

Ground-Water Availability by Water Quality and Depth Criteria, Middle Yellowstone River Area, Yellowstone and Treasure Counties, Montana

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Atlas organization
The Montana Ground-Water Assessment Atlas for the Middle Yellowstone River Area (Atlas 3) consists of a descriptive overview (Part A) and seven hydro-geologic maps (Part B). This map is intended to be a stand-alone document for use in identifying areas of ground-water availability. To obtain a more integrated understanding of the area's hydrogeology the reader is referred to Part A and the other Part B maps.

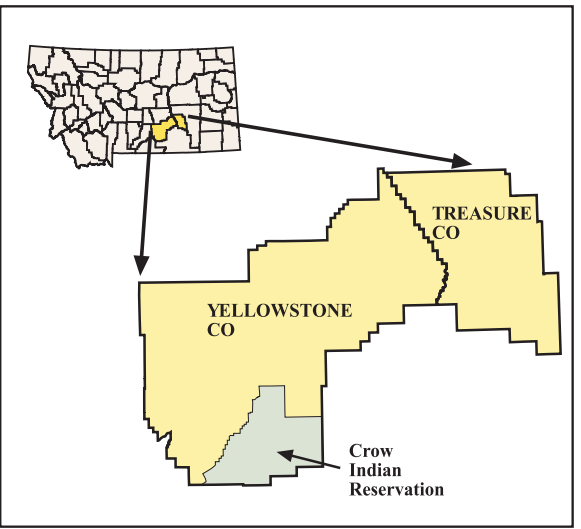
Introduction
Finding ground water that is of adequate quality and within an acceptable depth can be a difficult challenge in many areas in the Middle Yellowstone River Area. Understanding ground-water availability is essential when individuals conduct land-use planning, develop water resources, and sell property. Maps showing drilling depths and anticipated water quality for each aquifer are presented on the other plates in this series. This plate synthesizes the information on the other plates and is intended to summarize ground-water availability. These maps are meant as an approximation of likely drilling depths and do not replace the need for local-scale investigations.

The three maps on this plate show depths to ground water where dissolved constituent concentrations are: (1) less than 1,000 mg/L, (2) less than 2,000 mg/L, and (3) less than 3,000 mg/L. Dissolved-constituent concentration is a general measure of water quality and is the sum of the major ions (calcium, magnesium, sodium, bicarbonate, chloride, and sulfate). The three

maps represent different categories of waters. Water that has a concentration of less than 1,000 mg/L is considered high-quality water, and is acceptable for most uses without treatment. Water with concentrations from 1,000 to 2,000 mg/L is of moderate quality, and will likely require treatment for some uses. Water with concentrations greater than 2,000 mg/L is of poor quality, and will likely require significant treatment for most uses.

It is important to recognize that these maps represent multiple aquifers, and therefore different depths. Each map depicts the shallowest depth that water of the predicted quality could be expected to be found. In some cases, units with lower quality water overlie or underlie units with better quality water, so the lower quality unit would not show up until it meets the map criteria.

Method
Drilling depth maps were prepared for each aquifer by subtracting digital models of the land surface from digital models of the tops of the aquifers, and then adding the average well penetration into the aquifer. Water-quality maps for the aquifers were overlain onto drilling depth maps. The resulting information was clipped to only include areas with the specified water-quality range. Finally all the information was stacked, such that the information from the shallowest aquifer in any given area was shown.



Map locations
The Middle Yellowstone River Area consists of Yellowstone and Treasure Counties exclusive of the Crow Indian Reservation.

Well depths to encounter ground water with less than 1,000 mg/L dissolved constituents

High-quality ground water is most common in terrace and alluvial deposits in the vicinity of the Yellowstone, Clarks Fork of the Yellowstone, and the Big Horn Rivers.

Outside of the major river valleys, high-quality ground water may be found in the following small, isolated areas:

Cottonwood Creek area (far southwestern Yellowstone County): Ground water is available in and near where the Pryor Conglomerate (basal member of the Kootenai Formation) crops out along Cottonwood Creek.

Indian Arrow and Emerald hills (upland areas southeast and southwest of Huntley): High-quality ground water is present under outcrops of the Judith River Formation. Water quality in the Judith River Formation generally decreases with increasing thickness of Hearshaw Shale above the aquifer.

Bull Mountains (northernmost Yellowstone County): The best water quality in the Bull Mountains is typically found on higher altitude ridges in the Tongue River Member of the Fort Union Formation.

