

HARDEN ENVIRONMENTAL SERVICES LIMITED

Response to the Region of Waterloo Hallman Pit Hydrogeology

Prepared For:

Jackson Harvest Farms Ltd.

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Harden Environmental Services Ltd.

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Introduction

We are pleased to provide additional information requested by the Region of Waterloo (ROW). The ROW comments dated 18 February 2020 are found in Appendix A. In this discussion we have adopted the aquifer/aquitard nomenclature presented by Stantec (2019) as shown below;

Hydrostratigraphic Unit Designation	Description at Hallman Pit Site
ATB1	Surficial Aquitard
AFB1	Unconfined sand and gravel aquifer
ATB2	Clay and Silt Aquitard
AFB2	Confined Sand Aquifer
ATB3	Silt, Clay, Clay Till Aquitard

Our observations and measurements from the additional work requested by the ROW confirm our original findings, namely that the groundwater in AFB1 is flowing from north to south beneath the proposed Hallman Pit site. This includes all areas beneath the proposed Hallman site that are within the Well Head Protection Areas C and D (WHPA-C and WHPA-D) of Region of Waterloo (ROW) municipal wells K50-K52. The WHPAs are used to regulate changes in land uses that may have an impact on the water quality of the wellfield which draws water from the AFB1 and AFB2 aquifer. The confirmation of southerly groundwater flow in AFB1 means that within the WHPA, the only possible route for shallow groundwater to flow to the municipal wells is via the relatively impermeable clay/silt aquitard ATB2 and then through the fine sand aquifer AFB2. Although the additional work at the proposed Hallman Pit confirms a downward hydraulic gradient across the aquitard ATB2 and therefore the possibility that the shallow groundwater reaches the AFB2 aquifer, the additional work also confirms that nitrate concentrations are non-existent in the AFB2 aquifer beneath the site and therefore if this flow path exists, nitrate is denitrified. Therefore if groundwater from beneath the Hallman Pit site in AFB2 does flow to K50-K52 it will be of superior quality than the unconfined AFB1 aquifer known to supply the wells from elsewhere in their source area.

We also can confirm that nitrate inputs to groundwater from applied fertilizers will decrease after development of the gravel pit because no nitrogen-based fertilizers will be applied within the on-site Issue Contributing Area (ICA) of the K50-K52 wells and manure will no longer be stored onsite. This is clearly stated in the agreed Risk Management Plan signed by Jackson Harvest Farms Ltd. Groundwater quality with respect to nitrate will thus improve. There are no private wells downgradient of the site that obtain water from aquifer AFB1, therefore there can be no water quality changes in private well water.

We also conclude that the site does not presently provide runoff or groundwater to the Hunsberger Creek Subwatershed, therefore no changes will occur to storm runoff or baseflow for this subwatershed.

In regard to climate change, the nearby ROW monitoring wells show that there is no long-term trend of increasing water levels in the unconfined aquifer (AFB1) and the brief period of higher water levels occurring between 2008 and 2011 would be accommodated by the mandated 1.5 metres of separation between the pit floor and the water table.

The following is a point by point response to comments made in the February 18, 2020 memorandum received from the Region of Waterloo.

1. Potential onsite contamination from former Underground Storage Tanks

Comments regarding on-site contamination associated with former fuel storage and the record of site condition will be addressed by Chung & Vander Doelen Engineering Ltd. (CVD) in a Record of Site Condition submission.

2.0 General Draft Aggregate Guideline Deficiencies

2.1 Bedrock geology map

A bedrock geology map has been prepared as Figure 1. Water Well 6502184 located northwest of the site shows that the bedrock is encountered at an elevation of approximately 285 m AMSL. This is approximately 70 metres below the proposed pit floor. The geological mapping provided by the Ontario Geological Survey indicates that the underlying bedrock formation is the Salina formation. Green shales and brown dolostone are commonly found in the Salina Formation.

2.2 Review of available reports for nearby aggregate sites

The aggregate reports are very site specific in nature and none are found upgradient from the site in the direction of the ROW wells. None of the aggregate sites have been licenced in the last five years and any data available would not assist in the evaluation of this site with respect to potential interference with the ROW pumping wells or the local private wells. The nearest aggregate site with a Permit to take Water is the Lafarge Pit located at the southwest corner of Queen Street and Witmer Road. The taking is 2.1 kilometers from the site and as determined in Section 6.23 of this report, there is limited extent of water level change from the proposed wash pond and there can be no cumulative impact on water levels arising from the takings. The Harden (2019) report already determines that there will be no change in stress level in the Middle Nith River area from cumulative impacts of water taking.

Pertinent, up-to-date hydrogeological information specific to the ROW pumping wells in Shingletown has been obtained from detailed work done on behalf of the ROW including;

2018 Operational Testing Program, Wilmot Center Wellfield, Regional Municipality of Waterloo, Stantec Consulting, May 3, 2019

Region of Waterloo, Wilmot Center Monitoring Program, R.J. Burnside and Associates, March 2019

The recent hydrogeological findings made by Harden Environmental should be considered in future hydrogeological work done for the ROW as the following is pertinent in regard to groundwater flow and groundwater quality within the WHPA of the wells. These findings, detailed elsewhere in this report, include;

1. Groundwater flow in AFB1 southeast of the K50-K52 Wellfield is southeasterly, away from the municipal well. This suggests a competent aquitard separating the upper unconfined aquifer from the lower confined aquifer.
2. The pumping from the K50-K52 Wellfield does not influence groundwater flow in the AFB1 aquifer beneath the Hallman Pit site. The ATB2 aquitard is effective and persistent such that the long-term pumping tests conducted by Stantec Consulting Ltd. in 2018 did not influence the water table aquifer AFB1 beneath the Hallman Pit.
3. Day to day pumping operations do not affect the water level in the confined aquifer AFB2 beneath the Hallman Pit. A data logger installed in AFB2 beneath the proposed Hallman Pit does not detect any water level perturbations created by the pumping of the wellfield. The 0.10 m influence noted at ROW monitoring well OW10-67 during the 2018 OTP (Stantec, 2019) may extend beneath the Hallman Pit site, however, this would only occur in AFB2.
4. As is well known, the upper unconfined aquifer AFB1 has been contaminated with nitrate from ongoing farming practices throughout the well head protection area of wells K50-K52. However, information obtained from the proposed Hallman Pit site finds that there are denitrifying conditions prevalent in the confined aquifer AFB2 beneath the site, therefore any contributions to the water supply from the confined aquifer AFB2 beneath the site will not have nitrate present. Although the proposed Hallman Pit occupies 4% of the theoretical WHPA for the wellfield, the southeasterly groundwater flow direction in AFB1 and the denitrifying qualities of the ATB2 aquitard removes any potential for nitrate impacts from the Hallman Pit site and the ROW wells.

2.3 Hydraulic testing in monitoring wells MW3 and MW4 and any new wells drilled.

Falling head tests were conducted in the groundwater monitors in MW3, MW4, MW6, MW7S/D, MW8, MW9, MW10 and MW11 in order to determine an estimate of hydraulic conductivity of the sand and gravel formation. The tests are conducted by adding a known volume of water to the monitor and measuring the rate of decline of the water level in the monitoring well. An estimate of the hydraulic conductivity is then determined using the following method (Hvorslev, 1951);

$$K = r^2 \ln(L/R) / 2LT_0$$

where

k = hydraulic conductivity (m/s)

r = radius of the well (m)

L – length of screen (m)

R – radius of borehole (m)

T_o – lag time obtained from graph (s)

The graphs are provided in Appendix B. The resulting hydraulic conductivity values of the sand and gravel are presented in Table 1.

Monitor	k (m/sec)
MW1	1.17×10^{-4}
MW2	2.56×10^{-5}
MW3	5.10×10^{-5}
MW4	6.05×10^{-5}
MW5	7.65×10^{-5}
MW6	5.68×10^{-5}
MW7S	1.05×10^{-5}
MW7D	2.18×10^{-5}
MW8	7.82×10^{-5}
MW9	7.82×10^{-5}
MW10	2.69×10^{-5}
MW11	1.05×10^{-4}

Table 1: Estimated Hydraulic Conductivity

There is a relatively narrow range in estimates of hydraulic conductivity in the unconfined aquifer AFB1 beneath the site ranging from 1×10^{-5} to 1×10^{-4} m/s. The confined aquifer AFB2 has a similar hydraulic conductivity of 2×10^{-5} m/s.

Updated hydrographs from data loggers are also found in Appendix B. Water levels from MW6, MW7S and MW7D were obtained on five-minute intervals between May 1 and May 20. The perturbations observed on a daily basis are in the order of one centimeter.

2.4 Water samples as required will be provided including PHC's at appropriate locations.

Water samples were obtained from all groundwater monitors. CVD will be reporting on water quality obtained from MW9 and MW10. The results for all other wells are found in Table 2 (after text) with Certificates of Analysis and Chain of Custody Forms found in Appendix C. The field study included pH, electrical conductivity, dissolved oxygen and Oxidation-Reduction Potential (ORP) readings.

The unconfined sand and gravel aquifer (AFB1) at the water table has relatively high concentrations of dissolved oxygen ranging from 3.17 mg/L to 10.15 mg/L. The presence of

dissolved oxygen and the positive values in all Oxidation Reduction Potential (ORP) measurements are indicative of an aerobic environment in this unconfined aquifer.

The water quality results confirm that the shallow groundwater system in this area has been impacted by farming activities and nitrate concentrations are approaching and, on occasion exceed, the drinking water limit of 10 mg/L. The groundwater sample obtained from MW10 has a nitrate concentration of 25.4 mg/L. This is attributed to the historical storage of manure in the vicinity of MW10. The groundwater quality with respect to nitrate will improve with the development of the land for aggregate extraction. Manure will no longer be stored on the site (existing stockpiles will be removed by November, 2020) and after rehabilitation of the site to agriculture, no nitrogen-based fertilizer will be applied to the portions of the property that are within the Issue Contributing Area (ICA).

Nitrate contaminated groundwater is a widespread issue in the WHPA of the local ROW wellfield resulting in the recognition of the ICA for Nitrate as Nitrogen. The former manure storage area on the Hallman Pit site is outside of the ICA for the wellfield and has not contributed to water quality issues at the wellfield. As shown on Figure 2, the ICA has approximately 540 hectares of farmed land of which the Hallman pit site is 21 hectares or 3.8%. In addition, groundwater in the upper unconfined aquifer beneath the proposed Hallman Pit site does not flow towards the municipal wellfield, thereby the Hallman pit cannot contribute nitrate to the wellfield via the unconfined aquifer. Groundwater from the site may follow a tortuous route through aquitard ATB2 and into aquifer AFB2, but as discovered, no nitrate is found along this flow path. This means that if groundwater does follow this pathway, the denitrifying conditions in the aquitard and aquifer remove the nitrate from the groundwater.

There is an aquitard beneath the site as observed in MW7D. A water sample was obtained from the aquifer beneath the aquitard and the water was found to be devoid of any nitrogen compounds including nitrite, nitrate, TKN and ammonia. The field measurements find that there is a reducing environment in the lower aquifer as determined by the absence of dissolved oxygen and an Oxidation Reduction Potential measured at -176.5 mV. This aquifer has the conditions suitable for the denitrification of nitrate should nitrate be able to penetrate the aquitard. Therefore, even if groundwater in the lower aquifer beneath the site does flow toward the municipal well, there would be no contribution of nitrate from the Hallman Pit site. Furthermore, Jackson Harvest Farms has agreed to eliminate nitrogen-based fertilizers within the ICA, thereby reducing future nitrate impacts to the shallow groundwater system within the ICA and any perceived downgradient private well along Witmer Road.

Four soil samples were analyzed for the commonly used herbicide Atrazine, which was historically applied to the corn crop on the site. The analyses were conducted on the samples obtained during the drilling for MW6 and were analyzed by SGS Analytical Laboratories in Guelph. The results are found in Table 3 and the laboratory certificate and results are found in Appendix C.

Table 3: Summary of Atrazine Testing of Sand and Gravel

Sample	Depth (mbgs)	Atrazine Concentration (ppm)
BH6-10	3.05	<0.05
BH6-20	6.10	<0.05
Bh6-30	9.15	<0.05
BH6-75	22.86	<0.05

No Atrazine was present in any of the samples. This confirms that Atrazine has not adsorbed onto the aggregate and therefore cannot be released if aggregate processing occurs at the site.

The water and soil quality findings allow us to conclude the following;

- The aggregate does not contain Atrazine and therefore none can be released through the extraction and processing activities.
- Nitrogen currently applied as fertilizer percolates through the aggregate and contaminates the groundwater. This occurs commonly in this farming area and groundwater flowing beneath the site from off-site is also contaminated with nitrate.
- The groundwater in the shallow aquifer beneath the site is found to have concentrations of nitrate between 2.12 mg/L and 25.4 mg/L as a result of ongoing and former farming practices.
- There are oxidizing conditions in the unsaturated zone and groundwater (shallow aquifer) that do not allow for significant denitrification resulting in persistence of nitrate in the shallow groundwater system.
- There are reducing conditions in the aquitard ATB2 and lower aquifer (AFB2) that are suitable for denitrification.
- There are no nitrogen compounds found in the lower aquifer (AFB2).

2.5 Cross Sections including ROW municipal wells and monitoring wells

Figures 3 and 4 are cross-sections of geological conditions near the site. The well logs have been interpreted and hydrostratigraphic layers are similar to findings by Stantec in 2018 with the following exception; Harden has interpreted that unconfined aquifer (AFB1) may not coalesce with aquifer AFB2 in the vicinity of the municipal wells. This arises as a result of our field observations of ATB2 and interpretation of ATB2 extending westward through MW6-11 and OW8-99.

2.6 North-south cross section

A north-south cross section has been added and is found as Figure 4. The upper unconfined aquifer is found to extend north to south, however the confined aquifer has a limited southerly extent as it is not identified in private well 6504927 located along Witmer Road. The aquitard is found beneath the upper unconfined aquifer along the southern property boundary.

2.7 Groundwater Elevations and Topographical Changes

Monitoring locations have been increased from five wells to twelve wells to provide a better definition to the position of the water table. The groundwater elevations (Figure 5) do not reflect the minor changes in local topography. Monitor MW6 was installed at the highest ground surface elevation and at that location, the water table is lower than observed at MW3 and MW7S found at lower topographical elevations. Therefore, the local topographical high points on the site are not areas of locally higher groundwater potential. This is due to the relatively high permeability of the sand and gravel aquifer.

2.8 Nitrate in Groundwater Map

On-site testing by Harden Environmental and off-site testing by Burnside and Associates is shown on Figure 6. The on and off-site testing find that the nitrate contamination is widespread and similar concentrations of nitrate are observed off-site as found on-site.

2.9 Limit of extraction disparity between figure 7.1 and 2.7

Figure 7.1 is incorrect and has been updated to address water balance issue identified by the GRCA. The updated Figure 7.1 has been attached.

2.10 Rehabilitation and Monitoring Plan

The site rehabilitation plan is described in detail on Sheet 5 of 7 of the site plans. The monitoring plan has been updated and is found in Section 7.0 of this report.

3.0 Private Well Survey

3.11 Private Well Survey Justification for 500 metre limit

The proposed pit is above the water table and there will be no change in the position of the water table as a result of the above-water-table extraction. In the event that gravel processing operations (e.g. wash plant and wash ponds) are used at the site, the water balance has shown that there will be no net loss of groundwater at the site. Therefore, there will be no decrease in the quantity of water available to nearby private wells regardless of well construction details. It is our opinion that no wells outside of 500 m of the pit need be investigated in terms of water quantity.

The additional drilling has also confirmed that groundwater flow directions in the shallow water table aquifer are southerly. Groundwater flow direction inferred from the on-site monitoring wells is shown on Figure 5. The wells on Bleams Road are upgradient of the site and therefore

cannot have any water quality change arising from on-site activities. The wells east and west of the site on Witmer Road are cross-gradient to the site and therefore cannot have any water quality change arising from on-site activities. Nonetheless, these wells were included in the well survey. The private well survey conducted by Harden Environmental also included the only well downgradient of the site (1875 Witmer Road). This well obtains water from a very deep aquifer (at 103 metres below ground surface) and is thus not susceptible to water quality changes on-site. The site activities are non-polluting and with the removal of stored manure at the site and future reductions in nutrient applications, water quality will improve downgradient of the site.

Farmland makes up a large percentage of the land use in this area surrounding the proposed Hallman Pit. The fact that there is already an Issue Contributing Area for nitrate contamination and the measured nitrate concentrations in on-site wells and ROW monitoring wells confirms that farming practices have already impacted the water quality with respect to nitrate. The average nitrate concentration reported by Burnside and Associates in monitoring wells in this area is 10.5 mg/L. The range is 0 to 22.5 mg/L. Unless farming practices change, there will continue to be nitrate contamination in the groundwater. The proposed and post-extraction site activities will not exacerbate the nitrate conditions already found. With the removal of manure storage and agreement with the ROW to limit nitrogen-based fertilizer applications in the ICA, groundwater quality will improve downgradient of this site. Therefore, there is no need to determine existing conditions in private wells.

In regard to the unlikely incident of a leak of fuel or hydraulic fluid, Jackson Harvest Farms Lt. has adopted a detailed spills protocol as described in Section 8 of this report.

3.12 Municipally Connected Residences

The residential addresses connected to the municipal water supply were provided by Wilmot Township.

4.0 High Water Table Delineation

4.13 Rationale for locations of existing monitors

Groundwater monitors MW1 through MW4 drilled in 2017 were distributed in the central and northern portion of the site to provide information on the thickness of the unsaturated zone along the site boundaries. These monitoring wells provide information on the stratigraphy of the site and provide elevations of the water table for groundwater flow determinations. The monitors were placed on the edge of the site because any interior monitors would be removed by future aggregate operations. MW5 was placed proximal to the former manure storage area and fuel storage area as part of the Phase I/II study.

4.14 Additional Groundwater Monitor Installations

Groundwater monitors MW6, MW7S/D, MW8, MW9, MW10 and MW11 were installed in April 2020 to provide improved definition of the elevation of the water table. The locations of all monitors are shown on Figure 5. Monitors MW6 and MW7 are located to provide definition to the direction of groundwater flow within the identified WHPA-D of the ROW Municipal wells. MW6 was also located at the highest topographical elevation at the site to confirm that local on-

site topographical changes were not influencing groundwater elevations. MW8 was sited to provide additional definition to groundwater flow directions in the vicinity of the residence at 2008 Witmer Road. MW9 and MW10 were installed as part of the Record of Site Condition work conducted by CVD Engineering and MW11 was installed to assist with the definition of groundwater flow patterns in the southeast corner of the site.

Split spoon samples were obtained in the shallow wells and continuous coring of the unconsolidated sediments took place in MW7D. Well screens were installed at the water table or just below. Borehole logs of the drilling observations are found in Appendix D. The drilling found that the unsaturated zone comprises sand and gravel. The sand ranged from very fine to coarse grained.

An aquitard was encountered at a depth of 19.98 metres below ground surface (mbgs) in MW7D at an elevation of 347.1 metres above mean sea level (m AMSL). The aquitard was 6.05 m thick and comprised grey silt and grey silty clay till. A grain size analysis (Appendix D) of the aquitard found that the aquitard is 92% silt or clay sized particles.

A 6.02 m thick layer of fine-grained sand is found below the aquitard. Groundwater monitor MW7D was constructed with a screened portion in this sand layer. The fine-grained sand layer was underlain by at least 15 metres of silt, clay or silty clay till. The borehole at MW7D was terminated at an elevation of 320.146 m AMSL.

Figure 3 is a cross section that includes the municipal wells, ROW observation wells and wells at the Hallman Pit site. Aquitard ATB1 does not exist beneath the Hallman site as suggested by Figure No. 5 of the Stantec 2018 OTP report. The on-site drilling and our interpretation of off-site drilling logs confirms that there is an unconfined sand and gravel aquifer at this site. This corresponds to aquifer AFB1. This aquifer is underlain by aquitard (ATB2). Our interpretation of the logs for OW10-67, MW7D, MW7-11 and WM19-93 is that this aquitard continues east of the site. ATB2 occurs at the site and is also found in logs for OW10-67 and MW6-11. Our interpretation is that AFB2 is a relatively thin sand layer beneath the Hallman Pit extending westward through OW10-67 and MW6-11 and increases in thickness near to the municipal wells. A thick aquitard ATB3 was found beneath the Hallman site to a depth of at least 320 m AMSL.

We find that horizontal groundwater flow in AFB1 is away from the municipal wells beneath the proposed Hallman Pit and thus there cannot be any groundwater flowing from the site to the municipal wells through AFB1.

The site is underlain by an aquitard that separates AFB1 from AFB2. It is our interpretation that the aquitard is continuous beneath the site as it occurs in ROW monitoring wells east of the site (MW7-11 and WM19-93) and south of the site at private well 6504927. A downward hydraulic gradient is observed between AFB1 and AFB2 so it is possible that groundwater movement occurs through this aquitard. Groundwater flow will preferentially occur in the sand and gravel which is estimated to have at least three orders of magnitude greater hydraulic conductivity.

4.14.1 Potential Impact to Hunsberger Creek

We undertook two field studies in regard to the possibility of surface water and groundwater contributions to Hunsberger Creek. These were ground elevation surveying and installation of groundwater monitors to improve delineation of the position of the water table beneath the site.

In regard to Hunsberger Creek, located west of this site, the proposal is for an above water table pit. There will be no disturbance of the groundwater flow direction or magnitude of groundwater flow as result of the proposed aggregate extraction operation. The aggregate extraction will remain a minimum of 1.5 metres above the position of the seasonal high-groundwater table. The geological structure of the underlying saturated hydrostratigraphic layers remains unchanged, therefore properties such as porosity and hydraulic conductivity remain the same.

The only disturbance to the water table that could occur will be in the southeast corner of the site in association with the wash pond. The proposed wash pond is several hundred metres distant from any inferred groundwater divide between Hunsberger Creek (Nith River Subwatershed) and Alder Creek system. As determined in Section 6.23 of this report the area of influence of the proposed wash pond is very limited and there will be no change in groundwater elevation at the inferred groundwater divide.

We also conducted an on-site ground surface elevation survey and confirmed that the only potential for off-site surface water flow towards the Hunsberger Creek system occurs in the northwest corner of the site (near to MW7S) where surface elevations are relatively low. There is no indication that any surface water leaves the site due to the high infiltrative capacity of the soils and flat ground in the northwest corner. These conditions allowing for on-site infiltration of the storm water. We have been on-site many times and have not observed runoff from the site and none is indicated in any aerial photography reviewed. Even under a frozen ground, runoff event, it is unlikely that surface water could flow to Hunsberger Creek given other depressions including ponds, between the site and the creek. The groundwater flow direction in the northwest corner has been confirmed to be southeasterly, therefore, groundwater from that area does not contribute to Hunsberger Creek.

There is a depression in the central part of the site (near to MW4) where the ground elevation is found to be at least one metre lower than any spot along the western property line. This means that there is no surface water contribution from the central part of the site to the Hunsberger Creek system.

The water-table contours are shown on Figure 5. Groundwater elevations obtained from the newly installed groundwater monitor MW8 confirms that there is an increased hydraulic gradient between MW4 and MW8 confirming the southerly groundwater flow direction. This flow direction will not be changed by the proposed aggregate extraction activities. There will be no reduction in groundwater flow in a westerly direction and therefore no change in potential groundwater discharge to Hunsberger Creek.

In summary;

- the site elevation survey and site observations confirm that the site does not contribute surface water to Hunsberger Creek and will not in the future,

- the groundwater flow direction is southerly and there is no existing groundwater contribution to Hunsberger Creek from the site,
- the site is above the water table extraction only and therefore will not disturb the existing groundwater flow pattern.

4.15 Additional groundwater monitoring locations in the footprint of proposed extraction area

Three additional groundwater monitoring wells were installed within the proposed footprint of the Hallman Pit and four additional monitoring wells were installed along the perimeter of the proposed pit.

4.16 Water level increase due to climate change will be considered for monitoring plan and site plan notes.

There is already a 1.5 metre separation between the high position of the water table and the pit floor. This minimum 1.5 m separation only occurs for a very short period of time during the year and for the vast majority of the year the separation distance is between 1.5 and 2.3 metres. Also, the need to retain runoff to the wetland has required that the pit floor immediately north of the hinge line will be at least 2.2 metres above the water table. The minimum mandated separation accounts for reasonably expected changes in the position of the water table. A review of the March 2019 monitoring report prepared by Burnside and Associates Ltd. finds that nearby monitors OW8B-99 and OW17-67 do not have long-term trends towards higher groundwater potential. There was a period of higher water levels (between 0.5 m and 0.75 m higher than present) observed between 2008 and 2011 however, even this increase would not result in breakout at the pit floor.

In response to this concern, we have recommended to Jackson Harvest Farms Ltd. to retain groundwater level monitoring devices in stations MW7S, MW2, MW8 and MW11. Water levels will be reviewed on an annual basis for trends and if necessary, the pit floor will be raised accordingly to remain 1.5 metres above the seasonal high groundwater level.

5.0 Site Water Balance

5.17 Location of wash pond figure

The proposed location of the wash pond and silt ponds are shown on Sheet 2 of 7 of the site plans and repeated herein on Figure 7.

5.18 Justification for rate of pumping will be provided

The proposed rate of taking was based on the existing aggregate processing plant at the Germet Pit. The Germet Pit is licensed for 875,000 tonnes per year and processed between 240,000 and 404,000 tonnes of aggregate in the past 5 years. Figure 8 shows the daily influence that the pumping has on the clear water wash pond (source pond for the aggregate processing plant). The daily drawdown between 6 am and 6 pm is approximately 0.5 metres and there is significant recovery during 6 pm and 6 am as the water from the silt ponds slowly returns to the fresh water

pond. The on-site monitors, completed in the same sand and gravel unit as the fresh water pond, do not even register the daily effect of the pumping. It is thus our opinion that there will be no off-site impact of the water taking for the proposed aggregate processing plant.

5.19 Inconsistencies in the water balance

The GRCA also noted inconsistency between the Harden Report and the Dance Environmental Report and after discussion with the GRCA it was decided that the future pit floor areas would be rebalanced to result in similar runoff to the wetland pre and post development. This has been addressed by moving the hinge line northward and reducing the area of PE1 by 7.31 hectares. A revised water balance for the wetland is found in the Table 6.

Table 6: Wetland Water Balance for Revised Hinge line

Wetland Pre Extraction Water Balance					
	Area	Precipitation	Evapotranspiration	Surface Water Input	Infiltration
	(hectare)	(m ³ /year)	(m ³ /year)	(m ³ /year)	(m ³ /year)
Wetland	2.20	19,558	14,344	29,728	34,942
Wetland Post Extraction Water Balance					
	Area	Precipitation	Evapotranspiration	Surface Water Input	Infiltration
	(hectare)	(m ³ /year)	(m ³ /year)	(m ³ /year)	(m ³ /year)
Wetland	2.20	19,558	14,344	30,004	35,218
	Area	Precipitation	Evapotranspiration	Surface Water Input	Infiltration
	(hectare)	(m ³ /year)	(m ³ /year)	(m ³ /year)	(m ³ /year)
Pre Development Wetland	2.20	19,558	14,344	29,728	34,942
Post Development Wetland	2.20	19,558	14,344	30,004	35,218
Difference	-	-	-	276	276

5.20 Discrepancy in Pre-Development Infiltration

This discrepancy between values calculated in Tables 8 and Table 12 has been corrected.

5.21 Additional scenario(s) will be presented at different phase(s) of site development

The water balance is calculated as Precipitation = Evaporation/Evapotranspiration + Runoff + Infiltration. The amount of infiltration depends on the infiltration factor applied to the surplus water (Precipitation – Evaporation/Evapotranspiration). Depending on the phase of the pit, there will be different land uses including open excavation (disturbed lands), rehabilitated lands, cultivated lands and open water in wash and silt ponds. The following scenarios have been evaluated for impact to the water balance of the site;

Table 9: Infiltration Change during Site Development

Scenario	Infiltration Change from Predevelopment
Scenario 1: - Disturbed area = 18 ha, no aggregate processing with water, no rehabilitation, cultivated lands on balance of property.	Increase by 48,540 m ³
S2: Disturbed area = 18 ha, aggregate processing and ponds, no rehabilitation, cultivated lands on balance of property	Increase by 3,350 m ³
S3: Disturbed area = 18 ha, aggregate processing and ponds, 9 ha rehabilitation, cultivated lands on balance of property	Increase by 629 m ³
S4: Disturbed area = 18 ha, aggregate processing and ponds, 20 ha rehabilitation, cultivated lands on balance of property	Increase by 629 m ³
S5: Disturbed area = 18 ha, aggregate processing and ponds, 23.7 ha rehabilitation, cultivated lands on balance of property	Increase by 629 m ³
S6: Final Rehabilitation, no aggregate processing, 52.24 ha rehabilitation, no original cultivated land	Increase by 6,930 m ³

It is found that any losses through evaporation and entrainment in exported aggregate will be offset by maintaining a minimum of 18 hectares of disturbed area. Detailed calculations are found in Appendix E. It is assumed that 500,000 tonnes are processed in the wash plant. This is conservatively high as the Germet Pit is found to process between 240,000 and 400,000 tonnes per year. Any reduction in processed tonnage greatly increases groundwater infiltration.

In regard to dust control, assuming that 50,000 liters (10 truckloads of 5,000 liters) of water were used on a dry day, the wash pond (area = 5,000 m²) level would decline by an additional one centimeter. Perimeter monitoring as detailed in Section 7 will determine if any change in water level occurs, however, none is expected.

6.0 Potential Impacts to Nearby Municipal and Private Drinking Water Sources

6.22 Aquitard ATB2

The additional drilling has confirmed the presence of an aquitard beneath the proposed Hallman Pit. The aquitard has the following influence on groundwater flow.

- The aquitard ATB2 is found to be six metres thick beneath the site and the aquitard provides hydraulic separation between AFB1 and AFB2.
- Groundwater flow in AFB1 is found to be in a southerly direction, away from the municipal well. Therefore, the groundwater beneath the site that is presently impacted by past and present agricultural activities does not impact municipal water supply wells. Nitrogen contributions to the groundwater will decrease when the site is zoned to allow aggregate extraction.
- Jackson Harvest Farms Ltd. has agreed to eliminate nitrogen based nutrient applications on the active farm fields within the Issue Contributing Area, thereby improving groundwater quality over time.
- Jackson Harvest Farms Ltd. is removing the remaining manure from the site to be completed by November 2020, thereby improving groundwater quality over time.
- The only private well downgradient of the site has a well screen intake at a depth of 103 metres. There are no other downgradient private wells within 2500 metres of the site.
- Groundwater beneath the observed aquitard does not contain nitrogen, therefore, if any groundwater beneath the site flows towards the municipal well it is of high chemical quality and the aggregate extraction process will not alter this quality.
- Any existing water quality issues in private wells, if any, are not a result of on-site activity.

6.23 Area of Influence of Wash Pond

The maximum on-site disturbance of the water table is estimated to be between 0.5 to 1 metre, therefore any potential off-site impact to the water table aquifer will be much less. The nearest private well at 1875 Witmer Road has a depth of 103 metres, obtains water from the deep aquifer and has a static water elevation of approximately 327 m AMSL. This well cannot be affected by the proposed water recirculation system. The nearest shallow well is located at 1768 Witmer Road, has a depth of 12.8 metres below casing top and a static water level of 9.33 metres below casing top. This well is located approximately 800 metres from the proposed wash pond and is therefore outside of the area of influence of the wash pond.

The experience at the Germet Pit is that there is a 0.5 to 1 metre drawdown on a daily basis with recovery in the post operation hours (Figure 8). The groundwater monitor MW101-15A is located 110 m metres from the active pond and PW2 is located 250 metres from the pond. There is no influence on the water level at either location. This shows that the area of influence of less than 110 metres. This occurs because a) the influence of drawdown decreases exponentially with distance, that is, the greatest impact occurs nearest to the wash pond and b) water from the silt pond returns to the wash pond.

Therefore, it is our conclusion that the area of influence of the wash pond will be short lived on a daily basis and not extend beyond the site boundaries. In addition, two monitoring wells (MW11

and MW8) have been strategically located to provide assurance that water levels between the wash pond and the nearest wells along Witmer Road are not affected.

The proposed wash pond is located approximately 2000 metres away from Municipal Wells K50, K51 and K52. The daily fluctuation in water level in the wash pond will be approximately 0.5 to 1 metre with no long-term influence on water levels. The influence of the pond will extend a radius in the order of tens of metres from and will not extend off-site. There will not be any impact on the municipal well yield as a result of the water taking and recycling of wash water at the site.

6.24 Assessment of supply aquifers for local wells will be included

An assessment of supply aquifers for local wells was included in our 2019 Hydrogeology report and depicted on Figures 4.1 and 4.2 of that report. The local water supply comes from all three aquifers identified in the 2018 Stantec Report. Private wells obtain water from aquifer AFB1 and AFB2 as well as the bedrock aquifer. There will be no impact to the quantity or quality of water in any private well arising from the proposed pit development. There will be no impact quality or quantity of water to the municipal well arising from the proposed pit development.

6.25 Data supporting lack of response on site due to Region's testing will be provided

Hydrographs for on-site monitors during the OTP conducted by Stantec and also responses by ROW wells are found in Appendix F. There is no evidence for an on-site response to the pumping during any stage of the OTP testing period or recovery following the testing.

6.26 Multilevel monitoring well to confirm vertical hydraulic gradients – between extraction and well field areas

There is a downward vertical gradient at the site as determined from shallow and deep ground water monitors MW7S and MW7D. The vertical gradient is determined to be downward this a magnitude of 0.10 as shown in Table 5.

Table 5: Vertical Hydraulic Gradient at MW7S/D

	MW7S	MW7D
Monitoring Interval	353.43-356.48	338.95-340.47
Mid Point of Monitoring interval	354.96	339.71
Groundwater Potential on May 7, 2020	355.45	353.87
ΔZ	15.25	
Δh	1.58	

		MW7S	MW7D
Hydraulic Gradient ($\Delta Z/\Delta h$)		0.10	

Water quality testing has confirmed that the lower aquifer does not contain nitrate or nitrite compounds.

6.27 Removal of overburden effects on vertical travel times to nearby private and municipal wells

As determined from groundwater flow directions in the unconfined aquifer, there is no threat of contamination to any private well or municipal well arising from the proposed development.

Groundwater flow within the unconfined sand and gravel aquifer beneath the site does not flow toward the municipal well. Therefore, any Light Non-Aqueous Phase Liquids accidentally spilled such as hydrocarbons cannot be transported to the municipal well via groundwater. Any dissolved phase contaminants such as nitrate will also flow away from the municipal well. Any potential pathway back to the municipal well via the lower aquifer (AFB2) must follow a tortuous route through the aquitard. As discussed in Section 2.4 there are denitrifying conditions in the lower aquifer such that any nitrate migration that presently occurs is undetectable in the lower aquifer. Therefore, it is impossible for nitrate compounds originating at the Hallman Pit site to impact the municipal well.

The travel time for water passing through the unsaturated zone will decrease, the magnitude of decrease is relative to the thickness of unsaturated zone removed. The unsaturated zone advection time (UZAT) is estimated using;

$$\text{UZAT} = \text{depth to water table} * \text{specific yield/infiltration rate}$$

At MW6 for example, the present time of travel in the unsaturated zone is $21 \text{ m} \times 0.15/0.25 = 12.6$ years. When the unsaturated zone is reduced to 1.5 metres, the travel time will be reduced to 0.9 years. At MW1, where the unsaturated zone thickness will not change, there will be no change in travel time, it will remain at less than one year.

The only well downgradient of the site is located at 1874 Witmer Road. This well has an intake completed at 103 metres below ground surface. The water well record shows that there are approximately 80 metres of low permeability material between the unconfined sand and gravel aquifer and the well intake. Based on the grain size analysis of aquitard material sampled at MW7D, we estimate that there is a four orders of magnitude contrast in the hydraulic conductivity. Assuming a similar hydraulic gradient as observed at MW7S/D of 0.10 m/m, an estimated vertical hydraulic conductivity of $1 \times 10^{-8} \text{ m/s}$ and a porosity of 0.20, the velocity through the aquitard is estimated to be 0.157 m/year. It will thus take more than 500 years for groundwater to travel through the aquitard and as shown previously, the lower aquifer is denitrifying, therefore, nitrate will not penetrate the aquitard.

Using a similar approach, the travel time through the observed aquitard at MW7S/D is on the order of 40 years. It has been proven that nitrates do not survive this journey, any LNAPL cannot penetrate the shallow aquifer and Dense Non Aqueous Phase liquids will not be used at the site. Therefore, contamination of the municipal wells cannot occur.

6.28 Additional discussion of reduction of unsaturated zone with respect to water quality will be provided

The source of nitrate contaminated groundwater in the Issue Contributing Area is nitrogen found in commercial and agriculturally sourced material. Some nitrogen may originate from private sewage systems. The ROW is already engaging with farmers to reduce nitrogen applications within the ICA. Sufficient nitrogen is migrating with percolating rainwater through the unsaturated zone in the ICA to contaminate the uppermost aquifer. The unsaturated zone is not a suitable environment for the sorption of the negatively charged nitrate compound as most receptor sites on the sand and gravel are also negative. The unsaturated zone also does not have a suitable environment for significant conversion of nitrate to N_2 gas and CO_2 via the required anaerobic bacteria. The unsaturated zone is an aerobic environment. On-site testing has also proven that the unconfined groundwater system is also aerobic, thereby leading to the persistence of nitrate in the aquifer.

A reduction in the thickness of the unsaturated zone will not affect the water quality beneath fields treated with commercial fertilizers or agriculturally sources materials (ASMs). There will however, be an improvement of water quality downgradient of the site because of the removal of stored manure at the site and an agreed reduction in nitrogen-based fertilizers within the ICA.

Equipment failures resulting in the release of hydrocarbon-based contaminants are rare in farming and aggregate operations. However, unlike agricultural operations, all aggregate extraction operations undergo a rigid approval process and include contingency plans related to accidental spills of onsite materials. As reviewers of several aggregate sites in Puslinch Township for the past 25 years and responsible for monitoring several other sites over a 30 year period, Harden Environmental has never encountered a spill or read about an occurrence of a spill at an aggregate site. There will be no fuel storage within the WHPA of the municipal wells.

6.29 Will post-development reduction in runoff from D1 decrease recharge in Wilmot Centre well field?

There will be no reduction of recharge to the Wilmot Center Well Field as a result of the capture of runoff within the proposed Hallman Pit in drainage area D1. Although the topography suggests runoff can occur between the site and lands to the west, we confirm that the hedgerow is elevated above the field in that northwest corner resulting in runoff infiltrating within the actively farmed fields on the Hallman property. The sandy soils facilitate the infiltration, there is no evidence of erosion between the fields and our observations over three years is that surface water does not flow between the fields. We have also shown that groundwater flow in AFB1 in that area is in a southerly direction, away from the wellfield, therefore any recharge that does occur will tend to flow away from the wellfield.

6.30 Update reporting with respect to hinge line drainage both north and south.

This is addressed in Section 5.19 of this report.

6.31 Assess impact to Hunsberger Creek surface water catchment area.

This is addressed in Section 4.14.1 of this report.

6.32 Assess impact to water supply from proposed recycling area and add monitoring/mitigation if required.

We recommend that the recycling area be underlain by a one metre thickness of silt or clay materials (over and above the minimum 1.5 metre separation to the water table) and that runoff is captured within the recycling area and allowed to slowly infiltrate through the silt or clay. There is no risk to any local water supply as there are no private water wells downgradient of the proposed recycling area. As confirmation of the absence of contamination, groundwater monitoring MW12 will be installed downgradient prior to any recycling activities commencing. Water quality monitoring in MW12 will occur on an annual basis as detailed in Section 7 of this report.

7.0 Groundwater Monitoring Program

7.33 Rationale for not including private wells

There are no private wells obtaining water from the unconfined aquifer downgradient of the proposed Hallman Pit. The removal of stored manure and the agreed upon reduction in nutrient applications in the ICA will reduce the present loading of nitrate to the unconfined aquifer and therefore water quality will improve with respect to nitrate contamination. Over the life of the proposed Hallman Pit, there will be less land with applied Agriculturally Sourced Material (ASM) or non agriculturally sourced material (NASM) as a result of land utilized for extraction purposes. Therefore water quality will improve beneath the site. For these reasons, there can be no water quality impacts to any private well and no water quality monitoring is required.

In the event that a wash plant is utilized at the site, the area of influence of the wash plant will not extend beyond the boundaries of the site and there will be no impact to water levels in any private well along Witmer Road.

7.34 Trigger levels and contingencies with respect to water quality and water quantity will be considered and added to monitoring plan if necessary.

We do not recommend any trigger levels or contingencies with respect to water quality and water quantity as aggregate operations are non-polluting and there are no private wells that can be affected by the proposed pit development.

The nearest well to the proposed washing operation (1875 Witmer Road) is more than 300 metres away and outside of any potential area of influence of the temporary drawdown in the wash pond. This well is 103 metres deep and has approximately 60 metres of available drawdown (based on a measured water level of 42.91 metres below casing top). Any other private well is more than 450 metres away from the proposed wash pond and as shown in Section 6.23 is outside of any

potential area of influence of the temporary drawdown in the wash pond. Jackson Harvest Farms Ltd. will obtain daily water levels from several on-site monitors including MW8 and MW11 located between the wash pond and the nearest private wells. Any influence of the wash pond on water levels will be recorded and assessed on an annual basis in a monitoring report. Along with the agreed upon well complain protocol, any complaint can be investigated quickly to assess the influence of the on-site activities.

The municipal well is located more than 2000 metres from the proposed wash pond and there will be no influence of the wash pond on water levels in the municipal wells. No influence in the shallow aquifer is observed at MW3 or MW4 located 900 m and 1200 m from the municipal wells during the OTP testing, therefore the temporary drawdown of less than a metre at 2000 metres distance cannot affect the municipal well. Groundwater flow in aquifer AFB1 is away from the municipal wells and nitrate species are attenuated in the ATB2 aquitard and AFB2 aquifer. Therefore, there can be no water quality issue arising from the proposed Hallman Pit for the municipal wells.

Appendix G includes trigger levels and contingency plan for the on-site wetland as prepared by Dance Environmental.

7.35 A revised monitoring plan to protect local water supplies and ROW wells for quality and quantity will be presented.

The revised groundwater monitoring plan is as follows;

Parameter	Location	Frequency
Water Levels	SG1, MW1, MW2, MW3, MW7S, MW8, MW11	Once daily at 6 pm with data logger
Water Quality (general chemistry, anions, ICP metals, nutrients, PAH, TPH)	MW12	Annually

The purpose of the monitoring of water levels is as follows;

- 1) To document water levels around the perimeter of the proposed pit for identification of trends in the position of the high-water table. Should, during the life of the pit, the high-water table exceed those stipulated on the site plans, the pit floor will be adjusted upward commensurate with the observations.
- 2) To confirm that the hydroperiod of the wetland has not been changed. Should there be a trend in change to the hydroperiod, the GRCA will be notified and adjustments made to the working area.

