pH Presentation
to
WQS Stakeholder's Meeting
December 3, 2014

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Brief History of Time

- 1969 European Inland Fisheries Advisory Commission published pH recommendations
- 1969 US EPA did not exist, there were 9 planets in the solar system and the brontosaurus was my favorite dinosaur, and sewage lagoons outnumbered mechanical plants by many orders of magnitude
- Dec. 2, 1970, Richard Nixon created the US EPA (fourty-four years ago yesterday)
- 2014, there are now only 8 planets in the solar system, the brontosaurus never existed, but the EPA now does! And, sewage lagoons are becoming rarer all of the time.

Cited from “The Red Book” 1976
“The Gold Book” 1986

- **A** review of the effects of pH on fresh water fish has been published by the European Inland Fisheries Advisory Commission **(1969).** The commission concluded:

  There is no definite pH range within which a fishery is unharmed and outside which it is damaged, but rather, there is a gradual deterioration as the pH values are further removed from the normal range.

  The pH range which is not directly lethal to fish is 5 - 9; however, the toxicity of several common pollutants is markedly affected by pH changes within this range, and increasing acidity or alkalinity may make these poisons more toxic.

  Also , an acid discharge may liberate sufficient C02 from bicarbonate in the water either to be directly toxic, or to cause the pH range **5** - **6** to become lethal.

- Mount **(1973)** performed bioassays on the fathead minnow, Pimephal- promelas, for a 13-month, one generation time period to determine chronic **pH** effects. Tests were run at pH levels of **4.5,** 5.2.
- **PH**
- **Range** **Effect on Fish***

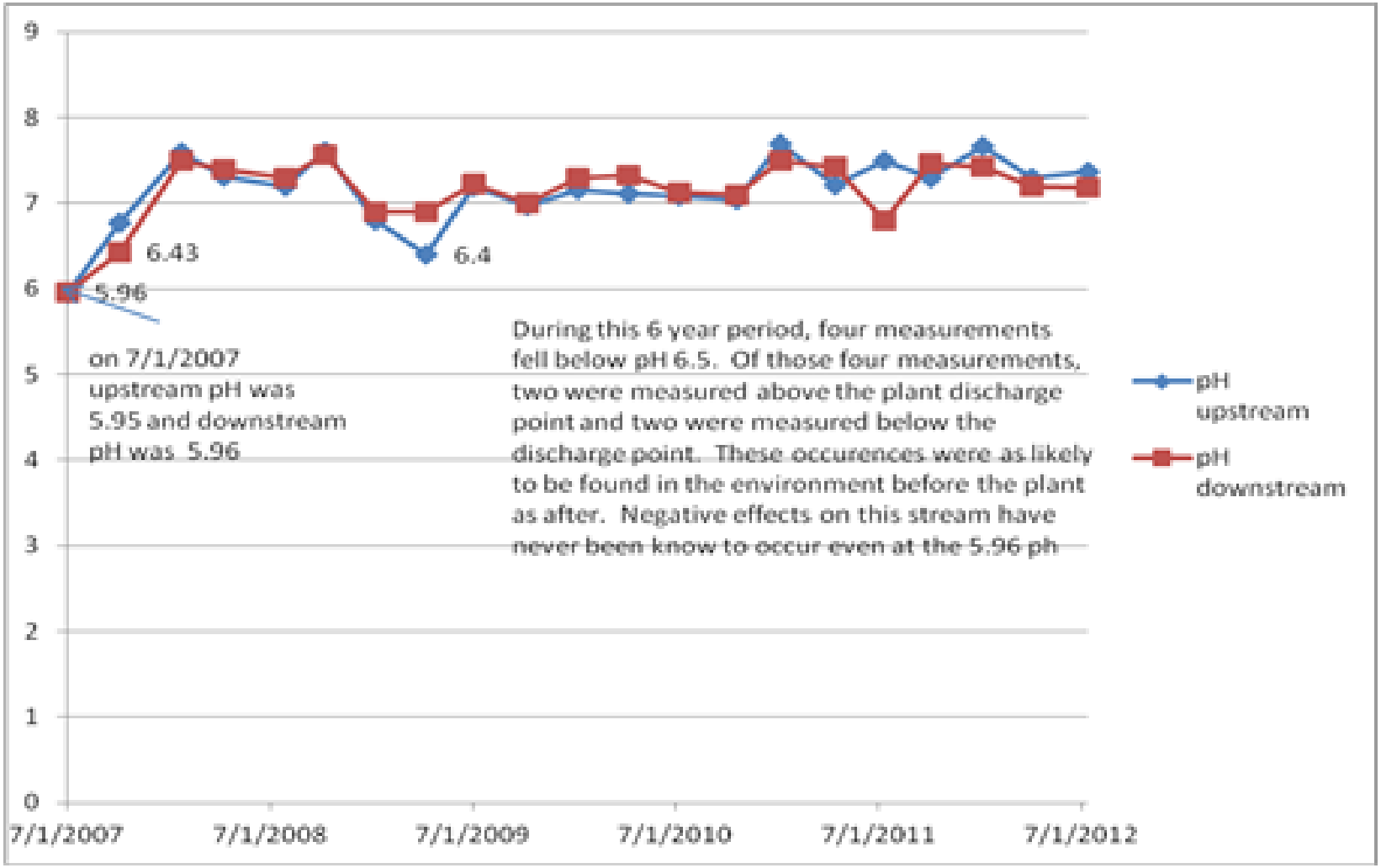
5.0 - **6.0**	Unlikely to be harmful to any species unless either the concentration of free **C02** is greater than 20 ppm, or the water contains iron salts which are precipitated as ferric hydroxide, the toxicity of which is not known
6.0 - **6.5**	Unlikely to be harmful to fish unless free carbon dioxide is present in excess of 100 ppm.
6.5 - **9.0**	Harmless to fish, although the toxicity of other poisons may be affected by changes within this range.

