

Summary of Water Quality Monitoring at The Dunes

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SCCF Marine Laboratory

Mark Thompson



The Dunes Golf Club and Homeowners Association has worked diligently with the City of Sanibel and SCCF to implement BMPs with goals to reduce nutrient discharges from their property and improve water quality in their lakes. This document serves as a graphical summary of water quality monitoring results obtained from annual wet and dry season stormwater system monitoring for The Dunes. Brief interpretation of graphical results is included. This summary serves as a quick reference for the City of Sanibel to aid in decision making. A more complete analysis of monitoring data will be contained in the Bi-annual Dunes monitoring report to be distributed during the first week of October 2017. Since 2012

Graphical Results and Interpretation

Three sample sites are within The Dunes stormwater system of lakes at Lake 4 (weir), Lake 5, and Lake 9. These values are averaged to get a composite analysis of the Dunes stormwater system. Horseshoe Lake (HSL) which is not directly connected to the stormwater system is also sampled and is analyzed separately. The sites have been sampled four times annually (2 wet, 2 dry) since the dry season of 2012.

Devitt Pond, located just south of The Dunes, was dug on the SCCF Homestead property in 2014 and has served as somewhat of a reference site for ponds in this area. It is sampled on the same schedule as the Dunes lakes. At the Homestead property, SCCF applies no fertilizer, uses no herbicides (near lake) and has planted the shoreline and littoral zone completely in native vegetation. The lake was stocked with only native fish. We assumed Devitt Pond water quality would approach the best which could be expected for lakes in this area of Sanibel.

Previous monitoring reports have shown downward trends in mean nitrogen values and chlorophyll a in both the stormwater system and HSL (seasonal Kendal trend analyses). Phosphorus in the lakes has been less responsive and an increasing trend is sometimes found in trend analyses. With this latest analysis, the downward trends previously found in the stormwater system have been reversed and an upward trend in chlorophyll a, nitrogen and phosphorus values is apparent (Figure 1). HSL has continued its improvements in chlorophyll and nitrogen values during this period but it also displays an upward phosphorus trend (Figure 1). At this point the stormwater system changes are a short term deviation from a longer term water quality improvement. The recent decay in water quality may be caused by unusually great rainfall volumes from the wet season of 2015 through the wet season of 2016 (rainfall shown in Figure 3). They may also be an indication that further water quality improvements will be more difficult to achieve due to groundwater interactions and/or continued use of reclaimed water. However, the continued improvement in nitrogen and chlorophyll levels in HSL suggest The Dunes Golf management should review management practices to identify any changes which may have contributed to the decreased water quality.

Comparison of The Dunes stormwater system's water quality to Devitt Pond shows they seem to be converging to similar chlorophyll and nitrogen concentrations (Figure 2). Devitt Pond

was initially below state impaired water criteria for nutrients and chlorophyll, producing a healthy diagnosis. After an unusually wet period from July 2015 through October 2016 which brought several monthly record rainfall volumes, Devitt Pond water quality quickly degraded to levels similar to those found at the Dunes. This can be explained by examining groundwater flow and quality in the area. Typically, groundwater in the vicinity of a lake or pond will flow toward the waterbody. This is due to the higher evapotranspiration rate of the waterbody creating a piezometric head gradient between the waterbody and surrounding connected groundwater. This gradient becomes greater during rainy periods due to the more rapid rise in groundwater elevation relative to the waterbody after rain events. The result is greater groundwater flow into lakes during rainy periods such as those experienced in 2015-2016. After the rainy period, Devitt Pond water quality values approached values seen in adjacent groundwater quality (as measured in 2015). Due to the young age of the pond and the strong application of stormwater BMPs in the pond's watershed, we attribute the steep decline in water quality to the influx of groundwater exacerbated by a very rainy period.

The explanation of decreased water quality at Devitt Pond can be extrapolated to The Dunes stormwater system, except that much of the time, the stormwater system is held at artificially high water levels by a flow control structure, resulting in lower overall flow towards the lakes than if the lakes were allowed to seek their natural levels.

At the present time, the nitrogen and chlorophyll values in The Dunes stormwater system have increased, changing an improvement seen from 2012 through 2016. Though an extremely wet period from 2015 through 2016 may have been a partial factor in water quality decline, any changes in management practices since late 2015 should be reviewed and evaluated for potential negative impacts of water quality. Examples of changes which may have had impacts on water quality is changes in fertilizer type or application schedule, reductions in vegetative buffer area, reduction in littoral zone vegetation, increased application of nutrient-containing materials (mulch, clippings, etc.) to watershed or lakes, herbicide use along lake edges, changes in aeration, etc.

