Riverbank Filtration at the Charles M. Bolton Well Field Organic and Particle Reduction

USEPA/USGS Meeting on Cryptosporidium
Removal by Bank Filtration
September 9-10, 2003

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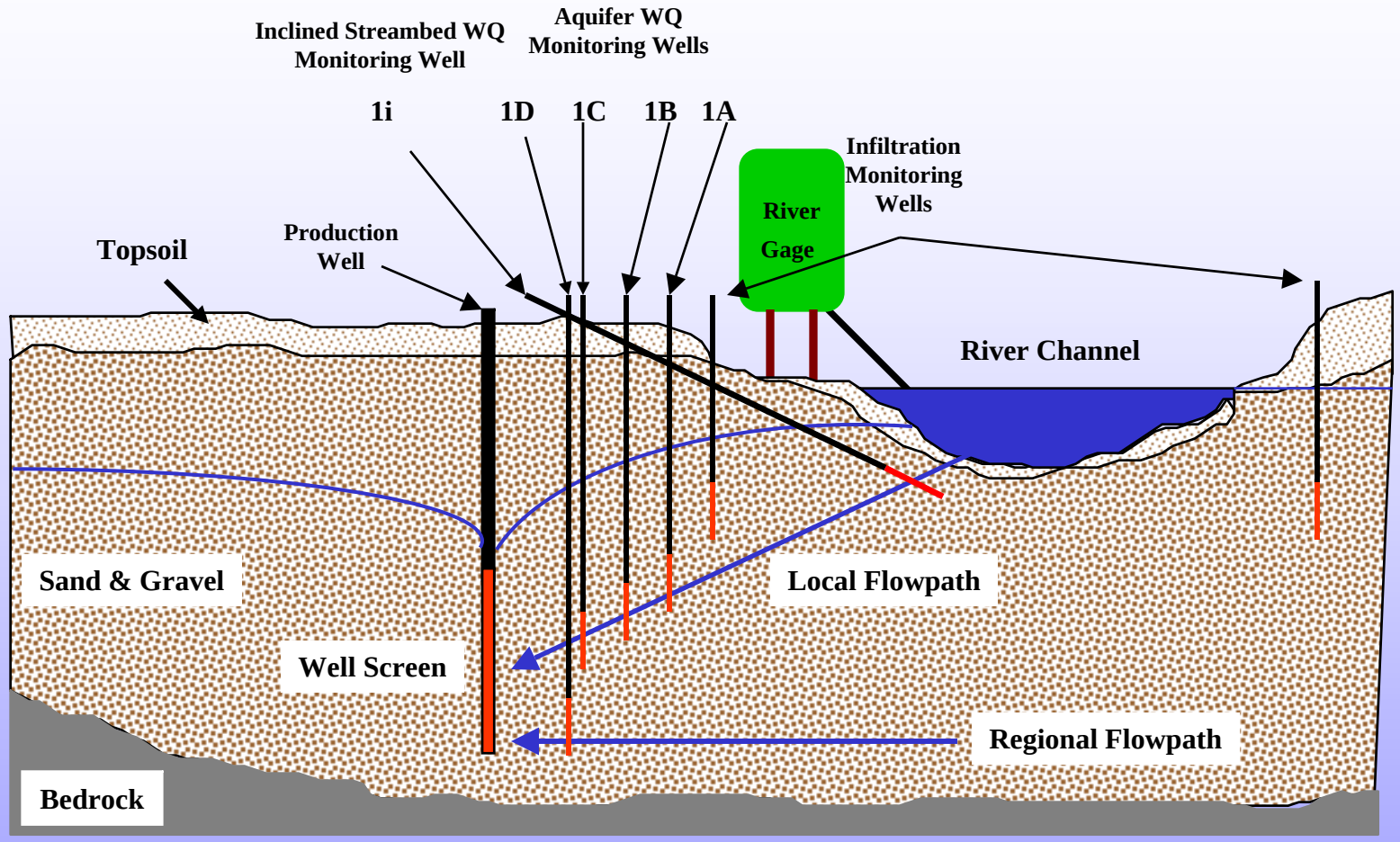
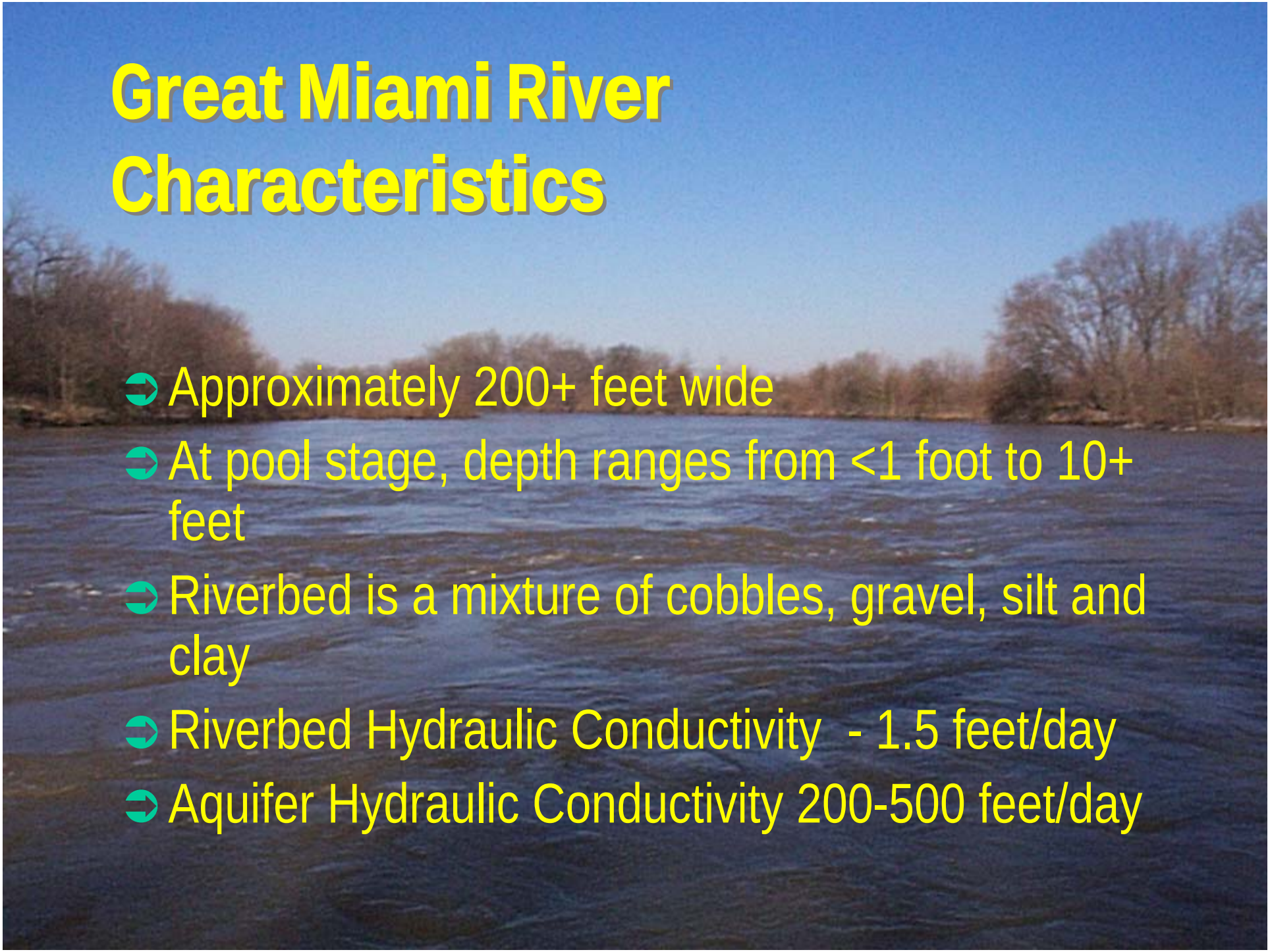
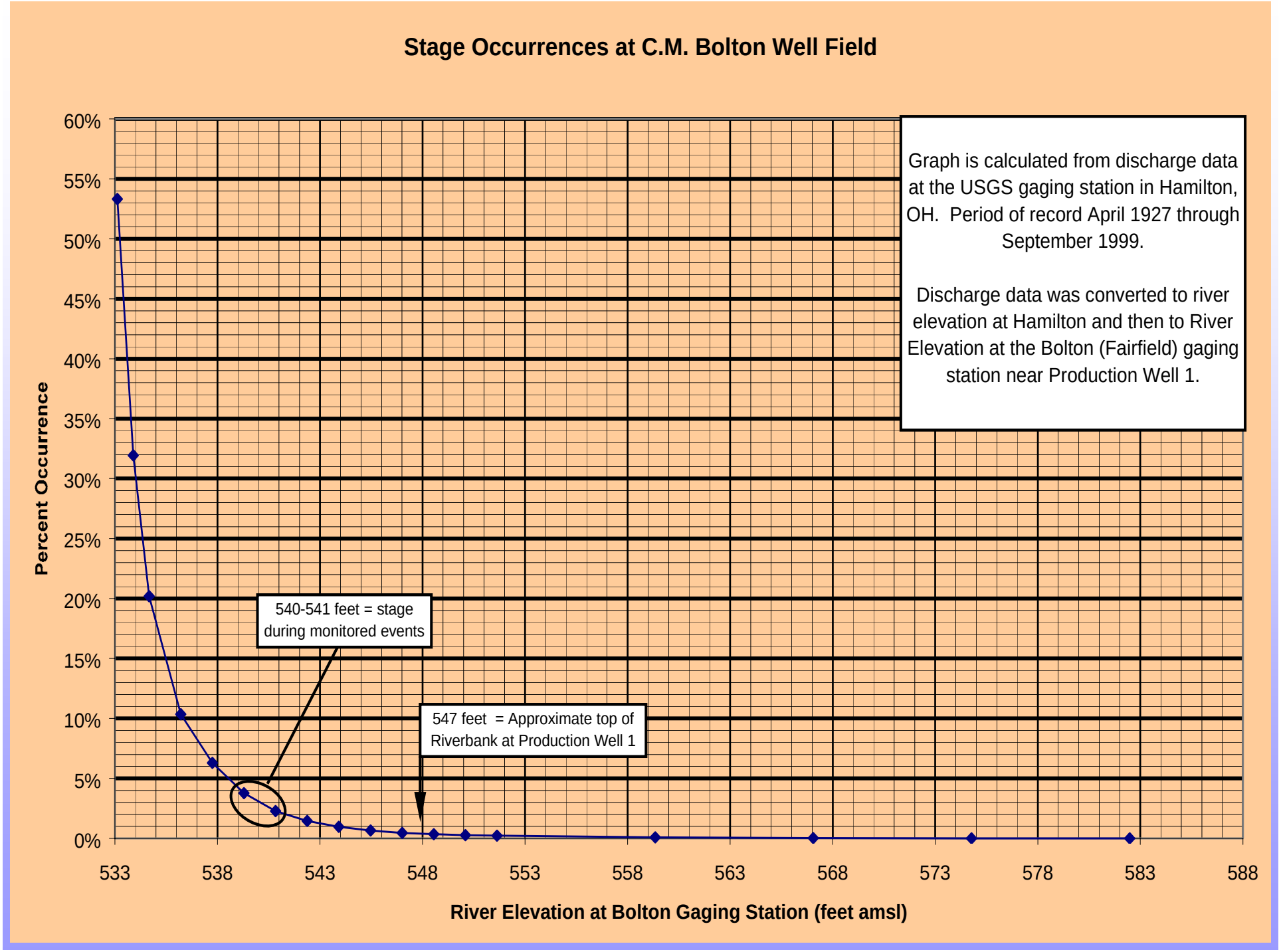
Conceptual Aquifer Profile @ Bolton Well Field

