Chapter 6

Calculation of Overburden Above the Mahogany Zone in the Piceance Basin, Colorado

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By Tracey J. Mercier

Chapter 6 of 7

Oil Shale and Nahcolite Resources of the Piceance Basin, Colorado

By U.S. Geological Survey Oil Shale Assessment Team

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Calculation of Overburden Above the Mahogany Zone in the Piceance Basin, Colorado

By Tracey J. Mercier

Introduction

As part of the National Oil Shale Assessment, the volume of overburden material was calculated above the Mahogany zone in the Piceance Basin. A common Geographic Information System (GIS) method was used to calculate the amount of overburden by subtracting a model of the Mahogany surface from a Digital Elevation Model (DEM). To maintain consistency with other models in the assessment, all overburden calculations and resultant files were analyzed using a one-acre (208.7 ft/63.615 m per side) raster-model cell size with an effective area of 43,560ft^2/4,047 m^2.

The first step was to digitize the Mahogany ledge outcrop, Parachute Creek Member outcrop, and detailed structure lines (fig. 1) of the top of the Mahogany zone from two published 1:100,000-scale geologic maps (Hail and Smith, 1994; 1997). The structure contour lines were converted to a point file containing elevation values for the top of the Mahogany zone. For the Mahogany outcrop, line surface elevation values, in ft, were extracted from the DEM to obtain elevation values for the Mahogany ledge. The two point files were merged to generate a surface model in ArcGIS (ESRI, 2006) by using the GeoStatistical Analyst's Radial Basis Function (RBF) contouring method. The RBF surface model was then converted to an ESRI GRID as well as a Triangulated Irregular Network (TIN) model (fig. 2) to use in ArcGIS's 3D Analyst extension.

The Mahogany surface GRID was then subtracted from the DEM GRID using the ArcGIS Spatial Analyst Raster Calculator. The resultant GRID (fig. 3) contains values of total overburden, in ft, above the Mahogany zone for each one-acre cell. The overburden GRID was converted to a TIN. Figure 4 shows the effect of applying hillshade to the overburden TIN to aid in visual analysis. In order to calculate the volume of overburden material contained in specific polygonal areas, we used ArcToolbox's TIN Polygon Volume function to calculate the total volume of overburden, in mi^3, found within the basin, as well as the amount of overburden found within each Public Land Survey System (PLSS) section (fig. 5).

This analysis found the total volume of overburden above the Mahogany zone in the Piceance Basin to be approximately 192 mi^3 of rock and other material. For comparison, that amount is approximately equal to 22 times the volume of water in Lake Mead; 320,000,000 Olympic-size swimming pools; 286 times the amount of rock removed during the Mt. St. Helens eruption; one-fifth the volume needed to fill the Grand Canyon; and over seven billion hopper cars at 4,000 ft^3 capacity.

References Cited

Environmental Systems Research Institute, Inc. (ESRI), 2006, ArcMap, ver. 9.2.

Hail, W.J., and Smith, M.C., 1994, Geologic map of the northern part of the Piceance Creek basin, northwestern Colorado**:** U.S. Geological Survey Miscellaneous Investigations Series Map I-2400, scale 1:100,000, http://pubs.er.usgs.gov/usgspubs/i/i2400.

Hail, W.J., Jr. and Smith, M.C., 1997, Geologic map of the southern part of the Piceance Creek basin, northwestern Colorado**:** U.S. Geological Survey Miscellaneous Investigations Series Map I-2529, scale 1:100,000, http://pubs.er.usgs.gov/usgspubs/i/i2529.

