

Terms Of Reference

**Wellhead Protection Area Plan
for Private Communal Wells**

October 2002

City of Ottawa
Development Services Department



1.0 Objectives

The quality of groundwater from any water well is dependant on the natural quality of the groundwater in the supply aquifer, and impacts due to human activities (anthropogenic impacts) that alter the quality of the groundwater from its natural state within the capture zone of the well. Future well water quality cannot be predicted by looking at current well water quality alone. In order to predict future well water quality, including possible future anthropogenic impacts, it is necessary to understand the following:

- i. The source(s) of groundwater supplying the well (where does the water come from?);
- ii. The sources of contamination that could potentially impact the well water quality; and
- iii. The degree of risk posed by the potential sources of groundwater contamination.

The City of Ottawa will not enter into a Responsibility Agreement or agree to municipal ownership for a water works to be supplied by a proposed communal well or well field, unless the proponent can demonstrate an understanding of the above issues, and that the proponent can clearly demonstrate that the source of the groundwater supplying the communal well or well field will be protected by means of a Wellhead Protection Area Plan (WHPAP).

To ensure that the City of Ottawa is provided with sufficient information regarding the aquifer/groundwater within the capture zone of a proposed communal well or well field, proponents of private communal well systems must complete a WHPAP according to this Terms of Reference (ToR). This ToR requires the proponent to prepare a WHPAP Report, consisting of :

1. The determination of the source of recharge to the aquifer(s) from which the well or well field obtains its water;
2. Numerical modeling of groundwater flow including calculation of well or well field capture zones;
3. Compilation of an inventory of contaminant sources within the Wellhead Protection Area (WHPA);
4. An assessment of the risk of contamination of aquifer groundwater for each contaminant source; and
5. A proposed well or well field WHPAP.

It will be the responsibility of the proponent to fulfil the WHPAP and to undertake all steps necessary to protect the aquifer groundwater within the WHPA.

2.0 Pre-submission Consultation

Pre-submission consultation is a dialogue between the proponent and the City of Ottawa prior to submission of a WHPAP for private communal wells. Pre-submission consultation is meant to assist proponents in defining the objectives of the WHPAP.

In the pre-submission consultation with the City, the proponent must be prepared to present and discuss a preliminary conceptual model of the hydrogeological system of the region surrounding the well or well field. To define a WHPA based on the capture zone of a well or well field with a high degree of confidence requires a good

understanding of the hydrogeological system within which the communal wells would operate (the conceptual model). The hydrogeological conceptual model will include, as a minimum, a description of recharge and discharge areas, general groundwater flow directions, groundwater use, and the characteristics of aquifers/aquitards in the region surrounding the well or well field. Also, as part of pre-submission consultation, the proponent must present and discuss a preliminary contaminant source inventory (see Section 4.3) and inventory of agricultural land use (see Section 4.4) for the area within a five kilometre radius of the well or well field.

3.0 General Requirements

The definition of the WHPA will be based on calculated groundwater capture zone(s). The City accepts the methodologies for mapping of WHPAs, and requirements for WHPA Studies as provided in Section 3.0 of the Ministry of the Environment's (MOE) Technical Terms of Reference (TToR) for Groundwater Studies, dated November, 2001. The methodologies and requirements of Section 3.0, and the data standards specified in Section 4.2 of the MOE TToR that relate to WHPA Studies, are to be considered applicable unless specified otherwise in this ToR. Additional WHPA Study requirements are provided herein. Further requirements may be imposed on a site-specific basis.

The MOE TToR is available via the internet from the MOE web site at:

<http://www.ene.gov.on.ca/envision/techdocs/4197e.pdf>.

The proponent will make use of available maps, air photos, water well record data, relevant hydrogeological and environmental reports, published databases of potential contaminant sources (MOE data bases and others) and pumping test data. Where required in order to properly characterize the hydrogeological system, the collection of additional groundwater quality, geophysical (down-hole or surface surveys), downhole hydrogeophysical, downhole packer test, environmental isotope, or other types of data may be necessary in order to successfully complete the WHPAP. While the need to collect additional data will be determined by the proponent, the City will apply a very high standard of care in its confirmation of the successful completion of the WHPAP by the proponent.

All WHPAP reports must be peer reviewed prior to submission to the City. A report on the peer review would be submitted to the City at the same time as the WHPAP report. The peer reviewer would be retained by the proponent. The City will provide the proponent with a list of acceptable peer reviewers.

4.0 WHPA Study Methodology and Report Components

4.1 Aquifer and Aquitard Parameter Characterization

Aquifer and aquitard parameters such as thickness, hydraulic conductivity and effective porosity must be determined, either from reliable existing information or through collection of new data. The hydrogeological

system, as described in the conceptual model, must be considered in order to determine the appropriate aquifer and aquitard parameter data requirements.

A minimum of one properly completed pump test at each well is required. The type and duration of the pumping test will also be based on the hydrogeological system and need to determine aquifer and aquitard parameters. A properly completed pump test utilizes a drilled observation well(s), and if possible, the acquisition of data concerning the vertical position and yield of individual water bearing zones within the aquifer formation(s) (bedrock or overburden). Downhole hydrogeophysical logging, downhole packer testing, and the installation of multilevel monitoring wells for the determination of site-specific vertically referenced data may be required in order to successfully complete the WHPAP.

4.2 Capture Zone Calculation

The preferred method for capture zone delineation methodology specified in the MOE TToR involves the use of a 3-dimensional (3D) steady state numerical model. The City requires that a 3D steady-state numerical model must be used for delineation of capture zones. MODFLOW/MODPATH or similar programs are acceptable for this purpose.