North of Shepherd: Small areas of high-quality water can be found in the Lance Formation near Razor Creek. This water tends to be relatively soft sodium-bicarbonate water.

Well depths to encounter ground water with less than 2,000 mg/L dissolved constituents

Ground water meeting this criterion is common in the alluvial and terrace deposits of the major river valleys and is present in the following other areas:

South hills area (the uplands south of Billings and Laurel): Ground water is available in the stream valleys in the shallow alluvium and/or in the underlying Moovy Shale. This shale unit contains layers of very hard, fine-grained sandstone which are not usually water-bearing. However, valleys in this area typically follow faults where fractures provide sufficient porosity and permeability to allow water production.

In the far southern part of Yellowstone County, ground water from the Pryor Conglomerate is available. However, northward from the outcrops, ground water becomes deeper and of poorer quality.

Billings Area: Ground water is available in the area of Eagle Sandstone outcrops north of Billings (Rimrocks area) and southeast of Billings (South rims area). Drilling depths are typically relatively shallow in valleys and draws and relatively deep on ridges.

Ground water is available in the area of Judith River Formation outcrops in the Emerald hills, Indian Arrow, and north of Billings Heights.

Broadview Area: West of Broadview, moderate water quality is present in north-south-trending outcrops of the Judith River Formation. Ground water from the underlying Eagle aquifer also meets this criterion, but is at depths greater than 500 ft.

East of Broadview, ground water of moderate quality is available in the Lance Formation along the eastern margin of Comanche Flat.

Coombs Flat: Ground water meeting this criterion can be found under outcrops of the Judith River Formation west of Acton.

Northeastern Yellowstone County: Moderate water quality is present under the portions of the Lance Formation in the area north of Crooked Creek and west of Pompeys Pillar. It is also present in the Fort Union sandstones along ridges in the Bull Mountains and in valleys near their southern confluences with the Yellowstone River.

Southern Treasure County: Ground-water conditions in this area are similar to those in northeastern Yellowstone County. Ground water with less than 2,000 mg/L of dissolved constituents can be found in the Lance or Fort Union Formations in upland areas of the Hysham hills or the Little Wolf Mountains or in the southern portion of the Sarpy Creek valley.

Well depths to encounter ground water with less than 3,000 mg/L dissolved constituents

This map shows the extent of usable water in the area. Ground water with more than 3,000 mg/L dissolved constituents is generally unusable without significant treatment. Several areas in the two-county area essentially have no source of acceptable ground water. Ground water with concentrations of less than 3,000 mg/L is relatively widespread but in some areas may require deep well completions.

Ground water of this quality may be found at shallow depths in most of the larger drainages. Acceptable ground water may also be present at shallow depths in some of the minor drainages not shown at this scale, but only if the alluvium is thick enough and it is not in contact with shale formations.

