Creative
LAND & WATER
Engineering, LLC

www.claweng.com
P.O Box 584
Southborough, MA 01722

clawe@claweng.com
(774) 454-0266 (cell)
(508) 281-1694 (office)

EFFECTIVE, AFFORDABLE, AND SUSTAINABLE SOLUTIONS FOR LAND & WATER ENVIRONMENT

March 1, 2024

Mr. Richard S. Novak
Chairman, Norton Zoning Board of Appeals Town of Sherborn
19 Washington Street
Sherborn, MA 01770

Re: Clawe response to Comments by **Thomas Trainor, 97 Washington Street, Sherborn MA**
Comments for ZBA on the proposed 40B Farm Road Homes: Septic Nitrogen (Nitrate) Loading, Threats to Groundwater and the Public Health.

Dear Mr. Novak and Board Members.

We received and reviewed the comments sent to ZBA by Mr. Trainor dated February 25, 2024. We would like to provide our response to each of his comments. We will quote the original comments first in *italics* and then followed by our response in red.

I would like to bring to the ZBA's attention some concerns I have with the 8,360 gal/day septic system now proposed for this 32-unit multi-family affordable housing complex (76 bedrooms), and the serious risks it represents to nearby private drinking water wells in Sherborn (closest wells being at Farm Road #'s 49, 53, and 55). Comments are organized in sections A through D that follow here.

A. Project Nitrogen (nitrate) Loading study – available YTD information.

As of this writing (Sunday 2/25/24), the Town's Land Development webpage project document repository contains four documents about the site-specific nitrogen study:

Initial nitrogen loading study (CLAWE):
https://www.sherbornma.org/DocumentCenter/View/2040/CLAWE-Letter-of-Response-to-BOH-Deficiencies-List-Appendices-February-2-2024

Comment letter, Andrea Stiller, LSP:
https://www.sherbornma.org/DocumentCenter/View/2059/Comments-from-Andrea-Stiller---Mounding-Analysis-February-6-2024

Sherborn BOH preliminary questions and comments:
https://www.sherbornma.org/DocumentCenter/View/2102/BoH-to-ZBA---- Preliminary-comments-regarding-septic-effluent-impact-analyses-February-15-2024

Letter with alternate nitrogen study, Scott Horlsey, Water Resources Consultant:
https://www.sherbornma.org/DocumentCenter/View/2141/Scott-Horsley-Comments-on-Farm-Road-Homes-February-22-2024

Most unfortunately, I have yet to see a posting of the expected independent review of the developer's

nitrogen loading study by the ZBA's peer reviewer, TetraTech. I trust that review will be available before the formal ZBA hearings on this project are completed, so all parties have time to review and comment.

Response: No comments.

B. Nitrate Concentrations of Concern in Groundwater within Massachusetts.

The Sherborn BOH (for private wells) and the MassDEP (for public water supplies, PWS) regulations both list a MCL of 10 mg/L (or 10 ppm) for nitrate (NO3, which you may also see labeled as "nitrate-nitrogen" or NO3-N) for a concentration limit in potable drinking water. Please know that this 10 mg/L limit was first proposed in this country by the US EPA back in 1975 (five years after the agency was first formed), about 49 years ago. Two very informative and frequently cited documents covering the practical challenges and many concerns of nitrate in groundwater/drinking water, and surface water in MA are attached here:

Appendix A – UMASS-Amherst Extension School, 2007, 5 pages:
https://ag.umass.edu/sites/ag.umass.edu/files/fact-sheets/pdf/nitrate.pdf

Appendix B – Cape Cod Commission, 1992, 25 pages: https://www.capecodcommission.org/resource-library/file/?url=/dept/commission/team/Website_Resources/regulatory/NitrogenLoadTechbulletin.pdf

Continued health concerns have been raised by the medical community across the country since 1975 and have hence led many authorities to lobby for an updated and lower national nitrate drinking water MCL, frequently suggesting that a limit of 5 mg/L nitrate would be much more protective of human health.

