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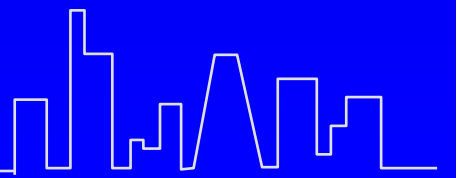
HH&C, Track 4, Session 4G, Modeling, 1:30 pm Aug. 4

- *Rick D. Ackerson*
- Hydraulic Engineer
- *U.S.* Army Corps of Engineers
- Chicago District
- *111 N. Canal St.*
- *Chicago, IL 60606*
- Phone: (312)-846-5511
- e-mail: rick.d.ackerson@usace.army.mil
- Fax:(312)-353-2156



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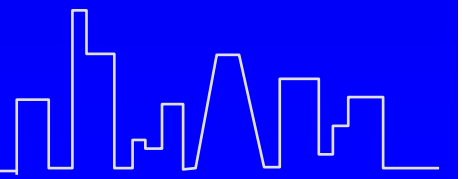
Little Calumet River Unsteady Flow Model Conversion UNET to HEC-RAS

- Rick D. Ackerson
- Hydraulic Engineer
- U.S. Army Corps of Engineers
- Chicago District



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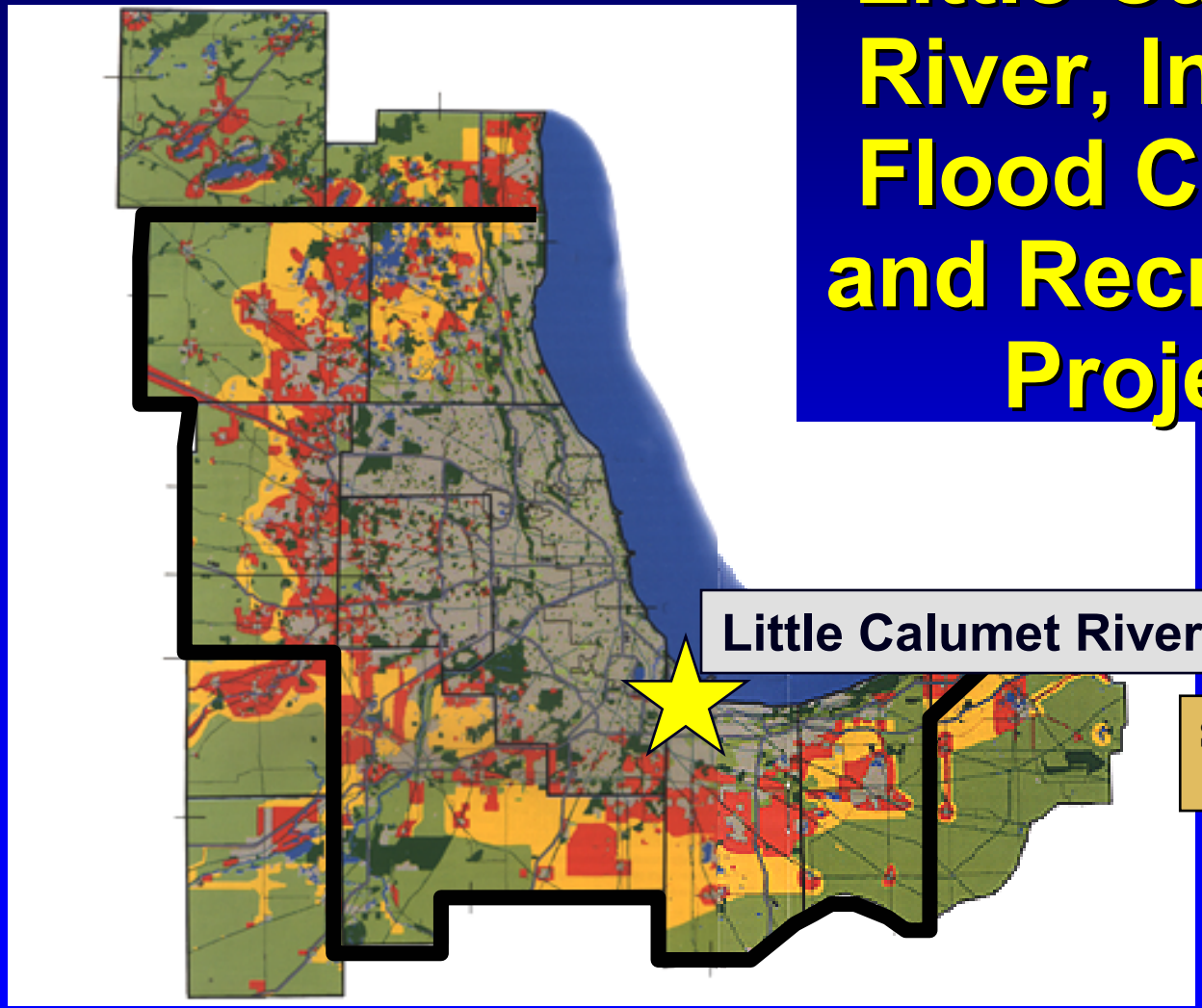
Little Calumet River, Indiana Flood Control and Recreation Project



Source: Openlands Project

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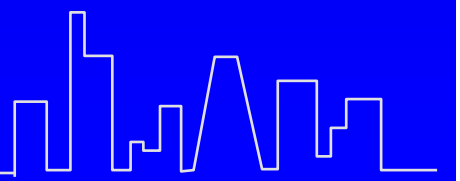
Project Description
Little Calumet River, Indiana

- Construct 22 miles of new urban levees
- Provides 200 year level of flood protection
- Construct 17 miles of hiking trails
- Fish and Wildlife mitigation - 550 acres of wetland
- Local Sponsor: Little Calumet River Basin Development Commission
- Authorization: WRDA 1986



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History of the Little Cal Models

- 1991 – Little Cal UNET model constructed from existing 1970's vintage HEC-2 and WSP-2 models HEC-1 was used to develop inflows
- 1995 – Deep River reach extended. Model recalibrated
- 2002 – Model converted from specialized Dr. Barkau version to the HEC version of UNET

  Updated to Bulletin 70/71 precipitation from TP-40 and recalibrated
- 2005 – HEC-UNET converted to HEC-RAS
  Updated special bridges to more detailed bridges

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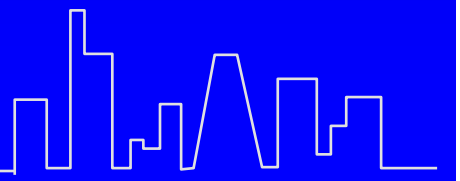
Reasons for Model Conversions

- 2002 specialized UNET to HEC-UNET
  - **To update to the more standard Bulletin 70/71 precipitation**
  - **To update to the more accepted standard HEC-UNET (specialized version did not run on the Windows platform)**
- 2005 - HEC-UNET to HEC-RAS
  - **City of Gary requested new floodway mapping to reflect the Corps levee construction to date**
  - **FEMA requested conversion for ease of review and ease of floodway determination**
  - **State of Illinois showed interest in new floodway mapping to reflect the impacts of the new Thornton reservoir**



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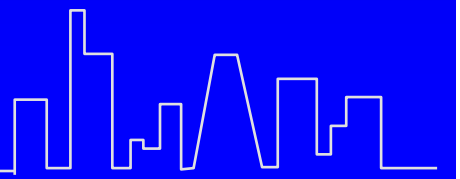
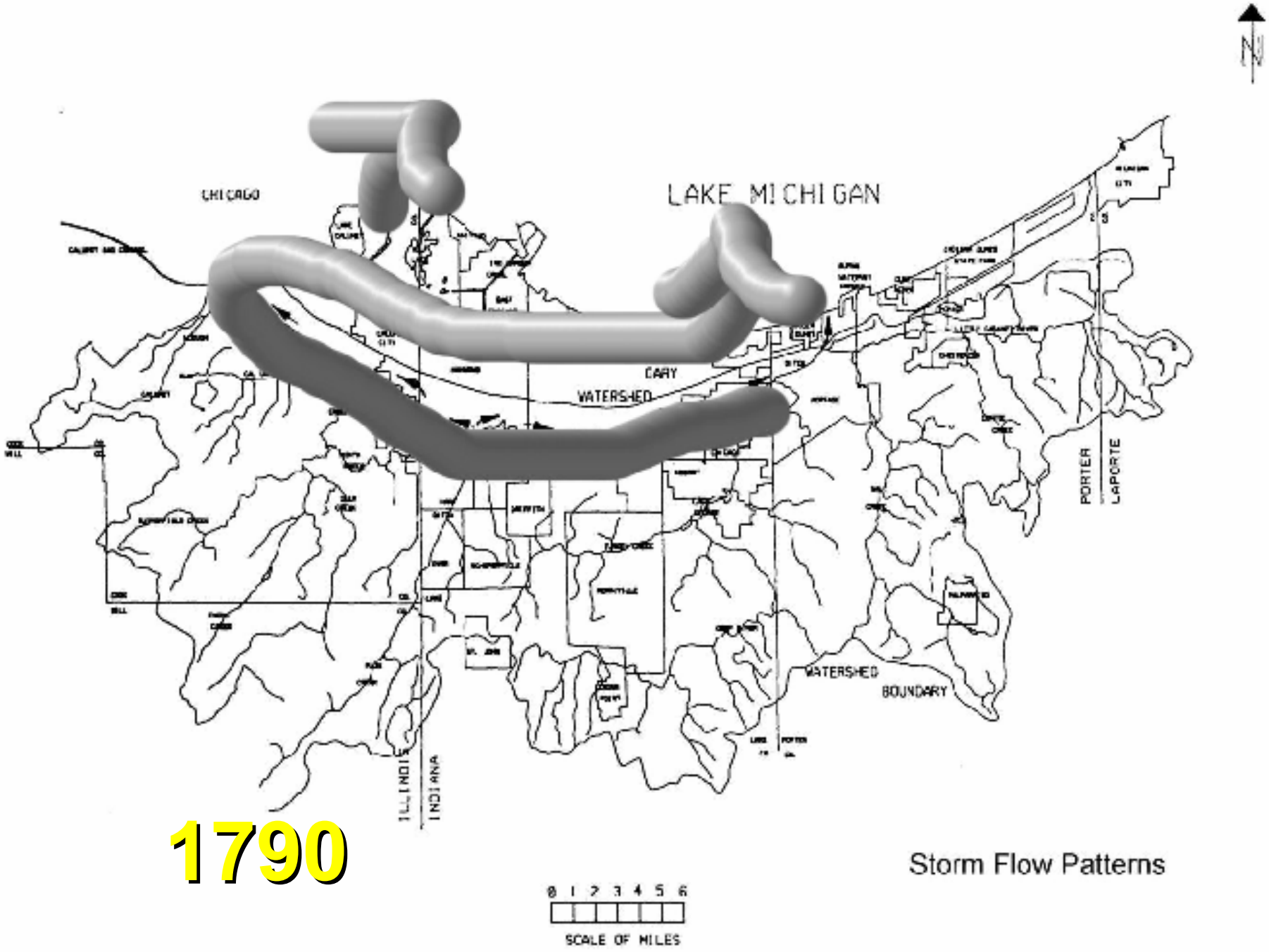
Various Uses for Little Calumet River Model

