Septic Tank Discharges from Captiva

A Re-evaluation of Nutrient Loading

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Background

We hope this document will serve as a best current estimate of nutrient loads to state waters from Captiva's septic systems, OSTDs and groundwater-discharging package treatment plants. The information contained here is based on the latest available data for population and housing characteristics taken from the 2010 US Census, and short-term rental data-gathering companies. We also use best current literature estimates for typical septic tank system nutrient removal efficiencies.

An estimate of nutrient loading from Captiva septic systems into state waters was originally undertaken in a study done by SCCF (Thompson et al. 2011) for the Lee County Tourist Development Council and Captiva Community Panel (CCP) in 2008-2011. In that study 36% (1,550 kg/yr) of the total nutrient load from Captiva was estimated to be from septic systems. The study concluded that septic system discharges from Captiva had significant current environmental impact to state groundwater and near shore waters and overall was a significant source of nutrients from Captiva. The study recommended that the Captiva community work towards reducing nutrient loading from septic system sources as well as stormwater runoff. A current review of that study's assumptions showed that revising the estimate based upon current data and using more detailed information for Captiva onsite package OSTDs could provide a better idea of the actual overall contribution of septic systems to nutrient loads from Captiva.

In 2019, a second study was undertaken with funding from the CCP (ESA 2019). The second study produced very similar stormwater runoff nutrient load estimates but septic system loading estimates were significantly lower than those produced in the 2008-2011 study. The 2019 study suggested about 20% (698 kg/yr.) of nitrogen loading from Captiva originated from septic systems, OSTDs and groundwater-discharging wastewater systems. This suggests that septic system loading is significantly less significant than stormwater runoff and therefore can be thought of as less important to target for nutrient reduction.

A review of that study's methods reveals assumptions that did not consider septic system nutrient loading values typically used by EPA or other environmental agencies. Instead an average groundwater value for inorganic nitrogen was used as a concentration for discharges from septic tanks, reducing the nitrogen loading estimate. The estimate also assumed soils and groundwater would further remove nitrogen after package plant OSTD waste entered waters of the state. As per **373.019** Florida Statutes (22); "Water" or "waters in the state" means any and all water on or beneath the surface of the ground or in the atmosphere, including natural or artificial watercourses, lakes, ponds, or diffused surface water and water percolating, standing, or flowing beneath the surface of the ground, as well as all coastal waters within the jurisdiction of the state." In Florida, groundwater is classified as a water of the state and the Florida Code covering OSTDs states that waste from OSTDs shall not be discharged into groundwater, aquifers or surface waters. From the Florida DOH/Dep Wekiva OSTDs study (Task3) comes this statement: "This third task was to determine an estimate of the nitrogen input and load in the Wekiva Study Area from OWTS. An input is defined as the amount of nitrogen that is released into the environment. An example would be

the amount of nitrogen from a bag of fertilizer applied to the ground surface. **A load is the amount of nitrogen that reaches the ground water**." In keeping with the designation of groundwaters as a Florida Waters in the state, nutrient loading from OSTDs should be calculated at the point in which it discharges into state waters - which is the groundwater beneath the aerated portion of the drainfield. No nutrient removal credits should be given for lateral movement away from the drainfield – per regulatory definition.

64E-6.005 Location and Installation. Sewage waste and effluent from onsite sewage treatment and disposal systems shall not be discharged onto the ground surface or directly or indirectly discharged into ditches, drainage structures, ground waters, surface waters, or aquifers

Methods and Results

The following values were used to estimate septic tank and groundwater-discharging wastewater plant (WWTP) system effluent from residential OSTDs. The groundwater-discharging community wastewater systems on Captiva are Tween Waters, Sunset Captiva and Captiva Shores.

