

## 2012 Cedar Lake Watershed Hydrology Report

This is the second annual hydrology report to the Cedar Lake Improvement Board (CLIB). This report contains data collected by 21 water level dataloggers installed in piezometers (shallow well points) at 14 locations throughout the watershed. Water level data is depicted for each piezometer throughout the recreational season in 2012. Temperature data is also collected by each datalogger, but it will not be reported on here. If there is a desire for this information, it is available.

Piezometers are used in conjunction with a lake level staff gauge (another piezometer installed in the lake at the outflow). Included in the report after the piezometer charts are data collected from the staff gauge (Outflow) datalogger. Its purpose is to measure water level in the lake throughout the year.

The point of monitoring the piezometers and staff gauge is to determine how water flows throughout the watershed. We also want to determine the dynamic of groundwater flow into and out of Cedar. Additionally there is interest in the effects of Cedar water levels on ground water levels in communities immediately east of the lake. Of great interest to Cedar Lake residents is the degree to which ground water contributes to Cedar's lake level, and to understand water level losses through ground water movement out of the lake.

A simple example; a single shallow pipe is installed on the lakeshore. If at a particular moment in time, the staff gauge reports a water level in the lake lower than the level reported by that single piezometer at that same moment in time, then at the location of that piezometer pipe, ground water is moving into the lake. If the piezometer reports a lower reading than the lake level staff gauge, then ground water is moving out of the lake at that location.

Two types of piezometer well pipes are installed in the watershed; a shallow PVC pipe, and a deep galvanized pipe. Where a deep pipe is installed, it is always installed immediately adjacent to a shallow pipe. There is approximately eight feet of difference between the well point screens of the adjacent shallow and deep pipes. The purpose of this configuration is to measure the vertical movement or pressure of water indicating a flow into or out of the lake.

Specifically, if the deep pipe is showing a higher water level than the adjacent shallow pipe at the same moment in time, that indicates that there is higher vertical pressure on the ground water in that area and is an indication that water is moving into the lake. If the deep pipe shows a lower water level than the adjacent shallow pipe, then the vertical pressure is lower which indicates that water is moving out of the lake.

There is one other configuration of piezometers used in our watershed. A shallow pipe is installed on the shore and a second shallow pipe is installed in a direct line with the first, approximately 200 feet back from the shore. This is to measure the direction of the flow, and to allow an evaluation of the amount of the flow. For example, if the second well pipe is producing reading higher than the shoreline piezometer, then you know that water is moving toward the lake. If it's lower then it's moving away from the lake. The slope of the flow is more for engineers. It allows them to calculate the amount and speed of the groundwater flow.

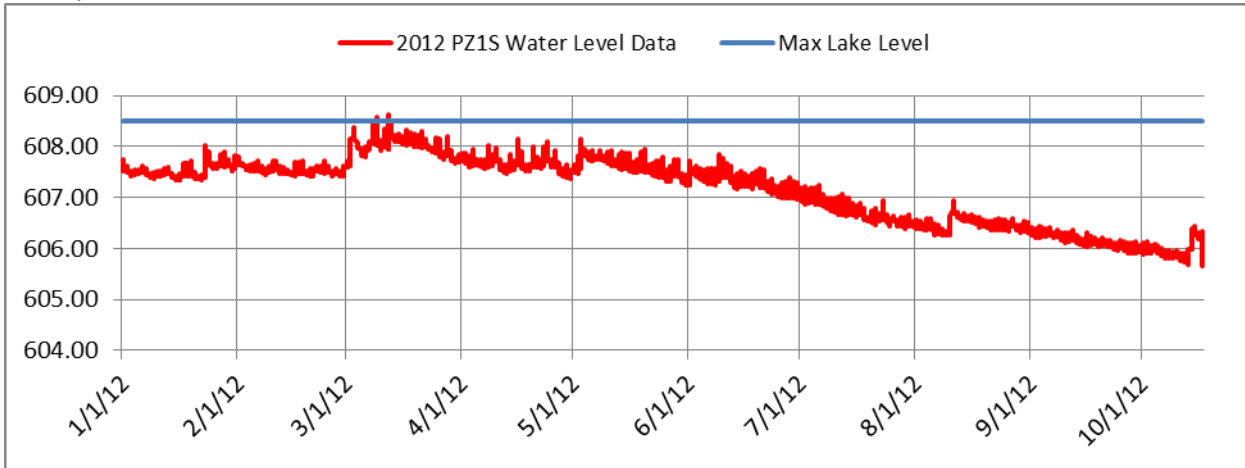
So, with that, what follows are a series of charts for each piezometer with enough information to know if it's a shallow or deep pipe, and its location. A PDF map depicting the location of each piezometer location is attached, and should be used in your analysis of the data. Each piezometer chart shows data collected through October 2012, and has a constant line drawn through the chart indicating the court ordered maximum water level for Cedar which might help you in your analysis.

There is no analysis offered here. The data is pretty clear, and with a bit of study the reader ought to be able to draw their own conclusions.

