Applying the Sub-Daily SWAT Model to Assess Aquatic Life Potential under Different Development Scenarios in the Austin, Texas Area

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Presented at

2011 International SWAT Conference
Toledo, Spain

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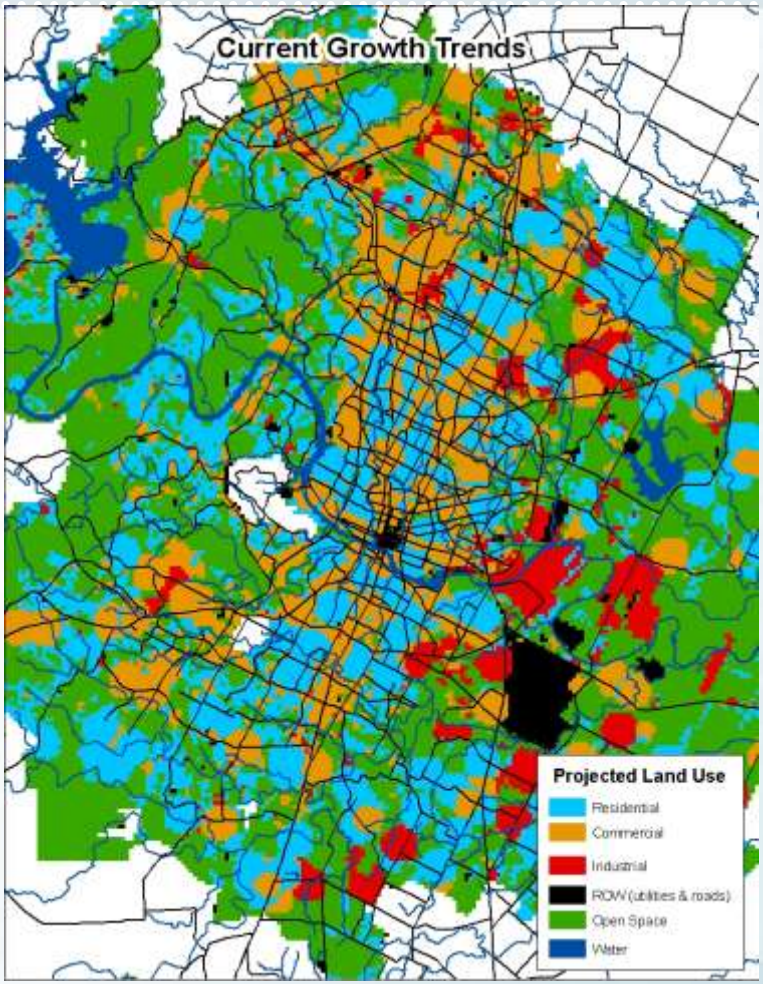
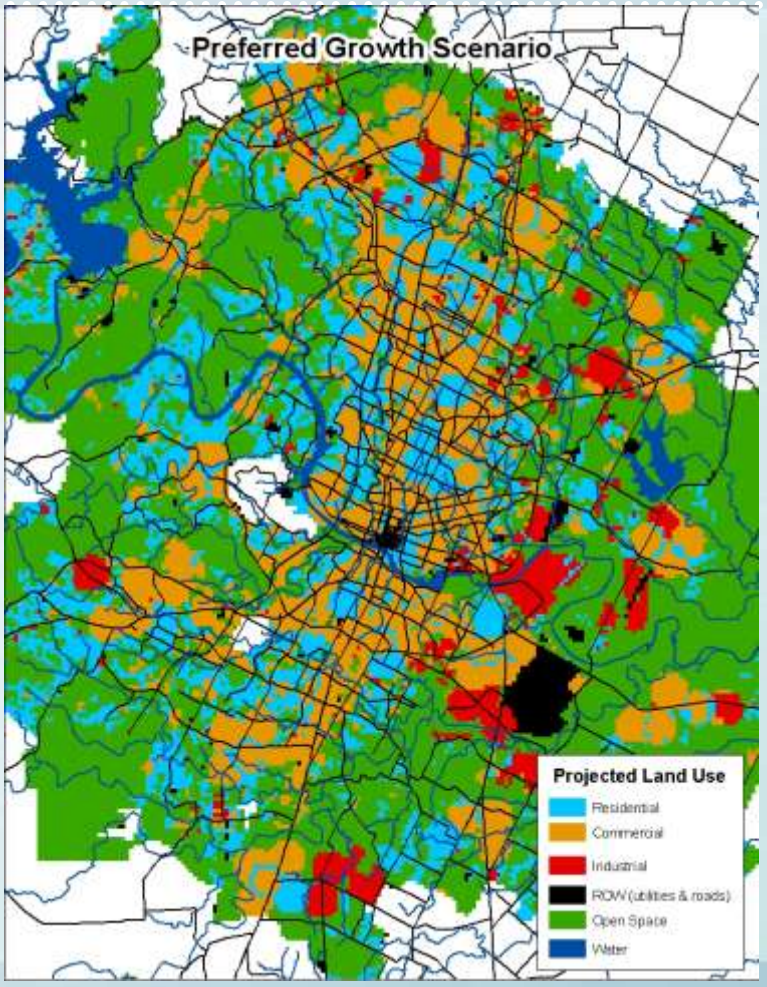
Differing Growth Scenarios





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Purpose and Objectives

- Identify measures of flow regime changes critical to aquatic life at different locations that are well-modeled by SWAT
- Evaluate changes in aquatic life potential at different locations with respect to critical hydrologic metrics

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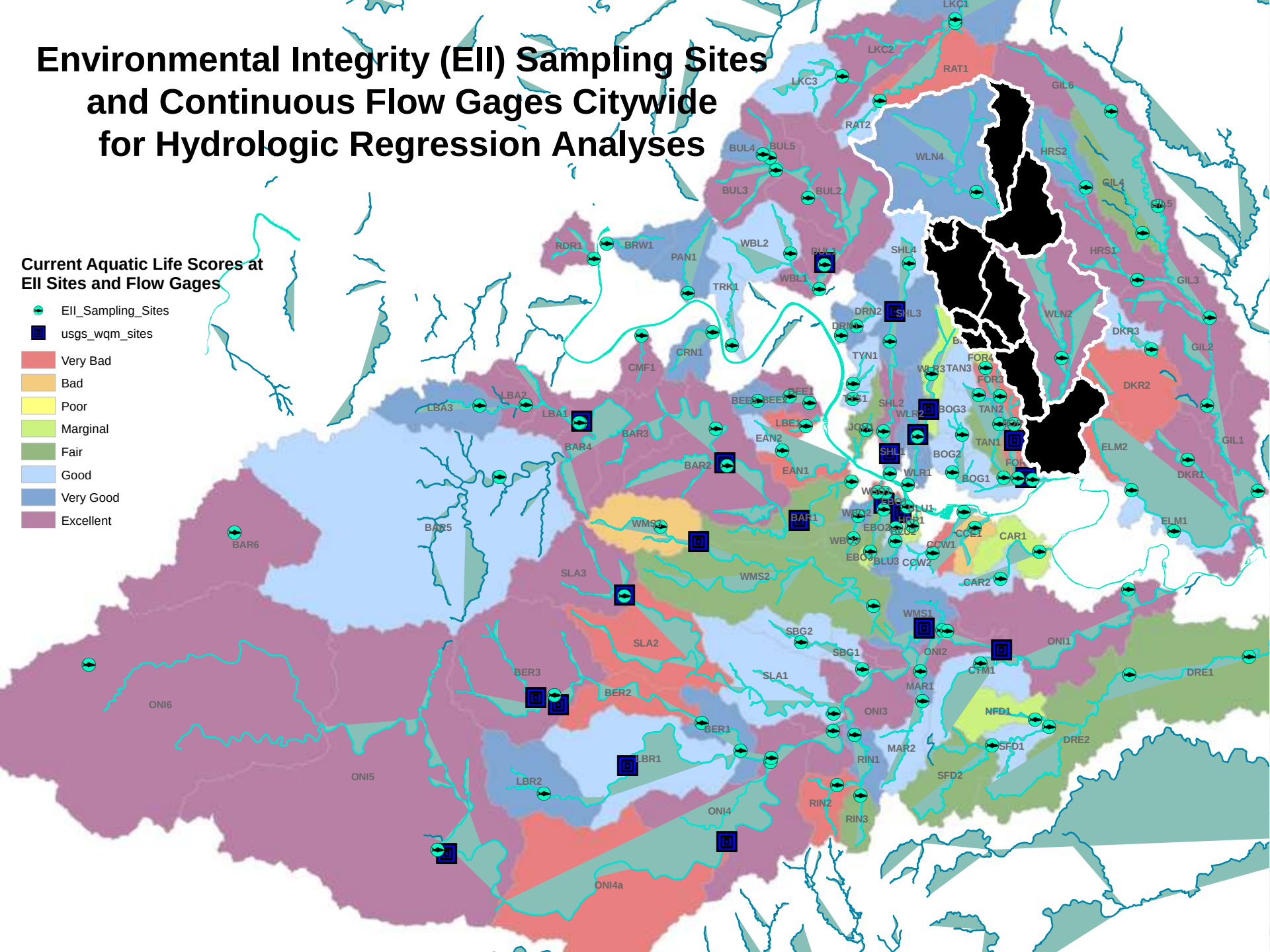
Environmental Integrity (EII) Sampling Sites and Continuous Flow Gages Citywide for Hydrologic Regression Analyses



