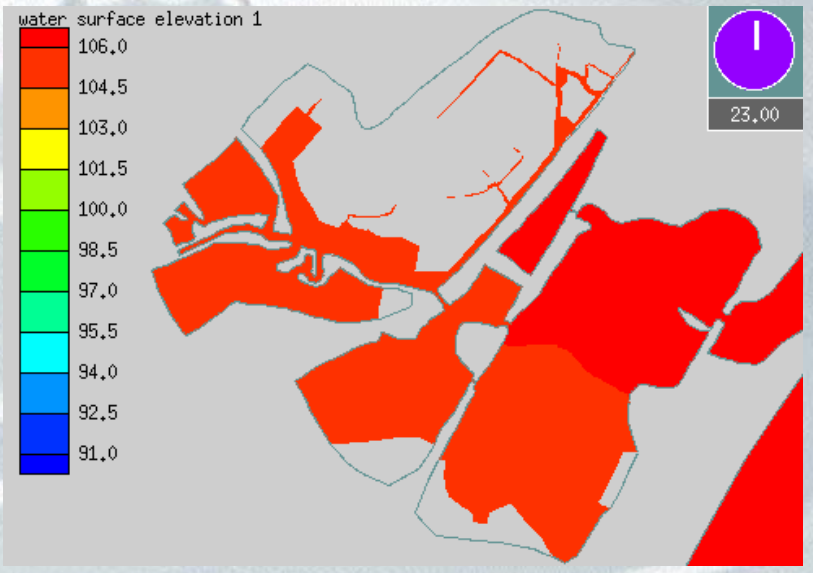
The Surface-water Modeling System (SMS)

2D Numerical Hydraulics

Alan K. Zundel Ph.D.

SMS – 2D Numerical Applications

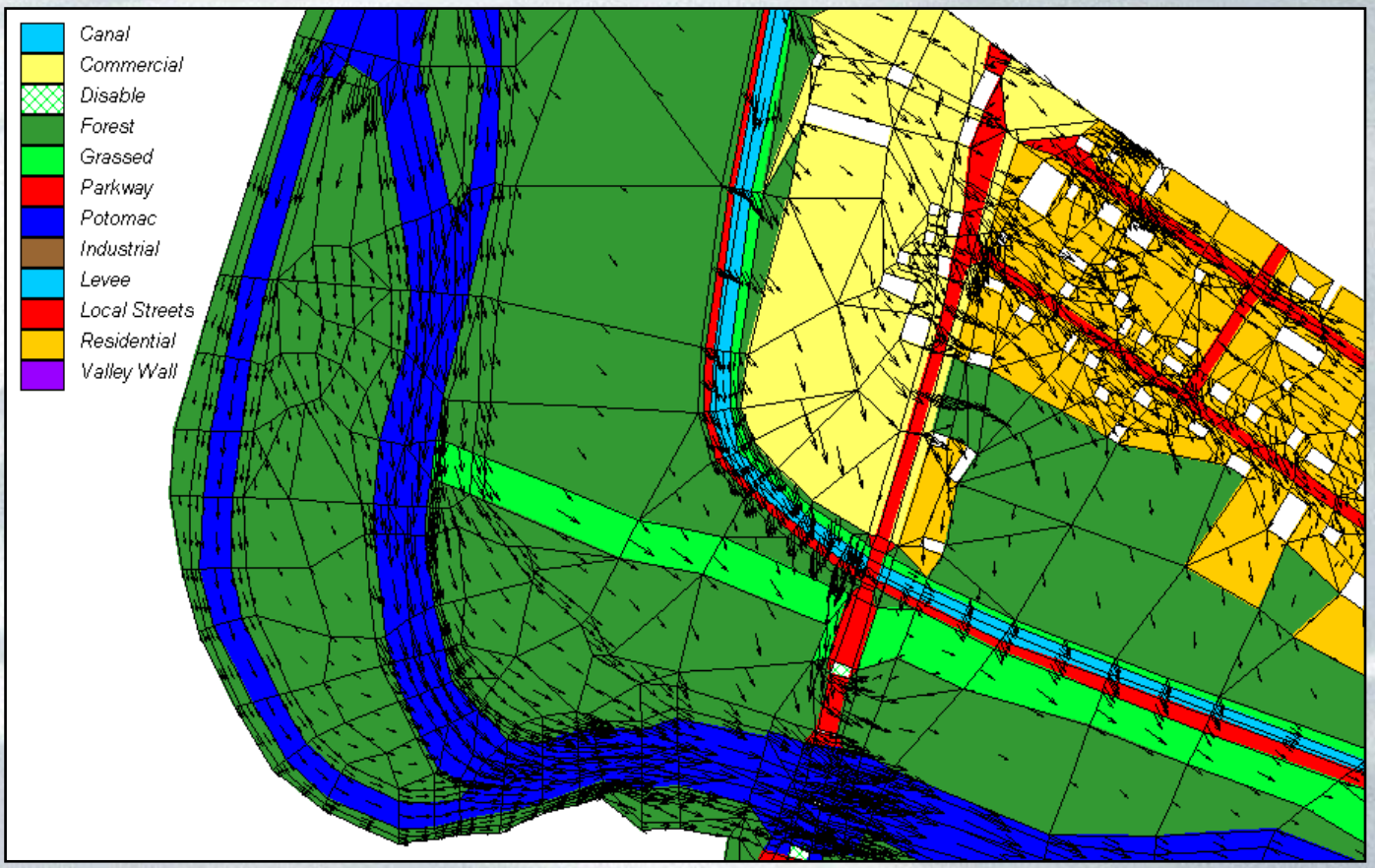
- Rivers
- Estuaries/Bays
- Coastal Zones
- Theoretical Studies



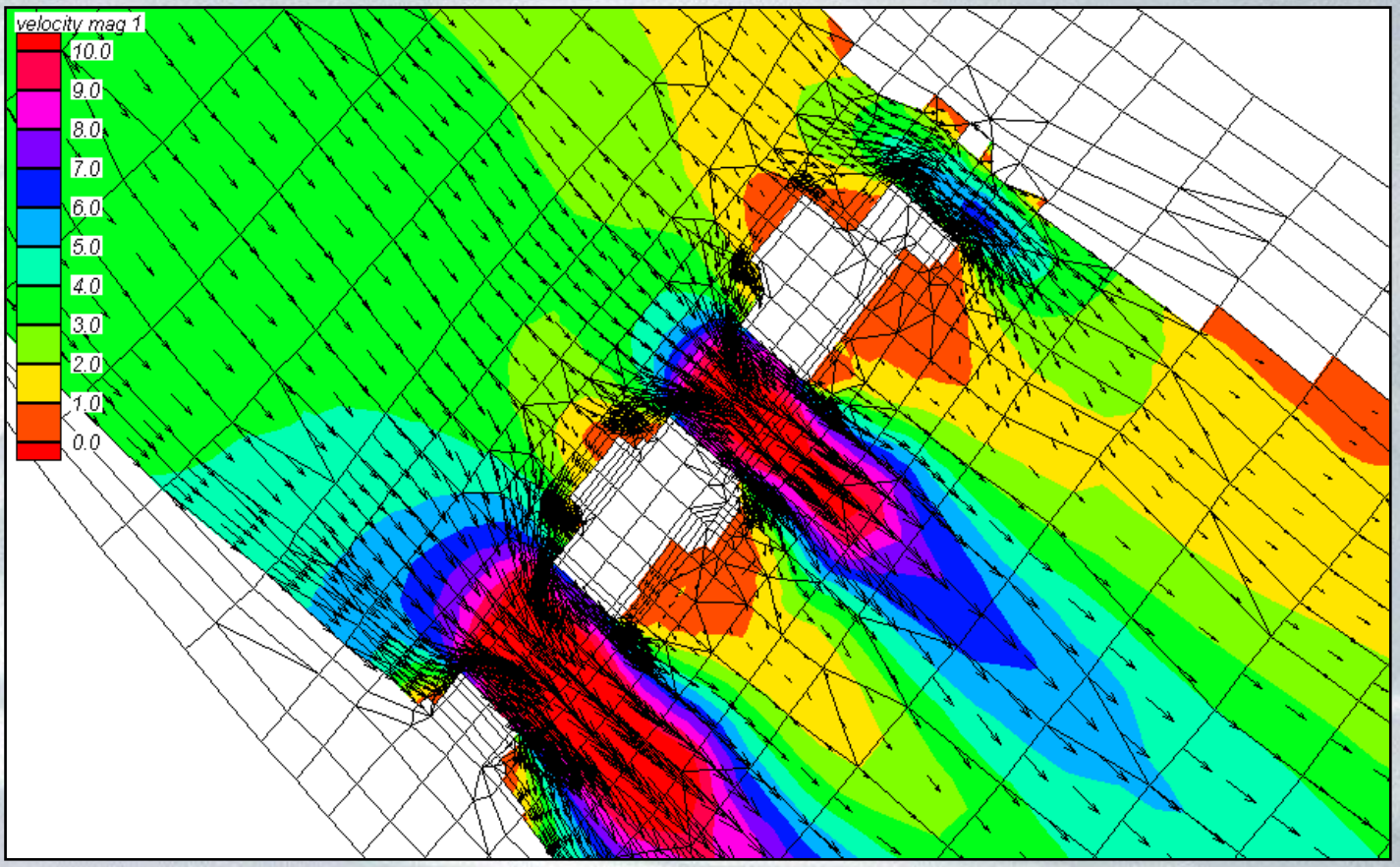
Rivers

- Flooding – Inundation studies
- Bridge Crossings
- Velocity/Scour/Sedimentation
- Flow Separations
- Navigation Studies