- Design Levee Height Superiority Analysis
- To determine impacts of various project features
- To develop the flood warning plan
- To determine the impact of staged construction
- To develop updated floodplain mapping for the city of Gary
- To develop updated floodplain mapping in Illinois

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LAKE MICHIGAN
CARY
WATERSHED
PORTER
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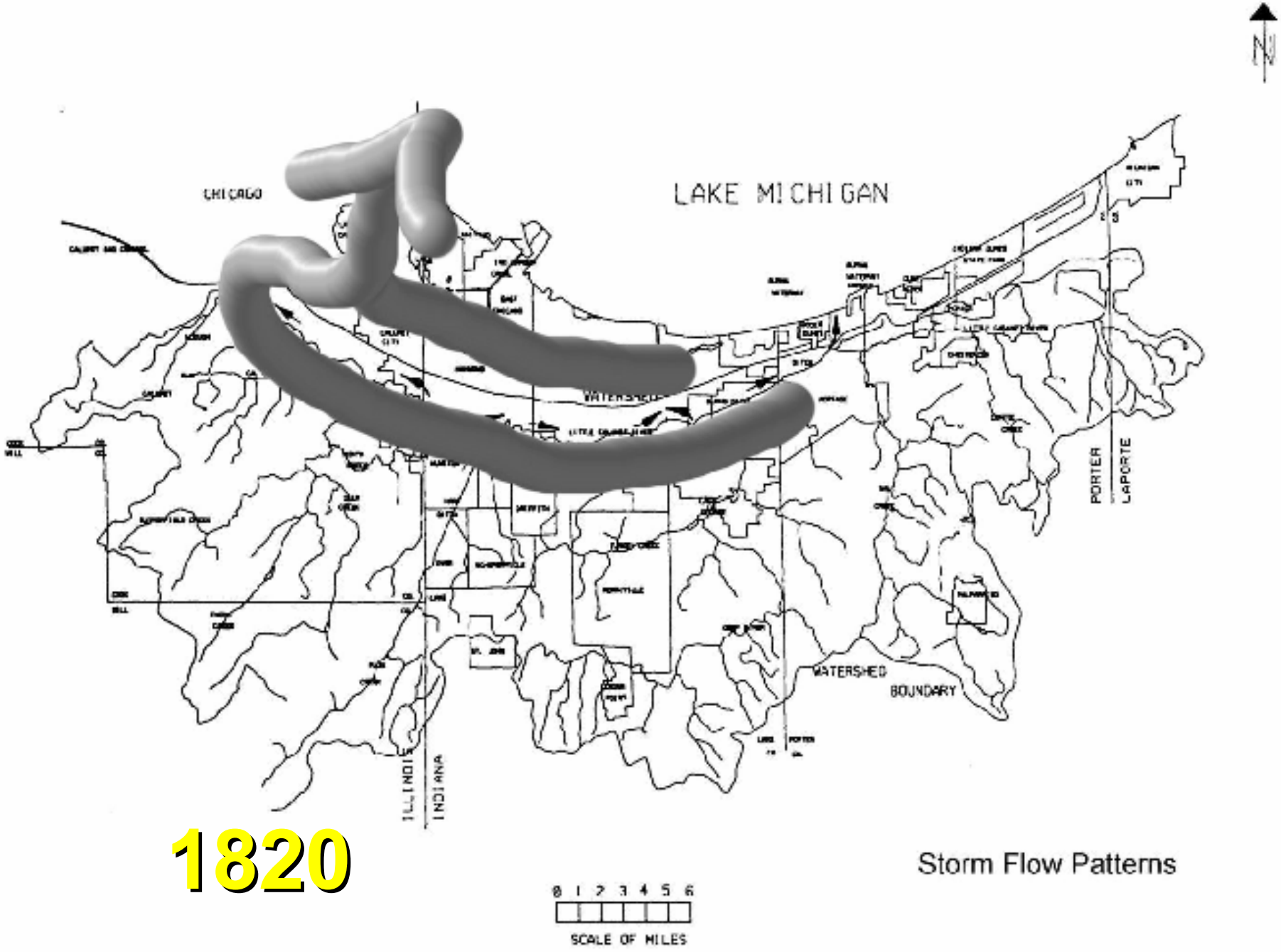
BOUNDARY
ILLINOIS
INDIANA
1790
Storm Flow Patterns
0 1 2 3 4 5 6
SCALE OF MILES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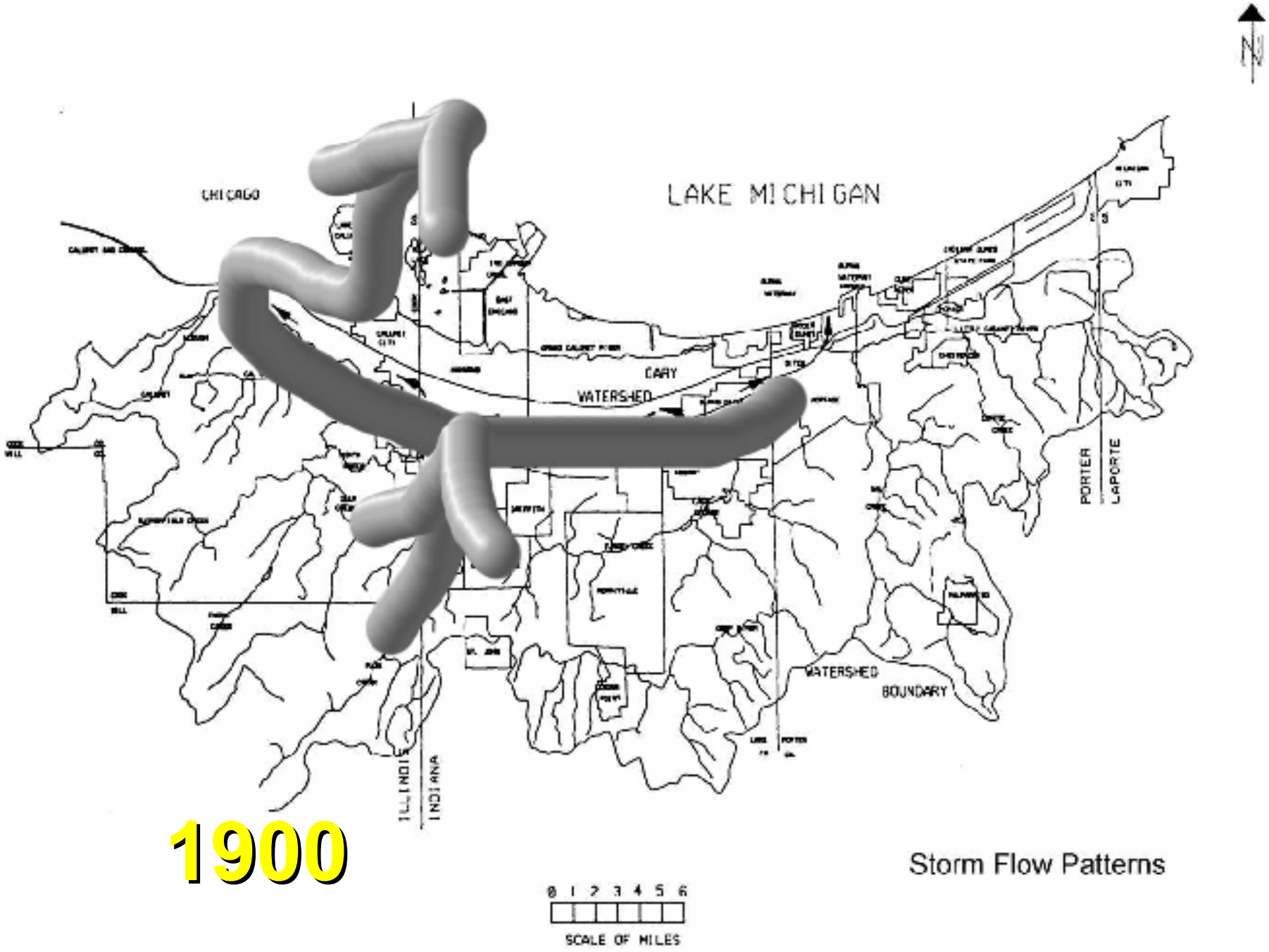
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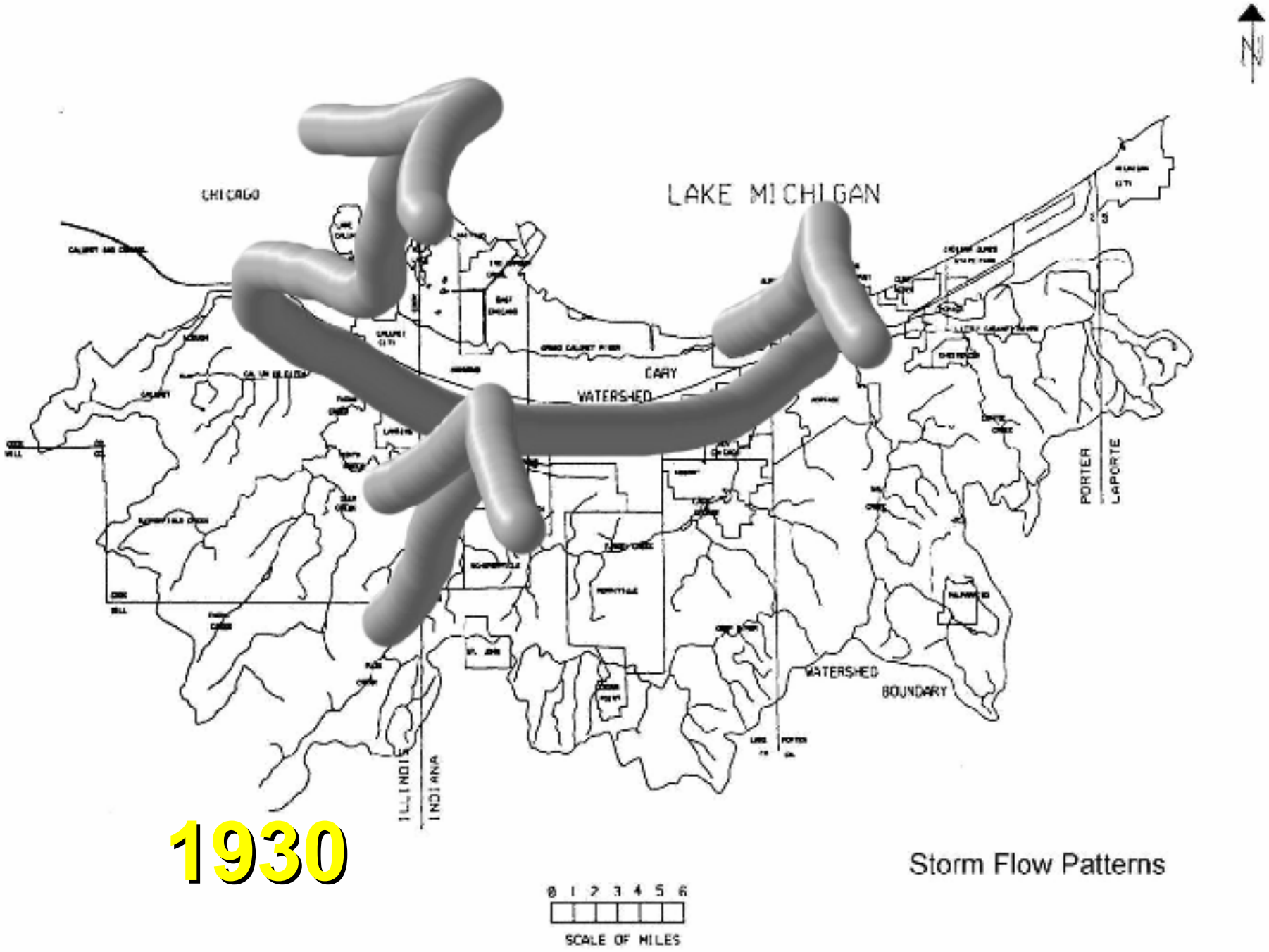
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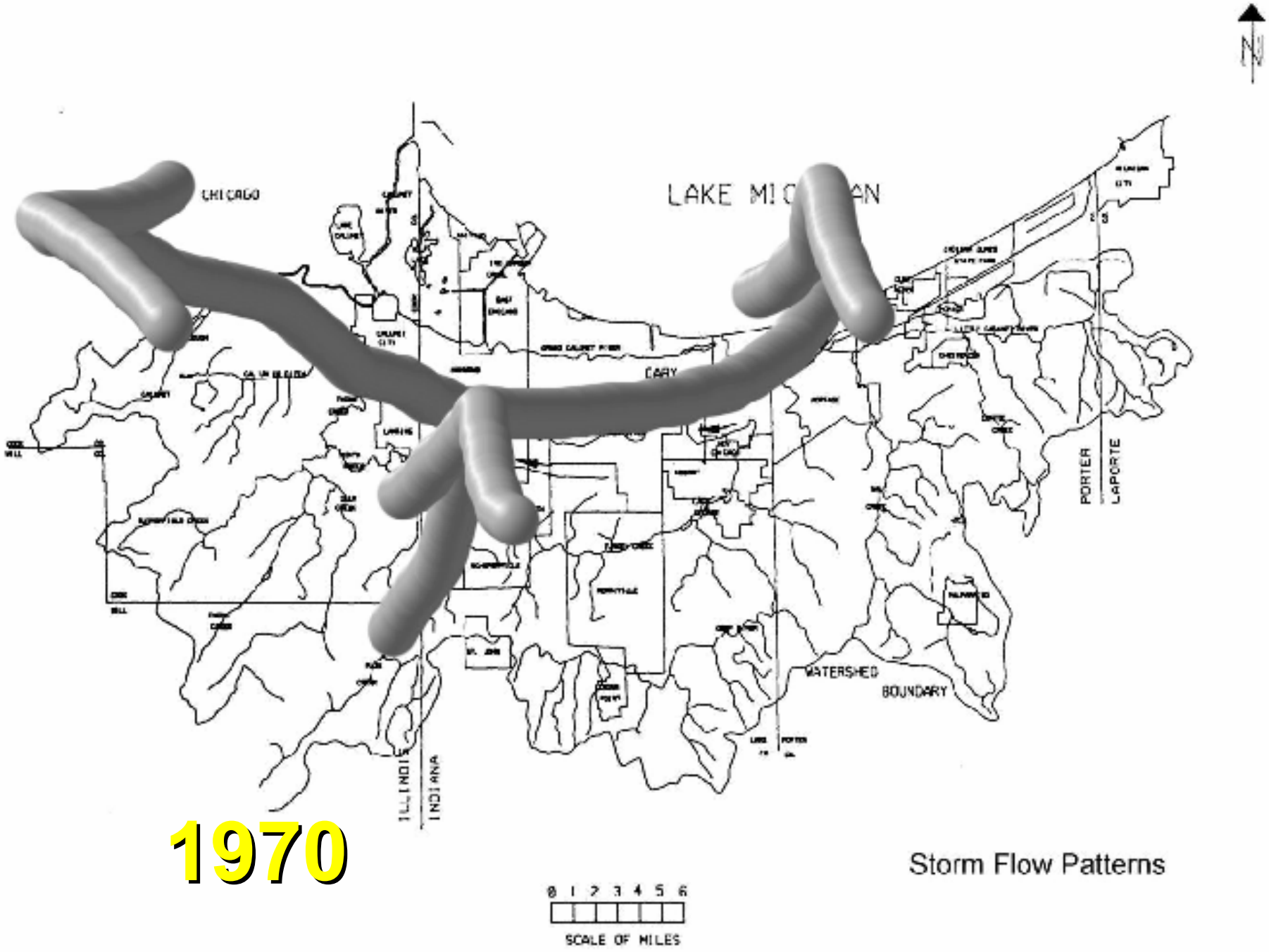
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Storm Flow Patterns
0 1 2 3 4 5 6
SCALE OF MILES

