Modeling Surface Runoff and Contaminants in Large Metropolitan Regions

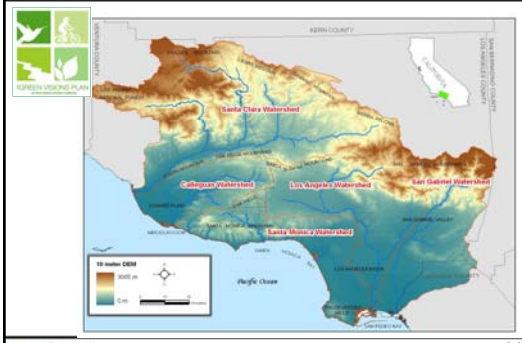
GIS research laboratory
John P. Wilson
University of Southern California
GIS Research Laboratory

USC Water Retreat

Davidson Conference Center

2 April 2010

Green Visions Project Study Area

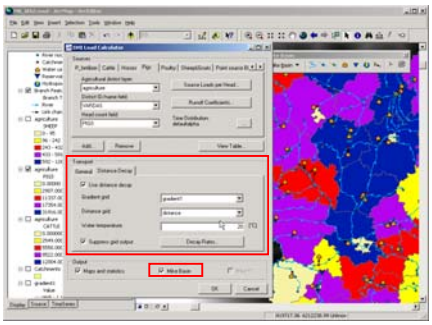


Los Angeles Basin …

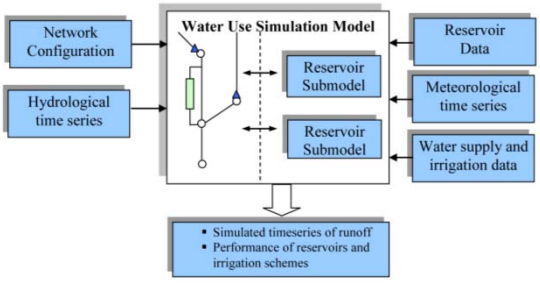
GVP Watershed Modeling Goals

- Determine quantities of contaminants entering stream network
- Simulate transport of contaminants in reservoirs, rivers, and groundwater
- Predict water quality by stream catchment
- Used Danish Hydraulic Institute's MIKE BASIN modeling tools

User Interface – WQ Module

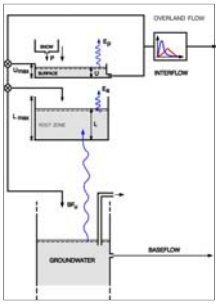


MIKE BASIN



Model Implementation

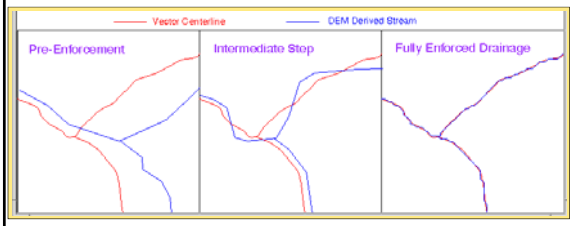
- Prepare model and data
- Calibrate rainfall-runoff relationships
- Calibrate delivery and transport of contaminants
  - NO3-N, NH3-N
  - Total P
- Validate rainfall-runoff and water quality predictions



National Hydrography Dataset

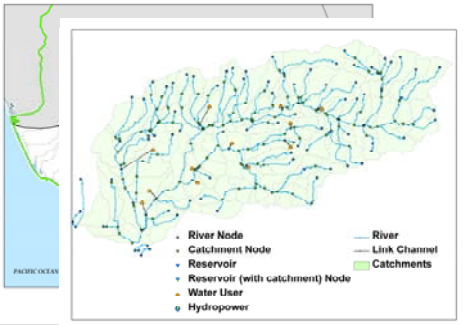
- Rich cartographic feature content for making maps
- Stream addressing system for linking water-related information to national drainage network
- Upstream/downstream modeling along drainage network
- Infrastructure for maintenance and enhancement

Drainage Enforcement



Slide Courtesy of Pete Steeves

Subwatershed Delineation

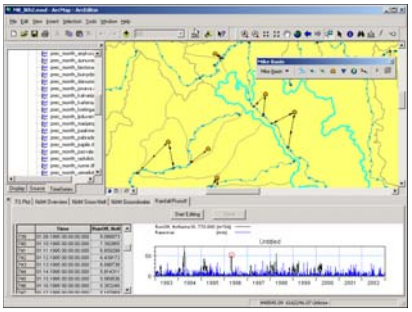


im
mum

Rainfall-Runoff Analysis

Additional inputs …

- Rainfall, potential evaporation & temperature time series
- Stream flow data for model calibration & validation



