

Department of Health Responses to Public Review Comments on the *Upcountry Maui Groundwater Nitrate Investigation Report*

General Responses

- There is a misconception that the mandate to replace all cesspools by 2050 was a result of the *Upcountry Groundwater Nitrate Investigation Report* (the “Investigation”). Act 125 passed by the legislature during 2017 legislative session mandates the replacement of cesspools by 2050. This law was enacted prior the results of the Investigation being completed. Act 125 also directed the Hawaii Department of Health (DOH) to submit a report to the Legislature prior to the 2018 session relating to cesspools and their priority for replacement (DOH, 2017). The Investigation did result in Upcountry Maui being designated a Priority One Cesspool Upgrade Area, but it was the previously enacted Act 125 that mandates replacement.
- It has been often expressed that Maui County wells are the drinking water sources in need of protection. Privately owned drinking water wells should either not be permitted or be required to treat for nitrate contamination. This is in effect a status quo solution since the BRE-1 Water System will include treatment for nitrate contamination at the well head. However, it is DOH’s responsibility to reduce groundwater contamination to the extent practicable and to ensure that any drinking water well can access uncontaminated groundwater.
- While the commenters cite other sources that could account for the elevated groundwater nitrate concentrations, these sources are either not in the zone of contribution to the affected wells or have not been shown to cause significantly elevated groundwater nitrate concentrations elsewhere in Hawaii. Nitrate concentrations of 5 mg/L or greater are unusual in wells across the State of Hawaii, and concentrations approaching the Maximum Contaminant Level of 10 mg/L are extremely unusual. There is a strong spatial correlation between the density of OSDS upslope from the affected wells, and nitrate concentration and nitrogen-15 isotopic enrichment in the groundwater captured by these wells. This line of evidence strongly indicates that OSDS, and predominantly cesspool leachate, is significantly elevating the groundwater nitrate concentration beneath Upcountry Maui.

Specific Responses

Commenter: Dick Mayer, 2/22/18 email

Who actually uses the water from the Omaopio well? Human consumption? or for irrigation (in which case the nitrates may even be helpful)?

The Omaopio Esty Well serves the Omaopio Ridge community that uses this water for their needs including drinking water. The Omaopio Ridge utility is in the process of becoming an approved public water drinking water system

Exactly where the "bad" wells are located? Is the Pukalani well near the golf course or, as mentioned, above Pukalani? Who uses that water? Human or golf course irrigation?

The wells that the study concluded were most impacted by OSDS leachate are:

- BRE-1, with nitrate that is a mixture of fertilizer and OSDS leachate, is intended to supply the public drinking water needs of the future Baldwin Ranch Estates community. This well is located near the community of Haliimaile and about 0.5 miles west-

northwest of the intersection of Baldwin Avenue and Haliimaile Road, and about 1.5 miles downslope from the community of Makawao.

- Maunaolu-Smith Well, with nitrate that is a mixture of fertilizer and OSDS leachate, is the public drinking water source for the Maunaolu Plantation community. This well is located just northeast of Baldwin Avenue and about 1.9 miles downslope from the community of Makawao.
- Omaopio-Esty Well, with nitrate that is predominantly OSDS leachate, serves the water needs of the Omaopio Ridge Community. The well is located slightly south of Omaopio Road, and is about 2.8 miles downslope from Kula.
- Pukalani Golf Course Well, with nitrate that is predominantly OSDS leachate and potentially some treated wastewater leachate, is used to irrigate the Pukalani Golf Course. This well is located at the downslope edge of the golf course and downgradient from the community of Pukalani.

What further studies need to be done? Is it just nitrates? or is there a bacteria problem (none was cited)?

Future studies will be determined by the collaborative review of the Upcountry Maui study results. Potential studies could include:

- Cesspool impact mitigation alternative cost/benefit analysis, and
- Confirmatory sampling by the USGS.

Bacteria was not the concern for the Upcountry Maui study since unlike nitrate, bacteria die-off and all water delivered to public drinking water systems is disinfected.

What is to be done with that information? New legislation? Limiting/stopping private wells? Requiring all water hook-ups to be connected to the Maui County Water Department which uses primarily surface water from areas with no cesspools?

This new data suggests solutions that could go in many directions, including but not limited to, utilizing water treatment technologies for individual wells, developing extensive sewer infrastructure to replace unsewered areas, and enacting legislative or County-level policies that affect the alteration or approval of existing or new cesspool or septic systems, respectively. A multi-pronged approach will likely be required to attack this problem. Interim (short-term) solutions should be developed to reduce both the rate of increase in Nitrate concentrations and the growing spatial influence from the densest unsewered areas. Further analysis of all possible solutions should include a serious discussion on a cost- benefit basis and funding plans.

What can be done to prevent new wells from going into production in "bad" areas? Who has the power to stop them?

We can't stop wells from being used in "bad" areas, but our HAR 11-20-29 process can look at the available water quality data and impose treatment and monitoring conditions to mitigate human health effects from consumption of the source.

Is there a need for existing cesspool owners to do anything now, or in the future? Are there minimal cost solutions?

Unfortunately, we cannot provide a response to your comment since it is outside of the scope of the draft Investigation. The DOH acknowledges and thanks you for your comments.

We urge the DOH and Maui County government to convene a meeting with Upcountry Maui leaders (Kula, Pukalani, Makawao, Haiku) to discuss the implications of the DOH study.

Unfortunately, we cannot provide a response to your comment since it is outside of the scope of the draft Investigation. The DOH acknowledges and thanks you for your comments.

Commenter: Sean O’Keefe, 2/22/18 email

Mr. O’Keefe also included the issues in this email in a more detailed set of comments in a letter dated March 30, 2018. Our responses on the email and letter comments are provided together later in our responses.

Commenter: Scott Meidell – Haleakala Ranch, 3/21/18 Letter (attached)

DOH appreciates the concerns that Haleakala Ranch has expressed about the attention paid to livestock operations in the Investigation. DOH felt it had to address the issue of livestock operations since the issue of Haleakala Ranch operations was raised at least twice in the public meeting held at Makawao on the evening of January 9, 2018. While we can’t totally eliminate references to Haleakala Ranch since it is by far the largest livestock operation upgradient of the study area, DOH will review what has been written, and early in the revised Investigation make clear that grazing operations pose a low groundwater contamination risk. We also appreciate the evaluation done by the University of Hawaii, College of Tropical Agriculture and Human Resources and will include that in our assessment (letter attached). Going forward, the DOH would appreciate discussing some of these concerns in more detail with you, and collaborating with Haleakala Ranch on any data, existing or yet to be developed, that would clarify livestock operations’ role in this study.

Commenter: Maui Cattleman’s Association, 3/28/18 Letter (attached)

Similar to our response to the concerns of Haleakala Ranch, we will review how livestock operations are portrayed in the Investigation and make clear early in the Investigation that livestock operations of the type that occur on the upper slopes of Haleakala have little potential for significant adverse impacts to the groundwater. We also appreciate the Maui Cattleman’s Association’s offer to be an active participant in the discussions regarding groundwater quality of Upcountry Maui. It is DOH’s position that a properly function leachfield does not pose a health risk to produce grown outside of the footprint of the leachfield. An improperly functioning leachfield or cesspool can result in overland flow of wastewater. The DOH concurs with the statement that parcels served by an OSDS should have a properly functioning system regardless of type.

Commenter: Paul Meyer, 3/4/18 email

I read in the Maui News you were soliciting comments on the Cesspool meeting last week.

I have a few thoughts. I will be brief.

Most people who have been around Upcountry for more than a few years have real problems with Bob's analysis and conclusions. The Haliimaile town sewer ponds (unlined raw sewage treatment ponds in operation since about 1930) have been in operation and discharging what amounts to raw sewage from its effluent pipe into a gulch about 1000 feet from the Baldwin well. To not consider and evaluate this significant vector seems to be a major problem in the analysis.

Please see responses to Mr. O’Keefe’s detailed comments

Secondly, the Pukalani community has been injecting the effluent from its sewer treatment facility very close to the old irrigation well for many years and has also recently been using the effluent for irrigation. This was the second well tested by Bob and analyzed in his study. Again he clearly said he did not evaluate the Pukalani sewage as

a vector. To ignore these very large point source vectors of raw sewage is truly extraordinary. I know both of these operations well and can certainly help Bob get the historical facts.

Please see responses to Mr. O'Keefe's detailed comments

Lastly to reach a finding that low density and low volume cesspools in the Upcountry area thousands of feet above the aquifer are the primary cause which can be mitigated by septic tanks and leach fields is simply not credible for a couple of well established reasons.

Please refer to Sections 3 and 4 of the Investigation as well as our responses to Mr. O'Keefe's comments, which clearly support the conclusions drawn. We would welcome discussing your specific concerns and your own scientific basis for this comment.

Please ask Bob to take time to get the facts and take them into account in your decision making.

