

# **Geographic Allocation of State Level Nonroad Engine Population Data to the County Level**

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## **I. Purpose**

The purpose of this report is to discuss the methodology and data that the Nonroad Engine Emission Modeling Team (NEEMT) decided to use in the NONROAD model to allocate equipment populations from the national to the county level.

## **II. Background**

The NEEMT is developing a national nonroad air emissions inventory model called NONROAD. This model will provide a tool for EPA, States, regional air pollution organizations, and local air pollution control agencies to use in estimating pollution from nonroad vehicles and equipment for State Implementation Plans (SIPs), as required by the 1990 Clean Air Act Amendments, and other regulatory needs.

The model uses national engine population data from Power Systems Research (PSR), a company that tracks the sales and populations of all types of engines sold in the U.S. Since PSR also matches the engines to the equipment in which they are used, the term “equipment populations” will be used for the purpose of this report. The NEEMT believes that PSR provides the most comprehensive national nonroad equipment population data currently available. PSR updates these data on a yearly basis.

The PSR database also geographically allocates equipment populations from the national to the county level and then aggregates the county-level populations to generate state totals. However, the methods and data that PSR uses to perform these allocations have only been explained in general terms, since PSR considers their methods to be proprietary information. Since the NEEMT wants the methods that it uses to allocate equipment populations in NONROAD to be fully understood by EPA and the public, we have decided to use publicly

available data as much as possible to serve as factors to allocate the national PSR equipment populations to the county level. State and local users may elect to substitute well-documented specific local (i.e., county, nonattainment area) equipment population data gathered by conducting surveys or from some other local source that they believe is more accurate.

### **III. Allocating Activity Versus Engine Population**

One central feature of the NONROAD model is that it uses the same methods to allocate engine populations, engine activity, and engine emissions to specific geographic areas. To the extent that engines are operated at the same power level and for the same number of hours in all areas, the distribution of engine populations will match the distribution of engine activity and engine emissions. In general, population, activity, and emissions will tend to track one another, since emissions are a direct function of engine activity and the conditions that stimulate increased engine activity are likely to stimulate increased engine populations.

In reality, however, the geographic distribution of nonroad engines may differ from the geographic distribution of emissions from those engines. The amount of activity that each piece of nonroad equipment of a given type experiences can vary from area to area as a result of variations in local economies, weather patterns, or other local conditions. For example, agricultural equipment and residential lawnmowers may experience more use per year in areas with longer growing seasons; construction equipment is likely to be used more intensively in areas experiencing an economic boom and less intensively where the economy is not as robust.

Currently, NONROAD is capable of handling only one activity level for each equipment type across all parts of the U.S. As a result, the model uses the same factors to allocate engine populations and their associated activity. Wherever possible, the NEEMT has sought indicators of engine activity, since it is engine activity that results in emissions (except for diurnal and hot soak emissions, which are more closely related to engine populations). In some cases, however, the NEEMT was unable to find a suitable activity indicator and had to rely on population indicators as a surrogate for engine activity. In this report, the NEEMT has attempted to be explicit as to whether each equipment type's geographic allocation factor is an activity-oriented indicator, a population-oriented indicator, or an indicator that is reasonable for both population and activity.

For several equipment categories, the NEEMT has had particular difficulty finding either activity or population indicators for several equipment categories. These categories include recreational, railway maintenance, and AC/refrigeration equipment. The NEEMT welcomes suggestions from the nonroad industry, state and local air quality agencies, and other interested parties concerning improved methods to allocate these equipment categories to the county level. The NEEMT also invites state and local air quality agencies to substitute adequately documented local data for the national default allocation estimates, in accordance with EPA guidance, for

these categories and for other categories such as recreational marine engines where the national default estimates may not adequately reflect local conditions.

The NEEMT plans to initiate an effort to develop methods to perform surveys of nonroad equipment activity at the county level that state, regional and local air agencies will be able to use to collect local data for input into NONROAD. This effort may include a pilot program that focuses on recreational equipment and recreational marine vessels. The NEEMT has not found fully satisfactory default geographic allocation factors for these categories, which comprise a large part of the total nonroad emission inventory. The initial pilot project is envisioned to include three parts:

- 1) performing a review and analysis of known survey methods that have been used by state and local air agencies to collect local nonroad equipment activity data,
- 2) choosing one of the survey methods reviewed and analyzed in part 1 or developing a new method to be included in EPA guidance to state and local air agencies, and
- 3) applying the chosen method to selected areas to ensure that it works properly and produces reasonable and useful results.

If this effort proves to be successful, the NEEMT will consider developing guidance on creating improved local population and activity estimates for other categories, such as construction and lawn and garden equipment. The NEEMT welcomes suggestions and comments about this effort, as well as information about surveys of nonroad equipment that have been conducted in the past or are presently being conducted, from stakeholders and other interested parties.

