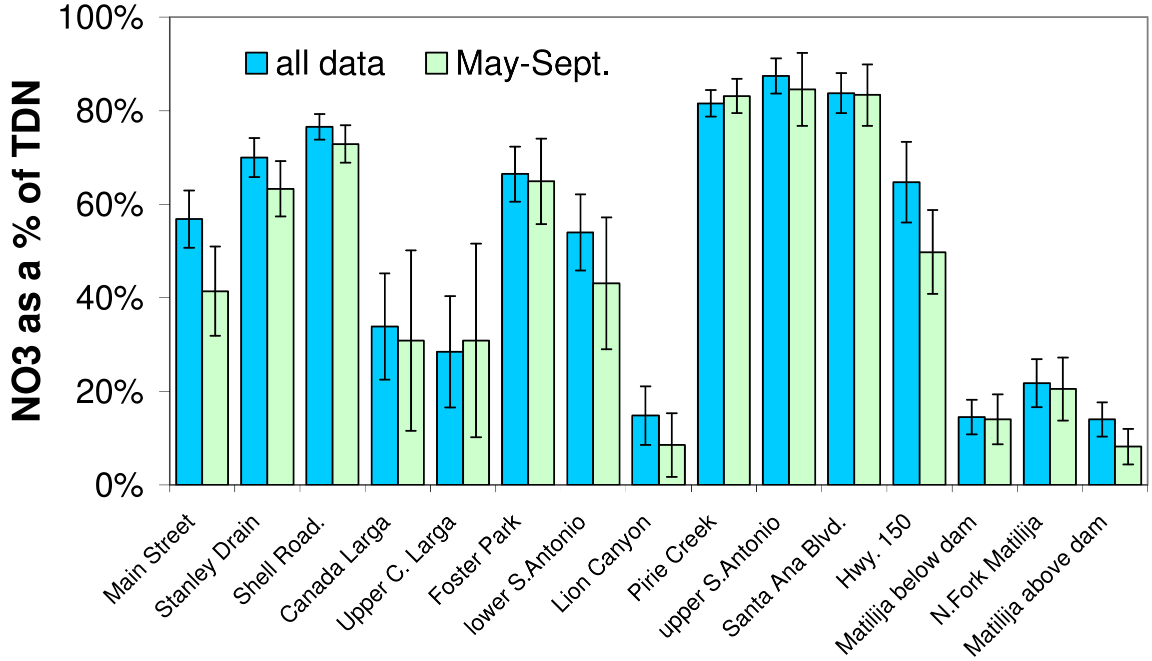
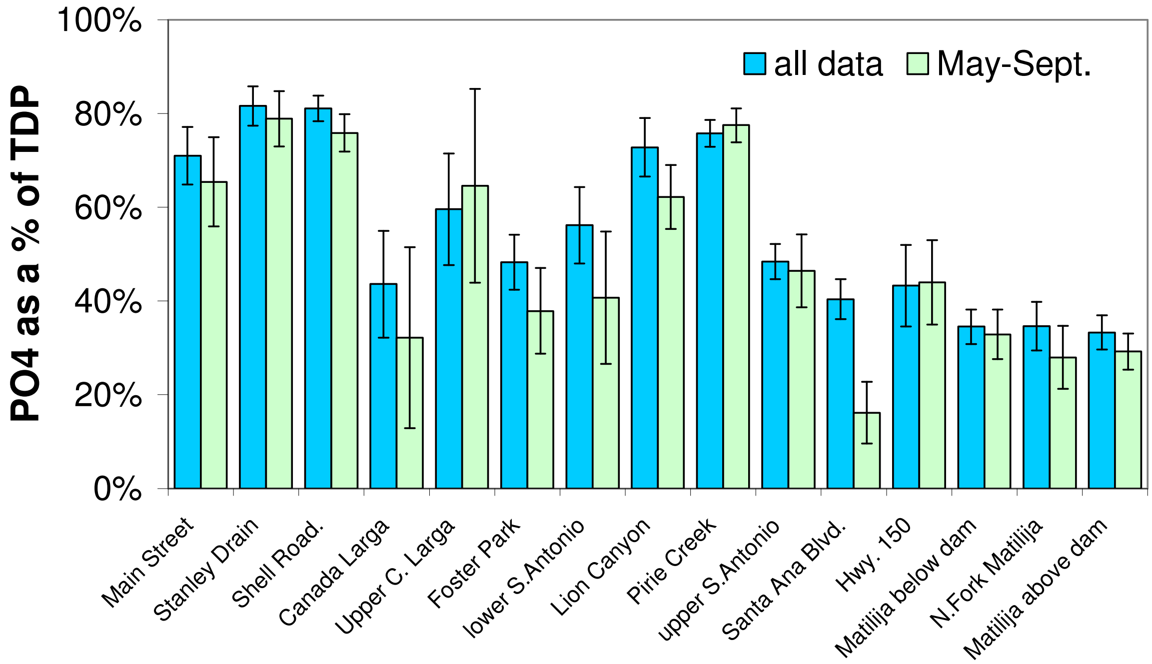
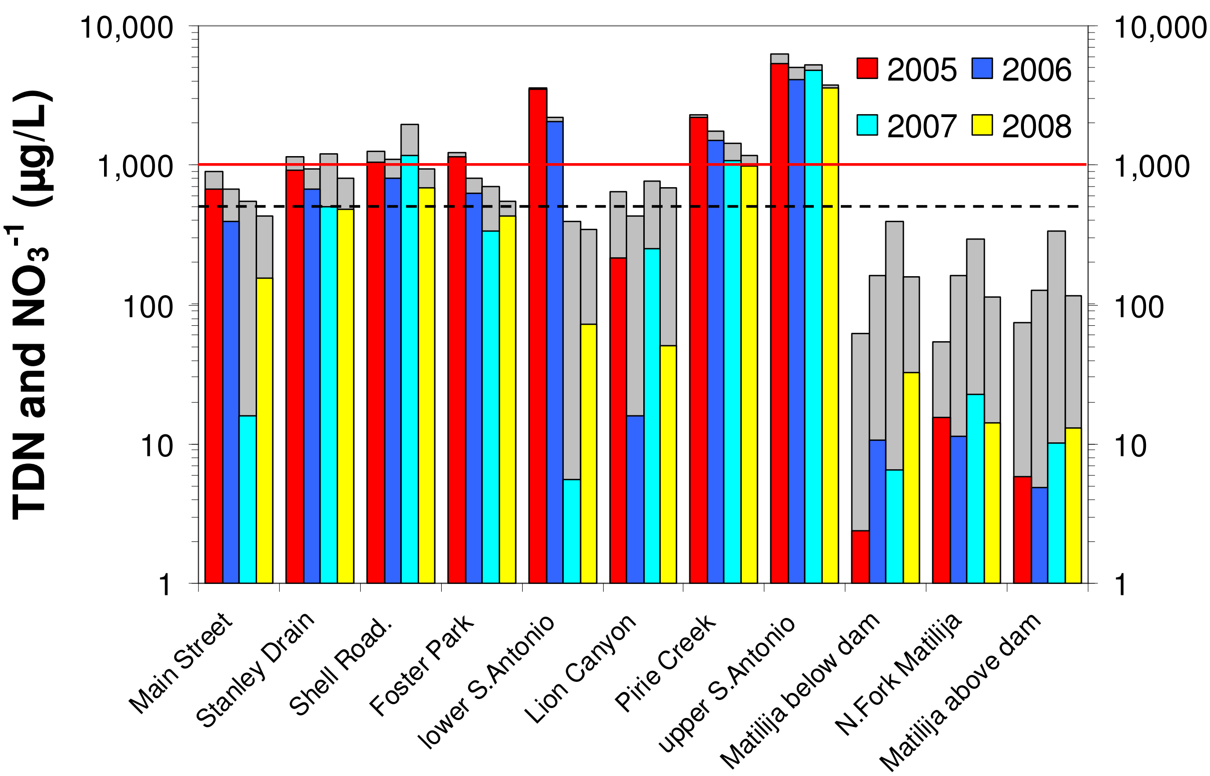




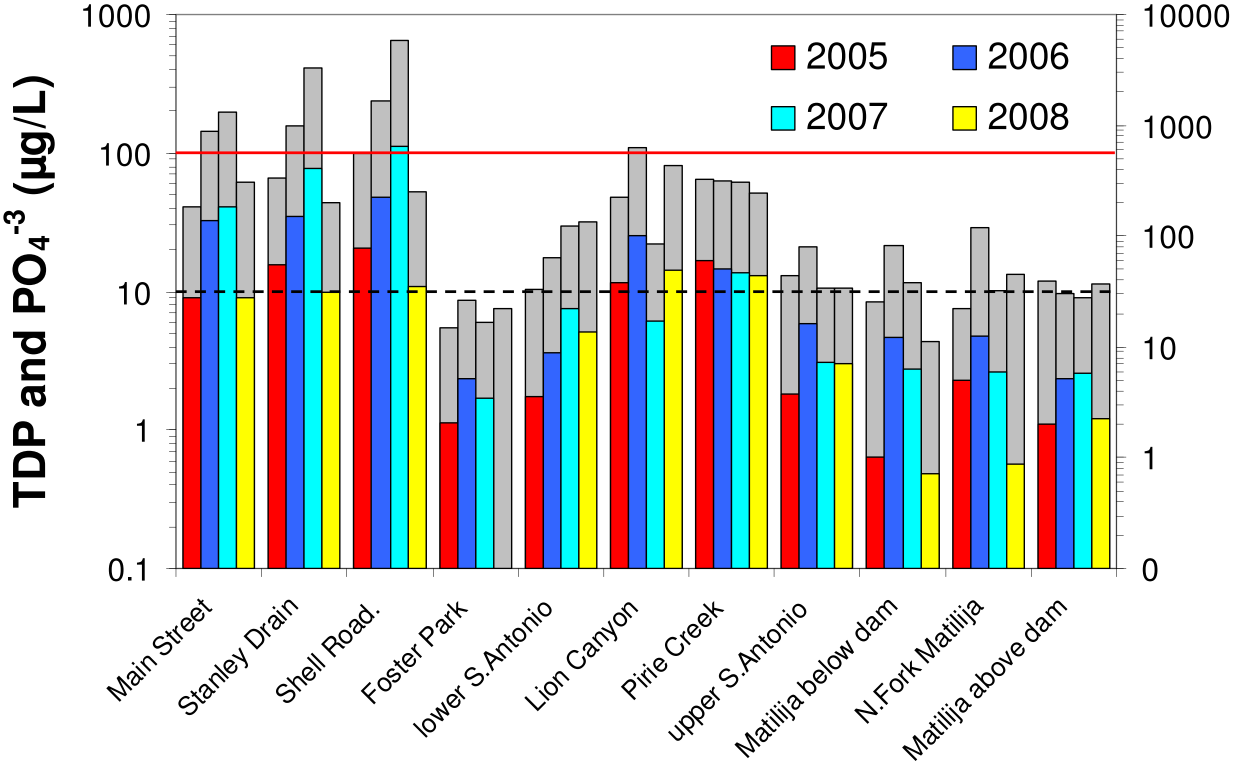
The two graphs show the percent of nitrate in TDN and of phosphate in TDP (with error bars showing 2-times the standard error of the mean). Separate results are shown for "all data" (i.e., all monthly SBCK values) and data summarizing May through September samples. Unfortunately, because of problems in the totals analysis, the true situation is not this simple. The graphs summarize SBCK monthly sampling data from 2001-2008, but two types of results were excluded in the calculation: (1) those showing zero totals concentrations or zero for both ionic and totals concentrations; (2) samples in which ionic concentrations (nitrate or phosphate) exceeded TDN or TDP. If I make the assumption that the type (2) exclusion is mainly an artifact of precision, and the statistical difficulty of subtracting one number from another to derive a much smaller difference (i.e. the ionic component is ~100 %

of the totals concentration), then the percentages shown are underestimates. (Lab accuracy has been stated as ± 10 % for TDN and TDP, ± 5 % for nitrate and phosphate.) Given that about 8 % of the TDN results fall into this category, it's only a 1-6 % underestimate in the case of nitrate (e.g. 1 % for upper San Antonio, 6 % for the Matilija), but it could be as high as 24 % for phosphate since 40 % of these samples show phosphate > TDP (e.g. 8 % below the treatment plant, 24 % for the Matilija).