We believe the *Upcountry Maui Groundwater Nitrate Investigation* does accurately state the facts and provides valuable data for decision making. Going forward, the results of this initial sampling of WQ in the region clearly points to the need for more data, defined solutions, rational stakeholder involvement, benefit-costs analyses and funding options.

If I can help please let me know.

With best regards.

Paul Meyer

Commenter: Patricia Hoskin, 3/4/18 email

My name is Patricia Hoskin. I live at [REDACTED] S. Kihei Rd. [REDACTED], Kihei, Hi. 96753. I am very disappointed that the State of Hawaii is not requiring that cesspools be removed and septic tanks placed on their property until 2050. The fact that nitrates are elevated in two upcountry wells should alarm all Maui residents. I personally think that the residents who chose to be inconsiderate and use cesspools be required to loan the money, if needed, and replace them with septic tanks by 2030.

The DOH acknowledges and thanks you for your comments.

Commenter: Ms. Kathy Thunholm, 3/27/18 email

My name is kathy thunholm and I live at [REDACTED] kenolio rd [REDACTED] kihei 96753. I'm absolutely shocked that cesspools exist on our island still and what's worse is all the building permits for large condo complexes with no requirements for infrastructure upgrades to accommodate the new structures. I empathize with the property owners but cesspools upcountry and in maui meadows are a health hazard and will eventually impact our tourist industry.

In Southern California shake roofs were outlawed as a fire hazard and cesspools are in the same dangerous category. We had 2 years to replace our roofs.

Waiting till 2050 is not a good option. Either the county needs to bring in sewer lines or property owners given access to low interest loans and be required to remedy the situation within 2 years. Another option would be to bring in a contractor for the work and add the costs to their property tax over time. I'd be very interested to know how many of these properties are rentals and if the owners live off island.

Mahalo for working on this

The DOH acknowledges and thanks you for your comments.

Commenter: Mr. Dick Mayer, 3/27/18 email

Some of the topics that we might wish to discuss are as follows:

a) What can be done to require all new water meters to be connected to the County's Department of Water Supply which by all accounts is safe?

Unfortunately, we cannot provide a response to your comment since it is outside of the scope of the draft Investigation. The DOH acknowledges and thanks you for your comments.

b) What can be done to prevent the further issuing of permits for private water wells that are intended to be used for drinking water?

Unfortunately, we cannot provide a response to your comment since it is outside of the scope of the draft Investigation. The DOH acknowledges and thanks you for your comments.

c) What are the rules going to be for allowing "exceptions" when property lots cannot include a septic system because of issues like slope or small-lot size?

Unfortunately, we cannot provide a response to your comment since it is outside of the scope of the draft Investigation. The DOH acknowledges and thanks you for your comments.

d) Are septic systems really an answer?

Unfortunately, we cannot provide a response to your comment since it is outside of the scope of the draft Investigation. The DOH acknowledges and thanks you for your comments.

e) Are there other solutions? And

Unfortunately, we cannot provide a response to your comment since it is outside of the scope of the draft Investigation. The DOH acknowledges and thanks you for your comments.

f) What are the economically feasible alternatives?

Unfortunately, we cannot provide a response to your comment since it is outside of the scope of the draft Investigation. The DOH acknowledges and thanks you for your comments.

Those are just some of the issues. I'm sure that others could add additional topics to be discussed. We would like to know when you are planning to convene such a meeting where we could discuss the whole upcountry cesspool issue in a collegial, constructive manner. Please get in touch with me, or DOH's Maui's District Health Officer (Lorrin Pang) at your earliest convenience, -- but sooner please, rather than later.

Unfortunately, we cannot provide a response to your comment since it is outside of the scope of the draft Investigation. The DOH acknowledges and thanks you for your comments.

Commenter: Mr. Sean O’Keefe, 3/28/18 Letter (attached with page numbers added)

First, DOH greatly appreciates the time and effort you put into your thoughtful review comments. Your letter does convey a great deal of sincere concern about your community. We will provide our responses to your comments by referencing the page and paragraph of your letter.

Page 1, Paragraph 2

Unfortunately, we cannot provide a response to your comment since it is outside of the scope of the draft Investigation. The DOH acknowledges and thanks you for your comments.

Page 1, Paragraph 3

Unfortunately, we cannot provide a response to your comment since it is outside of the scope of the draft Investigation. The DOH acknowledges and thanks you for your comments.

Page 2, Paragraphs 1 and 2

The *Upcountry Maui Groundwater Nitrate Investigation* only evaluated the cause of the significantly elevated nitrate and recommends a solution based on the conclusions of the study. There is no call in the Investigation for immediate action. While the Investigation’s conclusion does lend technical support to the cesspool requirement of Act 125, it was not considered when that legislation was passed. The requirement to replace cesspools with a higher method of wastewater treatment was independent of the *Upcountry Maui Groundwater Nitrate Investigation*.

Further studies and evaluations are desirable, particularly where the recommendations of the primary study are difficult and expensive to implement. Further studies can be identified and commissioned based on input from other government agencies, businesses, and the affected communities.

Page 2, Paragraph 3 and 4 and footnotes; Page 3 Paragraph 1

We agree that the nitrate concentrations measured by the *Upcountry Maui Groundwater Nitrate Investigation* and the Safe Drinking Water Branch drinking water compliance sampling do not warrant an immediate health concern since the nitrate concentrations in current public drinking water wells are below the health based threshold. Also, the Baldwin Ranch Estates development agreed to install nitrate removal treatment preventing an adverse health impacts from this well when it comes on line. However, DOH views the nitrate concentrations approaching the Maximum Contaminant Limit as a significant groundwater contamination problem and are obligated to work to correct the source of contamination. We agree that this has to be done in a thoughtful and purposeful manner due to the significant burden that is being placed on the residents of Upcountry Maui.

We also feel it is also important to point out that the 4 mg/L nitrate measured in the BRE-1 Well by the Upcountry Groundwater Nitrate Investigation was a grab sample. Two of three grab samples collected from this well were low when compared to samples collected with a pump. When the well goes into service it is expected that the nitrate concentration in the water delivered to the water system by the pump will likely be about 80 percent of the MCL or greater based on the results of samples previously collected with a pump.

Page 3, Paragraph 2 through 4 and footnotes; and Page 4 Paragraphs 1 through 3

The residential effluent rates used by DOH in the report to the Legislature (DOH, 2017) were taken from the relative risk ranking studies of OSDS throughout the Hawaii (Whittier and El-Kadi, 2009 and 2014). These effluent discharge rates were based on the regulatory OSDS design requirement of 200 gallons per day (gpd) per bedroom to provide a uniform basis for risk ranking. The OSDS risk ranking studies were the only statewide estimate of OSDS and cesspool effluent discharge rates and thus were used for the report to the Legislature.

For the Investigation the residential effluent rates were re-visited since the goal was to model the nitrate in the groundwater and compare the simulated and measured concentrations. The model used an estimated effluent rate of 105 gallons per day per bedroom based on a per capita wastewater load of 70 gallons per day per person and an occupancy rate of 1.5 persons per bedroom. There was a total of 8,924 cesspools in the model domain since the entire west flank of Haleakala was considered. When just the Upcountry Maui Priority One Cesspool Upgrade Area of the model is considered, the totals are:

- Total OSDS – 10,440
- Total number of cesspools – 7,400
- Total Effluent from OSDS – 3.4 mgd
- Back calculated population using 100 gpd per person (from Page 3 of comments) – 34,000 are served by OSDS
- Total effluent from cesspools – 2.3 mgd
- Back calculated population using 100 gpd per person (from Page 3 of comments) 23,000 and are served by cesspools

The model values for population and effluent rate do seem to be in reasonable agreement with what is stated on Page 3 of the comments.

Page 4, Paragraphs 4 and 5

The most comprehensive survey of domestic wastewater nitrate and nitrogen in Hawaii was done by the University of Hawaii, Water Resources Research Center (Cummings and Babcock, 2012). This study collected samples from 58 septic tanks that would be comparable to effluent to a cesspool. The average total nitrogen concentration was 96 mg/L. We agree that the total nitrogen in wastewater covers a wide range due to factors such as the number of persons served by the OSDS. Our assumed concentration of 87 mg/L is reasonable and supported by Hawaii specific data.

Page 4, Paragraph 6 (continued on Page 5); Page 5, Paragraph 2

Yes, it is correct that DOH assumed no attenuation of nitrogen in the cesspool effluent after discharge. The fate of cesspool effluent has not been characterized in a Hawaii environment. However, it is also important to note that when compared to measured data, the model underestimated rather than over-estimated the groundwater nitrogen concentration. The model results suggest that little to no attenuation of cesspool nitrogen occurs during infiltration and groundwater transport to the wells.

