



**Emery &
Garrett**
GROUNDWATER
INVESTIGATIONS
A Division of GZA

GEOTECHNICAL
ENVIRONMENTAL
ECOLOGICAL
WATER
CONSTRUCTION
MANAGEMENT

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October 28, 2020
Project No. 33.0083157.00

Mr. Richard C. Maier
Commissioner
Swains Lake Village Water District
P.O. Box 429
Barrington, NH 03825

Re: Assessment of Production Wells #6 and #7, Swains Lake Village Water District, Barrington, New Hampshire

Dear Mr. Maier:

Emery & Garrett Groundwater Investigations (EGGI), a Division of GZA GeoEnvironmental (GZA), has completed its assessment of Production Wells SWL-6 Alt and SWL-7 at the Swains Lake Village Water District (SLVWD) in Barrington, New Hampshire. The SLVWD retained EGGI to evaluate the Wells after production rates declined during late summer of 2020. The work completed and EGGI's recommendations are subject to the Limitations in **Appendix A**.

EGGI began our assessment by reviewing earlier documents prepared during the initial approval of the Production Wells and other documents related to the existing pumping infrastructure provided by SLVWD. In addition to the review of those documents, EGGI had multiple conversations with Richard Maier and other Commissioners regarding the operation of the Wells and the groundwater treatment system (the groundwater is treated for arsenic and iron). Both Wells pump to the common control building where oxidants are added to the water to suspend iron and arsenic compounds so they can be filtered through two parallel treatment trains, A and B.

The submersible pumps installed in both Wells are sized minimally (two horsepower motors) for the capacity of the treatment plant and operate at full rotation using the Variable Frequency Drives (VFD). These minimally sized pumps are sensitive to relatively minor changes to the total head (resistance to pumping) in the pumping/treatment system. Therefore, relatively small changes in head such as the lowering of the water table or minor clogging of the filters, cause the pumping rate to drift off (diminish) according to their performance curves.

A site inspection of the well field was conducted on August 10th, during which time automated water level recorders were installed in each Production Well plus Monitoring Well SWL-3. Groundwater levels in each of the three wells were collected at 30-minute intervals for six weeks during a period of extreme drought in southeastern New Hampshire. Those data were used to create time series plots of water level versus time for the period extending from August 15th through September 29th (**Figures 1, 2, and 3**).

During the monitoring period evaluated, water levels in Production Well SWL-6 Alt generally fluctuated between 70 and 100 feet below the top of casing (**Figure 1**). The data do not suggest an overall ambient water level decline due to the drought. During the period from September 18th through 25th, maximum daily water levels steadily rose from roughly 98 feet to 88 feet due to the gradual clogging of the filters at which time automatic backwashing was not occurring. A mechanical issue with the backwashing process led the District to stop automatic backwashing. Therefore, as the filters slowly became clogged, back pressure increased in the system, causing a decline in pumping rate. Once manual backwashing began, maximum daily water levels once again increased to levels of 97 to 101 feet. Well SWL-6 Alt has maintained water levels far above the projected drawdown of 128 feet below the top of casing based on the original pumping test data collected in 2011.

Well SWL-7 experiences greater daily fluctuation in water levels than seen in Well SWL-6 Alt, generally ranging from 70 to 80 feet down to 130 to 150 feet. However, there is no indication of a significant ambient decline in the water table due to the drought. Rather, these greater fluctuations in water levels are resulting from some inefficiency in the connection between the Well and the bedrock aquifer. The inefficiency in the pumping well is a general indicator that the bedrock well could benefit from redevelopment. Observed water levels in Well SWL-7 are below the originally projected long-term pumping water level based on the original pumping test, further suggesting that some well inefficiencies are present. Similar to Well SWL-6 Alt, maximum water levels steadily decreased during the period from September 9th through 25th as a result of the extra pressure created by the lack of backwashing. Because Well SWL-7 is less efficient, it needs to pump water from a lower elevation, so the pumping rate drops off (according to the manufacturer's pump curve) to a rate significantly lower than Well SWL-6 Alt. Once manual backwashing began on September 25th, pumping rates once again increased and maximum water levels increased, as expected.

