TAC Meeting – June 26, 2020

Attendees:

- Allison Higgins, City of Key West
- Andy Bruckner, FKNMS
- Ashley O'Neal, DEP
- Audrey Siu, Sandra Walters Consulting
- Chris Bergh, TNC
- Chris Kavanagh, NPS
- Cindy Fischler, DEP
- Daryll Joyner, DEP
- Dave Whiting, DEP
- Gary Hardie, DEP
- Gary Maier, DEP
- George Garrett, City of Marathon
- Greg Corning, Wood Consulting
- Gus Rios, DEP
- Henry Briceño, FIU
- Jennifer Carpenter, DEP
- Jerry Ault, UM
- Jim Fourqurean, FIU
- John Hunt, FWC
- Julie Espy, DEP
- Karen Bohnsack, FKNMS
- Lee Kump, Penn State University
- Mark Chiappone, Miami Dade College/USCG
- Michael Boehmler, Florida Keys Mosquito Control
- Michael Roberts, Monroe County
- Nancy Diersing, FKNMS
- Natalie Hardman, DEP
- Nia Wellendorf, DEP
- Nick Parr, DEP
- Rene Price, FIU
- Rob Ruzicka, FWC
- Sandy Walters, Sandra Walters Consulting
- Shelly Krueger, FL Sea Grant
- Steve Blackburn, EPA

Resources Suggested (Extracted from the Chat Box Log below)

- Jim Fourqurean: Map of substrate type around marathon: http://serc.fiu.edu/seagrass/NearshoreWeb/Marathon/masubtype.jpg
- Shelly Krueger: SCOTUS case of County of Maui vs Hawaii Wildlife Fund used tracers (fluorescein and sulpho-rhodamine B, along with piezometers). Could be useful to read the study:

https://archive.epa.gov/region9/water/archive/web/pdf/lahaina-gw-tracer-study-final-report-june-2013.pdf

- Henry Briceno: Work of USGS by folks like Gene Shinn and many others have documented the karstic nature of the ground geology that expedites flow of groundwater for hundreds of meters (specific citation not provided).
- Jim Fourqurean/Rene Price: Results of a geophysical survey completed of the freshwater lens on Big Pine Key; subsurface salinity maps created with resistivity mapping (PDF attached from Jim and available at https://link.springer.com/article/10.1007/s12237-019-00666-3):
    - Kiflai et al 2020, Estuaries and Coasts 43(5):1032-1044
- Jim Fourqurean: USACE Carrying Capacity Study—hydrodynamic modeling in nearshore areas (need to locate this reference)
- Lee Kump: Wastewater tool was developed in 2000 to predict where plumes may go. It may be worth updating the tool for new well locations and loadings. http://apps.cei.psu.edu/fldep/tool/
- Little Venice Study (http://ocean.floridamarine.org/FKNMS_WQPP/docs/special_projects/2011/Little_Venice_Final_Report_MST_Study_Gidley_052011.pdf)
- Lee Kump: Jeff Chanton conservative tracer study done at KML (Lee said he'd provide the study, but I think this is it): http://ocean.floridamarine.org/FKNMS_WQPP/docs/special_projects/2010/Fate_of_Wasterwater-borne_Nutrients_under_low_discharge_conditions_Chanton_052010.pdf.
- Lee Kump: (the pdf of this article was emailed to TAC and other participants on 6/19) The fate of wastewater-derived nitrate in the subsurface of the Florida Keys: Key Colony Beach, Florida. Erin M. Griggs, Lee R. Kump, J.K. Bohlke. Estuarine, Coastal and Shelf Science 58 (2003) 517–539. (This is a study using monitoring wells on Key Colony Beach to investigate the subsurface transport of wastewater-derived nutrients, funded by the EPA as part of the WQPP and supported by the USGS and DEP
- Florida Keys Reasonable Assurance Document (FKRAD): https://floridadep.gov/dear/alternative-restoration-plans/content/florida-keys-reasonable-assurance-plan

1. Karen reviewed the housekeeping for the meeting.
2. Nick reviewed the meeting goals, to provide technical feedback on a water quality project which could be brought to the Steering Committee for consideration.

3. Gus Rios reviewed the stakeholder concerns (below).

4. Karen stated that at a Nov 2019 Steering Committee meeting, a subgroup was directed to come up with priorities for the WQPP. That list is still draft, but evaluation of potential impacts of shallow injection wells is on the list.

