Northern Arkansas Groundwater Inventory

H. MacDonald
University of Arkansas, Fayetteville

Doy L. Zachry
University of Arkansas, Fayetteville

Hugh Jeffus
University of Arkansas, Fayetteville

Follow this and additional works at: http://scholarworks.uark.edu/awrctr

Part of the Fresh Water Studies Commons, and the Water Resource Management Commons

Recommended Citation
MacDonald, H.; Zachry, Doy L.; and Jeffus, Hugh. 1977. Northern Arkansas Groundwater Inventory. Arkansas Water Resource Center, Fayetteville, AR. MSC026. 186

This Technical Report is brought to you for free and open access by the Arkansas Water Resources Center at ScholarWorks@UARK. It has been accepted for inclusion in Technical Reports by an authorized administrator of ScholarWorks@UARK. For more information, please contact scholar@uark.edu, ccmiddle@uark.edu.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objectives and Background</td>
<td>1</td>
</tr>
<tr>
<td>Geologic Setting</td>
<td>3</td>
</tr>
<tr>
<td>Stratigraphy</td>
<td>4</td>
</tr>
<tr>
<td>Structural Configuration and Thickness of the Roubidoux and Gasconade</td>
<td>20</td>
</tr>
<tr>
<td>Formations</td>
<td>29</td>
</tr>
<tr>
<td>Groundwater in the Ozark Plateaus Province</td>
<td>30</td>
</tr>
<tr>
<td>General Hydrologic Character</td>
<td>31</td>
</tr>
<tr>
<td>Regional Hydrologic Character</td>
<td>36</td>
</tr>
<tr>
<td>Geologic Factors Influencing Water Availability</td>
<td>42</td>
</tr>
<tr>
<td>Recharge, Movement, and Discharge of Groundwater</td>
<td>47</td>
</tr>
<tr>
<td>Water Quality</td>
<td>79</td>
</tr>
<tr>
<td>Formation Hydraulics</td>
<td>94</td>
</tr>
<tr>
<td>Lithofacies Analysis</td>
<td>97</td>
</tr>
<tr>
<td>Regional Analysis</td>
<td>107</td>
</tr>
<tr>
<td>Summary and Conclusions</td>
<td>128</td>
</tr>
<tr>
<td>Recommendations</td>
<td>134</td>
</tr>
<tr>
<td>Maps and Charts Plates 1 - 17</td>
<td>separate envelope</td>
</tr>
</tbody>
</table>
GROUNDWATER INVENTORY

OBJECTIVES

The purpose of the FY 75 Groundwater Inventory Program is to evaluate the rock and hydrologic characteristics of the Roubidoux and Gasconade Formations. The overall objective was to define specific hydrologic and hydraulic parameters of the deeper groundwater aquifers. The objectives were to be accomplished through the following:

1) Construction of groundwater yield maps for estimating hydrogeologic parameters of the Roubidoux and Gasconade Formations.

2) Construction of regional lithofacies maps that depict the distribution of reservoir strata within the Gasconade and Roubidoux Formations.

3) Evaluation of recent and historical static water levels and the construction of piezometric maps for the deeper aquifers.

4) The evaluation of groundwater potential of the upper part of the Gasconade Formation.

To accomplish these objectives, the study area was expanded to encompass a large portion of Missouri. This area is believed to be the region of recharge for the deep aquifers of northern Arkansas, and is the outcrop region of the Roubidoux and Gasconade Formations.

BACKGROUND

Comprehensive surface and subsurface mapping of the Roubidoux and Gasconade Formations in Missouri was accomplished by McCracken and McCracken (1965), through the use of insoluble residue analysis. The complete Ordovician sequence to which the Roubidoux and Gasconade Formations belong, consists of cherty and siliceous dolomite and magnesian limestone, with erratic discontinuous sand-
stone units. Due to similarity of rock type in the sequence, no reliable regional subsurface markers are recognized. In the absence of well markers, McQueen (1931) and Grohskopf and McCracken (1949) established the use of insoluble residue analysis of well cuttings for correlation purposes in Missouri. By classifying types of residues, a definite pattern for the formations was established, and has been used successfully in Missouri. Some guide horizons are traceable into Arkansas, Kansas, Oklahoma, and Texas (McCracken, 1955).

Comprehensive subsurface mapping in northern Arkansas has not been feasible except in localized areas because of complex stratigraphy and inadequate well control. Previous subsurface investigations in Arkansas have utilized the analysis of lithic features of well cuttings in conjunction with electric logs; however, diagnostic marker beds were not easily defined (Caplin, 1960, and Lamonds, 1972). In view of the lack of diagnostic marker features in well cuttings from the Arkansas Ordovician sequence, the present study utilized available insoluble residue logs in conjunction with electric logs and a modified microscopic analysis of well cuttings based on recognition of insoluble constituents (Snyder, 1976). Isopachous and structural maps were constructed from these data for the Roubidoux and Gasconade Formations in northern Arkansas. These maps were tied into the maps for the Missouri area published by McCracken and McCracken (1965).

The basic hydrologic data for this study consist of a series
of maps constructed from data obtained from various State, engineering, and Federal agencies in Missouri and Arkansas. The potentiometric, yield, and specific capacity maps were developed from pumping tests supplied by the Missouri Geological Survey and Water Resources, Arkansas Geological Commission, United States Geological Survey, and the private engineering firms of McGoodwin, Williams, and Yates, John Mahaffey and Associates, Taylor Engineering, Inc., and Max Mehlburger Engineers. The data are summarized in Appendix A.

Data on groundwater quality were supplied by the Missouri Geological Survey and Water Resources and the Arkansas State Health Department.

Data on static water levels were supplied by the Missouri Geological Survey and Water Resources which utilizes monitored wells with continuous recorders, and the United States Geological Survey which measures water levels once a year in northern Arkansas.

GEOLOGIC SETTING

Bedrock throughout most of Missouri and northern Arkansas is of Paleozoic age, with rocks of the Cambrian, Ordovician, Mississippian and Pennsylvanian Systems being most prominent (Plate 1). Igneous rocks of Precambrian age crop out in the St. Francois Mountains of southeastern Missouri and consist of felsitic volcanic rocks ranging from rhyolite to andesite, and granite and basic gabbroic intrusions. These Precambrian rocks form the center of the
broad assymetrical Ozark dome. The structural attitude of the Paleozoic formations is controlled by the tectonic origin of this uplift, so that strata dip away in all directions from the periphery of the St. Francois Mountains into surrounding basins. These basins include the Forest City basin to the northwest, the Illinois basin to the northeast, the Anadarko basin to the southwest, the Arkoma basin to the south, and the Mississippian embayment to the southeast. Progressively younger Paleozoic formations are encountered at the surface toward the basins and attain their maximum thickness there.

STRATIGRAPHY

The generalized succession of stratigraphic units in Arkansas and Missouri is summarized in Figure 1.

Precambrian Rocks

The igneous rocks that are exposed in the St. Francois Mountains and the basement rocks of Missouri and Arkansas range in age from 1.2 to 1.45 billion years (Muelberger and others, 1967). The Precambrian rocks exposed in the St. Francois Mountains are felsitic volcanic rocks ranging from rhyolite to andesite, and granite and basic gabbroic intrusions. Rocks beneath the surrounding sedimentary cover range in lithologic type from granite, gneiss, and basic and intermediate plutonic rocks, to volcanic and metamorphosed volcanic rocks (Kisvarsanyi, 1974). These crystalline rocks
<table>
<thead>
<tr>
<th>PRECAMBRIAN SYSTEM</th>
<th>SERIES</th>
<th>STAGE</th>
<th>FORMATION</th>
<th>MEMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>PENNSYLVANIAN</td>
<td>UPPER</td>
<td>ATOKA</td>
<td>GREENLAND SANDSTONE</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>MOWROW</td>
<td>BLOYD</td>
<td>TRACE CREEK SHALE, KEESLER L.S., DYE SHALE, BRENTWOOD LIMESTONE, WOOLSEY SH.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HALE</td>
<td>PRAIRIE GROVE CANE HILL</td>
<td></td>
</tr>
<tr>
<td>MISSISSIPPIAN</td>
<td>UPPER</td>
<td>CHESTER</td>
<td>PITKIN</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>FAYETTEVILLE</td>
<td>WEDINGTON SANDSTONE</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>BATESVILLE</td>
<td>HINDSVILLE LIMESTONE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LOWER &amp; MIDDLE</td>
<td>OSAGE</td>
<td>BOONE</td>
<td>ST. JOE LIMESTONE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CHATTANOOGA</td>
<td>SYLAMORE SANDSTONE</td>
<td></td>
</tr>
<tr>
<td>DEVONIAN</td>
<td>UPPER</td>
<td>EVERTON</td>
<td>POWELL</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>COTTER</td>
<td>KINGS RIVER SANDSTONE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LOWER</td>
<td>JEFFERSON CITY</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ROUBIDOUX</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>GASCONADE</td>
<td>GUNTER SANDSTONE</td>
<td></td>
</tr>
<tr>
<td>ORDOVICIAN</td>
<td>UPPER</td>
<td>EMINENCE</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>POTOSI</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>DERBY-DOERUN</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>DAVIS</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>BONNETTERRE</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>LAMOTTE</td>
<td>(After Mapes, 1968)</td>
<td></td>
</tr>
</tbody>
</table>

Figure 1. Generalized stratigraphic column of northwestern Arkansas, southwestern Missouri, and northeastern Oklahoma.
formed prominent topographic and structural basement highs which had a profound influence on subsequent Paleozoic sedimentation.

Paleozoic Rocks

The Paleozoic Era is represented by sedimentary rock deposited throughout much of northern Arkansas and Missouri, when relatively shallow seas covered part and at times all of the area. Mild vertical movements modified the environment from time to time and uplift with local or regional emergence resulted in discontinuous sedimentation and unconformities. Downwarping favored the continuity but not necessarily increased thickness of sediments, and the section, therefore, varies in both thickness and character from place to place (Howe and others, 1967). Only minor igneous activity occurred in the area during the Paleozoic.

Cambrian System

Rocks of Cambrian age crop out along the periphery of the St. Francois Mountains Precambrian igneous complex in southeastern Missouri. These strata are regarded as late Cambrian in age, and lie unconformably on the irregular Precambrian basement. Outcrops of successively younger units occur in peripheral, annular patterns around this complex. The lower portion of the Cambrian succession consists of quartzose sandstone, and the upper part is composed of dolomite and shale (Howe and Koenig, 1961). These strata dip beneath younger Paleozoic formations.
away from the uplift. They are present in the subsurface throughout northern Arkansas and Missouri, except where they have been removed from Precambrian topographic highs by erosion. The upper Cambrian Series consists of the following formations in ascending order: the Lamotte, Bonneterre, Davis, Derby-Doerun, Potosi and Eminence Formations. The combined thickness of these formations in Missouri is 2,000 feet and in Arkansas averages 500 feet. The Davis and Derby-Doerun Formations have not been recognized in the subsurface of northern Arkansas (Caplin, 1960).

Lamotte Formation

The Lamotte Formation is the basal unit of the Cambrian in Missouri and Arkansas. It is predominantly a quartzose sandstone, which grades laterally into conglomerate and arkose where it lies on crystalline rock. The Lamotte attains its maximum thickness of 500 feet in the depressions between Precambrian ridges and knobs in Missouri (Howe and Koenig, 1961). In Arkansas the Lamotte has been encountered in only a few wells, with a maximum thickness of over 150 feet (Caplin, 1960).

Bonneterre Formation

The sandstone of the Lamotte Formation grades upward through a zone of arenaceous dolomite into the Bonneterre Formation. The Bonneterre is typically a light-gray dolomite, but locally, parts are shaly and glauconitic. The formation rests conformably on the Lamotte and attains
a maximum thickness of 1,580 feet in the subsurface of Pemiscot County, Missouri (Howe and Koenig, 1961). The Bonneterre has been recognized in only a few wells in Arkansas and is generally around 70 feet thick (Caplin, 1960).

Davis and Derby-Doerun Formations

These units constitute the Elvins Group of Missouri but are not present in the Arkansas subsurface. Strata of the Elvins Group are composed of shale, siltstone, fine-grained sandstone, and carbonate rock. Dolomite predominates in the upper formations, whereas the lower parts are shaly and glauconitic (Howe and others, 1967). The combined thickness is about 150 feet near their type localities in Missouri (Grohskopf and McCracken, 1949). The Davis is the lower of the two formations and is conformable with the underlying Bonneterre Formation. The contact of the Derby-Doerun with the underlying Davis Formation is conformable.

Potosi Formation

The Potosi is a massive, thickly-bedded, medium to fine-grained dolomite, containing an abundance of chert and associated quartz druse (Howe and Koenig, 1961). The formation rests conformably on the Derby-Doerun Formation in Missouri and ranges in thickness from 75 to a maximum of 300 feet. In northern Arkansas the Potosi and overlying Eminence Formation are undifferentiated. The Potosi has not been recognized in wells in northern Arkansas and like the Davis and Derby-Doerun Formations may not be present.
Eminence Formation

The Eminence marks the top of the Cambrian section in northern Arkansas and Missouri. The formation is principally a medium to massively-bedded, light-gray, medium to coarse-grained dolomite (Howe and Koenig, 1961). Nodular chert is present in small amounts in the upper portions of the formation in Missouri, and very thin sandstone or sandy dolomite lenses have been observed in northern Arkansas (Caplin, 1960). The contact of the Eminence with the underlying Potosi is conformable.

Thickness of the Eminence ranges from 200 to 250 feet in Missouri, except where it is absent over local structural features. In northern Arkansas the undifferentiated Potosi-Eminence section ranges between 307 feet and 384 feet (Caplin, 1960).

Lower Ordovician System

Rocks of the Lower Ordovician or Canadian Series of Missouri and Arkansas are principally arenaceous and cherty dolomite and sandstone. They crop out in eastern, central, and southern Missouri and are present in the subsurface over large portions of that state and northern Arkansas. The series is bounded at the base and top by regional unconformities and contains the following succession in ascending order: Gasconade, Roubidoux, Jefferson City, Cotter, Powell, and Smithville Formations. A persistent
sandstone unit designated the Gunter Member is present at
the base of the Gasconade.

Gasconade Formation

Nason (1892) proposed the term Gasconade for the
limestone series underlying the Roubidoux Formation along
the Gasconade River in central Missouri. He thus established
the upper boundary of the formation, leaving the base unde-
finied. Ball and Smith (1903) established the base of the
formation at the top of the Gunter Sandstone. Marbut (1907)
included the Gunter Sandstone in the Gasconade Formation,
making it the basal member. Bridge (1930) working in the
Eminence and Cardareva quadrangles of Shannon, Reynolds and
Carter Counties in Missouri, restricted the Gasconade by
including the lower dolomite and the Gunter Sandstone in
the Van Buren Formation. James (1948), and Grohskopf and
McCracken (1949) demonstrated that precise boundaries
between the Gasconade and Van Buren Formations could only
be drawn in local areas. Grawe (1945) and Knight (1954)
included the Gunter Sandstone in the Gasconade Formation,
and this use has persisted to the present.

The Gasconade Formation includes a sandy dolomite or
sandstone (Gunter Member) at the base, and an overlying
dolomite which has been informally divided into lower and
upper parts (McCracken, 1964). The lower portion of the
dolomite unit contains large amounts of chert which often
exceed 50 percent of the total volume of the rock (Howe
and Koenig, 1961). The upper portion of the dolomite is
finely crystalline and contains only small amounts of chert. Gasconade dolomite is typically light brownish-gray in color.

Gunter Member

The Gunter Member of the Gasconade Formation was first described by Swallow (1855) and later by Meek (1855). The term Gunter Sandstone was first used for the unit by Ball and Smith (1903). Knight (1954) discussed the stratigraphic relationships of the Gunter Member in southern Missouri. He also recognized facies of the Gunter from surface and subsurface data and produced a lithofacies map for the sand facies of the Gunter in Missouri. Subsurface study of the Gunter in northern Arkansas has been extremely limited by a lack of well data and analysis thereof. Prior to the initiation of this study, the work of Sheldon (1954), Caplin (1960), Lamonds and Stephens (1969), and Lamonds (1972) were the primary published sources of data.

The basal Gunter Sandstone Member is composed essentially of sandstone throughout a narrow belt that extends southward from central Missouri to the Arkansas border (Knight, 1954). East and west of this belt the unit is more dolomitic and in places consists of sandy dolomite (Figure 2). In northern Arkansas the Gunter maintains these trends but increases in thickness from an average of 30 feet to as much as 120 feet.

The contact of the Eminence Dolomite with the Gasconade Formation is unconformable throughout Arkansas and Missouri.
LITHOFACIES MAP
OF THE
GUNTER MEMBER IN SOUTH MISSOURI
(LOWER MISSISSIPPIAN)

By

to

Figure 2
The Gunter sand accumulated on an irregular surface of erosion developed on dolomite beds of the underlying Eminence Formation (Knight, 1954). The irregularity of the surface accounts for variations in thickness of this unit. The thickness of the Gasconade Formation averages 300 feet in central Missouri but may exceed 700 feet in the northern Arkansas subsurface. The contact with the overlying Roubidoux Formation is an unconformity.

Roubidoux Formation

Nason (1892) suggested the name Roubidoux for rocks described as "overspreading the Ozark region from Cabool to Gasconade City, and from Salem to Doniphan, Missouri". Bain and Ulrich (1905) defined the Roubidoux Formation and placed it stratigraphically below the Jefferson City Formation and above the Gasconade Formation. Heller (1954) described the Roubidoux as consisting of a complex of sandstone, chert, quartzite, dolomite and shale of uncertain thickness. He also recognized the need for further work and attempted to define both the fauna and faunal zones of the formation and where possible to correlate surface units with those of the subsurface. Unfortunately, Heller concluded that lithologic, stratigraphic and faunal character of the formation was extremely complex and inconsistent. One year later McCracken (1955) concluded that the fossil control was limited to a few localized areas and is almost absent in the subsurface.

At the same time paleontologists were attempting to identify the Roubidoux in the subsurface and because of the
economic importance of groundwater associated with sandstone, McQueen (1931) developed the use of insoluble residues for subsurface stratigraphic recognition. Grohskopf and McCracken (1949) and McCracken (1952) established insoluble residue zones for some Paleozoic formations, including the Roubidoux and Gunter units. The zones are used almost exclusively by the Missouri Geological Survey for their subsurface hydrological studies; however, subsurface work on groundwater associated with the Roubidoux and Gunter Member in Arkansas has been limited.

Sheldon (1954) examined selected wells in northern Arkansas for the purpose of determining the areal extent and lithologic character of Paleozoic formations, particularly in the subsurface. Several of these wells penetrated the Roubidoux and Gunter; however, only tentative correlations were provided. Caplin (1960) examined the pre-Everton Cambro-Ordovician sequence in northern Arkansas in terms of the petroleum possibilities. This study was based largely on examination of well cuttings. Generalized structural and isopach maps were developed for the Roubidoux Formation. A structure map of the Gunter was also presented as a part of this study. Lamonds and Stephens (1969) developed water resource data for the Ozark Plateaus of Arkansas. The study includes a compilation of data on structural tops and thicknesses for the Roubidoux Formation and Gunter Member, along with some chemical analyses of water from wells penetrating these units. The most recent study was conducted
by Lamonds (1972) who compiled structural and piezometric maps for the Roubidoux Formation and Gunter Member, and discussed the hydrologic characteristics of these and other water-bearing units of northern Arkansas.

The Roubidoux Formation unconformably overlies the Gasconade Formation and crops out extensively over a broad area in southeastern Missouri. The most southerly outcrop is approximately four miles north of the Arkansas-Missouri border (Heller, 1954). In Missouri the Roubidoux Formation ranges from 105 to 250 feet in thickness. Variations in thickness are in part attributed to the irregular nature of the unconformity at its base (Heller, 1954). The formation is conformably overlain by dolomite beds of the Jefferson City Formation.

The Roubidoux Formation consists of cherty dolomite, dolomitic sandstone, and well developed sandstone bodies in Missouri. The lithic characteristics in Arkansas are similar, but no persistent sandstone units have been observed in subsurface studies (Snyder, 1976). Dolomite in the Roubidoux is finely crystalline, light-gray to brown in color, and thinly to thickly bedded (Howe and Koenig, 1961).

Jefferson City and Cotter Formations

The Jefferson City Formation was described by McCracken (1964) as a cherty, somewhat silty dolomite with very few sand lenses. The formation is exposed around the periphery of the Ozark dome and is recognized in the subsurface by the characteristic type of oolitic chert it contains (Howe and
Koenig, 1961). The thickness of the Jefferson City Formation ranges from 100 to 500 feet and averages about 200 feet (Howe and Koenig, 1961). The Jefferson City rests conformably on the Roubidoux Formation and is overlain conformably by the Cotter Formation.

The Cotter Formation is similar to the Jefferson City Formation in that it is principally a light-gray to brown, cherty dolomite, but may locally contain thin beds of green shale and sandstone (Howe and Koenig, 1961). Because of the similarity of rock types the Cotter and Jefferson City Formations are often undifferentiated in subsurface studies (Caplin, 1960). The Cotter crops out along the northern and western edges of the Ozark uplift, and averages about 200 feet in thickness.

Powell and Smithville Formations

The Powell Formation rests conformably on the Cotter Formation, and because of similarities of lithology is often undifferentiated from the Cotter. The Powell crops out across southern Missouri and northern Arkansas and is composed of medium to fine-grained dolomite and thin beds of green shale and sandstone (Howe and Koenig, 1961). The thickness ranges from 150 to 175 feet.

The Smithville Formation is similar lithologically to the Powell in that it is composed of gray, finely-granular, dolomitic limestone, which may grade into dolomite locally (Caplin, 1960). The formation crops out in southeastern Missouri and northeastern Arkansas and reaches a maximum
of 150 feet in thickness (Howe and Koenig, 1961). The contact of the Smithville with the underlying Powell Formation appears to be one of conformity. However, their stratigraphic relationship has not been defined adequately, especially in Arkansas sections (Caplin, 1960).

Black Rock Formation

The Black Rock Formation crops out in northeastern Arkansas but has not been recognized in southeastern Missouri (Caplin, 1960). The unit consists of fine-grained, dolomitic limestone, similar to that of the underlying Smithville Formation. The Black Rock may also contain dolomite beds and small amounts of sandstone (Caplin, 1960). The maximum thickness ranges from 55 to 200 feet in surface exposures, and the formation is reported to overly the Smithville unconformably (Caplin, 1960).

Everton Formation

The Everton Formation unconformably overlies the Black Rock Formation in northern Arkansas and rocks of the Canadian Series in Missouri and Arkansas. It consists of sandy dolomite and sandstone containing sub-angular to rounded, frosted quartz grains (Caplin, 1960). Complex stratigraphy and facies changes are common in the Everton as the result of local unconformities and fluctuating environmental systems (Shum, 1974).
Devonian System

Chattanooga Formation

The Chattanooga Formation is described by Frezon and Glick (1959) as a black, carbonaceous, fissile shale unit containing a thin basal sandstone member. The formation rests unconformably on rocks of the Ordovician System in southern Missouri and northern Arkansas. The thickness of the Chattanooga ranges from a few inches to a maximum of 85 feet, with an average thickness of 30 feet (Croneis, 1930).

Mississippian System

Rocks of the Mississippian System Crop out over large portions of southwestern Missouri and northwestern Arkansas. The sequence of rocks varies lithologically because of facies changes within given units (Howe and Koenig, 1961).

Kinderhookian-Osagean Series

In southwestern Missouri the Kinderhookian-Osagean Series is represented by the Bachelor, Compton, Northview, Pierson, Reeds Spring, Elsey, Burlington and Keokuck Formations. In Arkansas the Boone Formation and basal St. Joe Member are equivalent to this entire sequence. Rock types of the Kinderhookian Series range from crinoidal limestone to siltstone and green shale. Rocks of the Osagean Series are dominantly coarse crystalline, cherty, crinoidal limestone. The rocks form a fairly continuous outcrop band around the Ozark region (Howe and Koenig, 1961).
Upper Mississippian

Rocks of late Mississippian age consist of the Meramecian and Chesterian Series in southwestern Missouri and northern Arkansas. Lithic types of the Meramecian Series are predominantly limestone with some shale units present, while the Chesterian Formations consist of crudely rhythmic repetitions of sandstone, shale and limestone (Howe and Koenig, 1961). The Meramecian rests conformably on the Osagean Series, and is overlain unconformably by Chesterian Series strata (Howe and Koenig, 1961).

Pennsylvanian System

Rocks of Pennsylvanian age are present beneath surficial deposits over much of northern Arkansas and southern Missouri. Pennsylvanian strata are dominantly clastic, but there are also many important limestone and coal beds. Strata of Pennsylvanian age in southwestern Missouri and northern Arkansas include the Morrowan and Atokan Series.

Morrowan Series

South of the Missouri boundary in the northern part of the Boston Mountains of northern Arkansas, the Morrowan Series consists of the Hale and Bloyd' Formations. North of the boundary the Morrowan is represented only by outliers of the Hale Formation (Howe and Koenig, 1961). The Hale in these areas of Missouri consists of massive, cross-bedded, quartzose sandstone, whereas in northern Arkansas it consists of a succession of shale, siltstone, and calcareous sandstone.
The Boyd Formation of northern Arkansas is composed of shale and limestone beds with some small coal seams (Croneis, 1930). The formation exhibits facies changes eastward along the outcrop and southeastward in the subsurface. (Caplin, 1957).

Atokan Series

The Atokan Series overlies the Chesterian Series, and forms the higher elevations of the Boston Mountains. The series crops out in northern Arkansas where it is entirely represented by the Atoka Formation. This formation consists mainly of dark shale and sandstone units, with occasional fossiliferous, sandy limestone units (Caplin, 1957). Approximately seventy-five percent of the formation is composed of black shale (Croneis, 1930).

STRUCTURAL CONFIGURATION AND THICKNESS OF THE ROUBIDOUX AND GASCONADE FORMATIONS

Subsurface isopachous and structure maps of the Roubidoux and Gasconade Formations in Missouri and northern Arkansas have been published by McCracken (1964), McCracken (1965), Caplin (1960), and Lamonds (1972). The present study utilizes McCracken's maps for the Missouri portion of the study area. Caplin and Lamonds data, which consisted of 28 control points, were expanded by the addition of data from 20 wells in northern Arkansas not previously used for correlation studies (Table 1). Structure and isopachous
<table>
<thead>
<tr>
<th>Well Ref. Number</th>
<th>Location</th>
<th>Ref. Zone, Rge. Sec.</th>
<th>County</th>
<th>Owner or Driller</th>
<th>Year Completed</th>
<th>T.D. Below Land Surface</th>
<th>Elev. Feet Above NGL</th>
<th>FM. at T.D. Penetration of Basal</th>
<th>Well Log Source</th>
<th>Roubidoux Fm. Elev. Thickness</th>
<th>Casconade Fm. Elev. Thickness</th>
<th>Log Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>219 3W 22</td>
<td>Benton</td>
<td>Sibley Eng. &amp; Mfg Co</td>
<td>1955</td>
<td>900</td>
<td>900</td>
<td>Og</td>
<td>30</td>
<td>1</td>
<td>30</td>
<td>165</td>
<td>Insol Residue</td>
</tr>
<tr>
<td>2</td>
<td>219 26W 15baal</td>
<td>Carroll</td>
<td>Holiday Island #2</td>
<td>1970</td>
<td>1,222</td>
<td>1,102</td>
<td>Og</td>
<td>184</td>
<td>2</td>
<td>64</td>
<td>185</td>
<td>Electric-gamma</td>
</tr>
<tr>
<td>3</td>
<td>219 26W 17bacl</td>
<td>Carroll</td>
<td>Holiday Island #1</td>
<td>1970</td>
<td>1,058</td>
<td>1,010</td>
<td>Og</td>
<td>81</td>
<td>2</td>
<td>33</td>
<td>185</td>
<td>Electric-gamma</td>
</tr>
<tr>
<td>4</td>
<td>219 26W 27ada</td>
<td>Carroll</td>
<td>Holiday Island #4</td>
<td>1972</td>
<td>1,800</td>
<td>1,520</td>
<td>Ca</td>
<td>10</td>
<td>2</td>
<td>375</td>
<td>185</td>
<td>Electric-gamma</td>
</tr>
<tr>
<td>5</td>
<td>219 18W 29dcl</td>
<td>Boone</td>
<td>Lead Hill Ark</td>
<td>1973</td>
<td>703</td>
<td>750</td>
<td>Og</td>
<td>13</td>
<td>2</td>
<td>60</td>
<td>274</td>
<td>Electric, gamma</td>
</tr>
<tr>
<td>6</td>
<td>219 15W 9ddcl</td>
<td>Ozark, Mo</td>
<td>Corps of Engr</td>
<td>1973</td>
<td>506</td>
<td>700</td>
<td>Og</td>
<td>8</td>
<td>2</td>
<td>202</td>
<td>244</td>
<td>Electric, gamma</td>
</tr>
<tr>
<td>7</td>
<td>219 15W 6</td>
<td>Marion</td>
<td>Oak Park Rec Area</td>
<td>1968</td>
<td>1,081</td>
<td>771</td>
<td>Og</td>
<td>276</td>
<td>1</td>
<td>-34</td>
<td>255</td>
<td>Insol Residue</td>
</tr>
<tr>
<td>8</td>
<td>219 13W 33</td>
<td>Baxter</td>
<td>B. Wilson/F. Schick</td>
<td>1949</td>
<td>800</td>
<td>945</td>
<td>Og</td>
<td>40</td>
<td>1</td>
<td>186</td>
<td>245</td>
<td>Insol Residue</td>
</tr>
<tr>
<td>9</td>
<td>203 26W 11</td>
<td>Benton</td>
<td>City of Gravette #2</td>
<td>1954</td>
<td>1,603</td>
<td>1,199</td>
<td>Ca</td>
<td>23</td>
<td>1</td>
<td>-51</td>
<td>185</td>
<td>Insol Residue</td>
</tr>
<tr>
<td>10</td>
<td>203 26W 14</td>
<td>Benton</td>
<td>City of Gravette #3</td>
<td>1954</td>
<td>1,611</td>
<td>1,275</td>
<td>Ca</td>
<td>1</td>
<td>1</td>
<td>10</td>
<td>185</td>
<td>Insol Residue</td>
</tr>
<tr>
<td>11</td>
<td>203 28W 13dcl</td>
<td>Benton</td>
<td>Lost Bridge Village</td>
<td>1973</td>
<td>1,626</td>
<td>1,380</td>
<td>Ca</td>
<td>77</td>
<td>2</td>
<td>190</td>
<td>204</td>
<td>Electric</td>
</tr>
<tr>
<td>12</td>
<td>203 26W 16dcl</td>
<td>Carroll</td>
<td>Eureka Springs P.S.</td>
<td>1972</td>
<td>1,418</td>
<td>1,250</td>
<td>Ca</td>
<td>34</td>
<td>2</td>
<td>240</td>
<td>214</td>
<td>Gamma-elec-</td>
</tr>
</tbody>
</table>

