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**Federal Aviation
Administration**

Aviation Environmental Design Tool (AEDT)

Supplemental Manual

Using MOVES with AEDT

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INTRODUCTION

The FAA's Office of Environment and Energy (AEE) has developed the Aviation Environmental Design Tool (AEDT)¹ as a software system designed to dynamically model aircraft performance in space and time to compute noise, emissions, and fuel consumption. A primary objective of the AEDT application is to help the analyst efficiently answer questions of interest about the environmental consequences of aviation activity. These environmental consequences are evaluated through metrics, many of which are defined by regulatory standards. AEDT has replaced the Emissions and Dispersion Modeling System (EDMS) as the preferred model for conducting airport emissions inventory and air quality analyses. Further information can be found at the AEDT website, <https://aedt.faa.gov/>.

As of March 2013, the Environmental Protection Agency (USEPA) requires the usage of the Motor Vehicle Emissions Simulator (MOVES)² for estimating emissions from on-road mobile sources. The latest version of MOVES is MOVES5, released in November 2024. There is no standalone user guide for MOVES, however USEPA has developed policy and technical guidance documents which include detailed instructions for users.^{3,4} MOVES also includes the capability of modeling off-road mobile sources with the integration of NONROAD2008. USEPA recommends use of the integrated model (by selecting “Nonroad” within the “Scale” portion of MOVES5), rather than the standalone NONROAD2008, due to updates to nonroad activity and fuel supply data. Analysts can utilize nonroad data integrated into AEDT for modeling ground support equipment (GSE) emissions. For cases where construction activity needs to be modeled, the analyst can use the nonroad model within MOVES to generate emissions rates.³

The analyst is required to generate emissions inventories and/or AERMOD input files for on-road or off-road mobile sources (e.g., construction equipment) independently of AEDT when conducting airport analyses. AEDT includes the capability of creating roadway, parking facilities construction zones using the AEDT graphical user interface (GUI) and exporting “Links” for use as input with the MOVES model. AEDT reads MOVES-Nonroad generated annual emissions inventory data in a pre-defined format and helps the analyst generate an emissions inventory report. For dispersion modeling it is enough for the analyst to generate the control (CO) and source (SO) pathway information needed for AERMOD; AEDT parses the control and source path information, identifies the pollutant in CO pathway and merges the source pathway information to the AEDT generated AERMOD file for all aircraft and airport operations. This document discusses the methodology for preparing an emissions inventory generated by MOVES output (onroad and nonroad) to be merged to an AEDT emission inventory and how to prepare MOVES output data for AERMOD when conducting dispersion analysis. Please refer to

¹ FAA, Aviation Environmental Design Tool (AEDT) User Manual.

² USEPA, Latest Version of Motor Vehicle Emission Simulator, <https://www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves>

³ USEPA, MOVES5 Policy Guidance on the Use of MOVES for State Implementation Plan Development, Transportation Conformity, General Conformity and Other Purposes, EPA-420-B-24-038, November 2024.

⁴ MOVES5 Technical Guidance: Using MOVES to Prepare Emission Inventories for State Implementation Plans and Transportation Conformity, EPA-420-B-24-043, November 2024.

the AEDT User Manual for more information on the capability for viewing on-road and non-road sources in the AEDT map interface.

RUNNING MOVES

Compatibility between MOVES Versions

USEPA requires the use of MOVES5 for new State Implementation Plans (SIPs) and conformity analyses. For ongoing projects, if a state or local agency has already completed significant work on a SIP with the previous MOVES version they do not have to redo analysis with MOVES5. A summary of changes to the MOVES user interface and algorithms and comparisons between MOVES5 and earlier versions of MOVES are provided in USEPA’s “EPA Releases MOVES5 Mobile Source Emissions Model: Questions and Answers” and “Overview of EPA’s MOVES5” documents.^{5,6}

The major updates which appear in the MOVES5 model are as follows:

- Accounts for EPA’s Light- and Medium-Duty Multi-Pollutant Rule with higher projected electric vehicle (EV) fractions and more stringent standards for carbon dioxide (CO₂), particulate matter (PM), non-methane organic gases (NMOG) and oxides of nitrogen (NO_x)
- Accounts for EPA’s Heavy-Duty Greenhouse Gas Emissions-Phase 3 Rule with higher projected EV fractions and updated energy consumption estimates for heavy-duty EVs
- Incorporates new data on light-duty (LD) and heavy-duty (HD) brake wear emissions
- Expands detailed calculations to vehicles of the last 40 model years, instead of 30
- Updates onroad and nonroad fuel properties for calendar year 2021 and later
- Updates historical and forecast default vehicle miles travelled (VMT), vehicle populations, age distributions, and fuel distributions

The structure of MOVES5 is fundamentally the same as MOVES4. USEPA recommends that users create new input databases using MOVES5 to utilize new capabilities within the tool.

When switching to MOVES4, new run specifications should be constructed using the MOVES4 Graphical User Interface. For user input databases that still contain the latest data, MOVES5 contains a database conversion tool that may be used to help convert a MOVES4 or a MOVES3 database to the MOVES5 format. The tool contains detailed instructions on performing this task. The format of output databases has not changed between MOVES5 and MOVES4.

Using MOVES for Air Quality Analyses

To execute a MOVES run the analyst is required to develop a run specification file (“RunSpec”) through the “Navigation Panel” of the MOVES GUI. Once the RunSpec has been defined, the analyst imports project specific data through the “Project Data Manager” within the MOVES GUI on the ‘Create Input Databases’ panel. This sections below provide the best practice in making the appropriate selections in the “Navigation Panel” and importing data utilizing the

⁵ USEPA, EPA Releases MOVES5 Mobile Source Emissions Model: Questions and Answers. EPA-420-F-24-031, November 2024.

⁶ USEPA. Overview of EPA’s Motor Vehicle Emissions Simulator (MOVES5). EPA-420-R-25-005, February 2025.

“Project Data Manager” in the MOVES GUI. Use of MOVES-Nonroad for construction activity at airports is described in more detail below.

Using MOVES when conducting an airport study requires the analyst to execute MOVES at the project level domain. Determining the number of MOVES runs is a key step in conducting a project level analysis. When run at the project-level domain, each MOVES run estimates vehicular emissions for a single hour of a single month of a single year specified by the analyst. The number of MOVES runs is determined by the variation in activity (e.g., changes in traffic volume) as well as seasonal and daily meteorological variation of the project area. The number of MOVES runs will also vary depending on the AEDT use case; in some instances, the analyst will only be required to conduct an emissions inventory, while in others an air quality dispersion analysis will be required. Typically, fewer MOVES runs are required for conducting an emissions inventory, while a higher number of MOVES runs are required for conducting an air quality dispersion analysis. However, for each use case, be it an emissions inventory or an air quality dispersion analysis, the number of MOVES runs could vary by the pollutant of concern or by the ambient air quality standard being assessed. The analyst should rely on the inter-agency coordination process to determine the appropriate number of MOVES runs when conducting an AEDT study.

Several use cases are highlighted below that provide some explanation on the number of MOVES runs required for a particular type of analysis. This document is only guidance for using MOVES with AEDT, for more specific questions on the appropriateness of using certain input parameters the analyst should refer to interagency coordination.