5. Ashley presented draft monitoring plan, and discussion ensued.

Discussion Notes

Stakeholder Concerns

- Caron Balkany (CB), attorney representing concerned stakeholders, sent a letter on April 29, 2020 to the WQPP co-chairs. The letter provided info/data from a study done using SERC/FIU data collected between 2011-2017. The study referenced 6 sampling stations located in nearshore waters: 2 in Marathon, 2 in Islamorada, and 2 in Key West. According to the information included in the letter, some of the nearshore waters stations sampled were not in compliance with EPA strategic targets for FKNMS; data collected in the City of Marathon's nearshore-water stations indicated deteriorating conditions for dissolved inorganic nitrogen (DIN) and total phosphorus (TP) when compared to the data collected at the Islamorada/KW sites. The referenced data also suggested the Islamorada and KW sites had slightly better
- water quality. These areas use advanced wastewater treatment and deep injection wells (DIW) for effluent disposal. Marathon's wastewater facilities also have AWT but use shallow injection wells (SIW) for effluent disposal.
- The Florida Keys Wastewater Legislation (Section 403.086(10), Florida Statutes) requires Sewage treatment plants in Monroe County with design capacities exceeding 1 million gallons per day (gpd) to use a DIW for effluent disposal. Marathon wastewater treatment plants have capacities less than 1 million gpd and their permits allow the use of SIWs with a total depth of 90 feet (cased to 60 feet below surface). Previous studies have shown groundwater migration of effluent from septic tanks and SIWs into nearshore waters.
    - The previous studies showed there's groundwater migration, but the advanced wastewater treatment (AWT) systems were built after the groundwater studies were done in 90s and early 2000s. Since then, we've implemented AWT which reduces the effluent concentration of N and P and provides effluent disinfection. So, we need a properly designed study and monitoring program to determine if these AWT plants and their SIW's are causing water quality degradation in the adjacent surface waters.

Discussion on Ashley's Presentation of DEP's Proposed Plan of Study

- The proposed plan of study included surface water monitoring around Marathon for water quality parameters and Sucralose and pharmaceutical tracers, which are known sewage indicators, but did not include groundwater monitoring. After the presentation, a discussion ensued on the need to conduct groundwater monitoring to characterize the fate and pathway of the effluent in groundwater in order to locate the surface water sampling stations in areas where the effluent plume is more likely to be detected.
- (Re: Q1 posed in Ashley's presentation) - Jim Fourqurean: Assume thick layer is an aquaclude and keeps water from coming out, but we don't have good information. Unfortunately, there are no places there where there is just rock exposed (always a thin layer over it). Has a map with substrate definition from Keys Carrying Capacity Study; will post the address to the group. We won't find areas without marl; instead look for rock outcrops with only a fine covering of marl (likely to have more connectivity).
- Rene – suggested dye tracing as a more effective way to determine connectivity.

- Andy – Surprised that DIN was only met in 22% of the samples, and P in 58% of samples (This was included in CB's letter). IF AWT plants are efficient at removing N and P, it must be coming from elsewhere (people not hooked up, people dumping illegally, runoff, etc). Through this sample plan, are we not measuring nutrients in the SIW effluent samples, but yes at the control and test sites?
    - Yes, nutrients collected in test and control waters; it's already collected in effluent for compliance (hence this study focuses on only tracers there).
- Andy - Why aren't we meeting standards? Where are these nutrients coming from?
    - George Garrett- need to look at groundwater as well to create a more proximal and potential causal relationship to WWTP wells (should also be looking at the karst character of Marathon). Could be the collection sewer systems connecting to the City's central sewer systems are leaky (could also explain sucralose values detected in surface waters).
    - DEP and the City of Marathon can help determine if it's a leaky system (treated vs. untreated sources), if there is evidence of this
    - Lee Kump: AWT wastewater standards and ambient surface water quality targets are very different. Even if the AWT plants are in compliance, they can still contribute nutrients to surface waters that are not meeting targets.
    - Gus: with regards to Andy's question on why we are not meeting standards, the EPA targets for the FKNMS were designed for the whole FKNMS coastal and nearshore waters, and may not be applicable to a limited number of sampling stations in nearshore areas. Based on the WQPP Report to Congress 2013, the water quality targets in the EPA strategic Goals call for at least 75% of all monitored stations in the nearshore and coastal waters of the FKNMS to maintain DIN and TP concentrations of less or equal than 0.75 uM and 0.25 uM, respectively. However, we agree the concerns expressed in the April 29 letter to the WQPP should be addressed.
        - Many of studies done were BEFORE AWT was in place.
        - Jim F. is correct that AWT (3mg/L TN annual average), is higher that the State's Nutrient Numeric Standards (NNC) offshore. However, while the Florida Keys Reasonable Assurance Document (FKRAD) water quality targets are in place, the NNC standards do not apply to the 500-meter halo zone.
        - Also looking at when this study was done in Key Colony Beach (KCB), they found denitrification in the ground water to some extent and adsorption of P in the limestone.
        - Other studies show up to 1 to 1million dilution when the effluent is injected to groundwater. The picture is not entirely clear, hence the need for a study and TAC input on the best science.
        - FYI: there is litigation going on, so it's important we come up with scientifically based answers.
- Jerry: There is a background condition and the SIWs are adding a 'delta' to the system. The control sampling is unidirectional. To answer this question, need to know what the background looks like – not sure if the spatial coverage is enough. Need a physical circulation transport view to see where water moves from that source, to understand where these additional pollutants may be delivered in the system.

