LARAMIE COUNTY AQUIFER STUDY
EXECUTIVE SUMMARY

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Introduction

On June 7, 2007, JR Engineering LLC entered into a contract with the Wyoming Water Development Commission (WWDC) to provide professional services for the Laramie County Aquifer Study, sponsored by the Board of Laramie County Commissioners. The purpose of this study is to characterize the hydro-geologic state of the High Plains Aquifer in Laramie County, Wyoming. This effort resulted in the preparation of the “Water Resource Atlas of Laramie County, Wyoming” (Atlas). The Atlas has been prepared in paper and electronic Geographic Information System (GIS) form. The GIS files reside at WWDC and the Laramie County Department of GIS and Information Technology.

In conjunction with JR Engineering, the following sub-consultants provided professional services for the study:

- HDR, Cheyenne, Wyoming.

This report contains background information including (1) the geology and hydrology of the Laramie County region, (2) a summary of existing water quality of the identified aquifers, (3) a summary of the land use zoning, (4) the present documented water utilization of the aquifers, and (5) developed aquifer management recommendations. The report also describes the development and purpose of the interactive Ground Water Decision Support System (GWDSS). The GWDSS was developed to be used as a planning and publication tool. The Water Resource Atlas of Laramie County, Wyoming summarizes all of the background information and when integrated with the foundation of a GWDSS GIS based system, will be used for the purpose of guiding future ground water development in Laramie County.

Background

Ground water use in Laramie County dates back to the late 19th century. In 1909, migration into the eastern part of the county had begun with dry-land agriculture as the primary industry. After the drought of the 1930s, irrigation began using the ground water resource. Currently, the County is experiencing growth in rural subdivisions that rely solely on ground water for domestic and irrigation supply. An understanding of the historic development and the present conditions of the aquifer will aid in planning for subdivision water development in the future.

Scoping and Project Meetings

Mr. Bruce Brinkman was the WWDC Project Officer, and JR Engineering, LLC, served as the project prime; and JR’s sub consultants, Lidstone and Associates and HDR Inc, were also integral in the research, compilation and organization of existing data within Laramie County for the development of the Atlas. The research for this project included numerous meetings with key stakeholders, the Wyoming State Engineer’s Office (SEO),
the Wyoming Department of Environmental Quality/Water Quality Division (WQD), the Wyoming Water Development Office (WWDO) and the WWDC. The following is a tabulation of the more notable meetings held throughout the contract:

(Note: all meetings were directed and attended by Mr. Bruce Brinkman of the WWDC)

**Meetings**

<table>
<thead>
<tr>
<th>Date</th>
<th>Meeting</th>
<th>Attendees</th>
</tr>
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<tbody>
<tr>
<td>June 29, 2007</td>
<td>WWDC Cheyenne, WY</td>
<td>JRE/LA/HDR</td>
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<tr>
<td>July 2, 2007</td>
<td>Laramie County GIS Tech Session</td>
<td>JRE/LA/WWDC</td>
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<tr>
<td>September 27, 2007</td>
<td>LCAS Public Input Meeting</td>
<td>Stakeholders &amp; Staff</td>
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<tr>
<td>October 29, 2007</td>
<td>Laramie County Aquifer Tour</td>
<td>LCAS Staff</td>
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<tr>
<td>June 12, 2008</td>
<td>LCAS Public Meeting</td>
<td>Stakeholders &amp; Staff</td>
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<tr>
<td>July 2, 2008</td>
<td>Laramie County Commissioners</td>
<td>Commissioners/Staff</td>
</tr>
<tr>
<td>January 20, 2009</td>
<td>Laramie County Commissioners</td>
<td>Commissioners/Staff</td>
</tr>
</tbody>
</table>

**Data Sources**

Wyoming Water Development Office  
Wyoming Department of Environmental Quality  
Wyoming Office of the State Engineer  
Wyoming State Geological Survey  
U.S. Environmental Protection Agency  
U.S. Geological Survey  
Cheyenne Board of Public Utilities  
Laramie County, Dave Sherrill, Gary Kranse, Joyce Pukash  
Laramie County Conservation District, Jim Cochran, Liberty Blain  
Source Water Assessment and Protection Program

**Study Area**

The population of Laramie County in 2007 was estimated to be approximately 85,000. This number is expected to grow to 93,000 by the year 2020, bringing additional demands on the water resources of the County. State and Federal lands comprise a significant portion of Laramie County lands. Historically, water development has occurred on these public lands as well as in privately owned areas.

Agricultural land in Laramie County is irrigated by both surface and ground water. The areas irrigated by surface water supplies are primarily located along the foothills, drawing water from minor tributaries, which include Horse Creek and Chugwater Creek to the north, and Crow Creek in the southern part of the County.

Research of statutes and regulations included the review and explanation of existing data, policies, state and federal statutes and regulations, and county, district and municipal
ordinances. Water development in Laramie County is administered primarily by two state agencies. These agencies are the SEO and the WQD. Subdivision developments, and water issues, are administered jointly by WQD, Laramie County, and the City of Cheyenne Development Office when subdivisions are to be located within close proximity to the city boundaries, or where annexation will occur. Federal agencies have some oversight when water supply systems will be funded utilizing federal sources or if a system will be constructed on federal land.