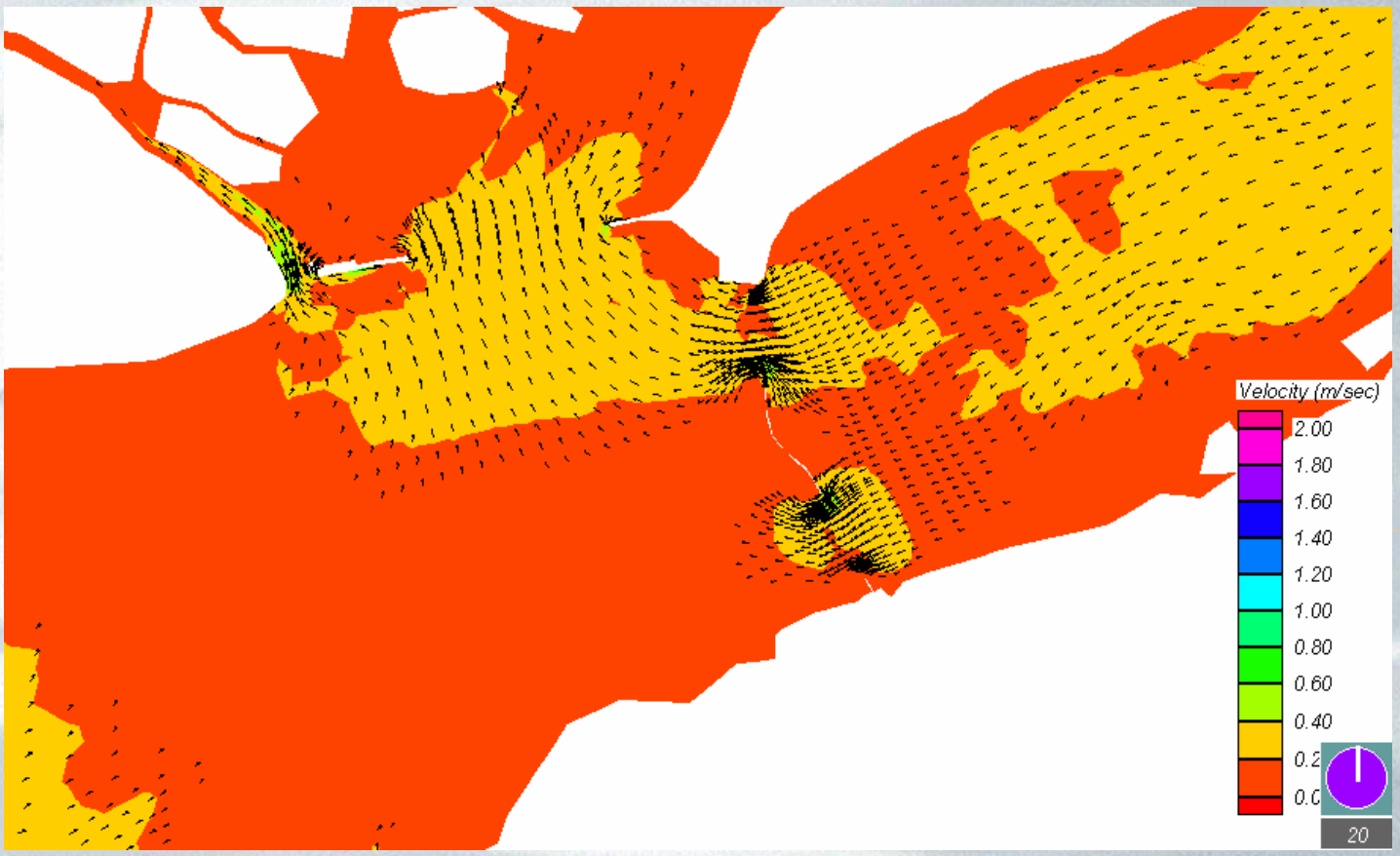
Floodplain Analysis



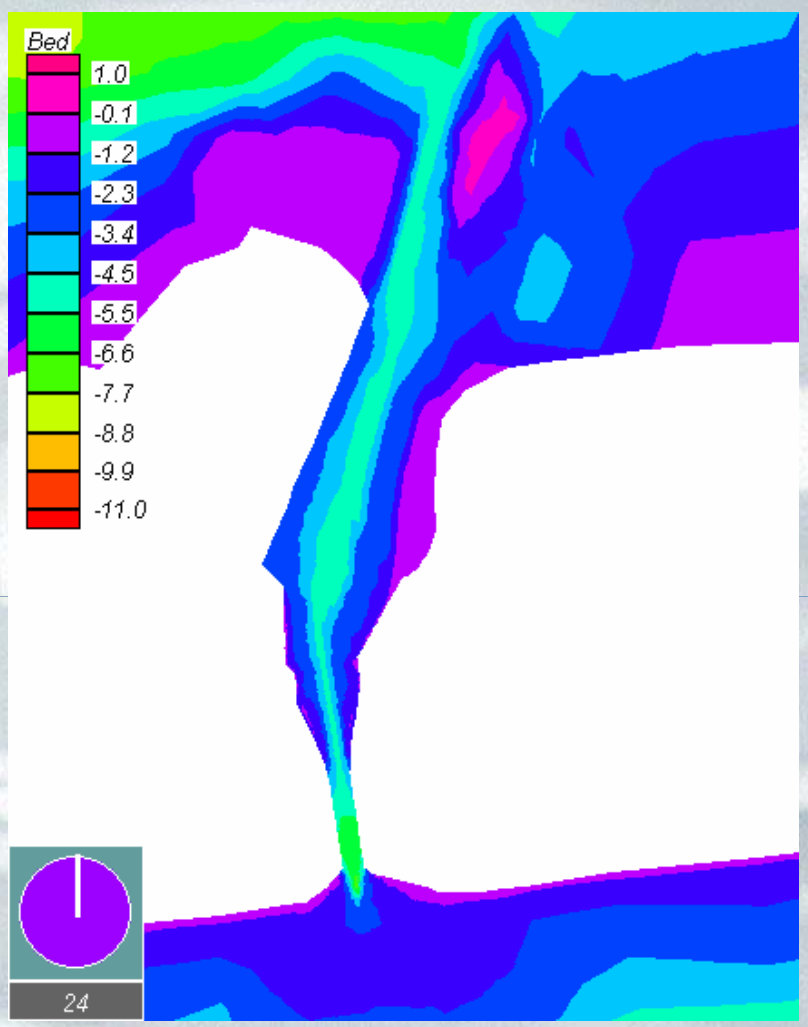
Bridge Design



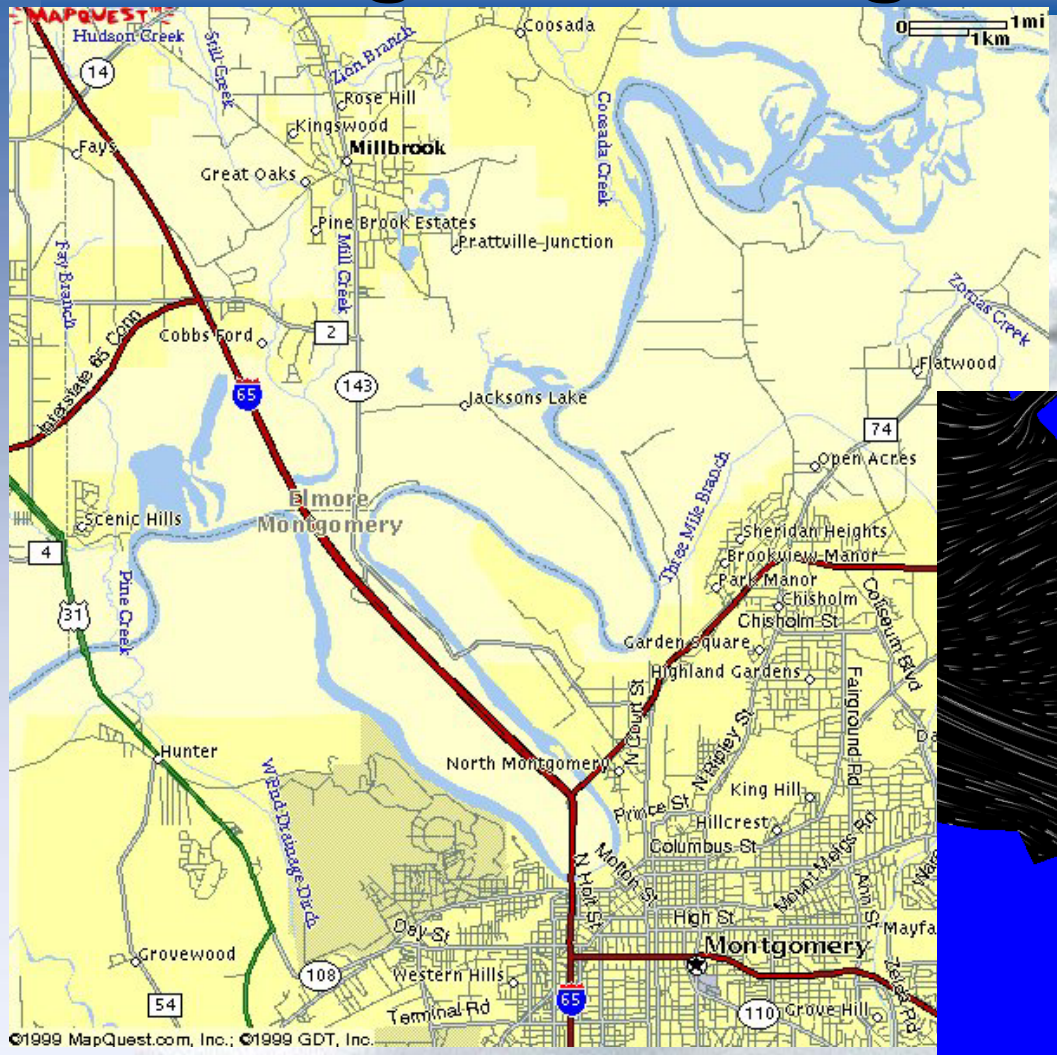
Dynamic Flow Analysis

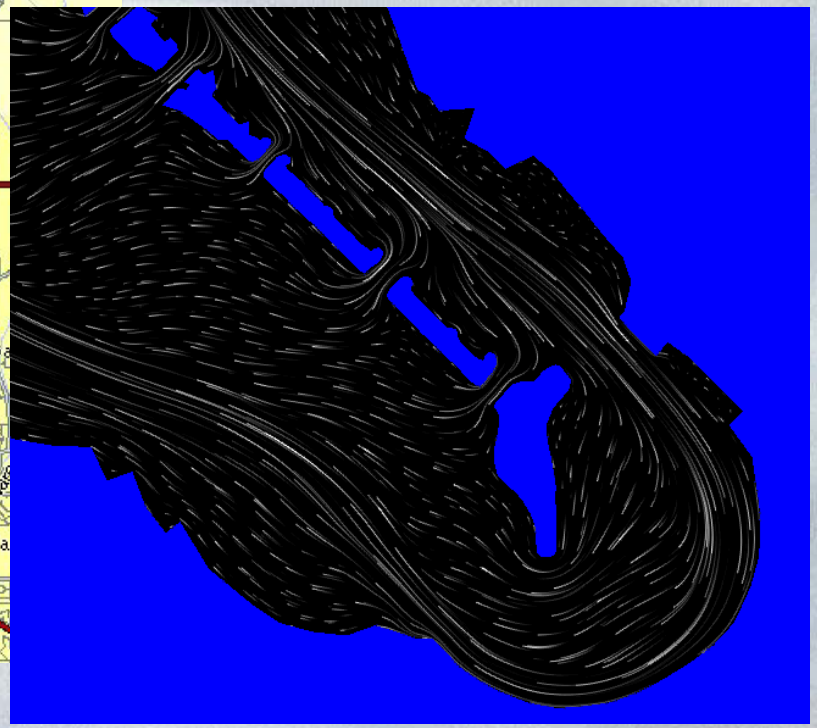


Sediment Transport



Bridge Crossings – Interstate 65





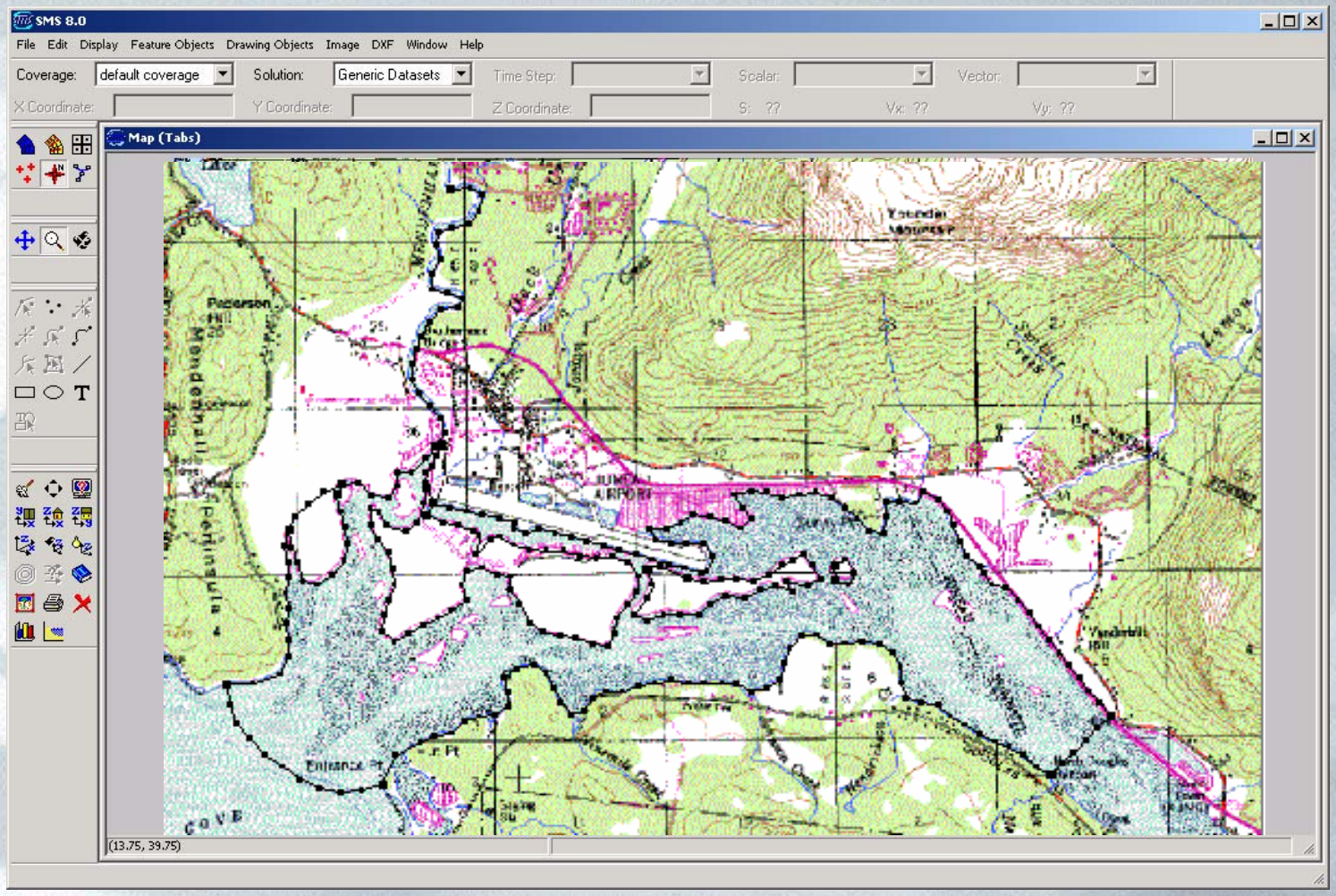
Environmental Modeling Research Laboratory, BYU

Flow Separations – Mississippi River

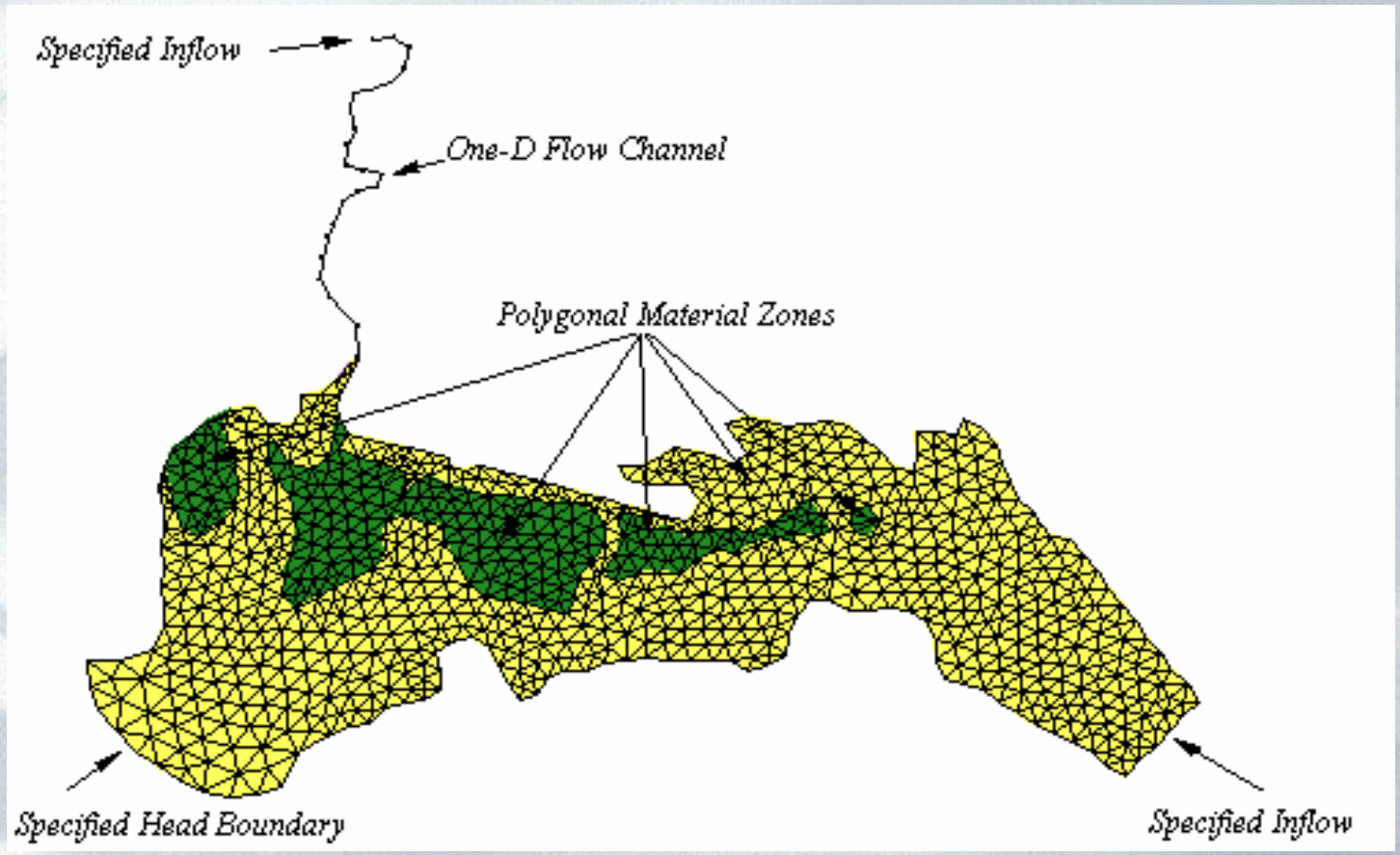
SMS Functional Modules

- Map Module
  - Background Images
  - Conceptual Model
- Scatter Point Module
  - Survey Data – Visualization and Filtering