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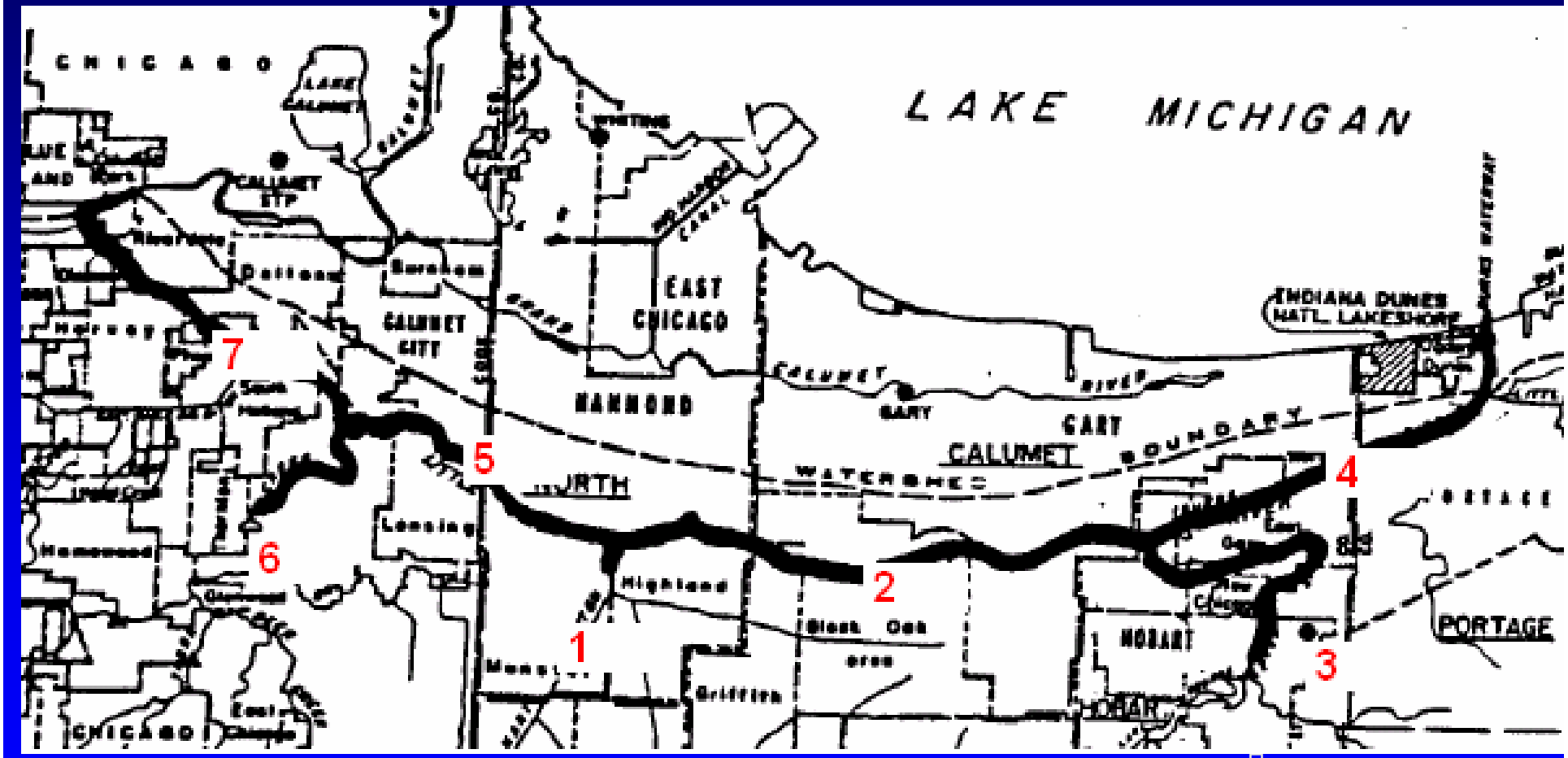
Little Cal Model