#### **IV. Methodology**

Since the NONROAD model only has the ability to allocate equipment populations from the state to the county level, the national PSR population data for each equipment type must be processed outside of the model to allocate these data to the state level. The same equation and allocation factors that the NONROAD model uses to allocate equipment populations from the state to the county level are applied to the PSR national equipment populations to allocate them to the county level, since these allocation factors are county-based. The county equipment populations are then aggregated by equipment type for each state to produce the total state equipment population input files used in the model. Due to the large amount of data that needs to be manipulated, modifying the model so that it could do all of this processing would increase the time it takes NONROAD to run a scenario beyond reasonable limits.

The NONROAD model uses information related to equipment population or activity to distribute the state equipment populations and their associated activity to the county level. This information constitutes a geographic allocation factor. The model can use a single allocation factor for entire categories of nonroad equipment, or it can use separate factors for one or more

equipment types within a category. The model multiplies the state population of the equipment type by the ratio of the county level allocation factor to its state total. In essence, the allocation factor serves as a surrogate for population or activity. Mechanically, the model assumes that each type of equipment experiences the same annual activity, which reduces the allocation problem to one of allocating engine populations. The basic calculation is as follows:

$$(\text{Equip. Population})_{\text{county}} = (\text{Equip. Population})_{\text{state}} \times \frac{\text{Surrogate}_{\text{county}}}{\text{Surrogate}_{\text{state}}}$$

## V. Sources and Types of Data

There are three basic types of data that are potentially useful as allocation factors: population, business activity, and geographic data. Most of these data are available from the U.S. Census Bureau or other federal agencies except for data concerning construction activity, which is discussed separately below. Information from the U.S. Census Bureau is especially attractive for use in the NONROAD model because census data undergo rigorous statistical analyses and quality assurance reviews.

### Population Data

The U.S. Census Bureau conducts a nationwide census on a decennial basis. The census includes data on population, housing (e.g., number of homes by type, number of occupants per home), and income. The most recent census occurred in 1990. The Census Bureau produces updated human population estimates on an annual basis, but does not produce an annual update for housing or income data.

### Business Activity Data

The U.S. Census Bureau publishes an annual report called County Business Patterns (CBP), which tracks the number of establishments and employees for various types of businesses and industries at the national and county level using Standard Industrial Codes (SICs). The most recent CBP data covers 1995. EPA used County Business Pattern indicators to allocate state-level populations to the county level for the 1991 Nonroad Engine and Vehicle Emissions Study<sup>1</sup> (NEVES).

### Geographic Data

Geographic data include factors related to an area's location or physical characteristics. Such factors include water or land surface area, weather data, and land use data. Such data are available from government agencies such as the U.S. Census Bureau, the National Oceanographic and Atmospheric Administration, and the U.S. Geological Survey.

## VI. Allocation of Specific Populations Equipment Categories/Types

The allocation indicators that the NEEMT examined and selected for use in the draft version of the NONROAD model are discussed below. The indicators chosen for use in the draft version of the model and the revisions being planned for the final version are summarized in Table 1 at the end of this report.

### Residential Lawn and Garden Equipment (except snowblowers)

To allocate lawn and garden equipment used by private households, the NEEMT plans to use U.S. Census data on one and two unit housing (i.e., single family homes and duplexes) by county from the USA Counties database. Structures containing more than two units tend to be condominiums or apartments that use commercial lawn care services. One and two unit housing information is used as an allocation factor in the NEVES, and an analysis of this set of data during the writing of the NEVES showed that it provided a good predictor of lawn and garden equipment populations. In addition, the NEEMT has not been able to find alternative types of data to use as an allocation factor for residential lawn and garden equipment that offer the high quality, the necessary county-level detail, and the predictive strength of one and two unit housing data from the U.S. Census Bureau.

The one and two unit housing data found in the USA Counties database and used in the draft version of the model come from the 1990 census. As stated in section V, housing information is only updated during each decennial census. However, using the 1990 one and two unit housing data will cause the model to underestimate lawn and garden emissions in more urbanized parts of the country because of the continuing creation and growth of suburbs in counties that were still partially or largely rural in 1990. To try to address this underestimation for the final version of the model, the NEEMT plans to try to account for this growth by adjusting the housing data by a ratio of 1997 human population estimates to human population data by county from the 1990 Census. It should be noted that if the 1997 human population estimate for a county is less than the 1990 census value, then the 1990 single and double housing unit value for that county will remain unadjusted. In such cases, the relative longevity of most housing structures suggests that the number of one and two-unit housing sites would not decline as quickly as human population. For counties which experienced an increase in population between 1990 and 1997, the equation to adjust the housing unit data is as follows:

$$1997 \text{ Adjusted Housing} = 1990 \text{ Housing} \times \frac{1997 \text{ human population estimate}}{1990 \text{ census human population}}$$

This adjustment could result in an overestimation of lawn and garden emissions to the extent that a disproportionate share of the population growth in the county is housed in multi-unit housing.