Aquatic Life Evaluation

$$AQP = 87.7539 - 0.016 * (Qpeak / Area) + 4.3842 * \ln(Q90) - 21.2655 * (Avg\_Rise)$$

where,

Qpeak/Area = peak flow rate in cms/100 sq km
Q90 = 90th percentile flow rate in cms; 90% of flow is below this value
Avg_Rise = mean of positive differences between consecutive rising flow values (rise rate in cms/sec)

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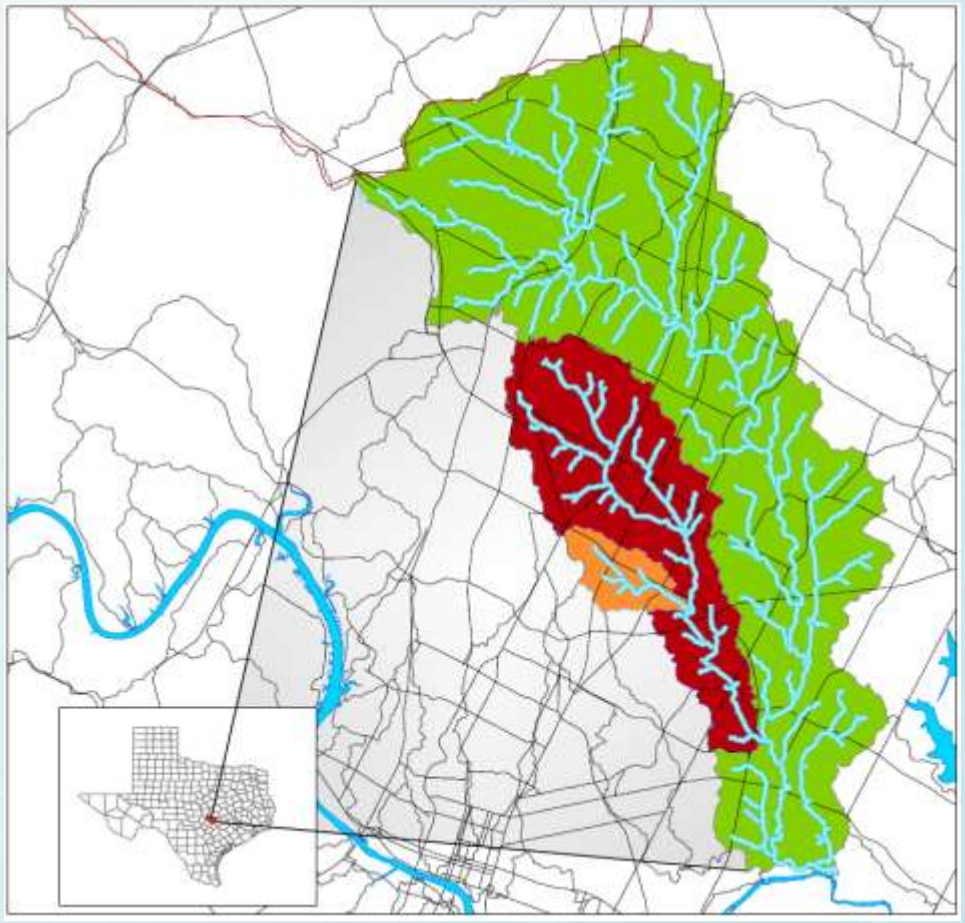
Study Area - Walnut Creek

- 145.8 km^2 watershed
- USGS gage data 1967 to present
- 3-m DEMs
- SURRGO Soils
- 15-minute rainfall at 18 gauges
- Lot level land use
- 298 sub-basins
- ~4500 HRUs
- Sub-daily
  - NSE = 0.74
  - r^2 = 0.78



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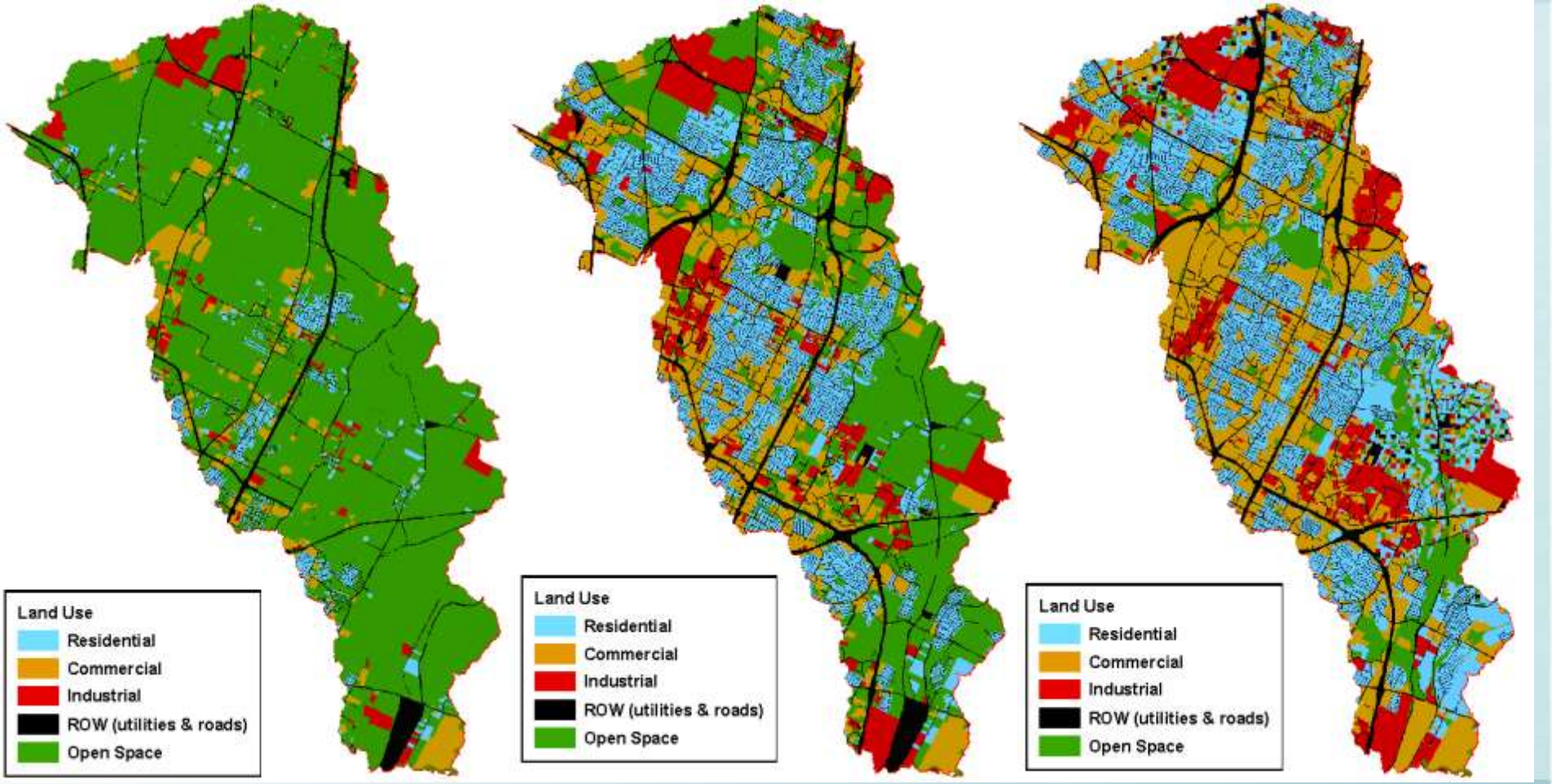
Walnut Land Use Scenarios



