APPENDIX K

Hydrogeology - Wells and Groundwater

HYDROGEOLOGY
WATERDOWN ROAD CORRIDOR

TABLE OF CONTENTS

1. INTRODUCTION 1

2. HYDROGEOLOGY 1
   - 2.1 Geological Setting 1
     - 2.1.1 Bedrock 1
     - 2.1.2 Overburden 2
   - 2.2 Groundwater Flow 2

3. PRIVATE WELLS ALONG THE PREFERRED CORRIDOR 2
   - 3.1 Private Wells in MOE Records 2
   - 3.2 Field-Surveyed Private Wells 3

4. POTENTIAL IMPACTS OF ROAD CONSTRUCTION 3
   - 4.1 Potential Impacts on Groundwater Quality 3
   - 4.2 Potential Impacts on Groundwater Quantity 4

5. CONCLUSIONS 5

6. REFERENCES 5

LIST OF FIGURES

Figure 1: Private Wells along the New East-West Road and Waterdown Road Corridors
Figure 2: Private Wells and Surficial Geology along the Waterdown Road Corridor
Figure 3: Cross-Section B-B'
Figure 4: Reported Static Level vs Well Bottom Elevation in Bedrock Wells along the Waterdown Road Corridor

LIST OF TABLES

Table 1: Summary of MOE Well Records for Private Wells along the Waterdown Road Corridor
Table 2: Private Wells in the Field Survey along the Waterdown Road Corridor

LIST OF APPENDICES

Appendix A: MOE Well Records
Appendix B: Results of the Field Survey of Private Wells
B-1: Field Survey Letter and Form
B-2: Completed Forms for Field Surveyed Wells
B-3: Completed Forms for Wells Not Field Surveyed

1.0 INTRODUCTION

The purpose of the hydrogeological component of the Class Environmental Assessment is to assess the potential impacts of the proposed road construction on the groundwater system and private groundwater users along the preferred Waterdown Road Corridor. This assessment is based on published geological reports and maps, Ministry of Environment (MOE) computerized well record data base, and a field survey of private wells along the corridor.

The MOE records were assessed of 21 wells located within a 100 m buffer zone along the preferred corridor, and these are shown in ***Figure 1***. The computerized MOE records of these wells are in ***Appendix A***. Selected information was extracted from these records and presented in a more usable form in ***Table 1***, and this provided the main data set for this assessment.

A field survey was also done of private wells along the preferred corridor within the 100 m buffer zone (***Figure 2***). During the field survey, only 2 wells were identified along the corridor, and the results are summarized in ***Table 2***. The field sheets are in ***Appendix B***.

2.0 HYDROGEOLOGY

2.1 Geological Setting

The regional geology in the area around the Waterdown Road Corridor consists of glacial overburden overlying Paleozoic dolostone and shale bedrock, and has been described by Karrow (1987), Johnson et al (1992), and Ontario Geological Survey (1982, 1984). The information from these reports was supplemented by geological logs in the MOE well records of private wells along the preferred corridor. The surficial geology along the corridor is shown in plan in ***Figure 2*** and in Cross-Section B-B' in ***Figure 3***.

The Waterdown Road Corridor trends northwest-southeast, and lies above and below the Niagara Escarpment, which is the major physiographic and geological feature in the area. The Niagara Escarpment forms a cliff about 300 m high that trends northeast-southwest across the study area (***Figure 1***). Streams on the flat area above the Escarpment drain southeastward off the Escarpment to Lake Ontario, the most prominent being Grindstone Creek.

Cross-Section B-B' in ***Figure 3*** was constructed using the MOE well records of the private wells, and illustrates elements of the geology and hydrogeology along the corridor, including surface topography, topography of the bedrock surface, overburden thickness and the approximate position of the water table. Cross-Section B-B' shows that the ground surface reflects the topography of the bedrock surface. Paleozoic bedrock formations are not differentiated.

2.1.1 Bedrock

The Amabel Formation forms the caprock of the Niagara Escarpment in this area, and is an important regional aquifer in Southern Ontario. Underlying the Amabel is the Queenston Formation, which consists mainly of red shale. The Amabel Formation outcrops along the Escarpment, and Queenston Shale is exposed along streambeds below the Escarpment (***Figure 2***). The bedrock formations dip gently toward the southwest.

2.1.2 Overburden

The overburden in the study area consists of a regional till blanket (mainly Halton Till in this area) deposited by the advancing glacial ice, which is overlain by a deposit of fine-grained glacial lake sand, in areas west of Waterdown above the Escarpment, and west of the Waterdown Road corridor below the Escarpment (***Figure 2***). The Halton Till is a low-permeability clay-silt unit that extends as a sheet across much of the area, and is generally the basal overburden unit.

The overburden thickness along the corridor ranges from 0 m to about 14 m, as interpreted from the surficial geology map by Karrow (1987) in ***Figure 2***, the MOE well records and Cross-Section B-B' (***Figure 3***). As indicated in ***Table 1***, the bedrock is probably exposed or very near the surface at several wells (Wells 61, 64, 66, 67 and 71) near the brow of the Niagara Escarpment, based on ***Figure 2***. The overburden thickness reported for these wells in the MOE well records (9.8 m to 13.7 m) appears to be incorrect, and is likely due to drillers' errors.

2.2 Groundwater Flow

The depth to the water table along the corridor is estimated at about 1 m, based on the MOE records. The reported static water levels in wells in ***Table 1*** do not represent the water table, but rather piezometric levels of deeper zones in the bedrock.

Groundwater generally flows southward and discharges to Lake Ontario. The vertical component of groundwater flow is downward from the water table, through the till and into the underlying Amabel and Queenston Formations toward deeper zones in the bedrock. ***Figure 4*** shows a plot of reported static level versus elevation of the well bottom for wells along the preferred corridor, using data from ***Table 1***. The plot indicates a strong vertical downward hydraulic gradient of about 0.3 m/m in the bedrock below the Niagara Escarpment.

