SEINE RIVER WATERSHED - STATE OF THE WATERSHED REPORT

GROUNDWATER RESOURCE INFORMATION

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1.0 INTRODUCTION

Groundwater is the major source of water supply for private domestic use as well as for municipal, industrial, commercial and agricultural purposes within the Seine River watershed. Groundwater discharge also provides base flow to rivers and streams and contributes water to marshes and wetlands. This makes groundwater a vitally important resource to the watershed.

A review of currently available groundwater resource information with respect to the understanding of the regional hydrogeology within the Seine River watershed has been completed using three main sources: groundwater reports, aquifer maps and the provincial computer data bases GWDrill and HYDATA. This report summaries the groundwater information, as well as provides a brief overview on provincial groundwater monitoring, acts and regulations, studies in progress and groundwater issues and concerns. A listing of reference material pertaining to the groundwater resources of the Seine River watershed is also provided.

2.0 GROUNDWATER INFORMATION

2.1 Aquifer Types

The principle aquifers in the Seine River watershed are:

- bedrock carbonate;
- bedrock sandstone; and
- sand and gravel.

The availability of groundwater varies considerably within the different aquifer types. In general, sufficient quantities of groundwater are available for private, domestic use. Larger quantities may also be available locally for municipal, industrial, commercial and agricultural uses.

Maps of the approximate boundaries of the bedrock and sand and gravel aquifers within the Seine River watershed are presented on Figures 1 and 2 respectively (Rutulis, 1986a,b). The aquifer boundaries presented on the maps are based on information up to the time of the map compilations in 1986. Consequently caution should be taken in using the maps to accurately define aquifer boundaries within the watershed.

2.1.1 Bedrock Aquifers

Bedrock deposits within the watershed consist of, in descending order, limestone, sandstone and shale of the Jurassic Formations, carbonate (limestone and dolomite) rocks of the Ordovician Red River Formation, shale, sandstone and sand of the Ordovician Winnipeg Formation and Precambrian rocks. Of these, only the Red River Formation carbonate and underlying Winnipeg Formation sandstone form aquifers which are utilized as a primary source for groundwater supply. Groundwater flow within the carbonate and sandstone aquifers is primarily from the east/southeast to the west/northwest. A detailed description of the regional hydrogeology of the Red River Formation carbonate and Winnipeg Formation sandstone are provided in Betcher et al. (1995) and Grasby and Betcher (2002).

Carbonate Aquifer

Permeable zones in the carbonate rocks of the Ordovician Red River Formation consist of fractured zones, bedding planes or solution features through which groundwater can readily flow and be extracted for water supply purposes. It is these permeable zones which form and is termed the carbonate aquifer. The intact carbonate rock matrix itself has a low permeability and does not transmit water at sufficient quantities for water supply purposes. The rock matrix however, as part of the overall carbonate rock system, may receive and transmit substantial quantities of water over long periods of time.

The carbonate aquifer is a significant source of water supply throughout the entire watershed. It extends over most of the watershed with the exception of a small north-south strip near the eastern boundary as shown on Figure 1. Most often the most highly permeable zones are found in the upper 15 metres (50 feet) of the carbonate rock although permeable zones can occur at any depth. The areal extent, thickness and hydraulic properties of the permeable zones are typically quite variable.

The thickness of overburden materials (clay, silt, till and sand and gravel) above the carbonate bedrock is typically a minimum of about 18 metres (60 feet) and increases in thickness to greater than 60 metres (200 feet) in the eastern portion of the watershed (Little, 1980 – Figure 2). In general,

- overburden materials in the Red River plain of the central lowland area of the watershed (the area below an elevation of about 259 metres (850 feet) as described by Ehrlich et. al., 1953.) are typically silt, clay and till; The carbonate aquifer in this area is considered at a low risk of aquifer contamination due to the natural protection of the low permeability overburden deposits (clay and till) which help prevent the downward movement of potential contaminants; and

- overburden materials in the upland areas of the south-eastern complex (the area above an elevation of about 259 metres (850 feet) as described by Ehrlich et. al., 1953) include clay and till as well as fairly extensive (and in some areas complex) deposits of surficial, near-surface, lenses of and major buried sand and gravel. Areas having surficial and near-surface sand and gravel are considered at a higher risk of aquifer contamination due to the lack of overburden protection from low permeability materials such as clay and till.

Well yields in the carbonate aquifer are quite variable. Domestic wells generally yield a minimum of 5 to 10 Imperial gallons per minute (Igpm). High capacity wells for municipal and other non-domestic uses are common, with yields of 100 to >200 Igpm in some areas.

Sandstone Aquifer

The sandstone aquifer is quite extensive throughout the watershed and underlies the full extent of the carbonate aquifer as shown on Figure 1. It is separated from the overlying carbonate bedrock by a thin layer of low permeability shale which effectively acts as an aquitard except near the eastern boundary of the carbonate rock. No map of the distribution or thickness of the shale aquitard has yet been compiled.

The depth to the top of the sandstone varies. It is deepest in the western portion of the watershed and becomes shallower from west to east. In the western portion of the watershed (range 4E) the depth of the sandstone typically ranges from about 88 to 107 metres (290 to 350 feet) below ground surface. In the eastern portion of the watershed (range 8E) the depth of the sandstone typically ranges from about 40 to 55 metres (130 to 180 feet) below ground surface. Very little information on the sandstone is available for range 9E.

Typically, shallower aquifers (carbonate and sand and gravel) overlying the sandstone aquifer are utilized for water supply purposes providing they produce a satisfactory yield and water quality. However, the sandstone aquifer is commonly used because of its potential to provide higher well yields and in some cases softer water. The sandstone aquifer is most commonly utilized within the R.M.'s of Tache and Ste. Anne, the north-eastern portion of the R.M. of Hanover and the northern and eastern portions of the R.M. of La Broquerie.

Well yields in the sandstone aquifer typically range from about 20 to 50 Igpm. Higher capacity wells in the range of 100 to >200 Igpm are common in some areas.

