A revised soil and geology report (April 24, 2020) has been submitted by Entech. General Note 2 on the plans should reference the date of the revised report.

CGS concurs with most of the recommendations of Note 3 on the plans. As recommended by the geotechnical engineer, Note 3 indicates that "lot-specific subsurface soil investigations will be performed to determine whether or not shallow groundwater, hydo-compacted soils, and/or potentially expansive soils are present on the lot, and for use in design of individual foundations, floor systems, subsurface drainage, and pavements, and/or if lot-specific recommendations are necessary to mitigate these conditions. If engineered foundations are required to address geological hazards, an engineered site plan will be required."

The listed conditions can be evaluated and properly designed for during a site-specific soils and foundation investigation except for shallow groundwater. This is due to variations in groundwater that cannot be determined by a single point in time. Groundwater may be encountered but if it isn't that does not support a conclusion that it will not impact the planned residence. In either case, fluctuations of groundwater levels are important to understand. This is especially true in sites with persistent but intermittent shallow groundwater such as this one.

The four test borings and forty test pits used to investigate the 824-acre site were advanced and excavated in the months of April and December/January respectively. Seasonal fluctuations of shallow groundwater cannot be determined from these singular data points but require measurements during the full course of spring, summer, fall and winter months. Precipitation data collected for over 40 years (Appendix A) show that much higher precipitation rates occur in this area in the late spring and summer compared to December, January and April, rates that will cause a rise in groundwater. In areas such as this one with known shallow groundwater the additional constraint of perched groundwater will also vary seasonally and over different years.

There have been several studies of the aquifer that underlies this proposed subdivision. While the focus of the studies is on nitrate contamination, they also include useful data on yearly precipitation rates of the area of this project. The data demonstrates significant variation in precipitation rates that in turn will lead to variations in groundwater levels and shows years with higher than average precipitation. It should be expected that groundwater levels potentially impacting basement and other below grade areas will be higher both seasonally and during years of higher than average precipitation rates. While groundwater may or may not be encountered, variation in shallow groundwater levels or the presence or potential presence of perched groundwater cannot be determined solely during an investigation conducted over the course of a few days as is typical for a site-specific soil and foundation investigation.

Entech has recommended drain systems for areas with seasonal groundwater issues. The other identified shallow groundwater condition identified at the site relates to perched groundwater. They state (p.13), "Perched water conditions could be encountered across the site where water can flow within permeable sand layers overlying impermeable bedrock. These areas should be identified on an individual basis at the time of construction. Where perched water conditions are encountered, the mitigation recommendations for seasonal and potentially season shallow groundwater should be followed."

As perched water conditions can be encountered anywhere within the site, CGS recommends that the drain systems presented by Entech by required for all areas within this subdivision unless it can be

proven with a groundwater monitoring program that below grade areas (basements or storage areas) will be maintained 3 to 5 feet above the highest measured or expected groundwater elevations and/or perched groundwater locations. We recommend requirements for drains for below grade habitable construction be added to the plans as a condition of approval. Raising site grades and/or garden-level basement construction could also be substituted for or be used in conjunction with drain systems.

Submitted 12/14/2020 by Jonathan R. Lovekin, Senior Engineering Geologist, Colorado Geological Survey

jlovekin@mines.edu

APPENDIX A

Annual and monthly precipitation rates, and

Precipitation variations by region in eastern El Paso County

There have been studies by both the Colorado Geological Survey (CGS) and the United States Geological Survey (USGS) of the aquifer that underlies this proposed subdivision. While the focus of the studies is on nitrate contamination, they also include useful data on yearly precipitation rates. Data from these studies demonstrate variation in precipitation rates that in turn will lead to variations and extent of groundwater levels.

The data also shows years with higher than average precipitation. It should be expected that groundwater levels potentially impacting basement and other below grade areas will be higher both seasonally and during years of higher than average precipitation rates.

The first two pages with charts (CGS report figures 2 and 3) depict precipitation data from the years 1963-2005. This is from both the City of Colorado Springs airport and from the town of Rush. The last page (USGS report figure 6) depicts regional variation in average annual precipitation from the years 1981-2010. This figure shows that the area of the project has precipitation rates that compare more with the rates from the airport than from Rush due to this regional variation.