    - Unknown if this design will address the question. Need more control stations to know background first, to then be able to point the finger at injection wells. Need a better physical set up for this environment.
    - Ashley: The Department would need more input on how to address appropriate spatial coverage and water transport patterns.
- Henry: There are too many sources of nutrients to be able to detect where it comes from. Instead concentrate on the chemicals that come mostly from treatment water. We know dye tracers work (Henry and Gene Shinn have done this in the past). Then characterize what's being injected (going out of the plant into the ground). To save money, don't analyze for nutrients – analyze for tracers, dyes. Also measure current and time when samples are collected.
- John Hunt: We talk about this as a special study. That is about increasing our knowledge. This is NOT a special study in that sense, even if funded by EPA. This is a response to the Stakeholders' letter and is a regulatory evaluation to WQ in response to this letter. Thus, site selection needs to be linked to where we reasonably know the WW is coming to the surface. Insufficient to use nutrients and chemical tracers to answer that question.
    - Look at Lee Kump's work, etc. The conservative tracers told us where waters were coming up. In KCB, it was nearby but in a certain direction. To be more than a standard survey, this kind of work with dye tracers needs to be done to appropriately select sites. As currently designed, it won't answer the core hypothesis.
- Ashley: So we should use groundwater monitoring wells?
- Lee: Agree, it's best is to trace the WW plume. Tracer testing similar to what was done by USGS in the late 90s, early 2000s is the best way to do that. Need to measure things that you can measure in high dilution, that don't have background concentrations. They've done this with monitoring wells. With a high-volume injection, it generates a well-traceable plume.
    - Overall likes the tracers that are being considered (comparison between those that are and are not removed by WWT). That is the right approach, but there is a more direct way to also trace these plumes.
- Henry: First step = groundwater study to locate vents; then you know where to target for the sampling sites.
- 10:20 am: John: Back to the April 29 letter from the Stakeholders, their perspective is that WW from these wells is traveling 100s of meters and popping up at select locations. This is a key statement made…we need to first identify if this is actually occurring (hence tracing first). Tidal forcing would suggest that waters from these wells are less likely to go to that location on the Bayside vs. Oceanside.
- Lee: Key Largo limestone is highly permeable (primary and secondary developed through dissolution). There is variability in this permeability with tighter rock in some places (e.g., coral rock is less permeable = longer residence times). Also remember the ambient groundwater in FL Keys is slightly hypersaline, so fresh WW effluent will rise to the surface.
- John Hunt: Hence, site selection needs to be revisited…knowing where the water goes helps make that selection.
- Nick: Detailed notes from Lee etc. re: site selection would be helpful as follow-up.
- Lee: WW tool developed in 2000 was used to predict where plumes may go. He will find this, and it may be useful to the team. (Note: this is included in the resources at the beginning of this document).