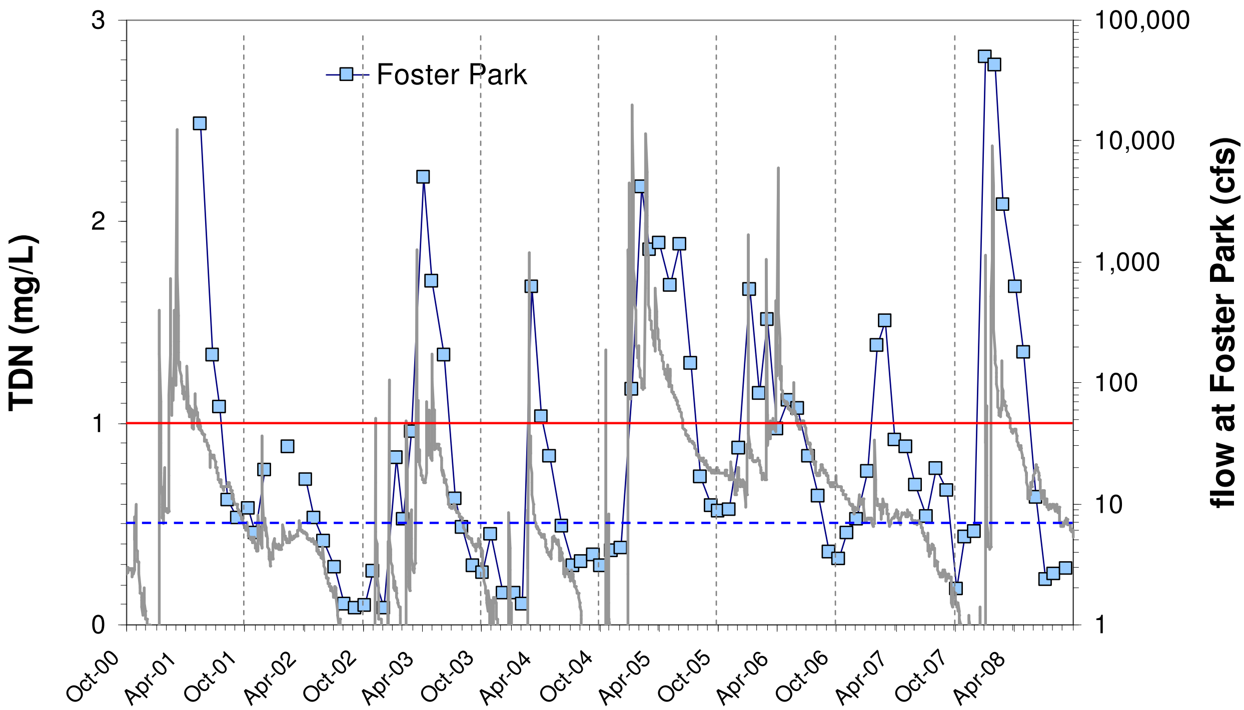
There are a number of other problems, especially concerning phosphorus (aside from the basic consideration of whether or not it's even appropriate to use TDP concentrations in quantitative sense). The elimination of about 40 % of the TDP samples probably leaves too few good data to accurately determine percent seasonal phosphate at sites that usually go dry (Canada Larga, Santa Ana, Pirie, etc.). TDP and phosphate concentrations, especially post-2004 values, at relatively undeveloped sites are usually very low. The stated detection limit is 0.3 μM, which is roughly 0.01 mg/L. My own feeling (given a relatively high percentage of *negative* values returned by the Lachet) is that the zero point is not accurately determined (a by-product of running many samples of widely varying concentrations in any given run) and that concentrations below 1 μM (0.3 mg/L) are always suspect. Post-2004 data at a number of sites are almost always below this limit (e.g. the Matilija) and any stated percentage has to be taken with a grain of salt. Although this is less of a problem with nitrate, lots of summer samples also fall into this suspect category.



