Rivers and Roads

Diving into the hydrology of San Antonio, Texas

Tufts UNIVERSITY

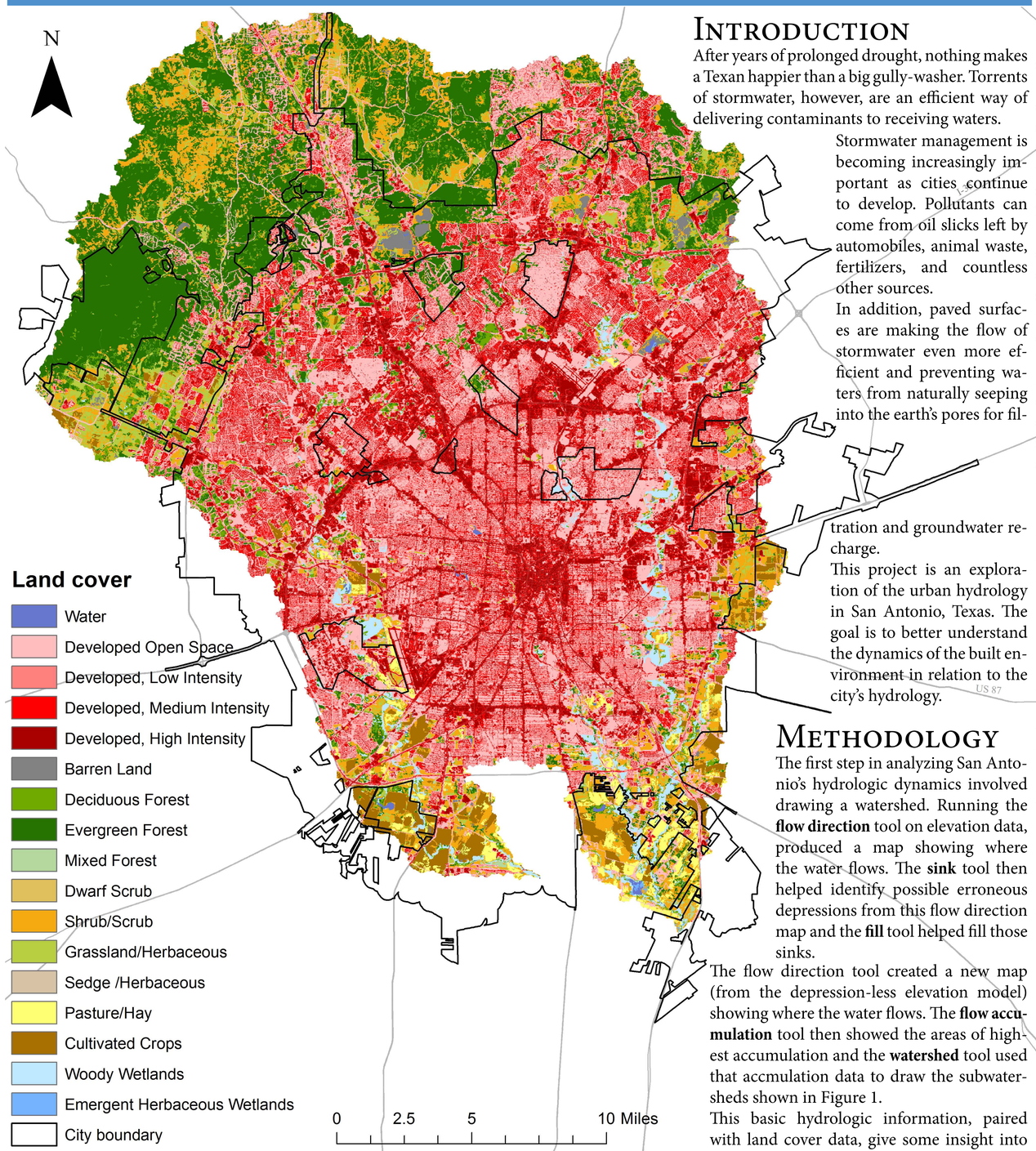

Figure 5. Most of the subwatersheds appear to cover developed land, especially within city boundaries. The northern portions of the watersheds, by contrast, seem to cover a lot of forested areas, particularly north of city limits. Moving towards the outlets at the southern points of each subwatershed, there appear to be more crops, scrub, and wetlands.

Monique Ching, 2016.
UEP 232, Introduction to GIS.