- Mesh Module
  - Numerical Model – FESWMS/Flo2DH Data
- River Module
  - HEC-RAS Data

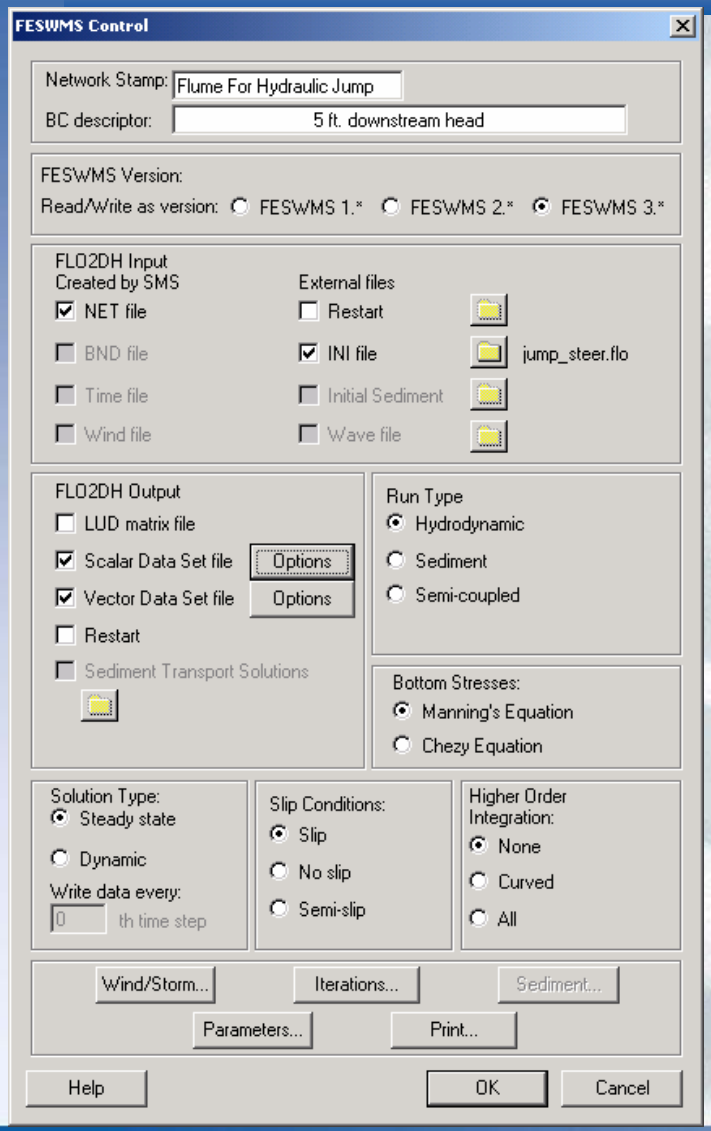
Map Module Data



Automatically Generated Mesh



Flo2DH Interface – Model Control

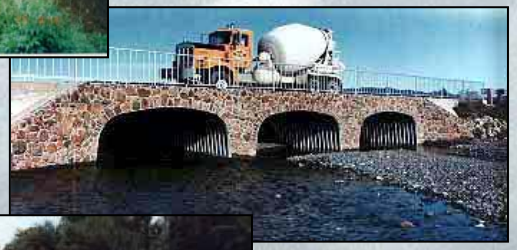


- Simulation Comments
- Version
- Hydrodynamics/Sediment
- Steady State/Dynamic
- Output Options

Hydraulic Structures

Hydraulic structures that can be modeled with 2D modeling include the following:

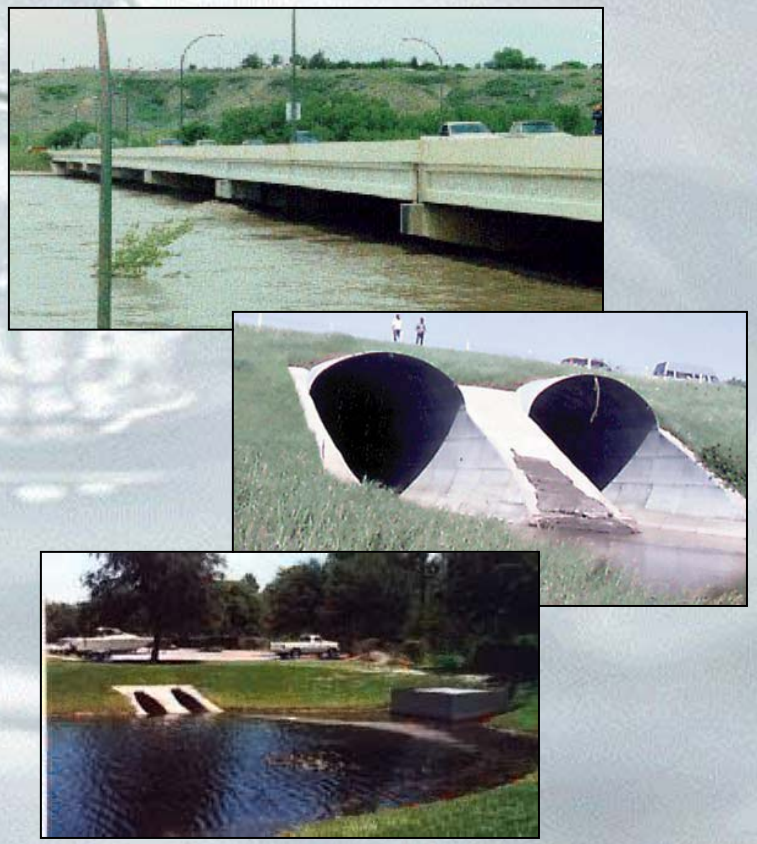
- Bridges
- Culverts
- Weirs
- Roadway embankments
- Drop-inlet spillways



