Spatial Distribution of Urban Runoff Pollutants in Orange County and Its Impacts on Environmental Justice Analysis
An Application of GIS Using EPA's PLOAD Model and SCAG Land Use Scenario Dataset

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Background Information

Non-point source (NPS) pollutants from urban runoff, which are hard to monitor and manage, exert significant impacts on watersheds in the Southern California Association of Governments (SCAG) region. These urban runoff pollutants have caused concerns from local jurisdictions about water quality and meeting regulatory requirements. Local jurisdictions do not have regulatory control over water, however, in California, they do have land use authority for local planning decisions.

Methodology

SCAG utilizes Environmental Protection Agency's (EPA) Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) model to calculate and spatially visualize urban runoff pollutants in relation to different urban growth scenarios and land use changes. Different urban growth scenarios will most likely generate different impervious patterns and urban runoff, which ultimately lead to various extents of impacts on the watershed environment. In compliance with Title VI of the Civil Rights Act of 1964 (Title VI), SCAG is mandated to perform environmental justice analyses on the low-income or minority populations regarding benefits and burdens of proposed projects in the region.

This project applies ArcGIS and EPA's PLOAD (Pollutant Loading Estimator) to visualize the NPS spatial distribution within SCAG region. We use the "Simple Method" approach of the PLOAD model to calculate pollutant loading.

Transportation analysis zones (TAZs) are used as the geographic unit of analysis for availability of land use data. By using GIS to demonstrate the spatial pattern changes of NPS pollutants under different land development scenarios provided from the draft 2016 Regional Transportation Plan/Sustainable Communities Strategies (RTP/SCS) long-term land use strategies, local jurisdictions and stakeholders can link the built environment to sustainable water quality and watershed management in Southern California.

Conclusions

The overall results show that the 2040 scenario will have very little impact (< 1%) on annual pollutant loads within Orange County. The annual pollutant load per acre within EJ areas is slightly higher than the county's annual average, which means that they have slightly disproportionate impacts. The EJ areas (i.e. DACs and CoCs) will benefit the most from these land use changes by having their annual pollutant load per acre decrease between 2012 and 2040. Improved water quality will require cooperation with local jurisdictions to recommend policies that encourage the use of Low Impact Development practices for infrastructure improvement projects (i.e. bio-retention ponds; rain gardens; and permeable pavement, etc.).

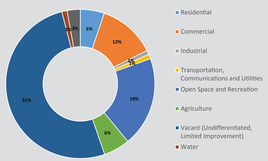
Contributions and Future Improvements

One of the major contributions at this particular project is that we are able to estimate the urban runoff pollutant load by different land use types in various geographical areas (catchment, TAZ). Local jurisdictions within the SCAG region may find this analysis useful at the micro level. The following are some of our contributions: 1) analyzing pollutant results with different land use types; 2) assessing the impact of transportation and land use policies on estimated pollutant; 3) identifying the impact of pollutants load on environmental justice populations; and 4) framing policy recommendations. For the next steps, there are several improvements that can be incorporated into the urban runoff pollutant model; for instance, we can refine the EMC table to better characterize the pollutant coefficients into SCAG region.

SCAG

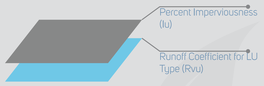
38,000 mi²

18.8 M (2015)



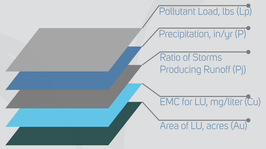
Formula

Runoff Coefficient for LU Type



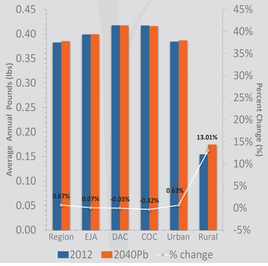
$$Rvu = 0.05 + (0.009*Iu)$$

Pollutant Load (pounds)



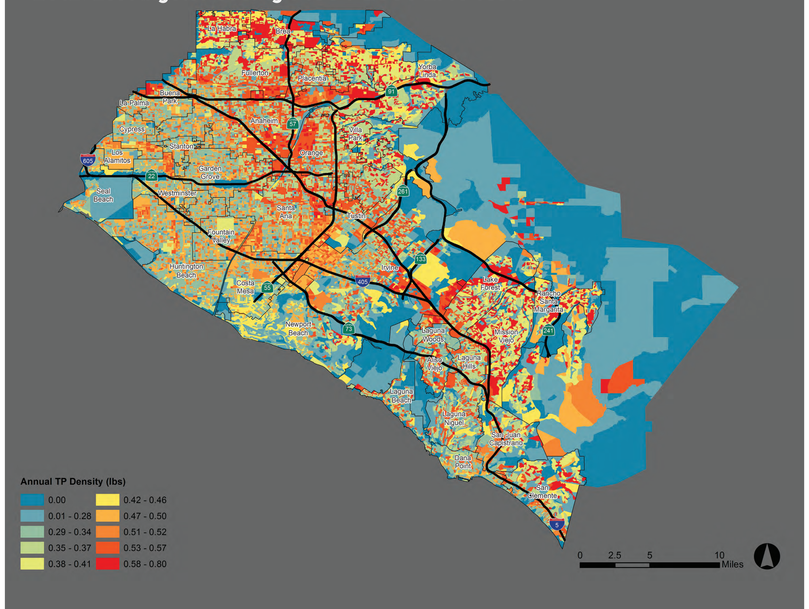
$$Lp = \Sigma u(P^* Pj^*Rvu^*Cu^*Au^*2.72/12)$$