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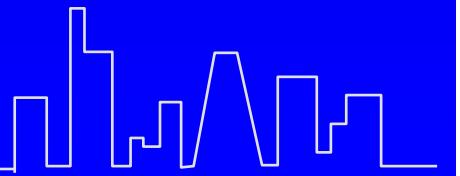
Advantages of Unsteady Flow Model versus Steady State Modeling

- Flow Reversals
- Flow Splits
- Backwater Impacts
- Preferred channel routing technique for very flat channels



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Little Cal HEC-RAS Model

- 7 reaches
- 50.3 miles of river
- 493 cross sections
- 85 bridges
- 54 storage areas
- 4 inline structures
- 93 lateral connections
- 18 interconnections between storage areas

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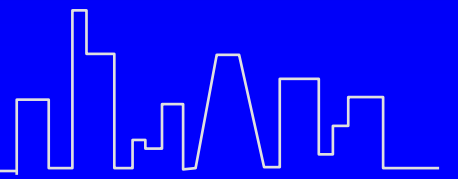
Boundary Conditions/Storage System

- HEC-DSS for Flow and Stage Hydrograph Storage
- Rating Curves at the Cal-Sag and 10 year level at Lake Michigan
- Inflow Hydrographs at Thorn Creek, Hart Ditch, Deep River and East Arm Little Calumet River



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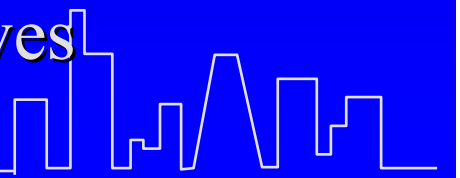
Little Cal Model Calibration

- Extensive high water data for 1989 and 1990 flood events
- Flow measurements during 1989 and 1990 flood events
- Observed flow and stage for 5 gages
- Observed stage for 2 gages
- Observed flow for 2 gages
- Long period of record (40+ years) for gages to develop stage and flow frequency curves



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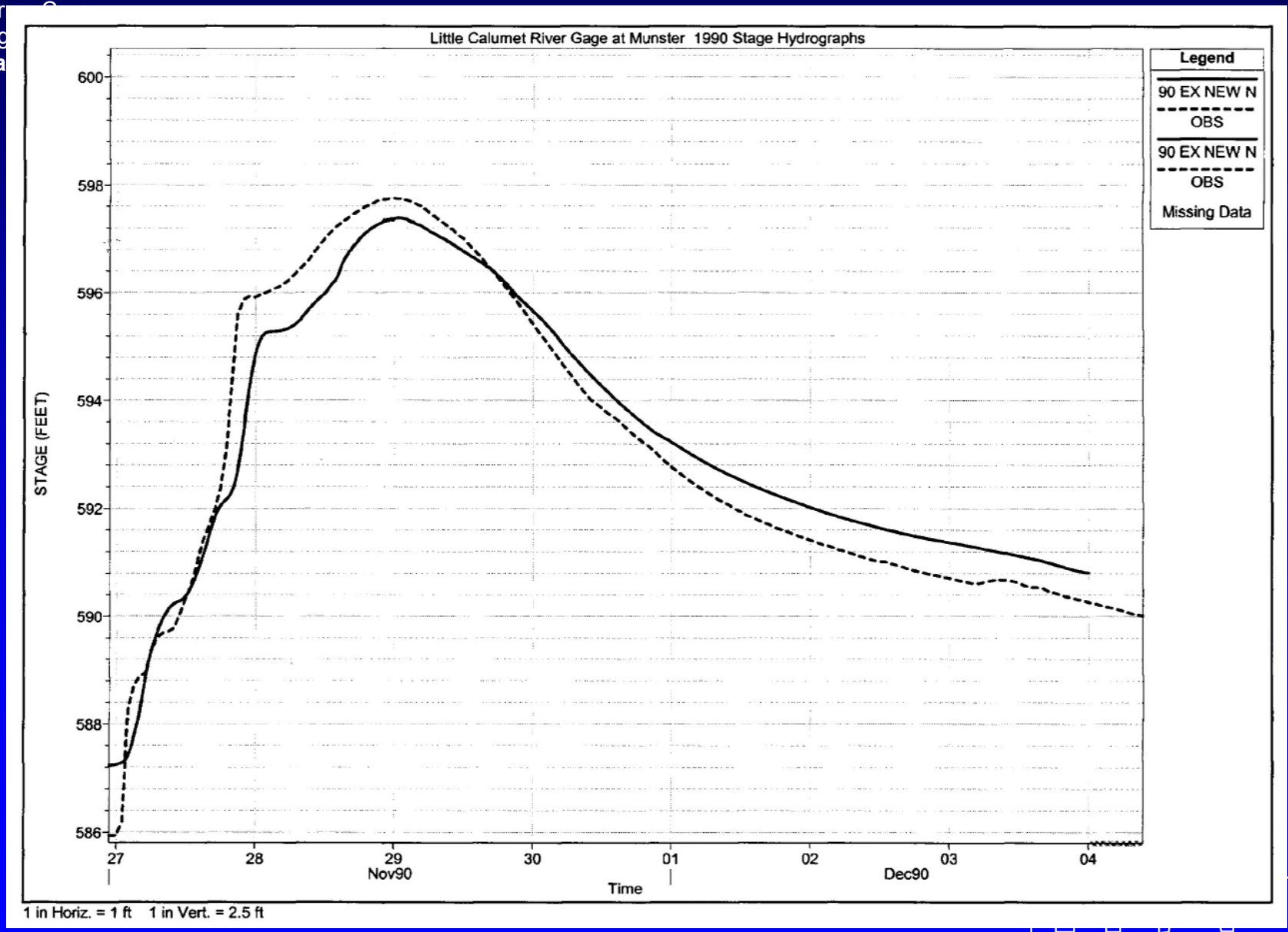

