



MEMORANDUM

Date: March 4, 2016

File: 38050-40/Hullcar

To: Christa Zacharias-Homer,
Deputy Director, Environmental Protection,
Ministry of Environment

From: Skye Thomson, M.Sc., P.Geo., Regional Hydrogeologist,
and
David Thomson, M.Sc., P.Geo., Regional Hydrogeologist
Ministry of Forests, Lands and Natural Resource
Operations

RE: **Ambient Groundwater Monitoring of the Hullcar Aquifers No. 102 and 103**

Background

In British Columbia, Ambient Groundwater Quality Monitoring Networks (AGWQMN) are comprised of public and/or private water wells which are sampled for a period of time to assess the groundwater quality in the aquifer. The private wells are usually active water supply wells (i.e., a pump permanently installed in the well), whereas some of the monitoring networks have dedicated provincially-owned monitoring wells. The data from ambient wells are used to analyze spatial and temporal variation of groundwater quality for a given aquifer.

In 2009, an AGWQMN was established by MOE staff (now FLNR groundwater staff) in the Hullcar area. The objectives of the Network are to characterize the water chemistry of the aquifer, identify any parameter that exceeds health standards or is trending in a direction that would impact human or ecosystem health, and help raise awareness about the linkage between land use practices and water quality.

This memorandum provides:

- Overview of the surficial geology of the Hullcar area and aquifer information;
- Description of the Hullcar AGWQMN;
- Summary of the nitrate data from the AGWQMN;
- Recommendations for next steps.

Surficial Geology of the Hullcar area and aquifer information

The Hullcar area is located in the Township of Spallumcheen in the North Okanagan, 5 km northwest of Armstrong BC (Appendix A). The Hullcar valley is a predominantly west-east trending valley.

The surficial geology in the Hullcar area is complex and contains lacustrine, glaciofluvial and glaciotectionized sediments, consisting of clay, silt, sand, gravel and diamicton (glacial till). Deep Creek originates from the north and meanders from a northwest to southeast direction, deeply incising these unconsolidated sediments, forming channels, gullies and alluvial fans.

There are two provincially mapped aquifers in the Hullcar area. These aquifers are subdivided into Hullcar unconfined (Aquifer No. 103) and Hullcar confined (Aquifer No. 102).

The Hullcar unconfined aquifer is mapped at greater than 14 km² (defined by area of groundwater development) and comprised of surficial glaciofluvial sand and gravel, including kettled topography. The thickness of the aquifer ranges from 3 to 45 metres, with thickening occurring to the west and east of Deep Creek. A review of available well records indicates subsurface conditions generally consist of sand and gravel overlying till. This dense till-like deposit is inferred to be relatively continuous across the Hullcar area, varying by depth. Static water levels vary from 1.5 to 14 metres below ground based on well records. Available well records in the BC WELLS Database indicate high productivity, with well yields as high as 13 L/s (200 US gpm) in this aquifer. This aquifer has been classified by the Ministry of Environment as IIA, due to the moderate level of groundwater development and the high vulnerability to contamination.

The Hullcar confined aquifer covers an area of greater than 12 km² (defined by area of groundwater development). The top of the Hullcar confined aquifer occurs from 15 to 50 metres below ground and has an average thickness of 17 metres. However, a limited number of wells have fully penetrated the entire aquifer so both the areal extent and full thickness of the confined aquifer is unknown. Wells in the southern portion of the aquifer (i.e., at WTN 48180 and 9216) indicate at least a 46 m thick dense till-like deposit overlies the confined sand and gravel aquifer (Golder 2006). This aquifer has a classification of IIC, which indicates a moderate level of development and a low vulnerability to contamination.

It has been reported by LeBreton (1972) that Deep Creek, originating from the north and meandering from northwest to southeast, continues to flow across the Hullcar valley during dry years when upstream reaches are dry. This suggests the Hullcar valley aquifers may be contributing to the baseflow of Deep Creek. However, the temporal and spatial interactions between Deep Creek and the underlying aquifers are poorly understood. Also, there is limited information on the groundwater flow directions in these aquifers.

Description of the Hullcar AGWQMN

This Network is hosted in BC Aquifer Nos. 102 and 103 (i.e., the Hullcar confined and unconfined aquifers). There is substantial agricultural activity in the area and community concerns were raised on the potential for groundwater contamination. Well sampling locations were based on private well owners that agreed to have their wells sampled annually. Consent letters were signed by each private well owner to consent to have their wells sampled (Appendix B).

In 2009, there were initially 8 sampling locations identified for the network. Two groundwater observation wells in the area, Well Nos. 409 and 384, were added at later dates.

