FDM 22-15-1 Description of Factors

February 15, 1988

The principal factors affecting air pollution concentrations are:

- Traffic
- Emission Factors
- Type of Roadway
- Terrain
- Meteorological Parameters
- Ambient Air Quality

1.1 Traffic

Highway air pollution varies directly with the volume of traffic. In addition to volume, vehicular speed, the mix of vehicle types, the age distribution, and the percent of vehicles in their cold start mode are considerations in determining the amount of air pollutant concentrations generated by the highway traffic. Vehicle speed, age distribution, and percent of vehicles in the cold start mode are further discussed in FDM 22-20-1 through FDM 22-20-5.

The WisDOT traffic data used to determine the mix of vehicle types, includes the peak and average eight hour traffic volumes, and truck percentages. Air quality projections require the use of the peak hour traffic volumes as a percent of the average daily traffic, P (ADT); and the percent of trucks in the peak hour, T(PHV). The hourly traffic in the highest eight hour period as a percent of the average daily traffic, K_8 (ADT); and the percent trucks in the highest eight hour period, T(A8HV) are also used for air quality projections. These values are typically included as a part of the traffic forecast for a project.

1.2 Emission Factors

Emission factors are numerical representations of the amount of pollutant emitted per distance (grams/vehicle mile) or per time (grams/vehicle minute) on a given roadway segment. These emission factors are a product of the emission standards mandated for new cars produced, the year for which emission factors are desired, the temperature, altitude, initiation of inspection maintenance programs, tampering and the various traffic parameters. Details on the current emission factor methodology are discussed in FDM 22-20-1 through FDM 22-20-5.

1.3 Type of Roadway

Air pollution concentrations may vary depending on the type of roadway. There are basically four types of roadways: 1) bridge section, 2) depressed section, 3) at-grade section, and 4) fill section. Discussion on how the different sections are modeled are in FDM 22-35-1 through FDM 22-35-10.

1.4 Terrain

Pollution concentrations are dispersed differently depending on the terrain surrounding the roadway. Flat or gently rolling terrain may readily be modeled using the models described in FDM 22-35-1 through FDM 22-35-10. A roadway may also be surrounded by continuous rows of tall buildings. Modeling for this roadway segment would require the use of a specialized street canyon model. If a specialized model is required, the Bureau of Environmental and Data Analysis (BEDA) should be contacted.

1.5 Meteorological Parameters

When a small concentrated puff of gaseous pollutant is released into the atmosphere, it tends to expand in size due to dynamic action of the atmosphere. In doing so, the concentration of the gaseous pollutant is decreased because the same amount of pollutant is now contained within a larger volume. This natural process of high concentrations spreading out to lower concentrations is the process of diffusion or dispersion.

Atmospheric dispersion is ultimately accomplished by the wind movement of pollutants, but the character of the source of pollution requires that this action of the wind be taken into account in different ways.

Four meteorological parameters influence the transport and diffusion of pollutants. They are wind speed, wind direction, mixing height, and surface stability class.

Mixing height is the height above the surface through which relatively vigorous vertical mixing occurs.

Meteorologists use this term to qualitatively represent the dispersion capacity of the atmosphere. The most commonly used mixing heights are for the morning and afternoon, and there are significant differences in seasonal averages for ceiling height (mixing height) at most locations.

Stability class is a measure of the tendency of an exhaust plume to mix with the surrounding air. Stability is related both to the vertical temperature structure (the change in temperature with increasing height) and the horizontal wind patterns of both speed and direction. However, the vertical temperature structure is generally used as the major measure of stability. A stable atmosphere tends to increase pollutant concentrations while an unstable atmosphere tends to minimize concentrations. Stability class is determined based on the parameters of mixing height, cloud cover, time of day, solar radiation, and wind speed.

1.6 Ambient Air Quality

Ambient air quality is the total level of pollution concentrations in the air. For a receptor near a highway, this is both the pollutant concentrations upwind of any local source (background) plus the pollutant concentrations contributed by the highway. Determination of a background CO concentration for use in the microscale analysis is discussed in FDM 22-30-1.