Laws governing the SEO and the WWDC, and the establishment of water and sewer districts outside municipal boundaries, are included in Title 41 of the Wyoming Statutes. Laws governing WQD are included in Title 35, the Environmental Quality Act. These agencies have developed rules, regulations and guidelines to implement the Wyoming Statutes. County responsibilities are addressed in Title 18 of the state statues. Chapter 5, Article 3 of Title 18 specifically applies to subdivisions.

**Surface Water**

On May 20, 2008, the JR project team conducted an interview with Messrs. Tim Wilson, Director of the City of Cheyenne Board of Public Utilities (BOPU) and Mike Purcell, Director, Wyoming Water Development Commission. A summary of current BOPU Surface Water Operations and Water Rights was documented and is contained in the final report. This interview was critical to understanding the interaction of the surface and ground water resources from the largest water user in Laramie County. The report presents a detailed summary of the BOPU’s water rights, and its current and future plans to meet the challenges of its growing water demands within the City of Cheyenne and the surrounding area. This summary included the possibility of additional, undeveloped water supplies. Such supplies include the continued development of the Belvoir Ranch ground water rights and supply and trans-basin supplies via a Colorado/Wyoming water supply project. The Belvoir Ranch water supply development project could include additional wells in the shallow Tertiary Aquifer and new wells in the deeper Paleozoic Aquifer. The trans-basin supply project targets unappropriated upper Colorado River Compact Water, which may include direct transmission from Flaming Gorge Reservoir or expansion and development from other reservoirs along the Green River including Fontenelle Reservoir. Should a project of this magnitude transpire, it could include the development and transfer of a portion of Wyoming’s share of the Green River Basin.

A detailed surface water rights map is included in the Atlas and shows the location of rights on streams in Laramie County. Data related to diversion points are included in the Atlas Appendix.

The report and Atlas discuss and identify active USGS gauging stations in Laramie County at the locations marked on Figure 1 and on the map located on page 4-2 of the Atlas.
Ground Water Investigation and Findings

The report and Atlas presents ground water development beginning with the first wells dug in the late 1800’s. There are now over 12,000 permits issued for wells in the county. The Ground Water Division of the Wyoming State Engineer’s Office has been registering ground water rights for all uses except stock and domestic since 1947. However, in 1969 the State Engineer started requiring that all wells be permitted.

Historical climatic conditions are presented in the report and Atlas. Laramie County is a semi-arid climate, with an average annual precipitation that ranges from approximately 14 inches in the central part of the county up to 24 inches in the Laramie Mountains on the west edge of the county. Precipitation, including snowmelt, is the source of recharge to the High Plains Aquifer.

Significant resources were devoted to identify areas in Laramie County that are under more stringent water regulation from the SEO along with numerous GIS layers that show the boundaries and extents of the areas where new water development is currently more heavily regulated. Maps of these areas are included in the final report the titled “Areas of Special Ground Water Regulation.”

Historical ground water data was obtained and evaluated from the Wyoming State Engineer’s Office, the U.S. Geological Survey, and the Wyoming Water Science Center.

Data from these agencies were catalogued and archived by each entity. Strategic sites from these sources were integrated into a network representing the southwestern High Plains aquifer system.

Water Quality

An important aspect of the project was to compile and evaluate the water quality of the aquifer systems within Laramie County. Data was collected from the U. S. Geological Survey, National Water Information System from 144 samples collected in Laramie County from 1911 to 2001.

The project integrated information and data from the State of Wyoming 1992 efforts to assess the vulnerability of ground water to contamination, and the 1998 the DEQ completed the “Wyoming Ground Water Vulnerability Handbook.” The summary of this effort is contained in the Atlas maps for ground water sensitivity and vulnerability of the ground water resources.

The report and Atlas includes a presentation and discussion of the 1996, United States Congress passed Safe Drinking Water Act and the DEQ’s directive to help protect public water systems (PWS).
The Atlas contains a map of permitted oil and gas wells, drilled in Laramie County. The well logs and data were obtained from the Wyoming Oil and Gas Conservation Commission (WOGCC) as of December 18, 2007.

Aquifers

The Laramie County Water Atlas provides a detailed overview of the aquifers that lie within Laramie County, as well as their stratigraphy. Data was compiled and included in the Atlas from a series of geologic cross sections and combined with data obtained from various drilling logs, and geologic reports to create contoured thickness maps of the White River Group, Arikaree Formation, Ogallala Formation, and the Quaternary Terrace Deposits.

The hydrogeologic properties associated with the aquifers in Laramie County were obtained from numerous professional sources, including U.S. Geological Survey (USGS) reports, Wyoming Geological Survey reports, consultant’s reports prepared for the Wyoming Water Development Commission, numerous cities, DEQ subdivision water supply assessments, Laramie County Conservation District pump test reports, and unpublished University of Wyoming Master’s theses. The aquifer properties assembled included:

- Hydraulic Conductivity
- Transmissivity
- Specific Yield
- Storage Coefficient
- Saturated thickness of water bearing materials

Potentiometric surface maps of the High Plains Aquifer in Laramie County were prepared for three separate time intervals using this data.

