6.5.2 Area 2 – Potable Water Injection by the Energy Industry

Members of the public have periodically expressed concern regarding the use of groundwater by the oil and gas industry in Alberta. Common concerns expressed by the public include the following:

- The volumes of potable groundwater being used for injection are large and once this water has been injected into an oil reservoir, it is lost forever.
- The use of groundwater by the oil industry negatively impacts the water wells used by the agricultural community and household users in rural residential subdivisions.
- The use of water by the oil industry can limit future agricultural expansion by having the water needed for the expansion licensed for industrial use and therefore not available for the local user.

Since the mid-1890s, the diversion and use of larger quantities of groundwater in Alberta has been the subject of prior approval. Initially the legislation that required licensing of the diversion and use of water was administered by the Dominion (federal) government, and was applied exclusively to surface water. The first Provincial water management legislation, the Water Resources Act, came into being in April 1931. The legislation continued to be directed toward the larger users of surface water.

The 1971 revision of the Water Resources Act specifically included clauses regarding the licensing of groundwater. The water management legislation underwent revisions from time to time. Largely in response to concerns by rural Albertans, from about mid-1981 the approval to divert groundwater for injection was a temporary permit rather than a permanent licence.

In March 1990, the Ground Water Allocation Policy for Oilfield Injection Purposes developed with input from various rural, agricultural and industrial groups took effect. The policy placed additional restrictions on the diversion and use of groundwater specifically for injection in the White (agricultural) Area of the province. The policy was to manage the groundwater resources of the province of Alberta in such a way as to provide continuing protection to the existing and future domestic, municipal, agricultural and industrial users while maintaining the important principle of multi-purpose use of water. The Policy was to substantially reduce the conflicts over the use of potable water for oilfield injection.

6.5.2.1 Diversion and Use of Groundwater for Injection

There are 60 permits and licences allowing the diversion of up to 4,308,460 cubic metres of groundwater per year for injection in the County. The adjacent graph indicates that the total licensed quantity has been gradually increasing over the years. Although the total licensed quantity can be diverted each year, it often is not.

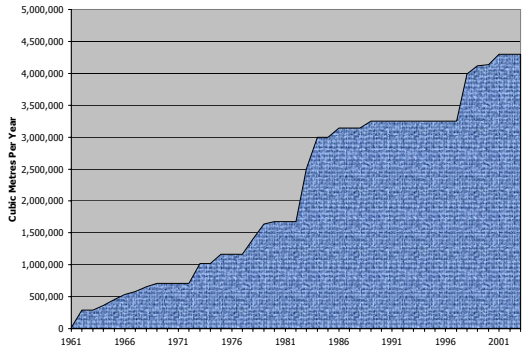

Figure 38. Licensed Groundwater Diversion for Injection Purposes

6.5.2.2 Licensed Allocations of Groundwater Versus Actual Diversion and Use

It has been possible to compare the quantity of groundwater licensed for diversion and use for injection by AENV, to the quantity actually being diverted and used based on the data collected by the Alberta Energy and Utilities Board (EUB).

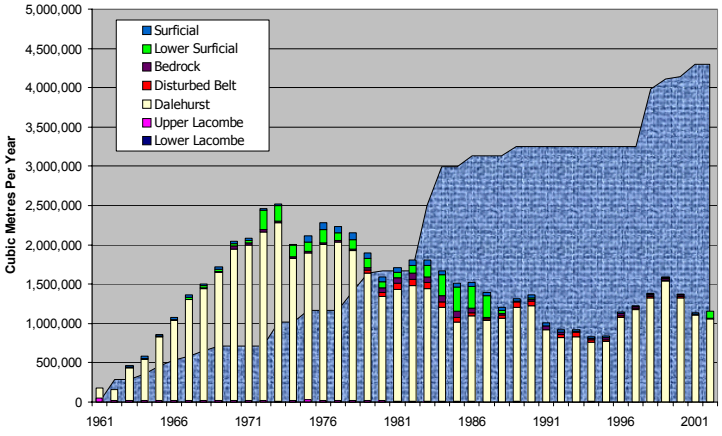

Figure 39. Licensed Groundwater Versus Diversion Reported

The adjacent graph indicates the yearly quantity of groundwater diverted by aquifer for injection in the County. The quantity of groundwater approved for diversion by AENV is also indicated. Nearly 90% of the total groundwater diverted is from the Dalehurst Aquifer. The total quantity of groundwater used in the County increased between 1961 and 1973 and has generally, with few exceptions, been gradually decreasing ever since. The total diverted in 2002, 1.15 million cubic metres, is only 45% of what it was in 1971 when the total diversion reached 2.54 million cubic metres. Based on the volumes reported to the EUB, the quantity of groundwater actually diverted in 2002, the most recent year for which data are available, is 27% of the total quantity licensed.

