CARON BALKANY, ESQUIRE, PO Box 420859, Summerland Key, Florida 33042 U.S.A. 305-849-1073

July 23, 2025

David Burke, Acting Superintendent, Florida Keys National Marine Sanctuary, David.Burke@noaa.gov

Wade Lehman, Environmental Protection Agency, Chair, Florida Keys National Marine Sanctuary Steering Committee, Lehmann.Wade@epa.gov

David Whiting, Florida Department of Environmental Protection, Co-Chair, Florida Keys National Marine Sanctuary Steering Committee, David.D.Whiting@dep.state.fl.us

Sirena Davila, District Director, Southeast District, Florida Department of Environmental Protection, Sirena.Davila@FloridaDEP.gov

M'Liss Bordelon, Environmental Administrator, Florida Department of Environmental Protection, Whitney.Bordelon@FloridaDEP.gov

Norva Blandin, Program Administrator, Permitting and Waste Cleanup, Florida Department of Environmental Protection, Norva.Blandin@Florida DEP.gov

Re: Sewage effluent upwellings in the Florida Keys National Marine Sanctuary halo zone waters off Stock Island, and protected manatees drinking from them

Greetings,

Undersigned counsel represents Friends of the Lower Keys, (FOLKs), an all-volunteer Keys-wide environmental advocacy group concerned about water quality degradation from shallow sewage wells.

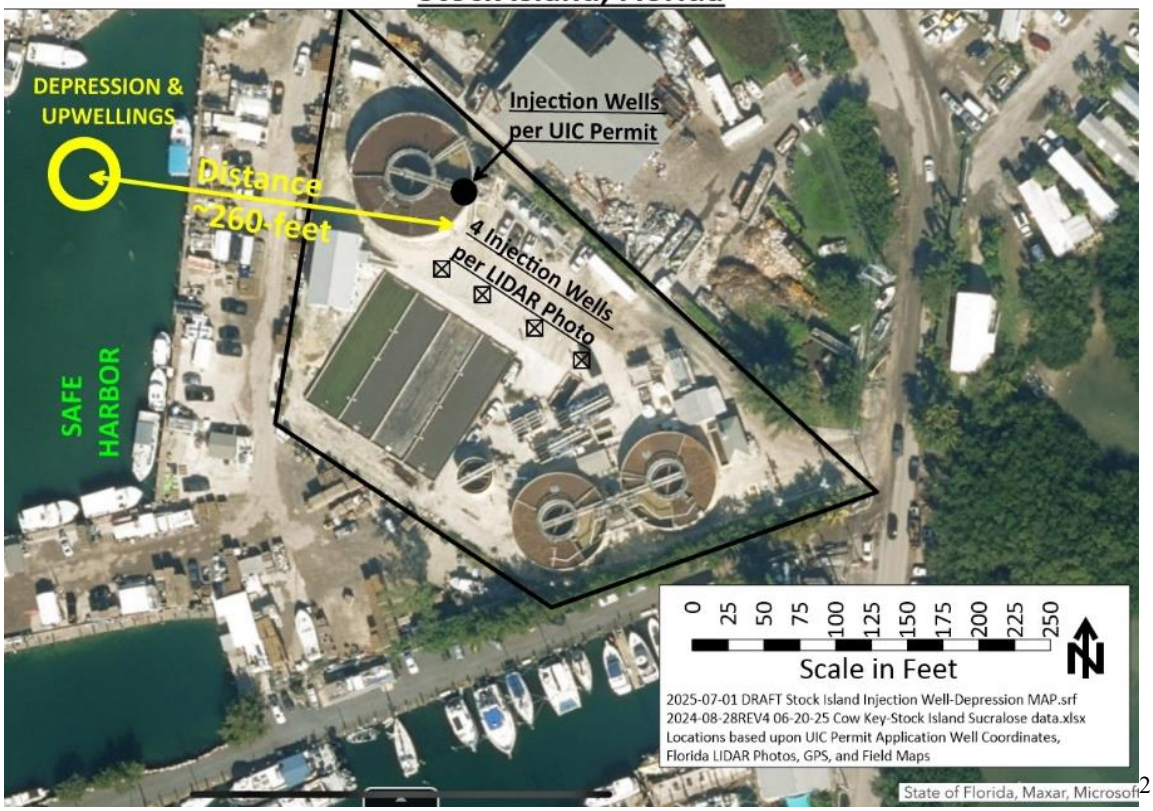
I'm writing to send you evidence of what appears to be upwellings from shallow sewage wells to the Florida Keys National Marine Sanctuary (Sanctuary) halo zone waters of Safe Harbor, Stock Island near the KW Resort Utilities Corp wastewater treatment plant and wells (KWRU). Our purpose in providing this evidence is to hopefully avoid litigation and its associated delays and expenses. FOLKs' litigation against Monroe County's Cudjoe Regional WWTP was successful in convincing the County to

convert to deep well disposal. FOLKs' litigation requiring a deep well for the City of Marathon's sewage was also successful but very expensive for the Marathon. We're trying to avoid litigation expense for Stock Island.

FOLKs and Dr. Matthew Finn, marine biologist, ecologist, underwater videographer,[1] located about 5 upwellings in a depression approximately 50 feet from the shore of Stock Island in Safe Harbor and about 300 feet from the four KWRU shallow sewage wells. Stock Island is an island immediately east of the City of Key West.

