B. Approach for Estimating Short-term Impacts of MPP at Meadview

A first step in attempting to estimate the maximum short-term impacts of MPP at Meadview during the summer is to estimate the duration of MPP tracer presents at Meadview using the two weeks of high-time resolution data during the summer intensive period. Determining the duration is complicated by the inability of the high-time resolution tracer monitor to reliably differentiate background tracer levels from those just above background and by the data gaps on many of the days. The method used minimizes the impacts of these problems by considering what fraction of the data collected during a 24-hour period is responsible for a specific fraction of the total tracer measured during that 24-hour period. For example on August 12, 50% of the tracer measured above background arrived in about 17% of the day, which corresponds to just over 4 hours. If we assume that this rate of MPP tracer arrival at Meadview were continued then the duration of the impact would be just over 8 hours (twice the duration corresponding to 50%).

Figure B-1 is a plot showing the range of estimated durations of MPP tracer impacts for each day with sufficient tracer data, calculated for fractions of tracer from 10% to 90%. Using the 50% tracer duration criterion (horizontal line at 50%), 11 of the 14 days have MPP tracer impact durations from about 5 to 10 hours with the other 3 having durations from 12 to14 hours. Selection of a fraction-of-tracer criterion to use is somewhat arbitrary, with larger fractions producing somewhat longer duration estimates. Though better estimates may be reasonably expected when using a higher fraction for the criterion, at some ill-defined day-dependent point the measurements are of sufficiently low concentration that they can no longer be reliably distinguished from background levels. Using a 75% criterion, the duration estimates are from about 6 to 16 hours with most days having values less than 12 hours.

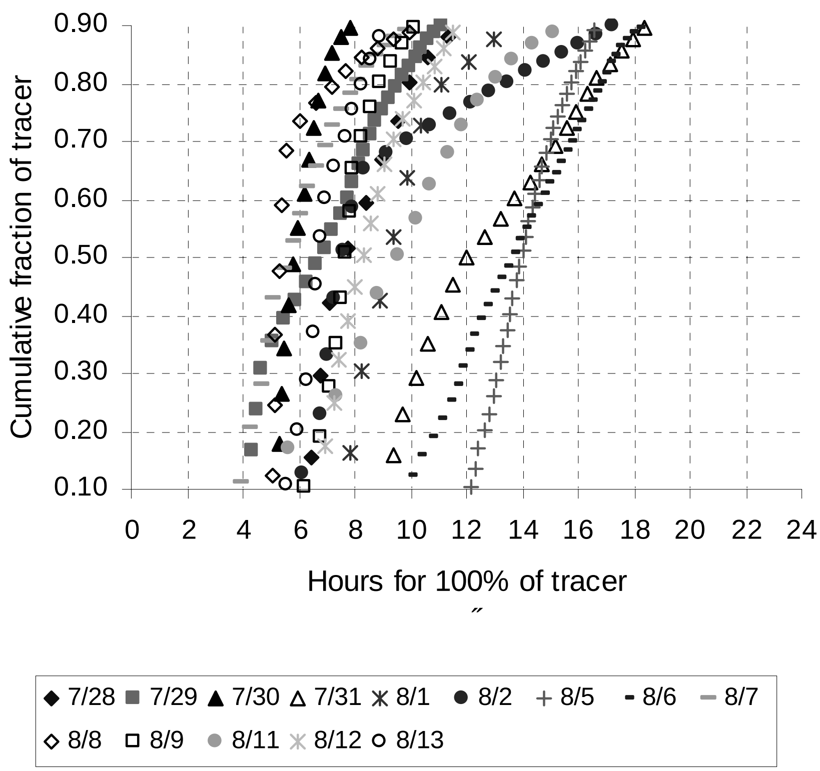

Figure B-1: Estimate time scales for tracer impact of Meadview on various dates.

The process selected to explore short-term impacts is to develop and use a simple adjustment factor (or range of factors) to estimate the magnitude of the highest short term impacts from the 12- and 24-hour estimated impacts. This allows adjustment to the estimates from any of the methods as presented above. Two approaches were used to develop adjustment factors. Both are only applied to the Meadview site during the summer intensive period for the MPP estimates of fractional light extinction coefficient. One approach uses the limited short-time resolution tracer data set, while the other uses CALPUFF predictions of hourly tracer concentrations.

