Use of GIS Data to Develop a Collection System Computer Model

City of East Chicago, Indiana

by

Stephen E. Sticklen

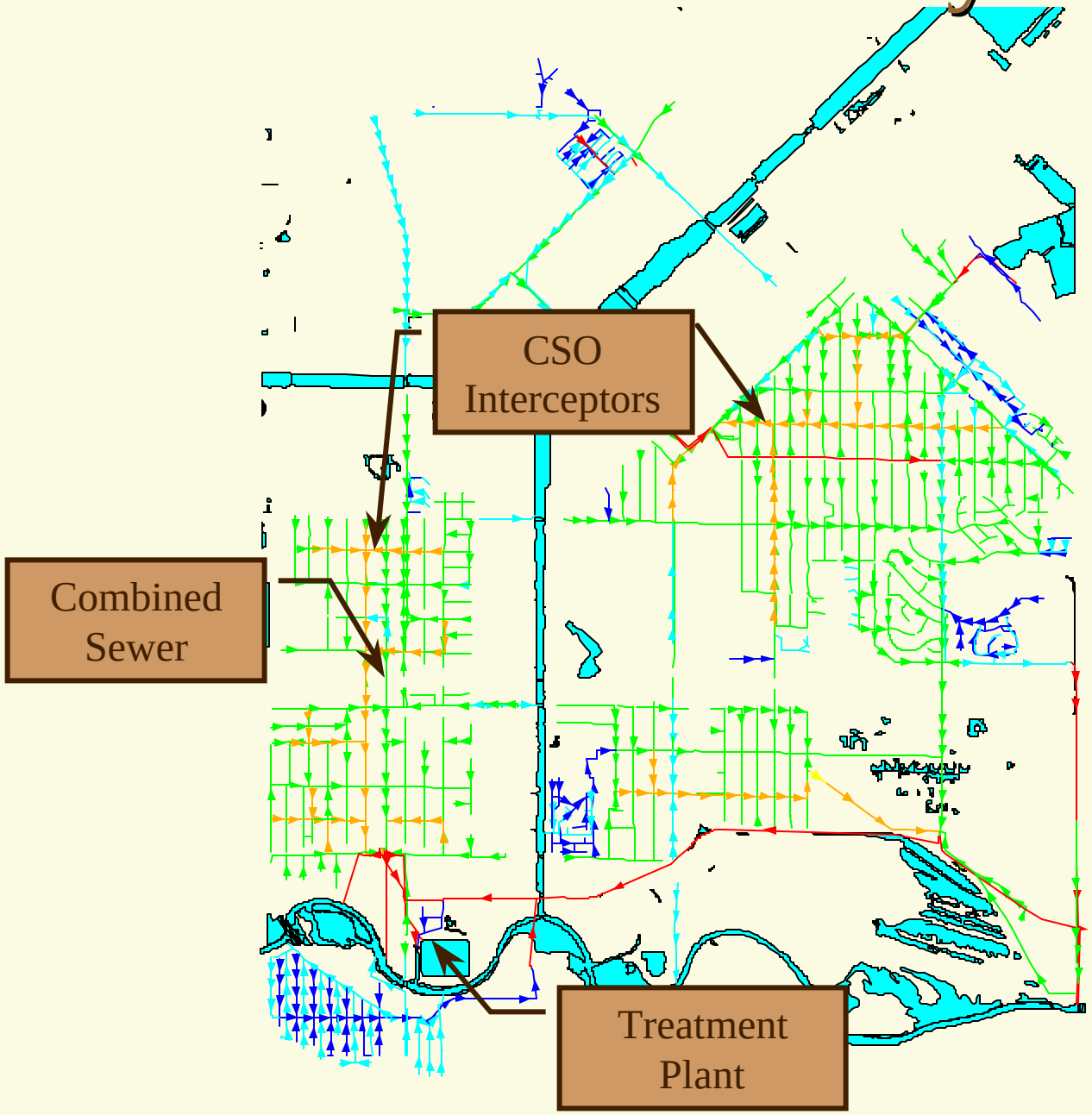
HNTB

East Chicago, Indiana

Existing GIS Data

- ✓ Digital Ortho Photography
- ✓ Planimetric Basemap
- ✓ Topography (USGS DEMs)
- ✓ Collection System Data

Combined Sewer System



Need for Sewer Model

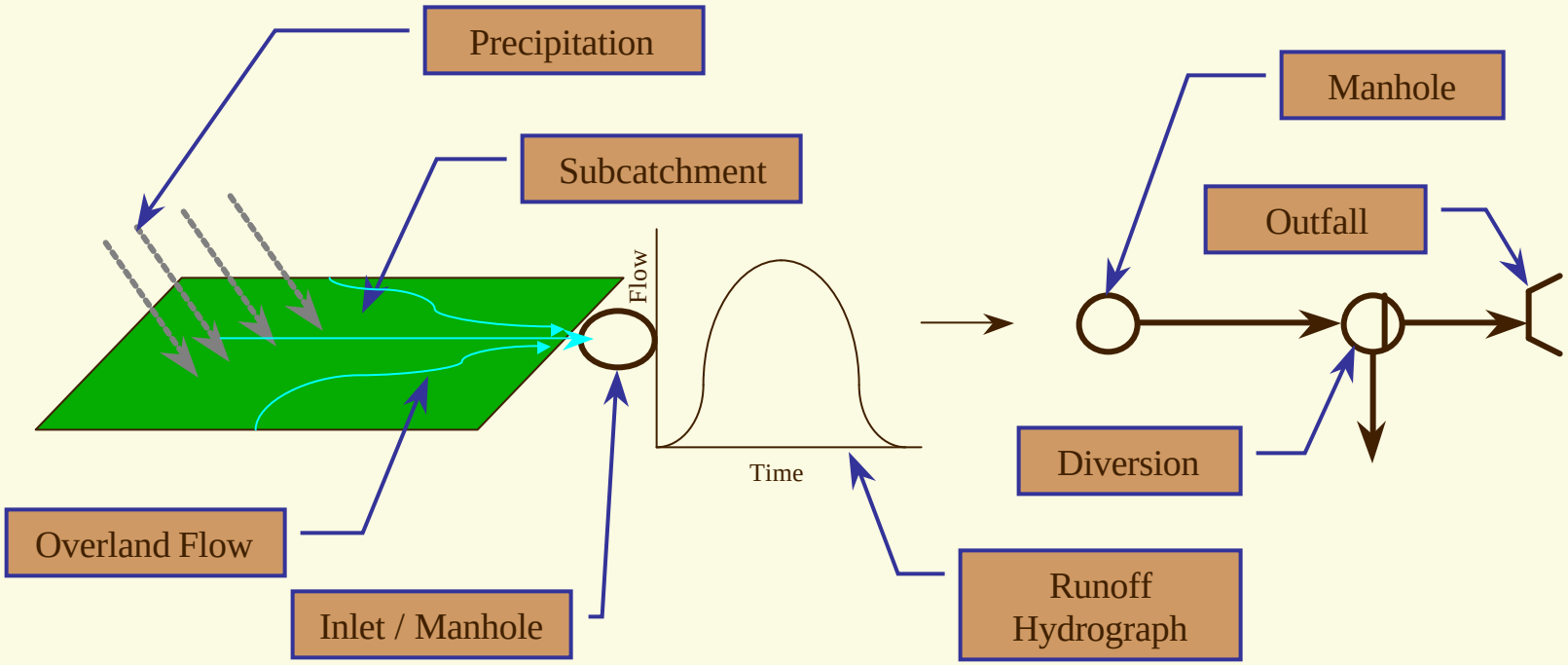
- ✓ Reduce combined sewer overflows (CSOs),
- ✓ Identify hydraulic deficiencies,
- ✓ Reduce basement backups.