REFERENCES

1. Groundwater quality, age, and susceptibility and vulnerability to nitrate contamination with linkages to land use and groundwater flow, Upper Black Squirrel Creek Basin, Colorado, 2013. United States Geological Survey Scientific Investigations Report 2016-5020.
2. Upper Black Squirrel Creek Basin, aquifer recharge and storage evaluation. Open File Report -08-04. Colorado Geological Survey, 2008.

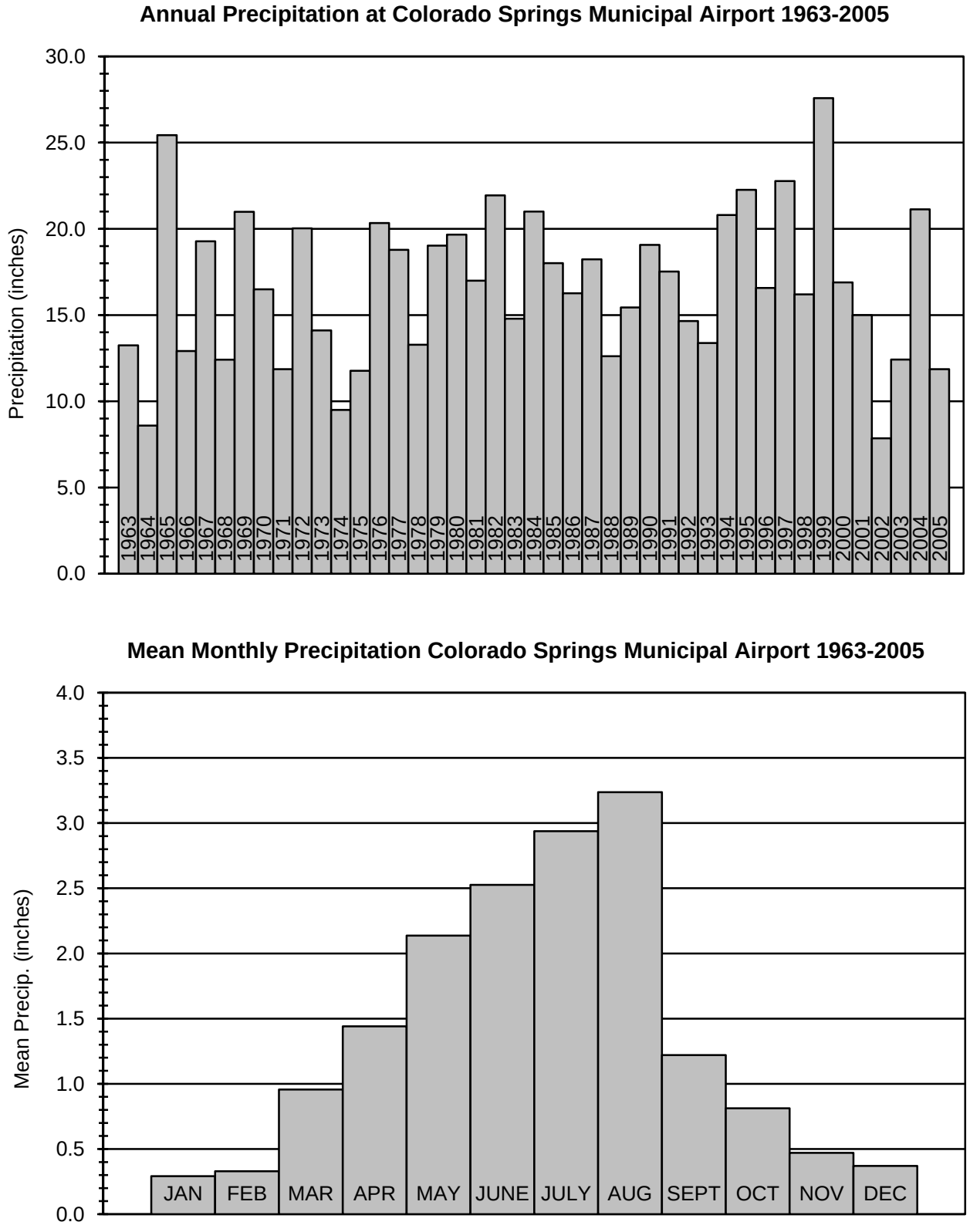

Figure 2 – Annual (A) and mean monthly (B) precipitation at Colorado Springs Municipal Airport, 1963-2005.

