Chapter 2 Rowlett Creek Watershed Characterization

Introduction

This chapter provides an overview of the Rowlett Creek watershed. Rowlett Creek was first placed on the Texas 303(d) list in 2014 for bacterial impairment. Rowlett Creek is also listed as having a concern for nitrate. The water quality problems to be addressed are bacteria impairment and concern for nitrate. The information in this chapter primarily comes from city, state, and federal data resources, as well as local stakeholder knowledge. The information in this chapter is critical to an accurate assessment of potential sources of water quality impairment in the Rowlett Creek watershed, and to accurately recommend best management practices for the watershed.

Watershed Description

Rowlett Creek watershed, a hydrologic unit code (HUC) 10 watershed, flows through the Dallas-Fort Worth (DFW) Metroplex cities of Plano, Garland, McKinney, Frisco, Allen, Murphy, and Rowlett, which constitute a highly urbanized watershed (Figure 2.1). The creek also flows to Lake Ray Hubbard, a major water supply reservoir owned by the City of Dallas. The majority of the creek is within the city limits of Plano. The City of Plano is the ninth most populous city in the state of Texas (2010 United States Census). Land uses in Plano consist of industrial (6%), commercial (23%), residential (66%), and agricultural (7%).

Rowlett Creek (Segment 0820B) and its tributaries make up a significant portion of the East Fork Trinity River drainage and Lake Ray Hubbard watershed. With continuous growth in the region, Rowlett Creek is exposed to water quality and habitat degradation caused from human activity, urban runoff, and erosion.

Spring Creek and its tributaries, Pittman Creek and Prairie Creek, make up a significant portion of the Rowlett Creek basin that drains into the East Fork Trinity River and Lake Ray Hubbard. The City of Plano contains the head waters of the Spring Creek basin, which eventually flows downstream through other Texas cities including Richardson and Garland. The land surfaces making up the Spring Creek watershed in Plano are mostly impervious, including roadways, alleys, buildings, parking lots, driveways, and sidewalks. Due to the lack of pervious surfaces and natural buffers in this drainage, over 90% of the precipitation that falls here flows to the stream, rather than being absorbed by the historical natural prairie habitat. Because of this, Spring Creek is exposed to water quality and habitat degradation caused from human activity, urban runoff, and erosion.

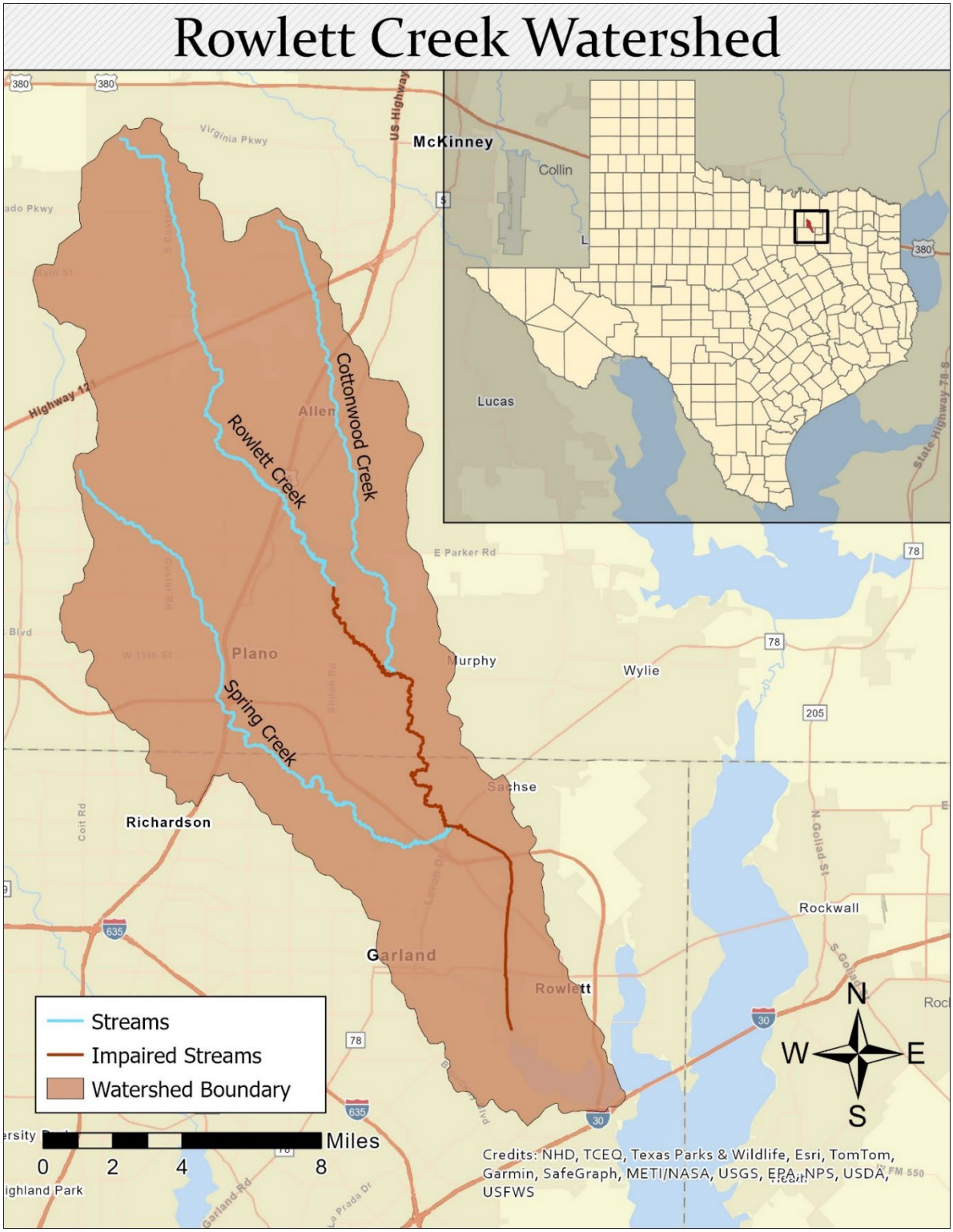

Figure 2-1. Rowlett Creek watershed.

