Proximity to Pollution

A study of socioeconomic status in Los Angeles County, California

Research by: **Angel Gomez** agomez@pdx.edu
Evan Kent ekent@pdx.edu
Jackson Voelkel jvoelkel@pdx.edu

Portland State University | GEOG 592/492, Winter 2014
Professor Geoffery Duh

Research Question:

Are lower socioeconomic-status communities disproportionately affected by geographic range of disamenities than higher socioeconomic-status communities?

Los Angeles County is the most populated county in the U.S. Despite this, it features large areas with little or no population mainly in the Mojave Desert, the San Gabriel Mountains effectively cuts off the desert from the coast making this region a very inhospitable place for major residential development.

Residential proximity to known pollution emitters tend to have a negative impact on property values, unfortunately economically disadvantaged residents seem to share a disproportionate amount of pollution due to their proximity to major highways, Superfund sites, factories and landfills (Holy-Cross).

Economically disadvantaged residents are effectively priced out of desirable low pollution areas, while their more economically advantaged counterparts reside in less polluted desirable areas (CDC). The main objective for our research is to figure out if this is the case in Los Angeles County, specifically in the densely populated core of the county. This research is not a health analysis on proximity to pollutants, we only seek to answer, are people with low socioeconomic status disproportionately affected by proximity to pollutants from highways, superfund site and landfills than people with higher socioeconomic status.

Methods:

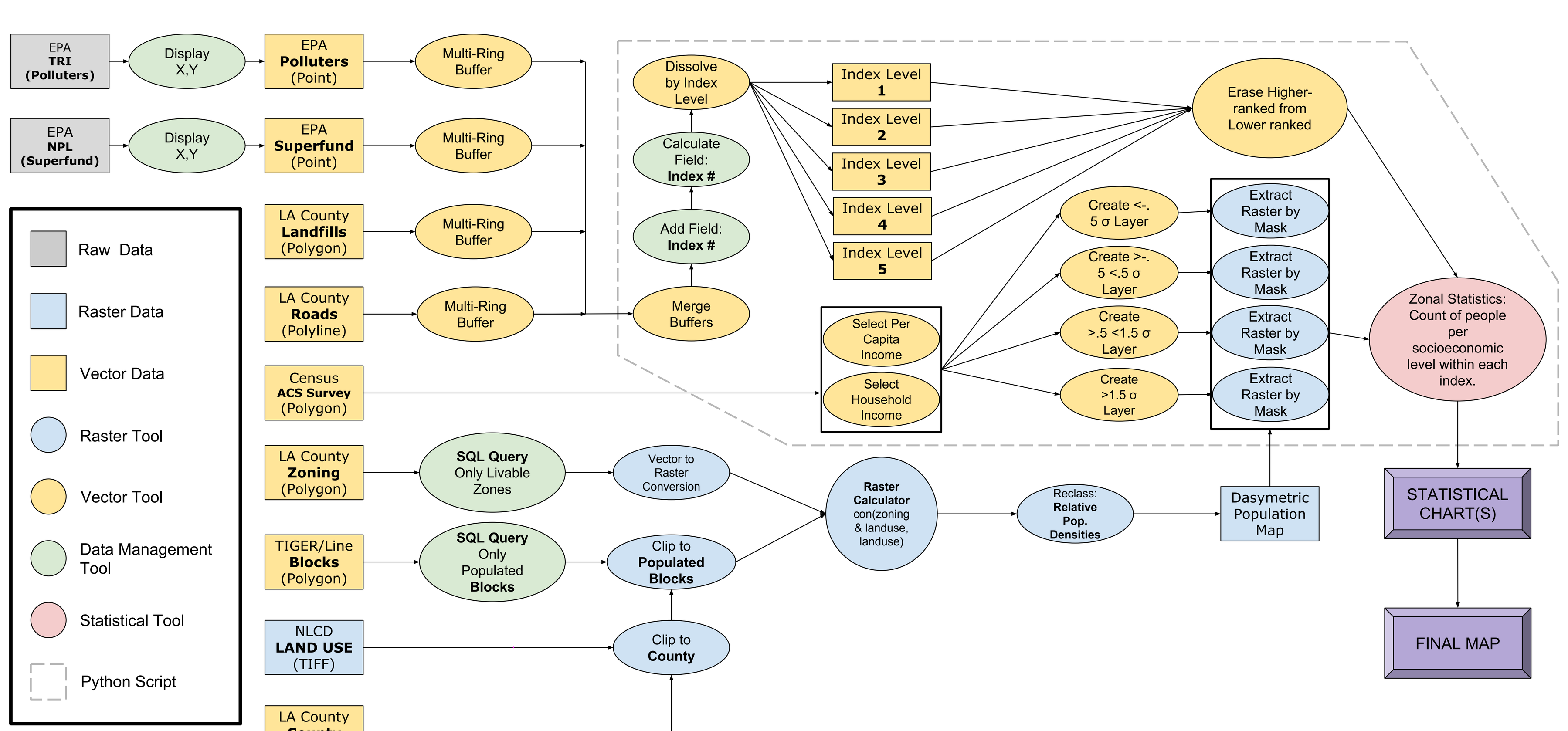
To more accurately represent the population distribution in the county, we sought to construct a dasymetric map. We started with US Census block groups, which contain aggregated population counts. To disaggregate them, first we eliminated all block groups with zero population. Next, we used a map of county tax lots by land use, provided by the LA County GIS Data Portal, to eliminate all areas that didn't contain residential units. Finally, we used a weighted map of land cover classes to distribute the population across the remaining areas. Our weights were chosen to represent the urban character of the county by assigning much more weight to urban land cover classes (chiefly the classes that concern impervious land cover). There are multiple classes of impervious surface, ranked by percentage of impervious surface. We selectively investigated these classes in Los Angeles County to determine the character of actual land uses that is associated with each of them. We found that most intensive development (e.g. large apartment buildings or densely packed buildings) was associated with rank three, "Developed, Medium Intensity." On reflection, this makes sense, because parking lots and other similar massive structures (arenas, warehouses) do not have any people living in them but feature the most impervious surface per area. Other weights were chosen to represent the typical density of their land class in the United States.