- **Voluntary Airport Low Emissions (VALE) Program Analysis**

MOVES runs for a VALE analysis will only be required if the emissions reductions include on-road mobile source related equipment. A VALE analysis will only require a single MOVES run for each year being analyzed for each of ‘the baseline condition’⁷ and ‘the project condition’⁸ scenarios. The number of years will vary based on the useful life of the equipment being assessed for emissions reductions. For example, an airport is going to replace diesel buses with compressed natural gas (CNG) buses that service the economy and employee parking lots. The CNG buses will have a useful life of 12 years. MOVES runs will need to be conducted for the VALE analysis associated with this vehicle replacement project. This project is funded in Fiscal Year 2024 so MOVES runs will need to be conducted for the years 2024 through 2035 to account for the emissions reduction through the 12 years of useful life of the CNG buses.

For this VALE analysis, ‘the baseline condition’ and ‘the project condition’ will each consist of 12 MOVES runs each (total of 24 MOVES runs). Each MOVES run will represent an annual emissions inventory for on-road mobile sources utilizing the airport average annual temperature that is used with AEDT (i.e., the AEDT airport average annual temperature and relative humidity and the MOVES ‘temperature’ and ‘humidity’

⁷ The baseline condition reflects the operation of existing or new conventional-fuel vehicles and equipment that would occur if no VALE project were implemented.

⁸ The project condition reflects operating changes that result from implementation of the VALE low-emission project.

meteorological inputs are to be identical). For each MOVES run the ‘year’ will need to match the year of the analysis (e.g., the FY 2024 runs will select the ‘year’ 2024 in MOVES, the FY 2025 runs will select the ‘year’ 2025 in MOVES). Please refer to the AEDT User Manual for more information on conducting VALE analyses.

- **Emissions Inventory for General Conformity Analysis**

The number of MOVES runs required for an emissions inventory associated with a general conformity analysis can vary depending on a number of factors. However, in many cases where an analysis to determine if a project is above or below general conformity *de minimis* thresholds⁹ a single MOVES run using the annual average temperature and humidity can be executed for each year being analyzed for each of the ‘build’ and ‘no build’ scenarios to determine the net emissions change. For example, a new carrier is adding operations at a regional airport which is located in a carbon monoxide (CO) maintenance area. AEDT will be used to model the emissions inventories associated with aircraft and GSE. MOVES will be used to model the emissions inventories associated with roadways, parking facilities, and construction sources. The aircraft operations are modeled using annual average meteorological data in AEDT. Since the aircraft operations are using annual average meteorological data, the MOVES runs will also utilize annual average temperature and humidity data for the runs. In this example the net emissions increase for CO is only 10 tons per year which is below the general conformity *de minimis* threshold for CO of 100 tons per year. Therefore, no further analysis would be required. However, if the net emission increase is near or over the general conformity threshold, additional MOVES runs may need to be conducted to account for the seasonal variation of vehicular traffic and emission rates. In this event, the analyst should rely on the inter-agency coordination process to determine the appropriate number of MOVES runs.

- **Air Quality Dispersion Analysis for National Environmental Protection Act (NEPA)**

When conducting an air quality dispersion analysis, the analyst will need to conduct a more detailed MOVES analysis to account for the temporal change in on-road vehicle activity and emission rates. For example, 16 MOVES runs are utilized for explanatory purposes. The number of MOVES runs should be determined through the inter-agency coordination process and will be dependent on the complexity of the project. The 16 runs represent an example combination of the four quarters of the calendar year (i.e., January through March, April through June, July through September, and October through December) and four levels of traffic volume (i.e., morning peak, midday, evening peak, and overnight) as well as daily variation in meteorology. Tables 1 and 2 define these time periods, respectively.

⁹ <https://www.epa.gov/general-conformity/de-minimis-tables>

Table 1. Quarters of the Year for MOVES Runs

Code	Name	Months
Q1	First Quarter	January – March
Q2	Second Quarter	April – June
Q3	Third Quarter	July – September
Q4	Fourth Quarter	October – December

Table 2. Traffic Volume Times of Day for MOVES Runs

Code	Name	Time of Day
AM	Morning Peak	0600 – 0900 (3 hours)
MD	Midday	0900 – 1600 (7 hours)
PM	Evening Peak	1600 – 1900 (3 hours)
ON	Overnight	1900 – 0600 (11 hours)

In this case a set of 16 MOVES runs will need to be conducted for each individual alternative for the year being analyzed.

In either case, the analyst should rely on the inter-agency coordination process to determine the appropriate number of MOVES runs when conducting an AEDT study.

Navigation Panel

When conducting a MOVES run the analyst needs to develop a RunSpec file (in XML format) through the “Navigation Panel” of the MOVES GUI. This section provides the best practice on the pertinent panel selections that should be made when using MOVES with AEDT. For a detailed description of the MOVES “Navigation Panel” options not discussed in this document, refer to the MOVES technical guidance for further information.⁴

The GUI selections for MOVES-Nonroad are similar to those for MOVES-Onroad. Key differences are highlighted below.

Scale

The analyst must first select between developing an “Onroad” or “Nonroad” model. If “Nonroad” is selected, the inputs for “Domain/Scale” and “Calculation Type” are pre-populated as “Default Scale” and “Inventory”, respectively. The Nonroad Data Importer or Nonroad Post-Processing (described in detail below) can be used to apply local data.

When using an “Onroad” model for conducting an airport analysis using MOVES with AEDT, the analyst chooses the “Project” domain to allow MOVES to accept detailed activity input at the link level. The “Inventory” option under “Calculation Type” needs to be selected for developing an emission inventory or conducting a dispersion analysis.

Time Spans

When using the project domain, MOVES will only process one hour, of one day, of one month, of one year for each run. The analyst should enter the desired time period within the “Time Span” panel. The analyst only selects either “weekday” or “weekend” for the “day” selection. Both options cannot be selected for project level analysis. The selections for “day” and “hour” should correspond to the type of activity data being used and the “month” should align with meteorological conditions.

MOVES-Nonroad does all calculations at the day level with no hourly detail. Multiple years, months, and day types can be specified in a single RunSpec, but not individual hours.

Geographic Bounds

The “Geographic Bounds” panel is where the analyst specifies the county in which the airport study area is located. Activity and fleet inputs supplied at the link level (see ‘Project Data Manager’ section below) are used to describe a particular project or airport geographic bounds.

Onroad Vehicles/Nonroad Equipment

The “Onroad Vehicles/Nonroad Equipment” panel is used to specify the vehicle types and fuel combinations that are to be included in the MOVES runs for use with AEDT. The MOVES runs for airport analyses must include all the vehicle (source) types and fuel types (gasoline, diesel, Compressed Natural Gas (CNG), Liquefied Petroleum Gas (LPG)), and electricity) that the analyst wants to model in the project area. MOVES automatically selects available fuel types for each source type. MOVES also includes the ability to model newer classes of vehicles including heavy-duty battery electric vehicles, heavy-duty fuel cell vehicles and CNG long-haul combination trucks.

Pollutants and Processes

The “Pollutants and Processes” panel is used to select the types of pollutants and the emissions processes the analyst wants to include in the analysis. When using MOVES for conducting an airport analysis, the analyst conducts a separate set of runs for modeling roadway links and parking facility links (parking facility will include off-network links). Whether a roadway or a parking facility link is being modeled will determine the emissions processes that are to be selected.

The analyst has discretion to determine the specific pollutants to be analyzed with MOVES for the airport study. In some airport analyses, only a single pollutant will be of concern so the analyst may only need to model that specific pollutant. However, it is important to note that some pollutants are chained pollutants within MOVES, so multiple pollutant selections need to be made in order to complete the chain and model the desired pollutant. For example, if the analyst is interested in obtaining Volatile Organic Compound (VOC) emissions, then Total Gaseous Hydrocarbons needs to also be selected. The MOVES GUI prompts the analyst to see if there is an incomplete pollutant chain.