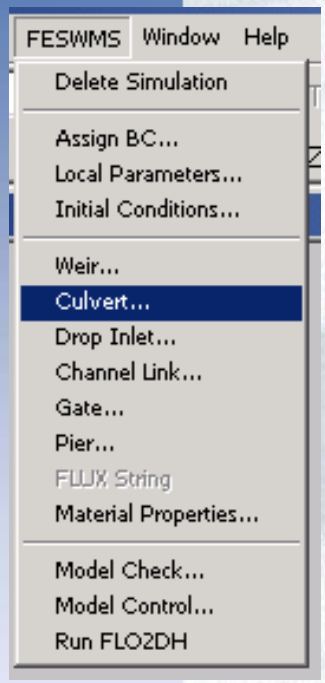
1 Dimensional Flow Control

Several types of hydraulic structures can be modeled as one-dimensional links between node points:

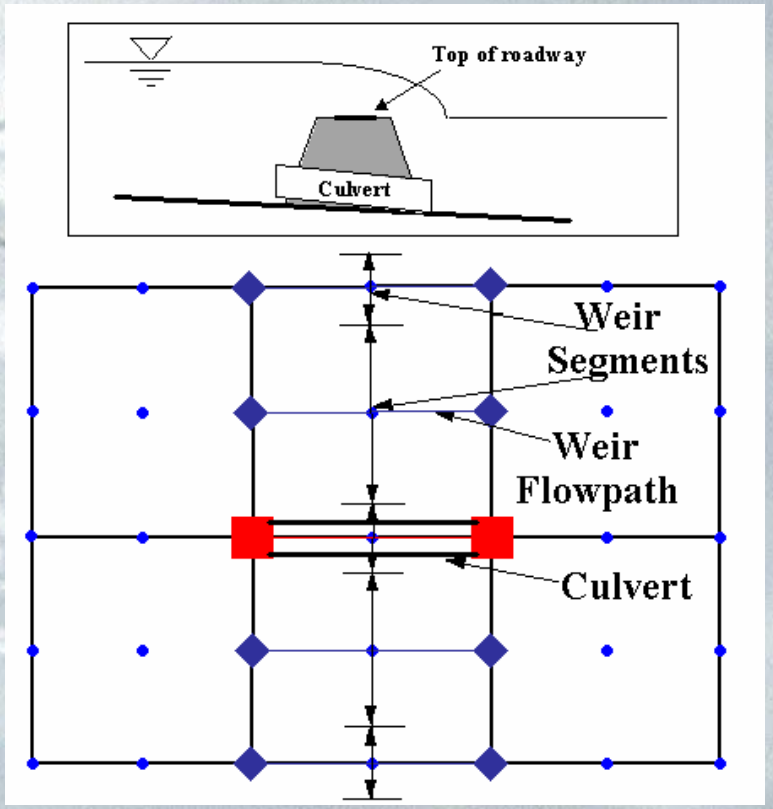
- Weirs
- Culverts
- Gates
- Channel Links
- Drop-inlet spillways