Data sources:

- USGS National Elevation Dataset
- Texas National Resources Information System
- City of San Antonio GIS Data
- National Land Cover Database
- Tufts S: Drive

Projection: NAD 1983 State Plane Texas South Central FIPS 4204 - Feet

Introduction

After years of prolonged drought, nothing makes a Texan happier than a big gully-washer. Torrents of stormwater, however, are an efficient way of delivering contaminants to receiving waters.

Stormwater management is becoming increasingly important as cities continue to develop. Pollutants can come from oil slicks left by automobiles, animal waste, fertilizers, and countless other sources.

In addition, paved surfaces are making the flow of stormwater even more efficient and preventing waters from naturally seeping into the earth's pores for filtration and groundwater recharge.

This project is an exploration of the urban hydrology in San Antonio, Texas. The goal is to better understand the dynamics of the built environment in relation to the city's hydrology.

Methodology

The first step in analyzing San Antonio's hydrologic dynamics involved drawing a watershed. Running the **flow direction** tool on elevation data, produced a map showing where the water flows. The **sink** tool then helped identify possible erroneous depressions from this flow direction map and the **fill** tool helped fill those sinks.

The flow direction tool created a new map (from the depression-less elevation model) showing where the water flows. The **flow accumulation** tool then showed the areas of highest accumulation and the **watershed** tool used that accmulation data to draw the subwatersheds shown in Figure 1.

This basic hydrologic information, paired with land cover data, give some insight into the stormwater dynamics of the city. This project focused on types of land cover and impervious surface.

The **raster calculator** helped visualize the impact of land cover and imperviousness. For example, adding the land cover values to the watershed raster (which had a value of zero) created a new watershed raster with all the land cover codes, as shown in Figure 2.

Zonal statistics as table provided a quantitative understanding of the same relationships. Shorter versions of these tables are shown in this poster. The tables are supplements to information shown visually, such as the percentage of the western subwatershed that is more than 75 percent impervious.

This same analysis was done using zoning data from the City of San Antonio, but the watersheds covered many zones that are classified as "outside city limits" and therefore gave little helpful insight into potential contaminant sources. Maps and tables from this analysis were not included in this poster.

Results

It appears much of the land within San Antonio's two major subwatersheds are 25 percent impervious or less. This is corroborated by the land cover analysis, which shows almost 22 percent of the eastern subwatershed is developed open space, while the western subwatershed is 25 percent evergreen forest and 17 percent developed open space.

While having fewer impervious surfaces is often viewed positively, it is important to note that the "open space" classification can include parks and golf courses, which can be major sources of pollutants such as from fertilizers. Further, low- and medium-intensity developments also are among the top five in each subwatershed. These classifications can include single-family housing and other similar developments that generate pollutants.

While San Antonio may not directly experience negative effects from contaminant loads in its stormwater runoff, because the elevation appears to be lowest on the southern tip of the city, officials and developers should remain vigilant in managing the city's stormwater.

Readers should note that this hydrologic analysis is somewhat simplistic, because it only assesses where stormwater flows using elevation data. Impervious surfaces often can alter flow dynamics and is not accounted for in this context. Instead, this project only examines the amount of impervious surface within the city's subwatersheds without analyzing how it affects the water's flow.

Eastern subwatershed		
Land cover	**Area (acres)**	**Percent of watershed area**
Developed, open space	56,219	21.9
Developed, low intensity	56,205	21.9
Developed, medium intensity	42,939	16.8
Evergreen forest	25,367	10
Developed, high intensity	25,132	10

Western subwatershed		
Land cover	**Area (acres)**	**Percent of watershed area**
Evergreen forest	41,284	25.3
Developed, open space	28,225	17.3
Developed, low intensity	21,165	13
Developed, medium intensity	18,977	11.6
Shrub/scrub	17,133	10.5

Western subwatershed		
Percent impervious	**Area (acres)**	**Percent of watershed**
0-25	119,328	73
26-50	17,776	10.9
51-75	16,500	10.1
76-100	9,760	6
Total	163,364	100

Eastern subwatershed		
Percent impervious	**Area (acres)**	**Percent of watershed**
0-25	143,268	55.9
26-50	46,885	18.3
51-75	37,059	14.5
76-100	28,973	11.3
Total	256,186	100