After each annual sampling event, the water quality results are sent to the participating well owners. The results are also sent to the Ministry of Environment and to the Interior Health Authority to provide residents with a contact to provide further information on the health significance of the results. The results from the sampling events are stored in the Ministry of Environment's Environmental Monitoring System (EMS).

Summary of reported nitrate concentrations from the AGWQMN

Table 1 below provides for a summary of the nitrate-nitrogen data collected as part of the Hullcar AGWQMN. According to the Canadian Drinking Water Guidelines, the maximum allowable concentration (MAC) for nitrate-nitrogen (NO₃-N) is 10 mg/L. NO₃-N levels greater than 3 mg/L are considered elevated showing the influence of human activities on the aquifer. None of the Network sampling locations (Appendix C) show NO₃-N levels above the MAC of 10 mg/L; however, elevated results above 3 mg/L were observed at 3 locations (E277391, E262364 and E275523).

Table 1: Summary of Hullcar AGWQMN sampling locations

EMS ID	Location	Sampling Date	Nitrate – Nitrogen (mg/L) (Detection limit 0.002)
E277389	Parkinson Rd	2009-09-30	0.002
		2010-11-03	0.002
		2012-03-14	0.002
		2014-07-24	0.002

		2015-10-13	0.015
E277390	Hullcar Rd	2009-09-30	0.002
		2010-11-03	0.008
		2012-03-14	0.002
		2014-07-24	0.002
		2015-10-13	0.015
E277391	Schubert Rd	2009-09-30	5.57
		2010-11-03	0.002 *
		2012-03-14	0.002
		2014-07-24	0.002
		2015-10-13	0.015
E277392	Hullcar Rd	2009-09-30	0.04 **
		2010-11-03	0.121
E277393	Schubert Rd	2009-09-30	0.004
		2010-11-03	0.002
		2012-03-14	0.002
		2014-07-24	0.002
		2015-10-13	0.015
E258763	Canyon Rd	2010-11-03	0.0031
		2012-03-14	0.002
		2014-08-12	0.002
		2015-10-13	0.015
E227271	Schubert Rd	1997-07-15	0.136
		2009-09-30	0.167
E262364	Schubert Rd	2014-07-24	7.75
		2015-10-13	9.19
E262366	Hullcar Rd	2006-03-16	0.0
		2010-11-03	0.105
		2012-03-14	0.002
		2014-07-24	0.0076
		2015-10-13	0.015
E275523	Obs Well 384, Schubert Rd	2015-11-27	3.29
E288429	Obs Well 409, Schubert Rd	2012-10-25	0.002
		2014-02-25	0.002
		2015-07-30	0.003
		2015-11-27	0.015

* Well owner drilled a new deeper well on the property in August 2010.

** Well owner advised that well was completed in bedrock.

Further information on nitrates in groundwater is available at:

<http://www.healthlinkbc.ca/healthfiles/hfile05a.stm>

<http://healthycanadians.gc.ca/publications/healthy-living-vie-saine/water-nitrate-nitrite-eau/index-eng.php>

Recommendations

- Look for opportunities to expand the Hullcar AGWQMN to other areas of the aquifer, including increasing the density and frequency of sampling in locations with observed elevated nitrate-nitrogen levels, as well as providing additional information on groundwater flow direction across the two aquifers.
- Look for appropriate up-gradient (background) sampling locations, and additional sampling coverage to the north, east and south of the existing Network area.
- Compile available surface water quality data and compare to groundwater quality for trends in the parameters of interest related to land use and aquifer setting.
- Sample locations reporting higher nitrate concentrations for nitrogen isotopes, to clearly separate manure from other nitrogen sources.
- During future sampling events, attempt to measure static water levels and survey well casing tops to assist with developing groundwater flow maps.
- Look for opportunities to develop collaborative research projects with the Okanagan Basin Water Board and UBC Okanagan.

If you have additional questions, please don't hesitate to contact the undersigned.

Sincerely,



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Regional Hydrogeologist
Skye.Thomson@gov.bc.ca



David Thomson, M.Sc., P.Geol.
Regional Hydrogeologist
David.Thomson@gov.bc.ca

References:

Golder, 2006. Groundwater potential evaluation for the Hullcar area, Township of Spallumcheen, BC. Report submitted to the Township of Spallumcheen and Urban Systems Ltd. 96 pages.

Le Breton, E. G. 1972. A Hydrogeological Study of the Okanagan River Basin. Canada-British Columbia Okanagan Basin Agreement Technical Supplement II To Final Report. Water Resources Service, Department of Lands, Forests, and Water Resources, British Columbia.