3.0 PRIVATE WELLS ALONG THE PREFERRED CORRIDOR

3.1 Private Wells in MOE Records

The MOE computerized data base indicated 21 wells along the preferred Waterdown Road Corridor. All of the wells are bedrock wells, and most are 6-inch diameter drilled wells, installed between 1953 and 1969. As discussed in ***Section 1.0***, the details of these wells were extracted from the MOE well records (***Appendix A***), and are summarized in ***Table 1***. Several parameters from ***Table 1*** are further summarized for convenience below:

Parameter	No. Wells	Range	Mean
Drilled Date	24	1953-1969	1960
Depth (m)	24	4.6-34.1	15.4
Static Water Level Depth (m)	23	1.2-18.3	6.0
Available Drawdown (m)	23	2.7-16.5	8.5
Depth to Top of Bedrock (m)	20	3.7-13.7	7.9
Tested Flow Rate (L/min)	21	4.6-54.6	12.9
Tested Drawdown (m)	20	1.5-12.5	6.7
Specific Capacity (L/min/m)	19	0.4-10.5	2.4

Notes:
Selected parameters are explained in ***Table 1***.

The wells shown in ***Figure 2*** along the corridor were plotted using UTM coordinates in the MOE well records. The coordinates for these wells were estimated by the MOE from topographic maps. On ***Figure 2***, several wells appear to lie outside the property boundary and within the road alignment (Wells 65, 71, 78, 79). This is due to inaccurate UTM coordinates in the MOE well records; these wells do not actually lie outside the property boundaries. As discussed in ***Section 1.0***, relatively few wells were field surveyed due to the difficulty in contacting the well owners.

3.2 Field-Surveyed Private Wells

The results of the field survey of 4 private wells along the corridor within a 100 m buffer zone are summarized in ***Table 2***. The field sheets are provided in ***Appendix B-2***. The wells are identified as D-28 to D-32. Wells for which the UTM coordinates were measured in the field (Wells D-28 and D-29) are plotted in ***Figure 2***.

In the 2 cases where the resident was home, the well was field surveyed (***Appendix B-1***), which included measurement of the UTM coordinates using a hand-held Global Positioning System (GPS) device. In the case of Wells D-31 and D-32, the residents were not home, and a survey package was mailed to them (***Appendix B-2.1***). Of the mailed survey packages, one (D-31) was returned completed by the well owner (***Appendix B-2.2***), and one (D-32) was returned unopened.

4.0 POTENTIAL IMPACTS OF ROAD CONSTRUCTION

Potential impacts on wells due to external factors generally fall into two categories: impacts on groundwater quality and impacts on groundwater quantity. This section discusses each of these potential impacts on the private wells along the Waterdown Road Corridor. Based on the available information we consider it unlikely that the proposed road construction will cause any significant impacts on private wells along the corridor.

4.1 Potential Impact on Groundwater Quality

This project will involve a widening of the existing road allowance by about 3.5 m on each side. This proposed widening will reduce the setback from the widened road allowance of the existing wells on lots along the corridor.

The reduced setback, combined with the increased traffic, could make some of the existing wells more susceptible to inflow of contaminants from surface sources, particularly road salt. The susceptibility of an individual well will depend on a number of factors, including the integrity of the well construction, the well's setback, the depth of the well and the type of the surficial geological material.

In wells that are (possibly) improperly constructed, contaminants such as road salt that may be present at the water table along the road could reach the well intake by inflow along the annulus of the well (the clearance between the casing and the formation).

Alternatively, such contaminants could migrate downward from the water table to the well intakes in the bedrock under the strong downward hydraulic gradient that exists in the saturated zone (See ***Section 2.2***). The risk of downward migration would be relatively low where the surficial material is low-permeability till. In the area near the brow of the Escarpment where the overburden is very thin or absent (***Figure 2***), the potential for downward migration would be greater due to the higher permeability of the bedrock (Wells 65, 71, 78, 79, ***Figure 2***).

The potential for downward migration is mitigated by the fact that almost all the wells in the MOE well records are deep bedrock wells. Of the 21 listed wells, 16 wells are >10 m deep and 10 wells are >15 m deep (***Table 1***). Of the 5 relatively shallow (<10 m deep) wells, all (Wells 63, 68, 69, 70, 72, ***Figure 2***) are located in the lower-risk till area and not in an area of bedrock outcrop.

4.2 Potential Impact on Groundwater Quantity

Impacts on the groundwater quantity in wells, i.e. those involving a reduction in yield or an increase in drawdown, are typically caused by interference from another pumped well nearby. In this case, the proposed road construction along the preferred corridor will not have any foreseeable such impacts on the local wells, because the construction activities will not involve any groundwater extraction.

5.0 CONCLUSIONS

Based on the above discussion, we present the following conclusions:

- The characterization of private wells along the preferred corridor was done using the Ministry of Environment (MOE) computerized well record data base, and also by a field survey of private wells along the corridor. This information was supplemented by government geological reports and maps.

- Based on the available information, we consider it unlikely that the proposed road construction will cause any significant impacts on private wells along the corridor.

Potential Impact on Groundwater Quality

- The proposed road widening will reduce by about 3.5 m the setback of existing wells on lots along the preferred corridor. The reduced setback, combined with the increased traffic, could make some of the existing wells more susceptible to inflow of contaminants from surface sources, particularly road salt. The susceptibility of an individual well will depend on a number of factors, including the integrity of the well construction, the well's setback, the depth of the well and the type of the surficial geological material.

- Contaminants (e.g. road salt) that may be present at the water table along the road could reach the well intake by inflow along the casing annulus of (possibly) improperly constructed wells.

- Alternatively, such contaminants could migrate downward from the water table to the well intakes in the bedrock under the strong downward hydraulic gradient that exists in the saturated zone. The potential of downward migration to the bedrock would be relatively low where the surficial material is low-permeability till. In the area near the brow of the Escarpment where the overburden is very thin or absent (***Figure 2***), the potential for downward migration would be greater due to the higher permeability of the bedrock.

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6.0 REFERENCES

Karrow, P.F., 1987. Quaternary Geology of the Hamilton-Cambridge Area, Southern Ontario. Ontario Geological Survey Report 255, 94p.

Johnson, M.D., Armstrong, D.K., Sanford, B.V., Telford, P.G. and M.A. Rutka, 1992. Paleozoic and Mesozoic Geology of Ontario. In Geology of Ontario, Ontario Geological Survey, Special Volume 4, p. 907-1008.