- Jerry is a statistician: do 2 each to E, W, N, S to determine control environment, then set up a configuration around the well sites. Consider sampling along the gradient to see if you can trace it back to the source. Need a good experimental design to make the stats work.
- Henry: In Cudjoe to define the potential groundwater pathways, they used remote sensing images with limited analysis. Trace linear features – this helps determine where groundwater comes to the surface. In Marathon may be more difficult to do this.
    - Need criteria for selecting stations: this is a geology-based criteria to move stations to more closely intersect these linear features (higher likelihood of finding a connection to surface waters). In Cudjoe those matched up to injected water pathways.
- Nick: Seems that doing some full geological study is beyond the scope of this project or could delay it. Is something else useable as a proxy to detect where water is coming out?
    - Ex. Detectable difference in salinity?
    - Henry: there is a station N of Key Largo (200 m offshore of Caloosa Campground). That station has fresher water and a higher concentration of pollutants/nutrients, etc. That could help detect potential vents in the Marathon area.
    - To note – this Key Largo site is one of the most polluted SHORE sampling sites.
- Gus: Lee was able to find the plume using salinity in KCB because of nature of effluent. The KCB WWTP is similar in size to the Marathon plants (200-300k gpd).
    - Lee – easy to detect subsurface plume with salinity, but it's a different situation once up in the surface waters. Didn't look at freshwater impacts in that sheltered area N of KCB or the canals E and W. It's difficult to detect plume with salinity in those environments; there is variability in salinity anyways. Don't rule it out, but also don't bank on it.
- Jim: What about flying the area to map conductivity of the groundwater. That is one way to trace salinity of the plume and provide a synoptic map of it.
    - Rene: There is difficulty with this if there are a lot of electrical wires/underground pipes…interferes with resistivity method. Groundwater measurements using geophysical surveys may be better approach. Dean Whitman (FIU) uses geophysical surveys in his research. Did a study of freshwater lens on BPK; unknown if he's done this in Marathon.
    - Jim: look at electrical field by measuring conductivity of fluids in subsurface. Run transects for 2D variations in resistivity with depth.
    - Henry: There may be noise from many sources of water getting to the ground, not just the SIWs. Can measure conductivity in the water with simple/fast surveys. Measure salinity quickly in those areas while injection is being done. Kevin Boswell (FIU) has instruments to do that kind of work.
- Nick: Main concern = need to do a groundwater study to characterize effluent plume and select the correct location of the nearshore water sampling sites. Other major concerns or elements that need to be considered?
- Rob R. – Obviously need more data about where water is coming from. Current sample vs. reference sites are S and N of US1. Although these are being treated as "independent sites" the WQ at these sites can vary widely based on canals, hydrodynamics nearby, etc. Need to standardize selection criteria for these sites across all 6 facilities.
- Nick: seems to be support for geophysical surveys before site selection is finalized. Correct?
    - Ashley agrees – that's what she's hearing.

    - Lee: Conduct a geophysical survey next to a specific site. To the extent to what WW plumes are similar to LK groundwater lens, this is promising to delineate plumes. Would also recommend this as a complement to tracer testing (definitive way to show connection between injection and surface waters).
        - Tracer and geophysical survey at 1 plant can happen simultaneously (or sequentially if needed). Characterize subsurface plume transport direction and its connectivity with surface. At multiple transects, may better know the transport paths to hone in on sampling sites.
        - Do this at 1 SIW as an experimental approach. That would inform the plan to implement a monitoring study on the impact of these wells.
- John: Do salinity and tracer study at same time. That is a precursor to the actual surface water monitoring study. Site selection is based upon outcome of these tracer studies.
    - Nia: Need to determine where plume is going (tracer and/or geophysical study) before delving into any WQM/looking at WW tracers.
    - Phase 1 = Determine where plume goes to inform site selection
    - Phase 2 = Surface water monitoring.
- Daryll Joyner: Involved in study design. Would have said it's not designed to determine WQ impact; it's a different kind of tracer study. Those chemical tracers work really well for WW. We have a responsibility to check the sites the stakeholder IDed as where it is possibly coming out.
    - Julie agrees – Not intended to look at impacts, just to trace if the WW is making it into those nearshore areas.
- Dave Whiting = Re: the chemical tracers…sucralose can be detected at a 1 ppt (trillion) concentration. From previous WW sampling, know the concentration in facilities varies, but they can still detect it with a lot of dilution (it's a sensitive tracer). Looking at tracers = determine if there is surface connectivity. Less conservative tracers (usually removed from ww), if IDed that would indicate an untreated signal.
- Jim F: There are legacy tracers in the environment from before AWT…how to differentiate?
    - Dave: difference between control and test locations.
    - Jim: not necessarily if there is a difference in the legacy amount of sucralose between control and other sites. Need to look at dye…can compare sucralose to dye ratios (sucralose and no dye = legacy; sucralose and dye = input from WW).
    - Nia: all chemical tracers may have legacy load. Is it feasible that if you don't know where the plume is, you could still see some trace?
    - Jim: tracers are likely to be found in environment proportional to population density in surrounding area. That affects ability to interpret differences in tracer concentrations. Need to better know where sewage is coming up now. Tracers are a good idea = need to be sure it's 'bomb proof' that the tracers pick up WW coming out now. Use SF6 or other fluorescent dye = allows you to erase that question about the legacy.
    - Lee = agrees this makes it more of a definitive vs. suggestive study. We can anticipate a lot of background variability so this additional element will help definitively tie the sampling to the plume.
- Nick: Area 3 site is in the middle of a mooring field/at end of a dead-end canal by the facility, so there may be confounding factors. Chemical tracers can probably distinguish between this.

