

Executive Summary

Study Background

Trow Associates Inc. (Trow), on behalf of the Cataraqui Region Conservation Authority (CRCA), has undertaken a Groundwater Study in the rural areas of the City of Kingston, Loyalist Township, the Town of Greater Napanee and South Frontenac Township, occupying the Western Cataraqui Region watershed (i.e., Study Area) (Executive Summary Figure 1). The Study was funded by the Ministry of the Environment (MOE), Ontario's Operation Clean Water Initiative, and the participating municipalities.

The rural areas of the Western Cataraqui Region rely primarily on groundwater for potable water. The municipalities and water managers, including the CRCA, therefore require a better understanding of the current regional groundwater resources to ensure protection of groundwater serving existing and future development in the Study Area.

The following are the general objectives for the Study:

1. To compile a groundwater resource inventory that identifies fundamental groundwater characteristics across the Study Area including:
 - sources of water including primary areas of groundwater recharge and discharge;
 - water well yields, including areas of low yields;
 - water quality, including areas of poor water quality;
 - direction of groundwater flow;
 - sensitive groundwater areas vulnerable to contamination; and
 - connections between land and surface water with groundwater.
2. To examine the use of groundwater and existing conservation practices.
3. Develop measures and controls to protect existing groundwater resources.

This Groundwater Study is presented in four (4) volumes:

- Volume I, Groundwater Inventory and Findings
- Volume II, Groundwater Management Plan and Recommendations
- Volume III, Mapping
- Volume IV, Cana Subdivision Wellhead Protection Study

The Study findings that fulfill objectives # 1 and # 2 are detailed in Volume I. Volume I also identifies three (3) distinct hydrogeological zones in the region that determine important aspects on the available groundwater quantity, groundwater quality and groundwater sensitivity:

- Zone 1A and 1B – Limestone

- Zone 2 – Precambrian Canadian Shield
- Zone 3 – Sandstone

The locations of these zones are shown in Executive Summary Figure 2.

The Study entailed consultation with the public, including creation of a website for the Study, public information sessions and distribution of a questionnaire and newsletter.

Volume I presents the primary issues to be addressed by a groundwater management plan.

This volume, Volume II, utilizes the findings from Volume I and its related mapping (Volume III) to develop management measures for protecting regional groundwater. This volume first considers the existing framework for groundwater protection in Ontario and other jurisdictions. It presents relevant examples of measures undertaken in other jurisdictions to protect groundwater resources.

This volume then presents the measures best suited for the Study Area and the ways these can be most effectively implemented. This groundwater management plan for the region is presented in Part E of this volume.

Fundamental Issues and Concerns

The groundwater inventory (Volume I) identified seven (7) major issues in the Study Area:

1. About two-thirds of the Study is estimated to be vulnerable to potential contamination (Executive Summary Figure 3). Vulnerability to contaminants is highest in the Limestone Plains (Zones 1A & 1B), where there is a relatively shallow depth to water, thin/absent soils, exposed fractured bedrock and karst terrain. Together, these result in groundwater that is relatively unprotected from surficial contamination. These areas are also the most populated in the region and, hence, contain the most potential sources of contamination.
2. Widespread recharge (replenishment of water to an aquifer) occurs in the Study Area. Recharge also occurs upgradient in neighbouring municipalities within the groundwater shed and flows potentially into the Study Area.
3. The highest density of wells occurs in the geographical area encompassing Verona, Harrowsmith, Westbrook, Glenburnie, Kingston Mills and Sydenham, and in Odessa and Napanee. These locations also have:
 - The highest number of old wells that were established prior to provincial separation distance requirements between wells and subsurface sewage disposal systems. They also were established before the current Provincial requirements for well casing, depth, and installation protocols, further increasing the likelihood of the wells receiving contamination. It is likely that aging sewage disposal systems are also operated at these locations;
 - The highest number of wells with short casings;

- The highest density of unused/abandoned wells that may not have been properly decommissioned (i.e., sealed/plugged).

Each of these factors increase the potential both that these wells could become contaminated and that they could serve as conduits for surficial contamination to reach the groundwater.

4. Lower yields and more dry wells occur in the limestone. Yields tend to be progressively lower toward the western part of the Study Area due to inherent differences in the limestone bedrock.
5. Bacteria, sodium, salt (chloride), nitrates, iron and manganese, hardness and hydrogen sulphide are elevated above Provincial standards in a significant number of wells.
6. Zone 2 (Precambrian) covers approximately 41 percent of the Study Area. Uranium, radon, arsenic and selenium may be more prevalent in the groundwater in this zone.
7. Artesian conditions exist in some locations.

The groundwater management measures proposed in this Volume are primarily based on the issues defined above.