1990 Flow Hydrograph for Little Calumet River Gage at Munster

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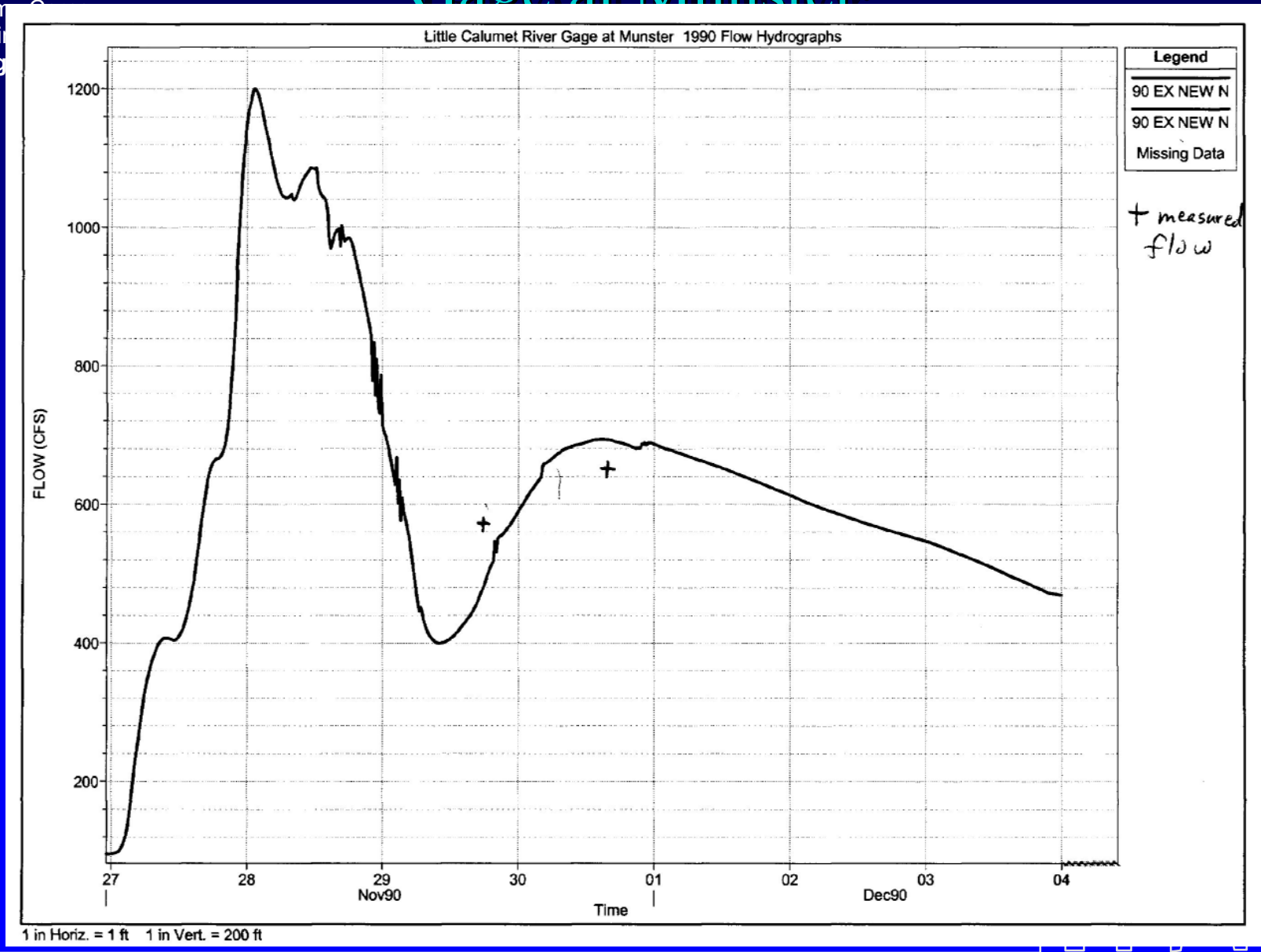

Little Calumet River at South Holland

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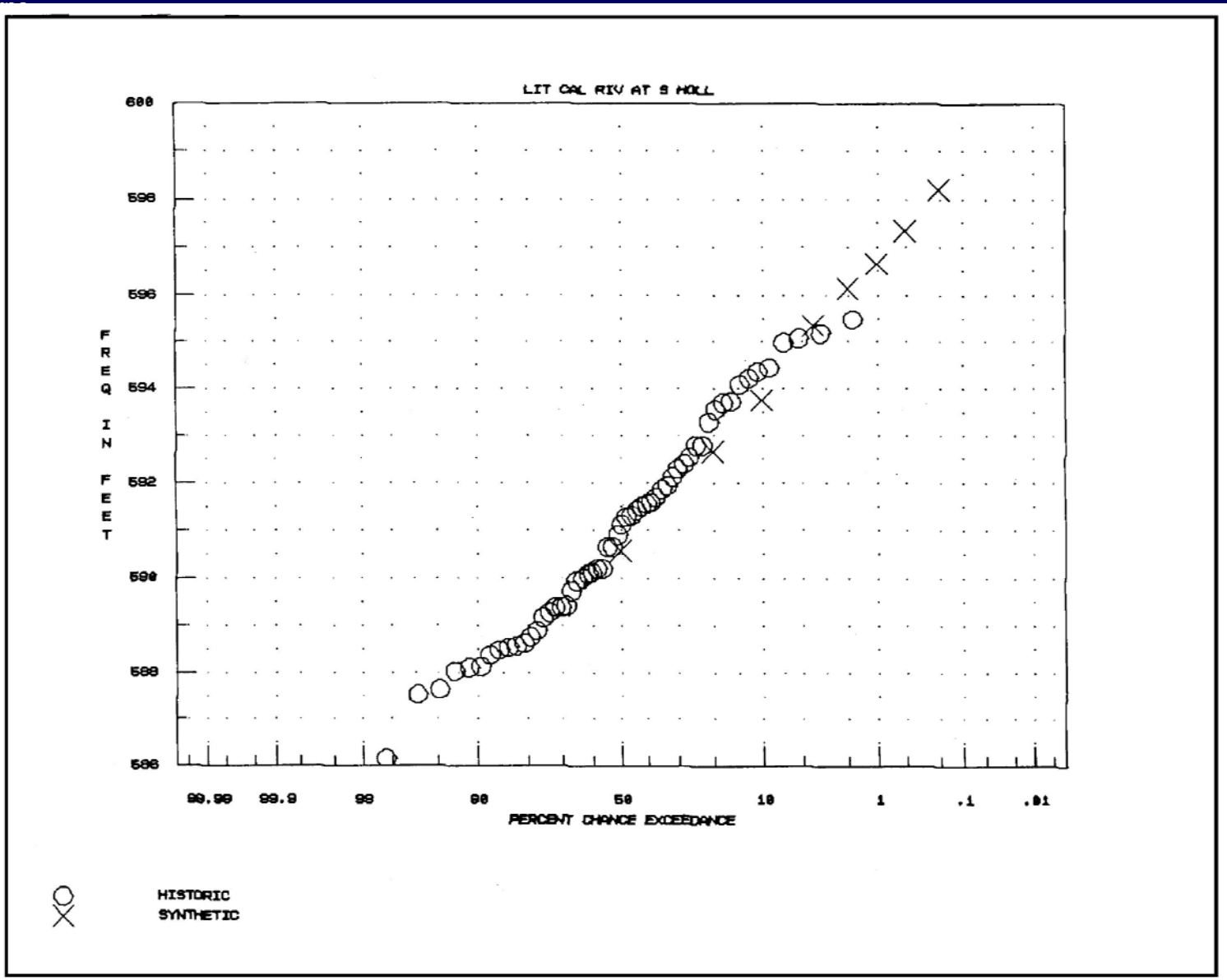

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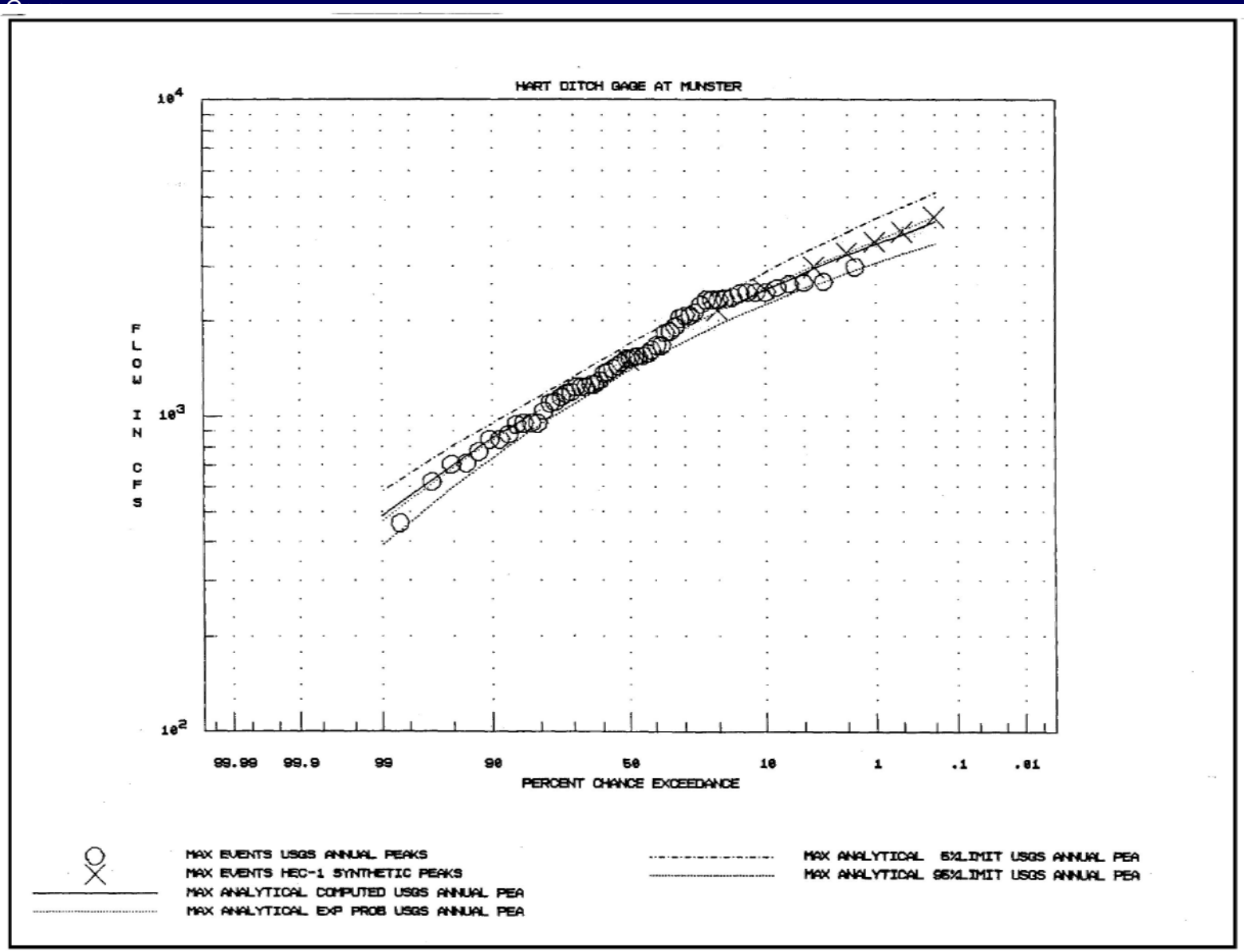
Hart Ditch Gage at Munster



