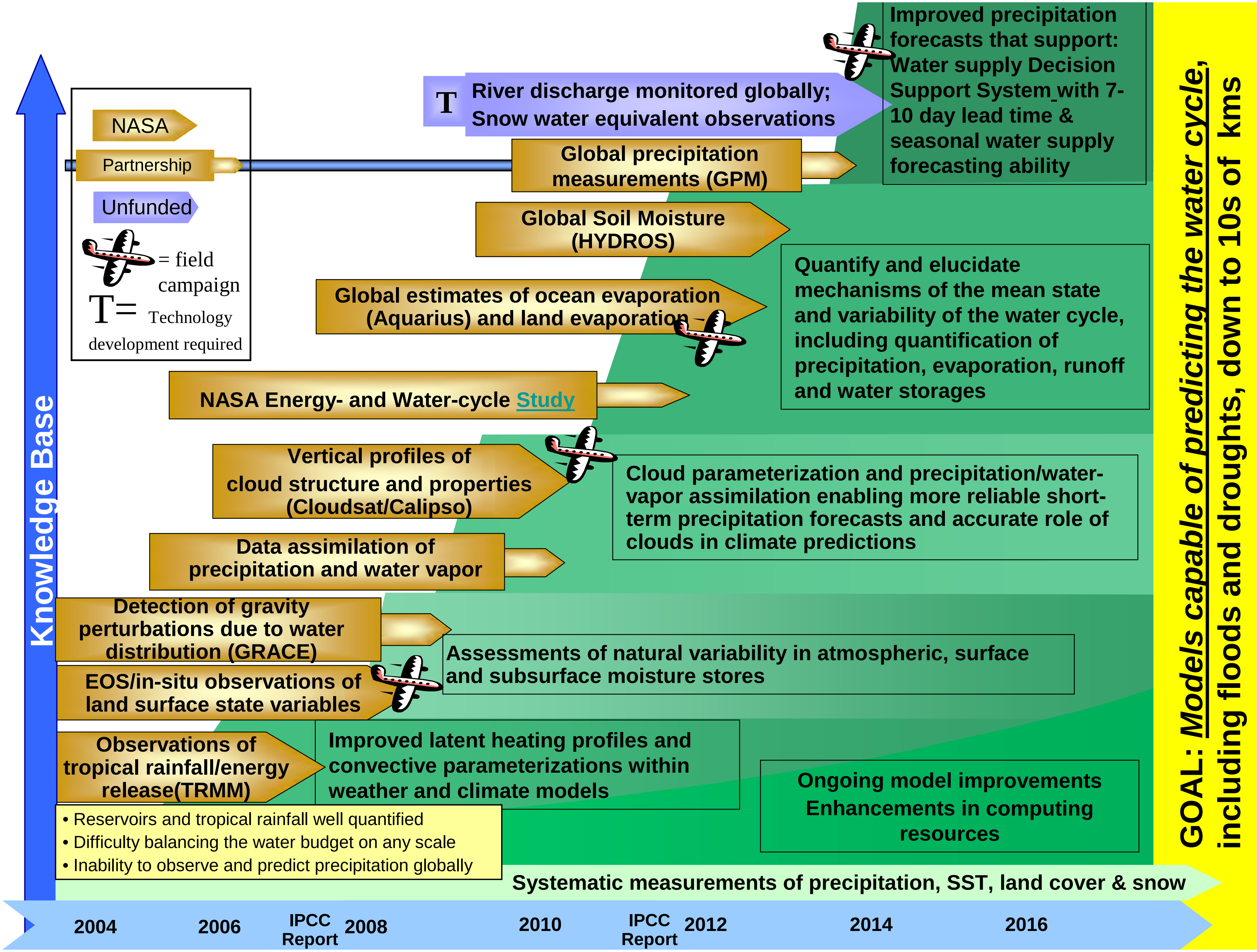
- Jerry Webb (HQUSACE)
  - New business model (2012)
    - One Headquarters (Washington and the Divisions)
    - Regional Business Centers
    - Regional Integration Teams
    - Communities of Practice
  - Corps requires future capability to carry out long term analyses in addition to day to day and seasonal operations and water management
  - Risk and uncertainty and other aspects of climate impacts must be included under the CWMS Modernization
- Harry Kitch (HQUSACE)
  - Project planning process
  - Introduction of performance management concepts into water management projects
  - Improved guidance for planners is required to respond to significant water challenges that appear to be climate driven
    - Devil's Lake
    - Colorado River water allocation
  - We need to better justify federal investments for long term uncertainties

Key Presenters

- Gene Stakiv (IWR):
  - Corps involvement in International Panel on Climate Change
    - Adaptation/adaptive management (no regrets)
    - Autonomous adaptation (cumulative, ad hoc tactical adjustments)
    - Plan new investments with a capability for capacity expansion
    - Operate existing structures/systems for optimal use
    - Modifying processes and demands
  - Perceives big gap between the science community doing global circulation modeling and the Corps water manager
- Rolf Olsen (IWR):
  - Upper Mississippi River Flow Frequency Study to update 100 yr floodplain
    - Examined the climate induced flow variability and flow frequency change on the Upper Miss and Missouri Rivers
    - Not enough compelling evidence to deviate from current guidance in Bulletin 17 B
  - Middle Mississippi River study on climate impacts and inland navigation
    - Climate variability was found to affect flood frequency with or without anthropogenic change.

Other Agencies

- Dr. Jared Entin – NASA Water and Energy Cycle Missions
- Dr. Don Cline – NWS National Operational Hydrologic Remote Sensing Center (NOHRSC)
- Dr. Ed O'Lenic – NOAA Climate Prediction Center / NCEP
- Dr. Tom Huntington – USGS Augusta ME
- Dr. Dan Cayan - Scripps