As indicated above the short-term tracer data suggest that MPP impacts at Meadview in the during the summer intensive period tend to be centered on the late afternoon and evening hours with duration typically of about 8 hours. The first approach makes use of the assumptions that MPP impact occurs exclusively during the period of tracer hit and that the MPP impact is uniform even though the tracer levels may be varying. In other words it assumes a step function impact of MPP on the light extinction coefficient with the width of the step equal to the duration of the tracer hit. If the first assumption is substantially correct, which seems reasonable, then the second assumption would be expected to result in an underestimate of the magnitude of the adjustment factor, because it seems unlikely that the impact is in fact uniform. The approach also assumes that the average non-MPP contributions to light extinction coefficient are the same during the short-term impact period as for the entire 12- or 24-hour long-term period. The approach calculates the adjustment factor, the ratio of the short-term to long-term impact, consistent with the assumed step function duration and the magnitude of the long-term impact value. The resulting adjustment factors increase as impact duration decrease and as the magnitude of the long-term impact decrease.

Figure B-2 shows the result of applying the approach to the typical range of MPP tracer duration estimated from the Meadview high time resolution measurements (8.2 ± 3.4 hours duration based on 50% of tracer arriving, see Section 9.3). The resulting adjustment terms to convert 24-hour duration fraction of light extinction coefficient impacts to short term impact range from less than 2 to greater than 5 at the 5% 24-hour duration impact level depending on what impact duration is assumed.

This highlights an important question, whether the duration of the MPP impact is related to the magnitude of the impact. One might assume that the largest 12- or 24-hour average impact results from longer than typical duration of impact over the period. If this were the case then the lower line in Figure B-2 representing 11.6-hour duration out of 24 hours might be the more appropriate one to use. On the other hand, the magnitude of the impact may be unrelated to the length of impact. The problem with addressing these questions is that we do not have any direct way to gauge the magnitude or duration of the MPP contributions to sulfate or light extinction coefficient. The best surrogate that we have, tracer measurements, cannot account for deposition and SO_2 to particulate sulfate conversion processes. For example, tracer data may indicate that MPP emissions are present for 8 hours on a particular day, but the first 4 hours may have involved very little converted sulfate so that the effective period of light extinction impact was closer to 4 hours. The various source contribution models provide the only estimates to gauge the magnitude of the light extinction coefficient impact.

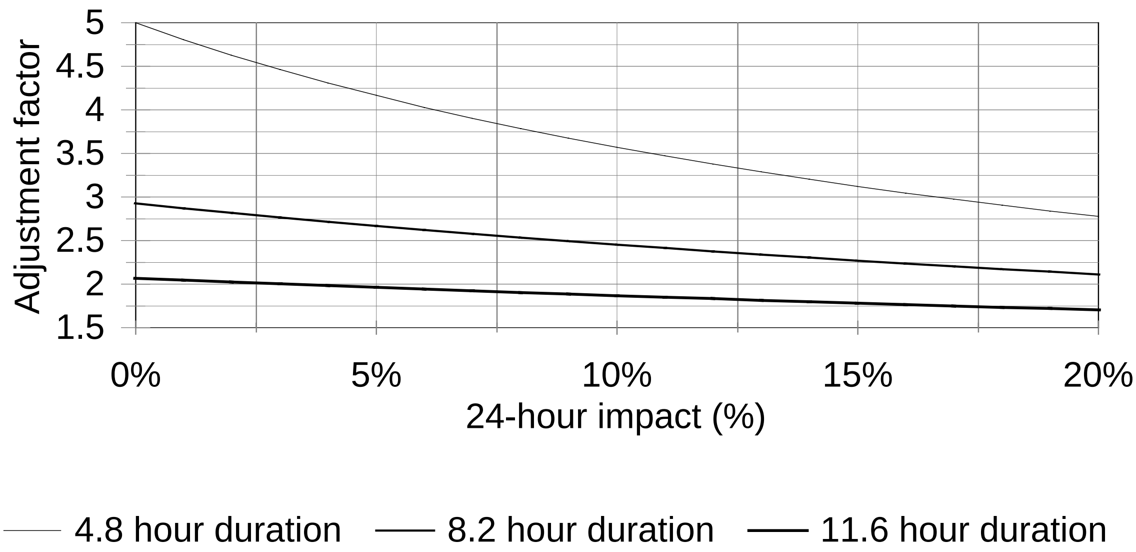

Figure B-2: Adjustment factor for converting 24 hour MPP estimated contribution to light extinction coefficient to short term impact.