1990 Maximum Water Surface for Little Calumet River/Burns Ditch

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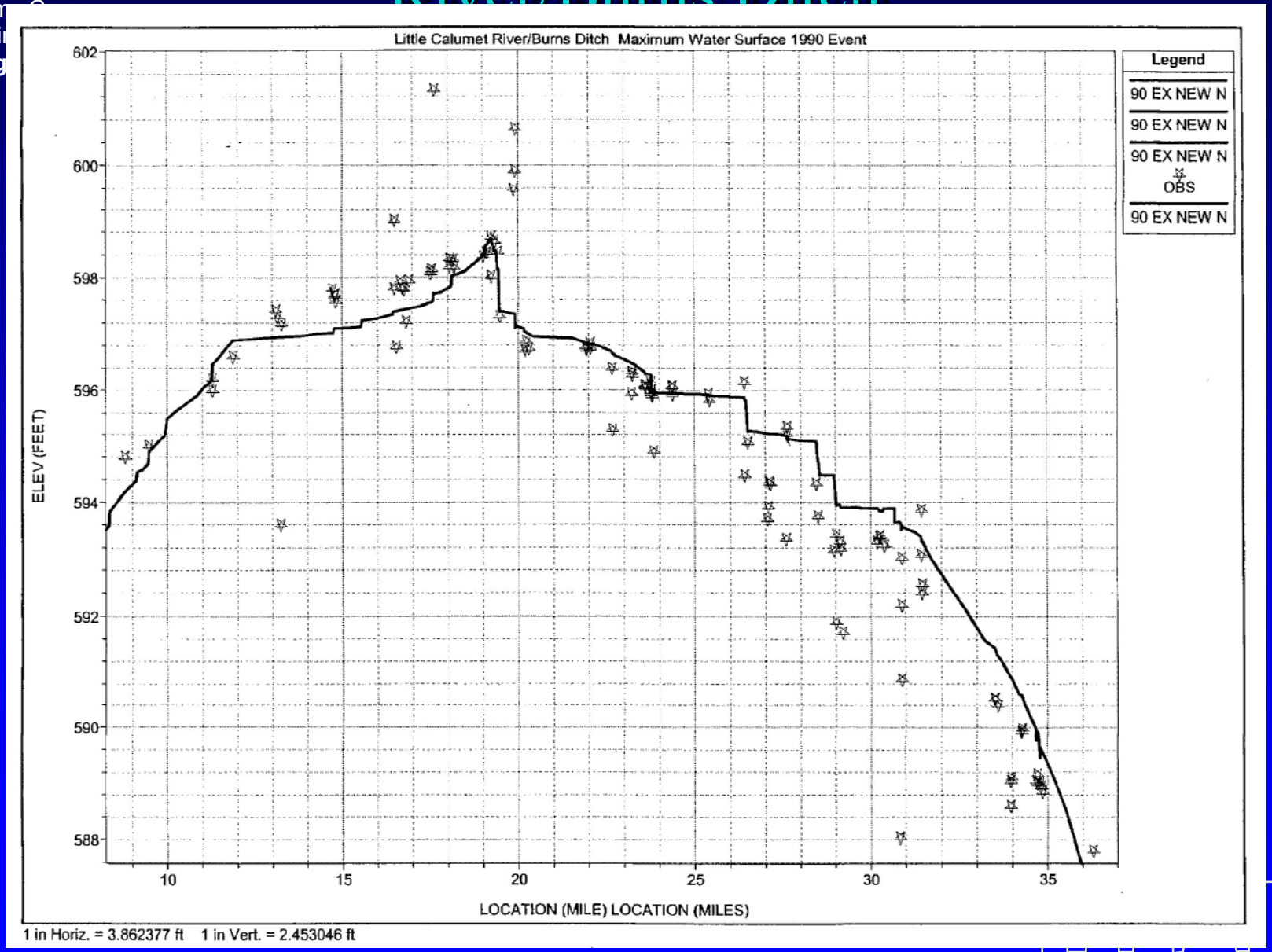

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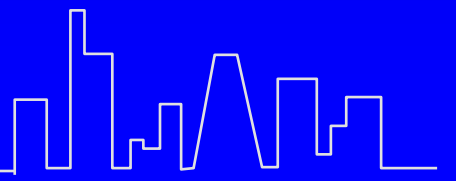
Project Conditions

- Bridge improvements
- Corps Levees
- Hart Ditch Control Structure
- Thorn Creek Reservoir
- Cady Marsh Ditch Diversion Tunnel



LITTLE CALUMET RIVER, INDIANA
FLOOD CONTROL AND RECREATION PROJECT

TYPE OF WORK LEGEND

- LEVEE/FLOODWALLS
- CONTROL STRUCTURE
- EAST BEACH PUMPING STATIONS (NEW)
- WEST BEACH PUMP STATIONS (Rehabilitation)
- OVERBANK FLOODWATER STORAGE

CONSTRUCTION STAGE LEGEND

EAST REACH
- STAGE II
- STAGE III
- STAGE IV

WEST REACH
- STAGE V
- STAGE VI
- STAGE VII
- STAGE VIII

- FY04 STARTS
- FY05 STARTS
- COMPLETE LEVEE SEGMENTS
- FUTURE LEVEE SEGMENTS

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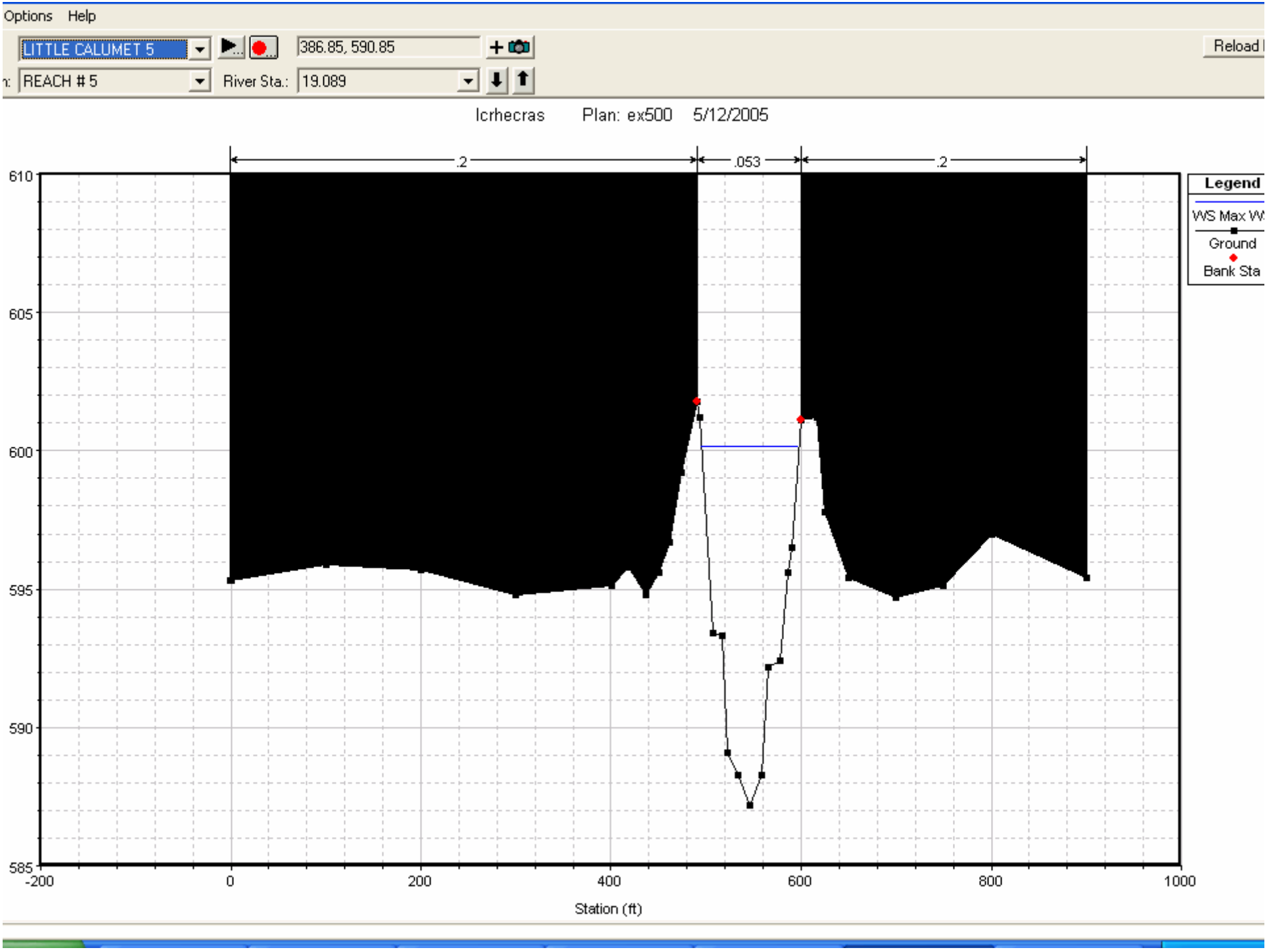
PROJECT MAP

OCTOBER 2004


Options Help
LITTLE CALUMET 5
386.85, 590.85
Reload
REACH # 5
River Sta.: 19.089
lcrhecras Plan: ex500 5/12/2005
.2
.053
.2
Legend
WS Max W
Ground
Bank Sta
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605
600
595
590
585
-200
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200
400
600
800
1000
Station (ft)