Subwatersheds

The Rowlett Creek watershed, a Hydrologic Unit Code (HUC) 10 watershed, is subdivided into five HUC 12 subwatersheds. Data was collected at the outlet of each subwatershed (Figure 2.2; Table 2.1). The subwatersheds consisted of the headwaters of Rowlett Creek (Site 1), Cottonwood Creek (Site 2), Brown Branch-Rowlett Creek (Site 3), Pittman Creek- Spring Creek (Site 4), and Rowlett Creek at Lake Hubbard (Site 5).

Table 2.1. HUC 12 watersheds (i.e., subwatersheds) within Rowlett Creek watershed (HUC 10) with IDs and area.

HUC 12	HUC 12 Name	Subwatershed ID (Figure 2)	Area (mi^2)
120301060404	Headwaters Rowlett Creek	1	38.6
120301060405	Town of Allen- Cottonwood Creek	2	19.3
120301060406	Brown Branch Rowlett Creek	3	25.5
120301060407	Pittman Creek- Spring Creek	4	36.7
120301060408	Rowlett Creek- Lake Ray Hubbard	5	27

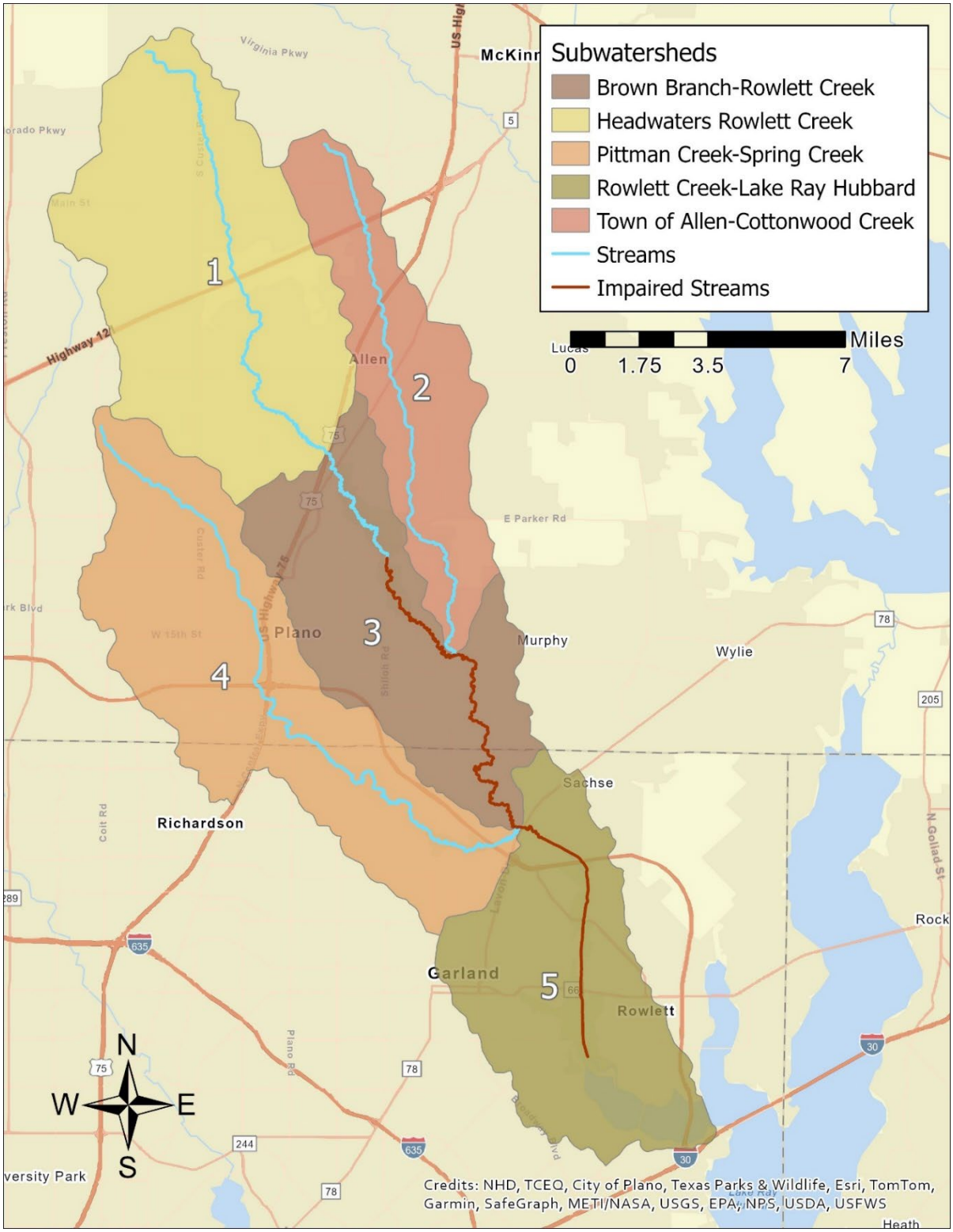

Figure 2.2. Rowlett Creek subwatersheds.