- 3) As confirmation that water levels are not being affected by water taking for the wash plant.

We are not recommending any water quality monitoring on-site or offsite for the following reasons;

- 1) The manure previously stored at the site is in the process of being removed. Therefore, the major source of nitrate in groundwater at the southern portion of the site has been removed and water quality will improve.
- 2) During the life of the pit, a portion of the existing farmland will be inactive, thereby reducing the opportunity for nutrient applications, therefore, water quality will improve.
- 3) Nutrient applications on-site will decrease as agreed between Jackson Harvest Farms Ltd. with the ROW as stipulated in the Risk Management Plan.
- 4) There are no downgradient wells within 2500 metres of the site that obtain water from the unconfined aquifer.
- 5) Nitrate contamination is widespread due to ongoing farming in the area and any impact to private wells cannot be from the Hallman Pit site.

The only water quality monitoring recommended is downgradient of the proposed recycling area. Should recycling occur, groundwater monitor MW12 will be installed ahead of time and annual water quality sampling will occur. Polycyclic Aromatic Hydrocarbons (PAHs) and Total Petroleum Hydrocarbons (TPH) will be included in the sample suite.

8.0 Spill Contingency Plan and Water Well Complaint Protocol

8.36 Additions to Spill contingency plan

A revised spill management plan has been prepared and is found in Appendix H. WHIMS data sheets will be kept on site as required.

8.37 Water Well Complaint Protocol

Jackson Harvest Farms Ltd. will address any water well complaint as detailed in the Water Well Complaint Protocol found in Appendix I.

9.0 Additional Considerations

9.1 Increase of Total Suspended Solids in the Aquifer AFB1

A part of a verbal presentation by Mr. Wilf Ruland on behalf of neighbouring residents during the Statutory Public Meeting on January 13, 2020, he said it was his experience that private wells could be affected by increased total suspended solids in the aquifer water. This is an incorrect assertion given the fine-sand to medium grained sand matrix of the unconfined aquifer at this site. The fine-grained particles to be mined from above the water table already exist in the aquifer. If the movement of fine-grained particles were an issue, every well in this area would

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already have sediment issues. There will be neither an increase in hydraulic gradient nor change in aquifer physical properties that will facilitate the movement of fine-grained material from the site to any well. The aggregate processing does not create these fine particles, it only concentrates them, puts them in a slurry and returns them to a settling pond. The settling pond is not constructed in the aquifer, it is constructed in the unsaturated zone.

10.0 Closure

Sincerely,

Harden Environmental Services Ltd.



Stan Denhoed, M.Sc., P.Eng.
Senior Hydrogeologist



Table 2: Water Quality Summary

Sampling Date					March 26, 2019	July 8, 2019	April 23,2020	March 26, 2019	July 8, 2019	April 23,2020	March 26, 2019
Sample ID					MW1	MW1	MW1	MW2	MW2	MW2	MW3
	UNITS	Criteria	MAC	A/O							
Field Parameters											
Temperature	°C				2.1		5.9	9.2		8.2	8.8
pH					7.86		7.29	7.44		6.8	7.51
Conductivity	µS/cm				192		399	635		705.4	681
TDS	mg/L				94			317			340
DO	mg/L						0			9.35	
ORP	mV						345.6			314.8	
Laboratory Parameters											
BOD							<5			<5	
Bicarb. Alkalinity (calc. as CaCO3)	mg/L				96	110	202	260	250	267	270
Calculated TDS	mg/L			500	110	130	240	410	390	416	420
Carb. Alkalinity (calc. as CaCO3)	mg/L				ND	1.2	<5	1.6	1.7	<5	1.9
Hydroxide (as CaCO3)							<5			<5	
Hardness (CaCO3)	mg/L			80:100	98	110	246	310	320	1,460	300
Alkalinity (Total as CaCO3)	mg/L			30:500	97	110	202	260	250	267	270
Colour	TCU			5	14	12	<5	ND	ND	<5	ND
Conductivity	umho/cm				210	220	462	720	650	822	760
Reactive Silica							4.03			9.66	
pH	pH	6.5:8.5		6.5:8.5	7.99	8.07	7.68	7.83	7.86	7.74	7.87
Turbidity	NTU			5	30	490	68.2	9900	3500	2530.0	700
Total Ammonia-N	mg/L				0.053	0.22	<0.02	ND	ND	0.03	0.051
Total Kjeldahl Nitrogen (TKN)	mg/L				0.48	0.64	0.35	ND (1)	ND (1)	0.19	0.21
Nitrite (N)	mg/L		1		ND	ND	0.16	ND	ND	<0.25	ND
Nitrate (N)	mg/L		10		ND	ND	2.12	14.6	10.8	10.6	9.44
Dissolved Organic Carbon	mg/L			5	5.6	3.6		0.63	0.70		0.73
Total Organic Carbon (TOC)	mg/L						2.9			2.1	
Orthophosphate (P)	mg/L				0.21	0.092	<0.10	ND	ND	<0.50	ND
Total Phosphorus	mg/L	0.01			0.29	3.7	0.14	4.8	2.8	0.90	0.58
Dissolved Sulphate (SO4)	mg/L			500	ND	1.9	5.92	12	13	15.5	18
Fluoride							<0.05			<0.05	
Bromide							<0.05			<0.25	
Dissolved Chloride (Cl-)	mg/L			250	5.5	7.5	5.62	31	33	49.6	42

Table 2: Water Quality Summary

Sampling Date					March 26, 2019	July 8, 2019	April 23,2020	March 26, 2019	July 8, 2019	April 23,2020	March 26, 2019
Sample ID					MW1	MW1	MW1	MW2	MW2	MW2	MW3
	UNITS	Criteria	MAC	A/O							
Metals ('Total' for SG1 Pond)											
Dissolved Aluminum (Al)	mg/L			0.1	0.0052	0.0056	0.021	ND	ND	0.008	ND
Dissolved Antimony (Sb)	mg/L	0.02	0.006		ND	ND	<0.001	ND	ND	<0.001	ND
Dissolved Arsenic (As)	mg/L	0.1	0.01		ND	ND	0.002	ND	ND	0.003	ND
Dissolved Barium (Ba)	mg/L		1		0.016	0.025	0.042	0.11	0.10	0.098	0.052
Dissolved Beryllium (Be)	mg/L	0.011			ND	ND	<0.0005	ND	ND	<0.0005	ND
Dissolved Bismuth (Bi)	mg/L				ND	ND	<0.002	ND	ND	<0.002	ND
Dissolved Boron (B)	mg/L	0.2	5		0.011	0.020	0.017	0.015	0.016	0.014	0.024
Dissolved Cadmium (Cd)	mg/L	0.0002	0.005		ND	ND	<0.0001	ND	ND	<0.0001	ND
Dissolved Calcium (Ca)	mg/L				30	34	57.6	93	92	86.0	87
Dissolved Chromium (Cr)	mg/L		0.05		ND	ND	<0.002	ND	ND	<0.002	ND
Dissolved Cobalt (Co)	mg/L	0.0009			ND	ND	<0.0005	ND	ND	<0.0005	ND
Dissolved Copper (Cu)	mg/L	0.005		1	0.0072	0.010	0.005	ND	ND	0.002	0.0010
Dissolved Iron (Fe)	mg/L	0.3		0.3	ND	ND	0.011	ND	ND	<0.010	ND
Dissolved Lead (Pb)	mg/L	0.005	0.01		ND	ND	0.0006	ND	ND	<0.0005	ND
Dissolved Lithium (Li)	mg/L						<0.05			<0.05	
Dissolved Magnesium (Mg)	mg/L				5.4	6.4	12.8	20	21	20.2	19
Dissolved Manganese (Mn)	mg/L			0.05	0.019	0.072	0.129	ND	ND	<0.002	ND
Dissolved Molybdenum (Mo)	mg/L	0.04			0.00063	0.00067	<0.002	ND	ND	<0.002	ND
Dissolved Nickel (Ni)	mg/L	0.025			ND	ND	<0.003	ND	ND	<0.003	ND
Dissolved Phosphorus (P)	mg/L				0.27	0.14	0.10	ND	ND	<0.05	ND
Dissolved Potassium (K)	mg/L				4.3	6.4	9.29	2.1	2.0	1.99	1.3
Dissolved Selenium (Se)	mg/L	0.1	0.05		ND	ND	<0.001	ND	ND	<0.001	ND
Dissolved Silicon (Si)	mg/L				0.82	1.7	1.89	4.6	4.3	4.17	4.7
Dissolved Silver (Ag)	mg/L	0.0001			ND	ND	<0.0001	ND	ND	<0.0001	ND
Dissolved Sodium (Na)	mg/L			200	1.8	2.1	2.01	22	20	26.4	35
Dissolved Strontium (Sr)	mg/L				0.035	0.040	0.082	0.13	0.13	0.131	0.13
Dissolved Thallium (Tl)	mg/L	0.0003			ND	ND	<0.0003	ND	ND	<0.0003	ND
Dissolved Tin (Sn)	mg/L						<0.002			<0.002	
Dissolved Titanium (Ti)	mg/L				ND	ND	<0.002	ND	ND	<0.002	ND
Dissolved Tungsten (W)											
Dissolved Uranium (U)	mg/L	0.005	0.02		ND	ND	<0.0005	0.00032	0.00027	<0.0005	0.00024
Dissolved Vanadium (V)	mg/L	0.006			0.00065	0.0026	<0.002	ND	ND	<0.002	ND
Dissolved Zinc (Zn)	mg/L	0.03		5	ND	ND	<0.005	ND	ND	<0.005	ND
Dissolved Zirconium (Zr)	mg/L						<0.004			<0.004	

ND = Not detected | N/A = Not Applicable

(1) Due to a high concentration of NOx, the sample required dilution. The detection limit was adjusted accordingly.

Criteria: Ontario Provincial Water Quality Objectives Ref. to MOEE Water Management document dated Feb.1999

MAC,A/O: Ontario Drinking Water Standards - Maximum Acceptable

Concentration [MAC] & Table 4-Chemical/Physical Objectives

[A/O] - Not Health Related, respectively (Made under the Ontario Safe Drinking Water Act, 2002)

Table 2: Water Quality Summary

Sampling Date					July 8, 2019	April 23,2020
Sample ID					MW3	MW3
	UNITS	Criteria	MAC	A/O		
Field Parameters						
Temperature	°C					8.2
pH						6.85
Conductivity	µS/cm					809
TDS	mg/L					
DO	mg/L					10.15
ORP	mV					298.8
Laboratory Parameters						
BOD						<5
Bicarb. Alkalinity (calc. as CaCO3)	mg/L				280	271
Calculated TDS	mg/L			500	410	452
Carb. Alkalinity (calc. as CaCO3)	mg/L				2.3	<5
Hydroxide (as CaCO3)						<5
Hardness (CaCO3)	mg/L			80:100	310	461
Alkalinity (Total as CaCO3)	mg/L			30:500	280	271
Colour	TCU			5	ND	<5
Conductivity	umho/cm				670	870
Reactive Silica						10.1
pH	pH	6.5:8.5		6.5:8.5	7.94	7.72
Turbidity	NTU			5	790	400.0
Total Ammonia-N	mg/L				ND	<0.02
Total Kjeldahl Nitrogen (TKN)	mg/L				ND (1)	0.29
Nitrite (N)	mg/L		1		ND	<0.25
Nitrate (N)	mg/L		10		8.93	8.38
Dissolved Organic Carbon	mg/L			5	1.5	
Total Organic Carbon (TOC)	mg/L					3.6
Orthophosphate (P)	mg/L				ND	<0.50
Total Phosphorus	mg/L	0.01			0.59	0.09
Dissolved Sulphate (SO4)	mg/L			500	18	16.9
Fluoride						<0.05
Bromide						<0.25
Dissolved Chloride (Cl-)	mg/L			250	32	63.1

Table 2: Water Quality Summary

Sampling Date					July 8, 2019	April 23,2020
Sample ID					MW3	MW3
	UNITS	Criteria	MAC	A/O		
Metals ('Total' for SG1 Pond)						
Dissolved Aluminum (Al)	mg/L			0.1	ND	<0.004
Dissolved Antimony (Sb)	mg/L	0.02	0.006		ND	<0.001
Dissolved Arsenic (As)	mg/L	0.1	0.01		ND	<0.001
Dissolved Barium (Ba)	mg/L		1		0.060	0.041
Dissolved Beryllium (Be)	mg/L	0.011			ND	<0.0005
Dissolved Bismuth (Bi)	mg/L				ND	<0.002
Dissolved Boron (B)	mg/L	0.2	5		0.052	0.026
Dissolved Cadmium (Cd)	mg/L	0.0002	0.005		ND	<0.0001
Dissolved Calcium (Ca)	mg/L				92	72.0
Dissolved Chromium (Cr)	mg/L		0.05		ND	<0.002
Dissolved Cobalt (Co)	mg/L	0.0009			ND	<0.0005
Dissolved Copper (Cu)	mg/L	0.005		1	ND	0.002
Dissolved Iron (Fe)	mg/L	0.3		0.3	ND	<0.010
Dissolved Lead (Pb)	mg/L	0.005	0.01		ND	<0.0005
Dissolved Lithium (Li)	mg/L					<0.05
Dissolved Magnesium (Mg)	mg/L				20	17.9
Dissolved Manganese (Mn)	mg/L			0.05	ND	<0.002
Dissolved Molybdenum (Mo)	mg/L	0.04			ND	<0.002
Dissolved Nickel (Ni)	mg/L	0.025			ND	<0.003
Dissolved Phosphorus (P)	mg/L				ND	<0.05
Dissolved Potassium (K)	mg/L				1.4	1.33
Dissolved Selenium (Se)	mg/L	0.1	0.05		ND	<0.001
Dissolved Silicon (Si)	mg/L				4.7	4.64
Dissolved Silver (Ag)	mg/L	0.0001			ND	<0.0001
Dissolved Sodium (Na)	mg/L			200	31	34.5
Dissolved Strontium (Sr)	mg/L				0.13	0.111
Dissolved Thallium (Tl)	mg/L	0.0003			ND	0.0005
Dissolved Tin (Sn)	mg/L					0.003
Dissolved Titanium (Ti)	mg/L				ND	<0.002
Dissolved Tungsten (W)						
Dissolved Uranium (U)	mg/L	0.005	0.02		0.00026	<0.0005
Dissolved Vanadium (V)	mg/L	0.006			ND	<0.002
Dissolved Zinc (Zn)	mg/L	0.03		5	ND	<0.005
Dissolved Zirconium (Zr)	mg/L					<0.004

ND = Not detected | N/A = Not Applicable

(1) Due to a high concentration of NOx, the sample required dilution. The detection limit was adjusted accordingly.

Criteria: Ontario Provincial Water Quality Objectives Ref. to MOEE Water Management document dated Feb.1999

MAC,A/O: Ontario Drinking Water Standards - Maximum Acceptable

Concentration [MAC] & Table 4-Chemical/Physical Objectives

[A/O] - Not Health Related, respectively (Made under the Ontario Safe Drinking Water Act, 2002)

Table 2: Water Quality Summary

Sampling Date					March 26, 2019	July 8, 2019	April 23,2020	March 26, 2019	July 8, 2019	July 8, 2019	2020-04-23	April 23, 2020
Sample ID					MW4	MW4	MW4	MW5	MW5	SG1 POND	MW6	MW7S
	UNITS	Criteria	MAC	A/O								
Field Parameters												
Temperature	°C				7.4		8.5	6.9			8.4	8.2
pH					7.67		6.9	7.12			6.65	6.8
Conductivity	µS/cm				441		481.2	1005			616.3	697.6
TDS	mg/L				219			502				
DO	mg/L						9.98				9.59	9.48
ORP	mV						311.5				293.7	307.3
Laboratory Parameters												
BOD							<5				<5	<5
Bicarb. Alkalinity (calc. as CaCO3)	mg/L				220	210	228	430	460	57	240	302
Calculated TDS	mg/L			500	270	270	286	610	620	71	332	354
Carb. Alkalinity (calc. as CaCO3)	mg/L				1.7	2.0	<5	1.7	1.8	ND	<5	<5
Hydroxide (as CaCO3)							<5				<5	<5
Hardness (CaCO3)	mg/L			80:100	240	250	479	570	530	52	287	632
Alkalinity (Total as CaCO3)	mg/L			30:500	220	220	228	430	460	58	240	302
Colour	TCU			5	ND	ND	<5	ND	ND	25	<5	<5
Conductivity	umho/cm				480	460	557	970	950	130	647	696
Reactive Silica							9.89				9.31	10.5
pH	pH	6.5:8.5		6.5:8.5	7.93	8.00	7.79	7.63	7.61	7.78	7.75	7.78
Turbidity	NTU			5	630	460	537.0	230	270	3.0	22.4	342.0
Total Ammonia-N	mg/L				0.052	ND	0.03	0.12	ND	ND	0.86	<0.02
Total Kjeldahl Nitrogen (TKN)	mg/L				ND (1)	ND (1)	0.17	ND (1)	ND (1)	0.82	<0.10	0.22
Nitrite (N)	mg/L		1		ND	ND	<0.05	0.022	ND	ND	<0.10	<0.10
Nitrate (N)	mg/L		10		4.47	7.60	7.66	11.5	12.2	ND	13.7	5.47
Dissolved Organic Carbon	mg/L			5	0.61	0.84		1.8	1.4			
Total Organic Carbon (TOC)	mg/L						1.3			10	3.8	13.0
Orthophosphate (P)	mg/L				ND	ND	<0.10	ND	ND	0.081	<0.20	<0.20
Total Phosphorus	mg/L	0.01			0.28	0.64	0.20	0.40	0.25	0.18	0.04	0.47
Dissolved Sulphate (SO4)	mg/L			500	6.4	4.1	6.15	41	38	ND	9.23	11.1
Fluoride							<0.05				<0.05	<0.05
Bromide							<0.05				<0.10	<0.10
Dissolved Chloride (Cl-)	mg/L			250	5.2	4.4	4.44	14	21	5.9	6.78	7.52

Table 2: Water Quality Summary

Sampling Date					March 26, 2019	July 8, 2019	April 23,2020	March 26, 2019	July 8, 2019	July 8, 2019	2020-04-23	April 23, 2020
Sample ID					MW4	MW4	MW4	MW5	MW5	SG1 POND	MW6	MW7S
	UNITS	Criteria	MAC	A/O								
Metals ('Total' for SG1 Pond)												
Dissolved Aluminum (Al)	mg/L			0.1	ND	ND	0.017	ND	ND	0.055	0.018	0.008
Dissolved Antimony (Sb)	mg/L	0.02	0.006		ND	ND	<0.001	ND	ND	ND	<0.001	<0.001
Dissolved Arsenic (As)	mg/L	0.1	0.01		ND	ND	<0.001	ND	ND	ND	<0.001	<0.001
Dissolved Barium (Ba)	mg/L		1		0.033	0.031	0.037	0.068	0.072	0.0071	0.045	0.030
Dissolved Beryllium (Be)	mg/L	0.011			ND	ND	<0.0005	ND	ND	ND	<0.0005	<0.0005
Dissolved Bismuth (Bi)	mg/L				ND	ND	<0.002	ND	ND		<0.002	<0.002
Dissolved Boron (B)	mg/L	0.2	5		0.010	ND	<0.010	0.026	0.024	0.023	0.015	0.013
Dissolved Cadmium (Cd)	mg/L	0.0002	0.005		ND	ND	<0.0001	ND	ND	ND	<0.0001	<0.0001
Dissolved Calcium (Ca)	mg/L				71	74	69.7	180	160	15	78.9	88.6
Dissolved Chromium (Cr)	mg/L		0.05		ND	ND	<0.002	ND	ND	ND	<0.002	<0.002
Dissolved Cobalt (Co)	mg/L	0.0009			ND	ND	<0.0005	0.0015	0.0013	ND	<0.0005	<0.0005
Dissolved Copper (Cu)	mg/L	0.005		1	ND	ND	<0.001	0.0022	0.0017	ND	0.002	0.002
Dissolved Iron (Fe)	mg/L	0.3		0.3	ND	ND	<0.010	ND	ND	1.4	<0.010	<0.010
Dissolved Lead (Pb)	mg/L	0.005	0.01		ND	ND	<0.0005	ND	ND	ND	<0.0005	<0.0005
Dissolved Lithium (Li)	mg/L						<0.05				<0.05	<0.05
Dissolved Magnesium (Mg)	mg/L				16	16	15.8	31	30	3.9	18.9	20.1
Dissolved Manganese (Mn)	mg/L			0.05	ND	ND	<0.002	0.45	0.15	0.15	<0.002	0.002
Dissolved Molybdenum (Mo)	mg/L	0.04			ND	ND	<0.002	ND	ND	ND	<0.002	<0.002
Dissolved Nickel (Ni)	mg/L	0.025			ND	ND	<0.003	0.0019	ND	ND	<0.003	<0.003
Dissolved Phosphorus (P)	mg/L				ND	ND	<0.05	ND	ND		<0.05	<0.05
Dissolved Potassium (K)	mg/L				0.75	0.55	0.72	19	19	8.6	0.90	0.99
Dissolved Selenium (Se)	mg/L	0.1	0.05		ND	ND	<0.001	ND	ND	ND	<0.001	<0.001
Dissolved Silicon (Si)	mg/L				4.5	4.4	4.08	4.5	4.2	0.34	3.98	4.80
Dissolved Silver (Ag)	mg/L	0.0001			ND	ND	<0.0001	ND	ND	ND	<0.0001	<0.0001
Dissolved Sodium (Na)	mg/L			200	4.3	3.2	3.87	7.2	11	1.7	4.32	4.89
Dissolved Strontium (Sr)	mg/L				0.11	0.095	0.095	0.21	0.20	0.026	0.098	0.174
Dissolved Thallium (Tl)	mg/L	0.0003			ND	ND	<0.0003	0.000051	ND	ND	<0.0003	<0.0003
Dissolved Tin (Sn)	mg/L						<0.002				<0.002	<0.002
Dissolved Titanium (Ti)	mg/L				ND	ND	<0.002	ND	ND	ND	<0.002	<0.002
Dissolved Tungsten (W)												
Dissolved Uranium (U)	mg/L	0.005	0.02		0.00030	0.00018	<0.0005	0.00085	0.00068	ND	<0.0005	<0.0005
Dissolved Vanadium (V)	mg/L	0.006			ND	ND	<0.002	ND	ND	ND	<0.002	<0.002
Dissolved Zinc (Zn)	mg/L	0.03		5	ND	ND	<0.005	0.0069	ND	ND	<0.005	<0.005
Dissolved Zirconium (Zr)	mg/L						<0.004				<0.004	<0.004

ND = Not detected | N/A = Not Applicable

(1) Due to a high concentration of NOx, the sample required dilution. The detection limit was adjusted accordingly.

Criteria: Ontario Provincial Water Quality Objectives Ref. to MOEE Water Management document dated Feb.1999

MAC,A/O: Ontario Drinking Water Standards - Maximum Acceptable

Concentration [MAC] & Table 4-Chemical/Physical Objectives

[A/O] - Not Health Related, respectively (Made under the Ontario Safe Drinking Water Act, 2002)

Table 2: Water Quality Summary

Sampling Date					May 7, 2020	2020-04-23	2020-04-23	2020-04-23	2020-04-23
Sample ID					MW7D	MW8	MW9	MW10	MW11
	UNITS	Criteria	MAC	A/O					
Field Parameters									
Temperature	°C				9	8	8.7	8.6	8.1
pH					7.3	6.88	6.55	6.8	7.03
Conductivity	µS/cm				759	581.6	886	994	755
TDS	mg/L								
DO	mg/L				0	9.77	7.49	3.17	3.22
ORP	mV				-176.5	311.8	340.6	336.5	301.7
Laboratory Parameters									
BOD					NA	<5	<5	NA	
Bicarb. Alkalinity (calc. as CaCO3)	mg/L				250	240	349	405	289
Calculated TDS	mg/L		500		472	324	492	576	420
Carb. Alkalinity (calc. as CaCO3)	mg/L				<5	<5	<5	<5	<5
Hydroxide (as CaCO3)					<5	<5	<5	<5	<5
Hardness (CaCO3)	mg/L			80:100	334	288	1,000	638	1,090
Alkalinity (Total as CaCO3)	mg/L			30:500	250	240	349	405	289
Colour	TCU			5	<5	<5	<5	<5	<5
Conductivity	umho/cm				949	614	966	1,120	831
Reactive Silica					10.50	8.67	8.61	9.87	11.2
pH	pH	6.5:8.5		6.5:8.5	7.60	7.76	7.60	7.59	7.75
Turbidity	NTU			5	24.5	64.7	685.0	204.0	1550.0
Total Ammonia-N	mg/L				<0.02	0.02	0.05	<0.02	0.03
Total Kjeldahl Nitrogen (TKN)	mg/L				0.15	<0.10	<0.10	<0.10	<0.10
Nitrite (N)	mg/L		1		<0.25	<0.10	<0.25	<0.25	<0.25
Nitrate (N)	mg/L		10		<0.25	12.7	12.4	25.4	6.38
Dissolved Organic Carbon	mg/L			5					
Total Organic Carbon (TOC)	mg/L				4.0	4.0	2.0	2.2	2.6
Orthophosphate (P)	mg/L				<0.50	<0.20	<0.50	<0.50	<0.50
Total Phosphorus	mg/L	0.01			0.03	0.21	0.43	0.25	0.85
Dissolved Sulphate (SO4)	mg/L			500	122.0	7.84	24.0	37.5	35.2
Fluoride					<0.05	<0.05	<0.05	<0.05	<0.05
Bromide					<0.25	<0.10	<0.25	<0.25	<0.25
Dissolved Chloride (Cl-)	mg/L			250	32.5	4.78	35.8	14.4	37.1

Table 2: Water Quality Summary

Sampling Date					May 7, 2020	2020-04-23	2020-04-23	2020-04-23	2020-04-23
Sample ID					MW7D	MW8	MW9	MW10	MW11
	UNITS	Criteria	MAC	A/O					
Metals ('Total' for SG1 Pond)									
Dissolved Aluminum (Al)	mg/L			0.1	0.007	0.008	0.010	0.013	0.016
Dissolved Antimony (Sb)	mg/L	0.02	0.006		<0.001	<0.001	<0.001	<0.001	<0.001
Dissolved Arsenic (As)	mg/L	0.1	0.01		<0.001	<0.001	<0.001	<0.001	<0.001
Dissolved Barium (Ba)	mg/L		1		0.090	0.040	0.069	0.133	0.080
Dissolved Beryllium (Be)	mg/L	0.011			<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Bismuth (Bi)	mg/L					<0.002	<0.002	<0.002	<0.002
Dissolved Boron (B)	mg/L	0.2	5		0.016	0.013	0.023	0.031	0.013
Dissolved Cadmium (Cd)	mg/L	0.0002	0.005		<0.0001	<0.0001	0.0007	<0.0001	<0.0001
Dissolved Calcium (Ca)	mg/L				89.9	76.3	114.00	147.00	94.1
Dissolved Chromium (Cr)	mg/L		0.05		<0.002	<0.002	<0.002	<0.002	<0.002
Dissolved Cobalt (Co)	mg/L	0.0009			<0.0005	<0.0005	<0.0005	0.0005	<0.0005
Dissolved Copper (Cu)	mg/L	0.005		1	<0.001	0.001	0.002	0.002	0.001
Dissolved Iron (Fe)	mg/L	0.3		0.3	0.183	<0.010	0.019	<0.010	0.011
Dissolved Lead (Pb)	mg/L	0.005	0.01		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Lithium (Li)	mg/L					<0.05	<0.05	<0.05	<0.05
Dissolved Magnesium (Mg)	mg/L				26.5	18.0	25.1	27.2	22.6
Dissolved Manganese (Mn)	mg/L			0.05	0.075	0.002	0.005	<0.002	0.002
Dissolved Molybdenum (Mo)	mg/L	0.04			<0.002	<0.002	<0.002	<0.002	<0.002
Dissolved Nickel (Ni)	mg/L	0.025			<0.003	<0.003	<0.003	<0.003	<0.003
Dissolved Phosphorus (P)	mg/L					<0.05	<0.05	0.06	0.08
Dissolved Potassium (K)	mg/L				1.51	1.64	9.63	20.3	1.53
Dissolved Selenium (Se)	mg/L	0.1	0.05		<0.001	<0.001	<0.001	0.001	<0.001
Dissolved Silicon (Si)	mg/L					3.65	3.80	4.13	5.03
Dissolved Silver (Ag)	mg/L	0.0001			<0.0001	<0.0001	0.0006	<0.0001	<0.0001
Dissolved Sodium (Na)	mg/L			200	20.40	3.92	17.0	9.73	18.2
Dissolved Strontium (Sr)	mg/L				0.238	0.105	0.165	0.203	0.163
Dissolved Thallium (Tl)	mg/L	0.0003			<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Dissolved Tin (Sn)	mg/L				<0.002	<0.002	<0.002	<0.002	<0.002
Dissolved Titanium (Ti)	mg/L				<0.002	<0.002	<0.002	<0.002	<0.002
Dissolved Tungsten (W)					<0.010				
Dissolved Uranium (U)	mg/L	0.005	0.02		0.0012	<0.0005	<0.0005	0.0005	0.0023
Dissolved Vanadium (V)	mg/L	0.006			<0.002	<0.002	<0.002	<0.002	<0.002
Dissolved Zinc (Zn)	mg/L	0.03		5	<0.005	<0.005	<0.005	<0.005	<0.005
Dissolved Zirconium (Zr)	mg/L				<0.004	<0.004	<0.004	<0.004	<0.004

ND = Not detected | N/A = Not Applicable

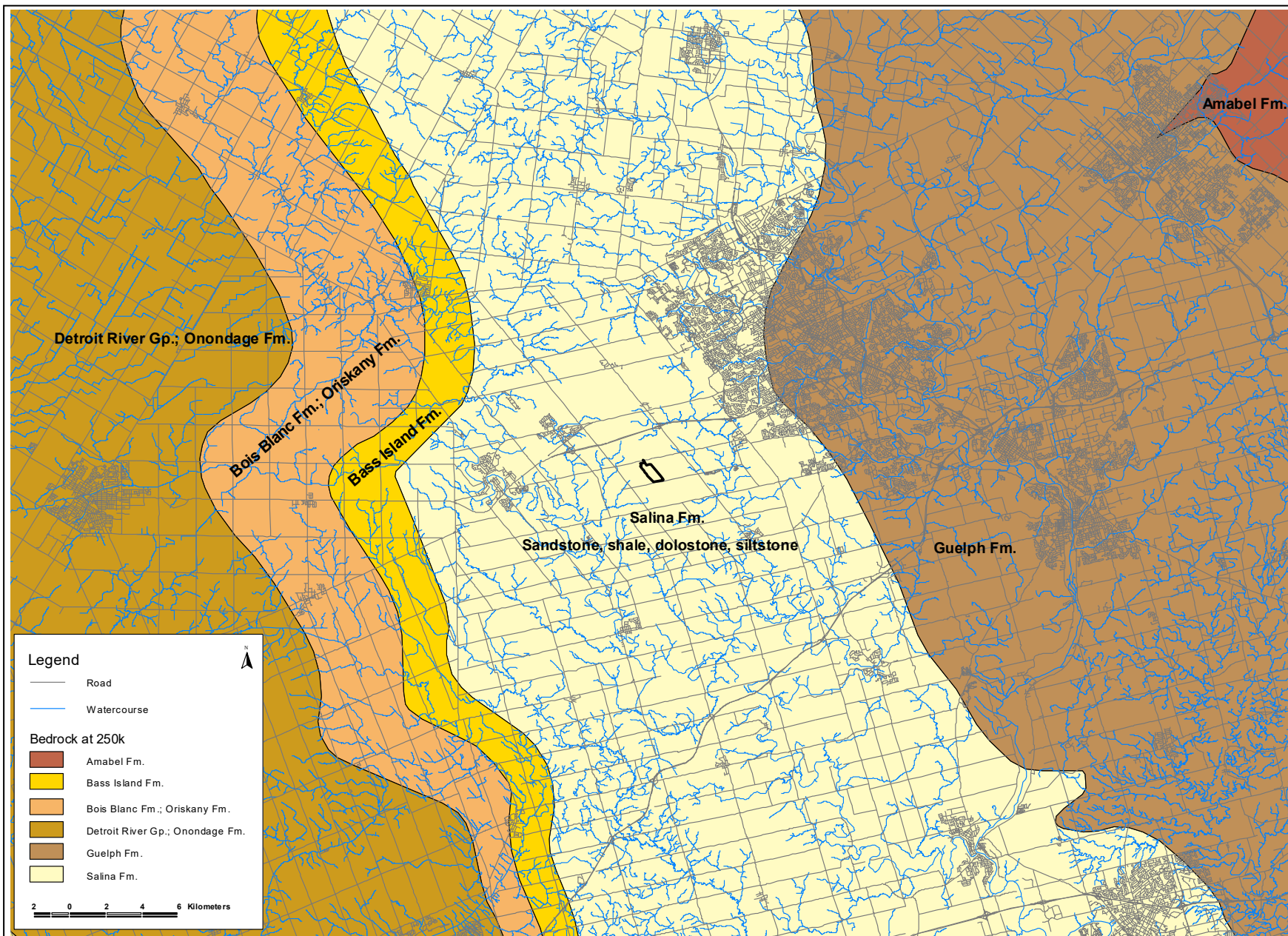
(1) Due to a high concentration of NOx, the sample required dilution. The detection limit was adjusted accordingly.

Criteria: Ontario Provincial Water Quality Objectives Ref. to MOEE Water Management document dated Feb.1999

MAC,A/O: Ontario Drinking Water Standards - Maximum Acceptable

Concentration [MAC] & Table 4-Chemical/Physical Objectives

[A/O] - Not Health Related, respectively (Made under the Ontario Safe Drinking Water Act, 2002)



Harden
Environmental
Services Ltd.

Project No: 1728

Date: Jun 2020

Drawn By: AR

Hydrogeological Assessment

1894 Witmer Rd, CON South of Bleams Rd, PT LOT 10
Township of Wilmot, Regional Municipality of Waterloo

Figure 1: Bedrock Geology

 Issue Contributing Area (ICA) (7,876,237 m²)

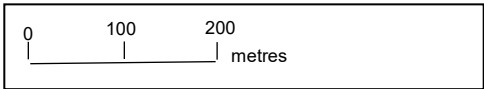
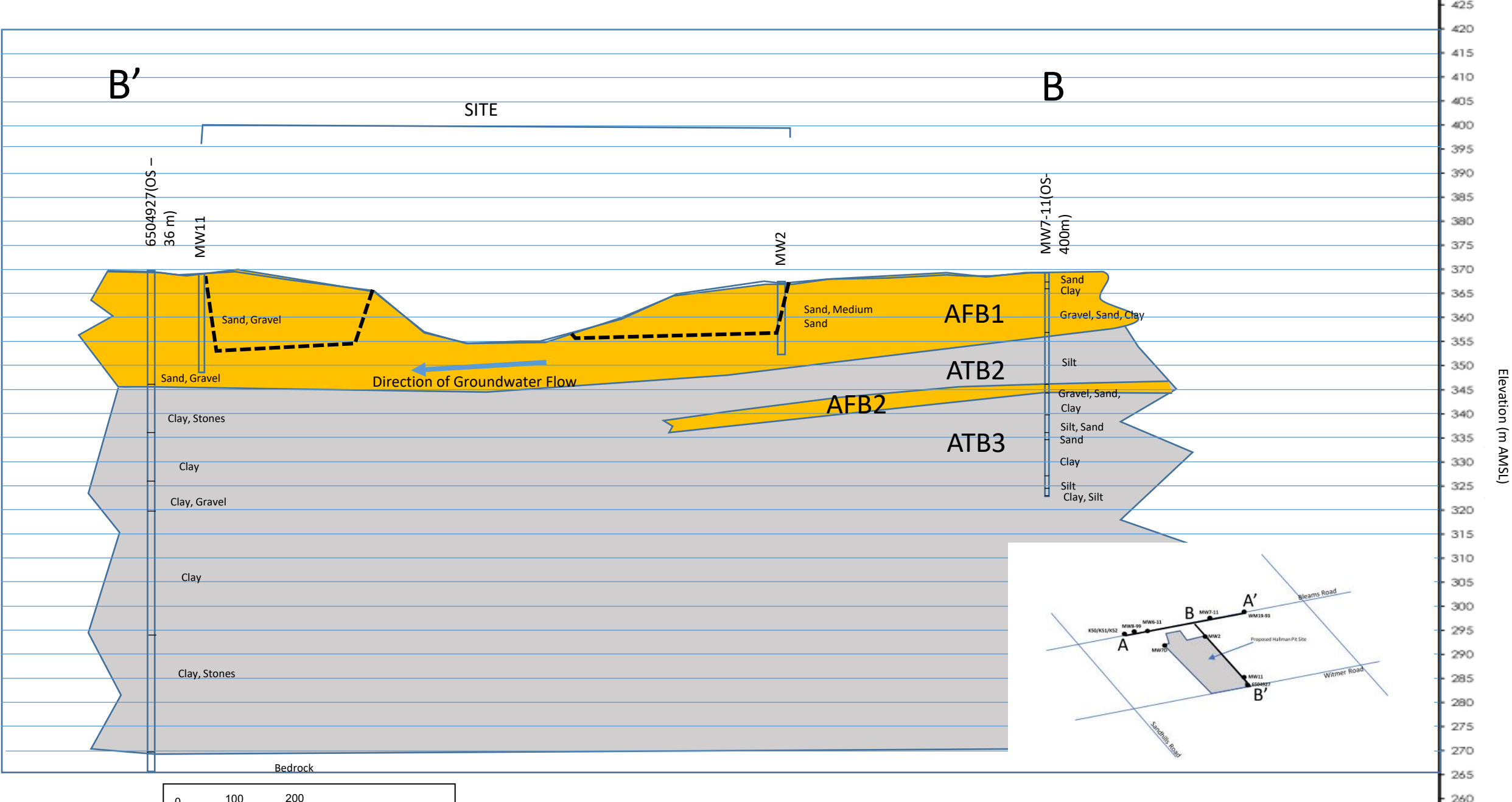
 Subject Lands (652,726 m²)

 Field within ICA (5,406,733 m²)

 Fields within ICA within Subject Lands - 211,552 m²

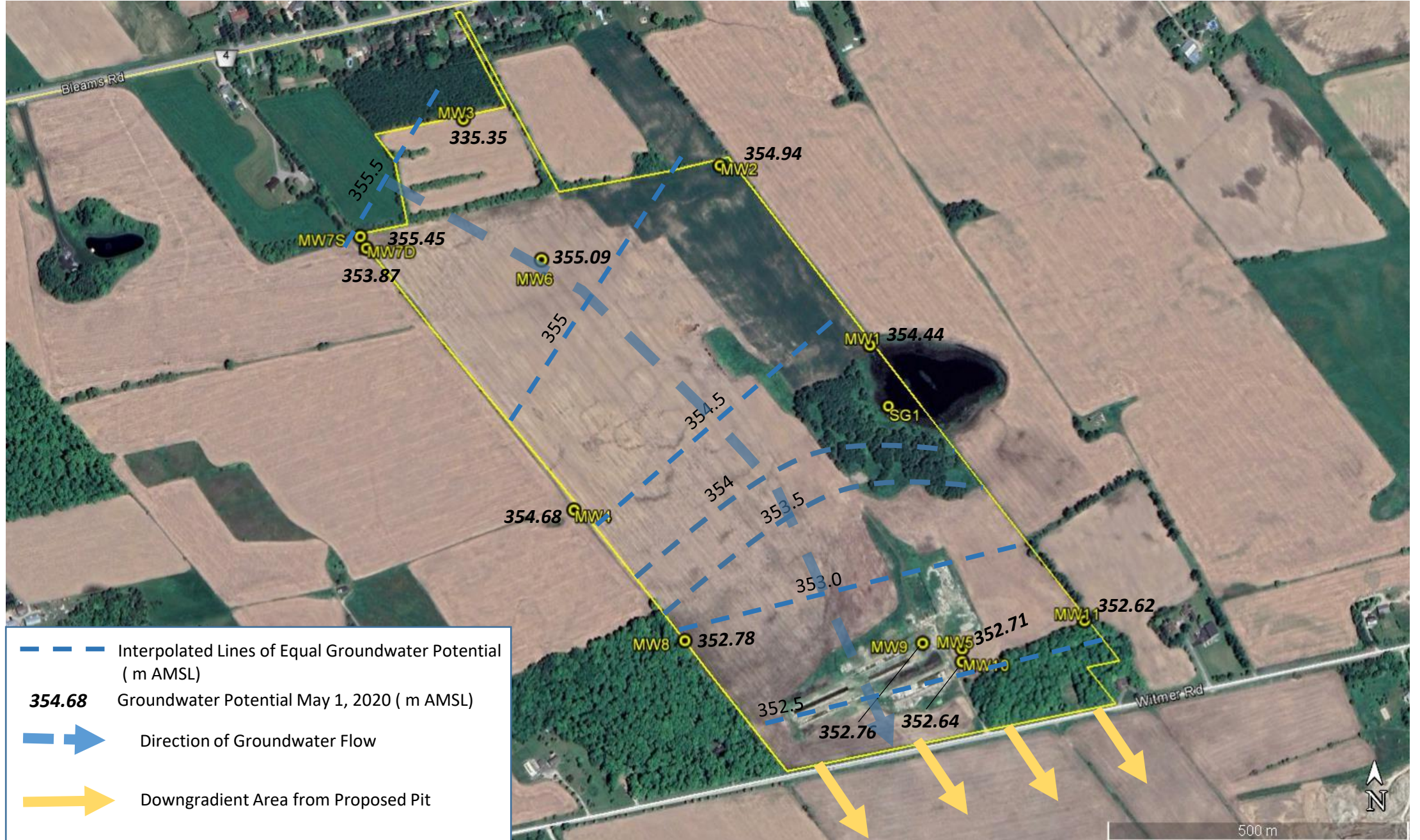
*ICA within Subject Lands - 220,723 m²

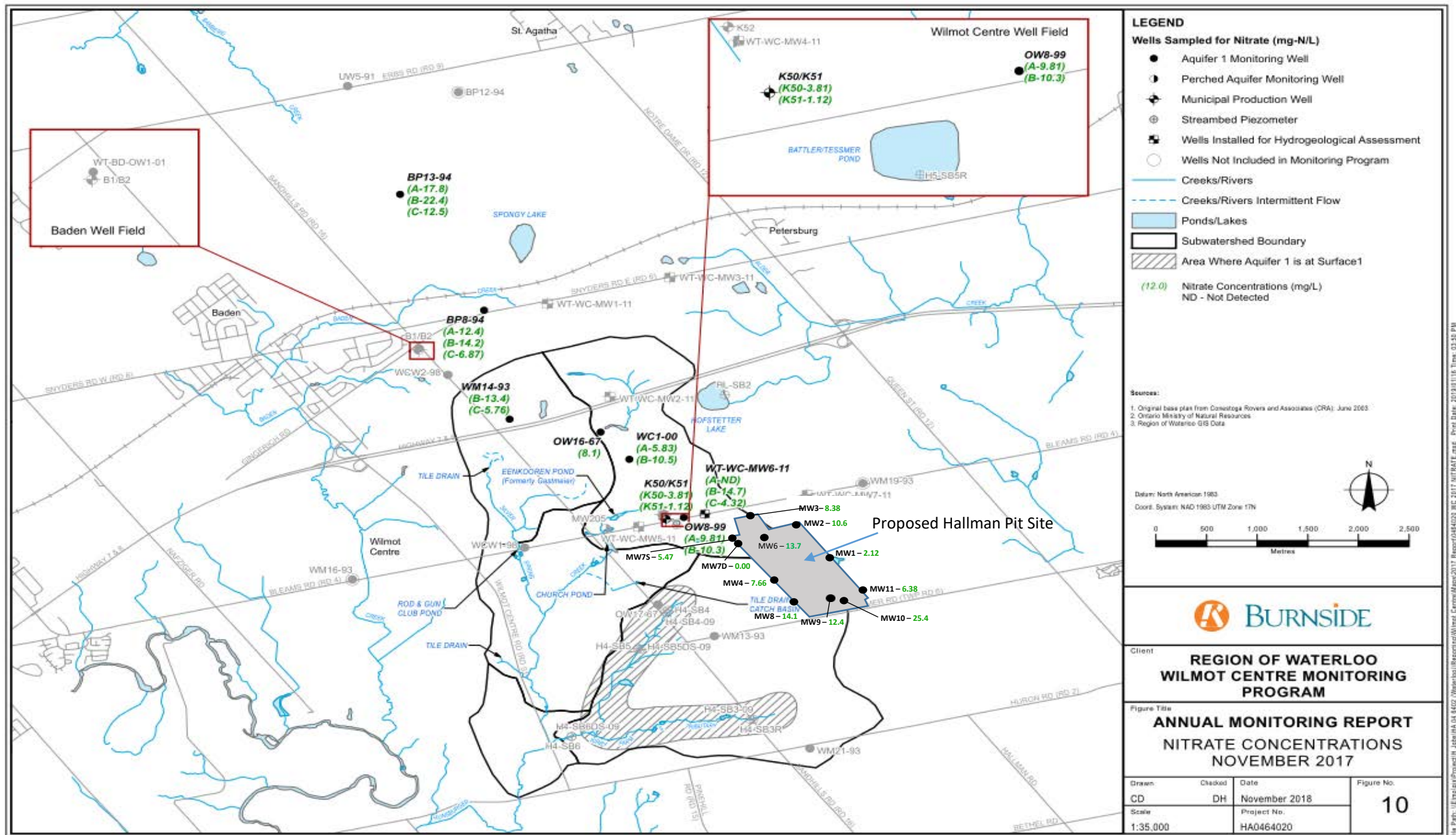




10x Vertical Exaggeration

 Harden Environmental Services Ltd.	Project No: 1728	Hydrogeological Assessment	Figure 4: Stratigraphic Section B-B' – Eastern Site Boundary
	Date: Jun 2020		
	Drawn By: SD		
	1894 Witmer Rd, CON South of Bleams Rd, PT LOT 10 Township of Wilmot, Regional Municipality of Waterloo		





Harden
Environmental
Services Ltd.