Modeling Software

- ✓ SWMM - Storm Water Management Model
- ✓ Developed by USEPA
- ✓ Extremely powerful
- ✓ 2 Primary Components (Computational Blocks)
  - RUNOFF
  - EXTRAN

RUNOFF - EXTRAN

RUNOFF → Linkage → EXTRAN



RUNOFF Data Requirements

- ✓ Subcatchment delineation,
- ✓ soil data,
- ✓ ground slopes,
- ✓ percent impervious

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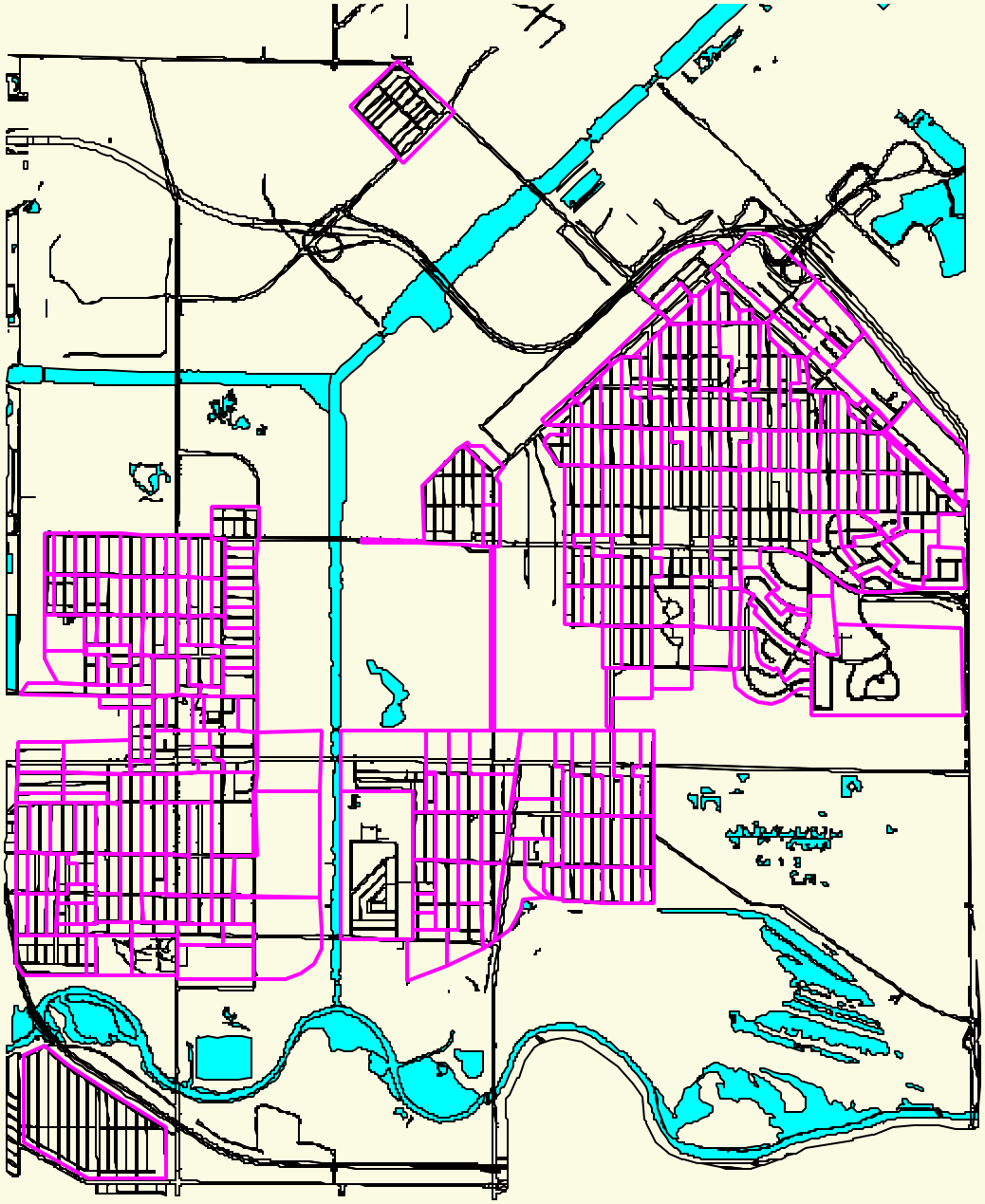
Subcatchment Delineation



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Soil Data

- ✓ No soil data exists in GIS format.
- ✓ USGS soil maps indicated urban disturbed soil.
- ✓ Used average soil parameters for surrounding areas.

