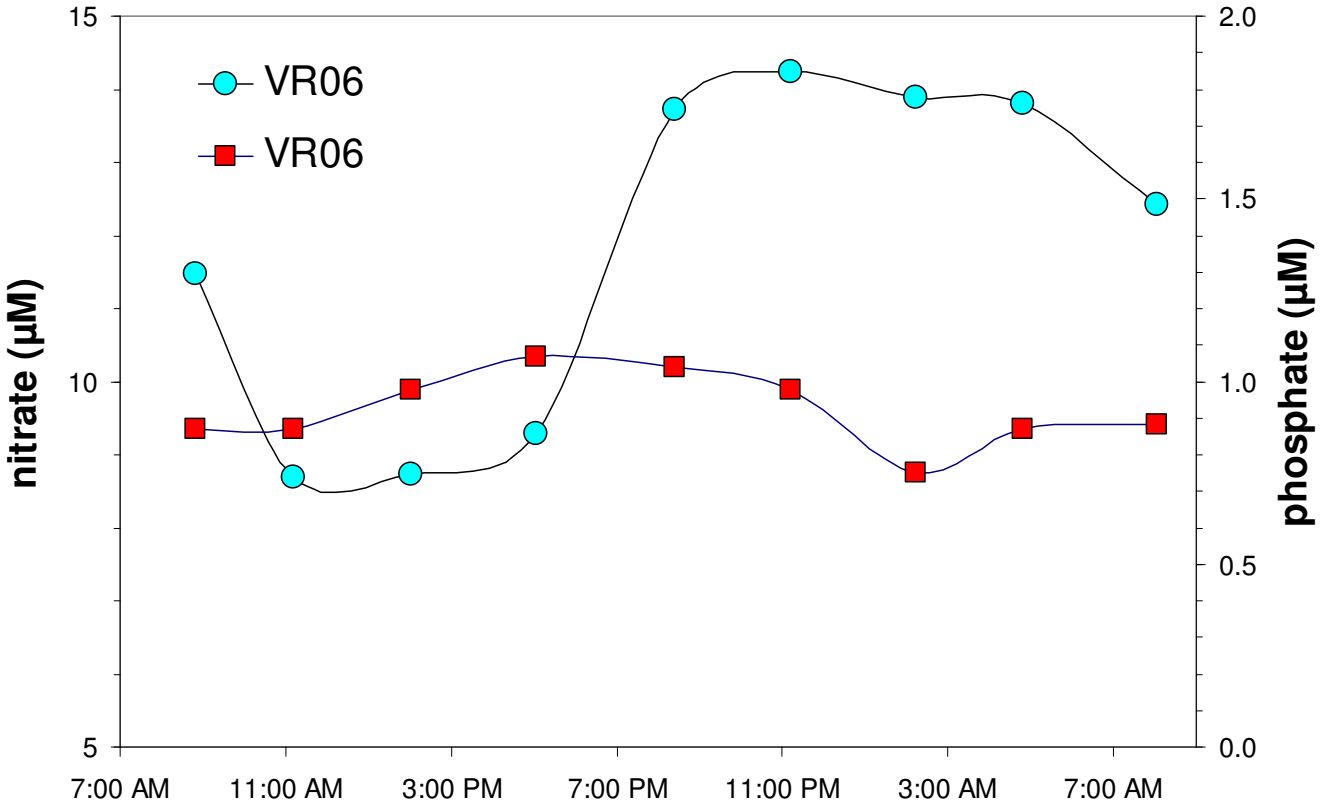
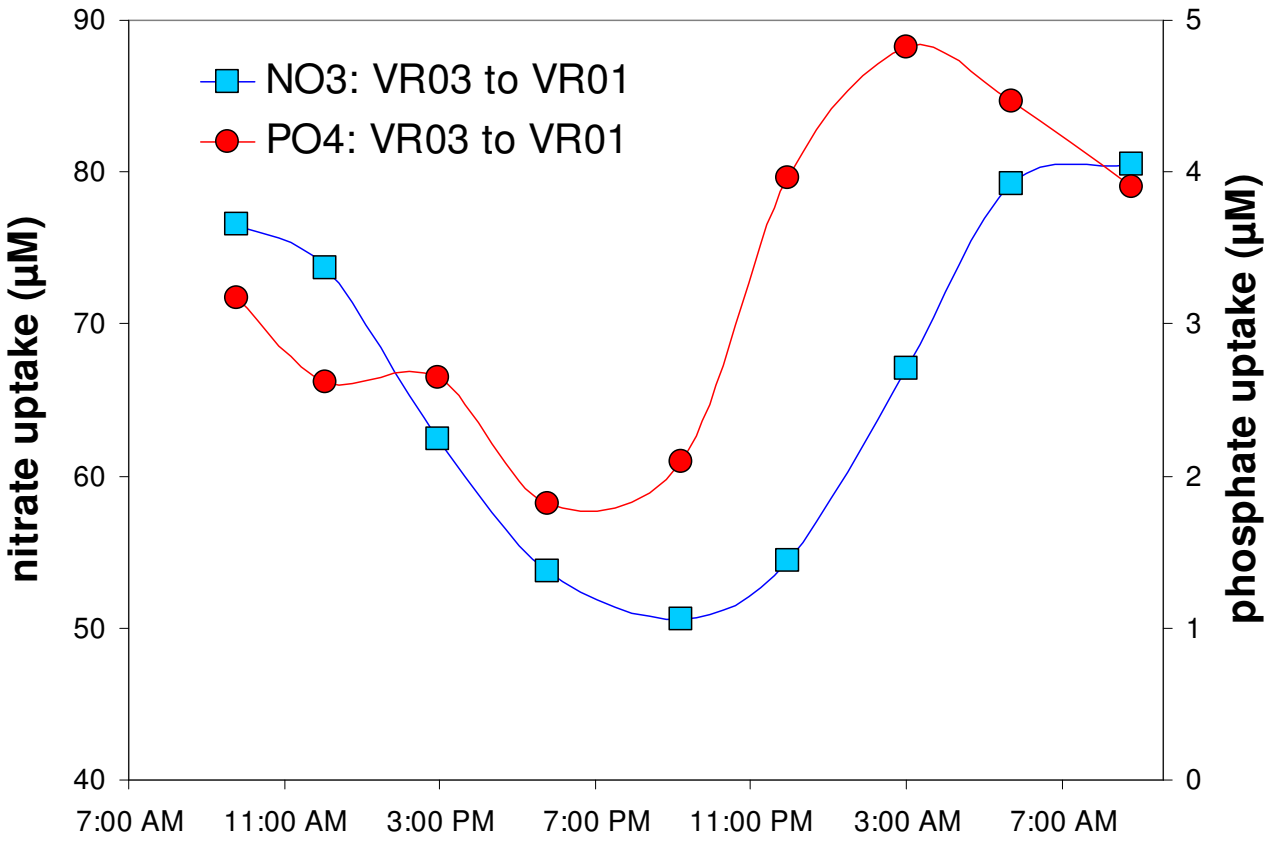