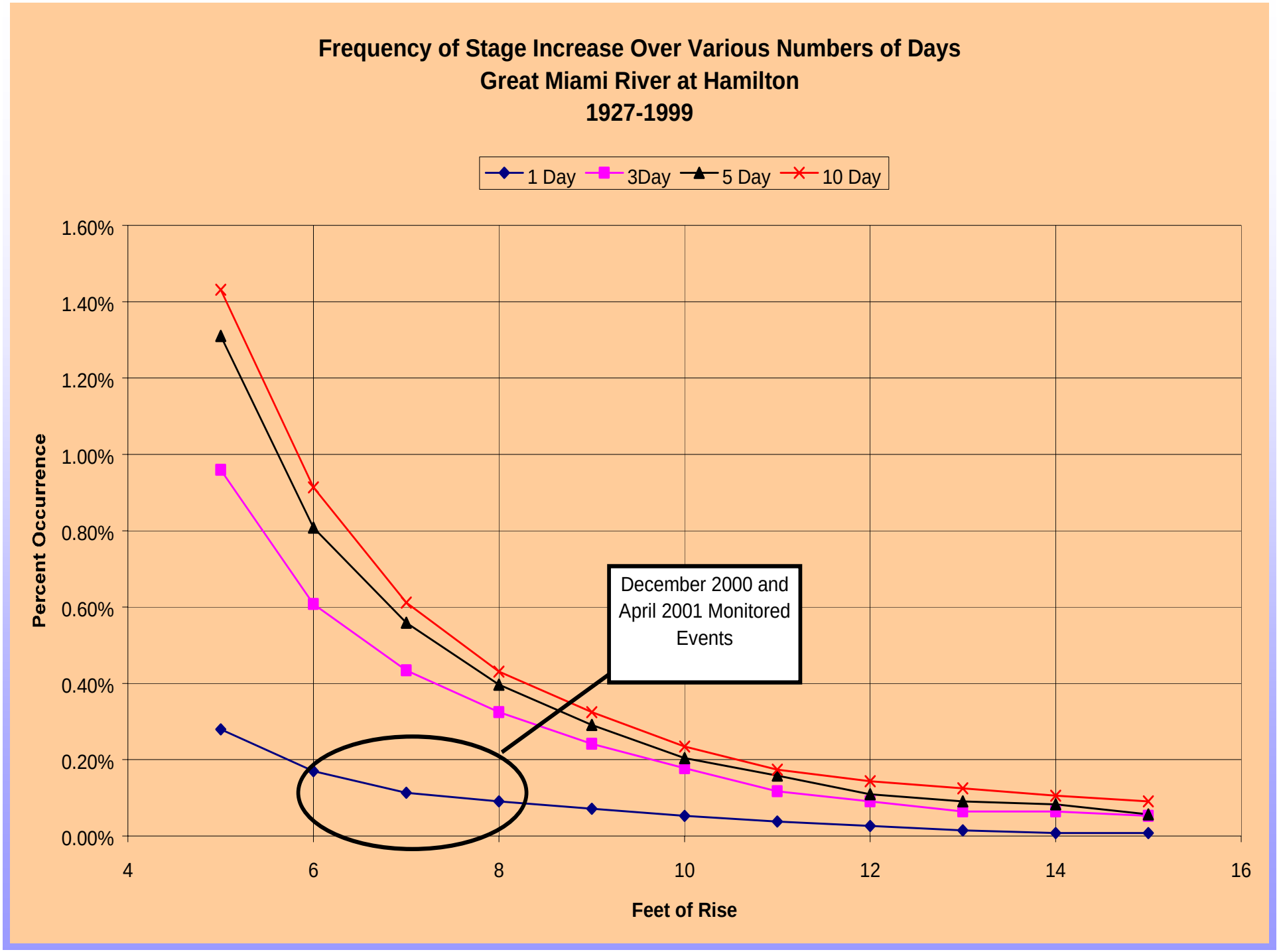




Great Miami River Characteristics

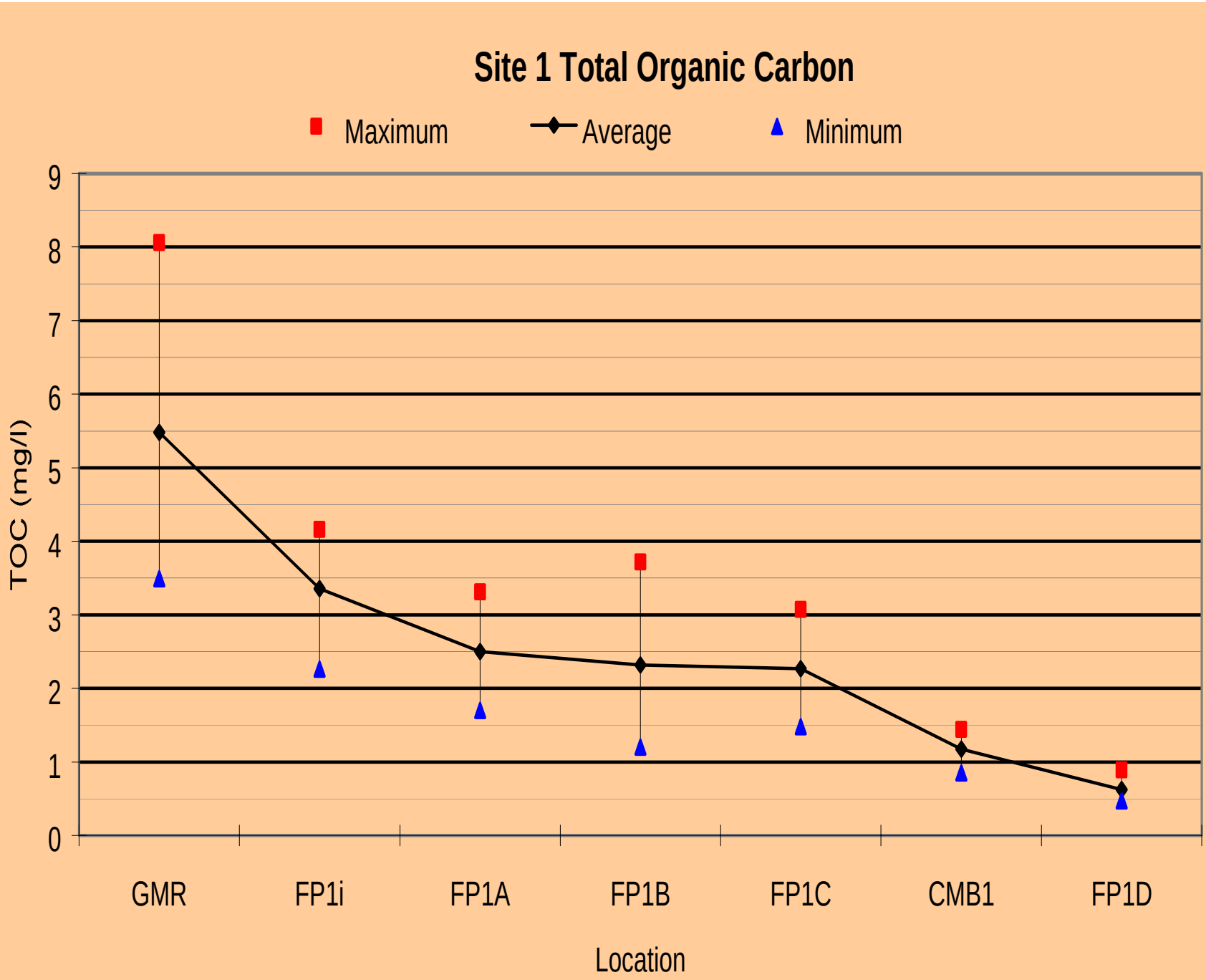
- Approximately 200+ feet wide
- At pool stage, depth ranges from <1 foot to 10+ feet
- Riverbed is a mixture of cobbles, gravel, silt and clay
- Riverbed Hydraulic Conductivity - 1.5 feet/day
- Aquifer Hydraulic Conductivity 200-500 feet/day

