

# **RE: ROSEAU RIVER WATERSHED PLAN GROUNDWATER RESOURCE INVENTORY**

## **REFERENCE MATERIAL**

Groundwater is an important source of water supply for private domestic use as well as municipal, agricultural and industrial purposes within the Roseau River Watershed. Groundwater resource information for areas of the watershed is available from within the following reference material:

- Betcher, R.N. 1986. Groundwater Availability Map Series, Kenora Map Area (52-E-W½). Manitoba Natural Resources, Water Resources.
- Betcher, R, G. Grove and C. Pupp. 1995. Groundwater in Manitoba: Hydrogeology, Quality Concerns, Management. National Hydrology Research Institute Contribution No. CS-93017. Environmental Sciences Division, NHRI, Environment Canada.
- Grasby, S.E. and R.N. Betcher. 2002. Regional Hydrogeochemistry of the Carbonate Rock Aquifer, Southern Manitoba. *Can. J. Earth Sci.* 39:1053-1063.
- Little, J. 1980. Groundwater Availability Map Series, Winnipeg Area (62-H). Manitoba Natural Resources, Water Resources.
- Manitoba Energy and Mines. 1988. Aggregate Resources Compilation Map Series, Map AR88-1-1, Kenora, NTS 52E.
- Manitoba Energy and Mines. 1988. Aggregate Resources Compilation Map Series, Map AR88-1-2, Winnipeg, NTS 62H.
- Manitoba Water Stewardship. 2002. Guide for Sealing Abandoned Water Wells in Manitoba. Canada-Manitoba Agreement on Agricultural Sustainability.
- Rutulis, M. 1978. Major Flowing Well Areas. Department of Natural Resources, Water Resources Branch.
- Rutulis, M. 1986. Aquifer Maps of Southern Manitoba, Map 1 of 2, Bedrock Aquifers. Department of Natural Resources, Water Resources Branch.
- Rutulis, M. 1986. Aquifer Maps of Southern Manitoba, Map 2 of 2, Sand and Gravel Aquifers. Department of Natural Resources, Water Resources Branch.
- Smith, R. E. and W. A. Ehrlich. 1964. Soil Survey of the South-Eastern Map Sheet Area. Soils Report No. 14. Manitoba Soil Survey.

Data is also available from GWDrill, a provincial digital data base containing geological, hydrogeological, geochemical and well construction information for test holes and water wells from well driller's reports. GWDrill is administered by the Groundwater Management Section of the Water Science and Management Branch, Manitoba Water Stewardship.

## **AQUIFER INFORMATION**

Aquifer information is available from three main sources: Aquifer Maps of Southern Manitoba (M. Rutulis, 1986), Groundwater Availability Map Series (Winnipeg Area, 1980 and Kenora Map Area, 1986) and the GWDrill Data base. The aquifer maps and groundwater availability map series are based on GWDrill data base information up to the time of these map compilations. The maps provide general information on aquifer boundaries, groundwater production rates and geochemistry.

Maps of the approximate boundaries of the sand and gravel and bedrock aquifers within the Roseau River Watershed are presented on Figures 1 and 2 respectively. Although current to the date of compilation, the maps do require updating to reflect additional geological, hydrogeological and geochemical information that may have been collected during the period from about 1986 to 2005. Caution should be taken in using these maps to accurately define aquifer boundaries.

Based on a review of current geological, hydrogeological and geochemical information available in GWDrill, a summary of the groundwater resources within the Roseau River Watershed is provided below.

### **Aquifers**

With the exception of Ranges 2E and 3E within sub-watershed area 5, groundwater is generally available throughout the watershed. The principle aquifers in the watershed are glacial sand and gravel aquifers and consist of either lenses of sand and gravel or major buried sand and gravel aquifers. These aquifers occur in till and other surficial deposits, and vary considerably in thickness and areal extent. The quantity and quality of groundwater can also vary considerably from location to location. Little groundwater is utilized from the underlying bedrock aquifers.

#### **Sand and Gravel Aquifers**

Throughout the watershed, the depth of the principle sand and gravel aquifers typically range from about 7 to 30 metres (25 to 100 feet), and to a lesser degree at depths ranging from about 30 to 60 metres (100 to 200 feet). Well yields are typically low to moderate, and range from about 10 to 225 L/min (2 to 50 Igpm). Higher capacity wells may yield from 450 to >900 L/min (100 to >200 Igpm).