Based on our observations, the reduction of pumping rates observed during our investigation are due to mechanical issues related to the minimally-sized pump motors and the need for regular automated backwashing of the filters. There is no reason to suspect that the bedrock aquifer is less capable of supplying groundwater or that you are running out of water. However, Well SWL-7 clearly is less efficient than Well SWL-6 Alt and is less efficient than it once was. Therefore, rehabilitation of this well should be considered in the next two years to ensure that this problem does not worsen. Early intervention with inefficient wells through well development techniques can help to prevent the acceleration of scaling problems within the fractures systems that can lead to permanent decline in well performance.

EGGI recommends the following steps be taken by the SLVWD:

- *Backwashing of filter needs to be done regularly.* This exercise has demonstrated the importance of regular automated backwashing of the filter trains. The submersible pumps in both Wells, powered with two horsepower motors, are marginally sufficient to meet normal system demands and pressure conditions. However, they have little extra capacity to address increases in pressure in the system and, therefore, are subject to substantial declines in production yield with only small increases in system pressure. When automated backwashing was terminated, excess pressure continued to increase resulting in substantial declines in pumping rates. For these reasons, it is important to maintain the operational capability of the automated backwash system.
- *The SLVWD should consider installing higher capacity pumps in the Production Wells particularly in Well SWL-6.* This would provide the excess pumping capacity that could overcome short-term pressure increases such

as those presented by the clogging of the filter beds. It would also allow for the ability to pump at higher rates from greater water level depths, in the event that the water table drops excessively or the Wells become more inefficient over their lifetime. It is important to note that currently there is no evidence that the “aquifer” is losing yield capacity, despite the continuing drought conditions. The excessive drawdown in Well SWL-7 is likely due to inefficiency of the well that might be due to mineral scaling or biofouling occurring between the borehole and the fractured bedrock aquifer. Another possibility is that there could be some minor collapse of fractured material in the well that is reducing the water flow through the fractures.

- *Both Production Wells should be rehabilitated (cleaned) on a five-year basis.* Well SWL-7 clearly has seen a substantial decrease in well efficiency and should be rehabilitated within the next two years. Well rehabilitation generally incorporates some combination of chemical and physical agitation of the borehole, such as mechanical surging combined with acid treatments. Well SWL-6 Alt has not shown any indication of excessive drawdown to date but should be monitored carefully such that rehabilitation can be completed if well efficiency declines. EGGI can recommend a contractor and/or rehabilitation method upon request.
- *The SLVWD should continuously monitor water levels in the Production Wells* -The SLVMD currently has no ability to monitor water levels in the Production Wells. We strongly recommend that the District invests in an automated water level monitoring system so that long-term changes in water levels can be monitored and regularly evaluated. There are a wide variety of methods available for water level monitoring. EGGI monitors water levels in many public supply wells throughout the Eastern US, plotting and evaluating the water level data for Water Districts annually to help develop long-term maintenance and management plans for Production Wells and to better understand the long-term yield capacity of aquifers.
- *Finally, EGGI recommends the District collect regular groundwater samples that are analyzed for certain chemical parameters, such as iron and arsenic.* Tables and plots with the analytical results should be maintained to determine if subtle water quality changes are occurring over time. Chemical changes can have significant implications for the treatment of the water and may influence the recommended schedule for well rehabilitation.

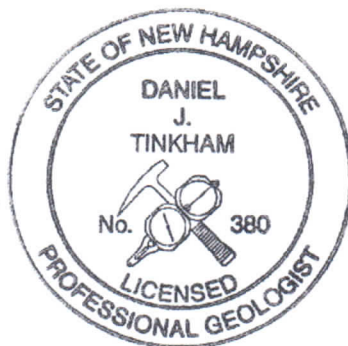
I hope this letter report is responsive to your needs. We appreciate the opportunity to work with you and will be happy to discuss our recommendations.