Ecoregions

Ecoregions are defined as land areas where ecosystems are generally similar in type, quality, and quantity of environmental and natural resources that include hydrology, geology, soils, climate, and vegetation+ (Omernik and Griffith, 2014). This spatial framework was originally derived from Omernik (1987) in collaboration with the EPA, other Federal agencies, state resource management agencies, and neighboring North American countries. There are four levels of ecoregion classification which refine from the level prior, starting at Level I with 12 ecoregions to Level IV with 967 ecoregions. The land within the Rowlett Creek watershed is characterized only by one ecoregion, Ecoregion 32 Texas Blackland Prairies at Level III. The Texas Blackland Prairie is characterized by its fine-textured, clayey soils and the dominant prairie natural vegetation (Griffith et al., 2004). This region contains Vertisol, Alfisol, and Molisol soils. Looking at the further refined scale of Level IV Ecoregion, this watershed is in Ecoregion 32a Northern Blackland Prairie. This ecoregion is characterized by fine-textured, dark, clayey Vertisols and dominant natural vegetation of prairie grasses.

Land Use and Land Cover

Watershed land cover data was obtained from the 2021 National Land Cover Database by the United States Geological Survey (USGS) in cooperation with the Multi-Resolution Land Characteristics (MRLC) Consortium (Dewitz, 2023). Over 75% of Rowlett Creek watershed is developed land, with 19.0% being low density, 42.2% medium density, and 14.4% high density developed land. 8.3% is developed open land (Figure 2.3; Table 2.2).

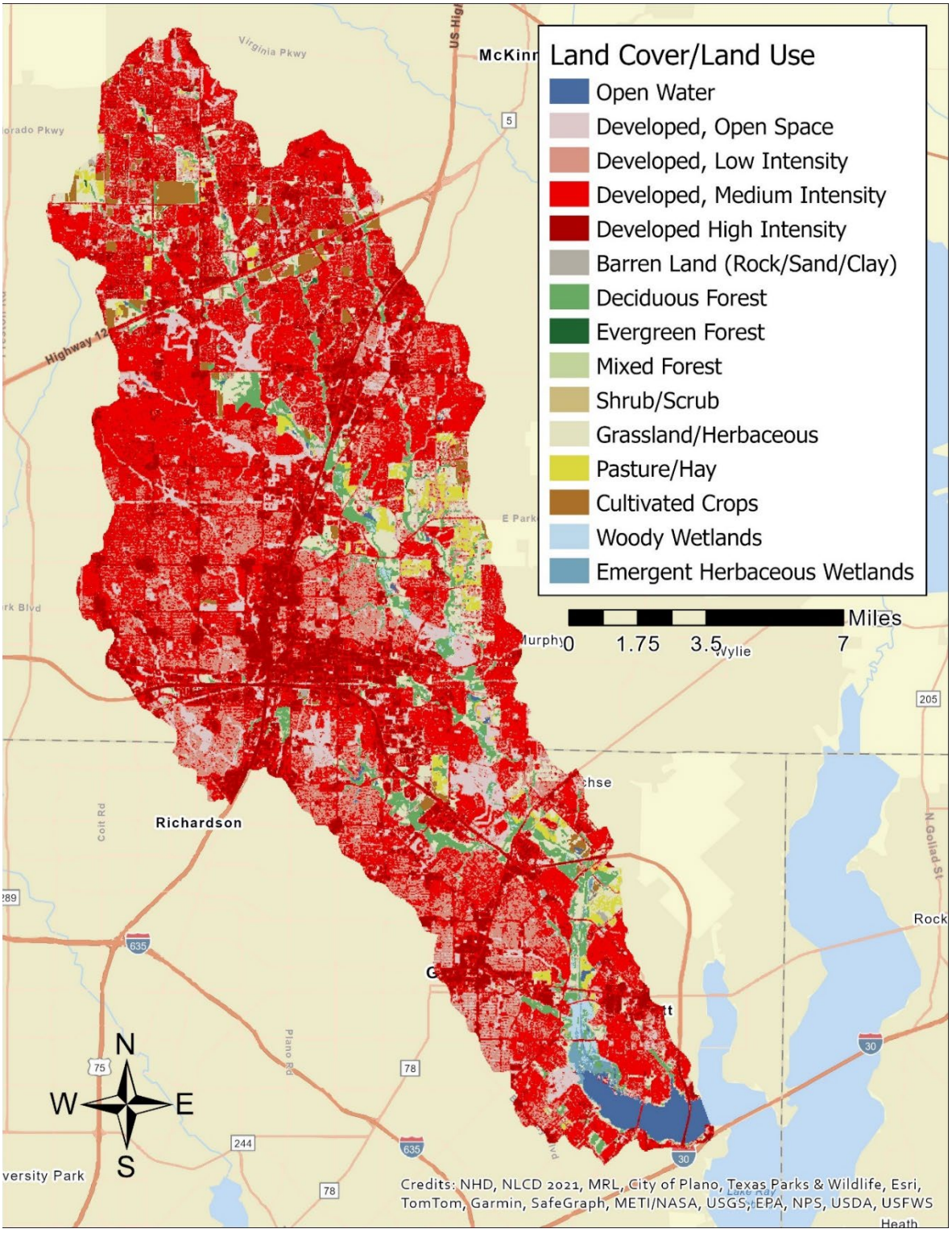

Figure 2.3. Land cover and land use in the Rowlett Creek watershed classified by the USGS and MRLC.

Table 2.2. Rowlett Creek land cover and land use

Name	Area (mi^2)	Percent Cover
Open Water	2.18	1.49
Developed, Open Space	12.15	8.27
Developed, Low Intensity	27.95	19.02
Developed, Medium Intensity	62.15	42.29
Developed, High Intensity	21.14	14.38
Barren Land (Rock/Sand/Clay)	0.28	0.19
Deciduous Forest	6.25	4.25
Evergreen Forest	0.05	0.04
Mixed Forest	0.10	0.07
Shrub/Scrub	0.30	0.20
Grassland/Herbaceous	8.13	5.54
Pasture/Hay	2.58	1.75
Cultivated Crops	2.58	1.75
Woody Wetlands	0.63	0.43
Emergent Herbaceous Wetlands	0.48	0.33
Overall	146.95	100.0

Soils and Topography

The hydrology of a watershed has many components, including soil properties and topography, specifically slope and elevation. Slope and elevation determine direction of water flow, while soil properties and elevation determine water speed and quantity that infiltrates, flows over, and moves through soil in the watershed.