- Gus: Years ago there was an outfall at the KCB plant with 2ndary treatment. Used coprostanol a derivative of cholesterol as an indicator of sewage pollution to monitor effectiveness of secondary treatment vs septic tanks (coprostanol is removed by 2ndary treatment, but not by septic tanks). None of that derivative was found at the KCB outfall, but was found in residential canals with homes using septic tanks for sewage disposal.
- Lee: Suggest focusing on KCB b/c we have background information from previous study.
    - Downside = different from other Marathon sites because of the mud cap.
    - Nick: Note KCB is different from Marathon; likely to be low wastewater use compared to elsewhere.
- Ashley: Wrap up: consider geophysical survey and dye tracer studies with surface water monitoring to follow. With surface water work, look more closely at hydrodynamics/transport to site locations. Appreciate written comments for consideration as well.
    - John Hunt: Will there be a consensus TAC recommendation/statement from today? Will that then go to steering committee?
    - Nick: hoping to gather comments to pass along to the research team; no need for a consensus for the steering committee at this point. Would like overall big-picture :
- Major elements that should be considered for addition to this Plan of Study?
    - Look at geology and connectivity. Establish presence of a plume first.
    - Select treatment sites and control sites based on this information.
    - Control site selection: Jerry offered good ideas for setting up standard experimental design to set these sites up around the treatment (to account for variations in background).
        - Control sites were in halo zone…does it make sense to look beyond here (plume may go beyond that).
        - John H: Unknown how far offshore in terms of meters those were IDed. There have been a lot of discussion over the years about WBIDs, etc. At 500 m offshore, there is a preponderance of evidence that oceanic factors tend to take over (vs. land-based impacts). What's happening on land is diluted by 500m offshore and would be less likely to be detected.
        - Jim: Just as Lee worked in KCB, Joe Hoyer, Henry and Jim also did. Looked for benthic signal of nutrient loading associated with onsite sewage disposal systems. Sampled an on to offshore gradient. Can see there are stable isotope signature, relative availability of N and P changes within 500m. This is the Little Venice study…should look at that information. (Note: this is included in Resources at the beginning of this document)
        - Jeff Chanton conservative tracer study done at Keys Marine Lab (KML) (funded by Special Studies). This involved 60' well (not WWT, but local package plant). See where the tracers came up – in this study it was immediately adjacent in the Bay (only a short distance away). Also detected in Zane Gray Creek on the ocean side (highest concentrations, even compared to adjacent). This also follows that tidal forcing scenario from bayside to oceanside. Lee Kump can provide that study. Also, they never found a real plume at KML b/c there was so little use. Dispersed disposal in some ways is better because it doesn't develop the buoyancy to develop a plume. Sometimes distributing WW makes more sense

that focusing it in one SIW. At KCB they also would like to have experimented with blending the effluent with groundwater….if you keep it denser, that would reduce impact on surface water. A special study on blending with tracers would be useful to see if you can impact that…. Plume buoyancy is so important to its transport and impact on surface water. Anything to reduce plume buoyancy helps!

