

AQUIFER STUDIES IN THE ARKANSAS RIVER BASIN

– A Digital, Geographic Bibliography

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“A geographically-referenced, digital bibliography of published studies with alluvial and bedrock aquifer information for the Arkansas River basin”

FOREWORD

In November 2007, the Colorado Geological Survey published Information Series 74 as a digital and geo-referenced bibliography of publicly-available studies and data related to the alluvial aquifer system of the lower Arkansas River mainstem below Pueblo Reservoir in Colorado. That project was funded by the Colorado Water Conservation Board (CWCB) utilizing monies from the Severance Tax Trust Fund Operational Account. The bibliography identifies existing literature that addresses the configuration, hydrologic properties, water levels, and/or water quality of the alluvial aquifer. The spatial bibliographic database was created within a Geographic Information System (GIS) platform providing an “interactive” digital product that can be used by ground-water professionals, water managers, and the public for researching information related to the alluvial ground-water resources of the lower Arkansas River basin.

On presenting that deliverable product to staff of the CWCB, they recognized the utility of the work and requested the Colorado Geological Survey to expand the focus area to include the entire Arkansas River basin watershed and compile references for both the alluvial and bedrock aquifers. A review and understanding of the available literature provides a foundational basis for a future decision support system in the Arkansas River basin. As with the previous study, the study areas and content for the bibliographic database were geo-referenced within a GIS platform to provide a searchable mapping tool. This tool allows the end-user to identify studies and data by geographic reference and specific content for either the alluvial aquifers, bedrock aquifers, or both. The content includes aquifer configuration, aquifer hydraulic properties, water level data, or water quality information. This new work product includes all of the citations and information contained in IS-74.

LITERATURE SEARCH METHODOLOGY AND LIMITATIONS

The Colorado Geological Survey (CGS) conducted a literature search for published studies containing information related to the alluvial and bedrock aquifer systems of the Arkansas River basin in Colorado. Potentially relevant publications were acquired, where possible, and reviewed for content. Published studies containing information related to either the alluvial or bedrock aquifer system in the Arkansas River basin were included in the bibliographic dataset. Polygons representing the area of each study for which there is relevant information were digitized into a GIS shapefile. Attribute fields were populated to identify and further describe the nature of each reference. Attribute fields and additional details regarding the composition of the database are discussed below and are provided in the shapefile metadata.

Although this study attempted to include as many relevant publications as possible the literature search focused on public sources of information that contained data or information on four principle areas of content: aquifer configuration, aquifer hydraulic properties, water level data,

and water quality information. Publications or studies that focused specifically on water rights, modeling, or water management strategies, for example, were not included in the database. While this bibliography represents a substantially complete representation of publications related to the alluvial and bedrock aquifer systems in the Arkansas River basin of Colorado, it should not be considered an exhaustive reference.

DATABASE COMPILATION AND STRUCTURE

After acquiring and verifying that identified publications contained information relevant to the goals of this project, polygons were digitized to represent each study area. Basin-wide studies were further evaluated to precisely determine sub-areas for which the study contained relevant information; in these cases county boundaries were selected to represent the study area. This was done in order to provide a more meaningful characterization of large-scale, basin-wide studies with respect to location specific information on the aquifer.

All data were qualified by subject matter, location, and size in the attribute table. Four principal subject matter categories were established:

- aquifer configuration;
- aquifer properties;
- water levels; and
- water quality.

All references in the database were catalogued by one or more of the subject matter categories. These criteria allow the user to focus in on their area of interest. Where available, hotlinks are provided in the database to directly access that publication on the internet.

County boundaries were used as the primary geographic reference to locate each study area. A descending hierarchical procedure was applied whereby the county of principal relevance to the study was entered in the field “County1”; with secondary and decreasing relevance entered in fields “County2” through “County13”. This provides the user a means of evaluating the dataset by location.

Finally, all references were designated a “study scale” to differentiate the size of the area covered in the study. It is assumed that the size of the study may reflect the level of detail contained in the publication. Publications covering an area nominally less than one county in size were designated “small area” studies. Publications of intermediate area size, considered as one or more counties in area yet not encompassing the entire basin, were designated “medium area” studies. Basin-wide or larger studies were designated “large area” studies.

The database (.xls or .mdb file) that represents the geographical, digital bibliography for the aquifer studies in the Arkansas River basin is organized into the following attribute fields (columns) characterizing each publication.

