Educational and Recreational Disparities and Environmental Justice in East Austin, TX
Jasmine Nelson

John Langmore

I. Introduction

Austin, TX is lauded as being both a socially progressive center and nature-oriented city, with its people being heavily involved in social justice reform, pursuing environmental sustainability, and enjoying many accessible outdoor spaces. Despite this, Austin has been and remains historically segregated, with East Austin being predominantly Black and Latinx serving[1]. This largely goes back to Austin's segregation in the 1960s, where the Eastern side of Austin was set aside largely for African American communities. This continues to be where the majority of the Black population resides in Austin today, with many other minoritized communities also residing in this portion of Austin.

Unfortunately, in many cities there are clear relationships between socioeconomic status and race and access to both green spaces (parks, sidewalks, trails) and important educational learning centers, such as libraries[2]. The more minoritized or lower the socioeconomic status of a community, the less likely they are to have ease of access to parks, trails, and important educational resources[3,4]. Beyond the correlation between socioeconomic status and green spaces / educational resources, there are also correlations between socioeconomic status and negative environmental factors. For instance, significantly higher levels of air, water, and sound pollution are found in more minoritized communities. Though this relationship has been clearly delineated in many large cities across the United States, I am interested in exploring these relationships in Austin, TX.

II. Questions and Hypotheses

This project aims to pursue two primary questions concerning socioeconomic status, educational resources, green spaces, and potential environmental hazards in Austin, TX:

1) **How do demographics and socioeconomic status correlate with green spaces, educational resources, such as schools and libraries?**
   - Hypothesis: I hypothesize that more minoritized areas of Austin (the East side) will be served by fewer schools, libraries, and less area of green spaces.

2) **What parts of Austin face the most threat from various forms of pollution or environmental hazards (soil, groundwater, noise, etc)**

   - Hypothesis: I hypothesize that we will see higher concentrations or proximity to all pollutants in minoritized communities compared to majority non racially minoritized communities.

   Answering these questions will allow us to have better understandings of equity and resource distribution in Austin, TX

III. Data

To pursue these questions, data was aggregated from a variety of sources. Below, I list the various resources collected along with where the data are sources from.

1) **Demographic Data**

   a) **2010 Census Data**

      i) Source: U.S. Census Bureau / austintexas.gov ArcGIS online

      ii) Data Use: This data will be used to get information on the local population, racial distribution, and income distribution of tracts / blocks in Austin.

2) **Environmental Justice Data**

   a) **2010 Land Use Data** (PLANNINGCADASTRE_land_use_2010)

      i) Source: austintexas.gov ArcGIS online

      ii) Data Use: To see what buildings are used for around the city of Austin, TX

   b) **Landfills (**Structure_landfillsbuffered)

      i) Source: austintexas.gov ArcGIS online

      ii) Data Use: I will use this to see where many of the landfills are placed in the Austin area

   c) **Austin Parks** (BOUNDARIES_city_of_austin_parks)

      i) Source: austintexas.gov ArcGIS online

      ii) Data Use: I will use this to see where many of the city parks are placed in the Austin area

   d) **Airport Overlay**

      i) Source: austintexas.gov ArcGIS online

      ii) Data Use: I will use this to see where many of the city parks are placed in the Austin area

3) **Educational Resource Distribution Data**

   a) **Libraries** (STRUCTURE_libraries)

      i) Source: austintexas.gov ArcGIS online

      ii) Data Use: I will use this to see where many of the city parks are placed in the Austin area

b) **High Schools**
   i) Source:
   ii) Data Use: I used this data to see where schools are located to see if there is an even distribution of educational resources within Austin, TX.

IV. Data Pre-processing

There is a bit of pre-processing that has to be done before analysis can be done with the data I have obtained. Before anything else, it is very important that all of my data be in the same projection, so as to avoid mistakes in my analysis.

1) **Projection Correction**
   a) First, I opened all of my data files to ensure that they were all in the same coordinate system (Figure 1a). I wanted all of them to be in NAD 1983 UTM 14N projection. If they were not in this coordinate system, I used the "Project" tool to permanently transform them into the correct coordinate system (Figure 1b).