**Formation Symbols**
- *Ce* Cambric - Eminence Formation
- *Cim* Cambric - Lamotte Formation
- *Od* Ordovician - Gasconade Formation
- *Or* Ordovician - Roubidoux Formation
<table>
<thead>
<tr>
<th>Well Ref.</th>
<th>Location Code, Reg. Sec.</th>
<th>County</th>
<th>Owner or Driller</th>
<th>Year Completed</th>
<th>T.D. Below Land Surface</th>
<th>Elev. Feet Above GSL</th>
<th>Fm. at T.D.</th>
<th>Penetration of Basal</th>
<th>Well Log Source</th>
<th>Roud'ous &amp; Gascoigne Fm. Thickness</th>
<th>Log Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>20X 1N 31</td>
<td>Baxter</td>
<td>Baxter Lab</td>
<td>1973</td>
<td>1,865</td>
<td>780</td>
<td>Ca</td>
<td>270</td>
<td>2</td>
<td>-295</td>
<td>-415 520</td>
</tr>
<tr>
<td>14</td>
<td>20X 1N 13</td>
<td>Baxter</td>
<td>CamaligPub Use Area Corps of Eng</td>
<td>1964</td>
<td>1,600</td>
<td>860</td>
<td>Ca</td>
<td>30</td>
<td>1</td>
<td>-290 255</td>
<td>370 490</td>
</tr>
<tr>
<td>15</td>
<td>20X 97 A</td>
<td>Fulton</td>
<td>City of Viola</td>
<td>1956</td>
<td>1,283</td>
<td>660</td>
<td>Ca</td>
<td>162</td>
<td>2</td>
<td>-10 255</td>
<td>-</td>
</tr>
<tr>
<td>16</td>
<td>20X 87 27</td>
<td>Fulton</td>
<td>Salem</td>
<td>1971</td>
<td>1,322</td>
<td>2,123</td>
<td>Ca</td>
<td>100</td>
<td>2</td>
<td>-95 190 305</td>
<td>-</td>
</tr>
<tr>
<td>17</td>
<td>19Y 3N 1Eda</td>
<td>Benton</td>
<td>Peterson Prod #2</td>
<td>1974</td>
<td>1,660</td>
<td>1,375</td>
<td>Ca</td>
<td>105</td>
<td>2</td>
<td>-80 210 340</td>
<td>-</td>
</tr>
<tr>
<td>18</td>
<td>19Y 3N 11</td>
<td>Benton</td>
<td>City of Decatur</td>
<td>-</td>
<td>1,375</td>
<td>1,250</td>
<td>Ca</td>
<td>10</td>
<td>1</td>
<td>170 340</td>
<td>-</td>
</tr>
<tr>
<td>20</td>
<td>19Y 2N 1d</td>
<td>Benton</td>
<td>City of Rogers</td>
<td>1954</td>
<td>1,660</td>
<td>1,375</td>
<td>Ca</td>
<td>105</td>
<td>2</td>
<td>-80 210 340</td>
<td>-</td>
</tr>
<tr>
<td>21</td>
<td>19Y 2N 35ca</td>
<td>Benton</td>
<td>Horseshoe Bend</td>
<td>1954</td>
<td>1,660</td>
<td>1,375</td>
<td>Ca</td>
<td>105</td>
<td>2</td>
<td>-80 210 340</td>
<td>-</td>
</tr>
<tr>
<td>22</td>
<td>19X 1N 4</td>
<td>Carroll</td>
<td>City of Green Forest</td>
<td>1963</td>
<td>1,587</td>
<td>1,349</td>
<td>Dg</td>
<td>7</td>
<td>1</td>
<td>-230 215</td>
<td>-</td>
</tr>
<tr>
<td>23</td>
<td>19X 2N 15c</td>
<td>Carroll</td>
<td>Starke-Weidner</td>
<td>1971</td>
<td>1,575</td>
<td>1,375</td>
<td>Dg</td>
<td>16</td>
<td>2</td>
<td>-261 229</td>
<td>-</td>
</tr>
<tr>
<td>24</td>
<td>19X 1N 8</td>
<td>Boone</td>
<td>City of Bergman</td>
<td>1971</td>
<td>1,725</td>
<td>1,205</td>
<td>Dg</td>
<td>205</td>
<td>1</td>
<td>-230 210</td>
<td>-</td>
</tr>
<tr>
<td>25</td>
<td>19X 1N 32kal</td>
<td>Marion</td>
<td>City of Summit</td>
<td>1970</td>
<td>1,520</td>
<td>950</td>
<td>Ca</td>
<td>82</td>
<td>1</td>
<td>16 170 488 472</td>
<td>-</td>
</tr>
<tr>
<td>26</td>
<td>19X 1N 28</td>
<td>Baxter</td>
<td>Geaville</td>
<td>1971</td>
<td>1,600</td>
<td>670</td>
<td>Dg</td>
<td>348</td>
<td>2</td>
<td>-285 230</td>
<td>-</td>
</tr>
<tr>
<td>27</td>
<td>19X 1N 30bcl</td>
<td>Baxter</td>
<td>Town of Cotter</td>
<td>1971</td>
<td>1,625</td>
<td>720</td>
<td>Ca</td>
<td>177</td>
<td>2</td>
<td>-204 234 524</td>
<td>-</td>
</tr>
<tr>
<td>28</td>
<td>19X 1N 31</td>
<td>Baxter</td>
<td>City of Cotter</td>
<td>-</td>
<td>666</td>
<td>Dg</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-276 215</td>
<td>-</td>
</tr>
<tr>
<td>29</td>
<td>19X 1N 9</td>
<td>Baxter</td>
<td>St. Home #2</td>
<td>1946</td>
<td>1,505</td>
<td>740</td>
<td>Dg</td>
<td>555</td>
<td>1</td>
<td>-210 210</td>
<td>-</td>
</tr>
<tr>
<td>30</td>
<td>19X 6N 234dal</td>
<td>Fulton</td>
<td>Cherokee Village</td>
<td>1972</td>
<td>1,630</td>
<td>682</td>
<td>Ca</td>
<td>350</td>
<td>2</td>
<td>-141 267 698 557</td>
<td>-</td>
</tr>
<tr>
<td>Well Ref. Number</td>
<td>Location (Twp., Rge., Sec.)</td>
<td>County</td>
<td>Owner or Driller</td>
<td>Year Completed</td>
<td>T.D. Below Land Surface</td>
<td>Elev. Feet Above NGL</td>
<td>FM at T.D.</td>
<td>Penetration of Basel</td>
<td>Wall Log Source</td>
<td>Roubidoux FM Elevation</td>
<td>Roubidoux FM Thickness</td>
</tr>
<tr>
<td>------------------</td>
<td>-----------------------------</td>
<td>--------</td>
<td>------------------</td>
<td>----------------</td>
<td>--------------------------</td>
<td>-----------------------</td>
<td>-----------</td>
<td>----------------------</td>
<td>----------------</td>
<td>------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>31</td>
<td>19N SW 21</td>
<td>Sharp</td>
<td>Cherokee Village</td>
<td>1972</td>
<td>1,555</td>
<td>750</td>
<td>Ce</td>
<td>1</td>
<td>0</td>
<td>230</td>
<td>-585</td>
</tr>
<tr>
<td>32</td>
<td>19N 33W 14</td>
<td>Benton</td>
<td>Ozarks-Products #1</td>
<td>1972</td>
<td>2,392</td>
<td>1,190</td>
<td>Elm</td>
<td>62</td>
<td>1</td>
<td>-210</td>
<td>205</td>
</tr>
<tr>
<td>33</td>
<td>19N 12W 3</td>
<td>Benton</td>
<td>Allen Canning</td>
<td>1972</td>
<td>1,378</td>
<td>1,150</td>
<td>Ce</td>
<td>163</td>
<td>1</td>
<td>-120</td>
<td>180</td>
</tr>
<tr>
<td>34</td>
<td>19N 21W 24</td>
<td>Boone</td>
<td>ANG Bray #2</td>
<td>1958</td>
<td>2,805</td>
<td>2,122</td>
<td>Ce</td>
<td>1</td>
<td>3</td>
<td>-120</td>
<td>256</td>
</tr>
<tr>
<td>35</td>
<td>19N 22W 25</td>
<td>Boone</td>
<td>ANG R. Roberts #1</td>
<td>1966</td>
<td>2,370</td>
<td>2,087</td>
<td>Og</td>
<td>1</td>
<td>3</td>
<td>-120</td>
<td>235</td>
</tr>
<tr>
<td>36</td>
<td>19N 21W 18</td>
<td>Boone</td>
<td>Ark West Gas Ladd #2</td>
<td>1967</td>
<td>2,260</td>
<td>1,814</td>
<td>Ce</td>
<td>33</td>
<td>3</td>
<td>-120</td>
<td>285</td>
</tr>
<tr>
<td>37</td>
<td>19N 19W 19</td>
<td>Boone</td>
<td>Ark Oil Corp.</td>
<td>1967</td>
<td>2,000</td>
<td>1,050</td>
<td>Og</td>
<td>400</td>
<td>1</td>
<td>-120</td>
<td>235</td>
</tr>
<tr>
<td>38</td>
<td>19N 19W 18</td>
<td>Boone</td>
<td>Valley Springs</td>
<td>1966</td>
<td>205</td>
<td>1,375</td>
<td>Ce</td>
<td>1</td>
<td>3</td>
<td>-120</td>
<td>235</td>
</tr>
<tr>
<td>39</td>
<td>19N 21W 2</td>
<td>Baxter</td>
<td>Norfolk Dam</td>
<td>1966</td>
<td>1,450</td>
<td>500</td>
<td>Og</td>
<td>300</td>
<td>1</td>
<td>-120</td>
<td>235</td>
</tr>
<tr>
<td>40</td>
<td>19N 22W 10</td>
<td>Sharp</td>
<td>City of Ash Flat</td>
<td>1966</td>
<td>1,565</td>
<td>555</td>
<td>Og</td>
<td>615</td>
<td>1</td>
<td>-120</td>
<td>220</td>
</tr>
<tr>
<td>41</td>
<td>19N 33W 6</td>
<td>Benton</td>
<td>Plum Poultry Co</td>
<td>1966</td>
<td>1,515</td>
<td>1,150</td>
<td>Og</td>
<td>90</td>
<td>1</td>
<td>-120</td>
<td>220</td>
</tr>
<tr>
<td>42</td>
<td>19N 29W 9bd1</td>
<td>Washington</td>
<td>White River</td>
<td>1973</td>
<td>2,071</td>
<td>1,481</td>
<td>Og</td>
<td>2</td>
<td>2</td>
<td>-120</td>
<td>220</td>
</tr>
<tr>
<td>43</td>
<td>19N 20W 21</td>
<td>Newton</td>
<td>Marble Falls</td>
<td>1972</td>
<td>2,576</td>
<td>1,344</td>
<td>Ce</td>
<td>43</td>
<td>2</td>
<td>-120</td>
<td>220</td>
</tr>
<tr>
<td>44</td>
<td>19N 32W 9bd1</td>
<td>Washington</td>
<td>Lake Vedington Park</td>
<td>1973</td>
<td>1,815</td>
<td>1,135</td>
<td>Ce</td>
<td>45</td>
<td>2</td>
<td>-120</td>
<td>220</td>
</tr>
<tr>
<td>45</td>
<td>19N 33W 6</td>
<td>Madison</td>
<td>Independent Oil &amp; Gas Banks</td>
<td>1973</td>
<td>1,815</td>
<td>1,135</td>
<td>Ce</td>
<td>45</td>
<td>2</td>
<td>-120</td>
<td>220</td>
</tr>
<tr>
<td>46</td>
<td>19N 33W 17bb1</td>
<td>Washington</td>
<td>D. Holcomb</td>
<td>1973</td>
<td>2,097</td>
<td>1,222</td>
<td>Og</td>
<td>2</td>
<td>2</td>
<td>-120</td>
<td>220</td>
</tr>
<tr>
<td>47</td>
<td>19N 16W 25</td>
<td>Searcy</td>
<td>Marshall</td>
<td>1973</td>
<td>2,415</td>
<td>1,100</td>
<td>Og</td>
<td>75</td>
<td>1</td>
<td>-120</td>
<td>220</td>
</tr>
<tr>
<td>48</td>
<td>19N 33W 28</td>
<td>Newton</td>
<td>Pan Am Petroleum Co USA B #1</td>
<td>1964</td>
<td>4,996</td>
<td>1,682</td>
<td>Og</td>
<td>4</td>
<td>-120</td>
<td>220</td>
<td>-700</td>
</tr>
<tr>
<td>49</td>
<td>19N 33W 28</td>
<td>Newton</td>
<td>Pan Am Petroleum Co USA B #1</td>
<td>1964</td>
<td>4,996</td>
<td>1,682</td>
<td>Og</td>
<td>4</td>
<td>-120</td>
<td>220</td>
<td>-700</td>
</tr>
</tbody>
</table>
maps were constructed for the northern Arkansas portion of the study area from this expanded database. These maps were then correlated with those published by McCracken.

**Structural Configuration of the Roubidoux and Gasconade Formations**

Structural development of the Cambrian and Ordovician Formations of Missouri and northern Arkansas appears to have been greatly influenced by the structural grain of the Precambrian basement. These rocks in Missouri and northern Arkansas form a structurally high area of the mid-continent region flanked by basins on the east, south, and northwest (Kisuarsanyi, 1974). The area has been subjected to repeated uplifts during and after Precambrian time, with the Ozark dome being the most dominant structural uplift feature. In addition to these epeirogenic movements, a considerable amount of faulting has taken place. This faulting gives the Ozark area the pattern of a ruptured dome near the center of the structural high (McCracken, 1967). The pattern of Precambrian faulting follows predominant northwest-southeast trends with secondary northeast-southwest and east-west trending faults (McCracken, 1971). Repeated movement along some of these structures has been reflected in the overlying rocks. Figure 3 shows the topography of the buried Precambrian surface in Missouri. The Southwest Missouri High, Central Missouri High and Southeast Missouri High appear to have exerted a strong influence on deposition.
Figure 3. Topography of buried Precambrian surface in Missouri.

(After Kisvarsanyi, 1974)
and structural development during Gasconade and Roubidoux sedimentation. Examination of the structural map contoured on the base of the Roubidoux Formation (Plate 2) shows strong correlation between structural highs present at the beginning of Roubidoux deposition and those of the Precambrian basement. The dominant trends of faults and of anticlinal and synclinal axes in these sediments are northwest, northeast, and east, which are similar to the Precambrian trends discussed above. Except in the vicinity of faults the regional dip of Paleozoic strata in Missouri is only a few degrees. The Paleozoic strata of northern Arkansas rest on a broad structural platform that extends into the state from Missouri. The Roubidoux and Gasconade Formations regionally dip from 18 to 36 feet per mile southward across this platform toward the Arkhoma basin in central Arkansas. Near the margin of the basin the dip steepens along a hinge that extends westward from central Searcy County to northern Crawford County and attains values that range from 80 to 100 feet per mile to the south. North of this hinge the southerly dip of the platform has been modified by several broad, poorly defined structural highs and intervening lows that trend generally to the southeast.
Thickness Trends of the Roubidoux and Gasconade Formations

The thickness of the Gasconade and Roubidoux Formations is depicted on the isopachous maps accompanying this report (Plates 3 and 4).

Gasconade Formation

The thickness of the Gasconade Formation ranges from 160 feet in Bates County, Missouri, to over 660 feet in Searcy, Stone, Izard, Sharp, and Randolph Counties, Arkansas. The direction of regional thickening of the Gasconade follows a pattern of increasing from northwest to southeast toward the Arkhoma basin of central Arkansas. This trend follows the regional gradient of the Precambrian topography (Figure 3) and is reflective of the strong influence that the Precambrian structural grain exerted on subsequent sedimentation. Thinning of the Gasconade corresponds with the Southwest Missouri High, Central Missouri High and Southeast Missouri High. Thickenings follow elongate troughs trending northwest, and are associated with recurrent basement faults of the same trend.

The northwest to southeast thickening and thinning of the Gasconade appears to extend across the structural platform in the Arkansas subsurface, with a regional increase in thickness to the southeast.
Gunter Sandstone Member

The basal Gunter Sandstone Member of the Gasconade Formation has been included in the isopachous map of the Gasconade Formation (Plate 3). In general the Gunter Member is a sandy dolomite unit averaging 30 feet in thickness in Missouri and increasing in thickness from the northwest to the southeast. Subsurface and outcrop studies of the Gunter Member in Missouri by Knight (1954) show that the Gunter is represented in different areas by a sandstone and a dolomite facies (Figure 2). The Gunter Member is largely sandstone in an area trending southward from Miller County through Greene and Webster Counties to Taney and Ozark Counties, Missouri (Knight, 1954). East and west of this belt it increases in dolomite content to a maximum of over 90 percent dolomite. Subsurface work by Snyder (1976) in Arkansas indicates a continuation of Knight's sandstone facies from Taney and Ozark Counties, Missouri through Carroll and Boone Counties, Arkansas. East and west of this area dolomite content increases to a maximum of approximately 70 percent.

The thickness of the Gunter Member is quite variable due to the uneven surface on which it was deposited (Knight, 1954). The thickness ranges from zero over Precambrian highs to 120 feet in northern Arkansas. The thickening of the Gunter is similar to that of the overlying Gasconade, having a northwest to southeast trend. This trend and the increase in sand content toward the south
suggests that the Gunter may have a source south of the Ouachita Mountain province (McCracken, 1964).

**Roubidoux Formation**

Thickness trends of the Roubidoux Formation are shown on Plate 3 of this report. The Roubidoux ranges from 100 feet thick in Hickory and Benton Counties, Missouri, to over 280 feet thick in Benton County, Arkansas. The regional trend is one of thickening of the Roubidoux Formation from northwest to southeast. The thickness of the Roubidoux Formation is remarkably regular from central Missouri to northeastern Oklahoma (McCracken, 1964). The unit is approximately 190 to 200 feet thick throughout a belt that extends southwest from southern Baxter County through southern Marion, central Newton and northern Franklin Counties, Arkansas. Regionally the Roubidoux thickens southeast of this belt.

The Roubidoux Formation of south central Missouri normally contains several lenticular sand bodies which occur near the top, middle, and base of the formation (McCracken, 1964). The development of these sand lenses has not been observed in the subsurface of northern Arkansas.
GROUNDWATER IN THE OZARK PLATEAUS PROVINCE

Occurrence

Groundwater in the Ozark Plateaus is derived from shallow and deep aquifers, with the total reservoir section consisting of over 2,000 feet. Similar to physiography, the Ozark Plateaus area may also be divided into three units in terms of groundwater availability; the Salem Plateau, Springfield Plateau, and Boston Mountains.

Groundwater in the Salem Plateau is derived from aquifers of Cambrian and Ordovician age, which are at or near the surface throughout the area. Groundwater in the Springfield Plateau and Boston Mountain areas is obtained from shallow aquifers of Mississippian and Pennsylvanian age and deeper aquifers of Cambrian and Ordovician age. Water from the shallow aquifers occurs under water table conditions and generally supplies enough water for domestic use. Groundwater from the deep aquifers is generally under artesian pressure and yields are usually considerably higher than those of the shallow aquifers. The most dependable water supplies for industrial, municipal and agricultural uses are derived from the deep aquifer section.

Deep Aquifers

Groundwater from the deep aquifers of the Ozark area is derived from Cambrian and Ordovician sandstone and dolomite. The deep aquifer section encompasses the following principal fresh water formations: the Lamotte Sandstone, Fitosi
Dolomite, Gasconade Dolomite and Gunter Sandstone Member, and the Roubidoux Formation. The position of these units in the geologic column and their relationship to other geologic units is shown in Figure 1. All of the principal aquifer units crop out in concentric belts surrounding the St. Francois Mountains but are confined to the subsurface in southwestern Missouri and northern Arkansas (Plate 1).

Recharge to the principal aquifers is by vertical movement of water through overlying younger formations (Fuller and Knight, 1967). Recharge and water yields are dependent upon the permeability of the formations. Yields often show large variations because of low permeability associated with the carbonate lithologies of the formations. Relative yields of the principal aquifers in southern Missouri are shown in Figure 4.

General Hydrologic Character of the Principal Aquifers

Lamotte Sandstone

The Lamotte Formation is the oldest aquifer in the Ozark Area and is the basal unit of the Cambrian system. The Lamotte crops out in the St. Francois Mountain area but is confined to the subsurface throughout southern Missouri and northern Arkansas. Depths to the Lamotte range from 1,200 feet in southern Missouri to over 2,500 feet in northern Arkansas.

The Lamotte Sandstone in Missouri is generally a low yield aquifer (average 75 gpm) due to the void-filling
Figure 4. Typical yields of wells in principal aquifers of the Ozark Plateaus.
cementation of the sand grains (Fuller and Knight, 1967); however, little is known about water yields from the Lamotte in northern Arkansas. No wells have been reported that produce from the Lamotte. The only penetration of the formation resulted from the drilling of oil wells which were not tested for fresh water yield.

Potosi Dolomite

The Potosi Dolomite is exposed on the flanks of the St. Francois Mountains and as the Lamotte is confined to the subsurface in southern Missouri and northern Arkansas. The Potosi of Missouri is generally a coarsely crystalline dolomite, and in most of the area it is drusy and vuggy (Fuller and Knight, 1967). The vugs are interconnected and water is able to flow freely (Fuller and Knight, 1967). This characteristic makes the Potosi one of the highest yielding formations of Missouri, and it is the primary source of water for municipal and industrial use in the area. Yields average 500 gpm (Knight, 1962) from the Potosi. Depths to the Potosi in Missouri average 1,200 feet.

As is true of the Lamotte, little is known about the yield potential of the Potosi in northern Arkansas. Only a few wells have penetrated the formation and are producing from it. A well drilled near Rogers, in Benton County, Arkansas is reported to be producing from the Potosi. The well is located in Sec. 13, T. 20 N., R. 29 W., and has a total depth of 1,968 feet, with a surface elevation of 1,460 feet. The well has a yield of 230 gpm with a drawdown
of 49 feet (Taylor Engineering Co., Springdale, Arkansas, Personal Communication, 1975). The water from this well is of good chemical quality.

A well located in Sec. 17, T. 15 N., R. 13 W., in Washington County, Arkansas is reported by the United States Geological Survey at Little Rock to be in the Potosi at a total depth of 2,097 feet. This is an old oil test well by the Camden Oil Company. The well is reported to have yielded 50 to 60 gpm and had an unusually high total dissolved solid content of 928 ppm. The chloride content was 290 ppm.

Water from the Potosi may be considered as a future potential source in northern Arkansas. As the need for water increases in the area deeper wells may have to be drilled. Also, in areas where the Gunter Member and Roubidoux Formation are not good producers, the Potosi may be a logical alternative.

Eminence Dolomite

The Eminence Dolomite is medium to coarsely-crystalline and locally very siliceous (Fuller and Knight, 1967). In Missouri only small quantities of water are produced from the upper 100 feet of the formation. Moderate quantities are obtained from the lower portion of the formation, down dip from the outcrop area. The water is being produced from openings and fractures in the dolomite in yields sufficient for municipalities and small industries (Fuller and Knight, 1967). Yields from the Eminence average 25 gpm
in Missouri (Knight, 1962).

In northern Arkansas the Eminence does not appear to be a significant aquifer. Many wells penetrate the first 50 feet of the formation, but no major increases in yield are apparent over those encountered in the penetration of overlying formations.

The Gasconade Formation and Gunter Sandstone Member

The Gasconade Formation is the earliest Ordovician unit in Missouri and northern Arkansas. The formation consists of an upper cherty dolomite unit averaging over 300 feet in thickness, and a lower basal sandstone and sandy dolomite member termed the Gunter Sandstone Member.

The Gunter Member crops out in the Lake of the Ozarks area of south central Missouri. It is generally a well developed sandstone averaging 30 feet in thickness throughout most of south central Missouri and north central Arkansas but becomes increasingly more dolomitic east and west of this area. Yields from the Gunter Member throughout most of southern Missouri to the Arkansas border average 40 to 50 gpm, and locally as much as 1,000 gpm (Fuller and Knight, 1967). Yields from the Gunter in northern Arkansas average greater than 100 gpm, with local yields as high as 581 gpm.

The dolomite beds of the Gasconade Formation above the Gunter Member contain several dense zones in the upper 150 feet of the formation. These zones apparently do not yield water and may form an aquiclude to water from over-
Regional Hydrologic Character of the Roubidoux and Gasconade Formations

Domestic supplies of groundwater outside of the outcrop area of the five principal deep aquifers in the Ozark Plateaus region are generally obtained from relatively shallow wells in formations of Pennsylvanian and Mississippian age. Water for municipal and industrial utilization is generally not available in sufficient quantities from these shallow aquifers, and must be obtained from the deep aquifer units (Feder and others, 1969). The Roubidoux and Gasconade Formations are being utilized extensively throughout Missouri as reliable aquifers for industrial and municipal needs. In northern Arkansas extensive development of these aquifers has been restricted by high drilling costs and relatively sparse population. At present, only a limited number of wells penetrate the Roubidoux and Gasconade Formations in the area; however, future development of large groundwater supplies in northern Arkansas appears to depend primarily on the water-bearing properties of the Roubidoux and Gasconade units.

Water Availability

To determine the general availability of water supplies from the Roubidoux and Gasconade Formations, groundwater yield and specific capacity maps were constructed. Data for the maps (Plates 5, 6, 7, and 8) were collected from the Missouri Geological Survey, the Arkansas Geological Commission, the U. S. Geological Survey and from consulting
lying formations. The next 100 feet to 150 feet below these dense zones contain up to 50 percent chert and yield water sufficient for farm and domestic use in Missouri. The availability of water from this zone in northern Arkansas has not been determined. Wells which penetrate only the upper Gasconade are not numerous enough at this time to permit proper evaluation of the aquifer's potential.

**Roubidoux Formation**

The Roubidoux Formation crops out extensively in southern Missouri, and is the most reliable shallow aquifer for farm wells in this area (Fuller and Knight, 1967). The Roubidoux is confined to the subsurface for the most part in southwestern Missouri and northern Arkansas. It consists of sandy, cherty dolomite, with distinct sandstone units appearing at the base, middle, and top of the formation in western Missouri.

Yields from the Roubidoux throughout Missouri average 15 to 20 gpm with some local production as high as 300 gpm (Fuller and Knight, 1967). Yields in northern Arkansas average 60 gpm with local variations as high as 600 gpm. The formation is the shallowest of the principal aquifers in the Ozark Region, and produces adequate yields for small industrial and municipal use.
engineers who have directed the drilling of wells in the area. In some cases data were obtained from individual owners of wells. In total, data from 257 wells throughout Missouri and northern Arkansas have been tabulated (Appendix A).

**Estimated Yields**

Most wells drilled into the Roubidoux and Gasconade Formations are open below a certain casing depth. This casing depth is determined by the presence of surface contaminants, the degree of weathering, and economics. Estimated yields from these wells, therefore, represent the total contribution from all open aquifers in the section. Yields from wells are dependent on the diameter and total depth of the bore hole, formations penetrated, geographic location, structural attitude of the rocks, and permeability of the aquifers tapped. The probability of interformational movement of water also makes it difficult to define parameters which describe the yield capabilities of the individual aquifers. It should be noted that the wells used to establish the yield and specific capacity zones shown in Plates 5, 6, 7, and 8 reflect these conditions. There is generally, however, a substantial increase in the collective yield of a well when either the Roubidoux or Gasconade Formations are penetrated. It is therefore possible to arrive at conclusions about the water-yielding properties of the Roubidoux and Gasconade Formations by using data from wells penetrating various aquifer combinations.
Analysis of the Roubidoux yield data presented in Plate 5 can be summarized as follows:

1. Yields range from 4 gpm to a maximum of 600 gpm, with an average yield of 50-60 gpm throughout the study area.
2. Yields are generally low (0-50 gpm) in the outcrop area of the Roubidoux Formation, but generally increase to the south and west of this area.
3. Yields appear to decrease significantly from the northern Arkansas structural platform toward the Arkhoma basin.
4. High yield areas (greater than 150 gpm) are not uniform throughout any portion of the study area. This observation would suggest that either the rock characteristics which dictate water production are not constant in their sub-surface distribution, or that yields are affected by structure, faulting, or solutioning more than by lithic character.
5. Yields of 50 to 150 gpm are available from a belt beginning in the southwestern corner of Missouri and extending southeast across northern Arkansas.

Analysis of the Gasconade yield data (Plate 6) can be summarized as follows:

1. Yields are generally higher than for wells penetrating the Roubidoux Formation. Yields range from 4 gpm to a maximum of 732 gpm, with the average being approximately 170 gpm.
2. Yields are low (0-50 gpm) in the outcrop area of the
Gasconade Formation, and increase to the south and west of this area.

3. Yields appear to decrease toward the Arkhoma basin.

4. High yield zones (greater than 250 gpm) are more uniform and continuous than those of wells penetrating the Roubidoux Formation. These yield zones appear as elongate belts localized in southwest Missouri and extreme northwest Arkansas.

5. Yields of from 50 to 250 gpm are available over a large portion of the study area extending from southwest Missouri, south and east into northern Arkansas to the border of the structural platform.

Specific Capacities

Yield data alone are not an indicator of the performance of the aquifers because the size of the pump, size of the drill hole, and other variables can also influence water output. A more significant and reliable measure of the performance of an aquifer or well is its specific capacity. The specific capacity of a well is its yield per unit of drawdown, usually expressed as gallons per minute per foot of drawdown (Johnson Division UOP, 1972). Dividing the yield by the drawdown, each measured at the same time during a pump test, gives the value of the specific capacity. The drawdown in a well is the amount the water level is lowered during pumping (Anderson, 1973). If the aquifer is very permeable or contains well developed interconnected fractures or solution channels, the drawdown will be
relatively small for any pumping rate, resulting in large specific capacity values. In contrast, aquifers having low permeabilities in the vicinity of the pumping well will produce large drawdowns and consequently low specific capacity values. Therefore, specific capacity can be a fairly reliable indicator of the water-bearing character of the aquifer.

Plates 7 and 8 show generalized specific capacity zones for wells penetrating the Roubidoux and Gasconade Formations. Analysis of these maps indicates the following for the Roubidoux Formation:

1. Specific capacities are less than 1 throughout most of the study area.
2. High specific capacities (greater than 5) are localized in portions of Dade, Barton, Vernon and Cedar Counties, Missouri, Newton County, Missouri, and portions of Carroll and Boone Counties, Arkansas. These zones appear to be related to localized fracturing or karst development.
3. Specific capacities appear to decrease toward the Arkhoma basin.

Analysis of Plate 8, Gasconade specific capacity data, can be summarized as follows:

1. Specific capacities for wells penetrating the Gasconade Formation are greater than those for Roubidoux wells, but they are less uniform in distribution.
2. Specific capacities are less than 2 over much of the
outcrop area of the Gasconade Formation.

3. Specific capacities average about 3 outside the outcrop area, and regionally decrease toward the Arkhoma basin.

4. A prominent high specific capacity zone extends from Vernon and St. Clair Counties, Missouri, southeast to extreme northern Taney County, Missouri.

Geologic Factors Influencing Water Availability
In the Roubidoux and Gasconade Formations

Groundwater in carbonate aquifers such as the dolomite which comprises the Roubidoux and Gasconade Formations moves quite differently than in granular rocks such as sandstone. In dolomite for example, porosity and permeability depend upon the presence or absence of discrete openings, whereas in granular rocks they are a function of intergranular pores. Although the ability of carbonate rocks to transmit groundwater can sometimes be attributed to original rock texture, secondary parameters such as faults, fractures, joints, bedding planes, and intercrystalline and solution passages are more important by far. Most workers in carbonate hydrogeology agree that the capacity of dense dolomite aquifers to transmit groundwater to wells and springs largely depends upon the size and number of these water-yielding secondary parameters. Nearly all aquifers composed of limestone, dolomite and siliceous rocks have at least some fracture porosity. The fracture planes combine with whatever porosity already exists to form an inter-
connecting system that greatly increases the permeability of the rock. Thus two systems of permeability are involved in many dense, fractured aquifers; (1) the low-permeability blocks between fractures where the water moves slowly through short distances, (2) the high permeability fractures that eventually lead to the well bore. No matter how dense and compact the rock formation may appear at the outcrop or in well cuttings, these same rocks may become a suitable aquifer at depth as the result of fracturing, fissuring, and shattering.

Examination of data presented in a recent study completed in northwest Arkansas which concerns relatively shallow carbonate aquifers, establishes that a significant correlation exists between high yield wells and springs and their proximity to zones of rock fracture (Hanson, 1973). The assumption that these secondary openings can extend into the subsurface for several thousands of feet has been supported by numerous fractured petroleum reservoirs which have produced millions of barrels of oil in the United States alone.

Wells which penetrate the Roubidoux or Gasconade Formations to depths in excess of 1,000 feet in portions of Missouri and northern Arkansas show some correlation with large surface linear or fault systems; however, more detailed research is necessary to document this observation. The high yield and specific capacity zones of the Roubidoux and Gasconade Formations located in Vernon, Cedar, Barton,
Dade, Lawrence, Greene, and Christian Counties in Missouri are associated with prominent northwest trending fault systems (Plates 2 and 8). These are the Chesapeake and Bolivar-Mansfield fault zones. These faults are reported to extend to great depths (McCracken, 1971), possibly to the Precambrian basement. In the area of the high yield, high specific capacity zones the Chesapeake fault is upthrown to the southwest and downthrown to the northeast, with a maximum displacement of approximately 250 feet. The Bolivar-Mansfield fault is upthrown to the northeast and downthrown to the southwest, with about the same amount of displacement. This pattern of faulting describes a large northwest trending horst and graben system, with higher yields and specific capacities localized within the graben block. Southeast of Greene County, Missouri the fault-block displacement changes, with the Chesapeake fault becoming upthrown to the northeast and downthrown to the southwest, and the Bolivar-Mansfield fault becoming upthrown to the southwest and downthrown to the northeast. The central block of the system, therefore, becomes a horst southeast of Greene County. Yields and specific capacities show a marked decrease from northwest to southeast throughout this horst block. The total effect of this faulting activity is to produce an elongated high-recharge trough trending northwest from Greene Count to the Kansas-Missouri border. Increases in permeability associated with the faulting activity are believed to be responsible for the high yields
throughout this zone; however, one might assume that some increase in water availability within the zone may be due to lithologic controls. Examination of well logs supplied by the Missouri Geologic Survey shows that this is not the situation because no major lithologic changes can be found within the aquifer section. The lithologic nature of the Roubidoux and Gasconade Formations is not dissimilar to that observed in wells from low yield zones. Structural setting, therefore, appears to be the major control over water availability in the highest yielding zone of the Ozarks.

Increased permeability related to secondary solutioning along zones of fracture and faulting has an important effect on water availability and movement in the Roubidoux and Gasconade Formations. Solution phenomena such as springs, caves, and sinks are common in the outcrop area of the formations on the west flank of the Ozark uplift (Skelton, 1966). Water-well drilling and temperature data show that water may circulate through interconnected solution openings to depths of 800 feet in some areas of the Salem Plateau (Harvey and Vineyard, 1967). These openings may extend to greater depths down dip from the outcrop area. Drillers in northern Arkansas have periodically reported the occurrence of cavities at depths exceeding 1,000 feet (Lee Taylor, Personal Communication), and water yields generally increase where subsurface solution channels are encountered. For
example, the high specific capacity zone of the Roubidoux Formation beginning in Texas and Wright Counties, Missouri and extending southward to Fulton County, Arkansas appears to be related to the development of an extensive subsurface drainage system (Plate 7). This zone is also associated with the Spring River drainage basin and Mammoth Spring. Mammoth Spring is the second largest spring in the Ozark Plateau Province. In 1966 fluorescein dye was traced from Grand Gulf, a large surface karst feature located in Oregon County, Missouri to Mammoth Spring (Vineyard and Feder, 1974).

Lateral changes in lithology or facies do not appear to be a major factor controlling water availability from the Roubidoux or Gasconade Formations in Missouri or northern Arkansas. Snyder (1976) has provided lithofacies data for these formations in northern Arkansas on the basis of sand, dolomite, and chert percentages. Snyder's facies in the Roubidoux and Gasconade Formations having high sand percentages show no apparent correlation with the yield zones presented by this investigation on Plates 5, 6, 7, and 8.

A somewhat different situation appears to exist in the Gunter Sandstone Member of the Gasconade Formation. Work by Knight (1954) in Missouri, and Snyder (1976) in northern Arkansas has provided facies of sand versus dolomite percentages for this unit. The Gunter consists of 100 percent sand in an area trending southward from Miller County, Missouri to Boone County in northern Arkansas.
East and west of this belt the member becomes increasingly more dolomitic reaching a maximum of over 90 percent. These facies appear on a regional scale to exert some control over water yields. Water yields generally increase over those available from the dolomite of the upper Gasconade and Roubidoux Formations when the Gunter Member is penetrated in Missouri and northern Arkansas. Westward into northern Oklahoma the Gunter is primarily dolomite, and yields are negligible (Reed and others, 1955). In contrast to these broad regional trends, sand facies of the Gunter Member show no specific correlation with the high yield-high specific capacity zones established in this study (Plates 5, 6, 7, and 8). The zones fall within the 10 to 40 percent sand facies rather than the 80 to 100 percent belt established by Knight and Snyder. The lack of increase in yield from the high sand percent facies may be due in large part to reduction in permeability by dolomite and silica cementation (Snyder, 1976). The high yields appear to be the result of complex faulting and structural control rather than lithic character.