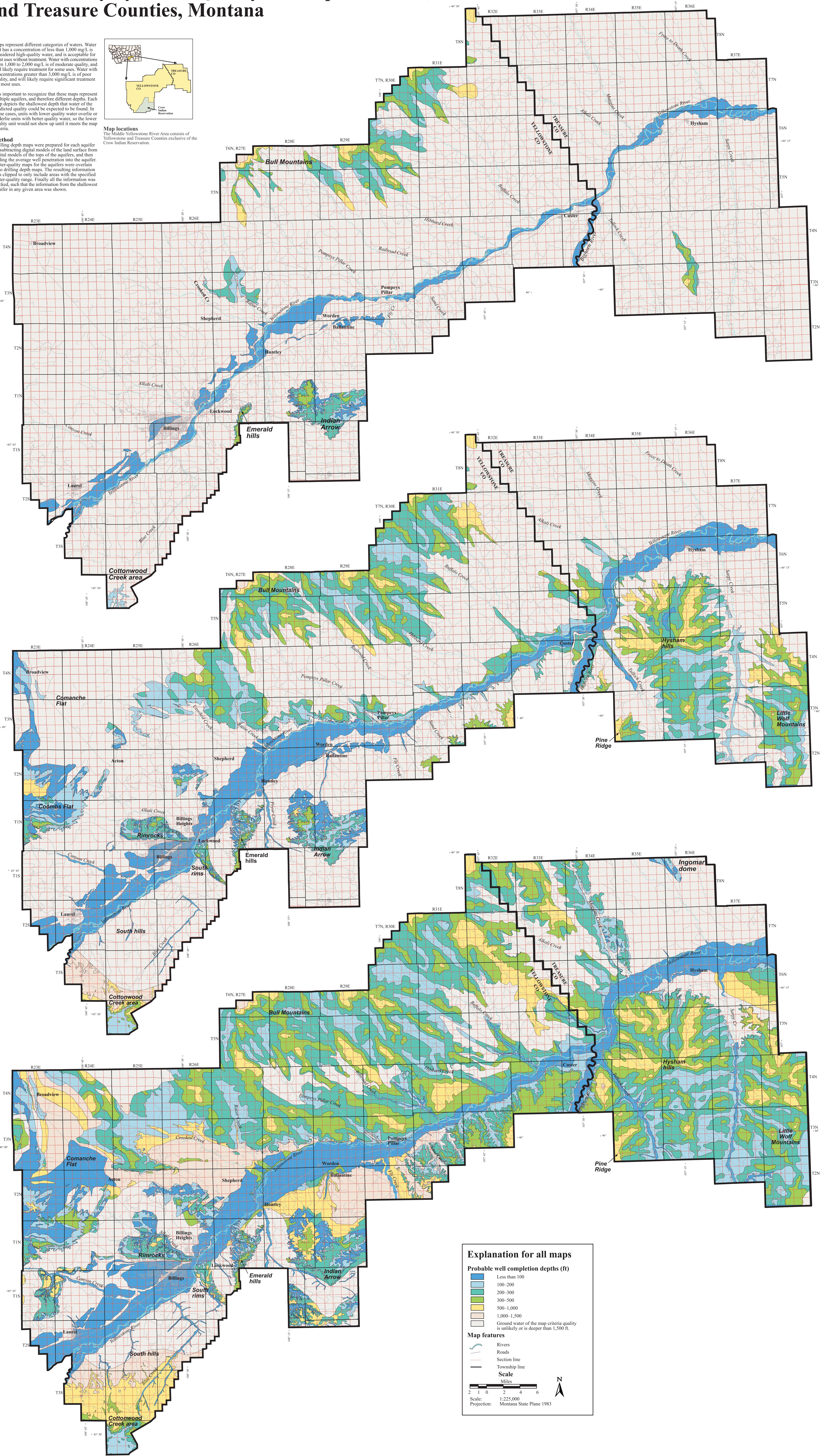
Ground water also may be available in formations that are encountered at depths greater than 1,500 ft within the mapped area. Of primary interest are the Pryor Conglomerate and the Madison Formation. However, as depth and distance from the outcrop (recharge area) increase, water quality is expected to decrease and may be poor to very poor.

Acknowledgments

Well owners who allowed collection of the data necessary for this map, and the people who collected the data are gratefully acknowledged. Reviews by Tom Patton, Larry Smith, John Mesek, Ed Deal, Susan Barth, and Luke Backley are also appreciated.

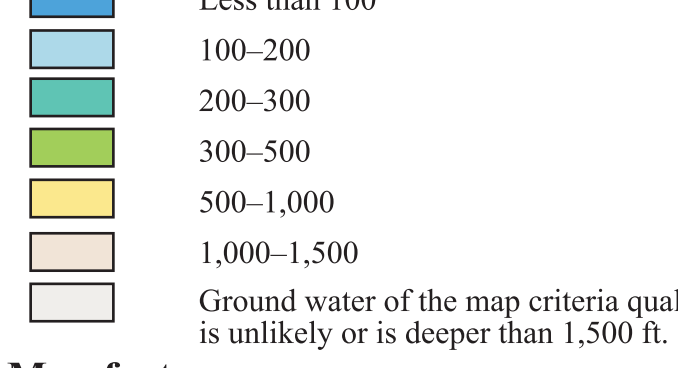
Data sources

Geographic features:
The following digital base map coverages were downloaded from the National Resource Information System (NRIS):
-land survey lines from Bureau of Land Management maps, scale 1:100,000, updated 1993
-TIGER redistributing 2000 data, scale 1:100,000, updated 2001
-county boundaries
-water-body polygons
-hydrography lines
-road lines

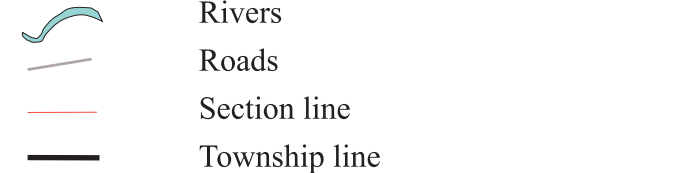


Explanation for all maps

Probable well completion depths (ft)



Map features



Scale