Weighting Assignments:

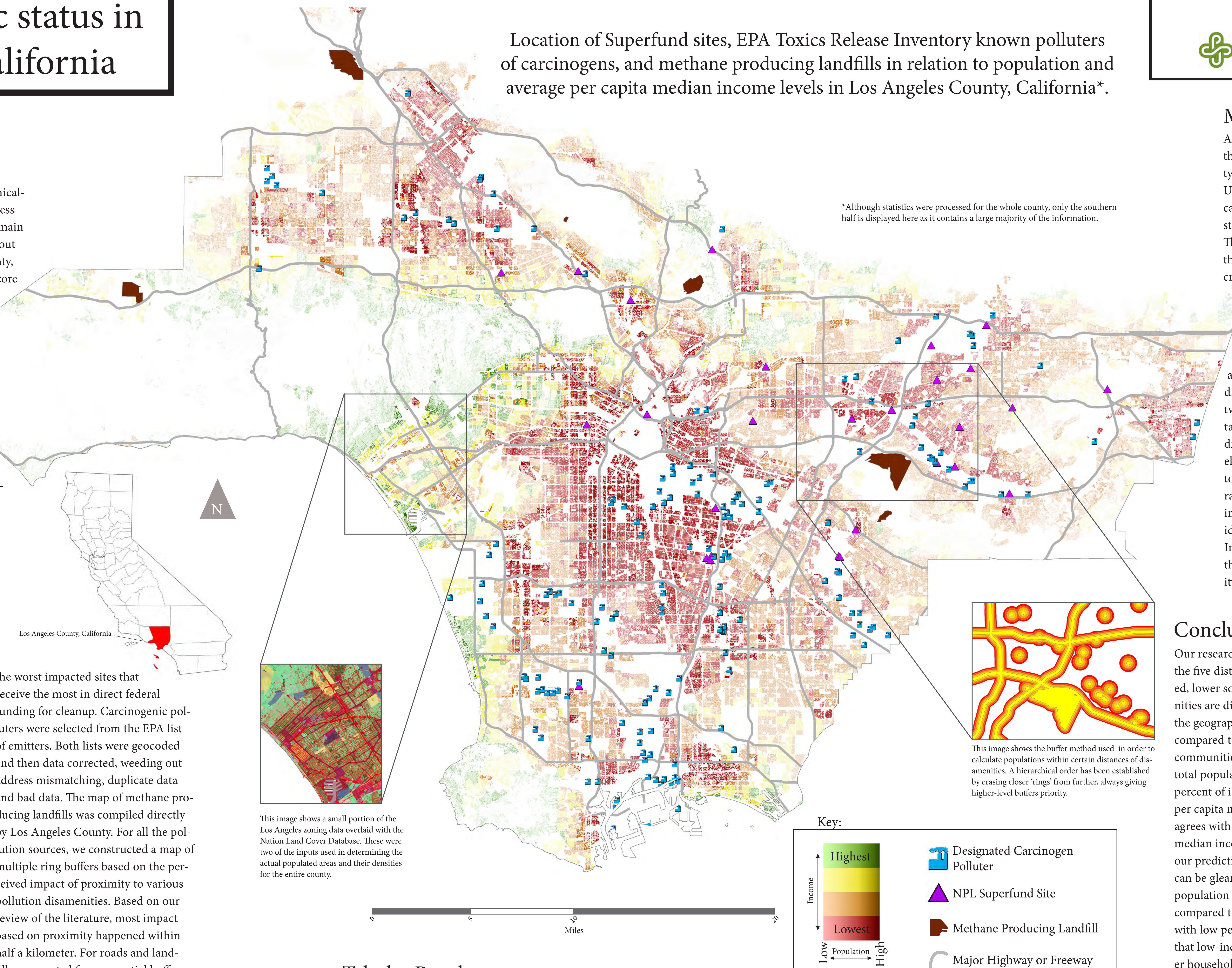
Wetland	1%	Barren		1%
Crops	1%	Parks		1%
Grass	1%	Developed	Low Intensity	25%
Shrubland	1%		Medium Intensity	60%
Forest	5%		High Intensity	5%