Ontario Geological Survey, 1991. Bedrock geology of Ontario, southern sheet. Ontario Geological Survey, Map 2544, Scale 1:1000000.

Ontario Geological Survey, 1982. Aggregate Resources Inventory of the City of Burlington, Regional Munipality of Halton. Aggregate Resources Inventory Paper 45. 31 p.

Ontario Geological Survey, 1984. Aggregate Resources Inventory of the Regional Munipality of Hamilton-Wentworth. Aggregate Resources Inventory Paper 50. 53 p.

FIGURES

DILLON NO.

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE[2] CNTR[3]	CASING DIA[4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTENDS,11
BURLINGTON CITY FEF 02(006)	17 590614 4797923[W]	1969/11 1205	06	FR 0030	030 / 076 004 / :0	DO		2803303 () PRDR 0050 BLUE SHLE 0076
BURLINGTON CITY FEF 02(006)	17 590770 4797858[W]	1960/03 4001	06 06	FR 0055	015 / 055 005 / 2:0	DO		2800324 () BRWN CLAY BLDR 0044 LMSN 0055
BURLINGTON CITY FEF 02(006) 63	17 590994 4797483[W]	1969/08 2519	30	FR 0006	006 / / :0	DO		2803136 () BLCK LOAM 0001 BRWN CLAY MSND 0004 BRWN CLAY 0012 GREY CLAY 0015
BURLINGTON CITY FEF 02(006)	17 590902 4797891[W]	1960/08 1102	02 02					2800325 () GREY MSND GRVL 0017 GREY SHLE 0040 RED SHLE 0125
BURLINGTON CITY FEF 02(006)	17 591161 4797870[W]	1960/09 2309	06 06	FR 0065	040 / 080 001 / 1:0	DO		2800326 () BLUE CLAY STNS 0020 BLUE CLAY 0032 RED SHLE 0090
BURLINGTON CITY FEF 02(006) 64	17 590657 4797868[W]	1960/10 1102	02 02	FR 0075	024 / 044 002 / 1:0	DO		2800327 () GREY CLAY STNS 0032 GREY SHLE 0075 RED SHLE 0078
BURLINGTON CITY FEF 02(006) 65	17 590776 4797675[W]	1961/06 4602	06	SA 0108				2800328 () BRWN CLAY 0027 RED SHLE 0112
BURLINGTON CITY FEF 02(006)	17 590972 4797904[W]	1962/07 4602	06					2800330 () BLDR SILT 0020 LMSN 0028 BLUE SHLE 0035 RED SHLE 0054
BURLINGTON CITY FEF 02(006)	17 591057 4798079[W]	1962/07 4602	06					2800331 () LMSN BLDR SILT 0028 LMSN 0035 BLUE SHLE 0045 RED SHLE 0069
BURLINGTON CITY FEF 02(006)	17 590974 4797903[W]	1962/08 4602	06 06	FR 0014	015 / 054 / 1:0	DO		2800332 () CLAY BLDR 0014 LMSN 0027 BLUE CLAY 0032 LMSN 0039 BLUE SHLE 0051 RED SHLE 0054
BURLINGTON CITY FEF 02(006)	17 591029 4797913[W]	1962/10 4602	06 06	FR 0023	016 / 026 009 / 2:0	DO		2800333 () BLDR SILT 0007 RED CLAY STNS 0015 GREY CLAY LMSN 0032 GREY LMSN 0034
BURLINGTON CITY FEF 02(006)	17 590814 4797863[W]	1962/12 4001	06 06	FR 0025	001 / 005 015 / 24:0	DO		2800334 () PRDG 0005 LMSN 0010 BLUE SHLE 0030
BURLINGTON CITY FEF 02(006) 66	17 590708 4797837[W]	1964/06 3608	06 06	FR 0045	027 / 045 002 / 2:0	DO		2800335 () BLUE CLAY 0010 RED CLAY 0038 GREY SHLE 0047
BURLINGTON CITY FEF 02(006)	17 591181 4797856[W]	1967/07 4602	06 06	FR 0053	016 / 053 001 / 1:0	DO		2800336 () BRWN CLAY 0010 RED CLAY 0014 RED SHLE 0053
BURLINGTON CITY FEF 02(006) 67	17 590694 4797818[W]	1956/10 4002	06 06	FR 0080	060 / 080 001 / :0	DO		2800318 () CLAY 0035 SHLE 0080
BURLINGTON CITY FEF 02(006)	17 591010 4797880[W]	1958/06 4602	06 06	FR 0036	031 / 067 001 / 1:30	DO		2800322 () BLCK LOAM LMSN BLDR 0021 CLAY 0029 LMSN 0051 RED SHLE 0067
BURLINGTON CITY FEF 02(006)	17 591154 4797883[W]	1980/09 4005	06	FR 0030	017 / 036 004 / 1:0	DO		2805556 () BRWN CLAY LOOS 0018 RED CLAY LOOS 0022 RED SHLE HARD 0040