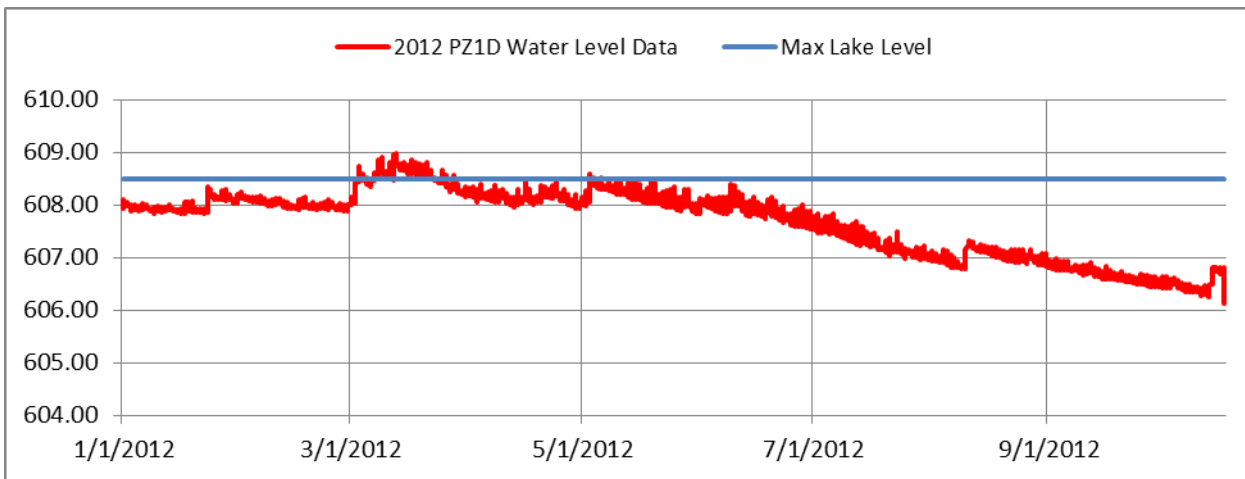
Finally, included at the end of the report is a chart depicting rainfall in the watershed. In 2012 this data is provided by a service called "Weather Source" gathered by them from the Harrisville weather station. You might use this in conjunction with the other charts to understand water level fluctuations reported by either or both the staff gauge and piezometers.

Any suggestions for changes and/or improvement to this report for next year will be welcomed with open arms.

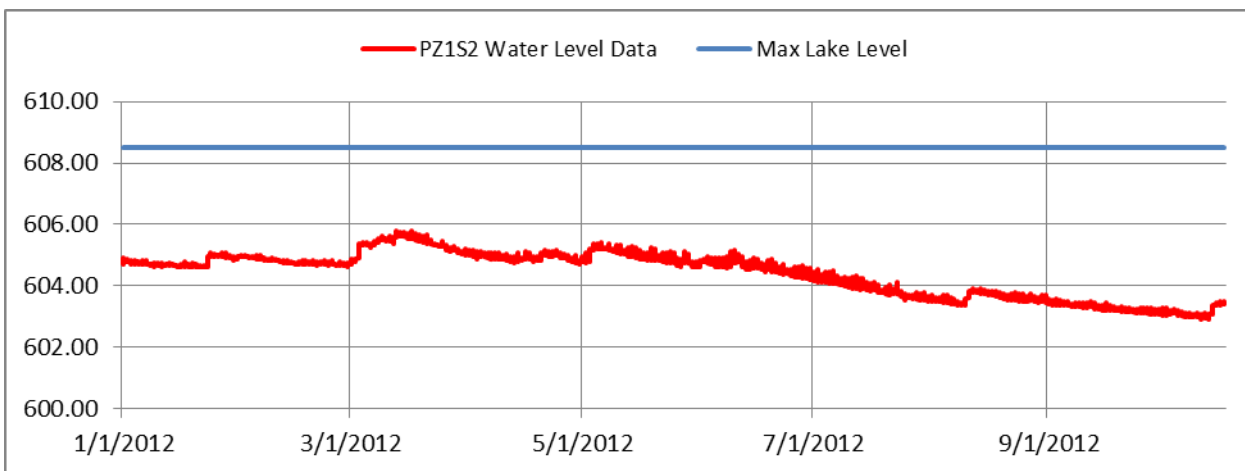
Refer to the map of piezometer locations to see where PZ1 is located on the lake. It is a single private residence, and there are three piezometers located at PZ1.



PZ1S is a shallow, near shore piezometer.

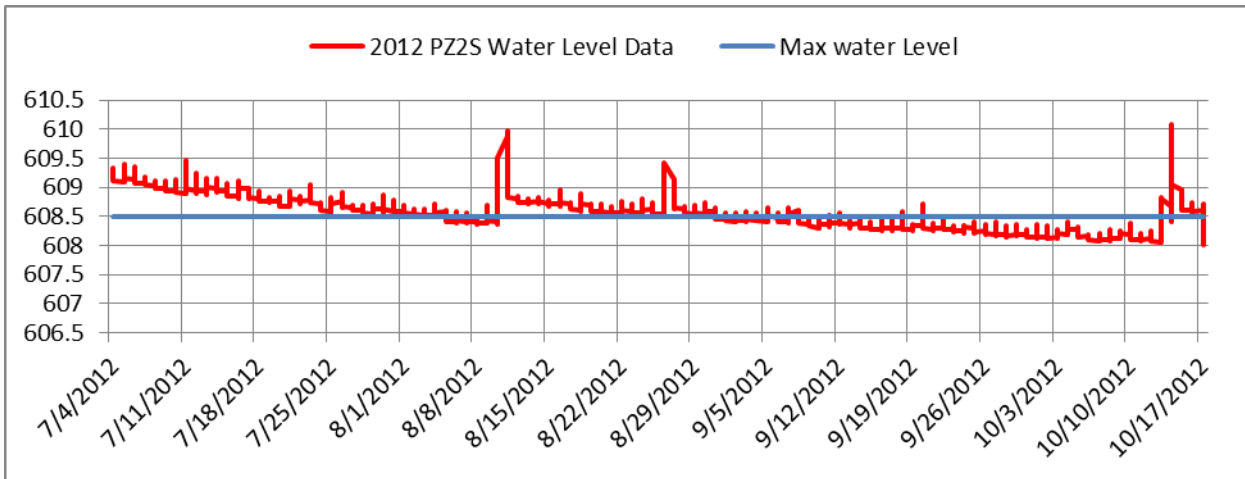


PZ1D is a deep, near shore piezometer. It is located immediately adjacent to PZ1S. The screen of the deep piezometer (PZ1D) is approximately always 8 feet deeper than the screen of the shallow piezometer (PZ1S).