2.1.2 Sand and Gravel Aquifers

Sand and gravel aquifers are most common in the upland areas of the watershed. They include areas of major buried sand and gravel aquifers and lenses of sand and gravel as shown on Figure 2. The depth and extent of the sand and gravel aquifers is quite variable. Many typically range from about 7 to 30 metres (25 to 100 feet) below ground surface, but some in the range of 30 to 60 metres (100 to 200 feet) have also been exploited. They can range in thickness from a metre to ten's of metres and can be less than a hectare to several square kilometres in area. In some areas, sand and gravel aquifers are very common but in others they are scarce; two or more sand and gravel aquifers separated in depth by till or clay deposits are also common.

The areas of the major buried sand and gravel aquifers include (Figure 2):

- an area southeast of Hochstadt that extends southward past Grunthal and southeastwards through the Pansy area;
- areas south/southwest and southeast of Steinbach; and
- an area east of Giroux that extends northeast past Richer.

Well yields in the sand and gravel aquifers are quite variable. They typically range from about 5 to 25 Igpm. Higher capacity wells in the range of 50 to >100 Igpm are common in some areas.

Shallow sand aquifers less than 7 metres (25 feet) in depth also occur throughout parts 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.

2.2 Water Quality

In general, the quality of the groundwater available under natural conditions is variable throughout the watershed, ranging from excellent to fair. In some areas of the watershed, elevated concentrations of naturally occurring elements may impose restrictions on the groundwater use. Manitoba's drinking water quality guidelines are based on the Guidelines for Canadian Drinking Water Quality (Health Canada, 2006).

2.2.1 Bedrock Aquifers

A natural fresh water-salt water boundary exists within the carbonate and sandstone bedrock aquifers near the western boundary of the watershed. The Red and Rat Rivers represent the approximate boundary between the fresh and salt water within the carbonate aquifer. Here, groundwater is saline to the west of the Red and Rat Rivers whereas to the east groundwater is fresh. The approximate boundary of the fresh water-salt water boundary within the sandstone aquifer is located just east of the Red River as illustrated on Figure 3 (Betcher, 1992). Groundwater is brackish to saline to the west of the boundary and is fresh to the east.

Carbonate Aquifer

Based on total dissolved solids (TDS) the chemical quality of groundwater within the carbonate aquifer in the western portion of the watershed is generally good to fair (TDS typically ranges from about 500 to 1,300 mg/L). Within the central and eastern portions of the watershed the groundwater quality ranges from excellent to good (TDS typically ranges from about 300 to 500 mg/L). The Canadian Drinking Water Quality (CDWQ) guideline value for TDS is 500 mg/L.

Throughout the watershed, the carbonate groundwater is typically hard, commonly contains iron above the CDWQ guideline value of 0.3 mg/L and has little to no nitrate. The CDWQ guideline value for nitrate (as nitrate-nitrogen) is 10 mg/L.

More recent sampling of groundwater from the carbonate aquifer indicates that the concentration of barium may be elevated at some locations within the central and eastern regions of the watershed, and in some cases above the CDWQ guideline value of 1.0 mg/L. It appears the elevated concentrations are a result of natural processes and not due to contamination (Betcher et al., 2003). However, the elevated concentrations may impose restrictions on the groundwater use.

Sandstone Aquifer

Groundwater in the sandstone aquifer may be brackish (TDS >1,000 g/L) within the area of the western boundary of the watershed (Figure 3). However in areas where the sandstone aquifer is most commonly utilized (the R.M.'s of Tache and Ste. Anne, the north-eastern portion of the R.M. of Hanover and the northern and eastern portions of the R.M. of La Broquerie) the chemical quality of groundwater based on total dissolved solids is generally excellent to good (TDS typically ranges from about 200 to 400 mg/L). The hardness of the sandstone groundwater is generally softer than the carbonate groundwater, may contain iron or manganese above the CDWQ guideline values of 0.3 mg/L and 0.05 mg/L respectively and has little to no nitrate.

Elevated concentrations of barium, fluoride and boron may be present in groundwater in the sandstone, and in some cases above the CDWQ guideline values. The CDWQ guideline values for barium, fluoride and boron is 1.0 mg/L, 1.5 mg/L and 5.0 mg/L respectively. Available water quality data suggests elevated barium concentrations may occur within the central and south-western portions of the watershed while elevated fluoride and boron concentrations may occur within northern and central portions of the watershed. The occurrence of these elevated concentrations appears to be a result of natural processes and not due to contamination (Betcher et al., 2003). However, the elevated concentrations may impose restrictions on the groundwater use.

2.2.2 Sand and Gravel Aquifers

Based on total dissolved solids the chemical quality of groundwater within the sand and gravel aquifers is generally excellent to good (TDS typically ranges from about 200 to 600 mg/L). The groundwater is typically hard, commonly contains iron and manganese above the CDWQ guideline values of 0.3 mg/L and 0.05 mg/L respectively and has little to no nitrate.

2.2.3 Private Well Sampling

A regional groundwater sampling program of well water quality was conducted by Manitoba Conservation in 1999 and 2000. The purpose of the sampling program was to gain a better understanding of the groundwater quality conditions in private, rural water wells located throughout the agriculture regions of Manitoba and develop a benchmark for future groundwater quality comparisons.

Approximately 950 private water wells were sampled. The well water samples were analyzed for routine water chemistry, nutrients and bacteria. Province-wide it was found that:

- 42% exceeded the CDWQ guideline value of zero organisms detectable per 100 mL for total coliform bacteria;
- 2.7% exceeded the CDWQ guideline value of zero organisms detectable per 100 mL for E. coli bacteria; and
- 16% exceeded the CDWQ guideline value of 10 mg/L nitrate (as nitrate-N).

Within the Seine River watershed 24 private water wells were sampled. These results show:

- 33% (8 wells) exceeded the CDWQ guideline value of zero organisms detectable per 100 mL for total coliform bacteria;
- none exceeded the CDWQ guideline value of zero organisms detectable per 100 mL for E. coli bacteria; and
- none exceeded the CDWQ guideline value of 10 mg/L nitrate (as nitrate-N). The highest measured nitrate value was 0.31 mg/L.

The findings of the program indicate that the risk of well water contamination can be related to aquifer type and well depth and type. Shallow water wells, particularly those completed in sand and gravel aquifers and/or constructed as large diameter wells, are at a higher risk of bacterial or nitrate contamination than deeper wells.