Page 5, Paragraphs 2 and 3

Uncertainties, assumptions, and limitations are an inherent characteristic of groundwater modeling, while they need to be considered, they do not by themselves invalidate the conclusions of the model. The 2014 OSDS human health and environmental risk study

(Whittier and El-Kadi, 2014) was a records based study with the goal of identifying relative risk. As such the listed limitations were substantial. The *Upcountry Maui Groundwater Nitrate Investigation* was a site-specific study to evaluate the cause of the elevated nitrate concentrations detected in the area wells. The assumptions and limitations of the risk ranking study were reviewed and refined. As with any such study limitations and the need for assumptions still remain and are discussed in Section 4.2 of Appendix VI. These limitations need to be viewed in the context of what would be required for a source other than OSDS to elevate the groundwater nitrate concentrations significantly above what would be expected from the identified natural and agricultural sources. This will be discussed in more detail in the response to comments on specific PCAs below.

Page 5, Paragraph 4; and Page 6, Paragraphs 1 through 3

In general, these paragraphs in the comment letter list alternative sources of groundwater nitrate, stating that a more rigorous survey of nitrate sources should be done prior to making decisions about cesspool replacement mandates. Since the cesspool replacement mandate was made independent of the Investigation by Act 125 in the 2017 Session, the focus of this response will be on the potential causes of the elevated nitrate in the Upcountry Maui groundwater.

It is unusual for wells not impacted by former sugar cane agriculture to have a nitrate concentration 2.5 mg/L or greater. Within the study area, wells upslope or outside of the high OSDS density and areas of former sugar cane cultivation have nitrate concentrations less than 1 mg/L. These wells include the West Kuiaha Meadows, Kaupakulua, Pookela, and the Maui Highlands 2 Wells. The Hamakuapoko Well 2 is located adjacent to former sugar cane and does have elevated nitrate at 4.1 mg/L, consistent with groundwater impacted by former sugar cane cultivation and one of the highest concentrations measured by the Investigation. Other wells starting at the Maunaolu-Smith well in the north of the study area to the Waiohuli Observation Well in the south of the study area have nitrate concentrations generally associated with sugar cane or seed corn agriculture but with none of these two activities upgradient of these wells. Nitrate source(s) needed to account for the elevated nitrate in each of these wells must chronically deliver nitrate to the groundwater and cover a broad spatial area. Otherwise dispersion and dilution quickly reduce the nitrate concentration. Potential sources identified during the public meetings and in the review comments include; the wastewater infiltration ponds below Haliimaile, livestock operations, and irrigation with recycled water at the Pukalani Golf Course. Each potential source will be addressed below:

- Haliimaile Wastewater Infiltration Ponds – the ponds are located about 1,300 ft down slope and thus down gradient from the BRE-1 and fall outside of the zone of contribution to this well. Attached is a zone of contribution analysis done by Tom Nance Water Resources Engineering (2016) that shows the Haliimaile Wastewater Infiltration Ponds are well outside of the capture zone for the BRE-1 Well and will not affect any well sampled as part of the *Upcountry Maui Groundwater Nitrate Investigation*.
- Livestock Operations – to result in significantly elevated nitrate concentrations in the groundwater beneath Upcountry Maui would require a large confined animal feeding operation. As indicated by the comments from Haleakala Ranch, the Maui Cattleman’s Association, the University of Hawaii – College of Tropical Agriculture and Human Resources, and a review of groundwater impact from the Hamakua area of Hawaii Island, the requisite conditions for livestock impact on the groundwater of Upcountry Maui do not exist.
- Application of Recycled Wastewater on the Pukalani Golf Course - First at the DOH presentation at Kula Community Association Meeting on February 21,

2018, Mr. Whittier misspoke. The application of recycled water on the Pukalani Golf Course was included in the groundwater model and indicated this source would increase the total groundwater nitrogen concentration at the Pukalani Golf Course Well by about 1.5 mg/L. Since nitrate was only 50 percent of the total nitrogen, the increase in the nitrate concentration attributable to the golf course irrigation would be about 0.8 mg/L. Other studies have also concluded that golf courses are not a major contributor of nitrate to Maui groundwater. These studies include those of TetraTech (1993), Soicher and Peterson (1996), and an on-going joint study by UH and DOH on the west Maui's coastal nutrient fluxes.

- DOH investigated this matter further in response to questions raised in the February 21, 2018 Kula Community Association Meeting. Below are the findings:
 - The golf course occupies 125 acres
 - About one (1) pound of fertilizer per 1000 square feet is applied monthly to the greens,
 - No other areas of the golf course receive supplemental fertilizer,
 - The average irrigation demand is about 300,000 gallons per day, and
 - No recycled water was used during the years 2017 and 2018.
- The modeled leachate concentration from the Pukalani Golf Course was 7 mg/L. Based on the data from the Pukalani Golf Course it appears the modeled concentration in the recharge from the golf course is much higher than likely occurs. Dewitt et al. (2008) measured an average nitrogen leaching factor of 0.25 for golf courses in the U.S. south west where recycled water was used for irrigation, making 2 mg/L a more likely leachate concentration. In summary, the use of recycled water on the Pukalani Golf Course, while measureable, could not account the elevated nitrate and total nitrogen concentrations measured at the Pukalani Golf Course Well.
- The output from the Pukalani Wastewater Treatment Plant is not currently applied to the golf course. The Pukalani WWTP sends the effluent to an infiltration pond at the plant. The location of the infiltration pond is not directly in the flowpath to the Pukalani Golf Course Well but could have a limited influence on the groundwater captured by this well (see Figure 2). An additional groundwater flow and transport model scenario will be run simulating the infiltration from this pond.

Page 6, Paragraph 4; and Page 7, Paragraphs 2 and 3

DOH agrees that the nitrate in groundwater is a mixture from various sources. DOH also agrees that the sample collected at the Pukalani Golf Course Well was the only sample where the $\delta^{15}\text{N}$ value fell exclusively in the wastewater range. However, since the wastewater range extends from 2 ‰ to 25 ‰, all sample results fell within with the wastewater range. The overlapping of the wastewater nitrate isotope range with that of ammonium fertilizer and soil nitrate complicates the interpretation of the nitrogen isotope data. To better differentiate this isotopic composition between groundwater impacted and not impacted by wastewater the data from Upcountry Maui was compared to groundwater samples collected in west Maui. Glenn et al. (2012) sampled wells that were located in areas of former sugar cane and pineapple agriculture, similar to Upcountry Maui well. But the west Maui wells had no OSDS contributing nitrogen to the groundwater. This data provides a reference point for what the nitrogen isotopic composition of groundwater in Maui is if only fertilizer and natural sources are considered. The average isotopic

composition of west Maui groundwater nitrate is very close to that of the Pookela Well indicating that groundwater with little to wastewater contribution should have a $\delta^{15}\text{N}$ value in the range from 2.1 to 2.9 ‰. The relative contribution from each of the primary sources (i.e. fertilizer and natural sources versus wastewater) would be indicated by relative position between the west Maui nitrate isotope data point and the wastewater nitrate isotope data point. Table 3-7 of the Investigation lists our assessment the primary sources contributing nitrate to the groundwater and this table does recognize that nitrate comes from multiple sources.

Page 7, Paragraphs 3 through 5

While Acesulfame-K was only detected in the Pukalani Golf Course Well, the PPCPs 4-nonylphenol, Amoxicillin, and sulfathiazole were detected in the Omaopio-Esty well indicating a wastewater contribution. The primary use of Amoxicillin and Sulfathiazole is for human health. Wastewater is the only reasonable source of PPCPs to the Omaopio-Esty Well.

Page 8, Paragraphs 1 through 4

Surface water sources were not included in Table 4-1 since this was a groundwater nitrate investigation. While it is true the Maui Department of Water Supply's wells are only minimally affected by the groundwater nitrate problem in Upcountry Maui, all current and potential sources of drinking water are of concern to DOH.

Page 8, Paragraph 5 and Page 9 Paragraph 1

First it is important to point out that the purpose of the *Upcountry Maui Groundwater Nitrate Investigation* was to identify the source(s) of elevated nitrate. We agree that there are multiple sources that contribute nitrate to the groundwater and the primary sources were specified in the Investigation. However, OSDS are the primary contributor to the wells with the most highly elevated levels of nitrate with the exception of the Hamakuapoko 2 Well. Most of the wells sampled in this study are either upgradient or at the very upper end on the major agricultural activities. The spatial correlation between high concentrations of OSDS and wells with significantly elevated nitrate indicate that domestic wastewater is the major contributor of nitrate to the groundwater in Upcountry Maui.

Second, the *Upcountry Maui Groundwater Nitrate Investigation* was independent of the cesspool conversion requirement. The Investigation did result in the designation of Upcountry Maui as a Priority One area for cesspool conversion due to the substantial impact on groundwater. However, there is currently no requirement that Upcountry Maui upgrade their cesspools any sooner than any other area of the state. Ideally the Priority One designations will be used to direct available resources to these areas where cesspool conversions can result in greater environmental and human health benefits.