Recharge, Movement, and Discharge of Groundwater

Recharge

The Roubidoux and Gasconade Formations receive recharge primarily from precipitation falling throughout the study area. The amount and rate of recharge depends upon the general configuration and physical character of the land
surface, the distribution and quantity of precipitation, the geologic framework of the area, the permeability and porosity of the soil and bedrock, and surface runoff and stream flow. Movement of water from the soil to the bedrock occurs along fractures and solution openings in the rock. The principal area of recharge to the formations falls within the Salem Plateau section of the Ozark Plateaus province. Throughout this area the Roubidoux and Gasconade Formations are at or near the surface. Recharge to wells penetrating the aquifers is in direct response to rapid infiltration of precipitation. The process of this recharge is illustrated by hydrograph data from monitored wells in the Salem Plateau provided by the Missouri Geologic Survey. Figures 5 and 6 show the relationship of water levels to precipitation in a well penetrating the Gasconade and Eminence Formations at West Plains in Howell County, Missouri. Figure 5 is a hydrograph with a nine year base (1965-1973). Figure 6 shows water level and precipitation fluctuations for the year 1973. Figures 7 and 8 are for a well penetrating the Gasconade Formation at Willow Springs in Howell County, and figures 9 and 10 are hydrographs of a well penetrating the Gasconade Formation at Bradleyville in Taney County, Missouri. In each case the period of record is a nine year base and the year 1973. These wells are largely representative of the correlation between precipitation and water levels characteristic of the Salem Plateau for both long and short term events.
Figure 5. Hydrograph of water level fluctuation in well at West Plains, Howell County, Missouri.
Figure 6. Hydrograph of water level fluctuation in well at West Plains, Howell County, Missouri during 1973.
Figure 7. Hydrograph of water level fluctuations in well at Willow Springs, Howell County, Missouri.
Figure 8. Hydrograph of water level fluctuations in well at Willow Springs, Howell County, Missouri during 1973.
Figure 9. Hydrograph of water level fluctuations in well at Bradleyville, Taney County, Missouri.
Figure 10. Hydrograph of water level fluctuations in well at Bradleyville, Taney County, Missouri during 1973.
Recharge to the aquifers outside the Salem Plateau is not in direct response to variations in precipitation. This area of low response corresponds to the Springfield Plateau section of the Ozark Plateau province. In this region the Roubidoux and Gasconade Formations are confined to the subsurface, and are generally overlain by thick sequences of upper Ordovician, Mississippian and Pennsylvanian rocks. Local variations in precipitation do not directly affect the supplies available from the deep aquifers (Feder and others, 1969). Well hydrographs (Figures 11, 12, 13, and 14) from wells penetrating the aquifers at Noel in McDonald County, Missouri, Rogers in Benton County, Arkansas and Flippin in Marion County, Arkansas illustrate the lack of response of wells to precipitation events and are characteristic of deep wells in the Springfield Plateau. Primary recharge to the aquifers in this area results from the slow migration of groundwater along bedding planes, faults, fractures, and solution channels down dip from the outcrop area in the Salem Plateau. Determination of the rate of this movement is not possible at this time; however, examination of existing data suggests that movement is extremely slow and non-uniform.

Some areas of the Springfield Plateau appear to have significant aquifer recharge by vertical infiltration along faults and from overlying shallow aquifers rather than by lateral migration from the outcrop area (Feder and others, 1969). The effect of this recharge is responsible
Figure 11. Hydrograph of water level fluctuations in well at Noel, McDonald County, Missouri.
Figure 12. Hydrograph of water level fluctuations in well at Noel, McDonald County, Missouri during 1973.
Figure 13. Hydrograph of water level fluctuations in well at Rogers, Benton County, Arkansas.
Figure 14. Hydrograph of water level fluctuations in well at Yellville, Marion County, Arkansas.
for most of the high-yield, high-specific capacity wells in the Springfield Plateau. The influence of local recharge of this nature on these wells can be illustrated by graphs of drawdown versus time plotted on semilog graph paper. Data for the graphs are derived from pumping tests supplied by drillers and engineering consultants in the area. When water is pumped from a well the quantity discharged initially is obtained from aquifer storage immediately surrounding the well. As pumping continues more water must be derived from greater distances away from the bore hole. This produces a circular-shaped cone of depression which expands and deepens as pumping progresses so that water can move from greater distances toward the well. The radius of influence and drawdown of the well will continue to increase as the cone expands and deepens until aquifer recharge starts to equal the pumpage. Figure 15 is a graph of drawdown versus time for a pump test of the Arkansas Highway Department well at Harrison, Arkansas, which penetrates the Gasconade Formation (Well #245, Appendix A). The graph indicates an increase in drawdown with an increase in time of pumping, thus suggesting that the well in not receiving significant recharge, and consequently drawing water from storage. The pumping rate for this test was varied from 170 gpm to 88 gpm in an attempt to establish an equilibrium between discharge and recharge. However, the lack of significant recharge to the well prevents the establishment of equilibrium at any of
these pumping rates. If pumping was continuous at these rates the water level would be in danger of falling below the level of the pump. Through the use of intermittent pumping, however, the well is allowed to recover during periods when the pump is off. Some recharge reaches the well, but the rate of movement is too slow to equalize the rate of withdrawal during pumping. Over a matter of hours or days of non-pumping the water level in the well will rise. This rise in water level is probably a measure of the lateral movement of water from the outcrop area to the well. The drawdown versus time graph may, therefore, be used as an indicator of the permeability of the aquifers penetrated. The graph for the Arkansas Highway Department may be considered as representative of wells in the Springfield Plateau which do not intersect solution channels, faults, fracture zones, or linears.

Figure 16 is a drawdown versus time graph for a well penetrating the Gasconade Formation at Valley Springs, Boone County, Arkansas (well #252, Appendix A). The well coincides with a large northeast trending linear which is inferred to be a reverse fault (Plate 2). The graph indicates an increase in drawdown for the first 1,080 minutes at a constant pumping rate of 200 gpm. This represents water drawn from storage. After 1,080 minutes of pumping a source of recharge is encountered and no further drawdown occurs, indicating that a condition of equilibrium has been reached. Another indication of
Figure 15. Graph of drawdown versus time for Arkansas Highway Department well at Harrison, Arkansas.
Figure 16. Graph of drawdown versus time for well at Valley Springs, Arkansas.
VALLEY SPRINGS, ARK.
Boone County, Ark.

Recovery curve.
Pump off.

Figure 17. Recovery curve for well at Valley Springs, Arkansas.
aquifers. This is suggested by the comparison of the water levels of wells penetrating only the Roubidoux Formation with those of wells penetrating both the Roubidoux and Gasconade Formations (Appendix A). The lack of substantial differences in water levels between wells for any given locality suggests that movement of groundwater between aquifers due to hydrostatic head differences in the units, occurs in areas where sufficient permeability exists between units. Plate 9 may therefore be considered largely representative of the combined groundwater movement associated with the Roubidoux and Gasconade Formations.

The general direction of groundwater flow is down gradient and at right angles to contours on the potentiometric surface. Water enters the aquifers where the potentiometric surface is high while being discharged where it is low. The principal area of high potentiometric levels in the study area describe a groundwater ridge which extends from Texas County, Missouri, southwest to McDonald and Barry Counties, Missouri and then southward to Washington and Madison Counties, Arkansas. Throughout this ridge water levels average greater than 1,000 feet above sea level, and the ridge is generally reflective of the surface topography. Subsequent regional groundwater movement is primarily north and south of this ridge toward groundwater troughs which are coincident with deeply incised drainage basins.

Departures from the regional trend of groundwater
movement may occur in local areas where faulting and frac-
turing of the carbonate rocks is extensive. Numerous
tracer studies using rhodamine dye have shown that water
may flow in surface streams in the outcrop area of the
aquifers until it reaches cavernous zones. The water then
sinks underground and follows the zone of solution for many
miles before issuing from springs, sometimes in a different
drainage basin (Vineyard and Feder, 1974).

Discharge

Natural discharge of groundwater from the Roubidoux
and Gasconade Formations may occur from springs, as effluent
seepage along a stream channel, as evapotransportation, and
as movement from one aquifer to another. Artificial
discharge is mostly from domestic or industrial wells
penetrating the aquifers throughout the Salem and Spring-
field Plateaus. The nature of discharge from the aquifers
is a function of geologic and physiographic controls and may
be examined in terms of discharge within the Salem and
Springfield Plateaus divisions of the Ozark Province.
Over long periods of time discharge appears to be balanced
by recharge and water levels are not drastically affected.

The most extensive natural discharge from the Roubidoux
and Gasconade Formations occurs within the Salem Plateau
where the formations are exposed over large areas (Plate 1).
The soluble nature of the aquifers coupled with wide areal
exposure has produced a topography characterized by deep,
narrow valleys and sharp ridges. The uplands are covered
for the most part by dolomites of the Jefferson City and Roubidoux Formations; valleys are floored chiefly by the Gasconade Formation (Vineyard and Feders, 1974). The development of extensive caverns and solution channels related to the solubility of the rock and fracture zones within these formations afford conduits for groundwater movement and storage. Some concept of the groundwater storage capacity of the Roubidoux and Gasconade Formations and other aquifers of the Salem Plateau can be gained by considering the number of caves in the region. Of a total of 3,000 known caves in Missouri, over 2,500 are in the Ozarks (Vineyard and Feders, 1974). Many of these caves sustain large springs which represent one of the principal forms of discharge from the aquifers. Most of the springs in the Salem Plateau are located at many points along deeply incised valleys, and offer outlets for subterranean waters flowing down the hydrodynamic gradient. Figure 18 shows that the majority of large springs of Missouri are associated with the topographic development related to the geology within the Salem Plateau. Many of these springs represent discharge points for waters from the Roubidoux and Gasconade Formations (Plate 1). Some appreciation for the amount of discharge from springs issuing from the Roubidoux or Gasconade Formation in the Salem Plateau may be gained from the examination of data presented in Table 2.

Discharge of water from the Roubidoux and Gasconade Formations in the Salem Plateau also takes the form of
RELIEF MAP
STATE of MISSOURI

MISSOURI GEOLOGICAL SURVEY AND WATER RESOURCES
WALLACE R. HOWE, STATE GEOLOGIST AND DIRECTOR

1969

SCALE IN MILES
0 10 20 30 40

Figure 18.
<table>
<thead>
<tr>
<th>Name of Spring</th>
<th>Aquifer</th>
<th>Location</th>
<th>Rate of flow in gallons per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>McDade</td>
<td>Roubidoux</td>
<td>T39N RSW Sec 16</td>
<td>517,000</td>
</tr>
<tr>
<td>Boiling</td>
<td>Gasconade</td>
<td>T37N R10W Sec 33</td>
<td>42,000,000</td>
</tr>
<tr>
<td>Maramec</td>
<td>Gasconade</td>
<td>T37N R6W Sec 1</td>
<td>93,024,000</td>
</tr>
<tr>
<td>Sweet Blue</td>
<td>Gasconade</td>
<td>T36N R17W Sec 30</td>
<td>8,010,000</td>
</tr>
<tr>
<td>Bartlett Mill</td>
<td>Gasconade</td>
<td>T36N R12W Sec 16</td>
<td>10,100,000</td>
</tr>
<tr>
<td>Bennett</td>
<td>Gasconade</td>
<td>T34N R18W Sec 1</td>
<td>100,000,000</td>
</tr>
<tr>
<td>Blue</td>
<td>Gasconade</td>
<td>T28N R6W Sec 31</td>
<td>69,100,000</td>
</tr>
<tr>
<td>Crystal</td>
<td>Roubidoux</td>
<td>T26N R15W Sec 22</td>
<td>7,490,000</td>
</tr>
<tr>
<td>Keener</td>
<td>Roubidoux</td>
<td>T26N R5E Sec 4</td>
<td>14,200,000</td>
</tr>
<tr>
<td>Big</td>
<td>Roubidoux</td>
<td>T25N R11W Sec 26</td>
<td>8,530,000</td>
</tr>
<tr>
<td>Greer</td>
<td>Gasconade</td>
<td>T25N R4W Sec 36</td>
<td>187,000,000</td>
</tr>
<tr>
<td>Hodgson Mill</td>
<td>Roubidoux</td>
<td>T24N R12W Sec 34</td>
<td>23,500,000</td>
</tr>
<tr>
<td>Double</td>
<td>Gasconade</td>
<td>T24N R11W Sec 32</td>
<td>100,000,000</td>
</tr>
<tr>
<td>Zanoni</td>
<td>Roubidoux</td>
<td>T23N R12W Sec 7</td>
<td>497,000</td>
</tr>
</tbody>
</table>

Table 2
Discharges of Selected Springs Emanating from the Roubidoux or Gasconade Formation
(After Vineyard and Feder, 1974)
effluent seepage to streams. Low-flow frequency analysis of streams can be used as an index of the amount of water contributed by groundwater runoff (Lamonds, 1972). Low-flow or base flow is defined as the discharge entering stream channels from groundwater or other delayed sources (AGI Glossary, 1957). Data on the low-flow characteristics of streams in Arkansas and Missouri have been published by Hines (1965) and Skelton (1966). These data indicate that streams of the Salem Plateau generally have high, well sustained low-flows. Skelton (1966) attributes this to the ability of the Roubidoux and Gasconade Formations to transmit and store large quantities of water. Examples of low-flow discharges of streams in the Salem Plateau are given in Table 3.

Natural discharge of the Roubidoux and Gasconade Formations within the Springfield Plateau appears to take a somewhat different form than that of the Salem Plateau, because the physiography of this area has a more gently rolling landscape, and stream valleys that are not as deeply incised. Surface rocks of the area are primarily Mississippian and Pennsylvanian limestone with some sandstone and shale (Plate 1). The Roubidoux and Gasconade Formations dip gently beneath this cover, and are confined to the sub-surface throughout the area. The altitude of the potentiometric surface of the artesian aquifers is generally less than the altitude of spring outlets and stream beds. Discharge from the deep aquifers therefore does not normally
<table>
<thead>
<tr>
<th>Station Number</th>
<th>Name</th>
<th>Drainage Area in Square Miles</th>
<th>Annual low-flow in cubic feet per second for indicated period of consecutive days and indicated recurrence interval, in years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>7-Day</td>
</tr>
<tr>
<td>6-9277.0*</td>
<td>Gasconade River near Nebo</td>
<td>-</td>
<td>14</td>
</tr>
<tr>
<td>6-9285.0*</td>
<td>Gasconade River near Waynesville</td>
<td>1,680</td>
<td>60</td>
</tr>
<tr>
<td>6-9284.5*</td>
<td>Roubidoux Creek at Waynesville</td>
<td>-</td>
<td>2.0</td>
</tr>
<tr>
<td>6-9289.0*</td>
<td>Big Piney River near Houston</td>
<td>-</td>
<td>16</td>
</tr>
<tr>
<td>6-9278.0*</td>
<td>Osage Fork at Drynob</td>
<td>404</td>
<td>14</td>
</tr>
<tr>
<td>6-9301.0*</td>
<td>Spring Creek at Spring Creek</td>
<td>-</td>
<td>18</td>
</tr>
<tr>
<td>7-0574.0*</td>
<td>North Fork River at Twin Bridges</td>
<td>-</td>
<td>26</td>
</tr>
<tr>
<td>7-0575.0*</td>
<td>North Fork River near Tecumseh</td>
<td>561</td>
<td>200</td>
</tr>
<tr>
<td>7-0580.0*</td>
<td>Bryant Creek near Tecumseh</td>
<td>570</td>
<td>110</td>
</tr>
<tr>
<td>7-0715.0*</td>
<td>Eleven Point River near Sardley</td>
<td>793</td>
<td>180</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10-year</td>
</tr>
<tr>
<td>7-1858.5*</td>
<td>North Fork Spring River at Lamar</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>7-1861.0*</td>
<td>Center Creek near Sarcoxie</td>
<td>-</td>
<td>6.8</td>
</tr>
<tr>
<td>7-1862.0*</td>
<td>Center Creek near Fidelity</td>
<td>-</td>
<td>8</td>
</tr>
<tr>
<td>7-1868.9*</td>
<td>Shoal Creek near Neosho</td>
<td>-</td>
<td>23</td>
</tr>
<tr>
<td>6-9184.2*</td>
<td>Sac River near Ash Grove</td>
<td>-</td>
<td>1-3</td>
</tr>
<tr>
<td>7-480**</td>
<td>West Fork White River near Greenland</td>
<td>83</td>
<td>7.9</td>
</tr>
<tr>
<td>7-495**</td>
<td>White River near Rogers</td>
<td>1,020</td>
<td>5.6</td>
</tr>
<tr>
<td>7-490**</td>
<td>War Eagle Creek near Hindsville</td>
<td>262</td>
<td>1.5</td>
</tr>
<tr>
<td>7-1950**</td>
<td>Osage Creek near Elm Springs</td>
<td>129</td>
<td>11</td>
</tr>
<tr>
<td>7-560**</td>
<td>Buffalo River near St. Joe</td>
<td>825</td>
<td>14</td>
</tr>
</tbody>
</table>
take the form of flow to springs or effluent seepage to streams. Springs and stream valleys of the Springfield Plateau are small by comparison to those of the Salem Plateau (Table 4), and typically drain karst topography developed in the limestone bedrock (Harvey and Vineyard, 1967). Patterns of sedimentation associated with the development of the bedrock in the Springfield Plateau produced thin rock units of varying rock type which have prevented the development of large integrated solution channels characteristic of the Salem Plateau (Harvey and Vineyard, 1967). This has generally resulted in the development of shallow aquifers which do not have the yield capabilities of the Roubidoux and Gasconade Formations. Spring discharge and stream low-flow measurements within the Springfield Plateau (Table 3) are lower than those of the Salem Plateau, and may be interpreted as indicative of the lack of available discharge from the deep aquifers.

The principal discharge of the Roubidoux and Gasconade Formations within the Springfield Plateau takes the form of recharge to the shallow aquifers, underflow to adjacent areas, and artificial discharge by deep wells. While the potentiometric surface of these artesian aquifers is generally lower than spring outlets and stream beds, water does often rise within a few hundred feet of the surface (Plate 8), and in many places is within Mississippian limestone strata. These shallower limestone formations therefore receive an undetermined amount of recharge from the
### Table 4

Discharges of Selected Springs of the Springfield Plateau

(After Vineyard and Feder, 1974 and Lamonds, 1972)

<table>
<thead>
<tr>
<th>Name of Spring</th>
<th>Aquifer</th>
<th>Location</th>
<th>Rate of flow in gallons per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scotland</td>
<td>Mississippian L.S.</td>
<td>T27N R32W Sec 1</td>
<td>1,990,000</td>
</tr>
<tr>
<td>Bay Scout</td>
<td>Mississippian L.S.</td>
<td>T26N R32W Sec 9</td>
<td>1,040,000</td>
</tr>
<tr>
<td>Spring River</td>
<td>Mississippian L.S.</td>
<td>T26N R26W Sec 28</td>
<td>3,290,000</td>
</tr>
<tr>
<td>Cave</td>
<td>Mississippian L.S.</td>
<td>T25N R29W Sec 12</td>
<td>2,200,000</td>
</tr>
<tr>
<td>Ford Spring</td>
<td>Boone Formation</td>
<td>T20N R30W Sec 7</td>
<td>6,314,351</td>
</tr>
<tr>
<td>Big Spring</td>
<td>Boone Formation</td>
<td>T18N R32W Sec 5</td>
<td>3,225,037</td>
</tr>
<tr>
<td>Keith Lake</td>
<td>Boone Formation</td>
<td>T18N R31W Sec 1</td>
<td>2,649,830</td>
</tr>
<tr>
<td>Johnson</td>
<td>Boone Formation</td>
<td>T17N R30W Sec 15</td>
<td>1,008,222</td>
</tr>
</tbody>
</table>
deeper aquifers. Some indication of this recharge was revealed by a study of the groundwater resources of St. Louis by Miller and others (1974). Working in the Valley Park area, they found that mineralized water from deep aquifers had moved up into shallower horizons in wells that were improperly cased or where casings deteriorated.

Some discharge from deep aquifers takes the form of "underflow" beneath shallow aquifers to areas adjacent to the Springfield Plateau. Evaluation of the water resources of the Joplin area of Missouri by Peder and others (1969) indicates that the potentiometric levels in wells penetrating the Roubidoux and Gasconade Formations are below the water levels of the shallow aquifers. The water from the deep aquifers is therefore confined and does not discharge into the overlying formations. Maps of the potentiometric surface indicate that groundwater movement in the deep aquifers is from east to west, and discharge is west of the state line. Examination of Plate 9 of this report suggests that underflow may also take place to the south and west of the Springfield Plateau in Arkansas.

An undetermined amount of discharge takes place through deep wells penetrating the aquifers within the Springfield Plateau. Detailed studies of the amount and rate of this discharge are generally not available. Although measurements of water levels in deep wells have been made by the United States Geologic Survey in the Arkansas part of the Springfield Plateau, the frequency
is not sufficient to determine if pumping has resulted in reduction of water availability (A summary of existing data is included in Table 5). A cursory examination of wells monitored by the Missouri Geologic Survey suggests that water levels in the Missouri portion of the plateau have not been substantially effected by pumping (Dale Fuller, Personal Communication, 1974). However, studies in at least two areas outside the region of this report suggest that substantial discharge has resulted from pumping of the aquifers. For example, Stramel (1957) in a study of the aquifers at Pittsburg, Kansas showed that pumpings of the aquifers for the period 1880 through 1954 resulted in a fairly steady rate of decline of water levels over that period. Reed, Schoff, and Branson (1955) showed that in Ottawa County, Oklahoma the water levels of the deep aquifers were at least 30 feet above the land surface in the early 1920's, but the increase of mining and milling operations since then has resulted in increased water use which lowered the water levels to well below the land surface.
## Table 5

Water Level Measurements in Deep Wells of Northern Arkansas

(Data provided by U.S.G.S., Little Rock, Ark.)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>19H13W16bab1</td>
<td>Baxter</td>
<td>1540</td>
<td>775</td>
<td>173.60</td>
<td>192.49</td>
<td>175.50</td>
<td>-</td>
<td>199.03</td>
<td>205.49</td>
<td>174.07</td>
<td>164.77</td>
<td>135.03</td>
<td>134.0</td>
</tr>
<tr>
<td>19H14W23dab1</td>
<td>Baxter</td>
<td>1503</td>
<td>690</td>
<td>-</td>
<td>-</td>
<td>216.10</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10-18</td>
<td>11-28</td>
<td>11-21</td>
</tr>
<tr>
<td>19H14W29dcb1</td>
<td>Baxter</td>
<td>1625</td>
<td>720</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10-13</td>
<td>11-9</td>
<td>10-18</td>
<td>11-28</td>
<td>11-20</td>
<td></td>
</tr>
<tr>
<td>20H13W30dbd1</td>
<td>Baxter</td>
<td>830</td>
<td>855</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>194.02</td>
<td>211.40</td>
<td>-</td>
<td>-</td>
<td>208.01</td>
<td>210.33 R</td>
</tr>
<tr>
<td>8H33W1dcd1</td>
<td>Benton</td>
<td>1150</td>
<td>1210</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>11-5</td>
<td>10-14</td>
<td>11-11</td>
<td>11-11</td>
<td>11-29</td>
<td>11-27</td>
</tr>
<tr>
<td>9H29W7dab1</td>
<td>Benton</td>
<td>1659</td>
<td>1220</td>
<td>-</td>
<td>-</td>
<td>139.26</td>
<td>279.68</td>
<td>131.77</td>
<td>120.55</td>
<td>119.05</td>
<td>116.35</td>
<td>117.83</td>
<td>113.38 G</td>
</tr>
<tr>
<td>9H29W18dbb1</td>
<td>Benton</td>
<td>1144</td>
<td>1345</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>12-17</td>
<td>11-11</td>
<td>10-19</td>
<td>11-11</td>
<td>11-29</td>
<td>11-26</td>
<td></td>
</tr>
<tr>
<td>9H33J11dad1</td>
<td>Benton</td>
<td>1700</td>
<td>1200</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>212.56</td>
<td>181.29</td>
<td>185.49</td>
<td>187.15</td>
<td>184.42 R</td>
</tr>
<tr>
<td>9H33J21dad1</td>
<td>Benton</td>
<td>1150</td>
<td>1380</td>
<td>-</td>
<td>11-3</td>
<td>6-8</td>
<td>11-6</td>
<td>9-24</td>
<td>10-19</td>
<td>11-29</td>
<td>11-26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0H12W29dab1</td>
<td>Benton</td>
<td>1614</td>
<td>1230</td>
<td>-</td>
<td>-</td>
<td>230.89</td>
<td>269.29</td>
<td>-</td>
<td>253.27</td>
<td>384.55</td>
<td>300.20</td>
<td>311.69</td>
<td>335.90</td>
</tr>
<tr>
<td>0H13W14dcb1</td>
<td>Benton</td>
<td>1406</td>
<td>294.0</td>
<td>-</td>
<td>-</td>
<td>6-6</td>
<td>5-21</td>
<td>11-4</td>
<td>10-13</td>
<td>11-9</td>
<td>10-18</td>
<td>11-29</td>
<td>11-27</td>
</tr>
<tr>
<td>11H29W35dab1</td>
<td>Benton</td>
<td>1760</td>
<td>295.97</td>
<td>-</td>
<td>308.02</td>
<td>308.02</td>
<td>303.05</td>
<td>304.29</td>
<td>300.88</td>
<td>301.11</td>
<td>298.22</td>
<td>296.21 G</td>
<td></td>
</tr>
<tr>
<td>12H19W1bd1</td>
<td>Boone</td>
<td>1484</td>
<td>1150</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>139.82</td>
<td>140.52</td>
<td>149.42</td>
<td>152.31</td>
<td>175.21</td>
<td>178.63</td>
</tr>
<tr>
<td>1H15W20cda1</td>
<td>Boone</td>
<td>604</td>
<td>830</td>
<td>-</td>
<td>-</td>
<td>157.05</td>
<td>158.0</td>
<td>155.48</td>
<td>160.73</td>
<td>168.69</td>
<td>170.43</td>
<td>166.6</td>
<td>169.56 R</td>
</tr>
<tr>
<td>9H23W4baj1</td>
<td>Carroll</td>
<td>1581</td>
<td>1350</td>
<td>-</td>
<td>-</td>
<td>195.87</td>
<td>196.92</td>
<td>178.9</td>
<td>272.89</td>
<td>-</td>
<td>246.98</td>
<td>248.35</td>
<td>235.15</td>
</tr>
</tbody>
</table>

Aquifer:
- G
- R
- Q
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1962W82d1</td>
<td>Carroll</td>
<td>2300</td>
<td>-</td>
<td>2-15</td>
<td>5-22</td>
<td>-</td>
<td>275.74</td>
<td>279.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>225.26G</td>
</tr>
<tr>
<td>2012W10dc1</td>
<td>Carroll</td>
<td>1332</td>
<td>1250</td>
<td>-</td>
<td>11-2</td>
<td>2-15</td>
<td>197.80</td>
<td>200.77</td>
<td>-</td>
<td>-</td>
<td>11-10</td>
<td>11-14</td>
<td>11-29</td>
</tr>
<tr>
<td>2112W15d2d</td>
<td>Carroll</td>
<td>1122</td>
<td>1102</td>
<td>-</td>
<td>11-19</td>
<td>11-10</td>
<td>11-19</td>
<td>11-19</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>132.17G</td>
</tr>
<tr>
<td>2112W17d1</td>
<td>Carroll</td>
<td>1060</td>
<td>1010</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>101.77</td>
<td>117.19</td>
<td>121.19</td>
<td>88.79R</td>
<td></td>
</tr>
<tr>
<td>1916W23d1</td>
<td>Fulton</td>
<td>1550</td>
<td>682</td>
<td>10-15</td>
<td>2-8</td>
<td>6-5</td>
<td>5-21</td>
<td>11-3</td>
<td>11-12</td>
<td>11-8</td>
<td>10-17</td>
<td>11-27</td>
<td>11-21</td>
</tr>
<tr>
<td>2018W12g1</td>
<td>Fulton</td>
<td>1282</td>
<td>660</td>
<td>29-59</td>
<td>18.08</td>
<td>20.58</td>
<td>35.08</td>
<td>42.57</td>
<td>46.23</td>
<td>47.49</td>
<td>48.49</td>
<td>50.73G</td>
<td></td>
</tr>
<tr>
<td>2019W18d1</td>
<td>Fulton</td>
<td>1250</td>
<td>880</td>
<td>-</td>
<td>6-6</td>
<td>3-21</td>
<td>11-3</td>
<td>11-11</td>
<td>11-9</td>
<td>10-14</td>
<td>11-28</td>
<td>11-21</td>
<td></td>
</tr>
<tr>
<td>1911W20bo</td>
<td>Marion</td>
<td>900</td>
<td>680</td>
<td>20-24</td>
<td>124.38</td>
<td>137.5</td>
<td>131.18</td>
<td>136.9</td>
<td>135.31</td>
<td>134.54</td>
<td>133.46</td>
<td>131.59R</td>
<td></td>
</tr>
<tr>
<td>1911W33db</td>
<td>Marion</td>
<td>753</td>
<td>750</td>
<td>325.40</td>
<td>321.22</td>
<td>275.95</td>
<td>346.54</td>
<td>356.10</td>
<td>362.04</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>351.35G</td>
</tr>
<tr>
<td>1911W32da</td>
<td>Marion</td>
<td>1524</td>
<td>950</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>11-9</td>
<td>11-9</td>
<td>11-10</td>
<td>11-10</td>
<td>11-20</td>
</tr>
<tr>
<td>1712W12d1</td>
<td>Newton</td>
<td>2576</td>
<td>1344</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>423.56</td>
<td>479.05</td>
<td>472.30</td>
<td>418.37G</td>
<td></td>
</tr>
<tr>
<td>1816W10d1</td>
<td>Sharp</td>
<td>1529</td>
<td>555</td>
<td>5-10</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>11-3</td>
<td>11-12</td>
<td>11-8</td>
<td>10-16</td>
<td>11-22</td>
</tr>
<tr>
<td>1914W15da</td>
<td>Sharp</td>
<td>511</td>
<td>590</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>39.23</td>
<td>34.93</td>
<td>24.71</td>
<td>24.36G</td>
<td></td>
</tr>
<tr>
<td>1513W17d1</td>
<td>Washington</td>
<td>2097</td>
<td>1140</td>
<td>6-9</td>
<td>-</td>
<td>-</td>
<td>126.60</td>
<td>92.29</td>
<td>100.21</td>
<td>108.66</td>
<td>188.99</td>
<td>153.44G</td>
<td></td>
</tr>
<tr>
<td>1513W3d1</td>
<td>Washington</td>
<td>2485</td>
<td>1175</td>
<td>8-26</td>
<td>-</td>
<td>-</td>
<td>11-12</td>
<td>11-10</td>
<td>11-10</td>
<td>11-10</td>
<td>11-10</td>
<td>11-10</td>
<td>11-10</td>
</tr>
<tr>
<td>1613W30d1</td>
<td>Washington</td>
<td>1815</td>
<td>1135</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3-24</td>
<td>11-11</td>
<td>20-20</td>
<td>11-20</td>
<td>11-20</td>
<td>11-20</td>
<td>11-20</td>
</tr>
</tbody>
</table>
Water Quality

Quality of water determination for individual deep aquifers in the Ozarks is not available for most areas. The general practice when drilling deep wells in the area is to case off the shallow formations and to leave the remainder of the well uncased. This allows mixing of water from all formations penetrated below the casing. Unless testing of specific horizons is conducted at the time the well is drilled, it is not possible to sample water from an individual aquifer after well completion to determine its representative water quality characteristics. The water quality analyses for wells presented in this report therefore represent mixtures of water rather than sampling of the individual aquifer and are discussed as such.

Water quality analyses for wells penetrating the Roubidoux or Gasconade Formations in the Ozarks area are available from the Missouri Division of Natural Resources, and the Arkansas State Health Department. Tables 6 and 7 represent data for selected wells located in southern Missouri and northern Arkansas. A regional plot of the location of these wells is included as Plate 9.