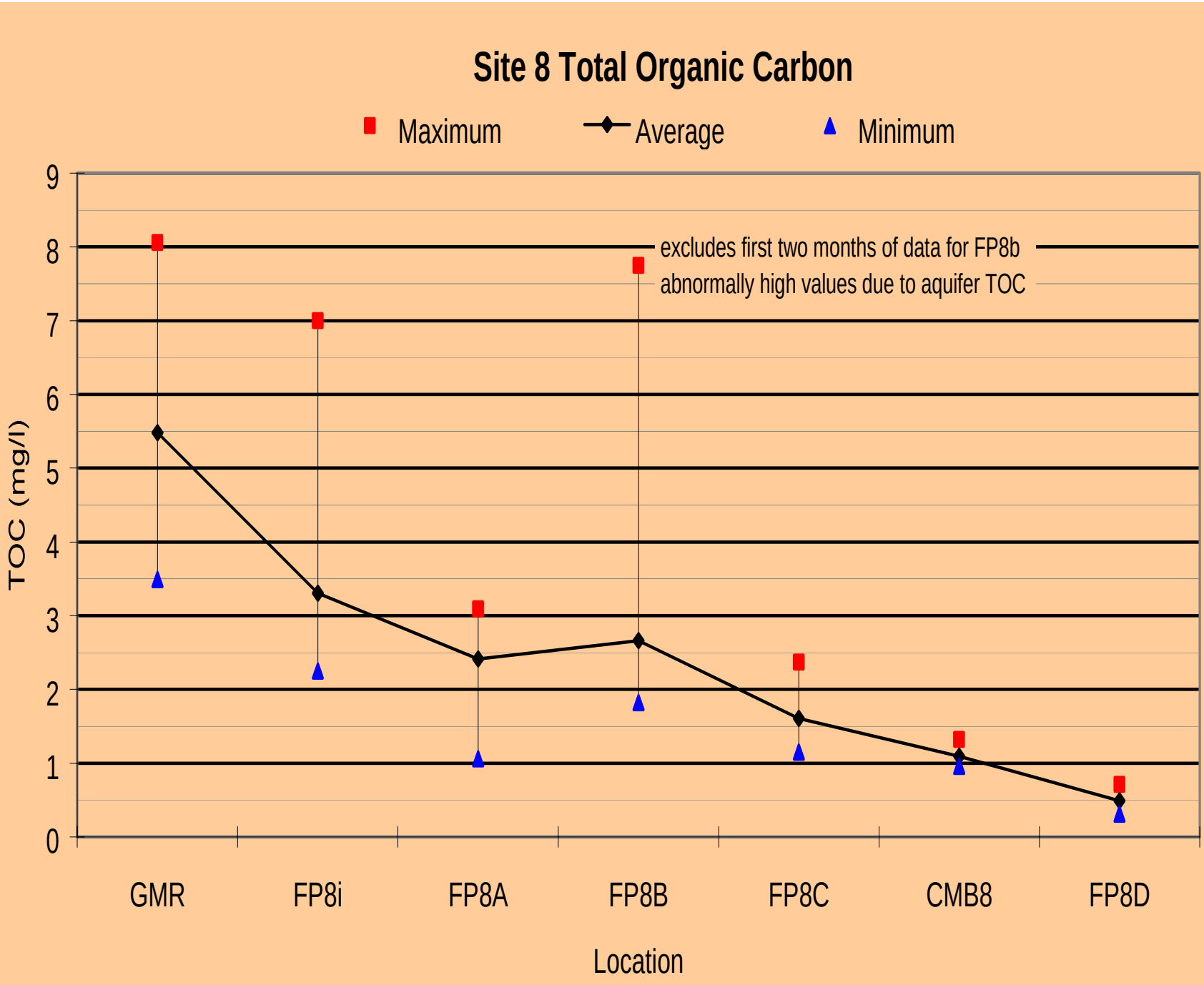


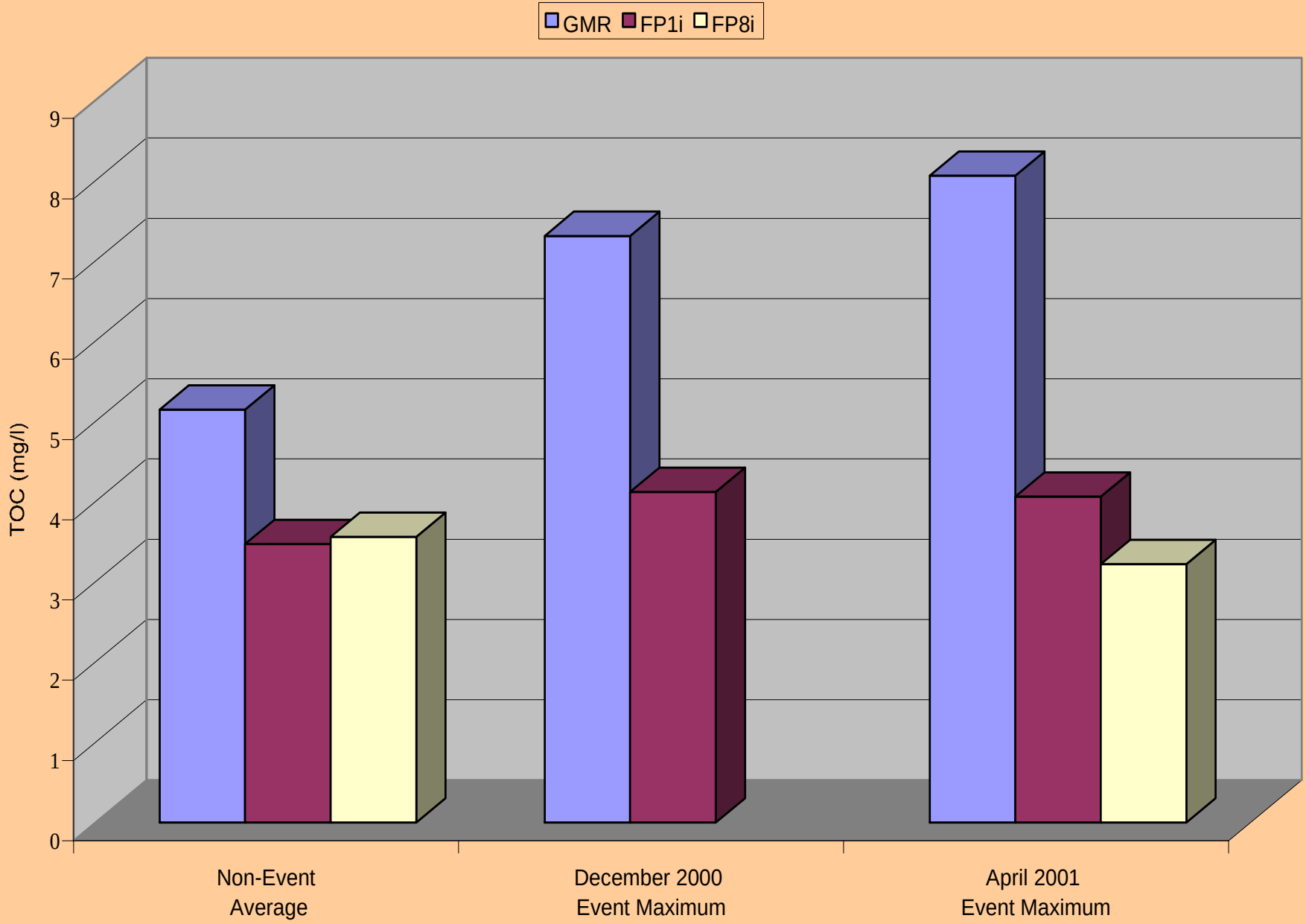


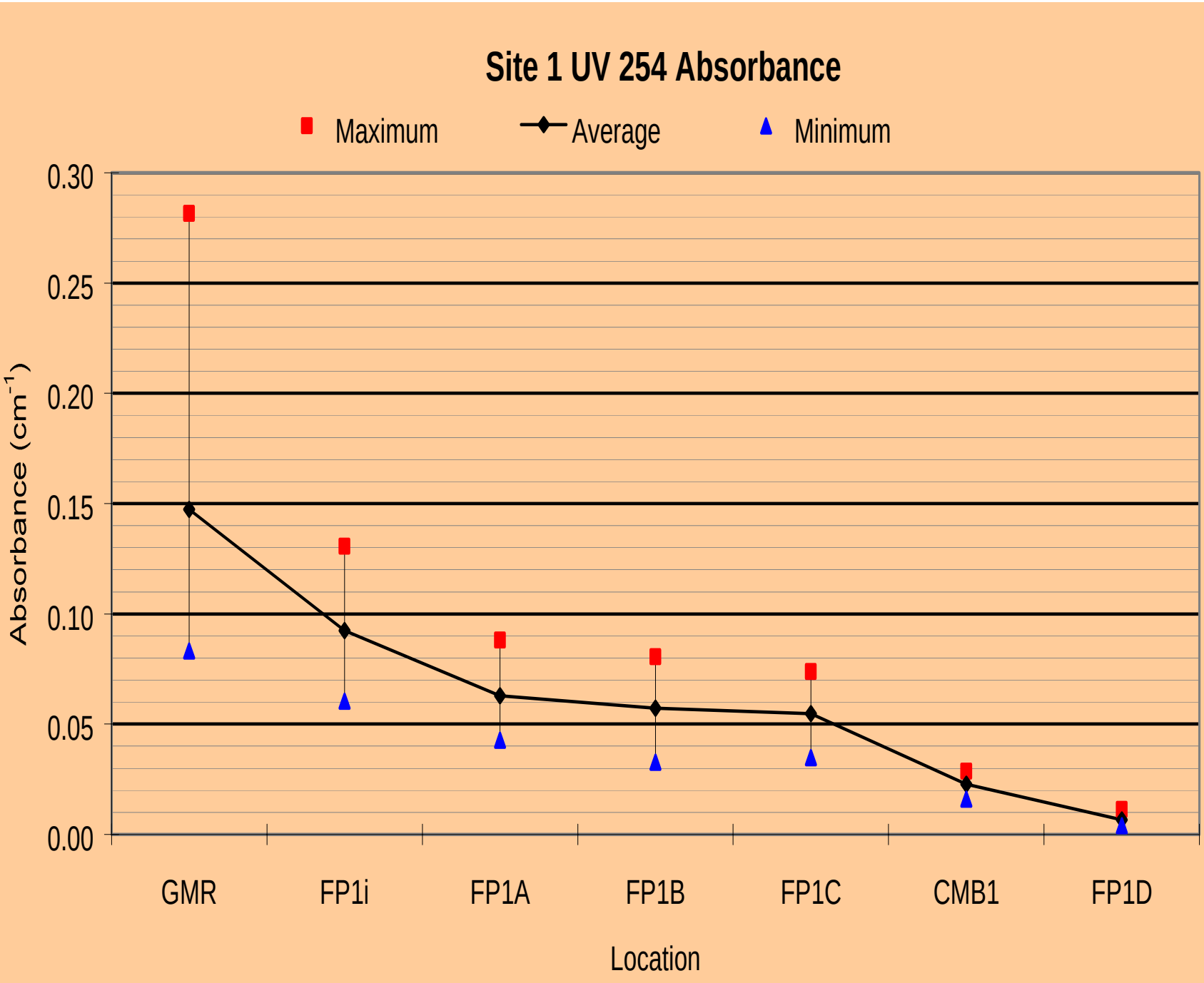
Water Quality Data

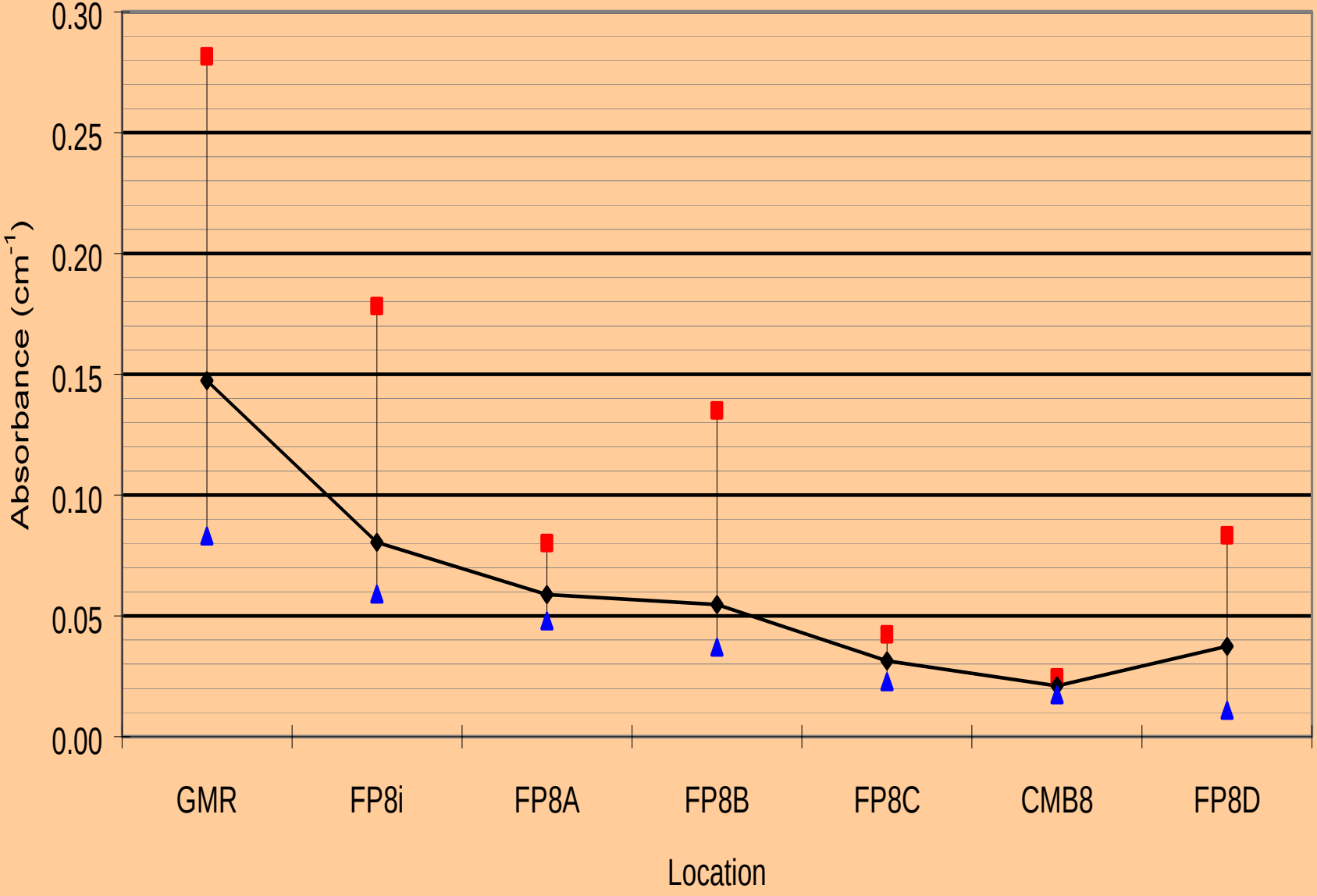
- Organic Reduction
- Particle Reduction