FIGURE 1[2]

KWRU Injection Wells, Depression and Upwellings Locations
Stock Island, Florida


[2]

[1] **Exhibit A**: *Sampling and Field Observation Summary*, Matthew Finn, Ph.D., July, 2025.

[2] All Figures by Donald Maynard, FL. P.G., retired P.E. and well driller, with decades of experience evaluating the movement, fate and transport of fluids in soils, rock and surface water. July 2025. Maynard also helped DeMaria, Finn, and Terrence Justice install an underwater on-line video camera loaned rom Fathom Ocean.

The below link[3] shows a small piece of paper Dr. Finn released above an upwelling, using SCUBA and extra sanitary protection, to show the upwelling flow --300 feet from KWRU four shallow sewage wells --rising towards the top of the surface water in the Sanctuary.

Video: Piece of paper rising in seabed upwelling

Dr. Finn also saw manatees drinking from the sewage effluent upwellings. "One almost knocked me over" heading to drink at an upwelling, he said. The two links below show legally protected manatees drinking the sewage effluent from an upwelling.[4]

Video: Manatees drinking seabed upwelling (time-lapse)

Video: Single Manatee drinking seabed upwelling

Dr. Finn visually observed the haloclines [5]and felt temperature differences between the upwelling flows and the nearby waters. Also, the upwelling flows were significantly less saline by an average 4 parts per thousand, indicating a groundwater source**.** See videos in links below.

Video: Halocline

Video: Halocline

Dr. Finn took upwelling water samples which were analyzed for sucralose, the wastewater indicator, at Florida International University's EARL laboratory.[6] **An order-of-magnitude higher concentration of sucralose is measured in FOLKs' upwelling water samples, when compared with samples collected near the top of the surface water above the upwellings**.

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[3] **(**Recommended to use the highest resolution on your computer. All blue fonts are hyperlinks to exhibits and videos.)

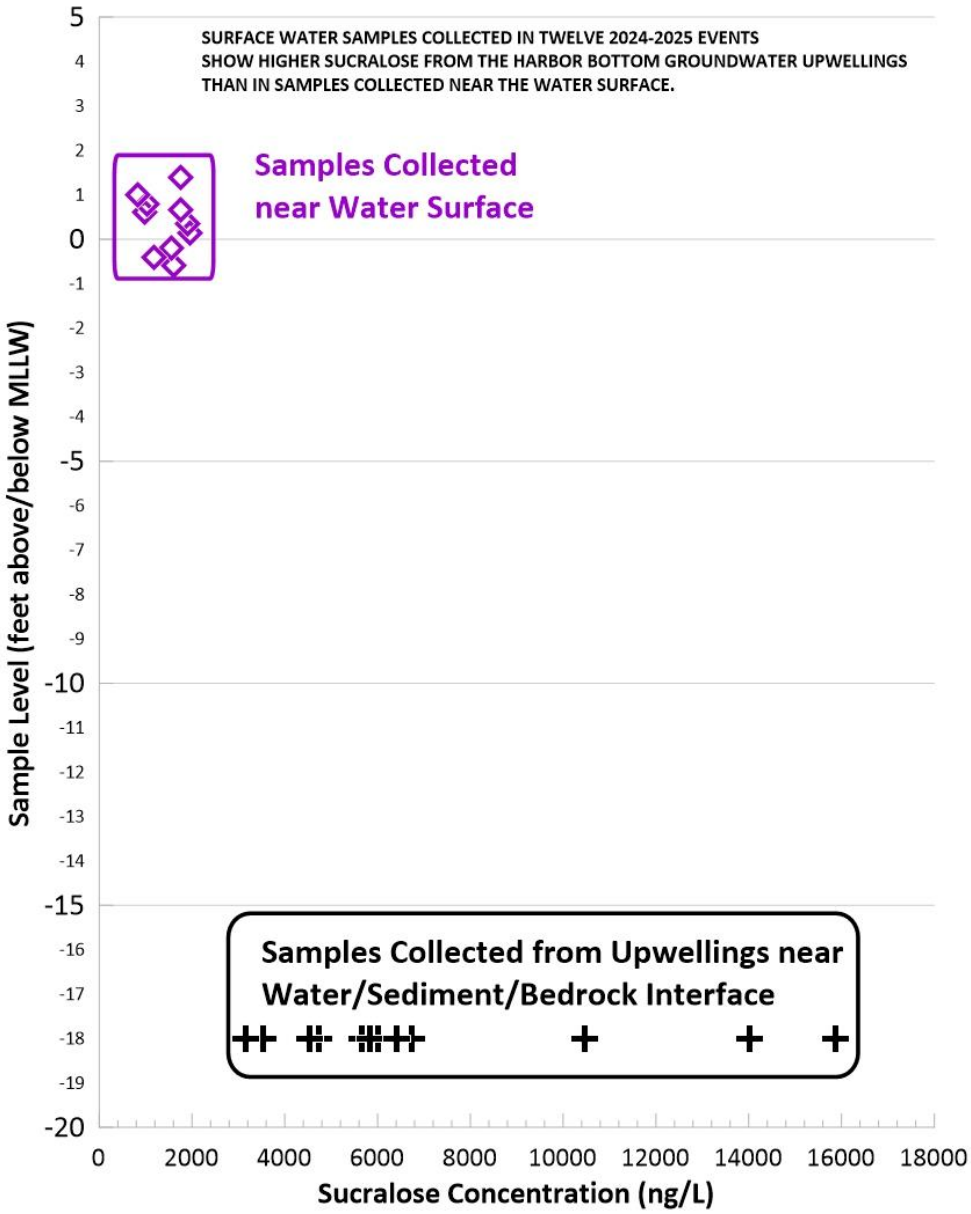
[4] Because manatees need fresh or less saline water to drink, the FOLKs videos are signs of a seabed upwelling of less saline groundwater to surface waters.