Water from wells penetrating either of the two aquifers is quite similar as shown by the analysis in Tables 6 and 7. The water is of the calcium-magnesium bicarbonate type, reflecting the predominantly dolomitic character of the rocks. Thus, calcium, magnesium, and bicarbonate are the
### Table 6

**Chemical Analyses (ppm) from wells penetrating the Roubidoux Formation, Arkansas and Missouri**

Missouri analyses supplied by the Missouri Department of Natural Resources
Arkansas analyses supplied by the Arkansas State Health Department

<table>
<thead>
<tr>
<th>Map No.</th>
<th>Location</th>
<th>County</th>
<th>City</th>
<th>Date Collected</th>
<th>Depth</th>
<th>Csg</th>
<th>Ph</th>
<th>Methal Orange Alk.</th>
<th>Total Solids</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>24N29W27</td>
<td>Barry</td>
<td>Wheaton</td>
<td>12-27-71</td>
<td>1010</td>
<td>408</td>
<td>7.7</td>
<td>200</td>
<td>273</td>
</tr>
<tr>
<td>4</td>
<td>24N28W2</td>
<td>Barry</td>
<td>Purdy</td>
<td>11-25-69</td>
<td>931</td>
<td>392</td>
<td>8.0</td>
<td>174</td>
<td>257</td>
</tr>
<tr>
<td>7</td>
<td>24N23W36</td>
<td>Stone</td>
<td>Reeds Spring</td>
<td>12-3-70</td>
<td>1100</td>
<td>-</td>
<td>7.8</td>
<td>191</td>
<td>249</td>
</tr>
<tr>
<td>10</td>
<td>24N12W34</td>
<td>Ozark</td>
<td>Hodgesan Spring</td>
<td>4-30-71</td>
<td>Spring</td>
<td>-</td>
<td>7.8</td>
<td>192.5</td>
<td>202</td>
</tr>
<tr>
<td>11</td>
<td>24N11W28</td>
<td>Ozark</td>
<td>Double Spring</td>
<td>4-30-71</td>
<td>Spring</td>
<td>-</td>
<td>7.8</td>
<td>203.5</td>
<td>222</td>
</tr>
<tr>
<td>12</td>
<td>24N10W6</td>
<td>Howell</td>
<td>Siloam Springs</td>
<td>9-25-52</td>
<td>Spring</td>
<td>-</td>
<td>7.4</td>
<td>316</td>
<td>403</td>
</tr>
<tr>
<td>13</td>
<td>23N32W8</td>
<td>McDonald</td>
<td>Goodman</td>
<td>8-26-68</td>
<td>1290</td>
<td>430</td>
<td>7.5</td>
<td>113</td>
<td>144</td>
</tr>
<tr>
<td>14</td>
<td>23N28W34</td>
<td>Barry</td>
<td>Exeter</td>
<td>4-1-71</td>
<td>990</td>
<td>334</td>
<td>8.0</td>
<td>186</td>
<td>234</td>
</tr>
<tr>
<td>17</td>
<td>23N23W33</td>
<td>Stone</td>
<td>Stone Co., N.W.</td>
<td>11-18-69</td>
<td>1325</td>
<td>-</td>
<td>7.9</td>
<td>250</td>
<td>422</td>
</tr>
<tr>
<td>18</td>
<td>23N21W29</td>
<td>Taney</td>
<td>Branson North</td>
<td>2-17-71</td>
<td>580</td>
<td>-</td>
<td>7.5</td>
<td>347</td>
<td>433</td>
</tr>
<tr>
<td>21</td>
<td>22N3W34</td>
<td>McDonald</td>
<td>Pineville #1</td>
<td>9-10-71</td>
<td>955</td>
<td>-</td>
<td>7.8</td>
<td>124.0</td>
<td>212</td>
</tr>
<tr>
<td>23</td>
<td>22N25W14</td>
<td>Barry</td>
<td>Knob Hill Acres</td>
<td>4-15-71</td>
<td>770</td>
<td>-</td>
<td>7.7</td>
<td>266</td>
<td>316</td>
</tr>
<tr>
<td>24</td>
<td>22N25W16</td>
<td>Barry</td>
<td>Holiday Acres</td>
<td>3-9-61</td>
<td>400</td>
<td>-</td>
<td>7.4</td>
<td>260.4</td>
<td>296</td>
</tr>
<tr>
<td>Map No.</td>
<td>Location</td>
<td>County</td>
<td>City</td>
<td>Date Collected</td>
<td>Depth</td>
<td>Csg</td>
<td>Ph</td>
<td>Methal Or-</td>
<td>Total Solids</td>
</tr>
<tr>
<td>---------</td>
<td>------------</td>
<td>--------</td>
<td>------------</td>
<td>----------------</td>
<td>-------</td>
<td>-----</td>
<td>----</td>
<td>-ange Alk.</td>
<td>--------------</td>
</tr>
<tr>
<td>25</td>
<td>22N25W35</td>
<td>Barry</td>
<td>Green Shores</td>
<td>5-6-71</td>
<td>525</td>
<td>-</td>
<td>7.7</td>
<td></td>
<td>246</td>
</tr>
<tr>
<td>27</td>
<td>22N11W12</td>
<td>Ozark</td>
<td>Alice Mine</td>
<td>2-24-46</td>
<td>755</td>
<td>-</td>
<td>-</td>
<td></td>
<td>483</td>
</tr>
<tr>
<td>28</td>
<td>21N34W33</td>
<td>McDonald</td>
<td>Southwest #2</td>
<td>3-30-66</td>
<td>989</td>
<td>269</td>
<td>7.3</td>
<td></td>
<td>174.0</td>
</tr>
<tr>
<td>30</td>
<td>21N29W31</td>
<td>Benton</td>
<td>Pea Ridge</td>
<td>5-7-65</td>
<td>1274</td>
<td>410</td>
<td>7.7</td>
<td></td>
<td>176</td>
</tr>
<tr>
<td>31</td>
<td>21N26W15</td>
<td>Carroll</td>
<td>Holiday Island #2</td>
<td>1-28-72</td>
<td>1128</td>
<td>500</td>
<td>7.7</td>
<td></td>
<td>230.5</td>
</tr>
<tr>
<td>32</td>
<td>21N26W17</td>
<td>Carroll</td>
<td>Holiday Island #1</td>
<td>1-28-72</td>
<td>1063</td>
<td>-</td>
<td>7.7</td>
<td></td>
<td>265</td>
</tr>
<tr>
<td>34</td>
<td>21N21W27</td>
<td>Boone</td>
<td>Omaha</td>
<td>10-7-69</td>
<td>1315</td>
<td>-</td>
<td>7.8</td>
<td></td>
<td>157</td>
</tr>
<tr>
<td>35</td>
<td>21N18W20</td>
<td>Boone</td>
<td>Diamond City</td>
<td>9-29-72</td>
<td>602</td>
<td>-</td>
<td>7.3</td>
<td></td>
<td>222</td>
</tr>
<tr>
<td>36</td>
<td>21N18W29</td>
<td>Boone</td>
<td>Lead Hill</td>
<td>9-29-72</td>
<td>703</td>
<td>-</td>
<td>7.3</td>
<td></td>
<td>245</td>
</tr>
<tr>
<td>37</td>
<td>21N18W32</td>
<td>Boone</td>
<td>Lead Hill</td>
<td>1-23-70</td>
<td>604</td>
<td>-</td>
<td>7.8</td>
<td></td>
<td>244</td>
</tr>
<tr>
<td>38</td>
<td>21N5W7</td>
<td>Fulton</td>
<td>Mammoth Springs</td>
<td>4-6-70</td>
<td>350</td>
<td>-</td>
<td>7.9</td>
<td></td>
<td>334</td>
</tr>
<tr>
<td>39</td>
<td>20N33W11</td>
<td>Benton</td>
<td>Gravette</td>
<td>7-29-71</td>
<td>1414</td>
<td>-</td>
<td>7.8</td>
<td></td>
<td>111</td>
</tr>
<tr>
<td>43</td>
<td>20N28W5</td>
<td>Benton</td>
<td>Garfield</td>
<td>4-7-70</td>
<td>1200</td>
<td>-</td>
<td>7.5</td>
<td></td>
<td>207</td>
</tr>
<tr>
<td>44</td>
<td>20N14W30</td>
<td>Baxter</td>
<td>Edgewood Bay</td>
<td>5-2-68</td>
<td>830</td>
<td>-</td>
<td>7.1</td>
<td></td>
<td>301</td>
</tr>
<tr>
<td>45</td>
<td>20N9W18</td>
<td>Fulton</td>
<td>Viola</td>
<td>5-26-70</td>
<td>1250</td>
<td>900</td>
<td>7.8</td>
<td></td>
<td>232</td>
</tr>
<tr>
<td>Map No.</td>
<td>Location</td>
<td>County</td>
<td>City</td>
<td>Date Collected</td>
<td>Depth</td>
<td>Csg</td>
<td>Ph</td>
<td>Methal Orange Alk.</td>
<td>Total Solids</td>
</tr>
<tr>
<td>-------</td>
<td>---------</td>
<td>----------</td>
<td>------------</td>
<td>----------------</td>
<td>-------</td>
<td>-----</td>
<td>-----</td>
<td>-------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>48</td>
<td>19N33W13</td>
<td>Benton</td>
<td>Decatur</td>
<td>10-6-72</td>
<td>1500</td>
<td>-</td>
<td>7.5</td>
<td>108</td>
<td>87</td>
</tr>
<tr>
<td>50</td>
<td>19N23W4</td>
<td>Carroll</td>
<td>Green Forest</td>
<td>2-7-65</td>
<td>2100</td>
<td>-</td>
<td>8.0</td>
<td>228</td>
<td>301</td>
</tr>
<tr>
<td>53</td>
<td>19N15W17</td>
<td>Marion</td>
<td>Flippin</td>
<td>2-6-74</td>
<td>800</td>
<td>-</td>
<td>7.7</td>
<td>282</td>
<td>330</td>
</tr>
<tr>
<td>54</td>
<td>19N15W20</td>
<td>Marion</td>
<td>Flippin</td>
<td>2-7-70</td>
<td>900</td>
<td>-</td>
<td>7.6</td>
<td>277</td>
<td>293</td>
</tr>
<tr>
<td>59</td>
<td>19N4W23</td>
<td>Sharp</td>
<td>Ozark Acres</td>
<td>3-24-69</td>
<td>611</td>
<td>-</td>
<td>7.5</td>
<td>322</td>
<td>326</td>
</tr>
<tr>
<td>60</td>
<td>18N19W19</td>
<td>Boone</td>
<td>Bellefonte</td>
<td>6-1-67</td>
<td>1649</td>
<td>-</td>
<td>7.4</td>
<td>175</td>
<td>219</td>
</tr>
<tr>
<td>62</td>
<td>18N7W31</td>
<td>Izard</td>
<td>Franklin 7</td>
<td>9-4-70</td>
<td>1100</td>
<td>-</td>
<td>7.9</td>
<td>278</td>
<td>314</td>
</tr>
<tr>
<td>64</td>
<td>17N32W11</td>
<td>Benton</td>
<td>Robinson</td>
<td>6-27-69</td>
<td>1505</td>
<td>-</td>
<td>8.2</td>
<td>-</td>
<td>257</td>
</tr>
<tr>
<td>65</td>
<td>17N31W1</td>
<td>Washington</td>
<td>Tontitown</td>
<td>5-24-68</td>
<td>1416</td>
<td>350</td>
<td>7.7</td>
<td>-</td>
<td>336</td>
</tr>
<tr>
<td>66</td>
<td>17N26W29</td>
<td>Madison</td>
<td>--</td>
<td>6-21-68</td>
<td>1525</td>
<td>-</td>
<td>8.0</td>
<td>-</td>
<td>300</td>
</tr>
<tr>
<td>69</td>
<td>16N31W7</td>
<td>Washington</td>
<td>Wedington Woods</td>
<td>3-26-73</td>
<td>1500</td>
<td>-</td>
<td>7.6</td>
<td>251</td>
<td>535</td>
</tr>
<tr>
<td>70</td>
<td>16N13W30</td>
<td>Baxter</td>
<td>Big Flat</td>
<td>8-22-72</td>
<td>2603</td>
<td>208</td>
<td>7.7</td>
<td>270</td>
<td>180</td>
</tr>
<tr>
<td>Map No.</td>
<td>Hardness as Chlorine</td>
<td>NaCl CaCO₃</td>
<td>Ca, Hg</td>
<td>Non Carbonate</td>
<td>NaCl</td>
<td>Sulphate</td>
<td>Ca</td>
<td>Hg</td>
<td>Fe</td>
</tr>
<tr>
<td>---------</td>
<td>----------------------</td>
<td>-----------</td>
<td>-------</td>
<td>---------------</td>
<td>------</td>
<td>----------</td>
<td>----</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>3</td>
<td>200</td>
<td>14</td>
<td>3.2</td>
<td>-</td>
<td>19.8</td>
<td>53.6</td>
<td>19.4</td>
<td>0.06</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>174</td>
<td>20</td>
<td>4.1</td>
<td>-</td>
<td>11.9</td>
<td>41.6</td>
<td>21.9</td>
<td>0.05</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>191</td>
<td>9.0</td>
<td>1.9</td>
<td>-</td>
<td>13.6</td>
<td>45.2</td>
<td>21.1</td>
<td>0.03</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>192.5</td>
<td>1.8</td>
<td>5.2</td>
<td>-</td>
<td>2.4</td>
<td>44.0</td>
<td>20.5</td>
<td>0.15</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>200.4</td>
<td>0</td>
<td>4.7</td>
<td>-</td>
<td>3.6</td>
<td>46.8</td>
<td>20.3</td>
<td>0.33</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>316</td>
<td>48</td>
<td>13.25</td>
<td>-</td>
<td>4.4</td>
<td>73.9</td>
<td>43.7</td>
<td>0.07</td>
<td>0</td>
</tr>
<tr>
<td>13</td>
<td>113</td>
<td>0</td>
<td>4.5</td>
<td>-</td>
<td>13.0</td>
<td>25.2</td>
<td>12.2</td>
<td>0.2</td>
<td>0</td>
</tr>
<tr>
<td>14</td>
<td>186</td>
<td>2</td>
<td>3.2</td>
<td>-</td>
<td>11.7</td>
<td>42.8</td>
<td>19.7</td>
<td>0.07</td>
<td>0</td>
</tr>
<tr>
<td>17</td>
<td>250</td>
<td>10</td>
<td>2.4</td>
<td>-</td>
<td>13.4</td>
<td>52.8</td>
<td>0</td>
<td>0.02</td>
<td>0</td>
</tr>
<tr>
<td>18</td>
<td>345</td>
<td>0</td>
<td>3.2</td>
<td>-</td>
<td>12.3</td>
<td>69.6</td>
<td>41.6</td>
<td>0.08</td>
<td>0</td>
</tr>
<tr>
<td>21</td>
<td>120</td>
<td>0</td>
<td>15.7</td>
<td>-</td>
<td>14.2</td>
<td>28.0</td>
<td>12.2</td>
<td>0.06</td>
<td>0</td>
</tr>
<tr>
<td>23</td>
<td>263</td>
<td>0</td>
<td>2.6</td>
<td>-</td>
<td>13.9</td>
<td>53.0</td>
<td>28.7</td>
<td>0.04</td>
<td>0</td>
</tr>
<tr>
<td>24</td>
<td>260</td>
<td>12</td>
<td>4.1</td>
<td>-</td>
<td>13.2</td>
<td>57.6</td>
<td>31.1</td>
<td>0.5</td>
<td>-</td>
</tr>
<tr>
<td>25</td>
<td>246</td>
<td>22</td>
<td>2.6</td>
<td>-</td>
<td>25.9</td>
<td>57.6</td>
<td>30.1</td>
<td>0.03</td>
<td>0</td>
</tr>
<tr>
<td>27</td>
<td>408.6</td>
<td>0</td>
<td>62.0</td>
<td>-</td>
<td>38.3</td>
<td>30.3</td>
<td>79.5</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Map No.</td>
<td>Hardness as Chloride</td>
<td>CaCO$_3$</td>
<td>Ca$_2$Mg$_3$ Non Carbonate</td>
<td>NaCl</td>
<td>Sulphate</td>
<td>Ca</td>
<td>Mg</td>
<td>Fe</td>
<td>Mn</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------</td>
<td>---------</td>
<td>---------------------------</td>
<td>------</td>
<td>----------</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>28</td>
<td>172</td>
<td>0</td>
<td>28.4</td>
<td>-</td>
<td>32.5</td>
<td>45.6</td>
<td>14.1</td>
<td>0.14</td>
<td>0.4</td>
</tr>
<tr>
<td>30</td>
<td>176</td>
<td>2.0</td>
<td>22.0</td>
<td>36.3</td>
<td>16.5</td>
<td>42.0</td>
<td>17.7</td>
<td>0.10</td>
<td>0</td>
</tr>
<tr>
<td>31</td>
<td>230.5</td>
<td>13.5</td>
<td>1.5</td>
<td>2.5</td>
<td>22</td>
<td>50.4</td>
<td>28.7</td>
<td>0.05</td>
<td>0.002</td>
</tr>
<tr>
<td>32</td>
<td>265</td>
<td>29</td>
<td>1.5</td>
<td>2.5</td>
<td>22</td>
<td>58.1</td>
<td>36.2</td>
<td>0.05</td>
<td>0.01</td>
</tr>
<tr>
<td>34</td>
<td>157</td>
<td>81</td>
<td>2.0</td>
<td>3.3</td>
<td>62</td>
<td>49.2</td>
<td>27.95</td>
<td>T</td>
<td>0</td>
</tr>
<tr>
<td>35</td>
<td>222</td>
<td>22</td>
<td>2.50</td>
<td>4.13</td>
<td>22.2</td>
<td>49.2</td>
<td>29.4</td>
<td>0.21</td>
<td>0.05</td>
</tr>
<tr>
<td>36</td>
<td>245</td>
<td>15</td>
<td>0.1</td>
<td>0.0</td>
<td>11.3</td>
<td>50.4</td>
<td>32.56</td>
<td>0.43</td>
<td>0.05</td>
</tr>
<tr>
<td>37</td>
<td>244</td>
<td>36</td>
<td>0.5</td>
<td>0.8</td>
<td>14</td>
<td>58.0</td>
<td>32.8</td>
<td>T</td>
<td>0</td>
</tr>
<tr>
<td>38</td>
<td>334</td>
<td>36</td>
<td>2.0</td>
<td>3.3</td>
<td>0</td>
<td>72.4</td>
<td>45.9</td>
<td>T</td>
<td>0</td>
</tr>
<tr>
<td>39</td>
<td>102</td>
<td>0</td>
<td>16.5</td>
<td>27.2</td>
<td>54</td>
<td>24</td>
<td>10.2</td>
<td>0.05</td>
<td>0.02</td>
</tr>
<tr>
<td>43</td>
<td>207</td>
<td>1.6</td>
<td>2.5</td>
<td>4.1</td>
<td>18.7</td>
<td>44.0</td>
<td>23.8</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>44</td>
<td>296</td>
<td>0</td>
<td>2.5</td>
<td>4.0</td>
<td>0</td>
<td>60.0</td>
<td>35.5</td>
<td>0.2</td>
<td>0</td>
</tr>
<tr>
<td>45</td>
<td>232</td>
<td>14</td>
<td>2.0</td>
<td>3.3</td>
<td>0</td>
<td>47.6</td>
<td>30.9</td>
<td>0.1</td>
<td>0</td>
</tr>
<tr>
<td>48</td>
<td>108</td>
<td>10</td>
<td>3.0</td>
<td>4.95</td>
<td>4.0</td>
<td>40.0</td>
<td>7.29</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>50</td>
<td>228</td>
<td>12</td>
<td>10.5</td>
<td>17.35</td>
<td>31.5</td>
<td>53.6</td>
<td>25.75</td>
<td>0.15</td>
<td>0</td>
</tr>
</tbody>
</table>
Table 6 Continued

<table>
<thead>
<tr>
<th>Hardness as Chloride</th>
<th>NaCl</th>
<th>Sulphate</th>
<th>Ca</th>
<th>Mg</th>
<th>Fe</th>
<th>Mn</th>
<th>F</th>
<th>Cr</th>
<th>Cu</th>
<th>Al</th>
<th>Pb</th>
<th>Na</th>
<th>K</th>
<th>NO₃</th>
<th>NO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>53 282 124 4.0</td>
<td>6.6</td>
<td>20.0</td>
<td>55.6</td>
<td>40.58</td>
<td>0.05</td>
<td>0.01</td>
<td>0.2</td>
<td>0.01</td>
<td>0.05</td>
<td>0.2</td>
<td>0.01</td>
<td>0.1</td>
<td>1.1</td>
<td>0.44</td>
<td>0.01</td>
</tr>
<tr>
<td>54 277 51 3.0</td>
<td>4.95</td>
<td>18.0</td>
<td>63.2</td>
<td>41.3</td>
<td>0.001</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.5</td>
<td>0</td>
<td>0.40</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>59 320 0 0.5</td>
<td>0.8</td>
<td>6.0</td>
<td>71.6</td>
<td>34.5</td>
<td>0</td>
<td>0</td>
<td>0.1</td>
<td>0</td>
<td>T</td>
<td>0</td>
<td>1.0</td>
<td>0.10</td>
<td>0</td>
<td>0.10</td>
<td>0.026</td>
</tr>
<tr>
<td>60 164 0 2.5</td>
<td>4.1</td>
<td>14</td>
<td>33.2</td>
<td>19.5</td>
<td>0.15</td>
<td>0</td>
<td>0.50</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>62 278 44 5.5</td>
<td>9.1</td>
<td>11.2</td>
<td>61.2</td>
<td>41.1</td>
<td>-</td>
<td>0</td>
<td>0.1</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.1</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>64 108 0 49</td>
<td>-</td>
<td>11</td>
<td>25</td>
<td>11</td>
<td>-</td>
<td>1.2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>55</td>
<td>2.8</td>
<td>0.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>65 84 0 -</td>
<td>6.0</td>
<td>17.0</td>
<td>10.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>82</td>
<td>3.2</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>66 150 0 6.2</td>
<td>-</td>
<td>10</td>
<td>40</td>
<td>12</td>
<td>-</td>
<td>1.3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>68</td>
<td>2.9</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>69 72 0 119.5</td>
<td>197.2</td>
<td>17.0</td>
<td>14.8</td>
<td>8.5</td>
<td>0.35</td>
<td>0.005</td>
<td>2.3</td>
<td>0.003</td>
<td>0.05</td>
<td>0.20</td>
<td>0.01</td>
<td>37</td>
<td>0.48</td>
<td>0.010</td>
<td></td>
</tr>
<tr>
<td>70 180 0 4.5</td>
<td>7.43</td>
<td>52</td>
<td>40.0</td>
<td>19.44</td>
<td>0.05</td>
<td>0.005</td>
<td>1.20</td>
<td>0.003</td>
<td>0.1</td>
<td>0.2</td>
<td>0.01</td>
<td>38.0</td>
<td>0.20</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>Map No.</td>
<td>Location</td>
<td>County</td>
<td>City</td>
<td>Date Collected</td>
<td>Depth - Csg</td>
<td>Ph</td>
<td>Methanol Or-</td>
<td>Total Solids</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>----------</td>
<td>--------</td>
<td>---------------</td>
<td>----------------</td>
<td>-------------</td>
<td>----</td>
<td>ange Alk.</td>
<td>--------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>26N28W36</td>
<td>Barry</td>
<td>Monett</td>
<td>2-19-66</td>
<td>1550</td>
<td>7.3</td>
<td>134</td>
<td>212</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>25N24W4</td>
<td>Stone</td>
<td>Crane #2</td>
<td>3-25-70</td>
<td>1120</td>
<td>7.9</td>
<td>127</td>
<td>226</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>24N28W36</td>
<td>Barry</td>
<td>Butterfield</td>
<td>2-18-70</td>
<td>1350</td>
<td>8.1</td>
<td>166</td>
<td>229</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>24N24W12</td>
<td>Stone</td>
<td>Galena #2</td>
<td>5-12-69</td>
<td>1300</td>
<td>7.6</td>
<td>148</td>
<td>186</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>24N20W34</td>
<td>Taney</td>
<td>Forsyth</td>
<td>4-12-71</td>
<td>970</td>
<td>8.2</td>
<td>222</td>
<td>305</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>24N19W27</td>
<td>Taney</td>
<td></td>
<td>4-12-71</td>
<td>1000</td>
<td>7.8</td>
<td>307</td>
<td>373</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>23N27W28</td>
<td>Barry</td>
<td>Cassville</td>
<td>2-26-70</td>
<td>1370</td>
<td>7.9</td>
<td>112</td>
<td>202</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>23N27W29</td>
<td>Barry</td>
<td>Cassville</td>
<td>5-10-71</td>
<td>1195</td>
<td>8.0</td>
<td>181</td>
<td>258</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>23N21W32</td>
<td>Taney</td>
<td>Branson #3</td>
<td>3-4-64</td>
<td>1085</td>
<td>7.2</td>
<td>300</td>
<td>310</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>22N33W25</td>
<td>McDonald</td>
<td>Lanagen</td>
<td>8-13-70</td>
<td>1340</td>
<td>7.8</td>
<td>125</td>
<td>201</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>22N28W28</td>
<td>Barry</td>
<td>Washburn</td>
<td>12-28-70</td>
<td>1675</td>
<td>7.7</td>
<td>91</td>
<td>116</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>22N21W9</td>
<td>Taney</td>
<td>Hollister #4</td>
<td>6-17-70</td>
<td>990</td>
<td>7.8</td>
<td>250</td>
<td>318</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>21N33W15</td>
<td>McDonald</td>
<td>Noel</td>
<td>7-22-71</td>
<td>1300</td>
<td>8.1</td>
<td>142</td>
<td>308</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>21N26W27</td>
<td>Carroll</td>
<td>Holiday Isl. #4</td>
<td>2-8-73</td>
<td>1880</td>
<td>7.4</td>
<td>199</td>
<td>200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Map No.</td>
<td>Location</td>
<td>County</td>
<td>City</td>
<td>Date Collected</td>
<td>Depth</td>
<td>Csg</td>
<td>Ph</td>
<td>Methal Orange Alk.</td>
<td>Total Solids</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>----------</td>
<td>--------</td>
<td>-----------------</td>
<td>----------------</td>
<td>-------</td>
<td>-----</td>
<td>----</td>
<td>-------------------</td>
<td>--------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>20N33W11</td>
<td>Benton</td>
<td>Gravette #2</td>
<td>7</td>
<td>1600</td>
<td>400</td>
<td>7.4</td>
<td>125</td>
<td>173</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>20N33W14</td>
<td>Benton</td>
<td>Gravette #3</td>
<td>7</td>
<td>1614</td>
<td>-</td>
<td>7.6</td>
<td>134</td>
<td>137</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>20N29W13</td>
<td>Benton</td>
<td>Avoca</td>
<td>8-7-74</td>
<td>2076</td>
<td>-</td>
<td>8.5</td>
<td>-</td>
<td>254.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>19N33W11</td>
<td>Benton</td>
<td>Decatur</td>
<td>?</td>
<td>1760</td>
<td>-</td>
<td>7.9</td>
<td>146</td>
<td>175</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>19N33W11</td>
<td>Benton</td>
<td>Decatur</td>
<td>?</td>
<td>1710</td>
<td>600</td>
<td>7.4</td>
<td>124</td>
<td>140</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>19N32W11</td>
<td>Benton</td>
<td>Peterson Indust.</td>
<td>12-6-71</td>
<td>1723</td>
<td>435</td>
<td>8.0</td>
<td>114</td>
<td>161</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>19N19W8</td>
<td>Boone</td>
<td>Bergman</td>
<td>9-17-71</td>
<td>1725</td>
<td>215</td>
<td>7.7</td>
<td>159</td>
<td>129</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>52</td>
<td>19N16W32</td>
<td>Marlon</td>
<td>Summit</td>
<td>9-12-72</td>
<td>1520</td>
<td>-</td>
<td>7.8</td>
<td>250</td>
<td>261</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>55</td>
<td>19N14W28</td>
<td>Baxter</td>
<td>Cassville</td>
<td>2-20-70</td>
<td>1400</td>
<td>-</td>
<td>7.5</td>
<td>290</td>
<td>323</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>56</td>
<td>19N14W29</td>
<td>Baxter</td>
<td>Cotter</td>
<td>2-2-73</td>
<td>1625</td>
<td>-</td>
<td>7.5</td>
<td>253</td>
<td>260</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>57</td>
<td>19N13W9</td>
<td>Baxter</td>
<td>Mt. Home #2</td>
<td>4-15-65</td>
<td>1505</td>
<td>-</td>
<td>7.4</td>
<td>296</td>
<td>371</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>58</td>
<td>19N13W16</td>
<td>Baxter</td>
<td>Mt. Home #3</td>
<td>4-15-65</td>
<td>1540</td>
<td>550</td>
<td>7.3</td>
<td>270</td>
<td>333</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>18N19W19</td>
<td>Boone</td>
<td>Hiway Department</td>
<td>8-1-69</td>
<td>2000</td>
<td>972</td>
<td>7.6</td>
<td>225</td>
<td>246</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>18N6W10</td>
<td>Sharp</td>
<td>Ash Flat</td>
<td>9-17-64</td>
<td>1600</td>
<td>-</td>
<td>7.4</td>
<td>279</td>
<td>300</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>67</td>
<td>17N20W21</td>
<td>Newton</td>
<td>Marble Falls</td>
<td>10-3-74</td>
<td>2573</td>
<td>503</td>
<td>7.45</td>
<td>168</td>
<td>239</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>68</td>
<td>16N32W9</td>
<td>Washington</td>
<td>Lake Wedington</td>
<td>4-19-68</td>
<td>1815</td>
<td>253</td>
<td>7.6</td>
<td>168</td>
<td>381</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Map No.</td>
<td>Hardness as CaCO$_3$</td>
<td>NaCl Sulfate</td>
<td>Ca</td>
<td>Mg</td>
<td>Fe</td>
<td>Mn</td>
<td>F</td>
<td>Cr</td>
<td>Cu</td>
<td>Al</td>
<td>Pb</td>
<td>Na</td>
<td>K</td>
<td>NO$_3$</td>
<td>NO$_2$</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------</td>
<td>--------------</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>---</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>1</td>
<td>134</td>
<td>22</td>
<td>8.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.0</td>
<td>0.2</td>
<td></td>
<td></td>
<td></td>
<td>0.1</td>
<td>5.2</td>
<td>1.4</td>
<td>1.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>127</td>
<td>15</td>
<td>3.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.0</td>
</tr>
<tr>
<td>5</td>
<td>166</td>
<td>12</td>
<td>2.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.9</td>
</tr>
<tr>
<td>6</td>
<td>148</td>
<td>8.0</td>
<td>3.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.2</td>
</tr>
<tr>
<td>8</td>
<td>222</td>
<td>6.0</td>
<td>4.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.7</td>
</tr>
<tr>
<td>9</td>
<td>307</td>
<td>3.0</td>
<td>2.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.2</td>
</tr>
<tr>
<td>15</td>
<td>112</td>
<td>12</td>
<td>2.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.9</td>
</tr>
<tr>
<td>16</td>
<td>181</td>
<td>15</td>
<td>2.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.6</td>
</tr>
<tr>
<td>19</td>
<td>308</td>
<td>8.0</td>
<td>5.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.9</td>
</tr>
<tr>
<td>20</td>
<td>114</td>
<td>0</td>
<td>28.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>32.5</td>
</tr>
<tr>
<td>22</td>
<td>91</td>
<td>4.0</td>
<td>2.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.5</td>
</tr>
<tr>
<td>26</td>
<td>250</td>
<td>14</td>
<td>2.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.0</td>
</tr>
<tr>
<td>29</td>
<td>104</td>
<td>0</td>
<td>74.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>64.5</td>
</tr>
<tr>
<td>33</td>
<td>199</td>
<td>15</td>
<td>1.5</td>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.32</td>
</tr>
<tr>
<td>40</td>
<td>108</td>
<td>0</td>
<td>12.5</td>
<td>20.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.95</td>
</tr>
<tr>
<td>Map No.</td>
<td>Hardness as CaCO₃ Cu, Mg</td>
<td>NaCl</td>
<td>Sulphate</td>
<td>Ca</td>
<td>Mg</td>
<td>Fe</td>
<td>Mn</td>
<td>F</td>
<td>Cr</td>
<td>Cu</td>
<td>Al</td>
<td>Pb</td>
<td>Na</td>
<td>K</td>
<td>NO₃</td>
</tr>
<tr>
<td>---------</td>
<td>-----------------</td>
<td>------</td>
<td>----------</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>---</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>41</td>
<td>100</td>
<td>0</td>
<td>11.0</td>
<td>18.15</td>
<td>10.5</td>
<td>22.4</td>
<td>10.7</td>
<td>-</td>
<td>0</td>
<td>1.15</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>42</td>
<td>84</td>
<td>0</td>
<td>42.0</td>
<td>-</td>
<td>17.0</td>
<td>20.4</td>
<td>8.0</td>
<td>0.05</td>
<td>0.005</td>
<td>1.55</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>24.0</td>
</tr>
<tr>
<td>46</td>
<td>146</td>
<td>10</td>
<td>2.0</td>
<td>3.3</td>
<td>6.0</td>
<td>37.2</td>
<td>15.3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>47</td>
<td>124</td>
<td>2.0</td>
<td>2.0</td>
<td>3.5</td>
<td>9.0</td>
<td>29.5</td>
<td>12.5</td>
<td>0.10</td>
<td>0</td>
<td>0.1</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>49</td>
<td>114</td>
<td>28.8</td>
<td>8.0</td>
<td>13.2</td>
<td>53</td>
<td>26.8</td>
<td>18.4</td>
<td>0.08</td>
<td>0.02</td>
<td>0.03</td>
<td>0.012</td>
<td>-</td>
<td>-</td>
<td>0.01</td>
<td>2.7</td>
</tr>
<tr>
<td>51</td>
<td>159</td>
<td>0</td>
<td>2.0</td>
<td>4.1</td>
<td>12.5</td>
<td>40</td>
<td>2.0</td>
<td>0.08</td>
<td>0.05</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>52</td>
<td>250</td>
<td>20</td>
<td>2.5</td>
<td>4.13</td>
<td>4.3</td>
<td>37.2</td>
<td>30.86</td>
<td>0.05</td>
<td>0.05</td>
<td>0.06</td>
<td>0.003</td>
<td>0.1</td>
<td>-</td>
<td>0.008</td>
<td>1.5</td>
</tr>
<tr>
<td>55</td>
<td>290</td>
<td>46</td>
<td>1.0</td>
<td>1.65</td>
<td>9.75</td>
<td>63.2</td>
<td>43.25</td>
<td>0.05</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>0.18</td>
</tr>
<tr>
<td>56</td>
<td>253</td>
<td>7.0</td>
<td>2.8</td>
<td>4.5</td>
<td>14.0</td>
<td>50.4</td>
<td>32.6</td>
<td>0.36</td>
<td>0.003</td>
<td>0.20</td>
<td>0.003</td>
<td>0.05</td>
<td>0.2</td>
<td>0.01</td>
<td>1.0</td>
</tr>
<tr>
<td>57</td>
<td>296</td>
<td>6.0</td>
<td>4.0</td>
<td>6.6</td>
<td>24</td>
<td>64.0</td>
<td>34.5</td>
<td>0.20</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2.0</td>
</tr>
<tr>
<td>58</td>
<td>270</td>
<td>32</td>
<td>6.0</td>
<td>9.9</td>
<td>11</td>
<td>56.8</td>
<td>32.10</td>
<td>0.15</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>3.0</td>
</tr>
<tr>
<td>61</td>
<td>225</td>
<td>31</td>
<td>2.5</td>
<td>4.1</td>
<td>10.0</td>
<td>54.8</td>
<td>29.0</td>
<td>0.15</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>2.0</td>
</tr>
<tr>
<td>63</td>
<td>279</td>
<td>25</td>
<td>3.0</td>
<td>4.95</td>
<td>16</td>
<td>59.2</td>
<td>37.9</td>
<td>0.2</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>3.5</td>
</tr>
<tr>
<td>67</td>
<td>168</td>
<td>2.8</td>
<td>2.9</td>
<td>4.8</td>
<td>16</td>
<td>40.6</td>
<td>17.3</td>
<td>0.06</td>
<td>0.01</td>
<td>0.23</td>
<td>0.01</td>
<td>0.05</td>
<td>0.2</td>
<td>0.01</td>
<td>-</td>
</tr>
<tr>
<td>68</td>
<td>118</td>
<td>0</td>
<td>114</td>
<td>188</td>
<td>7.0</td>
<td>32.8</td>
<td>8.5</td>
<td>0.2</td>
<td>0</td>
<td>0.85</td>
<td>0</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>93.0</td>
</tr>
</tbody>
</table>

Table 7 Continued
dominant constituents dissolved in the water. Other dissolved mineral constituents are present in small amounts. The source and significance of dissolved mineral constituents and properties of water are summarized in Table 8.

Although water from the aquifers is moderately hard to very hard, it is of good chemical quality and is suitable for most uses. Dissolved solids range from 87 to 535 parts per million. The calcium content ranges from 14.8 to 73.9 parts per million and magnesium has a range of 0 to 79.5 parts per million. Iron is present in varying quantities, but is generally below the 0.3 mg/l maximum as prescribed by the United States Public Health Service (1962) drinking-water standards. Sulfates average slightly greater than 16 parts per million and range from 0 to 64 parts per million. Chloride concentrations are quite variable ranging from 0 to 119.5 parts per million. Nitrate concentrations range from 0 to 33.6 parts per million.