- Feature ID (FID)**: internal GIS feature identifier
- Reference # (REF_NO)**: reference identifier sorted numerically by year
- Title (TITLE)**: publication title
- Author (AUTHOR)**: publication author(s)
- Publisher (PUBLISHER)**: publishing organization(s)
- Publication type (PUB_TYPE)**: type of publication or series
- Publication number (PUB_NO)**: publication number (when applicable)
- Publication info (PUB_INFO)**: additional information about the publication (pages, figures, etc.)
- Alluvial (ALLUVIAL)**: presence (Y) or absence (N) of information on the alluvial aquifer
- Alluvial aquifer properties (ALLUVIAL AQ PROPERTIES)**: presence/absence of aquifer hydraulic property information (hydraulic conductivity, transmissivity, yield, etc.)
- Alluvial aquifer configuration (ALLUVIAL AQ CONFIGURATION)**: presence/absence of aquifer configuration information (extent, thickness, etc.)
- Alluvial water levels (ALLUVIAL WATER LVLS)**: presence/absence of water level information
- Alluvial water quality (ALLUVIAL WATER QLTY)**: presence/absence of water quality information
- Bedrock (BEDROCK)**: type of bedrock or absence (N) of information on the bedrock aquifer(s)
- Bedrock aquifer properties (BEDROCK AQ PROPERTIES)**: presence/absence of aquifer hydraulic property information (hydraulic conductivity, transmissivity, yield, etc.)
- Bedrock aquifer configuration (BEDROCK AQ CONFIGURATION)**: presence/absence of aquifer configuration information (extent, thickness, etc.)
- Bedrock water levels (BEDROCK WATER LVLS)**: presence/absence of water level information
- Bedrock water quality (BEDROCK WATER QLTY)**: presence/absence of water quality information
- County 1 (COUNTY1)**: county of primary (highest) relevance
- County 2 (COUNTY2)**: county of second-highest relevance
- County 3 (COUNTY3)**: county of third-highest relevance
- County N (COUNTYN)**: county of Nth-highest relevance, $N_{\max}=19$
- Document format (DOC FORMAT)**: format of publication copy on file at CGS (digital, hardcopy, or both)
- Filed location (ARCHIVE LOC)**: location of publication copy within CGS (either “Project library” or main “CGS library”)
- URL (LINK_INFO)**: internet address to publication, with hotlink if available online
- Date URL accessed (DATE ACCESS)**: last date of access for online publications
- Study scale (STUDY SCALE)**: qualitative size of publication study area, classified as small, medium, or large
- Additional report/data info (REPORT COMMENTS AND DATA INFO)**: notes about the publication

GIS APPLICATION

GIS files may be viewed using software packages such as ESRI's ArcGIS. Shapefiles are located in the *GISData/Shapefiles* folder and can be viewed with most GIS software packages. Metadata is associated with all shapefiles in the *GISData/Shapefiles/Project* folder. Metadata will help the user understand the content details and history of the files provided; the best way to view this information is using the Metadata tab in ESRI's ArcCatalog. Shapefiles in the *GISData/Shapefiles/Basemap* folder do not contain metadata and are for the purpose of visual display of general background spatial information and are not for publication. Please note that the *Map of Aquifer Studies in the Arkansas River Basin.mxd* ArcMap project file and the *Aquifer studies in the Arkansas River basin – A digital geographic bibliography.pmf* ArcReader file use "relative" data source paths; therefore, in order to preserve these coverage data source links we recommend copying and/or moving the entire *GISData* folder and its contents together.

The GIS layer structure is presented as a screen shot at the end of this document. The ArcMap project file is comprised of the following main layers: labels, base layers, allreferences, alluvial aquifers, bedrock aquifers, and the hillshade30m image. The *AllReferences* layer is the entire digital bibliography dataset classified by the study area size. The *Alluvial Aquifers* layer is subdivided into: AlluvAqReferences that contains all references with alluvial aquifer information; Alluvial Scale that contains all references with alluvial aquifer information classified by the study area size; and Alluvial Content that contains all references with alluvial aquifer information classified by the subject matter categories. The *Bedrock Aquifers* layer is subdivided into: BedrockAqReferences that contains all references with bedrock aquifer information; Bedrock Scale that contains all references with bedrock aquifer information classified by the study area size; and Bedrock Content that contains all references with bedrock aquifer information classified by the subject matter categories. The user could elect to turn on (select check box) only those layers containing the information desired to view a specific map. For example, one may only wish to see the small scale studies with bedrock aquifer information. The output would be similar to the map images presented in pdf form, except the GIS application provides access to the attribute table containing the bibliographic information including hotlinks to publications available online.

Alternately, the GIS files can be used to identify publications by geographic location or by searching the fields of each publication record. In ArcMap the Identify, Find, or Select by attribute functions provide the ability to identify publications of interest.

- Identify button can be used to point to a location on the map and identify publications with polygons that overlap the selected location. To do this click on the Identify button, select the layer(s) from which you want to identify features, and click on the location within the map that you would like to search for. Identified publications can be further investigated in the Identify Results window that appears once you have selected the location to identify. Hyperlinks to digital copies are provided in the Identify Results window when available.
- The Find button or function can be used to search for publications based on keywords provided. The Find function can be applied to an entire layer or a select field.
- Additional searching capabilities are available through the Select by attribute functions in which publication records can be searched and selected based on any attribute table criteria provided.

Similar search functions can be used in ArcReader to identify publications of interest. Please look under Help in the program window or visit the ESRI website (<http://support.esri.com/>) for additional information on using ArcMap or ArcReader.

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