We gathered a number of pollution sources datasets: known emitters of pollution (the Toxic Release Inventory from the United States EPA), superfund sites (USEPA), highway and freeways in LA County (LA County GIS Data Portal), and methane producing landfills (LA county GIS Data Portal). From the list of superfund sites, we selected only the sites on the National Priority List. These are the worst impacted sites that receive the most in direct federal funding for cleanup. Carcinogenic polluters were selected from the EPA list of emitters. Both lists were geocoded and then data corrected, weeding out address mismatching, duplicate data and bad data. The map of methane producing landfills was compiled directly by Los Angeles County. For all the pollution sources, we constructed a map of multiple ring buffers based on the perceived impact of proximity to various pollution disamenities. Based on our review of the literature, most impact based on proximity happened within half a kilometer. For roads and landfills, we created five sequential buffers of 100 meters. For superfunds and the TRI emitters we used five sequential buffers of 150 meters.

Process:



Location of Superfund sites, EPA Toxics Release Inventory known polluters of carcinogens, and methane producing landfills in relation to population and average per capita median income levels in Los Angeles County, California*.



*Although statistics were processed for the whole county, only the southern half is displayed here as it contains a large majority of the information.

This image shows a small portion of the Los Angeles zoning data overlaid with the Nation Land Cover Database. These were two of the inputs used in determining the actual populated areas and their densities for the entire county.

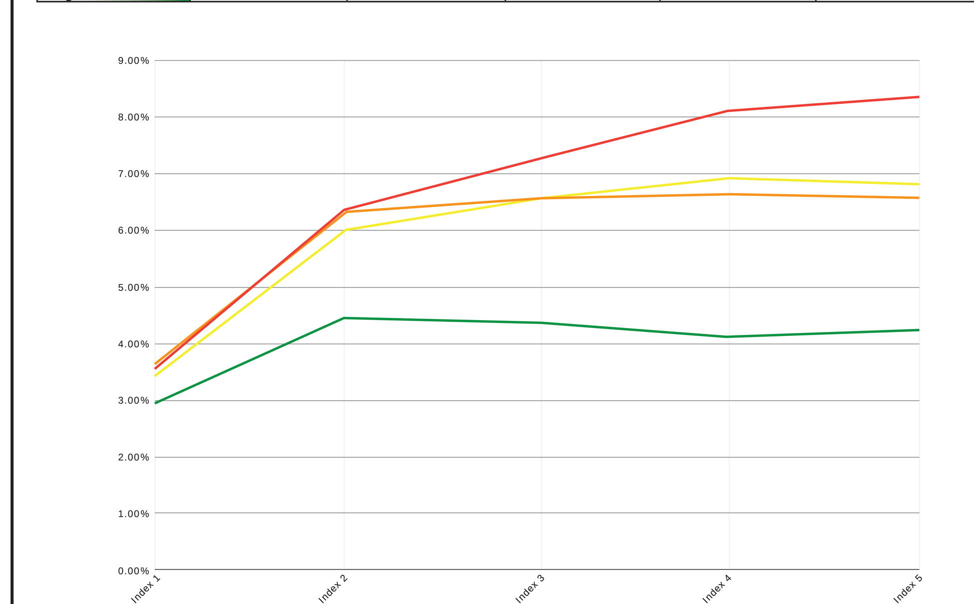
This image shows the buffer method used in order to calculate populations within certain distances of disamenities. A hierarchical order has been established by erasing closer 'rings' from further, always giving higher-level buffers priority.