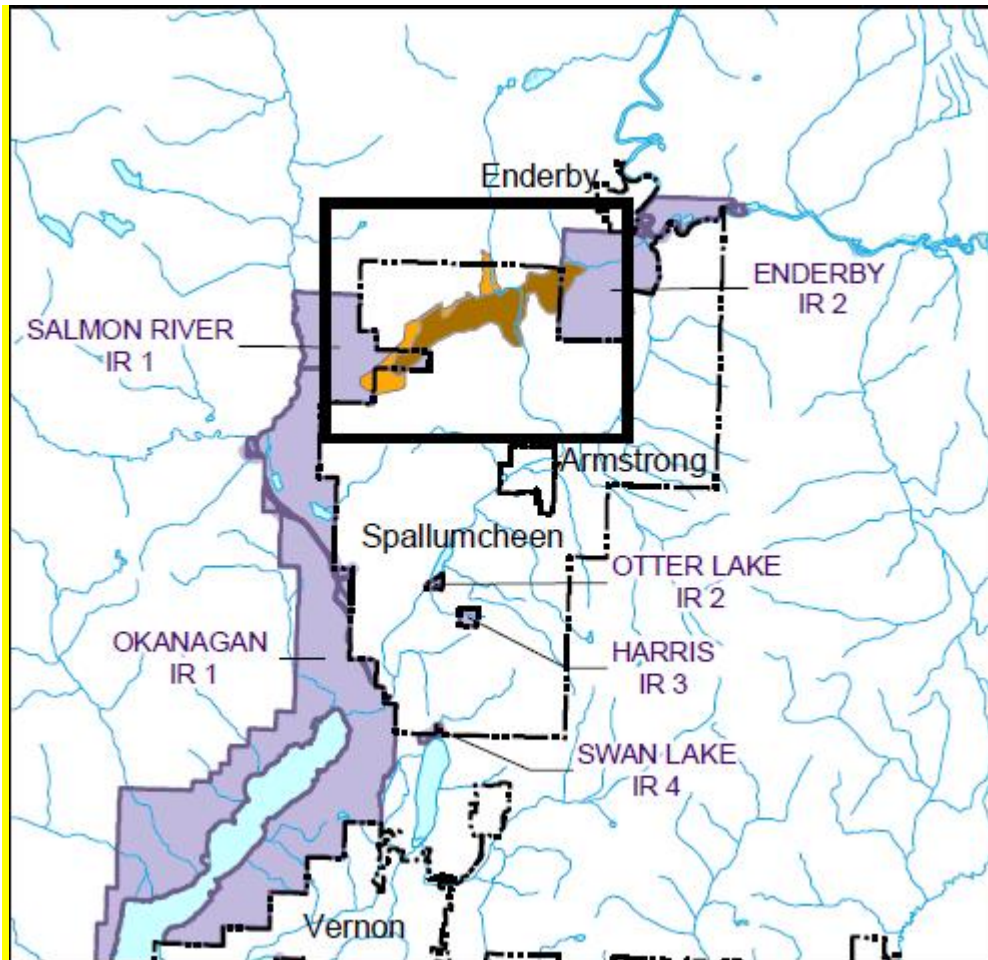
cc: Andy Oetter, Director of Authorizations, Ministry of Forests, Lands and Natural Resource Operations VIA E-MAIL

Orlando Schmidt, Regional Manager, Ministry of Agriculture VIA E-MAIL

Mike Noseworthy, Acting Regional Water Section Head, Ministry of Forests, Lands and Natural Resource Operations VIA E-MAIL

Mike Wei, Section Head, Groundwater and Aquifer Science, Ministry of Environment VIA E-MAIL

Appendix A – Map of the Spallumcheen area. Hullcar aquifers identified in brown.



Appendix B - Example of Consent Form

Ministry of Environment
Water Stewardship Division
Okanagan Region



102 Industrial Place, Penticton, British Columbia V2A 7C8 / Tel: (250) 490-8200 Fax: (250) 490-2231

Attention:

Subject: Water Well – XXXX Hullcar Rd, Armstrong, BC

I/we are the owner(s) of Section, Township, Plan, ODYD, Lot at XXXX Hullcar Rd, Armstrong BC (hereinafter the "Property") upon which the subject groundwater well is located.

For consideration received we consent to the Province of British Columbia as represented by the Ministry of Environment (herein referred to as the "Ministry") and its employees and agents entering the Property at any reasonable time in order to measure or assess the groundwater quality in and around the well. Such entry may include taking water samples, performing tests, taking photographs, establishing the well location, making recordings, and attaching a water source identification tag to the well head or other suitable location. It is expected that entry will be required at least annually for the collection of water samples.