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE[2] CNTR[3]	CASING DIA[4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND5,11
BURLINGTON CITY FEF 02(006) 68	17 591004 4797433[W]	1969/08 2519	30	FR 0010	012 / 029 / :0	DO		2803137 () BRWN FILL 0005 BRWN CLAY 0010 BRWN MSND 0016 GREY CLAY 0029
BURLINGTON CITY FEF 02(007) 69	17 590964 4797463[W]	1968/12 2519	30	FR 0015	015 / 027 003 / 1:0	DO		2802762 () LOAM 0001 BRWN CLAY MSND 0005 BRWN MSND 0019 GREY CLAY 0021 BLUE CLAY 0025 RED SHLE 0030
BURLINGTON CITY FEF 02(007) 70	17 590817 4797493[W]	1960/08 1308	30	FR 0009	009 / 002 / 8:0	PS		2800341 () BRWN MSND 0010 BLUE CLAY BLDR 0027
BURLINGTON CITY FEF 02(007) 61	17 590540 4797841[W]	1954/08 4002	06 06	FR 0058	025 / 060 001 / 4:0	DO		2800338 () LOAM MSND 0010 QSND 0045 LMSN 0060
BURLINGTON CITY FEF 02(007) 71	17 590631 4797805[W]	1953/11 4002	06 06	FR 0045	016 / 050 001 / 4:0	DO		2800337 () BLUE CLAY 0043 BLUE SHLE 0050
BURLINGTON CITY FEF 02(007) 72	17 590834 4797523[W]	1960/08 1308	30	FR 0008	008 / 002 / 8:0	PS		2800340 () BRWN MSND 0010 BLUE CLAY BLDR 0020
BURLINGTON CITY FEF 02(007)	17 590644 4797613[W]	1977/05 4005	06	FR	032 / 068 001 / 2:0	DO		6809592 () BRWN CLAY LOOS 0024 RED CLAY LOOS 0032 RED SHLE HARD 0070
EAST FLAMBOROUGH TOW CON 03(003)	17 591009 4799279[W]	2004/04 6607	02	FR 0030			0026 05	6814371 (Z11839) A011820 CLAY 0015 CLAY 0030 SAND 0031 ROCK
EAST FLAMBOROUGH TOW CON 03(005) 62	17 590360 4799164[W]	1955/12 2415	08 08	FR 0010	011 / 028 012 / 1:30	CO		6801628 () CLAY 0012 LMSN 0054
EAST FLAMBOROUGH TOW CON 03(005)	17 590197 4798981[W]	1962/03 4602	06 06	FR 0037	016 / 053 002 / 2:0	IR		6801630 () LOAM MSND 0011 GREY LMSN 0053
EAST FLAMBOROUGH TOW CON 03(005)	17 590559 4798725[W]	1953/12 4002	06 06	FR 0056	029 / 044 012 / 4:0	ST DO		6801627 () LOAM 0003 BLUE CLAY 0027 BLUE LMSN 0056
EAST FLAMBOROUGH TOW ()	17 590326 4798913[W]	2007/03 7238	04	0005		NU		7042379 (Z56102) A045327 BRWN LOAM 0000 BRWN CLAY SILT 0007 GREY LMSN 0025
WATERDOWN VILLAGE 03(007)	17 590150 4798181[W]	2006/01 6607	02	FR 0020			0024 03	6814441 (Z42267) A037812 BRWN SILT CLAY STNS 0016 GREY LMSN WTHD ROCK 0027
WATERDOWN VILLAGE ()	17 590414 4798133[W]	1973/05 4005	06	FR 0077	050 / 070 006 / 1:30	DO		6808449 () BLCK LOAM 0001 BRWN CLAY 0020 GREY CLAY 0077 GRVL 0078 GREY CLAY 0080
WATERDOWN VILLAGE ()	17 590216 4798786[W]	1960/08 4001	06 06	FR 0070	018 / 070 001 / 2:0	DO		6805476 () BLDR CLAY 0023 LMSN 0062 RED SHLE 0072
WATERDOWN VILLAGE ()	17 590188 4798223[W]	2005/01 6607	01				0023 05	6814196 (Z24226) A019234 BRWN FILL SILT SNDY 0005 BRWN SILT CLAY 0010 BRWN GRVL CSND 0012 BRWN CSND SLTY GRVL 0016 GREY SHLE WTHD 0018 GREY ROCK SHLE 0028

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE[2] CNTR[3]	CASING DIA[4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTENDS,11
BURLINGTON CITY FEF 01(007) 76	17 592106 4796340[W]	1955/08 2415	06 06	FR 0032 FR 0023	008 / 013 002 / 1:0	DO		2800274 () CLAY 0016 RED SHLE 0035
BURLINGTON CITY FEF 01(007)	17 592246 4795951[L]	2002/03 4005				DO		2809547 (227174)
BURLINGTON CITY FEF 01(007) 77	17 591685 4796533[W]	1968/07 5417	06 06	FR 0040	021 / 054 004 / 1:0	DO		2802812 () BRWN CLAY 0004 GREY CLAY 0012 RED CLAY SHLE 0020 RED SHLE 0068
BURLINGTON CITY FEF 01(007)	17 591542 4796420[W]	1964/05 4602	06 06	FR 0057	046 / 087 001 / 3:0	DO		2800282 () GREY CLAY 0011 RED CLAY 0019 RED SHLE 0087
BURLINGTON CITY FEF 01(007)	17 592047 4796284[W]	1963/10 4602	06 06	FR 0025	012 / 044 002 / 1:0	DO		2800281 () BRWN CLAY 0014 RED CLAY 0019 RED SHLE 0044
BURLINGTON CITY FEF 01(007)	17 592020 4795906[W]	1962/11 4602	06 06	FR 0056	030 / 065 001 / 2:0	DO		2800280 () LOAM MSND 0022 SHLE 0030 RED SHLE 0065
BURLINGTON CITY FEF 01(007)	17 592113 4796018[W]	1962/11 4602	06	SA 0063	037 / 064 001 / 1:0	NU		2800279 () LOAM MSND 0020 RED SHLE 0064
BURLINGTON CITY FEF 01(007) 78	17 592113 4796423[W]	1957/04 4002	06 06	FR 0035	005 / 035 005 / :0	DO		2800277 () CLAY 0015 RED SHLE 0035
BURLINGTON CITY FEF 01(007) 79	17 591951 4796526[W]	1956/10 4002	06 06	SA 0068	050 / 070 001 / 6:0	DO		2800276 () BLUE CLAY 0020 RED SHLE 0070
BURLINGTON CITY FEF 01(007) 80	17 592215 4796282[W]	1955/12 4002	06 06	FR 0043	004 / 045 005 / 3:0	DO		2800275 () BLUE CLAY 0015 RED SHLE 0045
BURLINGTON CITY FEF 01(008)	17 591965 4796175[W]	1962/11 4602	06 06	FR 0061 FR 0037 FR 0052	037 / 071 002 / 2:0	DO		2800287 () LOAM MSND CLAY 0022 SHLE 0030 RED SHLE 0071
BURLINGTON CITY FEF 01(008) 74	17 591642 4796581[W]	1956/08 4002	06 06	FR 0043	035 / 045 001 / 12:0	DO		2800283 () BLUE CLAY 0024 RED SHLE 0045
BURLINGTON CITY FEF 01(008)	17 591309 4795902[W]	1985/06 4207	06 06	FR 0016	008 / 014 020 / 1:0	DO		2806386 () RED CLAY SNDS 0014 RED SHLE 0016 RED SHLE 0031
BURLINGTON CITY FEF 01(009)	17 591295 4795923[W]	1980/10 4005	06	FR 0028	009 / 015 015 / 1:0	DO		2805592 () PRDG 0009 RED CLAY LOOS 0015 RED SHLE HARD 0035
BURLINGTON CITY FEF 02(006) 73	17 591221 4797218[W]	1959/01 4001	06 06	FR 0047	013 / 040 005 / 2:0	DO		2800323 () PRDG 0012 GREY SHLE 0047
BURLINGTON CITY FEF 02(006)	17 591434 4797393[W]	1973/09 4005						2804300 () BRWN CLAY 0042 BRWN SAND 0046 RED SHLE 0090