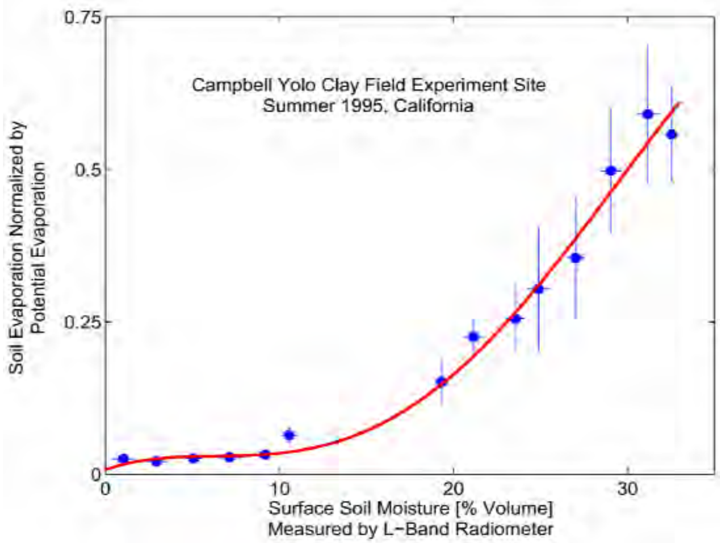


Knowledge Base
NASA
Partnership
Unfunded
= field campaign
T= Technology development required
T
River discharge monitored globally; Snow water equivalent observations
Improved precipitation forecasts that support: Water supply Decision Support System with 7-10 day lead time & seasonal water supply forecasting ability
Global precipitation measurements (GPM)
Global Soil Moisture (HYDROS)
Global estimates of ocean evaporation (Aquarius) and land evaporation
Quantify and elucidate mechanisms of the mean state and variability of the water cycle, including quantification of precipitation, evaporation, runoff and water storages
NASA Energy- and Water-cycle Study
Vertical profiles of cloud structure and properties (Cloudsat/Calipso)
Cloud parameterization and precipitation/water-vapor assimilation enabling more reliable short-term precipitation forecasts and accurate role of clouds in climate predictions
Data assimilation of precipitation and water vapor
Detection of gravity perturbations due to water distribution (GRACE)
Assessments of natural variability in atmospheric, surface and subsurface moisture stores
EOS/in-situ observations of land surface state variables
Observations of tropical rainfall/energy release(TRMM)
Improved latent heating profiles and convective parameterizations within weather and climate models
Ongoing model improvements Enhancements in computing resources
• Reservoirs and tropical rainfall well quantified
• Difficulty balancing the water budget on any scale
• Inability to observe and predict precipitation globally
Systematic measurements of precipitation, SST, land cover & snow
2004
2006
IPCC Report
2008
2010
IPCC Report
2012
2014
2016
GOAL: Models capable of predicting the water cycle, including floods and droughts, down to 10s of kms

Soil Moisture - HYDROS

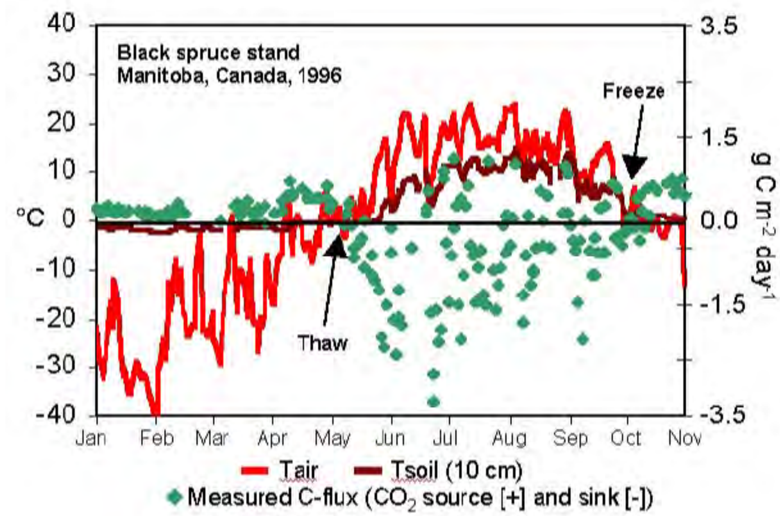
Soil Moisture a critical omission in observations suite (NASA, NOAA, USDA)

Water Cycle



Soil Moisture Strongly Influences Evaporation Rate and thus the Water and Energy Exchanges between Land & Atm.

Carbon Cycle



Freeze/Thaw Condition Influences Growing Season Length and thus the Carbon Balance.

Addresses Priority Soil Moisture Data Requirements Across Agencies

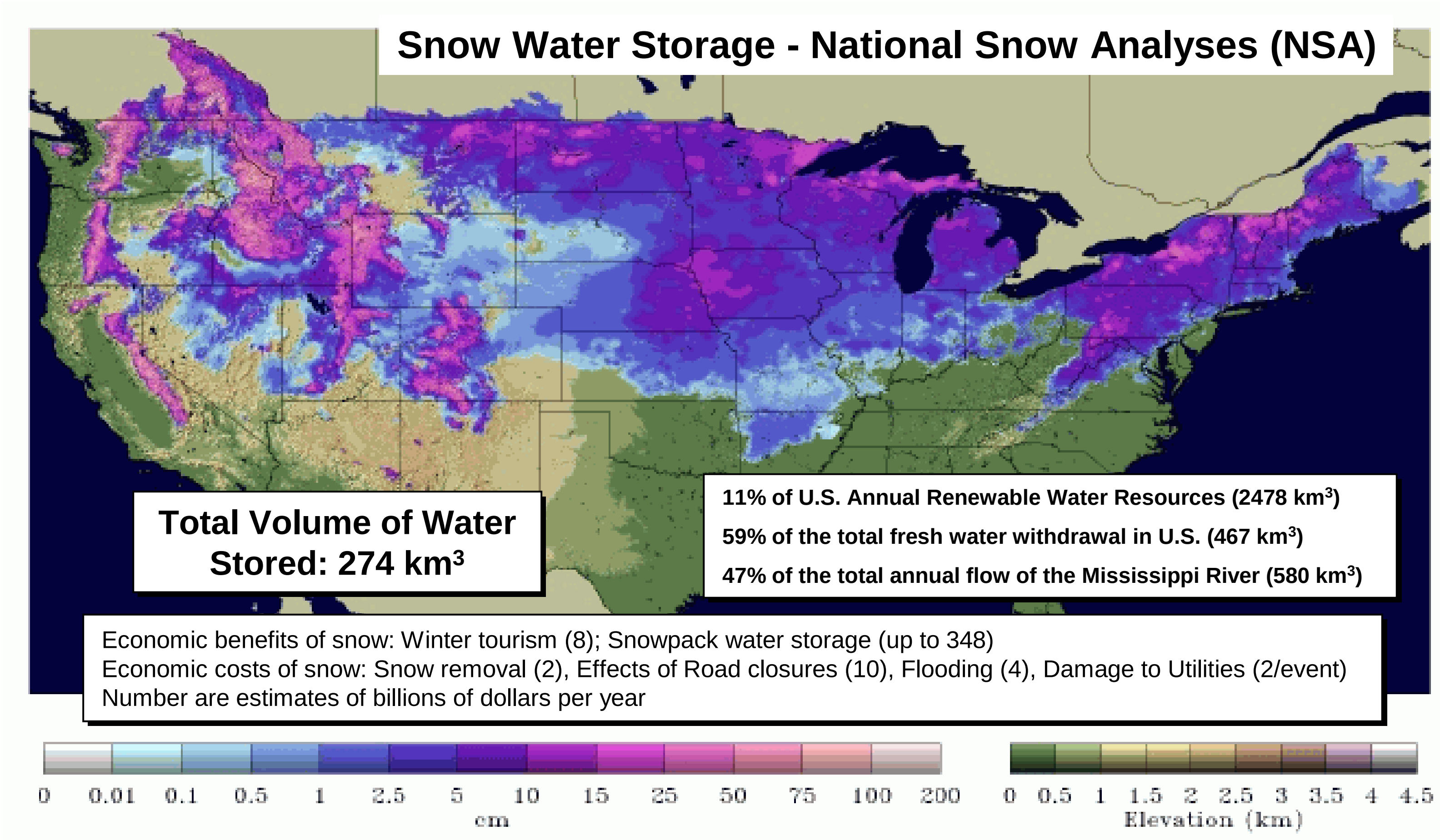
NASA: Monitor Process - Global Water, Energy, and Carbon Cycles