[5] "HALOCLINE is a usually vertical gradient in salinity (as of the ocean)." www.merriam-webster.com

[6] **Exhibit B**: laboratory analyses and chain of custody documents from Florida International University EARL laboratory for the upwellings and top of surface water.

FIGURE 2

Safe Harbor Depression Surface Water Depth Vs Sucralose Concentration



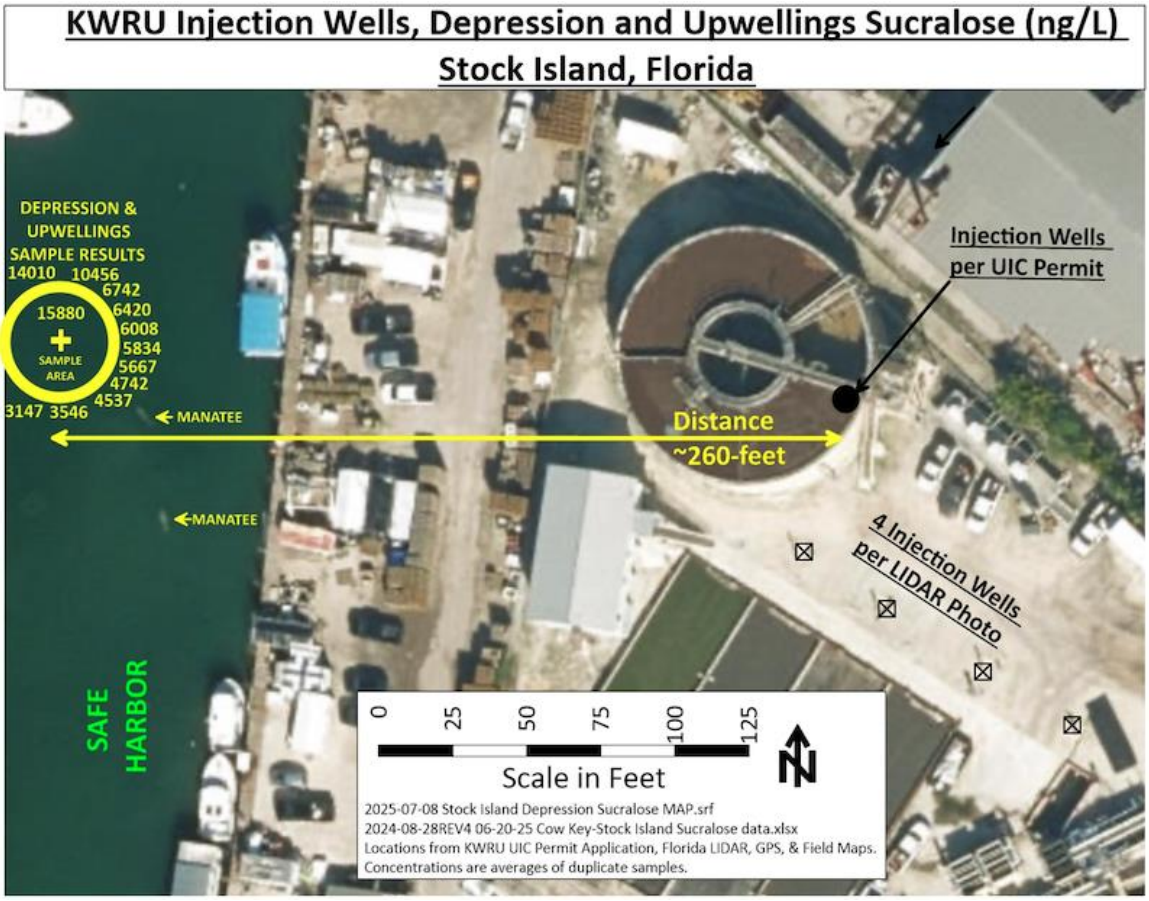
2025-07-07 2024-2025 Sample Depth VS Sucralose.gpj 2024-08-28REV4 06-20-25 Cow Key-Stock Island Sucralose data.xls
Surface Sample MLLW Depths from NOAA Cow Key Channel Station 8724527. Harbor Bottom Depth Estimated from Observation.
Upwelling concentrations are averages when dupicate samples were collected.

The analyses show sucralose at concentrations which indicate the presence of human sewage effluent from the upwellings discharging to the halo zone surface waters of the Sanctuary.

"*Below 57 ng/L is background; between 57 and 158 ng/L is human influenced; above 158 ng/L is human impacted.*" [7]

"Sucralose concentration levels from sea bottom upwelling samples ranged up to 15,880 nanograms per liter (ng/L), compared with concentrations less than 1,910 ng/L at the top of the surface water over the upwellings. On all sampling dates, the upwelling samples contained more sucralose than the top of the water surface samples. **The difference in concentration ranges between the two sample sets supports the conclusion that the source of the sucralose is the buoyant sewage effluent from the upwellings**. **The concentrations in both sets of samples indicate human impact on the Sanctuary waters**."[8]

FIGURE 3



[7] Henry O. Briceño, Research Professor, Florida International University, Institute of Environment, Southeast Environmental Research Center; Water Quality Coordinator, UNESCO Chair on Sustainable Water Security

[8] Donald Maynard, Fl. P.G., to FOLKS, July 2025.