6.5.2.3 Future Trends in Groundwater Use for Injection

It is difficult to obtain statistics on future trends for the use of groundwater for injection in the County. Where new injection schemes require water, groundwater generally continues to be the most sustainable and reasonable cost-effective alternative, especially where smaller quantities of water are required. Based on the water-level data available from most approvals, the diversion and use of the groundwater for secondary recovery projects is NOT having a negative effect on the groundwater resource. In fact, the water-level data obtained from the oil industry for this project was significantly greater than the water-level data provided by Alberta Environment.

6.5.3 Area 3 – Shallow Groundwater Nitrate Levels

Clearwater County has concerns with regard to nitrate contamination of water wells completed in shallow sandstones and/or in surficial sand and gravel aquifers.

In Clearwater County, there were two groundwater samples that had Nitrate + Nitrite (as N) concentrations that were greater than the Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ) for the surficial aquifers and 12 groundwater samples that had Nitrate + Nitrite (as N) concentrations that were greater than the SGCDWQ for the upper bedrock aquifer(s). The range for the Nitrate + Nitrite (as N) concentrations in the groundwaters is higher in the water wells completed in the surficial deposits than in the water wells completed in the bedrock, ranging from 31.5 to 84.3 mg/L for the surficial aquifers and from 10.5 to 27.34 mg/L for the bedrock aquifers.

The 14 groundwater samples that had Nitrate + Nitrite (as N) concentrations that were greater than the SGCDWQ represent only one percent of the total number of groundwater samples (1,095) for which analyses were available. The locations for the water wells with the elevated values are scattered and do not indicate the problem is area specific. The water well completion depths range from 6.1 to 47.2 metres below ground level. None of the chemical analyses are more recent than 1985 and at least five are for water wells completed in 1975 or earlier.

Aquifer	Nitrate + Nitrite (as N)	Chloride (mg/L)	Analysis Date	Water Well Completed Depth (m)	Water Well Completion Date	Legal	Proposed Use
Bedrock	10.5	30	05-Oct-77	11.3	10-May-64	NE 14-039-07 W5M	Domestic
Dalehurst Member	12	20	04-Oct-85	16.8		NW 09-039-05 W5M	Domestic
Dalehurst Member	14.1	23	18-Jan-84	42.7		NH 19-036-05 W5M	Domestic
Dalehurst Member	14.3	0.12	13-Jul-77	30.5		NE 05-043-06 W5M	Domestic
Dalehurst Member	14.9	42	30-Dec-76	20.4	01-Jan-48	SE 04-038-06 W5M	Domestic
Dalehurst Member	15.4	22	20-Aug-76	29.0		··- 21-039-07 W5M	Domestic
Dalehurst Member	17.9	176	14-Jun-77	18.3		NW 09-039-05 W5M	Domestic
Dalehurst Member	19	64	24-Sep-85	47.2	01-Oct-80	SW 23-037-04 W5M	Domestic
Dalehurst Member	19.5	22	26-Jul-78	21.3		SE 01-039-05 W5M	Domestic
Dalehurst Member	24.6	47	09-Mar-84	21.3		16-09-038-04 W5M	Domestic & Stock
Dalehurst Member	27.3	122	17-Jul-78	30.5	12-Nov-75	SW 25-038-06 W5M	Domestic
Disturbed Belt	19.5	26	20-May-75	22.9		SE 19-031-07 W5M	Domestic
Surficial	31.5	120	29-Sep-72	18.3		SE 35-039-05 W5M	Domestic
Surficial	84.3	70	09-Jan-76	6.1	1966	SE 14-035-04 W5M	Domestic

Table 12. Concentrations of Nitrate + Nitrite (as N) in Groundwaters

A review of the corresponding chloride concentrations for the 14 water wells indicated the chloride concentrations range from a low of 0.12 to a high of 176 mg/L, all below the SGCDWQ aesthetic guideline of 250 mg/L. However, the two higher chloride values of 120 mg/L for one of the surficial water well completions and 176 mg/L for one of the bedrock water well completions suggest surface contamination is a possibility.

Good groundwater management practices involve monitoring and recommend periodic analysis of a groundwater sample, especially where human consumption is involved.

7 RECOMMENDATIONS

The present study has been based on information available from the groundwater database. The database has three problems:

1) the quality of the data
2) the coordinate system used for the horizontal control
3) the distribution of the data.