Examples of this lower 5 mg/L nitrate concentration of concern include published recommendations from five MA-based entities (illustrative list provided here, but by no means meant to be a comprehensive set). In brief:

1. ***UMASS-Amherst Extension School:*** *"Ingestion of drinking water with nitrate concentrations in excess of 10 mg/L may be fatal to infants. Concentrations in excess of* ***5 mg/l indicate a severe degradation of groundwater quality****. In order to guard against nitrate concentrations reaching danger levels, if you have a nitrate concentration exceeding 5 mg/l in your well, you should monitor the nitrate for a trend of increasing concentrations." See link above for Appendix A.*

2. ***Cape Cod Commission, Water Resources Office (CCC WRO)****: "The CCC WRO believes that the* ***5 ppm NO3-N guideline*** *is appropriate for use on Cape Cod and will protect the largely undefined potential future water supply areas, private wells, and the small volume community and noncommunity supply wells, and, in the absence of recharge area specific studies establishing critical nitrogen loading limits, will provide some protection for coastal resources." See link above for Appendix B.*

3. ***Dover MA Board of Health:*** *Local BOH's in Massachusetts can set private well water contaminant limits below that of national US EPA and/or MassDEP public water supply limits, to better insure the protection of public health in their localities. Our neighbors across the river in 2018 amended their private well water regulations. Dover Chapter 233, Section 8B – Water Quality Testing: "Prior to the sale of any existing house, a water quality test shall be performed*

*on the existing well and shall be taken using a raw water sample. The sample shall be taken directly from the well, or in the event that is not possible, it shall be taken from the water line before it enters the holding tank**. If the nitrate or nitrogen levels exceed five mg/L**, a reverse osmosis (R.O.) system shall be installed. At a minimum, the system can be placed at the drinking water location and a **deed restriction requiring maintenance of the R.O. system** shall be recorded at the Registry of Deeds." See Town of Dover MA: https://ecode360.com/32765999*

4. ***Plainville MA Board of Health** regulations: Chapter 611 Groundwater and Water Supply Protection: 611-2 The applicant for construction of any subsurface wastewater system in the Town, except for repairs of existing systems which have failed and are not being enlarged to provide for additional building construction or use, shall submit a groundwater impact report (GIR) to the Board of Health. In the case of a subdivision, the GIR shall be submitted at the time of submittal of the preliminary plan. In case of lots not requiring approval as a subdivision, the GIR shall be submitted at the time of application for a disposal works construction permit.*
*§ 611-3 Method of calculation. A. The GIR shall be based on the following methodology for determination of nitrate loading which is based on procedures that have been accepted by and have been adopted and used by governmental planning agencies, enforcement agencies, and the U.S. Geological Survey. The GIR shall determine **whether or not the proposed project will cause unacceptable groundwater quality at the project boundary limits for the proposed use, based on the expected nitrate-nitrogen loading.** The calculations shall follow the guidelines contained herein, using data which is appropriate for the Town of Plainville.*
*B. The **maximum allowable calculated concentration of nitrate-nitrogen within each project boundary shall be five milligrams per liter in Zone II of the public water supply and areas of private on-site well water supplies.** It shall be 7 1/2 milligrams per liter in all other areas within the Town. See Town of Plainville MA: https://ecode360.com/15553666*

***5. Within the current MassDEP Title V septic regulations themselves**, the 5 mg/L nitrate concentration limit also gets cited at times, for instance, see: 310 CMR: SUBPART D: INSPECTION AND MAINTENANCE OF SYSTEMS,* 15.303: *Systems Failing to Protect Public Health and Safety and the Environment, section C:*

*"(c) Evaluation of systems with septic tanks and soil absorption systems near drinking water supplies: If any portion of the soil absorption system is within any of the dimensional criteria listed in 310 CMR 15.303(1)(c), unless the Approving Authority in its professional judgment, with the concurrence of the public water supplier, if any, **determines the system is functioning in a manner to protect the public health and safety, welfare and the environment.***