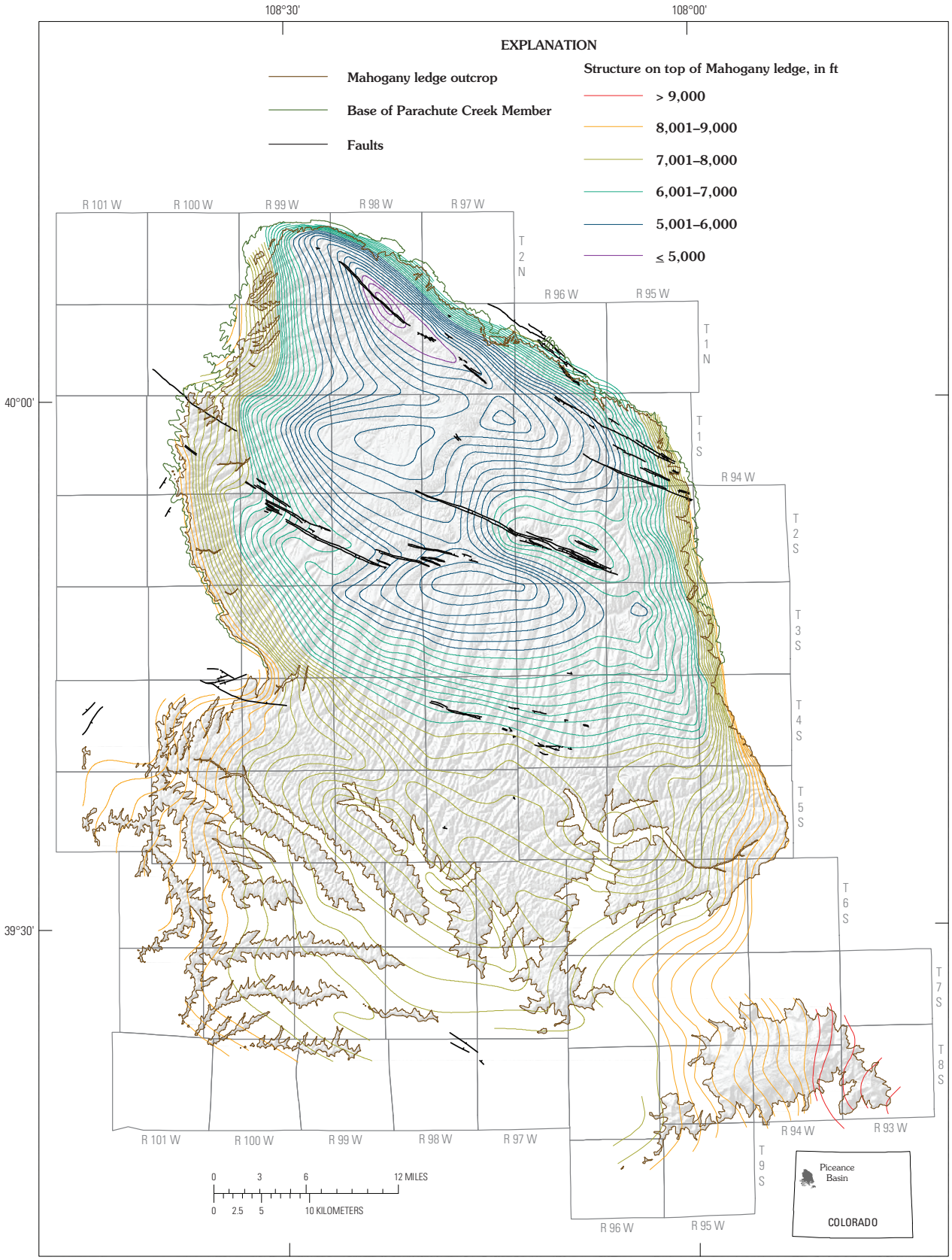

Figure 1. Mahogany zone structure contour lines (Hail and Smith, 1994; 1997) drawn on the Digital Elevation Model (DEM) clipped to the Piceance Basin.