Very truly yours,

EMERY & GARRETT GROUNDWATER INVESTIGATIONS, A DIVISION OF GZA

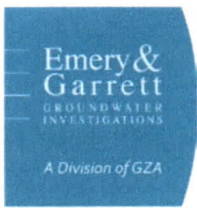


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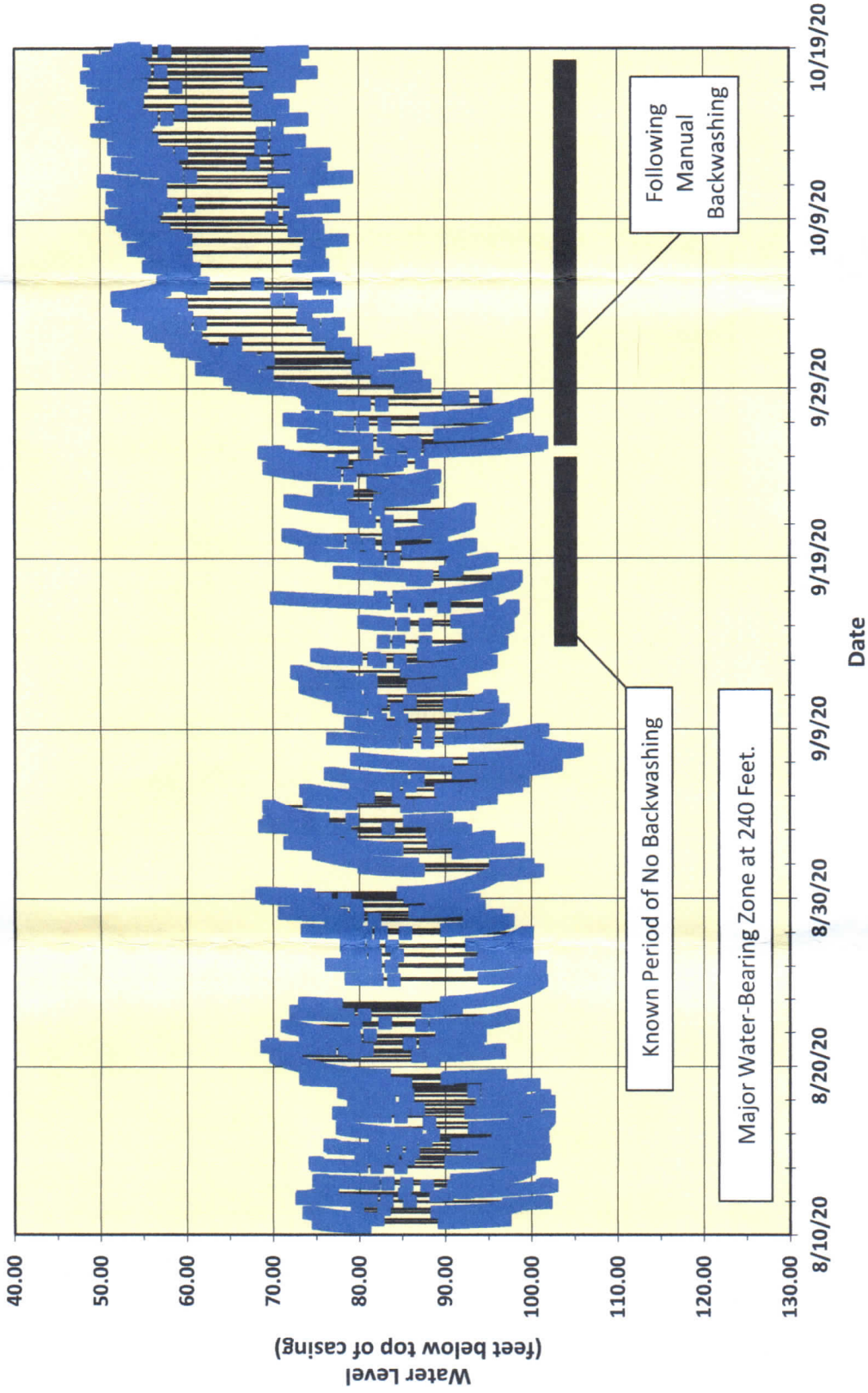
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Enclosures

- Figure 1 Plot of Water Level versus Time Production Well SWL-6Alt
 - Figure 2 Plot of Water Level versus Time Production Well SWL-7
 - Figure 3 Plot of Water Level versus Time Monitoring Well SWL-3
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- Appendix A Limitations