Figure modified from Tom Nance
Water Resource Engineering, 2016

BRE-1 Well

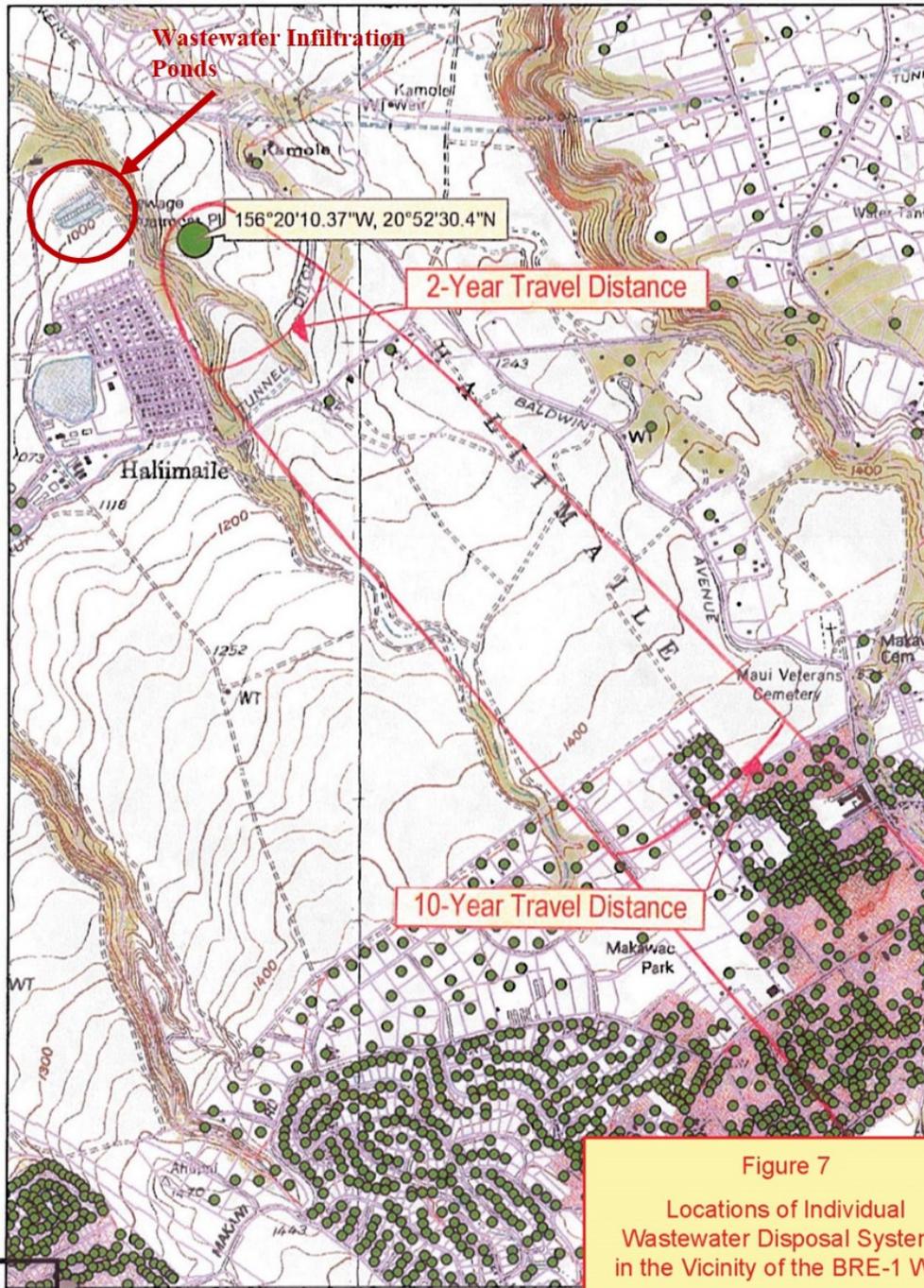


Figure 1. Map from the BRE-1 Well engineering report (Tom Nance Water Resource Engineering, 2016) showing the location of the Haliimaile wastewater infiltration ponds relative to the BRE-1 Well zone of contribution

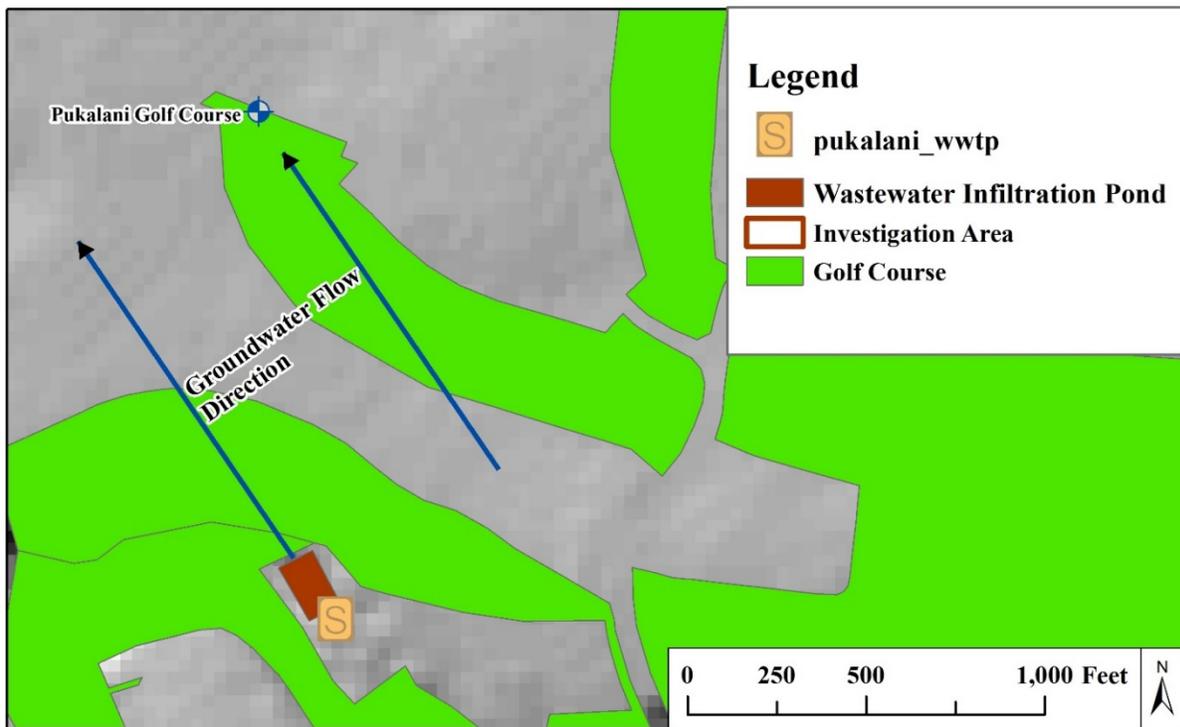


Figure 2. Map of the Pukalani Wastewater Treatment Plant and the wastewater infiltration pond relative to the location of the Pukalani Golf Course Well.

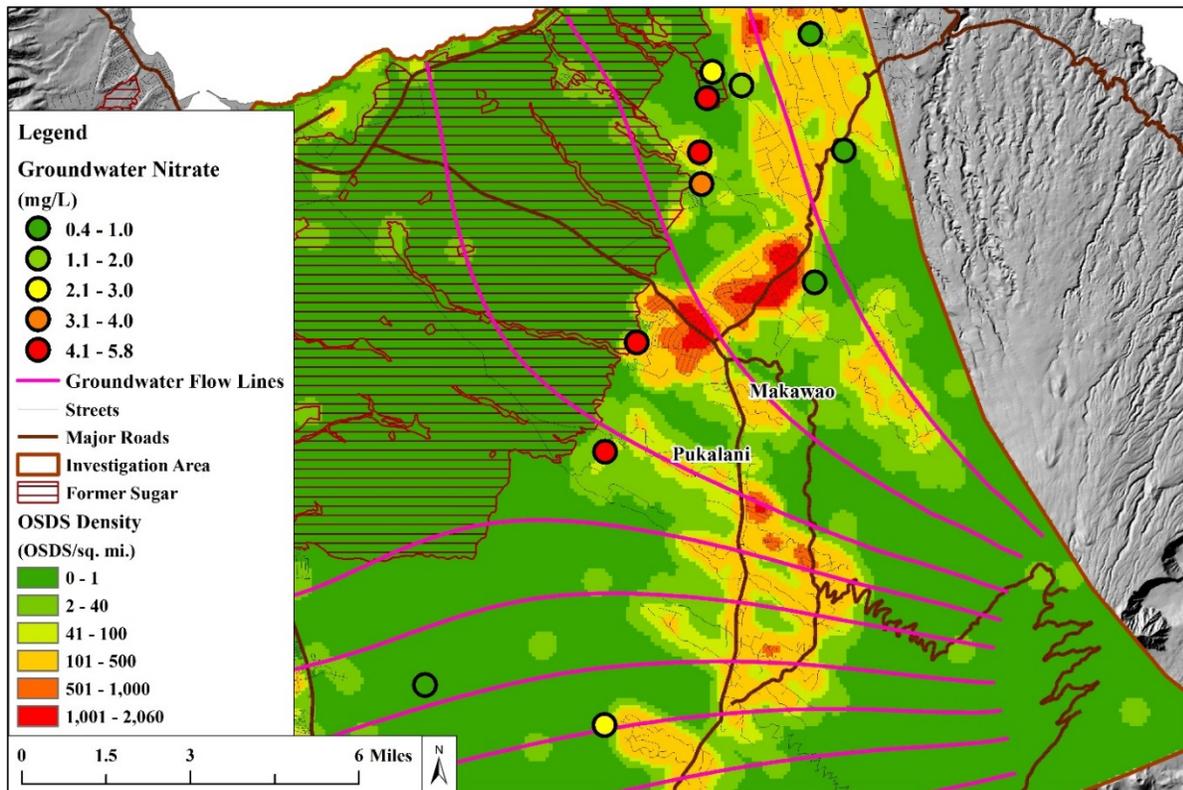


Figure 3. By visual inspection the elevated groundwater nitrate concentrations correlate very well with the high density of OSDS and former sugar cane (the Hamakuapoko Wells).