Figure 1a: *Layer properties displaying a layer in a different projected coordinate system than needed for this project.*
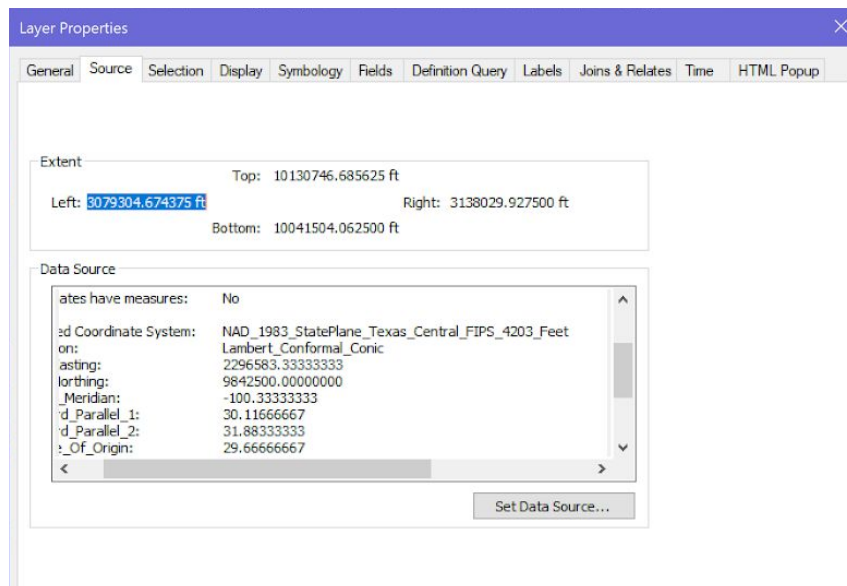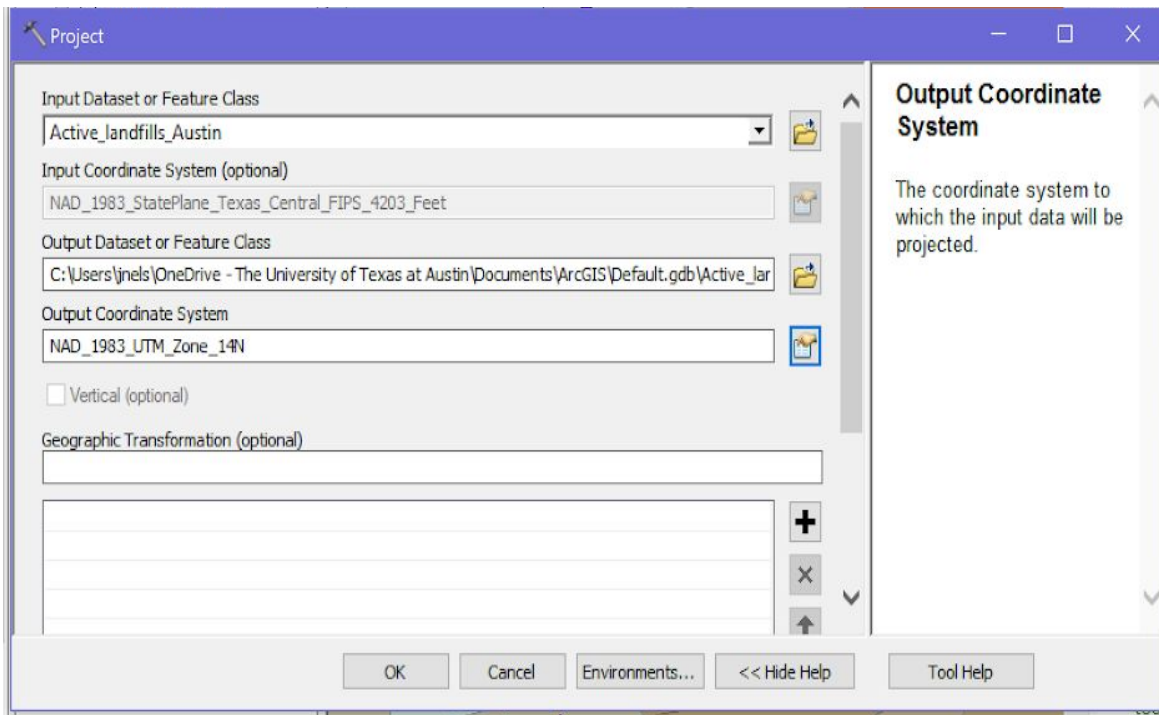
Figure 1b: *Using the project tool, I converted the coordinate system for each layer to NAD 1983 UTM Zone 14N, the appropriate zone for Austin, TX.*

2) **Join Tables**

    a) Some of the data that I have in CSV files I want to add to attribute tables of GIS files that I am using. For example, I want to combine some of the attributes from the Socioeconomic Dataset to the 2010 Census GIS dataset that I have.

        i) First, I identified an identifier by which I can join the tables. In this case, both of the datasets have the GEOIDs by which I can join the data.

        ii) I opened the tool "Join Data" and filled in the appropriate data (Figure 2).

            (1) I selected the 2010 census data as the layer that the join will be based on.

