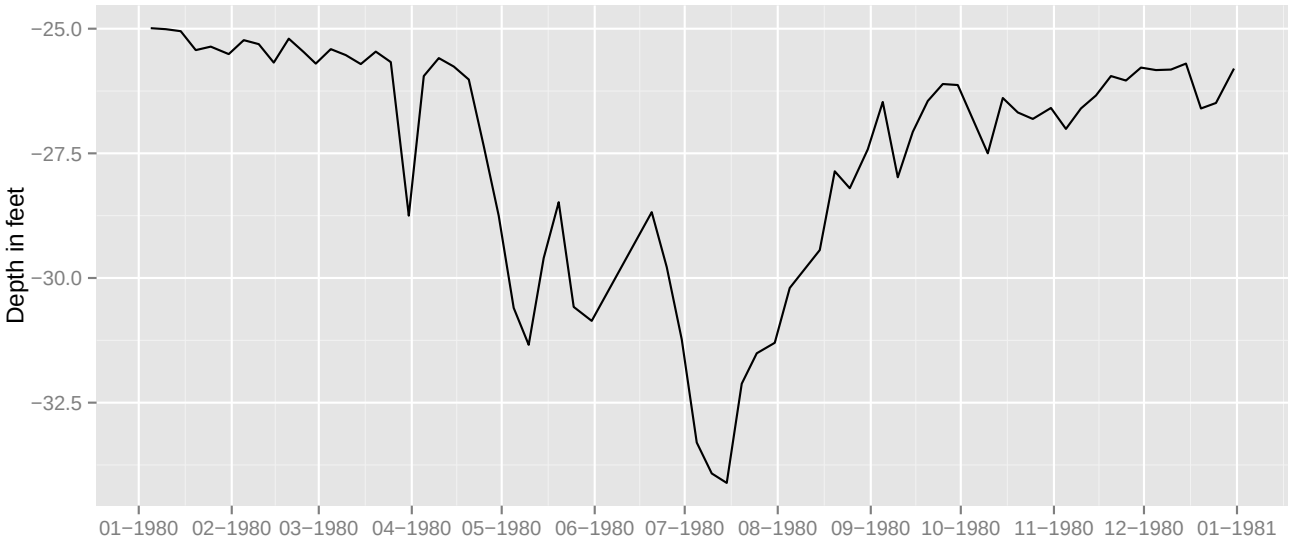
Aquifers – Water of Life

Human demand for water – including water for irrigation, lawn care, paper manufacturing, and other industrial uses – continues to increase, taxing our groundwater supply. How can we quantify this using the language of *rate of change*? We will work with graphs showing the water level in a well near Lake Minnetonka, Minnesota (DNR Obwell number 27010). Well levels give a proxy for aquifer level.

1. Using the graph below, what is the average rate of change in feet per month of the water level between January 1980 and July 1980?



2. Using the graph for 1980, what is the average rate of change in feet per month of the water level between July 1980 and August 1980? August 1980 and December 1980?

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3. Using a straightedge to draw a tangent line, estimate the instantaneous rate of change in water depth on July 1, 1980.

4. *Roughly* characterize the time domains on which the water depth is increasing. What seasons do they correspond with?

5. Come up with some explanations for why water depth is decreasing during certain seasons and increasing during others. Discuss with your group members and instructor!

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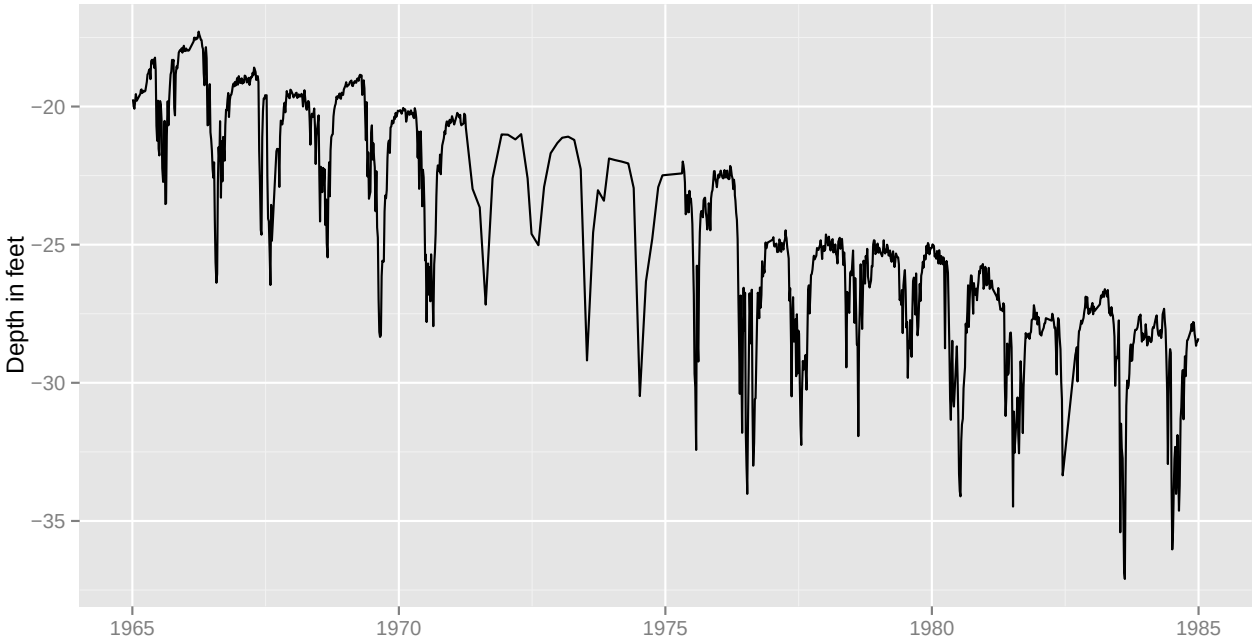
6. The graph below looks at water depth in the well over twenty years, 1965-1985. Why is the shape jagged, with an apparent period of a year? Use full sentences to explain your hypothesis.



7. Estimate the rate of change of winter water depth between 1965 and 1985. (Think about which part of the graph corresponds to each winter.)

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8. Use your estimate to write a linear function $W(t)$ for winter water depth W as a function of the year t.

9. The well in question is 437 feet deep. Assume water usage continues in the same pattern as illustrated. To figure out when the well will go dry, should you consider winter depth or summer depth? Discuss with your group members. Write an equation to estimate when the well will go dry according to your group decision.