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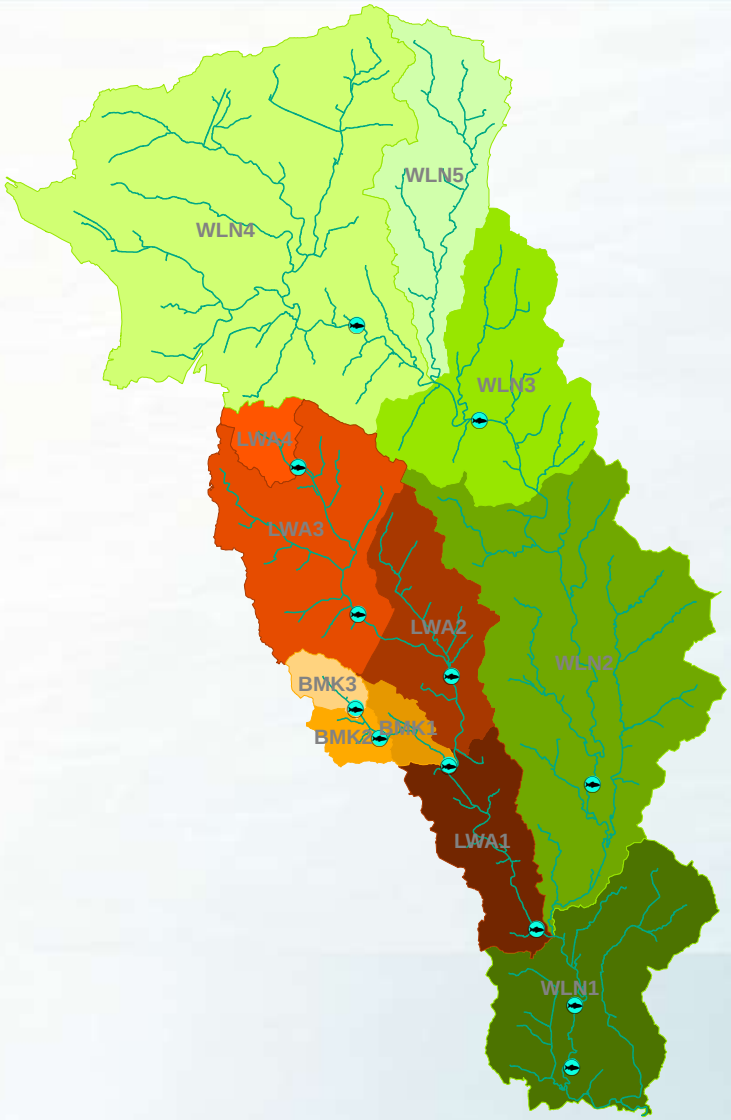
Environmental Integrity Sampling Sites for Benthic & Diatom Communities on Walnut Creek



- Environmental Integrity Index (EII) – Aquatic Life Support Assessment
- Benthic & Diatom Community Assessment – Changes over time:
  - Every three years, 4x/yr
  - Every two years, 3x/yr
  - Every two years, 1x/yr

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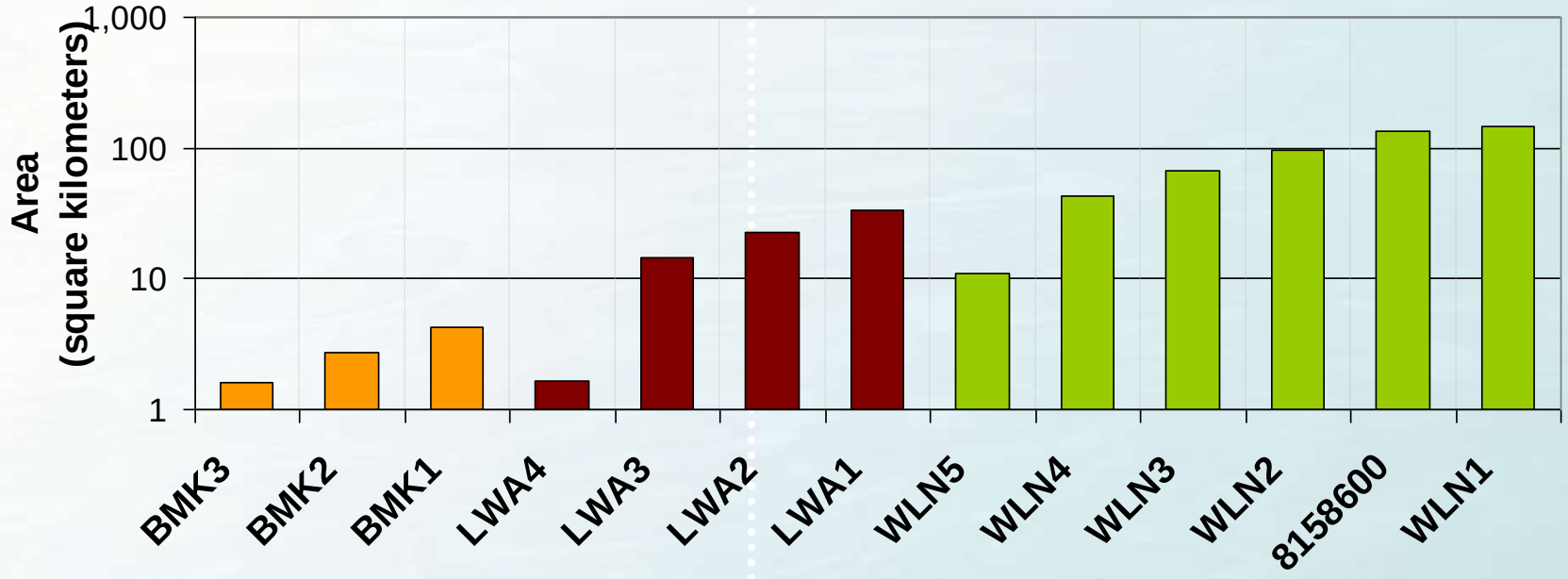
EII Reaches – Drainage Area