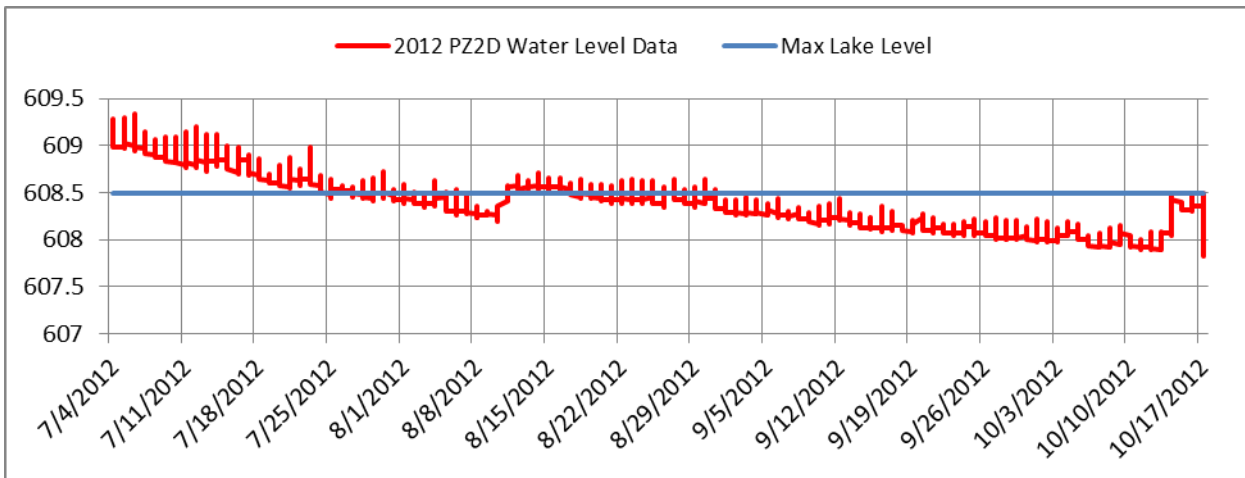


PZ1S2 is a second shallow piezometer located at this property. It is installed approximately 200 feet back from the lakeshore.

Refer to the map for the location of PZ2 on the lake. This is a single private residence. There are two piezometers located at this property.

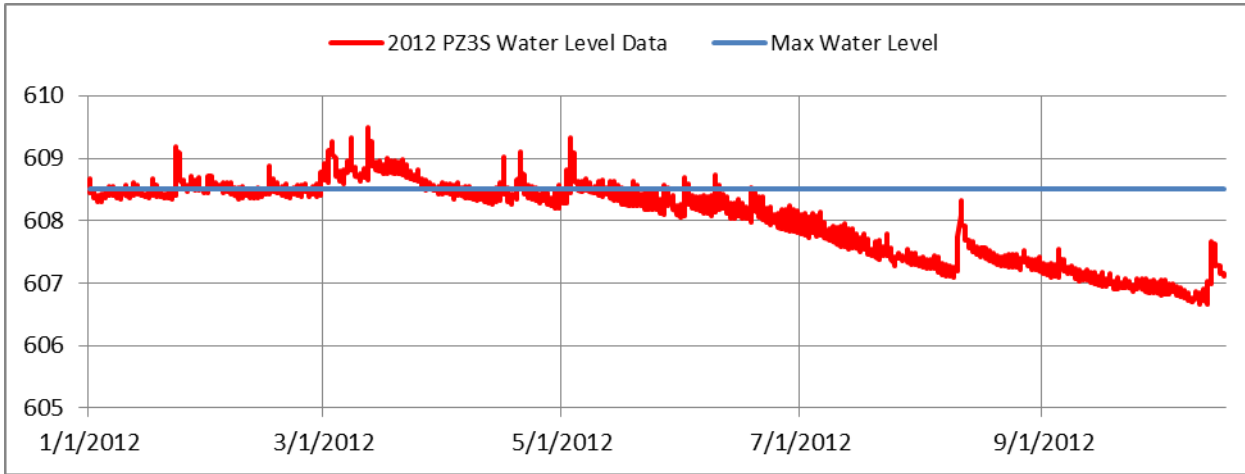


PZ2S is a shallow near shore piezometer.

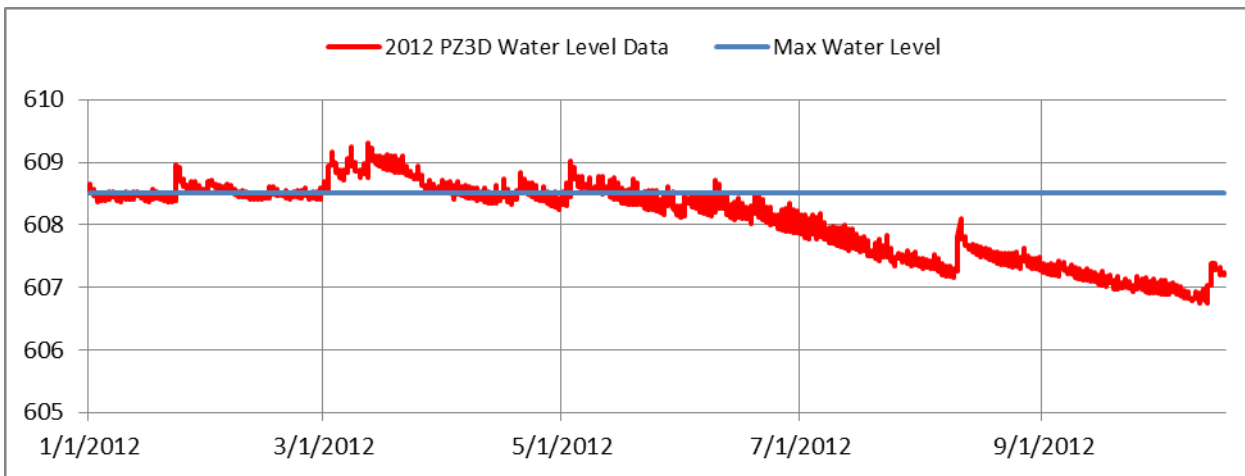


PZ2D is a deep near shore piezometer. It is installed immediately adjacent to PZ2S.