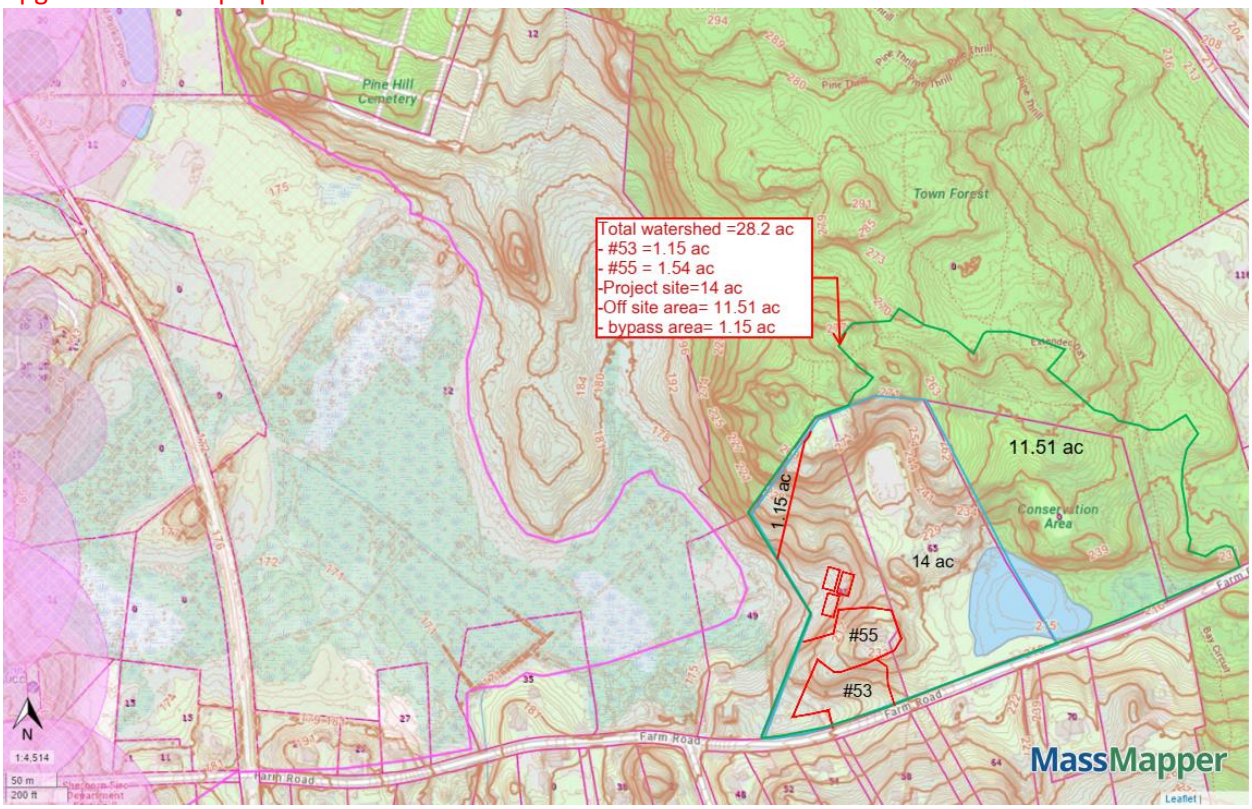
1. within 100 feet of a surface water supply or tributary to a surface water supply;
2. within a Zone I of a public well;
3. within 50 feet of a private water supply well;
*less than 100 feet but 50 feet or more from a private water supply well, unless a well water analysis, conducted at a laboratory that is certified by the Department for the parameters analyzed, indicates an absence of fecal coliform bacteria, **and the presence of ammonia nitrogen and nitrate nitrogen is equal to or less than 5 ppm."***

Additionally, medical professionals are now finding new troubling health concerns from even lower exposures of nitrate in drinking water, with peer-reviewed publications now identifying water

supplies with greater than 2 mg/L nitrate concentrations detrimental to human health (for one example see: "Examining Relationships Between Groundwater Nitrate Concentrations in Drinking Water and Landscape Characteristics to Understand Health Risks", 2022, GeoHealth, Hamlin et al, https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2021GH000524 .

Response: The project SAS is in compliance with the quoted section of Title 5 as it is located outside of all zones in *310 CMR 15.303(1)(c) see following detailed information*.