Any such overestimate would be offset by a concomitant underestimate in the growth in commercial lawn and garden activity levels.

One and two unit housing is most properly thought of as a population allocation factor for residential lawn and garden equipment. The population of such equipment in an area should be roughly proportional to the number of single and double housing units in the area, since the average household occupying such units would have the average probability of owning any given type of lawn and garden equipment. But the amount of use such equipment experiences may vary considerably from area to area based on such variables as the average size of yards, length of growing season, and amount of rainfall. Allocation factors based on residential lawn and garden equipment gasoline consumption, tons of yard waste removed, or the land area occupied by single and double housing units could, in principle, provide a more direct measure of activity. However, the information regarding such potential activity allocation factors are either not available, of questionable quality, or subject to confounding influences that make the potential allocation factor even less reliable than the one used in NONROAD.

#### Commercial Lawn and Garden Equipment (except snowblowers)

To allocate commercial lawn and garden equipment, the NEEMT plans to use the number of employees in landscape and horticultural services (SIC 78) from the CBP database. The 1991 NEVES study uses this factor to allocate commercial lawn and garden equipment. An analysis performed during the writing of the NEVES shows that the number of employees in landscape and horticultural services is a good predictor of commercial lawn and garden equipment populations. In addition, the NEEMT does not know of any other sources to adequately serve as a geographic allocation factor for commercial lawn and garden equipment.

The number of employees in landscape and horticultural services is better suited for allocating the population of commercial lawn and garden equipment than the activity associated with this type of equipment. The level of mechanization in the landscape services industry is likely to be relatively constant from county to county. By contrast, the number of hours per year that the average piece of commercial lawn and garden equipment operates is likely to vary considerably from county to county as a result of different growing seasons and rainfall patterns. Reliable information on allocation factors more directly related to activity levels, such as gallons of fuel consumed per county and year by commercial lawn and garden equipment, are not available.

One caveat for using the number of employees in landscape and horticultural services to geographically allocate commercial lawn and garden equipment populations is that this factor does not include municipal employees that perform landscape maintenance duties for schools, parks, and other properties owned and maintained by local governments. The implicit assumption used in NONROAD is that the population and activity level of such equipment is

proportional to commercial lawn and garden equipment population and activity levels. The NEEMT welcomes comments from interested parties concerning methods or sources of data that can better account for lawn and garden equipment used by municipal landscape employees.

### Snowblowers

Allocating snowblower populations and activity levels requires the use of allocation factors that account for the impact of climatic differences among regions, in addition to the factors used to allocate residential and commercial lawn and garden equipment. Put simply, snowblower populations and activity levels depend on snowfall. Snowblower populations in warm-weather states like Florida, Louisiana, and Hawaii should be zero. Snowblowers may be present in parts of states such as Texas and California because part of their territories receive snow (e.g., Texas Panhandle, Sierra Nevada Mountains in California), while snowblower populations in other parts of the state should be zero.

The approach chosen by the NEEMT involves examining the National Oceanographic and Atmospheric Agency (NOAA) long-term average snowfall data for major U.S. metropolitan areas and reallocating snowblower populations only to those areas that receive at least a certain minimum amount of annual snowfall. Since NONROAD cannot perform this reallocation internally, the NEEMT will reallocate snowblower populations manually and will revise the input files accordingly for the final release of NONROAD. Due to time and resource constraints, snowblower populations at the state and county levels have been set to zero for the draft version of the model to avoid misallocation problems. However, the model will still calculate national annual snowblower emissions.

### Construction Equipment

Initially, the NEEMT planned to use the number of employees engaged in construction by county (CBP SIC 15) to geographically allocate construction equipment. However, early comments from some stakeholders correctly pointed out that using this indicator could lead to errors in estimating construction equipment population and activity in a county because construction employees and equipment move from project to project, often crossing county lines. In some parts of the county, such as the Northeast, construction employees and equipment may cross state lines quite frequently. The CBP data only reflect where construction employees and establishments are headquartered, not where they work.