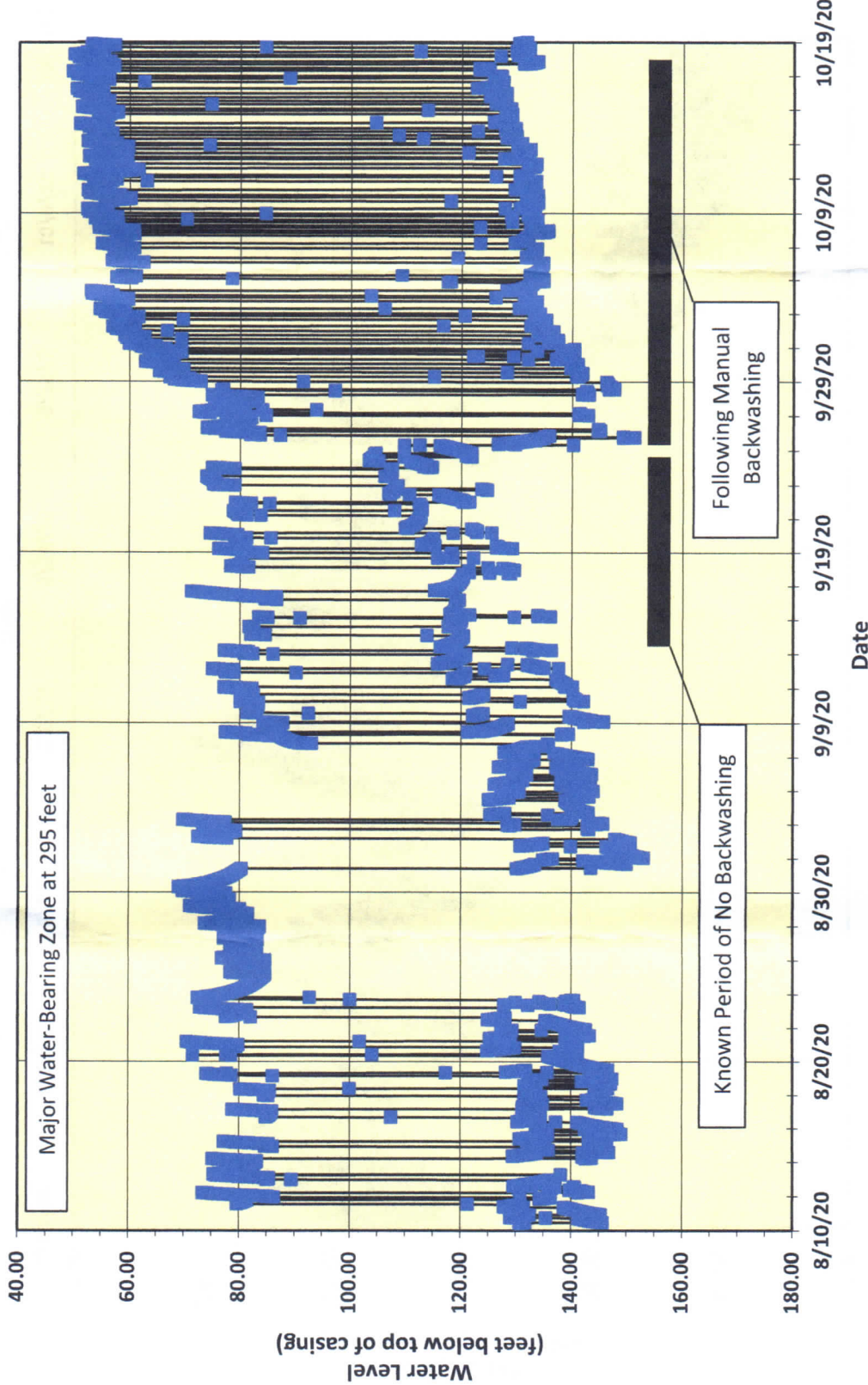
Figures

Figure 1 -- Production Well SWL-6 Alt



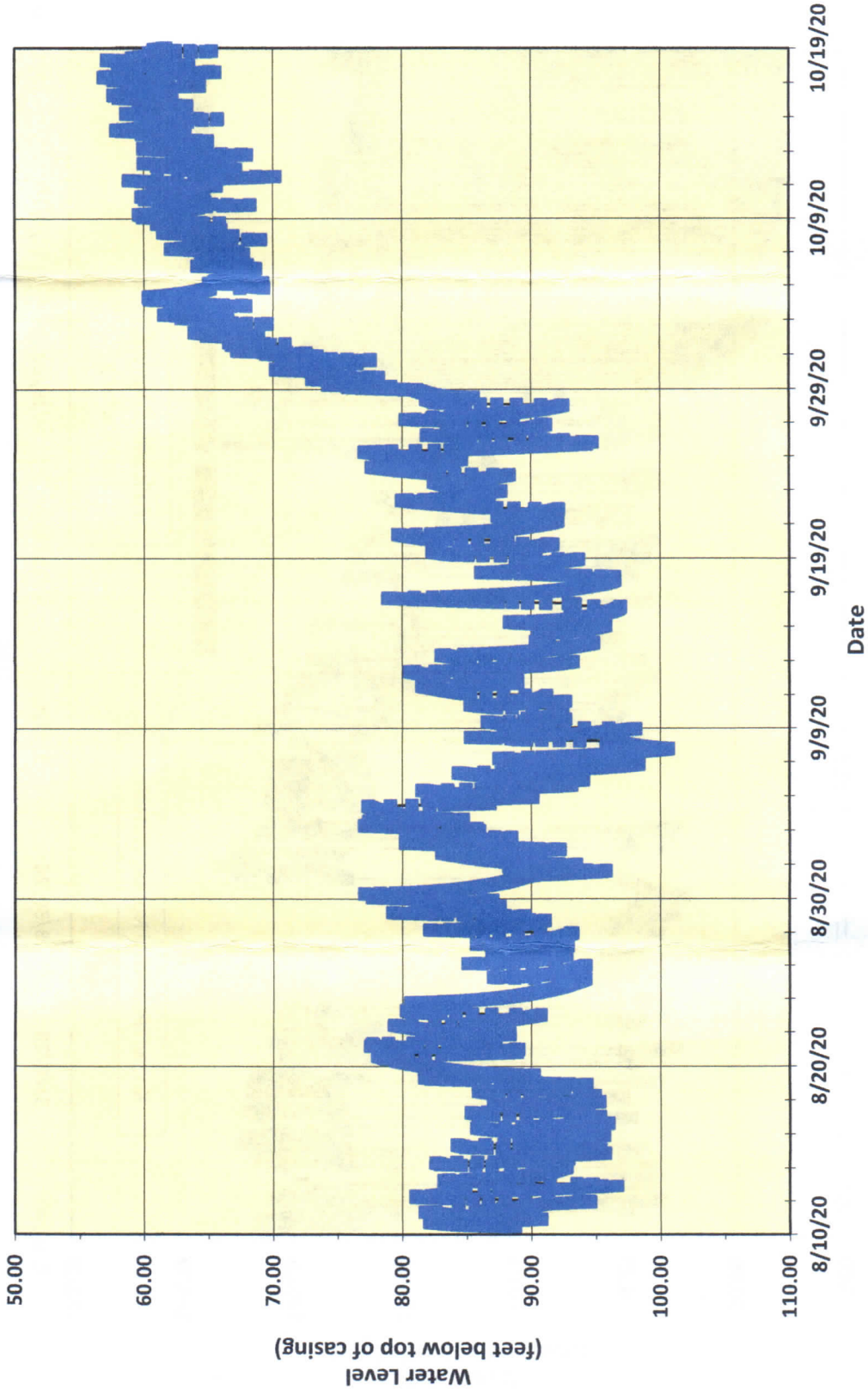
**Plot of Water Level versus Time for August 10 to October 19, 2020
Long-Term Water Level Monitoring Under Operating Conditions
Swains Lake Village Water District, Barrington, New Hampshire**

