

This document is based on data that predates the current background concentrations provided by the DNR. While the data used is historical, the methodologies, analyses, and conclusions presented within this document remain valid and are considered reliable.

Establishing NO₂ Urban & Rural Delineation using CAMx

Purpose

Modeled NO₂ concentrations produced by the Comprehensive Air Quality Model with Extensions (CAMx) model were used to identify an appropriate geographical delineation between urban and rural background concentrations. The modeled NO₂ concentrations were produced from an annual simulation covering the year 2011.

Model Inputs

CAMx is a Eulerian photochemical dispersion model that allows for integrated “one-atmosphere” assessments of gaseous and particulate air pollution over many scales ranging from sub-urban to continental. The CAMx modeling domain covered the entire continental U.S., but emphasis was placed on grid cells over Iowa. The resolution of the domain was 12 km, which is much finer than the ambient air observation network. The annual simulation used model-ready emissions data from EPA’s 2011 modeling platform. Meteorological inputs were incorporated from an annual 2011 simulation evaluated by the DNR and conducted by the EPA using the Weather Research and Forecasting (WRF) meteorological model.

Methodology

The urban and rural areas were delineated using predicted NO₂ concentration gradients from CAMx. There are two monitors located in urban areas: Des Moines and Davenport (see Figure 1 and Figure 2). Both monitors are located within the urban area but far enough away from major industry to provide an accurate representation of an urban background concentration. There is one monitor location in a rural area: Lake Sugema (see Figure 1 and Figure 2). This monitor is an accurate representation of a rural background concentration.

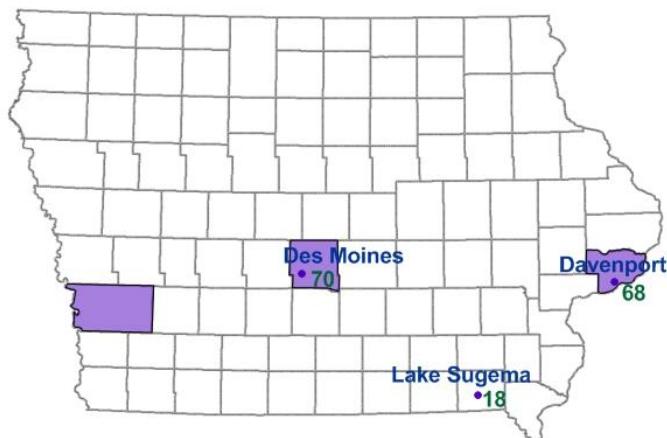


Figure 1. NO₂ 1-Hour Design Values

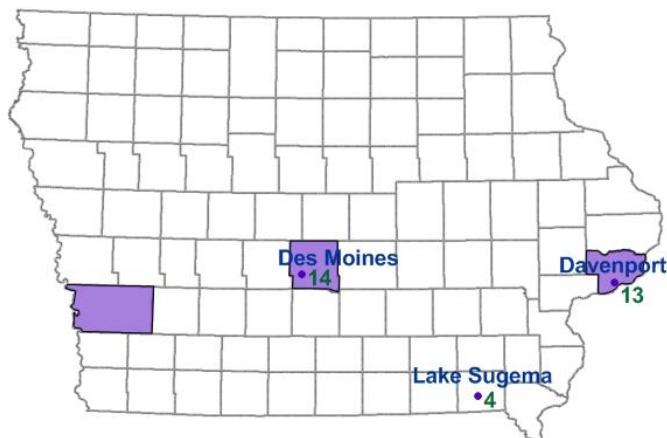


Figure 2. NO₂ Annual Design Values

The concentrations generated from CAMx data were processed at each grid cell to produce the total NO₂ concentrations for the 1-hour NO₂ standard. The data represented the predicted 98th percentile daily maximum 1-hour concentrations from CAMx. The 1-hour concentrations were chosen instead of the annual concentrations because the purpose of this analysis was to define the gradients between urban and rural areas of the state. The short-term concentrations provide a more appropriate metric for depicting the localized influences. Figure 3 shows the final analyzed NO₂ concentration field.