NOAA: Improve Weather and Climate Predictions: Flood and Drought

DoD: Applications in All Three Services (e.g. Terrain trafficability, Fog)

USDA: Agricultural Management, Drought Impact Mitigation

Snow – Liquid Water Equivalent



Preliminary information from "The Value of Snow and Snow Information Services" – Office of the chief economist (NOAA, 2004)

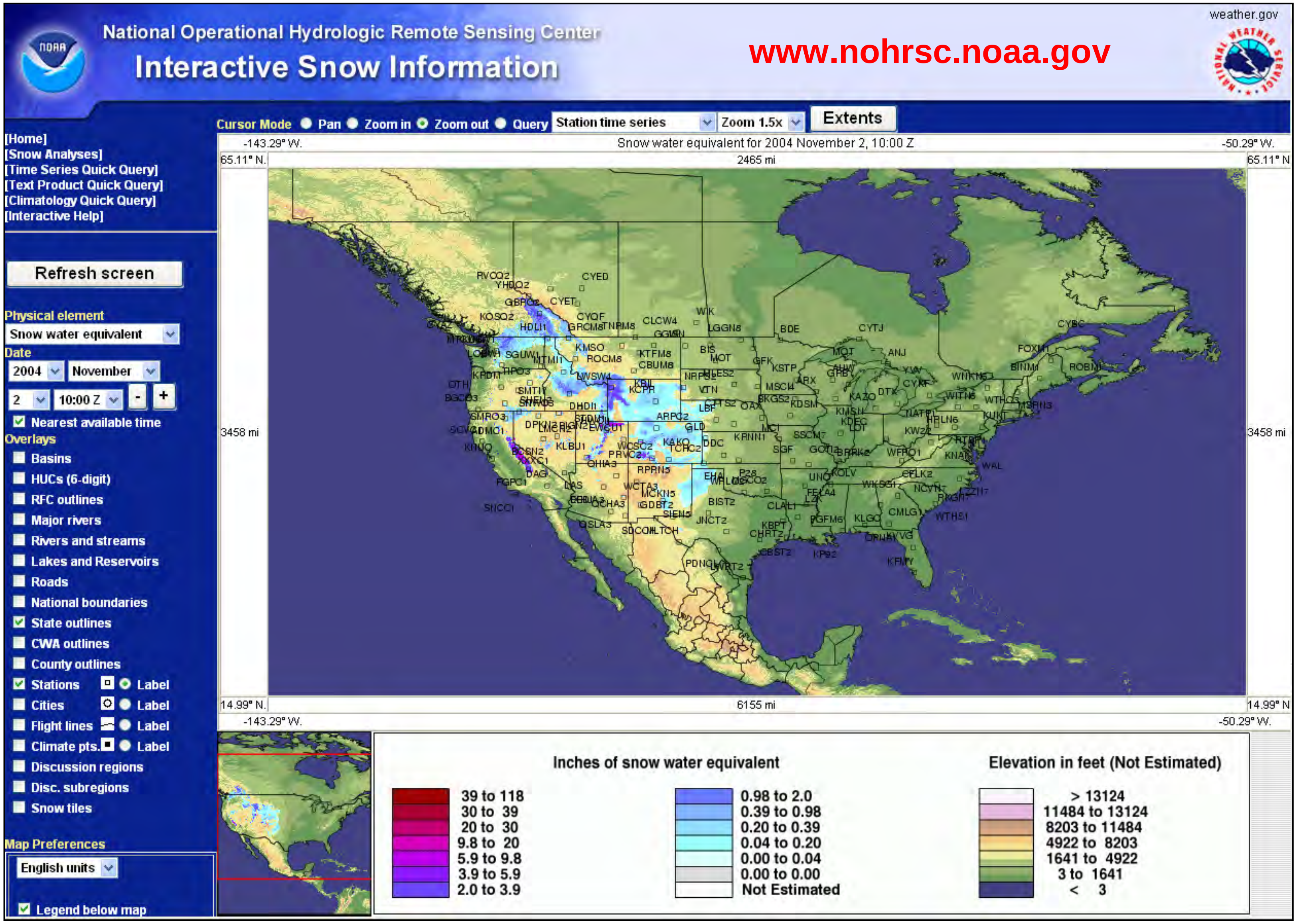
"..improved snow information and services have potential benefits greater than \$1.3 billion annually." "…investments that make only modest improvements in snow information will have substantial economic payoffs."

