REPORT TO:	**Halton-Hamilton Source Protection Committee**
REPORT NO.:	SPC-21-03-04
FROM:	Jacek Strakowski, Hydrogeologist, Watershed Planning and Source Protection **jstrakowski@hrca.on.ca**
DATE:	February 26, 2021
SUBJECT:	**S. 36 Updates: Methodology to Identify of Transport Pathways in Wellhead Protection Areas**

Recommendation

THAT the Halton-Hamilton Source Protection Committee **receive for information the Staff report S. 36 Updates: Methodology to Identify of Transport Pathways in Wellhead Protection Areas**

Executive Summary

This report describes a methodology to assess potential contaminant transport pathways of municipal linear infrastructure, excavations, septic systems, pits and quarries, oil and gas wells, and pipelines within wellhead protection areas of municipal drinking water systems. The methodology helps identify if the vulnerability of the drinking water source could increase due to the transport pathways. This work supports the Section 36 Workplan Task #6 (part 6): "Review transport pathways in wellhead protection areas and their influence on the vulnerability of the source water. Alter scoring as necessary and reassess threat activities in those areas", with the exception of the Freelton WHPA as technical work is in progress.

Report

Background

A transport pathway is a human-made feature below ground surface that increases the vulnerability of the sources of our drinking water supplies. Transport pathways bypass the natural protection provided by soil and rock layers and natural processes, resulting in a greater risk of contamination of our water sources.

Under the Clean Water Act O. Reg. 287/07, municipalities must notify the source protection authority and source protection committee (SPC) about proposals that may result in new or modified transport pathways, as they may affect the vulnerability of the drinking water source to contamination. The source protection authority and SPC may also become aware of potential transport pathways through other means. The source protection authority and SPC must assess whether the vulnerability score for the wellhead protection area (WHPA) should be increased or an intake protection zone (IPZ) expanded. These changes may result in the identification of additional threat activities that require management through source protection plan policies.

Per technical rules 39 through 41, the area vulnerability can be increased because of a presence of an anthropogenic transport pathway upon consideration of:

- Hydrogeological conditions
- The type and design of transport pathways
- The cumulative impact of any transport pathways, and
- The extent of any assumptions used in the assessment of the vulnerability of groundwater.

In the Halton-Hamilton Source Protection Region (HHSPR), a surface to well advection time (SWAT) method was used to assess the intrinsic vulnerability within WHPAs. The SWAT analysis assesses a time of travel through the unsaturated portion of subsurface (Unsaturated Zone Advection Time – UZAT) plus a time of travel from a water table, through the aquifer to a municipal well (Water Table to Well Advection Time – WWAT). The SWAT analysis is thought to be the most comprehensive of the four vulnerability assessment methods as proposed in the 2017 technical rules under the Clean Water Act. However, the method does not account for anthropogenic (human-made) changes to the subsurface.

The aquifers that supply municipal drinking water systems in the HHSPR are protected at the surface by low permeability deposits of various thicknesses overlying either sand and gravel or fractured bedrock aquifers. Anthropogenic transport pathways remove, decrease the thickness or reduce the protective capability of that protective blanket. These pathways can potentially include poorly constructed wells, pits and quarries that breech the confining layer, underground infrastructure such as storm sewers and sanitary sewers, pipelines, road ditches, etc.

The SPC Business Report #20-09-07 (from September 2020) assessed non-municipal wells constructed prior to the enactment of the Wells Regulation O. Reg. 903 (Ontario Water Resources Act). Staff are continuing the analysis of other potential transport pathways within WHPAs per the Section 36 workplan for the Halton-Hamilton source protection areas. The other types of potential transport pathways include:

- Municipal linear infrastructure
- Excavations
- Septic systems
- Pits and quarries
- Oil and gas wells
- Pipelines
- Geothermal systems.

Data Sources

The data to complete the assessment is obtained from several sources as summarised below:

- Storm sewer mapping obtained from local municipalities
- Roadside ditch mapping developed based on LiDAR and Orthophotos analysis by Conservation Halton engineering staff
- Watermain mapping obtained from Halton Region and the City of Hamilton
- Septic system locations are not available; an aerial photo analysis will be done to identify where septic systems are potentially located
- Sanitary sewer mapping obtained from Halton Region and the City of Hamilton
- Oil and gas well and pit and quarry mapping obtained from Land Information Ontario (LIO) open data resources
- Pipeline mapping obtained from pipeline owners
- Geothermal system data sources are being explored with municipalities and MECP.