The NEEMT believes that the dollar value of construction offers the best means available to allocate construction equipment activity to counties. The dollar value of construction provides a good reflection of activity, since there is a proportional relationship between the dollar value of construction and the amount of construction activity in a given area. Also, using the dollar value of construction by county as an allocation factor will distribute construction equipment to where

it is actually being used, as opposed to where it is headquartered. Furthermore, this indicator provides a reasonable allocation factor for construction equipment populations: competitive forces encourage construction companies to obtain the maximum return on their investments in costly pieces of construction equipment by maximizing their use as much as possible, thereby strengthening the correlation between construction activity and construction equipment population.

Data on the dollar value of construction is collected and maintained by the Census Bureau only for metropolitan statistical areas (MSAs) instead of counties. Construction valuation data by county for 1997 is available from the F.W. Dodge Company. The NEEMT plans to use the F.W. Dodge data in NONROAD to allocate construction equipment to the county level.

### Agricultural Equipment

For this category, the NEEMT considered using the number of employees involved in agricultural work by county as an allocation factor (CBP SIC 78), as was used in the NEVES. However, this allocation indicator may not correlate well with either agricultural activity or agricultural equipment populations. A small number of agricultural employees in a county could cause the model to underestimate the population and activity of agricultural equipment if the predominant type of farming in that county is highly automated or relies on migrant labor that is recorded as being based in a different county. Conversely, a large number of agricultural employees in a county could cause the model to overestimate the population and emissions of agricultural equipment if the predominant type of farming is labor intensive or if migrant labor is recorded as being based in the county. Instead, NONROAD uses the acreage of cropland harvested by county to allocate agricultural equipment populations and activity. This information is available from the U.S. Census Bureau's USA Counties database. It should be noted that in some cases where a county only contains a few small farms the Census Bureau does not publish crop acreage data out of a concern for confidentiality. However, agricultural equipment emissions in a county that only has a few small farms are likely to be small relative to other nonroad sources within this county and to agricultural equipment emissions in other counties within the state where farms and agricultural equipment are more numerous.

Using the amount of harvested cropland as an allocation factor provides a good predictor of agricultural equipment activity, since a proportional relationship generally exists between the amount of cropland harvested and how much equipment activity is needed to prepare the land and plant, maintain, and harvest the crops. However, the amount of cropland harvested does not necessarily provide as accurate a predictor of agricultural equipment population as it does for activity for several reasons. First, the same amount of cropland in a county can be plowed, planted and harvested by a few pieces of large equipment or several smaller ones. Second, the amount of equipment present in a county may be more dependent on the number of farms than on the amount of acreage harvested (although this source of inaccuracy in estimating populations



may be mitigated by the presence of equipment-sharing arrangements in areas with smaller farms).

### Recreational Marine Equipment

Because the county in which the equipment is purchased, registered, and/or stored may not be the same county where the equipment is used, the geographic allocation of recreational marine equipment presents a significant challenge. An urban or suburban county where a boat is sold, registered, and/or stored may not contain a body of water that can support recreational marine traffic, or water bodies near where a boat owner lives may be overcrowded. Small and medium recreational marine craft, which constitute most of the recreational marine fleet, can be transported by trailer over a wide area, further complicating matters. Thus, sales and registration data are not sufficient to accurately allocate recreational marine equipment to the county level. Fuel consumption would provide a direct measure of recreational marine activity, but such data are not collected specifically for recreational boating.

The NEVES report estimated the population of boats actually being used in each of the 24 urban nonattainment areas covered by the NEVES through the use of data from a 1991 National Marine Manufacturers Association survey of boat owners.<sup>2</sup> These data included where the boat owners said they primarily operated their boats, where the boats were registered, the boat owners' estimates of the amount of hours they used their boats per boating season, and their estimates of the amount of fuel their boats consumed per boating season. In general terms, the data from these surveys were used to adjust registration-based boat populations so that only the boats actually operating within the nonattainment area (as opposed to boats registered in the nonattainment area but used elsewhere) were included when calculating the recreational marine emissions for each area addressed in the NEVES. In order to check the reasonableness of the NMMA-based results, the total square miles of water surface area in a nonattainment area, the estimated square miles of water surface area needed for a typical boat to operate, and the maximum number of possible hours per boating season in each nonattainment area were used to ensure that the use of NMMA survey data did not result in a boat population estimate that exceeded the maximum number of boats that could theoretically operate during the boating season of a particular area. If the NMMA-based boat population estimate exceeded the theoretical maximum, then this population was adjusted downward.

This method cannot be incorporated into the current design of the NONROAD model, but at least some of its elements might be adapted to allocate recreational marine equipment populations and the activity associated with them to specific counties within a state for direct input into the NONROAD model. A limitation of the NEVES method was that it focused solely on urban areas. Since most boating tends to occur outside of urban areas, it is likely that NEVES significantly underestimated recreational marine emissions in the U.S. In order to be usable for the NONROAD model, the NEVES method would have to be modified to estimate the

population and accompanying activity of recreational marine equipment being used in both urban and non-urban counties. Also, new survey data would need to be collected, since much of the 1991 NMMA survey data are most likely outdated. This would be especially true in regard to the rapid population growth and usage of personal watercraft (jet skis), which also would have different activity profiles from other types of boats.