Figure B-3 and Figure B-4 contain scatter plots of 24-hour duration MPP tracer concentration versus tracer duration and estimates of MPP particulate sulfate concentration by the various methods versus tracer concentration. There doesn't appear to be any relationship between measured tracer or model estimated tracer and duration. From this it would seem that there is no reason to assume that periods of greatest impact have longer (or shorter) impact duration then average. In other words the uncertainty indicated by the three curves in Figure B-2 would seem to apply regardless of the magnitude of the 24-hour impact that is being adjusted to short-term impact.

Standard deviations of the ratios of short-term to 24-hour extinction coefficient measurements at Meadview were calculated to explore the effects of the assumption of the same contribution of non-MPP sources during the short- and long-term periods. These ranged from about 0.1 for 5-hours to 0.07 for 12-hour short-term periods. These are small compared to the one standard deviation range as shown by the upper and lower curves in Figure B-2 and therefore the contribution to uncertainty is minor from this assumption

The second approach to explore the short-term impacts employs hourly estimates of the MPP tracer concentrations at Meadview by CALPUFF. The method assumes CALPUFF is able to simulate the short-term temporal characteristics of MPP tracer impacts, and that MPP light extinction coefficient impacts are proportional to the tracer concentrations. As in the previous approach, it is assumes that the average non-MPP contributions to light extinction coefficient are the same during the short-term impact period as for the entire 12- or 24-hour long-term period.

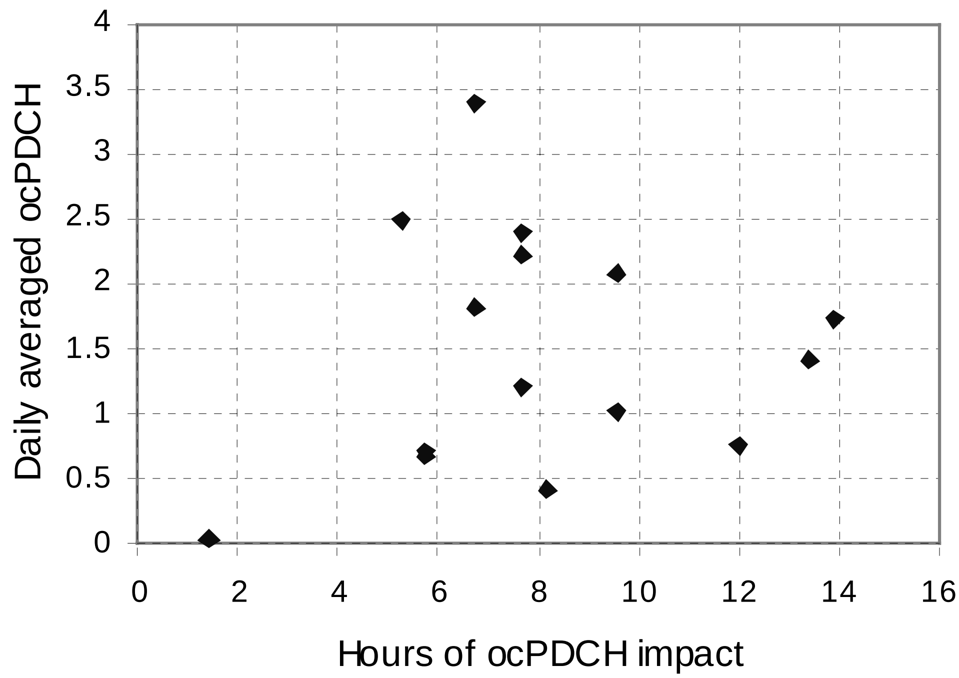

Figure B-3: Daily average ocPDCH tracer concentration at Meadview versus duration of tracer impact. The duration of impact is defined as two times the number of hours needed for 50% of the total daily tracer to arrive.