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Walnut @ Metric Blvd

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Walnut @ I-35

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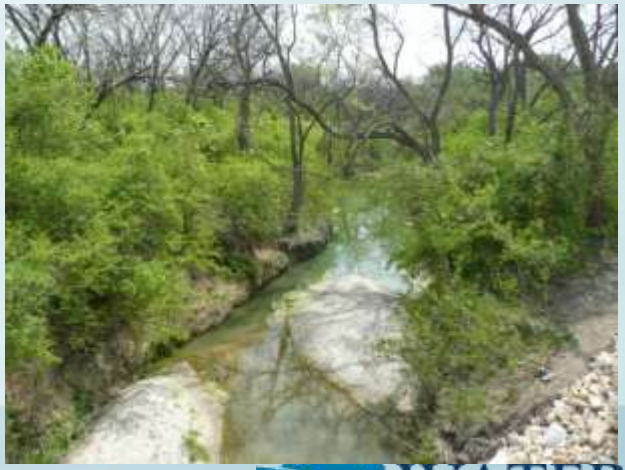
Walnut @ Old Manor Rd



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Walnut @ SPRR Bridge

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Tributaries

Little Walnut

Buttermilk

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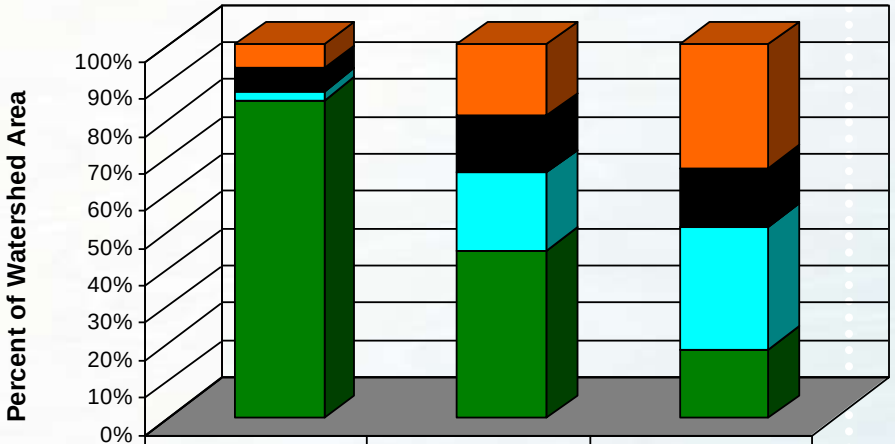
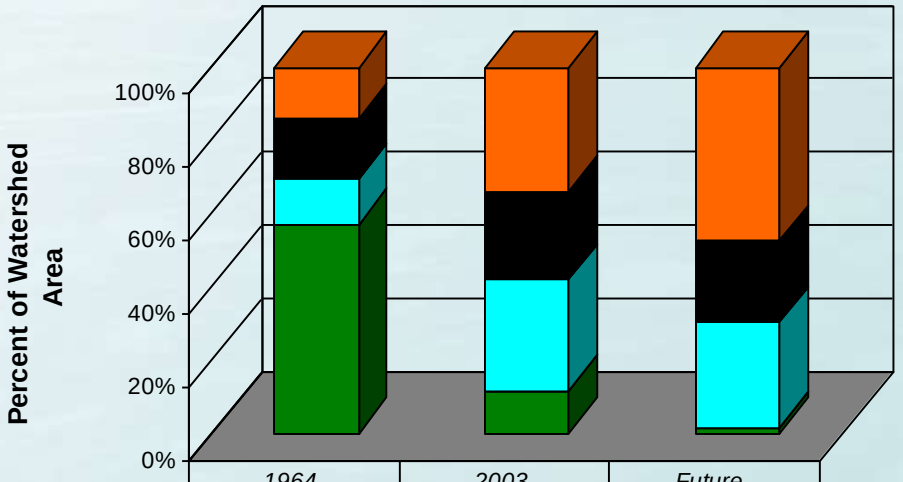
Land Use by Subbasin Over Time

Walnut Mainstem Land Use (sq km)



	1964	2003	Future
Com	7.14	21.27	36.59
ROW	6.89	16.90	17.16
Res	2.81	23.10	36.31
Undev	95.50	49.97	20.39

Buttermilk Subbasin Land Use (sq km)



	1964	2003	Future
Commercial/Industrial	0.61	1.40	2.02
ROW (roads & utils.)	0.69	0.99	0.97
Residential	0.54	1.25	1.23
Undeveloped	2.46	0.48	0.07

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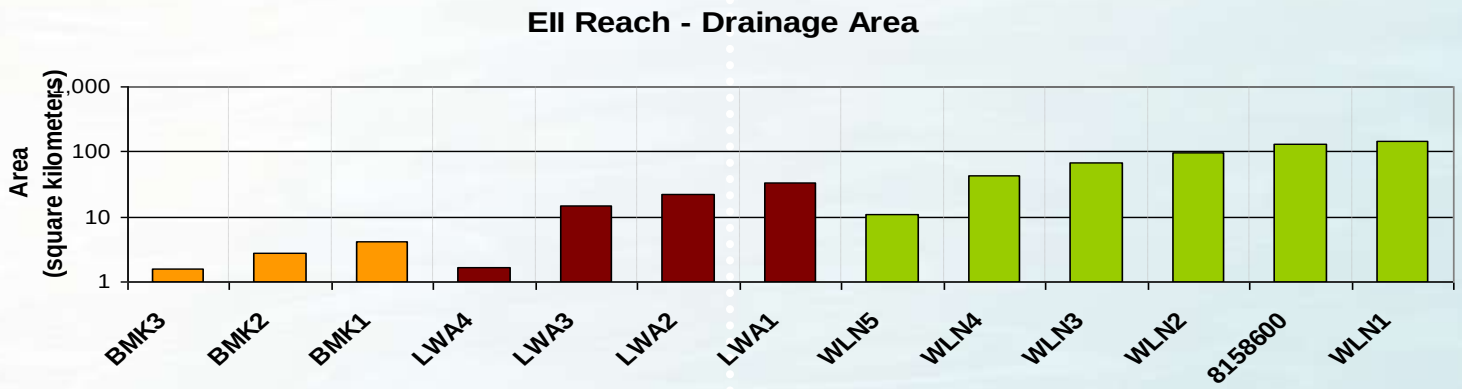
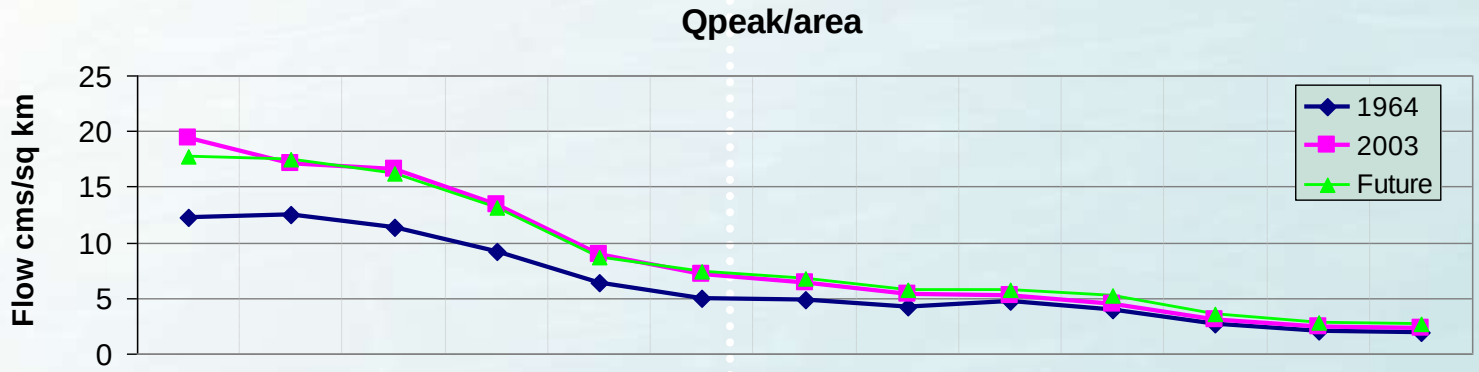
Hydrologic Metrics – SWAT Model