Table 3 lists all the pollutants and their associated processes in MOVES for producing an emission inventory and/or emission rates for dispersion modeling that are compatible with AEDT. Table 4 lists all the pollutants and their associated processes for analyzing parking

facility links (including off-network links). Although the analyst has discretion to determine which pollutant(s) are modeled with MOVES, the analyst is required to select the appropriate emissions process associated with the pollutants listed in Table 3 (Roadway Links), Table 4 (Parking Facility Links), and Table 5 (Nonroad Construction Activity).

Table 3. Pollutant and Its Associated Emissions Processes for Roadway Links

Pollutant	Emissions Process
Total Gaseous Hydrocarbons	
Non-Methane Hydrocarbons	
Non-Methane Organic Gases	
Volatile Organic Compounds	
Total Organic Gases	
Carbon Monoxide (CO)	
Methane (CH ₄)	
Oxides of Nitrogen (NO _X)	Running Exhaust and Crankcase Running Exhaust
Sulfur Dioxide (SO ₂)	
Total Energy Consumption	
Atmospheric CO ₂	
Primary Exhaust PM10 - Total	
Primary Exhaust PM2.5 - Total	
Primary PM2.5 - Species	
Primary PM10 - Brakewear Particulate	Running Exhaust, Crankcase Running Exhaust, and Brakewear
Primary PM2.5 - Brakewear Particulate	
Primary PM10 - Tirewear Particulate	Running Exhaust, Crankcase Running Exhaust, and Tirewear
Primary PM2.5 - Tirewear Particulate	

**Table 4. Pollutant and Its Associated Emissions Processes for Parking Facility Links
(Includes off-network links)**

Pollutant	Emissions Process
Total Gaseous Hydrocarbons	
Non-Methane Hydrocarbons	
Non-Methane Organic Gases	
Volatile Organic Compounds	
Total Organic Gases	
Carbon Monoxide (CO)	
Methane (CH ₄)	
Oxides of Nitrogen (NO _X)	
Sulfur Dioxide (SO ₂)	
Total Energy Consumption	
Atmospheric CO ₂	
Primary Exhaust PM10 - Total	
Primary Exhaust PM2.5 - Total	
Primary PM2.5 - Species	
Primary PM10 - Brakewear Particulate	Running Exhaust, Start Exhaust, Crankcase Running Exhaust, Crankcase Start Exhaust, Brakewear, Extended Idle Exhaust*, and Crankcase Extended Idle Exhaust*
Primary PM2.5 - Brakewear Particulate	Running Exhaust, Start Exhaust, Crankcase Running Exhaust, Crankcase Start Exhaust, Brakewear, Extended Idle Exhaust*, and Crankcase Extended Idle Exhaust*
Primary PM10 - Tirewear Particulate	Running Exhaust, Start Exhaust, Crankcase Running Exhaust, Crankcase Start Exhaust, Brakewear, Extended Idle Exhaust*, and Crankcase Extended Idle Exhaust*
Primary PM2.5 - Tirewear Particulate	Running Exhaust, Start Exhaust, Crankcase Running Exhaust, Crankcase Start Exhaust, Brakewear, Extended Idle Exhaust*, and Crankcase Extended Idle Exhaust*

* Extended Idle Exhaust and Crankcase Extended Idle Exhaust only need to be included when modeling combination long-haul truck (source type 62) within the parking facility. MOVES does not model these emissions processes for any other source type.

Table 5. Pollutant and Its Associated Emissions Processes for Nonroad (Construction) Links

Pollutant	
Total Gaseous Hydrocarbons	
Non-Methane Hydrocarbons	
Non-Methane Organic Gases	
Volatile Organic Compounds	Running Exhaust, Start Exhaust, Crankcase Running Exhaust
Total Organic Gases	
Carbon Monoxide (CO)	
Methane (CH ₄)	
Oxides of Nitrogen (NO _X)	
Sulfur Dioxide (SO ₂)	
Brake-Specific Fuel Consumption (BSFC)	
Atmospheric CO ₂	Running Exhaust
Primary Exhaust PM10 - Total	
Primary Exhaust PM2.5 - Total	

Road Type

The “Road Type” panel is used to define the types of roads that the analyst wants to include in the airport study area. MOVES defines five different road types:

- Rural Restricted Access – a rural highway that can be accessed only by an onramp;
- Rural Unrestricted Access – all other rural roads (arterials, connectors, and local streets);
- Urban Restricted Access – an urban highway that can be accessed only by an onramp;
- Urban Unrestricted Access – all other urban roads (arterials, connectors, local streets, or parking facility links); and
- Off-Network – any location where the predominant activity is vehicle starts and idling (Used for modeling vehicle starts for airport parking facilities).

For MOVES-Nonroad runs, the road type is automatically set to ‘Nonroad’.

General Output

“General Output” allows the analyst to name and create an output database. When modeling with MOVES to obtain emissions inventories or emission rates for AERMOD to be used with AEDT, the analyst models the roadway links and parking facility links (including off-network links) within MOVES.

- **Roadway Links and Parking Facility Links.** The analyst names and creates an output database to be used for each MOVES-Onroad run that will be conducted. When modeling roadway links, all output data to be used for developing an emission inventory or for dispersion with AERMOD is located in the

“movesoutput” table within the output database. For every MOVES run that is conducted, a unique identifier is populated in the “MOVESRunID” field within the “movesoutput” table. For example, if the analyst conducts multiple MOVES runs to account for vehicle activity and meteorological variations, the first MOVES run conducted is assigned a “MOVESRunID” of 1. The second conducted MOVES run is assigned a “MOVESRunID” of 2, and the “MOVESRunID” is incremented accordingly for each subsequent MOVES run thereafter. The analyst is responsible for managing the output data in the “movesoutput” table and confirming that the associated “MOVESRunID” values represent the intended scenario being modeled. It is important to note that at each level a parking facility has to be assigned an individual link.

- **Units.** The analyst selects “grams” for “Mass Units”, “MillionBTU” for “Energy Units”, and “Miles” for “Distance Units”.
- **Activity.** The analyst selects “Distance Traveled” and “Population”.
- **Nonroad (Construction) Activity.** The analyst names and creates an output database to be used for each MOVES-Nonroad run that will be conducted. When modeling construction activity, the output data are also located in the “movesoutput” table within the output database. “Units” selections are the same as with onroad links.

Output Emissions Detail

Output Emissions Detail is used to specify the level of detail desired in the output data. For running MOVES to develop emission inventories and emission rates for AERMOD to be utilized with AEDT, the analyst must select “road type” under the “Onroad” section. No other items need to be selected other than “road type”. The “emissionQuant” field in the “movesoutput” table represents the total emissions that occur for the timeframe being modeled (i.e., hourly, monthly, quarterly or annual). For project-level analysis, the MOVES output is hourly; analysts may aggregate data to report emissions for other timeframes.

For MOVES-Nonroad runs, output aggregation is set to 24-Hour Day. MOVES aggregates hourly output to estimate total emissions for a typical day for each month selected. Analysts should select “HP Class” under the “Nonroad” section if local horsepower data is available.

Data Importer – Onroad Activity

After the analyst has completed all of the necessary panels to create the MOVES RunSpec, the analyst must then create an input database and provide the necessary input database tables that describe the project in detail. The input database is populated using the County Data Manager (CDM), which can be accessed by selecting “Enter/Edit Data” in the “Create Input Database” panel. It is recommended that the analyst create a unique input database for each MOVES run that is to be conducted. For example, if the analyst is conducting multiple MOVES runs to account for vehicle activity and meteorological variations, individual input databases should be created for each run.