I have already constructed similar graphs (showing relative amounts instead of percentages) in the "II" files for TDN & nitrate and TDP & phosphate on the sheets labeled "DOP I ." The above figure shows seasonal concentrations (May through Sept.) from 2005-2008; TDN is in grey, the nitrate fraction in color.

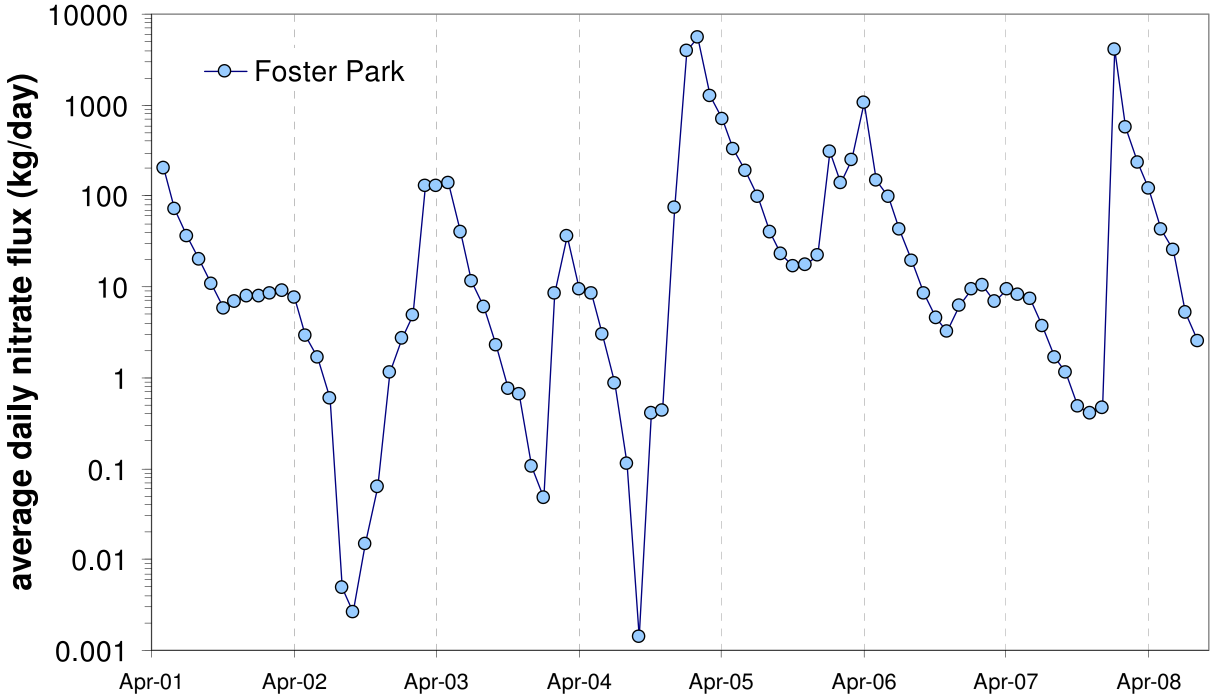


This is the corresponding figure for TDP and phosphate. Again, these are seasonal concentrations (May through Sept.) from 2005-2008; TDP is in grey, the phosphate fraction in color. All seasonal values, including those where TDN concentrations were set equal to nitrate and TDP to phosphate, are shown in these two figures

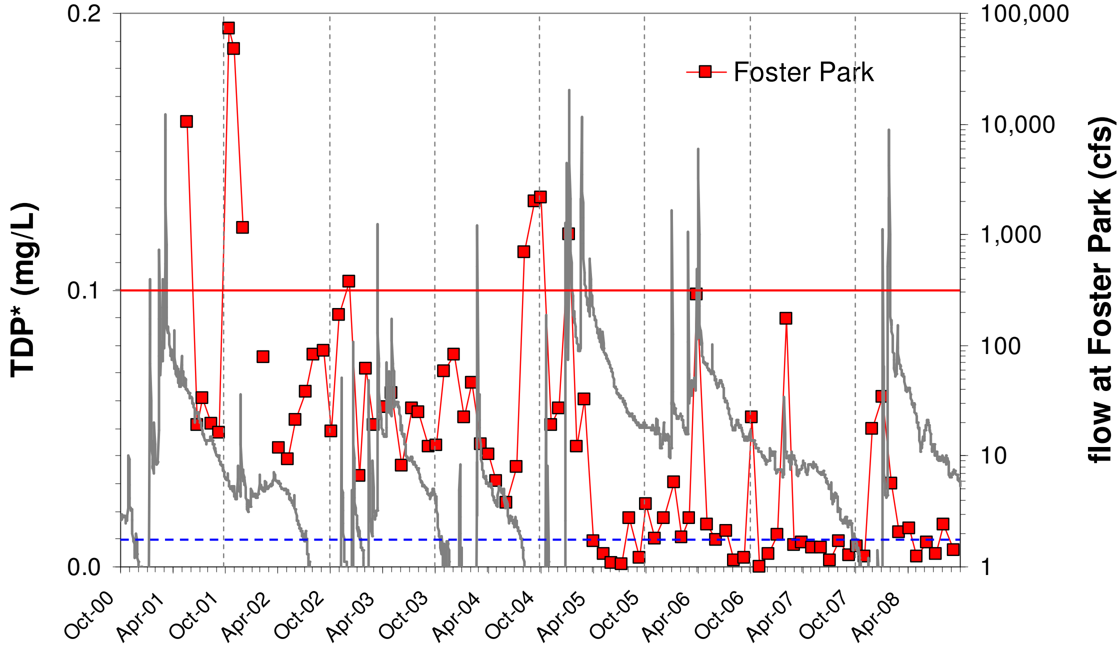


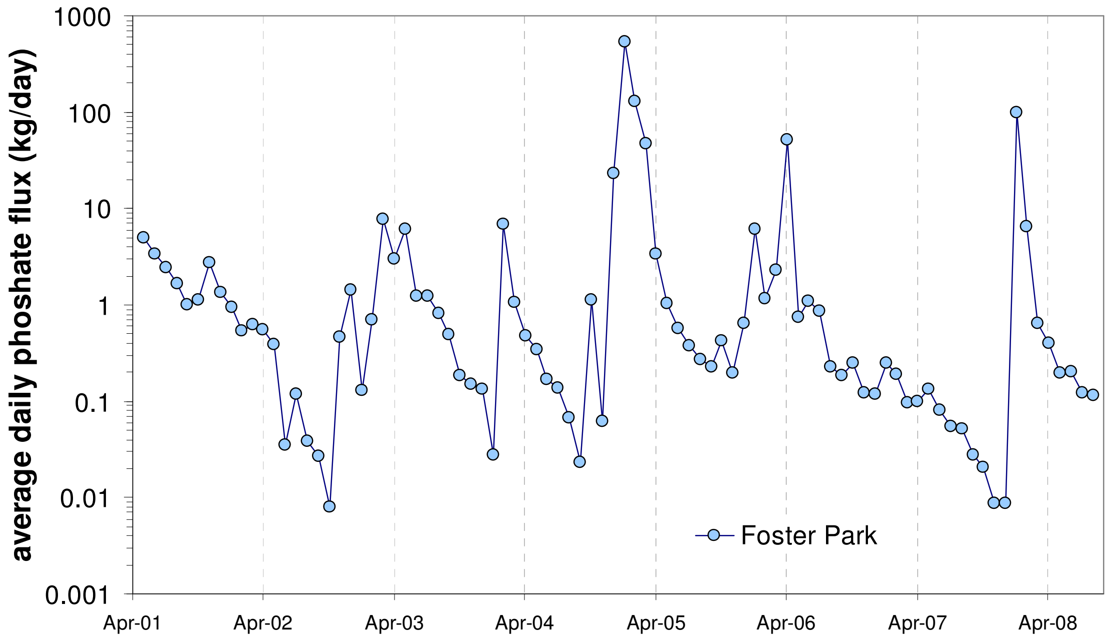
Between pasting in the graph and sitting down to write I'd already forgotten what question I was trying to address. I guess I meant to illustrate the standard nitrate response in an undeveloped catchment (discussed earlier) using Foster Park data as an example (relatively undeveloped). I'm showing TDN, but since this is a site where nitrate makes up about 70 % of TDN it could just as well have been nitrate. You can see the gradual build-up over winter to a peak – the peak being usually associated with the biggest storm (occurring soon afterwards via groundwater inputs from a recharged water table). Generally, the wetter the year the bigger the peak (2001, 2005: big years, big peaks; 2002, 2007: dry years, small peaks), but not always. The peak in 2003 was higher than in 2005 (thus my point about a real wet year diminishing the peak via dilution with extraordinary