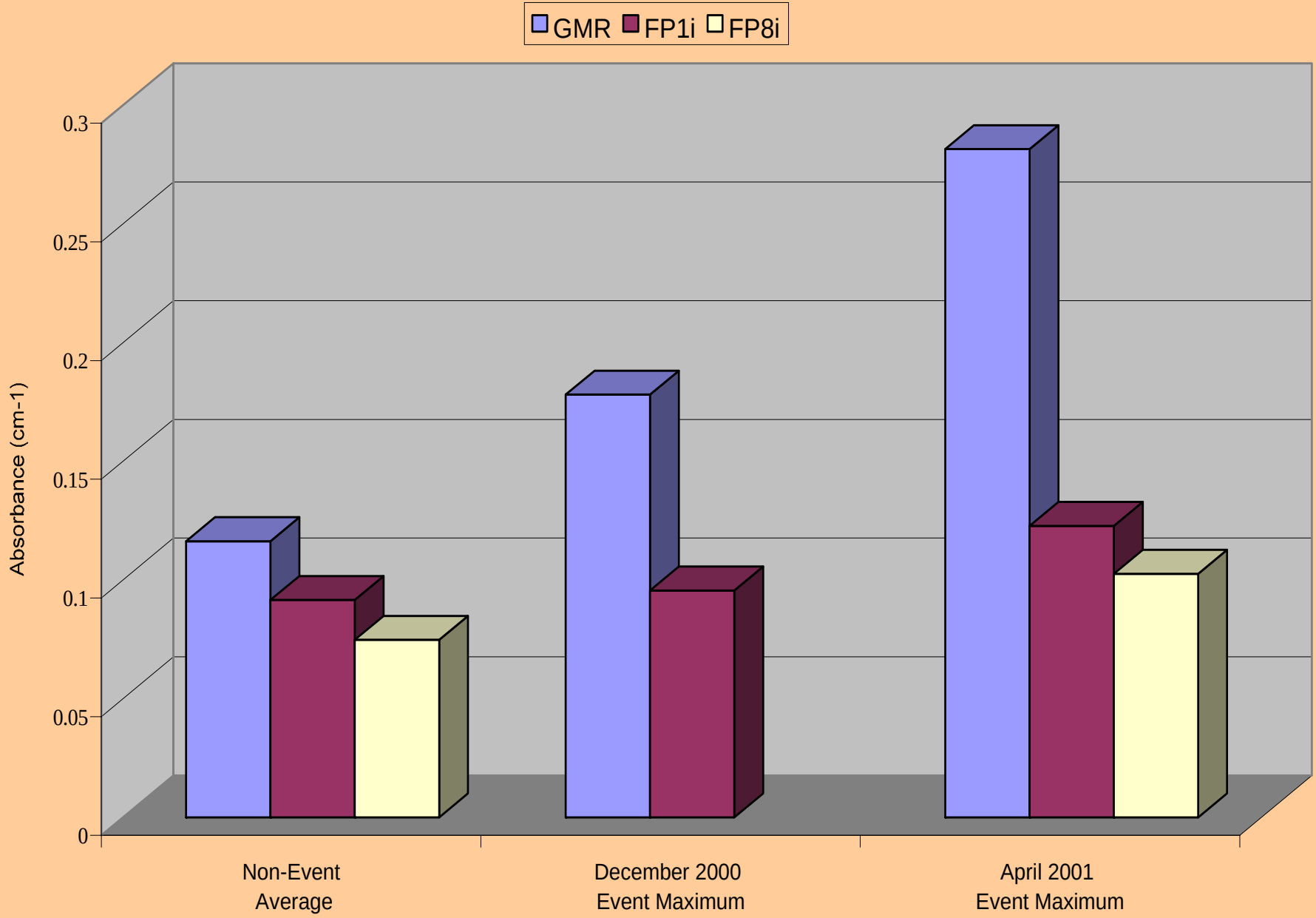






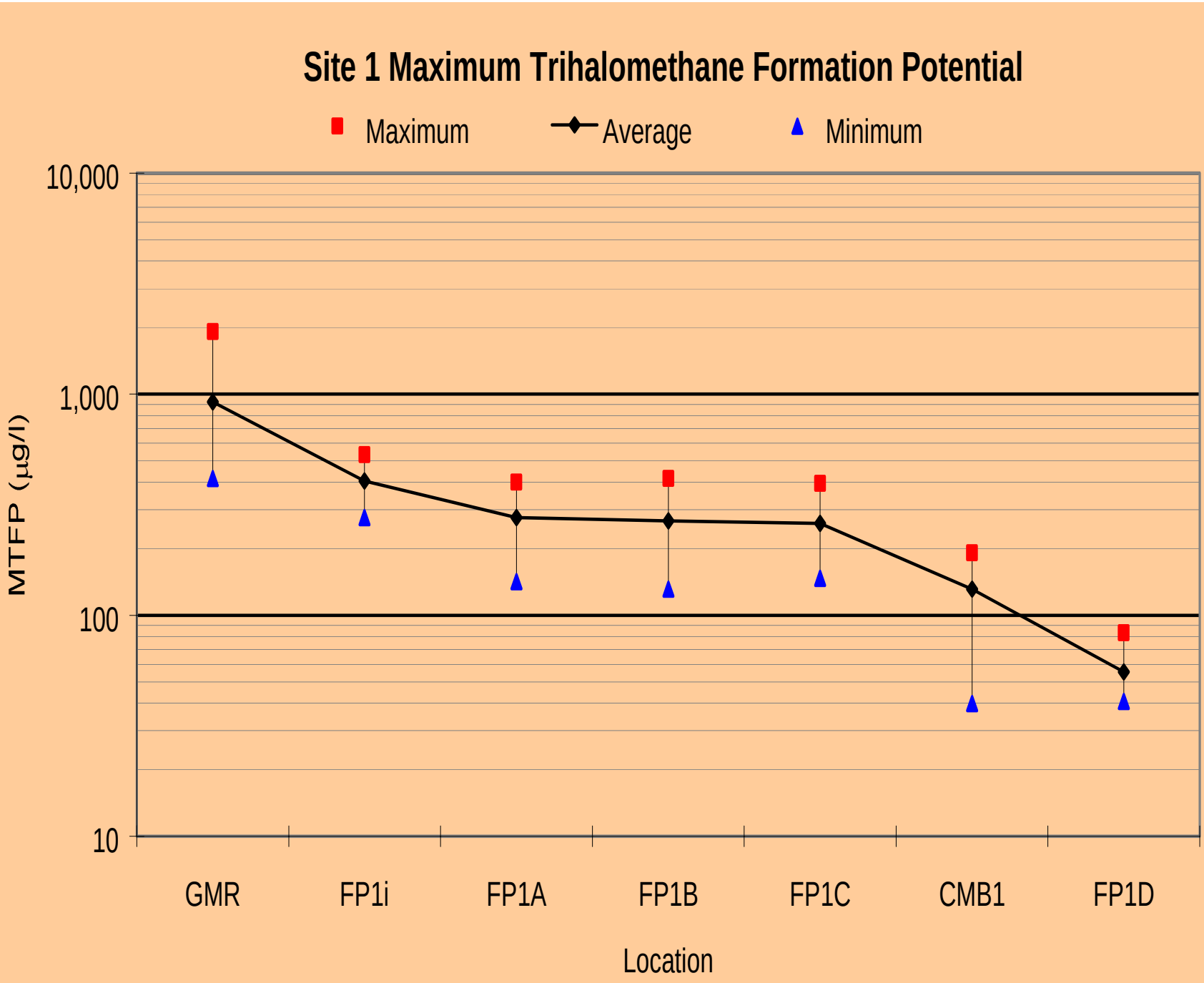


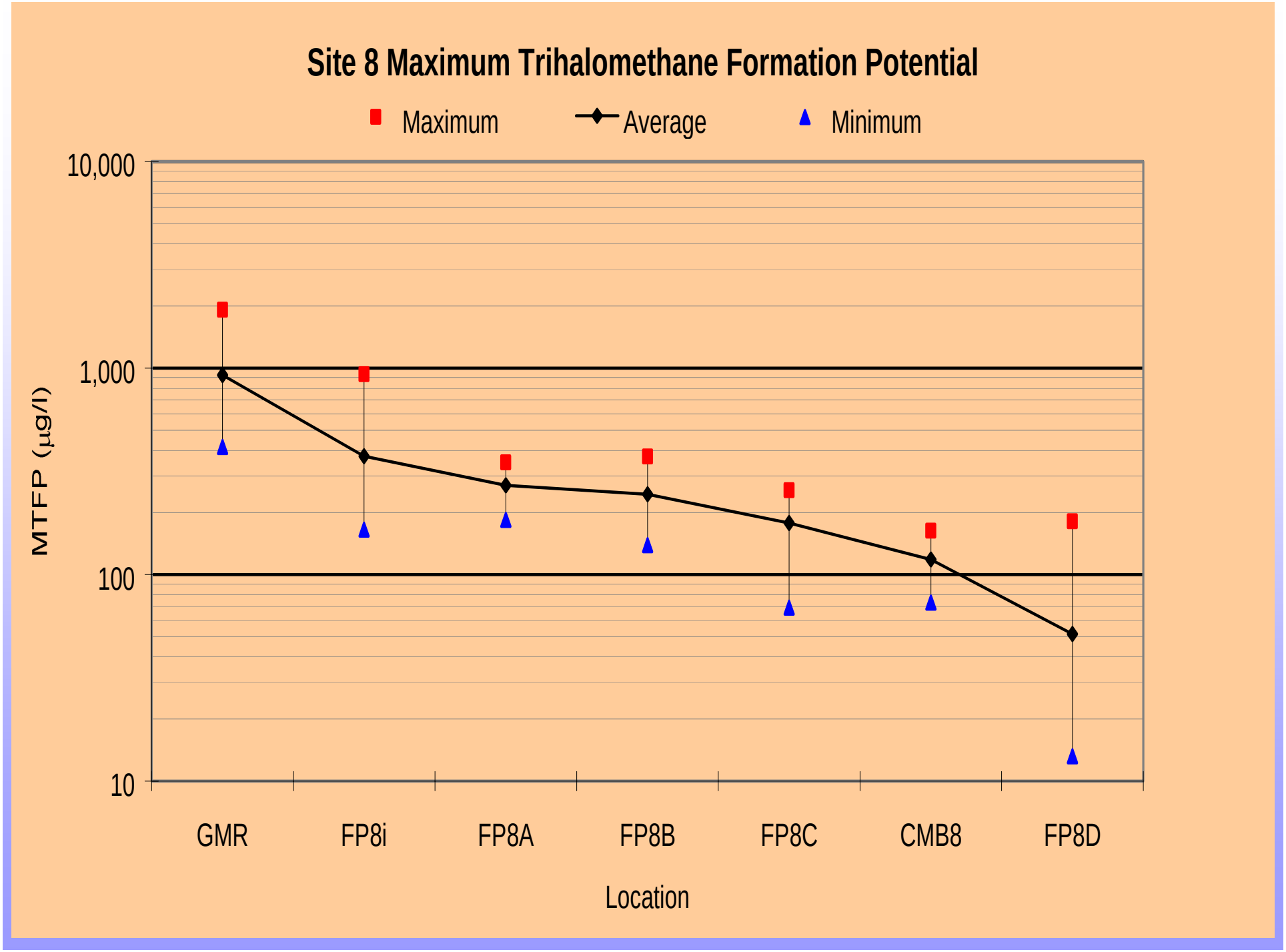


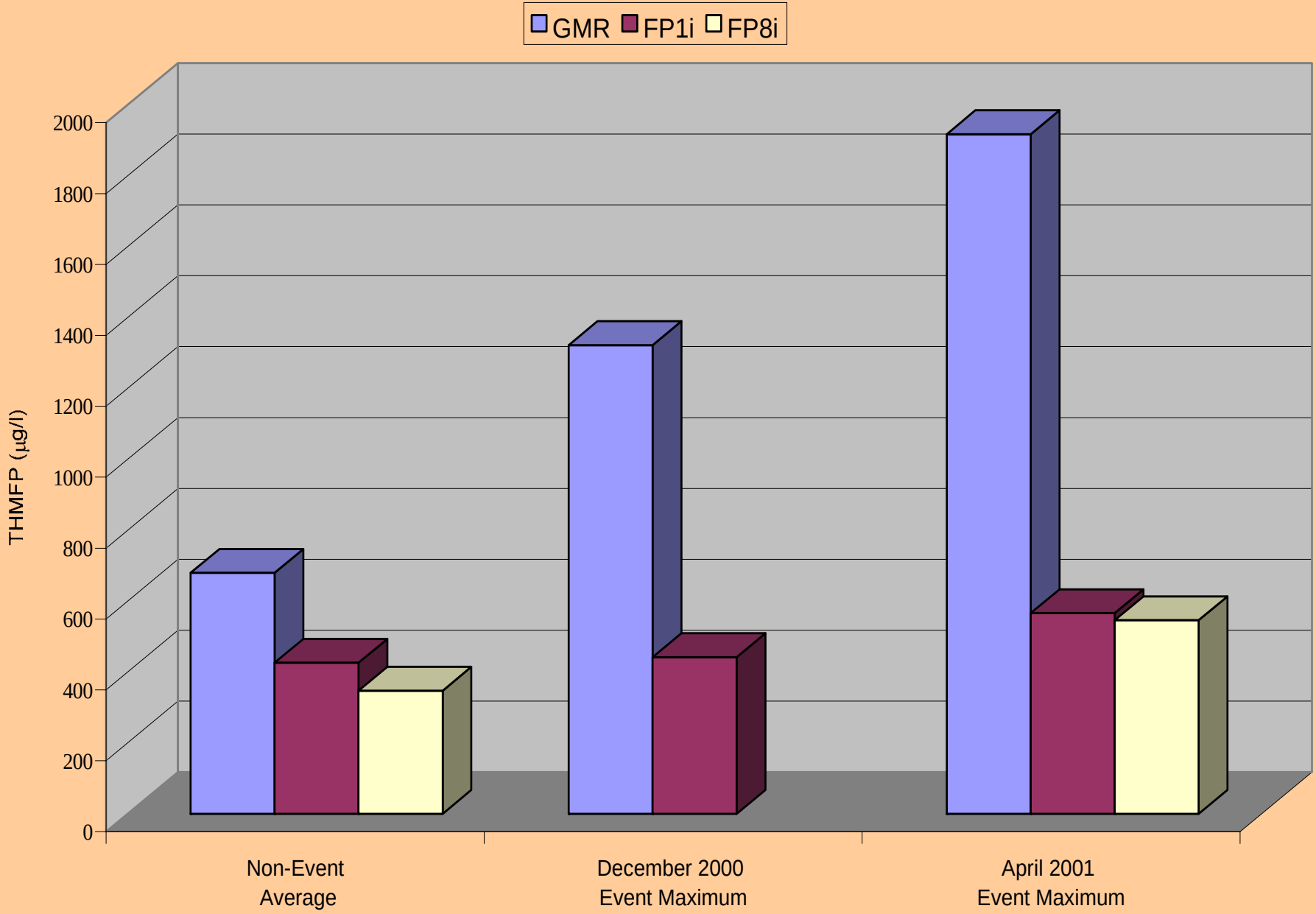


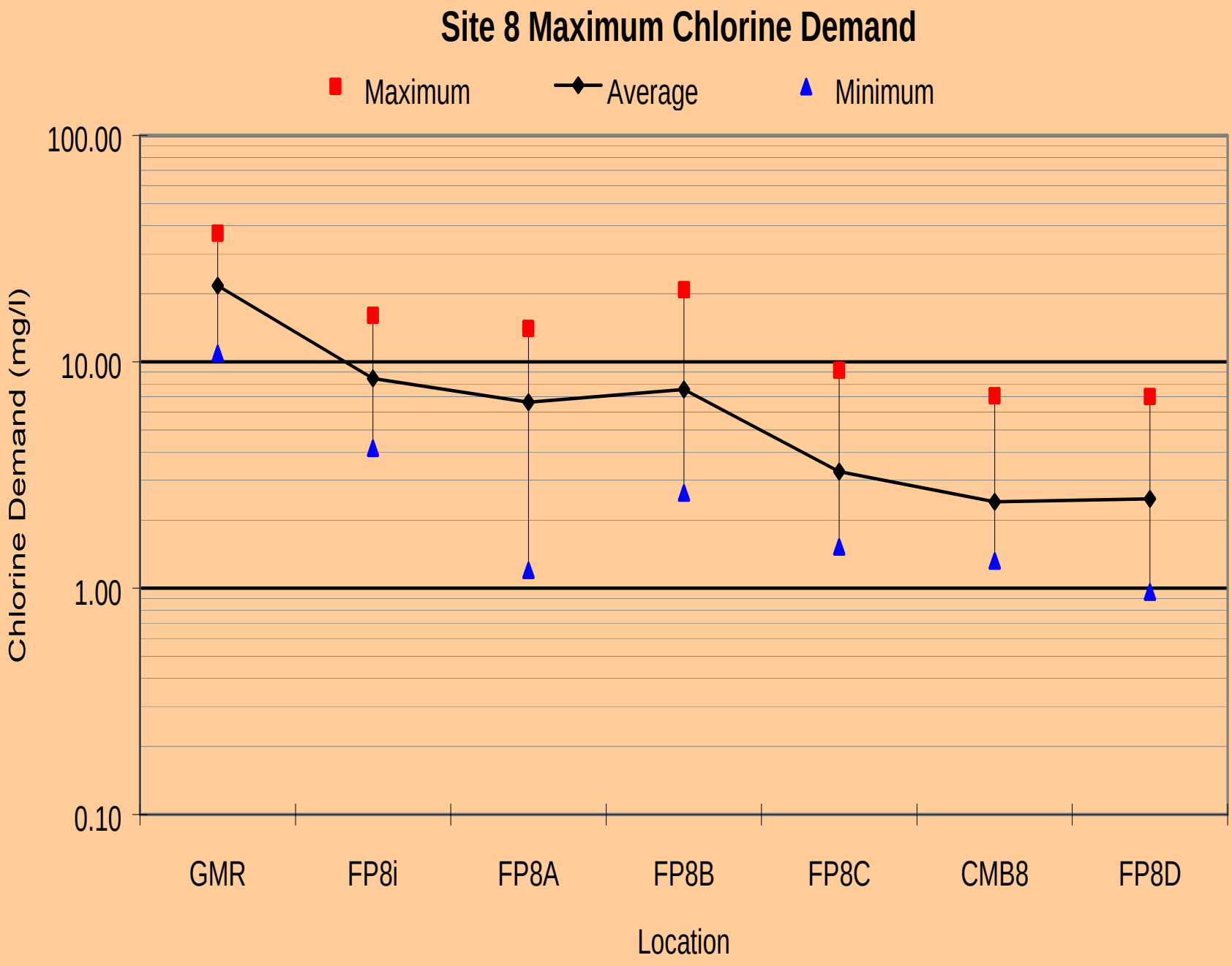
Trihalomethane Maximum Formation Potential

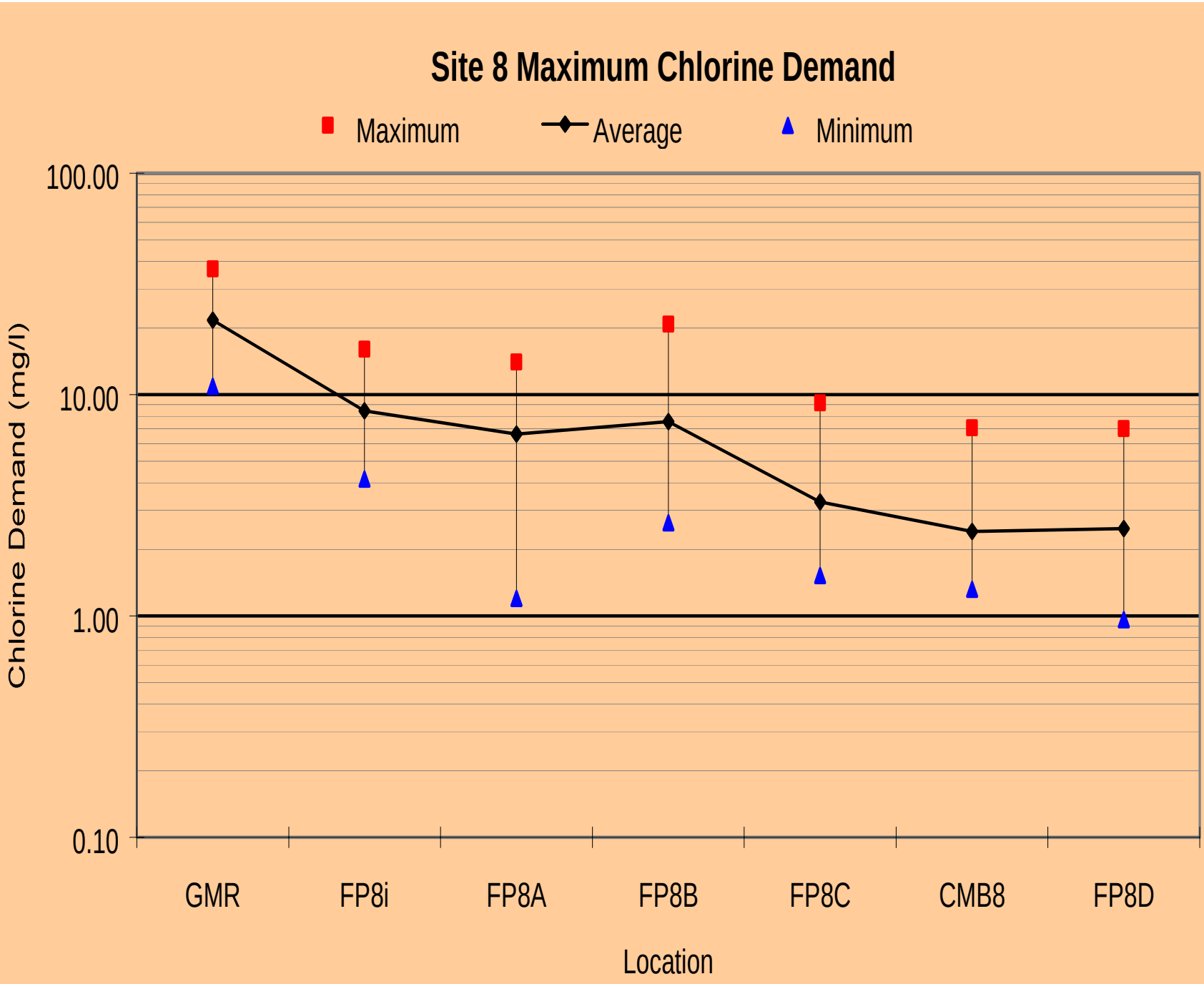
- **Laboratory "Bench Test"**
- **Provides a theoretical maximum amount of THMs which would form with the tested water.**
- **Water is dosed with chlorine and held at a constant temperature and pH for 7 days.**
- **THMs analyzed after 7 days of incubation.**