The CDM includes multiple tabs that open data importers, which are used to enter project-specific data. These tabs and data importers are:

- Meteorology
- Age Distribution
- Fuel Supply, including Alternative Vehicle Fuel and Technology (AVFT)
- Inspection and Maintenance
- Link Source Type
- Links
- Link Drive Schedule
- Operating Mode Distribution
- Hotelling
- Off-Network

When using the AEDT GUI to create roadways and parking facilities in the map viewer, AEDT will generate Links input files for Roadway Links, Parking Facility Links and Construction Links. Only the Roadway Links and Parking Facility Links can be modeled with MOVES. Construction Links need to be modeled separately from onroad activity, using the nonroad model within MOVES and manually appended to the MOVES-Onroad results (see section below on the Nonroad Data Manager). Please refer to the AEDT User Manual for information on exporting Roadway Links, Parking Facility Links, and Construction Links files.

The remainder of this section describes the CDM inputs and how they specifically relate to using MOVES for developing emissions inventories and emission rates for AERMOD to be utilized with AEDT. The analyst should rely on interagency coordination to determine the appropriateness of the project-specific input data that is to be imported into MOVES. The analyst should also refer to the MOVES technical guidance for the mechanics of using the data importers for project level analysis.⁴

Meteorology

MOVES requires the use of ambient air temperature and relative humidity data. When developing meteorological data for input into MOVES, the analyst should rely on interagency coordination to determine the appropriate data to be used. Neither FAA nor EPA endorses the use of the MOVES default meteorological data for project level analyses. The meteorological data required to be imported into MOVES directly corresponds to the number of MOVES runs to be executed for the airport study and are dependent on the use case. In some instances, when only an emissions inventory is being conducted, the airport average annual weather may be able to be used. In this particular case the analyst models all associated MOVES runs using the annual average temperature and relative humidity associated with the airport being modeled in AEDT for the MOVES run(s). For other instances where multiple MOVES runs need to be conducted to better represent activity and meteorological variation for an emissions inventory or air quality dispersion analysis, the analyst needs to rely on interagency coordination to determine the appropriate method of processing and/or obtaining representative meteorological data.

Age Distribution

The “Age Distribution” importer is used to enter data that provide the distribution of vehicle fractions by age for each calendar year (yearID) and vehicle type (sourceTypeID). These data are required for running MOVES at the project level for airport analyses. The distribution of ageID (the variable for vehicle age) fractions must sum to one for each vehicle type and year. This type of data should be obtained through the interagency coordination process; depending on the use case, a local agency may require the analyst to use the latest available state or local age distribution assumptions from their State Implementation Plan (SIP) or transportation conformity regional emissions analysis.

Fuel Supply, Including Alternative Fuels and Electric Vehicles

The analyst must define the fuel information that is used in the study area in MOVES. The “Fuel Supply,” “Fuel Formulation”, “Fuel Usage Fraction”, and “Alternative Vehicle Fuels & Technologies (AFVT)” importers are used to enter the necessary information to describe fuel type and fuel mix for each respective MOVES run. The analyst should obtain this type of data through the interagency coordination process. The AVFT tool allows users to modify the fraction of vehicles capable of using different fuels and technologies, including battery electric and fuel-cell electric. Note that hybrid gasoline/electric and plug-in hybrid electric vehicles are not listed separately in the AVFT table; in MOVES, these vehicles are included in the gasoline vehicle category consistent with EPA’s regulations for vehicles subject to gasoline vehicle standards.

Inspection and Maintenance

Projects within areas covered by an I/M program should define the program in the MOVES “Inspection and Maintenance” importer. The analyst should obtain this type of data through the interagency coordination process.

Link Source Type for On-Road Vehicles and Parking Facilities

The “Link Source Type” importer allows the analyst to enter the fraction of the link traffic volume (fleet mixture) that is represented by each vehicle type (source type). For each LinkID the “SourceTypeHourFraction” must sum to one across all source types. Additionally, the analyst needs to ensure that the source types selected in the MOVES Vehicles/Equipment panel match the source types defined through the “Link Source Type” importer. Otherwise, if a vehicle is represented in the “Link Source Type” table but is excluded from the RunSpec, the vehicle will not be modeled. There are no defaults that can be exported from the “Link Source Type” importer. For any analysis at the project level, the analyst may provide source type fractions for all vehicles being modeled and for each MOVES run (as vehicle mixes may change from hour to hour and month to month).

Links

The “Links” importer is used to define the individual roadway links and/or parking facility links (including off-network link) to be established in MOVES when conducting an airport study. All links being modeled are required to have unique LinkIDs. The “Links” importer requires information on each link’s length (in miles), traffic volume

(units of vehicles per hour), average speed (miles per hour), and road grade (percent). When using the AEDT GUI to create Roadway Links and Parking Facility Links, AEDT will determine the link length based upon the distance of the link segments. The analyst is able to modify the link length to the appropriate distance to be modeled.

The information below describes how to set up a Links input file for use with MOVES when conducting an airport study. The analyst should refer to the interagency coordination process to determine the appropriate number of links and the lengths of specific links that are to be used for the study.

- **Roadway Links.** Create a unique LinkID for each roadway segment that is to be modeled in the airport study. When developing the roadway links input file, the analyst creates a unique link (between 1 and 599,999) for each Roadway Link that would be set up within the airport study. If using the AEDT GUI to generate Roadway Links, AEDT will automatically assign the appropriate LinkID. The output associated with these roadway links are the total emissions that occur for the timeframe being modeled.
- **Parking Facility Links.** Create a unique Link ID for each parking facility link that is to be modeled in the airport study. When creating Parking Facility Links in the AEDT GUI, AEDT will automatically assign the appropriate unique LinkID for all the Parking Facility Links. When an analyst models a parking facility for an airport analysis, they must specify speed, distance traveled, and an idle time. For multi-level parking facilities (i.e., parking garages), the analyst is to model these links for each level. This information serves as inputs for the links input file. When modeling a parking facility in MOVES for use with an airport study, the analyst must create three links for each parking facility.
 1. Parking Facility Movement Link - The Parking Facility Movement link models the vehicle movement within the parking facility. The analyst enters distance traveled and the speed. These values are entered into the MOVES links input file as the “link length” (in miles) and the “average speed”, respectively, when building the links input file for parking facilities. The “Urban Unrestricted Access” road type (Road Type 5) should also be selected when modeling this link. A unique LinkID between the range of 700001 and 799999 must be used for the Parking Facility Movement Link. If using the AEDT GUI to generate Parking Facility Links, AEDT will automatically assign the appropriate LinkID
 2. Parking Facility Idle Link - A unique link is created utilizing an average speed of 0 miles-per-hour to obtain idle emissions for the parking facility. This link is only required if there is excess idling that needs to be accounted for when modeling the parking facility. Excess idling may occur in colder regions. Please rely to interagency coordination to determine if excess idling needs to be modeled for parking facilities. A unique LinkID between the range of 800001 and 899999 must be used for the Parking Facility Idle Link. If using the AEDT GUI to generate Parking

Facility Links, AEDT will automatically assign the appropriate unique LinkID.