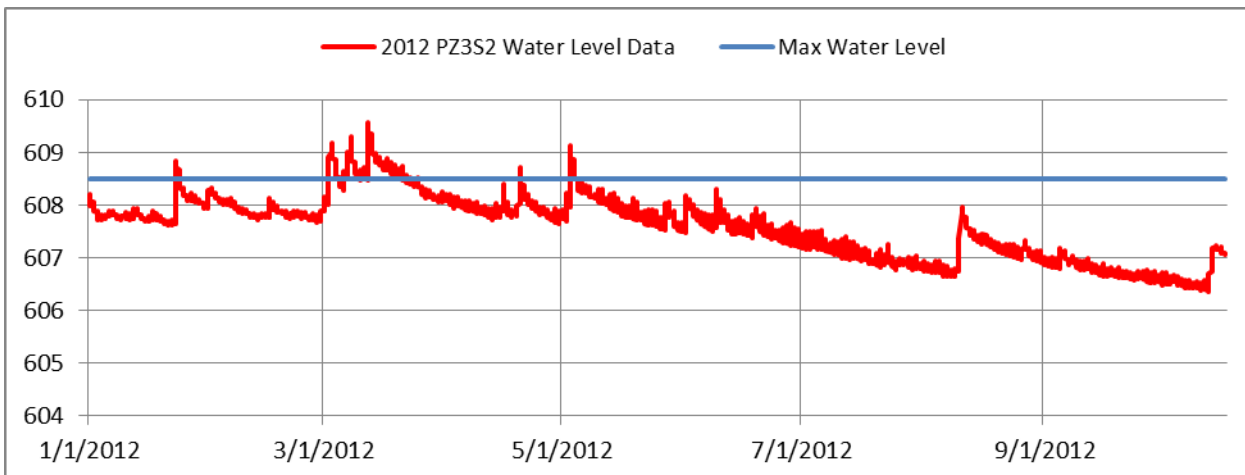
Refer to the map of piezometer locations to see where PZ3 is located on the lake. It is a single private residence, and there are three piezometers located at PZ3.



PZ3S is a shallow, near shore piezometer.

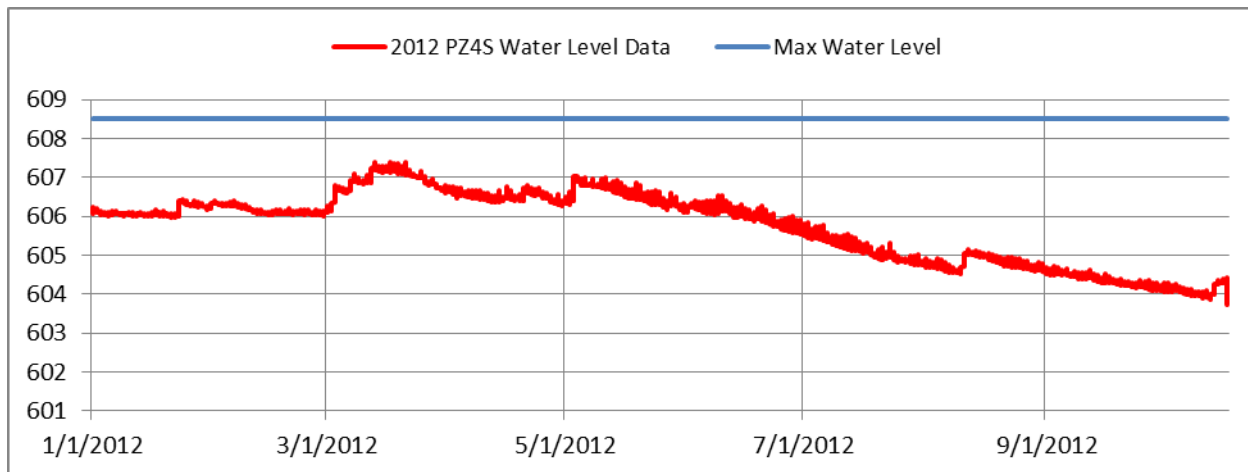


PZ3D is a deep, near shore piezometer. It is located immediately adjacent to PZ3S.



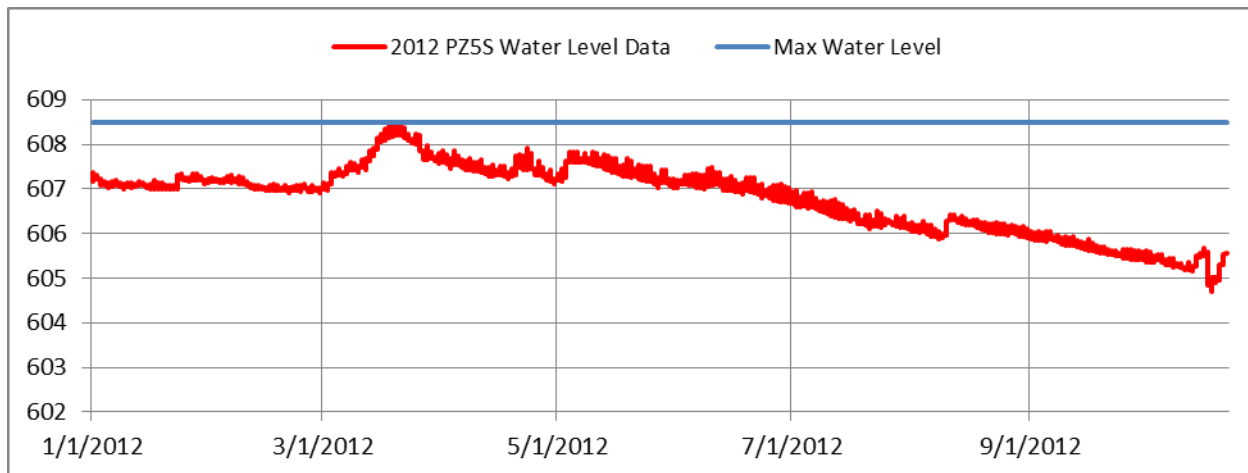
PZ3S2 is a second shallow piezometer located at this property. It is installed approximately 200 feet back from the lakeshore.