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Ground Slopes

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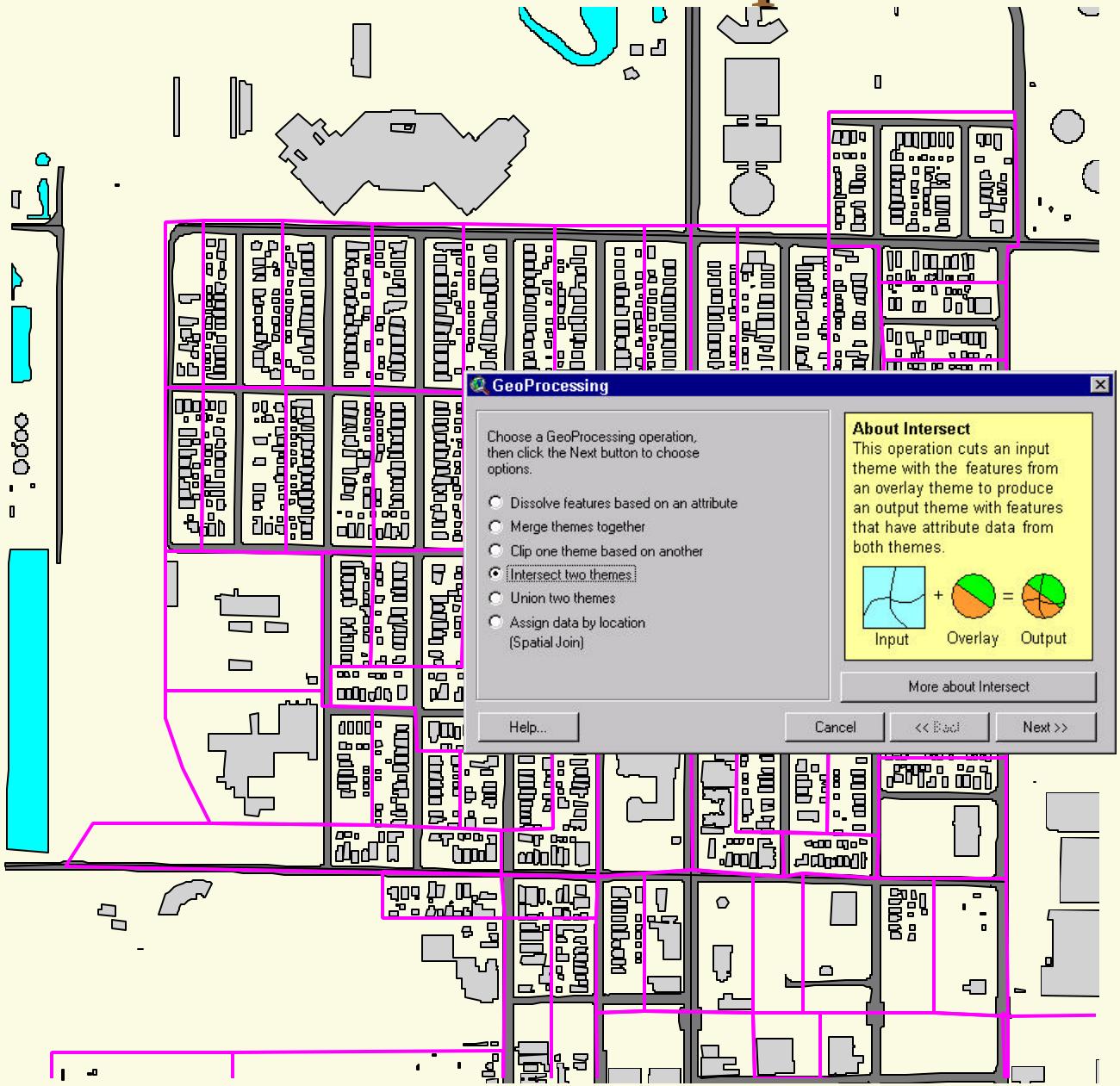
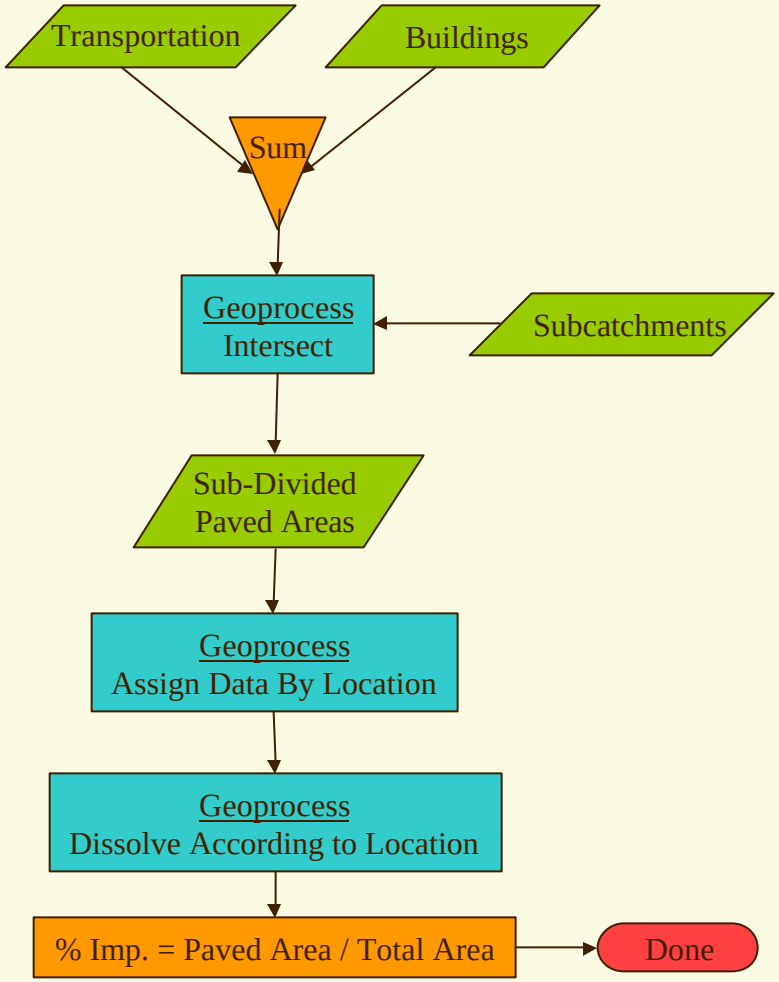
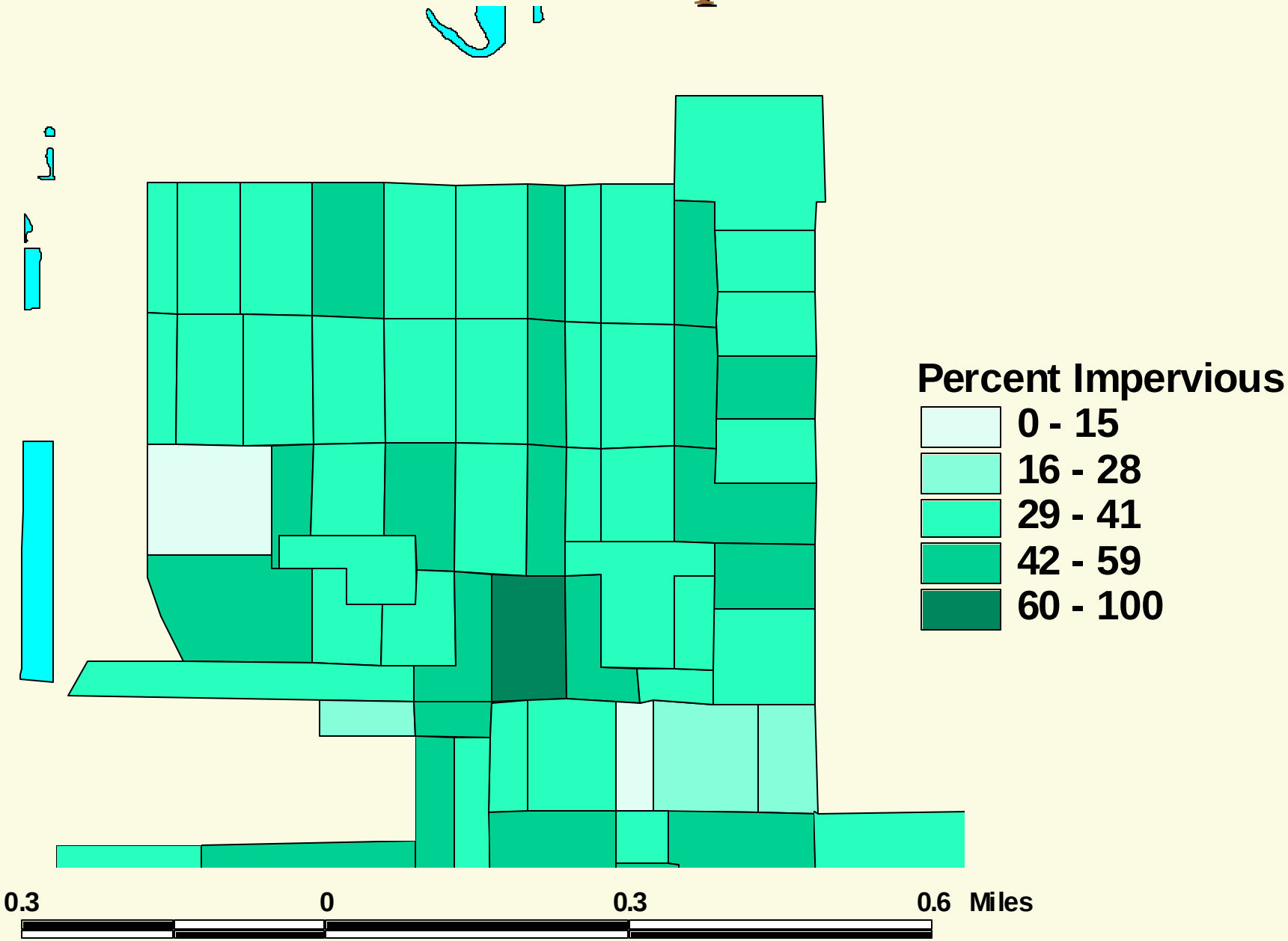
Percent Impervious