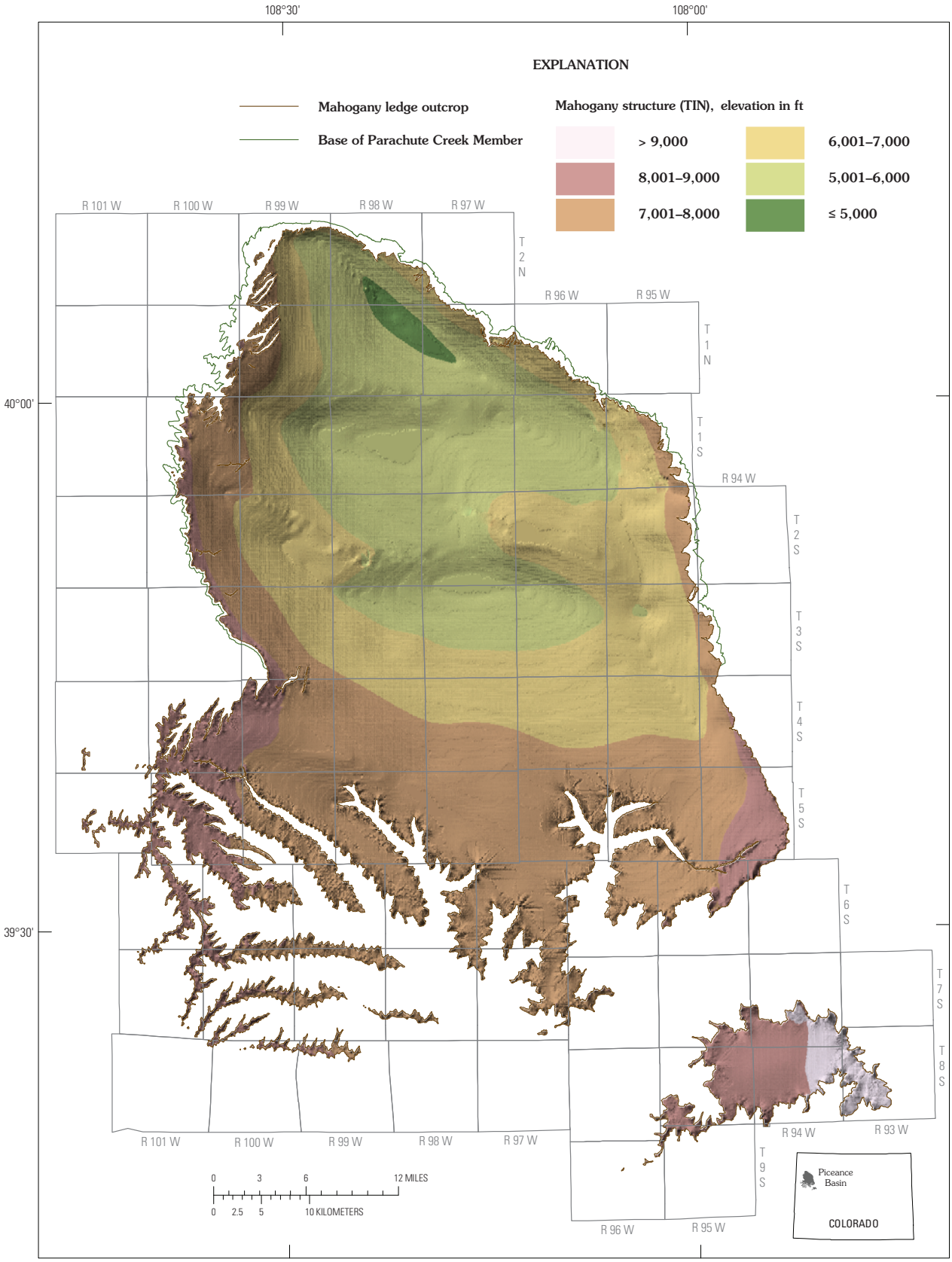

Figure 2. Map showing the Triangular Irregular Network (TIN) model of the top of the Mahogany zone subsurface structure.