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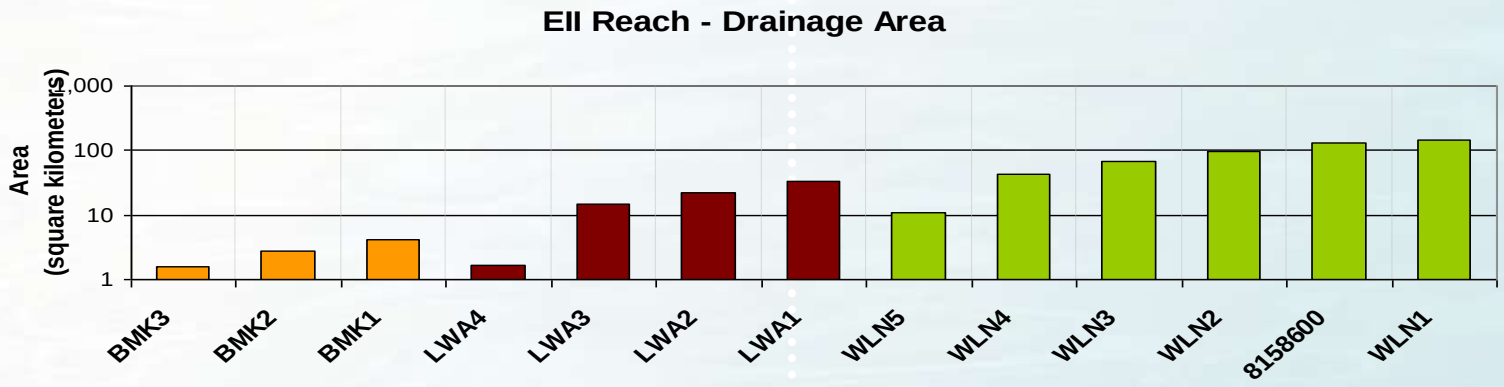
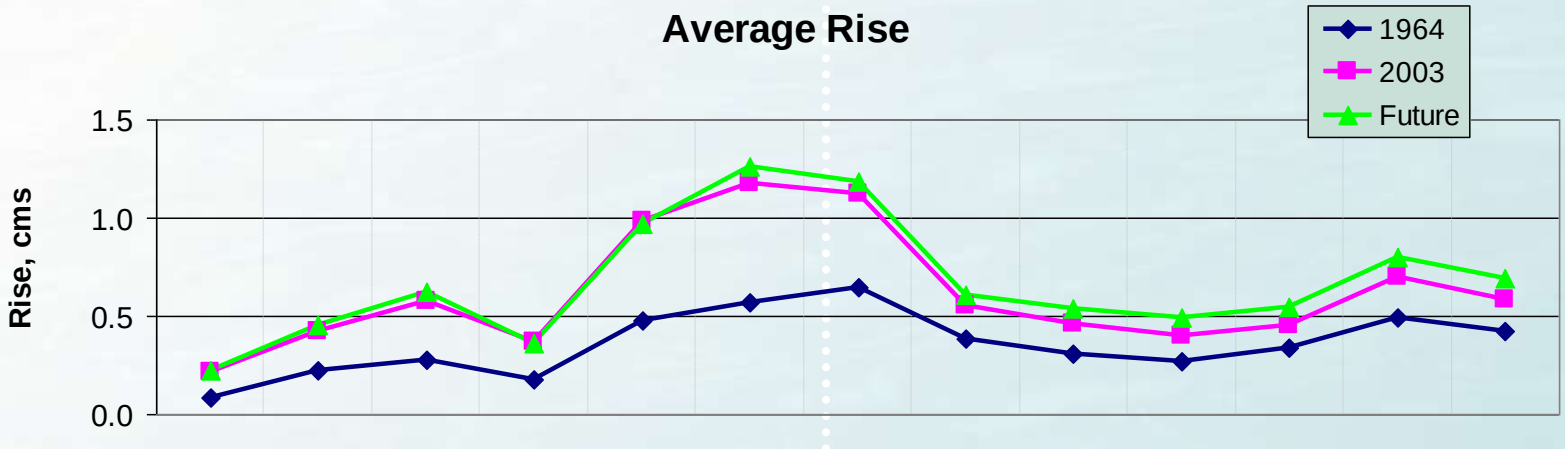
Hydrologic Metrics – SWAT Model





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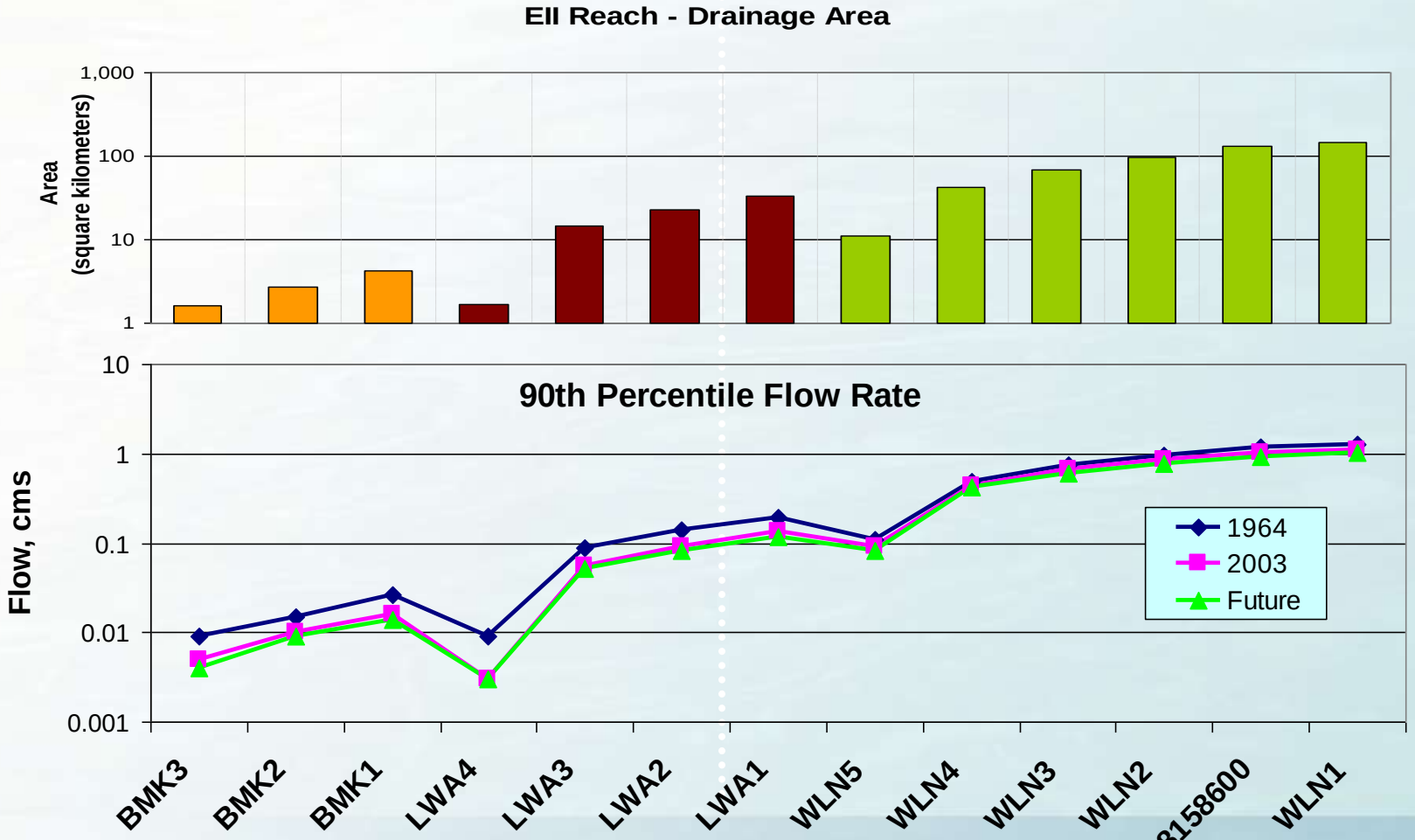