3. **Parking Facility Off-Network Link** - An off-network link for the purpose of calculating vehicle starts needs to be modeled. When modeling a parking facility for an airport analysis the analyst must consider vehicle starts. In MOVES, vehicle starts are modeled as a separate emissions process. For modeling vehicle starts the analyst uses the “off-network” road type (Road Type 1). The analyst also needs to enter data into the “Off-Network” and “Operating Mode Distribution” data importers to correctly model vehicle starts by accounting for the appropriate soak time. Soak time is the amount of time the vehicle engine is off while parked and is used to differentiate between a hot or cold start. A unique LinkID between the range of 600001 and 699999 must be used for the Parking Facility Off-Network Link. If using the AEDT GUI to generate Parking Facility Links, AEDT will automatically assign the appropriate unique LinkID.

It is also important to note that MOVES can only model a single off-network link per MOVES run. If parking facilities are similar, analysts may be able to utilize the same off-network link to obtain vehicle start emissions rates. This depends on whether the facilities have the same fleet mixture and operating mode distribution (soak times). In most cases, off-network links associated with hourly, daily, and longer term economy parking facilities need to be modeled using separate MOVES runs. The analyst should rely on the interagency coordination process to determine the appropriate number of off-network links that need to be modeled.

Link Drive Schedule

To use MOVES for airport analyses the FAA recommends that the analyst utilize the average speed approach to model roadway and parking facility links. However, the analyst does have the option to use Link Drive Schedule through the Link Drive Schedule Importer if data are available.

Operating Mode Distribution

For using MOVES for airport analyses the FAA recommends that the analyst utilize the average speed approach when modeling roadway links. When an off-network link is selected to model vehicle starts, the analyst is required to enter an operating mode distribution to assign appropriate soak time (this is discussed in further detail below). However, the analyst does have the option of using operating mode distributions through the “Operating Mode Distribution” importer for modeling roadway links, if data are available.

- **Operating Mode Distribution for off-network (parking facility) links.** In most cases an airport study includes multiple parking facilities that need to be modeled. If the airport study does contain an off-network (parking facility) link, then both the “Off-Network” table and “Operating Mode Distribution” table should be

populated and imported into the input database. The analyst needs to specify the fractions of the time spent during the hour in each operating mode. Creating an operating mode distribution for an off-network link specifically models vehicle starts and/or extended idle (if necessary) emissions. Table 6 lists the operating modes associated with calculating emissions for vehicle starts and extended idle emissions. The sum of the fractions of OpmodeID 101 through 108 needs to be 1. The fraction for Extended Idle Operating Mode (OpmodeID 200) should always be set to 1.

Table 6. Off-Network Operating Mode Distributions

OpmodeID Code	Operating Mode Description
101	Soak Time < 6 minutes
102	6 minutes <= Soak Time < 30 minutes
103	30 minutes <= Soak Time < 60 minutes
104	60 minutes <= Soak Time < 90 minutes
105	90 minutes <= Soak Time < 120 minutes
106	120 minutes <= Soak Time < 360 minutes
107	360 minutes <= Soak Time < 720 minutes
108	720 minutes <= Soak Time
200	Extended Idle Operating Mode

The use of operating mode distribution to define either a roadway link or parking facility link must be determined through the interagency coordination process.

Off-Network

The “Off-Network” importer is used to provide data about vehicle starts and extended idle activity within a parking facility. Extended idle operation applies only to long-haul combination trucks (source type 62) and is defined as the operation of the truck's propulsion engine when not engaged in gear for periods one hour or longer. Shorter periods of idling for long-haul combination trucks, and all idling for other vehicles, should be modeled as a roadway link with an Op-Mode distribution that consists only of idle operation (Op-Mode 1). This can be specified in the Links table by inputting the vehicle population and specifying an average speed of “0” mile-per-hour.

As previously mentioned, MOVES is only capable of modeling one off-network link per run. If more than one off-network (parking facility) link is associated with the airport study, another MOVES run (or set of MOVES runs) is required to characterize each additional off-network link. The Off-Network importer should also be used if the airport study includes an area where highway vehicles are parked, start their engines, or are in extended idling mode (such as at a truck stop, parking lot, or passenger or freight intermodal terminal).

There are no default values available for any of the off-network inputs; the analyst needs to populate the Off-Network table with information describing vehicle activity in the off-

network link being modeled. The necessary fields are vehicle population, start fraction, and extended idle fraction:

- The vehicle population reflects the total number of vehicles parked, starting, or idling on the off-network area, over the course of the hour covered by the MOVES run.
- The start fraction is the fraction of the total vehicle population that starts during the hour.
- The extended idle fraction specifies the fraction of time that the vehicle population spends in extended idle operation in the hour.

Hotelling

The “Hotelling” tab is used to import information on long-haul combination truck hotelling activity. Hotelling is defined by USEPA as any period of time one hour or longer than drivers of long-haul combination trucks spend resting in their vehicles during mandated down times during long distance trips. Hotelling activity may include use of the truck engine (extended idling) to power air conditioning, heat, and other accessories, use of auxiliary power units (APUs; diesel or battery), or truck-stop electrification. Extended idle emissions are reported in MOVES as extended idle exhaust and crankcase idle exhaust for the truck engine and auxiliary power exhaust for APUs.

The MOVES hotelling inputs are optional and should only be used if local data are available. If these local data are not available, MOVES will calculate hotelling activity based on truck VMT on restricted access roads. Analysts should refer to the MOVES technical guidance for detailed instructions on hotelling inputs.⁴

Idle Data

The “Idle” tab in MOVES can be used to import information on idling activity for vehicle source types other than long-haul combination trucks. Previous versions of MOVES only modeled idling for long-haul trucks (referred to as hotelling). ONI is defined in MOVES as time during which a vehicle engine is running idle and the vehicle is somewhere other than on the road (i.e., outside of the normal drive cycle), such as in a parking lot or terminal. This activity contributes to total mobile source emissions but does not take place on the road network.

The “Idle” inputs are optional and should only be used if better local data for ONI are available. MOVES includes default ONI data based on light-duty telematics data and studies of heavy-duty truck vehicle operations. Emissions from ONI activity are included in output from MOVES as running and crankcase exhaust for the off-network road type. Analysts should refer to the MOVES technical guidance for detailed instructions on ONI.⁴

Data Importer – Nonroad Activity

As described above, USEPA recommends use of the nonroad model integrated in MOVES, in place of the standalone NONROAD2008 model. After completing all necessary panels in the GUI to create a RunSpec (Scale set to ‘Nonroad’), the analyst must create a nonroad-specific input database by selecting “Enter/Edit Data” in the “Create Input Database” panel. As with onroad activity, it is recommended that the analyst create a unique input database for each MOVES run. For example, if the analyst is conducting multiple MOVES runs to account for construction activity and meteorological variations, individual input databases should be created for each run.

The Nonroad Data Manager includes multiple tabs that open data importers, which are used to enter project-specific data. These tabs and data importers are:

- Meteorology
- Fuel
- Generic

Meteorology

MOVES-Nonroad uses the same default meteorology data as MOVES-Onroad. The analyst may input local meteorology data for each month specified in the RunSpec.

Fuel

In MOVES-Nonroad, there are two tables that define fuel properties: NRFuelSupply and FuelFormulation. USEPA recommends that analysts use the default values in these tables, unless a full local fuel property study exists for a given region. USEPA notes that the one exception is for Reid Vapor Pressure (RVP). The “Fuel Wizard” tool can be used to adjust gasoline and gasoline-ethanol blend properties, including RVP. This tool is not applicable to E-85, diesel, or CNG.

Generic

The Generic tab can be used to import data on nonroad retrofit programs. Refer to the MOVES technical guidance for further detail.⁴

Post-Processing. Note that the output from MOVES-Nonroad is for individual counties. Post-processing may be needed to adjust results to the boundaries of the analysis (e.g., a nonattainment or maintenance area). Post-processing may also be used to apply locally-derived population and activity data for nonroad inventories. USEPA provides built-in scripts in the ‘Post Processing’ menu (see the MOVES technical guidance⁴ for further detail).