            (2) I then selected the attribute from the Socioeconomic dataset that I wanted to add to the 2010 Census dataset.
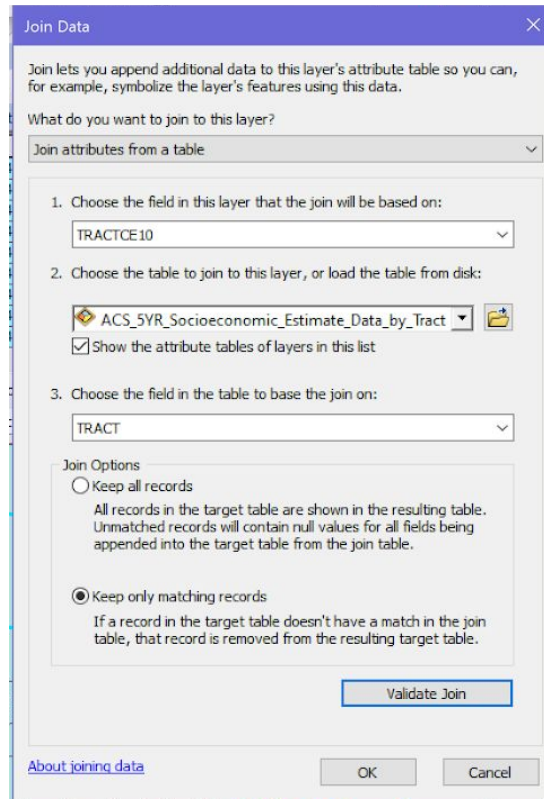
Figure 2: *Using the join data tool, I was able to combine the socioeconomic data from ACS to the demographic data for the census tracts. I joined these tables using the tract number attribute.*

        (3) Lastly, I identified the Census Tract number as the attribute used to join the tables

3) **Select and Export data for Austin, TX only**
   a) Many of the datasets that I am using encompass more data than necessary to answer the questions that I have specific to Austin, TX
      i) First, I used the tool "Select by Attribute" to select only the data that is for Austin, TX by using different identifiers.
      ii) After selecting the data for Austin, TX, I right clicked on the data layer in the TOC and selected "Export"
      iii) I exported these new, pruned layer files and added them as a feature layer to my current project. These are the subsequent layers to be used for data analysis

V. Data Processing and Analysis

Question 1: **How do demographics and socioeconomic status correlate with green spaces, educational resources, such as schools and libraries, and environmental hazards?**

To begin to answer this question, I aimed to first understand the estimated number of people that were served by each of the resources, assuming an even distribution of the population in every census tract. To do this, I used the tools buffer, intersect, as well as the field calculator.

1) **Buffers**
   ○ First, I created 1 mile radius buffers (Figure 3) around each of my features of interest. These buffers will be used to calculate the total number of people that may be served by a given resource location. For the sake of explaining the methodology, I will discuss the process using a dataset of the Austin High f in Schools.
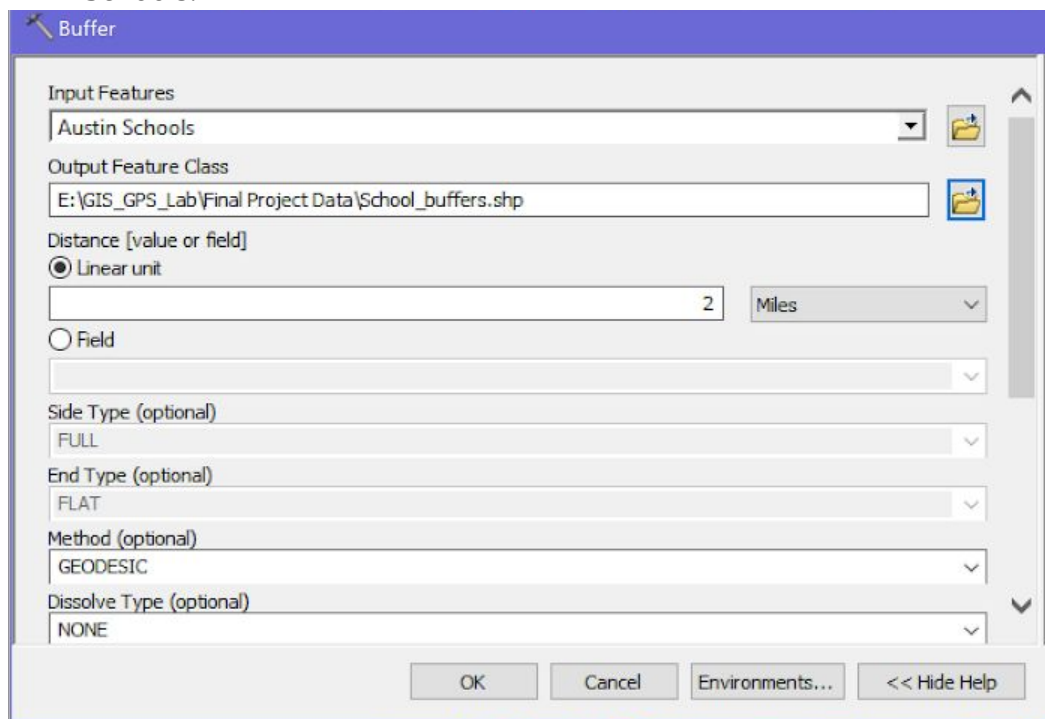