Description	Value	Reference
Number occupied residences Captiva	293	2010 US Census
Average household size Captiva	1.81 people	2010 US Census
Number of long-term rental units Captiva	111	2010 US Census
Average rented unit household size Captiva	1.34 people	2010 US Census
Number of seasonally occupied units Captiva	885	2010 US Census
Number of short-term rentals in OSTD zone	282	AirBnB/VRBO/AIRDNA 2019
Number of people per short term rental	2.3 people	Mashvisor 2019
Occupancy rate for short term rentals	54%	Mashvisor 2019 – Fort Myers area
TN load to shallow aquifer-for FL OSTD	4.38 kg/prsn/yr.	FLDOH Wekiva Study 2007
TP load to shallow aquifer-for FL OSTD	0.71 kg/prsn/yr.	Phosphorus Geochem Hndbk 2006
Tween Waters 2019 Annual Flow	7.66 MG	FLDEP Nexus Info Portal
Sunset Captiva 2019 Annual Flow	5.23 MG	FLDEP Nexus Info Portal
Captiva Shores 2019 Annual Flow	1.73	FLDEP Nexus Info Portal
Mean TN for community WWTPs	21 mg/l (ppm)	Annual Mean value for SSP WWTP
Mean TP for community WWTPs	4.6 mg/l (ppm)	Annual Mean value for SSP WWTP
Number of septic systems on Captiva	303	Estimates from GIS interpolations
Length of stay seasonal occupant	100 days	Estimate from causeway traffic data

In addition to the information supplied above, an estimate of septic system nutrient load from single resident OSTDs to the shallow aquifer will require knowledge of total number of households in the non-

sewered area. Adding the total number of seasonally occupied units to the occupied units and to the long-term rental units:

885 seasonal + 293 occupied + 111 rental units = 1,289 total units on Captiva

The % seasonal vs. %rental vs. %occupied units on Captiva is then calculated:

Seasonal (100days/year) =	68.5% of total Captiva units
Occupied (365days/yr) =	22.7% of total Captiva units
Long Term Rentals (365 days/yr.) =	8.6% of total Captiva units

From this information we can estimate person-days/yr. for housing units connected to septic systems. Assume the same distribution between seasonal/occupied/long tern rental as Captiva overall for the 303 septic systems. This gives us the following distribution of housing units on septic systems for Captiva:

Seasonal units on septic systems:	(0.685)(303) =	208
Occupied units on septic systems:	(0.227)(303) =	69
Long term rentals on septic systems:	(0.086)(303) =	26

We now estimate the number of person-days/yr. for these units to allow us to estimate nutrient loading rates:

Seasonal units person-days/yr.:	(208 units)(1.81 people/unit)(100days/yr.) =	37,648
Seasonal units person-days/yr.:	(69 units)(1.81 people/unit)(365 days/yr.) =	45,585
Seasonal units person-days/yr.:	(26 units)(1.34 people/unit)(365 days yr.) =	12,717

To estimate the impact of short-term seasonal rental such as AirBnB and VRBO we use the data provided by the short-term rental industry above, and assume that the season rental properties become short term rental properties when not used – assuming 265 available rental days per year (thus adding to number of occupied days/yr. for seasonal rentals):

Short term rental person days: (208 units)(265days/yr.)(0.54 occupancy rate)(2.3 people/unit)= 68,459

We add to get the total number of person days per year for housing units on septic systems:

(37,648) + (45,585) + (12,717) + (68,459) = 164,409 person-days/yr.

The nutrient loading from septic systems on Captiva to groundwater can now be estimated using the loading estimates from Florida septic tank performance studies shown above and the total number of people per year on septic systems.

TN load to groundwater= (164,409 people-day/yr.)(1yr/365days)(4.38kg/person-yr.)= **1,973kg/yr.**

TP load to groundwater= (164,409 people-day/yr.)(1yr/365days)(0.71kg/person-yr.)= **320 kg/yr**.

The load to groundwater from Captiva's three wastewater plants is now estimated. Tween Waters (TW), Sunset Captiva (SC) and Captiva Shores (CS) wastewater facilities are not required to sample their effluent for total nitrogen or phosphorus. However, the South Seas Plantation facility does monitor its effluent for TN and TP. The mean TN concentration from December 2018 through November 2019 for the SSP facility discharge was 21 mg/l. The mean TP concentration from December 2018 through November 2019 for the SSP facility discharge was 4.6 mg/l. The mean TN and TP concentrations are used with the actual 2019 flow data from these three plants to calculate load to drainfield:

TN load Tween Waters = (7.66 MGY)(8.34 lbs./gal)(21ppm TN)(kg/2.2lb) =	610 kg/yr.
TN load Sunset Captiva = (5.23 MGY)(8.34 lbs./gal)(21ppm TN)(kg/2.2lb) =	416 kg/yr.
TN load Captiva Shores = (1.73 MGY)(8.34 lbs./gal)(21ppm TN)(kg/2.2lb) =	138 kg/yr.
Total TN load to drainfield =	1,164 kg/yr.