Tabular Results

Per Capita Median Income

	Index 1 Population	Index 2 Population	Index 3 Population	Index 4 Population	Index 5 Population	LA County Population
Low	144135	258757	295219	329819	339659	4062794
Average	139776	243591	253032	255857	253424	3850715
High	42681	75165	81831	86426	85223	1248919
Highest	17705	26891	26368	24816	25407	603099

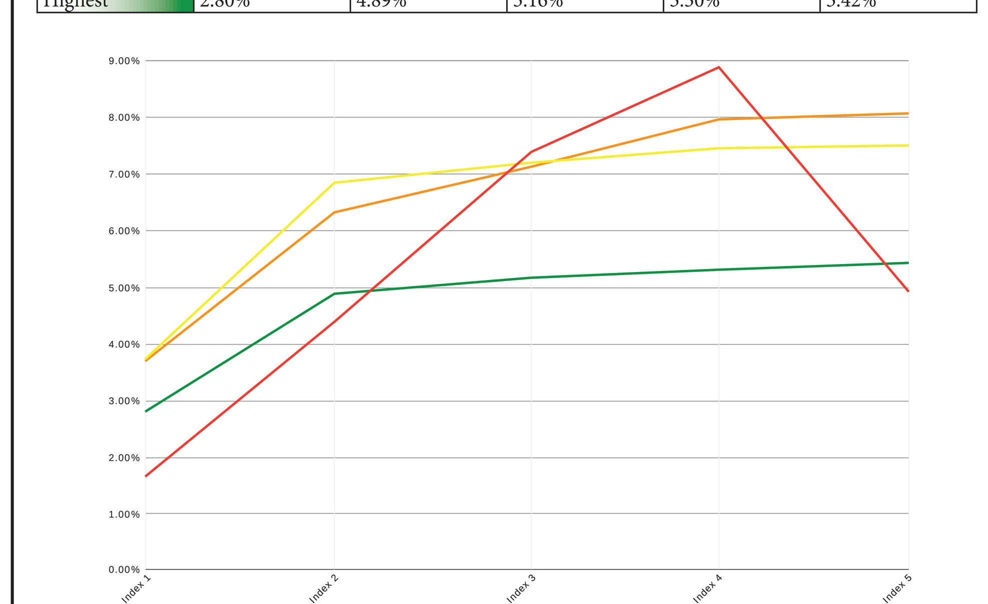
	Index 1 Percent of Total Income Level	Index 2 Percent of Total Income Level	Index 3 Percent of Total Income Level	Index 4 Percent of Total Income Level	Index 5 Percent of Total Income Level
Low	3.55%	6.37%	7.27%	8.12%	8.36%
Average	3.63%	6.33%	6.57%	6.64%	6.58%
High	3.42%	6.02%	6.55%	6.92%	6.82%
Highest	2.94%	4.46%	4.37%	4.11%	4.21%



Household Median Income

	Index 1 Population	Index 2 Population	Index 3 Population	Index 4 Population	Index 5 Population	LA County Population
Low	711	1900	3172	3838	2116	43175
Average	132301	227161	254908	285366	289439	3587933
High	145374	267501	280127	290118	292340	3899951
Highest	62071	108195	114334	117419	120039	2213891

	Index 1 Percent of Total Income Level	Index 2 Percent of Total Income Level	Index 3 Percent of Total Income Level	Index 4 Percent of Total Income Level	Index 5 Percent of Total Income Level
Low	1.65%	4.40%	7.35%	8.89%	4.90%
Average	3.69%	6.33%	7.10%	7.95%	8.07%
High	3.73%	6.86%	7.18%	7.44%	7.50%
Highest	2.80%	4.89%	5.16%	5.30%	5.42%



Methods continued:

A python script was used to count the number of people with proximity to pollution. The script reclassifies US Census block groups into four per capita income level groups based on standard deviation from the median. These classes were used as masks with the dasymetric map of population to create four new rasters. Zonal statistics was then used to tabulate the value of each raster within each pollution buffer. This yielded a table of the number people of each income class in each buffer zone. A similar table was produced for household income (four class breaks based on standard deviation from median household income).