Project No: 1728

Date: Jun 2020

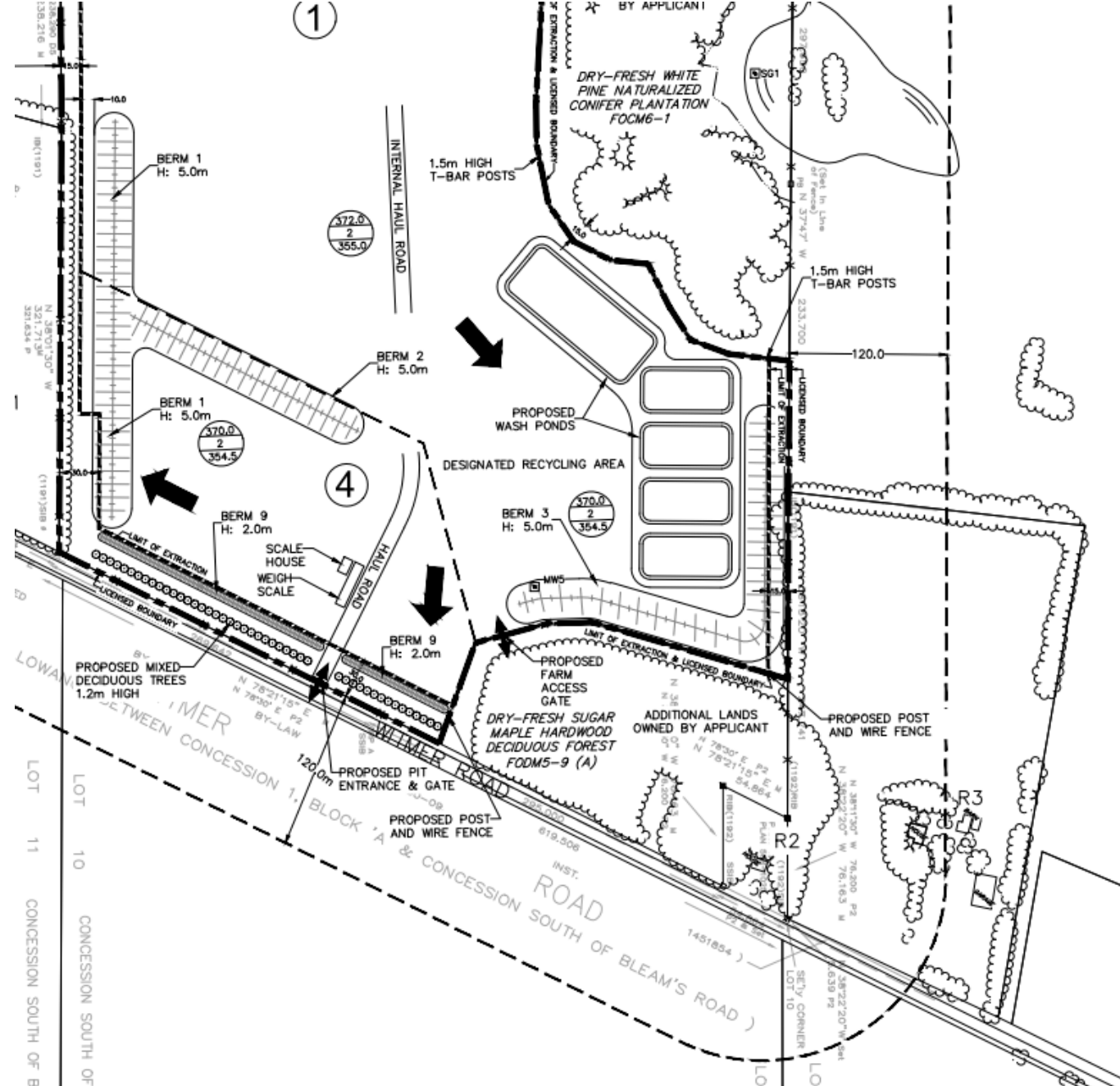
Drawn By: AR

Hydrogeological Assessment

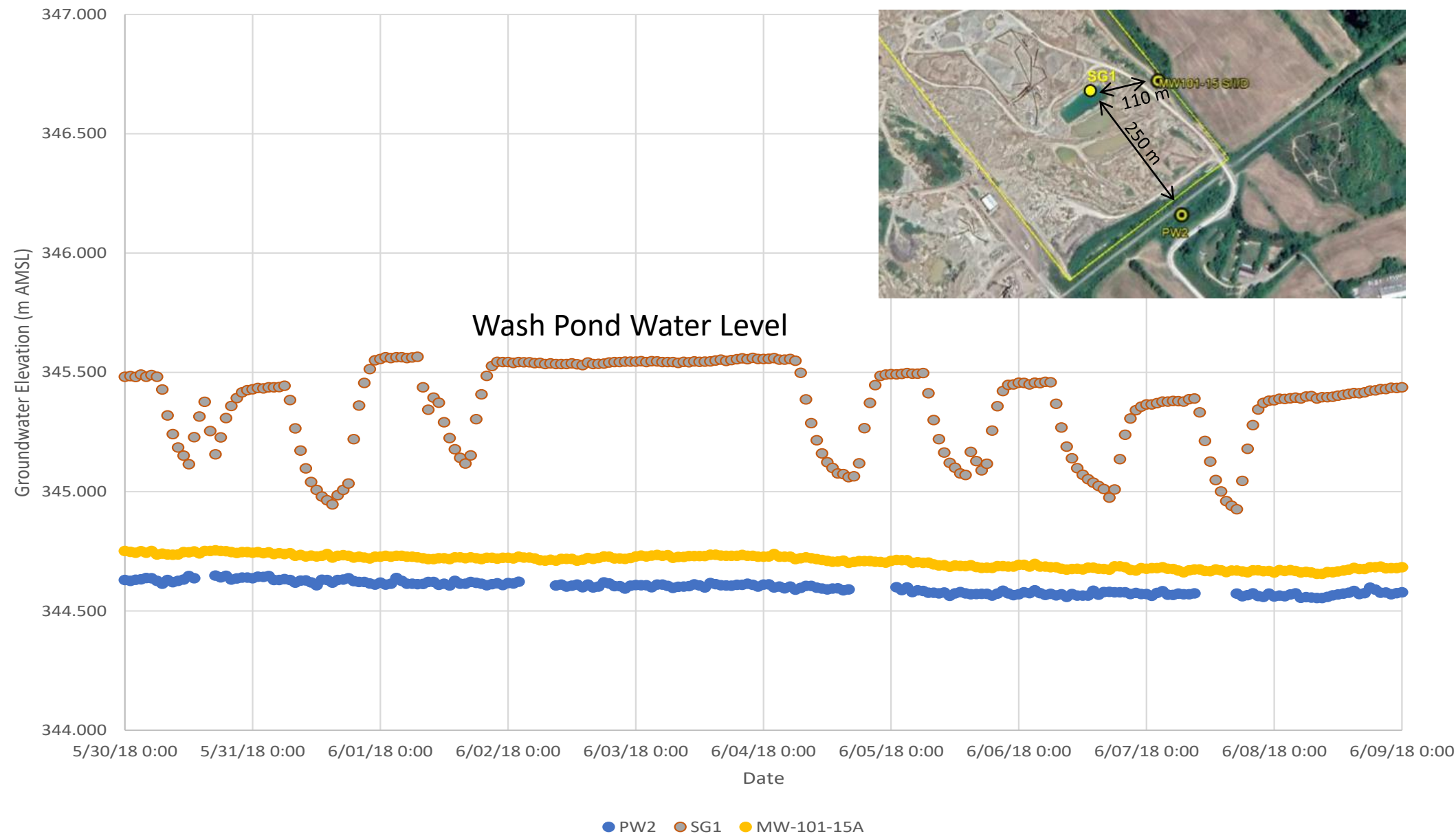
1894 Witmer Rd, CON South of Bleams Rd, PT LOT 10
 Township of Wilmot, Regional Municipality of Waterloo

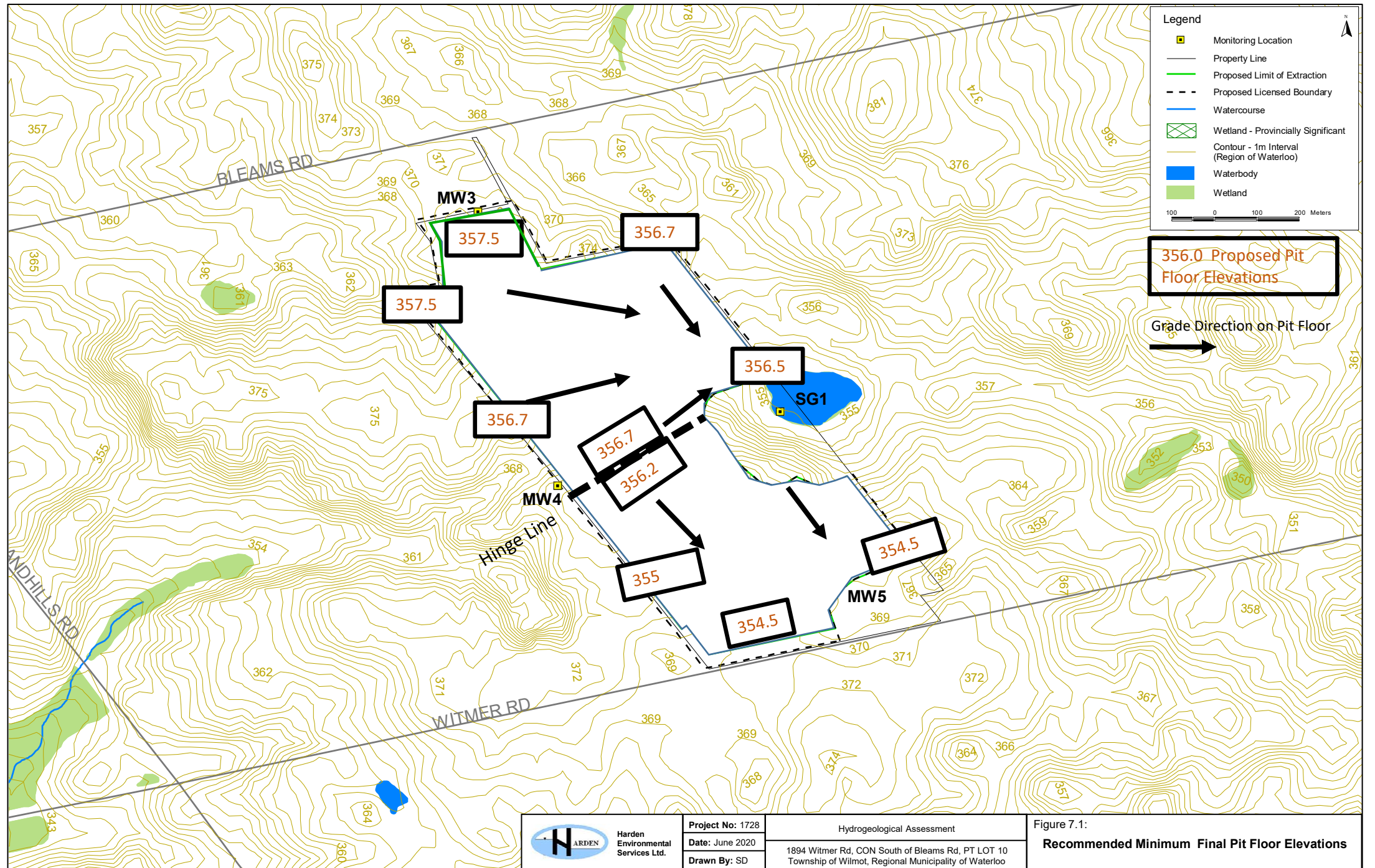
Figure 6:

Nitrate In Groundwater



Germet Pit Wash Pond and Nearby Monitors





Harden Environmental Services Ltd.

Appendix A – ROW Comments



Region of Waterloo

Transportation and Environmental Services
Water Services

Memorandum

To: Stan Denhoed, Harden Environmental Services Ltd.

From: Geoff Moroz

Subject: ZCA 11/19, Jackson Harvest Farms Ltd., 1894 – 1922 Witmer Road,
Township of Wilmot

File #: E06-08/WIL/19

Date: 18 February 2020

Dear Mr. Denhoed,

Hydrogeology and Source Water Protection (HSW) staff have reviewed the above-captioned Zone Change Application (ZCA) submitted on behalf of Jackson Harvest Farms Ltd. for a proposed above-water table aggregate operation at municipal addresses 1894 to 1922 Witmer Road in the Township of Wilmot. HSW staff reviewed the technical reports that were submitted in support of the proposed aggregate pit. The following relevant technical reports were reviewed by HSW staff:

- 1) Phase I Environmental Site Assessment (CVD, 2017a)
- 2) Phase II Environmental Site Assessment (CVD, 2017b)
- 3) Hydrogeological Assessment, Level 1 and 2 (Harden, 2019)

HSW staff reviewed the submission and assessed the technical reports with a focus on potential impacts to drinking water sources from the proposed aggregate pit as well as to ensure consistency of the technical work with the Region's Guidelines for Hydrogeological Assessments for Proposed Mineral Aggregate Resource Extraction Projects. As noted in the Region's comments to Andrew Martin at the Township of Wilmot dated February 7, 2020 HSW staff do not support the proposed Zone Change at this time. Additional investigation and reporting will be required prior to consideration for Zone Change approval.

Potential On-Site Contamination

- I. According to Hydrogeological Assessment report, groundwater flow is in a southerly direction in the shallow aquifer. Therefore, MW1 is cross-gradient of the historical USTs and may not adequately characterize potential impacts to groundwater in this Area of Potential Environmental Concern (APEC).
- II. The report indicated that contaminated soils were stockpiled and excavated. It is unclear whether these soils have been removed from the site or treated *in-situ*.
- III. Groundwater sampling was not conducted in concrete pad area with leaking drums.
- IV. Actual contamination was identified in soils excavated in APECs across the site. Based on the information provided in the Phase II Environmental Site Assessment (ESA), there appears to be potential risk of BTEX/PHC contamination in groundwater that was not adequately assessed.

General Draft Aggregate Guideline Deficiencies

- I. A bedrock geology map was not provided.
- II. Discussion of soil and other aggregate reports from nearby aggregate pits was not provided.
- III. Hydraulic response testing must be completed at monitoring wells.
- IV. Groundwater samples need to be collected from all on-site monitoring wells (including new wells) for petroleum hydrocarbons (PHCs), nutrients and general chemistry, including major cations and anions for a minimum of two years.
- V. Cross-sections require more detailed interpretation of the hydrogeological units of Regional significance, particularly showing the Regional Hydrogeologic Context connecting the Wilmot Centre Well Field to the subject property, and showing all available monitoring wells.
- VI. A north-south cross-section through the site was not provided.
- VII. Groundwater elevations do not appear to mimic the topography, which may be due to the lack of groundwater monitoring locations across the site.
- VIII. A snapshot of Groundwater nitrate concentrations should be presented on a map, including data from on- and off-site monitoring wells, if available. Private domestic wells should be included where allowed.
- IX. Figure 7.1 shows a different limit of extraction than Figure 2.7.
- X. A proposed rehabilitation and monitoring plan was not provided.

Private Well Survey

- XI. A water well survey of private wells was completed for a 500 m radius around the site, instead of the 1.0 km radius required by the Region's draft guidelines. The proponent should provide rationale for not using the 1.0 km radius.
- XII. Section 1.3.5 indicated that there are 16 civic addresses not connected to the municipal water supply within 500 m of the site; however, it is not clear if this was determined through the door-to-door well survey, roadside surveys, etc.

High Water Table Delineation

- XIII. Rationale was not provided for the chosen groundwater monitoring locations.

- XIV. HSW's opinion there is an inadequate number of groundwater monitoring locations to delineate the on-site high water table and groundwater flow direction, particularly in the proposed extraction area and in the west central portion of the property near the headwaters of Hunsberger Creek.
- XV. Additional groundwater monitoring locations will need to be installed within the footprint of the proposed extraction area.
- XVI. The report did not consider potential impacts to regional and on-site groundwater elevations related climate change. As demonstrated on the time-series plot of nearby Region monitoring well WT-WC-WM19-93-B, shallow aquifer groundwater elevations have varied by over 2 metres throughout the monitoring period, and exhibit an overall increasing elevation trend over time. The report should evaluate high water table elevations in comparison to the historical high groundwater elevations demonstrated below, as well as provide for forecasting of potential increases in the high water table as a result of climate change.

Site Water Balance

- XVII. The report did not include a figure showing the proposed location of the pond that will be excavated beneath the water table for aggregate washing.
- XVIII. The report identified an anticipated maximum daily taking of 144 L/s required for the aggregate wash ponds. How was this rate of taking determined?
- XIX. More details need to be provided for the site water balances presented in Section 2 and Section 6 of the report.
- XX. The pre-extraction infiltration volume presented in Table 12 is different than the pre-extraction infiltration volume presented in Table 8.
- XXI. The analysis prepared for Table 12 should include additional scenarios at the beginning and near the end of the operation.

Potential Impacts to Nearby Municipal and Private Drinking Water Sources

- XXII. The presence and thickness of the protective aquitard ATB2 referenced in the report cannot be confirmed/refuted at the site because groundwater monitoring wells were not advanced to sufficient depths.
- XXIII. Due to the lack of information about the connectivity between the unconfined aquifer and the municipal supply aquifer, and the lack of analyses regarding impacts from shallow groundwater pumping for the wash ponds, not enough information has been collected to determine whether there may be an impact to private and/or municipal supply wells in the vicinity of the proposed pit.
- XXIV. Section 4.2 indicates that the proposed extractive operation will not be physically disturbing any local aquifer; however, an assessment of the supply aquifers for the nearby private wells was not provided in this report.
- XXV. Section 4.2 indicates that during the Region's testing at the Wilmot Centre Well Field there were no impacts to on-site wells at the Jackson Harvest Farms Ltd. property. This was based on continuous 1-hour recordings from dataloggers during the testing period. However, data was not presented to support this.
- XXVI. At least one multi-level monitoring well will need to be installed to confirm vertical hydraulic gradients at the site, at a location between the areas of extraction and the municipal well field.

- XXVII. Section 4.2 of the report indicates that the removal of the sandy overburden will decrease the thickness of the unsaturated zone, but is of little or no consequence. The report should discuss potential impacts of reduced vertical travel times to nearby private and municipal wells.
- XXVIII. Section 4.4 of the report indicates that nitrate concentrations in the area of MW2 are from off-site sources. The report did not provide any interpretation of groundwater quality across the rest of the site or potential on-site nitrate sources.
- XXIX. Will the post-development reduction in runoff from Drainage Area D-1 (Figure 4.7) result in a decrease in recharge at the Wilmot Centre Well Field?
- XXX. The report does not indicate where the lands south of the “hinge line” will drain.
- XXXI. Surface elevation contours suggest there is flow to the west (Hunsberger Creek), but this is not identified in the report. Will there be a decrease in surface water contribution to Hunsberger Creek post-extraction?
- XXXII. The report did not provide any assessment of the potential risks to groundwater quality of nearby private and municipal wells as it relates to the recycling activities proposed at the subject property.

Groundwater Monitoring Program

- XXXIII. The report did not propose to include any private wells as part of the groundwater monitoring program. The proponent should provide rationale to confirm why they were not included.
- XXXIV. The report did not include a Trigger Level and Contingency Plan to evaluate potential adverse impacts to nearby private and municipal wells, in terms of groundwater quality and groundwater quantity, as a result of operations at the aggregate pit.
- XXXV. Ongoing groundwater monitoring is required at all on-site monitoring wells. Daily groundwater elevation recordings are sufficient. Quarterly manual groundwater elevation monitoring is required at all on-site monitoring wells. Annual groundwater quality samples are required at on-site monitoring wells for general chemistry including major cations and anions, nutrients, and BTEX/PHCs.

The Spill Contingency Plan

- XXXVI. The following details should be added to the Spill Contingency Plan:
 - i. A list of proposed chemical storage areas and maintenance areas, presented in tabular format and numbered, including the following details
 - a. Type of chemical
 - b. Storage capacity of the container/tank
 - c. Tank/container design specifications (i.e. double-walled, overflow alarms, leak sensors, overflow containment curbs, etc.)
 - ii. A Site Plan showing proposed locations of all spill kits, chemical storage areas and maintenance areas, and labelled on the Site Plan in accordance with the numbering scheme from the Table required in the previous comment
 - iii. Frequency of routine inspections
 - iv. Preventative maintenance requirements
 - v. Procedures and spill prevention measures for refilling of chemical storage tanks
 - vi. Recommended employee training
 - vii. Roles and responsibilities of individuals for implementing this Spill Plan

- viii. Name of person designated to ensure this Plan is followed, including contact information
- ix. Indicate that there will be record keeping and reporting procedures
- x. Indicate how often this plan will be reviewed
- xi. MSDS sheets for each chemical to be stored on-site

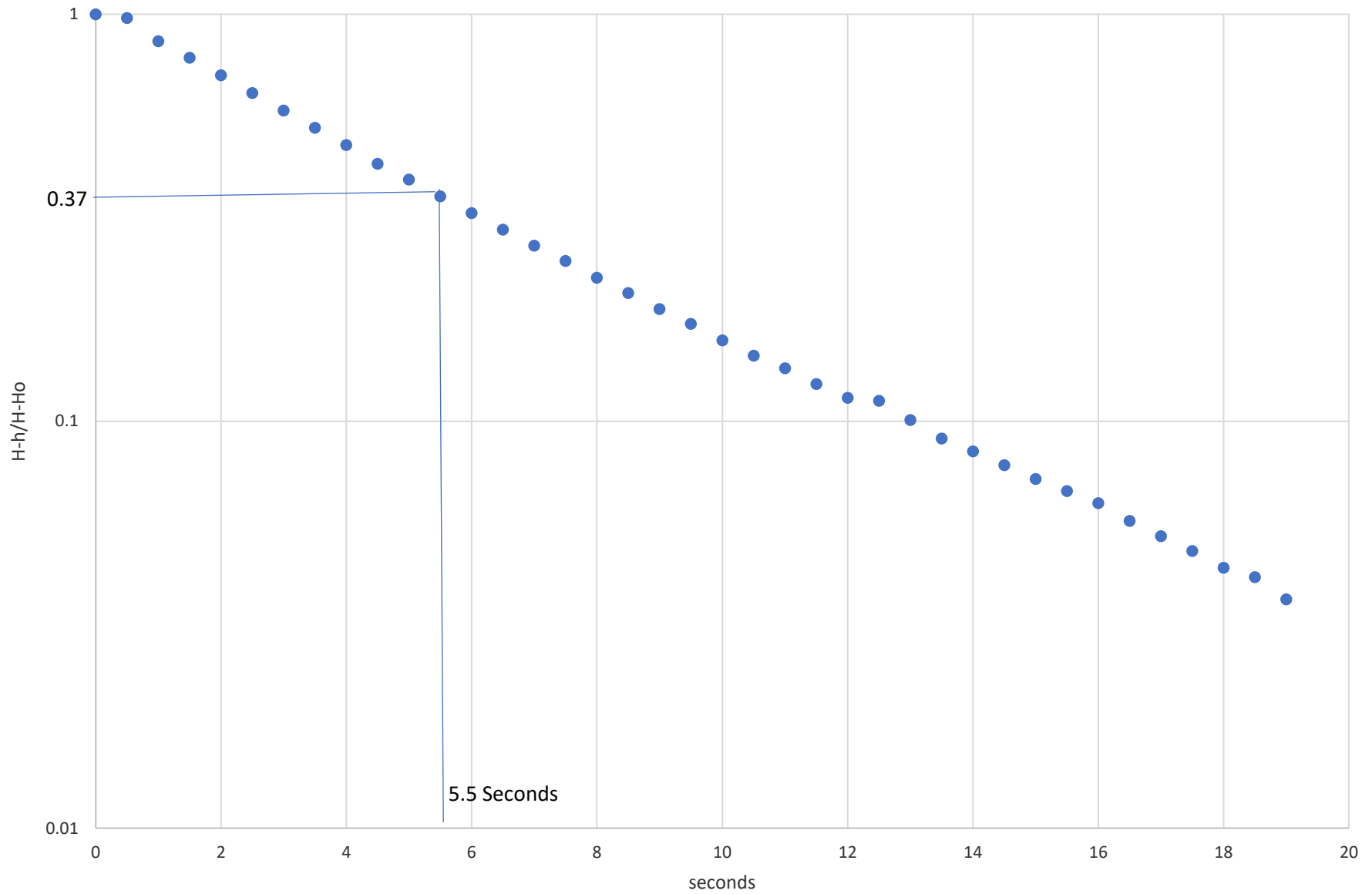
Best Regards,

Geoff Moroz, P.Geo.

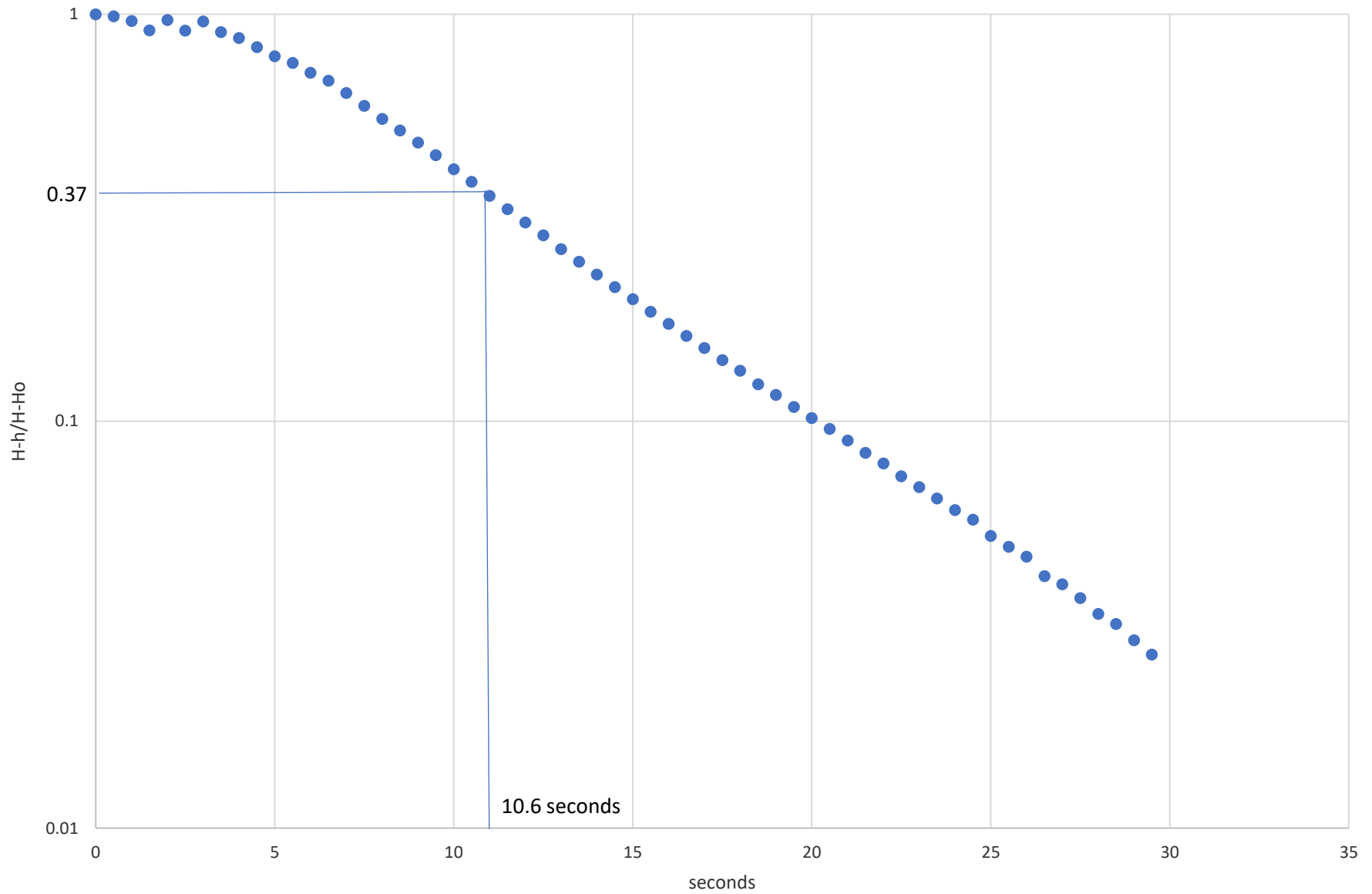
Cc: Don Corbett, P.Geo.
Eric Hodgins, P.Geo.

Appendix B – Results of Hydraulic Testing

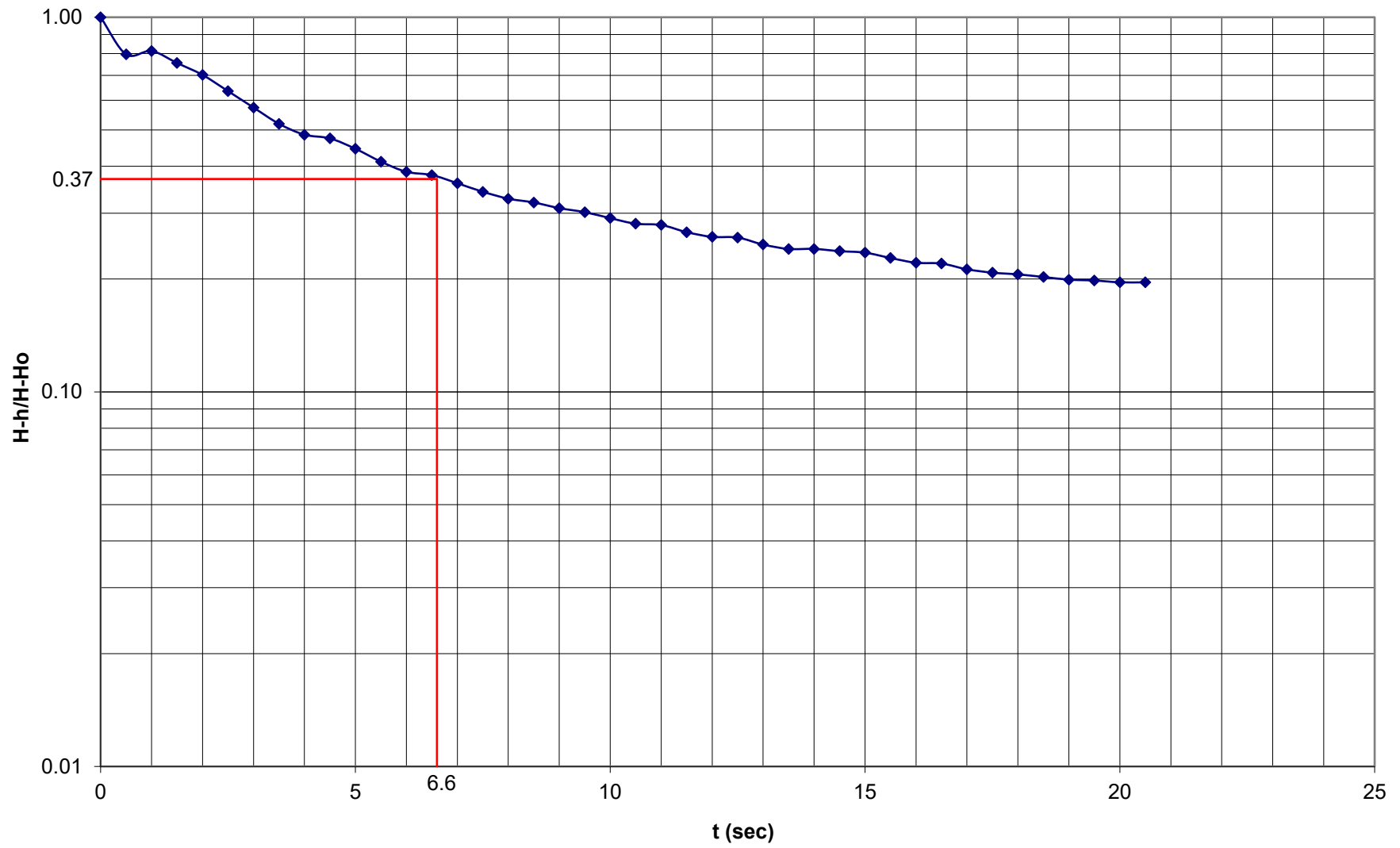
MW1 - Added 4L water
datalogger recording every 0.5 sec



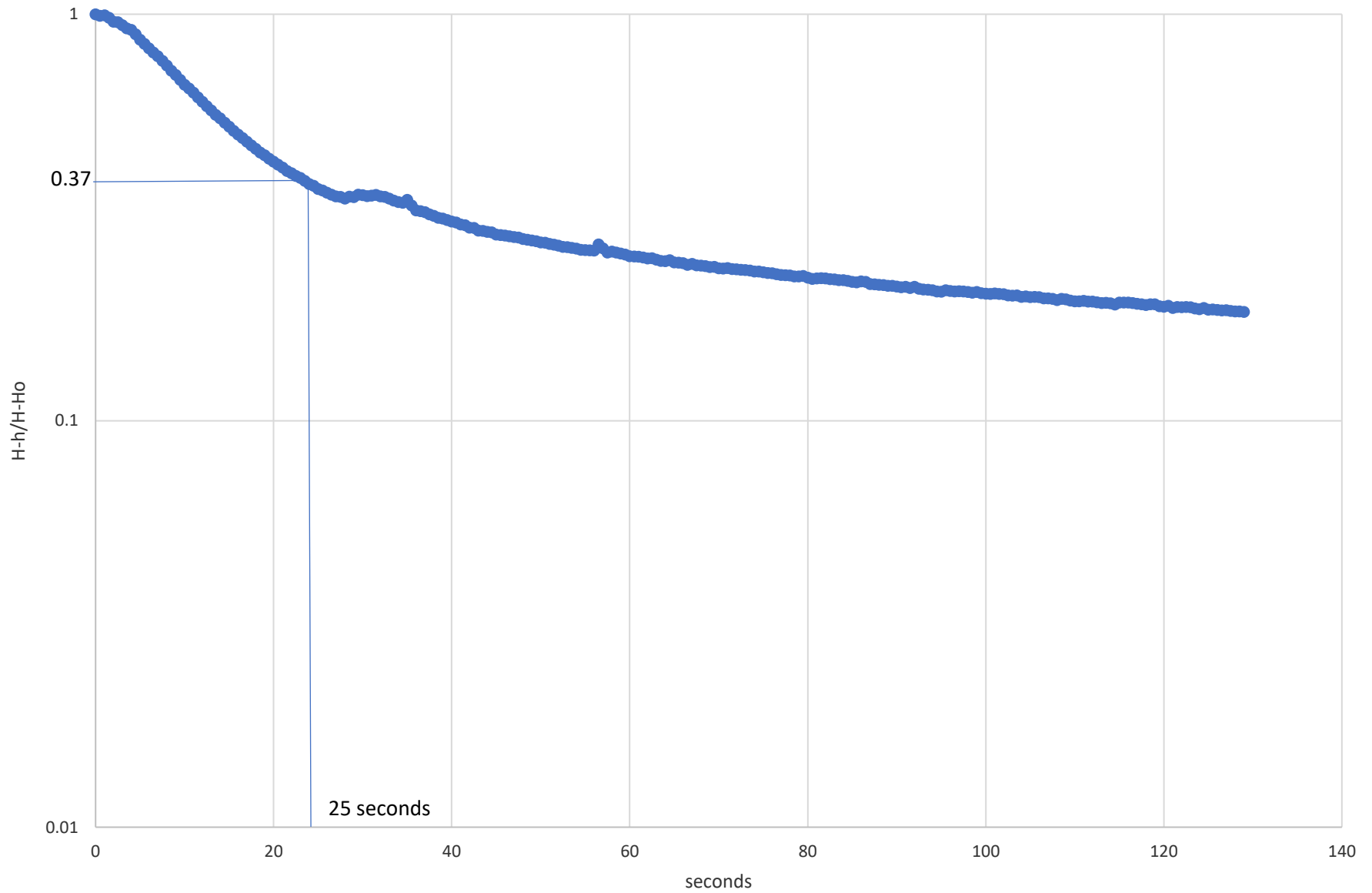
MW2 - added 8L water
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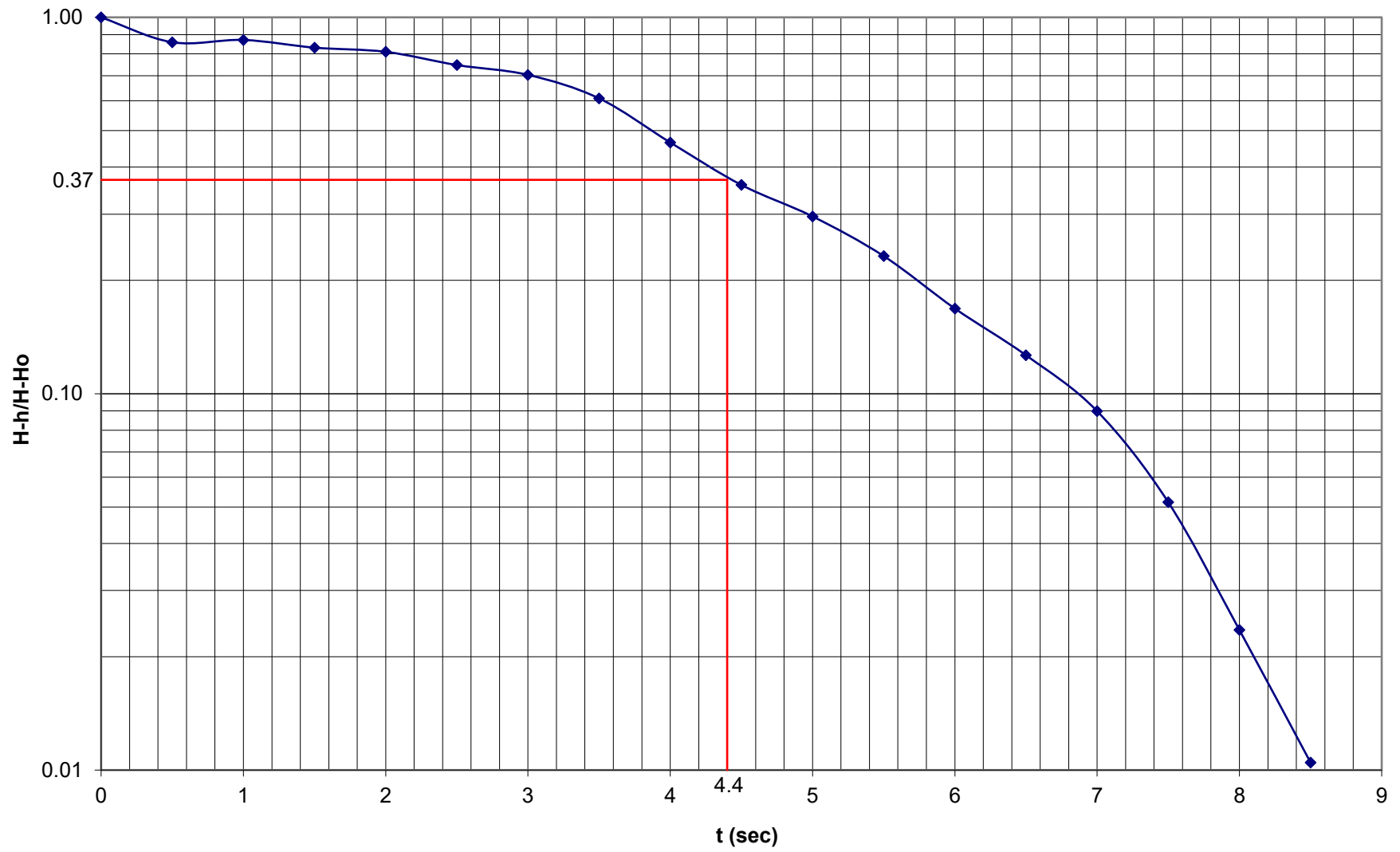
MW3 Falling Head Test (Hvorslev Method)
 $K = 5.10 \times 10^{-5}$ m/sec