Legislation Concerning Groundwater Protection

Provinces in Canada are legislated the primary responsibility for ensuring safe drinking water. Provinces establish enforceable standards and regulations for drinking water protection and for oversight and auditing of municipal drinking water systems. Municipalities operate and manage many of the water supplies, ensuring that the water provided to their citizens meets provincial standards. The production of groundwater from private wells is not subjected to the rigorous testing and standards that are applied to water from municipal services; after the establishment of a well, well owners must take responsibility to ensure that their drinking water is safe.

Provincial legislation that affects groundwater use and can be protective of groundwater resources includes the following:

- Planning Act (1990) – the basis of land use planning in the Province. Under this act, the Provincial Policy Statement was created, and municipalities are empowered to create Official Plans, By-Laws, etc., with the requirement that all aspects of these documents be consistent with the Provincial Policy Statement.
- Environmental Protection Act (1990) – prohibits discharge of contaminants into the environment
- Ontario Water Resources Act (1990) – under which the "Wells" Regulation (O. Reg. 128/03), the Permit to take Water requirements, and the Drinking Water Regulation (O. Reg. 459/00) were created.

- Municipal Act (2001) – states that "a municipality may regulate matters not specifically provided for by this Act or any other Act for purpose related to the health, safety and well being of the inhabitants of the municipality."
- Safe Drinking Water Act (2002) – evolved from the Walkerton tragedy; it focuses on "protection of human health and prevention of drinking water health hazards through control and regulation of drinking water system and drinking water testing." It's regulations are under development at the time of this printing.
- Sustainable Water and Sewage System Act (2002) – not yet in force.
- Nutrient Management Act (2002) – provides for "the management of materials containing nutrients in ways that will enhance protection of the natural environment and provide a sustainable future for agriculture operations and rural development."
- Aggregate Resources Act (1990)
- Building Code Act (1992) – Governs water distribution systems, sewage systems, and the set-back between sewage systems and water bodies, wells, and other features.
- Health Protection and Promotion Act (1990)
- Conservation Authorities Act (1990)
- Drainage Act, Tile Drainage Act, and Agricultural Tile Drainage Installation Act (all 1990)
- Clean Water Act (2006) – The Clean Water Act received Royal Assent on October 19, 2006. It ensures communities are able to protect their municipal drinking water supplies through developing collaborative, locally driven, science-based protection plans and take action to reduce or eliminate these risks.

The Federal government writes policy and guidelines and funds research regarding safe drinking water. Federal initiatives include the Federal Water Policy, Guidelines for Canadian Drinking Water Quality, CCME Source to Tap project; the Canadian Water Network of Centres of Excellence; a recent Road Salt Study; and the Canada/Ontario Water Use and Supply Project.

Municipalities in the Study Area have addressed groundwater protection through their Official Plans and Zoning By-Laws to varying degrees. The Town of Greater Napanee and Loyalist Township also have policies respecting watershed planning and the Township of South Frontenac has undertaken a septic system re-inspection program.

Groundwater Protection in Other Jurisdictions

Relevant examples of groundwater management in other Canadian and American jurisdictions include initiatives that can be considered for possible adoption in the Study Area. Examples of requirements that are more protective of groundwater in other

jurisdictions address the following issues:

- Mandatory septic system pump-outs and inspections;
- Well locations and separation distances;
- Development in karstic geology;
- The adoption of groundwater protection plans by private well owners; and
- Agency oversight.

Examples of relevant incentive and education programs related to groundwater are also presented.

Groundwater Management Plan Recommendations

The Groundwater Management Plan developed as a key part of this Study contained seven (7) major concept areas. Measures to be undertaken relative to each area were recommended, along with presentation of the reason for each measure; the parties responsible for implementation of each measure; the tools and authorities under which the measure would be enacted; a relative ranking of priority, cost, and implementation difficulty; and comments and examples for each.

The primary measures recommended to ensure groundwater management in the Study Area included the following seven (7) items:

1. Implementation – a Groundwater Protection Implementation Committee (GPIC) should be formed to evaluate and implement recommendations of this Study. The Committee should consist of representatives from the Ministry of Environment, Health Unit, municipalities, the Conservation Authority and the public.
2. Funding – Funding to implement recommendations should be primarily Provincial, as the province has the greatest responsibility for ensuring clean drinking water. Specific study recommendations may be best funded by other sources as appropriate.
3. Stewardship and Education
 - 3.1. Residents should be informed that a significant percentage of wells in the region contain elevated counts of bacteria, including e-coli, particularly in limestone areas; and that groundwater in the region, particularly in the limestone areas, is relatively vulnerable to contamination. Care should be taken by all residents to minimize the potential for contamination.
 - 3.2. The GPIC should develop a template of a residential groundwater protection plan, which all private well owners in the Study Area should be encouraged to adopt.
 - 3.3. Continuing education for the public and for decision makers and officials regarding groundwater protection should be promoted.