Foster Park, Sept. 10-11, 2003: Variations in nutrient concentrations over a 24 hour period. Assuming groundwater inflow (the only source of water at this location) nutrient concentrations remained constant, the nitrate cycle is the exactly one we might expect to see: lower daytime concentrations because of uptake by algae, the dominant primary producer at this site. There is no obvious phosphate cycle. Phosphate concentrations are so low that any pattern might easily be subsumed within analysis error (LTER phosphate analysis accuracy being questionable because of concerns raised later). If we apportion the difference between daylight and nighttime nitrate concentrations (~5 µM) to uptake, with a probable freshwater Redfield ratio of 20-30 we might expect a simultaneous phosphate fluctuation of 0.17-0.25 µM of phosphate – an easily misplaced amount.

The next figure shows nutrient uptake on Sept. 10-11, 2003, as indicated by the change in concentration between VR03 (Shell Road, below the treatment plant) and VR01 (Main Street, at the tidal limit). Variations in treatment plant output were not measured, but if the flow remained constant (an important caveat) changes in concentration between the two sites would indicate both the uptake pattern and amount.

What follows are my comments at the time:

“Well, there is a nice nitrate pattern. But why uptake should be at a maximum at 5 AM is a mystery. And why should uptake decrease during the day (when we might expect the maximum photosynthetic affect). Why 10 PM as a minimum? And why the late night/early morning (before sunrise) increase? A vampire effect?



That phosphate shows kind of the same pattern adds to the mystery. My only thought is that the nitrate pattern (and possibly most of the phosphate as well) is flow related. If flow increased during the day, and then gradually decreased at night, we might see this kind of nitrate uptake cycle (gross uptake in kg would not match the relative decrease in downstream concentrations).

However, flow at Foster Park *decreases* during the day, then increases from about 1800 or 1900 in the early evening (the decrease is about 13 %). This probably represents the daily evapotranspiration cycle. Still unknown is the treatment plant cycle and the combined result. And this flies in the face of the decrease in nitrate at VR03 -- if overall flow from VR06 is decreasing, then concentrations at VR03 should be increasing if treatment plant output is constant. Only a decrease in plant outflow and concentration would seem to account for the patterns in uptake and VR03 concentrations. (*Nitrate concentrations at VR03 decreased from ~125 µM at 9 AM to ~100 at 8 PM. We never determined the actual treatment plant discharge – one of many mistakes made during this experiment.*) It's ironic that the expected pattern appears at VR06 if we assume that the upstream nitrate source is constant: a decrease in nitrate during the day followed by a nighttime increase (see previous sheet). I kind of like the vampire plant hypothesis for Ludwiga -- it uptakes nutrients only at night."

Julie and I talked about using her Ludwiga tub experiments to answer some of these questions, particularly the one about when does uptake occur. However, it never worked out and remains an unanswered question.