NOHRSC Products

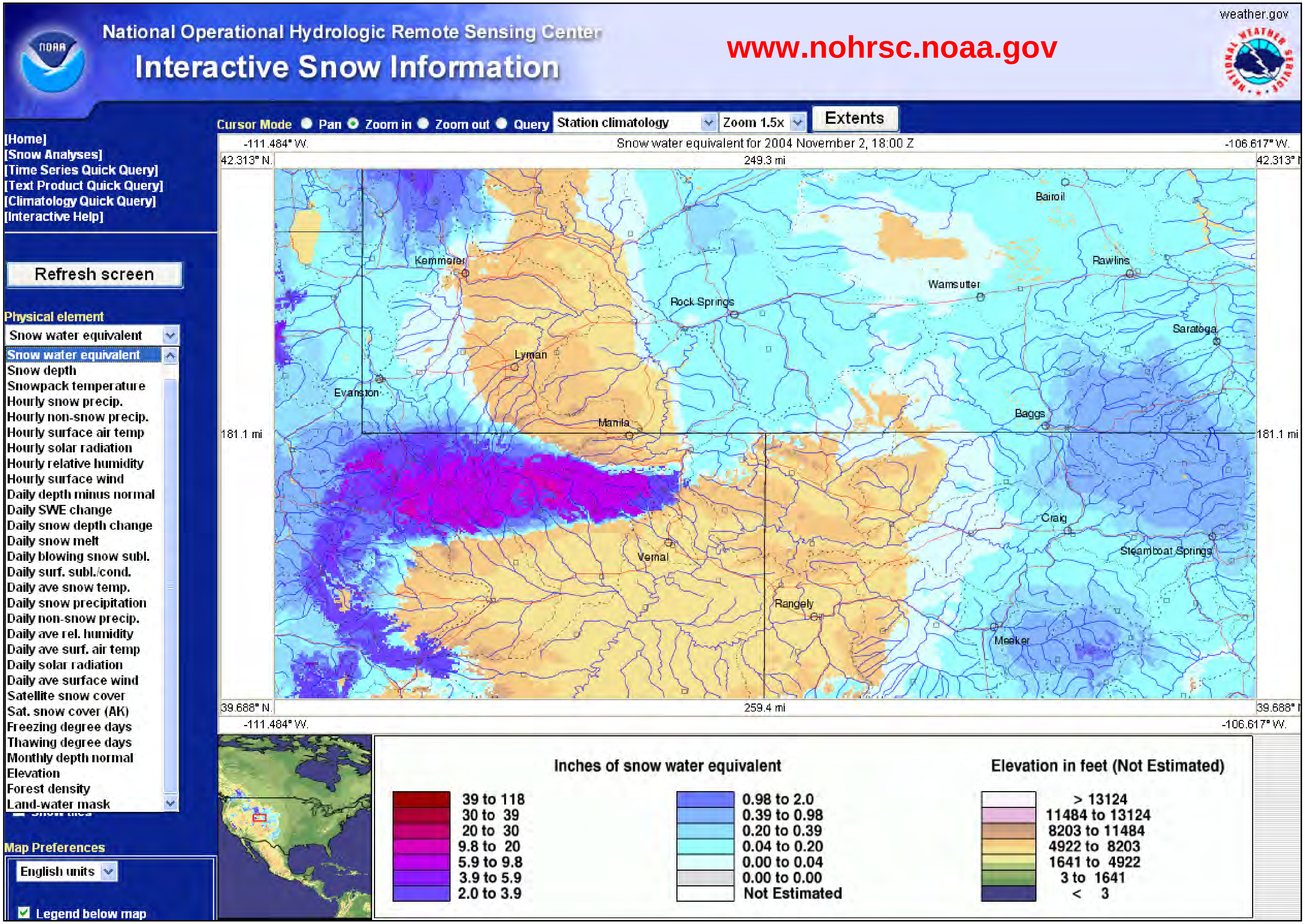
- National Snow Analyses (NSA)
  - **Snow modeling and data assimilation system for U.S.**
    - **Overview of the data, modeling framework and products**
- Interactive Snow Information System (Snow-Info)
  - **Web-based mapping and data querying system for NSA information**
    - **Overview of functions and capability**
- New Climate Diagnostic Tools in Snow-Info
  - **Monthly normal snow-depth maps for U.S.**
  - **Daily departure-from-normal snow-depth maps for U.S.**
  - **Snow-depth climatology and NSA time-series for 4000 stations**

