TECHNICAL MEMORANDUM

TO:	PHIL O'BRIEN PHIL DEGAETANO JIM OLANDER NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION USEPA REGION II	DATE:	APRIL16, 2009
		RE:	RECURRENCE INTERVALS
FROM:	CHARLES DUJARDIN	FILE:	RTIN.003.002.001.03

RE-EVALUATION OF RECURRENCE INTERVALS

The New York State Department of Environmental Conservation has raised concerns that the 2003 conditions in the Pathogen Allocation Tool (PAT) represents a condition that occurs rarely and that the conversions from the PAT load reductions to a different level of protection (i.e. 3, 4, or 5 year recurrence may not be appropriate. This was based on an analysis of rainfall data. Therefore, based on these comments that had a sound basis, the recurrence interval of loadings and receiving water concentrations were re-evaluated.

Although rainfall data is a good starting point to evaluate recurrence intervals, there are many other factors that influence the receiving water concentrations. These include rainfall intensity, duration, water temperature, and hydrodynamics. The first step in this analysis was to compare enterococci loadings for the long-term receiving water analysis (13 years) to a longer term record (in this case 31 years). The landside model RAINMAN was used to calculate enterococci loadings to the Harbor for each day during the 31 years (which includes the 13 years). These loadings are a better parameter than rainfall volumes since RAINMAN will also take into account rainfall intensity.

A second factor that was considered in this analysis is temperature. At warmer temperatures the decay of bacteria is larger resulting in lower receiving water concentrations. Therefore the same load in August will have less of an impact than if it occurred in May. Therefore, all the loads calculated by RAINMAN on a daily basis were temperature corrected based on average daily water temperature throughout the year. The formula for the temperature correction is the same formula to temperature correct the decay rate in the receiving water model, that is 1.065^{T-20} where T is degrees C.

Therefore:

$$Load_T = Load_{RAINMAN} \ / \ 1.065^{T-20}$$

Therefore a load at a higher temperature will be reduce and a load at a lower temperature may be increased.

For each day of the year, the average 30-day load was computed (starting with January 30). Then for each year, the maximum 30-day loading for the summer period (May 15 through September 15) was determined.

Probability distributions are then constructed. These probability distributions for both the 31 year analysis and for the 13 years s used for the receiving water analysis of the maximum 30-day loadings are shown on Figure 1.