2.3 Water Wells

2.3.1 Classification

The classification of water systems falls under *The Drinking Water Safety* Act which is administered by The Office of Drinking Water of Manitoba Water Stewardship. Under the Act, a water system is defined as a well, or a device or structure or an assemblage of devices and structures, used or intended to be used for the production, treatment, storage or delivery of potable water for domestic purposes.

There are three types of systems supplying water, namely:

1) public water system – a water system that has 15 or more service connections, unless otherwise specified in the Act.

2) semi-public water system – a water system that is not a public water system or a private water system (e.g., community well tank loading stations, schools, hospitals and hotels).

3) private water system – a water system that supplies water only to one private residence, unless otherwise specified in the Act.

2.3.2 Records

There is a requirement under *The Ground Water and Water Well Act* for the reporting of all water wells drilled in Manitoba by a licenced well driller. Water well information including location, stratigraphic, construction and well testing data is stored and maintained within the provincial GWDrill data base. In most cases, accurate well location (GPS) data is not available.

A well inventory program is currently underway between the Office of Drinking Water and the Groundwater Management section to update the records and map the locations of all public water system wells. This includes collecting accurate well location (GPS) data.

2.3.3 Construction

The responsibility lies with the owner of a water well to ensure their well and water distribution system is properly constructed and maintained and that the well provides water that is safe for drinking. Unfortunately, past groundwater investigations conducted by Manitoba Conservation and Manitoba Water Stewardship throughout regions of the province indicate that well water contamination is often caused by the improper construction, maintenance or protection of wells.

2.3.4 Flood Protection

Previous groundwater related flood protection work completed within the watershed includes:

- A groundwater rehabilitation program within the Red River valley by Manitoba Environment in 1997 (Lemoine et. al., 1998). The program was implemented to help remediate groundwater supplies which were rendered unusable following the 1997 Red River flood. Several principle components of the project included:

    - Field reconnaissance and groundwater quality testing to determine the areal extent and severity of impacted groundwater.

    - Design and implementation of remedial measures to restore groundwater resources to accepted standards of potability.

    - Reconstruction of defective water wells – 14 new wells were drilled and 35 abandoned wells were sealed.

- A groundwater protection program within the Designated Flood Area (DFA) of the Red River valley by the Groundwater Management section in 2000 through 2003 (Manitoba Conservation, 2003). The program was implemented to help protect potable water supplies within the DFA from the negative

effects of future surficial flooding as occurred in the spring of 1997 in the Red River valley. The main phases of the project included:

- Inventory of Water Wells – 350 wells were inventoried.
- Well Site Assessments – 77 well site assessments were conducted.
- Sealing of Abandoned Wells – 39 abandoned wells were sealed.
- Refurbishing Well Deficiencies of Operating Wells – 35 wells were refurbished

2.4 Interconnected Aquifers

Throughout the Seine River watershed there are locations where more than one aquifer is available for water supply purposes (i.e., carbonate aquifer overlying the sandstone aquifer). When completing a water well into the deeper aquifer at these locations, if the well construction methods are such that the lower aquifer is not isolated from the upper aquifer there is the potential for interconnecting the aquifers. In cases where there are significant water quality differences (i.e., fresh and saline water aquifers) this interconnection can cause a mixing of waters and contamination of fresh water aquifers.

An area of interconnected aquifers is located within the western region of the Seine River watershed. No map of this area has yet been compiled. Here, some private water wells have interconnected the fresh water (carbonate) and saline water (sandstone) aquifers which is allowing saline water to migrate into and mix with the fresh water. In almost all cases the problem wells are quite old, many dating to the 1960's. It is likely that similar problem wells also occur within other areas of the watershed.

2.5 Flowing Well Areas

The main concern regarding flowing well areas is the potential for the uncontrolled discharge of water from a well and the resulting loss of the valuable groundwater resource. The uncontrolled discharge of water could also contribute to local drainage and foundation problems. In order to avoid these potential problems it is advisable to ensure that proper well construction methods are used in these areas so that any discharge of water from the well can be controlled.

Several major flowing well areas have been identified within the watershed (Rutulis, 1978). The approximate boundaries of the flowing well areas are illustrated on Figure 4. These include:

- an extensive area in the New Bothwell, Kleefeld, Hochstadt, Randolp, Mitchell, Clear Springs and Steinbach areas. This includes portions of Township 6 in Range 3E, Townships 6 and 7 in Range 4E, Townships 5, 6, 7 and 8 in Range 5E and Townships 6 and 7 in Ranges 6E and 7E;
- a significant area extending from Giroux southeast to La Broquerie and Marchard. This includes portions of Townships 6 and 7 in Range 7E, Townships 5, 6 and 7 in Range 8E and Townships 5 and 6 in Range 9E; and
- areas northwest and northeast of Ste. Anne. This includes portions of Township 8 in Range 6E and Townships 8 and 9 in Range 7E.

The flowing well areas are based on information up to the time of the map compilation in 1978. Although current to the date of compilation, the map does require updating to reflect additional hydrogeological

information that may have been collected since 1978. Caution should be taken in using the map to accurately define flowing well areas within the watershed.

2.6 Recharge and Discharge

Groundwater exists in a long-term balance between recharge and discharge of water within an aquifer system. The fundamental mechanisms contributing to groundwater recharge and discharge within the regional aquifer system of south-eastern Manitoba (which includes the Seine River watershed) are generally well understood. However, the understanding of recharge/discharge processes and rates, surface water/groundwater interactions and aquifer/aquitard dynamics is not well developed. For example, it is expected that the upland areas of the Seine River watershed, particularly where extensive deposits of surficial and near-surface sand and gravel exist, would contribute significantly to the local as well as the regional recharge of both the overburden and bedrock aquifer system. A significant contribution to the recharge of the watersheds bedrock aquifer system (carbonate and sandstone aquifers) is also expected from the Sandilands glaciofluvial complex which begins just within the southeast boundary of the Seine River watershed. A groundwater resource evaluation is currently being undertaken by the Groundwater Management section to help gain a better understanding of recharge and discharge within the watershed.