Figure 2 -- Production Well SWL-7

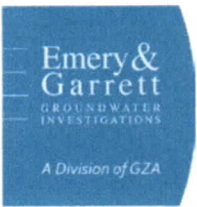


**Plot of Water Level versus Time for August 10 to October 19, 2020
 Long-Term Monitoring of Production Wells
 Swains Lake Village Water District, Barrington, New Hampshire**

Figure 3 -- Monitoring Well SWL-3



Plot of Water Level versus Time for August 10 to October 19, 2020
Long-Term Water Level Monitoring Under Operating Conditions
Swains Lake Village Water District, Barrington, New Hampshire



USE OF REPORT

1. Emery & Garrett Groundwater Investigations (EGGI), a Division of GZA GeoEnvironmental, Inc. (GZA) (hereafter referenced as GZA) prepared this report on behalf of, and for the exclusive use of our Client for the stated purpose(s) and location(s) identified in the Proposal for Services and/or Report. Use of this report, in whole or in part, at other locations, or for other purposes, may lead to inappropriate conclusions; and we do not accept any responsibility for the consequences of such use(s). Further, reliance by any party not expressly identified in the agreement, for any use, without our prior written permission, shall be at that party's sole risk, and without any liability to GZA.

STANDARD OF CARE

2. GZA's findings and conclusions are based on the work conducted as part of the Scope of Services set forth in the Proposal for Services and/or Report and reflect our professional judgment. These findings and conclusions must be considered not as scientific or engineering certainties, but rather as our professional opinions concerning the limited data gathered during the course of our work. Conditions other than described in this report may be found at the subject location(s).
3. GZA's services were performed using the degree of skill and care ordinarily exercised by qualified professionals performing the same type of services, at the same time, under similar conditions, at the same or a similar property. No warranty, expressed or implied, is made. Specifically, GZA does not and cannot represent that the Site contains no hazardous material, oil, or other latent condition beyond that observed by GZA during its study. Additionally, GZA makes no warranty that any response action or recommended action will achieve all of its objectives or that the findings of this study will be upheld by a local, state or federal agency.
4. In conducting our work, GZA relied upon certain information made available by public agencies, Client and/or others. GZA did not attempt to independently verify the accuracy or completeness of that information. Inconsistencies in this information which we have noted, if any, are discussed in the Report.

SUBSURFACE CONDITIONS

5. Water level readings have been made, as described in this Report, in monitoring wells at the specified times and under the stated conditions. These data have been reviewed and interpretations have been made in this report. Fluctuations in the level of the groundwater however occur due to temporal or spatial variations in areal recharge rates, soil heterogeneities, the presence of subsurface utilities, and/or natural or artificially induced perturbations. The observed water table may be other than indicated in the Report.

COMPLIANCE WITH CODES AND REGULATIONS

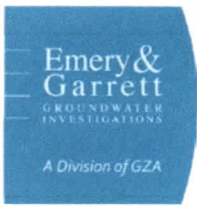
6. We used reasonable care in identifying and interpreting applicable codes and regulations necessary to execute our scope of work. These codes and regulations are subject to various, and possibly contradictory, interpretations. Interpretations and compliance with codes and regulations by other parties is beyond our control.

INTERPRETATION OF DATA

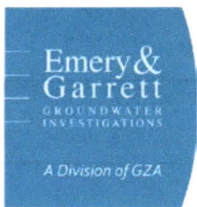
7. Our opinions are based on available information as described in the Report, and on our professional judgment. Additional observations made over time, and/or space, may not support the opinions provided in the Report.

ADDITIONAL INFORMATION

8. In the event that the Client or others authorized to use this report obtain additional information on environmental or hazardous waste issues at the Site not contained in this report, such information shall be brought to GZA's attention



Appendix A – Limitations



forthwith. GZA will evaluate such information and, on the basis of this evaluation, may modify the conclusions stated in this report.

ADDITIONAL SERVICES

9. GZA recommends that we be retained to provide services during any future investigations, design, implementation activities, construction, and/or property development/ redevelopment at the Site. This will allow us the opportunity to: i) observe conditions and compliance with our design concepts and opinions; ii) allow for changes in the event that conditions are other than anticipated; iii) provide modifications to our design; and iv) assess the consequences of changes in technologies and/or regulations.