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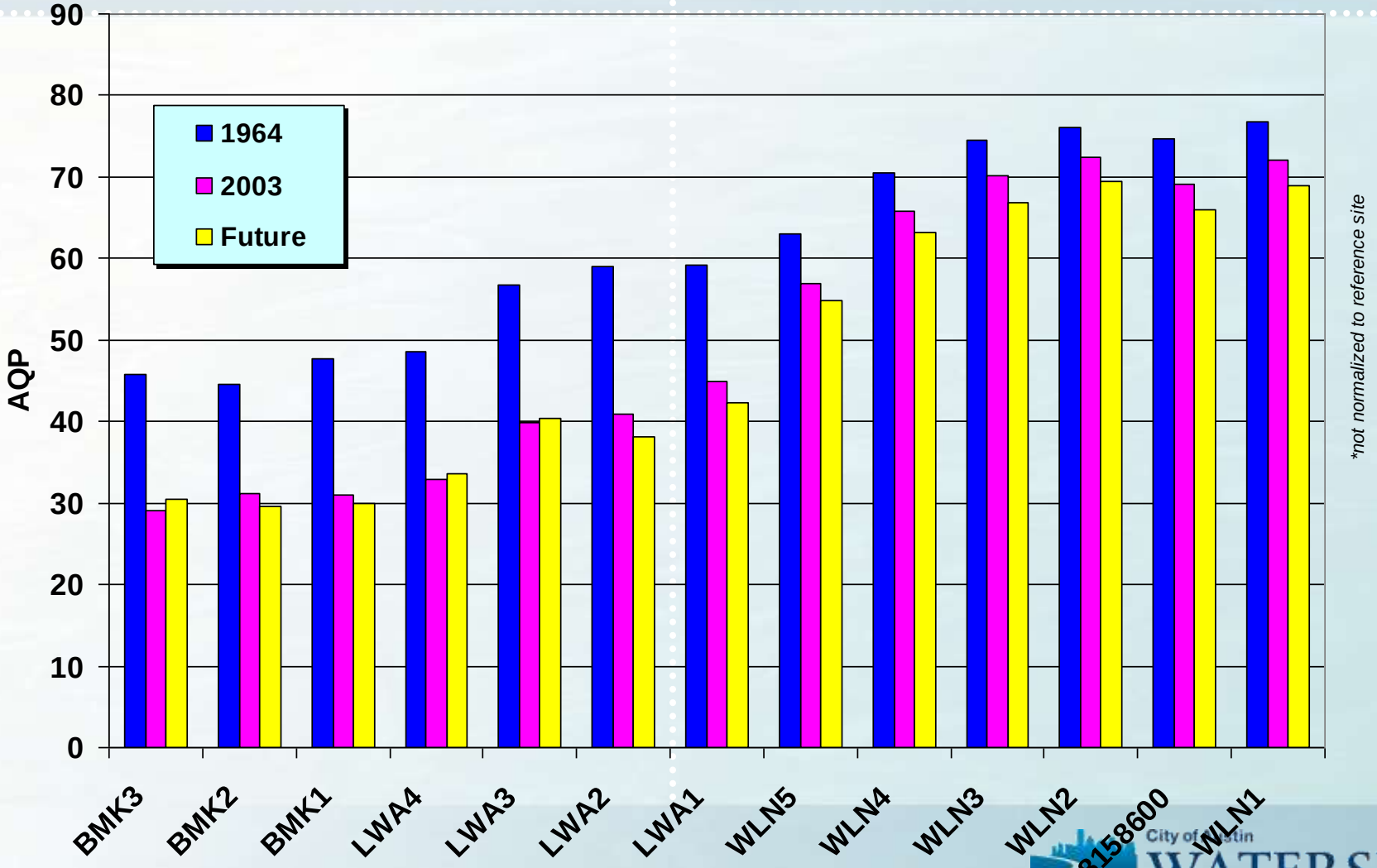
Aquatic Life Potential in Walnut Creek based on SWAT Flows



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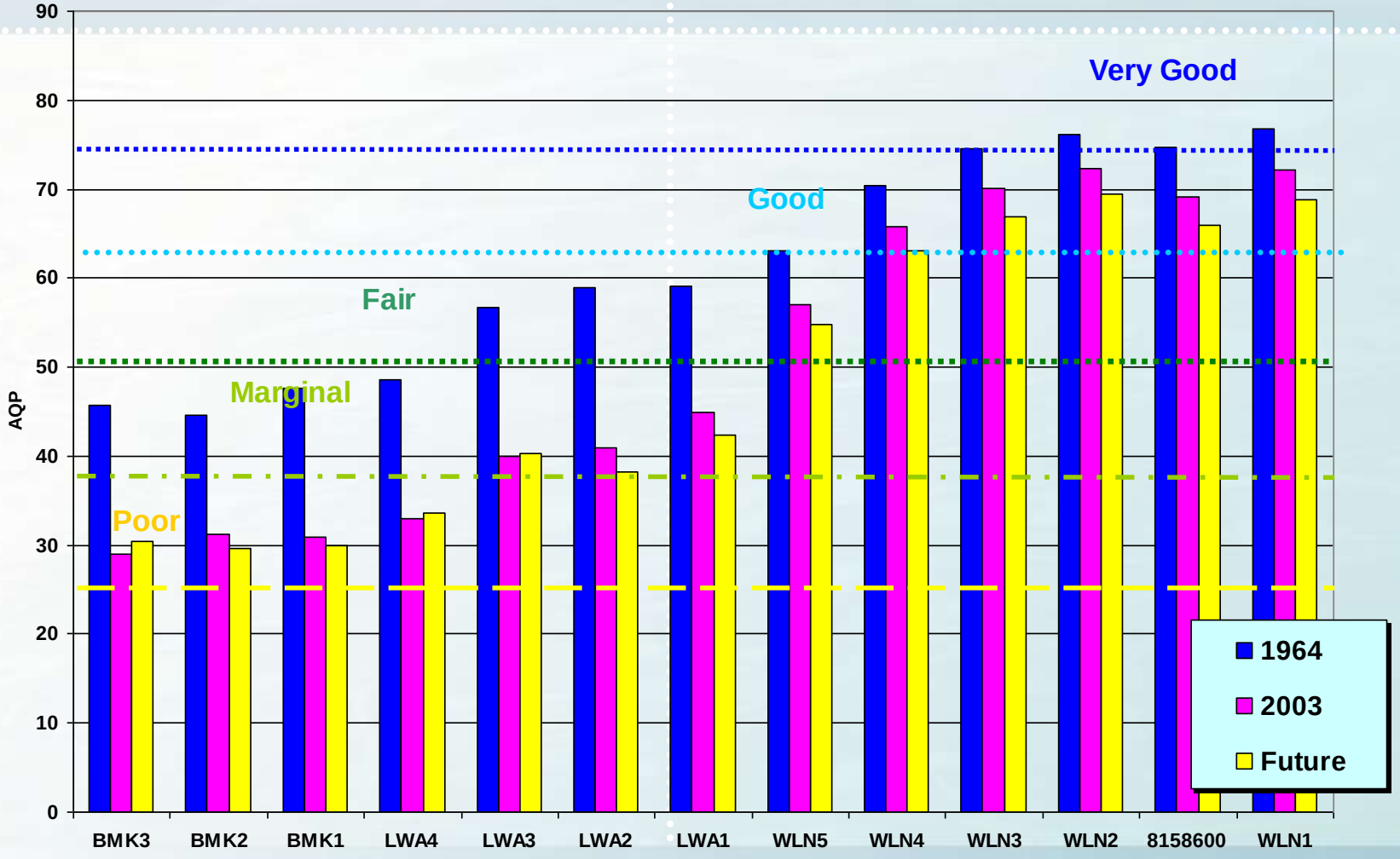
Changes in Aquatic Community Health