1 – No water supplies or tributaries to a surface water supply are located within 400' of the proposed SAS.
2 – The following are the approximate distances from the proposed SAS to the closest zones:
Zone 1: 2523-ft
IWPA: 2205-ft
Zone II: 225-ft
Note: These distances are obtained via Mass Mapper
3 – The closest offsite wells to the proposed SAS are located on 53 Farm Rd and 55 Farm Road. The well on 53 Farm Rd is located 252-ft downgradient or crossgradient of the proposed SAS while the well on 55 Farm Rd is located 141.6-ft upgradient of the of the proposed SAS. All of the seven onsite wells are located upgradient of the proposed SAS of which the closest is located 309.3-ft upgradient of the proposed SAS. The well at 49 Farm Road



While the GeoHealth paper presented us a large amount of data in health impact of nitrate, it is a common challenge to think about the overall land use and development. We also need to be aware that the data may or may not be true to a degree of the connected health issue at a low nitrate level as some of the researchers could not find that connection. More research and well

controlled data would be needed before any regulatory obligation can be required. We do not think it is applied to the project under the current regulations and the town's land use and onsite wastewater treatment requirements. We will discuss further in the following response sections that the project is designed to provide better protection to drinking water supply than a normal conventional septic system would at our site specific condition.

C. Background Levels of Nitrate in Sherborn Groundwater.

It is challenging to find water quality data on local private wells, but within Sherborn there are currently 14 public water supply (PWS) wells that are regulated by MassDEP, with various contaminant monitoring requirements. All the historical testing data on these PWS's is available for review on a state website: https://eeaonline.eea.state.ma.us/portal#!/search/drinking-water

A recent download of Sherborn PWS nitrate data from this database provides at least 519 nitrate values, covering the last 30 years (1993-2023). Reported nitrate concentrations vary from non-detectable (ND) to just under 10 mg/L in these Sherborn PWS wells (ND concentrations vary over this time but were typically at 0.1 mg/L years ago to about 0.03 mg/L today). Some of these PWS wells are Town of Sherborn-owned, and others are privately owned (office buildings, restaurants, shops, churches, etc.).

For some perspective, here is a short summary of nitrate data on 3 of the 14 PWS wells in Sherborn:

		Example Sherborn Nitrate Concentrations, mg/L					
				Range			
PWS ID	***PWS Location***	***Average***	***Std Dev***	***Low***	***High***	***# Values***	***Time Period***
3269011	*Town Campus*	*1.61*	*0.52*	*0.17*	*3.2*	*29*	*1994-2023*
3269019	*Pine Hill Elem School*	*0.53*	*0.34*	*0.08*	*1.1*	*33*	*1993-2023*
3269032	*Fields of Sherborn 40B*	*0.86*	*0.21*	*0.56*	*1.05*	*4*	*2020-2023*
For all 14 PWS's, reported nitrate range now is 9.88 to non-detectable mg/L, 519 reportable values.							

Four things to note from this table:

1) *Typical Sherborn groundwater "background" nitrate levels (with no human influence) might be considered somewhere in the low range of these three example wells, or perhaps at about 0.1 to 0.2 mg/L. My home's well, from a 2022 sampling had a reportable nitrate concentration of 0.32 mg/L (installed about 40 years ago), and of course has had a septic system operating this same time. Larger regional studies by the USGS also find typical groundwater background nitrate considerably less than 1.0 mg/L in New England. In Sherborn, since we have so many point sources of nitrate (perhaps 1500+ septic systems/cesspools), it is challenging to distinguish between "natural" and "anthropogenic" or human-induced nitrate background in either shallow or deep groundwater. Nitrate is a naturally occurring ion, and present at some level in all waters, soils, vegetation, foods, etc.*

2) *For all three PWS wells shown here, some human influence (septic leachate, roads, etc) is leading to an increase in nitrates above what might be considered pristine "natural" background levels.*
3) *At the Fields of Sherborn (also a 76-bedroom, 8,360 gal/day septic system), the nitrate trend has been tracking from 0.56 mg/L in 2020 to 1.05 mg/L in 2023 and will need to be watched in the future. Two co-located PWS wells serve this community and are located about 500 ft downgradient of the large leach field. Nitrate level has almost doubled in only 4 years.*
4) *Nitrate levels in groundwater wells with decades of monitoring do show some variability, which can be due to many factors not discussed here.*