USING MOVES OUTPUT WITH AEDT

After all MOVES runs have been completed for roadway links, parking facility links, the analyst will have generated output by each link represented in total grams of each pollutant for the timeframe modeled (depending on the use case, the total emissions by link may represent hourly, monthly, quarterly, or annual emissions per link). The

MOVES output for all links is located in the “movesoutput” table within the output database. Construction activity is modeled with MOVES-Nonroad. Nonroad results are also reported in the “movesoutput” table in the same format as onroad activity.

AEDT does not manage or utilize geospatial data associated with roadway links, parking facility links, or construction activity for usage with AERMOD dispersion modeling. However, for emissions inventories, AEDT can import on-road mobile source emissions inventories using one of two files formats.

The first format AEDT can import are annual inventories for each pollutant modeled with MOVES for Roadways, Parking Facilities, and Construction categories. AEDT will accept a comma separated file (.csv) with the annual emissions by pollutant modeled and add it to the emissions inventory calculated by AEDT. Figure 1 displays the information required of the emissions inventory input file. With this format the analyst must conduct post processing on the MOVES-Onroad and Nonroad output so that pollutants match those generated by the other sources modeled with AEDT. The Categorized Emissions Inventory Results File can contain an emissions inventory for a single year or multiple years that will be read into AEDT. The source categories that AEDT accepts are Roadways, Parking Facilities, and Construction. For the Pollutant ID column, the analyst only needs to provide the numerical Pollutant ID in the file. The information shown in the Pollutant ID column below displays how the MOVES Pollutant IDs match the AEDT pollutant name. The Emission Quant Field represents the emission inventory results in the units of grams. Appendix C provides an example displaying the .csv file format that is accepted by AEDT.

Figure 1. MOVES Categorized Emissions Inventory Results File Format

Year ID	Source	Pollutant ID	Emission Quant
Year – YYYY (example 2015)	Roadways Parking Facilities Construction	Matches the MOVES pollutant ID. THC 1 CO 2 VOC 87 NMHC 79 TOG 86 NOx 3 CH4 5 SOx 31 CO2 90 PM10 100 PM10 Brakewear 106 PM10 Tirewear 107 PM2.5 110 PM2.5 Brakewear 116 PM2.5 Tirewear 117 H2O 119	Total emissions in the units of Grams.

The second format AEDT can import are MOVES Link Level Inventory Results. When following the instructions in the Output section starting on Page 9 of this document the analyst can export the ‘movesoutput’ table from the output database by exporting a .csv file using HeidiSQL which will already be in a format AEDT will accept. When using this format to import MOVES output into AEDT the results should represent an annual inventory for each type of link that was modeled. In the case where multiple Parking Facilities were modeled (MOVES can only model a single off-network link per run) using multiple MOVES runs or construction activity modeled with MOVES-Nonroad, the output from those runs will need to be copied and appended into the links output file the analyst chooses to import into MOVES. Also, Link IDs for construction activity must use a unique ID range between 9000001 and 999999. Please refer to Appendix D for an example of a .csv formatted MOVES Link Level Inventory Results file.

When conducting an air quality dispersion analysis to obtain pollutant concentrations for roadways, parking facilities, and/or construction activity associated with an airport analysis, the analyst needs to run MOVES (Onroad and/or Nonroad) and prepare the AERMOD input files (.inp file and .hre file) independently of AEDT. Ensuring that the geospatial location of the airport roadways and parking facilities are correctly referenced to the airport coordinates listed in the Airport Details Pane is imperative when developing the .inp files (see the AEDT User Manual). The analyst is responsible for managing the geospatial coordinates of each MOVES roadway link and parking facility link. The analyst is also responsible for managing the geospatial location of any construction activity. All MOVES geospatial coordinates are to be based on the location of the airport reference point in the Airport Details Pane and entered into AERMOD in local coordinates. Although AERMOD can accept UTM coordinates, AEDT does not use UTM coordinates when generating the .inp file at this time. In order for pollutant concentrations from mobile sources to be appropriately placed relative to other sources and receptor locations defined in AEDT, the same coordinate system and all roadway, parking facilities, and/or construction activity must be located relative to the airport reference point found in the Airport Details Pane.

The analyst is responsible for managing the source name and location within the AERMOD input (.inp) file as well as the source names and associated emission rates in the hourly emission rate (.hre) file. Roadway links are to be represented in the AERMOD input file as area sources; parking facility links are to be represented as AREAPOLY sources; and construction activity can be modeled utilizing any AERMOD source type deemed appropriate (e.g., AREA, AREAPOLY, POINT, or VOLUME).

For roadway links, the analyst is required to enter the appropriate information for the following parameters for defining an area source using the SRCPARAM keyword:

- Aremis - area emission rate in g/(sec-m²),
- Relhgt - release height above ground in meters,
- Xinit - length of X side of the area (in the east-west direction if Angle is 0 degrees) in meters,
- Yinit - length of Y side of the area (in the north-south direction if Angle is 0 degrees) in meters (optional),

- Angle - orientation angle for the rectangular area in degrees from North, measured positive in the clockwise direction (optional), and
- Szinit - initial vertical dimension of the area source plume in meters (optional).

For parking facility links the analyst is required to enter the appropriate information for the following parameters;

- Aremis - area emission rate in $\text{g}/(\text{s}\cdot\text{m}^2)$,
- Relhgt - release height above ground in meters,
- Nverts - number of vertices (or sides) of the area source polygon,
- Szinit - initial vertical dimension of the area source plume in meters (optional).

When modeling multi-level parking facilities, the analyst will need to enter each level as a separate source. For example, sources for a five-level parking facility could have names of:

- PARKA001 for level 1
- PARKA002 for level 2
- PARKA003 for level 3
- PARKA004 for level 4
- PARKA005 for level 5

In addition to defining each level as a source using the SRCPARAM keyword, the analyst will also need to enter the location (e.g., local x- and y-coordinates) of all of the vertices associated with each level using the AREAVERT keyword. The analyst will assign a release height for each of the levels.

The Szinit parameter which defines the initial vertical dispersion coefficient of the AREA and AREAPOLY source plume should be estimated for roadway and parking facility sources. It is recommended to refer to Appendix J in EPA's latest PM hotspot guidance for how to estimate Szinit (e.g., initial vertical dimension divided by 2.15, corresponding to a Szinit of 1.2 m for typical light-duty vehicles). The analyst will enter a value of 1 for the Aremis input parameter because the actual emission rates will be in the hourly emission rate file. Figure 2 displays an example AERMOD input file which the analyst will need to create to input into AEDT.