Figure 3: Using the "Buffer" tool, I was able to create 1 mile buffers around points of interest

i) I opened the Buffer tool specifying Austin High Schools as the input feature and specifying the radius as 1 mile (Figure 3).
○ Below is a chart displaying the buffers placed on the schools
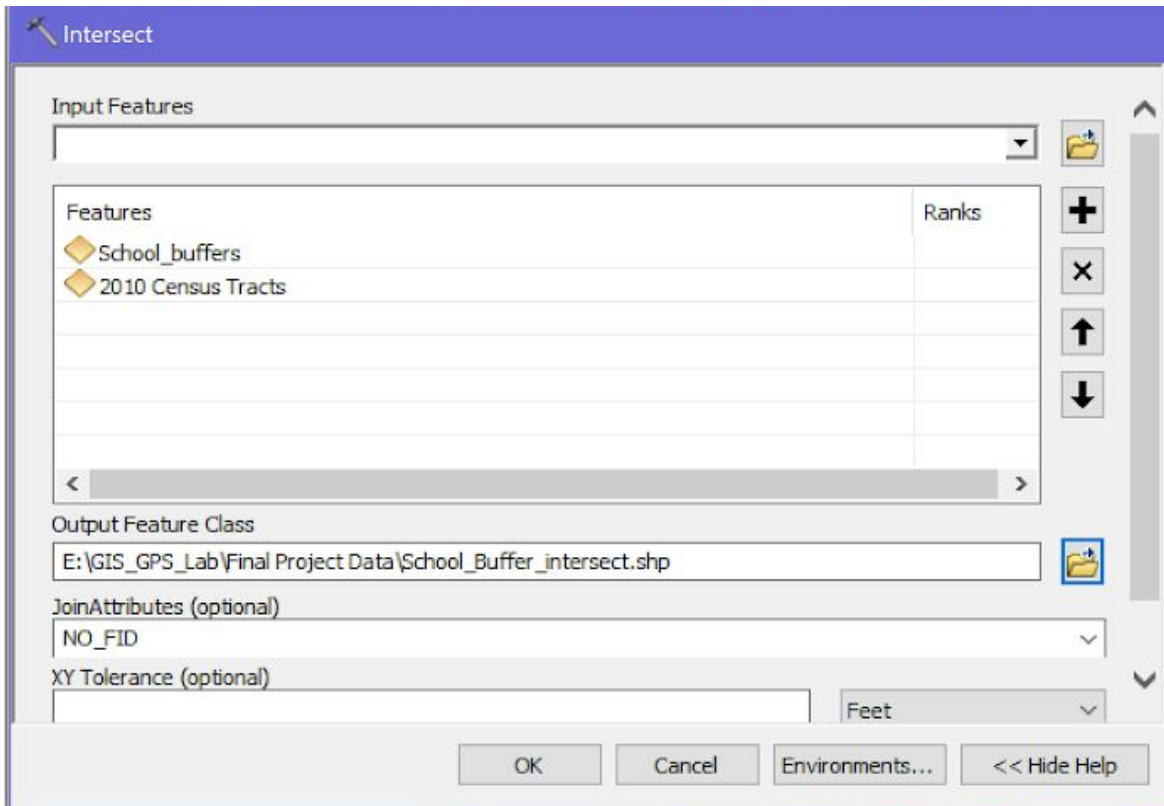
2) Intersect

Figure 4: The "Intersect" tool window was used to find the intersection between the buffers around points of interest and the 2010 Census tracts.