Presently, the NONROAD model allocates recreational marine populations using water surface area data by county from the U.S. Census Bureau. However, using this type of data has some limitations. Water surface area does not make a distinction between navigable bodies of water and those that are too shallow for boating or have obstructions through which boats are unable to pass. Also, water surface area does not account for convenience of location (proximity to areas of significant population) or the recreational quality of the water body (which includes such factors as its attractiveness for fishing, its visual appeal, and its water quality), both of which could be expected to affect a body of water's recreational marine activity per unit area. Lastly, water surface area alone does not account for access restrictions that may prevent boating or limit the number of boats permitted to operate on a given body of water. However, even with these limitations, the NEEMT has decided to use water surface area as an allocation factor for the allocation of equipment populations because either the other potential approaches described above have even greater limitations or, as in the case of the NEVES approach, additional work is needed to determine the best way to adapt the approach to be compatible with NONROAD (or vice versa) and collect the data necessary to implement the approach.

The NEEMT hopes to conduct a study to investigate ways to improve upon the water surface area allocation method currently used in the model and also explore whether there might be other methods and data available to use in NONROAD to better allocate the population of recreational marine equipment for all of the counties in the U.S. Local surveys of recreational boating activity focusing on things such as marina and boat ramp usage offer the most accurate means to assess boat populations and activity at the county level. One early stakeholder comment suggested using data on boating violations and accidents to allocate recreational marine equipment. Surveys better capture the actual activity on local lakes, rivers, and other waterways, as well as account for boats registered in one county but used in another. If States, regional air organizations, and local air pollution control districts have such types of data, then the NEEMT is interested in learning about them. Furthermore, EPA encourages state, regional, and local air organizations to use these local data in the NONROAD model for county-level boat populations, subject to appropriate guidance.

#### Recreational Equipment (except for snowmobiles and golf carts)

The allocation of recreational equipment, such as all terrain vehicles (ATVs) shares the same challenge as the allocation of recreational boats, namely where the equipment is registered, purchased, serviced, and stored is usually not the location where the equipment is actually used.

Because of convenience, people tend to purchase recreational equipment, like other products, near where they live. Hence, most recreational equipment is purchased in urban and suburban areas, where the majority of the U.S. population lives, and this equipment also is registered, stored and serviced in these areas. However, there are relatively few places in urban and suburban areas where it is possible and legal to operate recreational equipment. Generally speaking, recreational equipment usage tends to be concentrated in rural and semi-rural areas near a metropolitan area; such areas are conveniently accessible to the owners of most of the recreational equipment, have more area that is attractive for recreational equipment use, and tend to impose fewer restrictions on recreational equipment use than more densely populated areas. Thus far, however, the NEEMT has not found an adequate allocation factor that can be used with the current allocation method contained in the model (discussed in Section III, Methodology) to reflect this population/activity distribution pattern.

The NEVES report used CBP data set SIC 557 (number of motorcycle establishments) to allocate recreational equipment to the county level. However, this data is not available for one or more counties in some States. The NEVES report also used SIC 55 (number of employees in auto dealerships and service stations), of which SIC 557 is a subset. Neither of these data sets provide a reasonable allocation factor for recreational equipment because most motorcycle establishments, auto dealerships and service stations are located in urban and suburban areas instead of rural and semi-rural areas where most recreational equipment activity occurs.

Registration data also exist for ATVs in most States, but there may be some cases where these data are not available or up to date. Sales data also are available from PSR or manufacturers. However, using registration or sales data as allocation factors presents the same drawback as using the CBP data: the location of population does not correlate well with the location of recreational equipment activity outside of heavily urbanized or suburbanized areas.

The NEEMT has considered using the simple alternative approach of allocating recreational equipment population and activity based on the inverse of population or population density (i.e., the higher the population or population density of a county, the less recreational equipment activity is allocated to that county). The NEEMT has also considered allocating activity based on the amount of non-urbanized land area per county within a State. While these approaches would reduce the risk of overestimating urban activity, they would tend to overestimate activity in remote rural areas, such as the North Slope of Alaska, Michigan's Upper Peninsula, the Mojave Desert, or the Texas Panhandle. Yet another approach would use employment or Gross Domestic Product (GDP) economic activity directly associated with recreational equipment usage to allocate recreational equipment. However, the NEEMT has been unable to locate these data at the county level. The CBP database does not include recreational equipment GDP data, and the Bureau of Economic Analysis (BEA) only tracks GDP data down to the state level.