TP load Tween Waters = (7.66 MGY)(8.34 lbs./gal)(4.6 ppm TN)(kg/2.2lb) =	133 kg/yr.
TP load Sunset Captiva = (5.23 MGY)(8.34 lbs./gal)(4.6ppm TN)(kg/2.2lb) =	91 kg/yr.
TP load Captiva Shores = (1.73 MGY)(8.34 lbs./gal)(4.6ppm TN)(kg/2.2lb) =	30 kg/yr.
Total TP load to drainfield =	254 kg/yr.

Where: MGY = million gallons per year; ppm = parts per million (same as mg/l).

Treatment within the vadose zone (drainfield) must now be estimated for the discharges from the treatment facilities. Hazen Sawyer (2006) reported vadose zone TN reduction at 25%. The estimated total TN discharged to groundwater is 25% less than that discharged to the drainfield:

TN load to groundwater from Captiva WWTPs = (0.75)(1,164 kg/yr.) = **873 kg/yr.**

The same estimate must be made for Phosphorus discharged to Captiva groundwater. Phosphorus is much less mobile in the vadose zone and much of it is removed. The Phosphorus Geochemical Handbook (2006) shows vadose zone P removal between 23-99%, however calcareous sandy soils are typically toward the lower end. A value of 50% P removal will be used here as an estimate.

TP load to groundwater from Captiva WWTPs = (0.50)(254 kg/yr.) = **127 kg/yr.**

The total loading of TN and TP to Captiva groundwater from septic systems and community WWTPs discharging to groundwater is now made by adding the two estimates for each nutrient:

Total TN loading to Captiva groundwater = (1,973 kg/yr.) + (873 kg/yr.) =	**2,846 kg/yr**.
Total TP loading to Captiva groundwater = (320 kg/yr.) + (127 kg/yr.) =	**447 kg/yr.**

Discussion

The purpose of the estimates derived in this document are meant to provide a more in-depth picture of the relative influence of septic system TN loading compared to stormwater runoff on Captiva. In two previous studies, TN loading from Captiva stormwater runoff was estimated with similar results. A 2011 study by SCCF Marine Laboratory estimated stormwater TN loading to be 2,797 kg/yr. A 2019 review by ESA estimated TN stormwater runoff loads at 2,870 kg/yr. The average value is 2,834 kg/yr.

In each of the previous projects, septic tank TN loading was estimated to be less than from stormwater runoff. In the SCCF study, septic tank loads made up 36% of the total load from Captiva while the ESA work estimated a maximum 20% contribution by septic systems.

One of the take-aways from the previous works was that septic tank discharges are a lesser source of nutrient pollution than stormwater runoff and that idea will play into any decisions the Captiva Community makes regarding the future of wastewater treatment on the barrier island.

In this document, the latest information available was used to make a more thorough estimate of septic system loading into the groundwater on Captiva. Previously short-term rentals were not considered and more informed estimates of the total number of annual person-days was not made. Actual flowrates from the local WWTPs which discharge to groundwater were used to make more informed loading estimates along with local WWTP TN and TP values.

The point of load calculation is also highlighted here. Shallow aquifer groundwater is considered a water of the State and Florida uniform septic tank regulations prohibit the discharge of septic tank effluent into surface waters or groundwaters. Since groundwater is a state water resource just as surface water, the point of loading should be considered as the point at which septic system waste leaves the treatment system (after leaving the vadose zone). The further removal of TN and TP from septic system waste as it moves outside of the vadose zone and into the groundwater should not be credited as treatment, just as wastewater discharged to surface water is not allowed treatment credit by the surface water body. The "load" occurs at the exit from the vadose zone.

With this updated information and more thorough evaluation, the estimated TN load from Captiva septic system discharges is over 50% (2846 kg/yr./5680 kg/yr.) of the total TN load from the island. This finding will need to be considered along with all other information available when deciding what if any action should be taken to better manage Captiva's human wastes.

References

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