1 Dimensional Flow Control

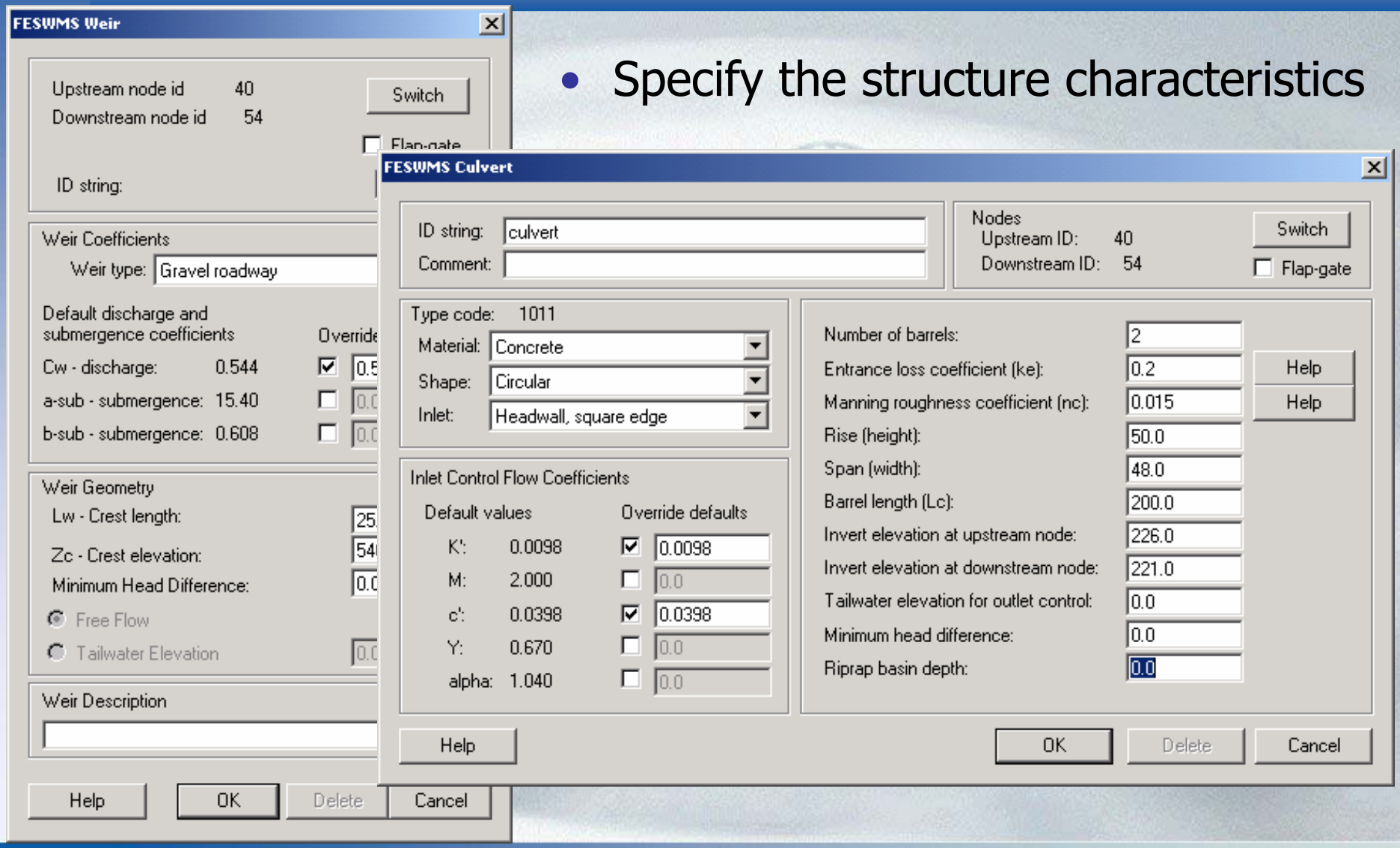


- Select the position in the network.
- Select the structure type from the menu

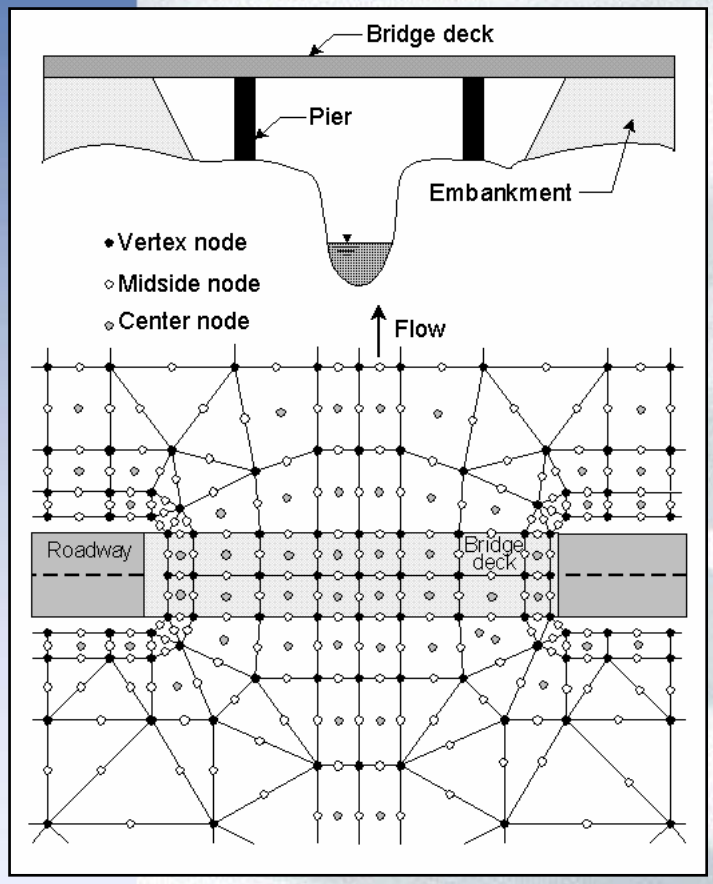


1 Dimensional Flow Control

- Specify the structure characteristics

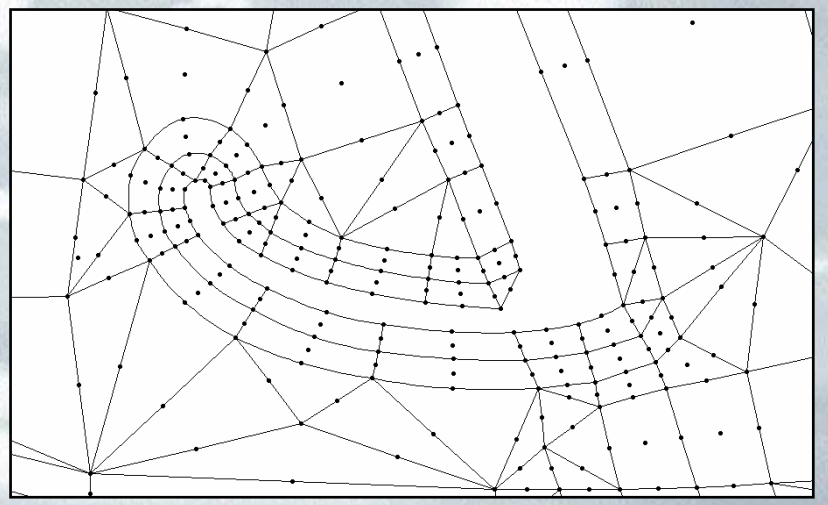


2-Dimensional Flow Control

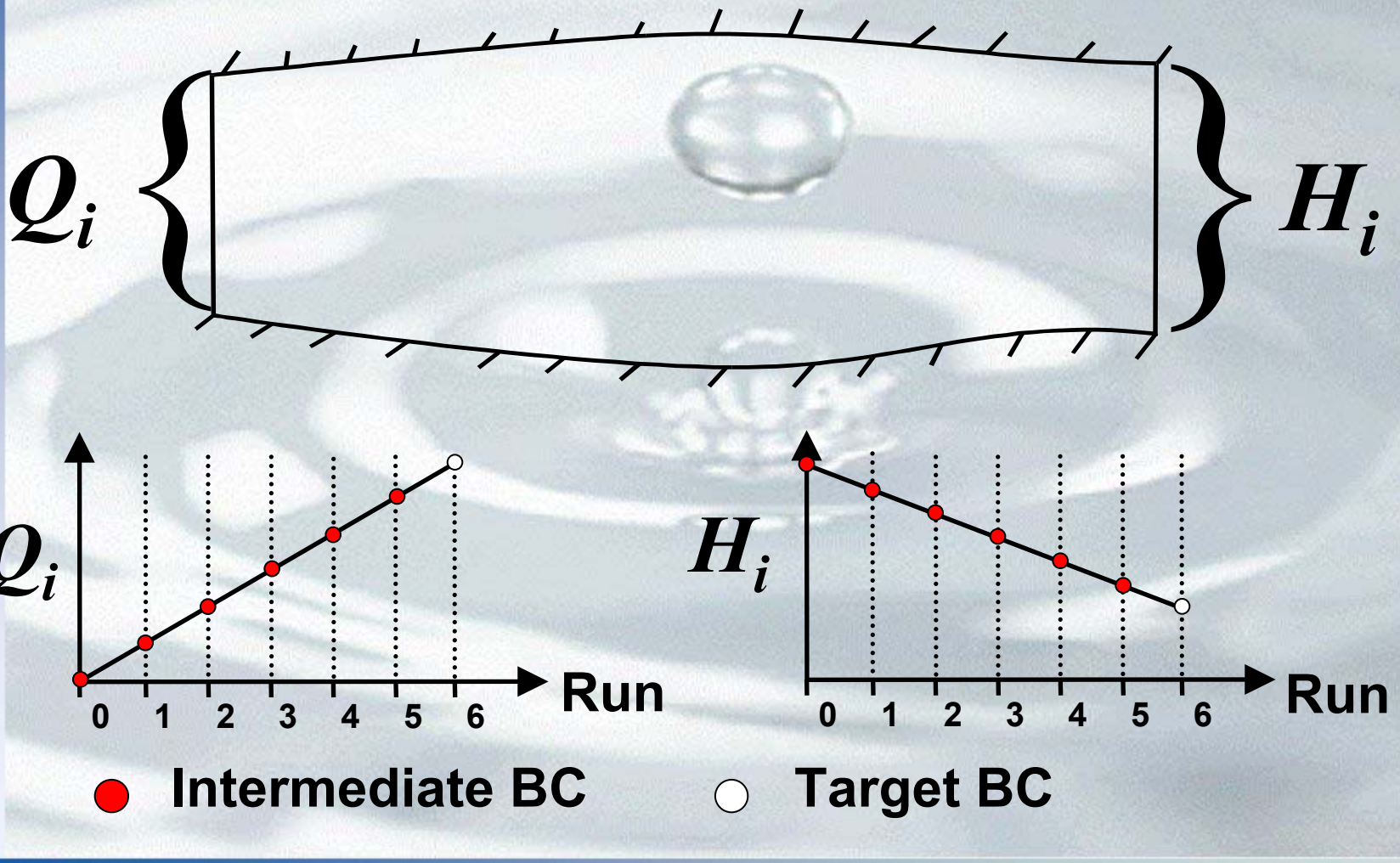


Form elements around the structure:

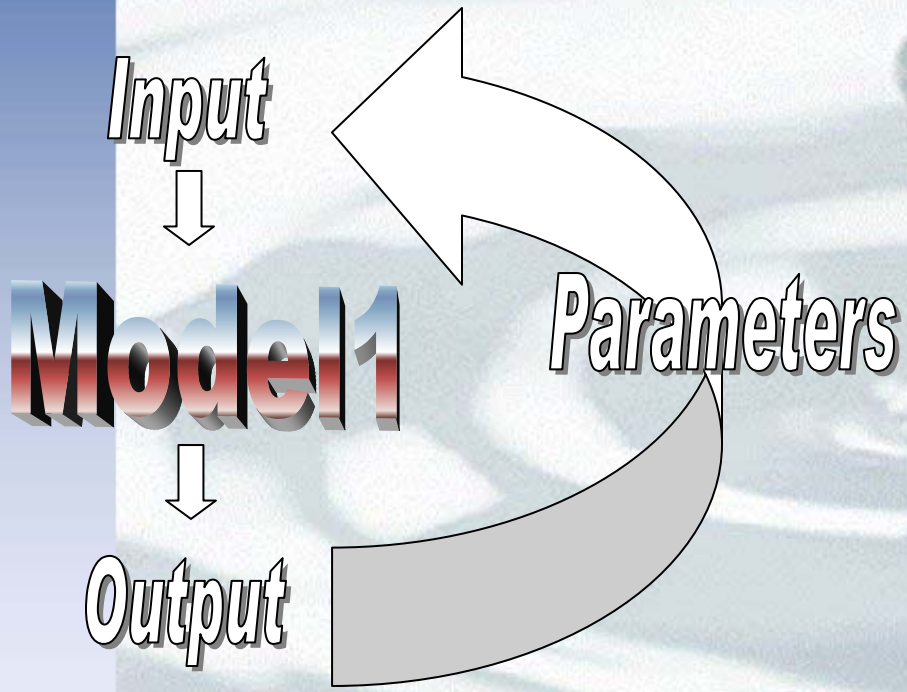
- Embankments
- Guidebanks



Incremental Loading Strategy



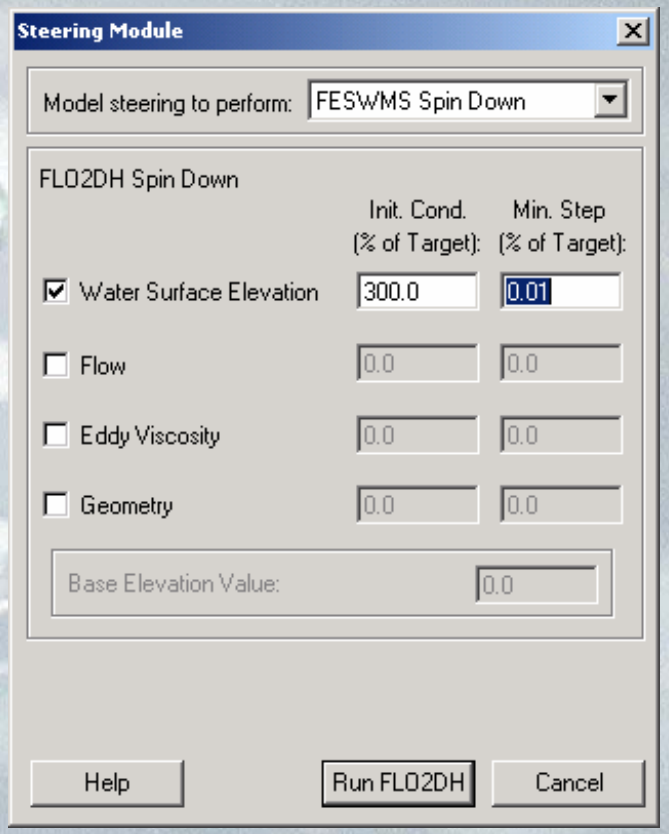
Single Model Steering



- Model Warm Up
  - Ramp Parameters
    - Flow rates
    - Water elevations
    - Eddy Viscosity
    - Geometry
- Multiple Cases
  - Range Parameters
    - Roughness
    - Viscosity
    - Particle Size

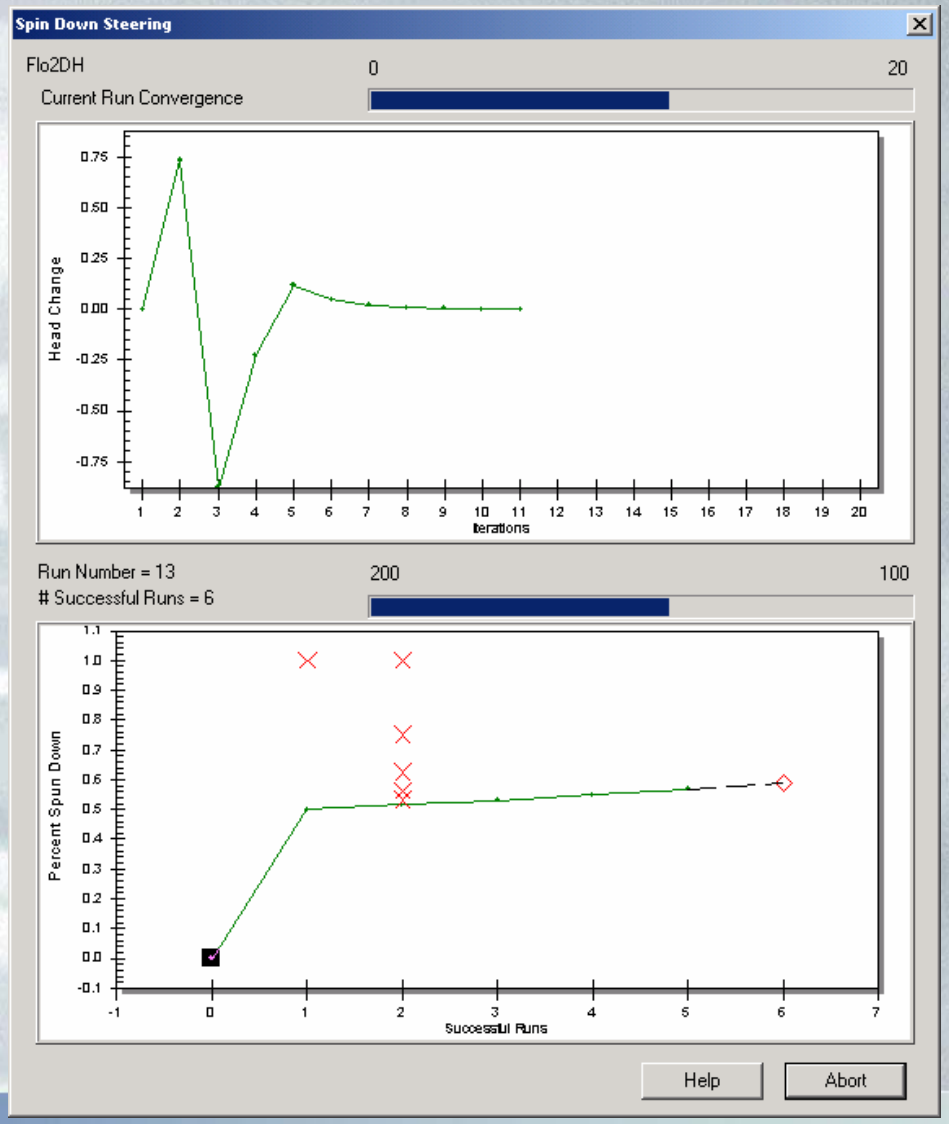
Automatic Incremental Loading

- Spin Down Channel
- Select Spin Down Option
- Initial Percentage
- Minimum Step