Given these problems, the NEEMT has chosen to use the number of camps and recreational vehicle park establishments (CBP SIC 7030) in the draft version of NONROAD. CBP SIC 7030 includes sporting and recreational camps, trailer parks, and campsites. The data subset from CBP SIC 7030 containing the number of establishments offers better coverage of the U.S. than the subset containing the number of camp and recreational vehicle park employees. The data subset containing the number of employees appears to be missing information for areas known to contain national and state parks, near which camps and recreational vehicle parks are likely to be located. The NEEMT acknowledges that this approach may not adequately account for recreational equipment being used on private and public lands that are not associated with and/or adjacent to camps and recreational vehicle parks. In addition, using the number of camps and recreational vehicle parks as an allocation factor is only loosely correlated to the level of recreational equipment activity occurring in a county. At the present time, however, the NEEMT is not aware of other allocation methods that are both practical and reasonably accurate. The NEEMT welcomes suggestions of alternative methods and requests reviewers and stakeholders with such suggestions to share them with the team.

### Golf Carts

Golf carts have a different pattern of usage from other types of equipment in the recreational category. Unlike ATVs or snowmobiles, golf carts are predominantly used in a central location (golf courses), which is usually within or close to an urban/suburban area. The NEEMT initially planned to use public golf course employees (CBP SIC 7992) as an allocation factor for this equipment type. However, the NEEMT has discovered that these data are incomplete for many counties in the U.S. For example, no employees of golf courses are reported for the state of Colorado. Since another allocation factor has not yet been selected to replace the number of public golf course employees, the draft version of NONROAD uses this factor as a temporary place holder. For the final version of the model, the NEEMT believes that using number of golf courses by county may provide the best means available for allocating golf carts. The NEEMT has examined data on the number of golf courses from the CBP SIC 7992 data and hopes to examine similar data from another source, such as the Professional Golf Association (PGA), to ensure that NONROAD uses the most robust set of data available.

Using the number of golf courses to allocate golf carts and their emissions to the county level does not provide a precise reflection of golf cart population or activity. Like the allocation factor presently being used to allocate the other types of recreational equipment (the number of camps and recreational vehicle parks), the relationship between the number of golf courses on the one hand and the population and activity level of golf carts and on the other is a loose one. The population and activity of golf carts at a given golf course depends on the size, popularity, and type of course. A large, popular, 36-hole championship golf course will have more golf carts that are used more intensively than a small, less intensively used 9 hole course. The location of a golf course also affects golf cart activity. A golf course adjacent to an urban area or in a suburban

area will tend to have more players than one located in a rural area, resulting in higher golf cart activity at the urban or suburban course. An additional complication is that many golf courses use electrically powered carts instead of carts using gasoline-powered engines. However, the NEEMT does not know of any nationally applicable allocation factors that account for these influences. In the case of golf carts, the use of local activity and/or population data may be the best alternative. The NEEMT welcomes comments from stakeholders and other interested reviewers concerning the existence of better factors or methods to allocate golf carts from the state level to the county level, as well as sources of local data on golf cart activity and/or population.

### Snowmobiles

The allocation of snowmobile activity presents the same challenges as for other recreational equipment and uses the same allocation factor, the number of camps recreational vehicle park establishments, used by other recreational equipment types, except golf carts. In addition, climatic factors must be considered, since snowmobile activity is restricted to areas that receive significant snowfall. These climatic factors are similar to those related to snowblowers, except that snowmobiles need more snow on which to operate than do snowblowers and require significant, persistent snow cover. Due to time and resource constraints, snowmobile populations at the state and county levels have been set to zero in the draft version of the model to avoid misallocation problems (the draft version will calculate national annual total emissions for snowmobiles, however). The NEEMT plans to modify the recreational equipment allocation factor (camps and recreational vehicle parks) in the final version of NONROAD to incorporate NOAA long-term average snowfall data for significant metropolitan areas in the U.S. By linking metropolitan areas to counties in the same vicinity, the NOAA data can be used to ensure that snowmobiles are only allocated to areas that receive the significant amounts of annual average snowfall required to support the use of snowmobiles.

### Airport Ground Support Equipment

For the draft version of NONROAD, the NEEMT uses the number of people employed in air transportation by county (CBP SIC 4500) to allocate ground support equipment. However, this indicator may include employees that are not directly connected to aircraft operations, such as airline reservation staff and ticket agents. Using this factor may lead to an overestimation of aircraft ground support equipment population and activity in a county, especially in counties that either have airports with one or more airline “hubs” or that do not have a commercial airport but have branch ticket offices for various airlines.