% Impervious Computation



Percent Impervious



EXTRAN Data Requirements

- ✓ Simplify & skeletonize collection system,
- ✓ manhole rim & invert elevations,
- ✓ pipe diameters,
- ✓ diversion structures,
- ✓ pump stations (rates, control elevations, etc.)

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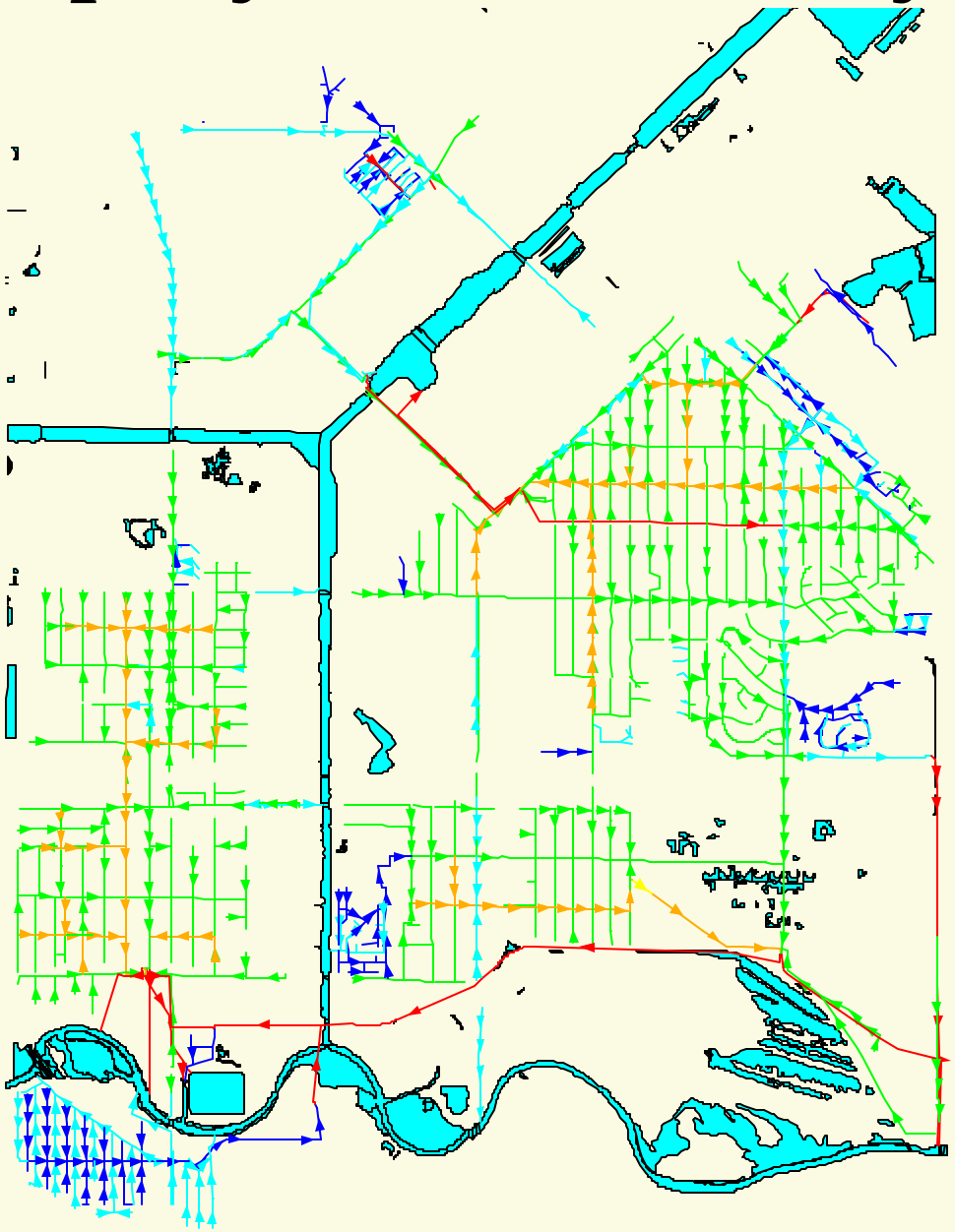
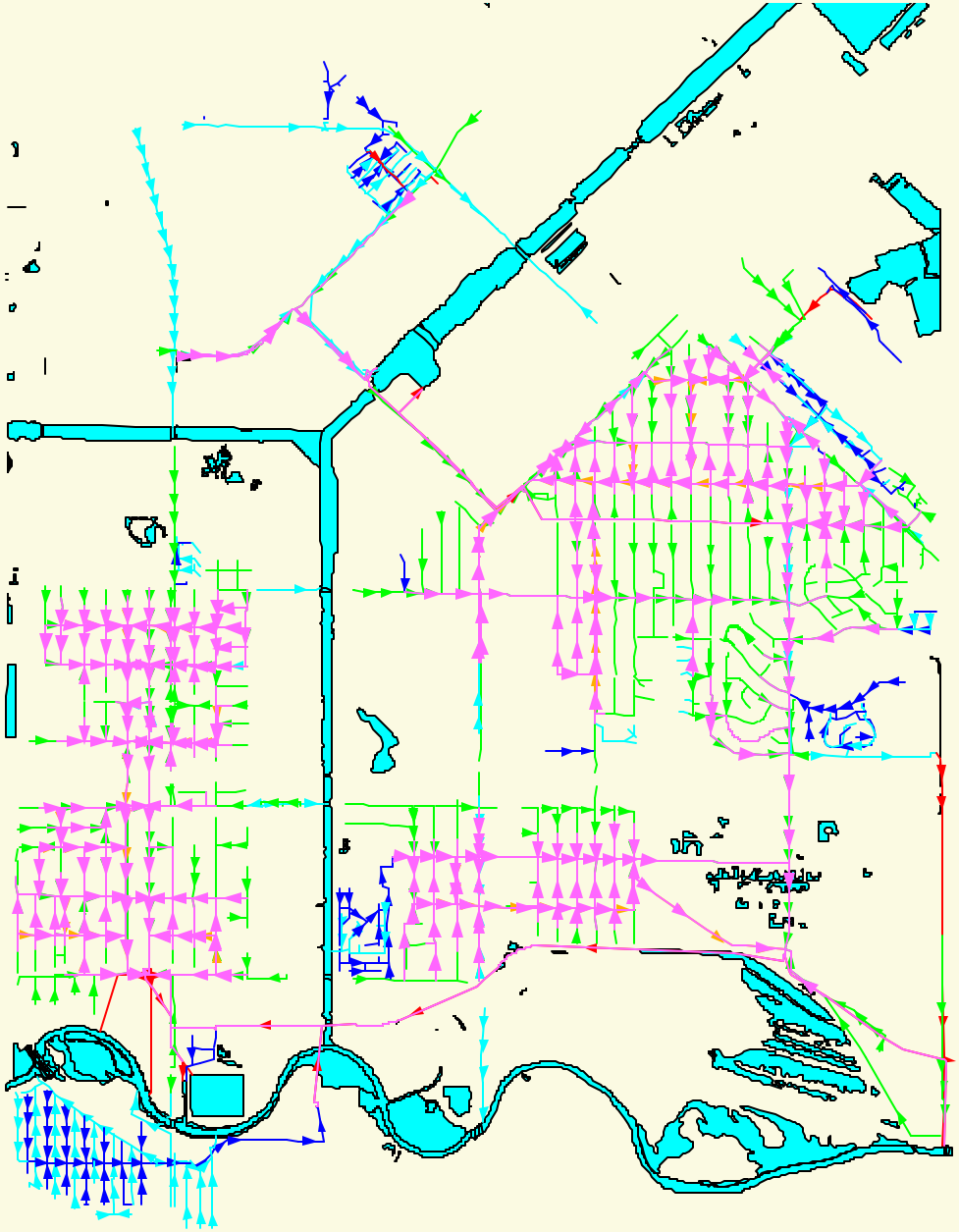
Simplify Collection System