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE[2] CNTR[3]	CASING DIA[4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND5,11
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BURLINGTON CITY FEF 02(007) 75	17 591691 4796684[W]	1955/05 2415	06 06	FR 0036	024 / 030 001 / 0:30	DO		2800339 () BRWN CLAY 0025 BLUE CLAY 0030 BLUE SHLE 0064
BURLINGTON CITY FEF 02(007)	17 591124 4797053[W]	1969/03 3637	30	FR 0021	010 / / :0	DO		2803026 () LOAM 0002 BRWN CLAY 0020 BRWN MSND 0023 BLUE CLAY 0029 RED SHLE 0030
BURLINGTON CITY FEF 02(008)	17 591076 4796457[W]	1992/01 3030	32 36	FR 0003 FR 0008 FR 0012 FR 0019	003 / / :0	DO		2807969 (093617). LOAM 0001 BRWN CLAY 0003 RED CLAY STNS WBRG 0008 RED CLAY CLAY HARD 0012 WHIT CLAY SLTY SOFT 0013 RED CLAY STNS 0019 WHIT CLAY SLTY WBRG 0020 RED SHLE HARD 0022 RED SHLE 0023
BURLINGTON CITY 02(007)	17 590940 4796662[W]	2006/01 6607	01	0020		NU	0031 03	2810487 (Z42226) A037774 BRWN SAND 0005 GREY CLAY GRVL TILL 0010 BRWN SILT FSND 0025 BLUE CLAY GRVL TILL 0034
BURLINGTON CITY ()	17 592088 4796322[W]	2007/08 7241	00				0007 10	7051041 (Z74089) A061508

July 30, 2008

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Attention: Local Water Well Users

Waterdown Road and New East-West Road
Class Environmental Assessment Projects
Water Well Survey
City of Hamilton, City of Burlington, Region of Halton

Dear Resident:

As part of the Class Environmental Assessments studies being carried out for improvements to Waterdown Road and the New East-West Road corridor, Dillon Consulting is conducting a technical study of conditions along the existing and proposed new road alignments to evaluate the potential for effects to groundwater supply wells.

Your property is located within the study corridors (see attached Key Plan). If you are serviced by a private supply well, we would appreciate your assistance with this survey. **Participation is voluntary.** Participation involves your completion of the attached questionnaire, which should take about fifteen minutes of your time. The questionnaire seeks information on well construction, available water quantity, and water quality. Finish the form to the best of your knowledge, and then please mail the form to our office using the envelope provided. Your participation helps to ensure that effects to your well are considered.

The information that you provide will be summarized in our final report. Personal contact information (e.g. name, address) will not be included in our summaries.

If you should have any questions, or require assistance with the questionnaire, please contact the undersigned at 416-229-4647 ext. 2324. Thank you in advance for your helpful assistance.