amounts of lower nitrate water), and, of course, the very high peak in 2008. It's possible that 2008 might not have been all that special, the initial 2001 sample was collected in May, two months after the big storm. The 2008 storm, and perhaps the 2001 storm, were obviously "Goldilocks" events.

I could also be wrong about that. 2007 had a relatively large nitrogen peak even though it was a comparatively dry year. We had less rainfall in 2007 than in 2002, yet flows and the nitrogen flux at Foster Park were both higher. I believe this was mostly caused by carryover from 2005 – that we were still seeing the effects of an elevated water table produced by the extraordinary rains of that year. But could also represent a fundamental change in the system, i.e., higher inputs of nitrogen, via groundwater, in more recent years. One problem with this hypothesis is that this nitrogen increase was seen at almost every sampling location, and it's extremely doubtful that there has been a general increase in nitrogen throughout the watershed (but then again I haven't seen any atmospheric deposition data for nitrogen either).



If we are talking, however, about fueling an algal bloom we should be equally, if not more, concerned with the nitrogen flux as with concentrations. This graph shows the nitrate flux at Foster Park. There are major year-to-year differences – the log scale tends to make these less obvious. 2005 was *the* big flux year, probably followed by 2006, 2001 and 2003. Ah, you ask, what about 2008? Note that there is something strange about 2008. The dashed verticals mark April 1, and the larger part of the 2008 nitrate flux had already come and gone by this date. Notice also that the post-April 1 fluxes of other years were far more substantial. The flux peak in 2008 occurred in January – in no other year was it this early, not even in 2005, although 2005 had its biggest storms early in that month. This brings us back to your question about other constraints on the algal bloom: flow, temperature, light, whatever. We saw algae start to develop on the Ventura in the beginning of March in 2008, but it didn't really get going until the end of that month. And then it went like gangbusters – like it needed to make up for lost time – reaching a peak near mid-April.





This is TDP at Foster Park. If you ignore the "step" you can see that there is no real winter pulse for phosphorus (or for phosphate, which makes up more than 50 % of non-dry-season TDP at Foster Park). What you do see is spikes in TDP associated with specific storms – associated that is with high sediment levels and occurring, more often than not, during a small storm. Since concentrations are relatively stable at other times the flux does vary, but in sync with flow. The peaks are much sharper than for nitrogen, and following April 1 there is just a slow and steady decrease. It's interesting that past April 1 all years look pretty much alike – except for the drought years where the previous year's decline simply continues. Yet, as nitrate often goes to zero in those years, phosphorus doesn't seem to be limiting. It's also interesting that past April 1, 2003 was a big phosphate year. I might have something more to say about that in connection with Julie's data.