Simplify Collection System



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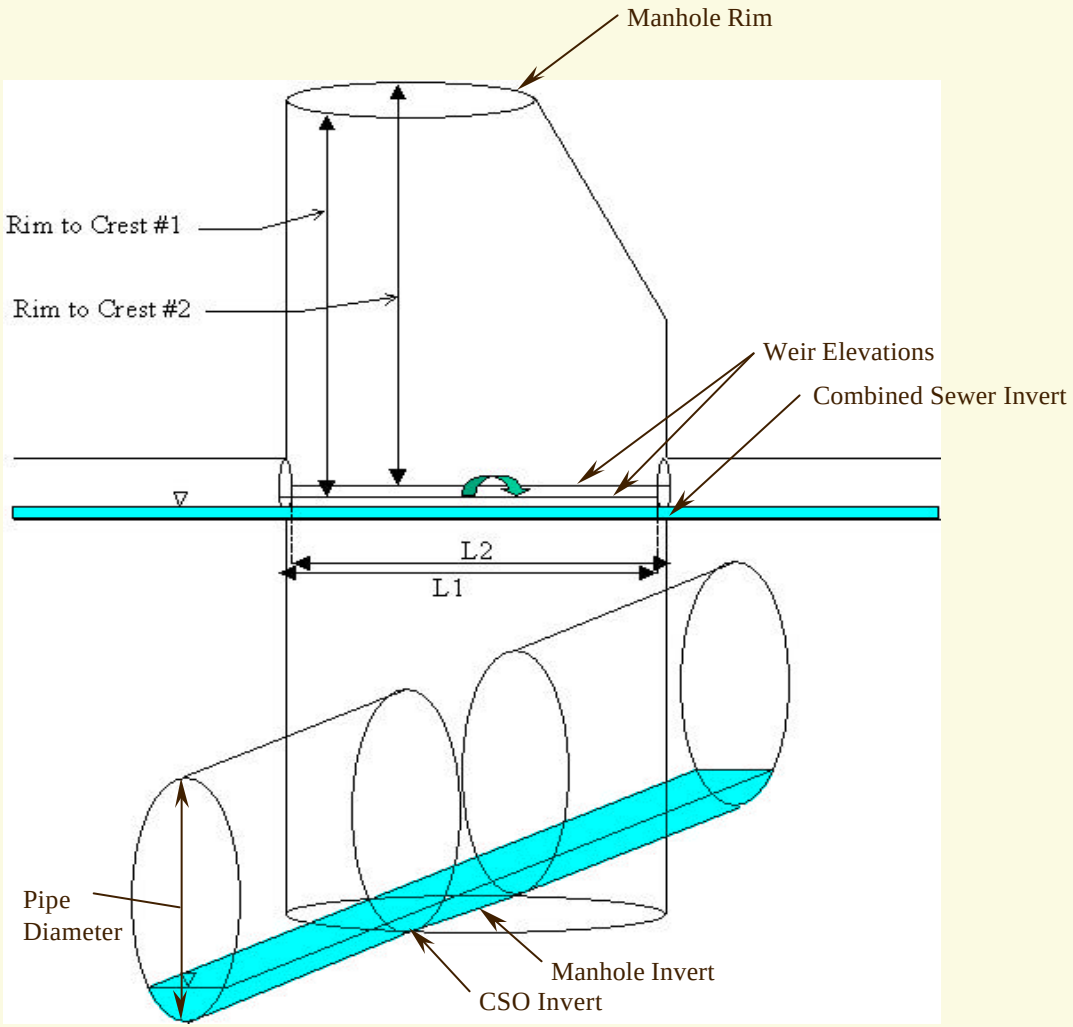
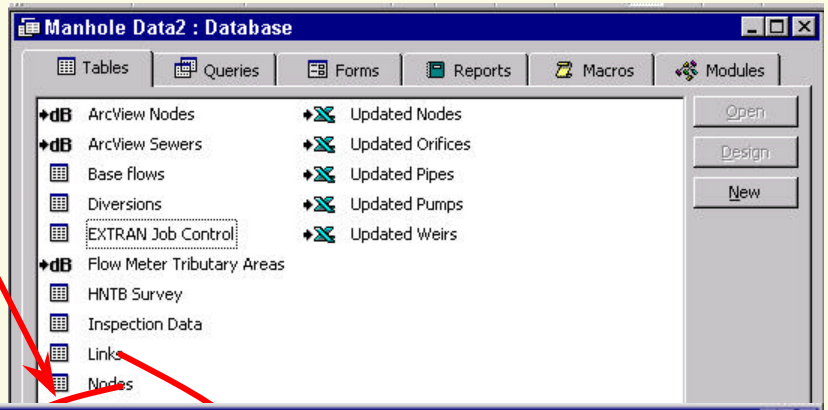
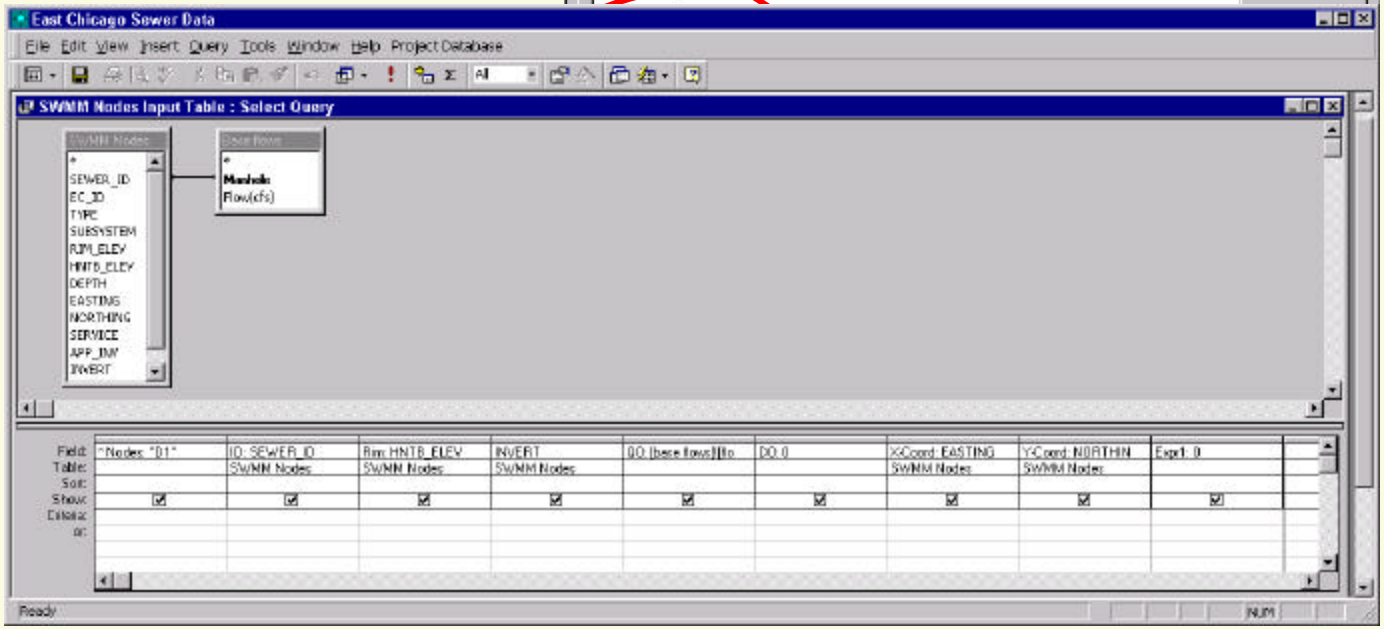
Elevations & Diameters



Export Model Data To SWMM

- ★ Linked directly to GIS data.
- ★ Queries & macros automate creation of model input files.





Model Calibration

- ✓ Flow & rainfall data collection
- ✓ Simulation of measured storms
- ✓ Comparison of simulated & measured flows
- ✓ Adjustment of model parameters (ground slope, percent impervious)