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Attachments:

Comment letter from Mr. Scott Meidell, Senior Vice President, Haleakala Ranch, dated March 21, 2018

Comment letter from Dr. Kyle C. Caires, Cooperative Extension, University of Hawaii at Manoa, College of Tropical Agriculture and Human Resources, dated March 9, 2018

Comment letter from Mr. William Jacintho, President, Maui Cattleman's Association, dated March 28, 2018

Comment letter from Mr. Sean O'Keefe, dated March 30, 2018 (page numbers added)



HALEAKALA RANCH

• EST. MAUI 1888 •

March 21, 2018

Joanna L. Seto, P.E.
Branch Chief
Safe Drinking Water Branch
Department of Health
2385 Waimanu Home Road
Uluakupu Building 4
Pearl City, HI 96782-1400

Via Electronic Mail: joanna.seto@doh.hawaii.gov

Dear Ms. Seto:

Subject: UPCOUNTRY MAUI GROUNDWATER NITRATE INVESTIGATION REPORT – Comments from Haleakala Ranch Company

Thank you very much for the opportunity to comment on the referenced report. As mentioned in my letter to you of March 9, 2018, Haleakala Ranch Company would like to point out some issues of concern that, in our view, should be addressed prior to the finalization of the report.

The fundamental objective of the report to identify sources of and solutions for nitrate contamination of groundwater in the Upcountry Maui region is of clear and obvious importance to the community and we appreciate the efforts of the Department of Health in this regard. We also believe that it is in the public interest that the reporting and analysis be unimpeachable in its conclusions and hope that our input supports that goal.

The report cites livestock operations – specifically confined animal feed operations (CAFO) - as one of the four likely causes of nitrate contamination of groundwater within the study area. Haleakala Ranch is specifically referenced in numerous places throughout the report as a potential contributor to nitrate contamination of groundwater and is somewhat exonerated of the allegations in the Summary and Conclusions on page 4-7 of the report. However, we note with concern that references to the potential contributions to nitrate contamination by livestock operations and of Haleakala Ranch's role are incorrectly and inappropriately repeated throughout the body of the report. The final conclusion that Haleakala Ranch is not a contributor to this problem would reasonably suggest that all specific references as to our purported role should be removed from the report entirely. We believe it is reasonable that reference to the investigation of livestock operations and final conclusions regarding the industry be made in a general manner that conveys a methodology of research that is comprehensive, rigorous and, above all, fair. To feature Haleakala Ranch specifically and exclusively is inappropriate and places us and the livestock industry at risk of negative public perspective generated by information that has the potential to easily be taken out of context.

An accurate treatment of this issue could have been significantly supported through dialog with Haleakala Ranch. This would have been a very effective way to confirm operational matters that were assumed in the report. For example, the report cites a “roadway survey” of Haleakala Ranch operations that generated the conclusion that “12 animal feed lots are suspected to be in the investigation area”. **For the record, Haleakala Ranch Company engages in rotational grazing and forage finishing programs and does not utilize confined animal feedlot operations.** CAFO programs differ very significantly from pastoral operations such as ours in terms of structure, appearance and impact. The impacts of CAFO are well-understood, such that these operations are subject to government regulation and monitoring requirements. We believe it is fair to assume that CAFO registration and monitoring data managed by the government would be a reliable source of information for an investigation of this nature.

We would like to point out that the actual surface contribution of nitrogen by our pastoral system of grazing is, by a very wide margin, significantly lower than CAFO and other intensive agricultural operations. We enclose, for your reference, a brief report by UH/CTAHR Extension Specialist Kyle Caires, PhD. Referencing current Haleakala Ranch program statistics, the conservative analysis by Dr. Caires suggests a surface nitrogen contribution by our operations of less than eight pounds per acre per year compared with 150 and 420 pounds per acre per year for fertilized pasture and pineapple production, respectively. We believe this is illustrative of the ongoing commitments of Haleakala Ranch and other regional livestock operations to manage our natural resources in a responsible manner. It is our opinion that this analysis also underscores the importance of factual accuracy and fairness in the development of reports that will be subject to use and citation by the general public.

We also note that a potential bias against Haleakala Ranch begins early in the report on page 1-3 where we are – to the exclusion of all other private landowners – specifically cited as being dominant within the study area. This impression of partiality is egregiously compounded by the exclusive representation of Haleakala Ranch’s landholdings in Figures 1-5, 1-6, 2-1, 3-1, 3-2, 3-4 and 3-6. **The final conclusions of the report notwithstanding, the repetitious specific references to Haleakala Ranch Company in narrative and illustration is patently unfair to us and the livestock industry and we strongly urge that they be removed from the report entirely.**

Thank you for the opportunity to comment on this report.

Sincerely,



J. Scott Meidell
Senior Vice President
Real Estate and Land Management

Enclosure: UH/CTAHR report

cc: Don Young, President
Greg Friel, Vice President
Jordan Jokiel, Vice President
William G. Jacintho, President, Maui Cattlemen’s Association
Dale Sandlin, Managing Director, Hawaii Cattlemen’s Council



COOPERATIVE EXTENSION
 UNIVERSITY OF HAWAII AT MĀNOA
 COLLEGE OF TROPICAL AGRICULTURE AND HUMAN RESOURCES

Kyle C. Caires, Ph.D.
 310 Kaahumanu Ave, Bldg 214
 Kahului, HI 96732
 808-244-3242, ext. 232
kccaires@hawaii.edu

Friday, March 9, 2018

Haleakala Ranch Company
 529 Kealaloa Avenue
 Makawao, HI 96768

Greg and Scott,

Thank you for including me in today's meeting regarding the recently drafted report by the Department of Health, in regards to their contaminated well study. During the meeting, we discussed trying to quantify the amount of ammonia and nitrate emissions from the cattle operations at the ranch. Please find the following estimates based upon the current herd inventory at the ranch using the most current information from American Society of Agricultural and Biological Engineers (ASABE) standards.

The ASABE estimates were generated for typical classes of beef cattle in confinement, obtained from concentrated animal feeding operations (CAFO). Therefore, pastoral cattle operations, like Haleakala Ranch, would be expected to generate less bulk waste, reduced nitrogen excretion, and decreased ammonia emissions per animal in contrast to the data from CAFO-based cattle operations in open-dirt lots. Significant regional and seasonal variation in ammonia emissions occurs due to influences of climate and management of the production or storage system, but for humid climates, the range of ammonia loss is between 30 – 45%; I used 45% in calculations because this is most likely the best estimate for pastoral production. A summary of estimates following herd analysis is provided below.

Class of Livestock	Number of Head	Total N excretion (lbs/h/day)*	45% lost to air as NH ₃	55% Nitrogen left on ground	Total lbs. N on ground	Summary of Livestock Impacts
Bulls (young)	28	0.29	0.13	0.16	4.47	492 lbs. total N per day
Bulls (mature)	51	0.42	0.19	0.23	11.78	
Mature Cows	1348	0.42	0.19	0.23	311.39	179,813 lbs. total N per year
Heifers (wean)	249	0.29	0.13	0.16	39.72	
Heifers (yearling)	263	0.3	0.14	0.17	43.40	Grazed on 23,000 acres
Steers (heavy)	180	0.36	0.16	0.20	35.64	
Steers (wean)	236	0.29	0.13	0.16	37.64	
Calves	54	0.29	0.13	0.16	8.61	7.82 lbs. N per acre, per year
Total Head	2409					

*Excretion estimates are based upon 2005 ASABE standards for typical classes of beef cattle in confinement, and is supported by data gathered from the USDA NRCS Agricultural Waste Management Field Handbook.



COOPERATIVE EXTENSION

UNIVERSITY OF HAWAII AT MĀNOA
COLLEGE OF TROPICAL AGRICULTURE AND HUMAN RESOURCES

Kyle C. Caires, Ph.D.
310 Kaahumanu Ave, Bldg 214
Kahului, HI 96732
808-244-3242, ext. 232
kccaires@hawaii.edu

Again, I used conservative estimates for generating these numbers that I feel best reflects the 'worst-case' scenario of livestock impacts. For comparison, the typical recommendation for applying Urea fertilizer (46-0-0) to pasture land is 150 lbs. per acre (69 lbs. of N per acre), whereas, pineapple usually requires at least 420 lbs. of nitrogen applied per acre for productive yields.