Phosphorus levels continue to be more independent of nitrogen and chlorophyll trends. Since monitoring began, phosphorus concentrations have remained constant or increased in both the stormwater system and HSL. The current explanation continues to be use of high-phosphorus reclaimed water for irrigation. Although phosphorus is commonly adsorbed to soil particles and used by vegetation, it is likely that the soils in The Dunes are saturated with phosphorus and act as sources instead of sinks due to the long-term use of reclaimed water. The soil phosphorus storage capacity (SPSC) should be evaluated for golf course soils to better understand how application of additional P may effect nutrient concentrations in runoff and groundwater.

Figure 1. Comparison of The Dunes Golf Club stormwater system monitoring results to results from Horseshoe Lake located in The Dune development but owned by the HOA.

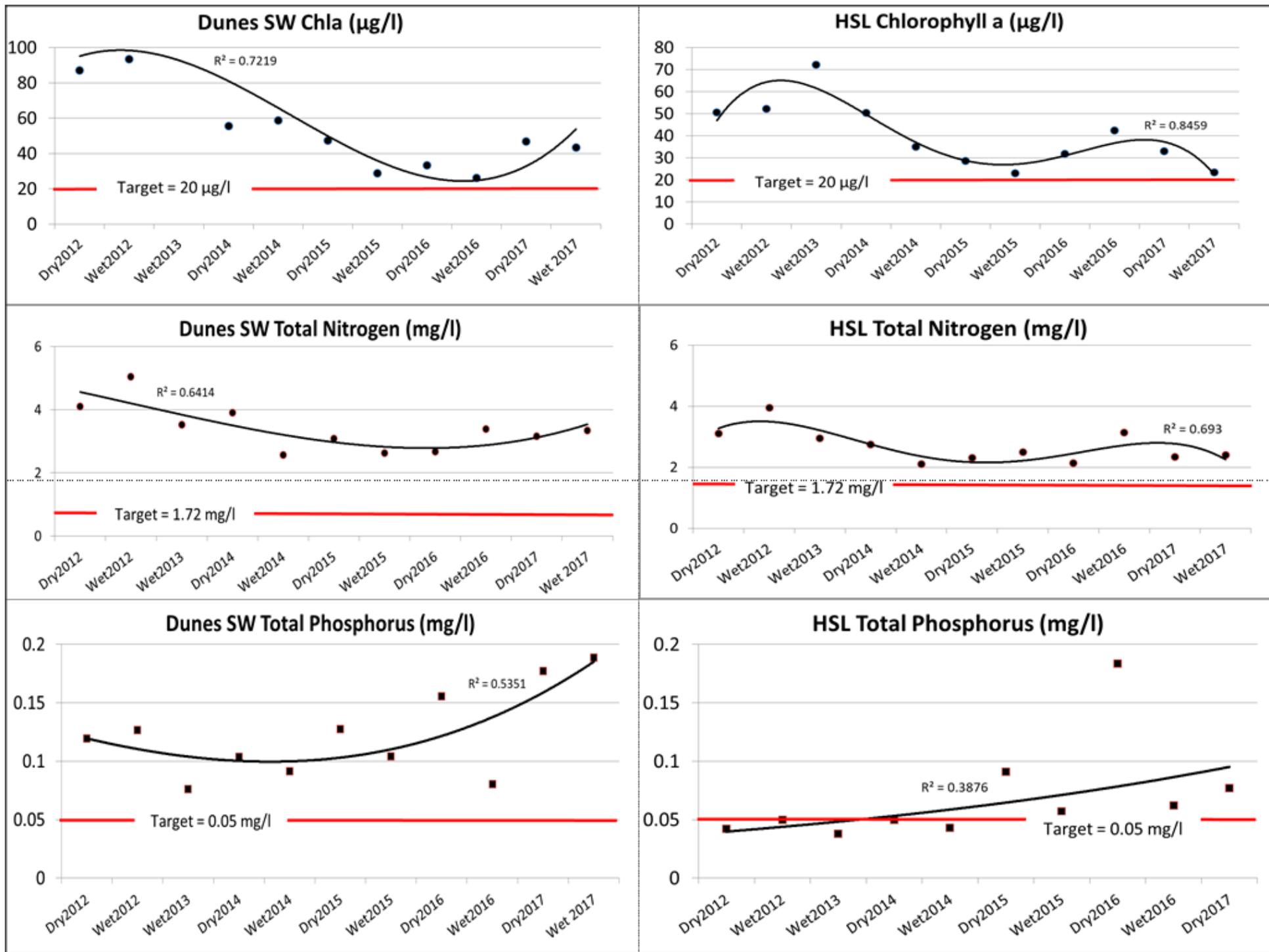


Figure 2. Comparison of The Dunes Golf Club stormwater system monitoring results to results from Devitt Pond located on the SCCF Bailey Homestead.