Figure 2. Example of AERMOD Input File (.inp)

```

CO STARTING
TITLEONE Example CO 1 HOUR INP FILE
TITLETWO Example
MODELTYPE CONC DEFAULT
AVERTIME 1
POLLUTID CO
FLAGPOLE 1.8
RUNORNOT RUN
SAVEFILE
CO FINISHED

SO STARTING
SO ELEVUNIT METERS
** -----
**          SOURCE   TYPE    X(m)    Y(m)    Z(m)
** -----
LOCATION PARKA001 AREAPOLY 1213.10 2565.50 16.76
LOCATION RD000001 AREA 719.51 1742.71 16.76
LOCATION RDC00001 VOLUME 1345.69 2147.62 16.76
** -----
** AREA AND VOLUME SOURCE PARAMETERS:      HEIGHT      WIDTH      LENGTH      ANGLE      SIGMA-Z0
** -----
SRCPARAM RD000001 1.00 0.00 14.63 100.0 91.39 3.00
SRCPARAM RDC00001 1.00 13.00 3.00 3.00
** -----
** AREAPOLY PARAMETERS:      HEIGHT      POINTS      SIGMA-Z0
** -----
SRCPARAM PARKA001 1.00 1.00 4 3.00
AREAVERT PARKA001 1213.10 2565.50 1358.80 2519.78 1346.30 2453.03 1193.29 2499.97
** -----
** HOURLY EMISSION FILE:
** -----
HOUREMIS appendixA.HRE RD000000-RD999999
HOUREMIS appendixA.HRE RDC00001-RDC99999
HOUREMIS appendixA.HRE PARKA001-PARKA999
** -----
** SOURCE GROUP DEFINITIONS:
** -----
SRCGROUP ALL
SRCGROUP ROADWAYS RD000000-RD999999
SRCGROUP CONSTRUCTION RDC00000-RDC99999
SRCGROUP PARKING PARKA001-PARKA999
SO Finished

```

The AERMOD input file example in Figure 2 will model CO pollutant concentrations for a 1-hour averaging period. The LOCATION information for a single parking facility source (PARKA001), a single roadway source (RD000001), and a single construction source (RDC00001) are identified as AREAPOLY, AREA, and VOLUME sources, respectively, and the local x-, y- and z-coordinates are referenced for each. The origin associated with those coordinates is based upon the airport reference point for the specific airport being modeled with AEDT. The SCRPARAM information for the parking facility source and the roadway source provides the source dimensions. The HOUREMIS specifies the file name of the hourly emission rate file including the range of source names associated within that file. The SRCGROUP defines how the analyst wishes to group the modeled sources. In this example the parking facility source, roadway source, and construction source are assigned to their own source groups. Roadway, parking facility, and construction sources should be binned within separate source groups in the AERMOD input file.

The analyst will create an hourly emission rate file (.hre file) to capture the variation of seasonal meteorological and daily traffic volume conditions associated with the MOVES emission rates. The emission rates for each hour throughout the year is defined for each source in the hourly emission rate file. For example, if 16 MOVES runs were conducted, the emission rates associated with those runs are to be assigned to the time periods listed in Table 1 and Table 2. For the hourly emission rate file. The total emissions output for roadway links and parking facility links for each MOVES run will need to be converted from grams per hour (g/hour) to grams per second square meter (g/sec-m²), which is the

emission rate per unit area. This is obtained by dividing the emission rate from each MOVES link by 3600 and the total area associated with the source.

Figure 3 displays an example of the hourly emission rate file. Please refer to Section 3.3.12 of the AERMOD User's Guide for further detail on using an hourly emission rate file.¹⁰ It is important to note that all parking facility sources must be ordered before all roadway sources in the .hre file.

Figure 3. Example of Hourly Emission Rate File (.hre)

Year	Month	Day	Hour	Source Name	Emission Rate		
SO	HOUREMIS	04	01	01	01	PARKA001	9.538541e+005
SO	HOUREMIS	04	01	01	01	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	01	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	02	PARKA001	9.538541e+005
SO	HOUREMIS	04	01	01	02	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	02	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	03	PARKA001	9.538541e+005
SO	HOUREMIS	04	01	01	03	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	03	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	04	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	04	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	04	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	05	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	05	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	05	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	06	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	06	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	06	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	07	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	07	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	07	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	08	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	08	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	08	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	09	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	09	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	09	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	10	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	10	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	10	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	10	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	11	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	11	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	11	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	12	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	12	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	13	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	13	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	13	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	14	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	14	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	14	RDC00001	2.000000e+005

¹⁰ USEPA, User's Guide for the AMS/EPA Regulatory Model (AERMOD), EPA-454/B-23-008, October 2023.

Due to the current computational code within AEDT that allows the analyst to import the AERMOD input file (.inp) and hourly emission rate file (.hre), there are specific criteria that must be followed when constructing the .inp file and .hre file for it to be correctly imported into AEDT.

- A minimum of one parking facility must be included in the .inp and corresponding .hre files. If the analyst does not want to model a parking facility, then the emission rates can be set to zero in the .hre file.
- The following naming conventions must be used for the AERMOD .inp file to import correctly into AEDT.
 1. Parking Facilities: naming range of PARKA001 through PARKZ999
 2. Roadways: naming range of RD000001 through RD999999
 3. Construction: naming range of RDC00001 through RDC99999
- The order of the sources listed under the SRCPARAM keyword in the .inp must be ordered in the following manner:
 1. All roadway sources are to be defined first
 2. All construction sources are to be defined following the roadway sources
 3. All parking facility sources are to be defined after the construction sources. If there are no construction sources to be modeled then the parking facility sources will follow the roadway sources.
- The POLLUTID in the CO (control) Pathway in the AERMOD .inp file must match the AEDT Metric Result being modeled. For example, if the CO (carbon monoxide) Metric is chosen to be modeled in AEDT then CO (carbon monoxide) must be listed with the POLLUTID keyword within the CO (control) Pathway section of the AERMOD input file.
- The AERMOD input file (.inp) and the hourly emission rate file (.hre) must have the same naming convention. For example, if the AERMOD input file name is CO_airportXYZ.inp then the hourly emission rate file shall be named CO_airportXYZ.hre.
- The order of sources in the hourly emission rate file (.hre) must be ordered in the following manner (for each hour of each day within the modeling domain):
 1. All parking facility sources are to be listed first
 2. All roadway sources are to be listed following the parking facility sources
 3. All construction sources are to be listed following the roadway sources.

AEDT will not import the AERMOD input file (.inp) correctly and AERMOD will fail to execute if any of these criteria are not followed.

Once the analyst has constructed the AERMOD input file and the hourly emission rate file for roadway, parking facility, and/or construction sources, the analyst can then import those files into AEDT which will combine the input with all the airport sources and execute AERMOD. Refer to the AEDT User Manual for more information on importing

the .inp and .hre files associated with roadway, parking facility, and/or construction sources.

It is important to note that although the analyst is required to define source groups in the AERMOD input file (.inp), AEDT **will not** currently create a PLOTFILE or POSTFILE to output the pollutant concentrations associated with these specific source groups. Even if the analyst supplies PLOTFILE and POSTFILE information into the AERMOD input file (.inp), AEDT will not import that information. If the analyst wishes to obtain the pollutant concentration contributions from roadway, parking facility, and/or construction sources, then the merged .inp and .hre files with the combined airport sources (e.g., Aircraft, GSE, Stationary Sources) and on-road/off-road sources (e.g., roadways, parking, and construction) can be found and modified in the following directory.

C:\AEDT\DATA\username\STUDYNAME@localhost\Output_Files\METRICRESULT_JOBID

The AERMOD input file (.inp) and the hourly emission rate file (.hre) will have the following naming convention.

- .inp file: STUDYNAME_JOBID_METRICRESULT_PollutantWithMove.INP
- .hre file: STUDYNAME_JOBID_METRICRESULT_PollutantWithMove.HRE

Once those files are located, the analyst can add in the desired PLOTFILE or POSTFILE information into the AERMOD input file (.inp) and execute AERMOD independent of AEDT to produce roadway, parking, and/or construction source pollutant concentration output files.

Appendix A contains an AERMOD (.inp) file example and Appendix B contains the hourly emission rate (.hre) file example that can be used with AEDT. The example contains a single parking facility source, a single roadway source, and a single construction source. The hourly emission rate file (.hre) contains emission rates for the full 24-hour period occurring on January 1, 2004.