www.nohrsc.noaa.gov

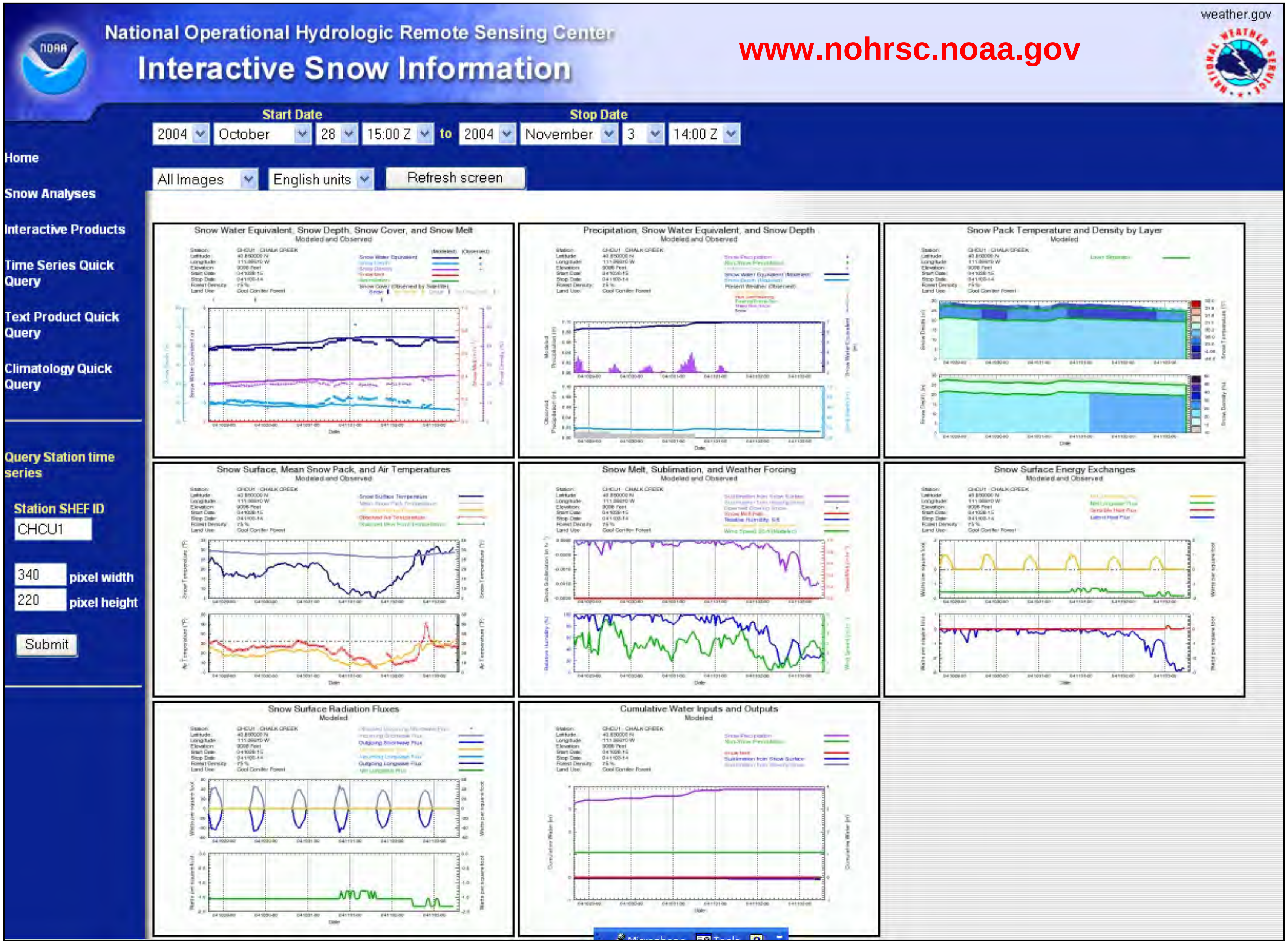
Interactive Snow Information System



Interactive Snow Information System



Interactive Snow Information System

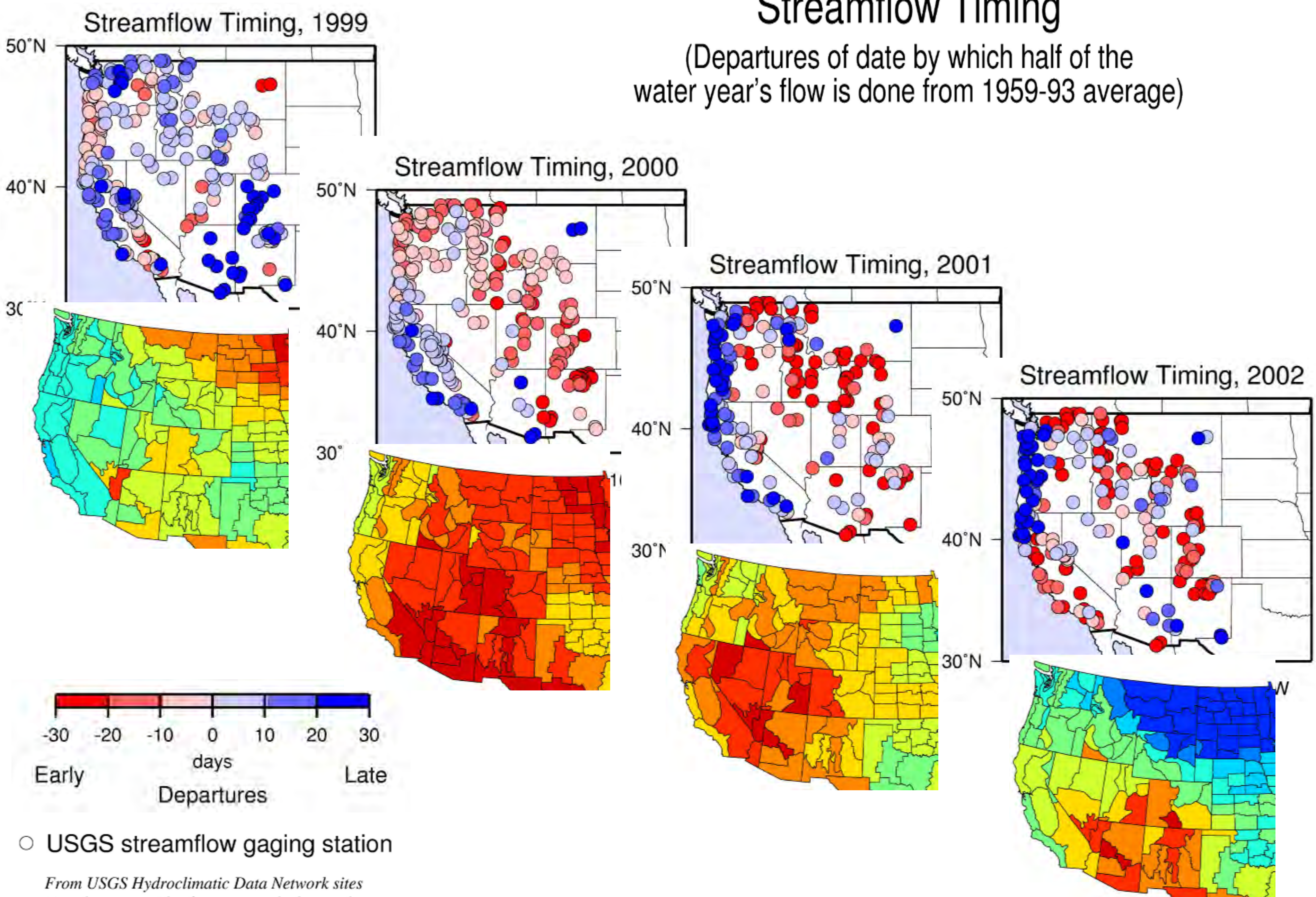


Huntington (USGS): Summary of Ongoing Hydrologic Changes

- **New England**
  - Advances in timing of lake and river ice-out
  - Decreases in number of days that ice affects flow
  - Advances in timing of snowmelt-dominated high spring flow
  - Decreases in river ice thickness
  - Decreases in the ratio of snow-to-total precipitation
  - No change in summer low flow
- **Northern Hemisphere (20th Century)**
  - Decreases in snow cover extent
  - Increases in precipitation
  - Increases in stream flow
  - Intensification of the Global Hydrologic Cycle