- Jim – We spent $2B on sewer, need to be careful with statement that diffuse problem was made worse by centralizing this. SIW are the issue in Marathon.
- Nick: This study does have serious implications. We don't come up with regulatory rules – that's beyond the purview; but this could inform those decisions. Needs to be well-designed and highly defensible.
- Rob: Frequency of sampling is important. Should this be addressed?
    - Jerry; we haven't identified the covariates/things that correlate with issue. The population level reflects the amount of water being injected into the well…this should be tracked. Percolation thru sediment is probably also a function of how much is in the well system. Precipitation may influence. Frequency of sampling should consider these – there may be very strategic times to sample.
    - Seasonal frequency has been used for other studies; but this may be greater with tourist season vs. off season. To really find out if plumes impact adjacent environments, understand when they would be the greatest. Consider more frequent sampling during highest discharges vs. at smaller volume (and less impact).
    - Lee: Consider residence time in the halo zone sample areas. There may be variability based on this, and should inform frequency if possible. Unknown if there have been residence time studies in Boot Key Harbor or other locations? Some sense of variability in flushing times/water residence time may inform frequency.
        - Gus – Unknown if this exists.
        - Jim F. – USACE Carrying Capacity study was a nearshore hydrodynamic modeling effort.
    - Gus: All WWTP are monitored for flow (gpd) so we can determine the seasonal flows. We can get this information to factor into the study.
        - Also, compliance process to require connections to central sewer in progress…it's not done yet. Key Largo, Islamorada, Key West and Long Key are being connected to AWT systems. Marathon may have densest population out of areas with shallow wells (1.7/1.8 mgd in Marathon). In Key Largo/Islamorada, this is closer to 3mgd. Also have areas that are more remote than Marathon (some areas in Long Key, Big Pine Key, etc.) that also have SIWs but with lower flows. Big Coppitt also has a AWT central facility with SIW's. A DIW can be up to $10M.
- Jim: 2nd tracer controlled and metered into ground water to help with site selection.

Chat Box Log (Edited to include only those comments specific to the study)

Rene Price 9:48 AM

I suggest dye tracing. Trying to identify porous regions could be difficult, but dye tracing might be more effective.

George Garrett 9:51 AM
I believe that you have to look at ground waters as well. It would create a more proximal and potential causal relationship to WWTP wells. I think that we also should be looking at the karst character of marathon as well.

Jim Fourqurean 9:51 AM
Map of substrate type around marathon:
http://serc.fiu.edu/seagrass/NearshoreWeb/Marathon/masubtype.jpg
Andy: the wastewater plants in the keys are not efficient at removing nutrients

George Garrett 9:53 AM
Potentially, collection systems connecting to the City's system are leaky. That may be why sucralose made it to nearshore.

Jim Fourqurean 9:55 AM
There is legacy nutrient pollution in the groundwater from before the centralized collection, and the wastewater plants don't remove the phosphorus that is the limiting nutrient in the area.

Shelly Krueger 9:55 AM
Do we know the nutrient concentrations of the treated water leaving the treatment plant at the time of injection into the well? Sucralose levels just prior to injection?

George Garrett 9:56 AM
Jim - I would disagree with your statement. WWTP in the Keys ARE meeting nutrient reduction standards.

John Hunt 9:56 AM
Concur with George. I am unaware of any information about how "karsty" the marathon area is. For me, given the assumption that karsts are funneling wastewater to the surface; then my thinking is that a pre-study that uses conservative tracers and an expanded surface water sampling for that tracer is needed to get flow. Would appreciate a robust discussion of this by the experts in the discussion section of the meeting.

Henry Briceno 9:56 AM
Linking nutrients to specific sources in this kind of project is not feasible. The study should concentrate on tracers instead.

Jim Fourqurean 9:57 AM
Yes, but AWT standards would still cause nutrient blooms in nearshore waters.

George Garrett 9:57 AM

Jim that I agree. That's why we need to look at what happens chemically between end of pipe and where it MAY come up in the nearshore.

Henry Briceno 9:58 AM
Current direction should be measured at the sampling sites when collecting samples

Nia Wellendorf 9:59 AM
If anyone has specific recommendations for where sites should be located, please provide those.

Rob Ruzicka 10:01 AM
To follow up on Jerry's point, is there modeling of nearshore currents around the marathon area? It might be prudent to set up control/references sites both to the E and W of the treatment facilities.

Nancy Diersing - NOAA Affiliate 10:01 AM
The EPA targets were based on baseline data that did NOT include the nearshore sites. The nearshore sites were added later. Therefore, it doesn't seem valid to compare them to the EPA targets. However, this does not change the fact that injection wells should be studied.

Cindy Fischler 10:02 AM
What about temperature as a tracer? Thermal imaging along the coast to show where groundwater is emerging close to shore.

