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1. Project Overview

"Water is the lifeblood of the earth." - Anonymous

How a County takes care of one of its most precious resources - groundwater - reflects the future wealth and health of its people. Good environmental practices are not an accident. They must include genuine foresight with knowledgeable planning. Implementation of strong practices not only commits to a better quality of life for future generations, but also creates a solid base for increased economic activity. **Though this report's scope is regional, it is a first step for Wheatland County in managing their groundwater. It is also a guide for future groundwater-related projects.**

1.1 Purpose

This project is a regional groundwater assessment of Wheatland County prepared by Hydrogeological Consultants Ltd. (HCL) with financial and technical assistance from the Prairie Farm Rehabilitation Administration branch of Agriculture and Agri-Food Canada (AAFC-PFRA), Wheatland County and the Western Irrigation District. The regional groundwater assessment provides the information to assist in the management of the groundwater resource within the County. Groundwater resource management involves determining the suitability of various areas in the County for particular activities. These activities can vary from the development of groundwater for agricultural or industrial purposes, to the siting of waste storage. **Proper management ensures protection and utilization of the groundwater resource for the maximum benefit of the people of the County.**

The regional groundwater assessment will:

- identify the aquifers[1] within the surficial deposits[2] and the upper bedrock
- spatially identify the main aquifers
- describe the quantity and quality of the groundwater associated with each aquifer
- identify the hydraulic relationship between aquifers
- identify possible groundwater depletion areas associated with each upper bedrock aquifer.

Under the present program, the groundwater-related data for the County have been assembled. Where practical, the data have been digitized. These data are then used in the regional groundwater assessment for Wheatland County.

[1] See glossary
[2] See glossary

1.2 The Project

This regional study should only be used as a guide. Detailed local studies are required to verify hydrogeological conditions at given locations.

The present project is made up of eight parts as follows:

Task 1 - Data Collection and Review
Task 2 - Hydrogeological Maps, Figures, Digital Data Files
Task 3 - Hydrogeological Evaluation and Preparation of Report
Task 4 - Groundwater Information Query Software
Task 5 - Review of Draft Report and GIS Data Files
Task 6 - Report Presentation and Familiarization Session
Task 7 - Provision of Report, Maps, Data Layers and Query
Task 8 - Provision of Compact Disk for Sale to General Public.

This report and the accompanying maps represent Tasks 2 and 3.

1.3 About This Report

This report provides an overview of (a) the groundwater resources of Wheatland County, (b) the processes used for the present project, and (c) the groundwater characteristics in the County.

Additional technical details are available from files on the CD-ROM to be provided with the final version of this report. The files include the geo-referenced electronic groundwater database, maps showing distribution of various hydrogeological parameters, the groundwater query, ArcView files and ArcExplorer files. Likewise, all of the illustrations and maps shown in this report, plus additional maps, figures and cross-sections, are available on the CD-ROM. For convenience, poster-size maps and cross-sections have been prepared as a visual summary of the results presented in this report. Copies of these poster-size drawings have been forwarded with this report, and are included as page-size drawings in Appendix D.

Appendix A features page-size copies of the figures within the report plus additional maps and cross-sections. An index of the page-size maps and figures is given at the beginning of Appendix A. A plastic County map outline is provided to overlay the maps, and contains information such as towns, main rivers, etc.

Appendix B provides a complete list of maps and figures included on the CD-ROM.

Appendix C includes the following:

1) a procedure for conducting aquifer tests with water wells[3]
2) a table of contents for the Water (Ministerial) Regulation under the new Water Act
3) interpretation of chemical analysis of drinking water
4) additional information.

The Water (Ministerial) Regulation deals with the wellhead completion requirement (no more water-well pits), the proper procedure for abandoning unused water wells and the correct procedure for installing a pump in a water well. The new Water Act was proclaimed 10 Jan 1999.

Appendix D includes page-size copies of the poster-size figures provided with this report.

Appendix E provides a list of water wells recommended for field verification.