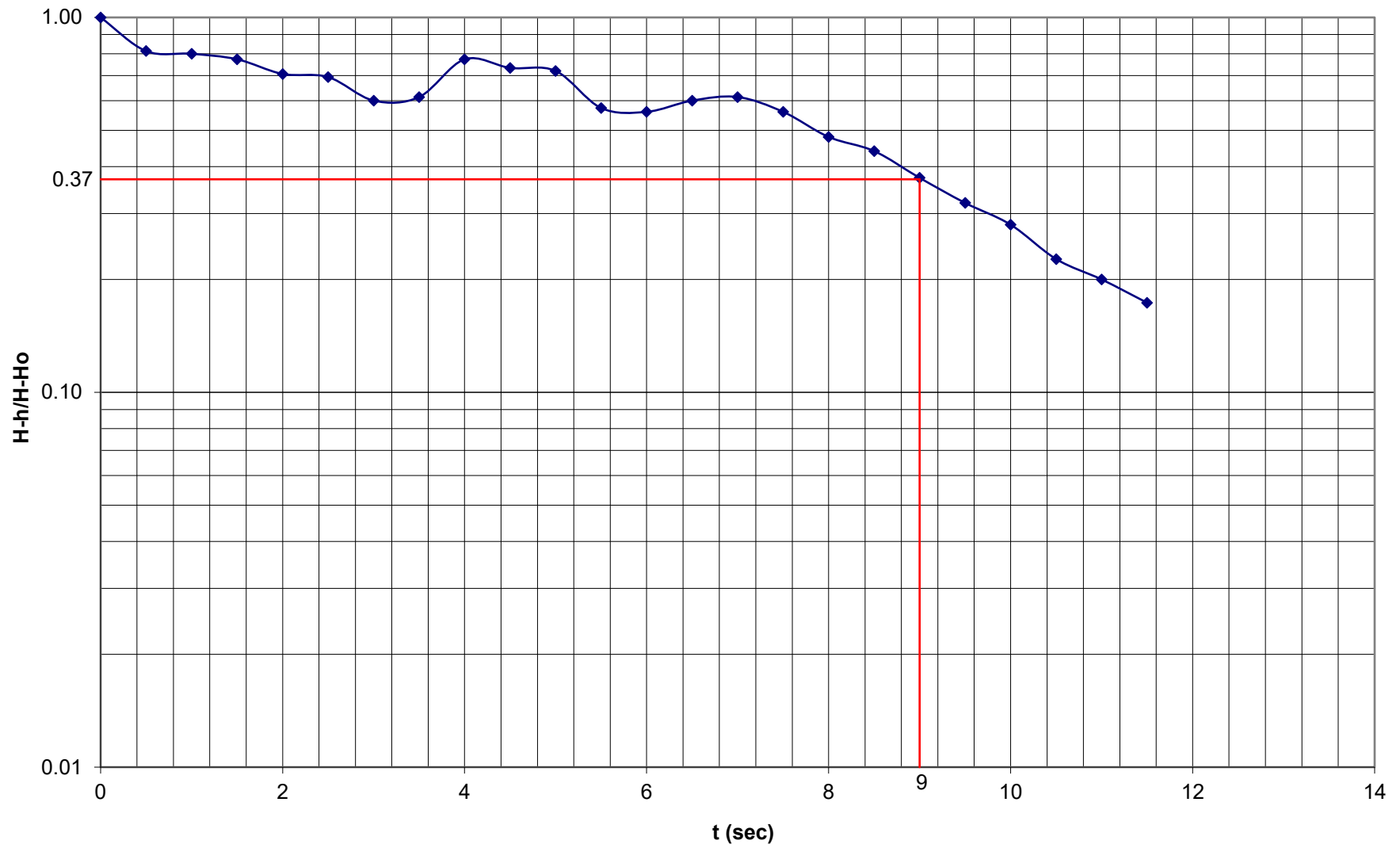
MW4 - Added 8L water
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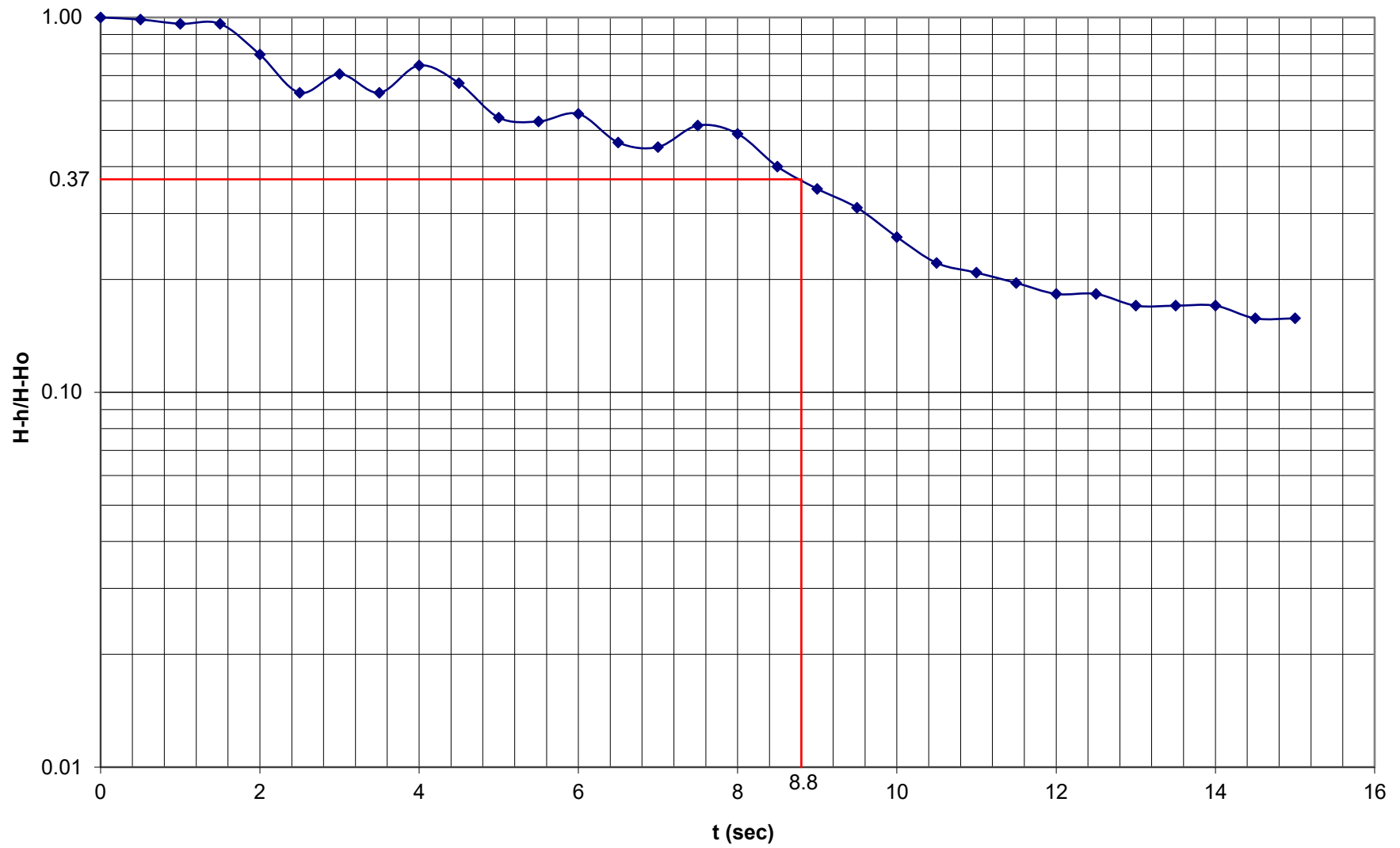
MW5 Falling Head Test (Hvorslev Method)
 $K = 7.65 \times 10^{-5} \text{ m/sec}$



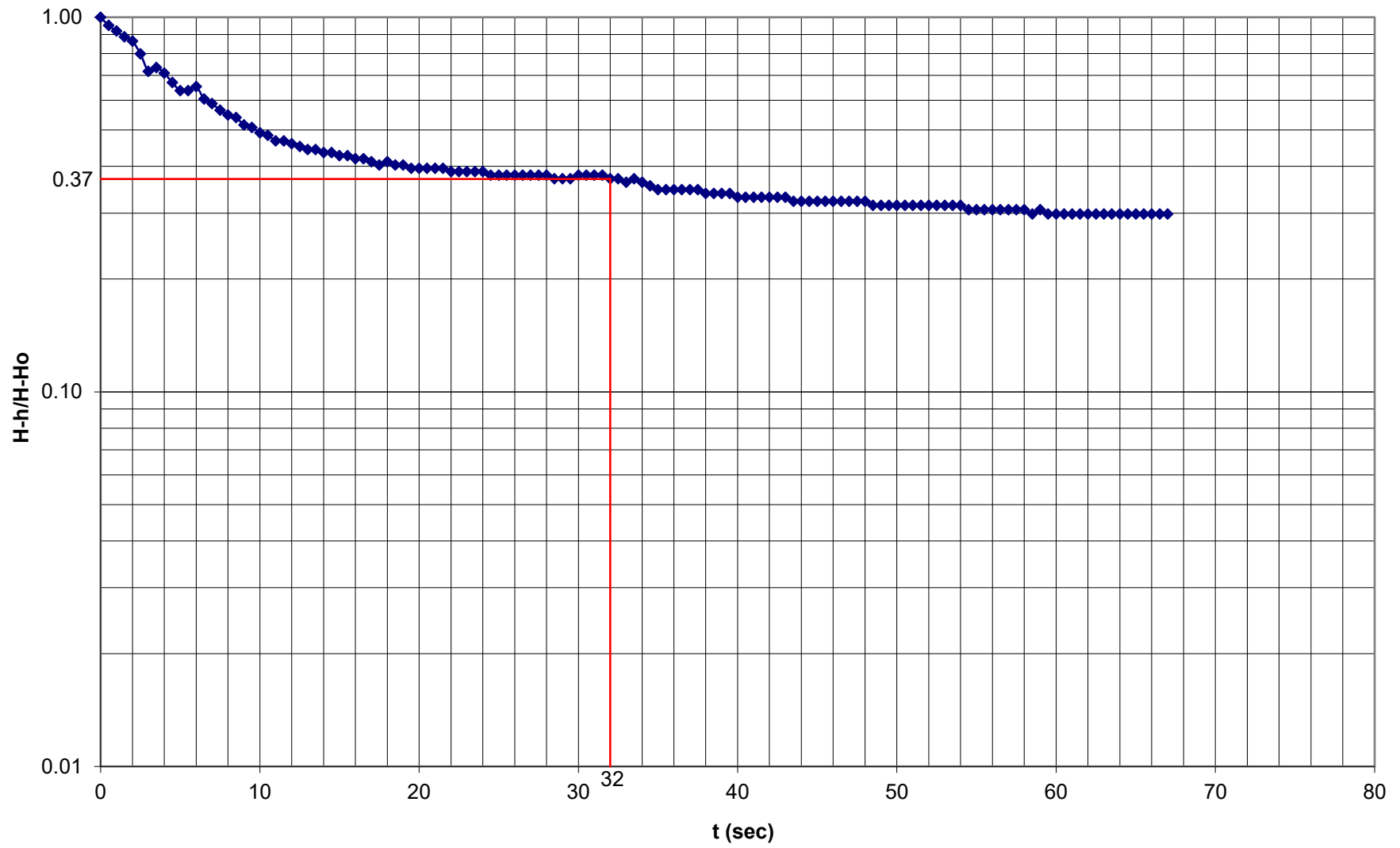
MW6 Falling Head Test (Hvorslev Method) - Test #1
 $K = 5.68 \times 10^{-5} \text{ m/sec}$



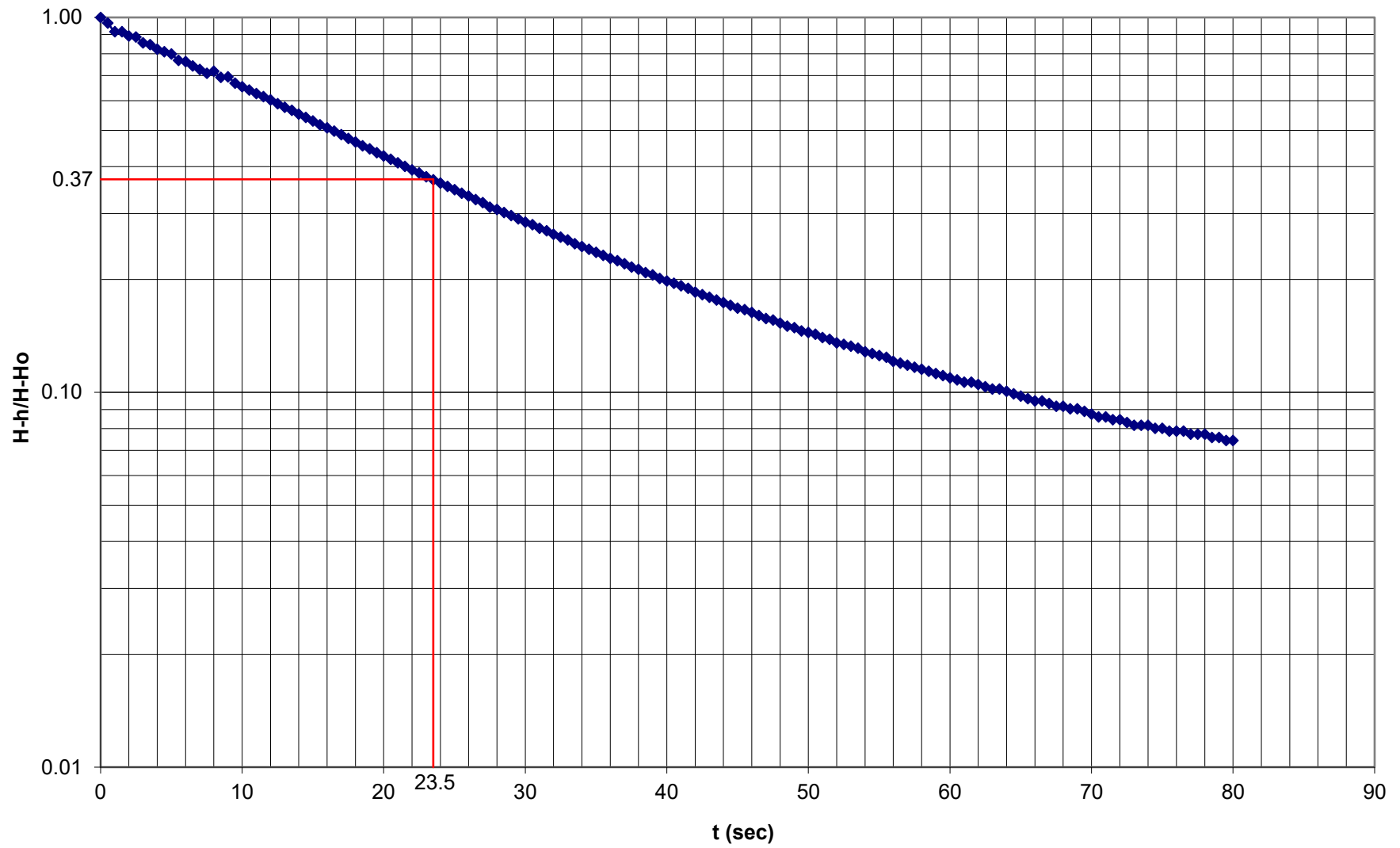
MW6 Falling Head Test (Hvorslev Method) - Test #2
 $K = 5.81 \times 10^{-5} \text{ m/sec}$



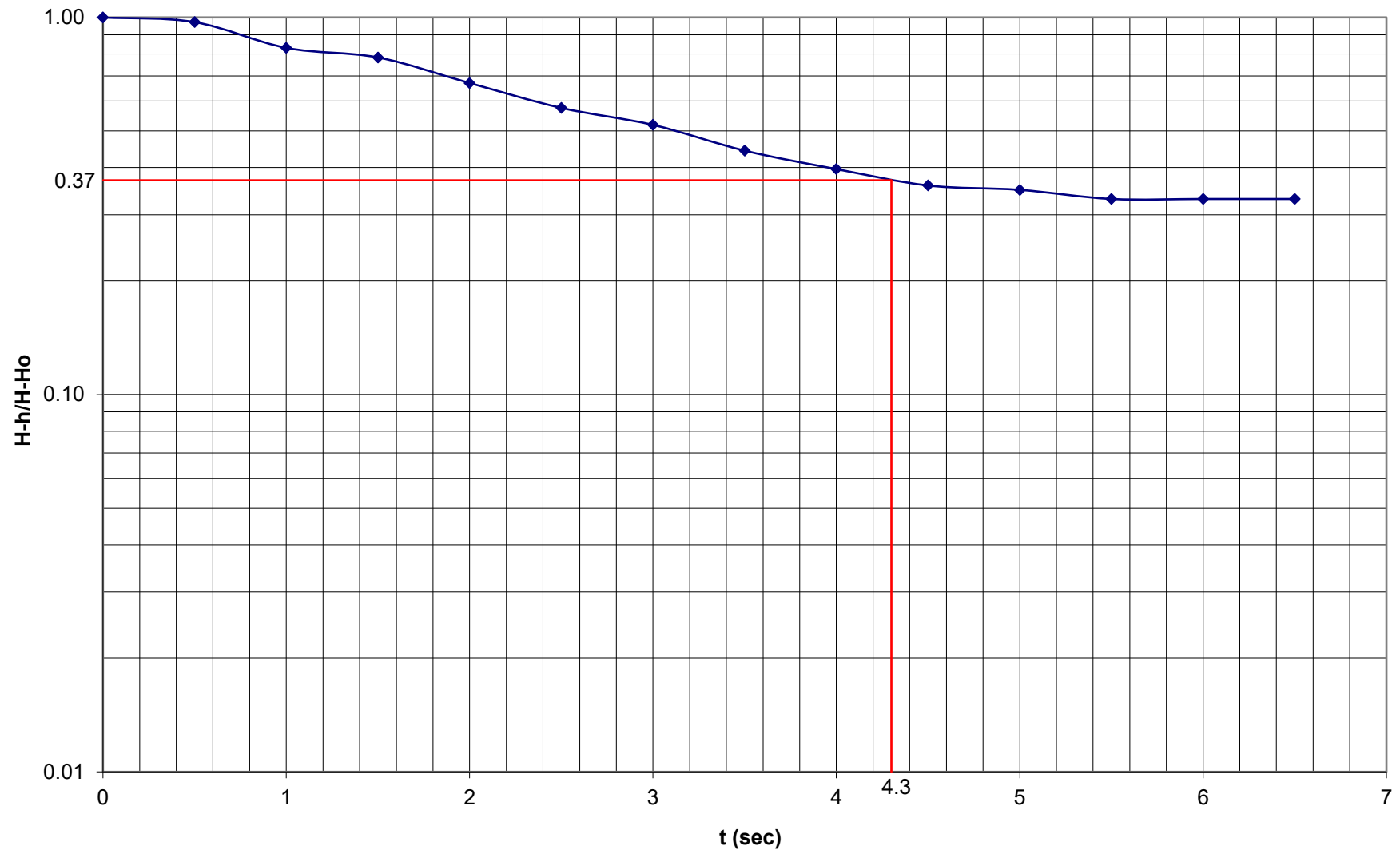
MW7S Falling Head Test (Hvorslev Method)
 $K = 1.05 \times 10^{-5} \text{ m/sec}$



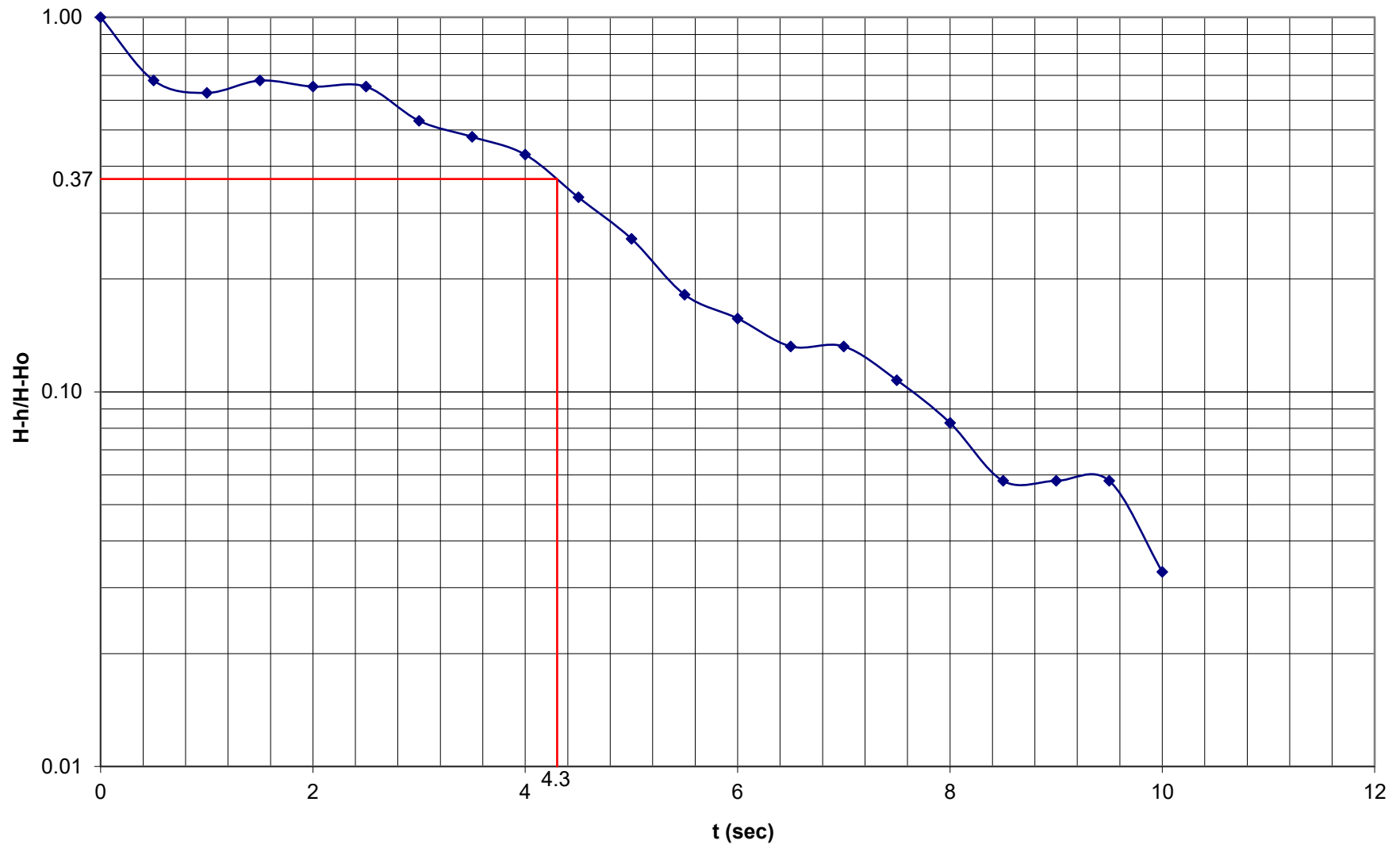
MW7D Falling Head Test (Hvorslev Method)
 $K = 2.18 \times 10^{-5} \text{ m/sec}$



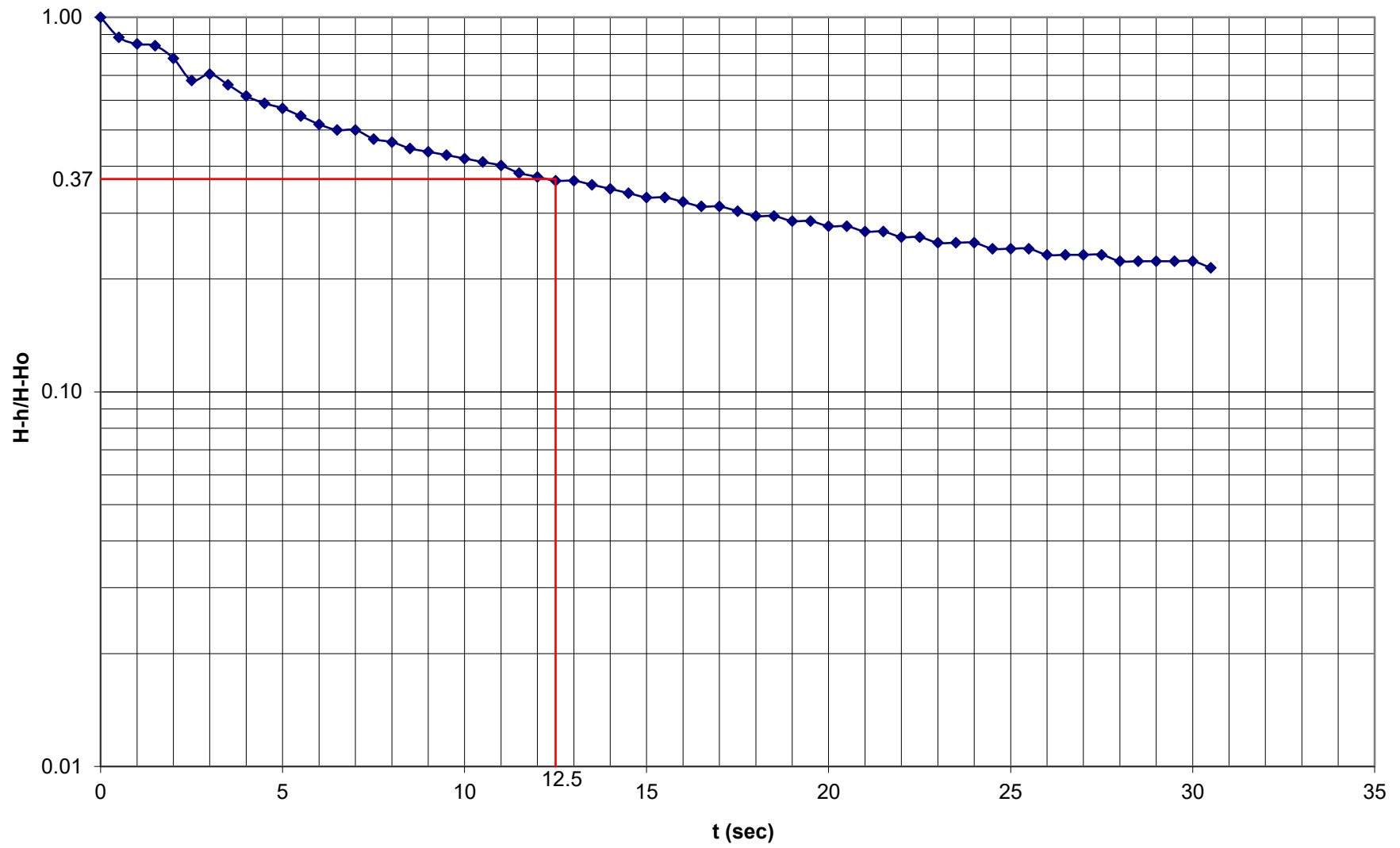
MW8 Falling Head Test (Hvorslev Method)
 $K = 7.82 \times 10^{-5} \text{ m/sec}$



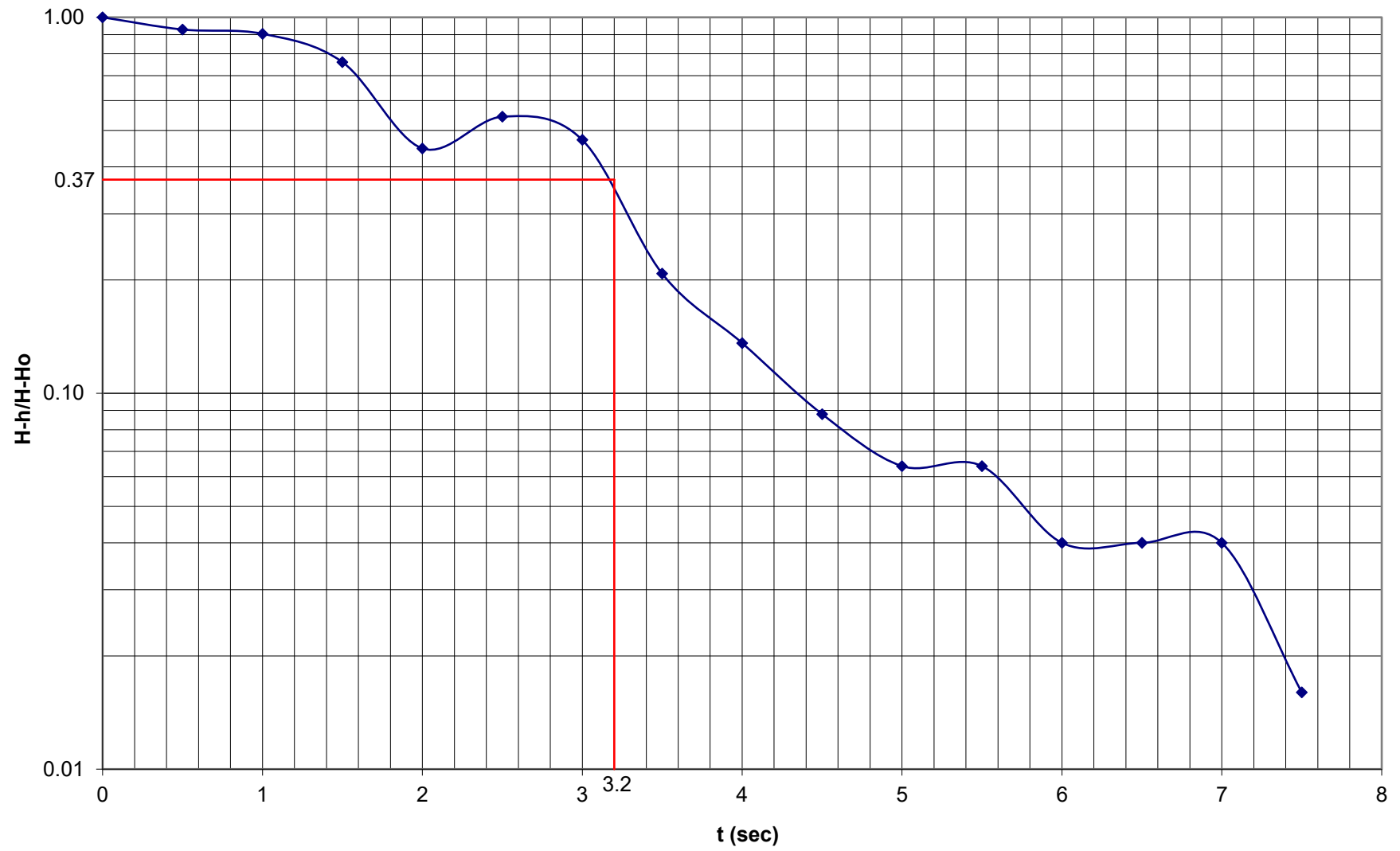
MW9 Falling Head Test (Hvorslev Method)
 $K = 7.82 \times 10^{-5} \text{ m/sec}$

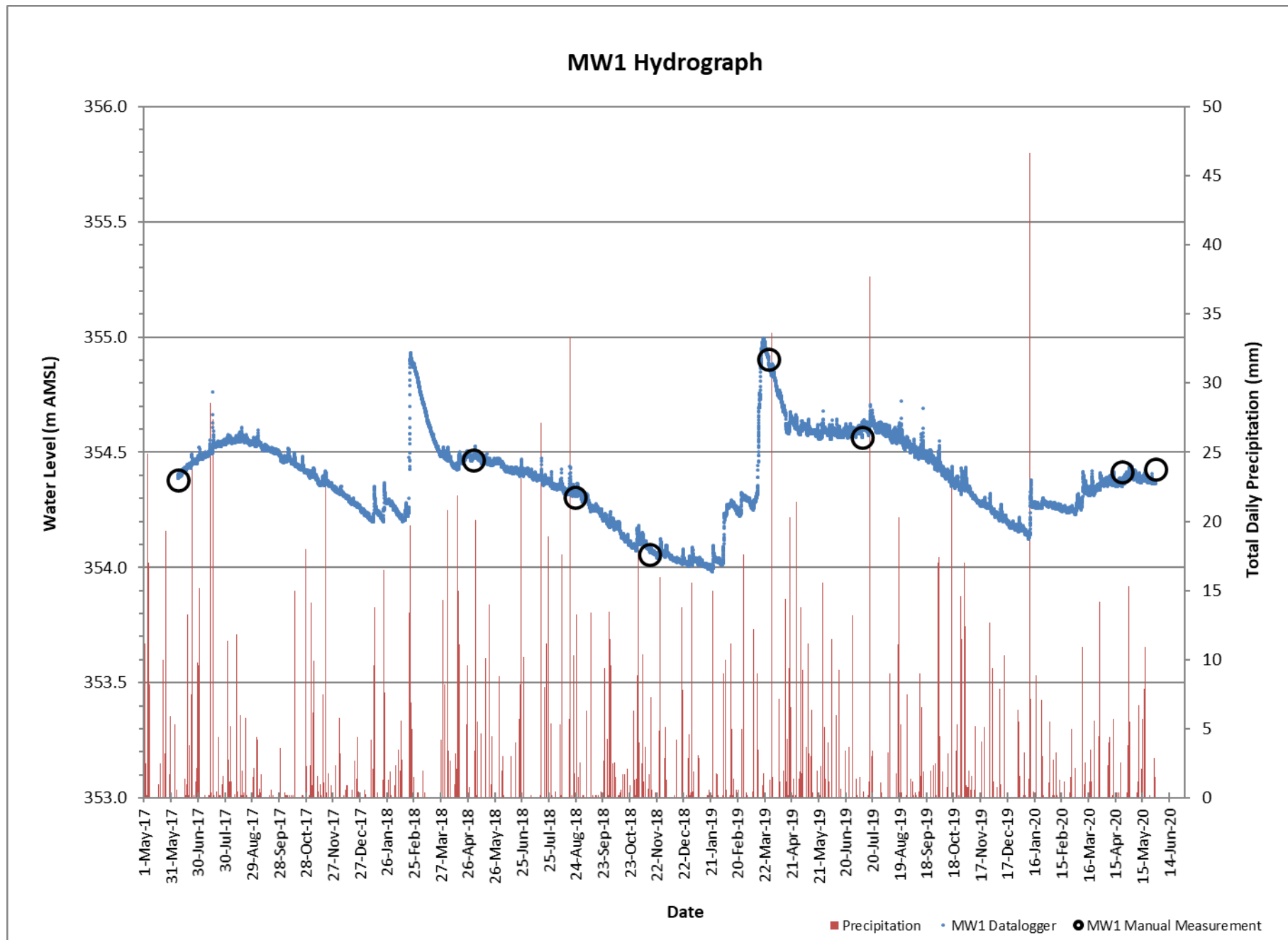


MW10 Falling Head Test (Hvorslev Method)
 $K = 2.69 \times 10^{-5} \text{ m/sec}$



MW11 Falling Head Test (Hvorslev Method)
 $K = 1.05 \times 10^{-4} \text{ m/sec}$





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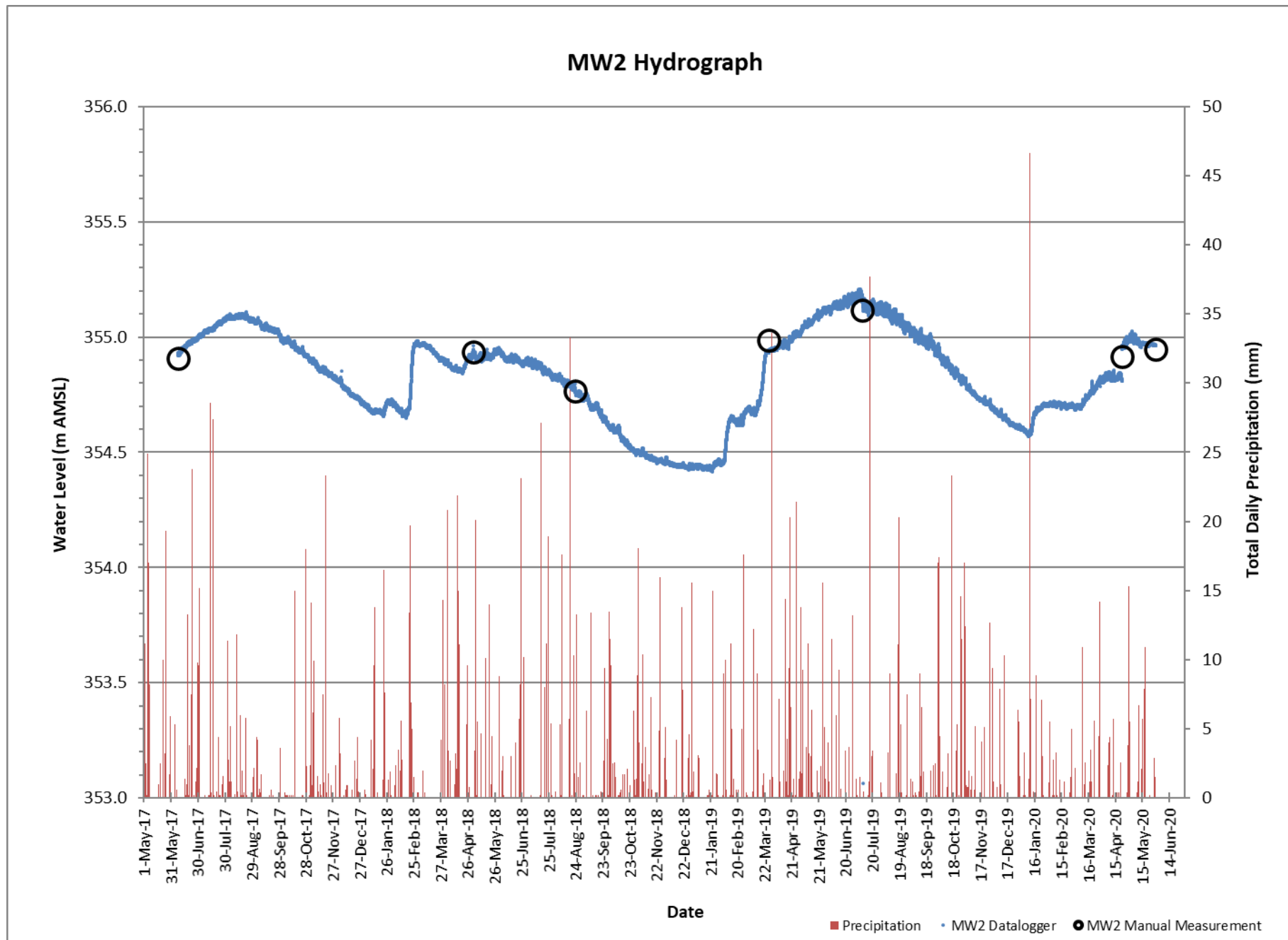
Date: May 2020

Drawn By: AR

Hydrogeological Assessment

1894 Witmer Rd, CON South of Bleams Rd, PT LOT 10
Township of Wilmot, Regional Municipality of Waterloo

Figure 1.5: MW1 Hydrograph



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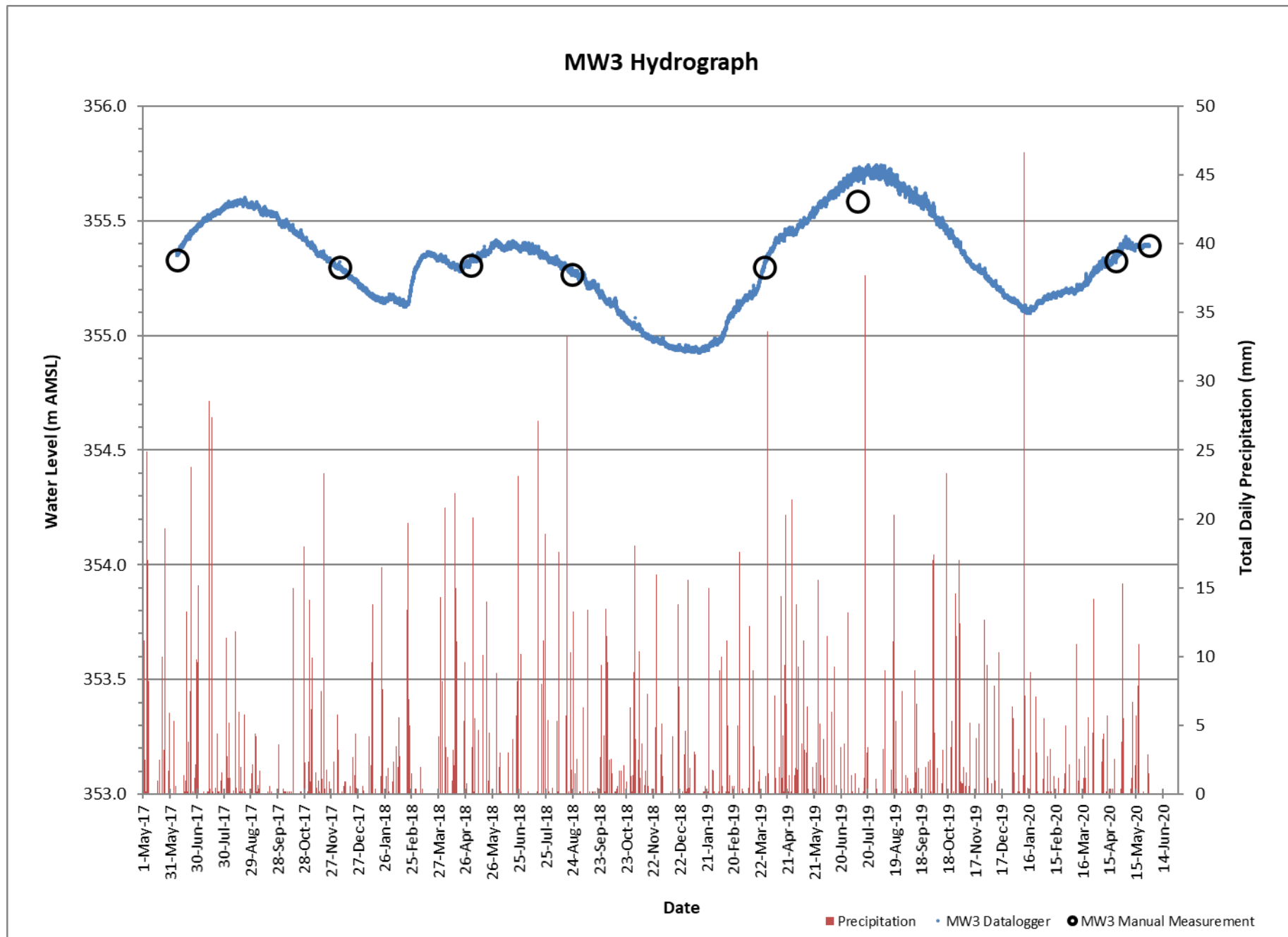
Date: May 2020

