The recharge classification shown on Figure 32 is used where the water-level surface in the uppermost surficial deposits is more than 15 metres above the water-level surface in the Lower Sand and Gravel Aquifer. The discharge areas are where the water level in the uppermost surficial deposits is more than ten metres lower than the water level in the Lower Sand and Gravel Aquifer. When the water level in the uppermost surficial deposits is between ten and 15 metres below the water level in the Lower Sand and Gravel Aquifer, the area is classified as a transition, that is, no recharge and no discharge.

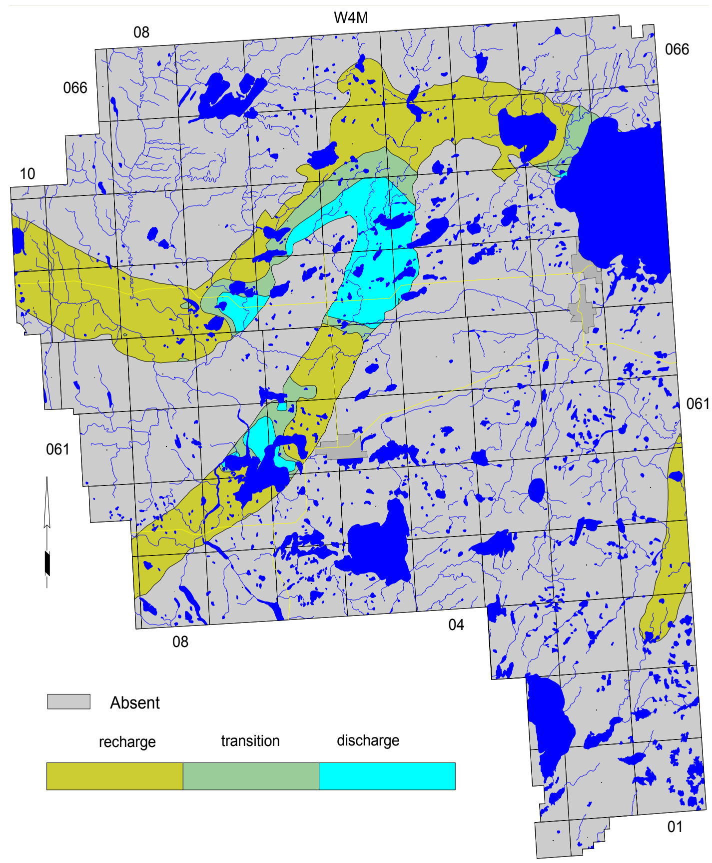

Figure 32. Recharge/Discharge Areas in Lower Sand and Gravel Aquifer

Figure 32 shows that, in more than 80% of the areas where the Lower Sand and Gravel is present in the M.D., there is a downward hydraulic gradient from the uppermost surficial deposits toward the Lower Sand and Gravel Aquifer (i. e. recharge). Ten percent of the areas with an upward hydraulic gradient from the Lower Sand and Gravel Aquifer to the uppermost surficial deposits (i. e. discharge) are mainly near the junction of the Buried Helena and Beverly valleys. The discharge in this area may be due to the groundwater flow being impeded in the Buried Beverly Valley by the deposits or the hydraulic gradient in the Buried Helena Valley. As a result, there is no opportunity for groundwater to move from the uppermost surficial deposits to the Lower Sand and Gravel Aquifer.

The remaining 10% of the M.D. are areas where there is a transition condition to the Lower Sand and Gravel Aquifer.

6.4 Areas of Groundwater Decline

In order to determine the areas of potential groundwater decline in the sand and gravel aquifer(s), the available non-pumping water-level elevation for each water well completed in the sand and gravel aquifer(s) was first sorted by location, and then by date of water-level measurement. The dates of measurements were required to differ by at least 365 days. Only the earliest and latest control points at a given location were used.