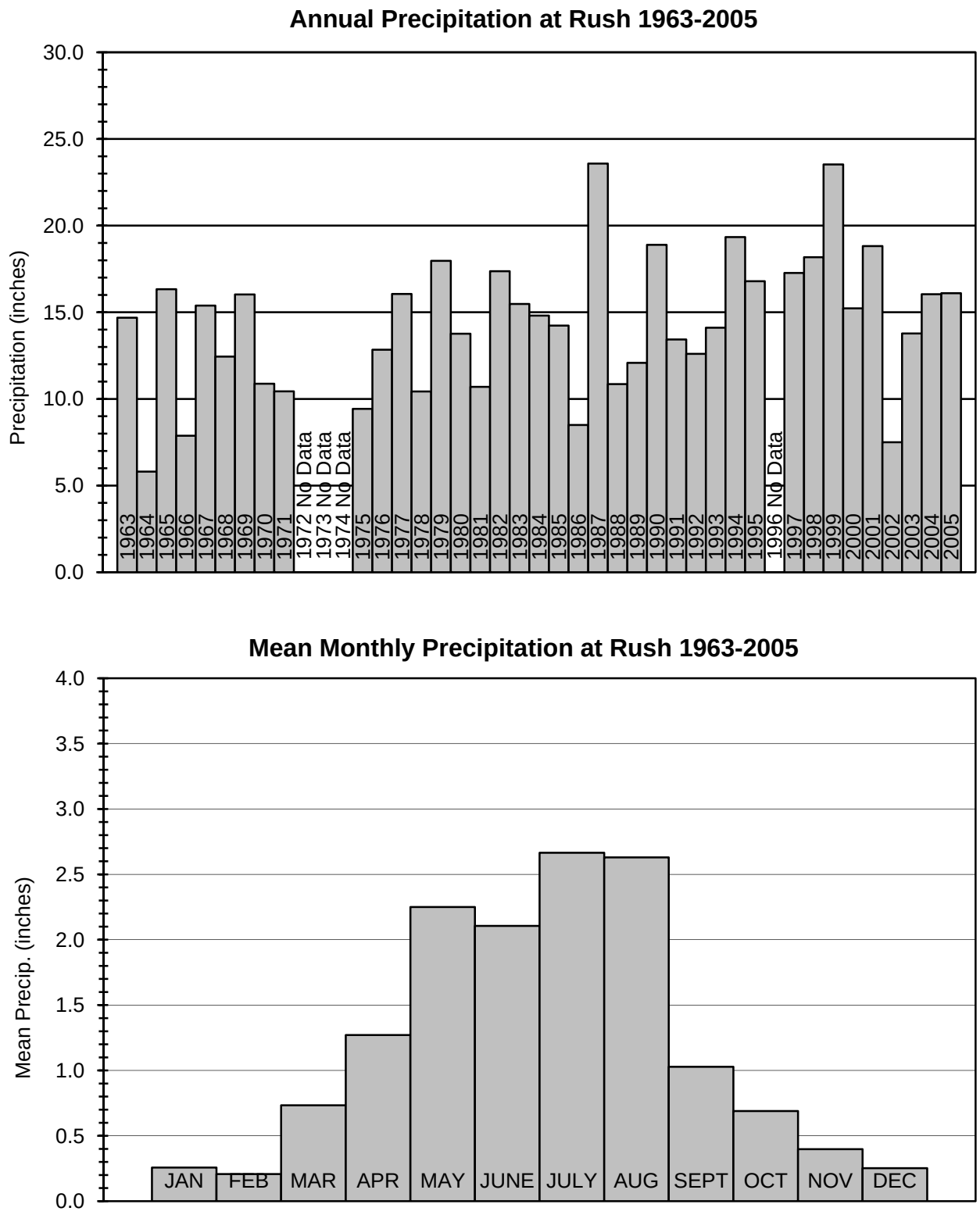

Figure 3 – Annual (A) and mean monthly (B) precipitation at Rush, 1963-2005.