The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) provides information about soils collected by the National Cooperative Soil Survey, available through the Soil Survey Geographic (SSURGO) Database (USDA NRCS, 2022). The SSURGO database provides hydrologic ratings for soils, which are groups of soils with similar runoff properties. These ratings are useful for considering the potential for runoff from properties under consistent rainfall conditions. Within Rowlett Creek watershed, the majority of soils are hydrologic type “D” (Figure 2.4), which have a very slow infiltration rate and a very slow rate of water transmission (Table 2.3). Soil textures are dominated by clay (Figure 2.5).

According to USGS (2023), the elevation of the watershed ranges from 132 feet to 245 feet above maximum sea level (MSL). The average slope of the watershed is 3.1% (Figure 2.6).

Table 2.3. Hydrologic soil groups as described by the USDA NRCS

Hydrologic Soil Group	Description
A	Soils have a high infiltration rate when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmissions.
B	Soils have a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have a moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
C	Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.
D	Soils having a very slow infiltration rate when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a clay layer at or near the surface, and soils that are shallow over a nearly impervious material. These soils have a very slow rate of water transmission.

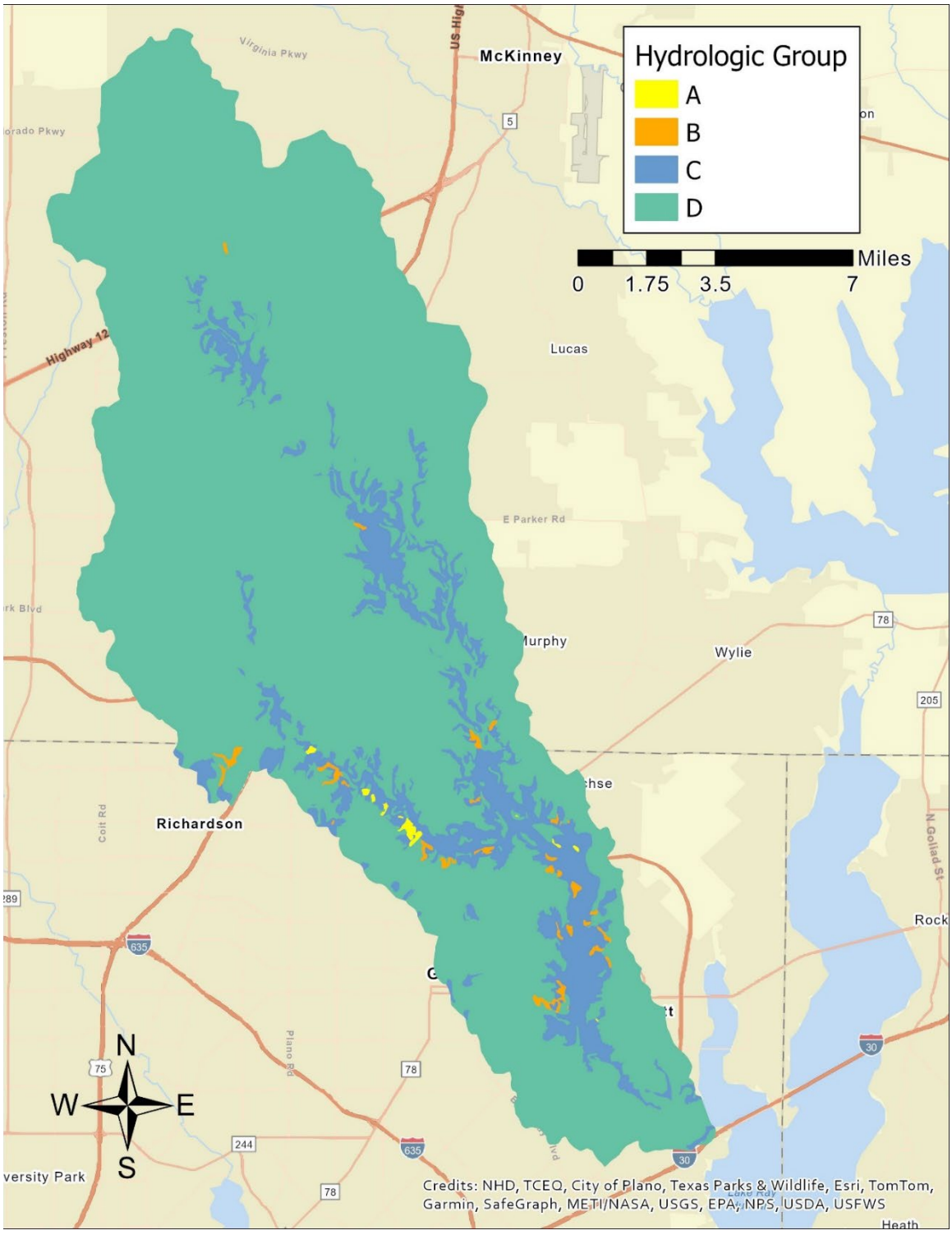

Figure 2.4. Map of the hydrologic soil groups in the Rowlett Creek watershed.