Linear Routing Connection

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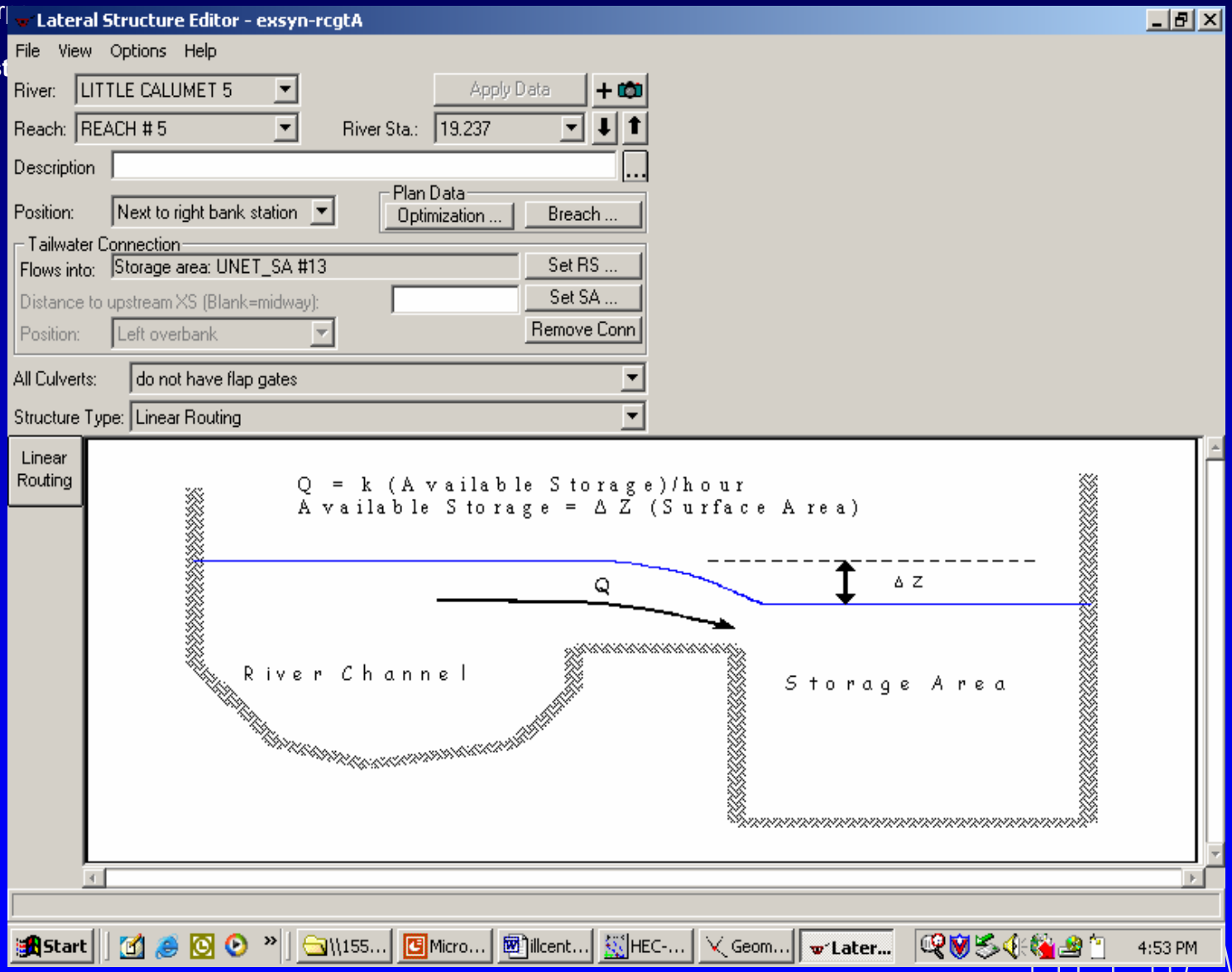

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Illinois Central Railroad Bridge

Illinois Central Bridge (UNET)

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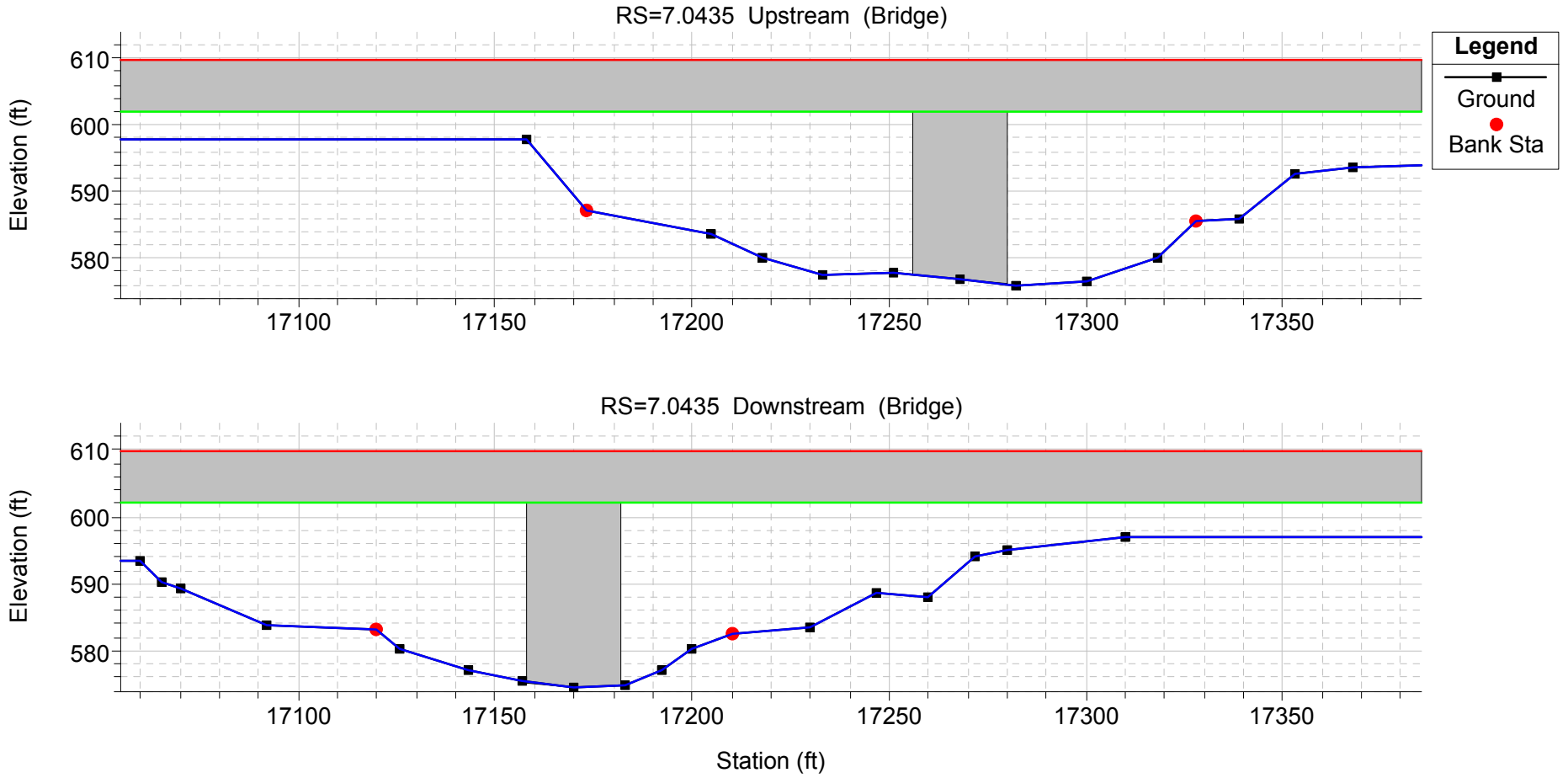

Illinois Central Bridge (HEC-RAS)

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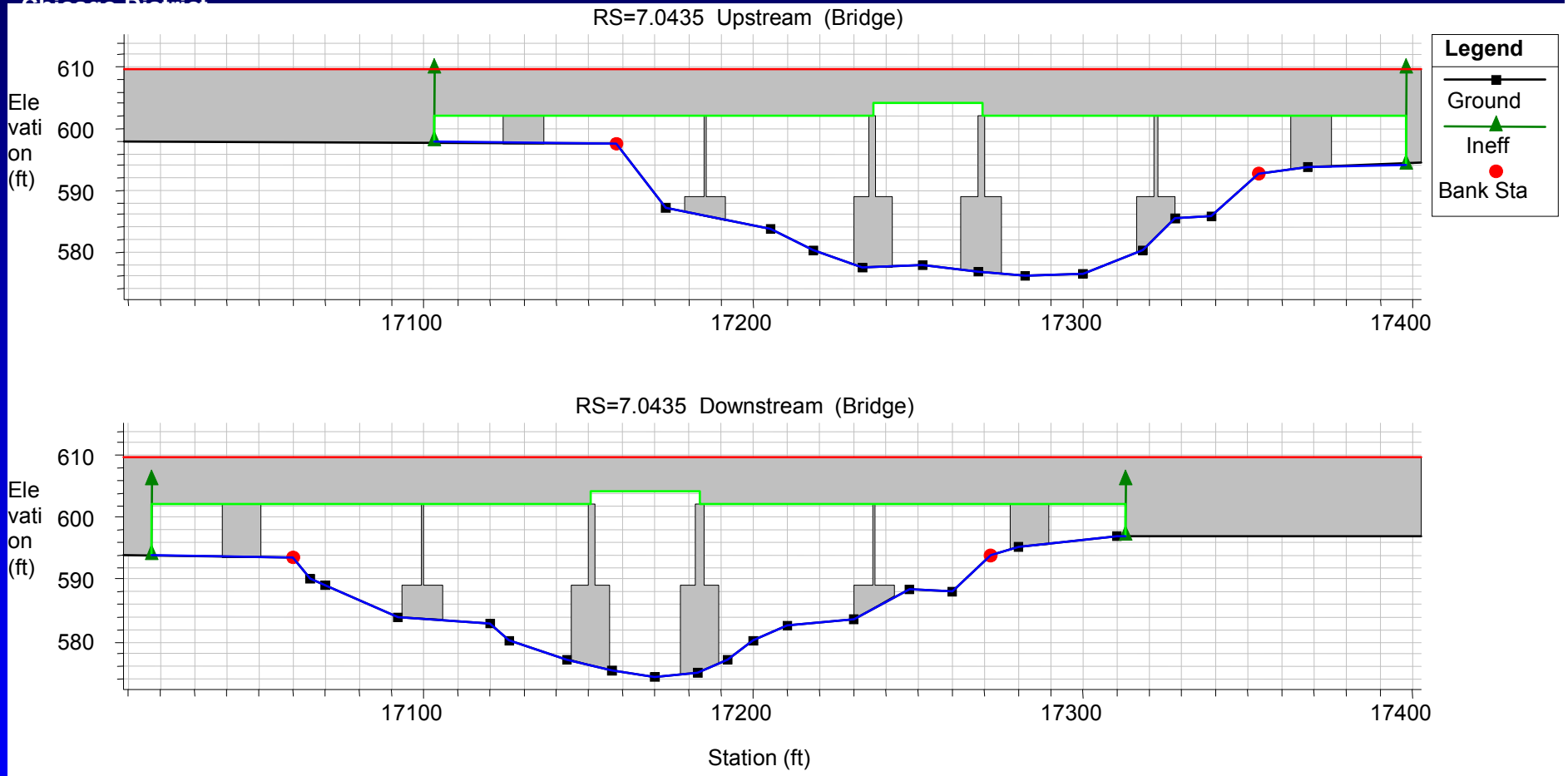