Methodology

In early 2021, staff contacted other source protection regions and areas to obtain methodologies to assess various types of transport pathways. Only one report is available with detailed information: Matrix Solutions Inc. completed a technical study including transport pathway assessment in 2018. Their work is summarised in "Township of Centre Wellington Wellhead Protection Area Delineation, Issue Contributing Area Delineation, And Vulnerability Scoring Report - Lake Erie Source Protection Region" (version 1) report for the Grand River Conservation Authority and County of Wellington.

According to the Matrix Inc. 2018 study, a linear infrastructure, deep excavation, septic system becomes a transport pathway if it is located either **within 2 metres** of the top of aquifer or below the water table. HHSPR proposes to apply the same criteria.

The depth to water table and the top of aquifer surfaces are obtained from groundwater models that were used to delineate each specific WHPA. These are exported into GIS software for a desktop analysis.

Linear infrastructure (storm sewers, roadside ditches, watermains) and septic systems

A GIS-based assessment will be used to compare the actual depth (if available) or assumed depth of the potential transport pathways as listed in **Table 1** with the depth to water table or depth to the top of aquifer. These depths were discussed with municipalities in early Feb. 2021. Input on the assumed depths was sought and obtained from Halton-Hamilton Source Protection Committee member Carla Coveart (of GM BluePlan Consulting) as well.

Potential pathways identified below the water table or within 2 metres of the top of aquifer will be confirmed as transport pathways. The analysis of septic systems as transport pathways will follow same criteria as linear infrastructure. As noted above under "data

sources", there is no septic system location mapping available, and staff must undertake an aerial photo analysis to identify potential locations.

Table 1: Assumptions of Depths of Transport Pathways

Transport Pathway Type	Presence in Wellhead Protection Areas (WHPAs)	Assumptions
Stormwater (storm sewers)	• Campbellville • Freelton • Carlisle • Greensville	Assumed to be 5 meters below ground surface. Note that Lake Erie also assumed 5 m (Matrix Solutions Inc., 2018).
Stormwater (roadside ditches)	• Kelso • Campbellville • Walkers Line • Freelton • Carlisle • Greensville	Assumed to be 1 metre below ground surface
Water main	• Kelso • Campbellville • Walkers Line • Freelton • Carlisle • Greensville	Assumed to be 2 meters below ground surface. There are local water mains existing within HH SPR WHPAs to distribute water to local water users. Our understanding is that these are shallow installations just below a frost line. Note that Lake Erie assumed 5 m depth (Matrix Solutions Inc., 2018).
Septic systems	• Kelso • Campbellville • Walkers Line • Freelton • Carlisle • Greensville	Assumed to be 2 meters below ground surface. Private septic systems are usually very shallow due to financial reasons and to properly function to avoid interactions with shallow groundwater. Note that Lake Erie assumed 5 m depth for septic systems (Matrix Solutions Inc., 2018).
Wastewater	There are no sanitary sewers within HHSPR WHPAs.	For possible (but unlikely) future scenarios, assessments may assume the infrastructure to be 5 meters below ground surface. This is consistent with Lake Erie transport pathway assessment by Matrix Solutions Inc., 2018.
Geothermal systems	To be determined	To be determined.

Pits and Quarries

Pits and quarries within WHPA are assessed on a site-specific basis. The methodology to complete the transport pathways assessment is as follows:

1. If a specific pit or quarry was inactive and represented in the numerical model (which was used to estimate the time of travel from the water table to a municipal well intake and subsequent unsaturated zone time of travel estimate to assess intrinsic vulnerability), such quarry would not be a transport pathway. If there is a proposal for more extraction within the area which intersects with WHPA, methodology in point 2 below is used.
2. If a specific pit or quarry was not represented in the model or is still active, and there is enough information available about the depth of licensed extraction, subsurface conditions, and state of rehabilitation, the same criteria for linear infrastructure would be used; otherwise the entire aggregate operation would be identified as a transport pathway.

Oil and gas wells

There are no oil and gas wells within HHSPR WHPAs, and therefore, no assessment is needed.

Pipelines

There are no pipelines crossing the HH SPR WHPAs, and therefore, no assessment is needed.

Next Steps

Staff will complete the assessment of transport pathways analysis, discuss with municipalities, and present the results as well as any policy implications at the June 2021 HHSPC meeting.

Brad Rennick, GIS Analyst Lead, is acknowledged for his assistance using GIS. Jeff Lee, Water Resources Analyst, is acknowledged for assistance including providing the roadside ditch data.

Prepared by:

Jacek Strakowski,
Hydrogeologist
jstrakowski@hrca.on.ca

Reviewed by:

Chitra Gowda, Senior Manager
Watershed Planning and Source Protection
cgowda@hrca.on.ca