Community-based groundwater and lake level management in Briarcliffe Acres, SC

Benjamin Thepaut, Susan Libes, and Rick Peterson (Coastal Carolina University)
Nancy Edelman and Huston Huffman (Town of Briarcliffe Acres)
Tom Garigen (Horry County Stormwater Department)

What & Where is Briarcliffe Acres?

Briarcliffe Acres is a small residential community (about 200 homes) located on the northeastern shoreline of South Carolina in Horry County (Figure 1). The municipality of Briarcliffe Acres is about 0.85 square miles or 545 Acres.

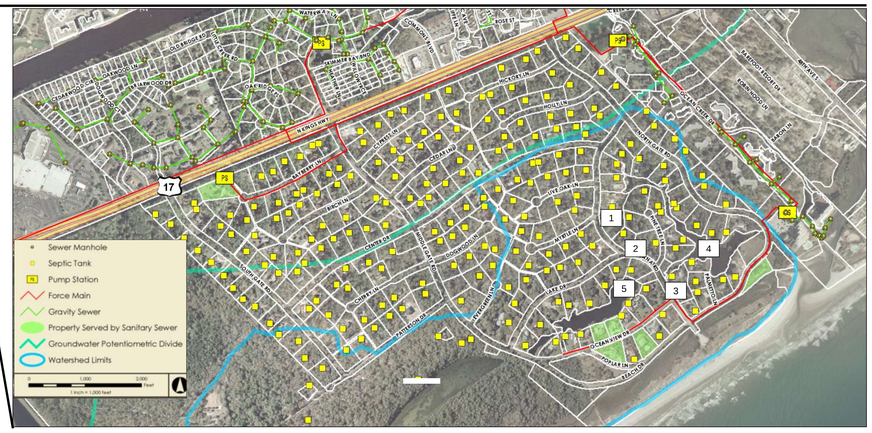

Figure1: ***Sampling sites at Briarcliffe Acres, South Carolina in Horry County. Map courtesy of Thomas & Hutton Inc.***

Why Briarcliffe?

A groundwater and lake level monitoring program was initiated in May 2012 to enable the community of Briarcliffe Acres to locally manage their water resources. The major water resource of concern is a series of networked lakes that are used for stormwater retention and as a source of irrigation water. Groundwater is also being used as a source of irrigation water. Extended drought conditions have led to lowered lake levels. Thus, quantification of the inputs and outputs of water is necessary to address a water budget for the community. To learn how to better maintain suitable lake levels, a monitoring program was instituted to document the relationship between groundwater and lake water levels.

Methods

To investigate a relationship between groundwater and lake water levels, we are monitoring the response of water levels to rainfall, drought, tides, and irrigation withdrawal. Our hypothesis is that water levels in the lakes and groundwater wells are interdependent.

In this study, Onset's Hobo® water-level loggers (Figure 2) are being used to measure water levels in three groundwater wells ranging from 5.4 to 11.3 ft in depth below the land surface and in two lakes (Table 1). To investigate the potential for saltwater intrusion and to trace groundwater sources, a continuous conductivity sensor is being deployed in one of the lakes. One water-level logger is deployed in a well above the water table to measure barometric pressure. Rain data (15-min accumulations) are downloaded from a weather station located less than 2 miles away at the Apache Family Campground's fishing pier.

Figure 2: Onset Hobo® Water-level logger

The groundwater wells are located along an upslope transect perpendicular to the shoreline. The well depths are estimated to be close to or somewhat below the bottom of the lakes. The lakes are located in the middle of the well transect (Figure 1).

All measurements are logged every 15 minutes. The data are manually downloaded every two to three weeks (Figure 3). Elevations are referenced to **NAVD 88.**

Figure 3: ***Download of data from Hobo® water-level logger at Briarcliffe Acres***

Table 1: Sampling sites, well depth and equipment deployed at Briarcliffe Acres.

Map number	Site Name	Site Type	Well Depth (ft)	Water Level & Temperature	Conductivity & Temperature	Barometric Pressure
1	Myrtle Lane	Well	11.3	X		
2	Lake Drive	Well	14.9	X		X
3	Ocean View	Well	5.4	X		
4	North Lake	Lake	NA	X	X	
5	Middle Lake	Lake	NA	X		

Field Deployment and Data processing

For the lakes, a simple stilling well was constructed using 1.75"-ID PVC pipe (Figure 4). The logger is suspended in the stilling well so it is always submerged, but not sitting on the lake bottom buried by silt. (Figure 5). The pipes are perforated to allow the water level to reflect what is in the lake.

In the case of the groundwater wells, the bottom end of the PVC pipe is slotted with several 1/4"-ID holes. To install the pipes, a auger was used to dig a hole ½" larger in the diameter than the PVC pipe. The PVC pipe was then inserted into the hole and the gap between the pipe and hole was filled with clean sand.

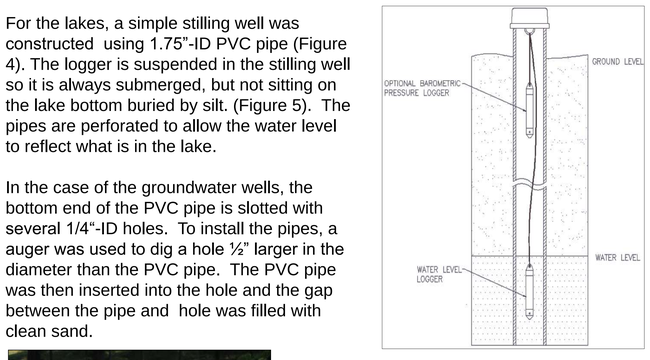

Figure 5:Stilling well design used in groundwater and lake wells . Graphic from Onset (http://www.onsetcomp.com/files/manual_pdfs/12315-E-MAN-U20.pdf)

Figure 4: North Lake stilling well being installed on May 21, 2012.