Average Annual Urban Runoff Pollutant (TP)

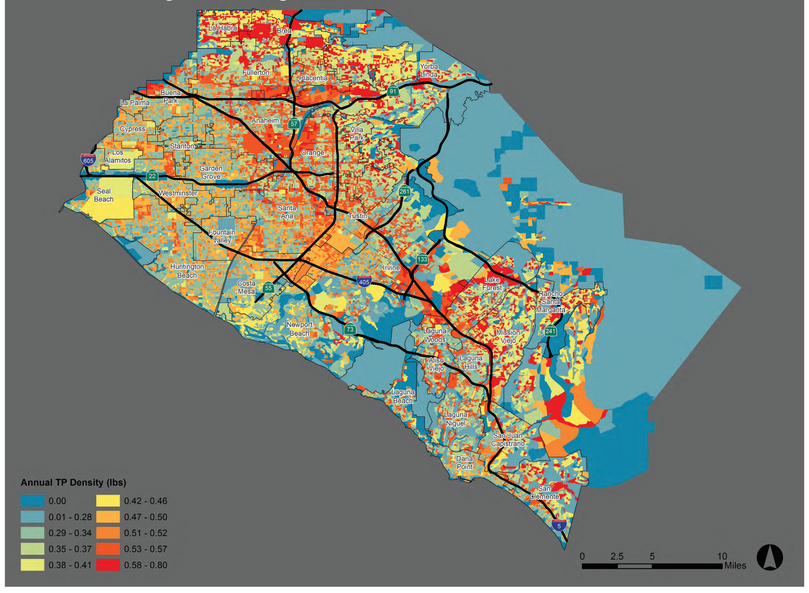


Total Phosphorus Load Distribution by LU Type (Draft 2016 RTP/SCS)

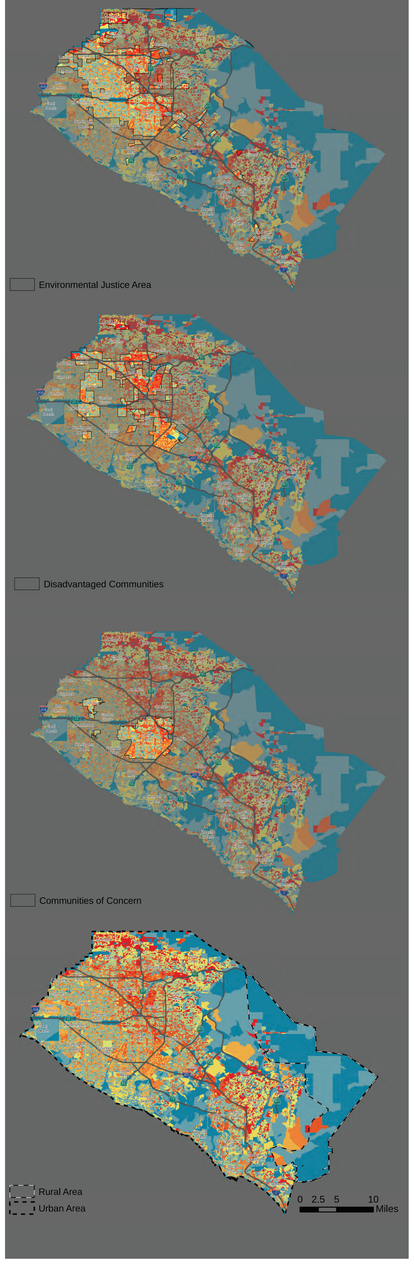
2012: Los Angeles County's 1994-2000 EMC Table



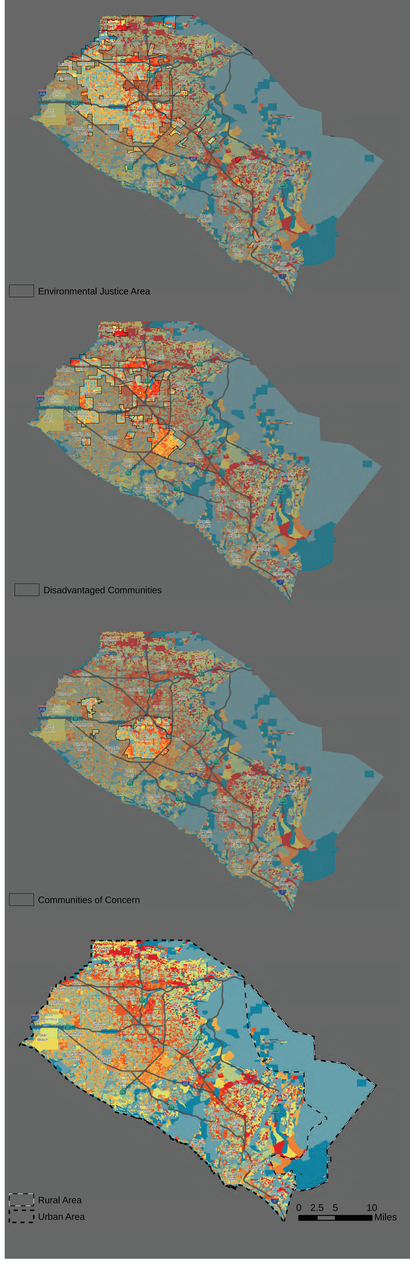
2040: Los Angeles County's 1994-2000 EMC Table



Base Year (2012)



Draft Planned (2040)



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