Streamflow Timing

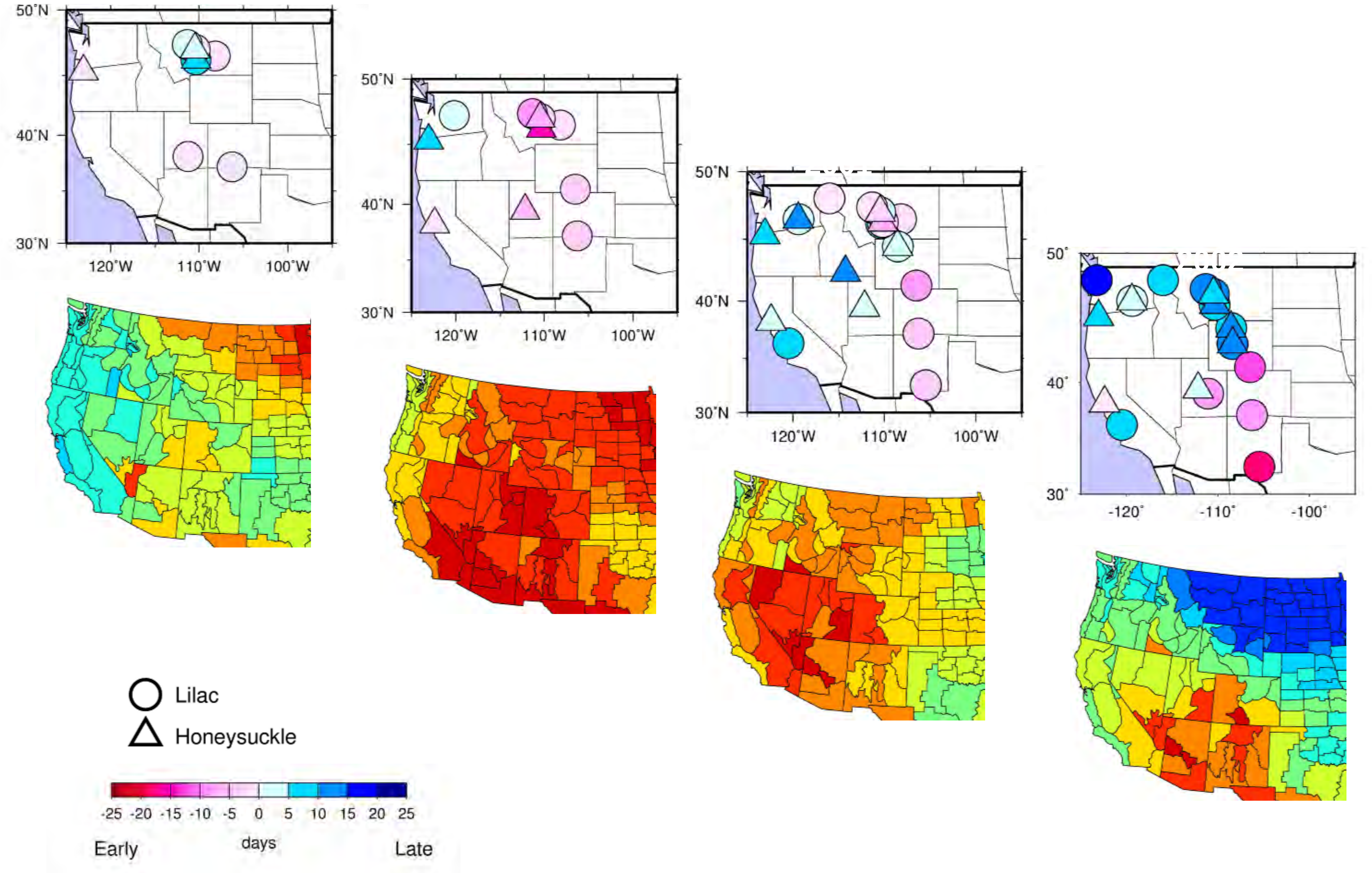
(Departures of date by which half of the water year's flow is done from 1959-93 average)



From USGS Hydroclimatic Data Network sites
Based on centroids of water-year hydrographs
Calculated by Dr. M. Dettinger and Dr. D. Cayan
California Applications Program 2/20/2002