3.0 GROUNDWATER MONITORING

Groundwater monitoring is undertaken on a broad provincial scale by the Groundwater Management section. This section maintains an extensive network of over 500 observation wells primarily within agro-Manitoba. Monitoring is carried out to observe long-term changes in groundwater levels and water quality in most major aquifers in the province, background changes occurring in undeveloped areas and in some cases responses to groundwater development. Groundwater monitoring may also be mandated at specific sites in licences or permits issued under *The Environment Act* or licences issued under *The Water Rights Act*.

Within the Seine River watershed, excluding observation wells located within the City of Winnipeg, a network of 43 active observation wells is currently maintained by the province. The earliest wells were drilled and instrumented in the 1960's (4 wells). The majority of the wells were drilled and instrumented post-1990 (31 wells). The observation wells are completed as follows:

- 27 wells within the bedrock carbonate aquifer – these are distributed throughout the watershed;
- 5 wells within the bedrock sandstone aquifer – these are located within the eastern portion of the watershed ; and
- 11 wells within sand and gravels aquifers - these are located within the central and south eastern portions of the watershed.

The locations of the observation wells in the bedrock and sand and gravel aquifers are shown on Figures 5 and 6 respectively.

Details of stratigraphic, well construction and well testing information for the observation wells is contained within the provincial GWDrill data base. Records of water level and chemical data for the observation wells are maintained within the provincial HYDATA data base. GWDrill and HYDATA are administered by Manitoba Water Stewardship. Information on well records, water levels and water quality is available upon request from the Groundwater Management section.

4.0 ACTS AND REGULATIONS

Groundwater is a provincial resource that is regulated under a number of Acts (*The Environment Act, The Water Protection Act, The Drinking Water Safety Act, The Water Rights Act, The Ground Water and Water Well Act, The Health Act* and others) and regulations. Groundwater may also be impacted by developments and so may be considered within *The Mines and Minerals Act* for instance.

The Ground Water and Water Well Act and *Well Drilling Regulation* are key pieces of legislation for the management and protection of the provinces groundwater resources. The Act and Regulation are administered by Manitoba Water Stewardship. 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.

5.0 STUDIES IN PROGRESS

5.1 Groundwater Mapping

The Groundwater Management section has begun to update regional groundwater maps on a watershed basis as part of its overall support to the development and implementation of integrated watershed management planning. The mapping process will involve the development of draft digital maps based on current information in existing groundwater data bases, followed by field mapping and water sampling, leading to development of a final version of the maps. Maps and an accompanying report will serve to define the geologic and hydrogeologic framework for the watershed, present information on groundwater quality and vulnerability, recharge and discharge areas, and point the way toward developing source water and well head protection areas. Co-operation with the Seine-Rat River Conservation District through this process will also serve to educate conservation district staff on groundwater related matters. The projected completion date for the draft groundwater maps is mid-2007 and for the final groundwater maps and report is late-2008.

5.2 Groundwater Resource Evaluation

The Groundwater Management section is currently conducting a groundwater resource evaluation to aid in the understanding and application of aquifer sustainability within the south-eastern region of the province which includes the Seine River watershed**.** The concept of aquifer sustainability includes ensuring that groundwater is not withdrawn from aquifers at rates that exceed long-term recharge and also that other parts of the natural systems that rely on groundwater discharge such as wetlands and streams will not be significantly impacted by future development. The study will include:

- evaluation of existing information;
- collection of additional information through test drilling, installation of monitoring wells or other studies if required;
- building mathematical models of aquifers for use as a management tool where there is sufficient data to do so; and
- development of written policies which will be used to set allocation limits for aquifers.

The study was initiated in mid-2006 and is expected to be completed sometime in 2009.

6.0 ISSUES AND CONCERNS

There are several issues and concerns related to groundwater within the Seine River watershed that should be considered in the development of the watershed management plan. These are summarized below.

6.1 Vulnerable Groundwater Areas

Vulnerable groundwater areas are defined as those areas with the greatest risk for contamination of groundwater from sources at or near ground surface regardless of how local or extensive the aquifer may be. The degree to which shallow aquifers are 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. As a general "rule of thumb" aquifers that are overlain by six 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 Seine River watershed, existing map information and water well logs can be used as a reconnaissance siting tool in identifying vulnerable groundwater areas. The current updating of regional groundwater maps by the Groundwater Management section will also help in identifying vulnerable areas. For any proposed site development in the watershed, site specific investigations should also be considered to assess potential impacts to the groundwater resources. 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.

6.2 Groundwater Development

It appears that groundwater resources are generally adequate for existing development within the watershed. There is less certainty in the long-term availability and sustainable yield of groundwater from the regional aquifer system. This will largely depend on the degree of future development, the demand for groundwater and climate impacts and change. The groundwater resource evaluation currently being undertaken by the Groundwater Management section will help address the issues of groundwater availability and sustainable yield.

Groundwater development within the carbonate or sandstone aquifers along the western boundary of the watershed may cause changes in the regional groundwater flow patterns that, in turn, may cause shifting of the fresh-water and salt-water boundaries. In particular, intensive development near the boundary in the fresh-water area may cause salt-water intrusion into the fresh-water area. Any such development should be thoroughly evaluated to prevent the potential for salt-water intrusion into the fresh-water aquifer area.

6.3 Groundwater Quality

Specific health-related groundwater quality issues in the watershed include:

- natural occurring barium concentrations exceeding drinking water guidelines in groundwater in the Ordovician Red River Formation carbonate aquifer;
- natural occurring barium, fluoride and boron concentrations exceeding drinking water guidelines in groundwater in the Winnipeg Formation sandstone aquifer; and
- bacterial and nitrate contamination of water wells.

In regards to the occurrence of naturally occurring elements in groundwater the Department of Water Stewardship is reviewing the available water quality data and will produce maps showing the current distributions of barium, fluoride and boron in groundwater in the carbonate and sandstone aquifers. The Department in conjunction with Manitoba Health will also produce a set of fact sheets on barium, fluoride and boron in groundwater for public distribution.

In regards to bacteria and nitrate in well water their presence is most often a result of point sourced, anthropogenic contamination of groundwater. Shallow water wells are considered at a greater risk than deeper wells. Bacterial contamination is typically seasonal, with a greater risk occurring during the spring snow melt or periods of heavy rainfall. The lack of adequate construction, maintenance and protection of water well infrastructure may also increase the risk of bacterial and nitrate contamination.