[3] See glossary

2. Introduction

2.1 Setting

Wheatland County is situated in south-central Alberta. Most of this area is part of the western Alberta Plains region. The County is within the South Saskatchewan River basin; the Bow River forms the southern boundary along with a portion of the Siksika First Nation lands, and the Red Deer River forms the northeastern boundary. The other County boundaries are as shown on the adjacent index map.

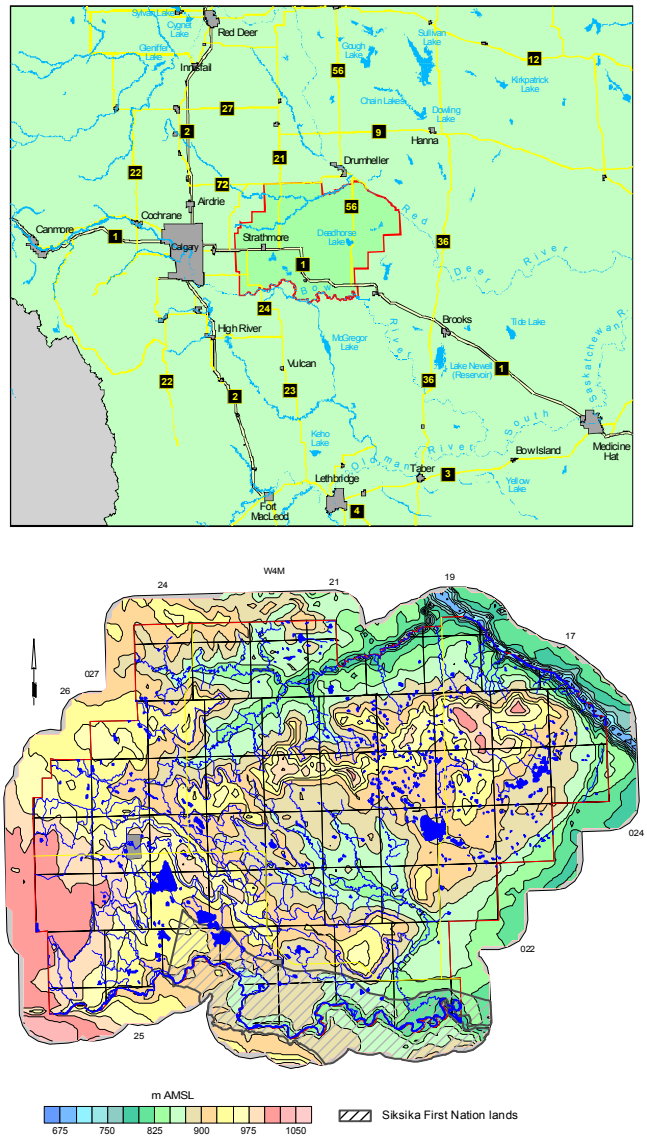

Figure 1. Index Map

Regionally, the topographic surface varies between 650 and 1,075 metres above mean sea level (AMSL). The lowest elevations occur mainly in the northeastern part of the County and the highest are in the southwestern parts of the County as shown on Figure 1 and page A-3. The area is well drained by numerous streams, including Crowfoot Creek, Parflesh Creek, Serviceberry Creek, and the Rosebud River, with the main ones being the Bow and Red Deer rivers.

2.2 Climate

Wheatland County lies within the transition zone between a humid, continental Dfb climate and a semiarid Bsk climate. This classification is based on potential evapotranspiration[4] values determined using the Thornthwaite method (Thornthwaite and Mather, 1957), combined with the distribution of natural ecoregions in the area. The ecoregions map (Strong and Leggat, 1981) shows that the County is located in the Mixed Grass region, a transition between Aspen Parkland and Dry Mixed Grass regions.

A Dfb climate consists of long, cool summers, severe winters and no dry season. The mean monthly temperature drops below -3° C in the coolest month, and exceeds 10° C in the warmest month. A Bsk climate is characterized by its moisture deficiency, where mean annual potential evapotranspiration exceeds the mean annual precipitation.