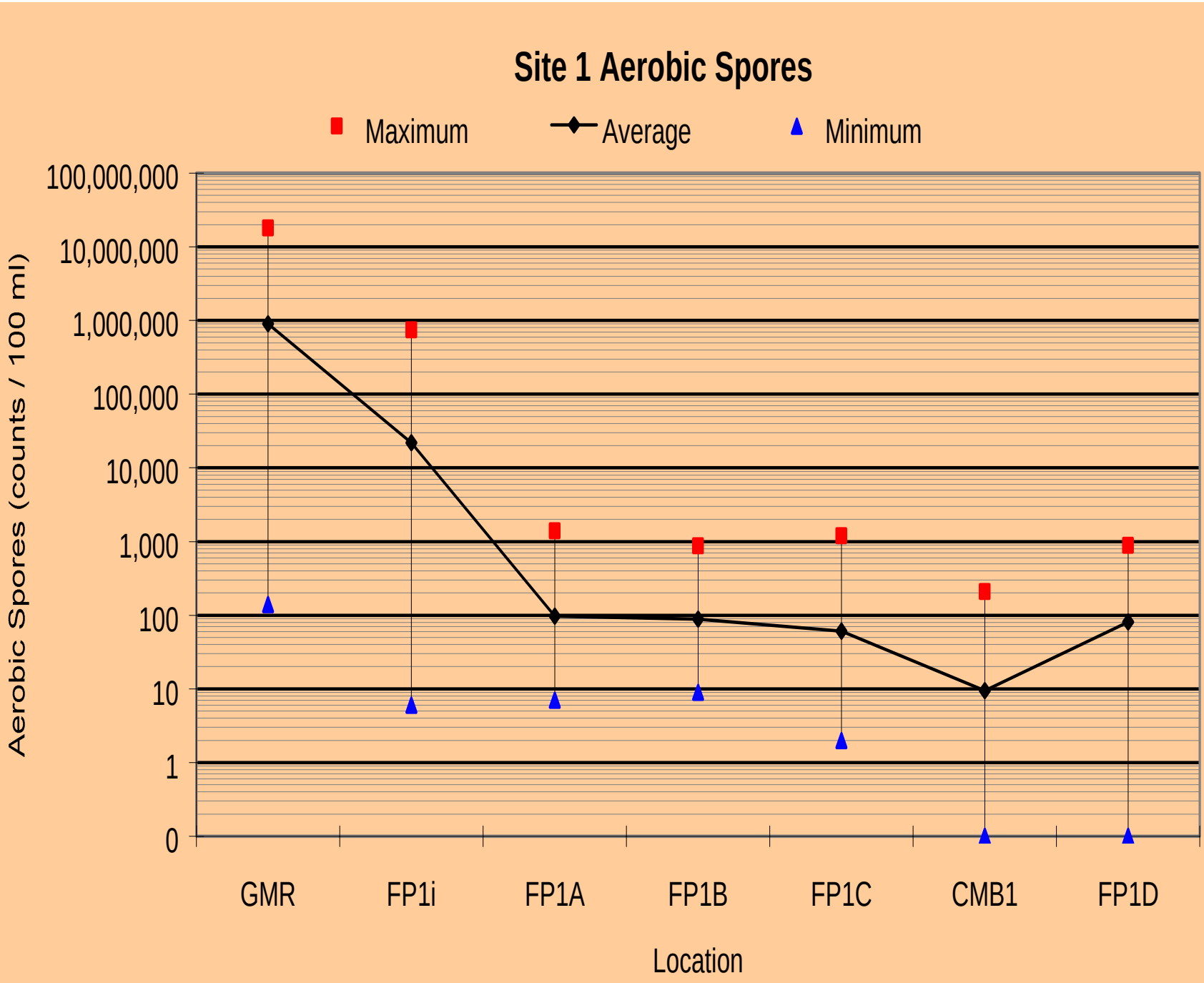


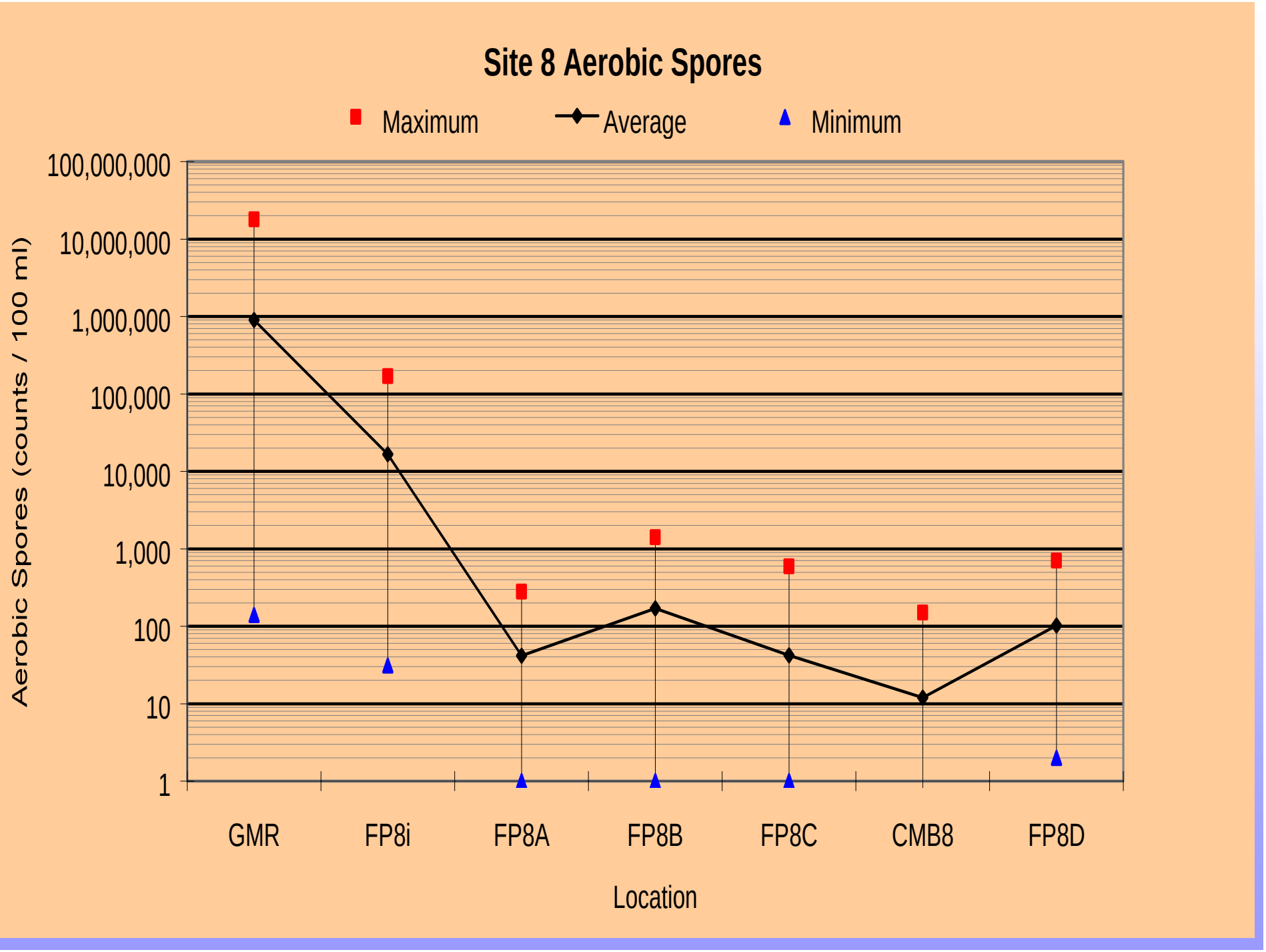


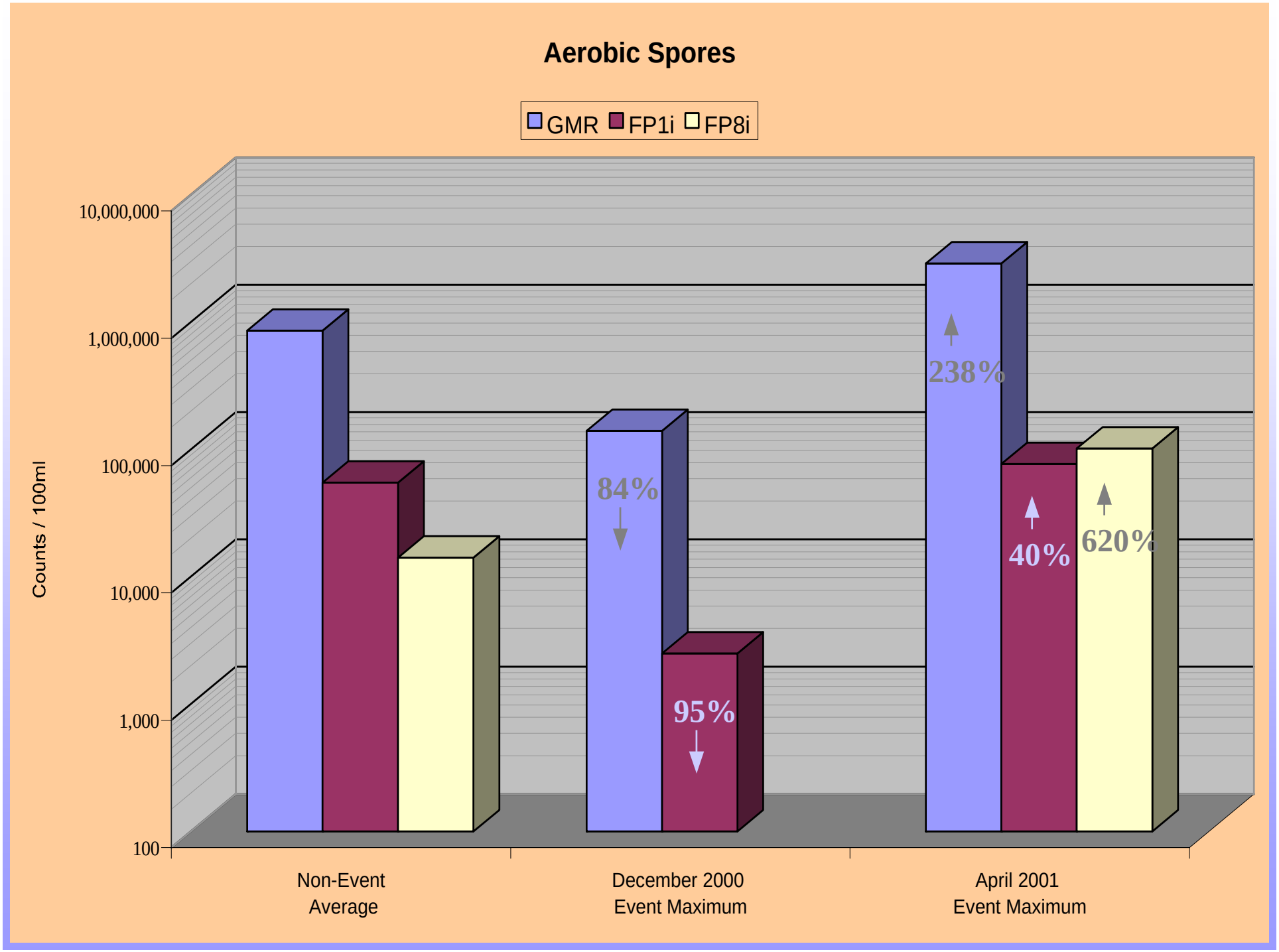


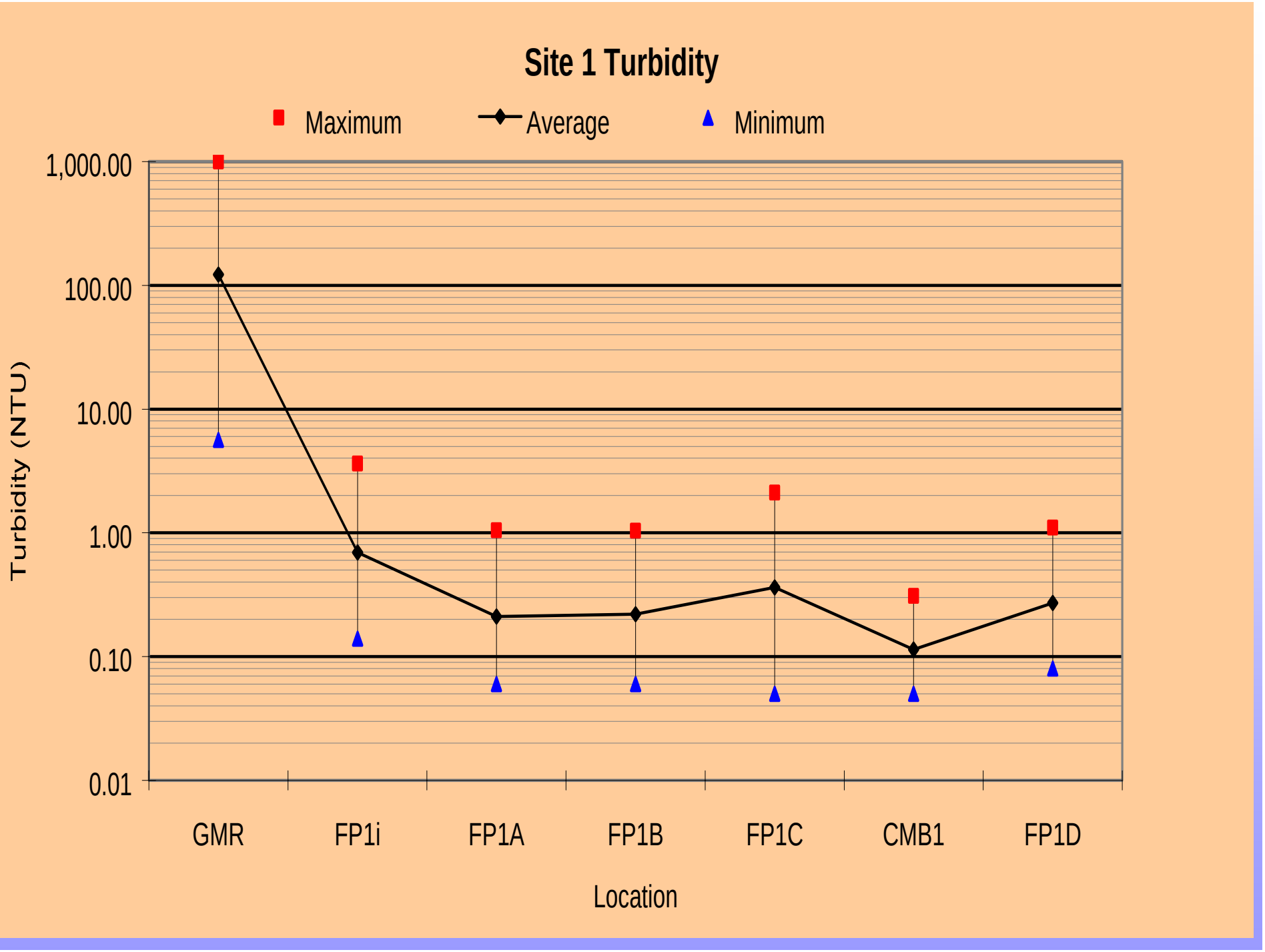


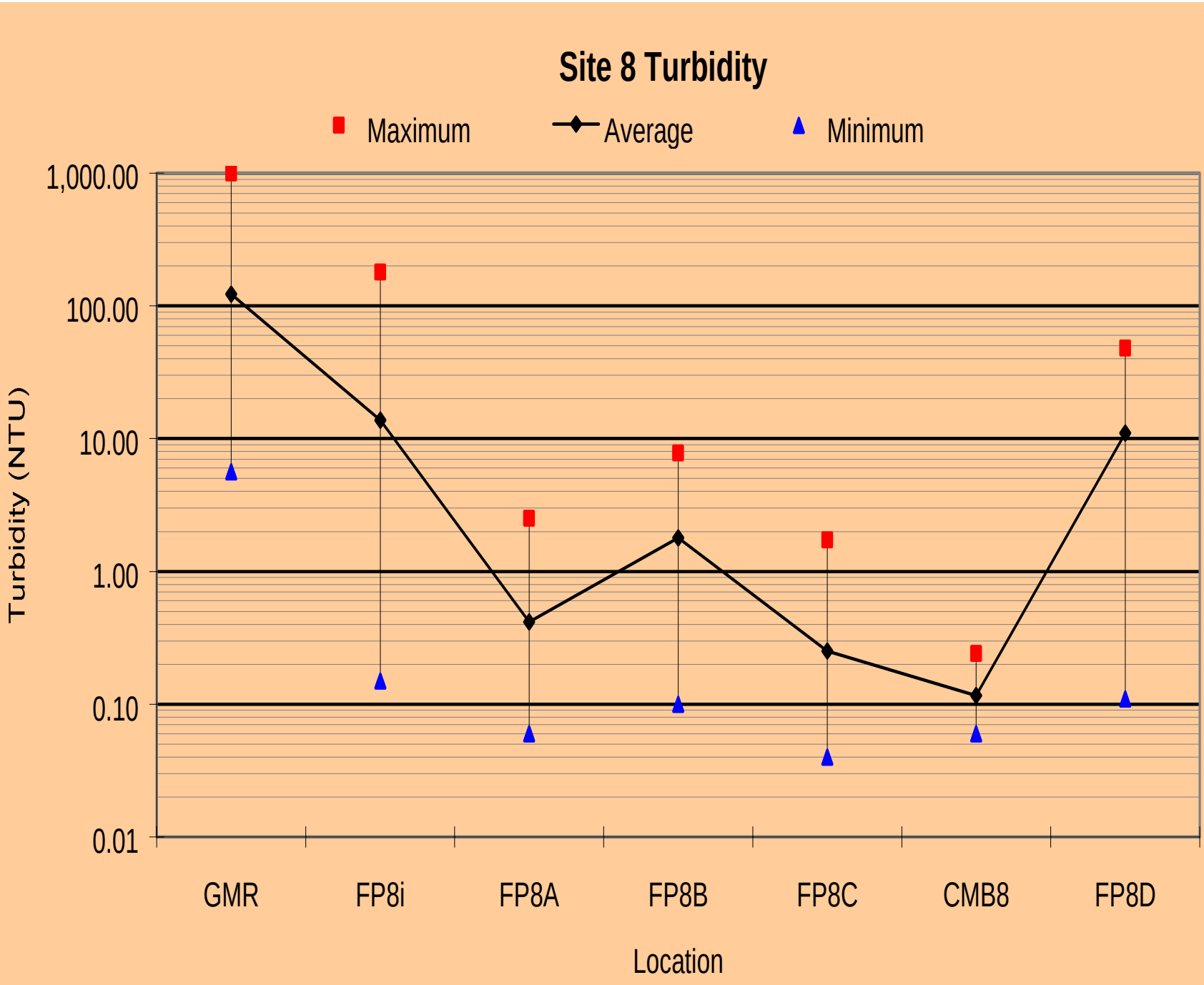


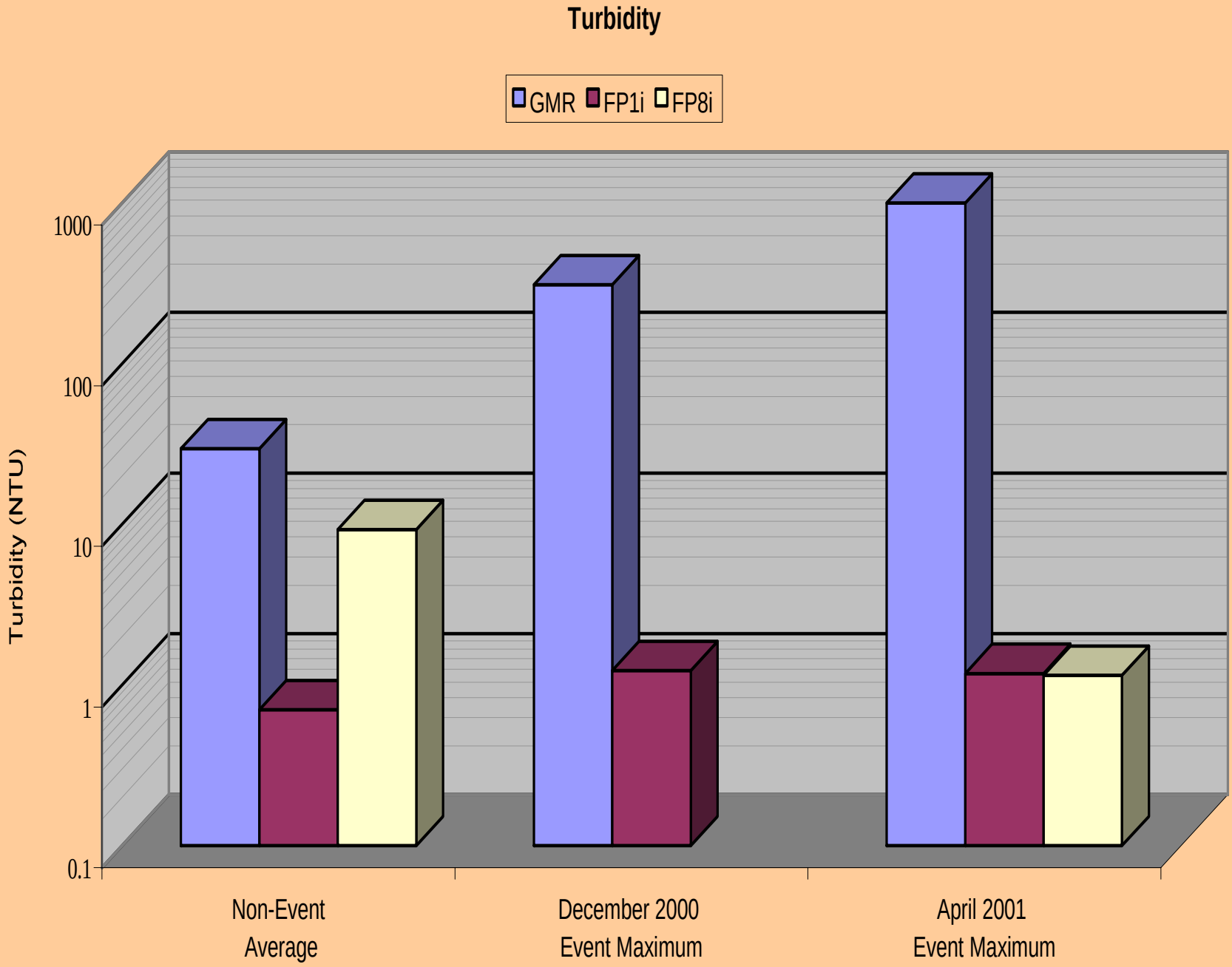


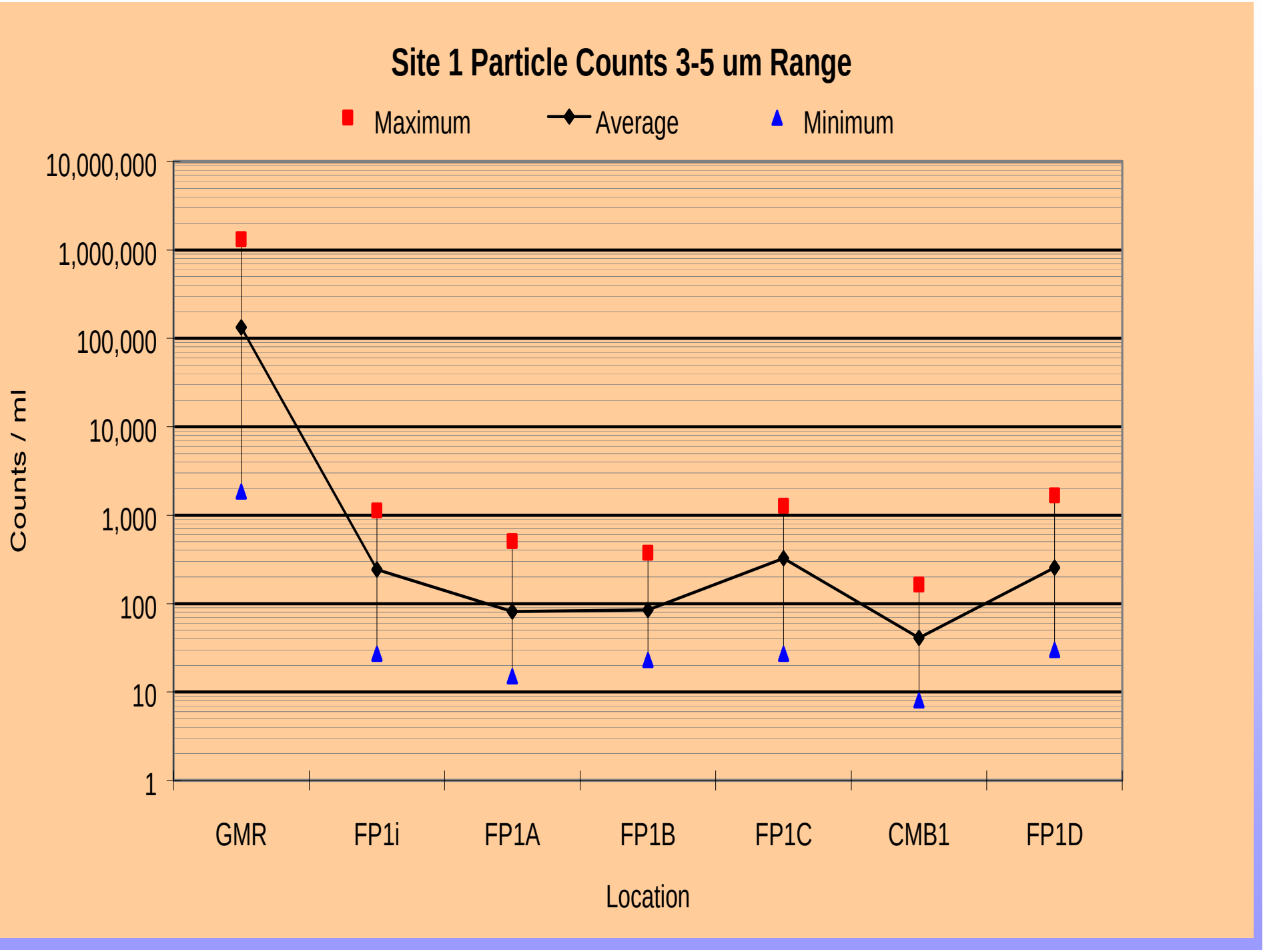


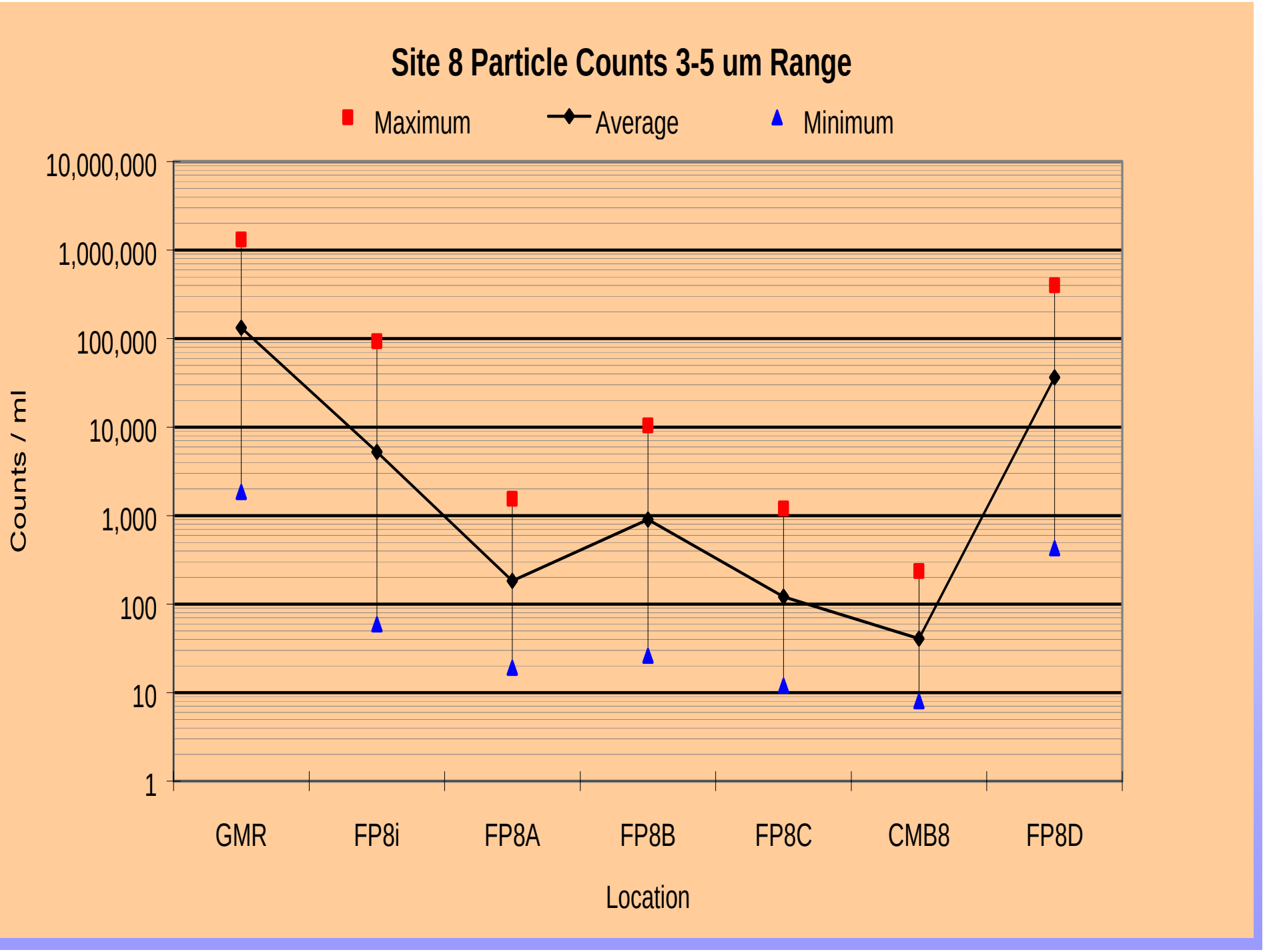


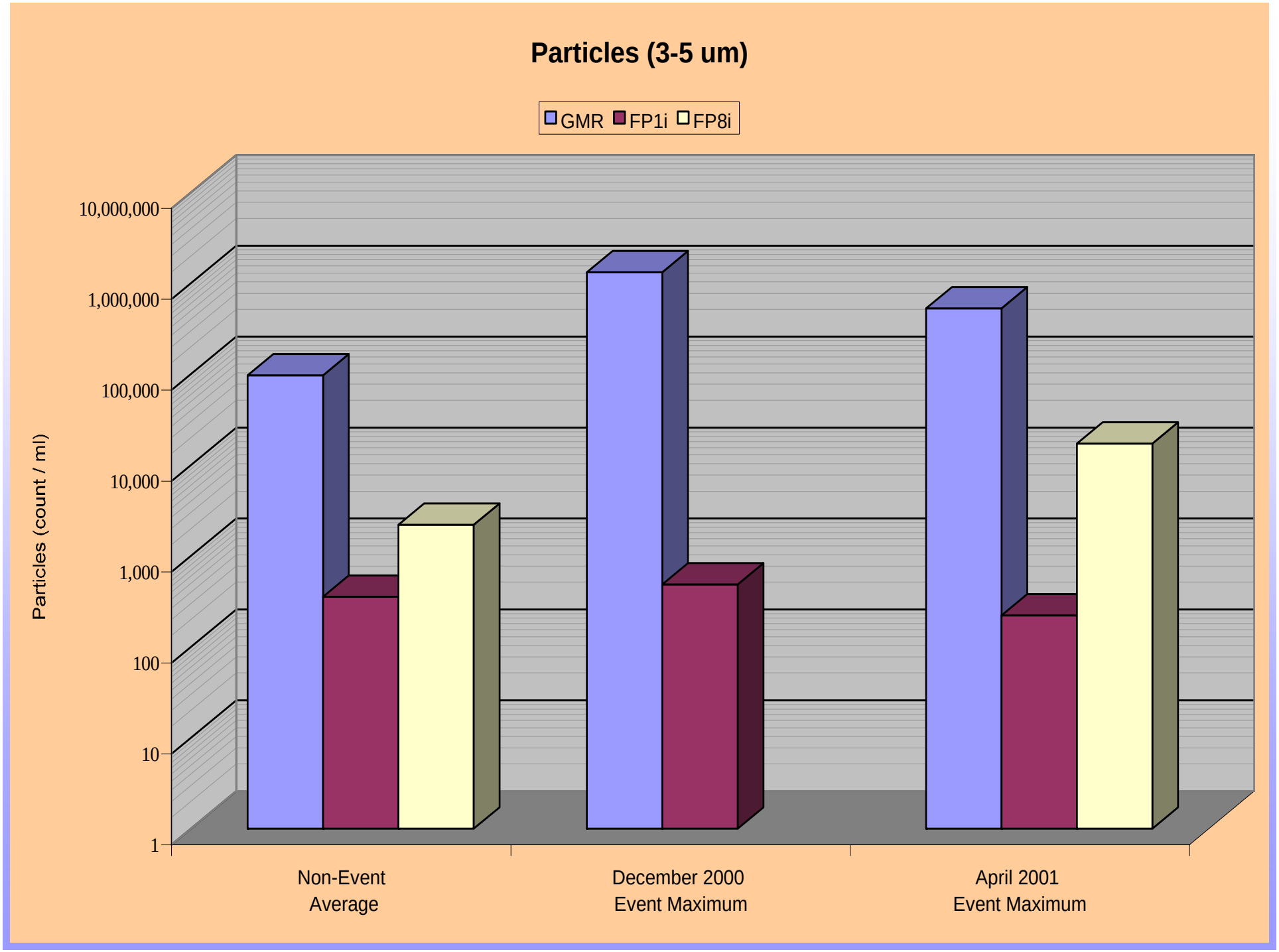


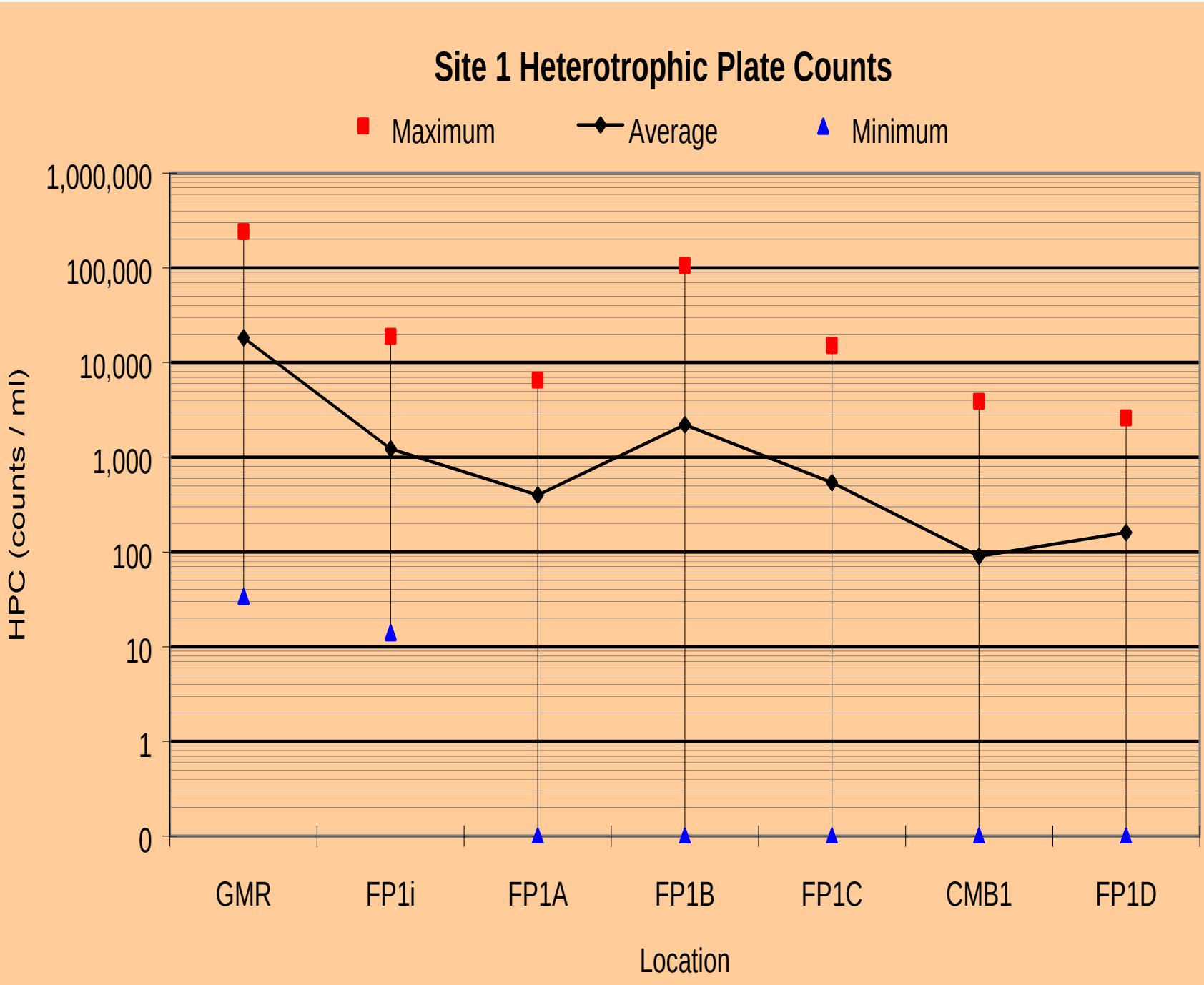


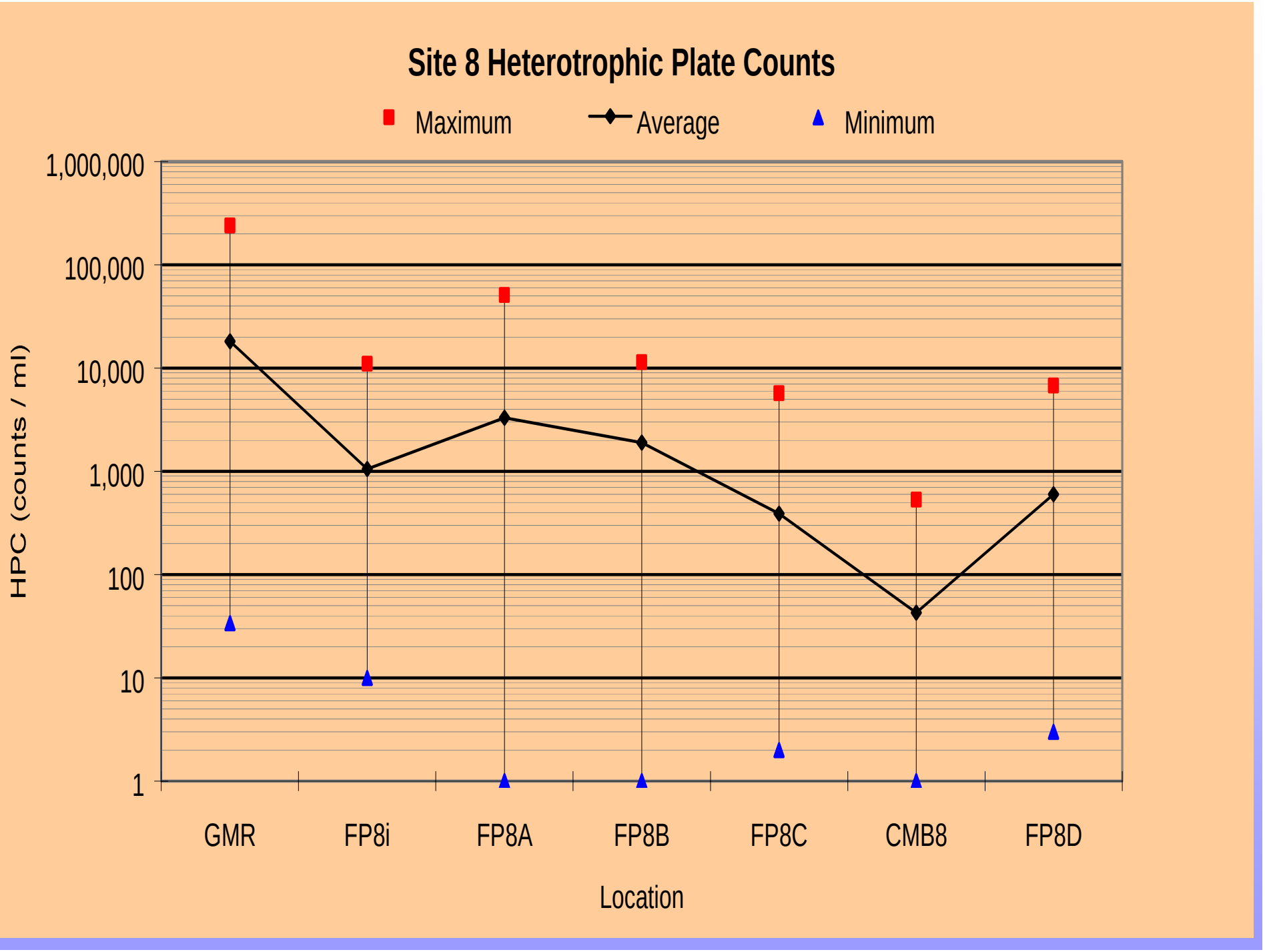


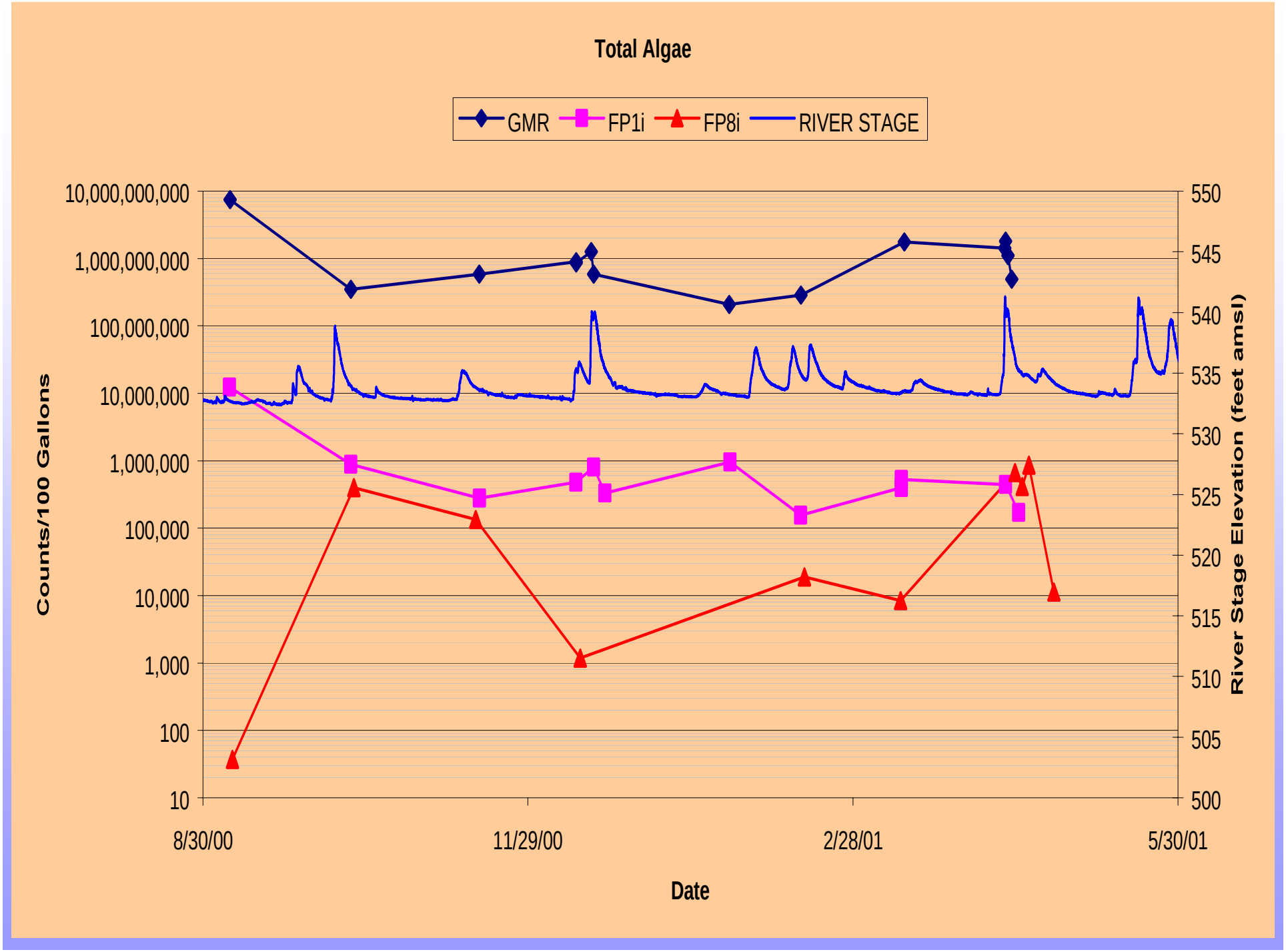


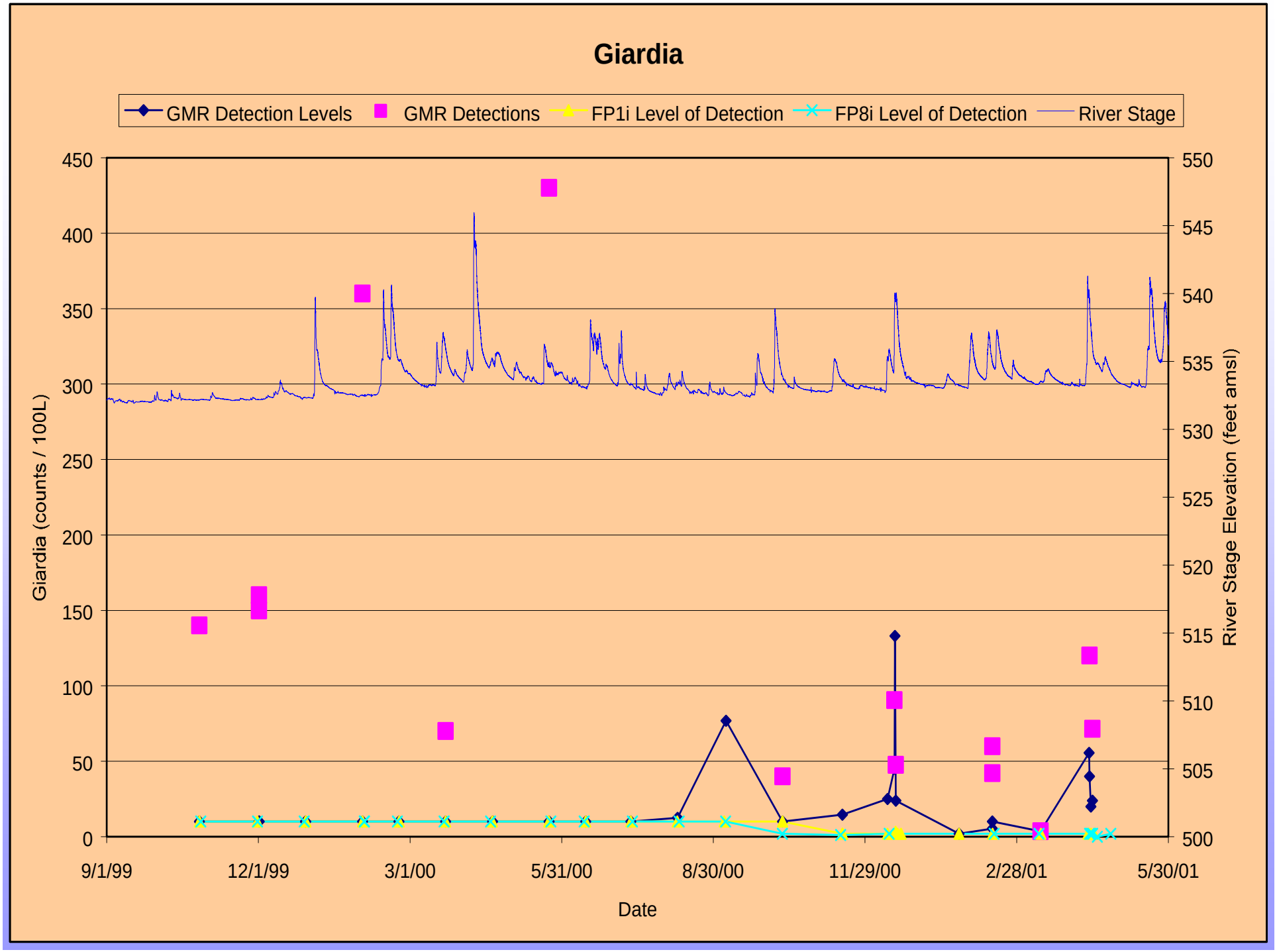


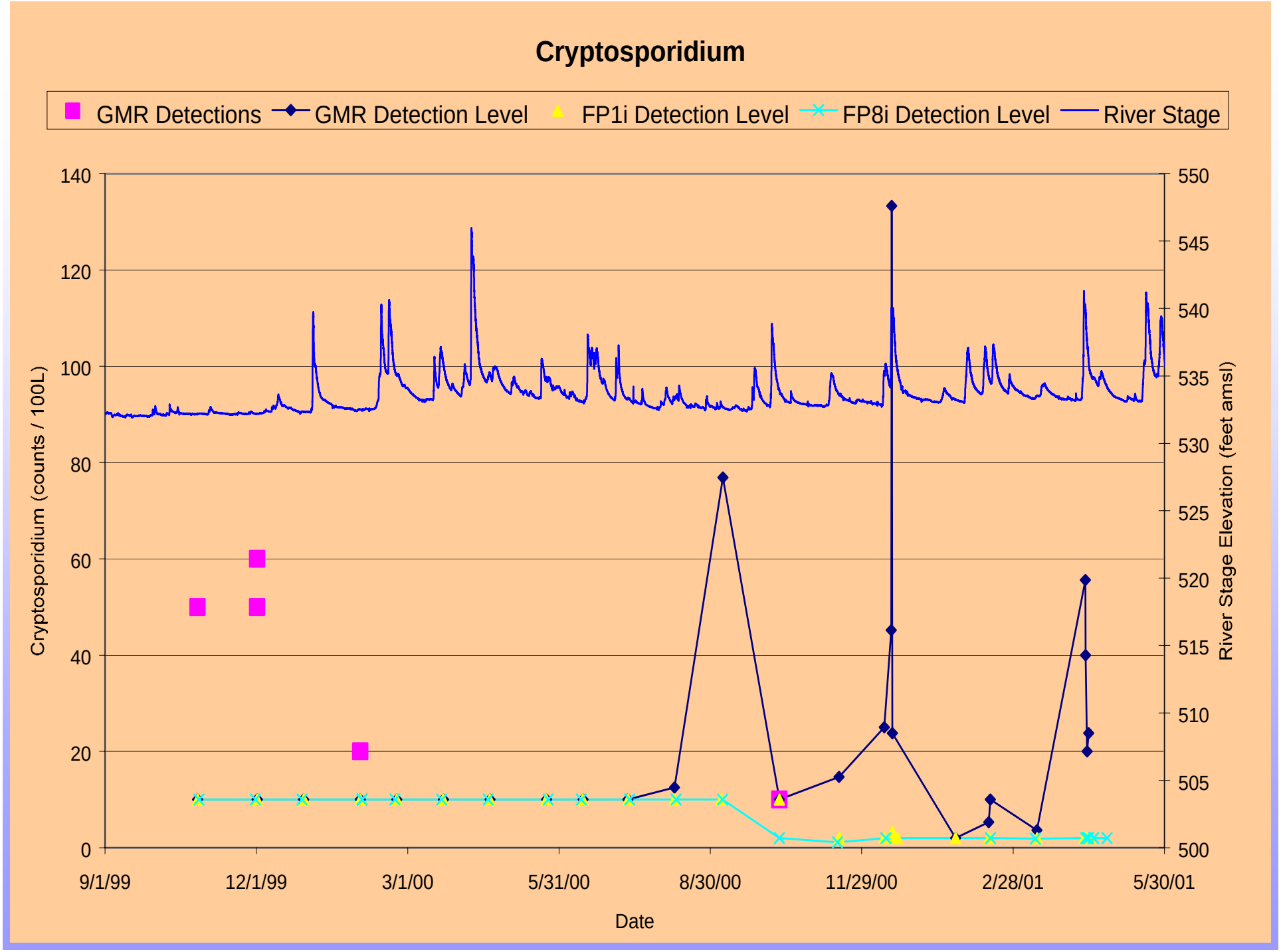












Conclusions