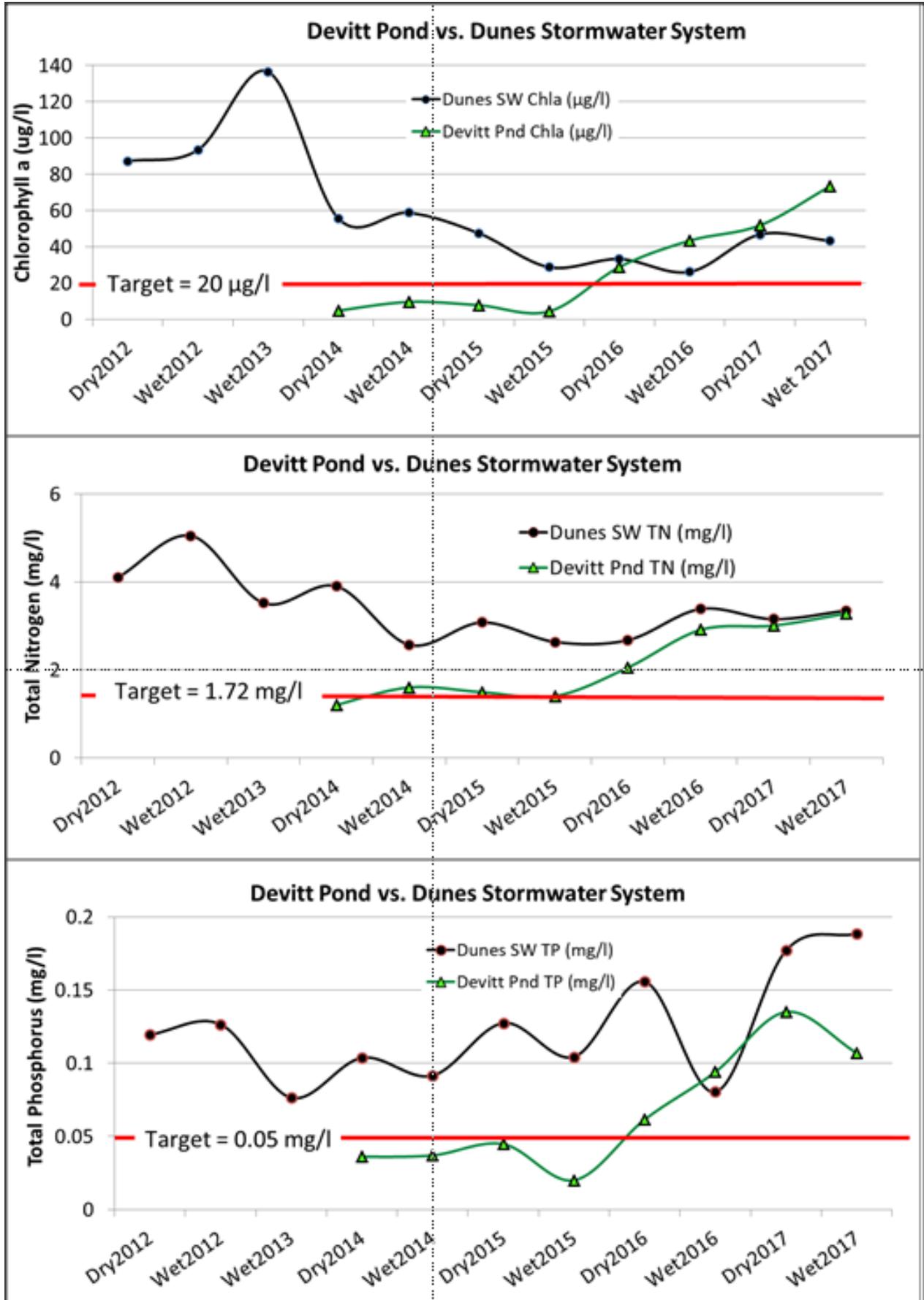


Figure 3. Comparison of Devitt Pond monitoring results to mean groundwater concentrations in 2015 and local rainfall.