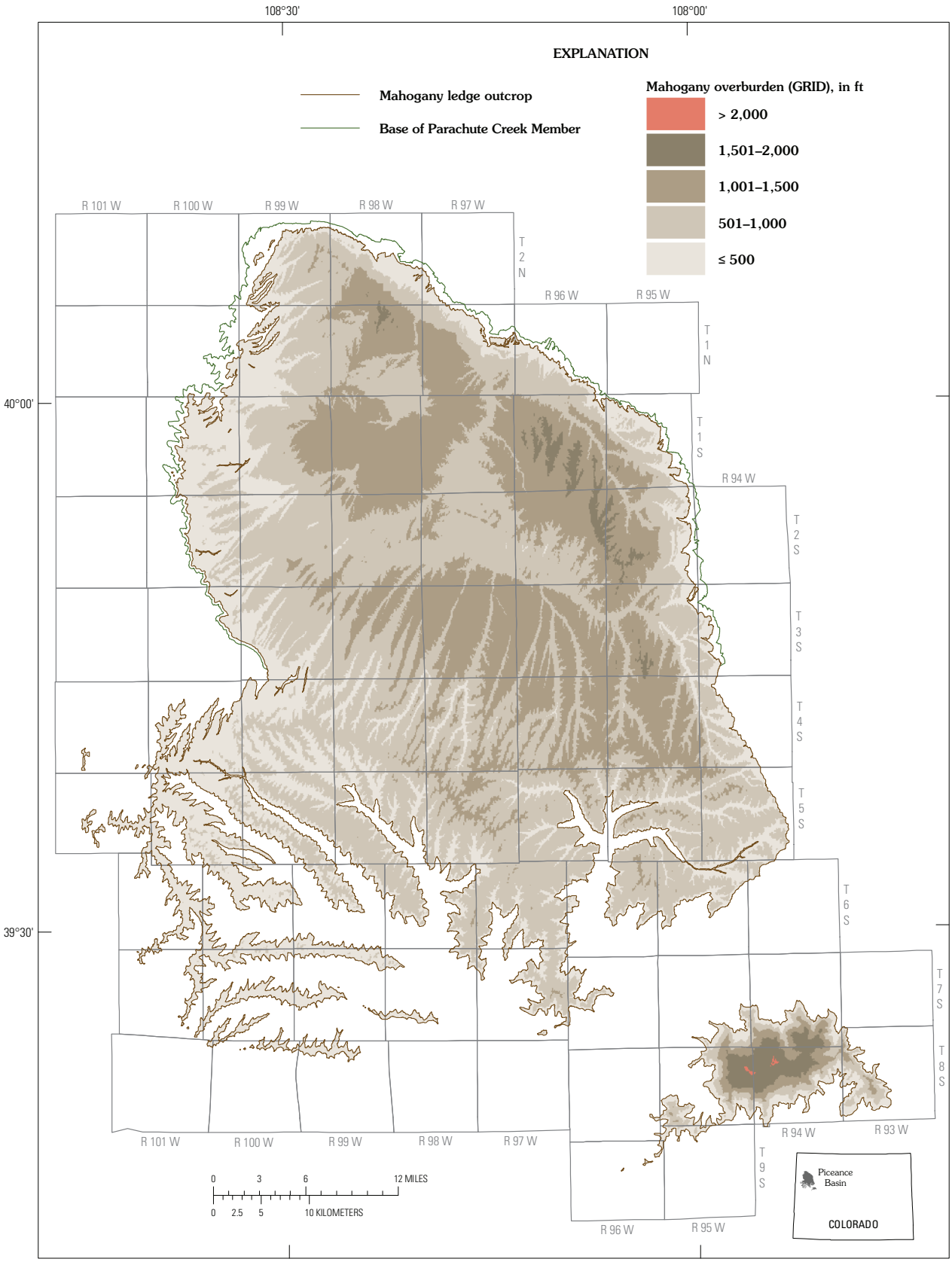

Figure 3. Map showing the overburden above the Mahogany zone in the Piceance Basin.