Drawn By: AR

Hydrogeological Assessment

1894 Witmer Rd, CON South of Bleams Rd, PT LOT 10
Township of Wilmot, Regional Municipality of Waterloo

Figure 1.6: MW2 Hydrograph



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Services Ltd.**

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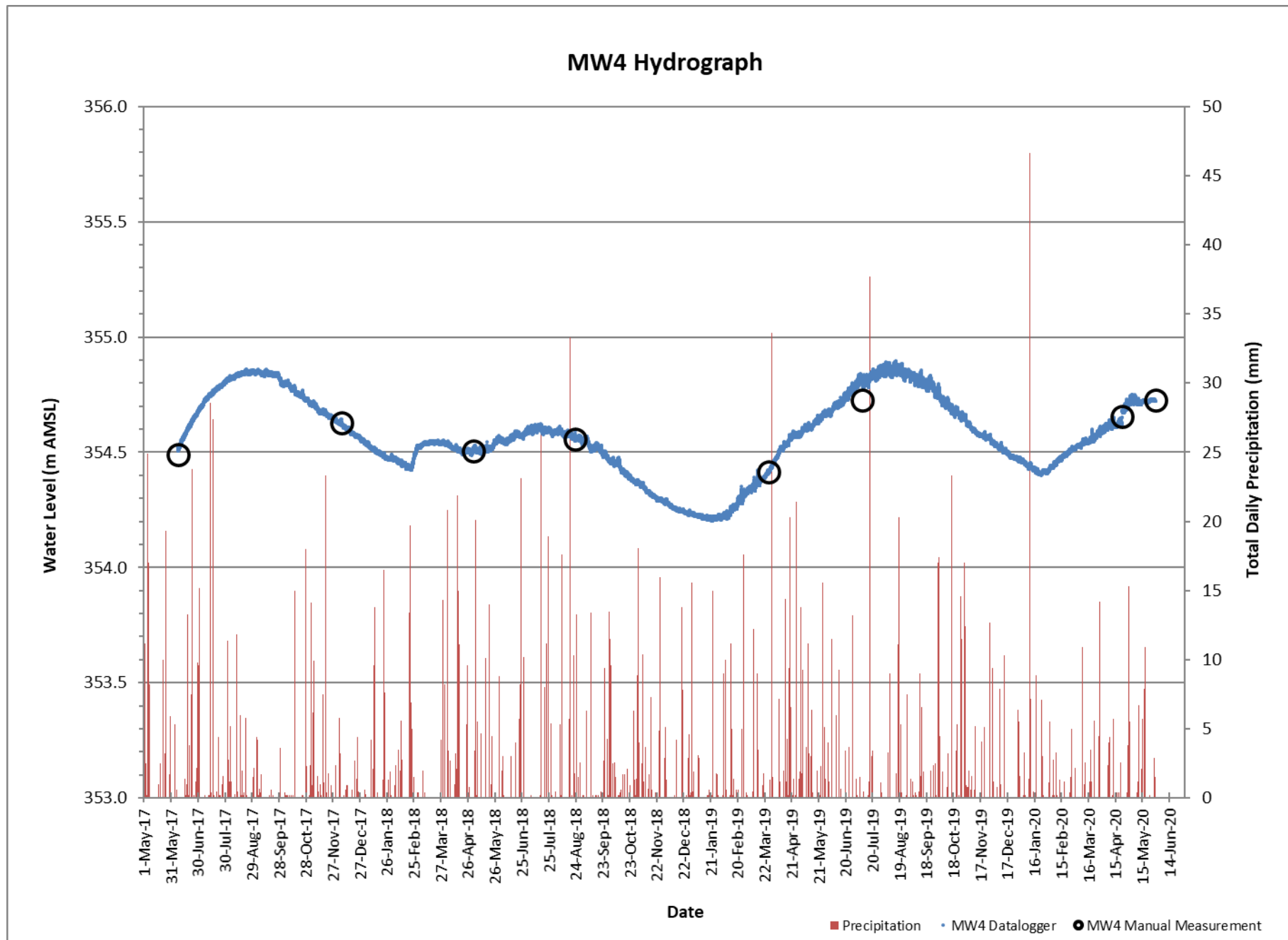
Date: May 2020

Drawn By: AR

Hydrogeological Assessment

1894 Witmer Rd, CON South of Bleams Rd, PT LOT 10
Township of Wilmot, Regional Municipality of Waterloo

Figure 1.7: MW3 Hydrograph



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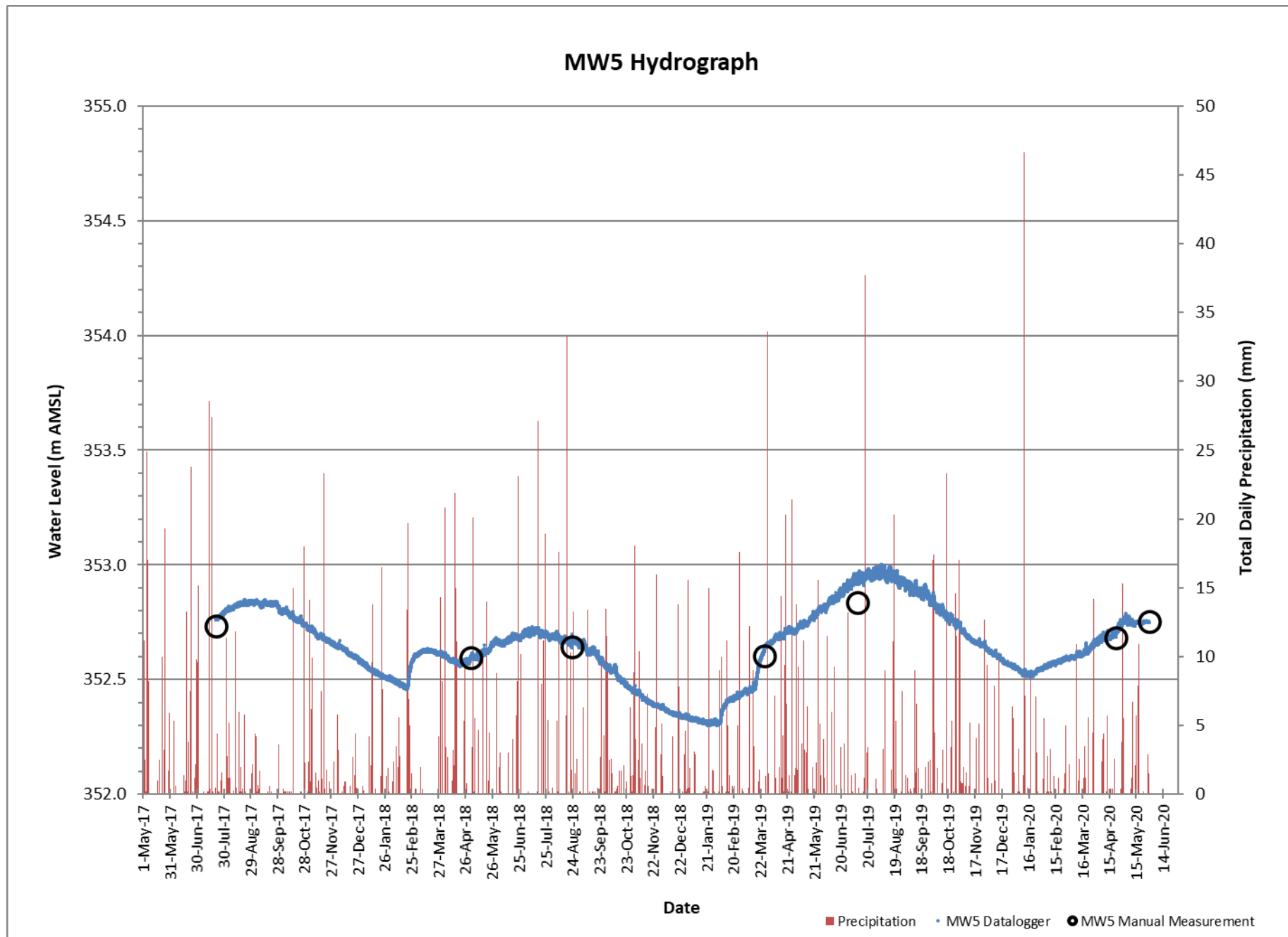
Date: May 2020

Drawn By: AR

Hydrogeological Assessment

1894 Witmer Rd, CON South of Bleams Rd, PT LOT 10
Township of Wilmot, Regional Municipality of Waterloo

Figure 1.8: MW4 Hydrograph



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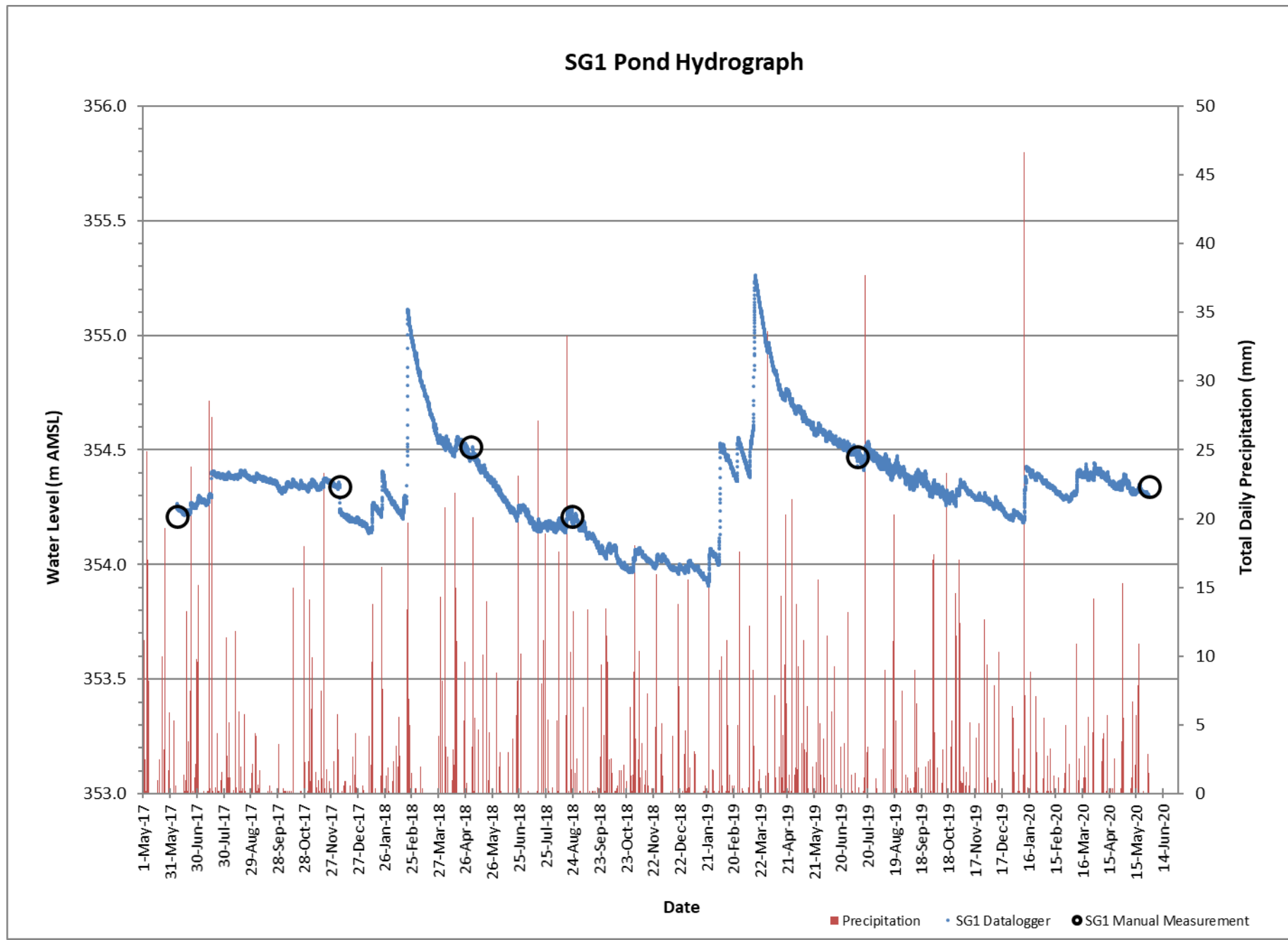
Date: May 2020

Drawn By: AR

Hydrogeological Assessment

1894 Witmer Rd, CON South of Bleams Rd, PT LOT 10
Township of Wilmot, Regional Municipality of Waterloo

Figure 1.9: MW5 Hydrograph



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Services Ltd.

Project No: 1728

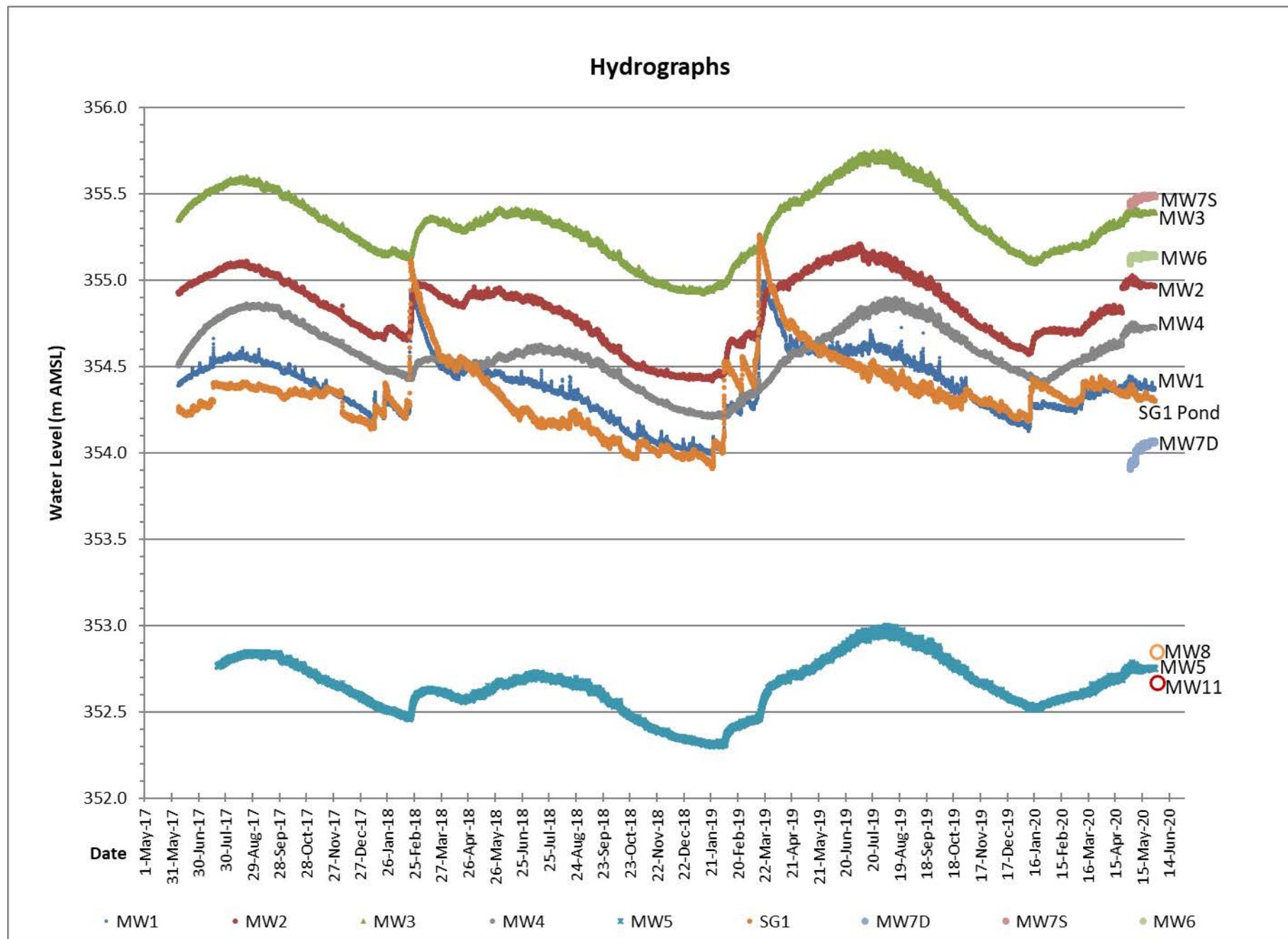
Date: May 2020

Drawn By: AR

Hydrogeological Assessment

1894 Witmer Rd, CON South of Bleams Rd, PT LOT 10
Township of Wilmot, Regional Municipality of Waterloo

Figure 1.10: SG1 Pond Hydrograph



Harden
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Services Ltd.

Project No: 1728

Date: May 2020

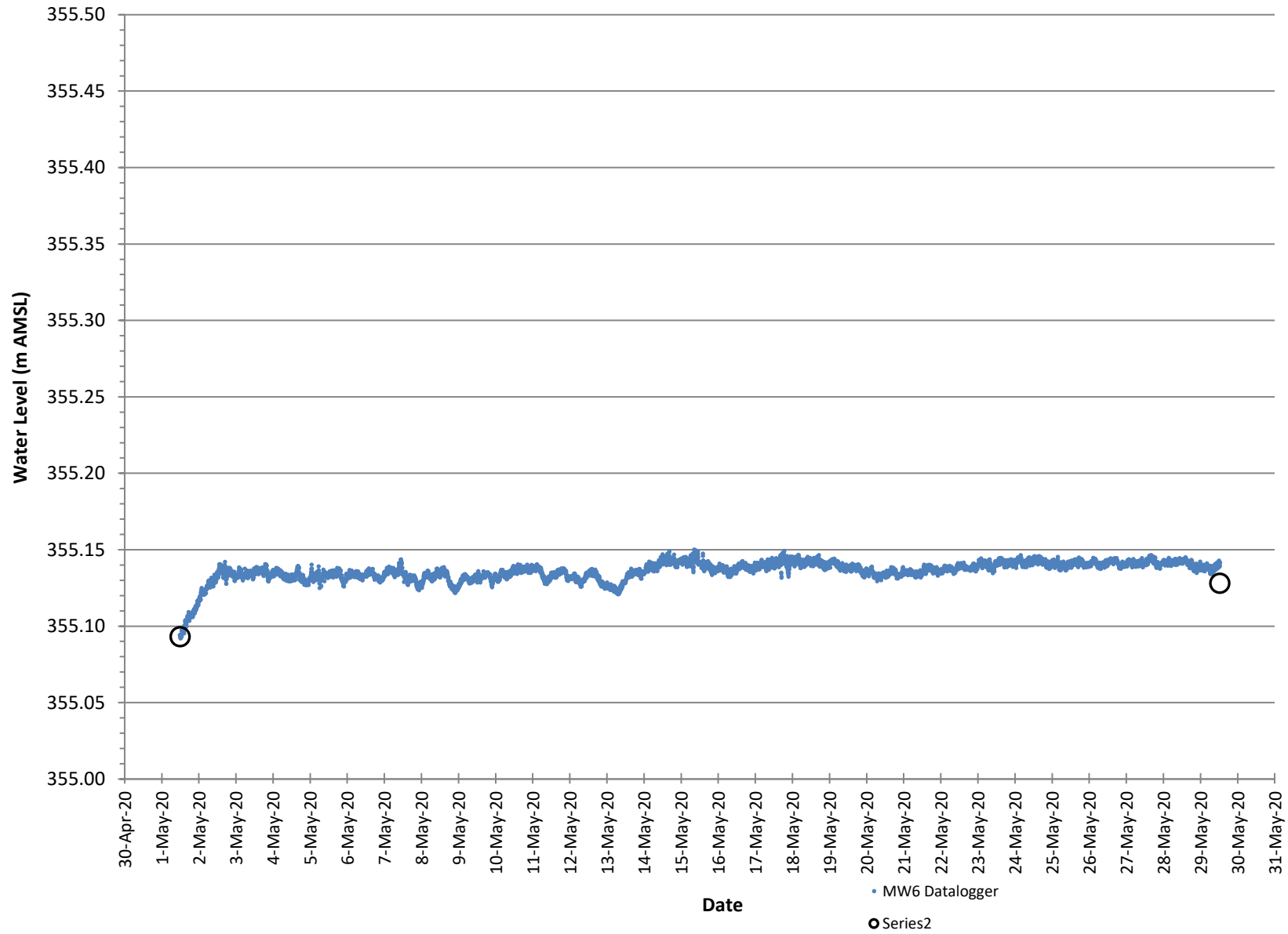
Drawn By: AR

Hydrogeological Assessment

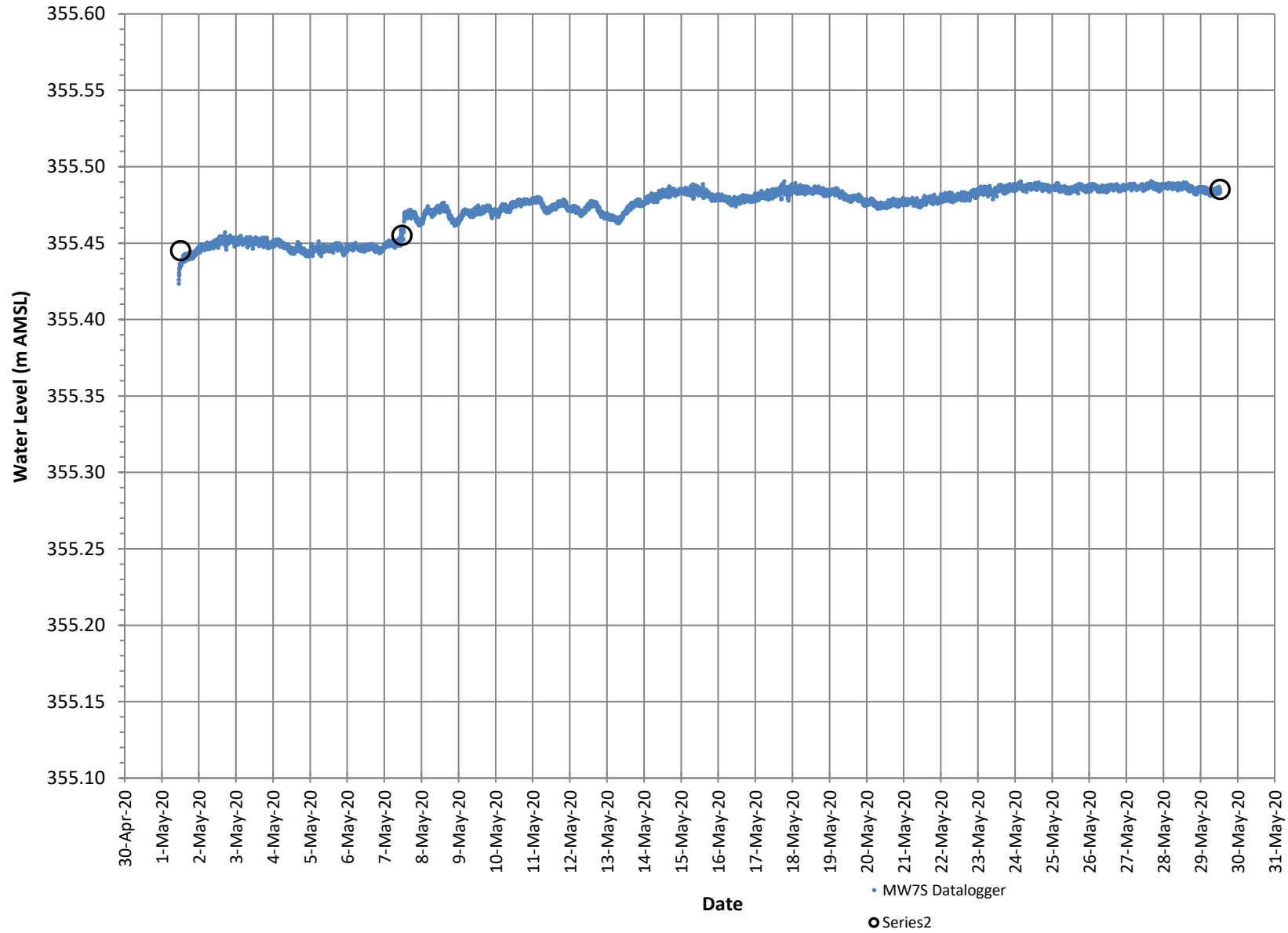
1894 Witmer Rd, CON South of Bleams Rd, PT LOT 10
Township of Wilmot, Regional Municipality of Waterloo

Figure 1.11: Hydrographs

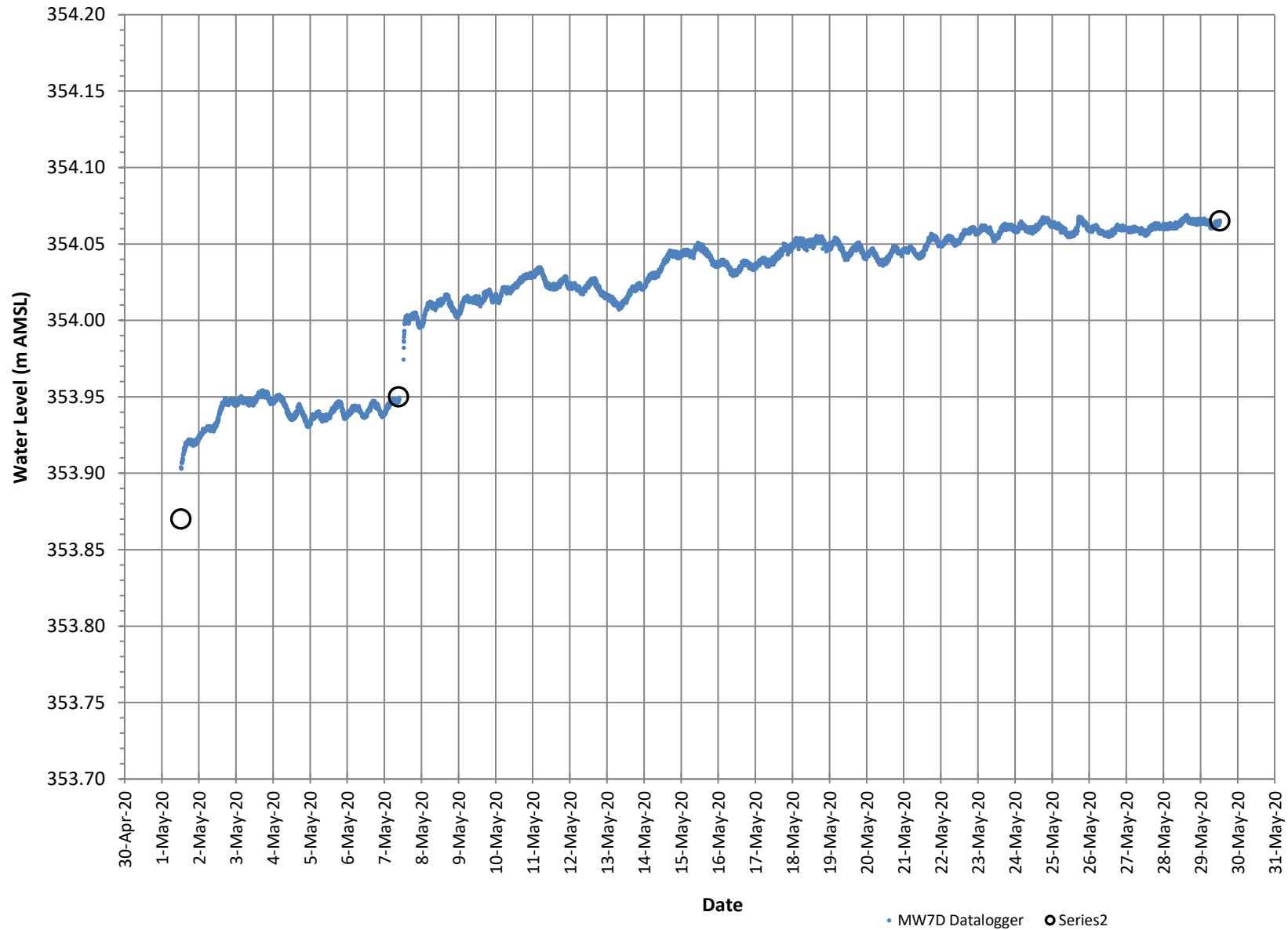
MW6 Hydrograph



MW7S Hydrograph



MW7D Hydrograph



Harden Environmental Services Ltd.

Appendix C – Water Quality Certificates

**CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.
4622 NASSAGAWEYA PUSLINCH TOWNLINE
MOFFAT, ON L0P 1J0
519-826-0099**

ATTENTION TO:

PROJECT: 1728 HALLMAN

AGAT WORK ORDER: 20T595299

WATER ANALYSIS REVIEWED BY: Yris Verastegui, Report Reviewer

DATE REPORTED: May 05, 2020

PAGES (INCLUDING COVER): 15

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

***Notes**

Disclaimer:

- All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.
- All samples will be disposed of within 30 days following analysis, unless expressly agreed otherwise in writing. Please contact your Client Project Manager if you require additional sample storage time.
- AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.
- This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
- The test results reported herewith relate only to the samples as received by the laboratory.
- Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.
- All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 20T595299

PROJECT: 1728 HALLMAN

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.

ATTENTION TO: Allan Rodie

SAMPLING SITE:

SAMPLED BY:

BOD (Water)

DATE RECEIVED: 2020-04-23

DATE REPORTED: 2020-05-05

		SAMPLE DESCRIPTION:		MW1	MW2	MW4	MW6	MW8	MW8-D	MW9	MW10
		SAMPLE TYPE:		Water	Water	Water	Water	Water	Water	Water	Water
		DATE SAMPLED:		2020-04-23	2020-04-23	2020-04-23	2020-04-23	2020-04-23	2020-04-23	2020-04-23	2020-04-23
Parameter	Unit	G / S	RDL	1090825	1090828	1090832	1090833	1090835	1090836	1090837	1090838
BOD (5)	mg/L	5	<5	<5	<5	<5	<5	<5	<5	<5	<5
		SAMPLE DESCRIPTION:		MW11							
		SAMPLE TYPE:		Water							
		DATE SAMPLED:		2020-04-23							
Parameter	Unit	G / S	RDL	1090839							
BOD (5)	mg/L	5	<5								

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Certified By:

Iris Veraistegui

Certificate of Analysis

AGAT WORK ORDER: 20T595299

PROJECT: 1728 HALLMAN

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.

ATTENTION TO: Allan Rodie

SAMPLING SITE:

SAMPLED BY:

Dissolved Metals in Water (mg/L)

DATE RECEIVED: 2020-04-23

DATE REPORTED: 2020-05-05

		SAMPLE DESCRIPTION:		MW1	MW2	MW3	MW4	MW6	MW7-S	MW8	MW8-D
		SAMPLE TYPE:		Water	Water	Water	Water	Water	Water	Water	Water
		DATE SAMPLED:		2020-04-23	2020-04-23	2020-04-23	2020-04-23	2020-04-23	2020-04-23	2020-04-23	2020-04-23
Parameter	Unit	G / S	RDL	1090825	1090828	1090829	1090832	1090833	1090834	1090835	1090836
Dissolved Aluminum	mg/L	0.004		0.021	0.008	<0.004	0.017	0.018	0.008	0.008	0.012
Dissolved Antimony	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Dissolved Arsenic	mg/L	0.001		0.002	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Dissolved Barium	mg/L	0.002		0.042	0.098	0.041	0.037	0.045	0.030	0.040	0.040
Dissolved Beryllium	mg/L	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Bismuth	mg/L	0.002		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Dissolved Boron	mg/L	0.010		0.017	0.014	0.026	<0.010	0.015	0.013	0.013	0.013
Dissolved Cadmium	mg/L	0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Dissolved Chromium	mg/L	0.002		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Dissolved Cobalt	mg/L	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Copper	mg/L	0.001		0.005	0.002	0.002	<0.001	0.002	0.002	0.001	0.001
Dissolved Iron	mg/L	0.010		0.011	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Dissolved Lead	mg/L	0.0005		0.0006	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Lithium	mg/L	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dissolved Manganese	mg/L	0.002		0.129	<0.002	<0.002	<0.002	<0.002	0.002	0.002	0.006
Dissolved Molybdenum	mg/L	0.002		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Dissolved Nickel	mg/L	0.003		<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Dissolved Phosphorus	mg/L	0.05		0.10	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dissolved Selenium	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Dissolved Silicon	mg/L	0.05		1.89	4.17	4.64	4.08	3.98	4.80	3.65	3.56
Dissolved Silver	mg/L	0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Dissolved Strontium	mg/L	0.005		0.082	0.131	0.111	0.095	0.098	0.174	0.105	0.105
Dissolved Thallium	mg/L	0.0003		<0.0003	<0.0003	0.0005	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Dissolved Tin	mg/L	0.002		<0.002	<0.002	0.003	<0.002	<0.002	<0.002	<0.002	<0.002
Dissolved Titanium	mg/L	0.002		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Dissolved Uranium	mg/L	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Vanadium	mg/L	0.002		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Dissolved Zinc	mg/L	0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Dissolved Zirconium	mg/L	0.004		<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004

Certified By:



Certificate of Analysis

AGAT WORK ORDER: 20T595299

PROJECT: 1728 HALLMAN

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.

ATTENTION TO: Allan Rodie

SAMPLING SITE:

SAMPLED BY:

Dissolved Metals in Water (mg/L)

DATE RECEIVED: 2020-04-23

DATE REPORTED: 2020-05-05

		SAMPLE DESCRIPTION:		MW9	MW10	MW11
		SAMPLE TYPE:		Water	Water	Water
		DATE SAMPLED:		2020-04-23	2020-04-23	2020-04-23
Parameter	Unit	G / S	RDL	1090837	1090838	1090839
Dissolved Aluminum	mg/L		0.004	0.010	0.013	0.016
Dissolved Antimony	mg/L		0.001	<0.001	<0.001	<0.001
Dissolved Arsenic	mg/L		0.001	<0.001	<0.001	<0.001
Dissolved Barium	mg/L		0.002	0.069	0.133	0.080
Dissolved Beryllium	mg/L		0.0005	<0.0005	<0.0005	<0.0005
Dissolved Bismuth	mg/L		0.002	<0.002	<0.002	<0.002
Dissolved Boron	mg/L		0.010	0.023	0.031	0.013
Dissolved Cadmium	mg/L		0.0001	0.0007	<0.0001	<0.0001
Dissolved Chromium	mg/L		0.002	<0.002	<0.002	<0.002
Dissolved Cobalt	mg/L		0.0005	<0.0005	0.0005	<0.0005
Dissolved Copper	mg/L		0.001	0.002	0.002	0.001
Dissolved Iron	mg/L		0.010	0.019	<0.010	0.011
Dissolved Lead	mg/L		0.0005	<0.0005	<0.0005	<0.0005
Dissolved Lithium	mg/L		0.05	<0.05	<0.05	<0.05
Dissolved Manganese	mg/L		0.002	0.005	<0.002	0.002
Dissolved Molybdenum	mg/L		0.002	<0.002	<0.002	<0.002
Dissolved Nickel	mg/L		0.003	<0.003	<0.003	<0.003
Dissolved Phosphorus	mg/L		0.05	<0.05	0.06	0.08
Dissolved Selenium	mg/L		0.001	<0.001	0.001	<0.001
Dissolved Silicon	mg/L		0.05	3.80	4.13	5.03
Dissolved Silver	mg/L		0.0001	0.0006	<0.0001	<0.0001
Dissolved Strontium	mg/L		0.005	0.165	0.203	0.163
Dissolved Thallium	mg/L		0.0003	<0.0003	<0.0003	<0.0003
Dissolved Tin	mg/L		0.002	<0.002	<0.002	<0.002
Dissolved Titanium	mg/L		0.002	<0.002	<0.002	<0.002
Dissolved Uranium	mg/L		0.0005	<0.0005	0.0005	0.0023
Dissolved Vanadium	mg/L		0.002	<0.002	<0.002	<0.002
Dissolved Zinc	mg/L		0.005	<0.005	<0.005	<0.005
Dissolved Zirconium	mg/L		0.004	<0.004	<0.004	<0.004

Certified By:





AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 20T595299

PROJECT: 1728 HALLMAN

5835 COOPERS AVENUE
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ATTENTION TO: Allan Rodie

SAMPLING SITE:

SAMPLED BY:

Dissolved Metals in Water (mg/L)

DATE RECEIVED: 2020-04-23

DATE REPORTED: 2020-05-05

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard
Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

Iris Veraástegui



Certificate of Analysis

AGAT WORK ORDER: 20T595299

PROJECT: 1728 HALLMAN

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MISSISSAUGA, ONTARIO
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CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.

ATTENTION TO: Allan Rodie

SAMPLING SITE:

SAMPLED BY:

TKN (Water)											
DATE RECEIVED: 2020-04-23						DATE REPORTED: 2020-05-05					
		SAMPLE DESCRIPTION:		MW1	MW2	MW3	MW4	MW6	MW7-S	MW8	MW8-D
		SAMPLE TYPE:		Water	Water	Water	Water	Water	Water	Water	Water
		DATE SAMPLED:		2020-04-23	2020-04-23	2020-04-23	2020-04-23	2020-04-23	2020-04-23	2020-04-23	2020-04-23
Parameter	Unit	G / S	RDL	1090825	1090828	1090829	1090832	1090833	1090834	1090835	1090836
Total Kjeldahl Nitrogen	mg/L		0.10	0.35	0.19	0.29	0.17	<0.10	0.22	<0.10	<0.10
		SAMPLE DESCRIPTION:		MW9	MW10	MW11					
		SAMPLE TYPE:		Water	Water	Water					
		DATE SAMPLED:		2020-04-23	2020-04-23	2020-04-23					
Parameter	Unit	G / S	RDL	1090837	1090838	1090839					
Total Kjeldahl Nitrogen	mg/L		0.10	<0.10	<0.10	<0.10					

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Certified By:

Iris Veraistegui



Certificate of Analysis

AGAT WORK ORDER: 20T595299

PROJECT: 1728 HALLMAN

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CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.

ATTENTION TO: Allan Rodie

SAMPLING SITE:

SAMPLED BY:

Water Quality Assessment (mg/L) (Excl. Hg)

DATE RECEIVED: 2020-04-23

DATE REPORTED: 2020-05-05

		SAMPLE DESCRIPTION:		MW1		MW2		MW3		MW4		MW6	
		SAMPLE TYPE:		Water		Water		Water		Water		Water	
		DATE SAMPLED:		2020-04-23		2020-04-23		2020-04-23		2020-04-23		2020-04-23	
Parameter	Unit	G / S	RDL	1090825	RDL	1090828	1090829	RDL	1090832	RDL	1090833		
Electrical Conductivity	µS/cm		2	462	2	822	870	2	557	2	647		
pH	pH Units		NA	7.68	NA	7.74	7.72	NA	7.79	NA	7.75		
Saturation pH (Calculated)				7.13		6.27	6.76		6.79		7.02		
Langelier Index (Calculated)				0.545		1.47	0.957		0.999		0.727		
Hardness (as CaCO ₃) (Calculated)	mg/L		0.5	246	0.5	1460	461	0.5	479	0.5	287		
Total Dissolved Solids	mg/L		20	240	20	416	452	20	286	20	332		
Alkalinity (as CaCO ₃)	mg/L		5	202	5	267	271	5	228	5	240		
Bicarbonate (as CaCO ₃)	mg/L		5	202	5	267	271	5	228	5	240		
Carbonate (as CaCO ₃)	mg/L		5	<5	5	<5	<5	5	<5	5	<5		
Hydroxide (as CaCO ₃)	mg/L		5	<5	5	<5	<5	5	<5	5	<5		
Fluoride	mg/L		0.05	<0.05	0.05	<0.05	<0.05	0.05	<0.05	0.05	<0.05		
Chloride	mg/L		0.10	5.62	0.50	49.6	63.1	0.10	4.44	0.20	6.78		
Nitrate as N	mg/L		0.05	2.12	0.25	10.6	8.38	0.05	7.66	0.10	13.7		
Nitrite as N	mg/L		0.05	0.16	0.25	<0.25	<0.25	0.05	<0.05	0.10	<0.10		
Bromide	mg/L		0.05	<0.05	0.25	<0.25	<0.25	0.05	<0.05	0.10	<0.10		
Sulphate	mg/L		0.10	5.92	0.50	15.5	16.9	0.10	6.15	0.20	9.23		
Ortho Phosphate as P	mg/L		0.10	<0.10	0.50	<0.50	<0.50	0.10	<0.10	0.20	<0.20		
Reactive Silica	mg/L		0.05	4.03	0.05	9.66	10.1	0.05	9.89	0.05	9.31		
Ammonia as N	mg/L		0.02	<0.02	0.02	0.03	<0.02	0.02	0.03	0.02	0.86		
Total Phosphorus	mg/L		0.02	0.14	0.02	0.90	0.09	0.02	0.20	0.02	0.04		
Total Organic Carbon	mg/L		0.5	2.9	0.5	2.1	3.6	0.5	1.3	0.5	3.8		
Colour	TCU		5	<5	5	<5	<5	5	<5	5	<5		
Turbidity	NTU		0.5	68.2	0.5	2530	400	0.5	537	0.5	22.4		
Dissolved Calcium	mg/L		0.05	57.6	0.05	86.0	72.0	0.05	69.7	0.05	78.9		
Dissolved Magnesium	mg/L		0.05	12.8	0.05	20.2	17.9	0.05	15.8	0.05	18.9		
Dissolved Potassium	mg/L		0.05	9.29	0.05	1.99	1.33	0.05	0.72	0.05	0.90		
Dissolved Sodium	mg/L		0.05	2.01	0.05	26.4	34.5	0.05	3.87	0.05	4.32		

Certified By:

Iris Veraestegui



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 20T595299

PROJECT: 1728 HALLMAN

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MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
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CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.