Refer to the map of piezometer locations to see where PZ4 is located on the lake. It is a single private residence, and there is one piezometer located at PZ4.



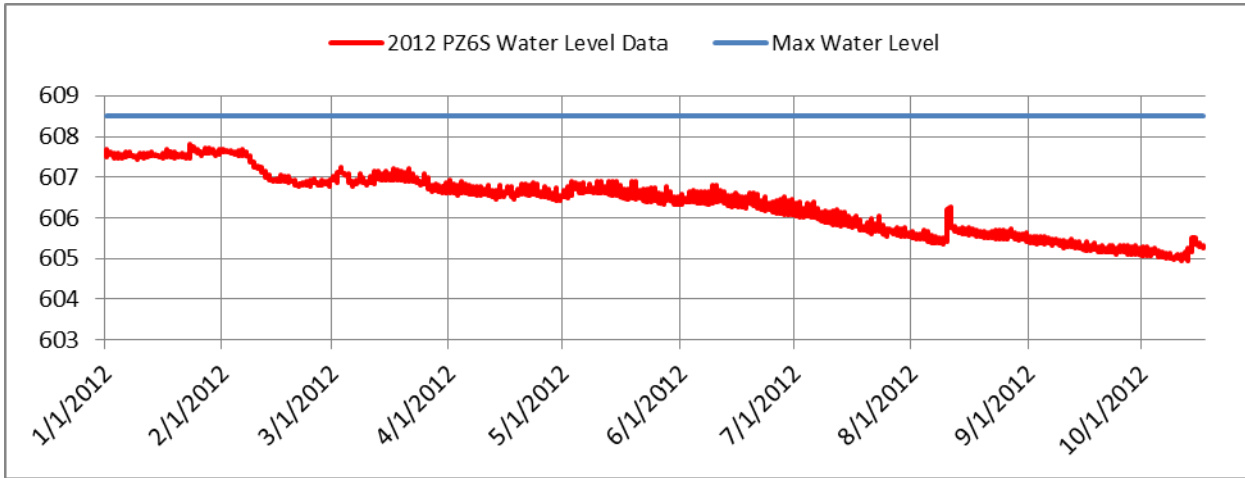
PZ4S is a shallow, near shore piezometer.

Refer to the map of piezometer locations to see where PZ5 is located on the lake. It is a single private residence, and there is one piezometer located at PZ5.

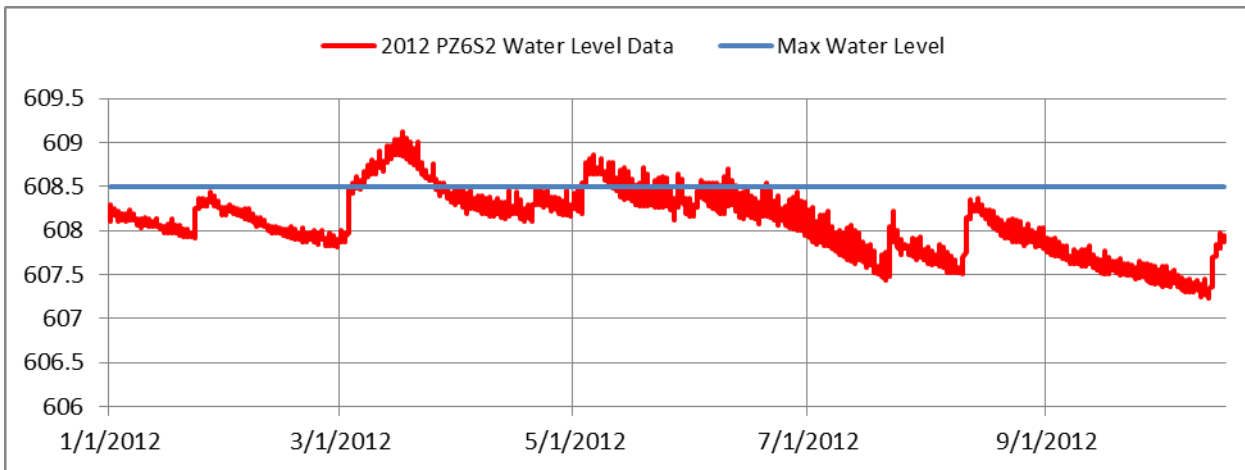


PZ5S is a shallow, near shore piezometer.

Refer to the map of piezometer locations to see where PZ6 is located on the lake. It is a single private residence, and there are two piezometers located at PZ6.

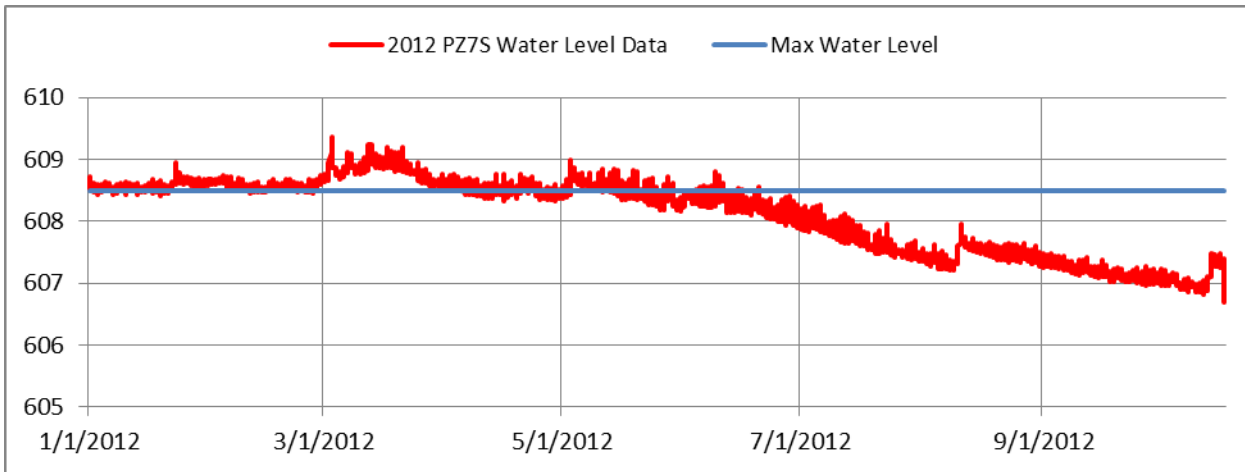


PZ6S is a shallow, near shore piezometer.