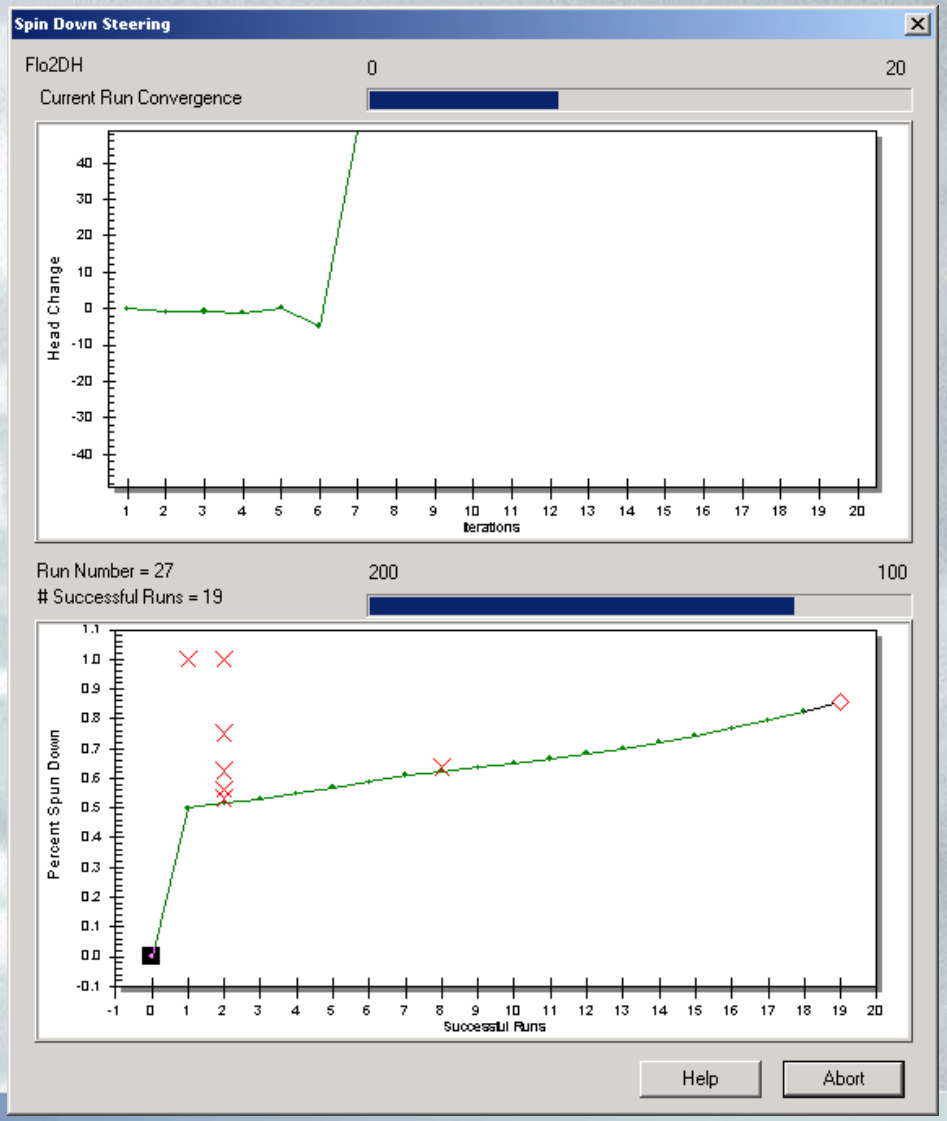
Successful Step

- Top Bar
  - Iteration Number
- Top Graph
  - Depth Convergence
- Run Numbers
- Bottom Bar
  - Percentage Complete
- Bottom Graph
  - Completion



Unsuccessful Step

- Divergent Top Graph
- X added to Bottom Graph
- Smaller increment selected



SMS – 2D Numerical Models

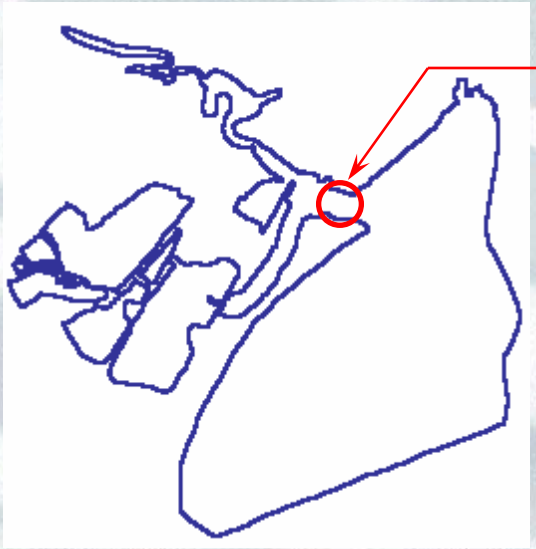
- River Hydraulics/Water Quality
  - Flo2DH
  - RMA2/RMA4/SED2D-WES
- Coastal Circulation
  - ADCIRC
  - M2D
- Wave Analysis
  - STWAVE
  - CGWAVE

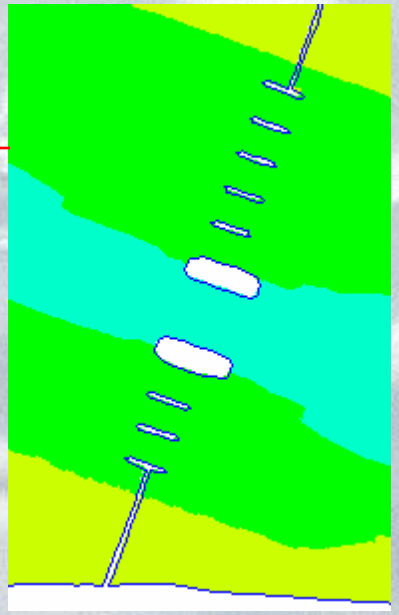
Applications in Estuaries/Bays

- Tidal Flooding
- Freshwater/Saltwater Interfaces
- Marsh Circulation
- Navigation Channels
- Water Quality – Detention
- Storm Modeling

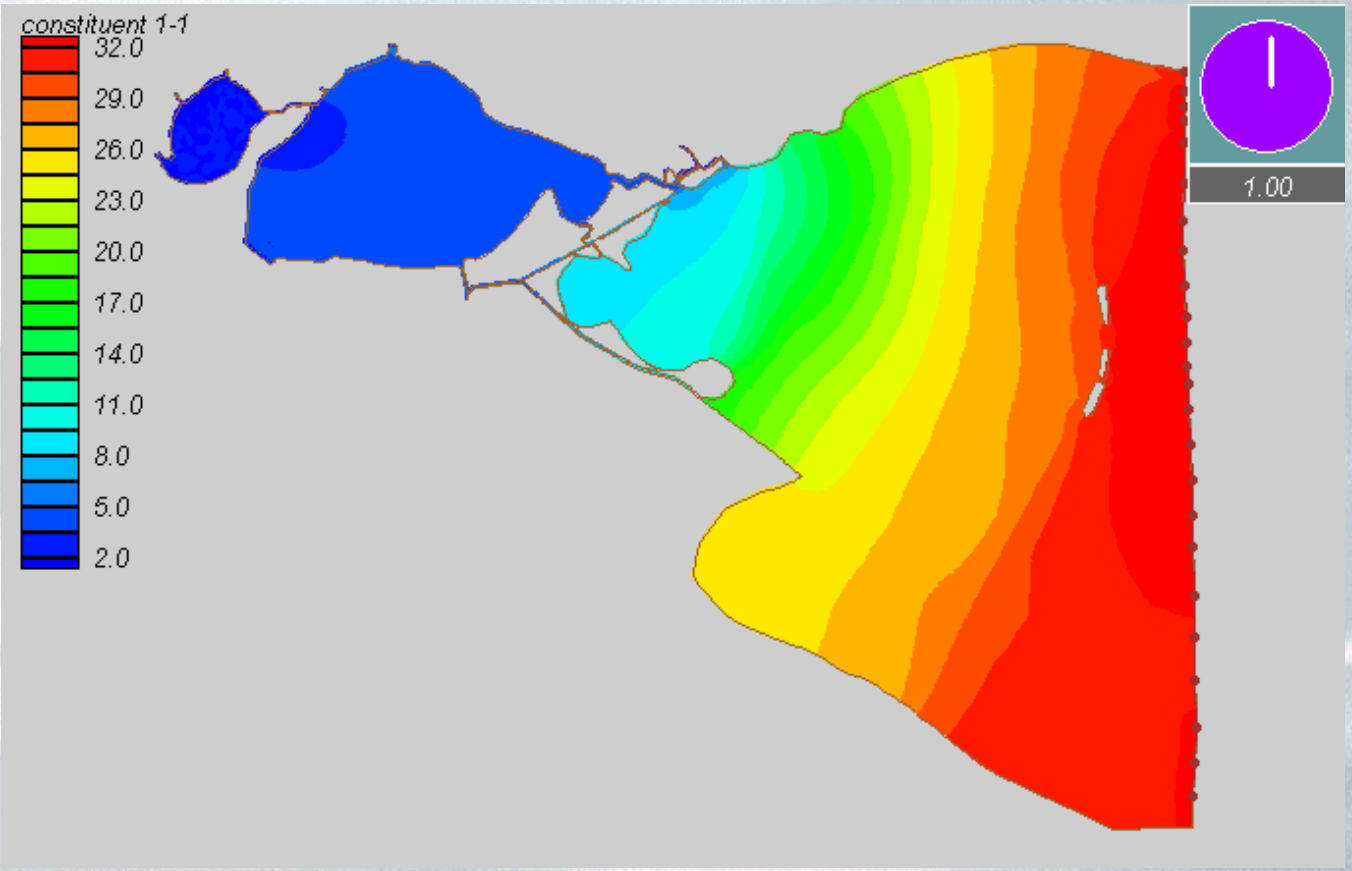
Tidal Flooding – Saugus Bay

- Wetting and drying
- Flood control gate
- Guard against severe wave conditions (storm serge)