The distribution of dissolved minerals in groundwater corresponds in a general way to the overall direction of movement of water. A comparison of the location of selected chemical constituents shown in Plate 10 with the elevation of the potentiometric surface (Plate 9) indicates the following:

1. Total dissolved solid concentrations are low along groundwater ridges and increase as water moves down the hydrodynamic gradient toward groundwater troughs. This increase is caused by additional material being dissolved.
### Table 8

<table>
<thead>
<tr>
<th>Constituent or property</th>
<th>Source or cause</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silica (SiO₂)</td>
<td>Dissolved from practically all rocks and soils, commonly less than 30 mg/L, High concentrations, as much as 100 mg/L, generally occur in highly alkaline waters.</td>
<td>Forms hard scale in pipes and boilers. Carried over in steam of high-pressure boilers to form deposits on blades of turbines. Inhibits deterioration of zeolite-type water softeners.</td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>Dissolved from practically all rocks and soils. May also be derived from iron pipes, pumps, and other equipment. More than 1 or 2 mg/L of soluble iron in surface waters generally indicates acid wastes from mine drainage or other sources.</td>
<td>More than about 0.3 mg/L stains laundry and utensils reddish brown. Objectionable for food processing, textile processing, beverages, ice manufacture, brewing, and other processes. USPHS (1962) drinking-water standards state that iron should not exceed 0.3 mg/L. Larger quantities cause unpleasant taste and favor growth of iron bacteria.</td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>Dissolved from some rocks and soils. Not so common as iron. Large quantities often associated with high iron content and acid waters.</td>
<td>Same objectionable features as iron. Causes dark brown or black stain. USPHS (1962) drinking-water standards state that manganese should not exceed 0.05 mg/L.</td>
</tr>
<tr>
<td>Calcium (Ca) and magnesium (Mg)</td>
<td>Dissolved from practically all rocks and soils, but especially from limestone, dolomite, and gypsum. Calcium and magnesium are found in large quantities in some brines. Magnesium is present in large quantities in sea water.</td>
<td>Cause most of the hardness and scale-forming properties of water; soap consuming (see Hardness). Waters low in calcium and magnesium desired in electroplating, tanning, and dyeing and in textile manufacturing.</td>
</tr>
<tr>
<td>Sodium (Na) and potassium (K)</td>
<td>Dissolved from practically all rocks and soils. Found also in ancient brines, sea water, industrial brines, and sewage.</td>
<td>Large amounts, in combination with chloride, give a salty taste. Moderate quantities have little effect on the usefulness of water for most purposes. Sodium salts may cause foaming in steam boilers, and a high sodium content may limit the use of water for irrigation.</td>
</tr>
<tr>
<td>Bicarbonate (HCO₃) and carbonate (CO₃)</td>
<td>Action of carbon dioxide in water on carbonate rocks such as limestone and dolomite.</td>
<td>Bicarbonate and carbonate produce alkalinity. Bicarbonates of calcium and magnesium decompose in steam boilers and hot-water facilities to form scale and release corrosive carbon dioxide gas. In combination with calcium and magnesium they cause carbonate hardness.</td>
</tr>
<tr>
<td>Sulfate (SO₄)</td>
<td>Dissolved from rocks and soils containing gypsum, iron sulfides, and other sulfur compounds. Commonly present in mine waters and some industrial wastes.</td>
<td>Sulfate in water containing calcium forms hard scale in steam boilers. In large amounts, sulfate in combination with other ions gives a bitter taste to water. Some calcium sulfate is considered beneficial in the brewing process. USPHS (1962) drinking-water standards recommend that the sulfate content should not exceed 250 mg/L.</td>
</tr>
<tr>
<td>Chloride (Cl)</td>
<td>Dissolved from rocks and soils. Present in sewage and found in large amounts in ancient brines, sea water, and industrial wastes.</td>
<td>In large amounts in combination with sodium gives salty taste to water. In large quantities increases the corrosiveness of water. USPHS (1962) drinking-water standards recommend that the chloride content not exceed 250 mg/L.</td>
</tr>
<tr>
<td>Fluoride (F)</td>
<td>Dissolved in small to minute quantities from most rocks and soils. Added to many waters by fluoridation of municipal supplies.</td>
<td>Fluoride in drinking water reduces the incidence of tooth decay when the water is consumed during the period of enamel calcification. However, it may cause mottling of the teeth depending on the concentration of fluoride, the age of the child, the amount of water consumed, and the susceptibility of the individual. The maximum concentration of fluoride recommended by the USPHS (1962) varies with the annual average of maximum daily temperatures, and ranges downward from 1.7 mg/L for an average maximum daily temperature of 10°C to 0.8 mg/L for an average maximum daily temperature of 32.5°C. Optimum concentrations for these ranges are from 1.2 to 0.7 mg/L.</td>
</tr>
</tbody>
</table>

(After Feder and others, 1969)
### Source and significance of dissolved mineral constituents and properties of water—Continued

<table>
<thead>
<tr>
<th>Constituent or property</th>
<th>Source or cause</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrate (NO₃⁻)</td>
<td>Decaying organic matter, legume plants, sewage, nitrate fertilizers and nitrates in soils.</td>
<td>Concentration much greater than the local average may suggest pollution. USPHS (1962) drinking-water standards suggest a limit of 45 mg/l. Waters of high nitrate content have been reported to be the cause of methemoglobinemia (an often fatal disease in infants and therefore should not be used in infant feeding. Nitrate has been shown to be helpful in reducing the intercrystalline cracking of boiler steel. It encourages the growth of algae and other organisms which may cause odor problems in water supplies. USPHS (1962) drinking-water standards recommend that the dissolved solids should not exceed 500 mg/l. However, 1,000 mg/l is permitted under certain circumstances. Waters containing more than 1,000 mg/l of dissolved solids are unsuitable for many purposes. Consumes soap before a lather will form. Deposits soap curd on bathtubs. Hard water forms scale in boilers, water heaters, and pipes. Hardness equivalent to the bicarbonate and carbonate is called carbonate hardness. Any hardness in excess of this is called noncarbonate hardness. Waters of hardness up to 60 mg/l are considered soft; 61-120 mg/l moderately hard; 121-180 mg/l hard; more than 180 mg/l very hard. Indicates degree of mineralization. Specific conductance is a measure of the capacity of the water to conduct an electric current. It varies with the concentrations and degree of ionization of the constituents, and with temperature. A pH of 7.0 indicates neutrality of a solution. Values higher than 7.0 denote increasing alkalinity; values lower than 7.0 denote increasing acidity. pH is a measure of the activity of hydrogen ions. Corrosiveness of water generally increases with decreasing pH. However, excessively alkaline water may also attack metals. Water for domestic and some industrial uses should be free from perceptible color. Color in water is objectionable in food and beverage processing and many manufacturing processes. Affects usefulness of water for many purposes. Most users desire water of uniformly low temperature. Seasonal fluctuations in temperature of surface waters are comparatively large depending on the volume of water. Sediment must generally be removed by flocculation and filtration before water is used by industry or municipalities. Sediment deposits reduce the storage capacity of reservoirs and lakes and clog navigable stream channels and harbors. Particulate distribution is a factor controlling the density of biotrophic organisms and is considered in the design of filtration plants. Sediment data are of value in designing reclamation and improvement projects, in the study of biological conditions and fish propagation, and in programs of soil conservation and watershed management.</td>
</tr>
<tr>
<td>Dissolved solids</td>
<td>Chiefly mineral constituents dissolved from rocks and soils.</td>
<td></td>
</tr>
<tr>
<td>Hardness as CaCO₃</td>
<td>In most waters, nearly all the hardness is due to calcium and magnesium. All the metallic cations other than the alkali metals also cause hardness.</td>
<td></td>
</tr>
<tr>
<td>Specific conductance (micromhos at 25°C)</td>
<td>Mineral content of the water.</td>
<td></td>
</tr>
<tr>
<td>Hydrogen-ion concentration (pH)</td>
<td>Acids, acid-generating salts, and free carbon dioxide lower the pH. Carbonates, bicarbonates, hydroxides, phosphates, silicates, and borates raise the pH.</td>
<td></td>
</tr>
<tr>
<td>Color</td>
<td>Yellow-to-brown color of some water usually is caused by organic matter extracted from leaves, roots, and other organic substances. Color in water also results from industrial wastes and sewage.</td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>Climatic conditions, use of water as a cooling agent, industrial pollution.</td>
<td></td>
</tr>
<tr>
<td>Suspended sediment</td>
<td>Erosion of land and stream channels. Quantity and particle-size gradation affected by many factors such as form and intensity of precipitation, rate of runoff, stream channel and flow characteristics, vegetal cover, topography, type and characteristics of soils in drainage basin, agricultural practices, and some industrial and mining activities. Luminous concentrations and loads occur during periods of storm runoff.</td>
<td></td>
</tr>
</tbody>
</table>

1"Public Health Service Drinking Water Standards," revised 1962, apply to drinking water and water-supply systems used by carriers and others subject to Federal quarantine regulations.
2. The ratio of calcium to magnesium is high along groundwater ridges and decreases in the direction of movement toward groundwater troughs. This distribution is most evident in the areas surrounding the White River drainage basin. In this region, recharge to the aquifers is accomplished, in part, by vertical infiltration of water through Mississippian limestone strata of the Springfield Plateau. This provides a source for increased concentration of calcium, and as a result, calcium-magnesium ratios are high in these areas. Subsequent movement of the water down the hydrodynamic gradient is confined to Ordovician dolomite. This results in the decline of calcium/magnesium ratios toward the discharge zones.

Evaluation of the distribution of chloride concentrations in the deep aquifer waters suggests that chlorides increase with the regional gradient from the southwestern portion of the study area toward the Arkoma Basin. Chloride concentrations average 17 parts per million for wells located in Benton County, Arkansas. To the south in Washington County, the concentration of chloride increases to an average of 94 parts per million. Southeast of this area deep water wells are not generally drilled because of the extreme depth of the aquifers and high drilling costs. Two gas exploration wells have been drilled in northern Johnson County by Arkansas Western Gas Company. The AG Gregory #1, located in Sec. 3, T. 12 N., R. 25 W., and AGW Federal ES084 #1, located in Sec. 8, T. 12 N., R. 24 W.,
penetrate the Roubidoux-Gunter Member to a depth of approximately 4,000 feet. Calculations using formation density and induction-electric logs indicate that the formation waters have a salinity concentration ranging from 2,000 to 3,000 parts per million.

The increase in chloride and total dissolved solid concentrations of formation waters with distance from the outcrop area is characteristic of many artesian systems associated with isolated geologic basins (Bredehoeft and others, 1963). Isocon maps for the Ordovician mid-continent area illustrate this condition (Dott and Ginter, 1930).

Formation Hydraulics

The specific capacity is an indirect measure of that transmissibility and storage capacity combination for the formation the well is taking water from. One of the difficulties of calculating either parameter separately in these wells is that the water is coming from several strata. Water supply wells are normally cased to a depth of 500 feet below the surface. Water from any strata below the casing may enter the well and contribute to the yield. Another difficulty in calculating either transmissibility or storage coefficient is that the wells are artesian. The static water level is above the formation producing the main portion of the yield. The drawdown in all of these wells does not reach the top of the aquifer.
The apparent transmissibility of the wells that pump test data could be obtained for are given in the following table. These transmissibilities are apparent rather than true because the water is rising above the top of the primary water producing formation and is not a true measure of the transmissibility of the aquifer.

### TABLE 9

<table>
<thead>
<tr>
<th>Well Location</th>
<th>Apparent Transmissibility</th>
<th>Specific Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>gpd/ft</td>
<td>gal/ft</td>
</tr>
<tr>
<td>Decatur</td>
<td>1318</td>
<td>3.52</td>
</tr>
<tr>
<td>Summit</td>
<td>218</td>
<td>0.3</td>
</tr>
<tr>
<td>Ark. Hwy. Dept.</td>
<td>419</td>
<td>0.75</td>
</tr>
<tr>
<td>Eureka Springs</td>
<td>680</td>
<td>0.69</td>
</tr>
<tr>
<td>Lost Bridge Village</td>
<td>2534</td>
<td>2.1</td>
</tr>
<tr>
<td>Valley Springs</td>
<td>1553</td>
<td>1.27</td>
</tr>
<tr>
<td>Bergman</td>
<td>unknown</td>
<td>10.7</td>
</tr>
<tr>
<td>Big Flat</td>
<td>116</td>
<td>0.23</td>
</tr>
<tr>
<td>Cotter #2</td>
<td>3683</td>
<td>3.0</td>
</tr>
<tr>
<td>Holiday Island #1</td>
<td>5866</td>
<td>8.8</td>
</tr>
<tr>
<td>Holiday Island #6</td>
<td>10602</td>
<td>5.9</td>
</tr>
</tbody>
</table>

All of the above wells are producing water from the Gasconade formation except Big Flat. The Bergman well transmissibility is unknown because the well is apparently drawing water from a fault and at a pumping rate of 149 gallons per minute the drawdown was stable at 14 feet for 10 hours. The well must be pumped at a much higher rate to determine apparent transmissibility.

The total area between the Arkansas-Missouri state line and the location of the contour marking sea level of the top of the Roubidoux formation is 3405 square miles. The average thickness of the formation over this area is 208 feet. The coefficient of storage is believed to
be approximately $3 \times 10^{-4}$. The water stored in this section would be approximately 136,000 acre-feet.

The surface area between the Arkansas-Missouri state line and the contour marking 800 feet below sea level of the top of the Gunter sandstone is 4380 square miles. The water stored in this section is 4,709,000 acre-feet. This is based upon an average thickness of 40 feet and a coefficient of storage of .042.
LITHOFACIES ANALYSIS

PROCEDURE

Samples from 21 wells in northern Arkansas were chosen from the Arkansas Geological Commission well-sample library on the basis of the well's location, its depth, and the availability of mechanical well logs. Each well was given a reference number that either coincides with or continues the series of numbers used in the Arkansas Water Resources Management Information System Report (closed file, 1974). Wells used in the lithofacies investigation are listed and numbered in Table 10. Well numbers and names are used to identify the wells in the text and numbers alone are used to locate wells on the lithofacies maps (Plates 11, 12, 13, 14) and cross-sections (Plates 15, 16, 17). The number of wells available for investigation was limited due to a paucity of wells in northern Arkansas that are sufficiently deep to penetrate the Roubidoux and Gasconade Formations, and also to the fact that samples from several wells that penetrate these formations are not on file in the Arkansas Geological Commission library. Figure 19 shows the locations of the wells analyzed in this investigation.

Figure 19: Index map showing well locations and reference numbers.
The disaggregated samples from both cable tool and rotary drilled wells were analyzed using a binocular microscope, and the lithic compositions of the samples were recorded. The rock types recorded included dolomite, sandy dolomite, cream colored chert, gray chert, blue chert, oolitic chert, sandstone, silicified sandstone, shale and limestone. The percent of each constituent was estimated and logged by using a column constructed on engineering graph paper. A color code was established so that each constituent could be recorded without confusion. The crystal size of the dolomite and sandy dolomite was also noted along with the average grain size of all quartz sand particles. Figure 20 depicts the column and color code used to record the samples. The logs were rechecked and the tops of the Roubidoux and Gasconade Formations and the Gunter Member were selected.

Roubidoux Formation: Upper Boundary

The Roubidoux Formation is generally differentiated from the overlying Jefferson City Dolomite on the basis of a definite increase in the sand and/or chert fraction within the section. Often this boundary is represented by the first appearance of continuous sand occurrences in the samples, indicating the presence of interbedded sandstone units. The Jefferson City Dolomite is essentially free of quartz sand and definable sandstone units.

Occasionally sandstone is not abundant near the top of the Roubidoux (Well numbers 1, 21, 32, 42, 66). In these situations the top of the Roubidoux was picked on the occurrence of in-
Figure 20: Well log format used to record lithic data from well samples
creasing percentages of chert. This selection is satisfactory in that the overlying Jefferson City is entirely dolomite in most of the wells and chert occurrences are almost nonexistent.

Analysis of the dolomite crystal size and quartz sand grain size reveals no characteristic repetative from well to well that would have enhanced the choice of the tops of Roubidoux Formation in the wells analyzed. However, comparison of the constructed lithologic logs with picks from the Missouri Geological Survey (insoluble residue logs), the Arkansas Water Resources Management Information System report (electric and insoluble residue logs), and the United States Geological Survey (electric logs) were useful in setting limits within the section where this boundary occurs.

Analysis of electric logs in the selection of formation tops within the section did not prove useful. No single characteristic could be found in the electric logs that consistently indicates the top of the Roubidoux Formation. This was probably due to the amount of carbonate rock in the section, along with a deficiency of other rock types.

Gasconade Formation: Upper Boundary

The top of the Gasconade Formation was selected at a horizon marked by the total to near total absence of sand and chert from the section. In the few wells where sand and chert persist (Well numbers 1, 44, 45, 61, 66) the top of the Gasconade was chosen as the horizon where these fractions exhibited a very marked decrease in abundance with respect to the overlying Roubidoux Formation percentages.
Crystal size and quartz sand grain size analysis did not prove to be of aid in delineating the top of Gasconade Formation. As with the Roubidoux, picks by other workers from various log types aided in setting boundaries for the Gasconade.

Gunter Sandstone Member: Boundaries

The Gunter Member of the Gasconade Formation was delineated by a distinct and significant quartz sand per cent increase near the base of the Gasconade. This increase is usually greater than 10 percent of the sample and the sand is quite continuous down section. In many wells the appearance of quartz sand at the top of the Gunter is the first sand encountered within the Gasconade Formation.

The base of the Gunter Member (and Gasconade Formation) was selected at a horizon where quartz sand was absent or did not represent at least 10 per cent of the sample. In wells where samples were not available in a part of the section where a formation boundary occurred, the most logical of the other available boundary selections was utilized.

Chert Types: Gasconade and Roubidoux Formations

Numerous distinctive types of chert were encountered in the Roubidoux and Gasconade Formations. The chert was analyzed to determine if either formation was characterized by a particular type. Much of the literature about this particular sequence of strata suggests that chert types characteristic of specific formation boundaries occur in insoluble residues (Groskopf and McCraken, 1949; Searight, 1955; McCraken, 1964). However, the
analysis of the bulk samples from the interval did not reveal any particular color or type of chert as entirely representative. It seems that residue characteristics are rather difficult to use in the analysis of the Roubidoux and Gasconade Formations.

Facies Analysis

The total percentages of sand, chert, and dolomite in the Roubidoux and Gasconade Formations were calculated for each well. This was done by utilizing the number of units on the log that define a particular interval (such as the Roubidoux Formation). This number was multiplied by 100 and considered to be the maximum percent a specific rock type could achieve within the section. The number of units that were actually occupied by the specific rock types were then tabulated and also multiplied by 100. A ratio was erected between these two numbers and this ratio was set equal to the actual percent of the specific rock type (the unknown value) and divided by 100 percent. The equation was then solved for the unknown and the actual percent of each specific rock type was tabulated.

After completion of these calculations the rock type distributions of the Roubidoux and Gasconade Formations were examined to see if the sand and chert fractions of the section showed any evident trends throughout the area.

The culmination of the thickness determinations and the lithic percentage evaluations was the construction of isopach and lithofacies maps of the Roubidoux and Gasconade Formations
Figure 21: Compositional triangle showing lithofacies groupings for the Roubidoux Formation. Numbers refer to specific wells examined.
Figure 22: Compositional triangle showing lithofacies groupings for the Gasconade Formation. Numbers refer to specific wells examined.
Figure 23: Compositional triangle showing lithofacies groupings for the Roubidoux and Gasconade Formations. Numbers refer to specific wells examined.
and of the Gunter Sandstone Member for northern Arkansas.

The maps were constructed on a base map having a scale of 1:500,000 and reduced. An isopach map was prepared and the regional lithofacies was superimposed over the isopach contours. The lithofacies distribution for each formation was determined by plotting the percentages of dolomite, sand and chert for each well on a compositional triangle, and grouping the results into similar percentage-based lithofacies. Figures 21 and 22 show the groupings as they were recorded for the Roubidoux and Gasconade Formations. The same procedure was followed for a lithofacies plot of the entire section - the Roubidoux and Gasconade Formations. This was done so that the overall lithic character of the sequence could be analyzed with respect to ground water occurrence in the area. Figure 23 shows the compositional triangle plot for the entire section. Plates 11, 12 and 13 in the back of this report are the isopach and lithofacies maps of the Gunter Member, Gasconade Formation and Roubidoux Formation spectively. It should be noted that the lithofacies map of the Gunter Sandstone Member is a sand percentage map. This was dictated by a paucity of other rock types in the interval.

Three structural cross-sections were prepared for the entire sequence; two depicting the north to south trends of the section and one depicting the east to west trends. Plates 15, 16 and 17 show these trends and also the location of the cross-sections with respect to northern Arkansas.
REGIONAL ANALYSIS

Gunter Sandstone Member

The Gunter Member was penetrated in 15 of the 21 wells that were analyzed in this report. In these wells the Gunter consists of sandstone, dolomite and chert. The sandstone is composed of white to clear, fine to medium, rounded to sub-rounded quartz grains, that usually exhibit a frosted surface. Caplan (1960) reported that the sand grains are coarser in size near the Eminence contact in several localities. This coarsening was not noted in the examination of the Gunter in any of these wells. The sandstone content of the Gunter ranges in amount from a low of around 16 per cent in the Viola water-well (42) in Fulton County to a high of approximately 97 percent in the Arkansas Western Gas Number One Bryan Well in Boone County (28A).

The sandstone of the Gunter Member in northern Arkansas are of two types: 1) dolomitic quartz sandstone and 2) silicious quartz sandstone. The difference in these two types is the cement present. The kind of cement was determined by appearance of the sand under a binocular microscope and by testing the sample with dilute hydrochloric acid. Of these two types, dolomitic quartz sandstone is by far the most abundant rock type in the Gunter Member. Only minor amounts of silicious quartz sandstone are present in northern Arkansas. However, both of these types of sandstone occur with dolomite and chert, which suggests that extensive interbedding of sandstone, dolomite,
and chert is a characteristic of the Gunter in the subsurface.

Cementation of the sandstone of the Gunter ranges from very weak to very strong. Most of the calcareous cemented (dolomitic) sandstone is quite friable and breaks down easily to individual quartz grains. The silicifyingly cemented sand grains are well bonded and not easily separated.

The quartz sand grains that comprise these sandstones show remarkable consistency across the study area. The size range of these grains is from .125 mm to .25 mm in every well analyzed in northern Arkansas. This excellent sorting is suggestive of repeated reworking of the sand grains, possibly in an advancing strandline during deposition of the Gunter Member.

The surface features of the quartz sand grains are of some use in delineating the Gunter Member in the section. The grains are almost always clear to very white, and have a frosted surface. This characteristic is useful because the sand that occurs in the section above the Gunter Member is usually a shade of gray or off-white.

The frosting on the surface of the quartz grains in the Gunter is probably due to processes similar to those described for the Everton Formation (Middle Ordovician) by Suhm (1970). He concluded that eolian processes were not important and that chemical solution processes were responsible for the frosted surfaces on most quartz sand grains.

Dolomite is the second major constituent of the Gunter in the wells of northern Arkansas. This also includes rock logged
as sandy dolomite. The dolomite is light to medium-gray, fine to medium crystalline and only locally contains quartz sand grains. Sandy dolomite in the Gunter Member observed in this investigation does not constitute a major fraction of the unit in any of the wells. The dolomite of the Gunter Member is virtually indistinguishable from the dolomite of the remainder of the Gasconade Formation. The color ranges from medium to light-gray and crystal sizes range from .060 mm to .105 mm. The dolomite crystal size of the Gunter Member is more uniform than the crystal size of the dolomite in the rest of the Gasconade. However, this slight increase in uniformity is not sufficiently pronounced to be of assistance in selecting the boundaries of the Gunter Member.

The Gunter Member of northern Arkansas also contains minor amounts of chert. The chert is commonly cream or gray and quite dense in appearance. Some ooliths occur within the chert in a few wells. The grain size of the ooliths is comparable to the quartz sand grain sizes encountered. Overall, there are no distinguishing characteristics of the chert within the Gunter that would enable their segregation from chert of the overlying Gasconade Formation.

The Gunter Sandstone Member of the subsurface of northern Arkansas ranges in thickness from 25 feet to 120 feet. However, this latter figure is not typical as extreme thicknesses (over 100 feet) only occur in one area of northern Arkansas. The excessive thicknesses (more than 100 feet) encountered in a few
of the wells were grouped closely around the Carrollton Dome in Carroll, Boone, and Newton Counties. These anomalous thicknesses may well represent part of a channel fill as described by Caplan (1960). Further evidence for this assumption can be obtained by comparing Knight's (1954) lithofacies map and cross section of the Gunter, Figure 2, with the isopach and lithofacies map of the Gunter in the back of this report (Plate II). Both maps show a localized thickening and an increase in sand percentage along a belt trending northward from the area of anomalous thicknesses in northern Arkansas. This could suggest that a well developed channel did in fact exist during the time of deposition of the Gunter, supplying significant quartz sand to the areas adjacent to and within the channel.

The Gunter thickens regionally in a southeastwardly direction across the state.

Sand percentages for the Gunter Member also exhibit an increase toward the southeast suggesting a source in that direction. Also of interest are three anomalous areas of higher sand percentages -- one in the eastern edge of the state in Sharp County; one around the Carrollton Dome; and the other in the northern edge of Benton County. Chenoweth (1968) has suggested that during the time of deposition of the Lower Ordovician, an archipelago existed in eastern Oklahoma due to highs in the Precambrian basement rocks of the area. It is possible that the areas of thickened strata in northern Arkansas are associated with such an archipelago. Anomalous amounts of sand derived from the surrounding highs could have been deposited in adjacent areas.
These areas are not believed to have been part of the islands themselves, because in the wells analyzed a normal succession of rock units exists and no overstepping of units as described by Chenoweth in Oklahoma seems to occur.

Parts of Benton, Carroll, and Washington Counties formed an embayment in the western part of the area. This part of the state may have been low and more sand derived from the surrounding terrain accumulated.

Gasconade Formation

The Gasconade Formation, excluding the Gunter Member, is composed almost completely of dolomite. Small quantities of sandstone and chert occur, but only locally do these constituents form a significant part of the unit.

The dolomite of the Gasconade Formation in northern Arkansas is light to medium-gray and ranges in crystal size from .035 mm to .135 mm. Complete dolomite rhombs are common, but the overall appearance of the disaggregated samples suggests that most of the dolomite has a xenotopic fabric. Dolomite with a hypidiotopic fabric is also present but much less common.

The various types of dolomite that occur (based on color and fabric) do not have specific positions stratigraphically within the Gasconade. Distributions of various colors and textures are random throughout the section. A particular type of dolomite may occur continuously for 50 to 100 feet. The zone of uniform occurrence is succeeded by zones that display a wide range of crystal sizes, colors and sand content within 25 feet.
It is difficult to predict that a particular type of dolomite will occur at a given position within the section in northern Arkansas. The origin of the dolomite is believed to be through the replacement of calcite or aragonite.

The chert fraction of the Gasconade Formation in northern Arkansas forms approximately 25 per cent of the unit with some variance noted. The colors recorded for the chert of the Gasconade are cream, blue, and gray. All have a dense appearance and only occasionally is oolitic chert encountered. Overall, the chert of the Gasconade is like that of the Gunter Member. The chert increases in content from the top of the Gasconade Formation toward the top of the Gunter Member, and decreases within the Gunter. This trend was observed in virtually every well logged in this study.

Quartz sand is a minor constituent of the Gasconade Formation. The sand is usually light to medium-gray, and amounts encountered range from 0 to about 5 per cent. The grain size measurements made reveal that the sand present is quite variable, ranging from .0625 mm to .25 mm across the state. No particular grain size is present consistently in any part of the section analyzed, and the use of the quartz sand grain sizes as stratigraphic guides is not viable in the Gasconade of northern Arkansas. Frosted grains are also quite abundant among the sands of the Gasconade and are probably the result of the processes described for the Gunter sands. The sand content increases eastward across the state, and a well developed sand unit is present near the middle of the formation in eastern Arkansas. The unit
is rather constant in thickness (around 15 to 20 feet), but
associated sand stringers in the City of Viola water well (42)
produce a total thickness of 50 feet. Correlation of this unit
is difficult in the three wells in which it has been logged.
Future drilling in the area may show that the unit can be cor-
related, and that it may be of some importance as an aquifer
within the Gasconade Formation.

Limestone is the only other rock type encountered in the
Gasconade of northern Arkansas. The limestone is light brown
and is extremely crumbly. The appearance is very granular and
the crystal size of the calcite was not determinable.

The Gasconade Formation, excluding the Gunter Member,
thickens across northern Arkansas in a southeasterly direction
from about 300 feet in Benton and Washington Counties to ap-
proximately 570 feet in Stone, Izard, Fulton, and Sharp Counties
(Plate 2). An area of thinner strata occurs around the Carrol-
lton Dome. This, along with the relatively sharp boundary be-
tween the Gunter Member and the rest of the Gasconade; and the
lithofacies pattern of the Gasconade that indicates an area of
terrigenous sediment deposition in the northern portion of the
state prior to carbonate deposition suggest that the unit was
deposited in possibly two phases.

After deposition of the Gunter Member in a sea transgres-
sive from the south, a minor regression occurred. This regres-
sion allowed the deposition of sediments derived from the ex-
posed northern areas in Missouri in the extreme northern parts
of Arkansas. As this regression waned and another transgressive
phase began, the area was inundated by deeper waters and carbonate deposition proceeded. However, because of the sediments derived from the north, the northern part of Arkansas was left with a somewhat higher sand content than the areas to the south that had not received any of the terrigenous sediments.

The upper portions of the Gasconade of northern Arkansas are relatively consistent, especially in composition.Thickness variations are more pronounced across the state than in the Gunter Member.

Roubidoux Formation

The Roubidoux Formation of northern Arkansas consists of dolomite, sand and chert. This unit is more sandy than the Gasconade (excluding the Gunter Member) and is a more important aquifer. Unlike the Gasconade, the Roubidoux displays certain stratigraphic characteristics that enable subdivision of the unit based on variations in lithic constituents -- basically sand and chert. These units will be discussed as separate entities in the text.

Roubidoux Formation - Unit A

The lowermost subdivision of the Roubidoux Formation of northern Arkansas is composed dominantly of dolomite, with sand and chert content ranging upward to approximately 25 per cent of the total unit. This unit rests unconformably on the underlying Gasconade Formation, and is not widespread throughout northern Arkansas. It is restricted to the northwestern and north-central parts of the state. To the south and east, this unit disappears
completely. The distribution of the Unit A may be seen by examining the structural cross-sections included with this report (Plates 15, 16, and 17).

Dolomite is the dominant constituent of Unit A. The dolomite has a crystal size ranging from .035 mm to .135 mm, is light to medium-gray and has a fabric that ranges from hypidiotopic to xenotopic. Some occasional sand grains occur in the dolomite of Unit A, but sandy dolomite is not volumetrically important.

Quartz sand is the next most commonly occurring constituent of Unit A in the Roubidoux. The sand content may range up to about 25 per cent of the unit, but more commonly forms between 10 and 20 per cent. The sizes of the quartz grains range widely from .0625 mm to .25 mm, and show no predictable patterns within the subdivision. The color of the sand is not widely variable, usually being light gray or occasionally white. The grains are rounded to subrounded (dominant) and are loosely cemented with calcareous and silicious cements. On the whole, the sandstone of Unit A does not appear to occur as thick continuous beds, but as thin interbedded layers with dolomite and chert.

The chert in this subdivision is much like the chert of the Gasconade and the remainder of the Roubidoux. Colors recorded for the chert in this unit are cream, gray, and blue. Some oolitic chert is present in minor amounts. However, in the lower unit the amounts of oolitic chert are insignificant, especially as compared to local occurrences in the upper sections of the
Roubidoux Formation. All of the chert types have a dense appearance and occur in less significant quantities than sand. Thicknesses of this unit range from 60 to 125 feet, with maximum thicknesses in the northern part of the state.

Roubidoux Formation - Unit B

The middle subdivision of the Roubidoux Formation in northern Arkansas is the most important of the units for two reasons: 1) it is the most widespread of the three units and occurs in every well, and 2) it consists of significantly more sand and chert than the other two subdivisions. This characteristic may prove useful to the water resource occurrence in the state, if the porosity and permeability of the unit are greatly enhanced by increased amounts of these constituents.

Overall, the lithic constituents of Unit B do not differ to any great extent from those of Unit A. Dolomite, sandstone, and chert are the major rock types, but the quantity of each does create a substantial difference.

Dolomite is a major constituent of Unit B and occurs throughout the unit in varying amounts. It is light to medium-gray, with crystal sizes ranging from .035 mm to .135 mm. The somewhat granular appearance again suggests hypidiotopic to xenotopic fabric, and although complete dolomite rhombs are common, none of the samples examined appeared to have an idiotopic texture. Occasional sand and chert fragments are also present in the dolomite of Unit B, but occurrences are not significant and have no stratigraphic meaning.
The quartz sands of Unit B are commonly light gray and range in grain size from .0625 mm to .25 mm. The distribution of the sizes is random and unimportant in a stratigraphic sense. Subrounded grains are most common, but rounded grains also frequently occur. The cements are both calcareous and silicious, but cementation is poor and the sandstone is quite friable. In contrast with the units above and below, the sand of Unit B appears to occur in somewhat thicker intervals and also appears to be more continuous laterally across the state.

Unit B is also characterized by significant amounts of chert, constituting slightly less of the section than the associated sand. Blue, gray, and cream chert is common, with minor amounts of oolitic chert occurring locally near the top of the unit. The chert has the dense appearance ascribed to the cherts of the Roubidoux and also seems to form thicker, more continuous intervals within the unit as compared to the other two units.

Thicknesses of Unit B range from 40 to 260 feet, and the unit is the only one of the three divisions present to the south and east across the state (Plates 15, 16, and 17).

Roubidoux Formation - Unit C

The third subdivision of the Roubidoux Formation in northern Arkansas, Unit C, contains the least amounts of sand and chert of the three units, and is at the top of the Roubidoux with its upper boundary overlain by the Jefferson City Dolomite.

Dolomite is by far the dominant rock type of Unit C, and
its appearance is similar to the underlying dolomite of the other two units. Crystal sizes range from .035 mm to .135 mm, the color is light to medium-gray, and the overall fabric is hypidiomorphic. Sand and chert fragments are present in minor amounts.

The sand content of Unit C is low with amounts never exceeding 20 per cent of the section and generally being much lower. The grains are light gray, subrounded quartz and have a size range of .0625 mm to .25 mm. The sands of Unit C appear to occur in thin beds interbedded with the thicker beds of dolomite and chert.

The chert content is as low or lower than the sand content of Unit C, and its overall character is similar to chert described earlier. Colors are blue, cream, and gray. The oolithic chert described in the other divisions occurs in slightly increased amounts in Unit C. This is probably the local zone of brown quartzose oolithic chert described by Grohskoph and McCraken (1949). Thicknesses of Unit C range from 20 to 120 feet, and the unit is restricted to the northwest portion of the area.