In signing this Consent I/we understand that:

1. the purpose is to test for a variety of inorganic chemicals, organic chemicals and bacteria, if any, in the groundwater;
2. the Ministry will upon request provide us with any information obtained from the visit, including the results of any tests performed;
3. results from tests may be stored in the Ministry's Environmental Monitoring System (EMS) and shared with the Interior Health Authority;
4. in keeping with the *Freedom of Information and Protection of Privacy Act*, the Ministry may disclose to the public information obtained from entry, including the results of any tests performed; and
5. I/we may rescind this consent at any time by notifying the Ministry in writing.

Owner's Signature

Owners Name (Please Print)

Date: _____

Address: _____

Owner's Signature

Owner's Name (Please Print)

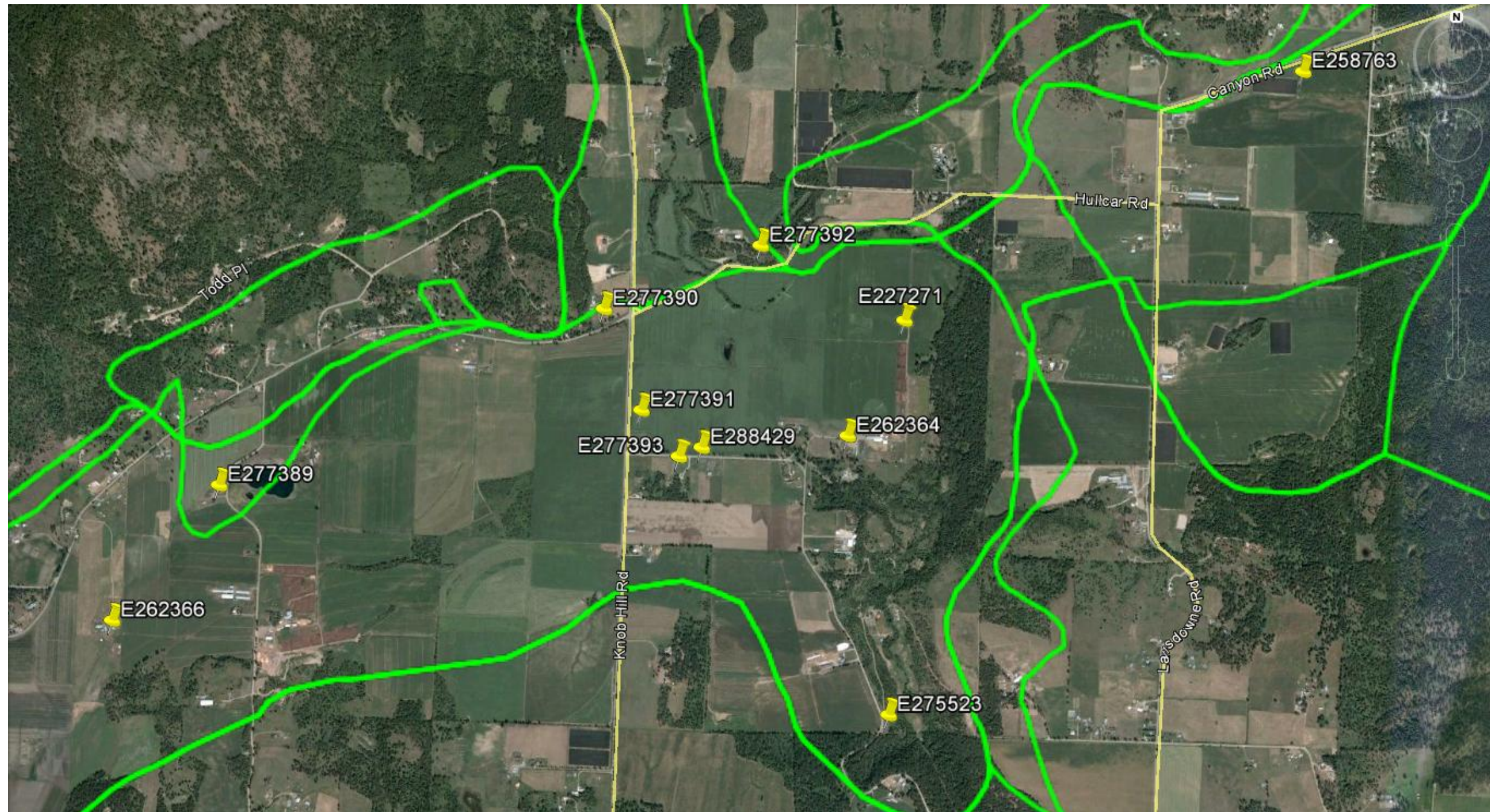
Date: _____

Address: _____

Witness Signature

Witness Name (Please Print)

MEMORANDUM



Appendix C – Map of EMS Sampling Locations