6.4 Water Well Construction

Improperly constructed, maintained or protected wells can lead to the contamination of well water. 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 (Manitoba Conservation, 2002).

The above measures could be incorporated into future source water/well head protection plans for the watershed.

6.5 Flood Protection

Water wells within any designated flood area within the watershed 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 designated flood areas, 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.

The above measures could be incorporated into future source water/well head protection plans for the watershed.

6.6 Water Well Inventory

Although there is a requirement under *The Ground Water and Water Well Act* for the reporting of all wells drilled in Manitoba by a licenced well driller there is currently no process in place to determine the ongoing status of a water well. Furthermore, most water wells within the watershed with the exception of the public water system wells do not have accurate well location (GPS) data. This hampers the ability to use existing water well information for various purposes, such as:

- locating problem wells which may be impacting aquifer water quality (such as wells interconnecting fresh water and saline water aquifers);
- locating abandoned wells for the purpose of well sealing; and
- improving the mapping capabilities of water well information (i.e., well location and water quality).

A water well inventory program to identify the current status and obtain accurate well location (GPS) information for water wells within the watershed is needed. This program could be jointly undertaken by the Seine-Rat River Conservation District and the Groundwater Management section.

6.7 Interconnected Aquifers

The contamination of groundwater due to interconnected aquifers is a concern, particularly in the fresh-water carbonate aquifer within the western region of the watershed. A well inventory and groundwater sampling program to define the extent of the problem and a plan of action on how to best address problem wells are needed. This program could be jointly undertaken by the Seine-Rat River Conservation District and the Groundwater Management section. The program could also be coupled with the water well inventory described in section 6.6.

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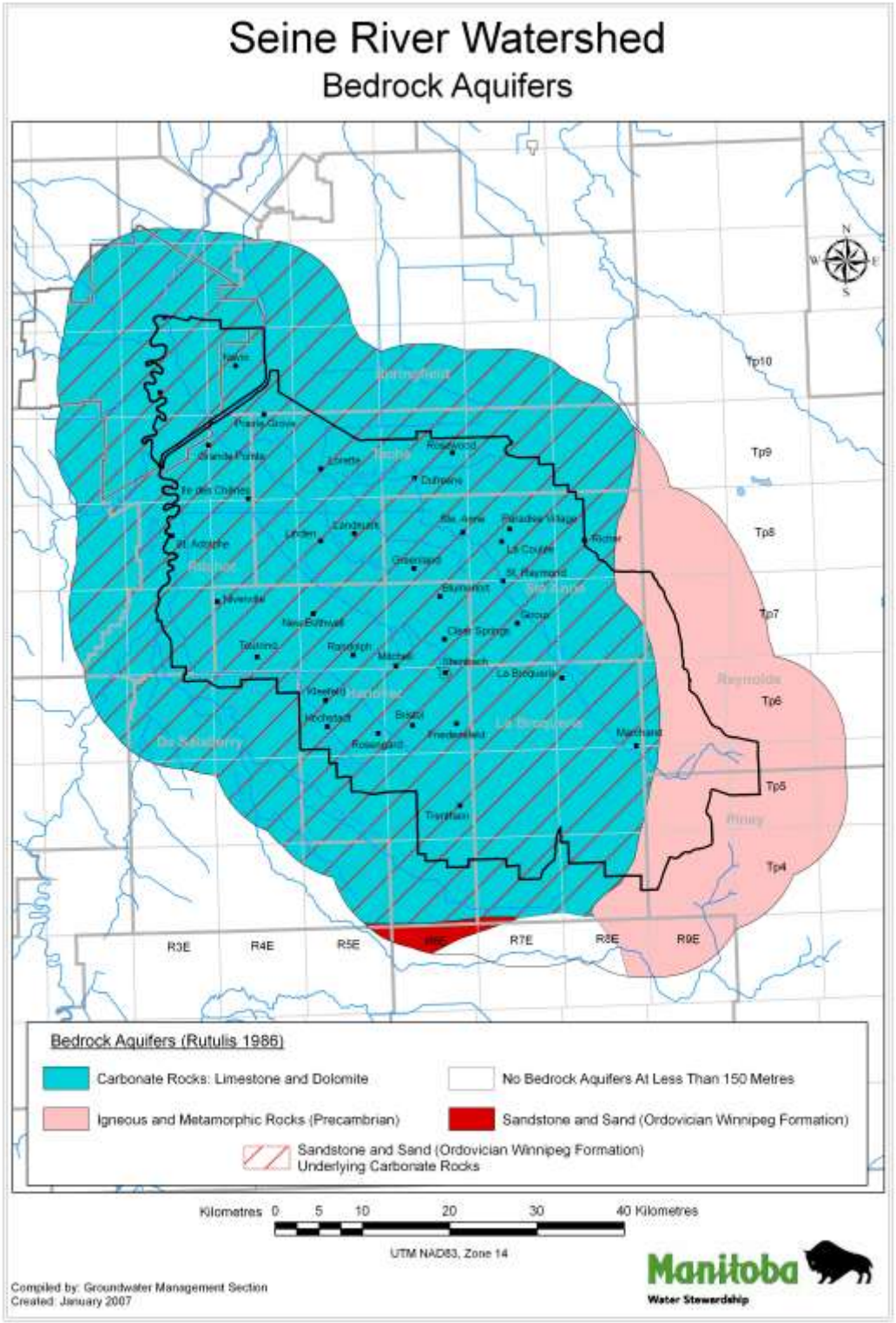