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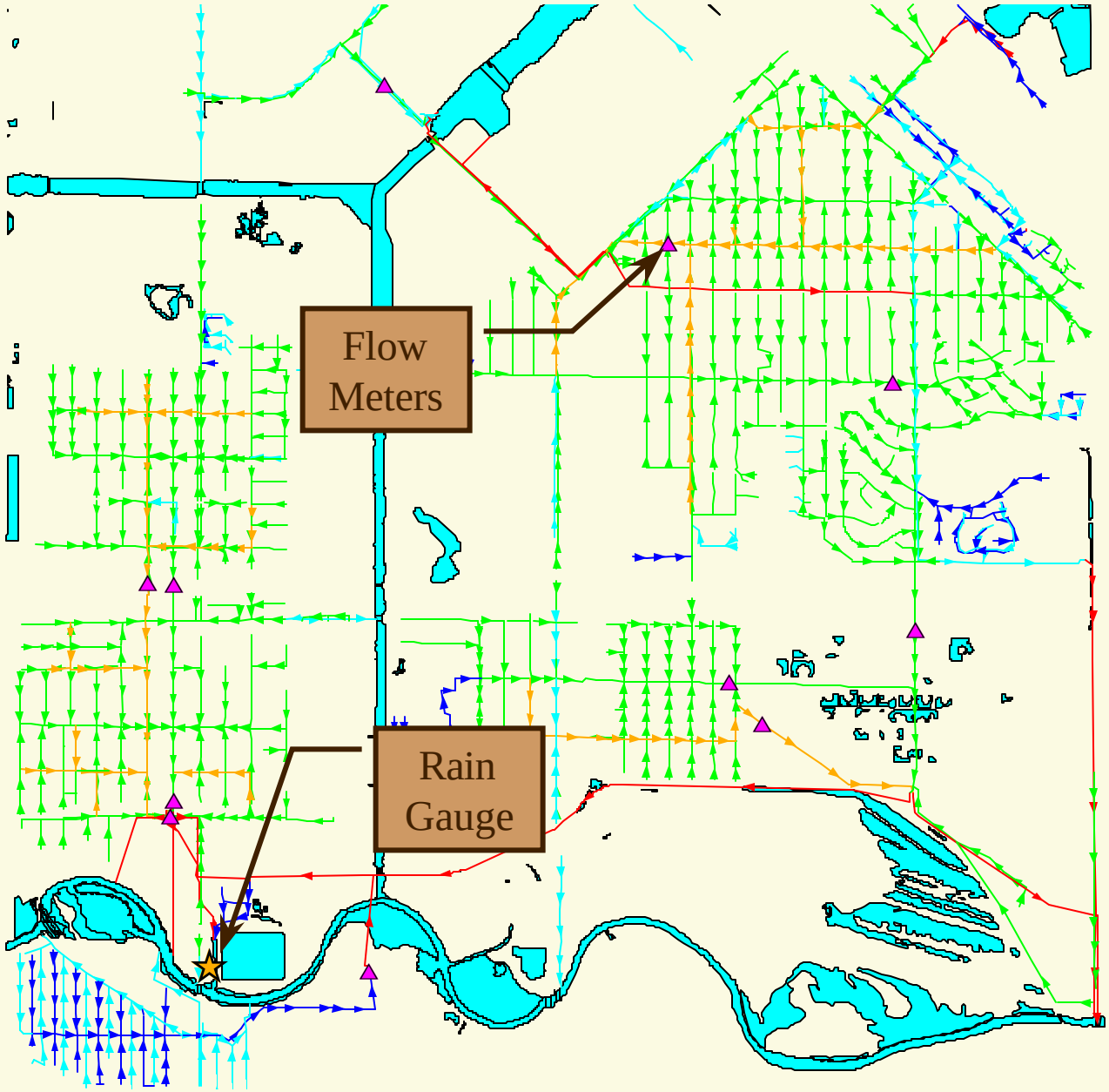
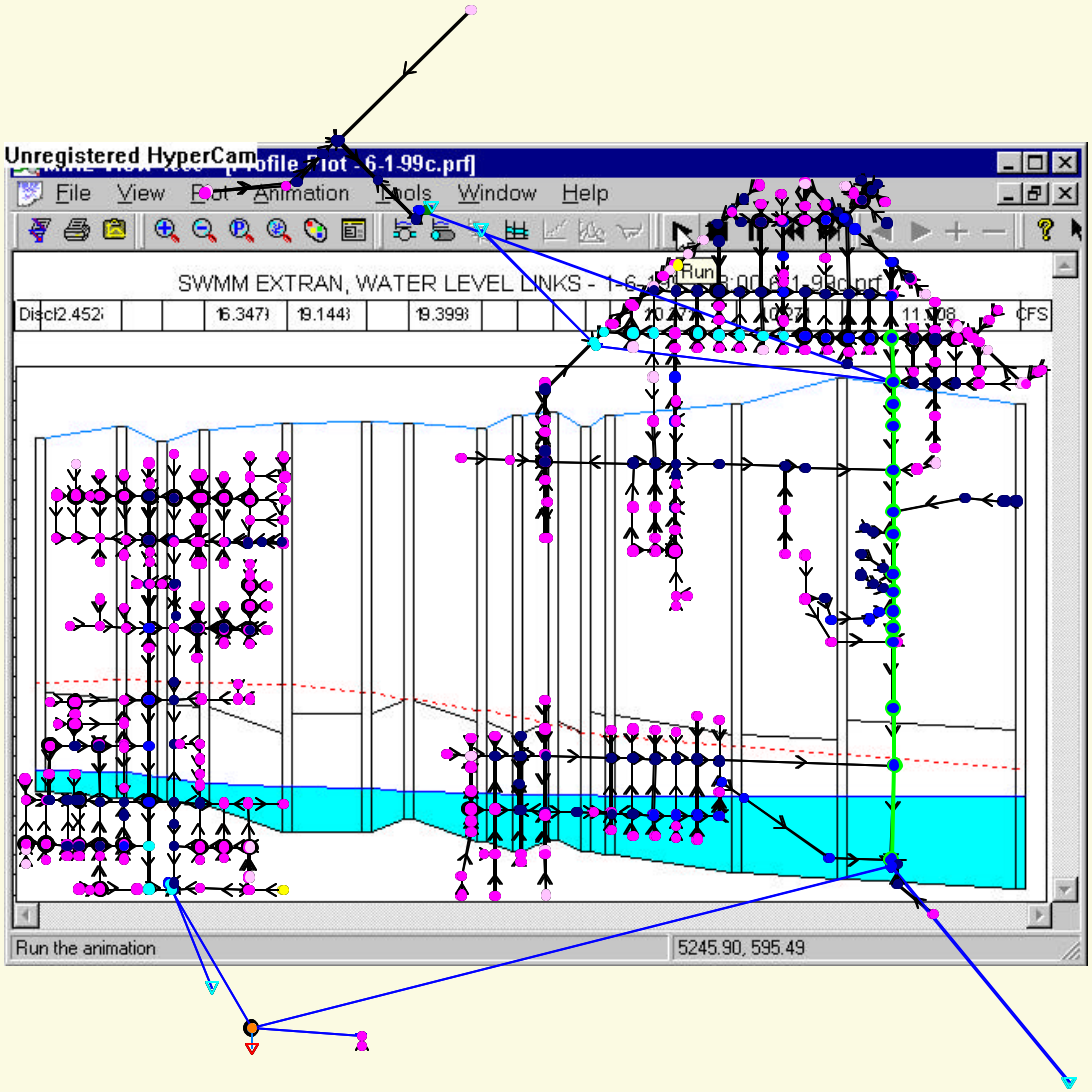
Flow Meter Locations