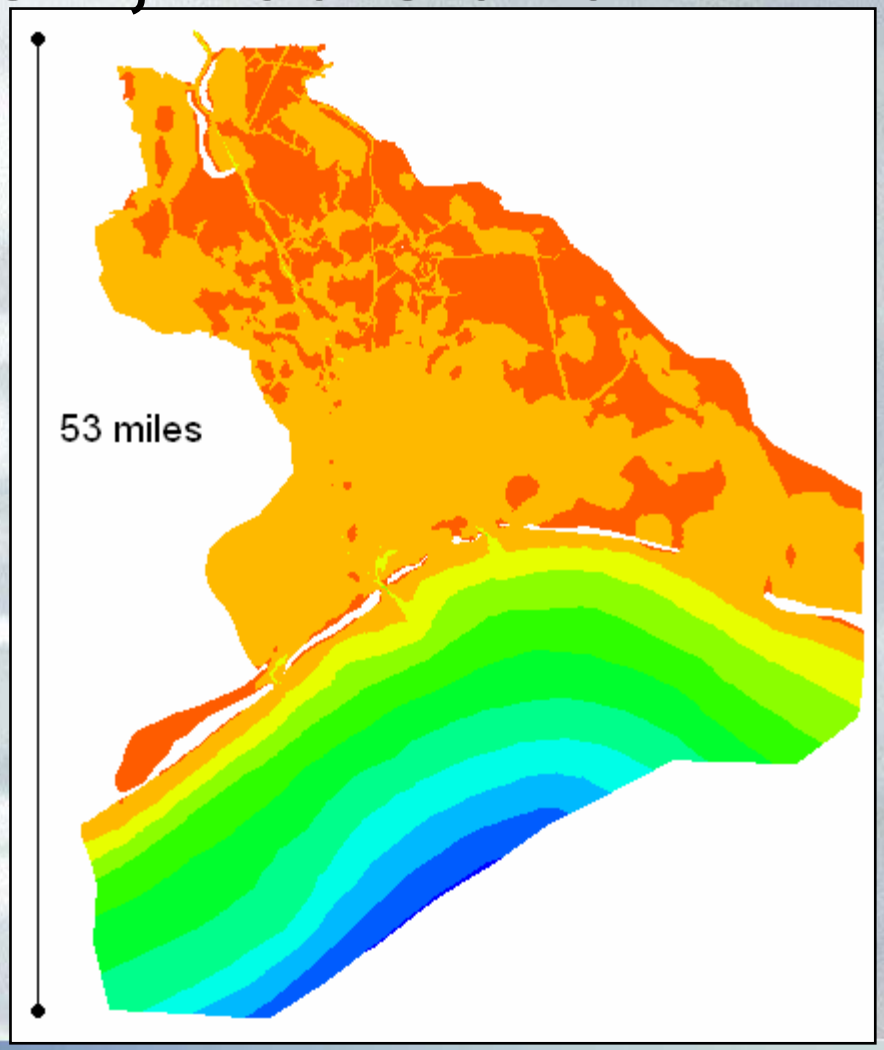


Salinity Intrusion –
Lake Ponchutrain - Louisianna

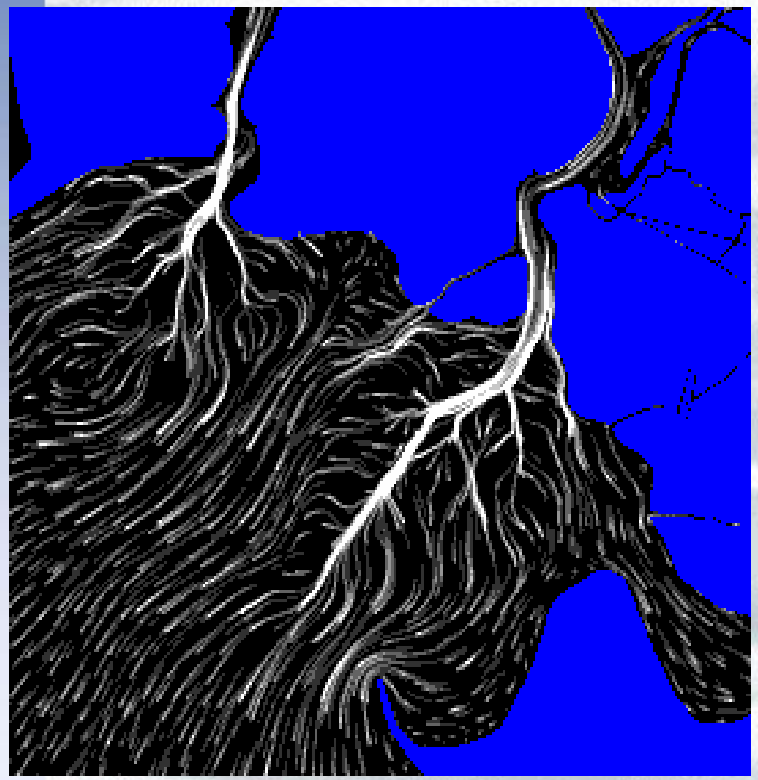


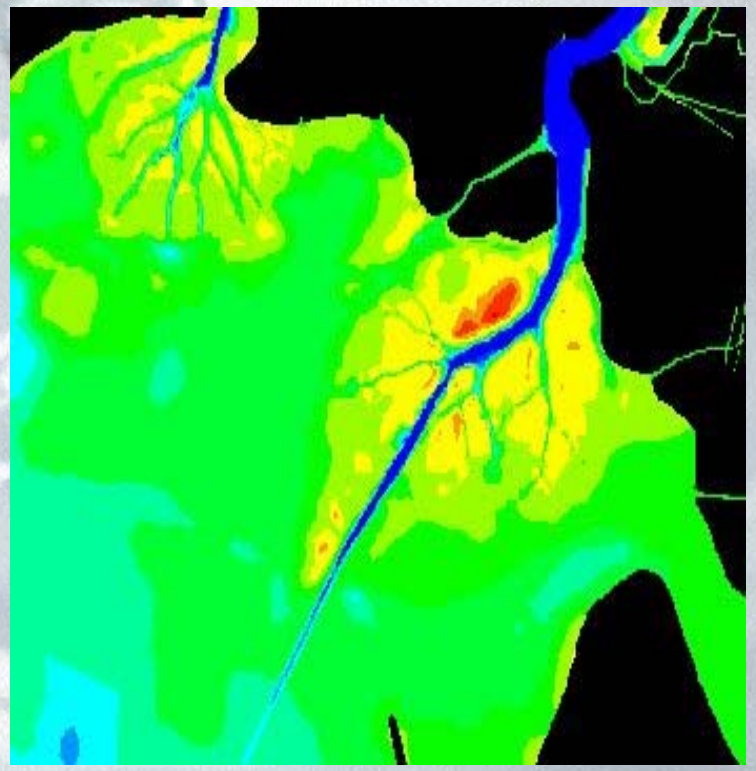
Freshwater Discharge – Barataria Basin, Louisiana

Water Quality Issues



Marsh Circulation–
Atchafalaya Bay Delta

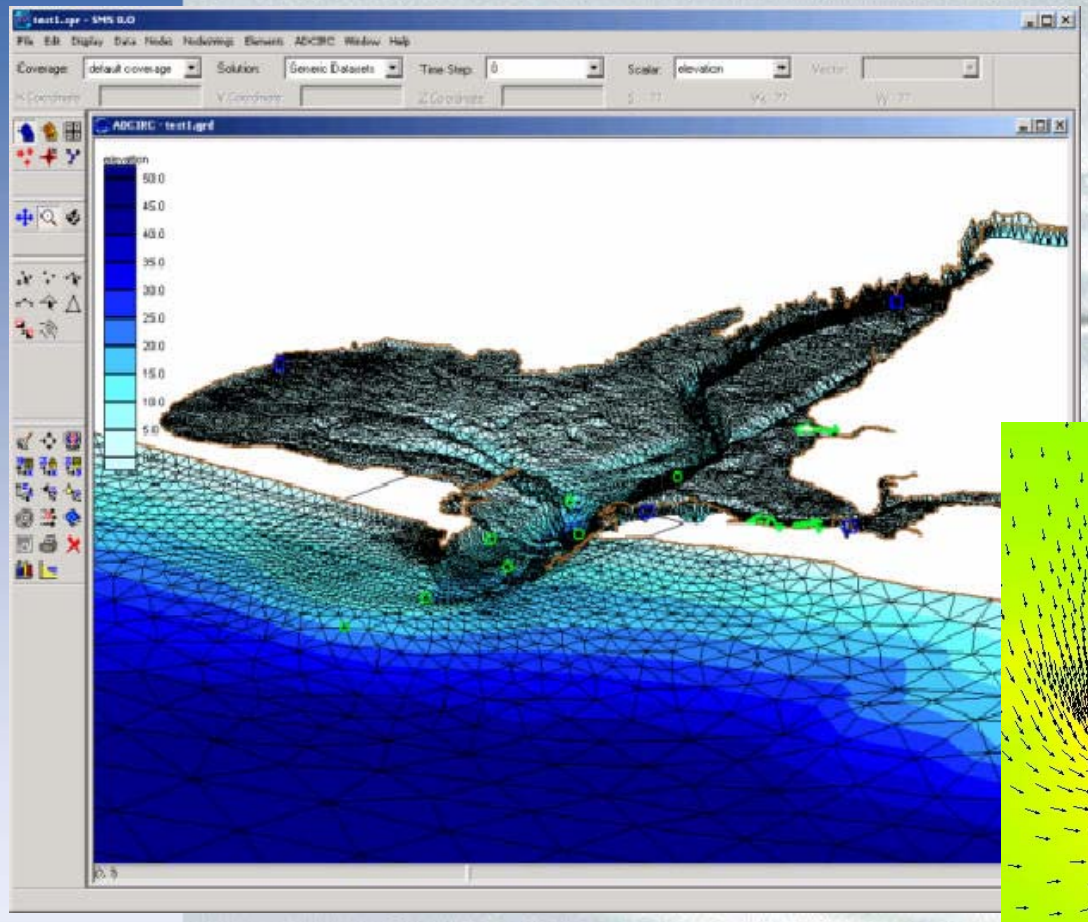


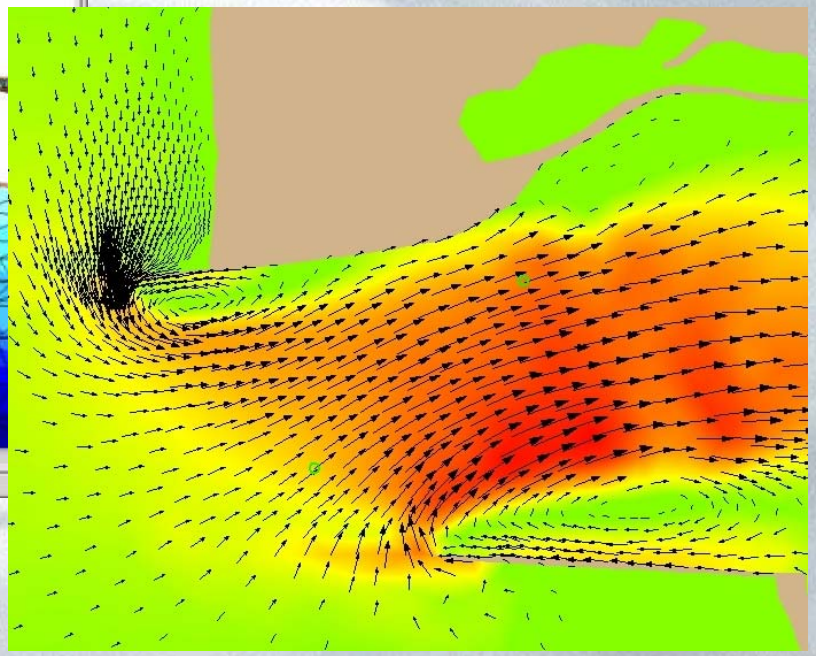


New Visualization

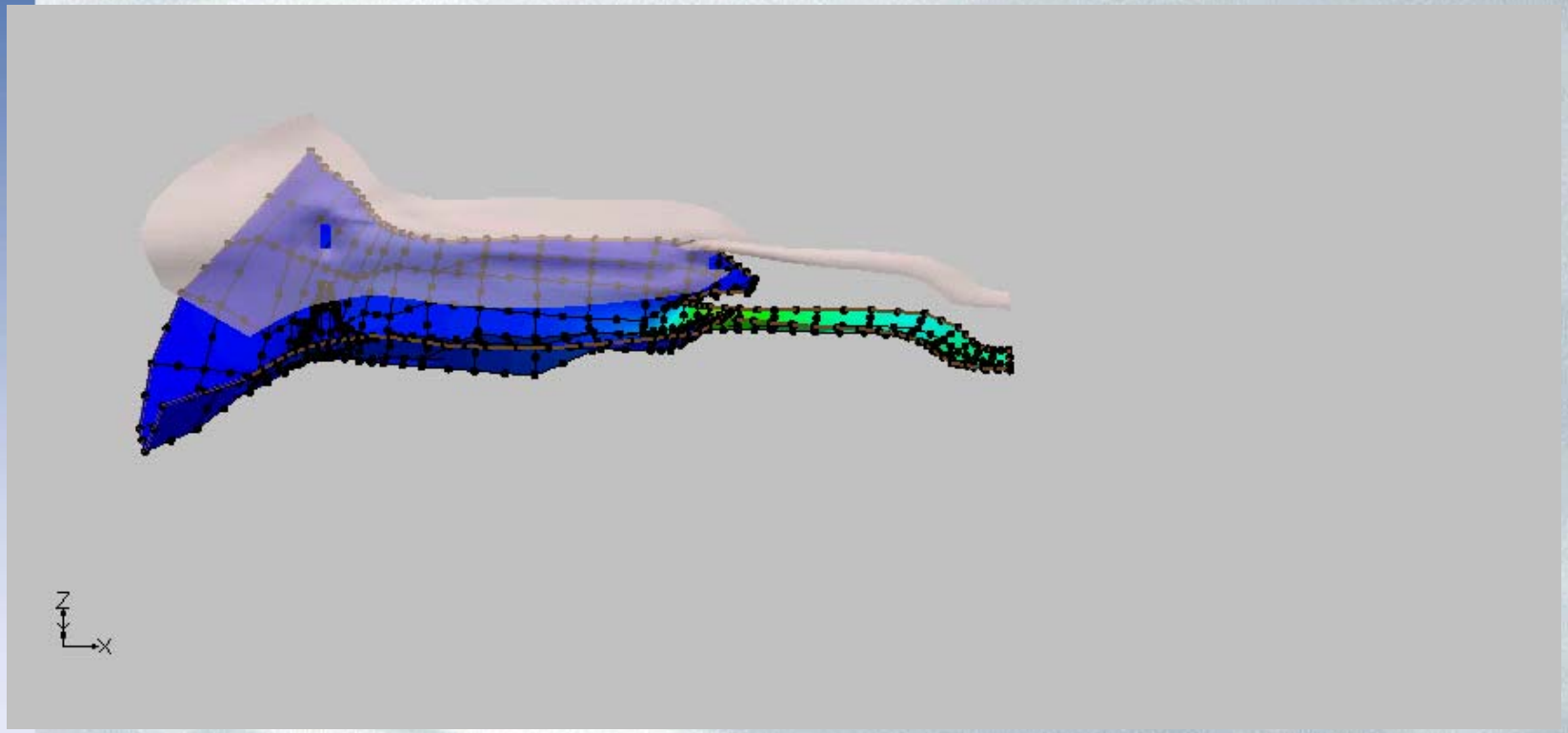
- Three Dimensional Views
- Functional Surfaces/Animations
- Drogue Plots