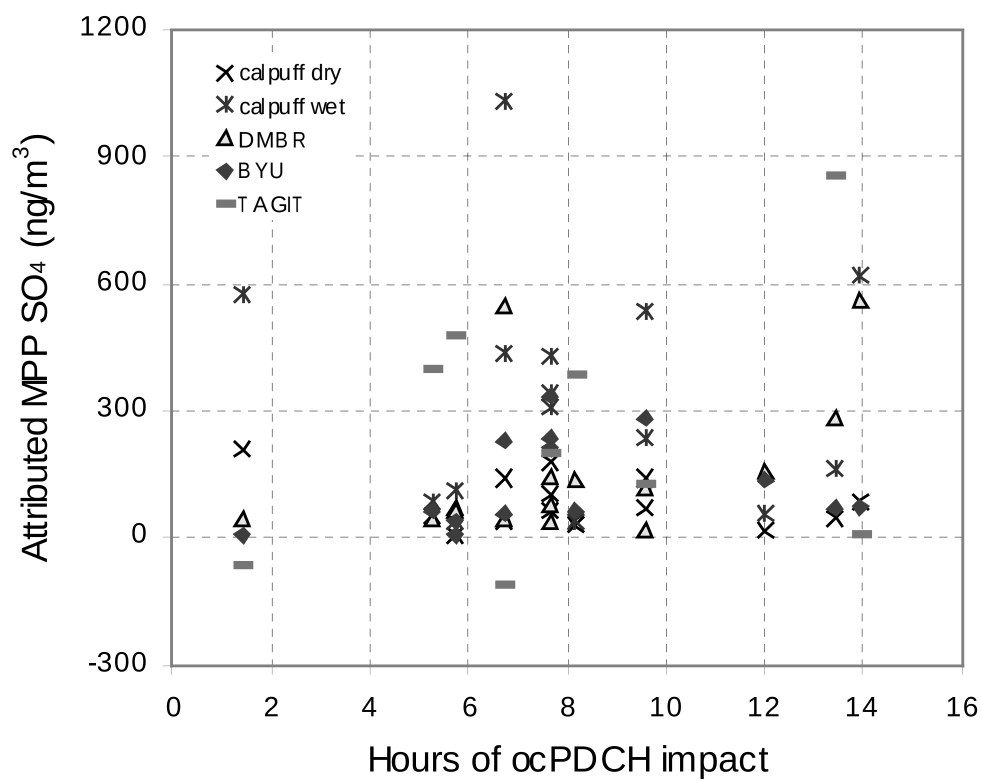

Figure B-4: Estimates of MPP attributed sulfate versus duration of tracer impact.

Unlike the high-time resolution tracer measurements, the CALPUFF hourly tracer estimates at Meadview are complete for the entire summer intensive. This permits the determination of the maximum ratio for each long-term period (12- or 24-hour) of the short-term average tracer to the 12- or 24-hour period average without concerns for missing data or detection limits near background levels. To be useful, these maximum ratios of short-term average to long-term average CALPUFF tracer estimates must be similar to what would have been obtained using short-term tracer data. Model estimates need not predict individual hourly concentrations correctly to meet the needs of this approach, but they must have about the same frequency, magnitude, and shape of peaks on a time plot as would be seen with measurement data. As seen in Figure B-5 where the CALPUFF estimates are shown as negative values to facilitate distinguishing them from the measurements, CALPUFF estimates match the frequency, but tends to have more narrow peaks that are about twice as high as the measurements. A 3-hour averaging of tracer estimates for the short-term value mitigates the problem of the narrow peaks since the peaks are generally only one or two hours long.