Figure 1: Bedrock Aquifers

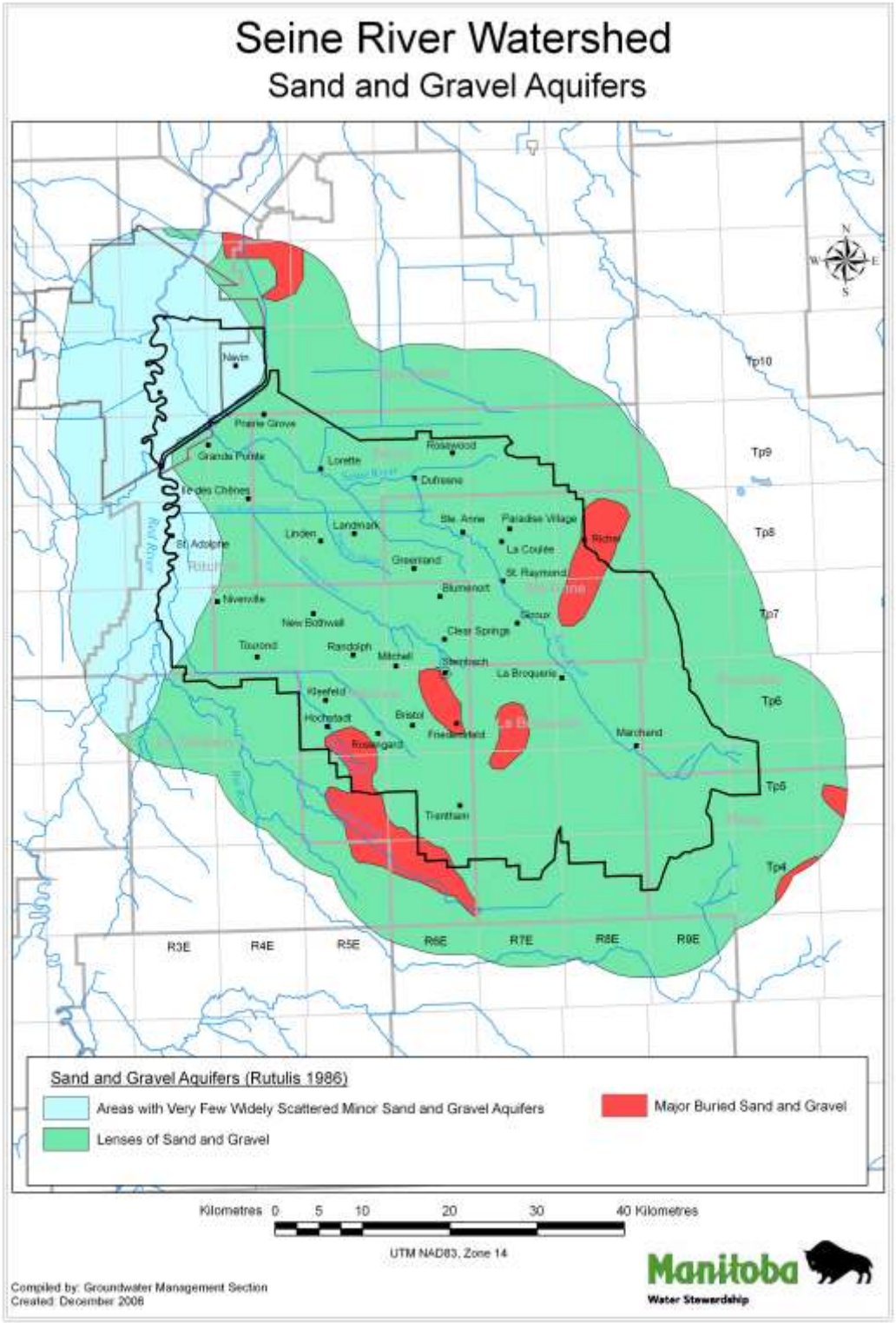

Figure 2: Sand and Gravel Aquifers

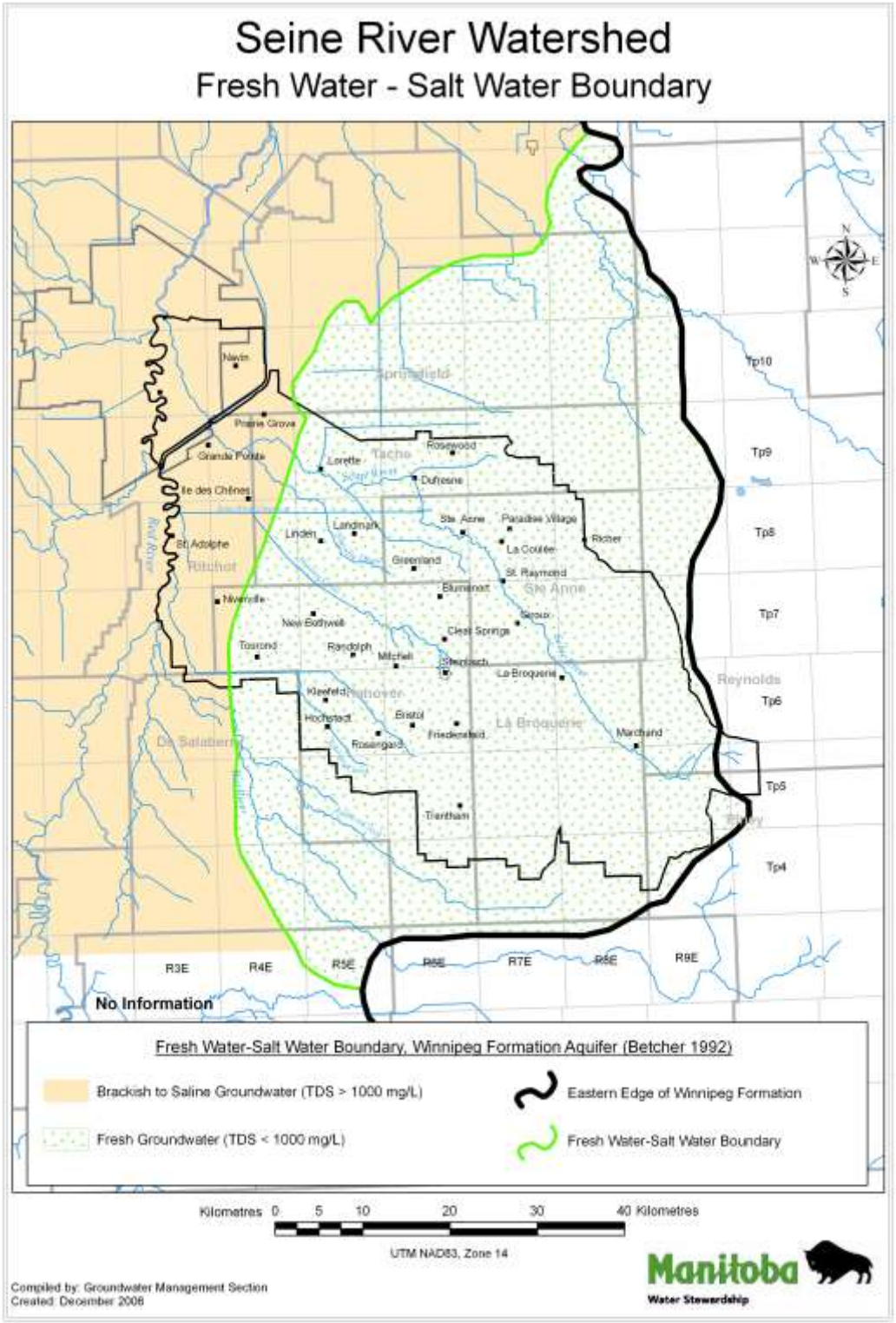