ATTENTION TO: Allan Rodie

SAMPLING SITE:

SAMPLED BY:

Water Quality Assessment (mg/L) (Excl. Hg)

DATE RECEIVED: 2020-04-23

DATE REPORTED: 2020-05-05

Parameter	Unit	SAMPLE DESCRIPTION:		MW7-S	MW8	MW8-D	RDL	MW9	RDL	MW10
		SAMPLE TYPE:		Water	Water	Water		Water		Water
		DATE SAMPLED:		2020-04-23	2020-04-23	2020-04-23		2020-04-23		2020-04-23
		G / S	RDL	1090834	1090835	1090836		1090837		1090838
Electrical Conductivity	µS/cm		2	696	614	640	2	966	2	1120
pH	pH Units		NA	7.78	7.76	7.74	NA	7.60	NA	7.59
Saturation pH (Calculated)				6.58	7.02	6.68		6.32		6.48
Langelier Index (Calculated)				1.20	0.739	1.06		1.28		1.11
Hardness (as CaCO ₃) (Calculated)	mg/L		0.5	632	288	582	0.5	1000	0.5	638
Total Dissolved Solids	mg/L		20	354	324	328	20	492	20	576
Alkalinity (as CaCO ₃)	mg/L		5	302	240	259	5	349	5	405
Bicarbonate (as CaCO ₃)	mg/L		5	302	240	259	5	349	5	405
Carbonate (as CaCO ₃)	mg/L		5	<5	<5	<5	5	<5	5	<5
Hydroxide (as CaCO ₃)	mg/L		5	<5	<5	<5	5	<5	5	<5
Fluoride	mg/L		0.05	<0.05	<0.05	<0.05	0.05	<0.05	0.05	<0.05
Chloride	mg/L		0.20	7.52	4.78	5.39	0.50	35.8	0.50	14.4
Nitrate as N	mg/L		0.10	5.47	12.7	14.1	0.25	12.4	0.25	25.4
Nitrite as N	mg/L		0.10	<0.10	<0.10	<0.10	0.25	<0.25	0.25	<0.25
Bromide	mg/L		0.10	<0.10	<0.10	<0.10	0.25	<0.25	0.25	<0.25
Sulphate	mg/L		0.20	11.1	7.84	9.70	0.50	24.0	0.50	37.5
Ortho Phosphate as P	mg/L		0.20	<0.20	<0.20	<0.20	0.50	<0.50	0.50	<0.50
Reactive Silica	mg/L		0.05	10.5	8.67	8.67	0.05	8.61	0.05	9.87
Ammonia as N	mg/L		0.02	<0.02	0.02	0.03	0.02	0.05	0.02	<0.02
Total Phosphorus	mg/L		0.02	0.47	0.21	0.26	0.02	0.43	0.02	0.25
Total Organic Carbon	mg/L		0.5	13.0	4.0	3.6	0.5	2.0	0.5	2.2
Colour	TCU		5	<5	<5	<5	5	<5	5	<5
Turbidity	NTU		0.5	342	64.7	472	0.5	685	0.5	204
Dissolved Calcium	mg/L		0.05	88.6	76.3	81.1	0.10	114	0.25	147
Dissolved Magnesium	mg/L		0.05	20.1	18.0	18.5	0.10	25.1	0.25	27.2
Dissolved Potassium	mg/L		0.05	0.99	1.64	2.31	0.10	9.63	0.25	20.3
Dissolved Sodium	mg/L		0.05	4.89	3.92	4.26	0.10	17.0	0.25	9.73

Certified By:

Iris Veraistegui



Certificate of Analysis

AGAT WORK ORDER: 20T595299

PROJECT: 1728 HALLMAN

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CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.

ATTENTION TO: Allan Rodie

SAMPLING SITE:

SAMPLED BY:

Water Quality Assessment (mg/L) (Excl. Hg)

DATE RECEIVED: 2020-04-23

DATE REPORTED: 2020-05-05

		SAMPLE DESCRIPTION:		MW11
		SAMPLE TYPE:		Water
		DATE SAMPLED:		2020-04-23
Parameter	Unit	G / S	RDL	1090839
Electrical Conductivity	µS/cm		2	831
pH	pH Units		NA	7.75
Saturation pH (Calculated)				6.36
Langelier Index (Calculated)				1.39
Hardness (as CaCO ₃) (Calculated)	mg/L		0.5	1090
Total Dissolved Solids	mg/L		20	420
Alkalinity (as CaCO ₃)	mg/L		5	289
Bicarbonate (as CaCO ₃)	mg/L		5	289
Carbonate (as CaCO ₃)	mg/L		5	<5
Hydroxide (as CaCO ₃)	mg/L		5	<5
Fluoride	mg/L		0.05	<0.05
Chloride	mg/L		0.50	37.1
Nitrate as N	mg/L		0.25	6.38
Nitrite as N	mg/L		0.25	<0.25
Bromide	mg/L		0.25	<0.25
Sulphate	mg/L		0.50	35.2
Ortho Phosphate as P	mg/L		0.50	<0.50
Reactive Silica	mg/L		0.05	11.2
Ammonia as N	mg/L		0.02	0.03
Total Phosphorus	mg/L		0.02	0.85
Total Organic Carbon	mg/L		0.5	2.6
Colour	TCU		5	<5
Turbidity	NTU		0.5	1550
Dissolved Calcium	mg/L		0.05	94.1
Dissolved Magnesium	mg/L		0.05	22.6
Dissolved Potassium	mg/L		0.05	1.53
Dissolved Sodium	mg/L		0.05	18.2

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SAMPLING SITE:

SAMPLED BY:

Water Quality Assessment (mg/L) (Excl. Hg)

DATE RECEIVED: 2020-04-23

DATE REPORTED: 2020-05-05

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

1090825 Elevated RDLs indicate the degree of sample dilutions prior to the analysis to keep analytes within the calibration range or reduce matrix interference.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

Iris Veraístegui

Quality Assurance

CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.

AGAT WORK ORDER: 20T595299

PROJECT: 1728 HALLMAN

ATTENTION TO: Allan Rodie

SAMPLING SITE:

SAMPLED BY:

Water Analysis															
RPT Date: May 05, 2020			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

Water Quality Assessment (mg/L) (Excl. Hg)

Electrical Conductivity	1090584		3660	3670	0.3%	< 2	107%	80%	120%						
pH	1090584		7.88	7.91	0.4%	NA	102%	90%	110%						
Total Dissolved Solids	1086473		350	352	0.6%	< 20	102%	80%	120%						
Alkalinity (as CaCO ₃)	1090584		241	257	6.4%	< 5	94%	80%	120%						
Bicarbonate (as CaCO ₃)	1090584		241	257	6.4%	< 5	NA								
Carbonate (as CaCO ₃)	1090584		<5	<5	NA	< 5	NA								
Hydroxide (as CaCO ₃)	1090584		<5	<5	NA	< 5	NA								
Fluoride	1090954		<0.05	<0.05	NA	< 0.05	100%	90%	110%	93%	90%	110%	107%	85%	115%
Chloride	1090954		150	149	0.7%	< 0.10	103%	70%	130%	101%	80%	120%	NA	70%	130%
Nitrate as N	1090954		<0.25	<0.25	NA	< 0.05	102%	70%	130%	99%	80%	120%	111%	70%	130%
Nitrite as N	1090954		<0.25	<0.25	NA	< 0.05	98%	70%	130%	94%	80%	120%	101%	70%	130%
Bromide	1090954		<0.25	<0.25	NA	< 0.05	108%	90%	110%	96%	90%	110%	111%	85%	115%
Sulphate	1090954		8.67	8.47	2.3%	< 0.10	108%	70%	130%	102%	80%	120%	108%	70%	130%
Ortho Phosphate as P	1090954		<0.50	<0.50	NA	< 0.10	102%	70%	130%	109%	80%	120%	101%	70%	130%
Reactive Silica	1088739		27.6	27.6	0.0%	< 0.05	104%	90%	110%	106%	90%	110%	NA	80%	120%
Ammonia as N	1091617		<0.02	<0.02	NA	< 0.02	95%	70%	130%	105%	80%	120%	100%	70%	130%
Total Phosphorus	1090782		1.97	1.95	1.0%	< 0.02	100%	70%	130%	101%	80%	120%	98%	70%	130%
Total Organic Carbon	1090825	1090825	2.9	2.9	0.0%	< 0.5	98%	90%	110%	103%	90%	110%	93%	80%	120%
Colour	1091742		<5	<5	NA	< 5	104%	90%	110%						
Turbidity	1090825	1090825	68.2	69.5	1.9%	< 0.5	100%	80%	120%						
Dissolved Calcium	1090825	1090825	57.6	60.4	4.7%	< 0.05	90%	70%	130%	100%	80%	120%	98%	70%	130%
Dissolved Magnesium	1090825	1090825	12.8	13.4	4.6%	< 0.05	94%	70%	130%	104%	80%	120%	102%	70%	130%
Dissolved Potassium	1090825	1090825	9.29	9.59	3.2%	< 0.05	94%	70%	130%	102%	80%	120%	101%	70%	130%
Dissolved Sodium	1090825	1090825	2.01	2.09	3.9%	< 0.05	94%	70%	130%	102%	80%	120%	101%	70%	130%

BOD (Water)

BOD (5)	1090837	1090837	<5	<5	NA	< 5	101%	75%	125%						
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TKN (Water)

Total Kjeldahl Nitrogen	1093222		<0.10	<0.10	NA	< 0.10	104%	70%	130%	93%	80%	120%	81%	70%	130%
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Dissolved Metals in Water (mg/L)

Dissolved Aluminum	1089772		0.014	0.013	NA	< 0.004	104%	70%	130%	98%	80%	120%	95%	70%	130%
Dissolved Antimony	1089772		<0.001	<0.001	NA	< 0.001	107%	70%	130%	100%	80%	120%	100%	70%	130%
Dissolved Arsenic	1089772		<0.001	<0.001	NA	< 0.001	103%	70%	130%	99%	80%	120%	99%	70%	130%
Dissolved Barium	1089772		0.058	0.056	3.5%	< 0.002	107%	70%	130%	99%	80%	120%	102%	70%	130%
Dissolved Beryllium	1089772		<0.0005	<0.0005	NA	< 0.0005	107%	70%	130%	98%	80%	120%	106%	70%	130%
Dissolved Bismuth	1089772		<0.02	<0.02	NA	< 0.002	104%	70%	130%	99%	80%	120%	97%	70%	130%
Dissolved Boron	1089772		0.019	0.019	NA	< 0.010	108%	70%	130%	100%	80%	120%	105%	70%	130%
Dissolved Cadmium	1089772		<0.0001	<0.0001	NA	< 0.0001	103%	70%	130%	100%	80%	120%	100%	70%	130%
Dissolved Chromium	1089772		<0.002	<0.002	NA	< 0.002	101%	70%	130%	101%	80%	120%	96%	70%	130%

AGAT QUALITY ASSURANCE REPORT (V1)

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AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation. RPDs calculated using raw data. The RPD may not be reflective of duplicate values shown, due to rounding of final results.

Results relate only to the items tested. Results apply to samples as received.

Quality Assurance

CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.

AGAT WORK ORDER: 20T595299

PROJECT: 1728 HALLMAN

ATTENTION TO: Allan Rodie

SAMPLING SITE:

SAMPLED BY:

Water Analysis (Continued)

RPT Date: May 05, 2020			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Dissolved Cobalt	1089772		<0.0005	<0.0005	NA	< 0.0005	100%	70%	130%	99%	80%	120%	94%	70%	130%
Dissolved Copper	1089772		0.001	0.001	NA	< 0.001	102%	70%	130%	99%	80%	120%	96%	70%	130%
Dissolved Iron	1089772		<0.10	<0.10	NA	< 0.010	104%	70%	130%	102%	80%	120%	98%	70%	130%
Dissolved Lead	1089772		0.0020	0.0020	NA	< 0.0005	109%	70%	130%	95%	80%	120%	96%	70%	130%
Dissolved Lithium	1089772		<0.5	<0.5	NA	< 0.05	104%	70%	130%	97%	80%	120%	105%	70%	130%
Dissolved Manganese	1089772		0.038	0.039	2.6%	< 0.002	99%	70%	130%	100%	80%	120%	97%	70%	130%
Dissolved Molybdenum	1089772		<0.002	<0.002	NA	< 0.002	105%	70%	130%	100%	80%	120%	101%	70%	130%
Dissolved Nickel	1089772		<0.003	<0.003	NA	< 0.003	103%	70%	130%	101%	80%	120%	94%	70%	130%
Dissolved Phosphorus	1089772		0.09	<0.05	NA	< 0.05	88%	70%	130%	109%	80%	120%	100%	70%	130%
Dissolved Selenium	1089772		<0.001	0.005	NA	< 0.001	101%	70%	130%	97%	80%	120%	96%	70%	130%
Dissolved Silicon	1089772		5.9	5.0	16.5%	< 0.05	92%	70%	130%	106%	80%	120%	81%	70%	130%
Dissolved Silver	1089772		<0.0001	<0.0001	NA	< 0.0001	105%	70%	130%	103%	80%	120%	95%	70%	130%
Dissolved Strontium	1089772		0.28	0.25	11.3%	< 0.005	101%	70%	130%	102%	80%	120%	95%	70%	130%
Dissolved Thallium	1089772		<0.0003	<0.0003	NA	< 0.0003	105%	70%	130%	98%	80%	120%	98%	70%	130%
Dissolved Tin	1089772		<0.02	<0.02	NA	< 0.002	95%	70%	130%	95%	80%	120%	95%	70%	130%
Dissolved Titanium	1089772		<0.02	<0.02	NA	< 0.002	99%	70%	130%	103%	80%	120%	98%	70%	130%
Dissolved Uranium	1089772		0.0007	0.0007	NA	< 0.0005	102%	70%	130%	99%	80%	120%	105%	70%	130%
Dissolved Vanadium	1089772		<0.002	<0.002	NA	< 0.002	101%	70%	130%	101%	80%	120%	100%	70%	130%
Dissolved Zinc	1089772		<0.005	<0.005	NA	< 0.005	100%	70%	130%	101%	80%	120%	95%	70%	130%
Dissolved Zirconium	1089772		<0.04	<0.04	NA	< 0.004	101%	70%	130%	99%	80%	120%	99%	70%	130%

Comments: NA signifies Not Applicable.

Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix spike: Spike level < native concentration. Matrix spike acceptance limits do not apply.

Certified By:



Method Summary

CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.
AGAT WORK ORDER: 20T595299
PROJECT: 1728 HALLMAN
ATTENTION TO:
SAMPLING SITE:
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
BOD (5)	INOR-93-6006	SM 5210 B	DO METER
Dissolved Aluminum	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Antimony	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Arsenic	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Barium	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Beryllium	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Bismuth	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Boron	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Cadmium	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Chromium	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Cobalt	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Copper	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Iron	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Lead	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Lithium	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Manganese	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Molybdenum	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Nickel	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Phosphorus	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Selenium	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Silicon	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Silver	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Strontium	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Thallium	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Tin	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Titanium	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Uranium	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Vanadium	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS

Method Summary

CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.

AGAT WORK ORDER: 20T595299

PROJECT: 1728 HALLMAN

ATTENTION TO:
SAMPLING SITE:
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Dissolved Zinc	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Zirconium	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Total Kjeldahl Nitrogen	INOR-93-6048	modified from EPA 351.2 and SM 4500-NORG D	LACHAT FIA
Electrical Conductivity	INOR-93-6000	SM 2510 B	PC TITRATE
pH	INOR-93-6000	modified from SM 4500-H+ B	PC TITRATE
Saturation pH (Calculated)		SM 2320 B	CALCULATION
Langelier Index (Calculated)		SM 2330B	CALCULATION
Hardness (as CaCO ₃) (Calculated)	MET-93-6105	modified from EPA SW-846 6010C & 200.7 & SM 2340 B	CALCULATION
Total Dissolved Solids	INOR-93-6028	modified from EPA 1684, ON MOECC E3139, SM 2540C,D	BALANCE
Alkalinity (as CaCO ₃)	INOR-93-6000	SM 2320 B	PC TITRATE
Bicarbonate (as CaCO ₃)	INOR-93-6000	SM 2320 B	PC TITRATE
Carbonate (as CaCO ₃)	INOR-93-6000	SM 2320 B	PC TITRATE
Hydroxide (as CaCO ₃)	INOR-93-6000	SM 2320 B	PC TITRATE
Fluoride	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Chloride	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Nitrate as N	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Nitrite as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Bromide	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Sulphate	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Ortho Phosphate as P	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Reactive Silica	INOR-93-6070	QuickChem 10-114-27-1-A & SM 4500 Si-F	LACHAT FIA
Ammonia as N	INOR-93-6059	modified from SM 4500-NH ₃ H	LACHAT FIA
Total Phosphorus	INOR-93-6057	modified from LACHAT 10-115-01-3A	LACHAT FIA
Total Organic Carbon	INOR-93-6049	modified from EPA 415.1 & SM 5310 B	SHIMADZU CARBON ANALYZER
Colour	INOR-93-6046	SM 2120 B	SPECTROPHOTOMETER
Turbidity	INOR-93-6044	modified from SM 2130 B	NEPHELOMETER
Dissolved Calcium	MET-93-6105	modified from EPA 6010D	ICP/OES
Dissolved Magnesium	MET-93-6105	modified from EPA 6010D	ICP/OES
Dissolved Potassium	MET-93-6105	modified from EPA 6010D	ICP/OES
Dissolved Sodium	MET-93-6105	modified from EPA 6010D	ICP/OES

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Report Information:

Company: HARDEN ENVIRONMENTAL
Contact: SERVICES LTD.
Address: 4622 NASSAGAWAGA - PUSLINCIT TR
MOFFAT ON LOPISD
Phone: 519-826-0099 Fax: 519-826-9099
Reports to be sent to:
1. Email: arodie@hardenv.com
2. Email: sdenhoed@hardenv.com

Project Information:

Project: 1728 HALLMAN
Site Location: Allan Rodie 519-400-7113
Sampled By: Christopher Tabone
AGAT Quote #: PO: 1728
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☒ No ☐
Company: Create A Focus
Contact: Marianne Embro
Address: include: cafocus@sentex.net
Email: arodie@hardenv.com

Regulatory Requirements:

(Please check all applicable boxes)

☐ Regulation 153/04

Table Indicate One
☐ Ind/Com
☐ Res/Park
☐ Agriculture

Soil Texture (Check One)

☐ Coarse
☐ Fine

☐ Sewer Use

☐ Sanitary
☐ Storm

Region Indicate One

☐ MISA

☐ Regulation 558

☐ CCME

☐ Prov. Water Quality
Objectives (PWQO)
☐ Other

Indicate One

Is this submission for a
Record of Site Condition?

☐ Yes ☒ No

Report Guideline on
Certificate of Analysis

☐ Yes ☐ No

Sample Matrix Legend

B Biota
GW Ground Water
O Oil
P Paint
S Soil
SD Sediment
SW Surface Water

Field Filtered ☒ Metals ☒ Hg ☒ CrVI

O. Reg 153

Metals and Inorganics

☐ All Metals ☐ 153 Metals (excl. Hydrides)
☐ Hydride Metals ☐ 153 Metals (incl. Hydrides)

ORPs: ☐ B-HWS ☐ Cl ☐ CN
☐ Cr⁶⁺ ☐ EC ☐ FOC ☐ Hg
☐ pH ☐ SAR

Full Metals Scan

Regulation/Custom Metals

Nutrients: ☐ TP ☐ NH₃ ☐ TKN
☐ NO₃ ☐ NO₂ ☐ NO₃+NO₂

Volatiles: ☐ VOC ☐ BTEX ☐ THM

PHCs F1 - F4

ABNs

PAHs

PCBs: ☐ Total ☐ Aroclors

Organochlorine Pesticides

TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs

Sewer Use

WQA Package

TKN

BOD

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/Special Instructions	Y/N
MW1	23.4.20	1340	6	GW	Mercury not field	Yes
MW2		1400	6		filtered. Mercury	
MW3		1000	5		NOT needed	
MW4		1145	6			
MW6		1115	6			
MW7S		1030	5			
MW8		1205	6			
MW8-D		1220	6			
MW9		1325	6			
MW10		1305	6			
MW11		1240	6			

Samples Relinquished By (Print Name and Sign): <u>Allan Rodie</u>	Date: 23.4.2020	Time: 1703	Samples Received By (Print Name and Sign): <u>SIMRAN</u>	Date:	Time:
Samples Relinquished By (Print Name and Sign):	Date:	Time:	Samples Received By (Print Name and Sign):	Date:	Time:
Samples Relinquished By (Print Name and Sign):	Date:	Time:	Samples Received By (Print Name and Sign):	Date:	Time:

Laboratory Use Only

Work Order #: 20T595299
Cooler Quantity: 2 L Black
Arrival Temperatures: 6.4 | 6.8 | 8.1
2 | 7.6 | 7.9 | 8.0
Custody Seal Intact: ☐ Yes ☐ No ☐ N/A
Notes: ON ICE

Turnaround Time (TAT) Required:

Regular TAT

☒ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
*TAT is exclusive of weekends and statutory holidays

For 'Same Day' analysis, please contact your AGAT CPM

**CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.
4622 NASSAGAWWEYA PUSLINCH TOWNLINE
MOFFAT, ON L0P 1J0
519-826-0099**

**ATTENTION TO: Allan Rodie
PROJECT: 1728 Hallman**

AGAT WORK ORDER: 20T599296

WATER ANALYSIS REVIEWED BY: Nivine Basily, Inorganics Report Writer

DATE REPORTED: May 13, 2020

PAGES (INCLUDING COVER): 9

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*Notes

Disclaimer:

- All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.
- All samples will be disposed of within 30 days following analysis, unless expressly agreed otherwise in writing. Please contact your Client Project Manager if you require additional sample storage time.
- AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.
- This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
- The test results reported herewith relate only to the samples as received by the laboratory.
- Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.
- All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 20T599296

PROJECT: 1728 Hallman

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.

ATTENTION TO: Allan Rodie

SAMPLING SITE:

SAMPLED BY:

BOD & TKN (Water)

DATE RECEIVED: 2020-05-07

DATE REPORTED: 2020-05-13

SAMPLE DESCRIPTION: MW7D
SAMPLE TYPE: Water
DATE SAMPLED: 2020-05-07
G / S RDL 1112329

Parameter	Unit	G / S	RDL	1112329
BOD (5)	mg/L		5	6
Total Kjeldahl Nitrogen	mg/L		0.10	0.15

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard
1112329 Complete results are now issued.

Certified By:

Divine Basily



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 20T599296

PROJECT: 1728 Hallman

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MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
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<http://www.agatlabs.com>

CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.

ATTENTION TO: Allan Rodie

SAMPLING SITE:

SAMPLED BY:

Water Quality Assessment (mg/L)

DATE RECEIVED: 2020-05-07

DATE REPORTED: 2020-05-13

		SAMPLE DESCRIPTION:		MW7D
		SAMPLE TYPE:		Water
		DATE SAMPLED:		2020-05-07
Parameter	Unit	G / S	RDL	1112329
Electrical Conductivity	µS/cm		2	949
pH	pH Units		NA	7.60
Saturation pH (Calculated)				6.94
Langelier Index (Calculated)				0.661
Hardness (as CaCO ₃) (Calculated)	mg/L		0.5	334
Total Dissolved Solids	mg/L		20	472
Alkalinity (as CaCO ₃)	mg/L		5	250
Bicarbonate (as CaCO ₃)	mg/L		5	250
Carbonate (as CaCO ₃)	mg/L		5	<5
Hydroxide (as CaCO ₃)	mg/L		5	<5
Fluoride	mg/L		0.05	<0.05
Chloride	mg/L		0.50	32.5
Nitrate as N	mg/L		0.25	<0.25
Nitrite as N	mg/L		0.25	<0.25
Bromide	mg/L		0.25	<0.25
Sulphate	mg/L		0.50	122
Ortho Phosphate as P	mg/L		0.50	<0.50
Reactive Silica	mg/L		0.05	10.5
Ammonia as N	mg/L		0.02	<0.02
Total Phosphorus	mg/L		0.02	0.03
Total Organic Carbon	mg/L		0.5	4.0
Colour	TCU		5	<5
Turbidity	NTU		0.5	24.5
Dissolved Calcium	mg/L		0.05	89.9
Dissolved Magnesium	mg/L		0.05	26.5
Dissolved Potassium	mg/L		0.05	1.51
Dissolved Sodium	mg/L		0.05	20.4
Dissolved Aluminum	mg/L		0.004	0.007
Dissolved Antimony	mg/L		0.001	<0.001
Dissolved Arsenic	mg/L		0.001	<0.001

Certified By:

Divine Basily



Certificate of Analysis

AGAT WORK ORDER: 20T599296

PROJECT: 1728 Hallman

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.

ATTENTION TO: Allan Rodie

SAMPLING SITE:

SAMPLED BY:

Water Quality Assessment (mg/L)

DATE RECEIVED: 2020-05-07

DATE REPORTED: 2020-05-13

		SAMPLE DESCRIPTION:		MW7D
		SAMPLE TYPE:		Water
		DATE SAMPLED:		2020-05-07
Parameter	Unit	G / S	RDL	1112329
Dissolved Barium	mg/L		0.002	0.090
Dissolved Beryllium	mg/L		0.0005	<0.0005
Dissolved Boron	mg/L		0.010	0.016
Dissolved Cadmium	mg/L		0.0001	<0.0001
Dissolved Chromium	mg/L		0.002	<0.002
Dissolved Cobalt	mg/L		0.0005	<0.0005
Dissolved Copper	mg/L		0.001	<0.001
Dissolved Iron	mg/L		0.010	0.183
Dissolved Lead	mg/L		0.0005	<0.0005
Dissolved Manganese	mg/L		0.002	0.075
Dissolved Molybdenum	mg/L		0.002	<0.002
Dissolved Nickel	mg/L		0.003	<0.003
Dissolved Selenium	mg/L		0.001	<0.001
Dissolved Silver	mg/L		0.0001	<0.0001
Dissolved Strontium	mg/L		0.005	0.238
Dissolved Thallium	mg/L		0.0003	<0.0003
Dissolved Tin	mg/L		0.002	<0.002
Dissolved Titanium	mg/L		0.002	<0.002
Dissolved Tungsten	mg/L		0.010	<0.010
Dissolved Uranium	mg/L		0.0005	0.0012
Dissolved Vanadium	mg/L		0.002	<0.002
Dissolved Zinc	mg/L		0.005	<0.005
Dissolved Zirconium	mg/L		0.004	<0.004

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

1112329 Elevated RDLs indicate the degree of sample dilutions prior to the analysis to keep analytes within the calibration range or reduce matrix interference.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

Divine Basily

Quality Assurance

CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.

AGAT WORK ORDER: 20T599296

PROJECT: 1728 Hallman

ATTENTION TO: Allan Rodie

SAMPLING SITE:
SAMPLED BY:

Water Analysis															
RPT Date: May 13, 2020			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

Water Quality Assessment (mg/L)

Electrical Conductivity	1110845		904	910	0.7%	< 2	104%	80%	120%						
pH	1110845		7.60	7.58	0.3%	NA	103%	90%	110%						
Total Dissolved Solids	1112329	1112329	472	476	0.8%	< 20	100%	80%	120%						
Alkalinity (as CaCO ₃)	1110845		230	231	0.4%	< 5	90%	80%	120%						
Bicarbonate (as CaCO ₃)	1110845		230	231	0.4%	< 5	NA								
Carbonate (as CaCO ₃)	1110845		<5	<5	NA	< 5	NA								
Hydroxide (as CaCO ₃)	1110845		<5	<5	NA	< 5	NA								
Fluoride	1110845		<0.05	<0.05	NA	< 0.05	108%	90%	110%	94%	90%	110%	102%	85%	115%
Chloride	1110845		36.2	36.5	0.8%	< 0.10	93%	70%	130%	101%	80%	120%	102%	70%	130%
Nitrate as N	1110845		<0.25	<0.25	NA	< 0.05	92%	70%	130%	100%	80%	120%	100%	70%	130%
Nitrite as N	1110845		<0.25	<0.25	NA	< 0.05	97%	70%	130%	99%	80%	120%	112%	70%	130%
Bromide	1110845		<0.25	<0.25	NA	< 0.05	109%	90%	110%	96%	90%	110%	93%	85%	115%
Sulphate	1110845		108	109	0.9%	< 0.10	94%	70%	130%	101%	80%	120%	102%	70%	130%
Ortho Phosphate as P	1110845		<0.50	<0.50	NA	< 0.10	104%	70%	130%	96%	80%	120%	105%	70%	130%
Reactive Silica	1112329	1112329	10.5	10.4	1.0%	< 0.05	106%	90%	110%	109%	90%	110%	NA	80%	120%
Ammonia as N	1112495		0.04	0.05	NA	< 0.02	95%	70%	130%	100%	80%	120%	96%	70%	130%
Total Phosphorus	1114604		1.59	1.56	1.9%	< 0.02	102%	70%	130%	100%	80%	120%	101%	70%	130%
Total Organic Carbon	1112329	1112329	4.0	4.1	2.5%	< 0.5	99%	90%	110%	109%	90%	110%	98%	80%	120%
Colour	1105892		<5	<5	NA	< 5	104%	90%	110%						
Turbidity	1112329	1112329	24.5	24.8	1.2%	< 0.5	100%	80%	120%						
Dissolved Calcium	1112329	1112329	89.9	90.0	0.1%	< 0.05	95%	70%	130%	95%	80%	120%	91%	70%	130%
Dissolved Magnesium	1112329	1112329	26.5	26.6	0.4%	< 0.05	94%	70%	130%	93%	80%	120%	91%	70%	130%
Dissolved Potassium	1112329	1112329	1.51	1.57	3.9%	< 0.05	99%	70%	130%	101%	80%	120%	97%	70%	130%
Dissolved Sodium	1112329	1112329	20.4	20.4	0.0%	< 0.05	94%	70%	130%	97%	80%	120%	91%	70%	130%
Dissolved Aluminum	1112495		0.009	0.008	NA	< 0.004	102%	70%	130%	101%	80%	120%	105%	70%	130%
Dissolved Antimony	1112495		<0.001	<0.001	NA	< 0.001	101%	70%	130%	100%	80%	120%	104%	70%	130%
Dissolved Arsenic	1112495		0.005	0.005	NA	< 0.001	99%	70%	130%	98%	80%	120%	104%	70%	130%
Dissolved Barium	1112495		0.030	0.029	4.4%	< 0.002	98%	70%	130%	100%	80%	120%	101%	70%	130%
Dissolved Beryllium	1112495		<0.0005	<0.0005	NA	< 0.0005	93%	70%	130%	97%	80%	120%	101%	70%	130%
Dissolved Boron	1112495		0.406	0.407	0.2%	< 0.010	102%	70%	130%	101%	80%	120%	103%	70%	130%
Dissolved Cadmium	1112495		<0.0001	0.0002	NA	< 0.0001	101%	70%	130%	99%	80%	120%	119%	70%	130%
Dissolved Chromium	1112495		<0.002	<0.002	NA	< 0.002	100%	70%	130%	101%	80%	120%	101%	70%	130%
Dissolved Cobalt	1112495		<0.0005	<0.0005	NA	< 0.0005	100%	70%	130%	97%	80%	120%	100%	70%	130%
Dissolved Copper	1112495		0.003	0.003	NA	< 0.001	100%	70%	130%	101%	80%	120%	99%	70%	130%
Dissolved Iron	1112495		<0.010	<0.010	NA	< 0.010	101%	70%	130%	96%	80%	120%	93%	70%	130%
Dissolved Lead	1112495		<0.0005	<0.0005	NA	< 0.0005	97%	70%	130%	95%	80%	120%	99%	70%	130%
Dissolved Manganese	1112495		0.007	0.007	NA	< 0.002	104%	70%	130%	101%	80%	120%	104%	70%	130%
Dissolved Molybdenum	1112495		0.113	0.111	1.9%	< 0.002	101%	70%	130%	99%	80%	120%	105%	70%	130%
Dissolved Nickel	1112495		<0.003	<0.003	NA	< 0.003	100%	70%	130%	98%	80%	120%	99%	70%	130%

AGAT QUALITY ASSURANCE REPORT (V1)

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Results relate only to the items tested. Results apply to samples as received.

Quality Assurance

CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.

AGAT WORK ORDER: 20T599296

PROJECT: 1728 Hallman

ATTENTION TO: Allan Rodie

SAMPLING SITE:

SAMPLED BY:

Water Analysis (Continued)

RPT Date: May 13, 2020			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Dissolved Selenium	1112495		<0.001	<0.001	NA	< 0.001	96%	70%	130%	95%	80%	120%	104%	70%	130%
Dissolved Silver	1112495		<0.0001	<0.0001	NA	< 0.0001	106%	70%	130%	111%	80%	120%	72%	70%	130%
Dissolved Strontium	1112495		0.933	0.946	1.4%	< 0.005	105%	70%	130%	104%	80%	120%	106%	70%	130%
Dissolved Thallium	1112495		<0.0003	<0.0003	NA	< 0.0003	98%	70%	130%	94%	80%	120%	96%	70%	130%
Dissolved Tin	1112495		<0.002	<0.002	NA	< 0.002	105%	70%	130%	98%	80%	120%	102%	70%	130%
Dissolved Titanium	1112495		<0.002	<0.002	NA	< 0.002	98%	70%	130%	98%	80%	120%	106%	70%	130%
Dissolved Tungsten	1112495		<0.010	<0.010	NA	< 0.010	102%	70%	130%	96%	80%	120%	103%	70%	130%
Dissolved Uranium	1112495		<0.0005	<0.0005	NA	< 0.0005	94%	70%	130%	93%	80%	120%	101%	70%	130%
Dissolved Vanadium	1112495		<0.002	<0.002	NA	< 0.002	99%	70%	130%	97%	80%	120%	103%	70%	130%
Dissolved Zinc	1112495		<0.005	<0.005	NA	< 0.005	100%	70%	130%	99%	80%	120%	106%	70%	130%
Dissolved Zirconium	1112495		<0.004	<0.004	NA	< 0.004	98%	70%	130%	99%	80%	120%	100%	70%	130%

Comments: NA signifies Not Applicable.

If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.

Matrix spike: Spike level < native concentration. Matrix spike acceptance limits do not apply.

BOD & TKN (Water)

BOD (5)	1112329	1112329	6	6	NA	< 5	102%	75%	125%						
Total Kjeldahl Nitrogen	1112510		0.16	0.16	NA	< 0.10	106%	70%	130%	102%	80%	120%	104%	70%	130%

Comments: If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.

Certified By:

AGAT QUALITY ASSURANCE REPORT (V1)

Page 6 of 9

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Results relate only to the items tested. Results apply to samples as received.

Method Summary

CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.

AGAT WORK ORDER: 20T599296

PROJECT: 1728 Hallman

ATTENTION TO: Allan Rodie

SAMPLING SITE:
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
BOD (5)	INOR-93-6006	SM 5210 B	DO METER
Total Kjeldahl Nitrogen	INOR-93-6048	modified from EPA 351.2 and SM 4500-NORG D	LACHAT FIA
Electrical Conductivity	INOR-93-6000	SM 2510 B	PC TITRATE
pH	INOR-93-6000	modified from SM 4500-H+ B	PC TITRATE
Saturation pH (Calculated)		SM 2320 B	CALCULATION
Langelier Index (Calculated)		SM 2330B	CALCULATION
Hardness (as CaCO ₃) (Calculated)	MET-93-6105	modified from EPA SW-846 6010C & 200.7 & SM 2340 B	CALCULATION
Total Dissolved Solids	INOR-93-6028	modified from EPA 1684, ON MOECC E3139, SM 2540C,D	BALANCE
Alkalinity (as CaCO ₃)	INOR-93-6000	SM 2320 B	PC TITRATE
Bicarbonate (as CaCO ₃)	INOR-93-6000	SM 2320 B	PC TITRATE
Carbonate (as CaCO ₃)	INOR-93-6000	SM 2320 B	PC TITRATE
Hydroxide (as CaCO ₃)	INOR-93-6000	SM 2320 B	PC TITRATE
Fluoride	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Chloride	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Nitrate as N	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Nitrite as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Bromide	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Sulphate	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Ortho Phosphate as P	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Reactive Silica	INOR-93-6070	QuickChem 10-114-27-1-A & SM 4500 Si-F	LACHAT FIA
Ammonia as N	INOR-93-6059	modified from SM 4500-NH ₃ H	LACHAT FIA
Total Phosphorus	INOR-93-6057	modified from LACHAT 10-115-01-3A	LACHAT FIA
Total Organic Carbon	INOR-93-6049	modified from EPA 415.1 & SM 5310 B	SHIMADZU CARBON ANALYZER
Colour	INOR-93-6046	SM 2120 B	SPECTROPHOTOMETER
Turbidity	INOR-93-6044	modified from SM 2130 B	NEPHELOMETER
Dissolved Calcium	MET-93-6105	modified from EPA 6010D	ICP/OES
Dissolved Magnesium	MET-93-6105	modified from EPA 6010D	ICP/OES
Dissolved Potassium	MET-93-6105	modified from EPA 6010D	ICP/OES
Dissolved Sodium	MET-93-6105	modified from EPA 6010D	ICP/OES
Dissolved Aluminum	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Antimony	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Arsenic	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Barium	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Beryllium	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Boron	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Cadmium	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Chromium	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Cobalt	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS

Method Summary

CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.

AGAT WORK ORDER: 20T599296

PROJECT: 1728 Hallman

ATTENTION TO: Allan Rodie

SAMPLING SITE:
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Dissolved Copper	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Iron	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Lead	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Manganese	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Molybdenum	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Nickel	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Selenium	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Silver	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Strontium	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Thallium	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Tin	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Titanium	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Tungsten	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Uranium	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Vanadium	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Zinc	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS
Dissolved Zirconium	MET-93-6103	modified from EPA 200.8 and EPA 3005A	ICP-MS

Report # 560716

Soil Nitrate Analytical Report

Page 1 of 1

Harden Enviromental Services - Stan -
BH610....BH675
4622 Nasagaweya Puslinch Townline Rd
RR 1
Moffat, ON L0P 1J0

Email

Fax:
Email: sdenhoed@hardenv.com

Date Received: Apr-15-2020
Date Reported: Apr-20-2020

Sample ID	Lab ID	Nitrate Nitrogen (ppm)	Ammonium Nitrogen (ppm)
BH6-10 - Coarse Sand	31999401	3.1	2.2
BH6-20	31999402	3.2	1.4
BH6-30	31999403	3.6	1.8
BH6-40	31999404	3.0	1.2
BH6-55	31999406	3.7	1.5
BH6-65 - Medium Sand	31999407	3.5	1.3
BH6-75 - Coarse Sand	31999408	4.6	1.1

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http://www.sgs.com/terms_and_conditions.htm. (Printed copies are available upon request.) Attention is drawn
to the limitation of liability, indemnification and jurisdiction issues defined therein.*

Authorized By: **Jack Legg**
CCA-ON, 4R NMS

Report # 560697

Analytical Report

Page 1 of 1

Harden Environmental Services - Stan -
BH610...BH675 ATZ
4622 Nassagaweya Puslinch Townline Rd
RR 1
Moffat, ON L0P 1J0

Email

Fax:
Email: sdenhoed@hadenv.com

Date Received: Apr-15-2020
Date Reported: Apr-23-2020

Sample ID:	Lab ID	Atrazine (ppm)
BH6-10 - Coarse Sand	31998901	< 0.05
BH6-20	31998902	< 0.05
BH6-30	31998903	< 0.05
BH6-75	31998904	< 0.05

Interpretation of Test Results

Triazine Residue Injury and Crop Information

< 0.05 ppm	Generally no injury except to very susceptible vegetables (i.e. cucumbers) and cash crops (i.e. tobacco) planted in sandy soil during warm, dry weather
0.05 - 0.10 ppm	Slight injury or stunted growth may be expected to susceptible plants (see above) in sandy loam at normal weather conditions. Tomatoes, oats, alfalfa and lawn grass seed may be affected.
0.10 - 0.20 ppm	Tomatoes, red beets, tobacco, oats and vegetables should not be planted, Beans (soya, kidney, white) and barley may be affected. Exception is soils with high organic matter content (12%).
0.20 - 0.30 ppm	Injury to most crops except corn, flax, sorghum and grass sodding.
> 0.30 ppm	Severe injury can occur on all susceptible crops except triazene resistant canola (i.e. OAC Triton)

These residue levels are based on representative soil samples.
Increased organic matter content in soil reduces injury
Dry and warm weather accentuates triazine activity.