- No *Giardia* or *Cryptosporidium* detected in any of the 285 GW samples (71% using Method 1623)
- In general, streambed/aquifer provides a 2-6 log reduction of surrogates, even during events
  - Aerobic spores - 2 to 6 log
  - Turbidity - 3 to 4 log
  - Particle counts - 3 to 5 log
    - cysts size - 2 to 4 log
    - oocysts size - 2 to 3 log
  - Algae - 3 to 6 log
  - Total coliform - 3.5 to 5+
- Streambed is important in the reduction process

Conclusions (cont.)

- Conclusions drawn from water quality data, particularly monitoring wells, must be based on averages (or similar "multiple data point" statistics) and not on isolated sampling events.

- Monitoring wells are more affected by aquifer heterogeneity (both physical, chemical, and biological), than are properly developed production wells. This is due to short screened intervals and smaller capture zones.

- Riverbed dredging should not be done in the vicinity of a production well utilizing riverbank filtration.

Argument for RBF Credit

- Water quality from production wells continues to meet high standards, and is comparatively better than effluent from a conventional SW plant.
- Multiple surrogates demonstrate log reductions ranging from 2 to 6 log.
- No *Giardia* or *Cryptosporidium* have been found in any ground water samples, even those with relatively high concentrations of algae (i.e. inclined wells)
- Periods of high infiltration rates continue to produce high quality water
- Frequency and period of high infiltration rates events is low

Future Riverbank Filtration Research - Our Wish List

- Quantification of infiltration rate variability
- Quantification of riverbed conductivity during high stage events
- Streambed scour - How can it be measured?
- Duplicate modified Flowpath Study @ other sites
- Aquifer spiking studies - How do you do it?
- Similar studies to evaluate the impact of bank filtration from lakes and gravel pits (are the risks higher or lower?)

A Parting Thought

33 gallons filtered from the river

1,100 gallons filtered from 5 feet below the riverbed