The 3D numerical model is to be constructed using parameters and information that are specific to the study area in which the well or well field is situated (e.g., surficial geology, bedrock geology, topography, surface water/hydrographic data, infiltration estimates) and calibrated using representative groundwater levels within the various hydrostratigraphic units. Boundary conditions and aquifer/aquitard parameters must be reasonable and defensible. Surface water/groundwater interactions must also be considered during model calibration. Following calibration, the 3D model will be used to delineate the four time-related capture zones listed in the MOE TToR (i.e., 0 to 50 day Time of Travel [ToT]; 50 day to 2 year ToT; 2 to 10 year ToT; and 10 to 25 year ToT). A fifth capture zone (25 yrs to the capture zone limit) will also to be determined. Uncertainty in the aquifer parameters or conceptualization of the flow system must be addressed with respect to the determination of the five capture zones.

Capture zones are to be determined using the calibrated model and appropriate future well or well field pumping rates. When applicable, the vertical ToT through the aquitard(s) to the aquifer(s) is to be determined throughout the WHPA. The WHPA Plan will be based on the limits of largest determined capture zone.

4.3 Contaminant Source Inventory

A detailed contaminant source assessment must be conducted for the properties within the WHPA, in accordance with the MOE TToR. The objective of this assessment is to identify past, present and possible future activities that are current, or potential future, point, and non-point sources of groundwater contamination (including, for example, road salting, subsurface disposal sewage systems and landfills).

The information for this review is to be obtained from, but not necessarily limited to, the MOE Inventory of PCB sites, MOE Inventory of Waste Generators, Land Use Schedules, Technical Standards and Safety Authority (TSSA) fuel sites, land assessment maps, business directories and city directories. If available, historical insurers' underwriter maps should be reviewed.

Interviews with officials from the District Office and Approvals Branch of the MOE, the Ottawa Septic Office and the City of Ottawa (Environmental Management Division, Planning, Environment and Infrastructure Policy Branch, Developments Services Department) will be conducted in order to identify any known issues of environmental concern. Historical air photographs will be reviewed and detailed field surveys will be conducted in order to confirm information provided by others, and to identify other or new potential sources of groundwater contamination. Industrial, commercial and institutional facilities within the WHPA must be visited and asked to complete the questionnaire included in the MOE TToR (Schedule E).

The WHPAP Report will include a discussion on the likelihood that improperly abandoned wells are present within the WHPA and the potential impact of improperly abandoned wells within the WHPA.

4.4 Inventory of Agricultural Land Use

Potential risks associated with existing or potential future agricultural activities within the capture zones will be discussed in the WHPAP Report.

Data from the Census of Agriculture (CoA) Enumeration Area database will be used to identify any areas of high intensity agriculture, including high animal density (manure production) and high nitrogen fertilizer use. Specific operations that may be potential sources of groundwater contamination should be determined from air photographs, through site visits or questionnaires. Each identified agricultural operation is to be characterized in terms of manure storage facilities, pesticide and fertilizer storage, bulk fuel storage, and pesticide mixing and filling of sprayers. A survey/questionnaire will be sent to all farm sites that fall within the 10 year ToT capture zone, inquiring about the intensity of farming, manure storage facilities, abandoned wells, etc.

4.5 Risk Assessment of Contaminant Sources and Agricultural Activities

Following identification and compilation of the potential contaminant sources and agricultural activities, a risk assessment is to be conducted. Each potential contaminant source (current or potential future source) within the WHPA must be categorized according the risk to cause contamination of the aquifer groundwater and impact on the groundwater supply at the wellhead .

The relative risk of causing aquifer contamination within the WHPA, and contamination of groundwater supplied from the well or well field, is to be determined for each identified historical, existing or potential future source of contamination. The relative risk determined for each potential source will be based on hydrogeological setting, aquifer vulnerability and ToT to the wellhead. The vertical ToT through the aquitard(s) to the aquifer(s) should be considered (where applicable) in addition to the overall ToT from the potential sources to the wellhead.

Potential sources of contamination that could theoretically affect the groundwater supply at the wellhead within 10 years are to be considered as “high risk”. Potential sources of contamination, located anywhere within the WHPA that could theoretically cause potentially long term aquifer contamination (e.g. dense non-aqueous phase liquids) are also to be considered as “high risk”. Other potential contaminant sources, or potential sources located at distances greater than the 10 year travel time (from the contaminant source to the wellhead) are to be considered as lower risk.

4.6 Wellhead Protection Area Plan

Prior to developing a WHPAP, the proponent must review relevant City policies, by-laws and programs concerning rural development, environmental protection, etc. The WHPAP must include specific actions to be undertaken by the proponent to address problems identified by the risk assessment. The need for the proponent to undertake additional groundwater investigations or establish a groundwater monitoring program must be addressed in the WHPAP. If necessary, the City may require land securement by the proponent in order to address issues related to potential sources of contamination.

3.0 5.0 Submission Requirements for the WHPAP Report

The WHPAP will be compiled into a report which references all historical data sources and contains all relevant original data. The WHPAP and the peer review report must be submitted together by the proponent to the City. Following acceptance of the WHPAP by the City, all data must be submitted to the City in accordance with the data standards described in Section 4.2 of the MOE TToR.

The WHPAP must be prepared and signed by Professional Engineer, or Professional Geoscientist, licensed for practice in the Province of Ontario, and qualified in the specialized field of Hydrogeology.