The Roubidoux Formation of northern Arkansas appears to have a somewhat similar depositional record to that of the Gasconade Formation. The unit thickens in an overall southeasterly direction from about 180 feet in the north to over 260 feet (except for the Carrollton Dome region) in the southerly portions of the study area. Anomalous areas of thickened Roubidoux exist in several parts of northern Arkansas as seen on the Isopachous and
Lithofacies map with this report (Plate 13). These areas are probably due to one of two things. Either the underlying Gasconade Formation is thinner in these areas, thereby leaving them slightly lower than the surrounding and enabling thicker Roubidoux accumulation, or these areas underwent differential compaction to a somewhat greater degree than their surroundings, allowing more Roubidoux sediment to accumulate in the overly compacted areas. There does appear to be a correlation between the somewhat thinner areas of the Gasconade Formation and the thicker deposits of the Roubidoux. An example of this is the Carrollton Dome region, where the Roubidoux attains a thickness of approximately 280 feet. This same area is covered by an anomalously thin section of Gasconade. Other areas that exhibit this trend are in central Washington and Madison Counties and in northern Fulton County. Both of these areas have thick Roubidoux sections and thin Gasconade sections (Plates 12 and 13).

The Roubidoux Formation also displays a central zone of higher sand and chert in northern Arkansas, with a zone to the south of increased dolomite content (Plate 13). This again suggests that terrigenous sediments were supplied to some extent from the north, and were emplaced in the central embayment. However, most of the deposition of the Roubidoux took place during a transgression of deeper waters from the south, much like the Gasconade Formation.

Also of interest is the high dolomite content of the western
<table>
<thead>
<tr>
<th>Well Reference Number</th>
<th>Township</th>
<th>Range</th>
<th>Section</th>
<th>County</th>
<th>Owner or Driller</th>
<th>Year Completed</th>
<th>Total Depth below Land Surface</th>
<th>Formation above MSL</th>
<th>Formation at Total Depth</th>
<th>Formation available from W.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16N</td>
<td>13W</td>
<td>30</td>
<td>Baxter</td>
<td>Town of Big Flat</td>
<td>1972</td>
<td>2603'</td>
<td>1305'</td>
<td>Gasconade</td>
<td>Gasconade</td>
</tr>
<tr>
<td>63</td>
<td>19N</td>
<td>14W</td>
<td>28</td>
<td>Baxter</td>
<td>Gassville</td>
<td>--</td>
<td>1503'</td>
<td>670'</td>
<td>Gunter</td>
<td>Gunter</td>
</tr>
<tr>
<td>67</td>
<td>20N</td>
<td>13W</td>
<td>33</td>
<td>Baxter</td>
<td>Baxter Lab</td>
<td>--</td>
<td>1865'</td>
<td>780'</td>
<td>Eminence</td>
<td>Eminence</td>
</tr>
<tr>
<td>14</td>
<td>18N</td>
<td>33W</td>
<td>34</td>
<td>Benton</td>
<td>Ozark Products Co. #1</td>
<td>--</td>
<td>2227'</td>
<td>1190'</td>
<td>Eminence</td>
<td>Eminence</td>
</tr>
<tr>
<td>15</td>
<td>19N</td>
<td>29W</td>
<td>18</td>
<td>Benton</td>
<td>City of Rogers</td>
<td>1954</td>
<td>1660'</td>
<td>1375'</td>
<td>Gunter</td>
<td>Gasconade</td>
</tr>
<tr>
<td>18</td>
<td>19N</td>
<td>33W</td>
<td>13</td>
<td>Benton</td>
<td>City of Decatur</td>
<td>--</td>
<td>1430'</td>
<td>1250'</td>
<td>Eminence</td>
<td>Eminence</td>
</tr>
<tr>
<td>Well Reference Number</td>
<td>Type of Well Log</td>
<td>Source of Well Log</td>
<td>Roubidoux Formation Top Thickness</td>
<td>Gasconade Fm. Top Thickness</td>
<td>Gunter Mbr. Top Thickness</td>
<td>Remarks</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------------</td>
<td>-------------------</td>
<td>-------------------------------</td>
<td>---------------------------</td>
<td>-------------------------</td>
<td>---------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Overall Zone C Zone B Zone A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Insol Res. Mo. Survey Electric- Gamma</td>
<td>U.S.G.S.</td>
<td>-1055 2360 230 - 230</td>
<td>-1285 2550</td>
<td></td>
<td>Previously called Gunter Well</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>--</td>
<td>--</td>
<td>-55 (725) 230 - 230</td>
<td>-285 (955) 495+ 780 (1450)</td>
<td>50+ T.D. in Gunter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>67</td>
<td>--</td>
<td>--</td>
<td>-- -- --</td>
<td>-295 (1075) 490+ 785 (1565)</td>
<td>55 Samples Begin in Roubidoux</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Insol Residue Mo. Survey</td>
<td>-5 (1195)</td>
<td>205 75 40 90</td>
<td>-210 (1400) 340+ 550 (1740)</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Insol Residue Mo. Survey</td>
<td>315 (1060)</td>
<td>210 40 150 20</td>
<td>105 (1270)</td>
<td>-- --</td>
<td>Roubidoux Top pick from Mis- No Samples</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Insol Residue Mo. Survey</td>
<td>-- -- --</td>
<td>-- 170 (1080) 310 (1390)</td>
<td>30</td>
<td>No Samples For Roubidoux</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well Reference Number</td>
<td>Location</td>
<td>County</td>
<td>Owner or Driller</td>
<td>Year Completed</td>
<td>Total Depth below Land Surface</td>
<td>Formation above HSL</td>
<td>Formation at Total Depth</td>
<td>Formation Available from W.S.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td>----------</td>
<td>--------</td>
<td>------------------</td>
<td>----------------</td>
<td>-------------------------------</td>
<td>---------------------</td>
<td>--------------------------</td>
<td>-------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>20N 33W 11</td>
<td>Benton</td>
<td>City of Gravette #2</td>
<td>1954</td>
<td>1603'</td>
<td>1199'</td>
<td>Eminence</td>
<td>Eminence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>19N 31W 12</td>
<td>Benton</td>
<td>Hillsap-Grady Jones #1</td>
<td>--</td>
<td>2338</td>
<td>1273</td>
<td>Pre-Cambrian</td>
<td>Pre-Cambrian</td>
<td></td>
<td></td>
</tr>
<tr>
<td>66</td>
<td>20N 30W 7</td>
<td>Benton</td>
<td>City of Pea Ridge</td>
<td>--</td>
<td>1255</td>
<td>7</td>
<td>Roubidoux</td>
<td>Roubidoux</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28A</td>
<td>18N 22W 24</td>
<td>Boone</td>
<td>AVG RHEA Bryan #1</td>
<td>--</td>
<td>2343</td>
<td>1894</td>
<td>Eminence</td>
<td>Eminence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>65</td>
<td>18N 19W 33</td>
<td>Boone</td>
<td>Valley Springs water well</td>
<td>--</td>
<td>2050</td>
<td>1375</td>
<td>Gunter (Base)</td>
<td>Gunter (Base)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>19N 23W 4</td>
<td>Carroll</td>
<td>City of Green Forest</td>
<td>1963</td>
<td>1587</td>
<td>1349</td>
<td>Gasconade</td>
<td>Gasconade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well Reference Number</td>
<td>Type of Well Log Available</td>
<td>Source of Well Log</td>
<td>Top Roubidoux Formation Thickness</td>
<td>Gasconade Fm. Top Thickness</td>
<td>Gunter Mbr. Top Thickness</td>
<td>Remarks</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td>----------------------------</td>
<td>-------------------</td>
<td>----------------------------------</td>
<td>----------------------------</td>
<td>--------------------------</td>
<td>---------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21 Insol.</td>
<td>No. Survey</td>
<td>139 (1060)</td>
<td>190 55 135</td>
<td>-51 (1250)</td>
<td>-361 (1560)</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>--</td>
<td>143 (1130)</td>
<td>210 20 100 90</td>
<td>-67 (1340)</td>
<td>-372 (1645)</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>66</td>
<td>--</td>
<td>7 (1130)</td>
<td>--- 70 ---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28A Insol. Res. and</td>
<td>No. Survey</td>
<td>274 (1620)</td>
<td>265 ---</td>
<td>9 (1885)</td>
<td>-326 (2220)</td>
<td>110</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electric A.W.G.</td>
<td>No. Survey</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65 Electric U.S.G.S.</td>
<td>85 (1290)</td>
<td>230</td>
<td>230 --</td>
<td>-145 (1520)</td>
<td>-555 (1930)</td>
<td>120</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32 Insol. Residue</td>
<td>-16 (1365)</td>
<td>215 35 105 25</td>
<td>-231 (1580)</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well Reference Number</td>
<td>Location</td>
<td>County</td>
<td>Owner or Driller</td>
<td>Year Completed</td>
<td>Total Depth below Land Surface</td>
<td>Formation above MSL</td>
<td>Formation at Total Depth</td>
<td>Formation Available from W.S.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td>----------</td>
<td>----------</td>
<td>---------------------------</td>
<td>----------------</td>
<td>--------------------------------</td>
<td>---------------------</td>
<td>--------------------------</td>
<td>--------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>21N 26W 27</td>
<td>Carroll</td>
<td>Holiday Island #4</td>
<td>1972</td>
<td>1880</td>
<td>1520</td>
<td>Eminence</td>
<td>Eminence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>20N 8W 27</td>
<td>Fulton</td>
<td>Salem W.W. #1</td>
<td>1956</td>
<td>1282'</td>
<td>660'</td>
<td>Gunter</td>
<td>Gunter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>20N 9W 18</td>
<td>Fulton</td>
<td>Viola W.W. #1</td>
<td>1964</td>
<td>1600</td>
<td>800'</td>
<td>Eminence</td>
<td>Eminence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>18N 7W 31</td>
<td>Izard</td>
<td>Franklin #2 Adcock Drillers</td>
<td>1970</td>
<td>1300</td>
<td>670'</td>
<td>Gasconade</td>
<td>Gasconade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>16N 2W 6</td>
<td>Madison</td>
<td>Independent Oil and Gas #1 Banks</td>
<td>--</td>
<td>2515</td>
<td>1545</td>
<td>Eminence</td>
<td>Eminence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>68</td>
<td>17N 20W 20</td>
<td>Newton</td>
<td>Marble Falls W.W.</td>
<td>--</td>
<td>2503</td>
<td>1544</td>
<td>Gunter (Base)</td>
<td>Gunter (Base)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well Reference Number</td>
<td>Type of Well Log Available</td>
<td>Source of Well Log</td>
<td>Top</td>
<td>Roubidoux Formation Thickness Overall Zone C Zone B Zone A</td>
<td>Gasconade Fm. Top Thickness Zone A</td>
<td>Gunter Mbr. Top Thickness Zone A</td>
<td>Remarks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------------</td>
<td>--------------------</td>
<td>-----</td>
<td>-----------------------------------------------</td>
<td>-----------------------------------</td>
<td>-----------------------------------</td>
<td>---------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>Insol. Residue and Electric</td>
<td>Mo. Survey U.S.G.S.</td>
<td>560 (960)</td>
<td>185 120 65 --</td>
<td>375 (1145)</td>
<td>335</td>
<td>40 (1480) 70</td>
<td>Incomplete Roubidoux Samples</td>
<td></td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>--</td>
<td>--</td>
<td>255 (415)</td>
<td>265 --- 265 --</td>
<td>-10 (670)</td>
<td>535</td>
<td>-545 (1205) 60+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>Insol. Residue</td>
<td>Mo. Survey (880)</td>
<td>210 --- 210 --</td>
<td>-290 (1090)</td>
<td>490</td>
<td>-730 (1580) 40</td>
<td>Poorly Developed Gunter Section</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>Insol. Residue</td>
<td>Mo. Survey (1030)</td>
<td>-360</td>
<td>250 --- 250 --</td>
<td>-610 (1280)</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>Insol. Residue</td>
<td>Mo. Survey (1486)</td>
<td>59</td>
<td>250 --- 125 125</td>
<td>-190 (1735)</td>
<td>305</td>
<td>-495 (2040) 60</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>68</td>
<td>Electric</td>
<td>U.S.G.S.</td>
<td>-176 (1720)</td>
<td>180 --- 120 60</td>
<td>-356 (1900)</td>
<td>440</td>
<td>-796 (2340) 120</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well Reference Number</td>
<td>Location</td>
<td>County</td>
<td>Owner or Driller</td>
<td>Year Completed</td>
<td>Total Depth below Land Surface</td>
<td>Formation above HSL</td>
<td>Formation at Total Depth</td>
<td>Formation Available from W.S.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td>------------</td>
<td>---------</td>
<td>------------------</td>
<td>----------------</td>
<td>-------------------------------</td>
<td>---------------------</td>
<td>------------------------</td>
<td>-----------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>15N 16W 25</td>
<td>Searcy</td>
<td>Marshall #3</td>
<td>---</td>
<td>2415</td>
<td>1100</td>
<td>Gasconade</td>
<td>Gasconade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>18N 6W 10</td>
<td>Sharp</td>
<td>Ash Flat #1</td>
<td>---</td>
<td>1545</td>
<td>555</td>
<td>Gunter</td>
<td>Gunter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>58</td>
<td>16N 32W 9</td>
<td>Washington</td>
<td>Lake Wedington Park Forest Service</td>
<td>1973</td>
<td>1815</td>
<td>1135</td>
<td>Eminence</td>
<td>Eminence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well Reference Number</td>
<td>Type of Well Log Available</td>
<td>Source of Well Log</td>
<td>Top</td>
<td>Roubidoux Formation Thickness Overall</td>
<td>ZoneC</td>
<td>ZoneB</td>
<td>ZoneA</td>
<td>Gasconade Fm. Top Thickness</td>
<td>Gunter Mbr. Top Thickness</td>
<td>Remarks</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------------------------</td>
<td>-------------------</td>
<td>-----</td>
<td>-------------------------------------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>--------------------------------</td>
<td>-----------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>53 Insol. Residue</td>
<td>Ho. Survey -1030</td>
<td></td>
<td>235</td>
<td>235</td>
<td>---</td>
<td>235</td>
<td>---</td>
<td>-1265 (2365)</td>
<td></td>
<td>---</td>
</tr>
<tr>
<td>54 Insol. Residue</td>
<td>Ho. Survey -200 (755)</td>
<td></td>
<td>220</td>
<td>220</td>
<td>---</td>
<td>220</td>
<td>---</td>
<td>-420 (975)</td>
<td>545 (1520)</td>
<td>25+</td>
</tr>
<tr>
<td>58 Electric U.S.G.S.</td>
<td>-70 (1205)</td>
<td></td>
<td>210</td>
<td>210</td>
<td>---</td>
<td>210</td>
<td>---</td>
<td>-280 (1415)</td>
<td>315 (1730)</td>
<td>40</td>
</tr>
</tbody>
</table>
edge of northern Arkansas. This is in contrast to the pattern exhibited by the Gasconade Formation. It is possible that this portion of the state became isolated from the bulk of the supply of terrigenous sediments. Then as inundation of the area occurred, extensive carbonate deposition took place and carbonates occur as the dominant sedimentary facies of the region.

SUMMARY AND CONCLUSIONS

The development of groundwater resources of the Ozark Plateaus region is essential to future economic growth in northern Arkansas and Missouri. Yields from shallow aquifer wells are generally inadequate to supply the needs of industry and municipalities. Adequate supplies must therefore be developed from deeper aquifer units. The Roubidoux and Gasconade Formations are the most accessible and reliable deep aquifers in the area. The future development and proper utilization of these aquifers depends on understanding the regional hydrogeologic characteristics of the Roubidoux and Gasconade Formations in the recharge and discharge areas.
of the Roubidoux and Gasconade Formations in Missouri and Arkansas. The specific objectives were accomplished in the following manner.

1) The description of the lithologic character of the aquifers and their areal distribution has been provided by synthesizing pertinent information sources.

The Roubidoux and Gasconade Formations, and the Gunter Sandstone Member of the Gasconade Formation, are the most reliable and accessible sources of water supplies for industrial and municipal development in the Ozark Plateaus region. The area of outcrop of the formations is confined to the Salem Plateau region of south central Missouri where the units are exposed in belts peripheral to the Ozark dome. Regionally the strata dip beneath successively younger units from the uplift toward surrounding basins.

Throughout most of the area the upper part of the Gasconade Formation consists of fine to coarsely-crystalline dolomite. The basal Gunter Member is composed of sandstone in south central Missouri and north central Arkansas and increases in dolomite content east and west of this area.

The lithology of the Roubidoux Formation is primarily cherty to sandy, finely-crystalline, light-gray to brown dolomite. Well developed
sandstone bodies are present in portions of Missouri, but have not been observed in Arkansas.

2) Isopachous maps for the aquifers along with a structure map contoured on the base of the Roubidoux Formation were prepared. The maps consist of data published by McCracken (1965) for the Missouri portion of the study area, and data derived from the analysis of available well logs and samples for the Arkansas Ordovician sequence.

Regional thickness trends within the aquifers follow the pattern of increasing in thickness from northwest to southeast. The Gasconade Formation, including the Gunter Member, has a range of thickness from 160 to 660 feet. The Gunter Sandstone Member averages 30 feet thick over much of the area, and ranges from 0 to 120 feet thick. The thickness of the Roubidoux Formation ranges from 100 to 280 feet.

3) The distribution of yields and specific capacities for wells penetrating the Roubidoux and Gasconade Formations have been evaluated. Yield and specific capacities maps were constructed from data obtained from various State, engineering, and Federal agencies in Missouri and Arkansas. These maps offer some estimate of the availability of water from the aquifers.
Reported yields from wells penetrating the Roubidoux or Gasconade Formations represent the contribution from all aquifers open below the casing rather than the water available from individual aquifers. Yields from wells penetrating the Roubidoux Formation range from 4 gpm to 600 gpm and average 50-60 gpm. Specific capacities of these wells are generally less than 1 gpm/ft. Wells penetrating the Gasconade Formation have yields ranging from 4 gpm to 732 gpm, with an average of 170 gpm. Specific capacities average less than 2 gpm/ft.

4) To determine the relationship of recharge, groundwater movement, and discharge associated with the aquifers, a map of the potentiometric surface was constructed from reported water level measurements in wells penetrating the deep aquifers. Records from continuous recording devices were then evaluated to determine the influence of precipitation on water levels. Graphs of drawdown versus time were derived from available pump tests to determine the effects of local recharge and discharge. Spring discharge and stream low-flow data were examined as indicators of the character of recharge and discharge from the aquifers.

Groundwater recharge, which is derived from
precipitation, takes place over virtually the entire area underlain by carbonate rocks, but is greatest within the Salem Plateau region where the aquifers crop out. The different responses of wells to individual rainfalls show that recharge is more frequent and rapid in this area than in the Springfield Plateau where the aquifers are confined to the subsurface.

The configuration of the potentiometric surface reflects the artesian conditions present within the aquifers and generally corresponds to major features of the land surface. Groundwater ridges underlie major stream channels. Water moves down the hydrodynamic gradient from groundwater ridges to groundwater troughs.

Discharge of groundwater takes the form of effluent seepage along stream channels, flowing springs, movement from one aquifer to another, and artificial discharge from wells. Discharge within the Salem Plateau is more extensive than that of the Springfield Plateau.

5) Selected water quality data were evaluated to determine the regional quality of waters associated with the aquifers.
Groundwater from wells penetrating the Roubidoux and Gasconade Formations is the calcium-magnesium, bicarbonate type. Although the water is hard to very hard, it is of good chemical quality and suitable for most uses. The distribution of dissolved minerals in the groundwater corresponds in a general way to the overall direction of movement of water. Total dissolved solids are low along groundwater ridges and high in groundwater troughs. Calcium/magnesium ratios are high along groundwater ridges and decrease toward groundwater troughs. Chloride concentrations increase with the regional gradient from the southwest portion of the study area toward the Arkoma Basin.
RECOMMENDATIONS

Knowledge of the extent and capabilities of water resources from the Roubidoux and Gasconade Formations is necessary in order to utilize them properly. This study has described the regional geologic and hydrologic character of the aquifers and offers some reasonable estimate of water availability and the factors influencing groundwater occurrence. The study utilized existing subsurface and hydrologic data which offer knowledge that may be sufficient for the present level of groundwater development of the area. The present data, however, may prove insufficient in many respects as the utilization of groundwater resources increases.

The following recommendations for further studies should be considered as increased utilization of groundwater from the Roubidoux and Gasconade Formations occurs.

1) Data are needed to outline more accurately the depths, thicknesses, facies changes, and continuity of the aquifers. As new wells are drilled they should be evaluated and the new data incorporated to increase the accuracy of existing maps.

2) Detailed evaluation of existing geophysical well logs was beyond the scope of this study. Analysis of these data may offer valuable information on porosity, permeability, safe yield, occurrence of of subsurface movement of water within the aquifer units.
3) The present study suggests that water yields are significantly higher along linear traces and fault zones. A more comprehensive study is necessary to establish the magnitude of influence that linear and fracture systems exert on water availability from the aquifers.

4) The existing water level monitoring program in northern Arkansas should be expanded to include several well sites equipped with continuous monitoring devices. This would provide more accurate information on discharge, recharge and water declines.

5) A program of co-operation between drillers, engineering companies, and state and federal agencies should be initiated in Arkansas to insure the optimum development and utilization of data from newly drilled wells.
REFERENCES


Knight, R. D., 1962, Groundwater areas in Missouri: Mo. Geol. Survey and Water Resources, one sheet.


McCracken, E. and McCracken, M. H., 1965, Subsurface maps of the lower Ordovician (Canadian series) of Missouri: Mo. Geol. Survey and Water Resources, 6 sheets. scale 1:1,000,000.