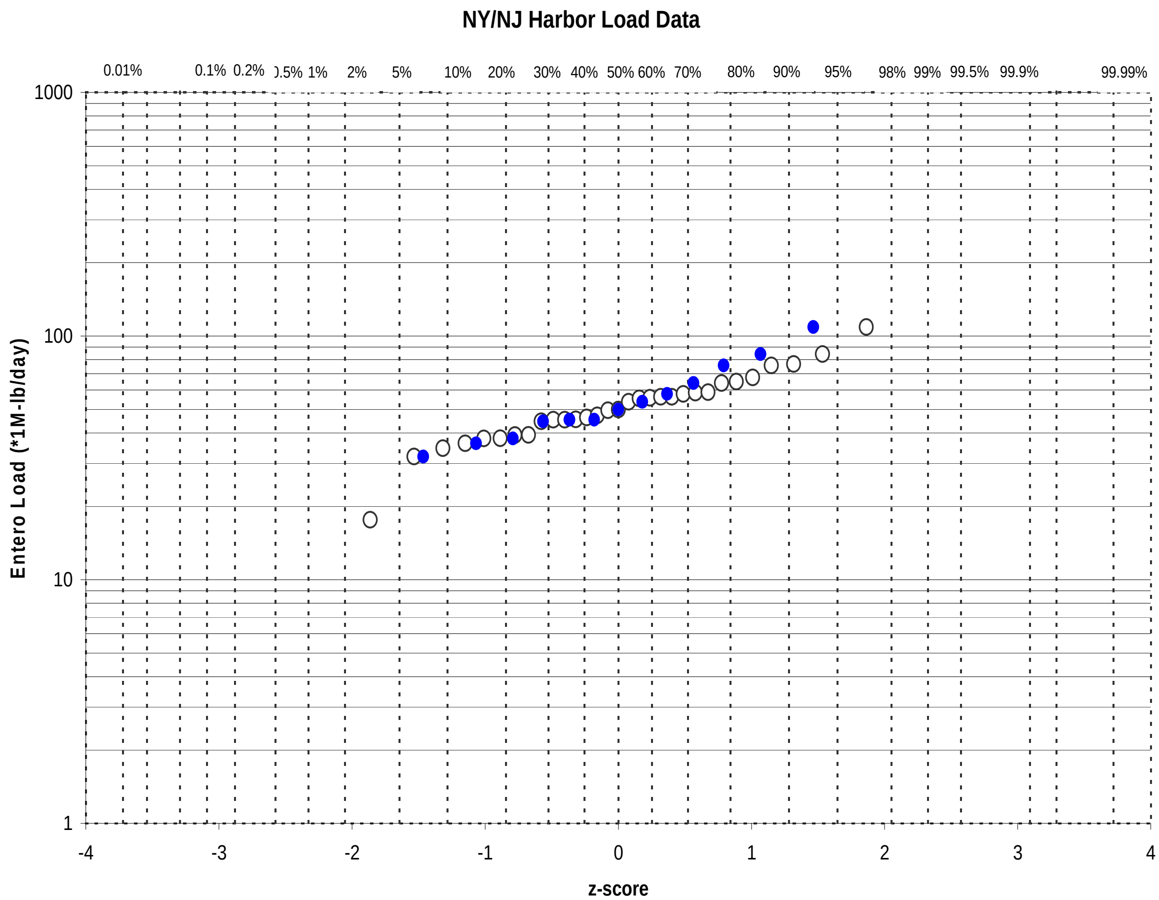

Figure 1.

Probability Distributions of Maximum 30-day Summer Loads
31 Year Analysis (Open Circles)
13 Year Analysis (Closed Circles)

As shown on the figure the two distributions are similar. However, since the 31 year has more data points, the distribution at the tails are more "stretched". It is noted that 2003 is the second highest data point on both distributions. Therefore, on the 31 year distribution 2003 corresponds to a probability of 93.75 which is equivalent to a recurrence interval of 16 years. This compares to the 13 year distribution where 2003 has a probability of 85.71 which is equivalent to a recurrence interval of 7 years.

Based on these results, the maximum 30-day geometric mean receiving water concentrations were re-calculated based on the 13 year receiving water quality model simulation. These were recalculated using the loading distributions shown on Figure 1. Using the load distributions as guidance, the Z-Scores of the 13 year distribution were adjusted to match the Z-scores of the 31 year distribution. Then the 30-day geometric mean concentrations for the 2, 4, 5 , and 10 year recurrence interval were calculated through interpolations.

The locations for the calculations are shown on Figure 2. The results of this analysis are shown on Table 1. Note that the table also shows the results that are in the PAT model (16 year recurrence interval based on loading).

It is important to note that these results will have some implications for converting load reductions in the PAT to load reductions for various recurrence intervals. These adjustments will be shown in a separate submittal.

Figure 2
Key Locations

Table 1
Calculated Maximum 30-day Geometric Mean Concentration

Enterococci Max 30-day GM Open Waters

	Recurrence Interval (Years)					
Location	**2**	**3**	**4**	**5**	**10**	**PAT Model**
Harlem River	32	37	42	48	72	110
Upper Hudson River	9	10	13	15	19	25
Lower Hudson River	17	18	24	28	34	48
Upper East River	27	36	39	42	67	103
Lower East River	30	38	43	47	69	98
Upper New York Bay	18	21	26	30	39	53
Lower New York Bay	12	16	19	22	30	40
Arthur Kill	93	104	112	125	194	236
Kill Van Kull	41	45	53	62	99	142
Raritan Bay	23	23	27	32	55	66
Raritan River	62	68	82	95	132	164
Newark Bay	81	92	114	138	212	306
Hackensack River	81	92	116	138	189	222
Passaic River	464	490	570	623	630	730