Monitoring Data

Rainfall-Runoff Results

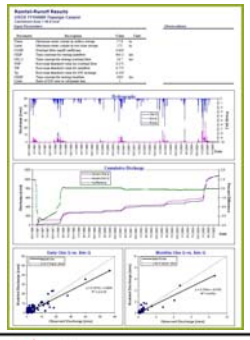
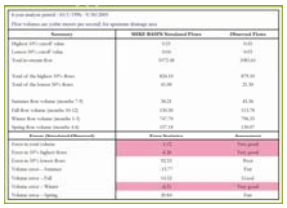
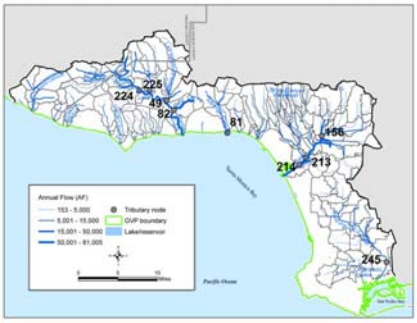


Table 9 General calibration/validation targets or tolerances for assessing model performance (Aqua Terra Consultants 2004)

	% difference between simulated and observed values			
	Very good	Good	Fair	Poor
Hydrology/Flow	<10	10 - 15	15 -25	>25
Water Quality/Nutrients	<15	15 - 25	25 -35	>35



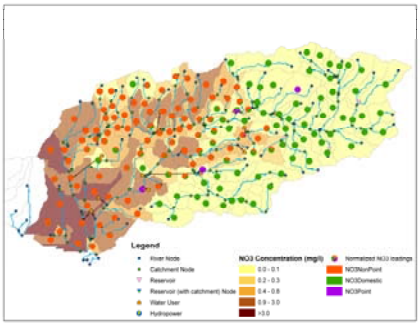
Santa Monica Bay Flows



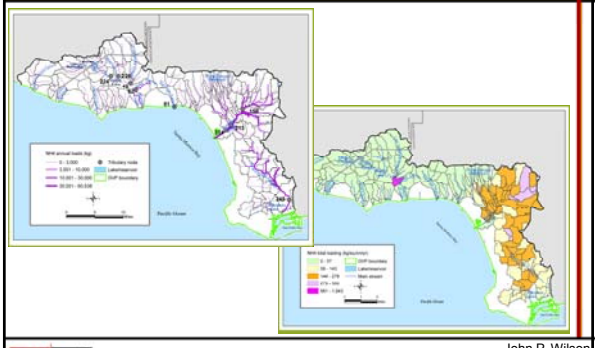
Contaminant Sources

- Fertilizer Sources
  - Crop data
  - Fertilizer application rates
  - Distance decay factor (calibration)
- Livestock Sources
  - Very few
- Domestic Sources
  - Population estimates
  - Sewage treatment data
  - Distance decay factor (calibration)
- Point Sources
  - Five major NPDES

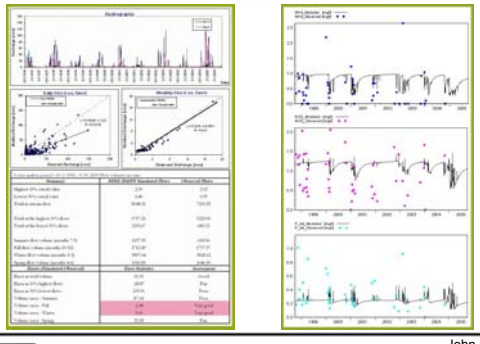
NO3-N Predictions



Santa Monica Bay Loads …

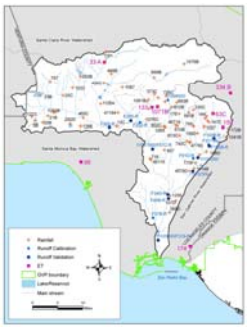


Water Quality Results



Spatial Granularity – LA River

- Drains 2,002 km^2
- 1,783 unique stream segments (links) in NHD Plus
- 171 tributaries and sub-catchments used for MIKE BASIN model runs
- 11.7 km^2 (1,171 ha) minimum map unit



GIS research laboratory

John P. Wilson
2010 USC Water Retreat

Final Thoughts

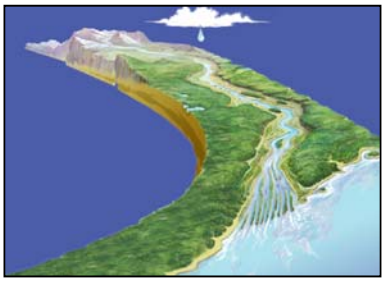
- Rethink our research paradigms
  - New ways to represent, measure and interpolate variables of interest, build and apply models & inform decisions
  - Sensitivity of MIKE BASIN to model design decisions and inputs for example
- New technologies
  - Computing, modeling & sensor networks will have major role to play in future

GIS research laboratory

John P. Wilson
2010 USC Water Retreat

Fundamental Goal …

…is to follow a drop of water from where it falls on the land, to the stream, and all the way to the ocean



GIS research laboratory

John P. Wilson
2010 USC Water Retreat