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Authorized By: **Jack Legg**

CCA-ON, 4R NMS

Appendix D – Borehole Logs



BOREHOLE LOG BH6

PROJECT NUMBER 1728	TOTAL DEPTH 25.91 m	COORDINATES E 531,935, N 4,803,647
PROJECT NAME Hallman Pit	HOLE DIAMETER 200 mm	COORD SYS NAD83 Zone17
DRILLING DATE April 7, 2020	CASING DIAMETER 50mm	COMPLETION
	SCREEN LENGTH 1.52 m	SURFACE ELEVATION 378.218 m AMSL
		WELL TOC 379.008 m AMSL

COMMENTS	LOGGED BY SD
	CHECKED BY AR

Depth (m)	Drilling Method	Graphic Log	Material Description	Samples	Sample Type	% Recovery	Blow Counts	N Value	Additional Observations	Water Level	MW6 Well Diagram	Elevation (mAMSL)
2	Auger		Sand, brown, medium to coarse grained									378
												376
4				S1	SS	75	5-5-13-13	18				374
												372
6				S2	SS	87.5	5-10-15-16	25				370
												368
8												366
				S3	SS	79.2	8-10-13-16	23				364
10												362
												360
12	Auger		Sand, brown, fine grained									358
												356
14				S5	SS	95.8	17-5-4-6	9				354
												352
16				S6	SS	100	8-14-14-13	28				350
												348
18												346
												344
20	Auger		Sand, brown, fine to medium grained									342
				S7	SS	100	9-14-19-19	33				340
22												338
												336
24	Auger		Sand and gravel									334
				S8	SS	100	13-13-16-18	29				332
26			Termination Depth at: 25.91 m									352



BOREHOLE LOG BH7S

PROJECT NUMBER 1728	TOTAL DEPTH 14.64 m	COORDINATES E 531,634, N 4,803,685
PROJECT NAME Hallman Pit	HOLE DIAMETER 200 mm	COORD SYS NAD83 Zone17
DRILLING DATE April 20, 2020	CASING DIAMETER 50mm	COMPLETION
	SCREEN LENGTH 3.05 m	SURFACE ELEVATION 368.065 m AMSL
		WELL TOC 368.925 m AMSL

COMMENTS	LOGGED BY SD
	CHECKED BY AR

Depth (m)	Drilling Method	Graphic Log	Material Description	Samples	Sample Type	% Recovery	Blow Counts	N Value	Additional Observations	Water Level	Well Diagram	Elevation (mAMSL)
1	Auger					NA	NA	NA				368
2												367
3			Coarse sand	S1	SS							366
4												365
5			Sand, fine grained	S2	SS							364
6			Sand, very fine grained	S3	SS							363
7			Sand, coarse grained	S4								362
8			Sand, very fine grained to fine grained	S5	SS							361
9			Sand, coarsening from medium to coarse grained	S6	SS							360
10			Sand, coarse grained	S7	SS							359
11			Sand and gravel	S8	SS							358
12			Sand, medium grained	S9	SS							357
13												356
14			Sand, fine to medium grained	S10	SS							355
15			Sand, medium to coarse grained	S11	SS							354
15			Termination Depth at: 14.64 m									353



BOREHOLE LOG BH7D

PROJECT NUMBER 1728	TOTAL DEPTH 47.24 m	COORDINATES E 531,644, N 4,803,666
PROJECT NAME Hallman Pit	HOLE DIAMETER 200 mm	COORD SYS NAD83 Zone17
DRILLING DATE April 22, 2020	CASING DIAMETER 50mm	COMPLETION
	SCREEN LENGTH 1.52 m	SURFACE ELEVATION 367.390 m AMSL
		WELL TOC 368.210 m AMSL

COMMENTS	LOGGED BY SD
	CHECKED BY AR

Depth (m)	Drilling Method	Graphic Log	Material Description	Samples	Sample Type	% Recovery	Blow Counts	N Value	Additional Observations	Water Level	Well Diagram	Elevation (mAMSL)						
1	Auger					NA	NA	NA				367						
2																		
3			Coarse sand	S1	SS													
4																		
5			Sand, fine grained	S2	SS													
6			Sand, very fine grained	S3	SS													
			Sand, coarse grained	S4	SS													
7			Sand, very fine grained to fine grained	S5	SS													
			Sand, coarsening from medium to coarse grained	S6	SS													
8			Sand, coarse grained	S7	SS													
			Sand and gravel	S8	SS													
9			Sand, medium grained	S9	SS													
10																		
11																		
12																		
13			Sand, fine to medium grained	S10	SS													
14			Sand, medium to coarse grained	S11	SS													
15																		
16																		
17																		
18																		
19			Sand, fine grained	S12	SS													
20			Sand, fine to medium grained	S13	SS													
21			Silty till, grey	S14	SS													
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BOREHOLE LOG BH7D

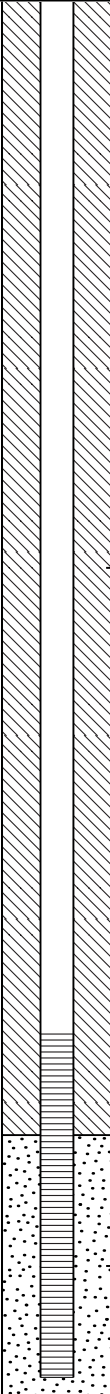
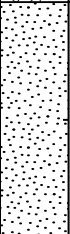
Depth (m)	Drilling Method	Graphic Log	Material Description	Samples	Sample Type	% Recovery	Blow Counts	N Value	Additional Observations	Water Level	Well Diagram	Elevation (mAMS)
24												344
25												343
26												342
27			Sand, fine to medium grained	S15	SS							341
28			Sand, grey, fine to medium grained	S16	SS							340
29			Sand, fining downward sequence fine sand to silt	S17	SS							339
30			Sand, grey, fine grained	S18	SS							338
31			Silt till, grey, dense, stony	S19	SS							337
32			Sand, grey, fine grained	S20	SS							336
33			Silty till, grey, stony	S21	SS							335
34												334
35												333
36			Clay, grey, layered	S22	SS							332
37			Silt till, stony	S23	SS							331
38			Silt till, stony, thin layers of fine sand	S24	SS							330
39												329
40												328
41												327
42												326
43												325
44			Silt till, grey, stony	S25	SS							324
45												323
46			Silt, massive, some clay	S26	SS							322
47			Silt till, some clay, stony	S27	SS							321
48			Termination Depth at: 47.24 m									320
49												319
50												318
												317



BOREHOLE LOG BH8

PROJECT NUMBER 1728	TOTAL DEPTH 24.38 m	COORDINATES E 532,174, N 4,803,026
PROJECT NAME Hallman Pit	HOLE DIAMETER 200 mm	COORD SYS NAD83 Zone17
DRILLING DATE April 2, 2020	CASING DIAMETER 50mm	COMPLETION
	SCREEN LENGTH 3.05 m	SURFACE ELEVATION 373.171 m AMSL
		WELL TOC 374.041 m AMSL

COMMENTS	LOGGED BY SD
	CHECKED BY AR

Depth (m)	Drilling Method	Graphic Log	Material Description	Samples	Sample Type	% Recovery	Blow Counts	N Value	Additional Observations	Water Level	Well Diagram	Elevation (mAMSL)	
1	Auger		Sand and gravel, rounded stones up to 2.5 cm									373	
2													372
3													371
4				S1	SS	54.1	1-7-11-11	18					370
5													369
6													368
7				S2	SS	91.7	9-12-20-17	32					367
8													366
9													365
10				S3	SS	83.3	13-14-14-16	28					364
11			Brown Sand, medium grained									363	
12												362	
13				S4	SS	87.5	13-14-15-14	29					361
14			Sand and Gravel									360	
15												359	
16				S5	SS	83.3	13-17-14-15	31					358
17												357	
18			Sand, brown, fine-medium grained									356	
19				S6	SS	83.3	7-13-16-14	29					355
20												354	
21												353	
22				S7	SS	100	10-17-29-34	46					352
23													351
24													350
25				Termination Depth at: 24.38 m									
											348		



BOREHOLE LOG BH11

PROJECT NUMBER 1728	TOTAL DEPTH 21.16 m	COORDINATES E 532,833, N 4,803,059
PROJECT NAME Hallman Pit	HOLE DIAMETER 200 mm	COORD SYS NAD83 Zone17
DRILLING DATE April 2, 2020	CASING DIAMETER 50mm	COMPLETION
	SCREEN LENGTH 3.05 m	SURFACE ELEVATION 370.422 m AMSL
		WELL TOC 371.392 mAMSL

COMMENTS	LOGGED BY SD
	CHECKED BY AR

Depth (m)	Drilling Method	Graphic Log	Material Description	Samples	Sample Type	% Recovery	Blow Counts	N Value	Additional Observations	Water Level	Well Diagram	Elevation (mAMSL)
1	Auger		Sand and gravel, rounded stones up to 2 cm									370
2												369
3												368
4				S1	SS	29	2-2-4-4	6	Rounded stones up to 2 cm			367
5			Brown Sand, fine-grained									366
6												365
7				S2	SS	87.5	3-3-5-7	8	sand fine-grained with layers of very fine grained			364
8												363
9				S3	SS	87.5	4-6-9-10	15				362
10												360
11												359
12				S4	SS	91.7	3-4-9-9	13				358
13												357
14			Sand and Gravel									356
15				S5	SS	79.2	13-17-14-15	31				355
16												354
17												353
18				S6	SS	79.2	14-24-16-16	40				352
19												351
20												350
21												349
22			Termination Depth at: 21.16 m									348



CHUNG & VANDER DOELEN
ENGINEERING LTD.

311 VICTORIA STREET NORTH
KITCHENER / ONTARIO / N2H 5E1
519-742-8979

May 12, 2020
File No.: M20082

4622 Nassagaweya-Puslinch Townline Road
Moffat, Ontario
L0P 1J0

Attention: Mr. Stan Denhoed, M.Sc., P.Eng., Senior Hydrogeologist

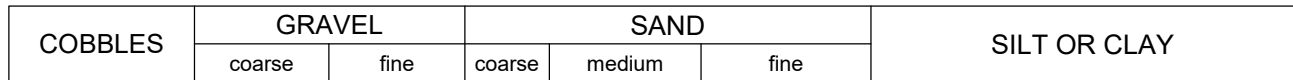
RE: Grain Size Analysis
Project Number: 1728

CHUNG & VANDER DOELEN ENGINEERING LTD. is pleased to submit the enclosed grain size analysis for the above-stated project.

Should you have any questions, please contact our office at your convenience.

Yours truly,
CHUNG & VANDER DOELEN ENGINEERING LTD.

Andrew LeDrew, C.E.T., BSS
Team Leader, Inspection & Materials Testing



Date:	May. 12 - 2020	Sieve Size (mm)	Percent Passing	No Specifications
Client:	Harden Environmental Services Ltd.			
Contractor:				
Source:	MW-7D			
Sampled From:	20.42 m			
Sample No.:	1			
Date Sampled:				
Sampled By:	Client			
Lab No.:	0280			
Date Tested:	May. 04 - 2020			
Type of Material:	Clayey Silt, trace Sand			



GRAIN SIZE DISTRIBUTION

Enclosure No.: 1

Appendix E – Water Balance Calculations

Hallman Pit Water Balance

	Value	Units
Precipitation	889	mm/year
Evapotranspiration	489	mm/year
Evaporation	652	mm/year
Total Extraction Area	52.2400	hectare
Drainage Area D1	5.79	hectare
Drainage AREa D2	6.20	hectare
Drainage Area D3	11.27	hectare
Drainage Area D4	24.77	hectare
Drainage Area D5	4.21	hectare
Wetland Area	2.00	hectare

		Pre Extraction Water Balance			
	Area	Precipitation	Evapotranspiration	Runoff	Infiltration
	(hectare)	(m ³ /year)	(m ³ /year)	(m ³ /year)	(m ³ /year)
Pre Development					
Drainage Area D1	5.79	51,473	28,310	9,265	13,898
Drainage AREa D2	6.20	55,118	30,315	-	24,803
Drainage Area D3	11.27	100,190	55,105	-	45,086
Drainage Area D4	24.77	220,205	121,113	29,728	69,365
Drainage Area D5	4.21	37,427	20,585	6,737	10,105
Pre Development Summary	52.24	464,414	255,427	45,730	163,256

	Units
Precipitation	889 mm/year
Evapotranspiration	488.95 mm/year
Evaporation	652 mm/year
Total Extraction Area	48.03 hectare
Post PE1	25.00 hectare
Post PE2	23.03 hectare

	Area	Precipitation	Evapotranspiration	Runoff	Infiltration
	(hectare)	(m ³ /year)	(m ³ /year)	(m ³ /year)	(m ³ /year)
Post Development					
PE1	25.00	222,250	122,238	30,004	70,009
PE2	27.24	242,137	133,175	-	108,962
Post Development Summary	52.24	464,387	255,413	30,004	178,970

	Area	Precipitation	Evapotranspiration	Runoff	Infiltration
	(hectare)	(m ³ /year)	(m ³ /year)	(m ³ /year)	(m ³ /year)
Pre Development Summary	52.24	464,414	255,427	45,730	163,256
Post Development Summary	52.24	464,387	255,413	30,004	178,970
Difference	- 0.00	- 26.67	- 14.67	- 15,726	15,714

Scenario 1: Disturbed Area: 18 ha, No Processing, No Rehabilitation

Total Extraction Area	522,400		
Wash Ponds and Silt Pond Area	0	Water Consumption	-
Undisturbed Cultivated Area	342,400		
Disturbed Area PE1	-		
Disturbed Area PE2	180,000.00		
Rehabilitated Area PE1	-		
Rehabilitated Area PE2	0		
Annual Tonnage	750,000.00		
Annual tonnage processed	-		
Infiltration Factor Undisturbed	0.7		
Infiltration Factor PE1	0.70		
Infiltration Factor PE2	1		

	Pre Extraction			During Extraction		
	Rate	Area	Volume	Rate	Area	Volume
	mm/year	m ²	m ³	mm/year	m ²	m ³
Precipitation	889	522,400	464,414	889	522,400	464,414
Precipitation on Created Ponds				889	0	-
Precipitation on Cultivated Lands				889	342,400	304,394
Precipitation on Disturbed Lands PE1				889	0	-
Precipitation on Disturbed Lands PE2				889	180,000	160,020
Precipitation on Rehabilitated Lands PE1				889	0	-
Precipitation on Rehabilitated Lands PE2				889	0	-
Evaporation From Created Ponds	654	0	0	654	0	-
Evapotranspiration from Cultivated Lands	489	522,400	255,454	489	342,400	167,434
Evapotranspiration from Disturbed Lands PE1				245	0	-
Evapotranspiration from Disturbed Lands PE2				245	180,000	44,100
Evapotranspiration from Rehabilitated Lands PE1	245	0	0	489	0	-
Evapotranspiration from Rehabilitated Lands PE2	489	0	0	489	0	-
Surplus Water in Ponds			0		0	-
Surplus Water on Cultivated Land			208,960		342,400	136,960
Surplus Water on Disturbed Land PE1			0		0	-
Surplus from Disturbed Lands PE2			0		180,000	115,920
Surplus Water on Rehabilitated Land PE1					0	-
Surplus from Rehabilitated Lands PE2					0	-
Infiltrated Water in Created Ponds			0		0	-
Infiltrated Water Cultivated Land			146,272		342,400	95,872
Infiltrated Water Disturbed Land PE1					0	-
Infiltrated Water Disturbed Land PE2			0		180,000	115,920
Infiltration from Rehabilitated Lands PE1					0	-
Infiltration from Rehabilitated Lands PE2			0		0	-
Total Infiltration			163,256			211,792
Difference Pre Extraction to Post						48,536
Consumption						-
Net Increase/Decrease in Water during Aggregate Extraction (m3)						48,536

*from Golder (2006) study 89 L/ tonne, licensed for 750,000 tonnes

Scenario S2: 18 Ha Disturbed, Aggregate Processing, No Rehabilitation

Total Extraction Area	522,400		
Wash Ponds and Silt Pond Area	15,185	Water Consumption	44,500
Undisturbed Cultivated Area	327,215		
Disturbed Area PE1	-		
Disturbed Area PE2	180,000.00		
Rehabilitated Area PE1	-		
Rehabilitated Area PE2	0		
Annual Tonnage	750,000.00		
Annual tonnage processed	500,000.00		
Infiltration Factor Undisturbed	0.7		
Infiltration Factor PE1	0.70		
Infiltration Factor PE2	1		

	Pre Extraction			During Extraction		
	Rate	Area	Volume	Rate	Area	Volume
	mm/year	m ²	m ³	mm/year	m ²	m ³
Precipitation	889	522,400	464,414	889	522,400	464,414
Precipitation on Created Ponds				889	15,185	13,499
Precipitation on Cultivated Lands				889	327,215	290,894
Precipitation on Disturbed Lands PE1				889	0	-
Precipitation on Disturbed Lands PE2				889	180,000	160,020
Precipitation on Rehabilitated Lands PE1				889	0	-
Precipitation on Rehabilitated Lands PE2				889	0	-
Evaporation From Created Ponds	654	0	0	654	15,185	9,931
Evapotranspiration from Cultivated Lands	489	522,400	255,454	489	327,215	160,008
Evapotranspiration from Disturbed Lands PE1				245	0	-
Evapotranspiration from Disturbed Lands PE2				245	180,000	44,100
Evapotranspiration from Rehabilitated Lands PE1	245	0	0	489	0	-
Evapotranspiration from Rehabilitated Lands PE2	489	0	0	489	0	-
Surplus Water in Ponds			0		15,185	3,568
Surplus Water on Cultivated Land			208,960		327,215	130,886
Surplus Water on Disturbed Land PE1			0		0	-
Surplus from Disturbed Lands PE2			0		180,000	115,920
Surplus Water on Rehabilitated Land PE1					0	-
Surplus from Rehabilitated Lands PE2					0	-
Infiltrated Water in Created Ponds			0		15,185	3,568
Infiltrated Water Cultivated Land			146,272		327,215	91,620
Infiltrated Water Disturbed Land PE1					0	-
Infiltrated Water Disturbed Land PE2			0		180,000	115,920
Infiltration from Rehabilitated Lands PE1					0	-
Infiltration from Rehabilitated Lands PE2			0		0	-
Total Infiltration			163,256			211,109
Difference Pre Extraction to Post						47,853
Consumption						44,500
Net Increase/Decrease in Water during Aggregate Extraction (m3)						3,353

*from Golder (2006) study 89 L/ tonne, licensed for 750,000 tonnes

Scenario S3: 18 Hectares Disturbed, Aggregate Processing, 9 Hectare Rehabilitated

Total Extraction Area	522,400		
Wash Ponds and Silt Pond Area	15,185	Water Consumption	44,500
Undisturbed Cultivated Area	227,215		
Disturbed Area PE1	70,000		
Disturbed Area PE2	110,000.00		
Rehabilitated Area PE1	-		
Rehabilitated Area PE2	100000		
Annual Tonnage	750,000.00		
Annual tonnage processed	500,000.00		
Infiltration Factor Undisturbed	0.7		
Infiltration Factor PE1	0.70		
Infiltration Factor PE2	1		

	Pre Extraction			During Extraction		
	Rate	Area	Volume	Rate	Area	Volume
	mm/year	m ²	m ³	mm/year	m ²	m ³
Precipitation	889	522,400	464,414	889	522,400	464,414
Precipitation on Created Ponds				889	15,185	13,499
Precipitation on Cultivated Lands				889	227,215	201,994
Precipitation on Disturbed Lands PE1				889	70,000	62,230
Precipitation on Disturbed Lands PE2				889	110,000	97,790
Precipitation on Rehabilitated Lands PE1				889	0	-
Precipitation on Rehabilitated Lands PE2				889	100,000	88,900
Evaporation From Created Ponds	654	0	0	654	15,185	9,931
Evapotranspiration from Cultivated Lands	489	522,400	255,454	489	227,215	111,108
Evapotranspiration from Disturbed Lands PE1				245	70,000	17,150
Evapotranspiration from Disturbed Lands PE2				245	110,000	26,950
Evapotranspiration from Rehabilitated Lands PE1	245	0	0	489	0	-
Evapotranspiration from Rehabilitated Lands PE2	489	0	0	489	100,000	48,900
Surplus Water in Ponds			0		15,185	3,568
Surplus Water on Cultivated Land			208,960		227,215	90,886
Surplus Water on Disturbed Land PE1			0		70,000	45,080
Surplus from Disturbed Lands PE2			0		110,000	70,840
Surplus Water on Rehabilitated Land PE1					0	-
Surplus from Rehabilitated Lands PE2					100,000	40,000
Infiltrated Water in Created Ponds			0		15,185	3,568
Infiltrated Water Cultivated Land			146,272		227,215	63,620
Infiltrated Water Disturbed Land PE1					70,000	31,556
Infiltrated Water Disturbed Land PE2			0		110,000	70,840
Infiltration from Rehabilitated Lands PE1					0	-
Infiltration from Rehabilitated Lands PE2			0		100,000	40,000
Total Infiltration			163,256			209,585
Difference Pre Extraction to Post						46,329
Consumption						44,500
Net Increase/Decrease in Water during Aggregate Extraction (m3)						1,829

*from Golder (2006) study 89 L/ tonne, licensed for 750,000 tonnes

Scenario S4: 18 Hectares Disturbed, Aggregate Processing, 20 Hectare Rehabilitated

Total Extraction Area	522,400		
Wash Ponds and Silt Pond Area	15,185	Water Consumption	44,500
Undisturbed Cultivated Area	127,215		
Disturbed Area PE1	70,000		
Disturbed Area PE2	110,000.00		
Rehabilitated Area PE1	110,000		
Rehabilitated Area PE2	90000		
Annual Tonnage	750,000.00		
Annual tonnage processed	500,000.00		
Infiltration Factor Undisturbed	0.7		
Infiltration Factor PE1	0.70		
Infiltration Factor PE2	1		

	Pre Extraction			During Extraction		
	Rate	Area	Volume	Rate	Area	Volume
	mm/year	m ²	m ³	mm/year	m ²	m ³
Precipitation	889	522,400	464,414	889	522,400	464,414
Precipitation on Created Ponds				889	15,185	13,499
Precipitation on Cultivated Lands				889	127,215	113,094
Precipitation on Disturbed Lands PE1				889	70,000	62,230
Precipitation on Disturbed Lands PE2				889	110,000	97,790
Precipitation on Rehabilitated Lands PE1				889	110,000	97,790
Precipitation on Rehabilitated Lands PE2				889	90,000	80,010
Evaporation From Created Ponds	654	0	0	654	15,185	9,931
Evapotranspiration from Cultivated Lands	489	522,400	255,454	489	127,215	62,208
Evapotranspiration from Disturbed Lands PE1				245	70,000	17,150
Evapotranspiration from Disturbed Lands PE2				245	110,000	26,950
Evapotranspiration from Rehabilitated Lands PE1	245	0	0	489	110,000	53,790
Evapotranspiration from Rehabilitated Lands PE2	489	0	0	489	90,000	44,010
Surplus Water in Ponds			0		15,185	3,568
Surplus Water on Cultivated Land			208,960		127,215	50,886
Surplus Water on Disturbed Land PE1			0		70,000	45,080
Surplus from Disturbed Lands PE2			0		110,000	70,840
Surplus Water on Rehabilitated Land PE1					110,000	44,000
Surplus from Rehabilitated Lands PE2					90,000	36,000
Infiltrated Water in Created Ponds			0		15,185	3,568
Infiltrated Water Cultivated Land			146,272		127,215	35,620
Infiltrated Water Disturbed Land PE1					70,000	31,556
Infiltrated Water Disturbed Land PE2			0		110,000	70,840
Infiltration from Rehabilitated Lands PE1					110,000	30,800
Infiltration from Rehabilitated Lands PE2			0		90,000	36,000
Total Infiltration			163,256			208,385
Difference Pre Extraction to Post						45,129
Consumption						44,500
Net Increase/Decrease in Water during Aggregate Extraction (m3)						629

*from Golder (2006) study 89 L/ tonne, licensed for 750,000 tonnes

Scenario S5: 18 Hectares Disturbed, Aggregate Processing, 23.7 Hectare Rehabilitated

Total Extraction Area	522,400		
Wash Ponds and Silt Pond Area	15,185	Water Consumption	44,500
Undisturbed Cultivated Area	215		
Disturbed Area PE1	70,000		
Disturbed Area PE2	110,000.00		
Rehabilitated Area PE1	237,000.00		
Rehabilitated Area PE2	90000		
Annual Tonnage	750,000.00		
Annual tonnage processed	500,000.00		
Infiltration Factor Undisturbed	0.7		
Infiltration Factor PE1	0.70		
Infiltration Factor PE2	1		

	Pre Extraction			During Extraction		
	Rate	Area	Volume	Rate	Area	Volume
	mm/year	m ²	m ³	mm/year	m ²	m ³
Precipitation	889	522,400	464,414	889	522,400	464,414
Precipitation on Created Ponds				889	15,185	13,499
Precipitation on Cultivated Lands				889	215	191
Precipitation on Disturbed Lands PE1				889	70,000	62,230
Precipitation on Disturbed Lands PE2				889	110,000	97,790
Precipitation on Rehabilitated Lands PE1				889	237,000	210,693
Precipitation on Rehabilitated Lands PE2				889	90,000	80,010
Evaporation From Created Ponds	654	0	0	654	15,185	9,931
Evapotranspiration from Cultivated Lands	489	522,400	255,454	489	215	105
Evapotranspiration from Disturbed Lands PE1				245	70,000	17,150
Evapotranspiration from Disturbed Lands PE2				245	110,000	26,950
Evapotranspiration from Rehabilitated Lands PE1	245	0	0	489	237,000	115,893
Evapotranspiration from Rehabilitated Lands PE2	489	0	0	489	90,000	44,010
Surplus Water in Ponds			0		15,185	3,568
Surplus Water on Cultivated Land			208,960		215	86
Surplus Water on Disturbed Land PE1			0		70,000	45,080
Surplus from Disturbed Lands PE2			0		110,000	70,840
Surplus Water on Rehabilitated Land PE1					237,000	94,800
Surplus from Rehabilitated Lands PE2					90,000	36,000
Infiltrated Water in Created Ponds			0		15,185	3,568
Infiltrated Water Cultivated Land			146,272		215	60
Infiltrated Water Disturbed Land PE1					70,000	31,556
Infiltrated Water Disturbed Land PE2			0		110,000	70,840
Infiltration from Rehabilitated Lands PE1					237,000	66,360
Infiltration from Rehabilitated Lands PE2			0		90,000	36,000
Total Infiltration			163,256			208,385
Difference Pre Extraction to Post						45,129
Consumption						44,500
Net Increase/Decrease in Water during Aggregate Extraction (m3)						629

*from Golder (2006) study 89 L/ tonne, licensed for 750,000 tonnes

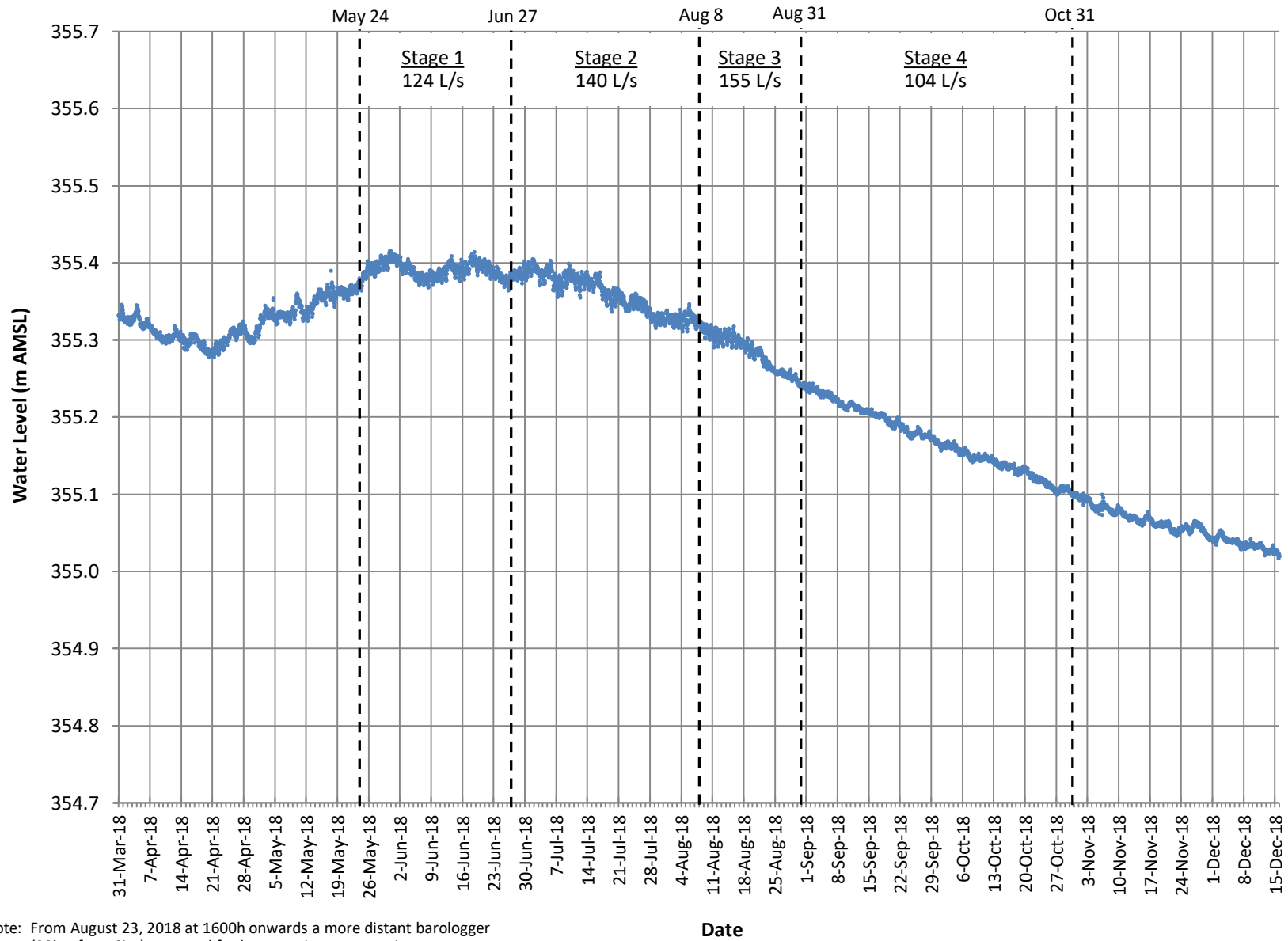
Scenario S6: Fully Rehabilitated

Total Extraction Area	522,400		
Wash Ponds and Silt Pond Area	0	Water Consumption	-
Undisturbed Cultivated Area	0		
Disturbed Area PE1	-		
Disturbed Area PE2	-		
Rehabilitated Area PE1	323,100.00		
Rehabilitated Area PE2	199,300		
Annual Tonnage	750,000.00		
Annual tonnage processed	-		
Infiltration Factor Undisturbed	0.7		
Infiltration Factor PE1	0.70		
Infiltration Factor PE2	1		

	Pre Extraction			During Extraction		
	Rate	Area	Volume	Rate	Area	Volume
	mm/year	m ²	m ³	mm/year	m ²	m ³
Precipitation	889	522,400	464,414	889	522,400	464,414
Precipitation on Created Ponds				889	0	-
Precipitation on Cultivated Lands				889	0	-
Precipitation on Disturbed Lands PE1				889	0	-
Precipitation on Disturbed Lands PE2				889	0	-
Precipitation on Rehabilitated Lands PE1				889	323,100	287,236
Precipitation on Rehabilitated Lands PE2				889	199,300	177,178
Evaporation From Created Ponds	654	0	0	654	0	-
Evapotranspiration from Cultivated Lands	489	522,400	255,454	489	0	-
Evapotranspiration from Disturbed Lands PE1				245	0	-
Evapotranspiration from Disturbed Lands PE2				245	0	-
Evapotranspiration from Rehabilitated Lands PE1	245	0	0	489	323,100	157,996
Evapotranspiration from Rehabilitated Lands PE2	489	0	0	489	199,300	97,458
Surplus Water in Ponds			0		0	-
Surplus Water on Cultivated Land			208,960		0	-
Surplus Water on Disturbed Land PE1			0		0	-
Surplus from Disturbed Lands PE2			0		0	-
Surplus Water on Rehabilitated Land PE1					323,100	129,240
Surplus from Rehabilitated Lands PE2					199,300	79,720
Infiltrated Water in Created Ponds			0		0	-
Infiltrated Water Cultivated Land			146,272		0	-
Infiltrated Water Disturbed Land PE1					0	-
Infiltrated Water Disturbed Land PE2			0		0	-
Infiltration from Rehabilitated Lands PE1					323,100	90,468
Infiltration from Rehabilitated Lands PE2			0		199,300	79,720
Total Infiltration			163,256			170,188
Difference Pre Extraction to Post						6,932
Consumption						-
Net Increase/Decrease in Water during Aggregate Extraction (m3)						6,932

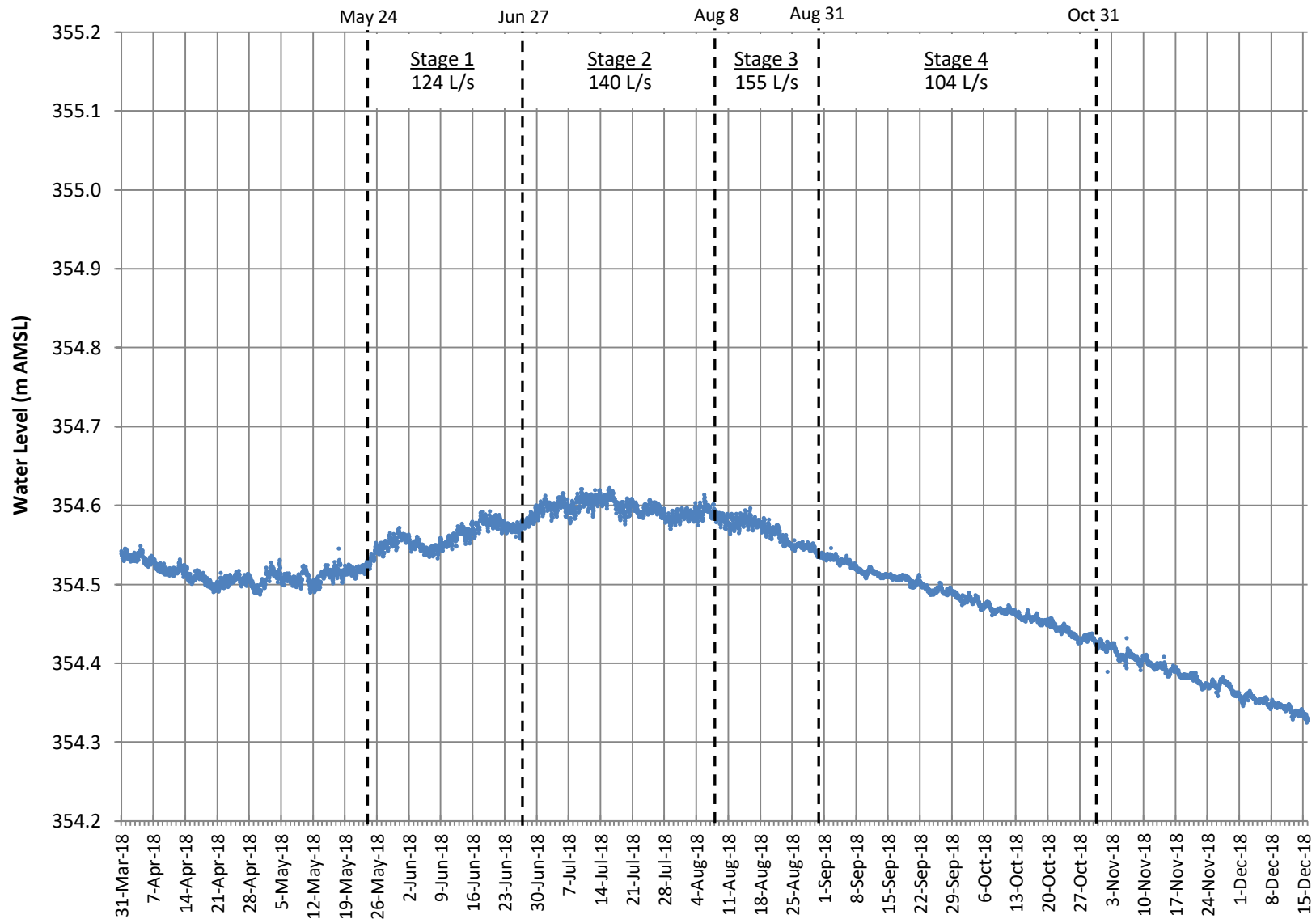
Appendix F – Onsite Hydraulic Response to OTP Testing in 2018

MW3 Hydrograph (Hourly Readings)



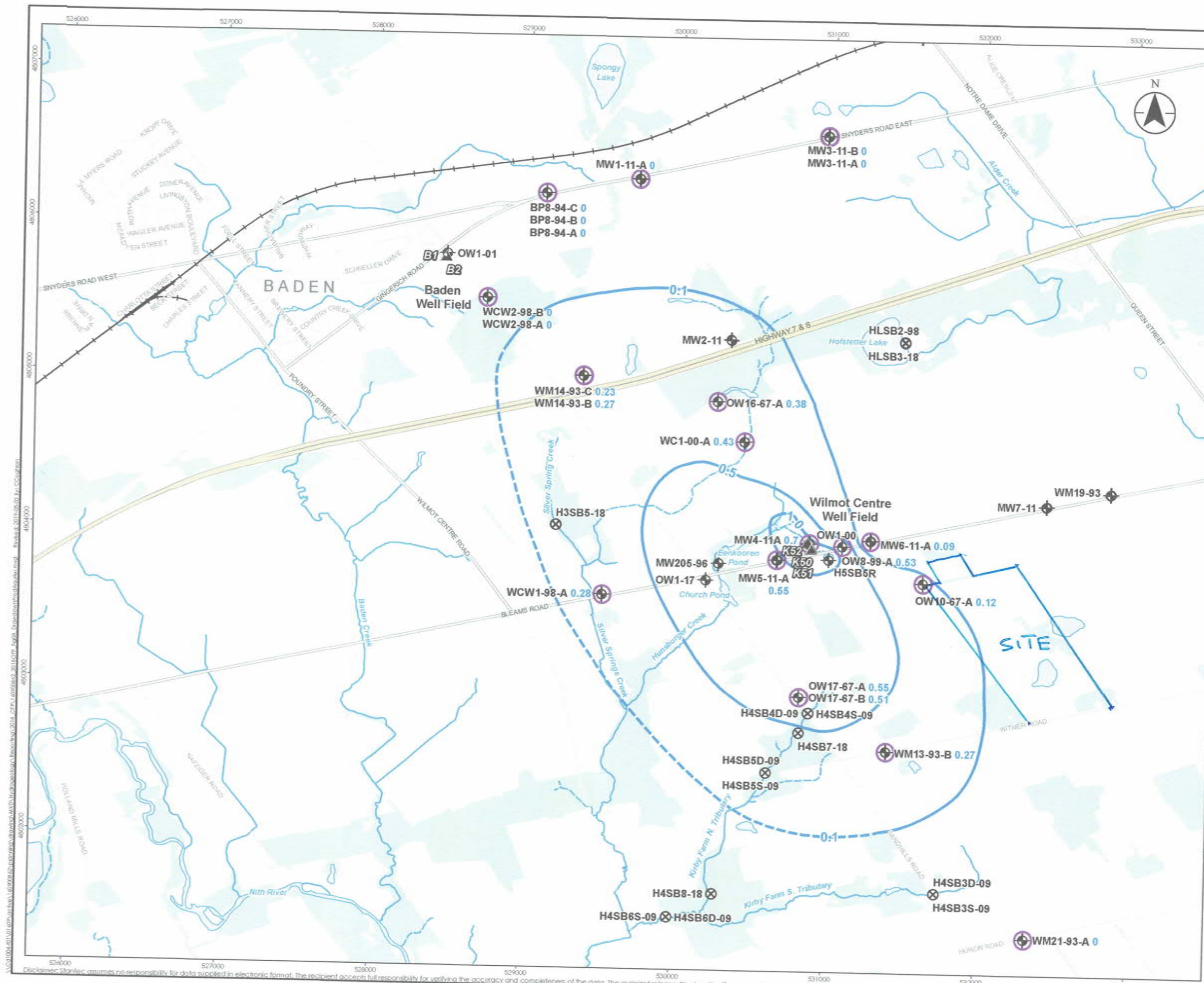
Note: From August 23, 2018 at 1600h onwards a more distant barologger (28km from Site) was used for barometric compensation

MW4 Hydrograph (Hourly Readings)

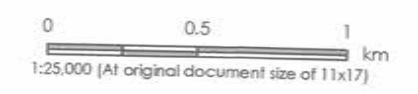


Note: From August 23, 2018 at 1600h onwards a more distant barologger (28km from Site) was used for barometric compensation

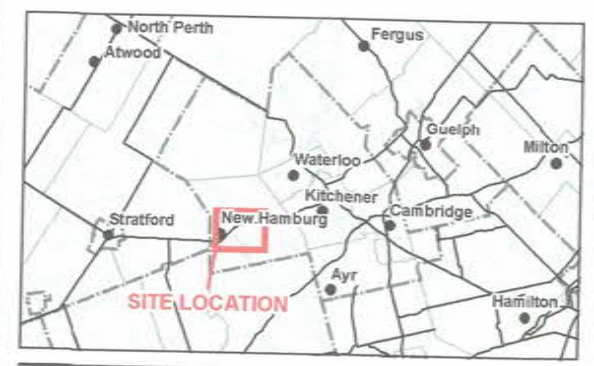
Date



- Legend
- Municipal Supply Well
 - Monitoring Well
 - Streambed Well
 - Well Screened Across AFB2
 - 1.5 Drawdown (m)
 - Drawdown Contour (m)
 - Expressway / Highway
 - Major Road
 - Minor Road
 - Railway
 - Watercourse
 - Intermittent Flow Path
 - Waterbody
 - Wooded Area



- Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
 2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
 3. Monitoring wells UW 5-91 and BP13-94 are located approximately 3km and 1.7 km North of Baden Well Field, respectively.



Project Location
Township of Wilmot,
Ontario

160900862 REVA
Prepared by CMC on 2019-05-03
Technical Review by LV on 2019-05-02

Client/Project
2018 OPERATIONAL TESTING PROGRAM
WILMOT CENTRE WELL FIELD
REGION OF WATERLOO

Figure No.
8

Title
Drawdown in Production Aquifer (AFB2)

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.



Notes:
Water level and pumping rate shown as provided by the Region of Waterloo. Pumping rates shown are instantaneous values reported as averaged daily.

Client/Project 2018 Operational Testing Program
Wilmot Centre Well Field
Regional Municipality of Waterloo

Figure No.

11

Title

North of Wilmot Centre Well Field Hydrographs

Appendix G

Wetland Monitoring and Contingency Plan



DANCE
ENVIRONMENTAL
INC.

Appendix 1 to the

Addendum to the

Natural Environment Level 1 & 2

Report and E.I.S.

For Aggregate Licence Application

For the Proposed Hallman Pit

DE-428

July 15, 2020.

1.0 INTRODUCTION

The GRCA has provided comments on the Natural Environment and Hydrogeological Technical reports that were submitted in support of the aggregate licence application for the proposed Hallman Pit in Wilmot Township.

In the GRCA comment letter dated December 6, 2019, it was indicated that the GRCA recommended that seasonal water level triggers be identified for the wetland and that a Contingency Plan be developed and implemented, as needed.

The present appendix documents proposed water level triggers and a conceptual Contingency Plan.

2.0 SEASONAL WATER LEVEL TRIGGERS

There are several key elements to designing and implementing an effective water level trigger program. These include:

- (a) defining the dates that bracket the seasons;
- (b) setting water level elevations that will be the triggers during each season;
- (c) establishing a water level data collection and data review system that is effective in providing alerts when triggers are approached or exceeded; and
- (d) establishing a mechanism for revising triggers, if long-term weather and/or climate conditions make it necessary and prudent.

Each of these are addressed below.

2.1 Defining the Dates that Bracket the Seasons

From an ecological perspective there are several factors that are important in the Schindelstедdle South Wetland and pond that are located to the east of the proposed pit.

Key ecological factors are: maintenance of wetland vegetation communities; provision of water for amphibian egg laying, hatching, tadpole emergence and adult overwintering; provision for turtle overwintering and feeding habitat for turtles; habitat for aquatic and wetland bird nesting and rearing of young; and expected fish habitat for overwintering and reproduction.

Given the variety of ecological features and functions present in the wetland and pond there is value in having triggers that address all seasons of the year.

Based on weather and ecological conditions in the GRCA drainage basin the following dates are proposed to bracket the seasons:

Winter:	December 1 to March 1
Spring:	March 2 to June 15
Summer/Autumn:	June 16 to November 30.

2.2 Setting Water Level Elevations that Will be Triggers

Harden Environmental has plotted water levels from SG1 located in the pond for the 3 seasonal periods between May 2017 and mid-June 2020, see Figure 1: SG1 Pond Hydrograph.

