Role of Ship Simulation in Channel Design

Dennis W. Webb, PE
U.S. Army Corps of Engineers
Engineer Research and Development Center
Vicksburg, MS

Why Model Navigation Projects?

- Allows end-users a controlled environment to operate ships in their waterway of the future.
  - Safety check
  - Gets pilots "onboard" project.
- Allows comparison between multiple proposals to optimize design.
- Provides rationalization of project design to competing interests.
  - Excellent means to communicate results
- ER 1110-2-1403: Engineering and Design: Studies by Corps Hydraulic and Hydrologic Facilities and Others.
  - Paragraph 6b. *Hydraulic design studies associated with the planning, design, construction, operation, and maintenance of navigation channels will include a ship-simulation investigation unless omission of such an investigation is approved by HQUSACE. This policy does not pertain to the design of commercial small-craft harbor channels.*

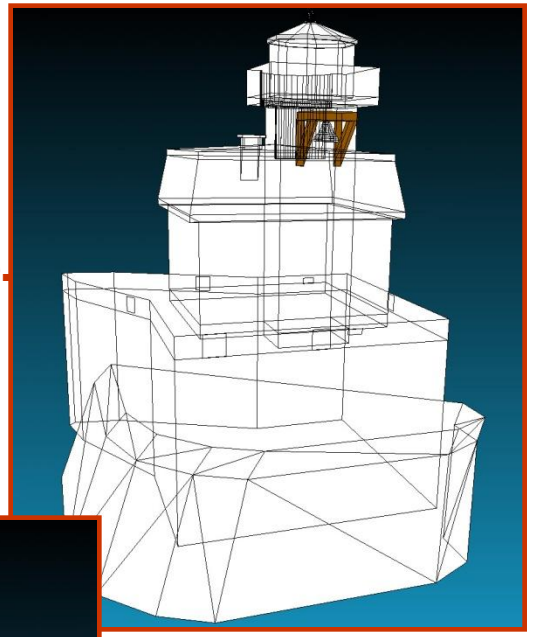
ERDC Ship/Tow Simulators

- Calculate & reproduce vessel response to forces:
  - Rudder
  - Propeller
  - Tugs and Thrusters
  - Currents
  - Banks
  - Wind
  - Waves
  - Vessel Interaction
- Real-Time
- Three Simulators
  - Ships, Tows, or Small Craft
  - Ownship towing

Steps for Conducting a Simulator-Based Navigation Study

- Reconnaissance Trip
- Database Preparation
- Validation
- Pretesting
- Testing
- Result Analysis and Reporting