Water use in the County was obtained from 2006 publication “Estimated Water Use in Wyoming”. In 2000 statewide withdrawals were estimated for ground water for irrigation, public supply, and industrial uses, and totaled about 475 Mgal/day. The High Plains aquifer which underlies Platte, Niobrara, Goshen, and Laramie Counties was the source of about 62 percent (293 Mgal/day) of these estimated withdrawals.

Water Resource Atlas of Laramie County

The Water Resource Atlas of Laramie County, prepared for this project as described in Task 7 of the Scope of Services and referred to throughout this report, provides a summary of the development of the water resources in the county, specifically the High Plains Aquifer. The Atlas was developed using GIS, which serves as the framework for the data and the maps. The GIS can be updated in the future as more data and information become available.
Ground Water Decision Support System

The Ground Water Decisions Support System (GWDSS), in beta testing form, is a modeling tool that was developed using GIS layers with the ESRI ArcGIS Spatial Analyst software. The purpose of this GWDSS is to allow the sponsor and other users to make informed decisions regarding current and future development within the County. The GWDSS assessment tool can be used to address (1) the availability of water resources to supply development and growth; and/or (2) the anticipated impact of a proposed development on these water resources – both on a local and a regional basis.

From 2000 to 2008, Laramie County has seen unprecedented growth (38% higher than the statewide average) and much of this growth has included rural subdivisions. The development of rural subdivisions has generally included individual wells and septic systems. Since 1969 the Wyoming State Engineer has required the public to obtain permits for all wells including domestic and stock wells. Several aquifers are present and utilized in Laramie County principally the Quaternary Alluvium, Quaternary Terrace, the Tertiary High Plains Aquifer and the pre-Tertiary Aquifer.

The report evaluates and presents recommendations relative to future management considerations for the ground water resources in Laramie County. These include:

- Aquifer Delineation
- Policy and Recommendations
  - Land-use management
  - Water acquisition
  - Irrigation management
  - Reductions in numbers of authorized water rights
  - Water conservation programs
  - Well construction and abandonment procedures
  - Establish and maintain monitoring well network

The project team decided to explore a GWDSS based on the GIS database, which was constructed as part of this project. The GWDSS allows many parameters to be considered in a simplified but often comprehensive fashion. In the case of the Laramie County Aquifer Management GWDSS the following parameters were derived from the project’s data collection and compilation previously discussed and include:

- Aquifers Present
- Hydraulic Conductivity
- Aquifer Specific Yield
- Saturated Thickness
- Distance to Large Irrigation Wells
- Special Ground Water Regulations
- Distance to Oil & Gas Wells
- Distance to Confined Feeding Lots
- Distance to CERCLA Sites
• Distance to WDEQ Contamination Sites
• Aquifer Sensitivity
• Aquifer Vulnerability

Recognizing that the GWDSS is a pilot study and is intended to demonstrate a conceptual decision making model, there are several possible refinements as discussed below:

• Ground water flow is ignored. The ideal shape for an exclusion zone around a particular ground water contamination site is likely not a circle. The zone of influence would likely extend further down gradient than up gradient.
• Contamination sites vary with regard to the amount of pollutant, toxicity of the pollutant, and solubility of the pollutant. Distances from a contamination source should be site specific.
• Changes in potentiometric surface over time should be included in this evaluation and can be evaluated with aquifers present;
• Losses in nearby well production should also be considered. A scale of 1 to 5 may not be the most appropriate scale.
Acknowledgements

The Water Resource Atlas of Laramie County, Wyoming was prepared by JR Engineering LLC, Lidstone and Associates and HDR with funding from the Wyoming Water Development Commission, at the request of the Commissioners of Laramie County, Wyoming. We are grateful to all the people and agencies that provided data, time and advice. The preparation of the atlas required an immense amount of time in data gathering and development of a Geographic Information System. All the maps you see in the atlas are also in GIS format at Laramie County.

The following people and agencies helped provide data and advice:

Laramie County Conservation District, Liberty Blain, Jim Cochran
Wyoming Department of Environmental Quality, Jane Francis
Laramie County, Dave Sherrill, Gary Kranse, Joyce Pokash
Wyoming Office of the State Engineer, Jeremy Manley
U.S. Environmental Protection Agency, Mike Wireman
U.S. Geological Survey
Cheyenne Board of Public Utilities

Much of the information contained herein was derived directly from two significant prior studies; The Platte River Basin Plan, and the Wyoming Ground Water Vulnerability Assessment Handbook. We thank all of those who were instrumental in the preparation of these documents.

Finally, special thanks go to Bruce Brinkman of the Wyoming Water Development Commission and especially to Marvin Crist who took of his own time to educate those of us less knowledgeable.