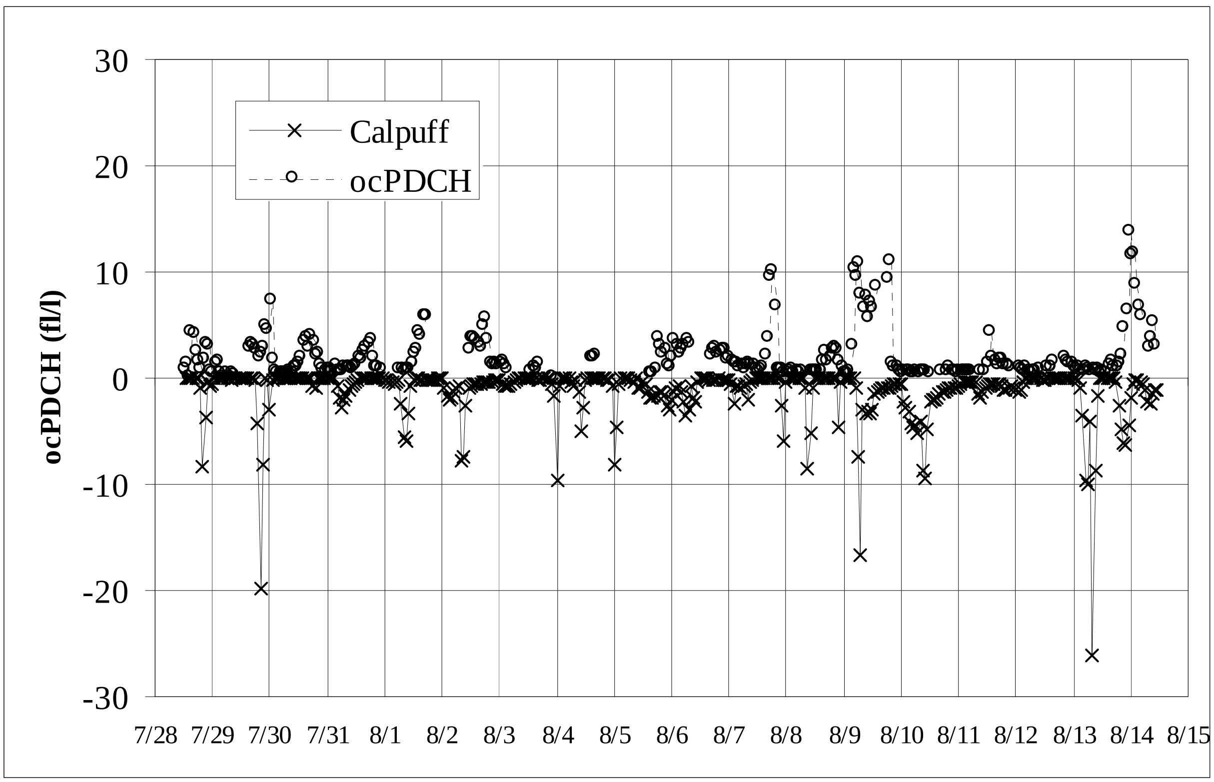

Figure B-5: One hour time series of observed ocPDCH concentration and CALPUFF predicted tracer concentrations (CALPUFF predictions are multiplied by –1 to facilitate comparison).

The second assumption for this approach, that the MPP contribution to light extinction be proportional to the tracer, basically indicates that transport and dispersion are thought to be of prime importance for determining MPP impacts. However, this can not be completely true since it ignores the variable effects of deposition and conversion chemistry. As an example consider that some periods with high tracer concentrations are probably the result of a relatively direct plume hit under moderately high wind speeds and consequently little time for dry conversion. Yet there are significant relationships between the estimate of MPP impact by the various models (except for TAGIT) and the tracer concentration with correlation coefficients ranging from about 0.5 to 0.6 as shown in Table 9-3.

Scatter plots of the maximum ratios of 3-hour average to 24-hour and to 12-hour average versus the long-term average concentrations are shown in Figure B-6. For the ratios to 24-hour values, the range is from about 2 to 8 for the smallest 24-hour tracer concentrations, and about 2 to 4 for largest tracer concentrations. For the ratios to 12-hour values, the range is from about 1.5 to 4 over the entire range of 12-hour average concentrations. For both the 12-hour and 24-hour periods the high ends of the ranges (8 for 24 hour and 4 for 12 hour) correspond to cases with all of the CALPUFF estimated tracer for the long term period predicted to arrive in three hours or less.

From the large ranges of possible adjustment factors generated by either of the two approaches, it must be concluded that there is substantial uncertainty in estimates of short-term MPP contributions to light extinction coefficient at Meadview from the 12-hour and 24-hour results of the various models. This is not surprising considering the lack of data gathered specifically to address short-term impacts and the limitations of air quality models for high time resolution predictions. However, there is one conclusion that is certain. The short-term impacts are generally greater than the long-term average estimates because every day there are periods with very little or no impact that are incorporated into the average. While the true adjustment factor probably varies from one sample period to another, it cannot be specified very well with the available data. Given the range of results for the two approaches as shown above, for the purposes of this report the maximum short-term impact will be assumed to be twice the 12-hour or 24-hour impact estimates from the various methods.