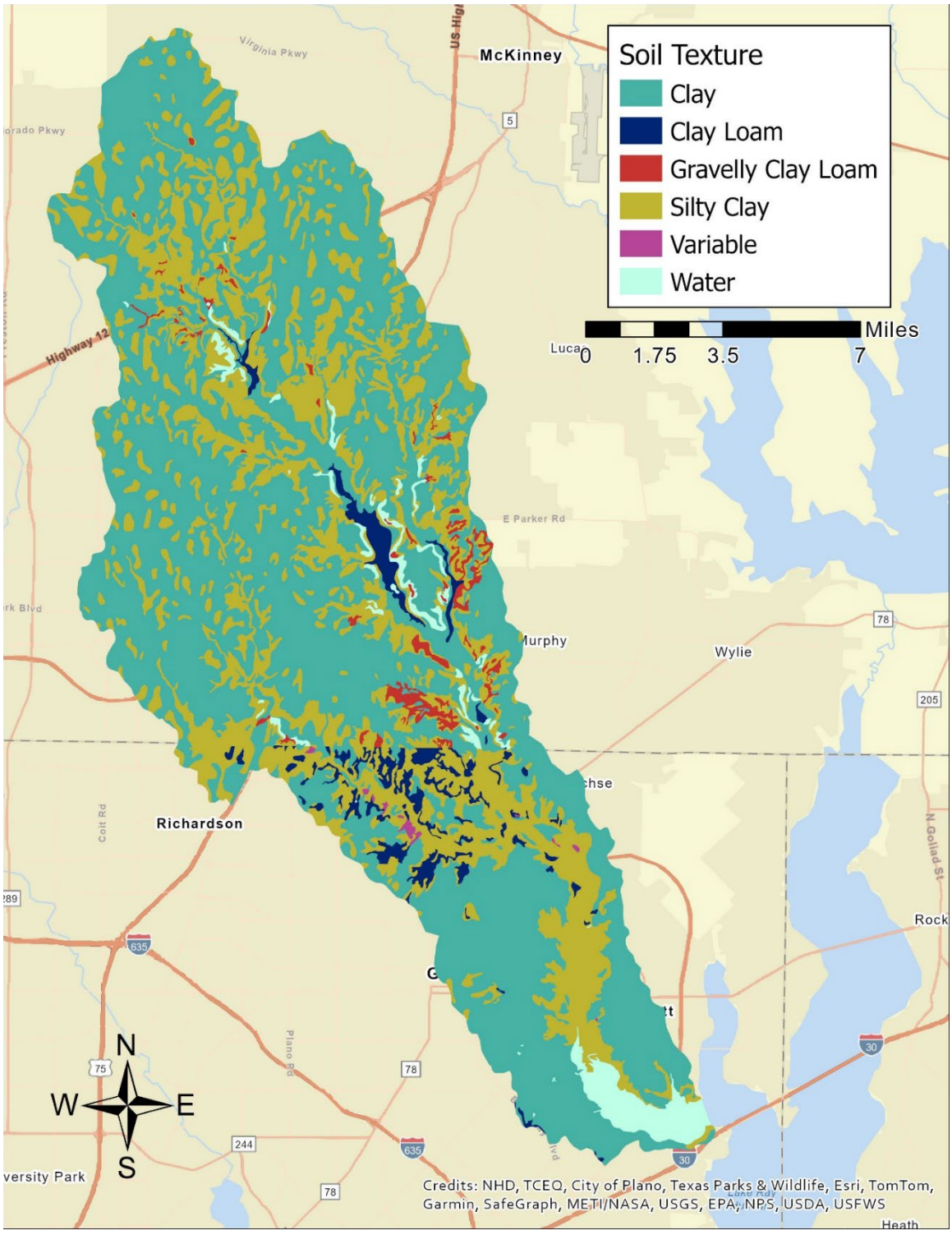

Figure 2.5. Map of the soil texture types in the Rowlett Creek watershed.