Figure 1 shows the warning level (historical lowest level measured) as a solid horizontal line for each season. The dashed line, set at 10cm below each warning line, is the proposed trigger level. The trigger set at 10cm below the warning level avoids frequent trigger exceedances due to weather-related reductions in pond levels in the future. Such events are expected because of continued record high temperatures and lack of rain that result in pond drawdowns that have become a pattern in the last 5 or more years.

Given the extensive pond surface area in the subject wetland, it is anticipated that triggers set at 10cm below the historic low water warning levels will protect the various ecological life histories that occur here.

As shown on Figure 1, the seasonal warning values would be: Spring 354.20m; Summer/Fall 353.97; and Winter 353.90, with seasonal trigger values being 10cm less than the warning elevations.

2.3 Water Level Data Collection and Review System

Data review once annually and annual reporting is not enough to detect and adequately address any trigger exceedances which might occur during the Spring and Summer seasons.

It is recommended that the Automatic Water Level Recorder (AWLR) at SG1 be downloaded during the first week of May and that an internal memo on conditions at SG1 relative to warning and trigger levels for the Spring season be circulated to the proponent and the Consulting Team by May 20th. The Consulting Ecologist should review the SG1 water level findings relative to ecological conditions observed during amphibian call surveys.

The other element of water level data collection and analysis would be manual water level recording during the inventory visits made to document amphibian choruses, turtle basking and turtle nesting. These visits will occur during the late March to mid-July period. This timing coincides with key ecological activities and key times for potential pond level flux.

The water levels observed by the Consulting Ecologist will be compared with the seasonal warning and trigger levels, immediately following each site visit.

The annual hydrogeological and ecology reports would also address any exceedances of triggers.

2.4 Mechanism for Revising Triggers

Since new record high temperatures, including numbers of days above 30°C have been increasing in the last 5 years, it seems reasonable to predict that long hot, dry periods may occur in the future. For example, late June/early July 2020 has had extensive periods of hot, dry weather which may result in new low Summer/Fall water levels being recorded at SG1.

It is recommended that seasonal water levels at SG1 continue to be reviewed and that if any new seasonal lows occur prior to commencement of extraction at this site the seasonal warning and trigger elevations be adjusted.

3.0 CONTINGENCY PLAN

If any trigger level is breached, the following measures will be taken:

- 1) Confirmation of water level within 24 hours. Increase monitoring to weekly until source of the trigger level exceedance is identified. Data from automatic water level recorders (AWLR) will be downloaded on a weekly basis.
- 2) Within seven days complete an evaluation of precipitation, groundwater monitoring data and pit activities to determine if pit activities are responsible for the low water level observed. The water level data from the AWLRs will be plotted and the water level trends analyzed so that the time it will take for the water level to recover above the trigger level can be predicted.

If extraction is found to be responsible for breaching the trigger level, the MNRF and GRCA will be informed in writing.

- 3) If pit activities are found to be responsible, Jackson Harvest Farms Ltd. will prepare contingency measures and a Responses Plan will be presented to the MNRF and the GRCA.

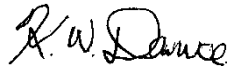
Responses might include the following:

- Cease water taking for the aggregate washing operation,
- Alter configuration or extraction extent,
- Alter timing of activities.

- 4) If extraction activity is not found to be the cause or contributor to the trigger level breach, then extraction activity will continue and monitor frequency will return to normal.

Consideration will be given to the need to revise the trigger. MNRF and GRCA will be involved in reviewing any proposed revision of a trigger.

Prepared by:

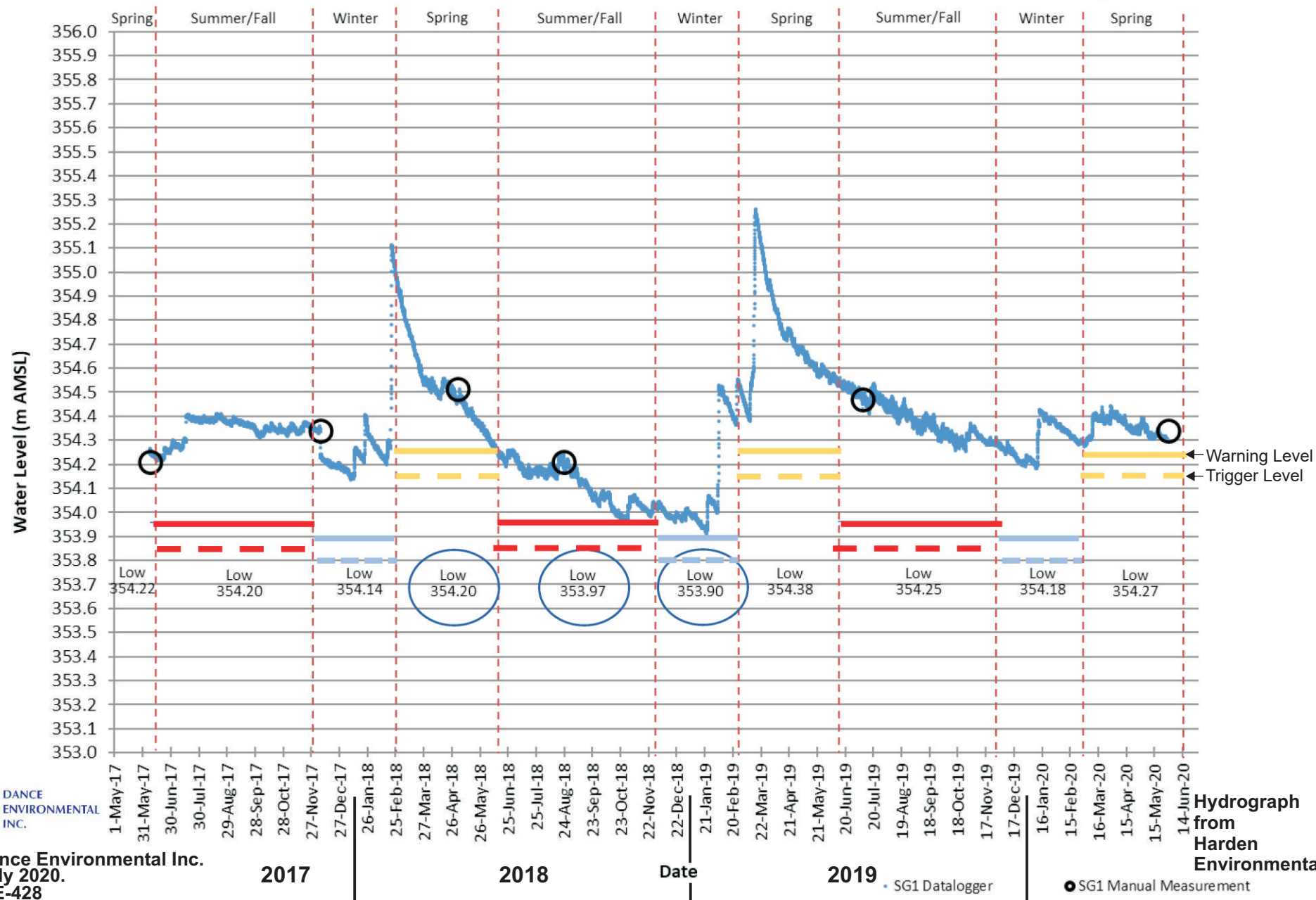
A handwritten signature in black ink, appearing to read "K.W. Dance". The signature is fluid and cursive, with the first letters of each word being capitalized and prominent.

K.W. Dance, M.Sc.
President
Dance Environmental Inc.

With significant technical
inputs and discussion with:
Stan Denhoed of
Harden Environmental.

FIGURE 1. SG1 Pond Hydrograph & Proposed Water Level Triggers.

Winter: Dec 1 - Mar 1
 Spring: Mar 2 - Jun 15
 Summer/Fall: Jun 16 - Nov 30



Dance Environmental Inc.
 July 2020.
 DE-428

2017

2018

Date

2019

Hydrograph
 from
 Harden
 Environmental

Harden Environmental Services Ltd.

Appendix H

Spills Management Plan

Spill Management Plan

<i>Site Location</i>	<i>Revision Date</i>	<i>Revision Number</i>
HALLMAN PIT	APRIL 2020	1

1 Purpose

The purpose of this Spill Management Plan (“SMP”) is to support the Miller Environmental Management Framework in the site specific spill prevention, preparedness, response requirements, and to promote the safe response to accidental spills, leaks, or releases of both hazardous and non-hazardous materials to the environment (i.e., releases to land and/or water); to eliminate or minimize the adverse effects should a spill occur; and, to protect the health and safety of employees.

The SMP was prepared for the Jackson Harvest Farms Ltd. pit located at 1922 Witmer Road, Petersburg, Ontario (the “Site”).

2 Scope

This SMP applies to the Site managers (i.e., Spill Response Coordinator and Alternate Spill Response Coordinator), Site Personnel (i.e., employees) and contractors at the Site.

The Site consists of a 57.27 hectares parcel of land. The Site consists of a contractor yard and maintenance shop, which includes a scale house.

Table 1: Site Information

Category	Information
Owner Site Location Mailing Address	Jackson Harvest Farms Ltd. Hallman Pit Part of Lot 10, Concession South of Bleams Road, being Part 1 on Plan 58R-19981, Township of Wilmot, Region of Waterloo 1922 Witmer Road, Petersburg, Ontario Phone: 519-588-2884 Email: rickesbaugh@gmail.com
Site Surroundings and Access	The surrounding area includes residential and agricultural property uses. Access to the Site is from Witmer Road.

A Site plan identifying the key areas of the Site is presented in Figure 1.

Spill Management Plan

<i>Site Location</i>	<i>Revision Date</i>	<i>Revision Number</i>
HALLMAN PIT	APRIL 2020	1

3 Roles and Responsibilities

The **Environmental Specialist** will:

- Report externally (Ministry of Environment, Conservation and Parks Spills Action Centre (“MECP SAC”), Township of Wilmot, and Regional Municipality of Waterloo), as required; and, ensuring a Spill Investigation Form (provided as Appendix B) is completed including an investigation of the causes of the spill and evaluation of actions taken to respond to the spill event;
- Report internally to the Environmental team including the Vice President of Health, Safety and Environmental Affairs.
- Provide support to all site operations including; training, and the remediation of the spill event.
- Draft a detailed Spill Report for internal communication and corrective action.

The **Spill Response Coordinator** (or designated **Alternate**) and **HSE Coordinator** has the following responsibilities:

- In case of a spill, responding to the spill location and taking charge or ensuring someone takes charge of containing the spill and ensuring the safe handling, clean-up, and proper disposal of spill residues and clean-up materials.
- Reporting the spill internally (to the Environmental Manager, Plant Manager, HSE Coordinator, Senior HSE Manager, and Environmental Specialist).
- Ensuring Safety Data Sheets (“SDSs”) are readily available and kept current for all hazardous materials used and in contact with on Site, including flammable and combustible liquids;
- Establishing availability/contracts with specialized spill response/clean-up contractors;
- Ensuring spill response equipment is readily available at critical points of use at all times; and,
- Ensuring that all employees are trained and knowledgeable of this SMP, and that the SMP is updated as needed.

Site Personnel (employees) must:

- Participate in spill training including general response procedures and notification requirements. Personnel, and their supervisors, will be trained on techniques to effectively contain a spill (i.e. spills of fuels and chemicals) as well as how and when to notify the Spill Response Coordinator; and,
- Immediately notify their Supervisor, the Spill Response Coordinator or, in their absence, the Alternate Spill Response Coordinator, and HSE Coordinator in the event of a spill.

Contractors must:

- Review and understand their obligations under this SMP, including general response procedures and notification requirements, prior to commencing work at the Site; and,
- Immediately notify the Spill Response Coordinator or, in their absence, the Alternate Spill Response Coordinator, and HSE Coordinator in the event of a spill.

Spill Management Plan

<i>Site Location</i> HALLMAN PIT	<i>Revision Date</i> APRIL 2020	<i>Revision Number</i> 1
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4 Definitions

Term	Definition
Adverse Effect	Section 1(1) of the Environmental Protection Act ("EPA") defines adverse effect as one or more of the following: (a) impairment of the quality of the natural environment for any use that can be made of it; (b) injury or damage to property or to plant or animal life; (c) harm or material discomfort to any person; (d) an adverse effect on the health of any person; (e) impairment of the safety of any person; (f) rendering any property, water, plant or animal life unfit for human use; (g) loss of enjoyment of normal use of property; and, (h) interference with the normal conduct of business.
Contaminant	Any solid, liquid, gas, odour, heat, sound, vibration, radiation or combination of any of them resulting directly or indirectly from human activities that causes or may cause an adverse effect.
Hazard	With regards to spills, the release of a hazardous material (liquid or solid) that: (a) may occur at the site or relate to the operations of the site; (b) are reasonably foreseeable; and (c) have the potential to cause adverse effects.
Reportable Spill	A reportable spill is a release, (a) into the natural environment, (b) from or out of a structure, vehicle or other container, and (c) that is abnormal in quality or quantity in light of all the circumstances of the discharge. A reportable spill includes: - any spill that has the potential to cause an adverse effect to the environment, other than those which can be readily remediated through clean-up and restoration of paved, graveled or sodded surfaces. Remediation must be carried out immediately; and - any spill that enter waters or is likely to enter waters directly or through drainage structures.
Natural Environment	The air, land and water or any combination or part thereof.
Non-Reportable Spills	Non-reportable spills include: - spills that occur indoors, that are contained by impervious surfaces; - spills that do not release to the outdoors (to air, water, ground) and do not reach a waterbody and do not have the potential to cause an adverse effect. Reporting to external agencies is not required.
Pollutant	A contaminant other than heat, sounds, vibration or radiation, and includes any substance from which a pollutant is derived [s. 91(1) of the EPA].
Spills	When used with reference to a pollutant, means a discharge into the natural environment, from or out of a structure vehicle or container, and that is abnormal in quality or quantity in light of all the circumstances of the discharge
Spills Action Centre ("SAC")	The Spills Action Centre (SAC), under the Ontario Ministry of Environment, Conservation and Parks, responds to spills and other urgent environmental concerns.

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	SAC can be contacted at 1-800-268-6060, and is available 24 hours a day, 365 days a year.
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5 Spill Management Plan

5.1 Possible Potential Sources of Spills

The purpose of spill management planning is to document and assess the risk of potential spills in order to identify appropriate procedures and mitigating actions to respond to a spill. Potential spill sources/areas are described below:

i. Fuel/Oil Storage and Handling

The following table identifies the fuels/oils stored and handled on-Site:

Product	Container	Use / Purpose	Controls
Diesel, Clear and Coloured	Two 4,540 L double-walled above ground storage tank ("AST")	The AST and fueling area are used to fuel an on-Site loader and dump trucks.	- The AST is situated on a concrete pad equipped with vehicle impact protection (concrete-filled bollards) . - Drip trays are placed at fueling connection points to capture any releases. - A Fueling Procedure is in place and Site Personnel responsible for fueling have received appropriate procedural training. - The Fueling Procedure and Spill Response Procedure are (see Section 6 – Spill Response Procedure) posted in the fueling area. - The diesel AST and Fueling Area are subject to weekly inspections.
Hydraulic Oil	Approximately two 205 L drum	The hydraulic oil drum is maintained for maintenance of the equipment.	- The hydraulic oil drum is stored in the Maintenance Shop. - The drum is stored on a spill containment pallet.
Propane	Two 15 kg cylinders	The propane is used for heating steel and forklifts.	The propane cylinders are stored in a locked cage adjacent to the Maintenance Shop.
Oxygen and Acetylene	Two 20 kg cylinders	The oxygen and acetylene are used for maintenance related welding.	The oxygen and acetylene cylinders are stored in a locked cage adjacent to the Maintenance Shop.

Vehicles (i.e. highway trucks) delivering raw materials (i.e. various aggregates, and small quantities of various oils and chemicals), excess fill, and shipping finished products enter and exit the Site via Witmer Road. The Site also maintains two on-Site loaders which serves the screening plant. These vehicles have also been identified as a potential source of fuel/oil spills.

The locations of the following potential spill sources / areas are shown in Figure 1 – Site Plan:

- 2 x 4,540 L double-walled diesel AST and fueling area
- Maintenance Shop – 2 x 205 5W-40 Motor Oil, 2 x 205L drum of hydraulic oil

Spill Management Plan

<i>Site Location</i> HALLMAN PIT	<i>Revision Date</i> APRIL 2020	<i>Revision Number</i> 1
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- Propane storage cage
- Oxygen / acetylene storage cage
- Potential vehicle spill areas

ii. Chemical Storage and Handling

On-Site chemical storage and handling is limited to the Maintenance Shop, the Utility Shed. The following table identifies the chemicals stored and handled on-Site:

Product	Container	Use / Purpose	Controls
Paint, Solvents, Antifreeze, Cleaners, Aerosols (i.e. paints, electrical contact cleaners, or cleaners and degreasers)	Small quantities	Used in the Maintenance Shop.	• Stored in the maintenance shop.

The locations of the following potential spill sources/areas are shown in Figure 1 – Site Plan:

A Maintenance Shop is also located on-Site which is used to store machinery and supplies.

5.2 Identified Receiving Bodies of Concern

There is a wetland located on the property located outside of the licenced boundary, but adjacent to the Site. Spills to the driveway area and to the internal roadways of the Site would likely not reach the wetland area. In general, storm water infiltrates the ground surface and any surface drainage flows towards to a low-lying area located near the center of the Site where it infiltrates the ground surface. The ground surface at this low-lying area is inferred to be approximately 1.5 metres above the local water table and therefore represents a potential risk for potential environmental impact.

Two water wells and ten monitoring wells are reported to be present at the Site. (See attached map for locations).

5.3 Preventive Measures

Appropriate measures should be taken to prevent the occurrence of a spill. Assigned Site Personnel are responsible for conducting regular inspections of the preventive measures implemented on-Site. All Site Personnel and contractors are responsible for following training, operating procedures, and work instructions set out and required by Jackson Harvest Farms Ltd.

On-Site re-fueling of equipment is only conducted by Site personnel who have received appropriate training. The Fuelling Area (adjacent to the maintenance shop) and is located greater than 30 m away from any surface watercourses, water bodies, wells, or other sensitive areas (i.e. the low-lying area located near the

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center of the Site). Site personnel follow a documented Fueling Procedure which is posted in the fuelling area along with a copy of the Spill Response Procedure. Drip trays are placed at fuelling connection points to capture any releases.

Drums and containers of oil and chemicals on Site should be stored indoors, where possible, and be provided with secondary containment. Drums/containers should be kept away from vehicular traffic and heavy equipment and/or collision protection (i.e. bollards or jersey barriers) should be provided, if necessary.

Spill kits are located in high risk areas and regular documented inspections are conducted to ensure the spill kits are fully stocked.

Up to date Safety Data Sheets ("SDS") are maintained on-Site for all applicable materials. This SMP and the Spill Response Procedure are also posted in the Maintenance Shop.

6 Spill Response Procedure

The primary steps to take in the event of a spill are as follows:

- a) **Assess the spill.** Protect the health and safety of Site personnel and the public (in the event of immediate public safety or health risk, i.e., explosion or fire contact 9-1-1 immediately).
- b) **Notify the Spill Response Coordinator and HSE team (Coordinator & Senior Manager) of the spill.** All Site personnel shall immediately notify the Spill Response Coordinator or in their absence, the Alternate Spill Response Coordinator, or on-Site Supervisor, and the HSE team of any spill situation. The Spill Response Coordinator, or Alternate, will direct all aspects of any spill incident.
- c) **Identify the material.** Wear appropriate personal protective equipment (refer to the appropriate SDS) before proceeding with spill response activities.
- d) **Evaluate the size of the response to be initiated.** Determine if the spill response and clean-up can be handled by Site personnel or whether the assistance of a spill response contractor is required. Refer to **Appendix A** – Emergency Contact Information for applicable contact numbers.
- e) **Decide whether or not Site personnel need to be evacuated from the area.** If evacuation is required, the Spill Response Coordinator, or Alternate, is responsible for ensuring that all Site personnel are safely evacuated from the building / area. Should the Spill Response Coordinator, or Alternate, not be available, an on-Site Supervisor may take the lead on evacuation, if required.
- f) **Stop/contain the spill, only if safe to do so.** Stop and contain the spill if possible and only if it is safe to do so in order to prevent further release. If possible, plug the leak from the drum, tank, or

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pipe with plugging compound. Deploy sorbent socks around the spill then dike the spill to prevent it from spreading. Turn off engines and other sources of ignition (i.e. cigarettes), if applicable.

- g) **Prevent the spill from entering nearby watercourses.** Use all available materials to contain the spill to prevent it from reaching the low-lying area on-Site and away from any watercourse. Cover/block all drains, ditches, etc. with drain covers, booms or diking materials.
- h) **Protect the affected area.** Protect the spill area as necessary, including the equipment and materials exposed to the spill. (Do not drive equipment through the spill and around the Site, this just increases the area requiring clean-up).
- i) **Report the spill as soon as possible.** Only the **Environmental Specialist or Senior HSE Manager** informs external parties (i.e. MECP SAC, Township of Wilmot and Regional Municipality of Waterloo, Technical Safety and Standards Authority, etc.). The MECP SAC must be notified **as soon as possible**. Refer to **Appendix A** – Emergency Contact Information for applicable contact numbers. Refer also to Section 6.2, Reporting Requirements.
- j) **Clean up the spill.** When the spill is contained, place sorbent on the ground at the outer edge of the spill. Then work your way with the sorbents towards the center of the spill.
- k) **Have back-up absorbent available.** If the spill is larger than the available sorbent capacity within the spill kit, obtain back up absorbents from other spill kits. Sand that may be available on-Site can also be utilized as sorbent for larger spills.
- l) **Complete the Spill Investigation Form.** Complete the Spill Investigation Form (**Appendix B**) and distribute to the Environmental Manager, Plant Manager (Alternate Spill Response Coordinator) and Senior Management. Include photos if possible.
- m) **Dispose of all spilled material and spent absorbent.** Collect spilled material/spent absorbent/impacted soil in drums or in a lugger bin, if applicable, properly label the contents and date of the drum/lugger bin; and, place it in a secure storage area. All waste is to be handled and disposed of in accordance to the MECP requirements. Refer also to **Section 6.3**, Disposal of Spilled Materials.
- n) **Replenish spill kits.** Take an inventory of all on-Site spill kits and replace all used sorbents.

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6.1 Spill Response Equipment and Safety Considerations

- a) Spill response equipment must be maintained and readily available on-Site. Absorbent materials must be stored in high risk areas (i.e. Fueling Area, Maintenance Shop) or provided by contractors delivering fuels / chemicals (i.e. maintained in their trucks). Where liquid transfers occur within the vicinity of on-Site ditches, booms must be available for placement in the ditch before the bulk transfer begins.
- b) Depending on nature of the potential spill sources/areas (i.e. quantity, physical and chemical characteristics), the spill kits may contain the following:
- Absorbent pads, pillows, socks;
 - Hydrophobic spill booms, of suitable size and length, to contain the spill in the ditch;
 - Absorbent material (i.e. clay absorbent) to absorb spills to the ground;
 - Dust pan/brooms;
 - Non-sparking shovel;
 - Neoprene drain cover(s);
 - Spilled material container/drum/bags;
 - Neoprene gloves; and,
 - Warning tape.

A loader is also available on-Site to facilitate spill response and clean-up if required.

- c) At minimum, the following personal protective equipment ("PPE") is kept within or in the vicinity of the spill kits, to assist with spill clean-up:
- Safety goggles;
 - Neoprene gloves;
 - Respirators with appropriate filters, if required (as identified in SDS); and,
 - Neoprene coveralls and/or aprons, if required (as identified in SDS).

The Spill Response Coordinator must ensure that regular inspections of spill response equipment / kits are completed to verify availability and whether maintenance / replacement of any equipment is warranted.

Spill kits are maintained on Site in the following areas:

- Main office / scale house;
- Maintenance Shop;
- Fueling Area;
- On-board heavy equipment (i.e., loader); and
- Maintenance Trucks.

The locations of the on-Site spill kits are shown in Figure 1 – Site Plan

Spill Management Plan

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6.2 Reporting Requirements

In the event of a spill, employees and contractors (if applicable) are required to immediately notify the Spill Response Coordinator (or Alternate) and HSE Coordinator, who are then required to notify the Environmental Manager, Plant Manager (Alternate Spill Response Coordinator) and Senior Management (Environmental Specialist and Senior HSE Manager).

The Environmental Specialist, or Alternate, will notify the MECP and other external parties (i.e. Township of Wilmot and The Regional Municipality of Waterloo), if required, **as soon as possible**. Internal and external contact numbers are available in **Appendix A** - Emergency Contact Information. Reporting to the MECP is accomplished by calling the 1-800-268-6060. The following information must be provided when reporting a spill. Make sure you prepare and keep a record of the telephone call when making a spill report, documenting what you say, and any instructions provided by SAC.

- i. Your name and phone number;
- ii. Nature of release (i.e. spill, leak, fire or explosion);
- iii. Impact on people, property, and environment;
- iv. Date / time / location of spill;
- v. Type / quantity of substance released;
- vi. Brief description of site and surrounding area;
- vii. Circumstances leading up to the event;
- viii. Resulting contamination; and,
- ix. Remedial action being taken/required.

Notification of the MECP/SAC **MUST** occur **as soon as possible** after the spill occurs (or is discovered).

A **reportable spill** is a release,

- (a) into the natural environment;
- (b) from or out of a structure, vehicle or other container; and,
- (c) that is abnormal in quality or quantity in light of all the circumstances of the discharge.

A reportable spill includes:

- Any spill that has the potential to cause an adverse effect to the environment, other than those which can be readily remediated through clean-up and restoration of paved, graveled or sodded surfaces. Remediation must be carried out immediately; and,
- any spill that enter waters or is likely to enter waters directly or through drainage structures.

By law, in accordance with the Environmental Protection Act: Every person having control of a pollutant that is spilled and every person who spills or causes or permits a spill of a **pollutant that causes or is likely to cause an adverse effect** shall forthwith notify appropriate persons of the spill. *EPA Sec 92(1)*

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The following persons shall be notified by Jackson Harvest Farms Ltd. in the event of a reportable spill:

- a) The MECP;
- b) The Township Of Wilmot, and the Region of Waterloo;
- c) The Technical Standards & Safety Authority ("TSSA") for spills of fuel and from fuel tanks;
- d) Where the person is not the owner of the pollutant and knows or is able to ascertain readily the identity of the owner of the pollutant, the owner of the pollutant; and,
- e) Where the person is not the person having control of the pollutant and knows or is able to ascertain readily the person having control of the pollutant, the person having control of the pollutant.

6.3 Disposal of Spilled Materials

Free standing liquids are usually removed by vacuum truck.

Spilled material, spent absorbent, and/or impacted soil should be placed into labelled, poly-lined drums, lugger bins, or other sealed containers. Lugger bins should be tarped to keep storm water out.

Larger quantities of impacted soil should be placed on a hard surface, if possible, tarped (both over and under the stockpile) and secured with sand bags or other ballast to keep storm water out.

Spilled material, spent absorbent, and/or impacted soil should be stored in a secure storage area until removed for disposal.

Spilled material, spent absorbent, and/or impacted soils will need to be sampled and analyzed using the toxicity characteristic leaching procedure ("TCLP") by a CALA accredited laboratory prior to disposal at a licensed landfill (non-hazardous or hazardous). The landfill will require the results of the TCLP analysis prior to accepting the waste. If the TCLP analysis confirms the waste is not hazardous, it may be disposed of at a landfill approved to accept non-hazardous waste. Hazardous waste and must be disposed of at a landfill licensed to accept hazardous waste.

Depending on the spilled material, additional testing may be required (i.e. corrosivity, ignitability, reactivity).

6.4 Training Requirements

All employees are expected to be fully aware of Jackson Harvest Farms Ltd.'s policies and emergency procedures.

Within three months of being hired, new employees will be trained on spill response as part of their new hire orientation. The orientation will include, but will not be limited to, an overview of this SMP document with emphasis on reporting requirements and spill prevention techniques, location and use of emergency equipment such as relevant PPE, fire extinguishers, spill kits, etc.

After the initial orientation, all employees will be retrained on spill response and pollution prevention every six months thereafter, as required by the Ontario Fire Code.

Spill Management Plan

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HALLMAN PIT	APRIL 2020	1

The Plant Manager is responsible for scheduling and arranging for both the orientation and semi-annual spill response training. Records of training will be retained including the trainees name and signature, the date on which training was provided and the name of the trainer.

6.5 Plan Review Requirements

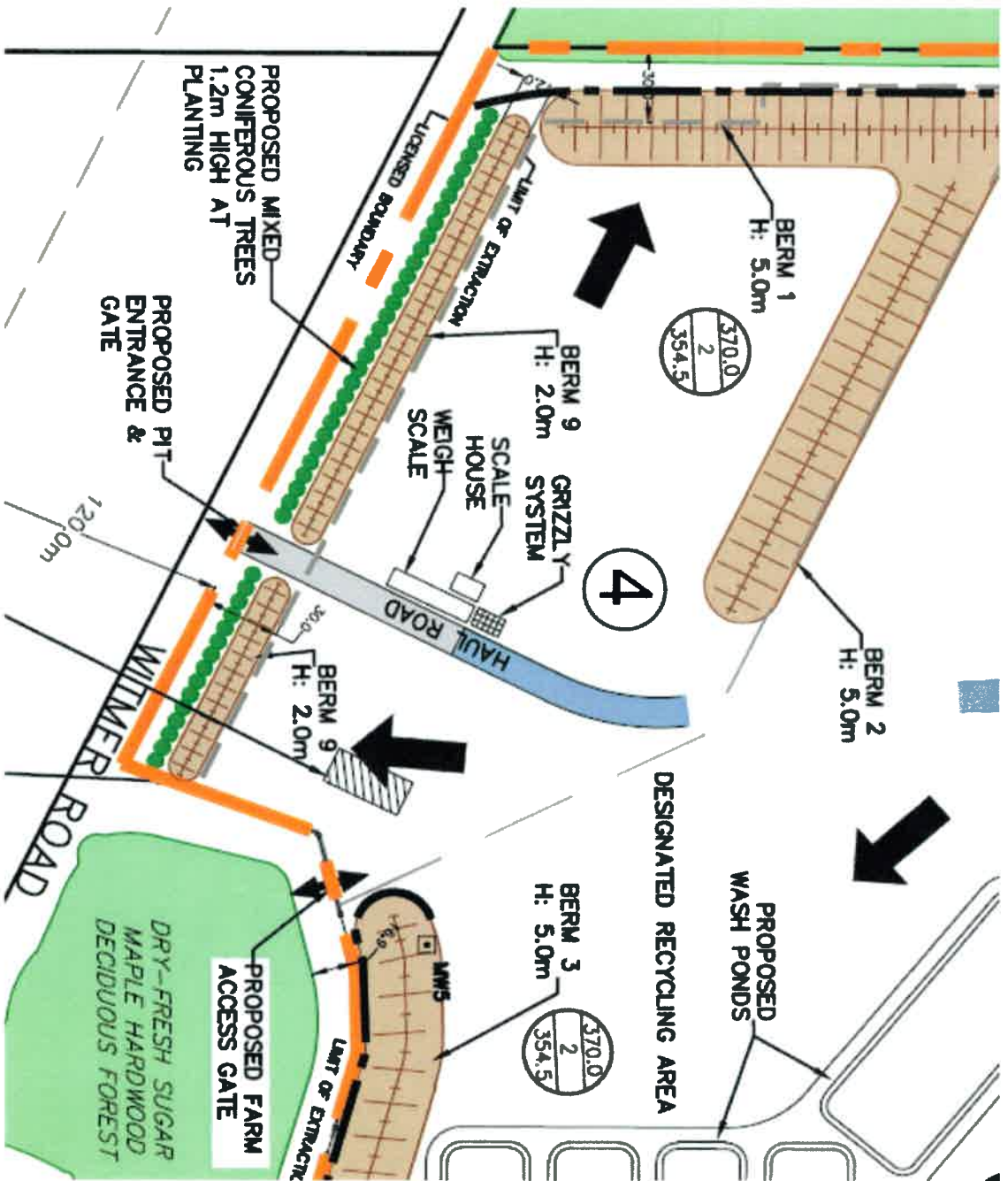
This SMP will be reviewed, at a minimum, on an annual basis and revised as required. The SMP will also be reviewed following each spill for which MECF notification is required and revised as necessary. A record of these reviews/revisions will be maintained as required under **Section 7**, Document Revision History.

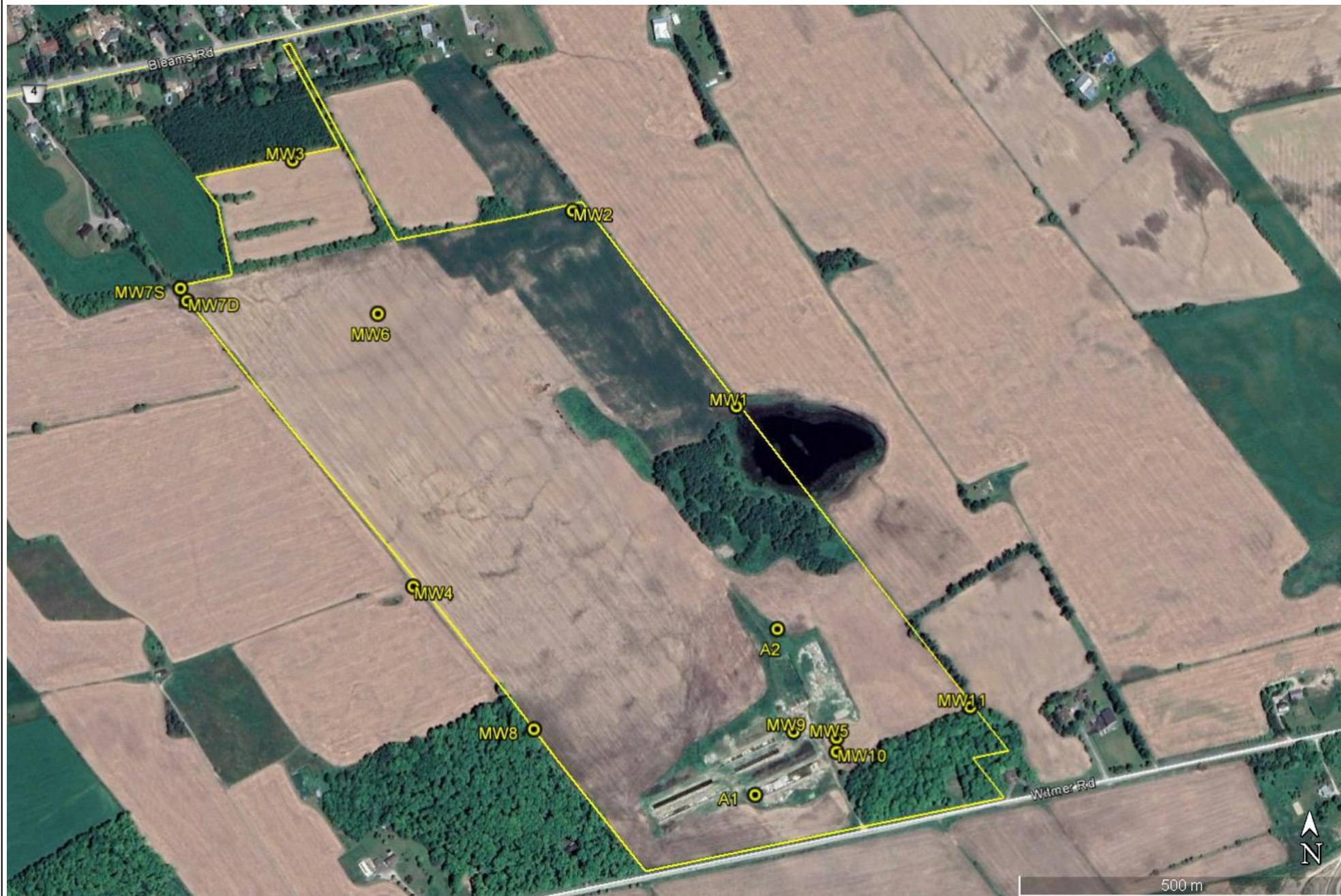
Spill Management Plan

<i>Site Location</i> HALLMAN PIT	<i>Revision Date</i> APRIL 2020	<i>Revision Number</i> 1
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7 Document Revision History

Revision	Revision Reason	Date
1.0	Draft Submission for review	April 2020





Harden
Environmental
Services Ltd.

Project No: 1728

Date: May 2020

Drawn By: AR

Spills Management Plan

1894 Witmer Rd, CON South of Bleams Rd, PT LOT 10
Township of Wilmot, Regional Municipality of Waterloo

Figure 1: Well Locations

Spill Management Plan

<i>Site Location</i> HALLMAN PIT	<i>Revision Date</i> APRIL 2020	<i>Revision Number</i> 1
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Appendix A: Emergency Contact Information (Hallman Pit)

Role	Name	Position	24 Hour Telephone Contact Number	E-mail
Spill Response Coordinator	Rick Esbaugh	Site Foreman	519-588-2884	rickesbaugh@gmail.com
Alternate Spill Response Coordinator	Rick Esbaugh	Plant Manager	519-588-2884	rickesbaugh@gmail.com
	Rick Esbaugh	Plant Operator	519-588-2884	rickesbaugh@gmail.com
Senior Management	Rick Esbaugh	Property Supervisor	519-588-2884	rickesbaugh@gmail.com
HSE	Danny Ferreira	HSE Coordinator	905-716-2538	danny.ferreira@millergroup.ca
HSE	Cindy Wilkins	Senior HSE Manager	416-677-9240	Cindy.wilkins@millergroup.ca
HSE	Anthony Remonde	Environmental Specialist	647-464-2699	anthony.remonde@millergroup.ca

Spill Management Plan

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EXTERNAL CONTACTS	Telephone
Fire / Police Department (24/7)	911
Ministry of Environment, Conservation and Parks Spills Action Centre (24/7) (Toll free number)	1-800-268-6060
Regional Municipality of Waterloo	519-575-4400
Township of Wilmot	519-634-8444
TSSA (in the event of death, serious injury or immediate hazard) Otherwise call the MOECC Spills Action Centre (see above)	1-877-682-TSSA (8772)
Spills Cleanup Ground Force Environmental	519-741-6463
St. Mary's Hospital 911 Queens Blvd. Kitchener	519-744-3311 24-hour Emergency Care
Grand River Hospital 835 King Str. West Kitchener	519-742-3611
Waterloo Regional Police	519-654-0150

Spill Management Plan

<i>Site Location</i> HALLMAN PIT	<i>Revision Date</i> APRIL 2020	<i>Revision Number</i> 1
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Appendix B: Spill Investigation Form

Hallman Pit Jackson Harvest Farms Ltd. 1922 Witmer Road Petersburg, Ontario 519-588-2884	DATE OF SPILL: TIME: ☐ A.M. ☐ P.M. LOCATION OF SPILL:
SUBSTANCE (INCLUDE SDS IF POSSIBLE):	MECP / SAC CALLED: ☐ A.M. ☐ P.M. CONTACT
MEDIUM: ☐ SOIL ☐ WATER Provide details:	TOWNSHIP OF UXBRIDGE / REGIONAL MUNICIPALITY OF DURHAM CALLED: ☐ A.M. ☐ P.M. CONTACT:
APPROXIMATE QUANTITY & DURATION:	
CIRCUMSTANCE / SOURCE / CAUSE OF DISCHARGE:	
POTENTIAL ADVERSE EFFECTS:	
RESPONSIBILITY / OWNER:	
WEATHER: ☐ CLEAR TEMP _____ °C WIND: _____ DIRECTION _____ SPEED ☐ CLOUDY ☐ PRECIPITATION	
INITIAL ACTION / WHO HAS BEEN CONTACTED:	
ASSISTANCE REQUESTED?	
CLEANUP COMPLETED:	DATE: TIME: ☐ A.M. ☐ P.M.
CLEANUP CONTRACTOR:	
CLEANUP METHODS:	
AREA AFFECTED: SEE ATTACHED PLAN	

Spill Management Plan

Site Location
HALLMAN PIT

Revision Date
APRIL 2020

Revision Number
1

% CLEANED UP:

ENVIRONMENT AFFECTED / ADVERSE EFFECTS:

PROPERTY DAMAGE:

WASTE HAULER:

MANIFEST / WAYBILL:

WASTE RECEIVER:

CLEANUP COST:

SUCCESS OF CONTAINMENT / CLEAN-UP EFFORTS / INTERNAL FOLLOW-UP:

PREVENTIVE MEASURES TO BE TAKEN:

Responsibility for implementation:

Targeted Deadline:

MECP / SAC ADVISED OF CLEAN-UP (if required):

DATE:

TIME:

☐ A.M.

☐ P.M.

MECP CONTACT:

REPORTED BY: _____

DATE: _____

Harden Environmental Services Ltd.

Appendix I

Water Wells Complaint Protocol

Jackson Harvest Farms Ltd.

Water Well Complaint Protocol

Hallman Pit

Jackson Harvest Farms Limited has committed to addressing any water well issues arising as a result of aggregate extraction activities. If Jackson Harvest Farms Limited receives of a complaint regarding any such issues, the following protocol will be followed.

Complaints about water well issues will be received any time at 519 588-2884 or by email messages sent to rickesbaugh@gmail.com. Updated contact information may be provided to local landowners prior to the start of construction.

In the event Jackson Harvest Farms Limited receives a complaint regarding an adverse impact on water supply or quality which, in the opinion Jackson Harvest Farms Limited and its consultants, may reasonably be attributed to aggregate extractive activities, a supply of bottled water for drinking/cooking will be delivered to the complainant within 12 hours of the complaint and, as necessary, an alternative water supply will be delivered within 24 hours of the complaint being received. The same commitment is made for industrial and agricultural operations and includes, as necessary, sufficient water supply for relevant farm and industrial requirements.

Within 48 hours, Jackson Harvest Farms Limited will initiate a hydrogeological investigation conducted by a qualified hydrogeologist or engineer to determine whether the water issue is attributable to aggregate extraction activities. The investigation may include but not be limited to the following actions;

- Confirmation of water levels in on-site groundwater monitoring wells
- Review of historical trends in groundwater levels and groundwater quality obtained in on-site groundwater monitoring wells, and surrounding domestic wells.
- Review of historical measured precipitation rates
- Scheduling an interview with resident regarding well complaint
- Investigation of subject well including flow testing, water level measurements and water quality testing if necessary
- Review of construction activities in the vicinity of the subject well
- Written report summarizing the findings.

In the event that activities related to the aggregate extractive activities are determined to be the cause of the complaint Jackson Harvest Farms Limited will undertake appropriate mitigation measures such as;

- Provision of the alternate water supply until water clarity/quality or water level issues abate
- Lowering the level of the pump within the resident's well
- Deepening the resident's well
- Replacing the resident's well
- Treating the resident's well water