Appendix A
Well Data for Water Well Yield and Specific Capacity Maps

**ABBREVIATIONS**

<table>
<thead>
<tr>
<th>Box Headings</th>
<th>Mb</th>
<th>Boone Formation</th>
<th>Oc</th>
<th>Cotter Formation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ft. - feet</td>
<td>Mbk</td>
<td>Burlington-Keokuk Formation</td>
<td>Og</td>
<td>Gasconade Formation</td>
</tr>
<tr>
<td>g.p.m. - gallons per minute</td>
<td>Meh</td>
<td>Chouteau Group</td>
<td>Oje</td>
<td>Jefferson City Formation</td>
</tr>
<tr>
<td>fm. - formation</td>
<td>Mfg</td>
<td>Fern Glen Formation</td>
<td>Or</td>
<td>Roubidoux Formation</td>
</tr>
<tr>
<td>T.-N. - Township-North</td>
<td>Mg</td>
<td>Grand Falls Formation</td>
<td>P</td>
<td>Pennsylvania System</td>
</tr>
<tr>
<td>R.-W. E. - Range-West, East</td>
<td>Mn</td>
<td>Northview Formation</td>
<td>Pcc</td>
<td>Cherokee Group</td>
</tr>
<tr>
<td>Stratigraphic Units</td>
<td>Mpb</td>
<td>Pitkin-Fayetteville Formation</td>
<td>Qal</td>
<td>Alluvium</td>
</tr>
<tr>
<td>Cambrian System</td>
<td>Mr</td>
<td>Reeds Spring Formation</td>
<td>Parentheses () indicate production after treatment</td>
<td></td>
</tr>
<tr>
<td>Ce Eminence Formation</td>
<td>Hsi</td>
<td>St. Louis Formation</td>
<td>Missouri Data after Robertson, 1963</td>
<td></td>
</tr>
<tr>
<td>M Mississippian System</td>
<td>Hw</td>
<td>Warsaw Formation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Well</th>
<th>Name</th>
<th>County</th>
<th>Location</th>
<th>Surface Formation</th>
<th>Penetration of Basal Fm. (Fm.)</th>
<th>Static Water Level</th>
<th>Yield GPM</th>
<th>Draw Spec. Down Capacity</th>
<th>Casing Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Harles</td>
<td>T. 41 N. R. 9 W.</td>
<td>0jc</td>
<td>600</td>
<td>Ce</td>
<td>15</td>
<td>220</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Miller</td>
<td>T. 40 N. R. 15 W.</td>
<td>Or</td>
<td>405</td>
<td>Ce</td>
<td>45</td>
<td>180</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Lowry City</td>
<td>T. 39 N. R. 26 W.</td>
<td>P</td>
<td>.0g</td>
<td>42</td>
<td>625</td>
<td>157</td>
<td>90</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>St. Clair</td>
<td>T. 39 N. R. 24 W.</td>
<td>Mbk</td>
<td>650</td>
<td>0g</td>
<td>160</td>
<td>150</td>
<td>91</td>
</tr>
<tr>
<td>Well #</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Depth</td>
<td>Penetration of Basal Fm. (Ft.)</td>
<td>Static Water Level</td>
<td>Yield GPM</td>
<td>Draw Down</td>
</tr>
<tr>
<td>-------</td>
<td>------------</td>
<td>--------</td>
<td>--------------</td>
<td>-------------------</td>
<td>-------</td>
<td>-------------------------------</td>
<td>-------------------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>5</td>
<td>St. Clair</td>
<td></td>
<td>T. 39 N.</td>
<td>Mbk</td>
<td>650</td>
<td>0g</td>
<td>160</td>
<td>148</td>
<td>124</td>
</tr>
<tr>
<td>6</td>
<td>Cuba #1</td>
<td>Crawford</td>
<td>T. 39 N.</td>
<td>P</td>
<td>602</td>
<td>Ce</td>
<td>55</td>
<td>225</td>
<td>135</td>
</tr>
<tr>
<td>7</td>
<td>Schell City</td>
<td>Vernon</td>
<td>T. 38 N.</td>
<td>Pcc</td>
<td>714</td>
<td>Og</td>
<td>125</td>
<td>35</td>
<td>250</td>
</tr>
<tr>
<td>8</td>
<td>St. Clair</td>
<td></td>
<td>T. 38 N.</td>
<td>Mch</td>
<td>550</td>
<td>Og</td>
<td>160</td>
<td>10</td>
<td>125</td>
</tr>
<tr>
<td>9</td>
<td>St. Clair</td>
<td></td>
<td>T. 35 N.</td>
<td>Mch</td>
<td>500</td>
<td>Og</td>
<td>30</td>
<td>105</td>
<td>40</td>
</tr>
<tr>
<td>10</td>
<td>Pulaski</td>
<td></td>
<td>T. 35 N.</td>
<td>Ojc</td>
<td>600</td>
<td>Ce</td>
<td>10</td>
<td>285</td>
<td>75</td>
</tr>
<tr>
<td>11</td>
<td>Phelps</td>
<td></td>
<td>T. 38 N.</td>
<td>Or</td>
<td>395</td>
<td>Og</td>
<td>205</td>
<td>255</td>
<td>40</td>
</tr>
<tr>
<td>12</td>
<td>Vernon</td>
<td></td>
<td>T. 37 N.</td>
<td>Pcc</td>
<td>852</td>
<td>Or</td>
<td>165</td>
<td>26</td>
<td>160</td>
</tr>
<tr>
<td>13</td>
<td>St. Clair</td>
<td></td>
<td>T. 37 N.</td>
<td>P</td>
<td>415</td>
<td>Or</td>
<td>105</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>Well</td>
<td>Name</td>
<td>County</td>
<td>Surface Location</td>
<td>Formation</td>
<td>Depth</td>
<td>Penetration of Basal Fm. (Fm.) (Ft.)</td>
<td>Static Water Level</td>
<td>Yield GPM</td>
<td>Draw Down</td>
</tr>
<tr>
<td>------</td>
<td>----------</td>
<td>--------</td>
<td>------------------</td>
<td>-----------</td>
<td>-------</td>
<td>--------------------------------------</td>
<td>-------------------</td>
<td>----------</td>
<td>-----------</td>
</tr>
<tr>
<td>14</td>
<td>St. Clair</td>
<td></td>
<td>T. 37 N. R. 25 W. 1</td>
<td></td>
<td>440</td>
<td>Or 73</td>
<td>125</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Hickory</td>
<td></td>
<td>T. 37 N. R. 22 W. 19</td>
<td>Mbk</td>
<td>416</td>
<td>Or 55</td>
<td>185</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>16</td>
<td>Hickory</td>
<td></td>
<td>T. 37 N. R. 21 W. 36</td>
<td>Oc</td>
<td>450</td>
<td>0g 45</td>
<td>85</td>
<td>35</td>
<td>22</td>
</tr>
<tr>
<td>17</td>
<td>Phelps</td>
<td></td>
<td>T. 37 N. R. 8 W. 2</td>
<td>Ojc</td>
<td>600</td>
<td>0g 245</td>
<td>292</td>
<td>80</td>
<td>58</td>
</tr>
<tr>
<td>18</td>
<td>Phelps</td>
<td></td>
<td>T. 37 N. R. 7 W. 4</td>
<td>Ojc</td>
<td>530</td>
<td>Ce 10</td>
<td>155</td>
<td>100</td>
<td>234</td>
</tr>
<tr>
<td>19</td>
<td>Phelps</td>
<td></td>
<td>T. 37 N. R. 6 W. 4</td>
<td>Or</td>
<td>310</td>
<td>0g 160</td>
<td>245</td>
<td>10</td>
<td>84</td>
</tr>
<tr>
<td>20</td>
<td>Nevada</td>
<td></td>
<td>T. 36 N. R. 31 W. 5</td>
<td>P</td>
<td>1,001</td>
<td>0g 147</td>
<td>78</td>
<td>275</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Vernon</td>
<td></td>
<td>Eldorado Springs</td>
<td>2</td>
<td>1,046</td>
<td>0g 220</td>
<td>70</td>
<td>175</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Cedar</td>
<td></td>
<td>Cedar</td>
<td>2</td>
<td>946</td>
<td>0g 125</td>
<td>166</td>
<td>315</td>
<td>5</td>
</tr>
<tr>
<td>Well #</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Depth</td>
<td>Penetration of Basal Fm. (Fm.) (Pn.)</td>
<td>Static Water Level</td>
<td>Yield GPM</td>
<td>Draw Down</td>
</tr>
<tr>
<td>-------</td>
<td>---------</td>
<td>--------</td>
<td>------------</td>
<td>-------------------</td>
<td>-------</td>
<td>-------------------------------------</td>
<td>------------------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>23</td>
<td>Hickory</td>
<td>Hickory</td>
<td>T. 36 N. R. 24 W. 11</td>
<td>Mbk</td>
<td>430</td>
<td>0r</td>
<td>45</td>
<td>125</td>
<td>15</td>
</tr>
<tr>
<td>24</td>
<td>Hickory</td>
<td>Hickory</td>
<td>T. 36 N. R. 22 W. 2</td>
<td>Oc</td>
<td>700</td>
<td>0g</td>
<td>340</td>
<td>110</td>
<td>41</td>
</tr>
<tr>
<td>25</td>
<td>Pulaski</td>
<td>Pulaski</td>
<td>T. 36 N. R. 11 W. 17</td>
<td>Or</td>
<td>450</td>
<td>Ce</td>
<td>15</td>
<td>223</td>
<td>20</td>
</tr>
<tr>
<td>26</td>
<td>Phelps</td>
<td>Nevada</td>
<td>T. 36 N. R. 7 W. 18</td>
<td>Pcc</td>
<td>432</td>
<td>0g</td>
<td>22</td>
<td>270</td>
<td>10</td>
</tr>
<tr>
<td>27</td>
<td>Nevada</td>
<td>Vernon</td>
<td>T. 35 N. R. 31 W. 5</td>
<td>Pcc</td>
<td>1,100</td>
<td>Ce</td>
<td>25</td>
<td>127</td>
<td>732</td>
</tr>
<tr>
<td>28</td>
<td>Vernon</td>
<td>Vernon</td>
<td>T. 35 N. R. 31 W. 12</td>
<td>Pcc</td>
<td>1,050</td>
<td>0g</td>
<td>150</td>
<td>140</td>
<td>350</td>
</tr>
<tr>
<td>29</td>
<td>Laclede</td>
<td></td>
<td>T. 35 N. R. 15 W. 32</td>
<td>Oje</td>
<td>571</td>
<td>Ce</td>
<td>10</td>
<td>174</td>
<td>10</td>
</tr>
<tr>
<td>30</td>
<td>Pulaski</td>
<td>Pulaski</td>
<td>T. 35 N. R. 13 W. 13</td>
<td>Oje</td>
<td>525</td>
<td>0g</td>
<td>340</td>
<td>370</td>
<td>15</td>
</tr>
<tr>
<td>31</td>
<td>Pulaski</td>
<td>Pulaski</td>
<td>T. 35 N. R. 13 W. 17</td>
<td>Oje</td>
<td>510</td>
<td>0g</td>
<td>325</td>
<td>175</td>
<td>20</td>
</tr>
<tr>
<td>Well #</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Depth</td>
<td>Penetration of Basal Fl. (Fm.) (Pt.)</td>
<td>Static Water Level</td>
<td>Yield GPM</td>
<td>Draw Down</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
<td>--------</td>
<td>------------------------</td>
<td>-------------------</td>
<td>-------</td>
<td>------------------------------------</td>
<td>-------------------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>32</td>
<td>Pulaski</td>
<td></td>
<td>T. 35 N. R. 12 W. 3</td>
<td>Ojc</td>
<td>455</td>
<td>0g</td>
<td>215</td>
<td>340</td>
<td>12</td>
</tr>
<tr>
<td>33</td>
<td>Pulaski</td>
<td></td>
<td>T. 35 N. R. 12 W. 8</td>
<td>Or</td>
<td>505</td>
<td>0g</td>
<td>320</td>
<td>365</td>
<td>20</td>
</tr>
<tr>
<td>34</td>
<td>Bronaugh</td>
<td>Vernon</td>
<td>T. 34 N. R. 32 W. 20</td>
<td>Pce</td>
<td>853</td>
<td>Or</td>
<td>78</td>
<td>195</td>
<td>82</td>
</tr>
<tr>
<td>35</td>
<td>Sheldon</td>
<td>Vernon</td>
<td>T. 34 N. R. 31 W. 35</td>
<td>P</td>
<td>930</td>
<td>Or</td>
<td>155</td>
<td>185</td>
<td>73</td>
</tr>
<tr>
<td>36</td>
<td>Cedar</td>
<td></td>
<td>T. 34 N. R. 26 W. 4</td>
<td>Mbk</td>
<td>456</td>
<td>Or</td>
<td>60</td>
<td>220</td>
<td>20</td>
</tr>
<tr>
<td>37</td>
<td>Cedar</td>
<td></td>
<td>T. 34 N. R. 26 W. 8</td>
<td>Mbk</td>
<td>850</td>
<td>Ce</td>
<td>15</td>
<td>200</td>
<td>105</td>
</tr>
<tr>
<td>38</td>
<td>Buffalo 1</td>
<td>Dallas</td>
<td>T. 34 N. R. 20 W. 28</td>
<td>Ojc</td>
<td>715</td>
<td>Ce</td>
<td>25</td>
<td>181</td>
<td>75</td>
</tr>
<tr>
<td>39</td>
<td>Dallas</td>
<td></td>
<td>T. 34 N. R. 18 W. 33</td>
<td>Ojc</td>
<td>323</td>
<td>0g</td>
<td>157</td>
<td>110</td>
<td>25</td>
</tr>
<tr>
<td>40</td>
<td>Laclede</td>
<td></td>
<td>T. 34 N. R. 13 W. 20</td>
<td>Ojc</td>
<td>700</td>
<td>Ce</td>
<td>15</td>
<td>272</td>
<td>25</td>
</tr>
<tr>
<td>Well</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Depth</td>
<td>Penetration of Basal Fm. (Ft.)</td>
<td>Static Water Level</td>
<td>Yield GPM</td>
<td>Draw Down Spec. Capacity</td>
</tr>
<tr>
<td>------</td>
<td>--------------</td>
<td>--------</td>
<td>----------</td>
<td>-------------------</td>
<td>-------</td>
<td>-------------------------------</td>
<td>-------------------</td>
<td>----------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>41</td>
<td>Phelps</td>
<td></td>
<td>T. 34 N R. 9 W. 18</td>
<td>Or</td>
<td>450</td>
<td>Ce 10 190</td>
<td>40</td>
<td>None</td>
<td>275</td>
</tr>
<tr>
<td>42</td>
<td>Texas</td>
<td></td>
<td>T. 33 N R. 11 W. 27</td>
<td>Oje</td>
<td>463</td>
<td>Og 90 378</td>
<td>15</td>
<td>111</td>
<td>1,478</td>
</tr>
<tr>
<td>43</td>
<td>Dent</td>
<td></td>
<td>T. 33 N R. 6 W. 30</td>
<td>Or</td>
<td>405</td>
<td>Og 300</td>
<td>10</td>
<td>307</td>
<td>1,300</td>
</tr>
<tr>
<td>44</td>
<td>Bollinger</td>
<td></td>
<td>T. 33 N R. 10 E. 30</td>
<td>Oe</td>
<td>630</td>
<td>Or 215 35</td>
<td>20</td>
<td>14</td>
<td>673</td>
</tr>
<tr>
<td>45</td>
<td>Liberal</td>
<td></td>
<td>T. 32 N R. 33 W. 2</td>
<td>P</td>
<td>817</td>
<td>Or 87 160</td>
<td>86</td>
<td>3</td>
<td>28.3</td>
</tr>
<tr>
<td>46</td>
<td>Lamar 2</td>
<td></td>
<td>T. 32 N R. 30 W. 18</td>
<td>Pcc</td>
<td>981</td>
<td>Og 35 247(238)</td>
<td>30(320)</td>
<td>(57)</td>
<td>(5.6)</td>
</tr>
<tr>
<td>47</td>
<td>Lamar 1</td>
<td></td>
<td>T. 32 N R. 30 W. 30</td>
<td></td>
<td>971</td>
<td>Og 35 220</td>
<td>20(255)</td>
<td>(16)</td>
<td>(15.9)</td>
</tr>
<tr>
<td>49</td>
<td>Polk</td>
<td></td>
<td>T. 32 N R. 22 W. 35</td>
<td>Or</td>
<td>475</td>
<td>Or 35 170</td>
<td>12</td>
<td>10</td>
<td>1.2</td>
</tr>
<tr>
<td>Well #</td>
<td>Name County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Depth</td>
<td>Penetration of Basal Fm. (Fm.) (Ft.)</td>
<td>Static Water Level</td>
<td>Yield GPM</td>
<td>Draw Down</td>
<td>Spec. Capacity</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
<td>----------</td>
<td>------------------</td>
<td>-------</td>
<td>----------------------------------</td>
<td>-------------------</td>
<td>-----------</td>
<td>-----------</td>
<td>----------------</td>
</tr>
<tr>
<td>50</td>
<td>Polk</td>
<td>T. 32 N. R. 21 W. 9</td>
<td>Oc</td>
<td>294</td>
<td>Or 44</td>
<td>141</td>
<td>15</td>
<td>75</td>
<td>0.2</td>
</tr>
<tr>
<td>51</td>
<td>Lacleda</td>
<td>T. 32 N. R. 12 W. 7</td>
<td>Oje</td>
<td>722</td>
<td>Og 385</td>
<td>170</td>
<td>37</td>
<td>12</td>
<td>3.0</td>
</tr>
<tr>
<td>52</td>
<td>Texas</td>
<td>T. 32 N. R. 12 W. 11</td>
<td>Or</td>
<td>337</td>
<td>Og 182</td>
<td>90</td>
<td>26</td>
<td>62</td>
<td>0.4</td>
</tr>
<tr>
<td>53</td>
<td>Dent</td>
<td>T. 32 N. R. 5 W. 7</td>
<td>305</td>
<td>Og</td>
<td>230</td>
<td>4</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>Golden City</td>
<td>T. 31 N. R. 29 W. 26</td>
<td>Mw</td>
<td>893</td>
<td>Og 148</td>
<td>155</td>
<td>150</td>
<td>29</td>
<td>5.2</td>
</tr>
<tr>
<td>55</td>
<td>Barton</td>
<td>T. 31 N. R. 28 W. 36</td>
<td>Mal</td>
<td>1,202</td>
<td>Ce 10</td>
<td>200</td>
<td>155</td>
<td>120</td>
<td>1.3</td>
</tr>
<tr>
<td>56</td>
<td>Dade</td>
<td>T. 31 N. R. 27 W. 5</td>
<td>Mw</td>
<td>670</td>
<td>Or 35</td>
<td>235</td>
<td>35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>57</td>
<td>Dade</td>
<td>T. 31 N. R. 26 W. 8</td>
<td>Mbk</td>
<td>455</td>
<td>Or 5</td>
<td>140</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Depth</td>
<td>Penetration of Basal Ft. (Ft.)</td>
<td>Static Water Level</td>
<td>Yield GPM</td>
<td>Draw Down</td>
</tr>
<tr>
<td>------</td>
<td>------------</td>
<td>--------</td>
<td>----------</td>
<td>------------------</td>
<td>-------</td>
<td>-------------------------------</td>
<td>-------------------</td>
<td>----------</td>
<td>-----------</td>
</tr>
<tr>
<td>58</td>
<td>Greenfield</td>
<td>Dade</td>
<td>T. 31 N. R. 26 W. 19</td>
<td>Mbk</td>
<td>1,006</td>
<td>0g</td>
<td>276</td>
<td>235</td>
<td>293</td>
</tr>
<tr>
<td>59</td>
<td>Walnut Grove</td>
<td>Green</td>
<td>T. 31 N. R. 24 W. 11</td>
<td>Mw</td>
<td>838</td>
<td>0g</td>
<td>25</td>
<td>215</td>
<td>100</td>
</tr>
<tr>
<td>60</td>
<td>Wright</td>
<td>Texas</td>
<td>T. 31 N. R. 13 W. 22</td>
<td>Ojck</td>
<td>300</td>
<td>Or</td>
<td>130</td>
<td>102</td>
<td>11</td>
</tr>
<tr>
<td>61</td>
<td>Texas</td>
<td></td>
<td>T. 31 N. R. 10 W. 6</td>
<td>Ojck</td>
<td>455</td>
<td>0g</td>
<td>90</td>
<td>315</td>
<td>17</td>
</tr>
<tr>
<td>62</td>
<td>Reynolds</td>
<td></td>
<td>T. 31 N. R. 1 W. 8</td>
<td>Or</td>
<td>384</td>
<td>0g</td>
<td>270</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>Bollinger</td>
<td></td>
<td>T. 31 N. R. 9 E. 3</td>
<td>Or</td>
<td>190</td>
<td>0g</td>
<td>65</td>
<td>122</td>
<td>5</td>
</tr>
<tr>
<td>64</td>
<td>Dade</td>
<td></td>
<td>T. 30 N. R. 29 W. 13</td>
<td>Or</td>
<td>660</td>
<td>Or</td>
<td>15</td>
<td>92</td>
<td>20</td>
</tr>
<tr>
<td>65</td>
<td>Dade</td>
<td></td>
<td>T. 30 N. R. 28 W. 5</td>
<td>Mw</td>
<td>705</td>
<td>Or</td>
<td>85</td>
<td>112</td>
<td>30</td>
</tr>
<tr>
<td>66</td>
<td>Dade</td>
<td></td>
<td>T. 30 N. R. 27 W. 35</td>
<td>Mw</td>
<td>600</td>
<td>Or</td>
<td>35</td>
<td>185</td>
<td>20</td>
</tr>
<tr>
<td>Well #</td>
<td>Name</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Penetration of Basal Fm. (Ft.)</td>
<td>Static Water Level</td>
<td>Yield GPH</td>
<td>Draw Down</td>
<td>Spec. Capacity</td>
<td>Casing</td>
</tr>
<tr>
<td>-------</td>
<td>-----------</td>
<td>----------</td>
<td>-------------------</td>
<td>-------------------------------</td>
<td>--------------------</td>
<td>-----------</td>
<td>-----------</td>
<td>---------------</td>
<td>--------</td>
</tr>
<tr>
<td>67</td>
<td>Ash Grove</td>
<td>T. 30 N.</td>
<td>Mbk</td>
<td>725</td>
<td>40</td>
<td>.115</td>
<td>17</td>
<td>6.8</td>
<td>255</td>
</tr>
<tr>
<td></td>
<td>Greene</td>
<td>R. 24 W.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>68</td>
<td>Marshfield</td>
<td>T. 30 N.</td>
<td>Oc</td>
<td>940</td>
<td>10</td>
<td>173</td>
<td>80</td>
<td>2.2</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>Webster</td>
<td>R. 18 W.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>69</td>
<td>Webster</td>
<td>T. 30 N.</td>
<td>Oc</td>
<td>965</td>
<td>405</td>
<td>175</td>
<td>80</td>
<td>1,480</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>R. 18 W.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>Wright</td>
<td>T. 30 N.</td>
<td>Ojc</td>
<td>400</td>
<td>60</td>
<td>7</td>
<td>36</td>
<td>0.2</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R. 13 W.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71</td>
<td>Texas</td>
<td>T. 30 N.</td>
<td>Oc</td>
<td>481</td>
<td>12</td>
<td>10</td>
<td>20</td>
<td>0.5</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R. 11 W.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>72</td>
<td>Bollinger</td>
<td>T. 30 N.</td>
<td>Oc</td>
<td>600</td>
<td>160</td>
<td>125</td>
<td>125</td>
<td>2.1</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R. 10 E.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>73</td>
<td>Bollinger</td>
<td>T. 30 N.</td>
<td>Oc</td>
<td>635</td>
<td>135</td>
<td>60</td>
<td>77</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>R. 10 E.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>74</td>
<td>Jasper</td>
<td>T. 19 N.</td>
<td>Mw</td>
<td>1,245</td>
<td>345</td>
<td>142</td>
<td>198</td>
<td>6.6</td>
<td>410</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R. 33 W.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>75</td>
<td>Jasper</td>
<td>T. 29 N.</td>
<td>Mw</td>
<td>909</td>
<td>105</td>
<td>120</td>
<td>207</td>
<td>1.4</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R. 33 W.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Depth</td>
<td>Penetration of Basal Fm. (Fm.) (Ft.)</td>
<td>Static Water Level</td>
<td>Yield GPM</td>
<td>Draw Down</td>
</tr>
<tr>
<td>------</td>
<td>-----------</td>
<td>--------</td>
<td>----------</td>
<td>------------------</td>
<td>-------</td>
<td>----------------------------------</td>
<td>--------------------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>76</td>
<td>Lawrence</td>
<td></td>
<td>T. 29 N.</td>
<td>Ce</td>
<td>1,075</td>
<td>10</td>
<td>164</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R. 27 W.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>Lawrence</td>
<td></td>
<td>T. 29 N.</td>
<td>Or</td>
<td>775</td>
<td>120</td>
<td>13</td>
<td>55</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R. 25 W.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>78</td>
<td>Lawrence</td>
<td></td>
<td>T. 29 N.</td>
<td>Or</td>
<td>764</td>
<td>150</td>
<td>165</td>
<td>36</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R. 25 W.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>79</td>
<td>Green</td>
<td></td>
<td>T. 29 N.</td>
<td>Ce</td>
<td>1,275</td>
<td>70</td>
<td>345</td>
<td>502</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R. 22 W.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>Green</td>
<td></td>
<td>T. 29 N.</td>
<td>Ce</td>
<td>1,216</td>
<td>12</td>
<td>233</td>
<td>350</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R. 22 W.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>29</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>81</td>
<td>Green</td>
<td></td>
<td>T. 29 N.</td>
<td>Ce</td>
<td>1,256</td>
<td>72</td>
<td>340</td>
<td>430</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R. 21 W.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>82</td>
<td>Green</td>
<td></td>
<td>T. 29 N.</td>
<td>Og</td>
<td>723</td>
<td>85</td>
<td>120</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R. 20 W.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>83</td>
<td>Hartville</td>
<td></td>
<td>T. 29 N.</td>
<td>Ce</td>
<td>785</td>
<td>20</td>
<td>217</td>
<td>99</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Wright</td>
<td></td>
<td>R. 15 W.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>84</td>
<td>Wright</td>
<td></td>
<td>T. 29 N.</td>
<td>Og</td>
<td>300</td>
<td>30</td>
<td>165</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R. 14 W.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well #</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Depth</td>
<td>Penetration of Basal Fm. (Fm.) (Pt.)</td>
<td>Static Water Level</td>
<td>Yield GPM</td>
<td>Draw Down</td>
</tr>
<tr>
<td>-------</td>
<td>------------</td>
<td>--------</td>
<td>----------------</td>
<td>------------------</td>
<td>-------</td>
<td>-------------------------------------</td>
<td>-------------------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>85</td>
<td>Wright</td>
<td></td>
<td>T. 29 N. R. 13 W. 22</td>
<td>Oje</td>
<td>208</td>
<td>Or</td>
<td>23</td>
<td>160</td>
<td>4</td>
</tr>
<tr>
<td>86</td>
<td>Texas</td>
<td></td>
<td>T. 29 N. R. 12 W. 10</td>
<td>Oje</td>
<td>300</td>
<td>Or</td>
<td>100</td>
<td>34</td>
<td>25</td>
</tr>
<tr>
<td>87</td>
<td>Wright</td>
<td></td>
<td>T. 29 N. R. 12 W. 33</td>
<td>Oc</td>
<td>675</td>
<td>Og</td>
<td>135</td>
<td>136</td>
<td>75</td>
</tr>
<tr>
<td>88</td>
<td>Jasper</td>
<td></td>
<td>T. 28 N. R. 33 W. 6</td>
<td>Mw</td>
<td>950</td>
<td>Og</td>
<td>5</td>
<td>158</td>
<td>23</td>
</tr>
<tr>
<td>89</td>
<td>Jasper</td>
<td></td>
<td>T. 28 N. R. 33 W. 8</td>
<td>P</td>
<td>925</td>
<td>Og</td>
<td>30</td>
<td>44</td>
<td>(330)</td>
</tr>
<tr>
<td>90</td>
<td>Webb City</td>
<td></td>
<td>T. 28 N. R. 32 W. 5</td>
<td></td>
<td>857</td>
<td>Og</td>
<td>100</td>
<td>170</td>
<td>220</td>
</tr>
<tr>
<td>91</td>
<td>Jasper</td>
<td></td>
<td>T. 28 N. R. 32 W. 13</td>
<td>Mw</td>
<td>1,230</td>
<td>Ce</td>
<td>25</td>
<td>55</td>
<td>340</td>
</tr>
<tr>
<td>92</td>
<td>Jasper</td>
<td></td>
<td>T. 28 N. R. 32 W. 34</td>
<td>Mw</td>
<td>945</td>
<td>Og</td>
<td>15</td>
<td>170</td>
<td>100</td>
</tr>
<tr>
<td>93</td>
<td>Carthage</td>
<td></td>
<td>T. 28 N. R. 31 W. 5</td>
<td>Mw</td>
<td>1,250</td>
<td>Ce</td>
<td>25</td>
<td>110</td>
<td>360</td>
</tr>
<tr>
<td>Well #</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Depth</td>
<td>Penetration of Basal Fm. (Ft.)</td>
<td>Static Water Level</td>
<td>Yield GPM</td>
<td>Draw Down</td>
</tr>
<tr>
<td>-------</td>
<td>------------</td>
<td>--------</td>
<td>----------------</td>
<td>-------------------</td>
<td>-------</td>
<td>-------------------------------</td>
<td>-------------------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>94</td>
<td>Jasper</td>
<td></td>
<td>T. 28 N. R. 31 W. 33</td>
<td>Mbk</td>
<td>805</td>
<td>Or</td>
<td>150</td>
<td>45</td>
<td>90</td>
</tr>
<tr>
<td>95</td>
<td>Lawrence</td>
<td></td>
<td>T. 28 N. R. 27 W. 28</td>
<td>Mbk</td>
<td>720</td>
<td>Or</td>
<td>95</td>
<td>75</td>
<td>30</td>
</tr>
<tr>
<td>96</td>
<td>Lawrence</td>
<td></td>
<td>T. 28 N. R. 26 W. 30</td>
<td>Mtr</td>
<td>891</td>
<td>Og</td>
<td>210</td>
<td>36</td>
<td>300</td>
</tr>
<tr>
<td>97</td>
<td>Mt. Vernon 2</td>
<td></td>
<td>T. 28 N. R. 26 W. 31</td>
<td>Mbk</td>
<td>1,115</td>
<td>Ce</td>
<td>10</td>
<td>129</td>
<td>450</td>
</tr>
<tr>
<td>98</td>
<td>Lawrence</td>
<td></td>
<td>T. 28 N. R. 25 W. 17</td>
<td>Mn</td>
<td>610</td>
<td>Og</td>
<td>50</td>
<td>99</td>
<td>32</td>
</tr>
<tr>
<td>99</td>
<td>Greene</td>
<td></td>
<td>T. 28 N. R. 24 W. 6</td>
<td>Mtr</td>
<td>1,210</td>
<td>Ce</td>
<td>5 (140)</td>
<td>(472)</td>
<td>(52)</td>
</tr>
<tr>
<td>100</td>
<td>Republic 2</td>
<td>Greene</td>
<td>T. 28 N. R. 23 W. 20</td>
<td>Mbk</td>
<td>1,189</td>
<td>Ce</td>
<td>20</td>
<td>200</td>
<td>242</td>
</tr>
<tr>
<td>101</td>
<td>Greene</td>
<td></td>
<td>T. 28 N. R. 22 W. 7</td>
<td>Mbk</td>
<td>1,080</td>
<td>Og</td>
<td>375</td>
<td>39</td>
<td>252</td>
</tr>
<tr>
<td>102</td>
<td>Green</td>
<td></td>
<td>T. 28 N. R. 22 W. 11</td>
<td>Mbk</td>
<td>1,230</td>
<td>Ce</td>
<td>15</td>
<td>170</td>
<td>400</td>
</tr>
<tr>
<td>Well #</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Depth (Ft.)</td>
<td>Penetration of Basal Frm. (Ft.)</td>
<td>Static Water Level</td>
<td>Yield GPM</td>
<td>Draw Down</td>
</tr>
<tr>
<td>-------</td>
<td>-----------</td>
<td>--------</td>
<td>----------</td>
<td>------------------</td>
<td>-------------</td>
<td>---------------------------------</td>
<td>-------------------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>103</td>
<td>Greene</td>
<td>Webster</td>
<td>T. 28 N. R. 22 W. 13</td>
<td>Mbk</td>
<td>1,235</td>
<td>Ce 20</td>
<td>152</td>
<td>165</td>
<td>3</td>
</tr>
<tr>
<td>104</td>
<td>Rogersville</td>
<td>Webster</td>
<td>T. 28 N. R. 19 W. 19</td>
<td>Mbk</td>
<td>1,260</td>
<td>Og 360</td>
<td>245</td>
<td>60</td>
<td>None</td>
</tr>
<tr>
<td>105</td>
<td>Webster</td>
<td>Fordland</td>
<td>T. 28 W. R. 18 W. 2</td>
<td>Mn</td>
<td>750</td>
<td>Og 55</td>
<td>230</td>
<td>70</td>
<td>170</td>
</tr>
<tr>
<td>106</td>
<td>Webster</td>
<td>Webster</td>
<td>T. 28 N. R. 18 W. 6</td>
<td>Mr</td>
<td>700</td>
<td>Og 60</td>
<td>190</td>
<td>95</td>
<td>130</td>
</tr>
<tr>
<td>107</td>
<td>Seymour 2</td>
<td>Webster</td>
<td>T. 28 N. R. 17 W. 2</td>
<td>Oc</td>
<td>1,225</td>
<td>Oe 85</td>
<td>296</td>
<td>232</td>
<td>115</td>
</tr>
<tr>
<td>108</td>
<td>Wright</td>
<td>Wright</td>
<td>T. 28 N. R. 14 W. 13</td>
<td>Oc</td>
<td>600</td>
<td>Oe 105</td>
<td>225</td>
<td>11</td>
<td>280</td>
</tr>
<tr>
<td>109</td>
<td>Wright</td>
<td>Mt. Grove 2</td>
<td>T. 28 N. R. 13 W. 10</td>
<td>Oje</td>
<td>300</td>
<td>Oe 67</td>
<td>32</td>
<td>22</td>
<td>40</td>
</tr>
<tr>
<td>110</td>
<td>Wright</td>
<td>Cabool 3</td>
<td>T. 28 N R. 11 W. 12</td>
<td>Oe</td>
<td>1,036</td>
<td>Ce 60</td>
<td>160</td>
<td>206</td>
<td>180</td>
</tr>
<tr>
<td>111</td>
<td>Texas</td>
<td>Texas 3</td>
<td>T. 28 N R. 11 W. 12</td>
<td>Or</td>
<td>700</td>
<td>Ce 45</td>
<td>114</td>
<td>155</td>
<td>76</td>
</tr>
<tr>
<td>Well</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Depth</td>
<td>Penetration of Basal Fm. (Fm.) (Ft.)</td>
<td>Static Water Level</td>
<td>Yield GPM</td>
<td>Draw Down</td>
</tr>
<tr>
<td>------</td>
<td>----------</td>
<td>--------</td>
<td>----------</td>
<td>-------------------</td>
<td>-------</td>
<td>-------------------------------------</td>
<td>-------------------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>112</td>
<td>Newton</td>
<td></td>
<td>T. 27 N. R. 33 W. 34</td>
<td>Mr</td>
<td>710</td>
<td>Or 150</td>
<td>Flowed</td>
<td>175+</td>
<td></td>
</tr>
<tr>
<td>113</td>
<td>Jasper</td>
<td></td>
<td>T. 27 N. R. 33 W. 3</td>
<td>Mr</td>
<td>1,300</td>
<td>Ce 35</td>
<td>90</td>
<td>150</td>
<td>135</td>
</tr>
<tr>
<td>114</td>
<td>Duenweg</td>
<td></td>
<td>T. 27 N. R. 32 W. 10</td>
<td>Mbk</td>
<td>1,228</td>
<td>Og 298</td>
<td>90</td>
<td>100</td>
<td>92</td>
</tr>
<tr>
<td>115</td>
<td>Sarcoxie</td>
<td></td>
<td>T. 27 N. R. 29 W. 8</td>
<td>Mr</td>
<td>1,258</td>
<td>Ce 20</td>
<td>104</td>
<td>275</td>
<td>35</td>
</tr>
<tr>
<td>116</td>
<td>Jasper</td>
<td></td>
<td>T. 27 N. R. 29 W. 17</td>
<td>Mr</td>
<td>1,059</td>
<td>Og 20</td>
<td>100</td>
<td>100</td>
<td>34</td>
</tr>
<tr>
<td>117</td>
<td>Christian</td>
<td></td>
<td>T. 27 N. R. 24 W. 10</td>
<td>Mbk</td>
<td>804</td>
<td>Or 155</td>
<td>150</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>118</td>
<td>Christian</td>
<td></td>
<td>T. 27 N. R. 24 W. 23</td>
<td></td>
<td>875</td>
<td>Og 5</td>
<td>150</td>
<td>20+</td>
<td></td>
</tr>
<tr>
<td>119</td>
<td>Christian</td>
<td></td>
<td>T. 27 N. R. 21 W. 21</td>
<td>Mfg</td>
<td>635</td>
<td>Or 125</td>
<td>Flowed</td>
<td>225</td>
<td></td>
</tr>
<tr>
<td>120</td>
<td>Christian</td>
<td></td>
<td>T. 27 N. R. 20 W. 25</td>
<td>Mr</td>
<td>902</td>
<td>Og 20</td>
<td>190</td>
<td>16</td>
<td>135</td>
</tr>
<tr>
<td>Well</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Depth</td>
<td>Penetration of Basal Fm. (Ft.)</td>
<td>Static Water Level</td>
<td>Yield GPM</td>
<td>Draw Down Capacity</td>
</tr>
<tr>
<td>------</td>
<td>------------</td>
<td>--------</td>
<td>----------</td>
<td>------------------</td>
<td>-------</td>
<td>-------------------------------</td>
<td>-------------------</td>
<td>-----------</td>
<td>-------------------</td>
</tr>
<tr>
<td>121</td>
<td>Sparta</td>
<td>Christian</td>
<td>T. 27 N. R. 20 W. 36</td>
<td>MbK</td>
<td>1,100</td>
<td>Og 155 269</td>
<td>143(100) 66(40) 2.2(2.5)</td>
<td>279</td>
<td></td>
</tr>
<tr>
<td>122</td>
<td>Douglas</td>
<td></td>
<td>T. 27 N. R. 13 W. 7</td>
<td>Or</td>
<td>425</td>
<td>Og 200 4</td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>123</td>
<td>Douglas</td>
<td></td>
<td>T. 27 N. R. 12 W. 35</td>
<td>Ojc</td>
<td>495</td>
<td>Og 295 357</td>
<td></td>
<td>4</td>
<td>60</td>
</tr>
<tr>
<td>124</td>
<td>Douglas</td>
<td></td>
<td>T. 27 N. R. 11 W. 14</td>
<td>Or</td>
<td>700</td>
<td>Ce 20 165</td>
<td>23</td>
<td>6</td>
<td>3.8</td>
</tr>
<tr>
<td>125</td>
<td>Willow Spgs</td>
<td>Howell</td>
<td>T. 27 N. R. 9 W. 29</td>
<td>Ce</td>
<td>960</td>
<td>Ce 5</td>
<td>90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>126</td>
<td>Shannon</td>
<td></td>
<td>T. 27 N. R. 4 W. 11</td>
<td>Or</td>
<td>675</td>
<td>Og 516 280</td>
<td>30 None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>127</td>
<td>Wayne</td>
<td></td>
<td>T. 27 N. R. 7 E. 5</td>
<td>Or</td>
<td>350</td>
<td>Og 165 150</td>
<td>20</td>
<td>150</td>
<td>0.1</td>
</tr>
<tr>
<td>128</td>
<td>Wayne</td>
<td></td>
<td>T. 27 N. R. 7 E. 31</td>
<td>Qal</td>
<td>250</td>
<td>Og 130 15</td>
<td></td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>129</td>
<td>Newton</td>
<td></td>
<td>T. 26 N. R. 32 W. 6</td>
<td>Mw</td>
<td>905</td>
<td>Or 140 140</td>
<td></td>
<td>66</td>
<td></td>
</tr>
<tr>
<td>Well #</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Depth</td>
<td>Penetration of Basal Fm. (Ft.)</td>
<td>Static Water Level</td>
<td>Yield GPM</td>
<td>Draw Down</td>
</tr>
<tr>
<td>-------</td>
<td>------------</td>
<td>--------</td>
<td>----------</td>
<td>-------------------</td>
<td>-------</td>
<td>-----------------------------</td>
<td>-------------------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>130</td>
<td>Diamond</td>
<td>Newton</td>
<td>T. 26 N. R. 31 W. 10</td>
<td>Mbk</td>
<td>1,250</td>
<td>Ce</td>
<td>25</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>131</td>
<td></td>
<td>Newton</td>
<td>T. 26 N. R. 31 W. 15</td>
<td>Mw</td>
<td>975</td>
<td>Or</td>
<td>150</td>
<td>130</td>
<td>65</td>
</tr>
<tr>
<td>132</td>
<td></td>
<td>Newton</td>
<td>T. 26 N. R. 30 W. 5</td>
<td>Mbk</td>
<td>832</td>
<td>Or</td>
<td>90</td>
<td>18</td>
<td>122</td>
</tr>
<tr>
<td>133</td>
<td>Pierce City</td>
<td>2</td>
<td>T. 26 N. R. 28 W. 5</td>
<td>Mbk</td>
<td>1,160</td>
<td>Og</td>
<td>215</td>
<td>38</td>
<td>320</td>
</tr>
<tr>
<td>134</td>
<td>Pierce City</td>
<td>1</td>
<td>T. 26 N. R. 28 W. 21</td>
<td>Mbk</td>
<td>1,000</td>
<td>Og</td>
<td>70</td>
<td>120</td>
<td>233</td>
</tr>
<tr>
<td>135</td>
<td>Monett</td>
<td>1</td>
<td>T. 26 N. R. 27 W. 30</td>
<td>Mg</td>
<td>1,200</td>
<td>Ce</td>
<td>25</td>
<td>184</td>
<td>350</td>
</tr>
<tr>
<td>136</td>
<td></td>
<td>Lawrence</td>
<td>T. 26 N. R. 26 W. 10</td>
<td></td>
<td>1,196</td>
<td>Ce</td>
<td>20</td>
<td>180</td>
<td>520</td>
</tr>
<tr>
<td>137</td>
<td></td>
<td>Aurora</td>
<td>T. 26 N. R. 26 W. 12</td>
<td>Mbk</td>
<td>1,240</td>
<td>Ce</td>
<td>5</td>
<td>195</td>
<td>250</td>
</tr>
<tr>
<td>138</td>
<td></td>
<td>Stone</td>
<td>T. 20 N. R. 24 W. 33</td>
<td>Mbk</td>
<td>895</td>
<td>Og</td>
<td>45</td>
<td>126</td>
<td>75</td>
</tr>
<tr>
<td>Well #</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Depth</td>
<td>Penetration of Basal Fm. (Fm.) (Ft.)</td>
<td>Static Water Level</td>
<td>Yield GPM</td>
<td>Draw Down</td>
</tr>
<tr>
<td>------</td>
<td>------------</td>
<td>--------</td>
<td>----------</td>
<td>-------------------</td>
<td>-------</td>
<td>-------------------------------------</td>
<td>--------------------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>139</td>
<td>Ava 3</td>
<td>Douglas</td>
<td>T. 26 N.</td>
<td>Ojc</td>
<td>838</td>
<td>Ce</td>
<td>10</td>
<td>248(238)</td>
<td>100(178)</td>
</tr>
<tr>
<td>140</td>
<td>Ava 1-b</td>
<td>Douglas</td>
<td>T. 26 N.</td>
<td>Ojc</td>
<td>903</td>
<td>Ce</td>
<td>25</td>
<td>290</td>
<td>250</td>
</tr>
<tr>
<td>141</td>
<td>USCCC-2</td>
<td>Howell</td>
<td>T. 26 N.</td>
<td>Or</td>
<td>780</td>
<td>Ce</td>
<td>55</td>
<td>240</td>
<td>25</td>
</tr>
<tr>
<td>142</td>
<td>Butler</td>
<td></td>
<td>T. 26 N.</td>
<td>Or</td>
<td>630</td>
<td>Og</td>
<td>530</td>
<td>150</td>
<td>20</td>
</tr>
<tr>
<td>143</td>
<td>Butler</td>
<td></td>
<td>T. 26 N.</td>
<td>Og</td>
<td>550</td>
<td>Og</td>
<td>149</td>
<td>25</td>
<td>327</td>
</tr>
<tr>
<td>144</td>
<td>Seneca 3</td>
<td>Newton</td>
<td>T. 25 N.</td>
<td>Or</td>
<td>950</td>
<td>Or</td>
<td>20</td>
<td>175</td>
<td>31</td>
</tr>
<tr>
<td>145</td>
<td>Seneca 5</td>
<td>Newton</td>
<td>T. 25 N.</td>
<td>Mw</td>
<td>1,435</td>
<td>Ce</td>
<td>60</td>
<td>236</td>
<td>335</td>
</tr>
<tr>
<td>146</td>
<td></td>
<td>Newton</td>
<td>T. 25 N.</td>
<td>Mw</td>
<td>950</td>
<td>Or</td>
<td>80</td>
<td>200</td>
<td>20</td>
</tr>
<tr>
<td>147</td>
<td></td>
<td>Newton</td>
<td>T. 25 N.</td>
<td>Mw</td>
<td>800</td>
<td>Or</td>
<td>100</td>
<td>40</td>
<td>150</td>
</tr>
<tr>
<td>Well</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Depth</td>
<td>Penetration of Basal Fm. (Fm.) (Pt.)</td>
<td>Static Water Level</td>
<td>Yield GPM</td>
<td>Draw Down</td>
</tr>
<tr>
<td>------</td>
<td>------------</td>
<td>--------</td>
<td>----------</td>
<td>-------------------</td>
<td>-------</td>
<td>-------------------------------------</td>
<td>-------------------</td>
<td>----------</td>
<td>-----------</td>
</tr>
<tr>
<td>148</td>
<td>Newton</td>
<td></td>
<td>T. 25 N. R. 31 W. 19</td>
<td>Mg</td>
<td>1,210</td>
<td>Ce 40 28</td>
<td></td>
<td>390</td>
<td></td>
</tr>
<tr>
<td>149</td>
<td>Neosho</td>
<td>Newton</td>
<td>T. 25 N. R. 31 W. 19</td>
<td>Mr</td>
<td>977</td>
<td>Og 270</td>
<td></td>
<td>350</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>Granby</td>
<td>Newton</td>
<td>T. 25 N. R. 30 W. 6</td>
<td></td>
<td>968</td>
<td>Or 113</td>
<td></td>
<td>150+</td>
<td></td>
</tr>
<tr>
<td>151</td>
<td>Green</td>
<td></td>
<td>T. 25 N. R. 27 W. 19</td>
<td>Mbk</td>
<td>770</td>
<td>Or 45 135</td>
<td></td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>152</td>
<td>Stone</td>
<td></td>
<td>T. 25 N. R. 23 W. 18</td>
<td></td>
<td>630</td>
<td>Or 65 28</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>153</td>
<td>Oregon</td>
<td></td>
<td>T. 25 N. R. 3 W. 6</td>
<td>Or</td>
<td>450</td>
<td>Og 160 190</td>
<td></td>
<td>40</td>
<td>14</td>
</tr>
<tr>
<td>154</td>
<td>Butler</td>
<td></td>
<td>T. 25 N. R. 6 E. 29</td>
<td>Or</td>
<td>450</td>
<td>Og 310 45</td>
<td></td>
<td>40</td>
<td>25</td>
</tr>
<tr>
<td>155</td>
<td>Newton</td>
<td></td>
<td>T. 24 N. R. 34 W. 8</td>
<td>Mbk</td>
<td>1,260</td>
<td>Og 310 69</td>
<td></td>
<td>505</td>
<td>112</td>
</tr>
<tr>
<td>156</td>
<td>Newton</td>
<td></td>
<td>T. 24 N. R. 32 W. 4</td>
<td>Mbk</td>
<td>1,450</td>
<td>Ce 80 45</td>
<td></td>
<td>243</td>
<td></td>
</tr>
<tr>
<td>Well #</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Forma-</td>
<td>Penetration</td>
<td>Static Water</td>
<td>Yield</td>
<td>Draw Down</td>
<td>Spec. Capacity</td>
</tr>
<tr>
<td>-------</td>
<td>-------</td>
<td>--------</td>
<td>----------</td>
<td>---------------</td>
<td>-------------</td>
<td>--------------</td>
<td>-------</td>
<td>-----------</td>
<td>---------------</td>
</tr>
<tr>
<td>157</td>
<td>Newton</td>
<td></td>
<td>T. 24 N. R. 30 W. 32</td>
<td>Mg 910 Or 140</td>
<td>.03</td>
<td>Flowed</td>
<td>300</td>
<td>1,150</td>
<td></td>
</tr>
<tr>
<td>158</td>
<td>Wheaton</td>
<td>Barry</td>
<td>T. 24 N. R. 29 W. 27</td>
<td>Hbk 1,008 Og 58 120</td>
<td>50</td>
<td>80</td>
<td>0.6</td>
<td>408</td>
<td>1,387</td>
</tr>
<tr>
<td>159</td>
<td>Purdy</td>
<td>Barry</td>
<td>T. 24 N. R. 28 W. 2</td>
<td>Hbk 931 Og 22 105</td>
<td>260</td>
<td>75</td>
<td>3.5</td>
<td>392</td>
<td>1,480</td>
</tr>
<tr>
<td>160</td>
<td>Stone</td>
<td></td>
<td>T. 24 N. R. 23 W. 26</td>
<td>Mg 1,005 Og 55 322</td>
<td>75</td>
<td>121</td>
<td>0.62</td>
<td>365</td>
<td>1,349</td>
</tr>
<tr>
<td>161</td>
<td>Taney</td>
<td></td>
<td>T. 24 N. R. 20 W. 20</td>
<td>Oc 500 Or 160 165</td>
<td>24</td>
<td>None</td>
<td>24</td>
<td>958</td>
<td></td>
</tr>
<tr>
<td>162</td>
<td>Taney</td>
<td></td>
<td>T. 24 N. R. 20 W. 32</td>
<td>Oc 1,015 Ce 15 295</td>
<td>152</td>
<td>25</td>
<td>6.1</td>
<td>256</td>
<td>946</td>
</tr>
<tr>
<td>163</td>
<td>Taney</td>
<td></td>
<td>T. 24 N. R. 18 W. 13</td>
<td>Oc 598 Og 90 250</td>
<td>40</td>
<td>23</td>
<td>1.7</td>
<td>206</td>
<td>1,088</td>
</tr>
<tr>
<td>164</td>
<td>Clark</td>
<td>West Plains</td>
<td>T. 24 N. R. 11 W. 11</td>
<td>Or 800 Og 495 700</td>
<td>20</td>
<td>None</td>
<td>370</td>
<td>1,058</td>
<td></td>
</tr>
<tr>
<td>165</td>
<td>Howell</td>
<td></td>
<td>T. 24 N. R. 8 W. 21</td>
<td>Oje 851 Og 475 89</td>
<td>85</td>
<td>None</td>
<td>958</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Depth</td>
<td>Penetration of Basal Fm. (Ft.)</td>
<td>Static Water Level</td>
<td>Yield GPM</td>
<td>Draw Down</td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
<td>---------</td>
<td>----------</td>
<td>-------------------</td>
<td>-------</td>
<td>-----------------------------</td>
<td>-------------------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>166</td>
<td>Alton 1</td>
<td>Oregon</td>
<td>T. 24 N. R. 4 W. 33</td>
<td>0jc</td>
<td>970</td>
<td>0g</td>
<td>580</td>
<td>75</td>
<td>33</td>
</tr>
<tr>
<td>167</td>
<td></td>
<td></td>
<td>T. 24 N. R. 2 W. 15</td>
<td>0jc</td>
<td>800</td>
<td>0g</td>
<td>500</td>
<td>150</td>
<td>22</td>
</tr>
<tr>
<td>168</td>
<td>Ripley</td>
<td></td>
<td>T. 24 N. R. 1 W. 28</td>
<td>Or</td>
<td>375</td>
<td>0g</td>
<td>155</td>
<td>70</td>
<td>20</td>
</tr>
<tr>
<td>169</td>
<td>Butler</td>
<td></td>
<td>T. 24 N. R. 6 E. 9</td>
<td>Or</td>
<td>200</td>
<td>0r</td>
<td>70</td>
<td>15</td>
<td>175</td>
</tr>
<tr>
<td>170</td>
<td>Butler</td>
<td></td>
<td>T. 24 N. R. 6 E. 18</td>
<td>Or</td>
<td>400</td>
<td>0g</td>
<td>275</td>
<td>70</td>
<td>60</td>
</tr>
<tr>
<td>171</td>
<td>Goodman</td>
<td>McDonald</td>
<td>T. 23 N. R. 32 W. 8</td>
<td>Mbk</td>
<td>1,290</td>
<td>0g</td>
<td>225</td>
<td>296</td>
<td>140</td>
</tr>
<tr>
<td>172</td>
<td>Exeter</td>
<td></td>
<td>T. 23 N. R. 28 W. 34</td>
<td>Mg</td>
<td>990</td>
<td>Or</td>
<td>170</td>
<td>81(190)</td>
<td>200</td>
</tr>
<tr>
<td>173</td>
<td>Cassville 1</td>
<td>Barry</td>
<td>T. 23 N. R. 27 W. 29</td>
<td>Mbk</td>
<td>1,200</td>
<td>0g</td>
<td>225</td>
<td>144</td>
<td>250</td>
</tr>
<tr>
<td>174</td>
<td>Cassville 3</td>
<td>Barry</td>
<td>T. 23 N. R. 27 W. 29</td>
<td>Mg</td>
<td>1,370</td>
<td>Ce</td>
<td>20</td>
<td>170(257)</td>
<td>200(200)</td>
</tr>
<tr>
<td>Well No.</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Depth</td>
<td>Penetration of Basal Fm. (Fm.) (Pt.)</td>
<td>Static Water Level</td>
<td>Yield GPM</td>
<td>Draw Down</td>
</tr>
<tr>
<td>----------</td>
<td>------------</td>
<td>--------</td>
<td>----------</td>
<td>-------------------</td>
<td>-------</td>
<td>-------------------------------------</td>
<td>-------------------</td>
<td>----------</td>
<td>-----------</td>
</tr>
<tr>
<td>175</td>
<td>Stone</td>
<td></td>
<td>T. 23 N. R. 23 W. 7</td>
<td>Oc</td>
<td>854</td>
<td>0g 230 79</td>
<td>198.</td>
<td>11</td>
<td>18.0</td>
</tr>
<tr>
<td>176</td>
<td>Taney</td>
<td></td>
<td>T. 23 N. R. 21 W. 12</td>
<td>Oc</td>
<td>425</td>
<td>0r 150 137</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>177</td>
<td>Branson 3  Taney</td>
<td></td>
<td>T. 23 N. R. 21 W. 32</td>
<td>Oc</td>
<td>1,085</td>
<td>Ca 10 294</td>
<td>129</td>
<td>180</td>
<td>0.7</td>
</tr>
<tr>
<td>178</td>
<td>Ozark</td>
<td></td>
<td>T. 23 N. R. 16 W. 4</td>
<td>Oc</td>
<td>402</td>
<td>0r 52 220</td>
<td>30</td>
<td>40</td>
<td>0.7</td>
</tr>
<tr>
<td>179</td>
<td>Howell</td>
<td></td>
<td>T. 23 N. R. 9 W. 33</td>
<td>Oc</td>
<td>450</td>
<td>0r 80 100</td>
<td>30</td>
<td>80</td>
<td>0.4</td>
</tr>
<tr>
<td>180</td>
<td>Thayer 3  Oregon</td>
<td></td>
<td>T. 23 N. R. 5 W. 31</td>
<td>Oje</td>
<td>535</td>
<td>0g 55 200</td>
<td>240</td>
<td>110</td>
<td>2.2</td>
</tr>
<tr>
<td>181</td>
<td>Ripley</td>
<td></td>
<td>T. 23 N. R. 2 E. 21</td>
<td>Or</td>
<td>275</td>
<td>0g 190 60</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>182</td>
<td>Ripley</td>
<td></td>
<td>T. 23 N. R. 2 E. 34</td>
<td>Oje</td>
<td>301</td>
<td>0g 31 46</td>
<td>40</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>183</td>
<td>Butler</td>
<td></td>
<td>T. 23 N. R. 5 E. 9</td>
<td>Og</td>
<td>290</td>
<td>0g 60 46</td>
<td>46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well #</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Depth</td>
<td>Penetration of Basal Pm. (Fm.) (Ft.)</td>
<td>Static Water Level</td>
<td>Yield GPM</td>
<td>Draw Down Capacity</td>
</tr>
<tr>
<td>--------</td>
<td>------------</td>
<td>--------</td>
<td>----------</td>
<td>-------------------</td>
<td>-------</td>
<td>-------------------------------------</td>
<td>-------------------</td>
<td>-----------</td>
<td>-------------------</td>
</tr>
<tr>
<td>184</td>
<td>McDonald</td>
<td></td>
<td>T. 22 N. R. 33 W. 12</td>
<td>Mr</td>
<td>986</td>
<td>0g 125 36</td>
<td>200</td>
<td>Flowed</td>
<td>150</td>
</tr>
<tr>
<td>185</td>
<td>McDonald</td>
<td></td>
<td>T. 22 N. R. 33 W. 14</td>
<td></td>
<td>1,045</td>
<td>Or 115 245</td>
<td>25</td>
<td>10</td>
<td>2.5</td>
</tr>
<tr>
<td>186</td>
<td>McDonald</td>
<td></td>
<td>T. 22 N. R. 33 W. 36</td>
<td>Mr</td>
<td>900</td>
<td>Or 150</td>
<td>120</td>
<td>Flowed</td>
<td>838</td>
</tr>
<tr>
<td>187</td>
<td>Pineville-3 McDonald</td>
<td>Roaring River-3</td>
<td>T. 22 N. R. 32 W. 33</td>
<td>Mbk</td>
<td>1,400</td>
<td>Og 285 135</td>
<td>150</td>
<td>174</td>
<td>0.9</td>
</tr>
<tr>
<td>188</td>
<td>Barry</td>
<td></td>
<td>T. 22 N. R. 27 W. 35</td>
<td>Oc</td>
<td>847</td>
<td>Og 85 120</td>
<td>52</td>
<td>20</td>
<td>3.1</td>
</tr>
<tr>
<td>189</td>
<td>Barry</td>
<td></td>
<td>T. 22 N. R. 25 W. 13</td>
<td>Oc</td>
<td>717</td>
<td>Og 116 335</td>
<td>12</td>
<td>17</td>
<td>0.7</td>
</tr>
<tr>
<td>190</td>
<td>Barry</td>
<td></td>
<td>T. 22 N. R. 25 W. 35</td>
<td>Oc</td>
<td>525</td>
<td>Or 185 160</td>
<td>21</td>
<td>7</td>
<td>263</td>
</tr>
<tr>
<td>191</td>
<td>Stone</td>
<td></td>
<td>T. 22 N. R. 23 W. 23</td>
<td>Oc</td>
<td>700</td>
<td>Or 145 160</td>
<td>28</td>
<td>20</td>
<td>1.4</td>
</tr>
<tr>
<td>Well #</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Depth</td>
<td>Penetration of Basal Pm. (Ft.)</td>
<td>Static Water Level</td>
<td>Yield GPM</td>
<td>Draw Down</td>
</tr>
<tr>
<td>-------</td>
<td>--------------</td>
<td>--------------</td>
<td>----------</td>
<td>-------------------</td>
<td>-------</td>
<td>--------------------------------</td>
<td>-------------------</td>
<td>----------</td>
<td>-----------</td>
</tr>
<tr>
<td>192</td>
<td>Sch of Ozarks</td>
<td>3 Taney</td>
<td>T. 22 N.</td>
<td>Oc</td>
<td>1,100</td>
<td>Ce 25 218</td>
<td></td>
<td>150</td>
<td>95</td>
</tr>
<tr>
<td>193</td>
<td>Hollister</td>
<td>4 Taney</td>
<td>T. 22 N.</td>
<td>Oc</td>
<td>990</td>
<td>Ce 10 148</td>
<td></td>
<td>217</td>
<td>30</td>
</tr>
<tr>
<td>194</td>
<td>Hollister</td>
<td>3 Taney</td>
<td>T. 22 N.</td>
<td>Oc</td>
<td>449</td>
<td>Or 173 42</td>
<td></td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>195</td>
<td>Taney</td>
<td>Gainsville</td>
<td>T. 22 N.</td>
<td>Oc</td>
<td>675</td>
<td>Or 105 340</td>
<td></td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>196</td>
<td>Gainsville</td>
<td>Ozark</td>
<td>T. 22 N.</td>
<td>Oc</td>
<td>860</td>
<td>Ce 15 63</td>
<td></td>
<td>115</td>
<td>93</td>
</tr>
<tr>
<td>197</td>
<td>Oregon</td>
<td></td>
<td>T. 22 N.</td>
<td>Oc</td>
<td>635</td>
<td>Og 125 168</td>
<td></td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>198</td>
<td>Thayer</td>
<td>Oregon</td>
<td>T. 22 N.</td>
<td>Oc</td>
<td>302</td>
<td>Og 30 7</td>
<td></td>
<td>200</td>
<td>90</td>
</tr>
<tr>
<td>199</td>
<td>Ripley</td>
<td></td>
<td>T. 22 N.</td>
<td>Oc</td>
<td>350</td>
<td>Or 65 42</td>
<td></td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>McDonald</td>
<td></td>
<td>T. 21 N.</td>
<td>Oc</td>
<td>991</td>
<td>Or 35 100</td>
<td></td>
<td>20</td>
<td>160</td>
</tr>
<tr>
<td>Well No.</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Depth (Ft.)</td>
<td>Penetration of Basal Fm. (Ft.)</td>
<td>Static Water Level</td>
<td>Yield (GPM)</td>
<td>Draw Down</td>
</tr>
<tr>
<td>-------</td>
<td>----------------</td>
<td>---------</td>
<td>----------</td>
<td>-------------------</td>
<td>-------------</td>
<td>--------------------------------</td>
<td>-------------------</td>
<td>-------------</td>
<td>-----------</td>
</tr>
<tr>
<td>201</td>
<td>S.W. City 1</td>
<td>McDonald</td>
<td>T. 21 N. R. 34 W. 33</td>
<td>Mr</td>
<td>989</td>
<td>0g</td>
<td>40</td>
<td>23</td>
<td>78</td>
</tr>
<tr>
<td>202</td>
<td>Noel</td>
<td>McDonald</td>
<td>T. 21 N. R. 33 W. 15</td>
<td>Ce</td>
<td>1,100</td>
<td>45</td>
<td></td>
<td>300</td>
<td>140</td>
</tr>
<tr>
<td>203</td>
<td>Noel-2</td>
<td>McDonald</td>
<td>T. 21 N. R. 33 W. 22</td>
<td>Or</td>
<td>850</td>
<td>150</td>
<td></td>
<td>56</td>
<td>Flowed</td>
</tr>
<tr>
<td>204</td>
<td>D.W. Sibley</td>
<td>Benton</td>
<td>T. 21 N. R. 33 W. 22</td>
<td>Mbn</td>
<td>900</td>
<td>0g</td>
<td>30</td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>205</td>
<td>Pea Ridge</td>
<td>Benton</td>
<td>T. 21 N. R. 29 W. 31</td>
<td>Mbn</td>
<td>1,769</td>
<td>0g</td>
<td>295.97</td>
<td>185</td>
<td>94.8</td>
</tr>
<tr>
<td>206</td>
<td>Seligman</td>
<td>Barry</td>
<td>T. 21 N. R. 28 W. 23</td>
<td>Mbk</td>
<td>1,693</td>
<td>0g</td>
<td>415</td>
<td>570</td>
<td>200</td>
</tr>
<tr>
<td>207</td>
<td>Holiday Isl 2</td>
<td>Carroll</td>
<td>T. 21 N. R. 26 W. 15</td>
<td>Oc</td>
<td>1,128</td>
<td>0g</td>
<td>82</td>
<td>500</td>
<td>60</td>
</tr>
<tr>
<td>208</td>
<td>Holiday Isl 1</td>
<td>Carroll</td>
<td>T. 21 N. R. 26 W. 17</td>
<td>Oc</td>
<td>1,063</td>
<td>0g</td>
<td>81</td>
<td>100</td>
<td>60</td>
</tr>
<tr>
<td>209</td>
<td>Barry</td>
<td>Barry</td>
<td>T. 21 N. R. 26 W. 21</td>
<td>Oc</td>
<td>653</td>
<td>0g</td>
<td>8</td>
<td>80</td>
<td>22</td>
</tr>
<tr>
<td>Well #</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Depth</td>
<td>Penetration of Basal Fm. (Fm.) (Ft.)</td>
<td>Static Water Level</td>
<td>Yield GPM</td>
<td>Draw Down</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------</td>
<td>--------</td>
<td>----------</td>
<td>-------------------</td>
<td>-------</td>
<td>----------------------------------</td>
<td>------------------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>210</td>
<td>Holiday Isl</td>
<td>Carroll</td>
<td>T. 21 N. 4 R. 26 W. 27</td>
<td>Oc</td>
<td>1,880</td>
<td>Ce 10</td>
<td>520</td>
<td>502</td>
<td>85</td>
</tr>
<tr>
<td>211</td>
<td>Barry</td>
<td></td>
<td>T. 21 N. R. 25 W. 2</td>
<td>Oc</td>
<td>450</td>
<td>Or 170</td>
<td>80</td>
<td>26.5</td>
<td>45</td>
</tr>
<tr>
<td>212</td>
<td>Barry</td>
<td></td>
<td>T. 21 N. R. 25 W. 6</td>
<td>Oc</td>
<td>340</td>
<td>Or 45</td>
<td>80</td>
<td>15+</td>
<td></td>
</tr>
<tr>
<td>213</td>
<td>Stone</td>
<td></td>
<td>T. 21 N. R. 22 W. 6</td>
<td>Mr</td>
<td>950</td>
<td>Or 125</td>
<td>468</td>
<td>25</td>
<td>18</td>
</tr>
<tr>
<td>214</td>
<td>Taney</td>
<td></td>
<td>T. 21 N. R. 22 W. 12</td>
<td>Oc</td>
<td>800</td>
<td>Og 40</td>
<td></td>
<td>90</td>
<td>None</td>
</tr>
<tr>
<td>215</td>
<td>Omaha</td>
<td>Boone</td>
<td>T. 21 N. R. 21 W. 27</td>
<td>Mbn</td>
<td>1,315</td>
<td>Or</td>
<td></td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>216</td>
<td>Diamond City</td>
<td>Boone</td>
<td>T. 21 N. R. 18 W. 20</td>
<td>Oc</td>
<td>602</td>
<td>Or</td>
<td></td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>217</td>
<td>Diamond City</td>
<td>Boone</td>
<td>T. 21 N. R. 18 W. 20</td>
<td>Oc</td>
<td>760</td>
<td>Or</td>
<td></td>
<td>140</td>
<td></td>
</tr>
<tr>
<td>218</td>
<td>Ozark</td>
<td></td>
<td>T. 21 N. R. 16 W. 12</td>
<td>Oc</td>
<td>1,080</td>
<td>Or 130</td>
<td>350</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Depth</td>
<td>Penetration of Basal Fm. (Fm.) (Pt.)</td>
<td>Static Water Level</td>
<td>Yield GPM</td>
<td>Draw Down</td>
</tr>
<tr>
<td>------</td>
<td>---------------</td>
<td>----------</td>
<td>----------</td>
<td>-------------------</td>
<td>-------</td>
<td>-------------------------------------</td>
<td>-------------------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>219</td>
<td>Oakland</td>
<td>Rec Area</td>
<td>T. 21 N. R. 15 W. 6</td>
<td>Oc</td>
<td>885</td>
<td>Og 276 129</td>
<td>100</td>
<td>200</td>
<td>0.5</td>
</tr>
<tr>
<td>220</td>
<td>Marion</td>
<td></td>
<td>T. 21 N. R. 5 W. 7</td>
<td>Oc</td>
<td>350</td>
<td>Or 235 70</td>
<td>230</td>
<td>50</td>
<td>4.6</td>
</tr>
<tr>
<td>221</td>
<td>Mammoth</td>
<td>Spring</td>
<td>T. 20 N. R. 33 W. 11</td>
<td>Mbn</td>
<td>1,603</td>
<td>Ce 23 170</td>
<td>140</td>
<td>400</td>
<td>1,199</td>
</tr>
<tr>
<td>222</td>
<td>Gravette 2</td>
<td>Benton</td>
<td>T. 20 N. R. 33 W. 14</td>
<td>Mbn</td>
<td>1,610</td>
<td>Ce 1 300</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>223</td>
<td>Gravette 3</td>
<td>Benton</td>
<td>T. 20 N. R. 29 W. 13</td>
<td>Mbn</td>
<td>1,968</td>
<td>Ce 325 230</td>
<td>50</td>
<td>4.6</td>
<td>1,432</td>
</tr>
<tr>
<td>224</td>
<td>East of</td>
<td>Avoca</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>225</td>
<td>Lost ridge</td>
<td>Village</td>
<td>T. 20 N. R. 28 W. 13</td>
<td>Oc</td>
<td>1,625</td>
<td>Ce 77 346</td>
<td>240</td>
<td>115</td>
<td>2.08</td>
</tr>
<tr>
<td>226</td>
<td>Eureka Spgs</td>
<td>Carroll</td>
<td>T. 20 N. R. 26 W. 16</td>
<td>Oc</td>
<td>1,332</td>
<td>Og 178.65 500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Eureka Spgs</td>
<td>Carroll</td>
<td>T. 20 N. R. 26 W. 16</td>
<td>Oc</td>
<td>1,418</td>
<td>Ce 55 259</td>
<td>250</td>
<td>358.5</td>
<td>0.69</td>
</tr>
<tr>
<td>Well</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Depth (Ft.)</td>
<td>Penetration of Basal Frm. (Ft.)</td>
<td>Static Water Level</td>
<td>Yield GPM</td>
<td>Draw Down</td>
</tr>
<tr>
<td>------</td>
<td>------</td>
<td>--------</td>
<td>----------</td>
<td>------------------</td>
<td>------------</td>
<td>------------------------------</td>
<td>------------------</td>
<td>----------</td>
<td>-----------</td>
</tr>
<tr>
<td>227</td>
<td>Brown Oil Tool</td>
<td>Marion</td>
<td>T. 20 N. R. 15 W. 8</td>
<td>Oc</td>
<td>775</td>
<td>Or</td>
<td>132</td>
<td>127.52</td>
<td>100</td>
</tr>
<tr>
<td>228</td>
<td>Fulton</td>
<td>Viola</td>
<td>T. 20 N. R. 9 W. 18</td>
<td>Oc</td>
<td>1,250</td>
<td>Or</td>
<td>126</td>
<td>140</td>
<td>40</td>
</tr>
<tr>
<td>229</td>
<td>Decatur</td>
<td>Benton</td>
<td>T. 19 N. R. 33 W. 11</td>
<td>Mpb</td>
<td>1,720</td>
<td>Og</td>
<td>258</td>
<td>350</td>
<td>99.3</td>
</tr>
<tr>
<td>230</td>
<td>Decatur</td>
<td>Benton</td>
<td>T. 19 N. R. 33 W. 13</td>
<td>Mpb</td>
<td>1,450</td>
<td>Og</td>
<td>10</td>
<td>136</td>
<td>250</td>
</tr>
<tr>
<td>231</td>
<td>Peterson</td>
<td>Industries</td>
<td>T. 19 N. R. 32 W. 11</td>
<td>Mpb</td>
<td>1,723</td>
<td>Ce</td>
<td>88</td>
<td>380</td>
<td>300</td>
</tr>
<tr>
<td>232</td>
<td>Rogers</td>
<td>Benton</td>
<td>T. 19 N. R. 29 W. 18</td>
<td>Mbn</td>
<td>1,662</td>
<td>Og</td>
<td>355</td>
<td>500</td>
<td>674</td>
</tr>
<tr>
<td>233</td>
<td>City of Green Brest</td>
<td>Carroll</td>
<td>T. 19 N. R. 23 W. 4</td>
<td>Mpb</td>
<td>1,587</td>
<td>Og</td>
<td>7</td>
<td>230</td>
<td>70</td>
</tr>
<tr>
<td>234</td>
<td>City of Green Brest</td>
<td>Carroll</td>
<td>T. 19 N. R. 23 W. 8</td>
<td>Mpb</td>
<td>2,300</td>
<td>Ce</td>
<td>277.24</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Well #</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Depth (Ft.)</td>
<td>Penetration of Basal Fm. (Ft.)</td>
<td>Static Water Level</td>
<td>Yield (GPM)</td>
<td>Draw Down</td>
</tr>
<tr>
<td>-------</td>
<td>--------------</td>
<td>--------</td>
<td>----------</td>
<td>-------------------</td>
<td>-------------</td>
<td>-------------------------------</td>
<td>-------------------</td>
<td>------------</td>
<td>-----------</td>
</tr>
<tr>
<td>235</td>
<td>Bergman</td>
<td>Boone</td>
<td>T. 19 N. R. 19 W. 8</td>
<td>Mbn</td>
<td>1,725</td>
<td>0g</td>
<td>205</td>
<td>355</td>
<td>14</td>
</tr>
<tr>
<td>236</td>
<td>Yellville</td>
<td>Marion</td>
<td>T. 19 N. R. 16 W. 33</td>
<td>Oc</td>
<td>753</td>
<td>Or</td>
<td>328.4</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>237</td>
<td>Summit</td>
<td>Marion</td>
<td>T. 19 N. R. 16 W. 32</td>
<td>Oc</td>
<td>1,520</td>
<td>Ce</td>
<td>82</td>
<td>61</td>
<td>195</td>
</tr>
<tr>
<td>238</td>
<td>Flippin</td>
<td>Marion</td>
<td>T. 19 N. R. 15 W. 20</td>
<td>Oc</td>
<td>900</td>
<td>Or</td>
<td>87.12</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>239</td>
<td>Gassville 1</td>
<td>Baxter</td>
<td>T. 19 N. R. 14 W. 28</td>
<td>Oc</td>
<td>1,400</td>
<td>0g</td>
<td>548</td>
<td>122</td>
<td>184</td>
</tr>
<tr>
<td>240</td>
<td>Cotter 2</td>
<td>Baxter</td>
<td>T. 19 N. R. 14 W. 29</td>
<td>Oc</td>
<td>1,625</td>
<td>Ce</td>
<td>177</td>
<td>284</td>
<td>132</td>
</tr>
<tr>
<td>241</td>
<td>Mtn Home 2</td>
<td>Baxter</td>
<td>T. 19 N. R. 13 W. 9</td>
<td>Oc</td>
<td>1,505</td>
<td>0g</td>
<td>555</td>
<td>167</td>
<td>53</td>
</tr>
<tr>
<td>242</td>
<td>Cherokee Village</td>
<td>Sharp</td>
<td>T. 19 N. R. 5 W. 21</td>
<td>Oc</td>
<td>1,555</td>
<td>Ce</td>
<td>200</td>
<td>210</td>
<td>280</td>
</tr>
<tr>
<td>243</td>
<td>Douglas Adcock</td>
<td>Benton</td>
<td>T. 18 N. R. 32 W. 12</td>
<td>Mbn</td>
<td>1,320</td>
<td>Or</td>
<td>320</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>Well</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Penetration of Basal Fm. (Fm.) (Ft.)</td>
<td>Static Water Level</td>
<td>Yield GPM</td>
<td>Draw Down</td>
<td>Spec. Capacity</td>
</tr>
<tr>
<td>------</td>
<td>-----------------------</td>
<td>--------</td>
<td>----------</td>
<td>-------------------</td>
<td>-------------------------------------</td>
<td>-------------------</td>
<td>------------</td>
<td>-----------</td>
<td>---------------</td>
</tr>
<tr>
<td>244</td>
<td>Bellefonte T. 18 N</td>
<td>Boone</td>
<td>R. 19 W. 19</td>
<td>Mbn</td>
<td>1,649 Or</td>
<td>141</td>
<td>96</td>
<td>115</td>
<td>.83</td>
</tr>
<tr>
<td></td>
<td>Ark Highway Dept</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>245</td>
<td>T. 18 N R. 19 W. 19</td>
<td>Boone</td>
<td>Mbn</td>
<td>2,000 Og</td>
<td>415 123.6</td>
<td>88</td>
<td>198</td>
<td>0.75</td>
<td>972</td>
</tr>
<tr>
<td>246</td>
<td>Franklin T. 18 N R. 7 W. 31</td>
<td>Izard</td>
<td>Oct</td>
<td>1,100 Or</td>
<td></td>
<td></td>
<td></td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>247</td>
<td>Ash Flat T. 18 N R. 6 W. 10</td>
<td>Sharp</td>
<td>Oct</td>
<td>1,545 Og</td>
<td>615 173</td>
<td>150</td>
<td>28</td>
<td>5.4</td>
<td>555</td>
</tr>
<tr>
<td></td>
<td>Plus Poultry T. 17 N R. 33 W. 6</td>
<td>Benton</td>
<td>Mbn</td>
<td>1,515 Og</td>
<td>90 141</td>
<td>396</td>
<td>300</td>
<td>1.009</td>
<td></td>
</tr>
<tr>
<td>249</td>
<td>Tontitown T. 17 N R. 31 W. 1</td>
<td>Washington</td>
<td>Mbn</td>
<td>1,416 Or</td>
<td>166</td>
<td>60</td>
<td>350</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>East of Springdale T. 17 N R. 29 W. 9</td>
<td>Benton</td>
<td>Mbn</td>
<td>2,076 Ce</td>
<td>106</td>
<td>250</td>
<td>185</td>
<td>1.35</td>
<td></td>
</tr>
<tr>
<td>250</td>
<td>Marble Falls T. 17 N R. 20 W. 21</td>
<td>Newton</td>
<td>Mbn</td>
<td>2,573 Ce</td>
<td>43 355</td>
<td>250</td>
<td>140</td>
<td>1.8</td>
<td>503</td>
</tr>
<tr>
<td>251</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well #</td>
<td>Name</td>
<td>County</td>
<td>Location</td>
<td>Surface Formation</td>
<td>Penetration of Basal Fm. (Ft.)</td>
<td>Static Water Level</td>
<td>Yield GPM</td>
<td>Draw Down Spec. Capacity</td>
<td>Casing Elevation</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------</td>
<td>--------</td>
<td>----------</td>
<td>-------------------</td>
<td>-------------------------------</td>
<td>-------------------</td>
<td>-----------</td>
<td>--------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>252</td>
<td>Valley Spgs T. 17 N.</td>
<td>Boone</td>
<td>R. 19 W. 3</td>
<td>Mbn 2,050 Og</td>
<td>332</td>
<td>200</td>
<td>157</td>
<td>1.27</td>
<td>1,043</td>
</tr>
<tr>
<td>253</td>
<td>Lake Wedington</td>
<td>Washington</td>
<td>T. 16 N. R. 32 W. 4</td>
<td>Mbn 1,815 Ce</td>
<td>45</td>
<td>100.6</td>
<td>26</td>
<td></td>
<td>253 1,135</td>
</tr>
<tr>
<td>254</td>
<td>Wedington Woods</td>
<td>Washington</td>
<td>T. 10 N. R. 31 W. 7</td>
<td>Mbn 1,500 Or</td>
<td>60</td>
<td>140</td>
<td>0.42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>255</td>
<td>Big Flat T. 16 N.</td>
<td>Baxter</td>
<td>R. 13 W. 30</td>
<td>Mbn 2,603 Or</td>
<td>243</td>
<td>656</td>
<td>54</td>
<td>0.23</td>
<td>208 1,305</td>
</tr>
<tr>
<td>256</td>
<td>J.W. Jrisson</td>
<td>Washington</td>
<td>T. 15 N. R. 31 W. 17</td>
<td>Mbn 2,097 Ce</td>
<td>150</td>
<td>43</td>
<td>95</td>
<td>0.45</td>
<td>30 1,140</td>
</tr>
<tr>
<td>257</td>
<td>Marshall T. 15 N.</td>
<td>Searcy</td>
<td>R. 16 W. 25</td>
<td>Mbn 2,415 Og</td>
<td>75</td>
<td>206</td>
<td>55</td>
<td></td>
<td>1,100</td>
</tr>
</tbody>
</table>
Appendix B

