March 9, 2001

Philip N. Asprodites, Commissioner of Conservation
Department of Natural Resources
625 North 4th Street, First Floor
Baton Rouge, LA 70802

Subject: Land Treatment of E&P Wastes

Dear Commissioner Asprodites:

Per your request, RAM Group has calculated the Minimum Safe Distance (MSD) that a land treatment cell may be located from a hypothetical resident to ensure protection of public health. To do this, we have used the API-DSS air dispersion model with the same assumptions and parameters that were employed in the Phase 3 report. We have estimated how much benzene from each type of E&P waste is placed annually in the treatment cell based on the TCLP-Benzene concentrations of all batches of E&P waste submitted to the Department of Natural Resources under the 29-B Emergency Rule. Our analysis indicates that the types of E&P waste requiring the greatest distance to the resident are Waste 06 (Production Storage Tank Sludge) and Waste 12 (Gas Plant Waste). The MSD for Waste 06 is 1965 feet from the edge of the treatment cell (based on data from 162 batches); the MSD for Waste 12 is 2195 feet (based on four batches only). The following comments are pertinent:

1. In our Phase 3 report, we calculated the amount of benzene that could be placed in a 5-acre treatment cell in the form of each type of E&P waste such that the Incremental Lifetime Cancer Risk (ILCR) to a hypothetical resident living 500 ft from the edge of the cell would not exceed 10^{-6}. This amount of benzene estimate was used to calculate the Maximum Permissible Concentration (MPC_{Res}) for each waste type.

2. The present question requires the API-DSS model to be solved for distance for a given amount of benzene. While your question is simple, it raises a number of technical issues that are not. Foremost among these, is how to estimate the total amount of benzene that will be placed in the treatment cell each year, in a manner that is health-conservative, yet fair. In order to calculate the distance to the receptor, we have to estimate the amount of benzene that will volatilized to the air each year.

3. Based on the analytical data submitted to DNR under the 29-B Emergency Rule, it is clear that most batches of E&P wastes have Total Benzene levels (as estimated from TCLP results) that are substantially less than the

recommended MPC_{Res} criteria. That is, the benzene emissions from each waste type will likely be substantially lower than the 131 kg/yr used to derive the MPCRes criteria, and the health risk (ILCR) to the hypothetical receptor will be substantially less than 10^{-6}.

For example, the maximum Total Benzene content of Waste 06 (Production Storage Tank Sludge) seen in the 162 submitted data was 157,500 mg/kg (a value that is highly suspect and thought to be an artifact of the analytical procedure). For comparison, the median Total Benzene content is only 5.0 mg/kg (i.e., one-half of the submitted batches have Total Benzene concentrations less than 5.0 mg/kg, and half have concentrations greater than 5.0 with one batch reported to have a concentration of 157,500 mg/kg). This is a distribution with an extremely long tail on the high end. The average Total Benzene (affected by the suspect data in the high-end tail region) for Waste 06 is 2168 mg/kg.

4. To keep the modeling simple here, I have used the same basic assumptions as those used in the Phase 3 report (i.e., a 5-acre treatment cell into which a historically derived volume of each E&P waste is placed annually; a receptor living for 30-years downwind from the treatment cell, and a target ILCR of 10^{-6} from each waste type). Given the above example, the technical question for our distance calculation boils down to "what do we assume to be the total amount of benzene placed in the treatment cell each year as Waste 06, etc.?" Potential parameters for this estimate include…

   a. Maximum: Clearly, it is unreasonable to assume that the hypothetical treatment cell will be filled only with batches of an E&P waste containing Total Benzene levels at the maximum reported concentration. Such an assumption in the case of Waste 06 would lead to an estimate of 182,991 kg of benzene being placed into the treatment cell annually, and require that the hypothetical receptor be located approximately 70 miles away to meet the 10^{-6} risk criterion.