Yours sincerely,

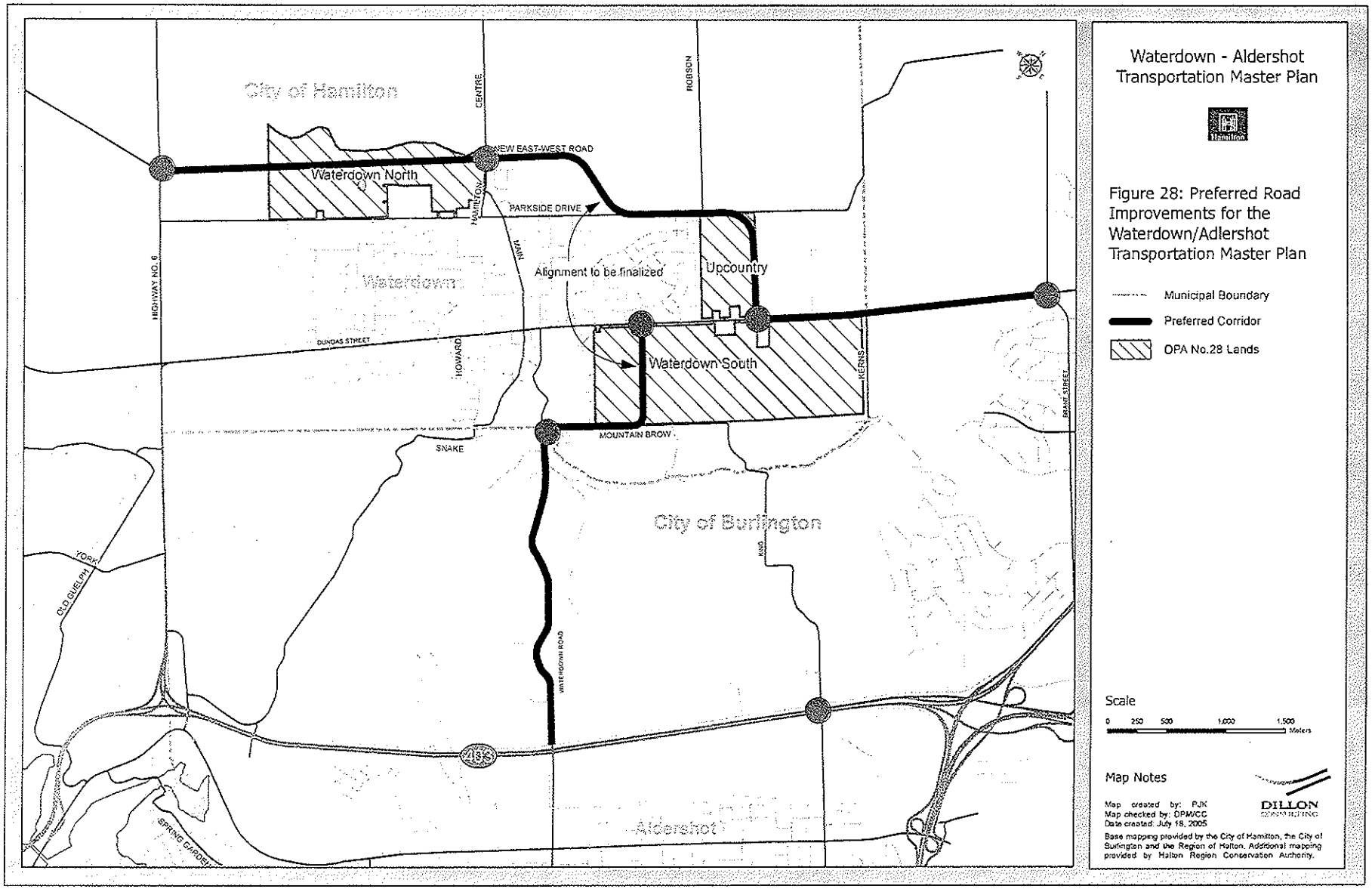
DILLON CONSULTING LIMITED

Ted Rannie, M.Sc., P.Geo.
Hydrogeologist

THR:lkc
Encl.

Our File: 08-9020

Dillon Consulting Limited


City of Hamilton
CENTRE
ROBSON
NEW EAST-WEST ROAD
Waterdown North
PARKSIDE DRIVE
HAMILTON
MAIN
HIGHWAY NO. 6
Waterdown
Alignment to be finalized
Upcountry
DUNDAS STREET
HOWARD
Waterdown South
KERNS
BRANT STREET
MOUNTAIN BROW
SNAKE
City of Burlington
KING
YORK
OLD GUELPH
WATERDOWN ROAD
403
SPRING GARDEN
Aldershot
Waterdown - Aldershot
Transportation Master Plan
Figure 28: Preferred Road Improvements for the Waterdown/Adlershot Transportation Master Plan
Municipal Boundary
Preferred Corridor
OPA No.28 Lands
Scale
0 250 500 1,000 1,500
Meters
Map Notes
Map created by: PJK
Map checked by: DPM/CC
Date created: July 18, 2005
DILLON
Base mapping provided by the City of Hamilton, the City of Burlington and the Region of Halton. Additional mapping provided by Halton Region Conservation Authority.

Water Supply Well Survey Form

(One sheet per well on property)

DILLON CONSULTING

Project Number: 08 - 9020

Project Name: Waterdown and E-W Corridor

Date:

Name of property owner: _____

Name of tenant [if different from above]: _____

Street address [911 Number]: _____

Mailing address: _____

Municipality, postal code: _____

Telephones: _____ [work, home]

Number of persons routinely using well water: _____

Property use: _____ [resid, comm, indust, instit]

Number and type of livestock: _____

Well Construction

Number of wells on property: _____

Usage activity: _____ [active, dormant]

Well usage: _____ [e.g. domestic, irrigation, washing]

MOE Well Tag No.: _____

Drilling contractor: _____

Depth of well: _____ [feet / metres]

Construction: _____ [dug, drilled, jetted]

Casing material and diameter: _____ [concrete, steel]

Screen presence, depth: _____ [open hole in bedrock?]

Static [un-pumped] water level: _____ [feet / metres]

Pump type: _____ [e.g. submersible, jet]

Is a driller's borehole record attached? _____ [yes / no]

Casing access port: _____ [yes / no]

Well location by GPS. Easting: _____ Northing: _____ Datum: _____

Please Complete as Best You Can !

Water Treatment Systems

Indicate all applicable components below:

◯ Water softener ◯ Iron filter ◯ UV ◯ Other (specify) _____

◯ Reverse osmosis ◯ Sediment filter ◯ Chlorination ◯ Other (specify) _____

Water Quantity History

How many years has the interviewed person used the well? _____

How often does the well run dry?

◯ Never ◯ Daily ◯ Weekly ◯ Monthly ◯ Annually ◯ Once. When: _____

If so, what activity is associated with the well running dry? _____

Is the well ever recharged by water truck? Last recharge date: _____

Was the well ever deepened? When? _____

Well Vulnerability

Direction of ground slope: _____

Well head stick-up above ground: _____ [inches / centimetres]

Casing condition: _____ [cracks, decayed wood, holes?]

Drainage at well head: _____ [level, mound, even slope, inward ditch, pit]

Condition of well lid: _____ [material, cracks, holes, rotted wood?]

Do livestock/pets have access to wellhead area? _____

Water Supply Well Survey Form (continued)

Street address: _____

Water Quality History

Odour problems: _____

Taste problems: _____

Colour problems: _____

Staining of fixtures or laundry: _____

Encrustation at fixtures or pipes: _____

Is the water used for drinking by occupants? _____

Is there any history of illness associated with the water? Frequency? _____

Was the water tested for microbiology by a laboratory and what were results?

Details: _____

Has the water quality changed over time?

Explain: _____

Additional Comments by Interviewed Well User

_____

_____

Draft Property Sketch

Indicate the following features:
(Even if only known approximately)

Property boundary
Houses and other buildings
Well
Septic tank
Septic field
Road
Driveway
North arrow
Distances between well and septic field
Ground slope direction [downward]
Ditches
Water pipe connections
Fuel storage /heating oil tanks
Watercourses, ponds, lakes

APPENDIX B

RESULTS OF FIELD SURVEY OF PRIVATE WELLS

APPENDIX B-2

Completed Forms for Field Surveyed Wells

Water Supply Well Survey Form

 (One sheet per well on property)

D28

DILLON CONSULTING

Name of property owner: Peter Downing

Name of tenant [if different from above]:

Street address [911 Number]: 22 Herring

Mailing address:

Municipality, postal code: Burlington

Telephones: ~~650-356~~ 690-3567 [work, home]

Number of persons routinely using well water: 2

Property use: Residential [resid, comm, indust, instit]

Number and type of livestock: None

Project Number: 08-9020

Project Name: Waterdown & E-W Corridor

Staff Interviewer: LGL

Date of Interview: 05/23/08

Well Construction

Number of wells on property: 1

Usage activity: Active [active, dormant]

Well usage: Domestic, drinking [e.g. domestic, irrigation, washing]

MOE Well Tag No.:

Drilling contractor:

Depth of well: 18' [feet / metres]

Construction: Dug [dug, drilled, jetted]

Casing material and diameter: [concrete, steel]

Screen presence, depth: [open hole in bedrock?]