Databases

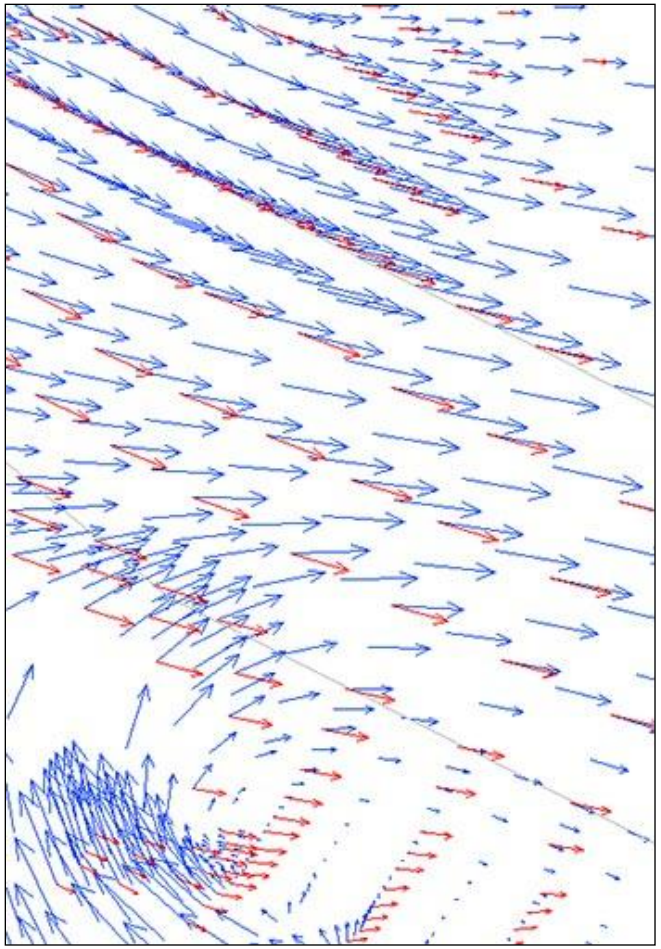


- Visual Databases
  - Represent the simulated world as realistically as possible.
    - Visual Scene
    - Radar
    - Electronic Chart Display and Information System (ECDIS)

- Environmental Databases
  - Channel Definition and Banks
  - Currents
    - Usually a separate model study
  - Waves
  - Wind
- Vessel Models
  - Ship, Tow, Assist Tug, Small Craft
  - Hydrodynamic and visual

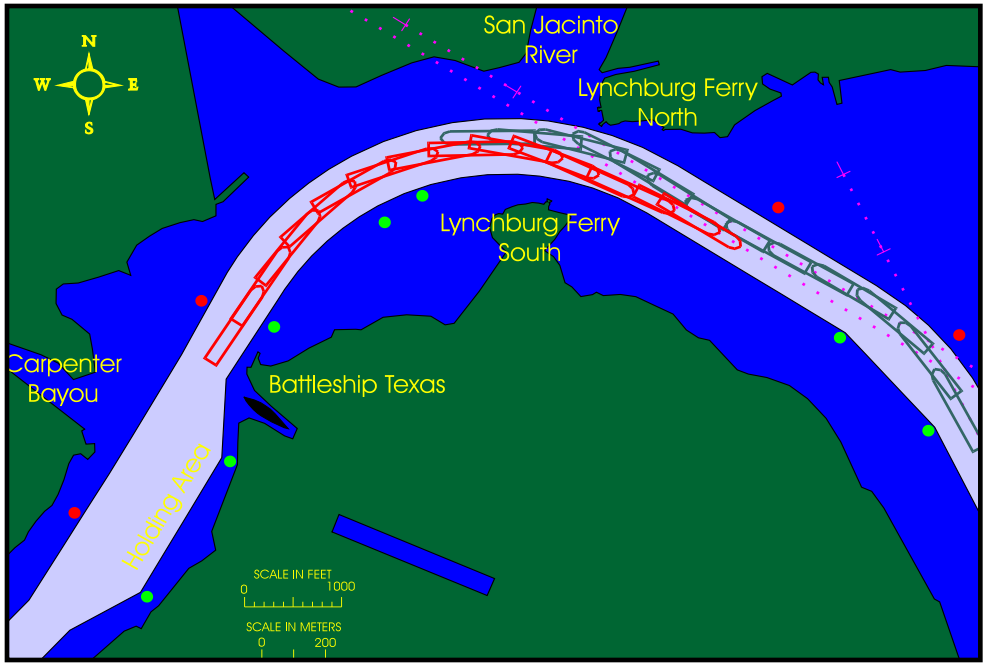
Current Modeling

- 2-D or 3-D Hydrodynamic Model
  - Adaptive Hydraulics (ADH)
  - TABS or RMA
  - ADCIRC
- Existing Conditions
  - Validate to field data
- Proposed Conditions
  - Deeper, wider, realigned



Data Recorded

- Position
- Heading
- Rudder Angle
- Engine Speed
- Ship Speed
- Yaw Angle
- Rate of Turn
- Tug/Thruster Usage
- Port and Starboard Clearances
- Vertical Motion due to Waves (every second)
- Pilot evaluations and questionnaires



Conclusions

- **ERDC Operates Corps' marine simulator.**
  - Simulate ship and/or tow traffic.
  - Operates in real time.
  - Evaluates proposed changes to federal channels.
    - Existing conditions (base)
    - Proposed conditions (one or more)

- **Contact information**
  - 601-634-2455 office
  - 601-831-0788 cell
  - 601-634-3218 fax
  - Dennis.W.Webb@usace.army.mil