Calumet Expressway (UNET)

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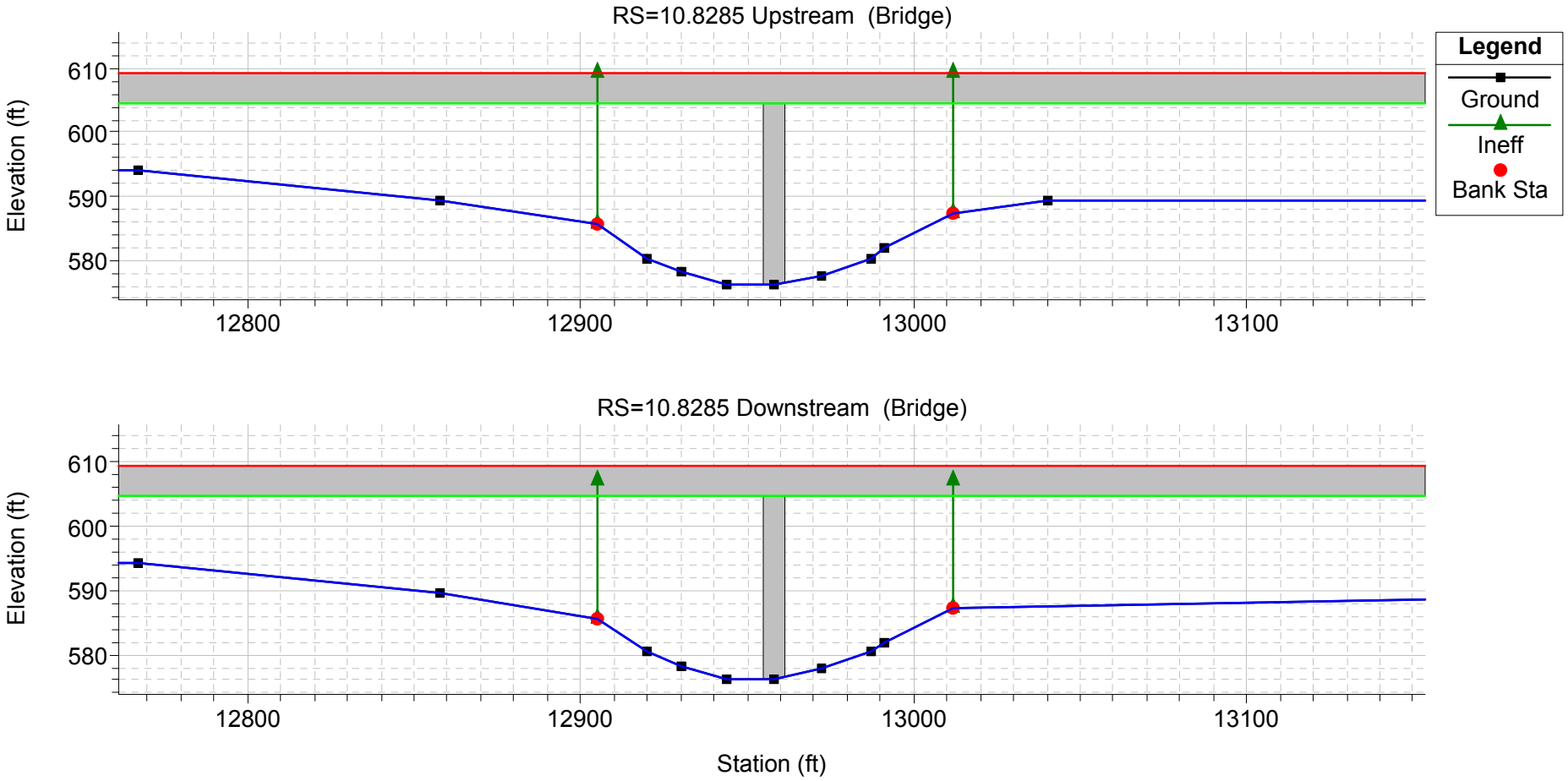

Calumet Expressway (HEC-RAS)

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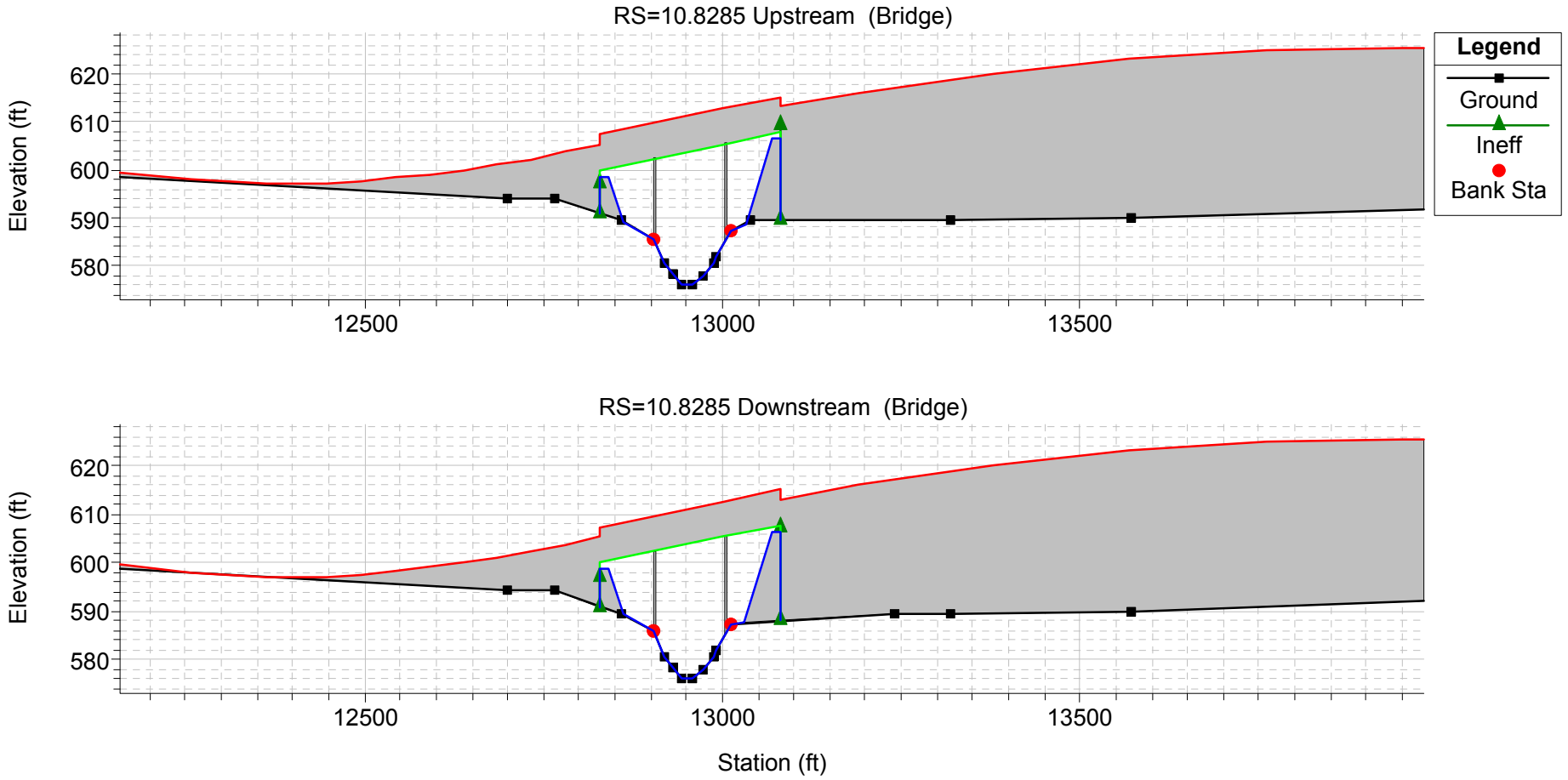

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UNET to HEC-RAS Model Conversion Challenges

- Automatic conversion did not work
- River miles renumbered (also channel relocation, differing river miles for project condition)
- Storage areas renumbered so reconnection and relabling required
- Linear Routing connections needed to be broken up
- Manual conversion of boundary condition file