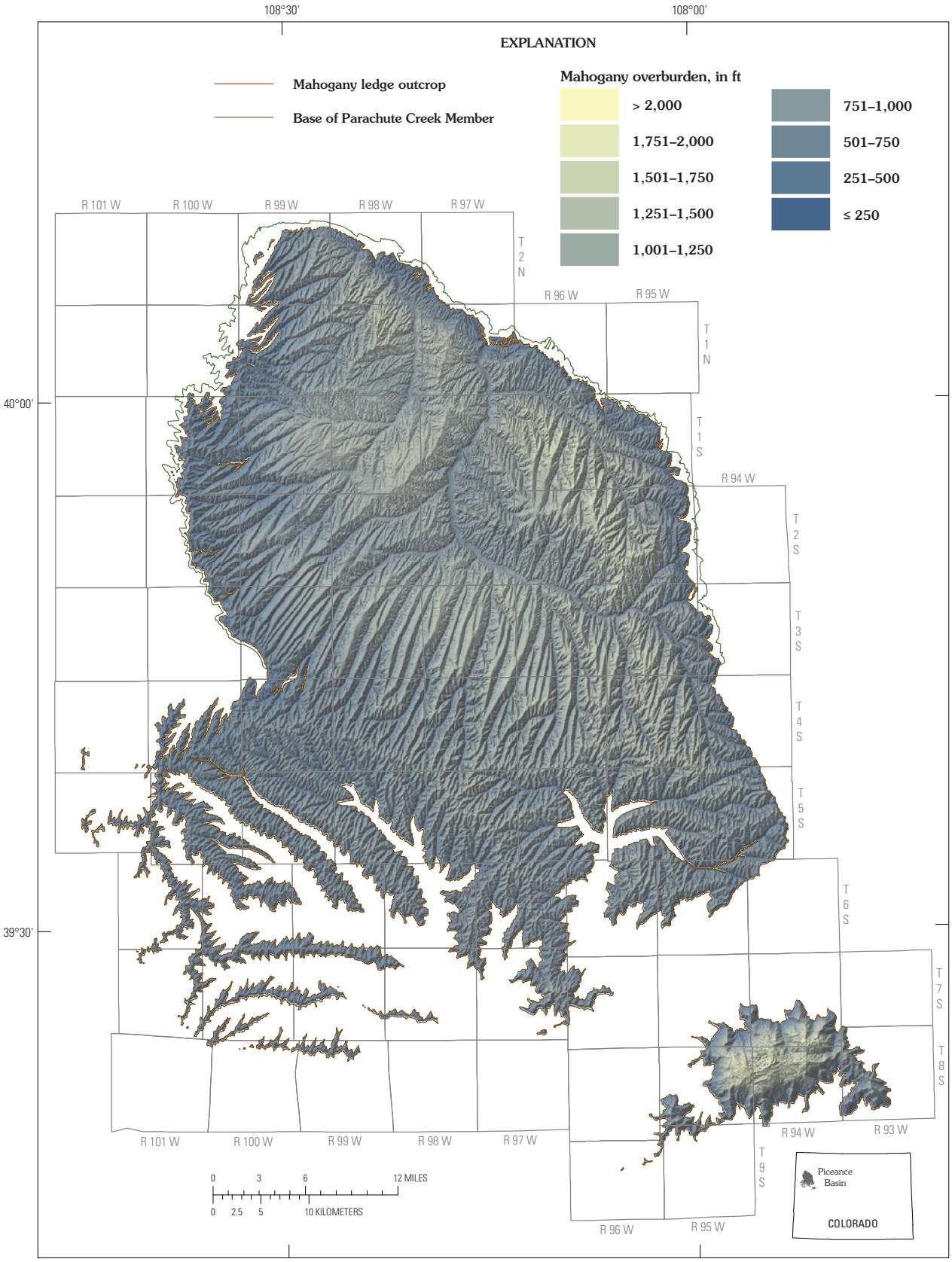

Figure 4. Map showing the overburden above the Mahogany zone in the Piceance Basin, hillshade effect applied.