Response: Appreciate the town's current nitrate condition in groundwater data. We will look into the three public water supply wells in relation to the septic leaching fields to help with our understanding of possible onsite system long-term impacts. We also checked the water quality for wells at 49, 53, and 55 and found that they currently have nitrate level of: 0.1-3.6 ppm (49, 2005-2006), ND ppm (53, 2022), 0.08-0. ppm (55, 1980-2020). The well water is likely impacted by the onsite conventional septic systems that are located upgradient of the wells. Given that the septic system at 49 Farm Road is a cesspool (failed) for many years, it could have impacted the area that the wells of 49 and 53 Farm Road are located as the nitrate level at 49 is slightly higher than the well at 53 Farm Road and the nitrate in the well of 55 Farm Road stayed low for over 40 years. It is also showed that the individual conventional septic might not provide well designed advanced septic system. It is also shown that the nitrogen in drinking water could be impacted by many factors: The bedrock fractures and its recharge source, the casing seal to prevent well head contamination. It is noted that though well at 53 located right down gradient of the SAS of 55 Farm Road, the nitrate level is not detectable. As Mr. Scott Horsely predicted the N-level would exceed 15 mg/l.

Just by a quick simple comparison to the Fields site, it is our professional opinion that the field water quality appears to be much better than wells located in regular septic system area. It is rather a positive confirmation of the Fields project, which used similar I/A and pressure dosing system in the wastewater treatment. It is also our professional opinion that the drinking water wells at the Fields is located direct downgradient of their SAS field and it is more concentrated to have large drawdown impact to funnel flow towards the well. Rather for the Farm Road project, we have the drinking water wells all located upgradient of the SAS field and have the wells more sparsely located in seven locations. Therefore, each will have much less drawdown zone and reduce possible impact by any near by source of contamination.

D. **Post-Development Nitrate Concentrations of Concern for the Farm Roads Homes site.**

Two nitrogen loading studies are available to the ZBA currently on this project:

1. From the developer's team, Table G3 copied here:

Table G3. Output Nitrogen Concentration at downgradient Receptor- Budget Analysis

Scenario	Sewage flow GPD	Effluent Nitrogen mg/l	Lawn fertilize %	Off site Recharge	Calculated Nitrogen at Downgradient, mg/l	Assumptions for notrogen budget analysis
1	8360	19	0	yes	3.89	1. Using Title 5 design daily flow for sewage nitrogen loading with I/A treatment 2. Assume all lawn will not be fertilized 3. Off site upgradient area recharge included.
2	8360	35	0	yes	6.95	1. Using Title 5 design daily flow for sewage nitrogen loading without I/A treatment. 2. Assume all lawn will not be fertilized 3. Off site upgradient area recharge included.
3	8360	19	0	no	5.6	1. Using Title 5 design daily flow for sewage nitrogen loading with I/A treatment 2. Assume all lawn will not be fertilized 3. Off site upgradient area recharge IS NOT included.
4	23271	19	40	yes	6.32	1. Using Title 5 design daily flow for sewage nitrogen loading with I/A treatment 2. Assume all lawn will be fertilized 3. Off site upgradient area recharge included.

If we consider say a conservative value of 0.5 mg/L nitrate groundwater concentration for Sherborn "groundwater background with human influences" pre-development for this site, that means for the calculated nitrate downgradient (property line) concentrations vs background, we see groundwater degradation post-development of about 7.8 to 13 times by this nitrogen loading study:

3.89/0.5 = **7.8X**; 6.95/0.5 = **14X**; 5.6/0.5 = **11X**; and 6.32/0.5 = **13X higher nitrate in groundwater.**