The mean annual precipitation averaged from three meteorological stations within the area measured 366 millimetres (mm), based on data from 1961 to 1993. The mean annual temperature averaged 3.9° C, with the mean monthly temperature reaching a high of 17.4° C in July, and dropping to a low of -11.1° C in January. The calculated annual potential evapotranspiration is 524 millimetres.

[4] See glossary

2.3 Background Information

2.3.1 Number, Type and Depth of Water Wells

There are currently records for 4,188 water wells in the groundwater database for the County, of which 463 are within the Siksika First Nation lands. Of the 4,188 water wells, 3,566 are for domestic/stock purposes. The remaining 622 water wells were completed for a variety of uses, including municipal, observation, industrial, irrigation, investigation and dewatering. Based on a rural population of 7,240 (Phinney, 2001-2002), there are two domestic/stock water wells per family of four. There are 3,366 domestic or stock water wells with a completed depth, of which 2,645 (79%) are completed at depths of less than 60 metres below ground surface. Water wells in the eastern half of the County mainly have completion depths of less than 60 metres. Details for lithology[5] are available for 2,567 water wells.

2.3.2 Number of Water Wells in Surficial and Bedrock Aquifers

There are 2,007 water well records with completion interval and lithologic information, such that the aquifer in which the water wells are completed can be identified. The water wells that were not drilled deep enough to encounter the bedrock plus water wells that have the bottom of their completion interval above the top of the bedrock are water wells completed in surficial aquifers. Of the 2,007 water wells for which aquifers could be defined, 241 are completed in surficial aquifers, with 185 (77%) having a completion depth of less than 50 metres below ground surface. The adjacent map shows that the water wells completed in the surficial deposits occur mainly along the Bow River, and in linear bedrock lows.

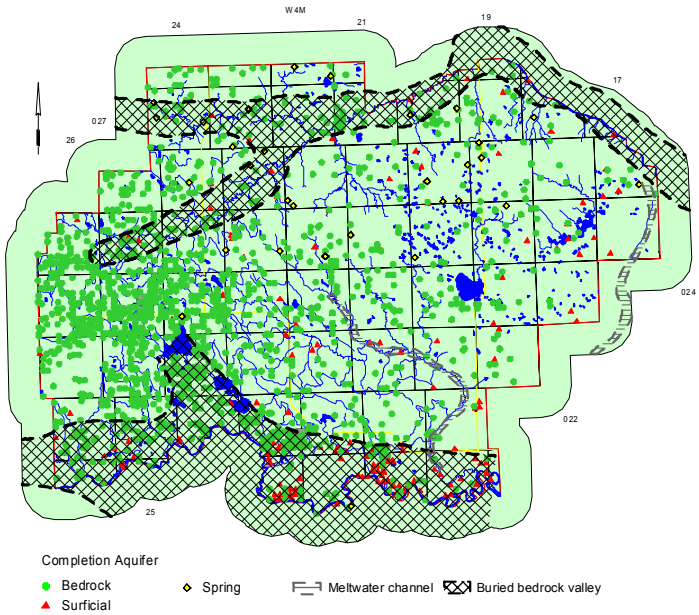

Figure 2. Location of Water Wells and Springs

The data for 1,766 water wells show that the top of the water well completion interval is below the bedrock surface, indicating that the water wells are completed in at least one bedrock aquifer. From Figure 2 (also page A-4), it can be seen that most of the water wells completed in bedrock aquifers occur in the western part of the County. Within the County, casing-diameter information is available for 1,747 of the 1,766 water wells completed below the top of bedrock. These 1,747 bedrock water wells have surface-casing diameters of less than 275 mm and these bedrock water wells have been mainly completed with either a perforated liner or as open hole; there are 38 bedrock water wells completed with a water well screen.

There are currently records for 33 springs in the groundwater database, including 11 springs that were documented by Borneuf (1983). There are 26 springs having at least one total dissolved solids (TDS) value, with a range from 313 to 2,618 milligrams per litre (mg/L); two of the 26 springs have TDS concentrations of less than 500 mg/L. Of the 30 available total hardness values, 21 have total hardness concentrations of more than 100 mg/L. The only available flow rate for a spring within the County is 68 litres per minute (lpm) measured in June 1969 for a spring in NE 08-024-24 W4M.