○ The intersect function allowed me to get a feature layer that shows the overlap between the buffers and the population data of the census tracts (Figure 4).
○ I added this layer to the map and opened the attribute table. Il

3) Field Calculator
○ In the attribute table of the intersect feature layer, I had the total census tract area and population. Since I wanted to know the new population that was served within the buffer of each educational resource, I needed to use the field calculator tool in order to make this calculation (Field 5).
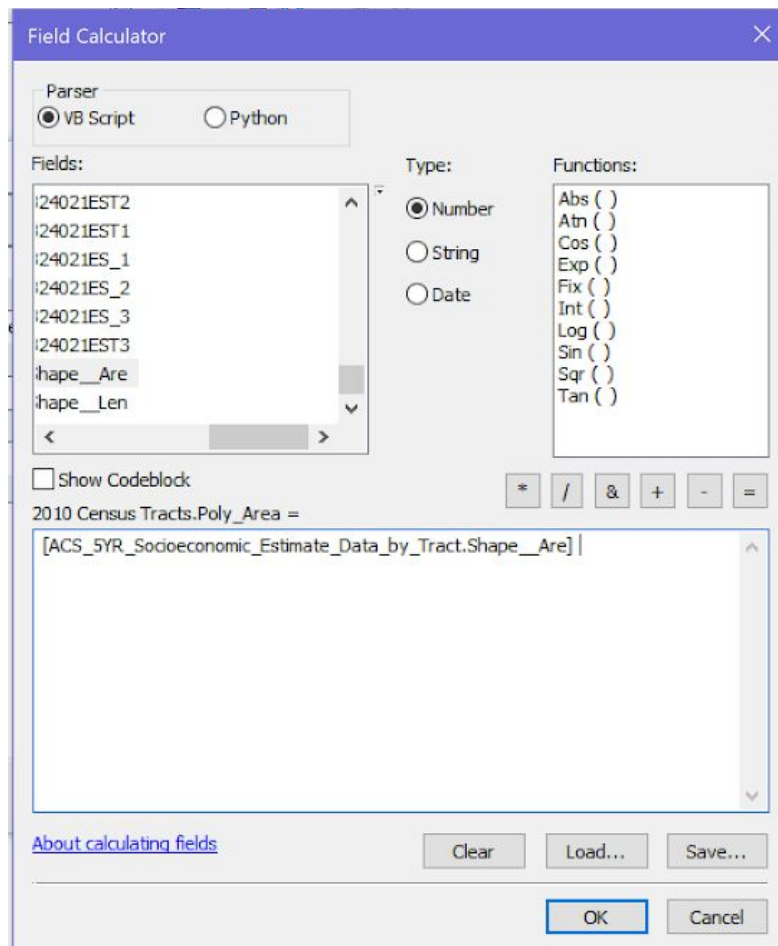
Figure 5: The field calculator tool was used to calculate the

      i)   First, I created two new label fields in the attribute table titled "intersect area" and "new population".

      ii)   Next, I needed to calculate the total population per every meter of area in the census tracts. I can then multiply this by this ratio by the area of the intersect. This allows me to get the new population that is served by every resource.

      iii)   Below are some screenshots of maps representing populations served by some of the educational resources looked at.

4) The aforementioned methods were used to understand the amount of people that libraries, Austin high schools, and recreation centers serve. For the distribution of natural areas and parks in Austin, I used the methodology listed below.

How much area of parks and natural areas are present within each of the census tracts? What is the proportion of natural areas and population demographics?

To answer this question specifically, we need to first measure the areas of each of the parks in square meters. Rather than creating buffers around these zones, I simply wanted to see whether or not there were proportionally fewer green areas in highly minoritized communities. To do this, I followed the modified steps below:

1. First, I calculated the areas in square meters of all the parks in Austin.
2. After this calculation, I used the intersect tool to find the overlap between the census tracts and the various parks.
3. I then took the sum of the area of parks within individual census tracts and divided it by the census tract area. This gave a ratio of the area of parks per census tract area.
4. Lately, I divided this ratioed value by the total population of the Census tract using the field calculator. A low calculated value would represent a tract that had low natural areas per population size, while a higher number would represent a tract with a high amount of natural area for the population served.

VI. Discussion

General Overview of Austin Demographics by Location

Race

As mentioned at the beginning of this project, Austin has clear geographic divides between racially minoritized communities. I sought to demonstrate these racial divides through my 2010 census dataset. Sorting the Austin, TX demographic census data by proportion of minoritized groups, I demonstrated a clear high prevalence of Black communities in east Austin, just east of I-35 highway. There were also higher proportions of Latinx communities in southeast Austin, closer to the river. Communities with the majority of the community

being White or non-racially minoritized had a tendency to be central and to the west within Austin, being West of I-35.

Question 1:

High Schools

It was found that there was not significantly higher access to schools based on the location of the school within Austin (Map 1). The high school serving the most students was Northeast Early College High School, with this one school having the potential to serve 19,000 people. As a caveat, this is the total all age population that would have access to the school. The proportion of minoritized populations potentially served by this school was very high, as it is positioned within a highly minoritized census tract. The High school serving the least potential population was International High School, with the school potentially serving about 4,000 people.

Future Project Direction: Though it seemed that high schools had equal access to facilities superficially, it would be crucial to know the fiscal budget of each of these schools to explore discrepancies between the amount of funding and support provided for the students educational gain based on geographic location.