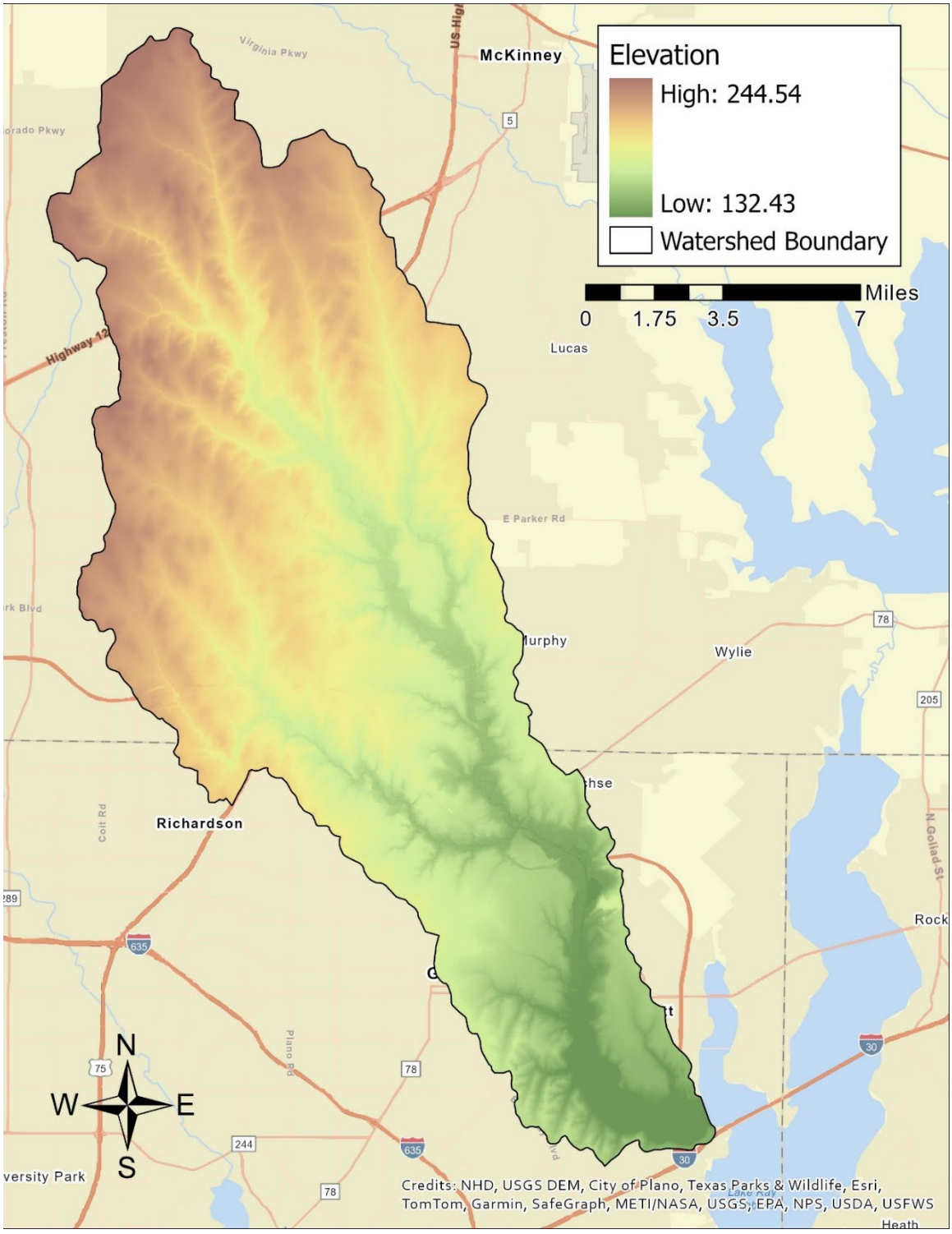

Figure 2.6. Elevation map of the Rowlett Creek watershed.

Climate

The Rowlett Creek watershed falls in the approximate boundaries of subtropical subhumid and subtropical humid climates as classified by Larkin and Bomar (1983), meaning it can share characteristics of both climate types. This classification system was based on the Köppen Climate Classification System and the long-term weather trends for Texas from 1951-1980. Subtropical Subhumid climate is characterized by hot summers and dry winters, and Subtropical Humid by warm summers. According to the revised Köppen-Geiger Climate Subdivisions used internationally, including by the National Oceanic and Atmospheric Administration (NOAA, 2023), the regional climate is described as humid subtropical characterized by mild winters and hot summers with no dry season. Therefore, we will consider this area as humid subtropical.

The 30-year climate normals of monthly precipitation and temperature data seen in Figure 2.7 were extracted from NOAA weather station Richardson, TX USC00417588, located within the watershed area from 1991 to 2020 (NOAA NCEI, 2021). The highest temperatures are during the summer months, August showing the normal hottest temperatures at 95.1 °F and the lowest at 73.8 °F. Winter months normal temperatures indicate a mild winter with minimum temperatures of 33.9 °F in January. The normal annual sum of precipitation is 41.61 inches with two rainy seasons in spring and fall months. May is the wettest month with a normal precipitation of 5.49 inches, while summer is the driest season with August normally receiving 2.18 inches. Additionally, looking at Figure 2.88 with data from the PRISM Climate Group at Oregon State University (PRISM Climate Group, 2024), the precipitation 30-year (1991 – 2020) normal for annual total precipitation indicates 40.1 to 40.9 inches across the Rowlett Creek watershed.

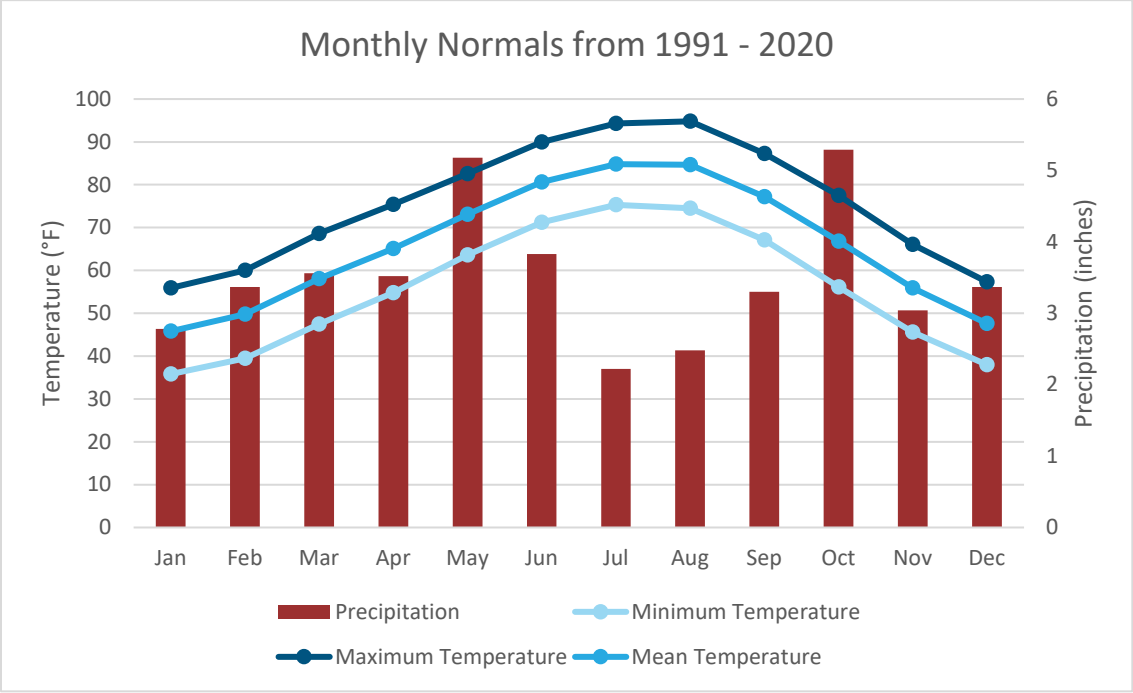

Figure 2.7. Chart of the monthly 30-year normal for the Richardson Weather Station located within Rowlett Creek watershed boundaries.