"Sucralose, the artificial sweetener, is a well-accepted scientific indicator of 'human impact' from the sewage effluent. Sucralose is excreted mostly unchanged from the human body, flows down the drain, and is discharged into the environment through wastewater treatment plants. Due to its ubiquitous occurrence and persistence, sucralose is used as a tracer of wastewater contamination in groundwater, landfill leachate, and drinking water. Sucralose has been reported in municipal wastewater treatment effluent at 29,600 ng/L, nearly the same concentration as the municipal wastewater influent. Less than 2% removal of sucralose by the wastewater treatment was reported by Subedi and Kannan in their 2014 studies.[9] Sucralose is not removed by advanced wastewater treatment, and only minimally breaks down in the environment. Therefore, sucralose is a prime conservative tracer of wastewater effluent. The rock formations under KWRU are porous and have tunnels and caverns similar to those at Marathon which also leaked sewage effluent to the Sanctuary's halo zone surface waters."[10]

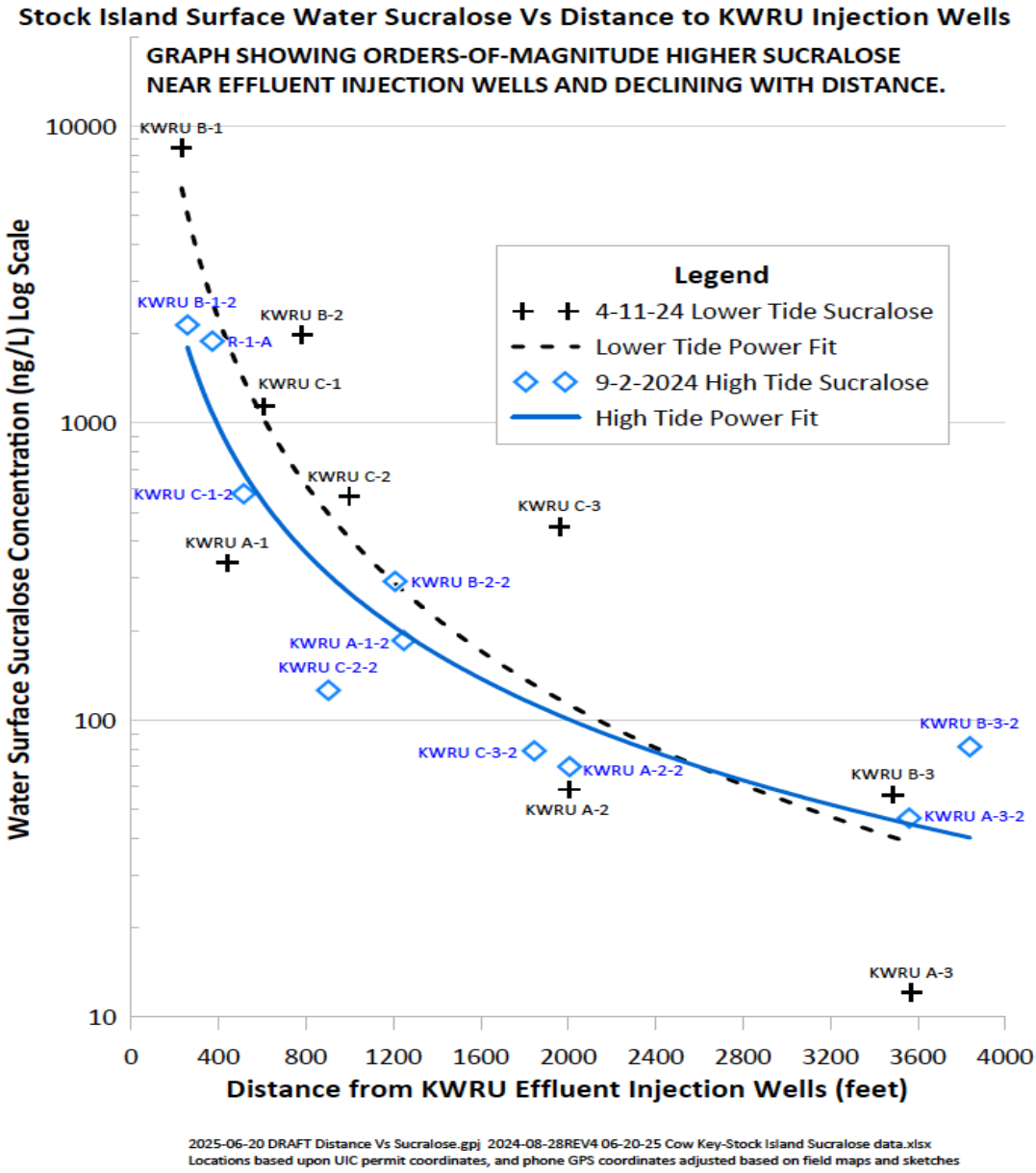
Don DeMaria from FOLKs took water samples for sucralose analyses from a shallow draft boat elsewhere in and around Safe Harbor at the top of the surface water. **FIGURE 4 shows the top of the surface water sucralose concentrations are above 1,000 ng/L near the KWRU effluent injection wells and decline in a decreasing gradient with distance to less than 100 ng/L in open water.**

The sucralose analyses and chains of custody from the EARL laboratory for these surface water gradients are in **Exhibit C.**

[9] Subedi, B. and Kannan, K. *Fate of Artificial Sweeteners in Wastewater Treatment Plants in New York State, USA. In Environmental Science and Technology No. 48. 2014, December 2*.