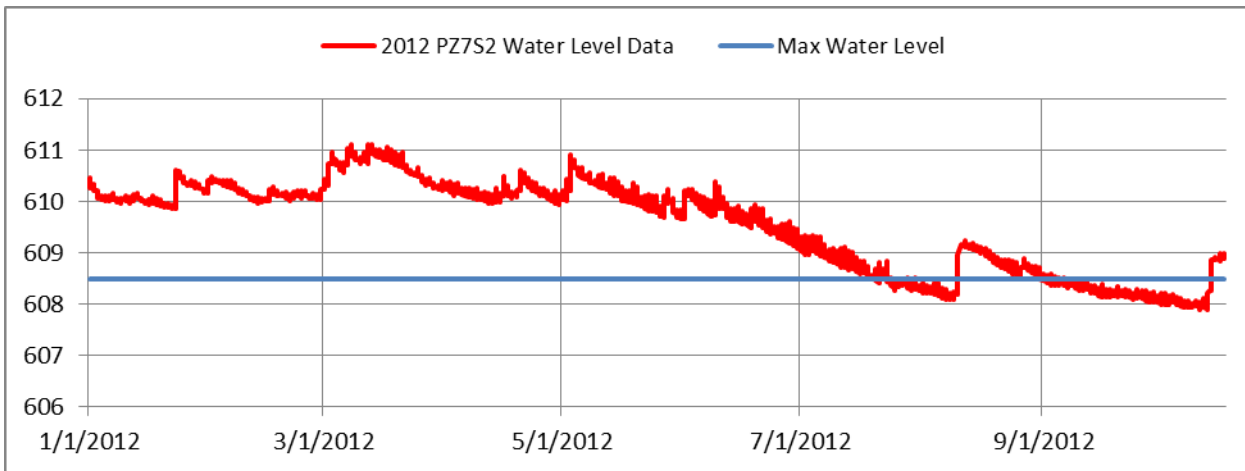


PZ6S2 is a second shallow piezometer located at this property. It is installed approximately 200 feet back from the lakeshore.

Refer to the map of piezometer locations to see where PZ7 is located on the lake. It is a single private residence, and there are two piezometers located at PZ7.

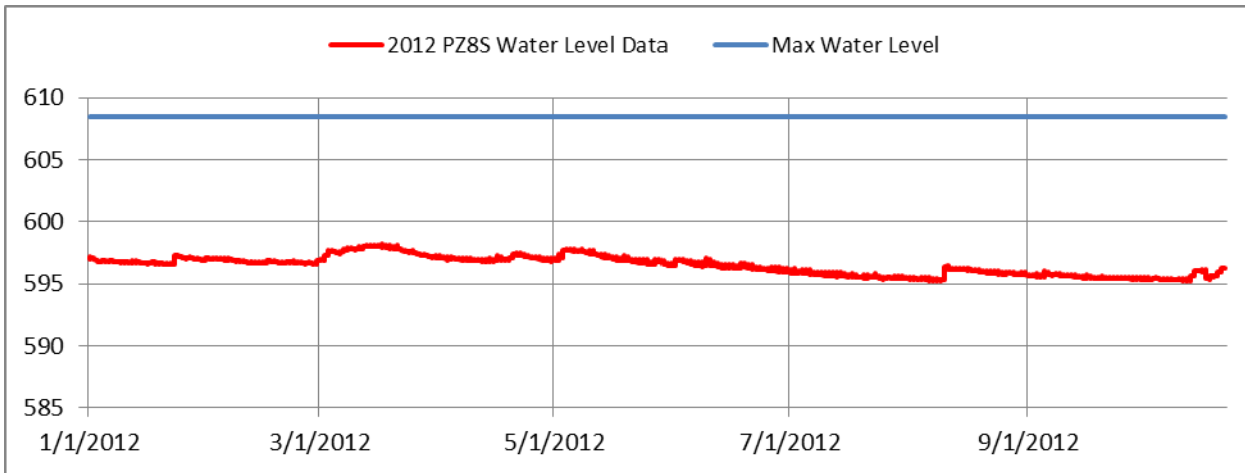


PZ7S is a shallow, near shore piezometer.

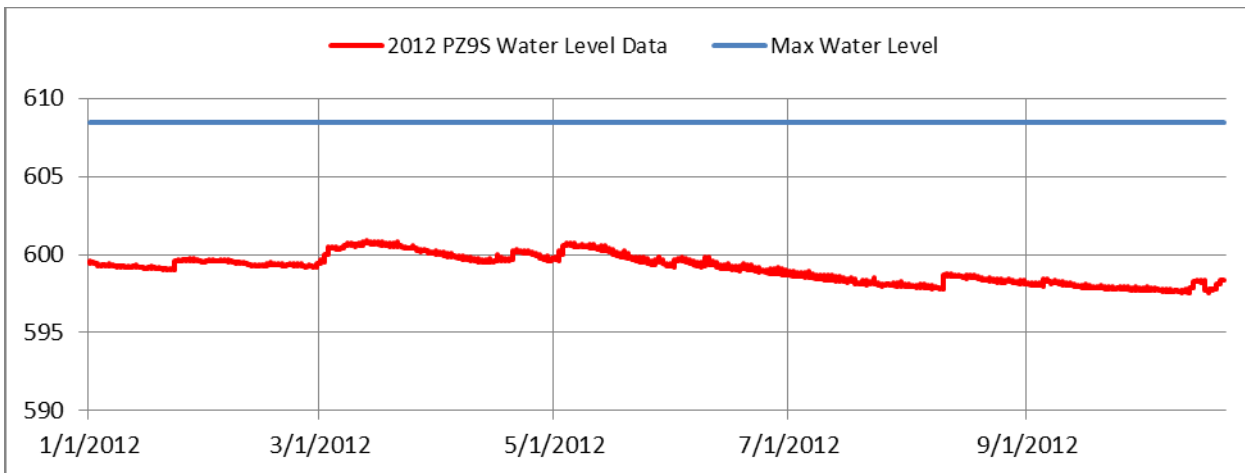


PZ7S2 is a second shallow piezometer located at this property. It is installed approximately 200 feet back from the lakeshore.