EIFAC, 1969

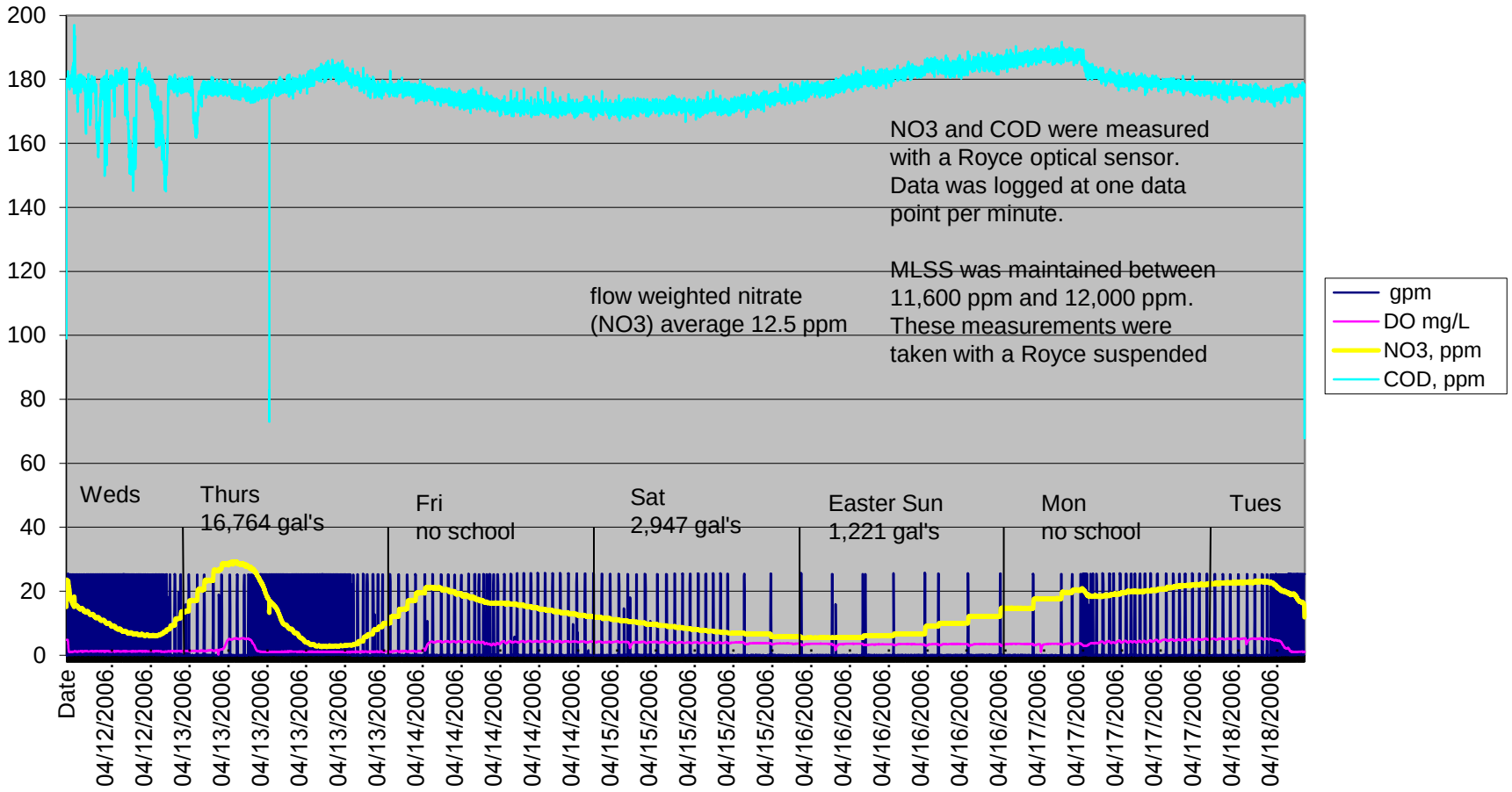
Lagoon Process versus Mechanical Aeration

- Sewage lagoons have a diurnal cycle that is driven by algae and sunlight. Each morning begins with oxygen levels low, pH low, alkalinity high and CO_2 high. Due to photosynthesis, these characteristics reverse up until sunset when the trends reverse again.
- Mechanically aerated plants tend to begin each morning with higher oxygen levels, lower pH levels, lower alkalinity, lower CO_2. These levels tend to reverse as daily peak flows are reached (although not as dramatically as in lagoons) until low flows occur late at night. This is driven by the nitrification of ammonia to nitrate that happens throughout the whole day, that mechanical aeration can accomplish efficiently and lagoons typically cannot.