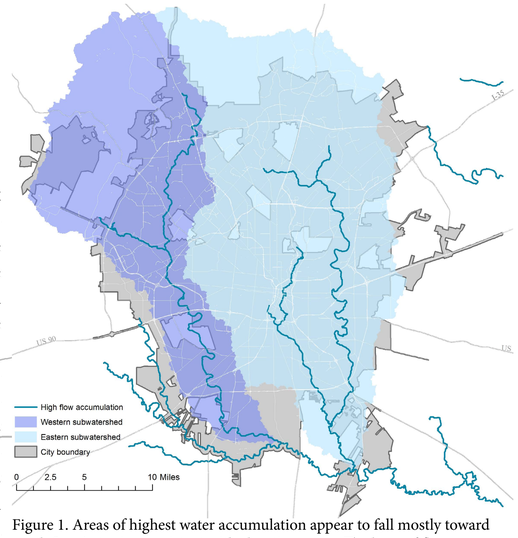

Figure 1. Areas of highest water accumulation appear to fall mostly toward south San Antonio, consistent with elevation maps. The lines of flow accumulation helped create the two main subwatersheds encompassing the city.

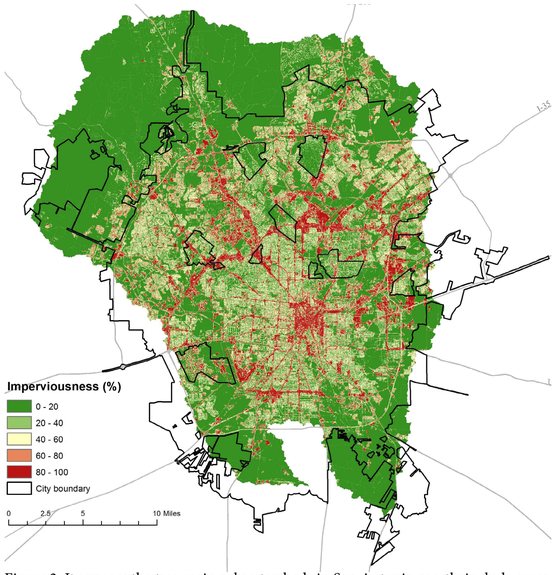

Figure 2. It appears the two main subwatersheds in San Antonio mostly include areas that are 20 percent impervious or less.

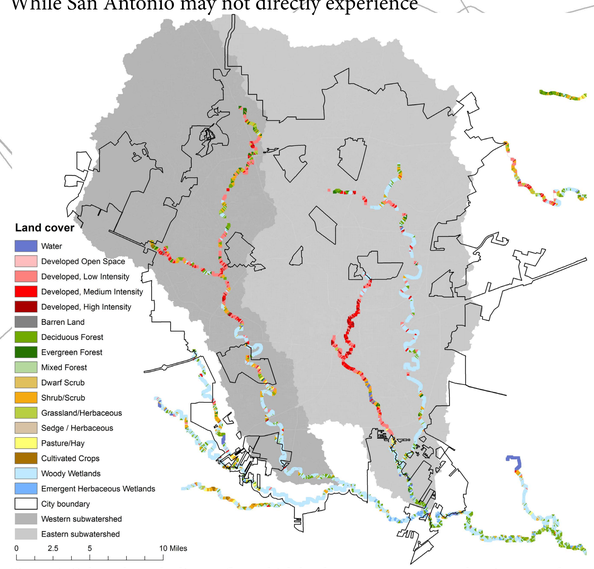

Figure 4. Colors along the lines reflect which land cover types are prevalent in areas of high flow accumulation.

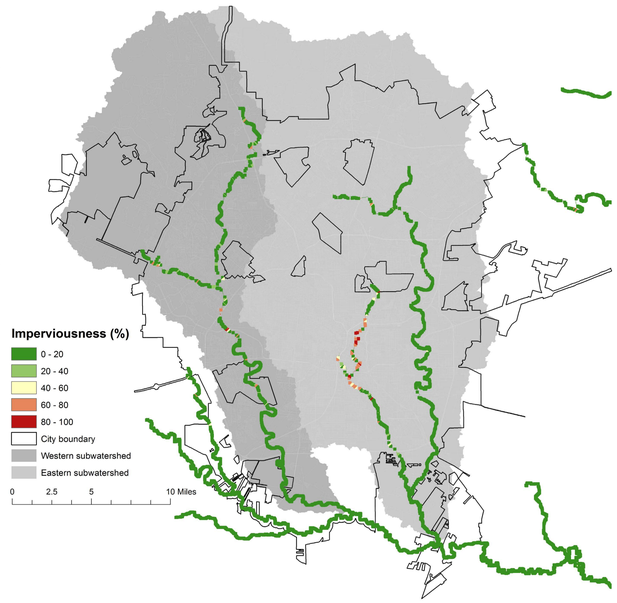

Figure 3. Colors along the lines reflect the level of imperviousness in areas of high flow accumulation.