Libraries

 In terms of other educational resources, such as libraries, there preliminarily seemed to be fewer libraries within census tracts with higher proportions of minoritized communities. There are 25 libraries within Austin, with 17 of them being located centrally or to the west and 8 being in east Austin. The libraries serving the majority of minority communities were Willie Mae Kirk Branch and University Hills Branch, with the largest library in Austin, the Austin Central Library, being in a predominantly White Census tract. The library serving the highest population within a 1 mile radius was the St. John Branch library. However, one limitation is not accounting for the accessibility to bus stations near the libraries. Though a 1 mile radius displays the walking distance that could be served, 5 miles may be a more accurate buffer as many have access to bus stations that would get them within walking distance of these crucial resources.

Austin Parks and Natural Areas

There are a whopping 745,139,209.78125 square meters of city parks and natural areas within the Austin City Limits, with the average park having an area of 2,427,163.549776 square meters. Of the census tracts in Austin, the tract with the highest amount of natural area in proportion to overall census tract area is in a predominantly White community. However, there was a surprising amount of access to green areas even in minoritized communities, with the second largest natural area to overall tract area being in a predominantly Black community . This goes against my original hypothesis. It seems that Austin really is outdoor and nature minded by providing seemingly equitable access to green spaces. Austin seems to be doing quite well in terms of providing easy and close access to parks, trails, and other natural areas to all communities.

Future exploration: Though it seems that Austin is successfully providing equal access to some green spaces, whether the quality of the green spaces in minoritized communities is the same has not been explored in this study. This would be a fantastic future direction for this portion of the project.

Question 2:

Austin City Dumpsites

As mentioned previously, communities with more minoritized communities often have higher exposure to multiple forms of pollution, In this case in particular, I was interested in where the dumpsites in the city were located, especially as dumpsites are correlated with higher amounts of _ and _ pollutants in the air and soil (). I found that there are 4 active dumpsites within Austin jurisdiction. All of these happen to be located in east Austin, where almost all of the racially minoritized communities reside (Map 2).

Austin Airport Noise Pollution

Using buffered overlays of the Austin-Bergstrom International Airport, I sought to elucidate the communities facing the highest amount of noise pollution from plane landings and takeoffs. The overlay of potentially damaging noise pollution intersects 25 total Census tracts, few of these tracts being non-majority Black or Hispanic. Of these 25 tracts, 10 of them had a Black and Hispanic population over 60%. The total population potentially

affected by the dangerous amounts of noise pollution is This is also the Census tract with the least amount of area in the noise pollution overlay zone.

Wastewater Outfalls

Lastly, I looked at the location of wastewater outfalls in Austin. Wastewater outfalls are where wastewater is dumped into a waterway for disposal, whether or not the wastewater is treated or not. These wastewater outfalls were found to almost exclusively be positioned in east austin, with the exception of only two wastewater outflows. I also found that there are the most wastewater outflows in majority Black and Latinx communities, with some census tracts having up to 6 different outflows contained within them.

General Limitations: There are two large limitations to this study. One limitation is that the new populations in these buffer zones assume that the distribution of the population is perfectly even within every Census Tract. This, as we know, is not the case, especially with different distributions of high occupancy living such as apartment complexes and single family homes. One way to improve upon this in this in the future is to get more precise calculations of population distribution by using the property footprint data that shows the building types

VII. Conclusions

Using GIS, I feel that I have successfully demonstrated that Austin has provided seemingly equal access to both natural areas and high schools, having seemingly equal distributions of both in racially minoritized and predominantly White census tracts. This went against my prediction that access to these resources would be disproportionately less in minority communities. However, there was a lack of libraries in many heavily minoritized communities on the East side of Austin. Unfortunately, These are the communities that would need these resources the most. However, I did not incorporate a larger buffer to account for the people that may have access via bus or bike.

In terms of environmental hazards, it is clear that the majority of the hazards are positioned in heavily minoritized communities. Noise pollution from the airport, proximity to a waste management area, and number of wastewater outfalls increase substantially in minoritized neighborhoods and communities.