To these ends, the environmental impact of nitrogen excretion by livestock is minimal, approximately 8.8- and 53.7-fold less than that of a typical application rate of fertilizer to maintain productive grass lands or pineapple, respectively.

Best regards,

A handwritten signature in cursive script, appearing to read "Kyle Caires".

Kyle Caires

MAUI CATTLEMEN'S ASSOCIATION

March 28, 2018

Maui Cattlemen's Association

PO Box 473

Kula, HI 96790

Board of Directors and Officers

Tanya Akaka

Brendan Balthazar

Harry Cambra

Robert Ferreira

Alex Franco

Greg Friel

Jimmy Gomes

William G. Jacintho

Kristin Mack

Ken Miranda

Jacob Tavares

Sustaining ranching communities in Hawaii

Joanna L. Seto, P.E.
Branch Chief
Safe Drinking Water Branch
Department of Health
2385 Waimanu Home Road
Uluakupu building 4
Pearl City, HI 96782-1400

Sent by Electronic Mail to: joanna.seto@doh.hawaii.gov

Dear Ms. Seto,

Thank you for the opportunity to comment on the DRAFT - UPCOUNTRY MAUI GROUNDWATER NITRATE INVESTIGATION REPORT. The results of this study, directly affects our Members and our Livestock Producers livelihood, and their families, personally.

According to information provided at presentations;

- The Primary purpose of the investigation was to provide critical data of likely sources of nitrate contamination in the upcountry aquifer.
- The Secondary purpose of the investigation was to define the groundwater flow paths to drinking water wells, and potential sources of nitrate contamination.
- The Mission is to reduce or eliminate contamination risk to public drinking water sources.
 - Evaluate susceptibility
 - Work collaboratively with all parties

We'd like to echo and support the comments of Haleakala Ranch, dated March 21, 2018, especially for the fact that information has the potential to easily be taken out of context that causes negative public interpretation that negatively affects our livestock industry. Equally important, we'd like to support the valuable information and comments provided by Dr. Kyle Caires of the University of Hawaii's Cooperative Extension office dated March 7, 2018. I believe it is very important to work collaboratively with the community, before making any susceptibility evaluations, decisions, and especially any potential laws, that will affect our Community. This is a complex issue, and I encourage the Project Organization Personnel, to hold off of any decision making until more discussion and information can be exchanged. There are Food Safety concerns that improperly functioning septic systems can cause for the Agriculture Industry. Crop farmers are very vulnerable to surface water movement when it comes to Food Safety requirements. Are septic systems really the answer? Are there other solutions? Maybe an alternative to gray water can be considered, instead of depositing all of it in a septic system. This would result in less nitrate surface runoff.

We ask to be included, and actively involved to provide information, in any further discussion regarding this study. The Maui Cattlemen's Association is an organization representing small and large livestock producers in Maui County including Molokai and Lanai. You may reach the Maui Cattlemen's Association through the address provided above, or this email address this letter was sent from.

Sincerely,

William Jacintho, President
Maui Cattlemen's Association

March 30, 2018

Ms. Joanna Seto, Chief
Safe Drinking Water Branch
Hawaii Department of Health
Via email: joanna.seto@doh.hawaii.gov
Copy to: sdwb@doh.hawaii.gov

Ms. Sina Pruder, Chief
Wastewater Branch
Hawaii Department of Health
Via email: sina.pruder@doh.hawaii.gov

Subject: Public Comment on the Draft “Upcountry Maui Groundwater Nitrate Investigation Report”

Thank you for the opportunity to comment on the draft report, and for your extensive public outreach on the issue of cesspools in Hawaii. I believe that most of the community appreciates that the Department of Health has a responsibility to identify threats to groundwater and surface water and to take action to address such threats, when warranted.

As I am sure you are aware, there is a great deal of concern among homeowners around the state, and especially on Maui, regarding the existing requirement (under Act 125) to close all cesspools in the state by 2050. Efforts by State government aimed at accelerating that deadline for certain cesspools, including the estimated 7,400 cesspools in Upcountry Maui, have heightened those concerns among homeowner who can expect to pay between \$20,000 and \$30,000 (and in some cases much more) to upgrade a cesspool. This amounts to a decrease of approximately four percent in the median value of a single-family home on Maui¹, which for many homeowners is the single largest investment they will ever make. Statewide, Act 125 can be expected to cost homeowners on the order of \$2.2 billion to close the estimated 87,900 existing cesspools statewide. Investments of this magnitude should not be mandated without a thorough evaluation of the purported justification for such investments. Additionally, in the event that corrective actions are determined to be justified, they should be based upon a comprehensive vetting of alternatives that might result in comparable benefits at lower cost.

While the Department of Health (DOH) has frequently stated that it is not, at this time, taking any action to require closure of cesspools ahead of the existing 2050 deadline, this statement is a bit at odds with the strong recommendations that DOH has made directly to the Legislature, as well as in the subject report. Specifically, see the Department of Health’s *Report to the Twenty-Ninth Legislature, State of Hawaii, 2018 Regular Session Relating to Cesspools and Prioritization for Replacement (December 2017)*, stating that action to address Priority 1 cesspools (which includes all 7,400 cesspools in Upcountry Maui) “should be achieved as soon as possible using any means available”. In Section 4.4 of the subject report, DOH concludes that “OSDS (on-site disposal systems) in Upcountry Maui needs to be considered a significant groundwater contamination source” which “needs to be mitigated or removed, or treated prior to

¹ Based on market statistics from the Maui Realtors Association for the month of February 2018.

delivery to the customers”, and that “the priority for resolving this contamination problem should be replacement of OSDS in the high-density areas”. The report further concludes that cesspools should be replaced in areas of lower OSDS density. These recommendations have directly resulted in a proliferation of proposals during the 2018 legislative session regarding cesspools, including at least two bills that would have required early closure of some cesspools.

Given the enormous cost of the course of action proposed by DOH “for resolving this contamination problem”, it is vital to first confirm that nitrate levels in Upcountry Maui groundwater are in fact elevated to the point that immediate corrective actions are necessary. It is equally important to ensure that any corrective actions that are taken will target the appropriate sources of nitrate; otherwise, they will be ineffective at achieving the desired objective.

In the subject report, DOH has identified and evaluated several potential sources of elevated nitrate levels in Upcountry Maui groundwater but has concluded that action must be taken “as soon as possible using any means available” to address one potential source – the 7,400 cesspools located in Upcountry Maui. Based on my review of the report, it is my strong belief and recommendation that further study of the presence and source of elevated nitrate levels in Upcountry Maui groundwater should be conducted before embarking upon a course of action which may or may not address any groundwater contamination issues but will certainly result in an enormous financial burden on residents of Upcountry Maui.

Measured nitrate levels in Upcountry Maui groundwater do not appear to require immediate corrective action.

DOH is recommending the replacement of all cesspools in Upcountry Maui because of data, including monitoring and modeling data, suggesting that nitrate levels in groundwater are approaching or exceeding the drinking water maximum contaminant level (MCL) for nitrate (10 mg/l).

The actual monitoring data of concern to DOH indicate that several Upcountry wells have nitrate levels in excess of 3.0 mg/l, the level at which DOH advises water systems “to start evaluating the cause of the elevated nitrate contamination”. In some of these wells, nitrate levels have been measured in excess of 6.0 mg/l, and in one well planned for use as a drinking water supply (the Baldwin Ranch Estates (BRE) well), nitrate has been measured as high as 8.7 mg/l, approaching the MCL.² For all of the monitored wells planned to be or currently used for drinking water, however, the most recently measured nitrate concentrations are below or very close to 5.0 mg/l, just half of the drinking water MCL (the only exception is the Pukalani Golf Course well, which is used solely for irrigation, at 5.8 mg/l).^{3, 4} Additionally, for most of the wells the nitrate levels are either steady, decreasing, or there is insufficient data to determine a trend.⁵

² The most recent data for the BRE well indicates a nitrate concentration of just 4.0 mg/l.

³ Table 3-7 of the report

⁴ While nitrate levels in excess of 5.0 mg/l in drinking water require more frequent monitoring for nitrate, such levels are not a health concern, nor are they particularly unusual. EPA estimates that in more than 20 states at least five percent of the total area of the state has nitrates in groundwater at levels in excess of 5.0 mg/l. In California, ten percent of the state falls into that category.

⁵ Table 4-2 of the report

Clearly, lower nitrate levels in drinking water are preferable to elevated levels, and 3.0 mg/l of nitrate or less is certainly a worthy goal. Nevertheless, corrective actions of the magnitude and cost being proposed would not appear to be warranted unless/until sufficient data has been collected demonstrating that nitrate levels are consistently elevated and trending upward.

