6.3 Areas of Groundwater Decline

The areas of groundwater decline in both the sand and gravel aquifer(s) and in the bedrock aquifers have been determined by using a similar procedure in both situations. Because major development began occurring in the 1970s, the changes in water-level maps are based on the differences between water-level elevations available before 1970 and after 1984. Where the earliest water level is at a higher elevation than the latest water level, there is the possibility that some groundwater decline has occurred. Where the earliest water level is at a lower elevation than the latest water level, there is the possibility that the groundwater has risen at that location. The water level may have risen as a result of recharge in wetter years or may be a result of the water well being completed in a different bedrock aquifer. In order to determine if the water-level decline is a result of groundwater use by licensed users, the licensed groundwater users were posted on the maps.

Of the 464 water wells completed in the sand and gravel aquifer(s) with a non-pumping water level and test date, 243 are from water wells completed before 1970 and 64 are from water wells completed after 1984. As a result of the disproportionate amount and location of control points prior to and after major development, the “Changes in Water Levels in Sand and Gravel Aquifer(s)” figure has not been included in the report or on the CD-ROM. In August and September 1999, an unpublished water well survey was conducted by Mow-Tech Ltd. that included measuring the water level in water wells located in ranges 26 and 27, W4M in Sturgeon County. There were six water wells completed in Sand and Gravel Aquifer(s) where access allowed a water level to be measured by Mow-Tech Ltd. and an original NPWL existed in the groundwater database. Of these six water wells, three water levels had declined by a maximum of 1.7 metres over a twenty-two year interval, one water level had risen 1.40 metres over a nine-year interval, and two water levels remained the same as shown in the adjacent table.

Date Drilled	NPWL (m)	Date Survey	NPWL (m)	Change (m)
26-Apr-77	0.9	12-Aug-99	2.6	-1.7
11-Oct-89	24.4	12-Sep-99	24.4	0.0
06-Sep-90	21.9	12-Sep-99	20.6	1.4
06-Jan-92	1.8	12-Aug-99	2.0	-0.2
22-Oct-92	0.9	12-Aug-99	0.9	0.0
30-Apr-93	5.5	12-Aug-99	5.8	-0.3

Table 10. Changes in Water Levels in Sand and Gravel Aquifer(s)

Of the 3,058 bedrock water wells with a non-pumping water level and test date, 455 are from water wells completed before 1970 and 1,068 are from water wells completed after 1984. The adjacent map indicates that in 60% of the County, it is possible that the non-pumping water level has declined. Of the 59 licensed groundwater users, most occur in areas where a water-level decline exists.

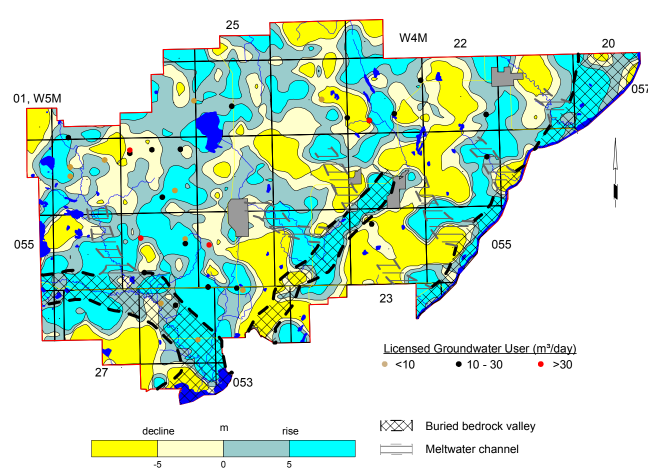

Figure 30. Changes in Water Levels in Upper Bedrock Aquifer(s)

Fifty-three percent of the areas where there has been a water-level decline of more than five metres in upper bedrock aquifer(s) correspond to where the estimated water well use is between 10 and 30 m³/day; 8% of the declines occurred where the estimated water well use is more than 30 m³/day; 32% of the declines occurred where the estimated water well use is less than 10 m³/day; the remaining 7% occurred where there is no groundwater use shown on Figure 26.

7. Potential For Groundwater Contamination

The most common sources of contaminants that can impact groundwater originate on or near the ground surface. The contaminant sources can include leachate from landfills, effluent from leaking lagoons or from septic fields, and petroleum products from storage tanks or pipeline breaks. Additional agricultural activities that generate contaminants include the improper spreading of fertilizers, pesticides, herbicides and manure. The spreading of highway salt can also degrade groundwater quality.

When activities occur that can or do produce a liquid that could contaminate groundwater, it is prudent (from a hydrogeological point of view) to locate the activities where the risk of groundwater contamination is minimal. Alternatively, if the activities must be located in an area where groundwater can be more easily contaminated, the necessary action must be taken to minimize the risk of groundwater contamination.