The areas of groundwater decline in the sand and gravel aquifer(s) have been calculated by determining the frequency of non-pumping water level control points per five-year periods from 1960 to 2000. There were no control points before 1955. Of the 2,407 surficial water wells with a non-pumping water level and date in the M.D., 1,041 are from water wells completed before 1985 and 1,366 are from water wells completed after 1985. Where the earliest water level (before 1985) is at a higher elevation than the latest water level (after 1985), 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 surficial 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.

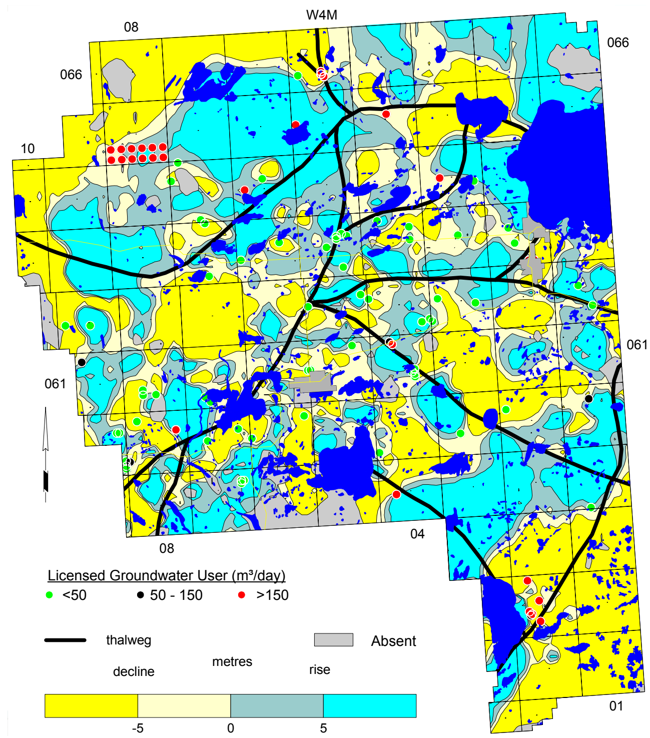

Figure 33. Changes in Water Levels in Sand and Gravel Aquifer(s)

Figure 33 indicates that in 50% of the M.D., it is possible that the non-pumping water level has declined. Of the 139 licensed groundwater users, most occur in areas where a water-level decline may exist. Table 19 shows that sixty-five percent of the areas where there has been a water-level decline of more than five metres corresponds to where there is no estimated water well use; 34% is less than 10 m³/day; 12% is between 10 and 30 m³/day per section; the remaining 1% of the declines occurred where the estimated groundwater use per section is greater than 30 m³/day, as shown previously on Figure 30. The areas of groundwater decline in the sand and gravel aquifer(s) where there is no estimated water well use suggests that groundwater production is not having an impact and that the decline may be due to variations in recharge to the aquifer.

Estimated Water Well Use	*% of Area of Affected*
<10	*34*
10 to 30	*12*
>30	*1*
no use	*65*

Table 19. Water-Level Decline of More than 5 Metres in Sand and Gravel Aquifer(s)

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 386 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 are two water wells for which the M.D. has responsibility, neither one of which satisfies the above criteria; the five M.D.-operated water wells are included in Appendix E. It is recommended that these five M.D.-operated water wells plus the 386 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.

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 391 water wells listed in Appendix E for which water well drilling reports are available, plus the five M.D.-operated water wells, 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 391 water wells that could be considered for the above program is given in Appendix E and on the CD-ROM.

An attempt to link the AENV groundwater and licensing databases was about 70% successful in this study (see CD-ROM). About 30% 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 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 (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. M.D. personnel and/or local residents could measure the water levels in the water wells regularly.

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. Imperial Oil Limited was contacted for this project but due to time constraints was unable to participate. 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 M.D. taking an active role in the activities associated with the construction of lease sites for the drilling of hydrocarbon wells, licensing of groundwater diversions, conducting of seismic programs, and conscientious groundwater monitoring of the licensed groundwater diversions.

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.

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