Response: This predication is just to show a simple mathematical mass balance. The real chain of denitrification would also be affected by vegetation update in the downgradient area in the buffer zone and near the fringe wetland, which is one of the natural function of the wetland as described in 310 CMR 10.55 (1) and proven effective in removing nitrogen by plant update and other biochemical process in the wetland. The design concentration of this project to have less than 10 mg/l of TN will not overburden the downgradient wetland and cause significant impact of its function. As we all know, nitrogen is one of the basic nutrients to vegetation, moderate amounts may enhance the growth of the vegetation in the receiving wetlands. For a complex ecosystem, we believe that it will a constructive to form a long-term monitoring of the town groundwater related to different types of wetlands and treatment system to verify that the presumption in the current Title 5 or wetlands protection regulations are correct or in adequate with concrete supporting data so we can make our future design and review in a better supported way by better in depth understanding of our concern environment. It is very difficult to simply use other data without differentiation of the context and setting. At this point, by reviewing the town's data in water quality, we believe that the presumption of the septic system design in Title 5 and wetland protection regulations are reasonably providing needed protection to the drinking water and our environment. The emerging contamination related pharmaceutical and personal care protects (PPCP) is a new challenging issue that will require better understanding, management and technology and apply to all septic systems.

2. From an abutters consultant (S Horsley):

Table 1 – Summary of Nitrogen Loading Analysis

	Adjacent Lots	40B	40B
Wastewater design flow (gals/day)	880	8360	8360
Source Concentration (mg N/liter)	35	35	19
Concentration at Property Boundary (mg N/liter)	15.8	26.9	14.6

Again, if we consider the conservative value of 0.5 mg/L nitrate groundwater concentration for Sherborn "groundwater background with human influences" pre-development for this site, that means for the calculated nitrate downgradient (property line) concentrations vs background, we see degradation many folds by this second nitrogen loading study, by factors of 29 to 54:

26.9/0.5 = **54X**; and 14.6/0.5 = **29X higher nitrate in groundwater.**

Hence the estimated degradation at the property line for the groundwater are on the order of 7.8 to 54 times higher nitrate concentrations than what may exist today. Moreover, all the nitrogen loading analyses show groundwater nitrate concentrations above the new 2 mg/L health concerns threshold, and a majority predict nitrate concentrations above the consensus 5 mg/L health level. Please also know that nitrate is just one of many expected contaminants that would be traveling in the septic leachate plume (PFAS, pharmaceuticals, personal care products, cleaning agents, etc. etc.).

Based on either of these widely different nitrogen/nitrate loading estimates, I find the public health risks to the abutter's private wells (Farm Road #'s 49, 53, and 55) very serious.

Please ZBA members: work with the developer, Town BOH and Conservation Commission, Select Board, and Sherborn residents to bring affordable housing to our town without sacrificing the long-term viability of our irreplaceable groundwater resources.

Response: As we quoted above the current background nitrate level at 49 and 53 has reflected the impact of the currently installed septic systems to a level of 3.5 – 3.6 ppm, which is well below Mr. Horseley's predication, which is more than 4 times of the predicated value. As we pointed out at our meetings, the proposed common system will provide much better treatment level than all the sounding conventional septic systems for the following reasons:

1. **The system will reduce the nitrogen level from 45 ppm from septic tank to 19 ppm leaving I/A, which is better than after the SAS treatment of 35 ppm for the conventional septic system.**
2. **The pressure dosing of distribution for the proposed system will spread the effluent more uniformly through the large leaching fields, which will reduce the impact of concentrated flow pattern in conventional system and reduce high concentration plume.**
3. **The design of the proposed common system is based on my more detailed study of soil evaluation, groundwater flow, groundwater mounding and nitrogen loading analysis.**
4. **The siting of the SAS for the proposed wastewater treatment also has the following features:**
    a. **Located at the downgradient area of all onsite and nearby drinking water wells so to avoid the direct plume impact.**
    b. **The downgradient area is a conservation wetland that will provide further denitrification by plan uptake and dilution before entering any drinking water draw down zone.**
    c. **The performance of the system will be operated and checked regularly by a licensed wastewater treatment plant operator.**

Feel free to contact us if you have any questions.

Sincerely,

Creative Land & Water Engineering, LLC

By

Desheng Wang, Ph.D., P.E., CWS, CSE

Francis Alves, E.I.T., CSE
Civil/Environmental Engineer

Cc: Bob Murchison
Paul Haverty,