[5] See glossary

2.3.3 Casing Diameter and Type

Data for casing diameters are available for 2,578 water wells, with only two indicated as having a diameter of more than 275 mm. The casing diameters of greater than 275 mm are mainly bored or dug water wells and those with a surface-casing diameter of less than 275 mm are drilled water wells.

In the County, steel, galvanized steel and plastic surface casing materials have been used in 99.9% of the drilled water wells over the last 40 years. The remaining 0.1% was for two water wells completed with concrete-type surface casing in the 1960s. Until the mid-1960s, the type of surface casing used in drilled water wells was mainly undocumented. Steel casing was in use in the 1950s and is still used in 76% of the water wells being drilled in the County. Galvanized steel and plastic surface casing (PVC) have been used in less than 6% of the new water wells; galvanized steel was last used in April 1994 for the completion of a drilled water well.

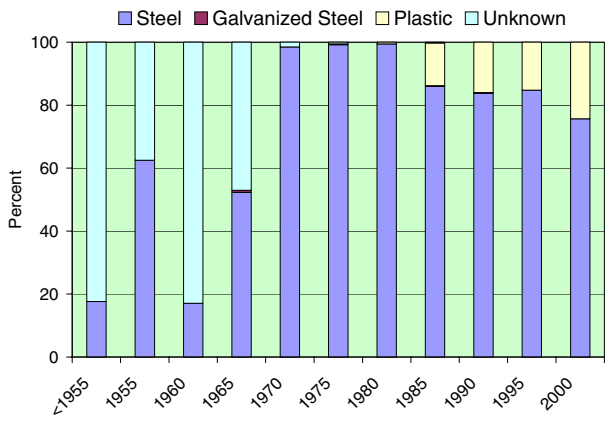

Figure 3. Surface Casing Types Used in Drilled Water Wells

Steel casing has been dominant in the County probably because it has resisted corrosion and also because water well drillers may be reluctant to use PVC if there have been no documented problems with steel casing in the area.

2.3.4 Dry Water Test Holes

In the County, there are 4,910 records in the groundwater database. Of these 4,910 records, 71 are indicated as being dry or abandoned with “insufficient water”. Also included in these dry test holes is any record that includes comments that state the water well goes dry in dry years. The 71 “dry” test hole records are located throughout the County.

2.3.5 Requirements for Licensing

Water wells used for household needs and all other groundwater use must be licensed if the use is in excess of 3.4 cubic metres per day (1,250 cubic metres per year) (750 imperial gallons per day[6]). The only groundwater users that do not need licensing are (1) household use of up to 1,250 m³/year and (2) groundwater with total dissolved solids in excess of 4,000 mg/L. In the last update from the Alberta Environment (AENV) groundwater database in September 2001, 202 groundwater allocations were shown to be within the County, with the most recent groundwater user being licensed in June 2000. Of the 202 licensed groundwater users, 136 (**which is 67% of all licensed water wells in the County**) could be linked to the AENV groundwater database. Of the 202 licensed groundwater users, 149 are for agricultural purposes, 25 are for municipal purposes, 18 are for exploration purposes (specifically cooperative and stock), seven are for commercial purposes, and the remaining three are for recreation or irrigation purposes. The total maximum authorized diversion from the water wells associated with these licences is 5,880 cubic metres per day (m³/day), although actual use could be less. Of the 5,880 m³/day, 4,518 m³/day (76.8%) is authorized for agricultural purposes, 584 (10%) is authorized for municipal purposes, 555 m³/day (9.4%) is authorized for exploration, and the remaining 223 m³/day (3.8%) is allotted for commercial, recreation or irrigation use, as shown in Table 1 on the following page. A figure showing the locations of the licensed users is in Appendix A (page A-6) and on the CD-ROM. Table 1 also shows a breakdown of the 202 licensed groundwater allocations by the aquifer in which the water well is completed. Approximately thirty-four percent of the total licensed groundwater allocations are in multiple bedrock completions (10.4%) and in unknown aquifers (24%). The aquifer name is unknown because there is no

[6] see conversion table on page 67