[10] *Id*, Maynard

FIGURE 4



The City of Marathon is approximately 50 miles east, up the Keys, from Stock Island. EPA-funded and Sanctuary-supported studies by Pennsylvania State University (PSU) at the City of Marathon's Area 3 sewage effluent shallow disposal wells demonstrated "**buoyancy of the sewage effluent and its rapid migration to surface waters,**" as well as the impact from the effluent related contaminants on those Sanctuary waters:

> **"The density contrast between the wastewater effluent and saline groundwater caused the effluent plume to buoy to the shallow subsurface near the injection well**. Soluble reactive phosphorus (SRP) and sucralose were both detected in nearshore waters, **indicating incomplete removal of contaminants**." (emphasis supplied**)**
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> ****
>
> **"The use of shallow injection as a disposal mechanism for treated wastewater should be re-evaluated at facilities with discharge capacities of this magnitude."** (emphasis supplied).[11]

Florida Statute 403.086 (11)(h) provides: "If it is demonstrated that a discharge, ***even if the discharge is otherwise in compliance with this subsection***, will cause or contribute to a violation of state water quality standards, the department shall:

1. Require more stringent effluent limitations;
2. Order the point or method of discharge changed;
3. Limit the duration or volume of the discharge; or
4. **Prohibit the discharge**." (emphasis supplied)

The Statement of Basis for the current KWRU operating permit relies on modeling predictions which have since been disproven by site-specific evidence. The current permit for KWRU's four shallow wells uses modeling predictions, not site-specific evidence, as a basis for the permit: "The permittee's geologist, Michael Alfieri, P.G., determined the effluent travels through the ground at least one mile before meeting navigable waters."[12] FOLKs upwelling videos prove that sewage effluent reaches surface waters within 300 feet of KW Resort Utilities' shallow wells. Mr. Alfieri used the same type of model, and predicted a similar distance, for the Marathon Area 3 sewage plant, which was proven wrong by the PSU study.

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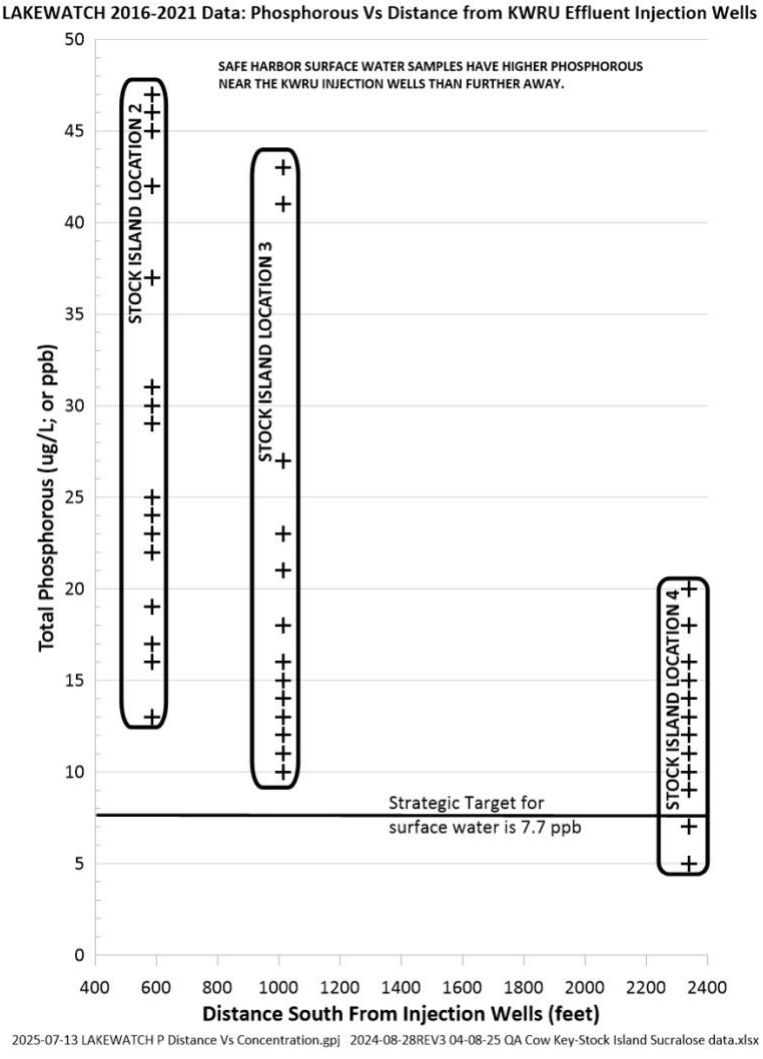
[11] Kump and Ingalls*, Quantifying the impact of shallow wastewater injection on groundwater nutrient fluxes to surface waters in the Florida Keys National Marine Sanctuary, November 2023 project update; Myers and Martin, "Impact of shallow wastewater injection on the Florida Keys National Marine Sanctuary" Semi-Annual Progress Report, EPA Grant Number 02D02621*
October 2021

[12] *Statement of Basis*, Permit Number FLA014951-018, KW Resort Utility, 4-1-2022