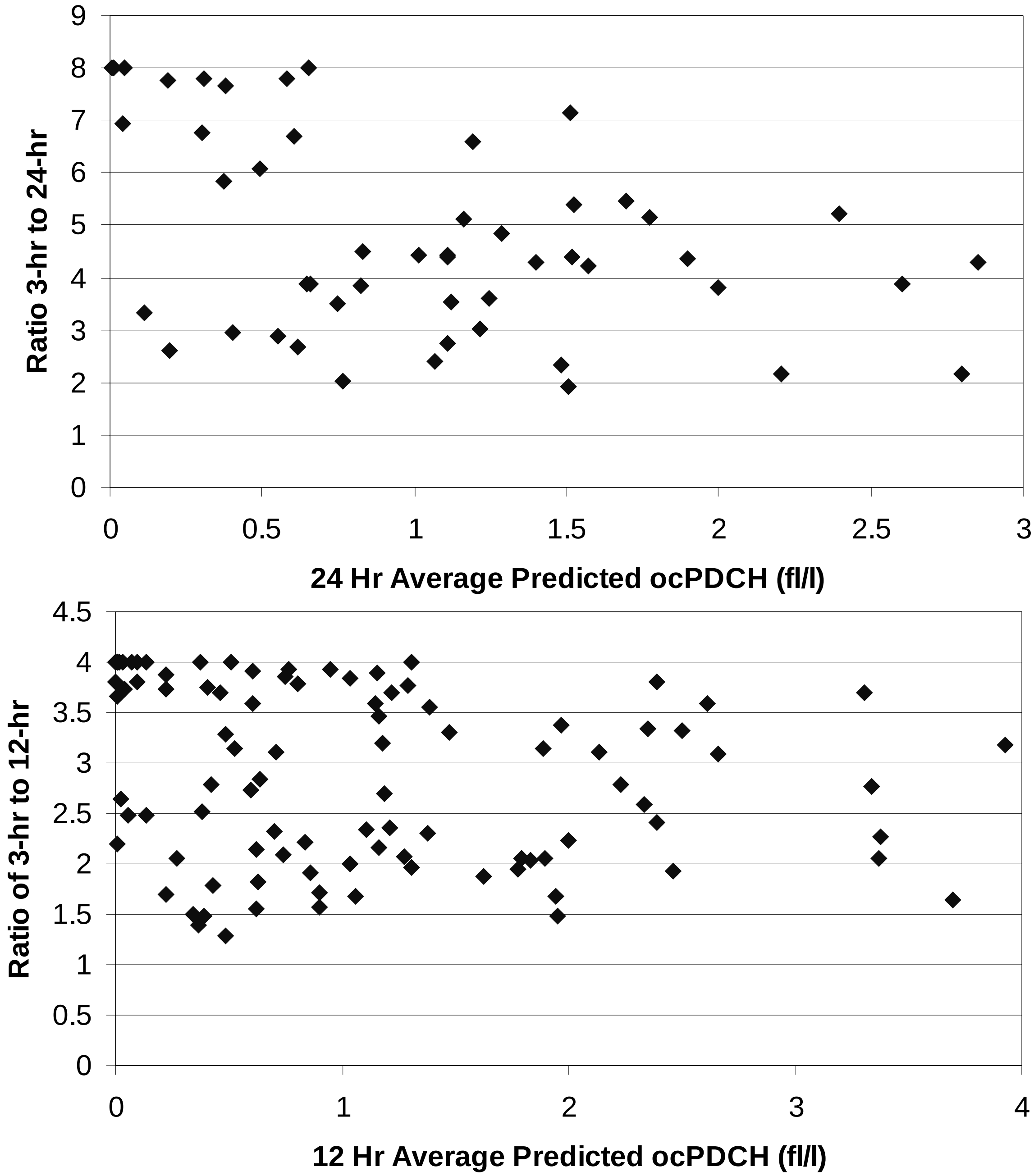

Figure B-6: Ratios of maximum 3 hour CALPUFF predicted tracer concentration to 12 and 24 hour average values.