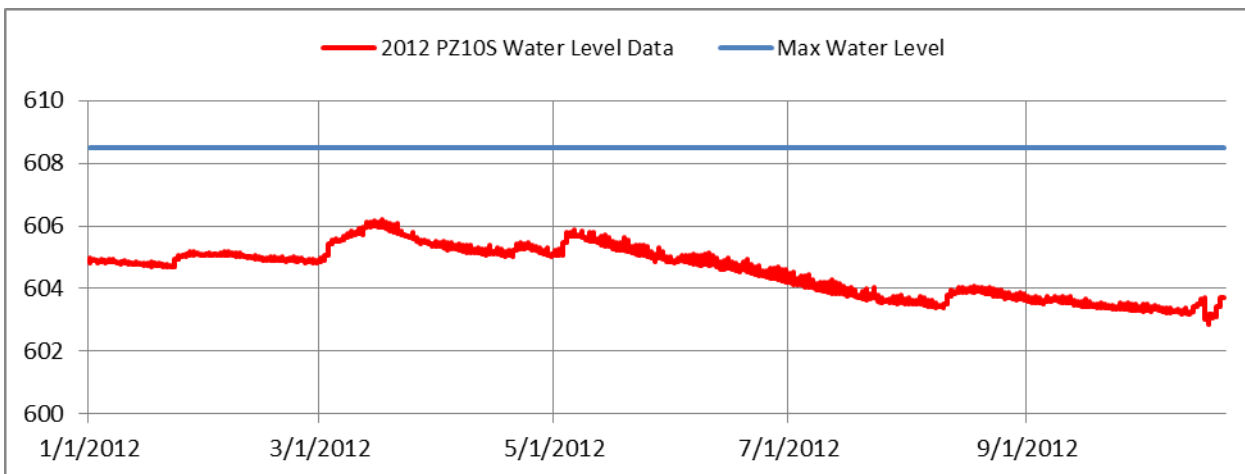
Refer to the map of piezometer locations to see exactly where PZ8, PZ9, PZ10, and PZ11 are located in the lake's watershed. They are equally spaced throughout the Lakewood Shores POA's green-space, and there is one piezometer located at each of these locations.



PZ8S is a shallow piezometer.

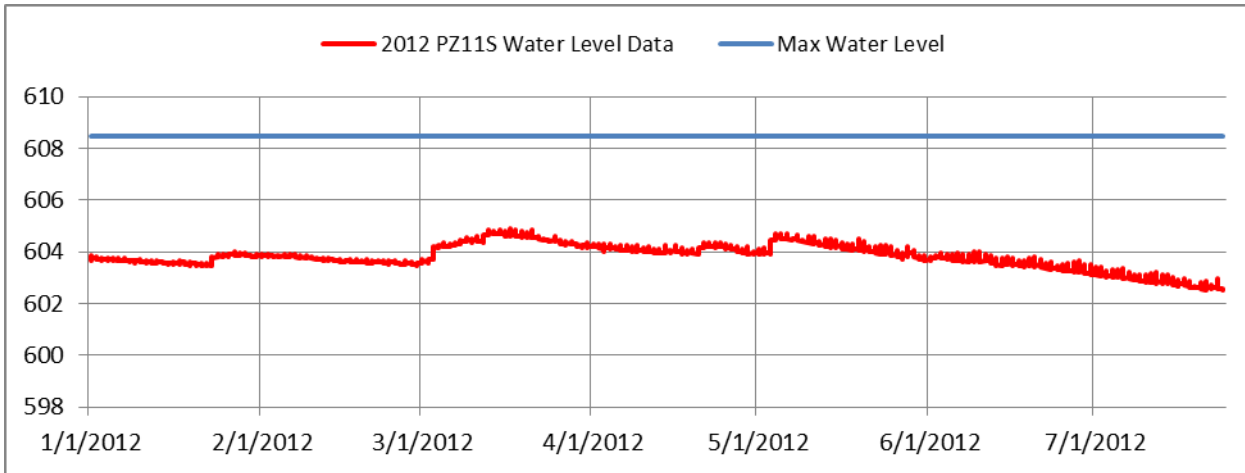


PZ9S is a shallow piezometer.



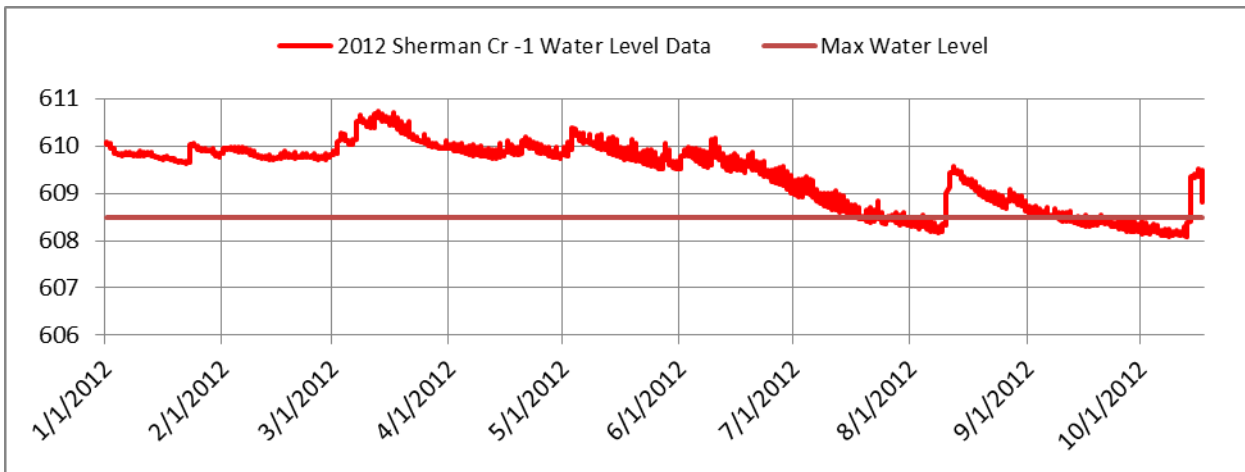
PZ10S is a shallow piezometer.