Figure 3: Fresh Water-Salt Water Boundary

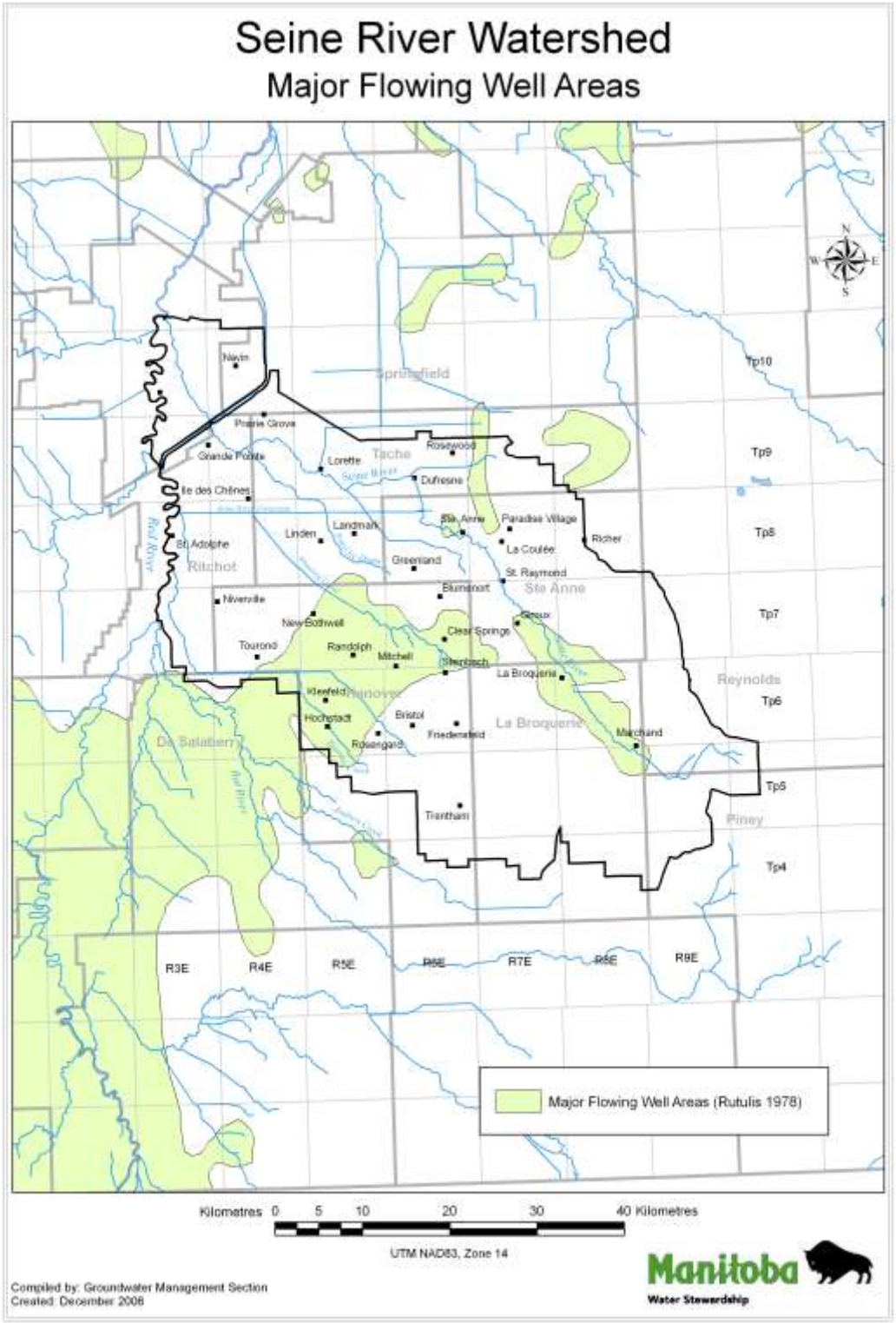

Figure 4: Major Flowing Well Areas