Animation of Simulation Results

SWMM EXTRAN, WATER LEVEL JUNCTIONS - 2-6-1999 03:20 6-1-99c.prf



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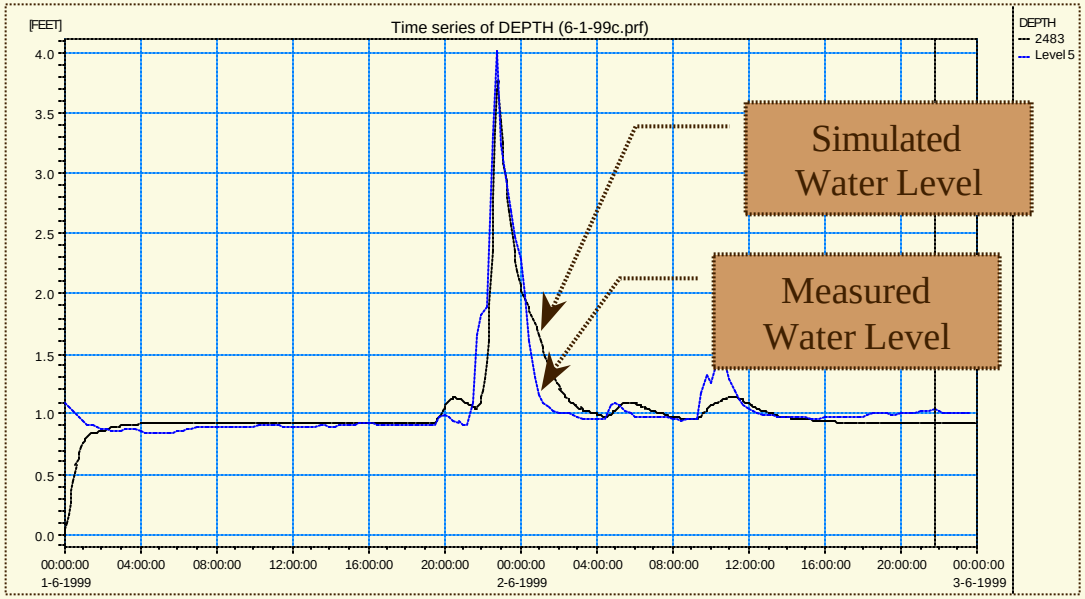
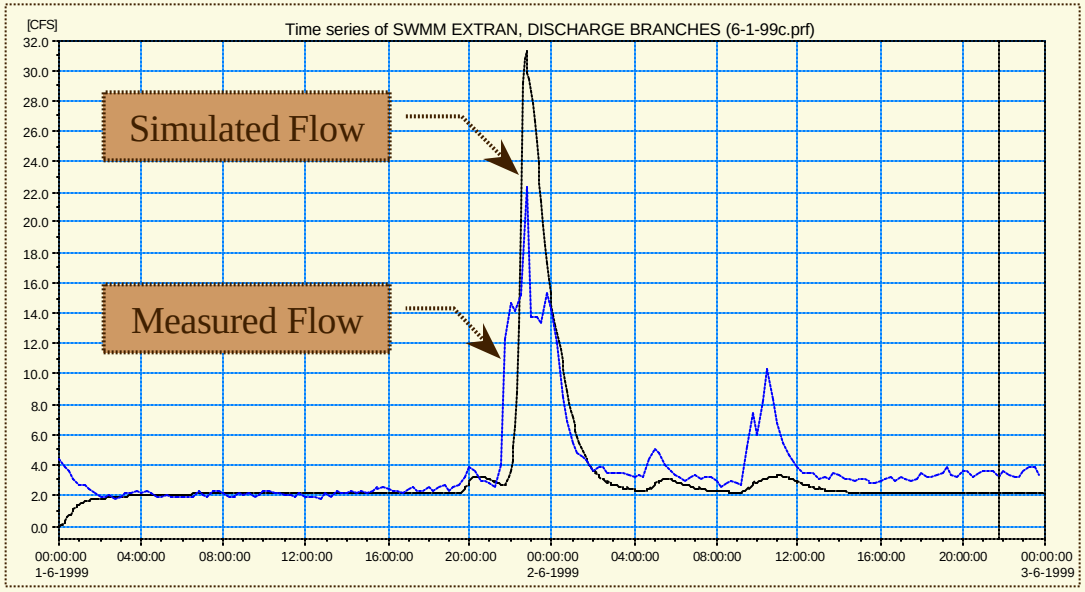
Comparison of Flows & Levels





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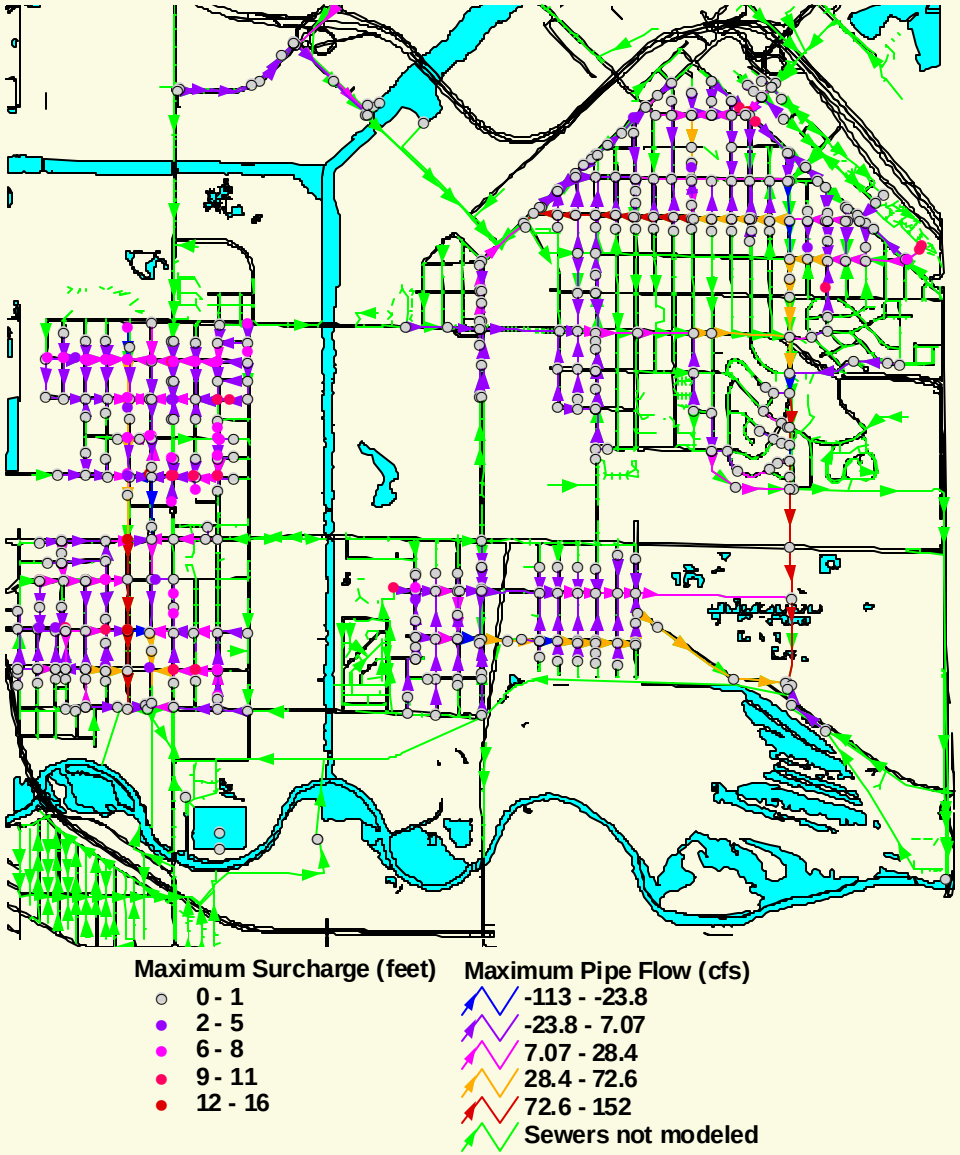
Model Results Easily Transferred to GIS and Displayed In ArcView



Applications

- ✓ Reduce combined sewer overflows (CSOs),
- ✓ Identify hydraulic deficiencies,
- ✓ Reduce basement backups,
- ✓ Available pipe capacities.

Costs

- Total Length of Sewers = 125 miles
- Total # of Manholes = 2,426
- Length of Modeled Sewers = 49 miles (39%)
- # of Modeled Manholes = 575 (24%)
- Model Development Cost = $22,500
- Flow Monitoring & Calibration Cost = $63,000
- Total Cost = $85,500
- Approx. Cost per Mile of Sewer = $683 / mile

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