Static [un-pumped] water level: [feet / metres]

Pump type: Well pump (1hp) [e.g. submersible, jet]

Is a driller's borehole record attached? [yes / no]

Casing access port: [yes / no]

Please Complete as Best You Can!

Ht. 4.03 m
Bottom 5.70 m

Well location by GPS. Easting: 590587 Northing: 4797760 Datum: NAD 83 17N

Water Treatment Systems

Indicate all applicable components below:

- (●) Water softener
- ( ) Iron filter
- ( ) UV
- (●) Other (specify) Xeon Water Filter
- ( ) Reverse osmosis
- ( ) Sediment filter
- ( ) Chlorination
- ( ) Other (specify)

Water Quantity History

How many years has the interviewed person used the well? 5 years

How often does the well run dry?

- ( ) Never
- ( ) Daily
- ( ) Weekly
- ( ) Monthly
- ( ) Annually
- (●) Once. When: Last Summer

If so, what activity is associated with the well running dry? Dry season

Is the well ever recharged by water truck? Last recharge date: No

Was the well ever deepened? When?

Well Vulnerability

Direction of ground slope: West

Well head stick-up above ground: ~ 0.35 m [inches / centimetres]

Casing condition: Good [cracks, decayed wood, holes?]

Drainage at well head: Roof on well [level, mound, even slope, inward ditch, pit]

Condition of well lid: Concrete [material, cracks, holes, rotted wood?]

Do livestock/pets have access to wellhead area? Possible

Water Supply Well Survey Form (continued)

Street address: D28

Water Quality History

Odour problems: No

Taste problems: No

Colour problems: No

Staining of fixtures or laundry: No

Encrustation at fixtures or pipes: No

Is the water used for drinking by occupants? No

Is there any history of illness associated with the water? Frequency? No

Was the water tested for microbiology by a laboratory and what were results?

Details: Yes, 5 years ago, bacteria was high.

Has the water quality changed over time?

Explain: Yes.

Additional Comments by Interviewed Well User

Went 1' of water during dry season

Water Sampling Record (to be completed by Dillon staff)

Date and time of sample

Sampling point:

Confirm sampling point is off-line from treatment systems:

Number of bottles:

pH: E.C. (uS/cm): Temperature (C):

Odour: Colour: Suspended sediment:

Indicate the following features:

(Even if only known approximately)

Property boundary
Houses and other buildings
Well
Septic tank
Septic field
Road
Driveway
North arrow
Distances between well and septic field
Ground slope direction [downward]
Ditches
Water pipe connections
Fuel storage /heating oil tanks
Watercourses, ponds, lakes

Draft Property Sketch

Water Supply Well Survey Form

(One sheet per well on property)

D29 DILLON CONSULTING

Project Number: 08-9020

Project Name: Waterdown & E-W Corridor

Staff Interviewer: LWL

Date of Interview: 05/23/08

Name of property owner: Dale Pushing
Name of tenant [if different from above]:
Street address [911 Number]:
Mailing address: 1875 Old Waterdown Road
Municipality, postal code: Burlington, L7R3X5
Telephones: 905-685-7857 [work, home]
Number of persons routinely using well water: 2
Property use: Residual [resid, comm, indust, instit]
Number and type of livestock: None

Well Construction

Number of wells on property: 2
Usage activity: 1 Active, 1 Dormant [active, dormant]
Well usage: Non drinking, laundry, shower, toilet, some cooking [e.g. domestic, irrigation, washing]
MOE Well Tag No.:
Drilling contractor: ~~[illegible]~~ B. O'Connor
Depth of well: ~~[illegible]~~ 55' [feet / metres]
Construction: [dug, drilled, jetted]
Casing material and diameter: [concrete, steel]
Screen presence, depth: [open hole in bedrock?]
Static [un-pumped] water level: [feet / metres]
Pump type: [e.g. submersible, jet]
Is a driller's borehole record attached? [yes / no]
Casing access port: [yes / no]
Well location by GPS. Easting: 590780 Northing: 4797854 Datum: Nad83 17N

Please Complete as Best You Can!

April 1960

Water Treatment Systems

Indicate all applicable components below:

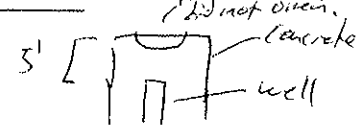
○ Water softener ○ Iron filter ○ UV ○ Other (specify)
○ Reverse osmosis ○ Sediment filter ○ Chlorination ○ Other (specify)

Water Quantity History

How many years has the interviewed person used the well? 1965
How often does the well run dry?
○ Never ● Daily ○ Weekly ○ Monthly ○ Annually ○ Once. When:
If so, what activity is associated with the well running dry? Could be wrong screen zone
Is the well ever recharged by water truck? Last recharge date: Every 3-4 weeks. Water truck.
Was the well ever deepened? When?

Well Vulnerability

Direction of ground slope: South east
Well head stick-up above ground: 5' below gs according to owner [inches / centimetres]
Casing condition: Concrete casing [cracks, decayed wood, holes?]
Drainage at well head: [level, mound, even slope, inward ditch, pit]
Condition of well lid: [material, cracks, holes, rotted wood?]
Do livestock/pets have access to wellhead area? No



Water Supply Well Survey Form (continued)

Street address: 1875 Old waterdown

D29

Water Quality History

Odour problems: No

Taste problems: No

Colour problems: Iron colouration, stained hair 20 years ago. Now only city water

Staining of fixtures or laundry: Slight rust.

Encrustation at fixtures or pipes:

Is the water used for drinking by occupants? No

Is there any history of illness associated with the water? Frequency?

Was the water tested for microbiology by a laboratory and what were results?

Details: Yes, ~~ctd~~ Cholitoform count high, five years ago.

Has the water quality changed over time?