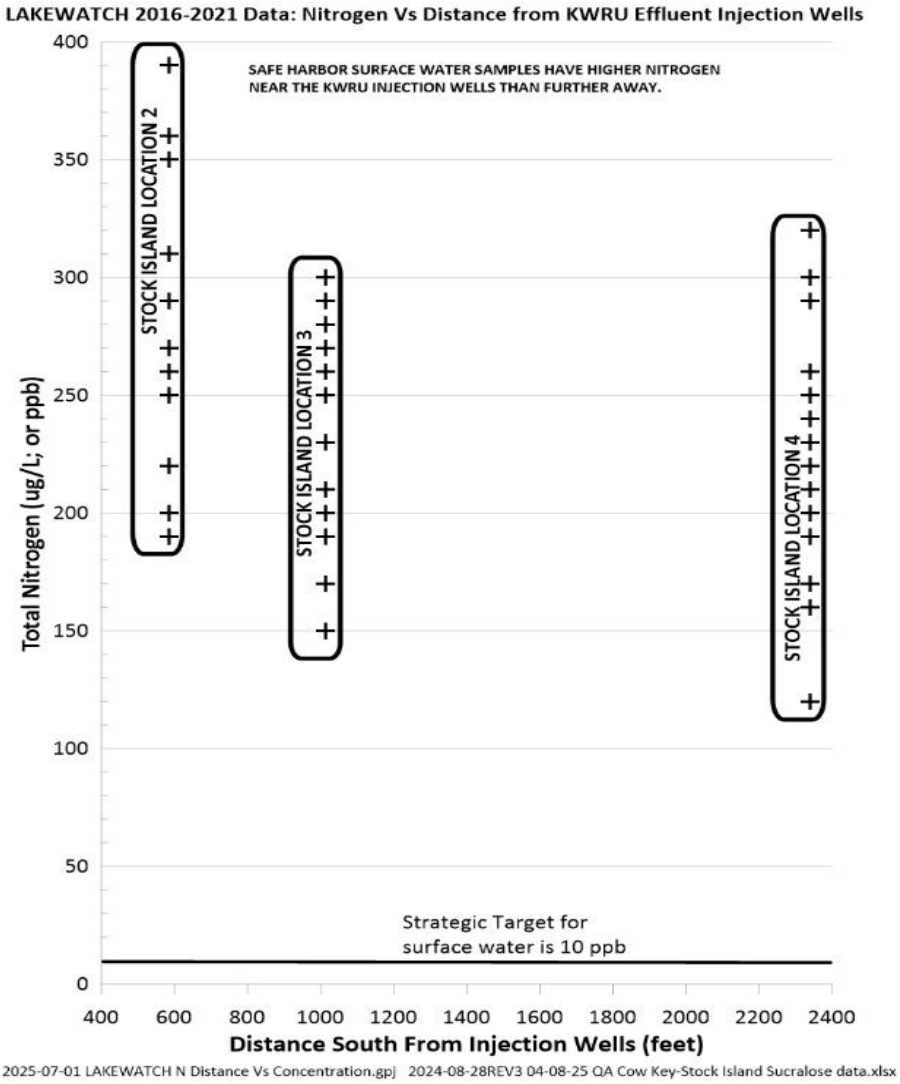
This modeling prediction for KWRU is also contradicted by the Stock Island Safe Harbor site-specific evidence provided by FOLKS and by LAKEWATCH.[13] The site-specific data include the visible upwellings from the seabed 300 feet from the wells, higher sucralose concentrations near the KWRU injection wells, and the higher nutrient levels near the KWRU injection wells. The upwellings, located about 50 feet from shore, also have lower salinity, indicating a groundwater source. Additionally, as shown in the graphs below, surface water samples collected over a period of years have higher nutrient (Nitrogen and Phosphorous) concentrations within 600 feet of the KWRU injection wells, when compared with samples collected further away.

FIGURE 5



[13] LAKEWATCH, *Report for Stock Island -1, -2, -3, -4; in Monroe County, Estuary and Estuary Segment: Using Data Downloaded 12/9/2022. https://drive.google.com/drive/folders/1LEWAcdV-gWJ6Wmemx06mBxCTytbwC7zp*

FIGURE 6



There are many examples of the adverse effects on animals and plants from chemicals found in sewage (including nutrients, pharmaceuticals, PFAS (forever chemicals), personal care products, pesticides, herbicides, and others). The adverse effects of various of these chemicals include: reduced reproductive success; delayed or incomplete development of sexual organs; growths or tumors; immune system dysfunction; and behavioral changes that reduce an individual's success in avoiding predators and therefore cause increased mortality.[14]

[14] See*, Office of Marine Sanctuaries, National Oceanic and Atmospheric Administration, Draft Environmental Impact Statement for Florida Keys National Marine Sanctuary: A Restoration Blueprint 211 (2019),* hereinafter "DEIS."

At present there are 23 threatened or endangered marine species that exist in the Sanctuary, which completely surrounds Stock Island.[15] The National Marine Fisheries Service – a unit of the National Oceanic and Atmospheric Administration – has designated critical habitat within the Sanctuary for 12 species, including loggerhead turtles, smalltooth sawfish, elkhorn coral, staghorn coral, and piping plover.