Graphs of drawdown versus time for selected wells penetrating the Roubidoux and Gasconade Formations

Time (minutes) in powers of ten
EUREKA SPRINGS, ARK.
Carroll County, Ark.

DRAWDOWN IN FEET

TIME IN POWERS OF 10

+ + + 330 gpm
++ + 270 gpm

+ + 400 gpm
GASSVILLE, ARK.
Baxter County, Ark.
LOST BRIDGE VILLAGE
Benton County, Ark.

+ — 240 gpm
++ — 225 gpm
+++ — 224 gpm
++ — 227 gpm
— — 227 gpm
— — 244 gpm

DRAWDOWN IN FEET
35.00 45.00 55.00

TIME IN POWERS OF 10
0.00 0.80 1.60 2.40 3.20 4.00

—240 gpm
LOST BRIDGE VILLAGE
Benton County, Ark.

Recovery curve.
Pump off.
MARBLE FALLS, ARK.
Newton County, Ark.

- 257 gpm
- 222 gpm
Constant pumping rate
52 gpm

OMAHA, ARK.
ASH GROVE = 1 MO
Greene County, Mo.

+ + — 460 gpm

+ + — 450 gpm

+ + + — 445 gpm

DRAWDOWN IN FEET

22.00 24.00 26.00 28.00 30.00

TIME IN POWERS OF 10

0.00 0.50 1.00 1.50 2.00 2.50
TIME IN POWERS OF 10

0.00 0.80 1.20 1.60 2.00 2.40

ORAHOWN IN FEET

471.00 470.00 469.00 468.00 467.00 466.00 465.00

Pump off.
Recovery curve.

Stone County, Mo.
Kimberling Hills, Mo