Explain: Hard to tell due to mix city water in holding tank

Additional Comments by Interviewed Well User

Water Sampling Record (to be completed by Dillon staff)

Date and time of sample

Sampling point:

Confirm sampling point is off-line from treatment systems:

Number of bottles:

pH: E.C. (uS/cm): Temperature (C):

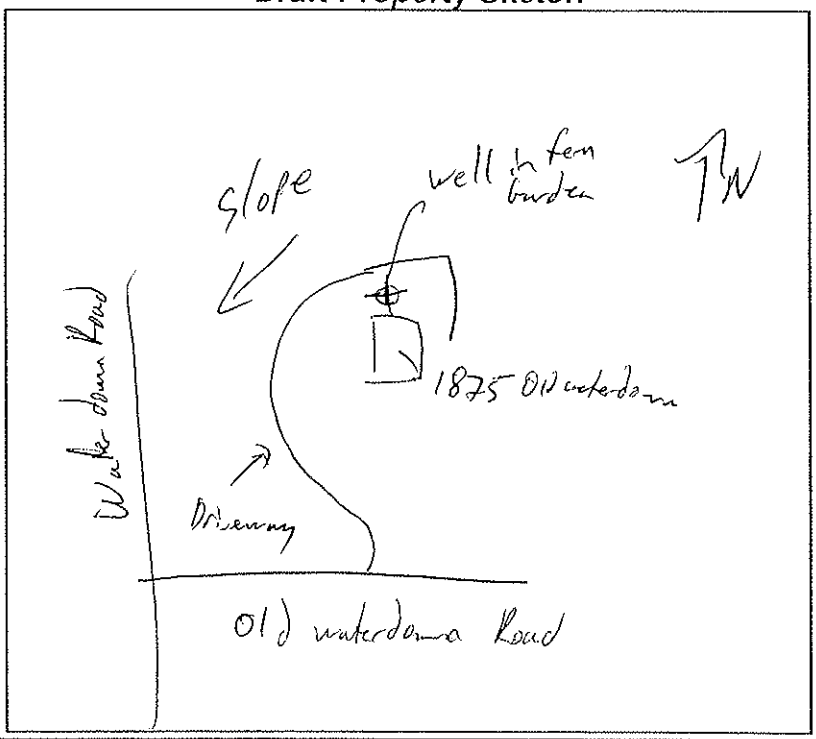
Odour: Colour: Suspended sediment:

Indicate the following features:

(Even if only known approximately)

Property boundary
Houses and other buildings
Well
Septic tank
Septic field
Road
Driveway
North arrow
Distances between well and septic field
Ground slope direction [downward]
Ditches
Water pipe connections
Fuel storage /heating oil tanks
Watercourses, ponds, lakes

Draft Property Sketch



APPENDIX B-3

Completed Forms for Wells Not Field Surveyed

Water Supply Well Survey Form

(One sheet per well on property)

D31 DILLON CONSULTING

Project Number: 08-9020

Project Name: Waterdown & E-W Corridor

Staff Interviewer: LbL

Date of Interview: 05/23/08

Name of property owner: Doug West

Name of tenant [if different from above]:

Street address [911 Number]: 1887 Old Waterdown Road

Mailing address:

Municipality, postal code: Burlington, L7R 3X5

Telephones: 905-689-8942 [work, home]

Number of persons routinely using well water: 2

Property use: Resident [resid, comm, indust, instit]

Number and type of livestock: None.

Well Construction

Number of wells on property: 1

Usage activity: Active [active, dormant]

Well usage: Laundry, toilet, shower, no drinking [e.g. domestic, irrigation, washing]

MOE Well Tag No.:

Drilling contractor:

Depth of well: [feet / metres]

Construction: [dug, drilled, jetted]

Casing material and diameter: [concrete, steel]

Screen presence, depth: [open hole in bedrock?]

Static [un-pumped] water level: [feet / metres]

Pump type: [e.g. submersible, jet]

Is a driller's borehole record attached? [yes / no]

Casing access port: [yes / no]

Well location by GPS. Easting: Northing: Datum:

Please Complete as Best You Can !

Water Treatment Systems

Indicate all applicable components below:

- (●) Water softener
- (●) Iron filter
- ( ) UV
- ( ) Other (specify)
- ( ) Reverse osmosis
- ( ) Sediment filter
- ( ) Chlorination
- ( ) Other (specify)

Water Quantity History

How many years has the interviewed person used the well? 15 years

How often does the well run dry?

(●) Never ( ) Daily ( ) Weekly ( ) Monthly ( ) Annually ( ) Once. When:

If so, what activity is associated with the well running dry?

Is the well ever recharged by water truck? Last recharge date:

Was the well ever deepened? When?

Well Vulnerability

Direction of ground slope:

Well head stick-up above ground: [inches / centimetres]

Casing condition: [cracks, decayed wood, holes?]

Drainage at well head: [level, mound, even slope, inward ditch, pit]

Condition of well lid: [material, cracks, holes, rotted wood?]

Do livestock/pets have access to wellhead area?

Water Supply Well Survey Form (continued)

Street address: _____

D31

Water Quality History

Odour problems: No

Taste problems: No

Colour problems: No

Staining of fixtures or laundry: No

Encrustation at fixtures or pipes: No

Is the water used for drinking by occupants? No

Is there any history of illness associated with the water? Frequency? No

Was the water tested for microbiology by a laboratory and what were results?

Details: Yes, the results fine, tested 3 or 4 years ago

Has the water quality changed over time?

Explain: No

Additional Comments by Interviewed Well User

Thinks it is a spring well. Doesn't know where well is.

Water Sampling Record (to be completed by Dillon staff)

Date and time of sample _____

Sampling point: _____

Confirm sampling point is off-line from treatment systems: _____

Number of bottles: _____

pH: _____ E.C. (uS/cm): _____ Temperature (C): _____

Odour: _____ Colour: _____ Suspended sediment: _____

Indicate the following features:

(Even if only known approximately)

Property boundary
Houses and other buildings
Well
Septic tank
Septic field
Road
Driveway
North arrow
Distances between well and septic field
Ground slope direction [downward]
Ditches
Water pipe connections
Fuel storage /heating oil tanks
Watercourses, ponds, lakes

Draft Property Sketch