Another unit of NOAA, the Office of National Marine Sanctuaries, oversees the Sanctuary, and has been developing a "Restoration Blueprint" for the Sanctuary. The Sanctuary contains nationally significant marine habitats including seagrass beds, coral reef colonies, and mangrove-fringed islands. The Sanctuary is home to thousands of marine species, including dozens of threatened and endangered species of animals and plants.[16]

Coral reefs, seagrass beds, and hardbottom habitats in the Keys are all critical types of habitat. There are seven coral species within the Florida Keys that are listed as threatened under the Endangered Species Act, including elkhorn, staghorn, and star corals – all of which are found in the waters near KWRU. Water low in nutrients such as nitrogen and phosphorus is an important factor in the survival of a coral reef community. Coral reefs in the Florida Keys are also an important feeding area for visiting predators.[17]

The seagrass beds of the Florida Keys are home to many threatened marine invertebrates.[18] Further, many seabird species are dependent on Florida Keys seagrass communities for their diet, including great white heron; reddish egret; tricolored heron; white pelicans and others. "Federally listed animal species that depend upon seagrass habitat in South Florida include: American crocodile (Crocodylus acutus), green sea turtle (Chelonia mydas), loggerhead sea turtle

[15] *Id,* DEIS
[16] *Id,* DEIS
[17] Data available from NOAA Fisheries ESA Critical Habitat Mapper (https://www.fisheries.noaa.gov/resource/map/critical-habitat-maps-and-gis-data)
[18] *Id,* DEIS

(Eretmochelys imbricata), leatherback sea turtle (Dermochelys coriacea), Kemp's ridley sea turtle (Lepidochelys kempii), roseate tern (Sterna dougallii dougallii), wood stork (Mycteria americana), bald eagle (Haliaeetus leucocephalus), smalltooth sawfish (Pristis pectinata), West Indian manatee (Trichechus manatus), and others."[19]

As noted above, shallow sewage well effluent discharges contain significant quantities of nutrients – nitrogen and phosphorus. The waters around KWRU are impaired by excess nutrients, exceed the water quality Strategic Targets set by the EPA for the Sanctuary, and have higher concentrations compared to many other areas of the Florida Keys.[20] These nutrient loadings are harming endangered animals found near KWRU and the habitats they rely on: coral reefs, seagrass beds, and hard bottom habitats.[21]

Water quality degradation, particularly an excess of nutrients, is an important cause of declines in the abundance, distribution, and species composition of coral reefs and seagrass beds in the Florida Keys. As the National Oceanic and Atmospheric Administration notes in the Restoration Blueprint for the Florida Keys National Marine Sanctuary: "Ensuring good water quality in the sanctuary is essential to maintaining the richness and diversity of its varied environments. Coral reefs depend on clear, clean, low-nutrient waters to thrive. Seagrass meadows also need a relatively low-nutrient environment and clear water. An excess of nutrients is also harmful to coral reefs near KWRU. Nutrient-fed algal blooms are a key stressor associated with reduced coral cover in the Florida Keys: waste nutrients promote algal blooms that shade photosynthesizing corals and lower oxygen levels.[22]

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[19] *Id,* DEIS

[20] *Division of Environmental Assessment and Restoration Water Quality Evaluation and TMDL Program Florida Department of Environmental Protection with participation from the Florida Keys Stakeholders December 2022,* p. 23

[21] *Id*, DEIS

[22] *Id,* Finn

Nutrient loading in Florida waters (and other waters) is generally strongly correlated with seagrass die-offs – nutrient enrichment leads to phytoplankton growth in the water, which reduces light availability to seagrasses. It also encourages excessive periphyton growth on the seagrasses themselves that further reduces light to the seagrasses. For the same reasons, high nutrient levels kill corals and harm coral reefs – light reaching the seabed is important for both coral reef and seagrass habitats.[23]

Other constituents of sewage effluent discharges harm important habitats. In addition to causing nutrient enrichment of surrounding waters, sewage pollution also harms listed species and the habitats they rely on in other ways. Sewage pollution contains a wide variety of other pollutants besides nutrients that can harm listed species and their habitats. Laboratory analyses by third party laboratories Pace and SGS Analytics show the contaminants in partially treated sewage effluent from Marathon's Area 3 shallow wells immediately before discharge include illegal opiates; blood pressure medicine, pain relievers, diabetes medicine, hormones, and other pharmaceuticals; heavy metals; and PFAS. **Exhibit D**. There is no scientific basis upon which to conclude that sewage effluent from Stock Island would be much different. Many of these sewage contaminants have been shown to be harmful to marine animals and their habitat.

According to the EPA, PFAS "break down very slowly and can build up in people, animals, and the environment over time." PFAS are present in many products including food, food packaging, household products, and personal care products, such as some shampoos and cosmetics.

The accumulation of PFAS in the marine environment is leading to the accumulation of high concentrations of these same substances in the tissue of fish that people eat, and in a number of threatened and endangered species including manatees, turtles, alligators, seabirds, dolphins, and

[23] *Id*, DEIS

whales.[24] PFAS pose known health risks to people exposed to them above threshold concentrations.

Given this mix of pollutants, it is unsurprising that research conducted in Florida has found that exposure to sewage pollution is associated with increased stress in corals, fish, and reptiles, including in some listed species found near KWRU. This increase in stress leads to immune suppression and a general decrease in health – affected animals are more prone to disease, injury and death. Similarly, the Sanctuary's Restoration Blueprint notes that toxins including herbicides and pesticides negatively affect water quality in the immediate waters around the Keys.[25]

A number of pesticides and herbicides (for example, DEET) are among the chemicals commonly found in sewage waste. Sewage discharges are understood in the scientific literature to pose a threat to corals because they convey pesticides, pharmaceuticals, and other harmful chemicals to reefs, which creates stress on individual corals and on the reef community. Sewage discharges can alter the microbiome of corals – the microbial community that lives in and on corals and which is vital to their health.