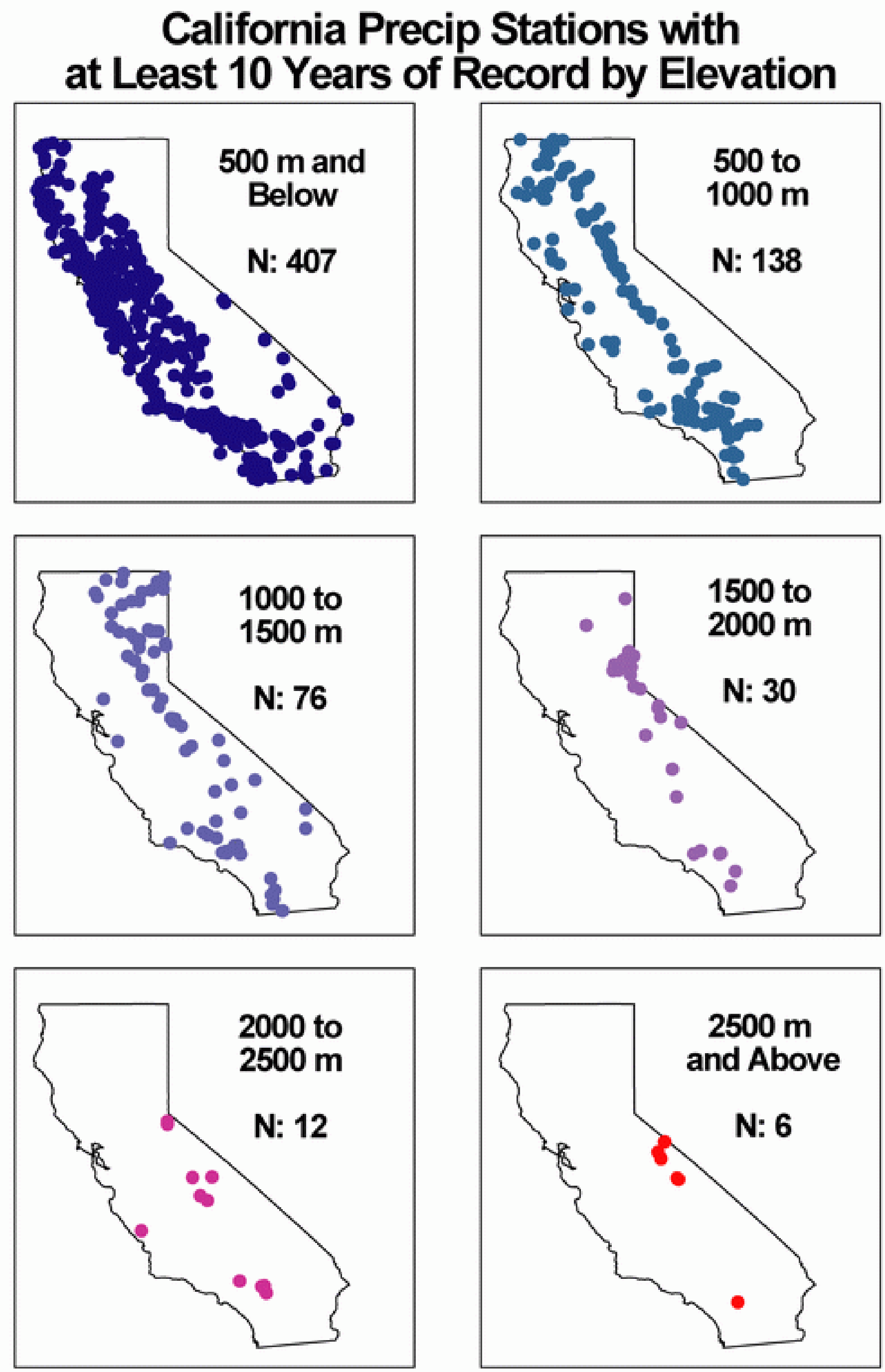
Lilac/Honeysuckle Phenology

(departures from 1983-1994 average phenological stage data)



Cayan: Summary

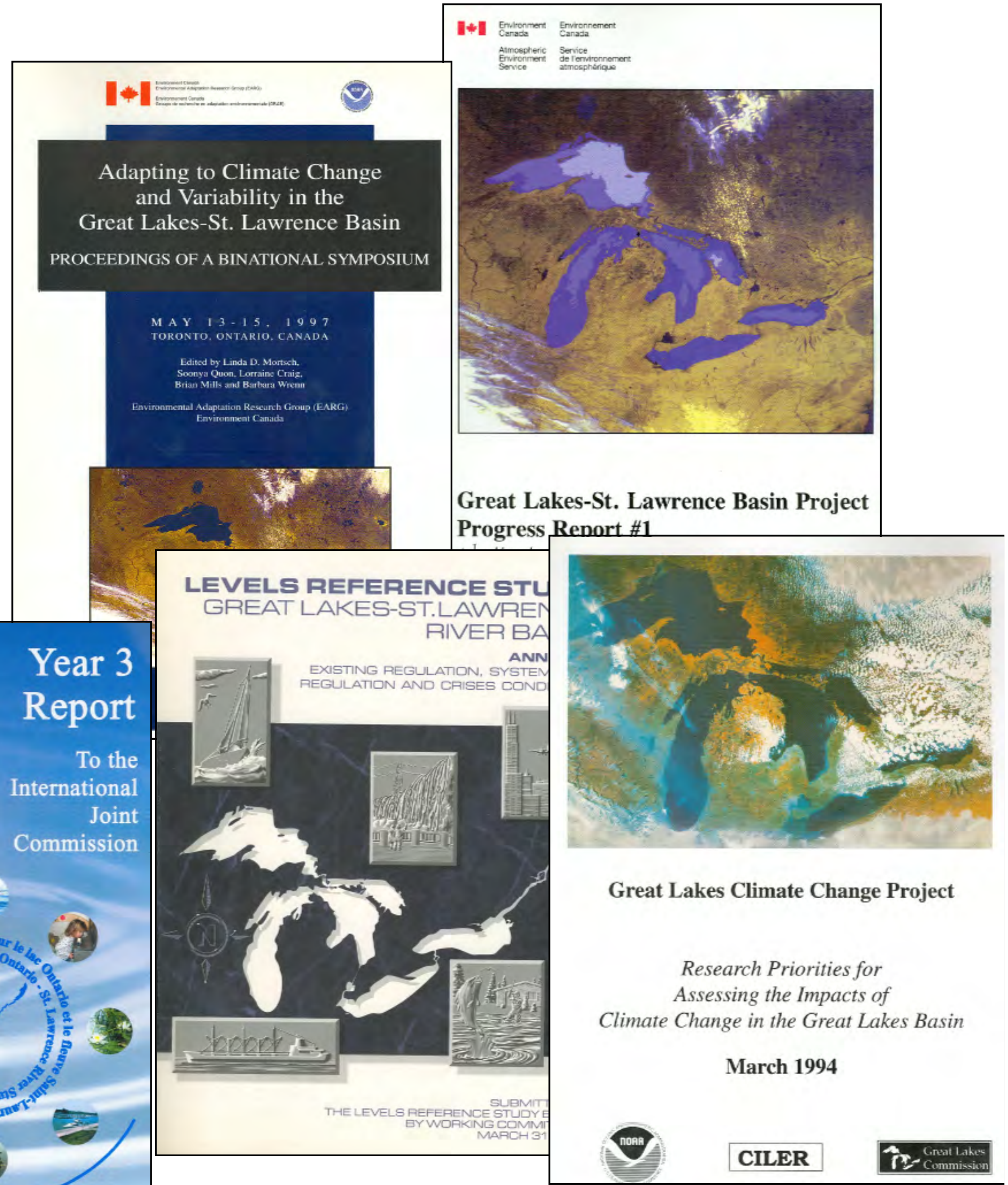
- **Rain vs. snow is crucial to water issues in the West**
- **In CA Sierra Nevada, only 20-30 days deliver most of the year's water**
- **Timing of spring runoff 1-3 wks earlier in decades after 1977**
- **Not only early snowmelt but more immediate rainfall runoff occurred**
- **Trends have been a response to warming trends (not Δ precipitation)**
- **Need more & better monitoring at mid-high elevations**
  - **Most precipitation gauges are sited in low elevation population centers**
  - **Most concern is for climate in mid-high elevations**



USACE Experiences

- **John Kangas – LRD Great Lakes**
- **Stephen Brooks – SWF Texas Water Challenges**
- **Bob Collins – SPK Variability in Snow Affecting Reservoir Operations**
- **John Heitstuman – NWW Winter Rainfall on Frozen Ground**
- **Joan Pope – Coastal**
- **Steve Daly – R&D**