Jim Fourqurean 10:02 AM
AWT TP goal is 1 mg P per liter, or 30 uMol/L. Background TP in the marathon surface waters is about 1-2 uMol/L.

Rene Price 10:04 AM
Temperature tends not to work well as a tracer in groundwater in our environment where there is not a large seasonal difference in temperature. It works better in more temperate climates.

Rob Ruzicka 10:04 AM
At the moment controls sites appear to be placed in both E & W directions dependent upon the treatment facility

George Garrett
10:04 AM
I repeat…That's why we need to look at what happens chemically between end of pipe and where it MAY come up in the nearshore.

Jim Fourqurean 10:07 AM
I support Henry's observation - nutrients are rapidly taken out of the input by biofilms. We can't measure DIP in the water more than 10m away from bird rookery islands which are huge sources of P

Cindy Fischler 10:07 AM

Temperature has worked well in locating offshore springs in Florida.

Shelly Krueger 10:09 AM
The recent SCOTUS case of County of Maui vs Hawaii Wildlife Fund used tracers. Link to study: https://archive.epa.gov/region9/water/archive/web/pdf/lahaina-gw-tracer-study-final-report-june-2013.pdf

Julie Espy 10:09 AM
Sucralose is a very good tracer for treated WW. I wonder if dye is needed, if we have info about currents and good station locations.

George Garrett 10:10 AM
John is absolutely correct

Rene Price 10:10 AM
Cindy, those results might be springs originating from deep groundwater in the Floridan Aquifer and the temperature difference could be detected. In Marathon we are trying to detect wastewater that originates from close to the land surface so it is in equilibrium temperature of the ground surface and then it is pumped to only 60 or 90 feet deep. I don't expect a difference in temperature from the wastewater and the surrounding waters.

George Garrett 10:12 AM
Ground water monitoring wells are probably a good idea

Jim Fourqurean 10:14 AM
A detailed study of groundwater movement and the biogeochemical reactions in the subsurface in response to the injection wells really is what is needed. I agree with John on that point. That doesn't mean it's not worth looking at tracers in the environment as has been proposed

Henry Briceno 10:15 AM
Defining the pollutants path as John suggests would require a groundwater study as a first step to locate the "vents" to be sampled in a second phase. Additionally hydrodynamic modeling of coastal areas in areas of interest are also necessary as Rob suggests

Jim Fourqurean 10:18 AM
Julie - sucralose currently in the sediment is likely to be a function of the long history of on-site sewage disposal as well as current loading. I would think a dye tracer would be necessary to understand current sucralose loading.

Rene Price 10:18 AM
I agree that tracer testing, including a wide variety of tracers, dye, sucrolose, and maybe isotopes along with intensive sampling near each of the injection wells. A more detailed hydrogeologic study would take a while. It can co-occur with the tracer testing.

George Garrett 10:19 AM
Can we bring a karst expert into this discussion as well - Alfieri

Henry Briceno 10:19 AM
If we do not look for nutrients or tracers, then what are we going to look for?

Rene Price 10:21 AM
There are a couple of karst experts on this panel and from my end the bedrock is extremely porous everywhere.

Jim Fourqurean 10:21 AM
Rene is a Karst expert! And so is Lee!

Henry Briceno 10:25 AM
The work of USGS by folks like Gene Shinn and many others have documented the karstic nature of the ground geology that expedites flow of groundwater for hundreds of meters. So, that is the framework we have.

George Garrett 10:26 AM
Understood, really was trying to get at the specifics of Marathon. Porosity VS solution features VS aquacludes. The presumption in shallow wells has to do with the supposed (as previously demonstrated) aquaclude layers that are assumed to lie ABOVE the level of the well screens

Jim Fourqurean 10:33 AM
Jerry, finding adequate control areas unaffected by wastewater in the groundwater anywhere in the Keys is likely impossible. I think a more targeted process study may be the only clean way of answering the question for the exact site of the process study. That would help interpret the data of the spatial distribution of the potential tracers

Rene Price 10:35 AM
Could there be available geologic logs from when the injection wells were constructed? An inspection of those geologic logs could be helpful.

Jim Fourqurean 10:36 AM
What about using airborne resistivity methods to look at salinity in the subsurface?