Research conducted in South Florida has also found that sewage effluent can have a direct effect on the microbiome of coral communities located several kilometers away. Even at such a distance, "microbial contaminants can and do reach the actual reef corals and may influence the community structure of reef microbiota (and thus presumably influence the health status and resiliency of reef ecosystems)."[26]

Further, a number of chemicals found in sewage are persistent and bio-accumulative, meaning that when they enter the marine environment,

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[24] *Id,* DEIS
[25] *Id,* DEIS, note 38, at 226.
[26] Christopher Staley, et al, *Differential Impacts of Land-Based Sources of Pollution on the Microbiota of Southeast Florida Coral Reefs (2017*), https://doi.org/10.1128/AEM.03378-16

they do not degrade. Instead, they enter the ecosystem, are consumed by all kinds of smaller forms of life and become concentrated in the tissues of fish and animals.

Additionally, many of the pharmaceuticals, personal care products, and other chemicals discussed above are also bio-accumulative and affect the behavior and physiology of animals at relatively low concentrations. This is particularly a concern with pharmaceuticals. Fish and other animals exposed to pharmaceuticals in ambient water or in the prey they eat have been found to accumulate these chemicals and to suffer adverse physical and behavioral effects.

CONCLUSION

FOLKs, on behalf of its more than a thousand members and supporters, respectfully urges that DEP, with Sanctuary support, take steps immediately to ensure that sewage effluent shallow well disposal/injection is discontinued on Stock Island. Arrangements can be made for sewage from Stock Island to be transported to the City of Key West's treatment plant and its deep wells, or another deep well system can be developed. [27]

Respectfully submitted,

Caron Balkany, Esquire
Counsel for FOLKs
FBN 236179
PO Box 420859
Summerland Key, Florida 33042
Fax 866-4056610
Phone 305-8491073

[27] Copies to additional recipients listed on the following page.

Additional recipients:

Edan Rotenberg, Esq., Super Law Group	edan@superlawgroup.com
Daniel Corbett, Esq., FDEP	Daniel.Corbett@FloridaDEP.gov
Barton Smith, Esq., Smith Hawks, PL	bart@smithhawks.com
Matt Willman, KW Utilities	utilities@cityofkeywest-fl.gov
Alison Higgins, KW Resiliency Manager	a.higgins@cityofkeyweet-fl.gov

Florida Keys National Marine Sanctuary Steering Committee

Wade Lehmann, EPA	lehmann.wade@epa.gov
Becky Allenbach, EPA	allenbach.becky@epa.gov
Katie Butler, EPA	butler.kathlene@epa.gov
Heather Stewart, FWS	heather.stewart@fws.gov
David Burke, NOAA	David.Burke@noaa.gov
Karen Bohnsack, NOAA	karen.bohnsack@noaa.gov
Tylan Dean, NPS	Tylan.Dean@nps.gov
Pedro Ramos, NPS	pedro.ramos@nps.gov
Mark Schafer, USACE	Mark.D.Shafer@usace.army.mil
Brandon Bowman, USACE	brandon.l.bowman@usace.army.mil
David Whiting, FDEP	david.d.whiting@dep.state.fl.us
Lawrence Glenn, FDEP	lawrence.glenn@floridadep.gov
Carla Fry, FDOH	Carla.Fry@flhealth.gov
Mark Roby, FDOH	Mark.Roby@flhealth.gov
Yazmin Valdez, Florida Commerce	Yazmin.Valdez@commerce.fl.gov
Gil McRae, FWC	gil.mcrae@myfwc.com
Tom Matthews, FWC	Thomas.Matthews@myfwc.com
Armando Vilaboy, SFWMD	avilaboy@sfwmd.gov
Julio Tejeda, SFWMD	jtejeda@sfwmd.gov
Emmy Koenig McDowell, FKAA	emcdowell@fkaa.com
David Hackworth, FKAA	dhackworth@fkaa.com
Andrea Leal, FKMCD	aleal@keysmosquito.org
Sue Heim, KLWTD	sue.heim@klwtd.com
George Garrett, Marathon	garrettg@ci.marathon.fl.us
Craig Cates, Monroe County	cates-craig@monroecounty-fl.gov
Lindsey Ballard, Monroe County	Ballard-Lindsey@monroecounty-fl.gov
Steve Friedman, Village of Islamorada	steve.friedman@islamorada.fl.us
Sandy Walters, Eco Legacy Solutions	sandy@ecolegacy.us
Shelly Krueger, Florida Sea Grant	krueger-shelly@monroecounty-fl.gov
Patience Cohn, Marine Industries Assoc.	Patience@MIASF.org

Marisa Carrozzo, SAC Representative	mcarrozzo@npca.org
Kelly Cox, SAC Representative	kelly.cox@audubon.org
Chris Bergh, TNC	cbergh@tnc.org

Florida Fish and Wildlife Conservation Commission

George Warthen, Chief Conservation Off.,	George.Warthen@MYFWC.com
Melissa Tucker, Habitat and Species Cons.	Melissa Tucker@ MYFWC.com
Thomas Reinert, Regional Head (South),	Thomas.Reinert@MYFWC.com
Mary Atkins, Legal	Mary.Atkins@MYFWC.com,