- **Extensive studies on the Great Lakes basins**
  - **excellent data base**
  - **show that climate variability was more significant than long term climate change**
- **Flexible policy that allows more rapid response to water regime variability is needed**



Brooks: Texas Water Challenges

- Need for Future Water Supply
  - Population Projections
  - Water Demand/Supply Projections
  - Texas Senate Bill 1
  - Texas Water Plan – 2002
- Corps of Engineers Support for Texas Water Plan
  - Texas Water Allocation Assessment
- Current Watershed Studies
- Urban River Restoration

Need for Future Water Supply

- Texas Senate Bill 1
  - Passed by 75th Texas Legislature in 1997
  - Established 16 regional water planning groups (RWPG)
  - Required development of water management strategies to meet projected regional shortages
  - Required update to regional water plans on 5-Year cycle
  - Initial regional water plans submitted January 2001
  - Texas Water Plan Adopted January 2002

USACE Support for Texas Water Plan

- **Texas Water Allocation Assessment (TWAA) Initiatives:**
  - Review of 16 Regional Water Plans
  - Brush Management Study
  - Brush Management - Phase II
  - Review of COE Water Supply Authorities
  - System Assessment of Corps Reservoirs – Sulphur Basin
  - Instream Flow Analyses – Brazos and Sulphur Basins
  - GIS-Based Decision Support System
  - Texoma Partial Reallocation Study
  - Rural Issues Study
  - Prioritization of Candidate Watersheds for Ecosystem Restoration

Collins Summary:

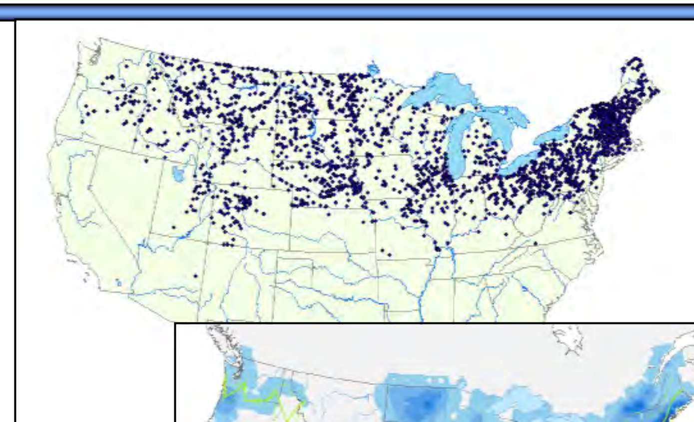
- Climate change is causing spring snowmelt to come earlier in the Central Valley
- Capturing spring snowmelt runoff without increasing flood risk requires us to be “smarter” water managers
- One possible adaptive management solution is to create more flexibility in water control diagrams by incorporating forecast information
- This strategy is currently being studied under the Folsom Dam Modifications Project
- This project could be an example that other Corps reservoirs follow in the future

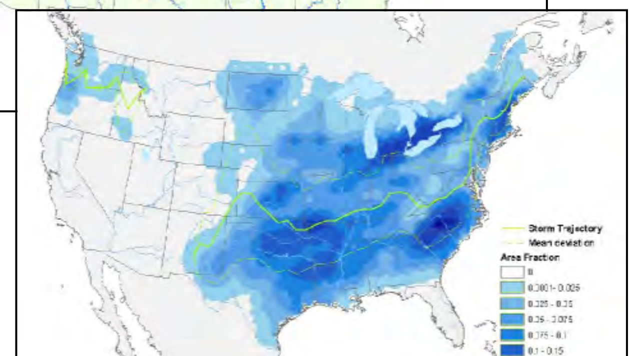
Heitstuman Summary:

- Recent major NWW floods occur due to rain on frozen ground
- Flood characteristics
  - Short duration (7-10 days)
  - Nearly impervious floodplains
  - In many cases, higher elevation snowpack will show increased SWE after event, setting the stage for a subsequent flood on highly saturated or refrozen ground
- Generally generate > 2% chance annual flood, often the flood of record

Daly – ERDC Climate Studies (Mil & CW)

- **Climate statistics**
  - Impacts from climate variation and indices, precipitation, ice jams and severe storms
- **Climate modeling and impacts**
  - Ice and atmosphere physics in models for the IPCC
  - Modeled trends in climate, ice, precip and evaporation
- **Polar studies**
  - Arctic ice, permafrost, and glaciers shrinking
  - Changes in temps, snow, and vegetation
  - Changes monitored on land and by satellites





US Army Corps
of Engineers

Summary of Workshop Observations

- **Warming is accelerating and will continue**
- **While specific areas are responding differently, weather is becoming more energetic and more variable**
- **Climate is one of multiple forces that are shaping the future of water resource management**
- **Both variability and long term change are of concern**
- **Temporal and spatial mismatches of supply and demand that is the problem in water supply**

Workshop Breakout Sessions

1. What aspects of climate variability are really significant to water resources management and the Corps of Engineers mission?
2. How do these important issues relate to the Civil Works Strategic goals and objectives?
3. How can the emerging knowledge and tools concerning climate change and variability be incorporated into the Corps water management business practices to assist in mission execution?
4. What are the next steps for the Corps to accomplish more effective water management in an environment of climate variability and change?

Workshop Recommendations

- Increase awareness of knowledge and capabilities concerning climate impacts and climate forecasting
- Establish alliances with individuals and organizations that have expertise to assist water managers
- Develop a Community of Practice to systematically and effectively incorporate climate in water resources planning and analysis (tonight)
- Conduct demonstration projects between the Corps R&D community and Districts to co-develop strategies that lead to more effective short and long term management of climate impacts in concert with the philosophy of holistic, watershed scale, systems approach to water resources management

Corps Workshop on Climate Impacts

(November 2004, Baltimore)

- **Water resource mangers are faced with increasingly complex issues**
  - climate dynamics
  - changes in supply and demand
  - other processes of globalization
- **These issues demand a different framework for policy and practice**
  - enable the Corps to address climate change/variability as an integral component to its planning and operations functions
  - can be evolved from the current water management capabilities
  - emerging and evolving policies, coupled to real situations and decisions
- **Significant capabilities emerging that we can integrate and leverage**
  - collaboration in technology and policy development
  - alliances for planning and operations
  - continual development and evolution of a national common operating picture and strategy for water resource management