The quality of the data in the groundwater database is affected by two factors: a) the technical training of the persons collecting the data, and b) the quality control of the data. The possible options to upgrade the database include the creation of a "super" database, which includes only verified data. The first step would be to field-verify the 180 existing water wells listed in Appendix E. These water well records indicate that a complete water well drilling report is available along with at least a partial chemical analysis. The level of verification would have to include identifying the water well in the field, obtaining meaningful horizontal coordinates for the water well and the verification of certain parameters such as water level and completed depth. There is one water well for which the County has responsibility; the County-operated water well is included in Appendix E. It is recommended that the County-operated water well plus the 180 water wells be field-verified, water levels be measured, a water sample be collected for analysis, and a short aquifer test be conducted. An attempt to update the quality of the entire database is not recommended.

The most notable areas where surficial water wells are completed in the Sand and Gravel Aquifer(s) are where the thickness of the Sand and Gravel Aquifer(s) is greater than five metres, particularly in the southeastern part of the County, and in association with the meltwater channel north of Rocky Mountain House. The median apparent yield value from surficial water wells in these areas is greater than 100 m^3/day (15 igpm).

The results of the present study indicate the following recommendations:

- **Improve the Data**

Before an attempt is made to provide a major upgrade to the level of interpretation provided in this report, the accompanying maps and the groundwater query, it is recommended that the 180 water wells listed in Appendix E for which water well drilling reports are available, plus the one County–operated water well, be subjected to the following actions (see pages C-2 to C-3):

1) The horizontal location of the water well should be determined within ten metres. The coordinates must be in 10TM NAD 27 or some other system that will allow conversion to 10TM NAD 27 coordinates.
2) A four-hour aquifer test (two hours of pumping and two hours of recovery) should be performed with the water well to obtain a realistic estimate for the transmissivity of the aquifer in which the water well is completed.
3) Water samples should be collected for chemical analysis after five and 115 minutes of pumping, and analyzed for major and minor ions.

This additional information would provide a baseline to be used for comparison to either existing chemical analyses or aquifer tests, or to determine if future monitoring would be necessary if significant changes in the aquifer parameters had occurred.

A list of the 181 water wells (180 plus 1 County) that could be considered for the above program is given in Appendix E and on the CD-ROM.

- **Link AENV Groundwater and Licensing Databases**

An attempt to link the AENV groundwater and licensing databases was 35% successful in this study (see CD-ROM); sixty-five percent of licensed and/or registered water wells do not appear to have corresponding records in the AENV groundwater database. There is a need to improve the quality of the AENV licensing database. It is recommended that attempts be made in a future study to find and add missing drilling records to the AENV groundwater database and to determine the aquifer in which the licensed and/registered water wells are completed.

- **Monitor Groundwater Use and Water Levels**

While there are a few areas where water-level data are available at different times, on the overall, there are an insufficient number of water levels to set up a groundwater budget. One method to obtain additional water-level data is to solicit the assistance of the water well owners who are stakeholders in the groundwater resource. In the M.D. of Rocky View and in Flagstaff County, water well owners were being provided with a tax credit if they accurately measured the water level in their water well once per week for a year. A pilot project indicated that approximately five years of records are required to obtain a reasonable data set. The cost of a five-year project involving 50 water wells would be less than the cost of one drilling program that may provide two or three observation water wells. Monitoring of water levels in domestic and stock water wells is a practice that is recommended by PFRA in the “Water Wells That Last for Generations” manual and accompanying videos (Buchanan, Bob (editor). Alberta Agriculture, Food and Rural Development, 1996).

A second approach to obtain water-level data would be to conduct a field survey to identify water wells not in use that could be used as part of an observation water well network. County personnel and/or local residents could measure the water levels in the water wells regularly.

Communities that are concerned about apparent water-level declines in the aquifers in which their water supply wells are completed should implement a conscientious groundwater monitoring program.

- **Provide Water Well Driller with Feedback**

There is also a need to provide the water well drillers with feedback on the reports they are submitting to the regulatory agencies. The feedback is necessary to allow for a greater degree of uniformity in the reporting process. This is particularly true when trying to identify the bedrock surface. One method of obtaining uniformity would be to have the water well drilling reports submitted to the AENV Resource Data Division in an electronic form. The money presently being spent by AENV to transpose the paper form to the electronic form should be used to allow for a technical review of the data and follow-up discussions with the drillers.

- **Partnership with the Petroleum Industry**

An effort should be made to form a partnership with the petroleum industry. The industry spends millions of dollars each year collecting information relative to water wells. Proper coordination of this effort could provide significantly better information from which future regional interpretations could be made. This could be accomplished by the County taking an active role in the activities associated with the construction of lease sites for the drilling of hydrocarbon wells and conducting of seismic programs.

In summary, for the next level of study, the database needs updating. The updating of information for existing water wells requires more details for the water wells listed in Appendix E; the additional information for new water wells is mainly better spatial control.

Groundwater is a renewable resource and it must be managed.