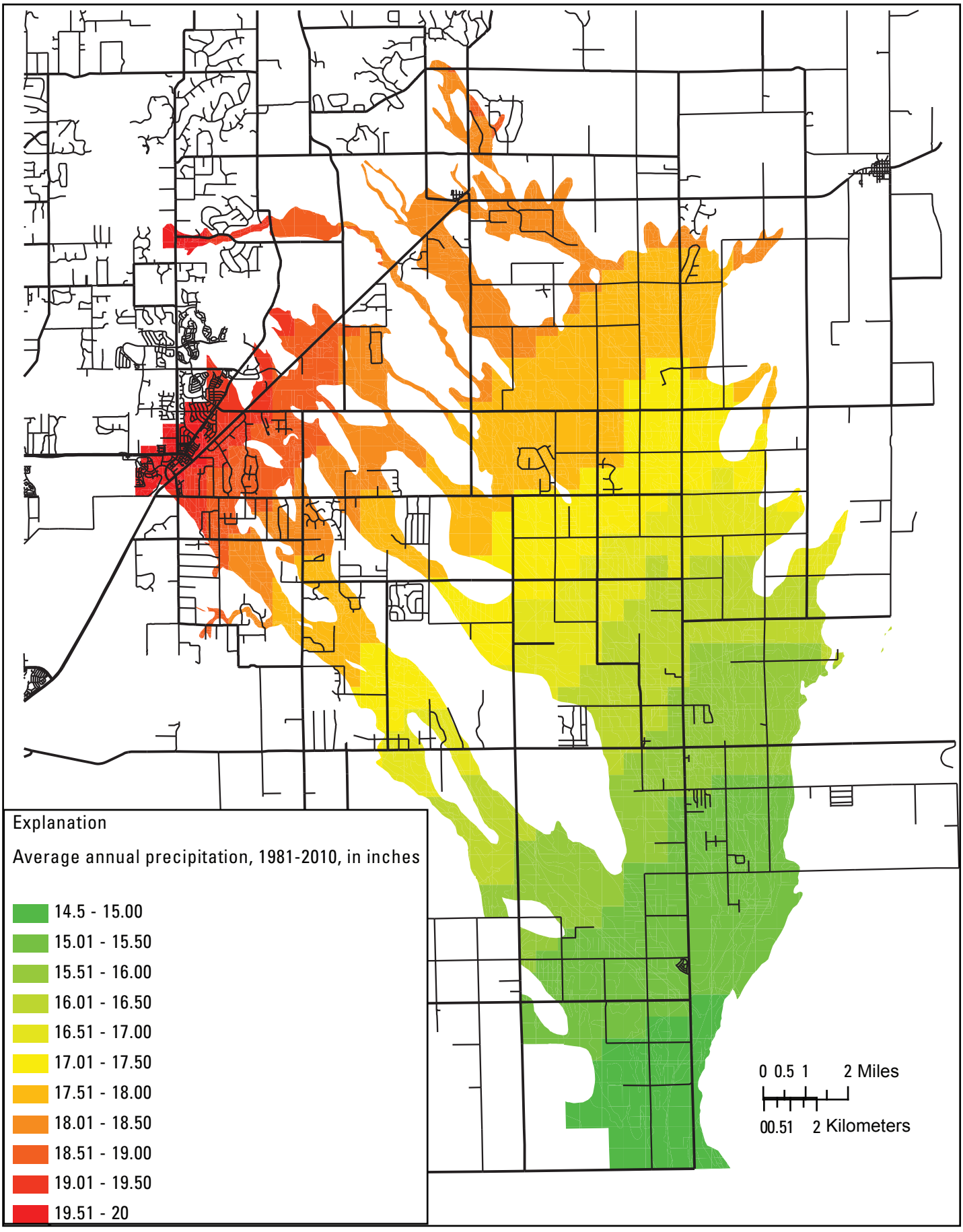

Figure 6. Average annual precipitation in the Upper Black Squirrel Creek Basin, El Paso County, Colorado, 1981-2010.