Modeling results suggesting that the drinking water MCL is being exceeded in parts of the aquifer must be carefully evaluated before meaningful conclusions can be drawn.

The report includes a modeling analysis which concludes that on-site disposal systems (OSDS), including cesspools, are the source of elevated groundwater total nitrogen (and therefore nitrate) concentrations, and that in some areas of Upcountry Maui nitrate levels in groundwater may be exceeding the MCL. There are some significant issues with the modeling analysis that may impact the validity of the conclusions.

Effluent flows into Upcountry cesspools appear to be grossly overestimated: In its *Report to the Twenty-Ninth Legislature, State of Hawaii, 2018 Regular Session Relating to Cesspools and Prioritization for Replacement*, DOH indicates that there are 7,400 cesspools in the Upcountry area of Maui, with a total effluent discharge of 4.4 million gallons per day (or approximately 600 gpd discharged into each cesspool).⁶ This equates to six persons in each household served by a cesspool.⁷

The vast majority of these cesspools must be residential cesspools, since large capacity cesspools of the type formerly found at public buildings have been banned nationwide since 2005. Assuming a residential wastewater flow of 100 gpd per person (per capita flows into small, non-residential cesspools would be much lower), this means that a total of 44,000 Upcountry residents would need to be served by cesspools in order to generate the amount of effluent discharge estimated by DOH. According to the most recent census data, however, the total population within what DOH has defined as the Upcountry Maui Priority 1 Area (Kula, Makawao-Pukalani, and part of Haiku) is only about 24,000 persons. Of these, at least 2,000 residents of Pukalani are served by the Pukalani Wastewater Treatment Plant (WWTP), and about 1,000 residents of Haliimaile are served by a WWTP there.⁸ **Thus, the DOH estimate of the total effluent flow into Upcountry Maui cesspools corresponds to a resident population that is more than double the actual population of this area.**⁹

⁶ Note that the Upcountry Maui study area covered by the modeling analysis does not appear to match up exactly with the Upcountry Area of Maui that DOH was designated as Priority 1 for cesspool upgrades. According to Table 3-6 of the report, the modeling study area includes 9,150 cesspools while the Priority 1 area includes only 7,400 cesspools. It is unclear why DOH chose to define the Upcountry area differently in the two documents, but the analysis of effluent flows provided here remains applicable in either case.

⁷ According to census data, the average number of persons in each household in Upcountry Maui communities ranges from 2.4 in Kula to 2.8 in Makawao.

⁸ In addition, there are reportedly about 2,000 septic systems within the Upcountry Maui area, meaning the actual number of persons served by cesspools is even less than 21,000.

⁹ Table 3-6 of the report indicates that the modeling analysis assumed an effluent rate of 70 gpd per person. In that case, the population corresponding to 4.4 million gallons per day of effluent flow would be 62,857, or nearly three times the actual population of the area.

The flaw in the modeling analysis is that the estimated total effluent flow into Upcountry Maui cesspools, and the corresponding nitrogen flux, appear to be based on the number of bedrooms served by cesspools (i.e., the design flow into the cesspools) rather than on the number of persons actually using the cesspools (i.e., the actual flow into the cesspools).

While design flows are appropriate for designing wastewater systems, they are not appropriate for modeling actual environmental impacts from operating those systems, particularly when the modeling results are to be compared to results of environmental monitoring, as is the case here.

A reasonable conclusion based on this apparent overestimation of effluent flows into cesspools is that the groundwater impacts predicted by the model are more than double the actual impacts to groundwater from nitrogen in effluent from Upcountry cesspools.

DOH should re-evaluate the effluent flows based on the actual population served by cesspools in Upcountry Maui (i.e., on the order of 2.5 persons per household rather than the theoretical 1.5 persons per bedroom that was used) and revise the modeling analysis accordingly. In all likelihood, significantly different conclusions would be reached as a result.

Effluent nitrogen flux from cesspools appears to be grossly overestimated: As a result of the total effluent flow from cesspools being overestimated as described above, a significant error in the nitrogen flux from cesspools has been introduced into the modeling analysis.

An additional error could be introduced into the model if the nitrogen concentration of the cesspool effluent is overestimated. DOH chose to use a value of 87 mg/l for the concentration of nitrogen in cesspool effluent, citing data from the Water Environment Research Foundation (WERF) representing the nitrogen content in septic system influent. There are a number of alternative estimates which might have been used, any of which would have resulted in significantly lower modeled nitrogen impacts to groundwater. For example, the report *Onsite Wastewater Treatment Survey and Assessment* (2008; UH Water Resources Research Center and Engineering Solutions, Inc.) estimates 15 to 90 mg/l of nitrogen in cesspool effluent (which suggests an average value of 52 mg/l might be appropriate), and also cites 14 to 40 mg/l nitrogen as typical of raw domestic wastewater. The EPA source¹⁰ upon which the model relied for the effluent rate (70 gpd per person and 1.5 persons per bedroom) provides a value of 26 to 75 mg/l in typical residential wastewater, but also gives a mean value of 11.2 grams of nitrogen per person per day in residential wastewater (less than half of the value estimated by the model).¹¹ Based on available data for nitrogen content of cesspool effluent alone, the cesspool nitrogen flux could easily be as little as half the value that was input to the model.

No attenuation of nitrogen from cesspools in the environment is predicted by the model: In Section 3.2.3 of Appendix VI to the report, DOH states that, aside from nitrogen loss due to treatment in septic tanks and leach fields that is taken into account in the assigned loading rate, no other transformations of decay are assumed and nitrogen is otherwise treated as a conservative contaminant, meaning that it does not sorb to the aquifer matrix or decay to another species. DOH acknowledges that, since cesspools are the dominant OSDS, this assumption

¹⁰ *Onsite Wastewater Treatment Systems Manual* (2002; EPA)

¹¹ At 87 mg/l of nitrogen, 70 gallons (265 liters) per day per person equates to 23 grams of nitrogen per person per day.

could lead to an overestimation of the groundwater nitrogen content. Elsewhere (Section 4.3.1 of the report), DOH states that there is likely incidental treatment of the discharged wastewater within a cesspool. This statement is supported by the work of Field, et al. which found that total nitrogen decreased rapidly with distance from the sidewalls of a seepage pit *as well as with depth below the seepage pit*, a finding that is particularly relevant in light of the significant depths to groundwater in the Upcountry Maui area.¹²

As acknowledge in the report, any reduction in effluent nitrogen levels in the soil between the bottom of a cesspool and groundwater is not accounted for in the model and has the potential to introduce error in the modeled groundwater impacts.

Other sources of error may impact the validity of the modeling results: In a previous report prepared for DOH that modeled impacts of OSDS on Maui and assessed associated risks, several possible sources of modeling error were identified with regard to the number and location of OSDS, and their discharge rates and chemistry.¹³ According to that report, “This list of potential errors is substantial, and thus the data provided by this study needs to be viewed as a *qualitative* assessment of where negative impacts from OSDS are most likely to occur and what ROCs are most likely to be negatively impacted” (emphasis added). Since the number and location of OSDS, as well as their discharge rates and chemistry, were developed from similar sources for the modeling analysis contained in the subject report, it is logical to conclude that there are similar possible sources of error which may warrant also viewing these modeling results as *qualitative* rather than in the *quantitative* manner they are presented.

In light of the factors described above, it appears that a re-evaluation of the modeling analysis and reconsideration of the resulting conclusions may be warranted.

The roadway reconnaissance of potential sources of nitrate contamination appears be inadequate for the purposes of the study.

In Section 2.2.1 of the report, DOH indicates that it conducted a “roadway survey” of potential sources of nitrate contamination. The potentially contaminating activities (PCAs) identified included former sugarcane and pineapple fields, other agriculture, golf course, recycled water use, and animal feedlots suspected to be in the investigation area. According to DOH, the identified PCAs “were visited to the extent practical to evaluate the degree to which they may be contributing to nitrate in the groundwater” and “no livestock concentrations great enough to pose

¹² See *Comparative Treatment Effectiveness of Conventional Trench and Seepage Pit Systems* (2007; Field, Farrell-Poe, and Walworth). This report was cited in the report *Human Health and Environmental Risk Ranking of On-Site Sewage Disposal Systems for the Hawaiian Islands of Kauai, Molokai, Maui, and Hawaii* (2014; Whittier and El-Kadi) prepared for the Department of Health in support of the statement that “Soil is not only the designed method of treatment for effluent Class I OSDS, but it also mitigates the impact from all OSDS to varying degrees”. Since cesspools and seepage pits are essentially identical, the decreasing contaminant concentration with increasing soil depth observed by Field, approaching background levels within 18 meters, would likely occur in a cesspool as well.

¹³ See Section 3.2.7, *Human Health and Environmental Risk Ranking of On-Site Sewage Disposal Systems for the Hawaiian Islands of Kauai, Molokai, Maui, and Hawaii* (2014; Whittier and El-Kadi).

a groundwater contamination risk were observed”.¹⁴ This roadway survey approach appears to have resulted in potentially significant sources of groundwater nitrate being overlooked.