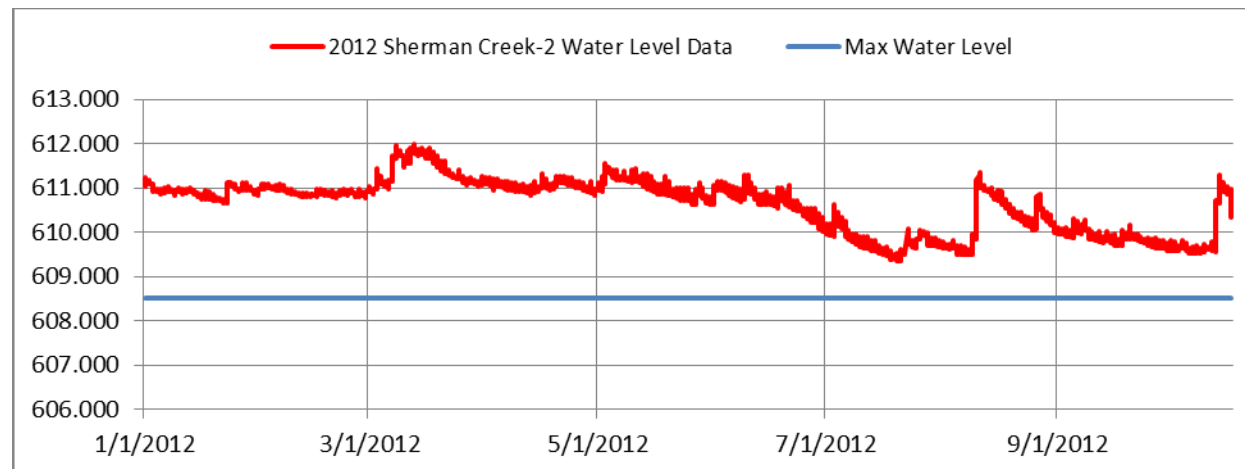


PZ11S is a shallow piezometer. The datalogger was re-deployed in July of 2012 incorrectly after it was pulled to collect data, hence, no data collected in 2012 beyond July. It was re-deployed properly in October 2012. So, data is once again being collected.

Refer to the map for the exact locations of the Sherman Creek piezometers. There are two piezometers located in Sherman Creek.



Sherman Cr-1 is a shallow piezometer.



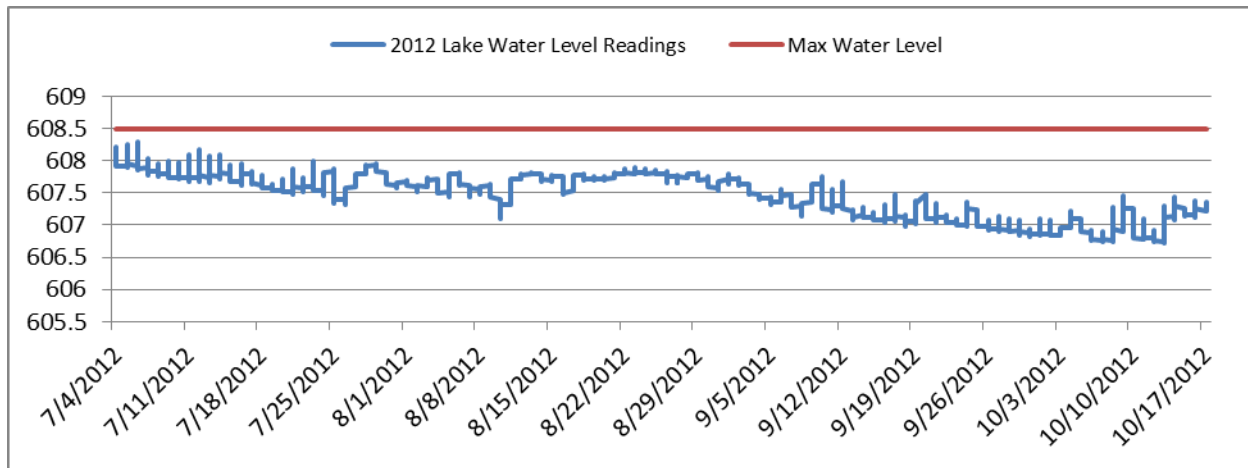
Sherman Cr-2 is a shallow piezometer.

Refer to the map for the location of the Jones Creek Piezometer. There is one piezometer at this location.

**Jones Creek piezometer was damaged in the winter of 2011/2012. It was not functional during most of 2012, including the entire recreational season. It was replaced and made operational in the fall of 2012. Data is now being collected. In the spring of 2013 the top of casing needs to be surveyed before the data collected from it can be used.**

The Jones Cr piezometer is a shallow piezometer.

Refer to the map for the location of the Lake Outflow Piezometer.



The outflow piezometer is located in the lake. It is unique to the rest of our piezometers, as it is not used to measure ground water movement. It functions as an automated staff gauge, recording the lake's water level readings.

The datalogger installed in the rain gauge located at the southernmost point of the lake, normally used to track rainfall from May through October or November, failed in 2012. Data from "Weather Source" collected from the Harrisville weather station was used as our 2012 rainfall data source. The rain gauge datalogger has been repaired and it is our intention to go back to using that as our rainfall data source in 2013.