The water-level logger measures pressure using a transducer. Hoboware Pro ® software was used to convert the absolute pressure readings into water depths, correcting for water temperature and overlying barometric pressure. These depths were referenced to NAVD 88 using laser and GPS surveys from known benchmarks. Elevation uncertainties are on the order of 0.05 m. The Hoboware Pro ® software was also used to convert conductivity to specific conductivity using sensor-based temperature.

Groundwater hydrology

Groundwater should spontaneously flow from high to low elevations. During periods of abundant rainfall, the groundwater is expected to be discharging into the lake (Figure 6a). During periods of low rainfall, the lake should be discharging water into the groundwater aquifer. (Figure 6b)

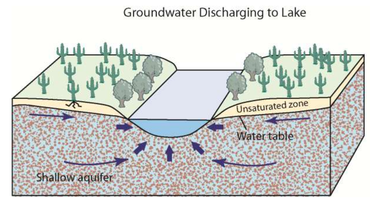

Figure 6(a): Groundwater hydrology during periods of abundant rainfall.

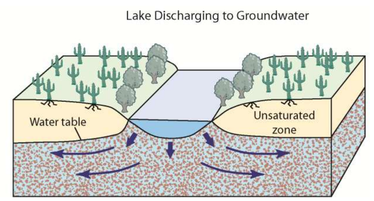

Figure 6(b): Groundwater hydrology during periods of low rainfall.

Results and Discussion

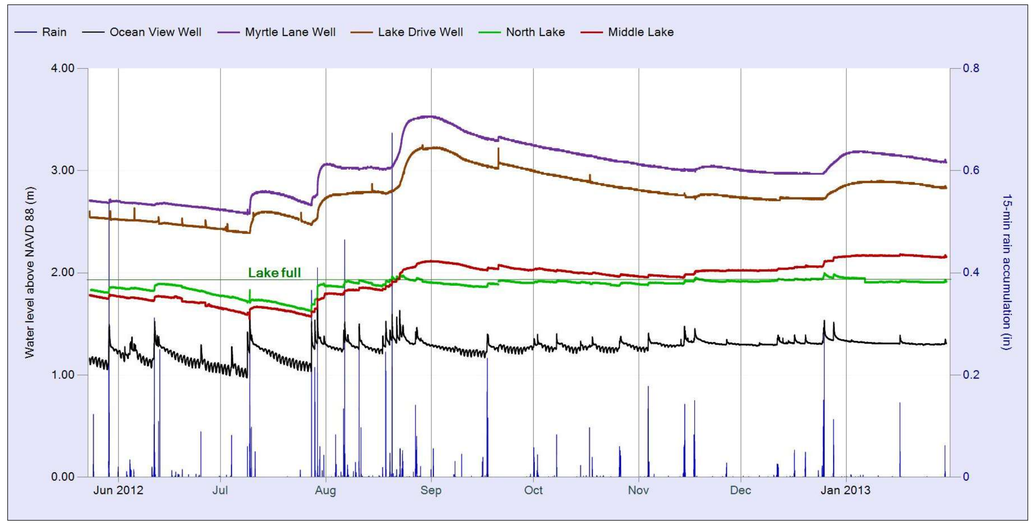

Figure 7: Water levels and rain accumulation since May 2012 in the lakes and groundwater at Briarcliffe Acres.

Rainfall since August 2012 has returned lake levels to near full conditions (Figure 7).

Thus far, monitoring has revealed that groundwater levels and lake conductivity respond rapidly to rain events, i.e. in a matter of hours (Figure 8).

Some of water levels in the groundwater wells oscillate diurnally, although local tides are semidiurnal (Figure 8). It is hypothesized that this diurnal oscillation is due to local evapotranspiration.

Additional conductivity measurements are now being made in the groundwater wells and Middle Lake. If the groundwater specific conductivity is higher than that of the lakes, we should be able to determine when and the degree to which groundwater is discharging into the lakes or vice versa.

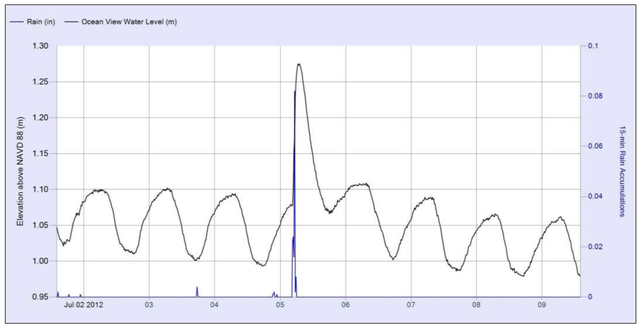

Figure 8: The groundwater oscillations at Ocean View

Conclusions

A unique feature of this monitoring program is the close collaboration between the community representatives and the university scientists and students. The town intends on using the results from the monitoring program to develop and implement an irrigation management plan. Other management activities that will rely on these data include: dredging of the lakes and troubleshooting septic tank problems associated with a high water table.

Acknowledgements

This project is jointly funded by the Horry County Stormwater Department and the Town of Briarcliffe Acres. The technical work is being conducted by the Waccamaw Watershed Academy at Coastal Carolina University.

Poster prepared by B.Thepaut, CCU, 3/5/13