For the final version of NONROAD, the NEEMT plans to use the number of landings and take-offs (LTOs) by airport to allocate ground support equipment populations. This data may only be available for airports with commercial air carrier operations, but commercial airports

operations contribute the bulk of ground support equipment emissions in most areas. The NEEMT believes that using LTO data is the best method currently available for allocating ground support equipment activity because landings and take-offs are the primary determinant of the level of aircraft ground support equipment activity at a given airport; to the extent that airlines strive to avoid having excess ground service equipment, LTO data would provide a good allocation factor for ground support equipment populations as well. An allocation factor based on LTO data would not be subject to the problems associated with using the number of employees in air transportation as an allocation factor. In addition, LTO data can be broken down by wide and narrow-bodied aircraft, allowing an adjustment to be made to account for the larger amount of activity (expressed in NONROAD by increasing the equipment population allocation) needed to service large wide-bodied aircraft.

### Light Commercial and Industrial Equipment

For light commercial and industrial equipment, the NEEMT chose to use the same indicators as those used in the 1991 NEVES report. For light commercial equipment, NONROAD will use the number of wholesale establishments by county (CBP SIC 50). For industrial equipment, the NEEMT chose to use the number of employees in manufacturing (CBP SIC 20). Analyses done for the NEVES report showed that these indicators provided reasonable predictors of light commercial and industrial equipment populations. Because these types of equipment are expected to remain close to a fixed central base of operations, as opposed to types of equipment that tend to move around a wide area (e.g., construction equipment), one would expect that the number of establishments and employees would be good factors with which to allocate light commercial and industrial equipment populations, respectively. The NEEMT acknowledges that the number of establishments may not be a good indicator of activity, which is a function of the size of the average establishment and the mix of establishment types in addition to the absolute number of establishments. The NEEMT requests comment on possible sources of alternative activity-related allocation factors such as the dollar value of commercial, wholesale, or industrial output, including their advantages and disadvantages relative to the number of employees and establishments and their availability on a county-by-county basis for the entire U.S.

### Logging Equipment

For logging equipment, the NEEMT used the number of employees in logging (CBP SIC 2410) combined with the number of employees in saw and planing mills (CBP SIC 2420) in the draft version of the model. However, the number of employees in saw and planing mills allocated logging equipment populations to unlikely places such as Southern California and various urban areas in Texas. For the final version of NONROAD, the NEEMT plans to use only the number of employees in logging operations to allocate logging equipment. The number of logging employees should provide a good reflection of logging equipment activity: generally

speaking, each employee most likely uses one piece of equipment at a time. Economic pressures would discourage logging companies from having expensive logging equipment sit idle for long periods of time, which suggests that the number of employees in logging operations can also serve as an allocation factor for logging equipment populations. The NEEMT requests comment on potentially more reliable activity and population allocation factors, such as the number of acres of forest harvested per county, and on possible sources of data for those alternatives.

#### Oil Field, Underground Mining, Railroad Maintenance, and AC/Refrigeration Equipment

To allocate oil field equipment population and activity, the NEEMT plans to use the number of employees in oil and gas extraction operations (CBP SIC 1300) in both the draft and final versions of the model. To allocate underground mining equipment population and activity, the draft version of NONROAD uses the number of employees engaged in metal mining (CBP SIC 1000). However, the NEEMT no longer believes that this indicator represents underground mining operations because most metal mining is now performed above ground through the excavation of large open pits. As a result, the NEEMT plans to use CBP employment data on coal mines (CBP SIC 1200) to allocate underground mining equipment in the final version of the model. Employment data provide reasonable allocation factors for oil field and underground mining equipment activity because a proportional relationship between the number of employees and the amount of equipment they use is likely to exist for both of these categories. Furthermore, economic incentives to avoid leaving expensive equipment idle suggests that activity and equipment populations will be closely correlated. Finally, these types of equipment tend to not move around (unlike construction equipment, for example), so the location of activity for oil field and underground mining equipment usually coincides with the location where the employees are based. A production-based allocation factor, such as gallons of oil pumped or tons of coal mined, might be an even better allocation factor, but the NEEMT has been unable to find these types of activity-related data at the county level.