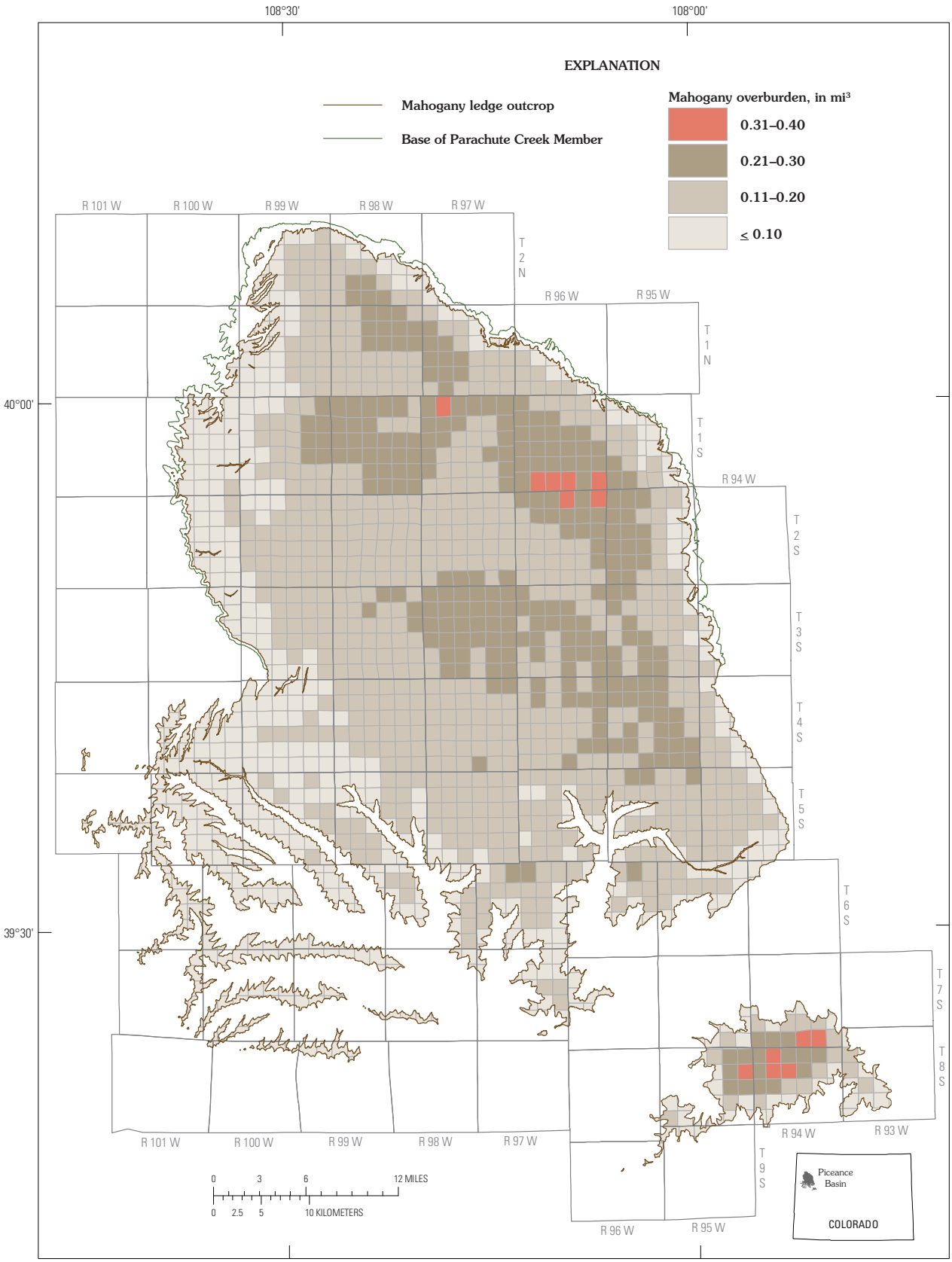

Figure 5. Map showing cubic miles (mi³) of overburden per section above the Mahogany zone in the Piceance Basin.

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