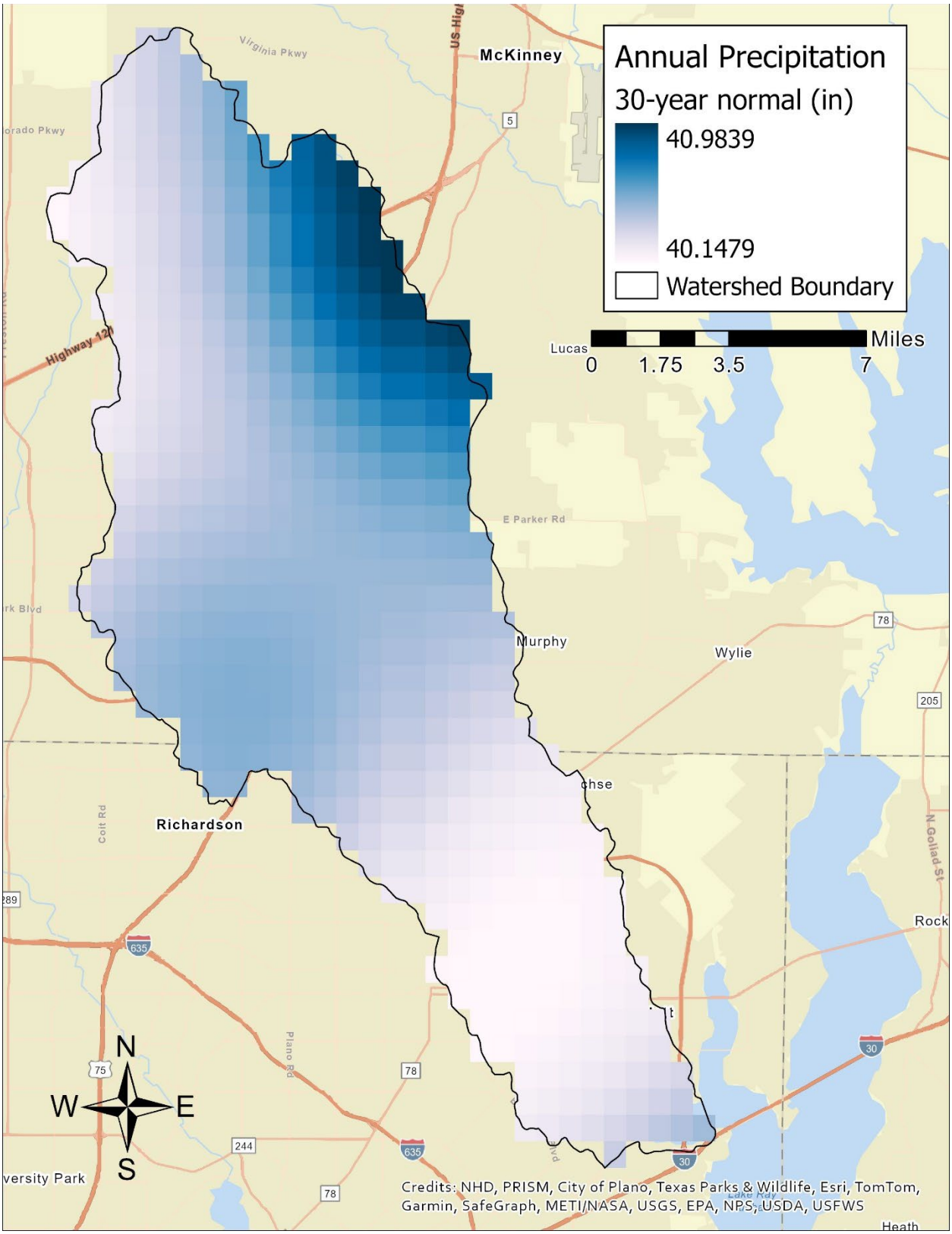

Figure 2.8. 30-year Normal Annual Precipitation from 1991-2020.

Demographics

According to the 2020 census, about 792,767 people live in the watershed (USCB, 2021). This watershed is in a highly urbanized area with population densities ranging from 843 to 13,119 persons per square mile (Figure 2.9). According to population projection statistics produced by the Office of the State Demographer and the Texas Water Development Board (TWDB), from 2020 to 2070, rapid development and population increases (Table 4) will continue for the county areas within the watershed (TWDB, 2021). However, much of that growth is expected to be outside of this watershed area. Looking back at the land cover data (Table 2.2), over 75% of the land is already developed, therefore much of the approximate 126% population growth expected for Collin County is outside of the watershed boundaries. Dallas County from 2020 to 2070 is estimated to increase by nearly 46% with an estimated population of over 3.7 million by 2070 (TWDB, 2021). Less than 10% of the population lives under the poverty level and a majority (>90%) have at least a high school degree. Renters constitute around 35% of the watersheds and around 37% do not consider English their primary language. The demographics are shown in Table 2.5 per subwatershed (Census Bureau, 2020).

Table 2.4. Population projections from 2020 to 2070 by 10-year increments of the surrounding counties of the Rowlett Creek watershed. (TWDB, 2021).