To allocate railroad maintenance equipment populations, no applicable CBP SIC exists and no other reasonable alternatives have been found. The NEEMT is investigating the possibility of using railroad track mileage for the final version of NONROAD, if such data are available by county. The NEEMT has also been unable to find a targeted allocation factor for air conditioning/refrigeration units used on trucking trailers to keep food cold and fresh while it is transported to restaurants and markets. In the absence of an allocation factor that is more directly related to such activity, the NEEMT has decided to use human population as the allocation factor for railroad maintenance and AC/refrigeration equipment in the draft NONROAD model. The NEEMT acknowledges that human population is unlikely to correspond well to the location and usage of railroad maintenance equipment. The NEEMT is considering using miles of railroad tracks as the allocation factor for such equipment in the final NONROAD model and requests comment on this approach. Human population may be a sufficiently reliable indicator of AC/refrigeration unit populations and activity levels, since the number of units being used to

transport food into or within a given county is likely to be directly related to the size of the population in the county. The NEEMT has not yet determined whether to retain this allocation factor in the final model for AC/refrigeration equipment and welcomes comments concerning better allocation factors for this equipment category.



**Table 1****NONROAD Surrogate Allocation Factors**

<b>Nonroad Equipment Category</b>	<b>Allocation Factor Draft Version</b>	<b>Activity vs. Population Allocation*</b>	<b>Allocation Factor Proposed For Final Version</b>	<b>Activity vs. Population Allocation*</b>
Lawn and Garden Residential	Number of single and double (duplex) family housing units from 1990 Census by county.	Population	Adjusted by 1997 county human population estimates from U.S. Census Bureau.	Population
Lawn and Garden Commercial	Number of employees in landscape and horticultural services, County Bus. Patterns (CBP), Standard Industrial Code (SIC)78.	Population	Same as draft version.	Population
Residential Snowblowers	Snowblowers set to zero pending implementation of proper allocation based on snowfall.	Not Applicable	Same as residential lawn and garden, adjusted by annual average snowfall.	Population
Commercial Snowblowers	Snowblowers set to zero pending implementation of proper allocation based on snowfall.	Not Applicable	Same as commercial lawn and garden, adjusted by annual average snowfall.	Population
Construction	Total dollar value of construction by county.	Activity and Population	Same as draft version.	Activity and Population
Agricultural	Harvested cropland (U.S. Census Bureau, <a href="#">USA Counties</a> database).	Activity	Same as draft version.	Activity
Recreational Marine	Ratio of county water surface area to total national water surface area.	Activity	Same as draft version.	Activity

<b>Nonroad Equipment Category</b>	<b>Allocation Factor Draft Version</b>	<b>Activity vs. Population Allocation*</b>	<b>Allocation Factor Proposed For Final Version</b>	<b>Activity vs. Population Allocation*</b>
Recreational (except snowmobiles and golf carts)	Number of camps and recreational vehicle park establishments (CBP SIC 7030).	Activity	Might be revised for final version, pending review.	Activity
Snowmobiles	Snowmobiles set to zero pending implementation of proper allocation based on snowfall.	Not Applicable	Same as recreational equipment and annual average snowfall.	Population
Golf Carts	Number of public golf course employees (CBP SIC 7992).	Population	Number of public golf courses. (CBP SIC 7992)	Population
Aircraft Ground Support Equipment	Number of employees in air transportation (CBP SIC 4500).	Activity and Population	Revised to be based on number of landings and takeoffs (LTOs) of commercial aircraft.	Activity and Population
Light Commercial	Number of wholesale establishments (CBP SIC 50).	Population	Same as draft version.	Population
Industrial	Number of employees in manufacturing (CBP SIC 20)	Activity and Population	Same as draft version.	Activity and Population
Logging	Number of employees in logging plus saw and planing mills (CBP SIC 2410 and 2420).	Activity and Population	Number of employees in logging only (CBP SIC 2410).	Activity and Population
Oil Field Equipment	Number of employees engaged in oil and gas extraction (CBP SIC 1300).	Activity and Population	Same as draft version.	Activity and Population
Railroad Maintenance Equipment	1990 Human Population	Activity and Population	Might be revised for final version, pending review.	Activity and Population

<b>Nonroad Equipment Category</b>	<b>Allocation Factor Draft Version</b>	<b>Activity vs. Population Allocation*</b>	<b>Allocation Factor Proposed For Final Version</b>	<b>Activity vs. Population Allocation*</b>
Underground Mining Equipment	Number of employees engaged in metals mining(CBP SIC 1000).	Activity and Population	Number of Employees in Coal Mining (CBP SIC 1200).	Activity and Population
AC/Refrigeration Equipment	1990 Human Population	Activity and Population	Might be revised for final version, pending review.	Activity and Population

\* These columns indicate whether the allocation factor is more directly related to nonroad equipment activity levels or equipment population.

## **Endnotes**

1. Environmental Protection Agency, Office of Air and Radiation. Nonroad Engine and Vehicle Emission Study, 21A-2001, November 1991.
2. Irwin Broh & Associates, Inc., NMMA Boat Usage Survey, prepared for the National Marine Manufacturers Association, Des Plaines, IL, August 1991.