2010 Census Tracts of Austin, TX by Hispanic Population Density
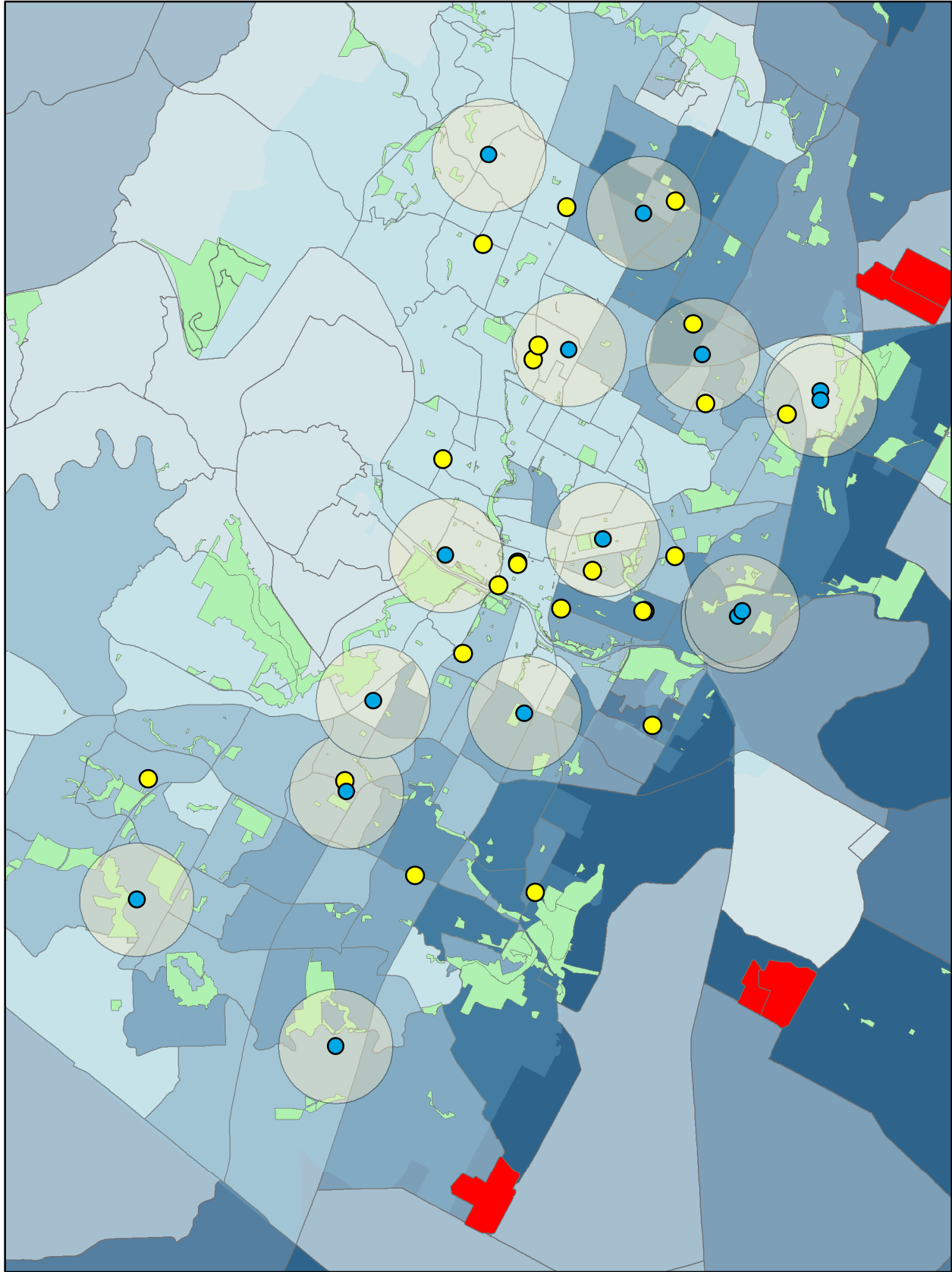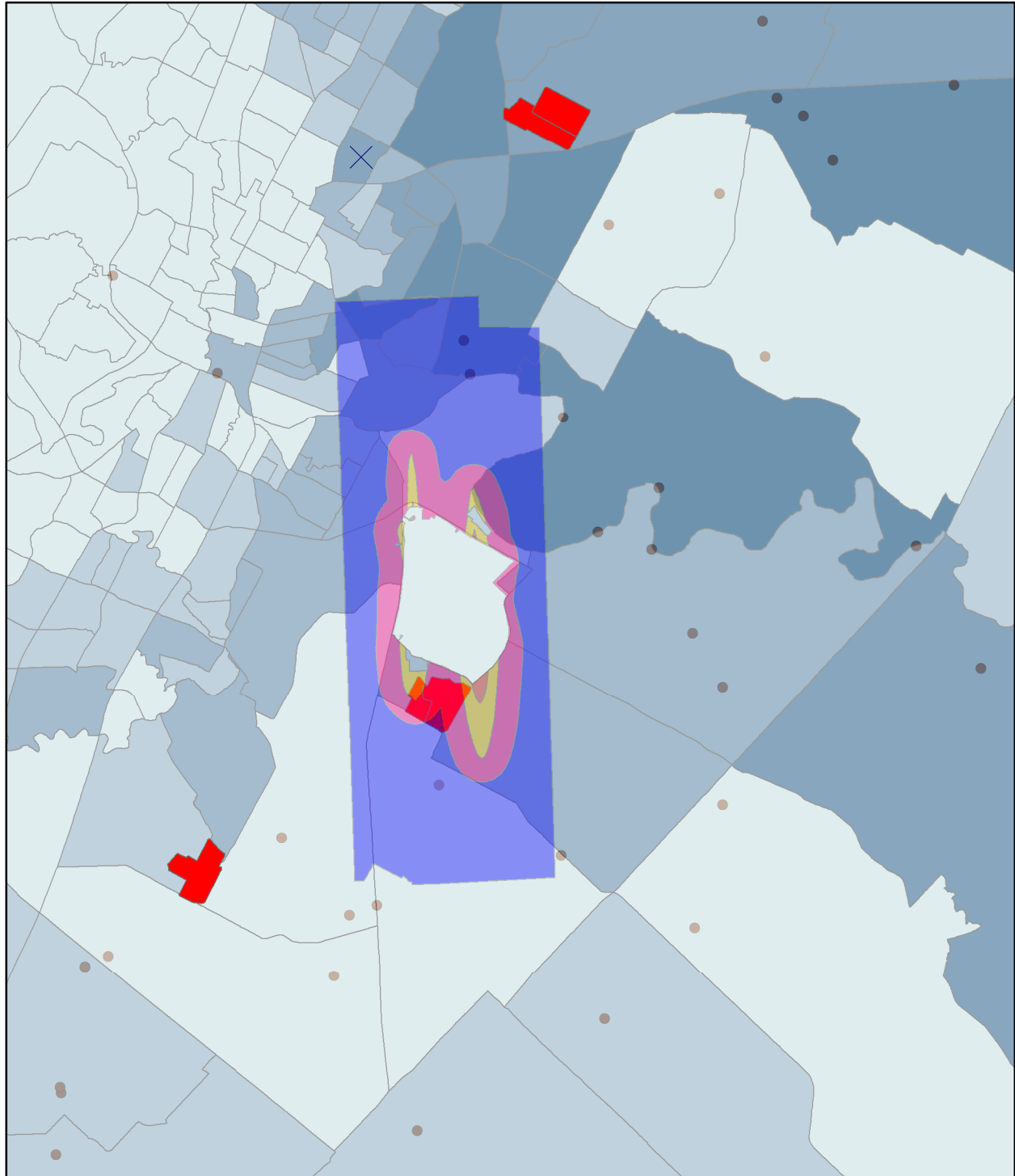