Jerald Ault 10:38 AM
Jim, Control sites don't necessarily have to be unaffected sites, but rather are those that are unaffected by the hypothesized injection well sites. It seems the question being asked is what is the additional contribution of pollutants/nutrients from those sites? You'll need a reference point to statistically establish those differences, if they exist.

George Garrett 10:38 AM

Rene: As I understand it, some of those logs are available

Rene Price 10:40 AM
A look at those logs would be useful to trying to identify preferential flow zones at depth.

Steven Blackburn 10:41 AM
While important to address concerns expressed by FOLKS, the letter shouldn't direct site selection. As Gus pointed out, the numbers she cited are not EPA Water Quality Standards. The DIN, TP, Chl.a, and light clarity targets were established as performance measures for the water quality monitoring program in the Keys. They haven't been reported to EPA headquarters in four years.

Rene Price 10:41 AM
I agree with Jim, that doing land-based geophysical surveys near the injection wells can provide evidence of changes in salinity with depth and might also corroborate potential flow paths at depth beyond the core holes of the injection wells.

Shelly Krueger 10:42 AM
Capacity is down in terms of gallons of water per day being injected since the hotels and tourism is not at normal capacity for the foreseeable future

George Garrett 10:42 AM
Rene: Yes. I brought up Alfieri, because he has actually looked at some of those logs recently. I don't necessarily mean to pick him out otherwise.

George Garrett 10:45 AM
Yes on geophysical sites

Jim Fourqurean 10:47 AM
Look at the Big Pine subsurface salinity maps created with resistivity mapping in Kiflai et al 2020, Estuaries and Coasts 43(5):1032-1044

Rene Price 10:49 AM
Here is a recently published paper on the results of a geophysical survey completed of the freshwater lens on Big PIne Key, completed by researchers at FIU. Kiflai, M., D. Whitman, D.E. Ogurcak, and M.S. Ross (2019). The effect of Hurricane Irma storm surge on the freshwater lens on Big Pine Key, Florida, using electrical resistivity tomography, Estuaries and Coasts, 1-13

Rene Price 10:51 AM
The reference Jim provided for that paper is more accurate.

Shelly Krueger 11:02 AM
Lahaina groundwater study from the Supreme court case Maui vs Hawaii Wildlife Fund used fluorescein and sulpho-rhodamine B, along with piezometers. Could be useful to read the study: https://archive.epa.gov/region9/water/archive/web/pdf/lahaina-gw-tracer-study-final-report-june-2013.pdf

George Garrett 11:02 AM
Actually, that mooring field is pumped out constant, including the anchored out vessels. Not absolutely perfect, BUT HIGHLY Managed

Jim Fourqurean 11:04 AM
Link to Kiflai paper: https://link.springer.com/article/10.1007/s12237-019-00666-3

George Garrett 11:12 AM
All: The discussion is fantastic. I think the result of the conversation says that the study design must be very tight. The implications are significant. The purposes for the questions before us are related to whether you go to deep wells or not and it is potentially about managing growth in the Keys. So, between the potential costs and other policy issues, the answers that we get here need to be tightly defensible. If we need to change the effluent standards or the physical means of effluent disposal so be it! But, let's make sure that we are right

Steven Blackburn 11:13 AM
While we are not discussing funding today, I would be remiss not mention that the EPA Special Studies RFA is scheduled to be published next week. Shallow well studies have been identified as a high priority in the RFA.

George Garrett 11:20 AM
Whether in the halo zone or further offshore, what happens adjacent to wells is what is most important. The further away from a source that you monitor, the less you understand about what is happening to the source. We need to be monitoring near the wells and understanding where effluent goes from there. The assumption being made is that the well effluent is coming up in the nearshore. WE DO NOT KNOW that. WE need to be testing for it

Rob Ruzicka 11:25 AM
The discussion on site selection has been productive. I wanted to put on the list of talking points about the frequency of sampling. Is the quarterly sampling done at each potential site just once within the quarter? Are there times of year when there is more discharge than others and should there be a greater frequency of sampling during that time? It's unfortunate Henry had to leave so he could provide his perspective and if we run out of time today can this be discussed in the future?

Mark Chiappone 11:29 AM
Related to that, if volume flow varies from what is being injected, then wouldn't that affect plume volume ultimately?

Christopher Kavanagh
11:46 AM
Yes, with revisions addressing plume direction and sample site location, density, and frequency.

Rob Ruzicka

11:47 AM

Everyone would like to see this study succeed and be defensibly sound.