Findings:

After all statistics were computed for both per capita median income and household median income, we discovered a potential correlation between an individual's income and distance to certain pollution producing disamenities. While all income levels share similar percentages of their total population at the lowest buffer range, the gap between the highest income class and the rest grows rapidly through all other buffer ranges. In all distance-derived Index levels the low-income group had a majority of total population. Interestingly, by evaluating the statistics for household median income we were presented with very different results. In all Indexes the High income level had a majority of total population. As a percent per total income-level population the Low group did attain more presence at Indices 3 and 4, however this dropped sharply by Index 5. It is significant to note the extremely low relative population of the Low income group compared to the other groups' populations. At 43,175 people, the Low income level group has millions less people than any other group.

Conclusions:

Our research has concluded that within the five distance based Index levels created, lower socioeconomic-status communities are disproportionately affected by the geographic range of disamenities when compared to higher socioeconomic-status communities at an individual level. In both total population counts and normalized percent of income-group population, the per capita median income data generated agrees with our hypothesis. The household median income does not appear to fit into our predictions, though some information can be gleaned from it. The incredibly low population with low household incomes compared to the incredibly high population with low per capita income would suggest that low-income individuals have larger households, putting them in a different income group and thus explaining the incredibly low population for low household median income. If this research were to be continued, it is our belief that by adding more index levels (possibly covering the entire county) more patterns would emerge and higher accuracy conclusions could be made. Our research does not take into account the correlation or chance of error in our data, nor does it factor in spatial autocorrelation. Further research could include developing a more statistically rigorous model for the relationship between income and proximity to pollution. Other demographic trends relating to the spatial distribution of polluters may be worth investigating, especially demographics that measure communities of disadvantage.

Data Sources:

United States Census Bureau

- 2010 Census Population & Housing Unit Counts - Blocks
  https://www2.census.gov/geo/tiger/TIGER2010BLKPOPHU/tabblock2010_06_pophu.zip
- 2008 - 2012 American Community Survey 5-Year Estimates Block Group Data
  https://www2.census.gov/geo/tiger/TIGER_DP/2012ACS/ACS_2012_5YR_BG_06.gdb.zip

United States Environmental Protection Agency (USEPA)

- Toxics Release Inventory:
  http://www.epa.gov/tri/tridata/data/basicplus/US_2012_v12.zip
- Superfunds:
  http://cumulis.epa.gov/supercpad/cursites/srchsites.cfm

Los Angeles County GIS Data Portal (LA County)

- Methane Producing Landfills
  http://egis3.lacounty.gov/datffvaportal/2014/01/06/methane-producing-landfills-2/
- LA County Outline
  http://egis3.lacounty.gov/dataportal/2013/11/06/los-angeles-county-boundary/
- Roads - Countywide Address Management System
  http://egis3.lacounty.gov/dataportal/2013/09/26/2011-la-county-street-centerline-street-address-file/Countywide
- Zoning
  http://egis3.lacounty.gov/dataportal/wp-content/uploads/2012/03/zoning_countywide.zip

United States Geological Survey

- National Land Cover Database 2006
  http://gisdata.usgs.gov/TDDS/DownloadFile.php?TYPE=nlcd2006&FNAME=NLCD2006_landcover_4-20-11_se5.zip

Researched Literature:

Boehmer, Tegan. Foster, Stephanie. Henry, Jeffrey. Woghiren-Akinnifest, Efomo. Yip, Fuyuen. "Residential Proximity to Major Highways – United States, 2010." Morbidity and Mortality Weekly Report. (2013) 62(03);46-50

Kiel, Katherine. Williams, Michael. "The Impact of Superfund Sites on Local Property Values: Are All Sites the Same." Department of Economics College of the Holy Cross. (2005) NO 05-05

Brugge, Doug. Durant, John. Rioux, Christine. "Near-highway pollutants in motor vehicle exhaust: A review of epidemiologic evi vdence of cardiac and pulmonary health risk" Environmental Health (2007) 6:23

Anderson, Sarah. "Air pollution from freeway extent further than previous thought" UCLA Newsroom. Web June 10, 2009.