VII. 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. The agricultural activities that generate contaminants include the 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, which 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 groundwater recharge areas, 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 surficial geology map prepared by the Alberta Research Council (Shetsen, 1990) 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; and
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 4,909 records in the project area with lithological descriptions, 1,618 have the top of a sand and gravel deposit present within one metre of ground level. In the remaining 3,291 records, the first sand and gravel is deeper 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.

1) Risk of Groundwater Contamination Map

The information from the reclassification of the surficial geology 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 8. Risk of Groundwater Contamination Criteria

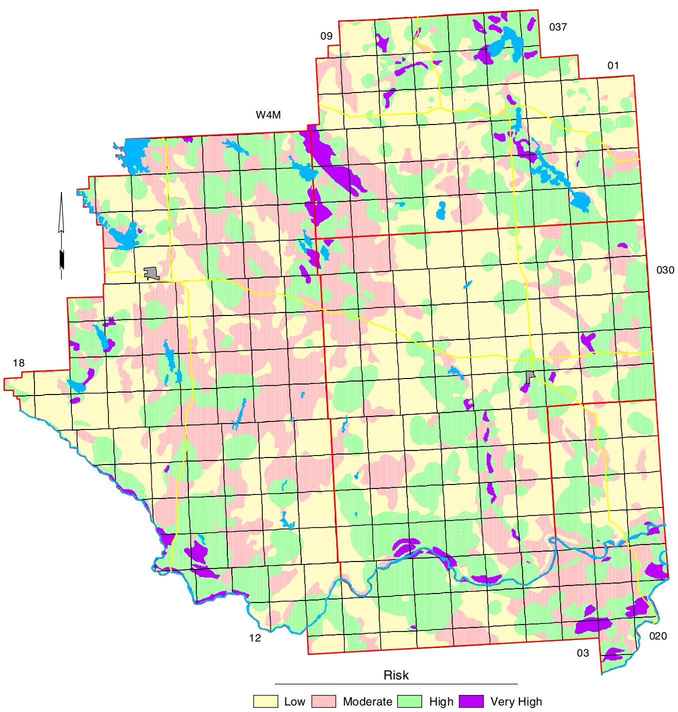

Figure 32. Risk of Groundwater Contamination

The Risk of Groundwater Contamination map shows that, in 35% of the project area, 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.

VIII. 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; and
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 432 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 water wells for which Special Areas or the M.D. has responsibility do not satisfy the above criteria, it is recommended that they be field verified, water levels be measured, a water sample collected for analysis, and a short aquifer test be conducted. A list of at least some of the Special Areas and M.D.-operated water wells are also included in Appendix E. An attempt to update the quality of the entire database is not recommended.

In general, the elevation of the Base to Groundwater Protection may be too shallow along stretches of the Red Deer River. It is recommended that the elevation of the Base of Groundwater Protection be reviewed by EUB and AE in the study area, specifically along the Red Deer River and the other areas indicated on Figure 4 (Page 7) where the water wells are completed below the Base of Groundwater Protection.

In the bedrock, there are indications that a useable aquifer in the western part of the study area may be present in parts of the Oldman Aquifer. The top of the Oldman Formation varies between 100 and 500 metres below ground level in the western part of the project area. In 31-031-12 W4M, the main sandstone unit was encountered at 236 metres. This Aquifer would represent the maximum depth that can be considered for the development of groundwater supplies for traditional agricultural purposes. Because of the depth of the Aquifer, it would not normally be developed because of the cost and the risk of not encountering a suitable groundwater supply. Therefore, a test-drilling program could be considered to evaluate the Oldman Aquifer in areas where only limited groundwater supplies are available from shallower aquifers. The purpose of the program would be to determine the parameters of the Oldman Aquifer and the chemical quality of the groundwater from the Aquifer to assist local residents in determining if an attempt should be made to develop a groundwater supply from the Oldman Aquifer.

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.

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 network. Special Areas or M.D. personnel and/or local residents could measure the water levels in the water wells regularly. Because of the apparent lowering of the water level in the Oldman Aquifer in the Oyen area as shown in Figure 28 (Page 33), it is recommended that some water wells in this area be included in a groundwater monitoring program.

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 upgrade the level of interpretation provided in this report and the accompanying maps and groundwater query, it is recommended that all water wells for which water well drilling reports are available be subjected to the following actions (see pages C-2 to C-4):

1. The horizontal location of the water well should be determined within 10 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 5 and 115 minutes of pumping, and analyzed for major and minor ions.

A list of 432 water wells that could be considered for the above program is given in Appendix E.

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 AE Resource Data Division in an electronic form. The money presently being spent by AE and PFRA 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. Special Areas 2, 3 and 4, and the M.D. of Acadia could accomplish this by 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.