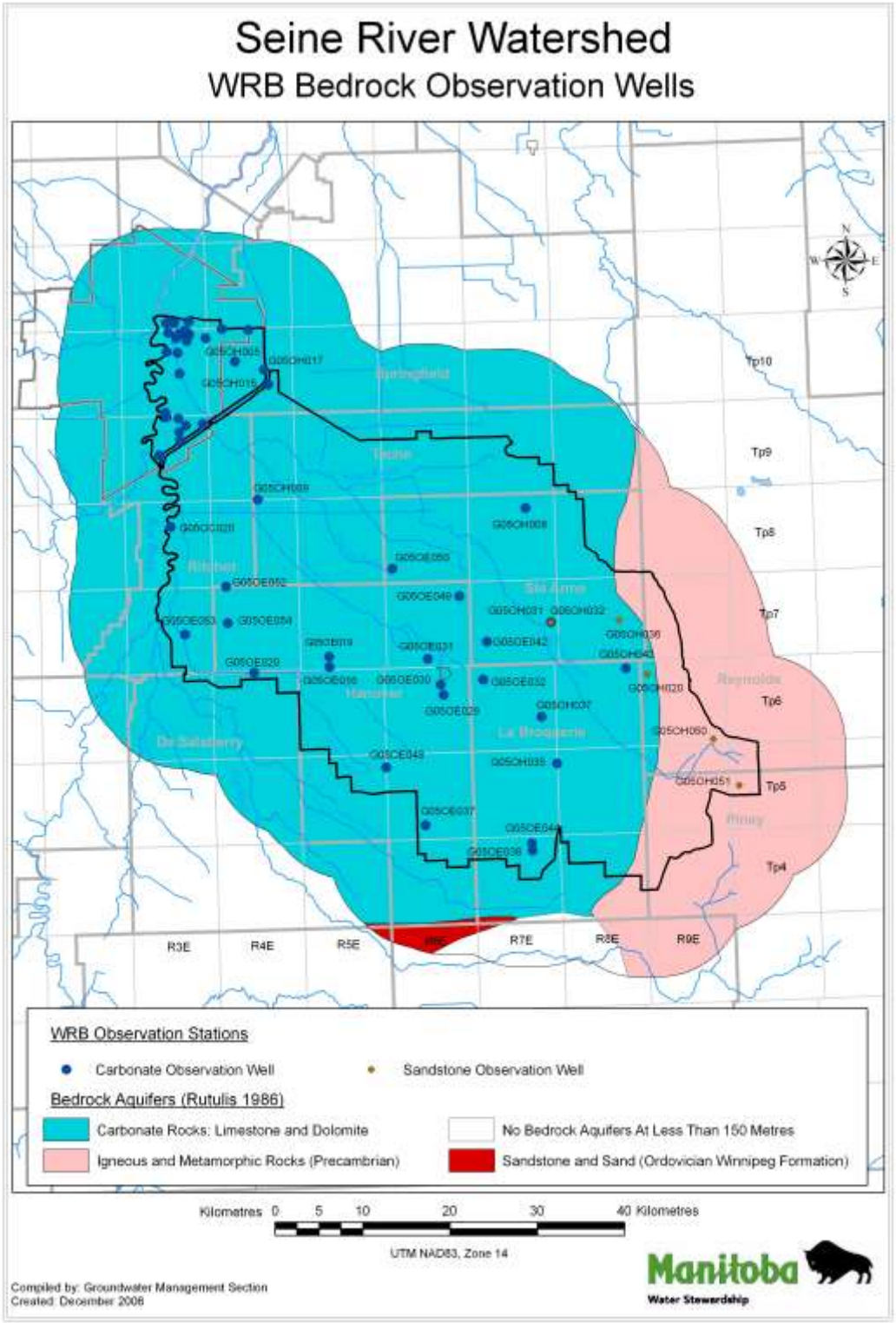

Figure 5: Bedrock Observation Wells

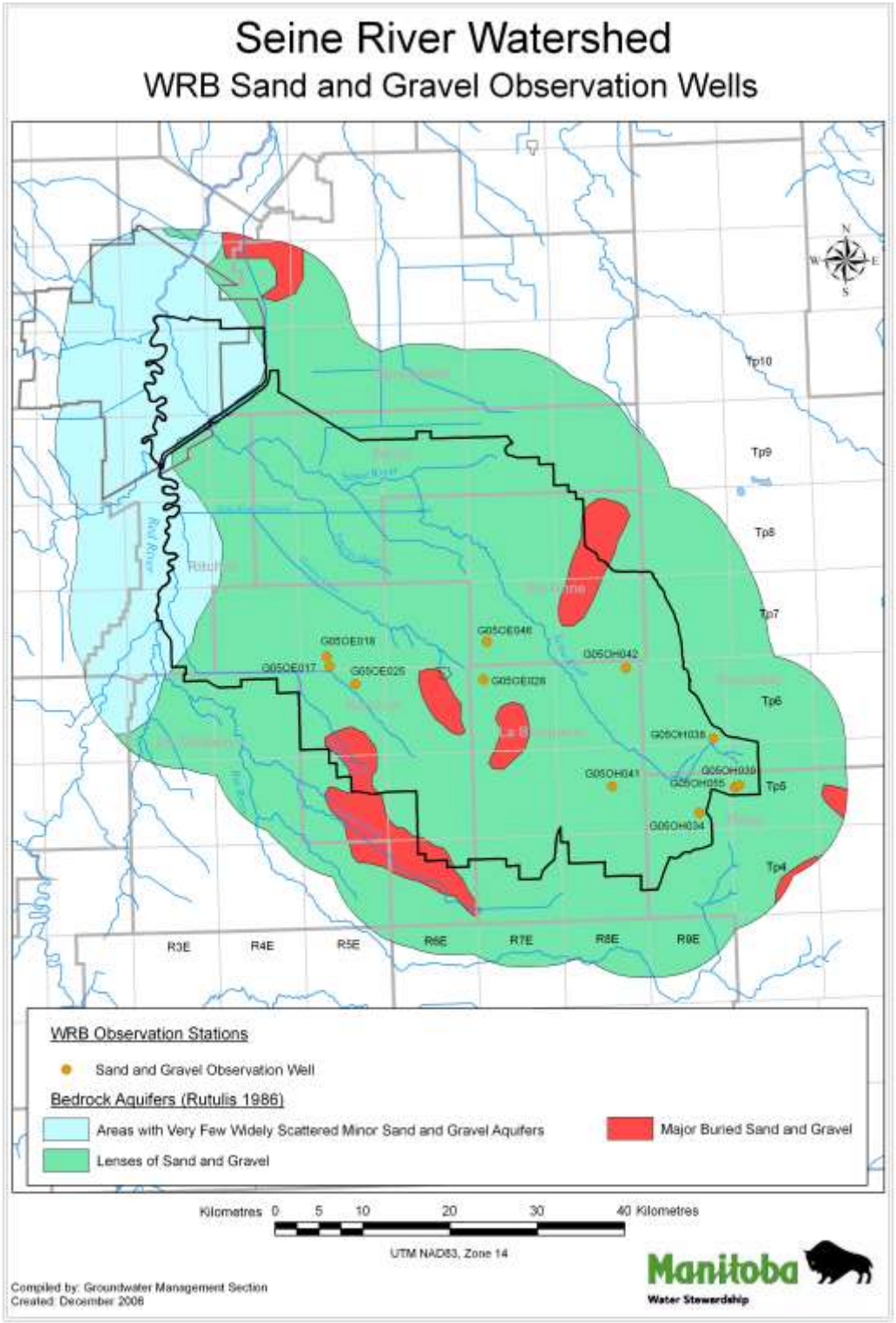

Figure 6: Sand and Gravel Observation Wells