Educational Resources and Pollution Sources

- 🔵 Austin High Schools
- 🟡 Austin Libraries
- ▫️ Austin High School Buffers
- 🟩 Austin Parks
- 🟥 Active Landfills

2010 Census Tracts
SUM_hispan / none

- 0.00000000 - 906.000000
- 906.000001 - 1893.00000
- 1893.00001 - 3012.00000
- 3012.00001 - 4178.00000
- 4178.00001 - 7533.00000

N

0   1.5 Miles
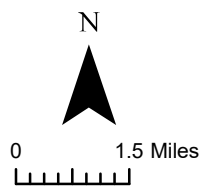
Coordinate System: NAD 1983 UTM 14N
Author: Jasmine Nelson
Date: December 1st, 2020

2010 Census Tracts of Austin, TX by
Black Population Density with Environmental Hazards

Educational Resources and Pollution Sources

OBJECTID

1

2

3

4

Active Landfills

2010 Census Tracts

SUM_black

0.000000 - 178.000000

178.000001 - 439.000000

439.000001 - 790.000000

790.000001 - 1358.000000

1358.000001 - 2856.000000

Outfalls

N

Coordinate System: NAD 1983 UTM 14N
Author: Jasmine Nelson
Date: December 1st, 2020

0   2 Miles

1. In press. Inheriting inequality: Austin's segregation and gentrification. See http://projects.statesman.com/news/economic-mobility/ (accessed on 7 December 2020).

2. Byrne J, Wolch J. 2009 Nature, race, and parks: past research and future directions for geographic research. *Prog. Hum. Geogr.* **33**, 743–765. (doi:10.1177/0309132509103156)

3. Rigolon A. 2016 A complex landscape of inequity in access to urban parks: A literature review. *Landsc. Urban Plan.* **153**, 160–169. (doi:10.1016/j.landurbplan.2016.05.017)

4. Byrne J. 2012 When green is White: The cultural politics of race, nature and social exclusion in a Los Angeles urban national park. *Geoforum* **43**, 595–611. (doi:10.1016/j.geoforum.2011.10.002)