3-Dimensional View

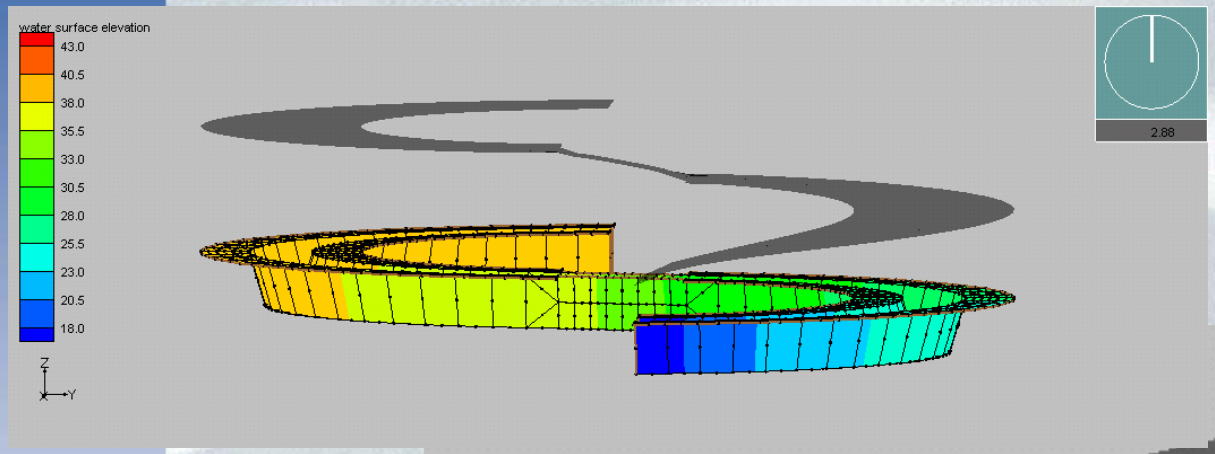


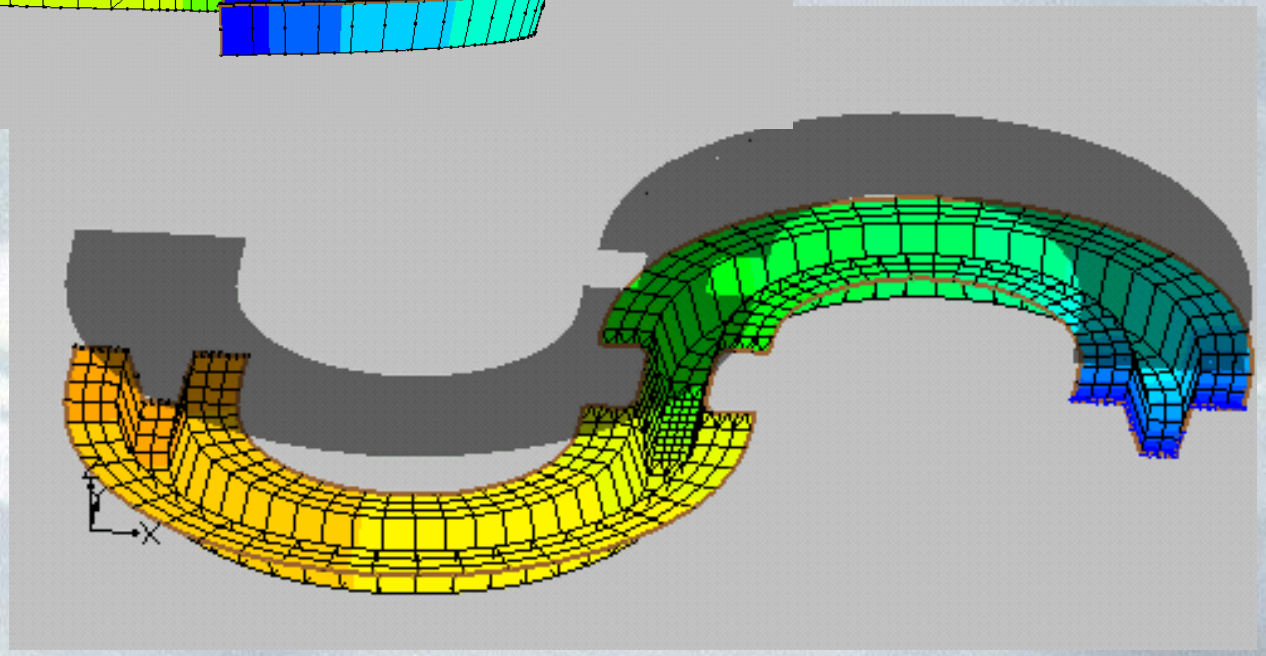


Animation of View Location



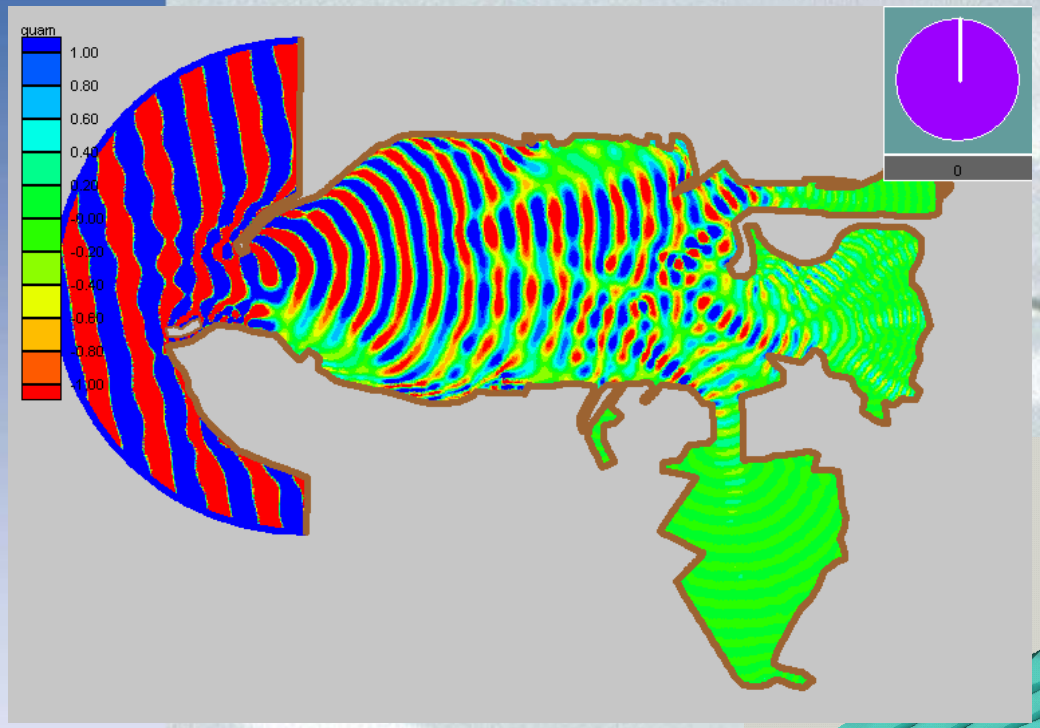
Animated Water Surface

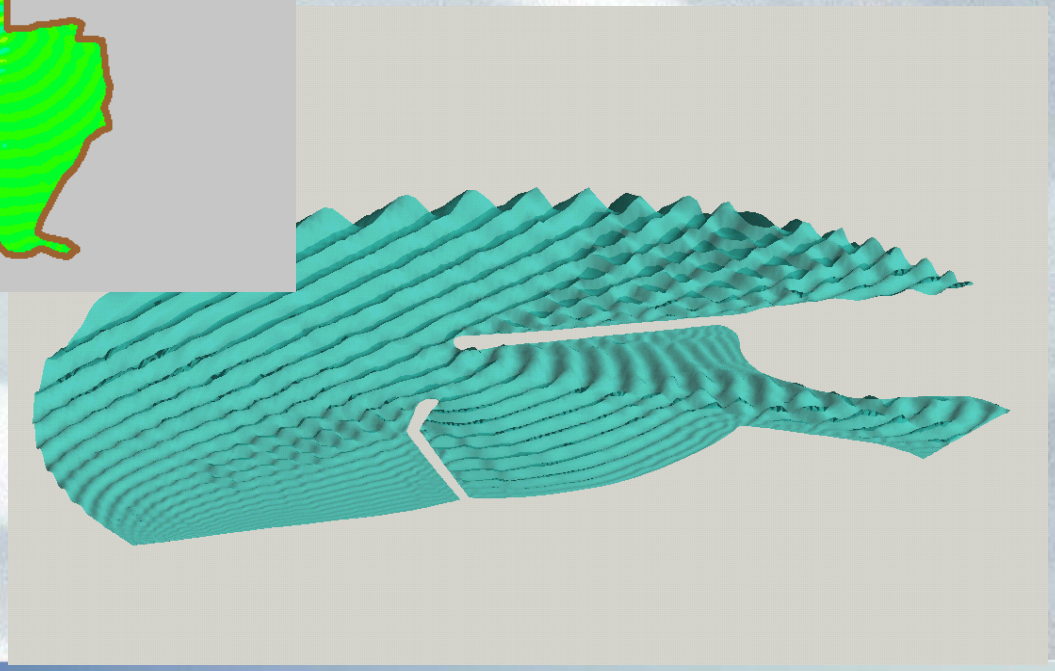




Drogue Plots

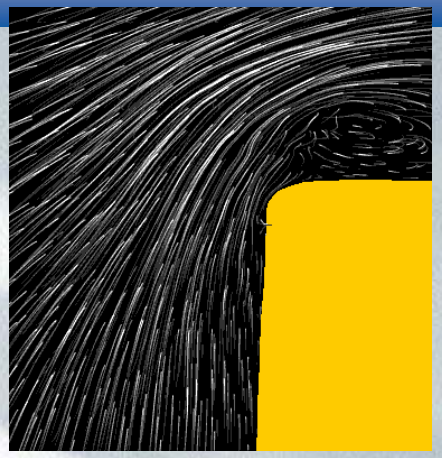
Other Applications



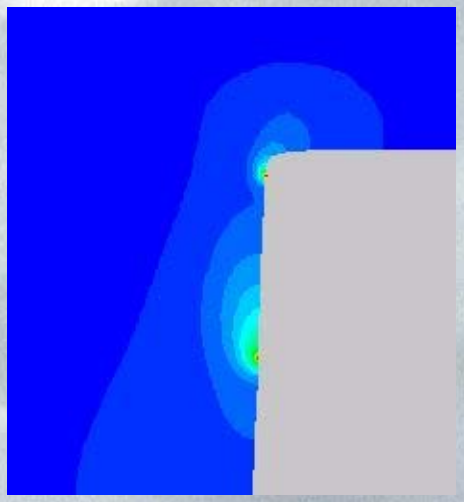


Theoretical Applications

- Design Alternatives
- Flumes
- Artificial Conditions
- Sensitivity



Flow Trace at Ebb Tide



Turbidity Plume at Ebb Tide

Using models to Examine Effects of Outlet Weirs from a Confined Disposal Facility (CDF)

The End

- Questions?