Texas Natural Resource Conservation Commission

INTEROFFICE MEMORANDUM

TO: NSRPD Technical Staff **DATE:** September 2, 1998

FROM: Dom Ruggeri, Team Leader
Air Dispersion Modeling Team (ADMT)

SUBJECT: Background Concentration Determination for Use in NAAQS Analyses

As defined by the EPA, background air quality includes pollutant concentrations due to natural sources, nearby sources other than the one(s) under consideration, and unidentified sources (EPA, 1995). Background concentrations are obtained from ambient air quality monitors. Ideally, a network of monitors would be available to provide concentrations near the site of the permit application. By near we mean within about 1 kilometer (km) of the area of maximum concentrations from existing sources or the area of the combined maximum impact from existing and proposed sources. However, existing monitors within 10 km of the proposed sources can also be used (EPA, 1987). Unfortunately, data from nearby monitors are rarely available; and, time and cost constraints usually prohibit the establishment of site specific networks.

The procedure to determine background concentrations includes various levels of refinement. The goal is to use the most conservative and readily available background concentration in the permit review process. In addition, the objective is not to identify the highest background concentration ever measured. The recommendation for the year to use to obtain a monitored background concentration is based on the PSD preconstruction monitoring process, which usually requires data for the year before the permit application. However, data from any representative year may be used if the previous year's data are incomplete or not available. Representativeness is determined by reviewing monitor location, quality of the data, and currentness of the data. Currentness means the data were collected during a 3-year period before the permit application. The data may be older if they represent current conditions; that is, the emissions inventory is about the same as when the data were collected.

Use the following procedure to determine background concentrations for state NAAQS and PSD permit review as applicable. The steps do not need to be followed in order. While the process can be used by engineers, it is primarily intended for use by ADMT.

Re: Background Concentration Determination for Use in NAAQS Analyses

Procedure

Step 1. Use the Screening Background Concentrations Table (September 2, 1998 memo) to obtain a conservative background concentration.

- Screening Modeling. If the total concentration is less than 90 percent of the NAAQS, the demonstration is complete.[1] If not, additional review is needed to determine if refined modeling may be required. Go to Step 2.

- Refined Modeling (CO, NO_2, Pb, PM_{10}). Screening background concentrations can be used with refined modeling that included retrieved sources from the PSDB. This is a conservative approach since the PSDB sources were included in the modeling. If the total concentration is less than the NAAQS, the demonstration is complete. If not, attempt to obtain a refined background concentration. Go to Step 2.

    - For SO_2, do not add a screening background concentration, unless there could be mobile or marine sources of SO_2 in the area. In that case, add 10 percent of the appropriate NAAQS to the modeled prediction.[2] This may be appropriate near the Houston Ship Channel and Port of Corpus Christi Channel, or the Dallas metropolitan area.

Step 2. Use the following procedure to determine a refined background concentration.

- Obtain ambient monitoring data from the EPA AIRSWEB at the following URL: http/epa.gov/airsweb/monreps.htm, or by contacting the Data Management and Analysis Section, Monitoring Operations Division. Following are monitor types: State or Local Air Monitoring Stations (SLAMS), National Air Monitoring Stations (NAMS), Prevention of Significant Deterioration (PSD), and Special Purpose Monitoring Stations (SPMS).

- Select the high, second highest concentration monitored during the previous year for short-term averaging periods (24 hours or less), and the highest concentration monitored for

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[1] This is a conservative approach since the background concentrations are based on the highest concentrations monitored in a county over a 6-year period, and they are added to the screening concentrations without regard to time and space.

[2] Limited emissions come from non-point sources. The 10-percent factor is conservative, and the concentrations are added to modeled concentrations without regard to time and space.

long-term averaging periods (more than 24 hours) if the data are complete.[3] For example, for a permit application in 1998, use data obtained in 1997.

- Determine if the data are complete by evaluating the number of observations taken. *Note: Use the second highest short-term value reported even if a year does not meet the criteria for completeness but has a higher reported short-term concentration than from the next complete year*. For example, if there were only 4000 1-hour observations for SO_2 for 1997 and 8760 for 1996 and the high, second highest 24-hour observation in 1997 was 300 $\mu g/m^3$ and 250 $\mu g/m^3$ in 1996, use the 1997 concentration. See Table 1. Go to Step 3.