Shallow sand aquifers less than 7 metres (25 feet) in depth also occur throughout areas of the watershed. These aquifers are less commonly exploited because they are more susceptible to contamination from surface sources, often have limited yield because of their shallow depth and reliable groundwater sources often occur in deeper underlying aquifers. Many of the wells

completed in shallow aquifer situations are large diameter types which reflect the lower water producing capacity of these aquifers.

Based on available well information reports within the watershed the chemical quality of groundwater in the sand and gravel aquifers is generally good to fair. Total dissolved solids (TDS) typically range from about 200 to 600 mg/L. The water is generally hard and it is not uncommon for iron to exceed the Canadian Drinking Water Quality aesthetic objective guideline of 0.3 mg/L. Nitrate concentrations in the groundwater are typically low.

### Bedrock Aquifers

Bedrock aquifers within the watershed consist of carbonate rocks (Ordovician Formations), sandstone and sand (Ordovician Winnipeg Formation), limestone, sandstone and shale (Jurassic Formations) and Precambrian rocks. Of these, only the carbonate rock aquifer is utilized as a source for groundwater supply. The carbonate rock aquifer extends eastward of the Red River and underlies portions of sub-watershed areas 2, 3, 4 and 5. Its eastern boundary terminates within sub-watershed areas 2 and 4.

There is limited use of groundwater from the carbonate rock aquifer because of the adequate capacity and quality of groundwater that occurs at shallower depths within the overlying sand and gravel aquifers. Well information reports in GWDrill show that only a small number of production wells have been completed in the carbonate rock aquifer within sub-watershed areas 3, 4 and 5. The depth to the carbonate rock aquifer varies from about 15 to 91 metres (50 to 300 feet). Well yields are variable and range from about 20 to 340 L/min (5 to 75 Igpm). The chemical quality of groundwater is generally poor (TDS >2000 mg/L) and is saline within the western portion of sub-watershed area 5 (TDS >10,000 mg/L).

### **Provincial Observation Wells**

The province currently maintains a network of 19 active observation wells within the Roseau River Watershed as shown on Figure 3. Five observation wells are located within sub-watershed area 1 (two wells are located on NW32-1-13E) and are completed within sand and gravel aquifers ranging in depth from about 15 to 64 metres (50 to 210 feet). The observation wells are used to monitor groundwater levels and collect groundwater chemistry data. The remainder of the observation wells are located throughout sub-watershed areas 2 through 5. These wells were completed in 2001 to obtain baseline groundwater quality information from shallow aquifers, generally at depths less than 9 metres (30 feet), within areas of the south-eastern region of the province. Records of water level and chemical data for all observation wells are maintained within the provincial HYDATA data base, a digital computer data base designed for storing, checking, presenting and analyzing hydrological data.

### **Recharge Areas**

Little information is available regarding areas of groundwater recharge within the watershed. The Sandilands glaciofluvial complex is recognized as a major recharge area for the underlying sand and gravel and bedrock aquifers within south eastern Manitoba. The distribution of the

Sandiland deposits within the Roseau River watershed is illustrated on Figure 4 (Smith and Ehrlich, 1964). The southern portion of the complex covers portions of sub-watershed areas No.'s 1, 2 and 4.

### **Flowing Well Areas**

Major flowing well areas have been identified within sand and gravel aquifers located in sub-watershed areas 1 and 2, namely within portions of Townships 1 and 2 in Range 11E, Townships 1 and 2 in Range 12E, Township 1 in Range 13E and Townships 1 and 2 in Range 14E. The approximate boundaries of these areas are provided in the Major Flowing Well Areas Map by Rutulis (1978) and the Generalized Aquifer Map (Figure 6) by Betcher, 1986.

### **GROUND WATER AND WATER WELL ACT**

Groundwater resources are managed under The Ground Water and Water Well Act and Well Drilling Regulation. The Act applies to all sources of groundwater and to all wells whether drilled or developed before or after the Act was established in 1963. With the exception of controlling the flow from wells and the prevention of polluting groundwater and wells, the Act does not apply to a well that is drilled or developed by an owner on his land, using equipment owned by him, for the purpose of obtaining water solely for his domestic use.

Specifically, the Act:

- licenses all persons engaged in the business of drilling water wells;
- allows access and inspection of all wells or operations, and to all records, plants or equipment;
- allows undertaking of surveys of groundwater resources and studies of the conservation, development and utilization of groundwater;
- allows control of flow from wells;
- requires all reasonable precautions be taken to prevent contamination of groundwater via wells; and
- allows establishment of regulations related to the conservation, development and control of groundwater resources and the drilling and operation of wells and the production of groundwater there from.