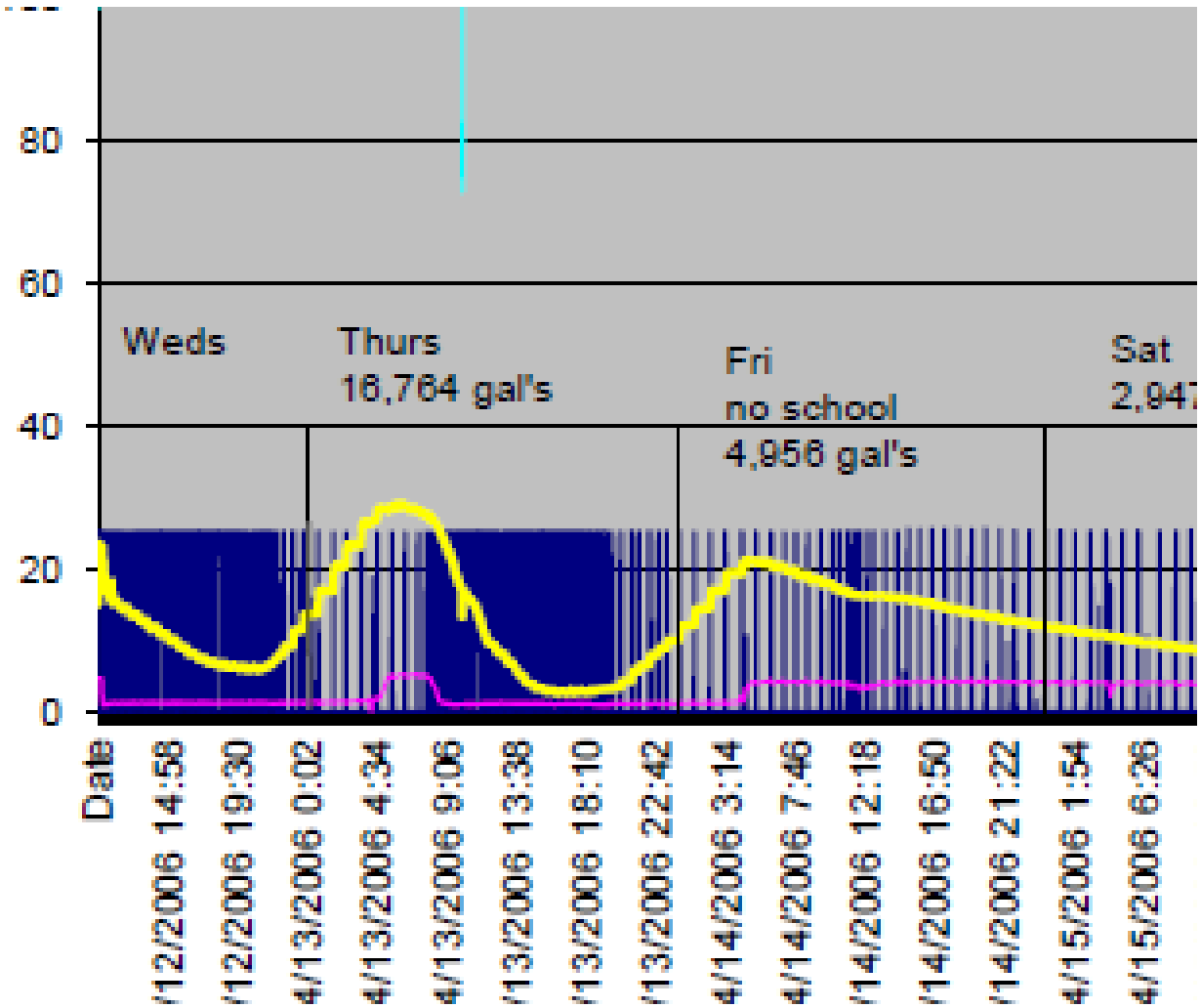
Five Year Upstream/Downstream pH Measurements from the Wyndgate MBR Treatment Plant
Waters do fall below pH's of 6.0 in their natural states