Table 1

Pollutant	Averaging Period/Number of Observations Required					
	1-hour	3-hour	8-hour	24-hour	Quarter	Annual
CO	6570	-	6570	-	-	-
SO_2	-	6570	-	6570	-	6570
PM_{10}	-	-	-	75% of period*	-	75% of period*
NO_2	-	-	-	-	-	6570
Pb	-	-	-	-	68	-

* 45 days for every 6-day period; 91 days for every 3-day period; etc.

Step 3.

- For sources located *in the same general area* as SLAMS, NAMS, PSD, or SPMS monitors. Use the background concentration determined in Step 2. Compare the predicted concentration plus background concentration for each pollutant to the appropriate NAAQS. If the maximum concentrations are below the NAAQS, the demonstration is complete. If not, determine if the background concentrations are representative. If they are conservative for the project, then attempt to refine them. Go to Step 4.

[3] Use of the second high follows the one exceedance form of the short-term NAAQS. In addition, background concentrations are added to modeled concentrations without regard to time and space.

- For sources located *outside the same general area* of SLAMS, NAMS, PSD, or SPMS monitors. Determine the county-wide point source emissions and population for the site under review. Find a PSD, NAMS, SLAMS or SPMS monitor in an area with about the same or greater emissions and population, and similar topography. Use the procedures in Step 2 to determine a monitored concentration. Compare the predicted concentration plus background concentration for each pollutant to the appropriate NAAQS. If the maximum concentrations are below the NAAQS, the demonstration is complete. If not, determine if the background concentrations are representative. If they are conservative for the project, then attempt to refine them. Go to Step 4.

Step 4. Refine the background concentration to remove or limit contributions from the background point sources. Several methods are provided. The goal is to obtain a background concentration with the least amount of time and effort. Therefore, the options do not need to be followed in sequence and may be combined as appropriate.

- For sources located *in the same general area* of SLAMS, NAMS, PSD, or SPMS monitors. Determine the potential contribution of modeled background point sources to the monitored concentration. Use the same PSDB retrieval if refined modeling has already been conducted. If refined modeling has not been conducted, obtain a PSDB secondary retrieval for a radius of 10 km[4] from the monitor of interest. Model the contribution of the background point sources at the location of the monitor. Subtract the predicted contribution of the point sources from the monitored concentration and use the result as the background concentration.

- For sources located *outside the same general area* of SLAMS, NAMS, PSD, or SPMS monitors. Determine the potential contribution of background point sources to the monitored concentration. Obtain a PSDB secondary retrieval for a radius of 10 km from the monitor of interest. Model the contribution of the background point sources at the location of the monitor. Subtract the predicted contribution of the point sources from the monitored concentration and use the result as the background concentration.

- For isolated[5] sources located *in the general area* of SLAMS, NAMS, PSD, or SPMS monitors. A source could impact a monitor within a 90-degree sector downwind of the

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[4] Follows the concept of nearby monitor. The retrieval will include all point sources within the radius and search for significant point sources out to 70 km from the monitor.

[5] Isolated means there are no other point sources within the 90-degree sector, or whose emissions would interact within the 90-degree sector with the same meteorological conditions.

source. Determine the average background concentration at each applicable monitor for the year under review by excluding values when the source(s) in question impacts the monitor. For short-term averaging periods, obtain hourly or daily concentrations and corresponding meteorological data from the Data Management and Analysis Section, Monitoring Operations Division. Exclude concentrations caused by transport from the source toward the monitor within the 90-degree sector. Average the remaining concentrations for each separate averaging time to determine the average background value. If there is more than one monitor, determine the mean background concentration from the average concentration at each monitor. The mean annual background is the average of the annual concentrations at each monitor. The short-term exclusion process can be used for long-term averaging periods. Applicable hourly concentrations may be added and averaged to determine longer averaging period concentrations (EPA, 1995). *Note: For PM_{10}, use technical judgement to exclude data, since concentrations are not provided on an hourly basis and transport may be difficult to determine because of missing meteorological data or meteorological conditions outside the 90-degree sector*.

- Identify the location of the receptors with significant concentrations from the project. Determine the meteorological conditions associated with these concentrations. Obtain hourly or daily concentrations and corresponding meteorological data from the Data Management and Analysis Section, Monitoring Operations Division. Find meteorological conditions that are similar to those that caused the modeled concentrations and identify applicable monitoring data with the same meteorological conditions. Use this concentration as the background concentration.

- Find a monitor that is not affected by the background point sources included in the modeling demonstration. This could be done by modeling the background point sources to identify those that contribute to the monitored concentrations or by analyzing wind flow patterns.