APPENDIX A.

.INP Filename = appendixA.inp

```

CO STARTING
  TITLEONE Example CO 1 HOUR INP FILE
  TITLETWO Example
  MODELOPT CONC DEFAULT
  AVERTIME 1
  POLLUTID CO
  FLAGPOLE 1.8
  RUNORNOT RUN
  SAVEFILE
CO FINISHED

SO STARTING
SO ELEVUNIT METERS
** -----
**      SOURCE   TYPE      X (m)      Y (m)      Z (m)
** -----
LOCATION PARKA001 AREAPOLY 1213.10 2565.50 16.76
LOCATION RD000001 AREA 719.51 1742.71 16.76
LOCATION RDC00001 VOLUME 1345.69 2147.62 16.76
** -----
-----
** AREA AND VOLUME SOURCE PARAMETERS:           HEIGHT      WIDTH      LENGTH
ANGLE   SIGMA-Z0
** -----
-----
SRCPARAM RD000001  1.00 0.00 14.63 100.0 91.39 3.00
SRCPARAM RDC00001  1.00 13.00 3.00 3.00
** -----
** AREAPOLY PARAMETERS:           HEIGHT      POINTS      SIGMA-Z0
** -----
SRCPARAM PARKA001  1.00 1.00 4 3.00
AREAVERT PARKA001  1213.10 2565.50 1358.80 2519.78 1346.30 2453.03
1193.29 2499.97
** -----
** HOURLY EMISSION FILE:
** -----
HOUREMIS appendixA.HRE RD000000-RD999999
HOUREMIS appendixA.HRE RDC00001-RDC99999
HOUREMIS appendixA.HRE PARKA001-PARKA999
** -----
** SOURCE GROUP DEFINITIONS:
** -----
SRCGROUP ALL
SRCGROUP ROADWAYS RD000000-RD999999
SRCGROUP CONSTRUC RDC00000-RDC99999
SRCGROUP PARKING PARKA001-PARKA999
SO Finished

```

APPENDIX B.

.HRE Filename = appendixA.hre

SO	HOUREMIS	04	01	01	01	PARKA001	9.538541e+005
SO	HOUREMIS	04	01	01	01	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	01	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	02	PARKA001	9.538541e+005
SO	HOUREMIS	04	01	01	02	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	02	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	03	PARKA001	9.538541e+005
SO	HOUREMIS	04	01	01	03	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	03	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	04	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	04	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	04	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	05	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	05	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	05	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	06	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	06	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	06	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	07	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	07	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	07	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	07	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	09	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	09	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	10	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	10	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	10	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	11	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	11	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	11	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	12	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	12	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	12	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	12	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	13	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	13	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	13	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	13	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	14	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	14	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	14	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	14	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	15	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	15	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	15	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	16	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	16	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	16	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	17	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	17	RD000001	1.118548e+005

SO	HOUREMIS	04	01	01	17	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	18	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	18	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	18	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	19	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	19	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	19	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	20	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	20	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	20	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	21	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	21	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	21	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	22	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	22	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	22	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	23	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	23	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	23	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	24	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	24	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	24	RDC00001	2.000000e+005

APPENDIX C.

Example of Categorized Emissions Inventory Results File Format for Input into AEDT.

```
Year ID,Source,Pollutant ID,Emission Quant
2018,Roadways,100,100
2018,Roadways,106,200
2018,Roadways,107,300
2018,Parking Facilities,100,100
2018,Parking Facilities,106,200
2018,Parking Facilities,107,300
2018,Construction,100,100
2018,Construction,106,200
2018,Construction,107,300
2018,Roadways,1,455
2018,Roadways,2,433
2018,Roadways,3,221
2018,Parking Facilities,1,123
2018,Parking Facilities,2,6789
2018,Parking Facilities,3,4567
2018,Construction,1,345
2018,Construction,2,367
2018,Construction,3,234
```

APPENDIX D.

Example of MOVES Link Level Inventory Results from MOVES for input into AEDT.

```

MOVESRunID,iterationID,yearID,monthID,dayID,hourID,stateID,countyID,zoneID,linkID,pollutantID,processID,sourceTypeID,regClassID,fuelType
peID,fuelSubTypeID,modelYearID,roadTypeID,SCC,engTechID,sectorID,hpID,emissionQuant,emissionQuantMean,emissionQuantSigma
1,1,2018,7,5,9,25,25025,250250,11,122,NULL,NULL,NULL,NULL,5,NULL,NULL,NULL,0.93772,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,10,122,NULL,NULL,NULL,NULL,5,NULL,NULL,NULL,14.8769,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,9,122,NULL,NULL,NULL,NULL,5,NULL,NULL,NULL,23.0477,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,8,122,NULL,NULL,NULL,5,NULL,NULL,NULL,8.08422,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,7,122,NULL,NULL,NULL,5,NULL,NULL,NULL,0.545136,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,6,122,NULL,NULL,NULL,5,NULL,NULL,NULL,1.62481,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,5,122,NULL,NULL,NULL,5,NULL,NULL,NULL,1.98238,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,4,122,NULL,NULL,NULL,5,NULL,NULL,NULL,4.86738,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,3,122,NULL,NULL,NULL,5,NULL,NULL,NULL,16.4516,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,2,122,NULL,NULL,NULL,5,NULL,NULL,NULL,42.1727,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,1,122,NULL,NULL,NULL,5,NULL,NULL,NULL,209.949,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,11,121,NULL,NULL,NULL,5,NULL,NULL,NULL,0.385567,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,10,121,NULL,NULL,NULL,5,NULL,NULL,NULL,6.11701,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,9,121,NULL,NULL,NULL,5,NULL,NULL,NULL,9.47663,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,8,121,NULL,NULL,NULL,5,NULL,NULL,NULL,3.32403,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,7,121,NULL,NULL,NULL,5,NULL,NULL,NULL,0.224146,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,6,121,NULL,NULL,NULL,5,NULL,NULL,NULL,0.668081,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,5,121,NULL,NULL,NULL,5,NULL,NULL,NULL,0.815104,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,4,121,NULL,NULL,NULL,5,NULL,NULL,NULL,2.00135,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,3,121,NULL,NULL,NULL,5,NULL,NULL,NULL,6.7645,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,2,121,NULL,NULL,NULL,5,NULL,NULL,NULL,17.3404,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,1,121,NULL,NULL,NULL,5,NULL,NULL,NULL,86.3259,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,11,119,NULL,NULL,NULL,5,NULL,NULL,NULL,0,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,10,119,NULL,NULL,NULL,5,NULL,NULL,NULL,0,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,9,119,NULL,NULL,NULL,5,NULL,NULL,NULL,0,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,8,119,NULL,NULL,NULL,5,NULL,NULL,NULL,0,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,7,119,NULL,NULL,NULL,5,NULL,NULL,NULL,0,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,6,119,NULL,NULL,NULL,5,NULL,NULL,NULL,0,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,5,119,NULL,NULL,NULL,5,NULL,NULL,NULL,0,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,4,119,NULL,NULL,NULL,5,NULL,NULL,NULL,0,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,3,119,NULL,NULL,NULL,5,NULL,NULL,NULL,0,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,2,119,NULL,NULL,NULL,5,NULL,NULL,NULL,0,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,1,119,NULL,NULL,NULL,5,NULL,NULL,NULL,0,NULL,NULL
1,1,2018,7,5,9,25,25025,250250,11,118,NULL,NULL,NULL,5,NULL,NULL,NULL,6.83482,NULL

```