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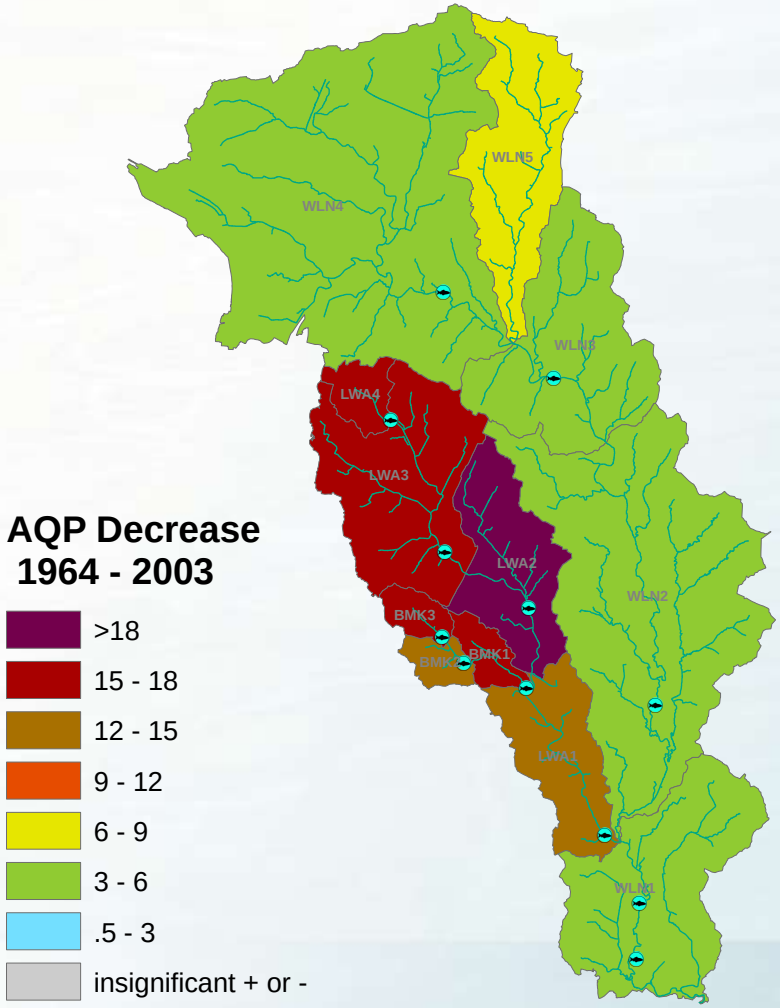
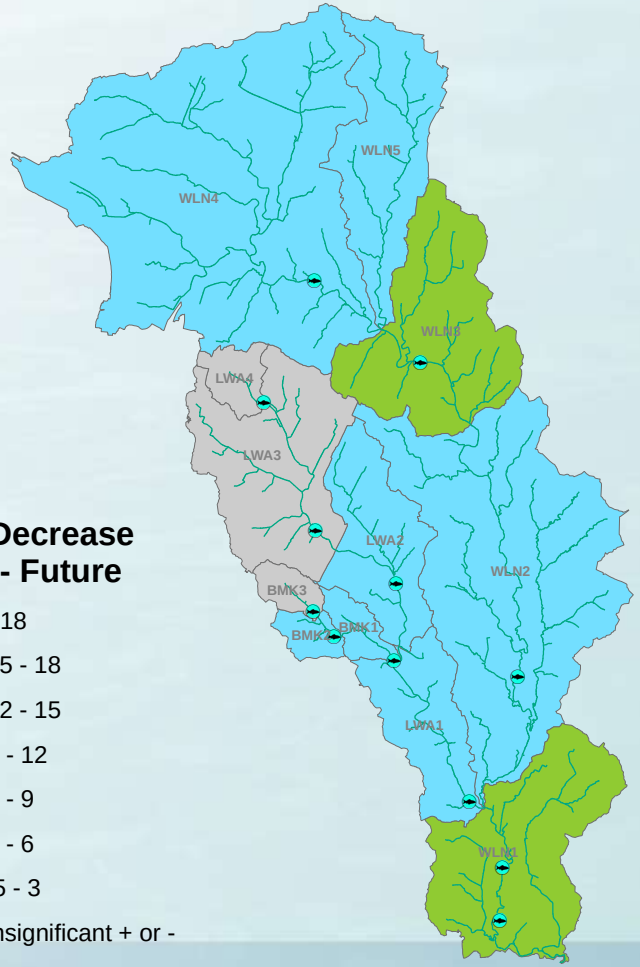
Predicted Response (AQP) of Aquatic Communities to Development



AQP Decrease 1964 - 2003

- >18
- 15 - 18
- 12 - 15
- 9 - 12
- 6 - 9
- 3 - 6
- .5 - 3
- insignificant + or -



AQP Decrease 2003 - Future

- >18
- 15 - 18
- 12 - 15
- 9 - 12
- 6 - 9
- 3 - 6
- .5 - 3
- insignificant + or -