- For particulate, determine if the concentration was caused by a nonprescribed wildland fire (such as the Mexican fires of 1998) or wind speed in excess of the monthly average. If so, use the next highest concentration that would not be affected by these events.

- Determine the objective used to site the monitor. Determine if the gradient should be significant, that is, quickly decline away from the monitor or be relatively flat for the spatial scale. For example, maxima for CO, PM_{10}, and Pb from mobile sources occur near major roadways and intersections with high traffic density and poor atmospheric ventilation and decline rapidly away from the emission source—on the order of 15 meters. NO_2 concentrations would decline rapidly outside of urban areas. Adjust concentrations

using technical judgement.

Discussion

There are several factors which complicate the process to determine representative background concentrations permit review. One factor is the monitoring objective. PSD and SPMS monitors that are designed to obtain data related to permitting or enforcement activities are rare, and their period of operation is usually limited. The majority of ambient monitoring data is available from air quality monitoring networks composed of SLAMS and NAMS. A network is designed to meet a minimum of four basic monitoring objectives. These objectives are to determine: highest concentrations expected to occur in the area covered by the network; representative concentrations in areas of high population density; the impact of ambient pollution levels of significant sources or source categories; and, general background levels. In order to meet the objectives, the monitoring stations must be located so that the spatial geographical scale represented by the sample of monitored air matches with the spatial scale most appropriate for the monitoring objective of the station. There are six spatial scales that are the most pertinent to the design of network. Monitored data from any of the first five scales can be used to determine a background concentration for permit review (40 CFR, 58):

- Micro Scale. Defines the concentrations in air volumes associated with area dimensions from several meters to 100 meters;

- Middle Scale. Defines the concentrations typical of areas up to several city blocks in size with dimensions ranging from about 100 meters to 500 meters;

- Neighborhood Scale. Defines the concentrations within some extended area of the city that has relatively uniform land use with dimensions ranging from 0.5 kilometer to 4 kilometers;

- Urban Scale. Defines the overall, citywide conditions with dimensions on the order of 4 to 50 kilometers. This scale usually requires several monitoring stations;

- Regional Scale. Usually defines a rural area of reasonably homogeneous geography and extends from 10s to 100s of kilometers; and

- National and Global Scales. These scales represent concentrations characterizing the nation and the globe as a whole.

A second factor is the identification of the monitoring objective. The monitoring objective for

a station is usually not apparent to the NSRPD staff, applicants or the public—and may have changed over the years. Monitoring data that are readily available to the applicants and the technical staff are not identified by spatial scale or monitoring objective. Therefore, the selection of a representative monitor in the network is complicated.

A third factor is knowledge of the emissions inventory used in the siting process. Depending upon the pollutant, the monitor may have been sited based on area or mobile source emissions rather than the size and distribution of point sources, or a combination of the three. This is likely to be the case in the siting of a CO monitor. Additionally, the emission inventory may have been broken out into diurnal or seasonal categories.

A fourth factor is the knowledge of how climatological data was used to site the monitor. Annual or seasonal wind data from regional meteorological stations may have been used to site the monitor. These data may be appropriate to use to obtain representative concentrations for pollutants with long-term averaging period standards. However, these data are of less value in siting decisions to obtain concentrations for pollutants with short-term averaging period standards.

A fifth factor is the use of a single monitor to sample for multiple pollutants. Compromises may have been made in siting based on resource constraints. The user of the data would rarely have this information.

A sixth factor is availability of monitoring, emissions, and meteorological data bases. The information that is readily available to the applicant and the technical staff is presented in summary form. Usually, only the highest concentrations are provided, without any quantifying information such as time of day or associated meteorological data. In addition, there is no information on the emission inventory for the applicable hour, day, or quarter or year that corresponds to the monitored data. When these data are available they are often inconsistent. For example, for PM_{10} the meteorological data may be available on a 5-minute-to-hourly basis but the concentrations are reported on a 24-hour basis—this makes the determination of source culpability very difficult. In addition, the emissions data would rarely be readily available on the same time scale as the monitoring and meteorological data.

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References

EPA, 1987: Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD), EPA-450/4-87-007, May, 1987. U.S. Environmental Protection Agency, Research Triangle Park, NC.

EPA, 1995: Guideline on Air Quality Models, (Revised), EPA-450/2-78-027-C, August, 1995. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC.

40 CFR, 58: Code of Federal Regulations, Title 40 (Protection of Environment), Part 58. Office of the Federal Register National Archives and Records Administration.