Particularly noteworthy are the facultative ponds associated with the wastewater treatment facility serving the Haliimaile community, which are located less than 1,500 feet from the Baldwin Ranch Estates well site where nitrate levels as high as 8.7 mg/l were measured. This system serves a community of approximately 950 residents and concentrates all of the wastewater from these residents into a set of (reportedly) unlined ponds from which an estimated 50,000 to 100,000 gallons per day of effluent is discharged, evaporated, and/or leached into the ground. Like the cesspools in the surrounding communities, this system was approved to operate by DOH, and there are no obvious indications that it is not being operated properly. While there are no direct indications that this wastewater system is significantly impacting the BRE well, it seems at least as likely to be a PCA for this well as would any nearby cesspools.¹⁵ Yet because this PCA was not even identified as such, its impacts to groundwater nitrate levels (if any) are being attributed to OSDS.

Additional PCAs which were overlooked during the roadway survey have the potential to impact other wells, including the Omaopio-Esty well, but were not identified in the report or accounted for in the modeling analysis. Again, like the nearby cesspools these PCAs may be properly sited, maintained, and operated in accordance with applicable requirements while still potentially contributing to nitrate levels in nearby wells.

While DOH has done a thorough job of identifying the locations of OSDS in the Upcountry Maui area, the identification of other PCAs appears to have been more perfunctory. As a result of some PCAs being overlooked, their contributions to nitrogen levels in groundwater may be improperly attributed to cesspools, resulting in an overestimation of cesspool impacts and ultimately leading to these cesspools being targeted for corrective action to the exclusion of other contributors. A more thorough assessment of PCAs is strongly recommended. This could include, for example, a review of Google Earth maps for obvious PCAs (an approach that should prove far superior to roadway surveys), discussions with UH-CTAHR staff or persons similarly familiar with local livestock and other agricultural operations, review of approved wastewater systems (other than OSDS) in the study area, and similar measures.

Conclusions that can be drawn from the isotopic composition analysis and the PPCP analysis appear to be limited.

The report describes the use of isotopic composition of nitrate as a source tracker for nitrate in groundwater. It has been suggested that the isotopic analysis strongly implicates human and/or animal wastewater as the primary source of elevated nitrate levels in Upcountry Maui wells. In reality, this conclusion is strongly supported for only one well – the Pukalani Golf Course well, for which the isotopic analysis result “falls exclusively in the livestock/wastewater range and outside of the soil nitrate range”. This is not surprising in the least because the well is located at

¹⁴ Unsurprising, given the report’s singular and unwarranted focus upon Haleakala Ranch, which is exclusively a pasture-fed operation with no feedlots.

¹⁵ It is unclear why this PCA was neither identified in the report or nor addressed in the modeling analysis, since it is an approved wastewater system and would likely have been identified as a potential source of contamination during the review process for the BRE well under HAR Section 11-20-29.

the bottom of the Pukalani Golf Course, which is irrigated with recycled water.¹⁶ Despite this, the report appears to attribute the nitrate levels in this well primarily to OSDS rather than to the use of reclaimed water (see Table 3-7).

According to the report, the Omaopio-Esty well results also strongly imply that livestock/wastewater are the dominant source of nitrate even though the results fall on the “heavy end of the soil nitrate border”. As noted previously, this does not necessarily implicate only OSDS because there may be other PCAs in the area of this well which were not identified during the study.

For the remainder of the wells, the results of the isotopic analysis are consistent with soil and fertilizer nitrogen and in fact are much closer to the end-member for Maui groundwater not impacted by OSDS leachate than to the end-member for wastewater. It would therefore appear that the most that could be said with respect to these wells is that OSDS leachate could be one contributor to groundwater nitrate levels but that the isotopic analysis does not suggest that it is the primary contributor. This is reflected in Table 3-7 of the report presenting current nitrate concentrations and an evaluation of the nitrate source.

The report also describes the use of analyses for pharmaceuticals and personal care products (PPCPs) as a source tracker for leachate in groundwater. The presence of PPCPs, which are commonly found in domestic wastewater, can be used to demonstrate that domestic wastewater is impacting groundwater. Of course, this demonstration can be confounded by the fact that some chemicals found in PPCPs (notably antibiotics) are also used by livestock operations.

In the study, analyses for PPCPs were conducted on samples from the Pukalani Golf Course well and the Omaopio-Esty well, and certain PPCPs were detected in each. According to the report, the detections of certain chemicals in the two wells “can’t be exclusively linked to OSDS”, but the detection of Acesulfame-K, a non-calorie sugar substitute, “does provide a much stronger link between the groundwater sampled from these two wells to OSDS”. This statement is actually incorrect for two reasons. First, the detection of any PPCPs in the Pukalani Golf Course well is at least as likely (if not more so) to have resulted from the application of reclaimed water to the golf course as from any nearby OSDS. Secondly, Acesulfame-K **was not detected** in the Omaopio-Esty wells, so no link to OSDS can be posited based on this chemical.¹⁷ Thus, the results of the PPCP analyses conducted to date do not provide any reliable basis for conclusions regarding the impacts of OSDS on either of these wells.

The limitations of the analyses for PPCPs and isotopic composition of nitrate conducted to date should be highlighted in future presentations regarding the study, as the presentation conducted in Kula in February seemed to convey that fertilizers were not a primary source of groundwater nitrate and there was clear evidence of OSDS impacts based on these analyses. This is not the

¹⁶ Importantly, until about 2010 the golf course was irrigated with R-2 water, which received less treatment and contained higher contaminant levels than the current R-1 water. Although modeling inputs for the golf course’s use of reclaimed water are based on R-1 water, existing nitrate levels in the well may correlate to past use of R-2 water (since nitrate levels have not change much between 2010 and 2017).

¹⁷ See Table 3-5 of the report, and note that all detections of PPCPs in the Omaopio-Esty well can be attributed to sources other than OSDS.

case, and for most wells the report itself is at least somewhat clear on this in Table 3-7 (I would argue that the statement that OSDS leachate is a significant fraction of the nitrate in the Omaopio-Esty well has not been established).

The report provides a misleading picture of public water systems affected by nitrate contamination in Upcountry Maui.

Table 4-1 of the report purports to provide a summary of the Public Water Systems affected by nitrate contamination. The table is misleading and should be revised.

First, the table indicates that the total population served by Upcountry Maui PWSs is 30,088 persons. This is incorrect because the table only shows the Maui Department of Water Supply (DWS) Makawao system and various private wells (some of which have not yet been approved for public water system use). The total population served by Upcountry Maui Public Water Systems is actually greater than indicated, because all residents of Kula (approximately 6,500 persons) are served by the Upper Kula and Lower Kula Water Systems. Both of these systems are exclusively surface water systems. It is important to make this correction in order to accurately reflect the percentage of the Upcountry population that is served by private wells impacted by nitrates.

The table correctly lists four wells which provide water to the Makawao Water System to augment the approximately 80 percent of water system needs provided by surface water. What is not noted is that the Hamakuapoko wells are not normally used to supply this system, and in fact are not even listed on the system's annual Water Quality Report. Conversely, the Pookela well, which has very low levels of nitrate, is part of the Makawao system. Thus, all of the wells which currently supply water to the Makawao system have very levels of nitrate below the 3.0 mg/l level deemed suggestive of contamination (the highest being 1.9 mg/l in the Haiku well).¹⁸

All of the foregoing means that none of the water supplied to Upcountry Maui residents through the DWS is "affected by nitrate contamination". Only a small fraction (less than one percent) of the Upcountry Maui community (currently less than 200 customers) is served drinking water supplied by private wells, some of which are impacted by nitrates. This will be an important factor to keep in mind when considering appropriate corrective actions, if any, that should be implemented to limit the nitrate concentration in Upcountry Maui wells.

Solutions to this matter will be complex, not simple, and decision-making must be well-informed.

A clear takeaway from the subject report is that the issue of nitrates in Upcountry Maui is a complex one and therefore will not be simple to address. While there appear to be a number of factors contributing to higher than desirable nitrate levels in Upcountry groundwater, the evidence suggests that these factors may vary considerably depending upon the location of the well. In the event that corrective actions are eventually necessary to limit or reduce groundwater nitrate levels, it is likely that differing sets of actions - potentially including upgrades to cesspools - may be appropriate depending upon the location of the well and relative contributions

¹⁸ In the Makawao System, well water is not served directly to customers but is blended with surface water, reducing nitrate levels to negligible amounts.

of nearby PCAs. Equally possible is that there will be some areas where no actions at all are necessary because no significant impacts to groundwater are indicated.

Rather than suggesting the expedited closure of all Upcountry cesspools as the solution to a perceived contamination problem that is not yet fully understood, it is my hope that DOH and other stakeholders can work together to gain a better understanding of the issues and then tailor a solution that will be effective, affordable, and most of all, fair to all involved.

Thank you for considering my comments on this important issue.

Sean M. O'Keefe
Kula, Maui, Hawaii