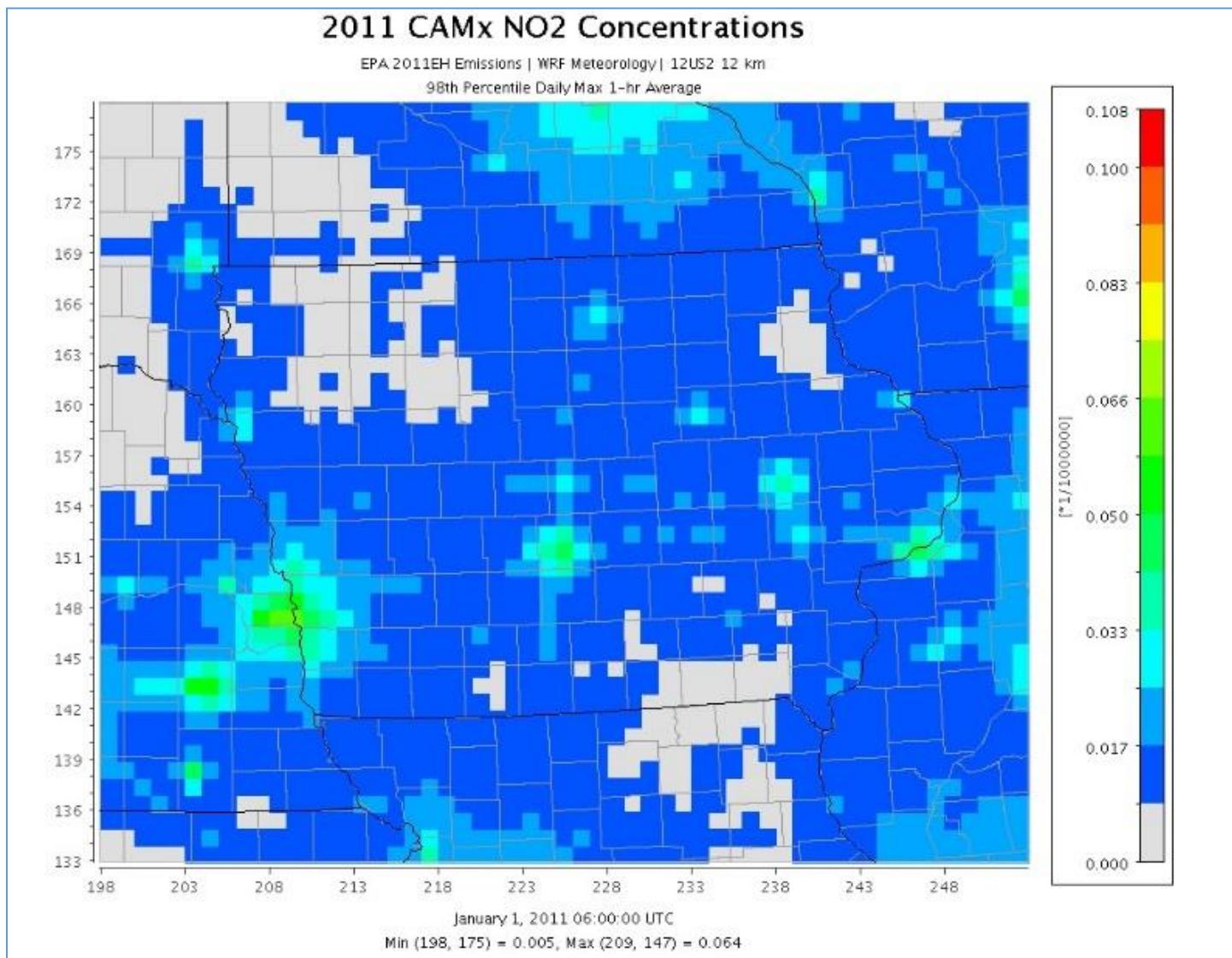


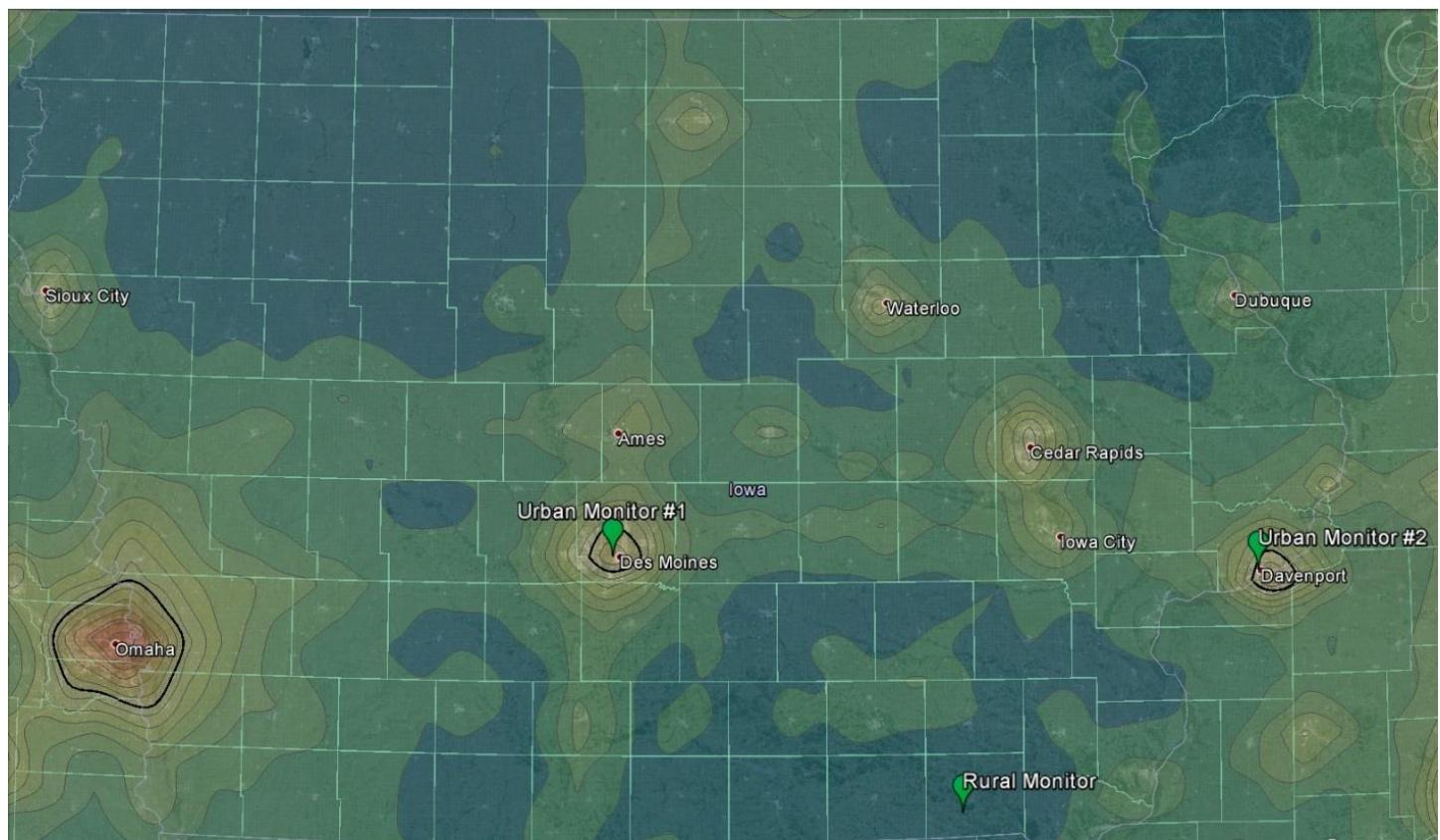
Figure 3. Modeled NO₂ 1-hour Concentrations (in parts per million) over Iowa

The predicted model concentrations at both the urban and rural sites were determined using the Golden Software Surfer graphing program (version 12.8). Table 1 compares the modeled NO₂ concentrations to the monitored NO₂ concentrations.

Table 1. Comparison of Modeled vs. Monitored Design Values

Location	Monitor Design Value ($\mu\text{g}/\text{m}^3$)	Model Design Value ($\mu\text{g}/\text{m}^3$)
Davenport (urban)	68	73
Des Moines (urban)	70	81
Lake Sugema (Rural)	18	13

The upper confidence limit (95%) of the two urban model design values ($73 \text{ & } 81 \mu\text{g}/\text{m}^3$) was calculated at $126 \mu\text{g}/\text{m}^3$. This upper confidence limit was used to represent the urban NO_2 concentration level. The modeled design value at Lake Sugema ($13 \mu\text{g}/\text{m}^3$) was used to represent the rural NO_2 concentration level. The average of these urban and rural concentrations ($70 \mu\text{g}/\text{m}^3$) was used to divide the state into urban and rural regions by plotting lines across the state connecting all areas with a concentration equal to the average of $70 \mu\text{g}/\text{m}^3$. The resulting urban/rural delineation is depicted in Figure 4 by a dark black line.

**Figure 4. Urban/Rural Delineation (black line = $70 \mu\text{g}/\text{m}^3$)**

Default NO_2 Background Concentrations by County

In order to simplify the implementation of the default background concentrations it was decided to limit the extent of the areas represented by the urban background to the county in which the urban influence originates. The default urban background counties are:

- Polk
- Pottawattamie
- Scott

For all three locations the urban influence does not extend over the entire county in which it originated. In cases where a project occurs in a default urban background county, the Department will consider a rural background if the location can be shown to be outside the urban influence area in the data. A [Google Earth KML file](#) is provided on the website so that applicants can zoom in to a specific area to make this determination. All other counties are considered rural even if the black line partially crosses into the county.