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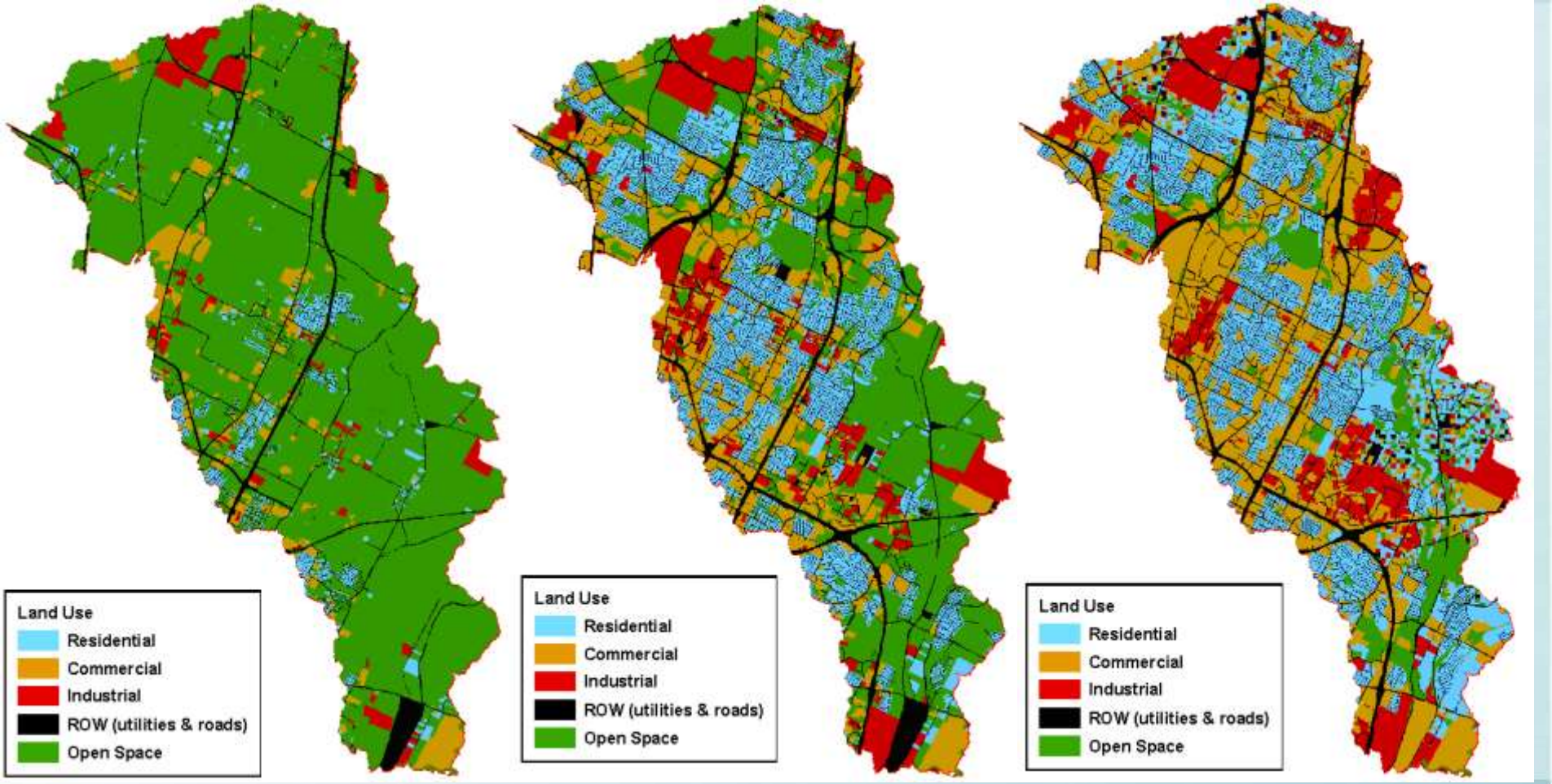
Walnut Land Use Scenarios



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Conclusions

- Flow regime is an important factor in the health of the aquatic community and can be characterized by regression equations.
- The sub-hourly SWAT model can simulate flow characteristics well for many measures of urban impacts (Glick & Gosselink 2011)
- Predicted flow, that is well modeled, can be used to estimate the changes in aquatic life from development, making SWAT models useful tools for environmental management.
- With BMP capabilities, SWAT can evaluate management methods to control aquatic impacts that are driven by flow alterations
- Estimates of Aquatic Life Potential based on modeled hydrology can assist in setting goals and focusing resources on appropriate solutions

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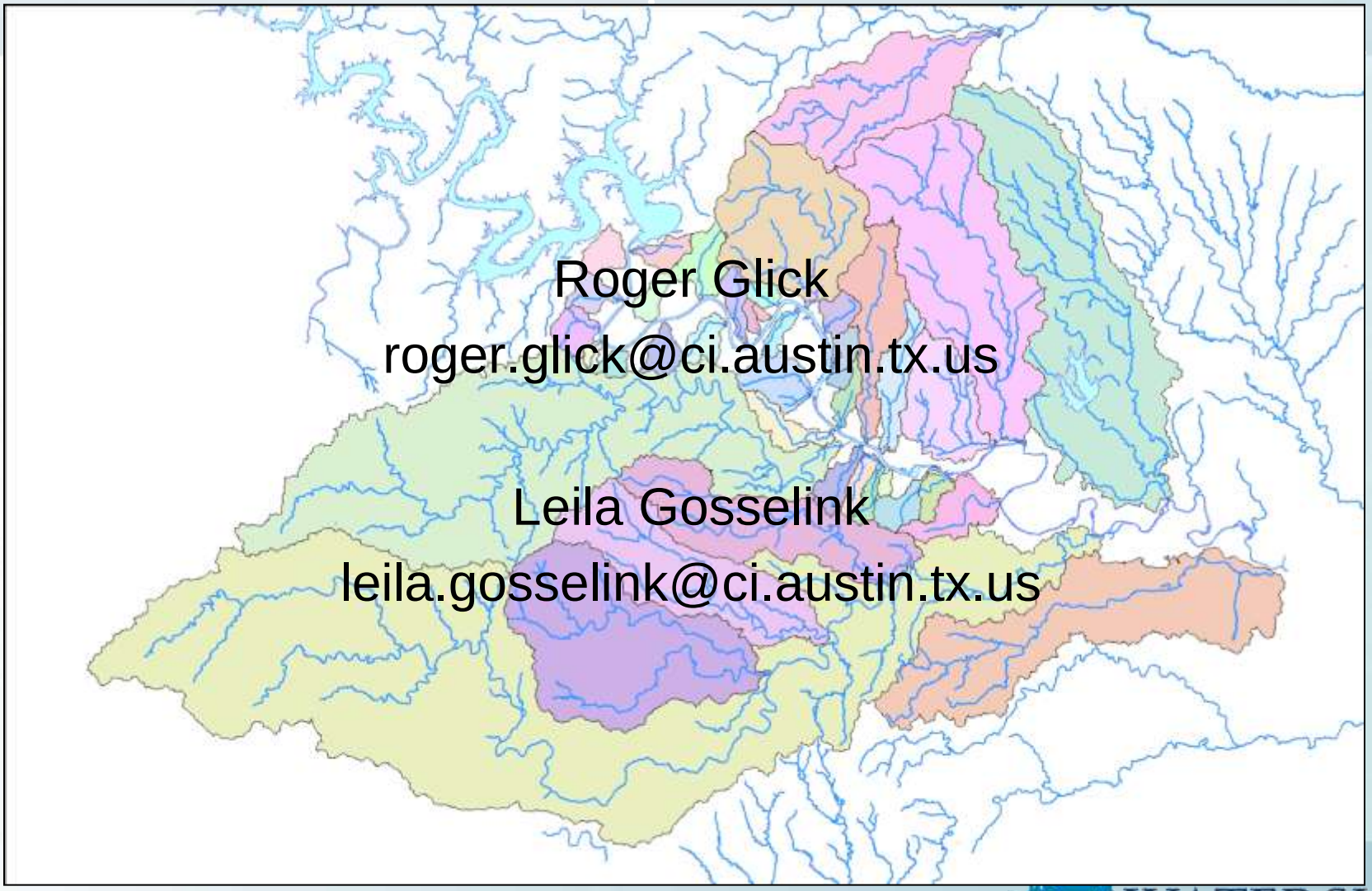
Questions?



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Further Studies

Hydrologic Metrics/SWAT:

- Use SWAT with BMPs to simulate conditions with & without existing BMPs (currently not included in calibration model)
- Evaluate methods to quantify & separate watershed size factors;
  SWAT simulations holding land use, etc. the same for different watershed sizes could provide insight
- Evaluate hydrologic measures, appropriate time steps & normalization
- Evaluate SWAT modeling capabilities relative to individual metrics

Aquatic Community Metrics:

- Evaluate bioassessment data for representativeness vs. hydrologic data
- Evaluate appropriateness of normalizing aquatic life relative to a reference site

- Sensitivity analyses

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