   b. Maximum based on Maximum TCLP Benzene Solubility: I had originally proposed using the maximum solubility of benzene in the TCLP extraction solvent (water) as the basis of estimating the amount of benzene placed in the treatment cell. However, after looking at the data distributions, I believe that this approach greatly overestimates the amount of benzene, and is not appropriate for DNR's purposes. In the case of Waste 06, assuming that the maximum solubility of benzene in water to be 1800 mg/L and that a total of 1,161,848 kg of Waste 06 is placed annually in the treatment cell, it can be calculated that the amount of benzene in the treatment cell from Waste 06 will be 21,959 kg/yr.

   c. Median: The median may be viewed as the most frequently expected concentration of Total Benzene in the batches of each E&P waste type

placed in the treatment cell. While most batches of waste will contain Total Benzene levels that are near the median, others may contain Total Benzene levels that are substantially greater than the median. For that reason, this parameter is not considered to be adequately health-conservative for DNR's purposes.

d. Mean: The mean is the average Total Benzene concentration for all batches of each E&P waste type placed in the treatment cell. While at first glance, the mean appears to be the most appropriate estimate of the amount of benzene, in my opinion this parameter is unduely influenced by values in the tail of the data distribution. For example, if the one batch (out of the 162 submitted data) showing a Total Benzene concentration of 157,500 mg/kg is omitted from the calculation, the mean benzene concentration is reduced by almost 45% (from 2168 to 1203 mg/kg). A similar effect is seen in the case of Waste 12 (Gas Plant Waste), for which only four data points are available. Because of this, I do not consider the mean to be an appropriate estimator for the amount of benzene place in the treatment cell.

e. 90% Limit Value: An alternative estimator for the amount of benzene is based on the concentration of Total Benzene below which 90% of submitted batch data are found. This approach determines the 90% limit from the actual analytical data submitted to DNR. It should be emphasized that my selection of the 90% limit (as opposed to some other percentage level) was a matter of professional judgment. While 90% may be overly health-conservative, its use allows me to take into account the complete DNR data set (including the data points in the high-end tail region). I would note also that the use of a 90% upper limit is similar to the Reasonable Maximum Exposure (RME) estimate suggested by the EPA for use in the risk assessment process. For the above reasons, I consider the 90% Limit Value to be the preferred estimator of the amount of benzene placed in the treatment cell annually. For Waste 06, the 90% Benzene Limit Value is 846 mg/kg.

5. The table below lists the 90% Benzene Limit Values for each of the four wastes that were recommended for regulatory consideration in the Phase 3 report. Using the 90% limit value and the expected (historical) volume of each waste, it is possible to estimate the total amount of benzene that will be placed annually in the hypothetical treatment cell. All of the benzene in each waste type is assumed to volatilize to the atmosphere). When this annual benzene emission rate is incorporated into the API-DSS model, it is possible to calculate the Minimum Safe Distance (MSD) to the receptor (i.e., the hypothetical resident) as measured from the edge of the 5-acre treatment cell.

E&P Waste		Volume	90% Bz	Bz Emissions	Distance
Code	Description	(kg/yr)	(mg/kg)	(kg/yr)	(Feet)
05	Production Pit Sludge	3,028,478	31	92	374
06	Production Storage Tank Sludge	1,161,849	846	983	1965
07	Produced Oily Sands & Solids	1,355,448	34	46	194
12	Gas Plant Waste	107,886	10,851	1,171	2195

As shown on the above table, the closest that a treatment cell receiving Waste 05 should be placed relative to a residential receptor is 374 feet (0.07 miles). For Waste 06 the minimum acceptable distance is 1965 feet (0.37 miles); for Waste 07, 194 feet (0.04 miles); and for Waste 12, 1961 feet (0.42 miles). Based on the submitted TCLP-Benzene data, the residential receptor can live at these distances from the edge of the treatment cell without exceeding our 10^{-6} cancer risk criterion for each waste.

I hope that the above information is helpful. Please do not hesitate to call me if you have any questions or require additional information.

Sincerely,

F. B. Thomas, Ph.D.