2021 Regional Water Plan
County Population Projections for 2020-2070

	Population by Year						Percent Increase
County	2020	2030	2040	2050	2060	2070	
Collin County Total	1,050,506	1,239,303	1,497,921	1,807,279	2,093,720	2,373,092	125.9%
Dallas County Total	2,587,960	2,871,662	3,180,529	3,429,783	3,627,334	3,770,858	45.7%

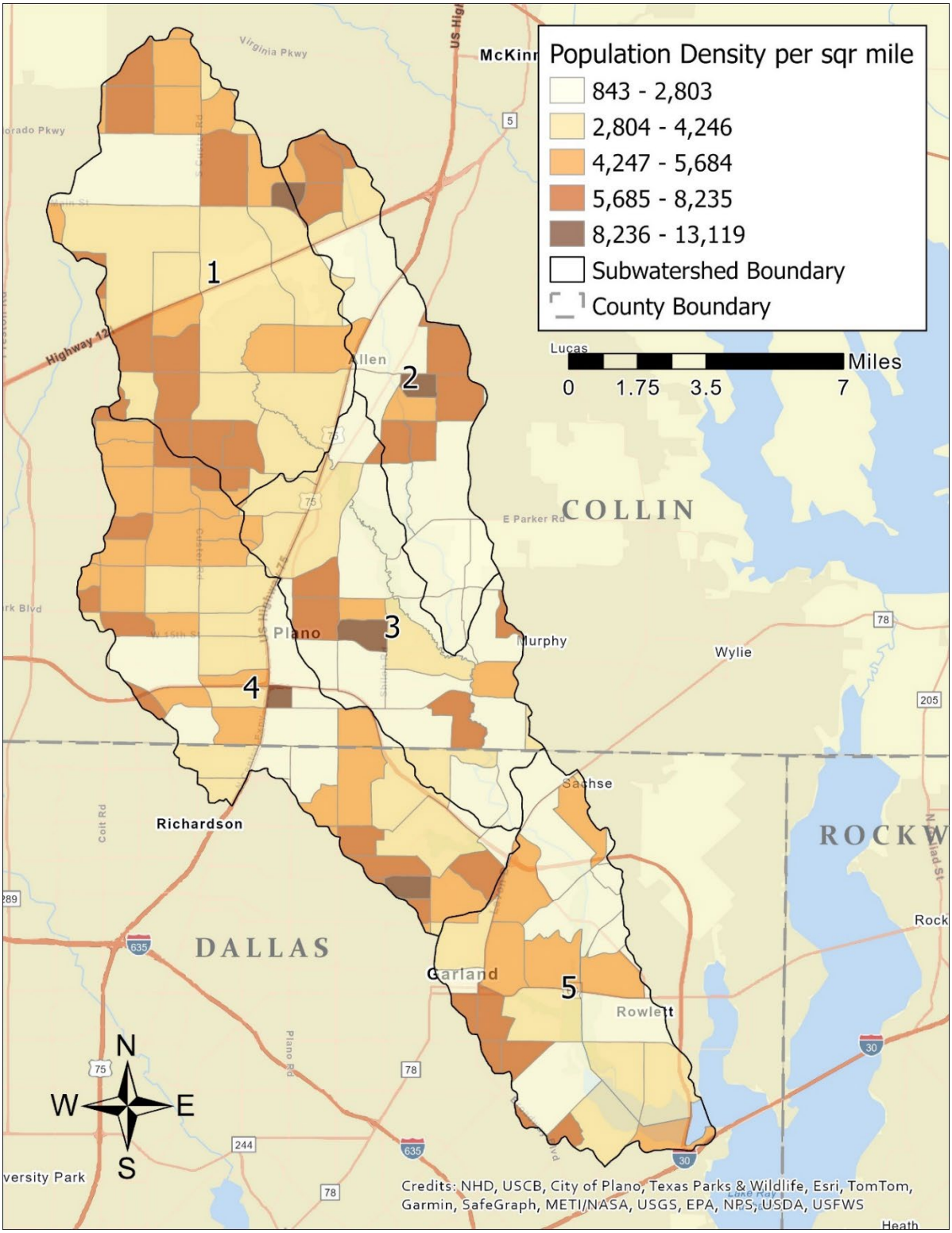

Figure 2.9. Population density from 2020 U.S. Census tracts within the Rowlett Creek watershed.

Table 2.5. Population demographics of the subwatersheds of the Rowlett Creek watershed (Census Bureau, 2020).

ID	Subwatershed (HUC 12) Name	Poverty Level (%)	Renters (%)	Less Than High School (%)	Non-English Primary (%)
1	Headwaters Rowlett Creek	4.35	33.11	3.62	36.77
2	Town of Allen-Cottonwood Creek	5.99	25.10	4.10	24.91
3	Brown Branch-Rowlett Creek	9.12	40.24	10.90	42.91
4	Pittman Creek-Spring Creek	7.74	40.95	6.95	30.88
5	Rowlett Creek-Lake Ray Hubbard	10.06	33.26	18.12	48.45

Other Water Sources

Groundwater

There is only one major aquifer that is found in the boundaries of the watershed, the Trinity Aquifer (TWDB, 2006). The Trinity Aquifer covers the entirety of the watershed. The Trinity Aquifer is a large aquifer that extends across the central region of Texas into the northeast and into the southern portion of Oklahoma. The aquifer's freshwater saturated thickness averages about 600 feet in North Texas (TWDB, 2011). The northern portion where the Rowlett Creek watershed is located is at the subsurface, the part of an aquifer that lies below other formations. According to the 2021 Regional Water Plan Summary for Region C, the water planning area that covers the county domains of the watershed, municipalities used about 75,000 acre-feet per year in 2020, of which 4,908 Acre-feet were used in Collin County (TWDB, 2021). However, these water supply needs are not predicted to increase by 2070. Although groundwater is the most utilized water source in Texas, according to TWDB Groundwater data viewer (TWDB, 2024), most wells in the Rowlett watershed have been plugged back and surface water is the main water supply source.