The Well Drilling Regulation provides regulation for:

- the terms of licensing;
- collecting well drilling and testing information, maintaining well logs and submitting well reports;

- construction requirements;
- control of flow (artesian conditions);
- prevention of contamination of wells and aquifers; and
- sealing of abandoned wells.

## **GROUNDWATER CONTAMINATION CONCERNS**

With respect to contamination of water wells or aquifers, any well or aquifer has the potential to become contaminated if measures are not taken to protect from or reduce the risk of contamination. In considering development within the watershed, the following comments are offered.

### **Groundwater Sensitive Areas**

Groundwater sensitive areas are defined as those areas with the greatest risk for contamination of groundwater from sources located at or near the surface regardless of how local or extensive the aquifer may be. The degree to which aquifers will be vulnerable to contamination from the surface will largely depend upon the thickness and properties of the material overlying the aquifer and the properties of the contaminant. Aquifers that are overlain by 6 metres (20 feet) or more of low permeability material (such as clay or till) are considered as having low potential for contamination from surface activities. Aquifers consisting of sand and/or gravel or bedrock that are exposed at the surface are vulnerable to water degradation from surface activities. The degree of protection of the groundwater will increase with increasing cover of low permeability material.

Within the Roseau River Watershed, existing map information and water well logs can be used as a reconnaissance tool in identifying groundwater sensitive areas. For any proposed site development in the watershed, site specific investigations should be considered. The degree of detail for the site specific investigations would depend on the proposed site use and potential for contamination of underlying soil and groundwater.

## **Water Well Construction**

All water wells should be properly constructed, maintained and protected to help ensure a reliable and safe water supply. The keys to reducing the risk of well water contamination include:

- Location (where the well is located)
- Construction (how the well is built)
- Maintenance (how the well is maintained)
- Management (how waste products and chemicals are managed)

The following measures are recommended to help reduce the risk of well water contamination:

- retain an experienced and licensed well drilling contractor for the drilling and construction of a water well;
- locate the water well at a safe distance from potential sources of contamination and in an area away from surface runoff from potential sources;
- ensure an experienced and licensed contractor completes the hook-up of the water well to the water distribution system (pitless well construction);
- after the water well has been completed but before it is put into operation, ensure the well, pump and water distribution system are disinfected to kill any bacteria that may be present; and
- ensure old wells are properly sealed to the standards recommended in Manitoba's Guide for Sealing Abandoned Water Wells.

## **Flooding**

Water wells within any designated flood area should have adequate well head protection to ensure flood waters do not enter directly into the well as this could cause contamination of the well water and possibly groundwater within the aquifer. Within a designated flood area, one of the following well head protection measures should be implemented:

- extend the top of the well casing above the expected elevation of the flood water;
- flood proof the well cap and electrical conduit using a water tight well cap, check valve type of air vent and conduit cable seal. This assembly will help prevent flood waters from entering the well casing;
- locate the well on a pad or structure that is elevated above any expected flood water level; or

- locate the well within a ring dike whose top elevation is above any expected flood water level.

### **Private Sewage Disposal Systems**

Private sewage disposal systems are regulated by the Onsite Wastewater Management Systems Regulation under The Environment Act. Municipalities within the watershed should ensure the design and construction of private sewage disposal systems are suitable for the soil conditions encountered and lot size proposed for any development.

### **Livestock Operations**

Livestock operations and manure spreading are regulated under the Livestock Manure and Mortalities Management Regulation under The Environment Act. As well, the Province has prepared Farm Practice Guidelines for Hog / Beef / Dairy / Poultry Producers in Manitoba and provides a Technical Review process for new and expanded operations. These processes have been developed to reduce the potential risk of groundwater contamination.

### **Sand and Gravel Pits**

There are a number of gravel pits located throughout the watershed (Maps AR88-1-1 and AR88-1-2, Manitoba Energy and Mines, 1988). The establishment and operation of quarries are regulated by the Quarry Minerals Regulation under The Mines and Minerals Act. The regulation states that no operator shall contaminate groundwater, or permit the contamination of groundwater, through the establishment or operation of an aggregate quarry.

### **Other Considerations**

Other potential sources of contamination that may be considered include: municipal sewage systems, waste disposal grounds, agricultural operations, industrial operations, pipelines, gas stations and transportation spills.

Well head protection programs, at the private, municipal or watershed level, should also be considered to reduce the risk of contaminating water supplies.