- 3.4. Well owners should be encouraged to monitor their well water at least three (3) times per year for bacteria. Free analysis available through the Health Units should receive further increased promotion.
 - 3.5. Testing of well water for nitrates, pesticides, herbicides and arsenic should be encouraged as appropriate.
 - 3.6. Testing of well water for uranium, radon, arsenic and selenium should be encouraged for residents in Zone 2, where Precambrian Shield rock predominates.
 - 3.7. All homeowners should be encouraged to install water treatment systems to treat bacteria.
4. Land Use Planning
- 4.1. Strengthen municipal policies regarding groundwater protection in Official Plans and Zoning By-laws; ensure that these policies map and incorporate the areas highly vulnerable to groundwater contamination.
 - 4.2. Review standards for stormwater management, road design, maintenance, etc., to ensure that the standards are the best management for groundwater protection given the high vulnerability of aquifers in the Study Area.
 - 4.3. Incorporate groundwater management plans into municipal growth strategies.
 - 4.4. Site plans should be reviewed by a qualified groundwater professional for all residential site plan control applications for all development proposed on full or partial private services in areas with “Very High” vulnerability (Executive Summary Figure 3). All commercial site plans should be reviewed by a qualified groundwater professional, regardless of vulnerability.
 - 4.5. Management Specific to Groundwater Sensitivity Zones
 - 4.5.1. All lands in Sensitivity Zone 1 (“Very High” vulnerability) should be designated as environmentally sensitive and any new development should be prohibited, unless site specific studies support development;
 - 4.5.2. Sensitivity Zone 2 (“Medium to High” vulnerability) should require minimum 1 hectare lots unless a small lot is supported by acceptable studies completed by a qualified professional; raw water should be sampled; no chipped or blasted wells should be permitted; dug wells should be permitted only by special permission on existing lots of record and severances; septic system standards should be modified to reflect the groundwater vulnerability.
 - 4.6. For other development (e.g., commercial, industrial, agricultural), guidelines should be developed to ensure development proceeds appropriately given the vulnerability of the groundwater; Official Plans and Zoning By-Laws should be written to standards that are more stringent than Provincial standards to reflect the groundwater vulnerability.
5. Well and Sewage System Standards

- 5.1. Develop a formal method of well construction compliance, beginning with an audit to evaluate whether existing regulations are being adhered to; consider higher standards for well construction to reflect groundwater vulnerability.
 - 5.2. Evaluate the minimum separation distances between wells and septic systems.
 - 5.3. Discourage dug wells; prohibit chipped and blasted wells.
 - 5.4. Collect water quality information for all newly constructed wells in Area.
 - 5.5. Locate and properly decommission existing unused/abandoned wells and those new wells that will not be used (e.g., due to lack of water quantity or poor water quality).
 - 5.6. Make inspections of wells and sewage disposal systems mandatory at time of property transactions. (Members of the Technical Advisory Committee for this Study did not achieve consensus on this recommendation. It is recommended that the GPIC discuss this further.)
 - 5.7. Evaluate the need for more stringent design/siting requirements for new sewage disposal systems.
6. Monitoring and Analysis
- 6.1. Expand the groundwater and surface water monitoring programs under the MOE to include more sites in the Study Area.
 - 6.2. Develop a detailed water budget for the Study Area.
 - 6.3. Conduct research on the karst limestone and fractured bedrock in the Study Area.
 - 6.4. Develop and up-to-date ground- and surface water GIS database for water quality analytical results, MOE Water Well Records, static water levels, etc.
 - 6.5. Establish a database of potential sources of groundwater contamination.
 - 6.6. Geo-reference all new data collection associated with groundwater.
7. Specific Area Issues
- 7.1. Properly decommission wells located near roadsides and containing “salty” water and site new wells at a generous setback from the roads.
 - 7.2. Test all new wells for constituents of potential concern in each area.
 - 7.3. Record all failed (dry) wells and the proper decommissioning of each in the area where the majority of failed wells occur.
 - 7.4. In areas with artesian conditions, drillers advancing new wells should be prepared to use special well construction techniques to ensure control of the flowing well water.

- 7.5. Undertake a detailed study of groundwater quality in the areas with the highest groundwater vulnerability containing a high density of old wells and old sewage treatment systems that are potential sources of groundwater contamination.
- 7.6. Inform residents of their area-specific issues in addition to general groundwater protection. Area specific issues that residents should be aware of include areas with elevated bacteria, salt (sodium and chloride) and high vulnerability to contamination.

The majority of the groundwater in the Study Area is vulnerable to contamination. A combination of the above measures will be valuable to ensuring protection of the area's groundwater resources.