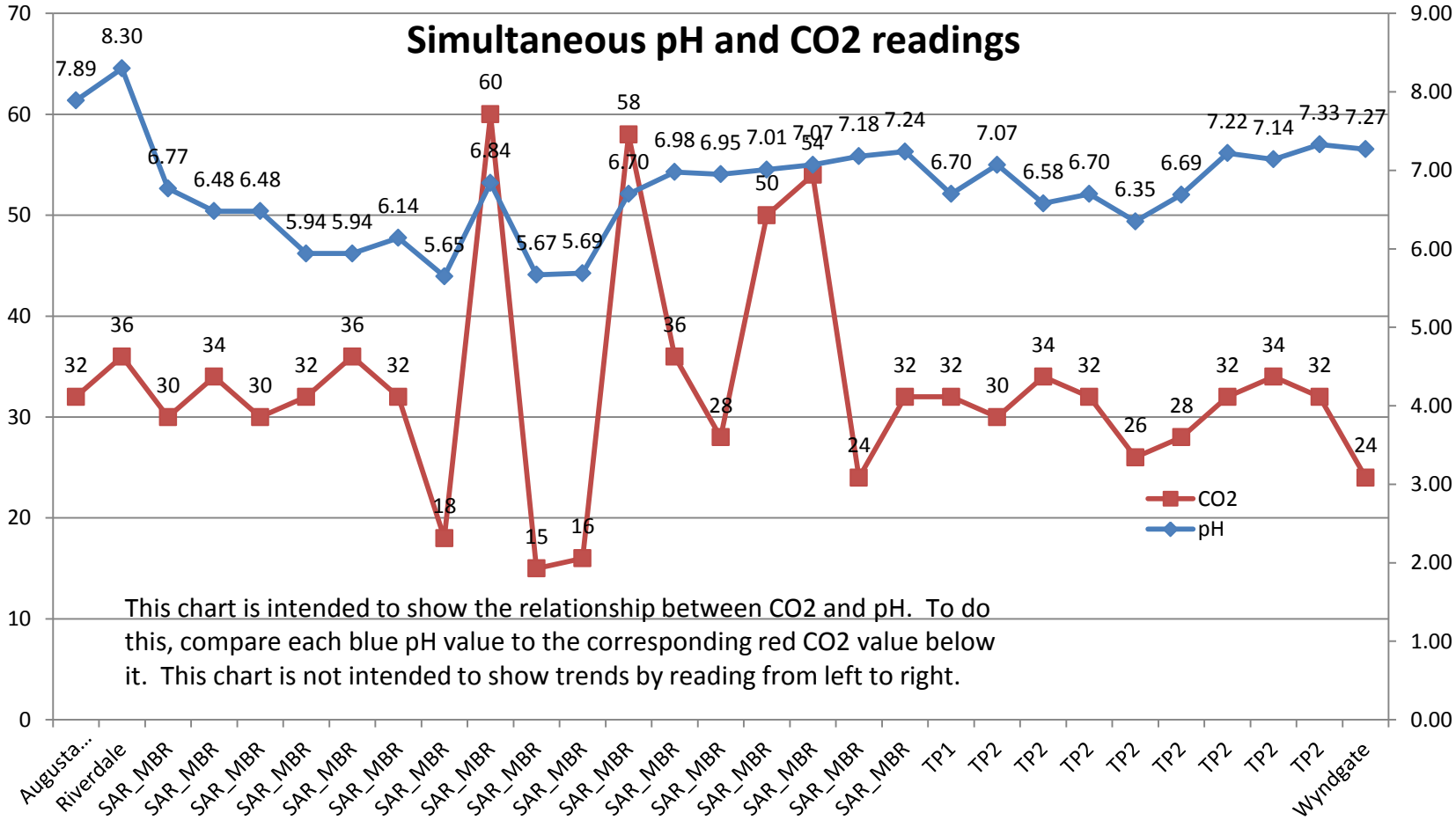
Example of diurnal nitrogen/oxygen cycle in a mechanically aerated plant "Steven A Rogers MBR" treatment plant with anoxic zone for nitrate removal



Dark blue=flow
Yellow=nitrates
Pink=oxygen



Simultaneous pH/CO_2 from several locations



Summary

- We are noting that pH, in the 6.0 to 6.5 range, taken by itself, is neither an environmental nor a human health concern.
- It is common for natural waters to measure in the range of 6.0 to 6.5.
- When pH's fall into these ranges in mechanically aerated plants, CO_2 levels tend to be low and D.O. levels tend to be high. This is driven, in large part, by de-nitrification – which is good.
- Low pH's and high CO_2 are rarely seen together from modern mechanical treatment plants.
- Therefore, regulating to the narrower limits, does not accomplish what was once intended, because high CO_2 – although once something to be watchful of in lagoon systems – are very rare from modern mechanically aerated treatment methods.