The potential for groundwater contamination is based on the concept that the easier it is for a liquid contaminant to move downward, the easier it is for the groundwater to become contaminated. In areas where there is groundwater discharge, liquid contaminants cannot enter the groundwater flow systems to be distributed throughout the area. In areas of groundwater recharge, low-permeability materials impede the movement of liquid contaminants downward. Therefore, if the soils develop on a low-permeability parent material of till or clay, the downward migration of a contaminant is slower relative to a high-permeability parent material such as sand and gravel of fluvial origin. Once a liquid contaminant enters the subsurface, the possibility for groundwater contamination increases if it coincides with a higher permeability material within one metre of the land surface.

To determine the nature of the materials on the land surface, the Agricultural Region of Alberta Soil Inventory Database (AGRASID) (CAESA, 1998) has been reclassified based on the relative permeability. The classification of materials is as follows:

1) high permeability - sand and gravel
2) moderate permeability - silt, sand with clay, gravel with clay, and bedrock
3) low permeability - clay and till.

To identify the areas where sand and gravel can be expected within one metre of the ground surface, all groundwater database records with lithologies were reviewed. From a total of 3,871 records with lithological descriptions in the area of the County, 542 have the top of a sand and gravel deposit present within one metre of ground level. In the remaining 3,329 records, the first sand and gravel deposit is deeper than one metre or not present. This information was gridded to prepare a distribution of where the first sand and gravel deposit could be expected within one metre of ground level.

7.1.1 Risk of Groundwater Contamination Map

The information from the reclassification of the soil map is the basis for preparing the initial risk map. The depth to the first sand and gravel is then used to modify the initial map and to prepare the final map. The criteria used for preparing the final Risk of Groundwater Contamination map are outlined in the adjacent table.

Surface Permeability	Sand or Gravel Present - Top Within One Metre Of Ground Surface	Groundwater Contamination Risk
Low	No	Low
Moderate	No	Moderate
High	No	High
Low	Yes	High
Moderate	Yes	High
High	Yes	Very High

Table 11. Risk of Groundwater Contamination Criteria

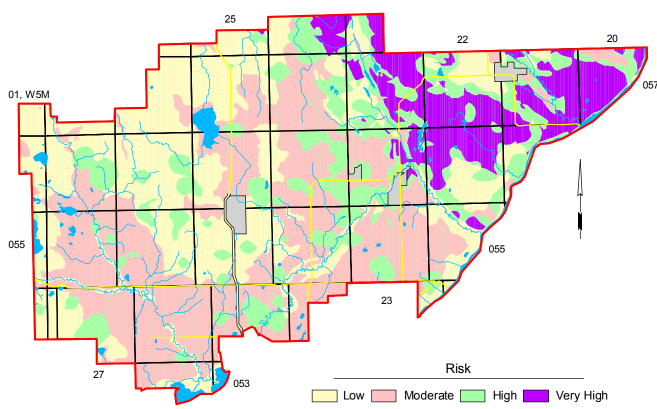

Figure 31. Risk of Groundwater Contamination

The Risk of Groundwater Contamination map shows that, in 32% of the County, there is a high or very high risk for the groundwater to be contaminated. These areas would be considered the least desirable ones for a development that has a product or by-product that could cause groundwater contamination. However, because the map has been prepared as part of a regional study, the designations are a guide only. Detailed hydrogeological studies must be completed at any proposed development site to ensure the groundwater is protected from possible contamination. At all locations, good environmental practices should be exercised in order to ensure that contaminants will not affect groundwater quality.

8. 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 261 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. Even though the two water wells for which the County has responsibility do not satisfy the above criteria, it is recommended that the water wells be field-verified, water levels be measured, a water sample be collected for analysis, and a short aquifer test be conducted; the two County-operated water wells are also included in Appendix E. An attempt to update the quality of the entire database is not recommended.

An attempt in this study to link the AENV groundwater and licensing databases was about 65% successful. About one-third of licensed 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 water wells are completed.

While there are a few areas where water-level data are available, 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 are being provided with a tax credit if they accurately measure 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 (Alberta Agriculture, Food And Rural Development, 1996). Of the 261 water wells recommended for field verification, 194 of the bedrock water wells and 67 of the surficial water wells are in areas of water-level decline. Because the flow through the individual aquifers is significantly less than the total of the licensed and unlicensed diversions, it is strongly recommended that a groundwater-monitoring program be established. The cost of establishing such a groundwater-monitoring program for Sturgeon County would be in the order of $50,000.

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.

In general, for the next level of study, the database needs updating. It requires more information from existing water wells, and additional information from new ones.

Before an attempt is made to provide a major upgrade to the level of interpretation provided in this report and the accompanying maps and groundwater query, it is recommended that the 261 water wells for which water well drilling reports are available 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.

A list of the 261 water wells that could be considered for the above program is given in Appendix E.

In addition to the data collection associated with the existing water wells, all available geophysical logs should be interpreted to establish a more accurate spatial definition of individual aquifers.

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.

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.

Groundwater is a renewable resource and it must be managed.

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